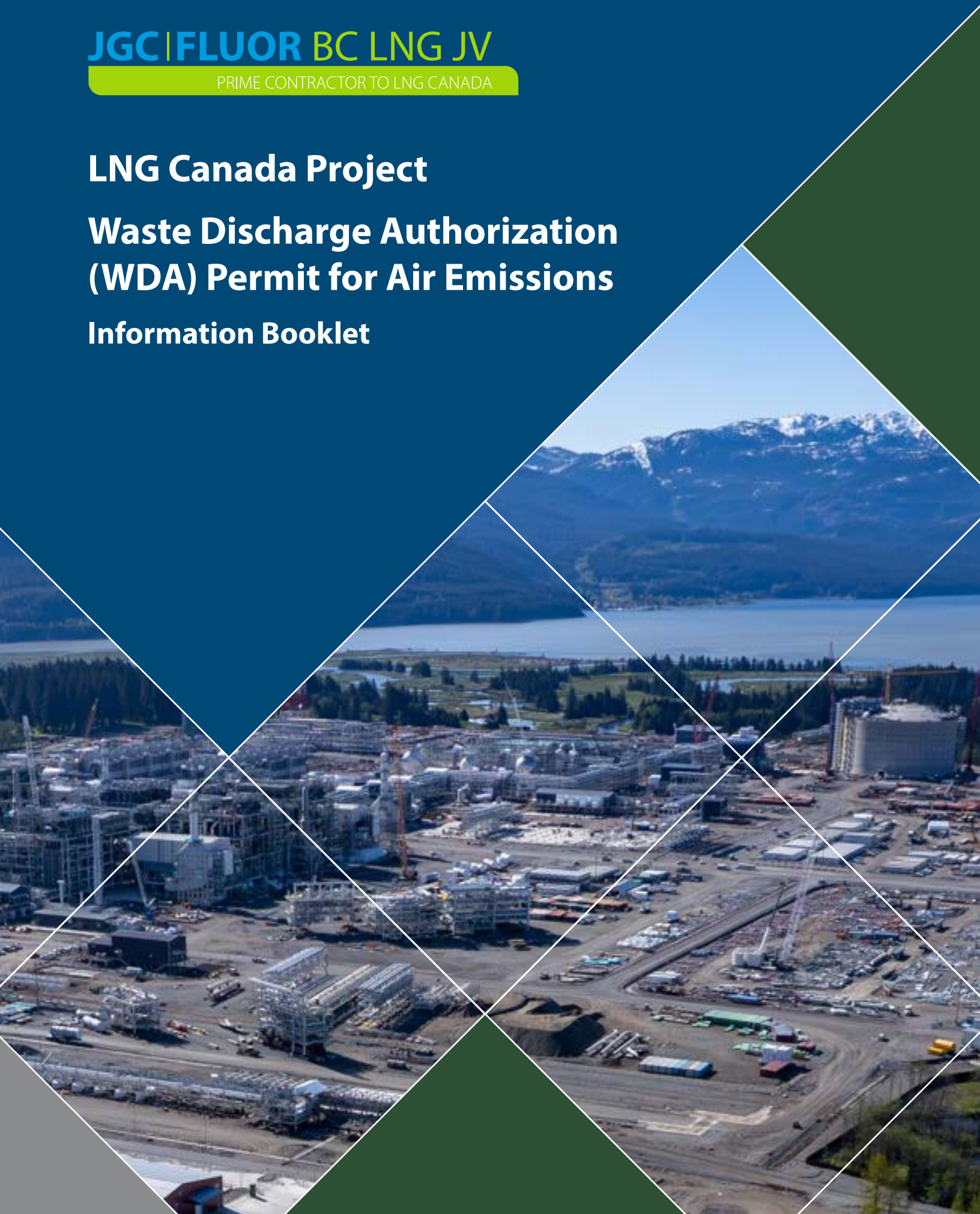
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LNG Canada Project

Waste Discharge Authorization (WDA) Permit for Air Emissions

Information Booklet



WHAT IS THE WDA PERMIT APPLICATION PROCESS?

How/where are the outcomes from each step documented?

Develop WDA Pre-Application Package

Develop Air Quality Dispersion Modelling Plan
Air Quality Dispersion Modelling Plan

Perform Air Quality Dispersion Modelling
Technical Data Report

Outline Operational Controls and Perform Risk/Effects Assessments
Technical Assessment Report

Undertake Public Consultation
Notification and Engagement Report

Complete WDA Application Package

BC Energy Regulator (BCER) Decision on WDA
Permit issued by BCER

Comply with WDA
Monitoring and Reporting

WHAT IS THIS WASTE DISCHARGE AUTHORIZATION?

LNG Canada is seeking a waste discharge authorization (WDA) for air emissions from Phase 1 (two liquefaction processing units, also referred to as trains, operating) of the **Liquefied Natural Gas** (LNG) Facility, under the *BC Environmental Management Act*, from the BC Energy Regulator (BCER). The BCER has involved the Ministry of Environment and Climate Change Strategy's air quality specialists in the review of WDA pre-application materials.

WHAT TYPES OF EMISSIONS ARE INCLUDED IN THIS WASTE DISCHARGE AUTHORIZATION?

The B.C. government has established Air Quality Objectives for Criteria Air Contaminants (CACs) to protect human health and the environment. There are four key CACs from the LNG Facility that are assessed in the WDA permit application:

- Oxides of Nitrogen (NOx)
- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- Respirable particulate matter ($PM_{2.5}$), or particles with an aerodynamic diameter less than 2.5 micrometres.

How small is 2.5 micrometres?

The average human hair is about 70 micrometres in diameter – which is approximately 30 times wider than a single particle of $PM_{2.5}$.

Greenhouse gas (GHG) emissions are not air contaminants, and are addressed separately from this waste discharge authorization due to their relevance to global climate change, rather than local air quality.

What is NOx?

NOx is a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2). When NO is released into the atmosphere, it is rapidly transformed to NO_2 due to the reaction with ozone (O_3). B.C. has Air Quality Objectives for NO_2 rather than NOx. Therefore, NO_2 is the basis for presenting air quality dispersion results.

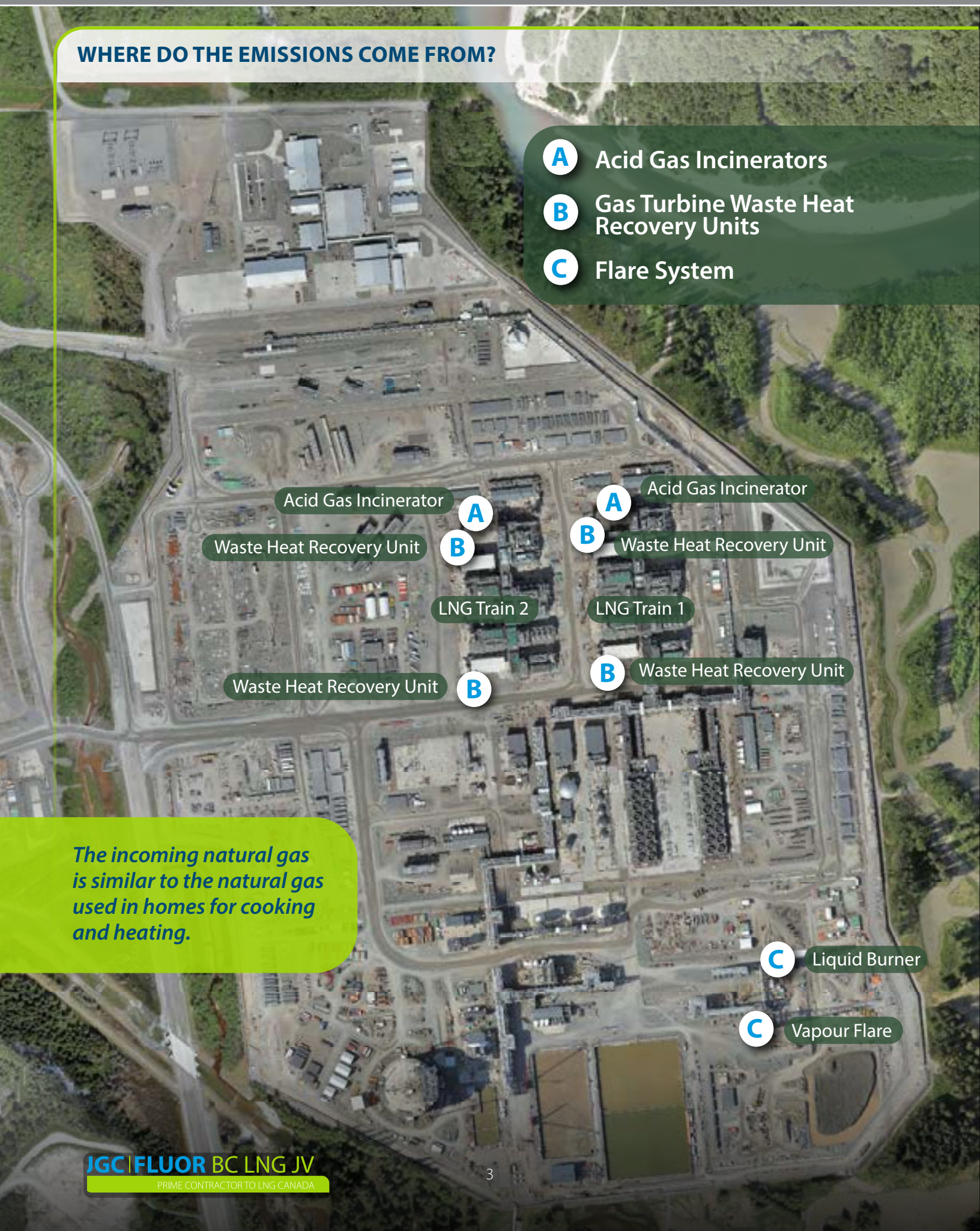
LNG Canada's export facility in Kitimat is designed to have the lowest carbon intensity of any large-scale LNG export facility of a similar size operating in the world today: 35 percent lower than the world's best performing facilities and 60 percent lower than the global weighted average.



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WHERE DO THE EMISSIONS COME FROM?

- **A** Acid Gas Incinerators
- **B** Gas Turbine Waste Heat Recovery Units
- **C** Flare System



The incoming natural gas is similar to the natural gas used in homes for cooking and heating.

MAIN SOURCES OF LNG FACILITY AIR EMISSIONS AND LNG CANADA'S EMISSIONS REDUCTION TECHNOLOGIES

ACID GAS INCINERATORS (TWO)

- **Purpose.** The gas supplied to the LNG Facility needs to be cleaned of impurities before being liquified into LNG. In each LNG processing train, the incoming gas will be sent to an Acid Gas Removal Unit (AGRU) to remove hydrogen sulphide (H_2S), carbon dioxide, and other impurities in the natural gas. The impurities from the AGRU are incinerated, before being discharged as carbon dioxide, SO_2, and water vapour.
- **Emissions Reduction Technology.** The burner in the Acid Gas Incinerator is designed to remove 99.99% of impurities.

GAS TURBINES, VIA THE WASTE HEAT RECOVERY UNITS (FOUR)

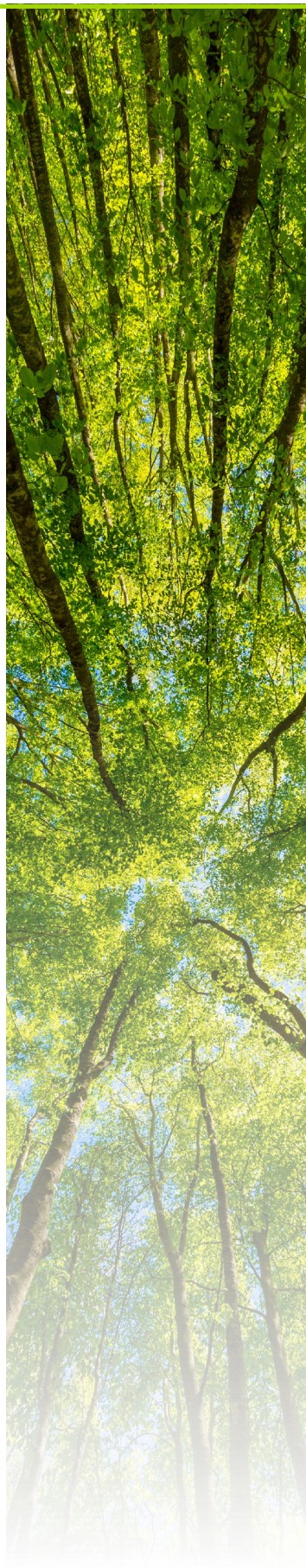
- **Purpose.** Each LNG train has two refrigerant compressor systems to condense and cool the gas, which are driven by gas powered turbines. The turbine exhaust stacks are equipped with waste heat recovery units to recover waste heat for process heating needs at the LNG Facility.
- **Emissions Reduction Technology.** LNG Canada selected the most energy-efficient gas turbines for the LNG liquefaction process. These gas turbines have a dry low NOx combustion optimization system that reduces NOx emissions. This technology emits 10 times less the NOx emissions of conventional burners.

FLARE SYSTEM (VAPOUR AND LIQUID FLARES)

- **Purpose.** Used to safely combust excess hydrocarbons, when necessary. During normal operations, there will be a continuous flare pilot (small, smokeless flame), so any gas that needs to be sent to the flare is immediately ignited and combusted.
- **Emissions Reduction Technology.** LNG Canada flares have been selected to ensure efficient combustion of the gas with an efficiency rate of at least 99.53%.

There will also be air emissions from the LNG carriers and tug boats while at the marine terminal. These sources have been included in the air quality dispersion modelling for completeness, but are not regulated by the BC Energy Regulator under the *Environmental Management Act*.

Additionally, there will be non-routine point source emissions during intermittent operations, maintenance, start-up, shutdown, or upset conditions. Further information on the air emissions from these operating activities is provided in the WDA Air Emissions Technical Assessment Report (see page 12 for how to obtain a copy).



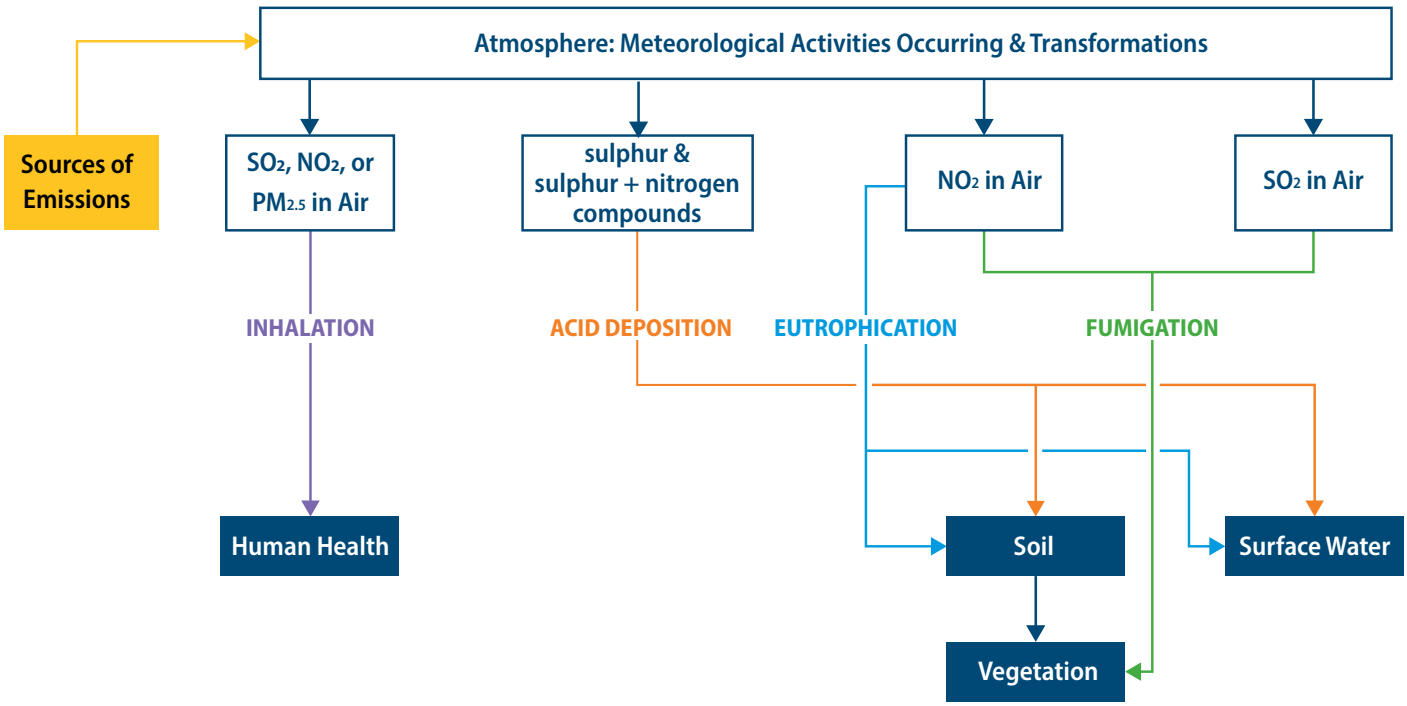
POTENTIAL INTERACTIONS WITH PEOPLE AND THE ENVIRONMENT

There are various ways emissions may interact with people and the local environment:

- **Inhalation.** NO_2 and SO_2 can mix with the moisture in the lungs, which has the potential to irritate the lungs and lower resistance to respiratory infection. Respirable $PM_{2.5}$ can also irritate the eyes, nose, throat, and lungs.
- **Acid Deposition.** NOx and SO_2 react with water and air in the atmosphere and are deposited on land/soil or water bodies. This reaction can subsequently reduce the pH in the soil, which in turn may affect the vegetation, and reduce the pH in lakes and streams, which may result in adverse effects on freshwater systems within the regional water bodies.
- **Eutrophication.** An increase in nutrient concentrations (i.e., nitrogen deposition originating from NOx) in the soil, lakes, and streams can have an effect similar to adding fertilizer. This can affect vegetation health and diversity.
- **Fumigation.** Direct exposure to high concentrations of NO_2 and SO_2 in gaseous form may affect plant health or growth (i.e., directly affecting plant tissues).

Similar to Air Quality Objectives, B.C. has also developed screening criteria for modelling to determine where potential effects may occur.

PATHWAYS TO RECEPTORS



AIR QUALITY DISPERSION MODELLING APPROACH AND FINDINGS

Dispersion modelling is used to predict how air contaminants are dispersed in the region. Inputs to the model include emission sources and rates as well as meteorological data (e.g., wind speeds and direction). This is done in advance of permitting decisions, by a regulatory agency, to provide information on how a project's emissions are likely to interact with people and the environment. It is conservative by nature, and is based on historical data in order to best model what the likely impacts will be, prior to operating.

WHAT WAS INCLUDED IN THE AIR QUALITY DISPERSION MODELLING?

Several scenarios were modelled, which included the "routine" cases as outlined in the table below.

Case	Description
Base Case	Existing conditions, based on the Rio Tinto Modernization and associated marine vessels.
Project-Alone Case 1	Phase 1 (LNG Trains 1 and 2) of the LNG Facility in isolation
Application Case	Base Case + Project-Alone Case 1 + Phase 1 marine traffic
Project-Alone Case 2	Phase 1 & 2 (LNG Trains 1 to 4) of the LNG Facility in isolation
Future Case	Base Case + Project-Alone Case 2 + Phase 1 & 2 marine traffic

A baseline was added to these cases to account for natural sources globally and local sources, such as home heating and vehicles.

The "Application Case" is the basis for this WDA permit application, with the "Future Case" included for information and awareness. A WDA will be required to authorize emissions from Phase 2 of the LNG Facility (two additional liquefaction processing trains) if LNG Canada moves forward with Phase 2.

"Non-routine" cases were also assessed in the air quality dispersion model to help understand different potential operating conditions, where emissions could fluctuate or occur for shorter-term operating scenarios.

WHAT ARE THE KEY FINDINGS?

- The highest NO_2 concentrations are predicted to remain below the BC Air Quality Objectives, and the predicted effects on future air quality are not substantial. The LNG Facility's air emissions result in moderate increases in ground-level concentrations of NO_2.
- Maximum predicted SO_2 and $PM_{2.5}$ concentrations are greater than the BC Air Quality Objectives, largely attributed to the existing conditions. The incremental contribution from the LNG Facility does not substantially alter the existing air quality.
- Maximum predicted CO concentrations are below the BC Air Quality Objectives.

WHAT IS THE CERTAINTY OF THE MODELLING FINDINGS?

Our confidence in the assessment is high. Model predictions are typically conservative (i.e., over estimate the emissions and the predicted effects). Comparisons of our predicted concentrations of CACs against local measurements from Kitimat air monitoring stations confirm the predictions are conservative.

SPOTLIGHT ON OXIDES OF NITROGEN (NOx)

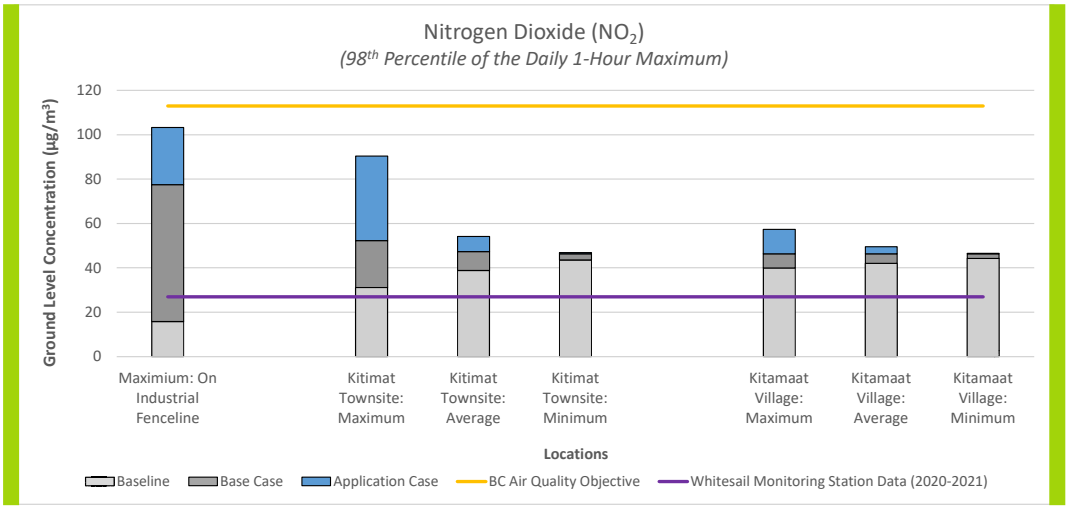
WHERE IS NOx SOURCED FROM?

NOx comes from human sources (by combustion of fossil fuels) and natural sources (by forest fires and lightning). It is formed when nitrogen (N_2), an inert gas that makes up 78% of air, is exposed to high temperatures, and a small portion of it spontaneously binds with oxygen.

For the LNG Facility, NOx is produced through combustion activities within **the gas turbines, acid gas incinerators, and the flare system**. The exhaust from the gas turbines account for over 90% of the LNG Facility NOx emissions during normal operations for Phase 1.

WHAT ARE THE AIR QUALITY DISPERSION MODELLING RESULTS FOR NO_2?

In summary, **the maximum* predicted 1-hour ground-level NO_2 concentrations are less than the BC Air Quality Objective (113 µg/m³).** The maximum predicted 1-hour concentration for NO_2 occurs near LNG Canada's marine terminal. The graph below also illustrates the daily 1-hour maximum NO_2 measured at the Whitesail Monitoring Station from 2020 to 2021, which is below the predicted Base Case values in all locations.



** Maximum is determined by the regulatory guidance (which is to use the 98th percentile of the daily 1-hour maximum, averaged over three years)*

WHAT IS THE POTENTIAL EFFECT OF THE LNG FACILITY NOx EMISSIONS ON HUMAN HEALTH AND THE ENVIRONMENT?

The modelling shows that from Base Case to the Application Case:

- In Kitamaat Village and the District of Kitimat, 1-hour NO_2 and annual average NO_2 concentrations will remain below the BC Air Quality Objectives for the protection of **human health**.
- No direct effects on vegetation are predicted due to NO_2 (**fumigation**).
- 595 hectares of increased nutrients in soil from nitrogen **deposition** could occur in and around the LNG Facility site.
- An up to 4% increase in nitrogen concentrations in surface water (lakes and streams) but no overall change in the **nutrient productivity (tropic status)** of the lakes and streams.

SPOTLIGHT ON SULPHUR DIOXIDE (SO_2)

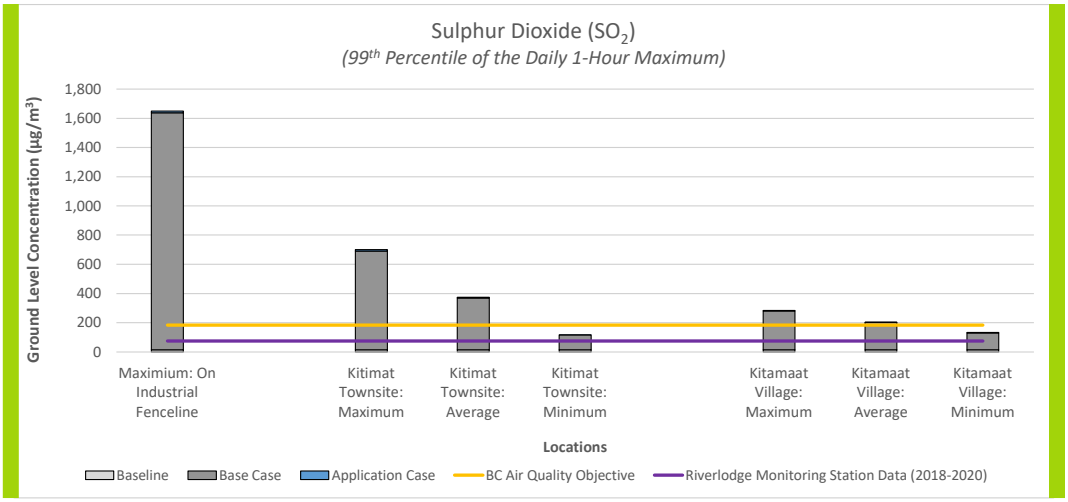
WHERE IS SO_2 SOURCED FROM?

SO_2 comes from human sources (e.g., combustion of fossil fuels that contain sulphur) and natural sources (e.g., volcanoes).

For the LNG Facility, the incoming natural gas has a very low sulphur content, which will be removed via the Acid Gas Removal Unit and the **Acid Gas Incinerator**. In the Application Case, Phase 1 adds approximately 2% to existing local SO_2 emissions.

WHAT ARE THE AIR QUALITY DISPERSION MODELLING RESULTS FOR SO_2?

In summary, **the maximum* predicted 1-hour ground-level SO_2 concentrations are greater than the BC Air Quality Objectives (183 µg/m³) for the Base Case and, subsequently, the Application Case**. The incremental addition from the LNG Facility does not substantially alter the existing air quality. The graph below also illustrates the daily 1-hour maximum of SO_2 measured at the Riverlodge Monitoring Station from 2018 to 2020, which is below the predicted Base Case values in all locations.



** Maximum is determined by the regulatory guidance (which is to use the 99th percentile of the daily 1-hour maximum, averaged over three years)*

WHAT IS THE POTENTIAL EFFECT ON HUMAN HEALTH AND THE ENVIRONMENT FROM THE LNG FACILITY SO_2 EMISSIONS?

The modelling shows that from Base Case to the Application Case:

- LNG Canada's contribution to SO_2 **health** risk is negligible.
- An approximate 7% increase in the area potentially affected by SO_2 **fumigation** (direct effects on vegetation).

Turn to the next page for more information on the cumulative effects of NOx and SO_2.

SPOTLIGHT ON NO_2 + SO_2

WHAT IS THE POTENTIAL EFFECT OF THE REGIONAL CUMULATIVE NO_2 + SO_2 EMISSIONS ON HUMAN HEALTH AND THE ENVIRONMENT?

The modelling shows that from Base Case to the Application Case:

- **The combined health risk from inhalation of SO_2 and NO_2 from all regional sources is low.** The additional combined exposure is predicted to result in less than 1 additional respiratory event over 5 years (an increase of 0.04% to 0.10%) for those with asthma and chronic obstructive pulmonary disease (COPD).
- An approximate 16% increase in the area potentially affected by **soil acid deposition** to the north and south of the region (near Terrace and Maitland Island).
- The LNG Facility emissions are not predicted to cause any new significant harmful effects (critical load exceedances) in lakes and streams due to **acid deposition**.



SPOTLIGHT ON $PM_{2.5}$

WHERE IS $PM_{2.5}$ SOURCED FROM?

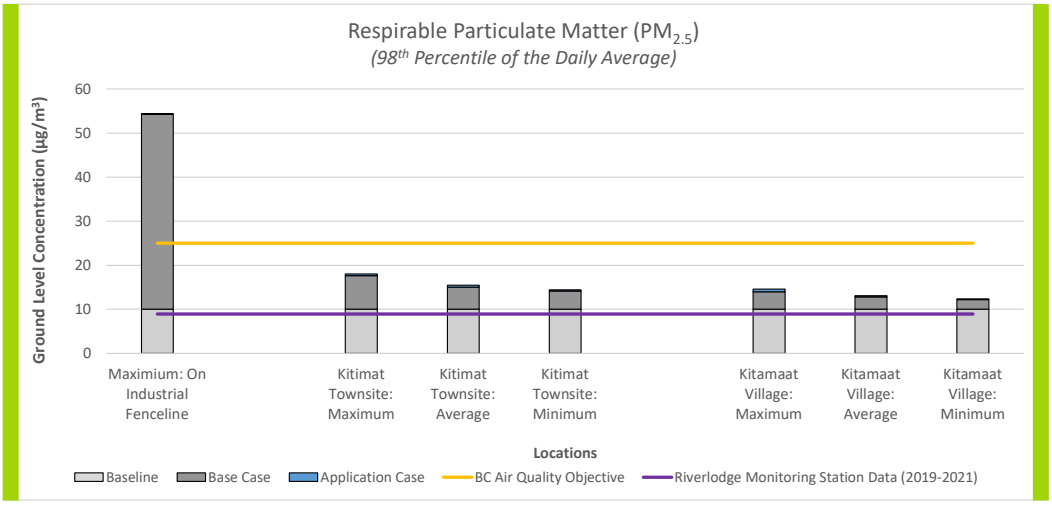
$PM_{2.5}$ is produced primarily from fuel combustion (e.g., natural gas, diesel, gasoline) and fires (e.g., forest fires, incinerators).

In the Application Case, Phase 1 adds approximately 6% to existing local $PM_{2.5}$ emissions.

WHAT ARE THE AIR QUALITY DISPERSION MODELLING RESULTS FOR $PM_{2.5}$?

In summary, $PM_{2.5}$ is generally below the BC Air Quality Objectives (25 µg/m^3, for daily average); however, the dispersion modelling shows a small, isolated region south of the neighbouring industrial facility with a predicted Air Quality Objective exceedance in the Base Case and, subsequently, the Application Case. The graph below also illustrates the maximum daily average of $PM_{2.5}$ measured at the Riverlodge Monitoring Station from 2019 to 2021, which is below the predicted Base Case values in all locations.

The incremental addition from the LNG Facility does not substantially alter the existing air quality.



WHAT IS THE POTENTIAL EFFECT ON HUMAN HEALTH FROM THE LNG FACILITY $PM_{2.5}$ EMISSIONS?

The modelling shows that from Base Case to the Application Case:

- LNG Canada's contribution to $PM_{2.5}$ **health** risk is negligible. $PM_{2.5}$ concentrations in Kitimat are predicted to remain below Air Quality Objectives during the Application Case.



NEXT STEPS

HOW ARE THE LNG FACILITY EMISSIONS AND ASSOCIATED ENVIRONMENTAL EFFECTS MONITORED?

- Continuous Emission Monitoring Systems are installed in the LNG Facility to measure and support reporting of air emissions.
- LNG Canada's proposed monitoring approach is to supplement existing environmental effects monitoring programs (air quality, soil, vegetation, and surface water) in the region, with a focus on NOx emissions.
- LNG Canada is committed to monitoring and reporting on the effects of their activities over the life of the LNG Facility with the goal of demonstrating ongoing responsibility and responsiveness to potential effects.
- To learn more about the current network of air quality monitoring stations in Kitimat, visit the Kitimat Airshed Group (KAG) website at: www.kitimatairshedgroup.com/.

HOW TO GET MORE INFORMATION ABOUT THIS WDA PERMIT?

- Request a copy of the Technical Assessment Report during the public comment period by emailing **comments@jfjvkitimat.com** or review a printed copy at the Kitimat Public Library.
- Provide feedback by submitting your comments to **comments@jfjvkitimat.com** or in writing at the JFJV Project Resource Centre at 234 City Centre, Kitimat.



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