

## A. Introduction

The *Environmental Management Act*<sup>1</sup> (EMA) gives the Minister of Environment and Climate Change Strategy the authority to prepare and publish policies, strategies, objectives, guidelines and standards for the protection and management of the environment. In B.C., the Ministry of Environment and Climate Change Strategy (ENV) has adopted air quality objectives (AQO) on a number of pollutants<sup>2</sup>, including particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>), ozone, sulphur dioxide, nitrogen dioxide (NO<sub>2</sub>) and carbon monoxide. Provincial AQO serve as benchmarks to assess air quality and inform air management decisions. They define acceptable non-statutory limits for specific air pollutants that are not legally binding unless referenced in an authorization or regulation.

The provincial AQO for NO<sub>2</sub> were adopted in 2014 under an interim status while B.C. was involved with the development of a national standard. In 2017, the national Canadian Ambient Air Quality Standard (CAAQS) for NO<sub>2</sub> was adopted by the Canadian Council of Ministers of the Environment (CCME) and established as part of the national Air Quality Management System (AQMS). The new CAAQS<sup>3</sup> define targets for 2020 and 2025 that are significantly more stringent than the provincial interim ambient air quality objectives (IAAQO).

The “Provincial Framework for Developing Provincial Air Quality Objectives”<sup>4</sup>, which was updated in early 2020, outlines the process for reviewing AQO. Following the approach defined in the framework, we reviewed the scientific assessments gathered during CAAQS development and considered B.C. specific factors such as vulnerable populations and sensitive receptors, achievability, and clarification of where/how the AQO are applied. We are proposing to update NO<sub>2</sub> AQO as follows:

- Adopt the standards specified in the 2020 NO<sub>2</sub> CAAQS as the new Provincial AQO. This strengthens the AQO and replaces the current IAAQO
- Provide clarifications on the application of Provincial AQO, particularly on air quality dispersion models

Table 1 is a summary of the values of IAAQO, CAAQS, and the proposed AQO. The proposed AQO and CAAQS are more stringent than the IAAQO on both the 1-hour and annual values. The 2025 CAAQS is the most stringent with 1-hour and annual standards that are more than 60% lower than the IAAQO, and 30% lower than the 2020 CAAQS and proposed AQO. CAAQS and the proposed AQO also apply three-year averaging statistics on the 1-hour standard instead of the one-year averaging used in the IAAQO.

### **Proposal to Update the Air Quality Objectives**

The B.C. Ministry of Environment and Climate Change Strategy proposes to adopt new air quality objectives for nitrogen dioxide. The new objectives would be based on the Canadian Ambient Air Quality Standards adopted in 2017 by the CCME. This intentions paper describes the proposal and seeks feedback from interested parties.

<sup>1</sup> See: [https://www.bclaws.ca/civix/document/id/complete/statreg/03053\\_00](https://www.bclaws.ca/civix/document/id/complete/statreg/03053_00)

<sup>2</sup> See: [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/prov\\_aqo\\_fact\\_sheet.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/prov_aqo_fact_sheet.pdf)

<sup>3</sup> See: <https://www.ccme.ca/en/air-quality-report#slide-7>

<sup>4</sup> See: [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/provincial\\_framework\\_for\\_developing\\_provincial\\_air\\_quality\\_objectives\\_-\\_info\\_sheet.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/provincial_framework_for_developing_provincial_air_quality_objectives_-_info_sheet.pdf)

Table 1. Summary of provincial and national ambient air quality objectives or standards for NO<sub>2</sub>.

Averaging Period	2020 CAAQS	2025 CAAQS	B.C. IAAQO	B.C. AQO (Proposal)
1-hour	60 ppb*	42 ppb*	100 ppb**	60 ppb*
Annual	17 ppb <sup>+</sup>	12 ppb <sup>+</sup>	32 ppb <sup>+</sup>	17 ppb <sup>+</sup>

\* Annual 98<sup>th</sup> percentile of daily 1-hour maximum, averaged over three consecutive years

\*\* Annual 98<sup>th</sup> percentile of daily 1-hour maximum over one year

<sup>+</sup> Annual average of 1-hour values

## Nitrogen Dioxide – Effects and Emission Sources

Nitrogen dioxide (NO<sub>2</sub>) is a gaseous pollutant produced along with other nitrogen oxides (NO<sub>x</sub>) during high temperature burning of fossil fuels. Exposure to NO<sub>2</sub> is known to affect human health and the environment. Long term exposures, for example, has been shown to induce the development of allergic responses, asthma, increases the susceptibility for respiratory infections, and has been linked to cardiovascular system and reproductive effects<sup>5</sup>. Short term exposures can reduce lung function and aggravate respiratory symptoms and airway inflammation. These effects have no observed lower threshold, i.e., negative effects are observed even at low concentrations.

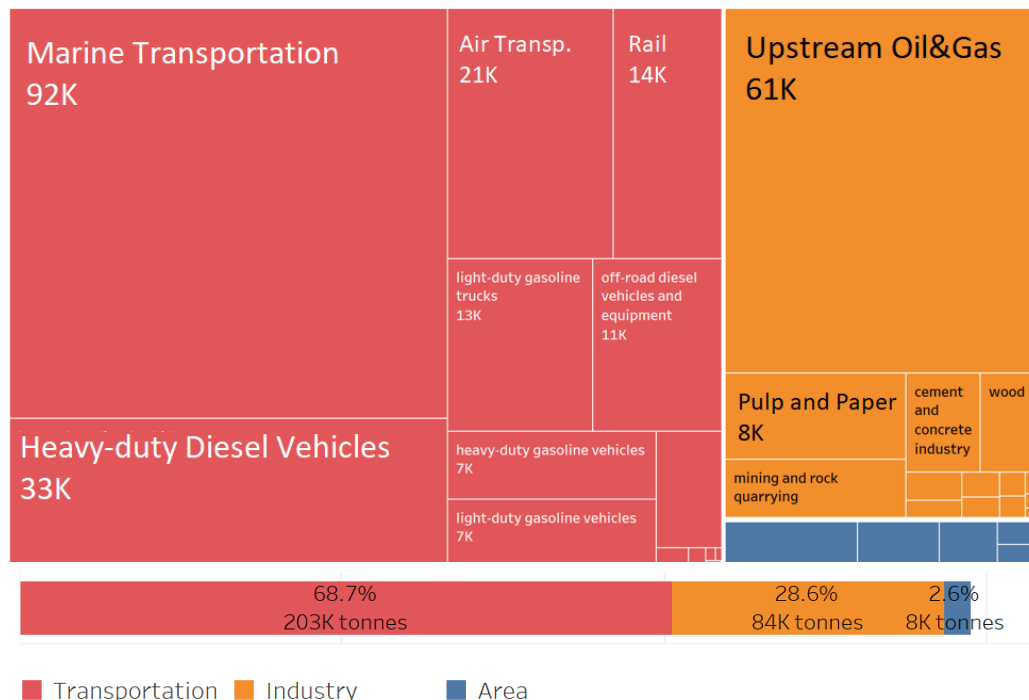


Figure 1. Multiple sources of nitrogen oxides (NO<sub>x</sub>) in B.C. based on the 2017 National Pollutant Release Inventory.

<sup>5</sup> Brauer, Michael & Henderson, Sarah & Kirkham, Tracy & Lee, Kit & Rich, Kira & Teschke, Kay. (2002). Review of the health risks associated with nitrogen dioxide and sulfur dioxide in indoor air.

Environmental effects of NO<sub>2</sub> (and NO<sub>x</sub> in general) include altered plant growth due to absorption through their leaves and from nitrogen deposition. Impact on plants can negatively affect animals like caribou that depend on arboreal lichens for sustenance<sup>6</sup>. NO<sub>2</sub> also has indirect effects including its role in ozone formation and acid rain. Ozone is detrimental to plant life because exposure oxidizes (burns) plant tissues, and acid rain results in the acidification and eutrophication of ecosystems. Reddish-brown haze commonly found over urban centres is the result of higher concentrations of NO<sub>2</sub> pollution.

According to the National Pollutant Release Inventory, majority of B.C.'s total NO<sub>x</sub> emissions in 2017 are from transportation sources (69%) followed by industrial (29%) and area sources (2%). Transportation sources are dominated by emissions from marine vessels (31% of total) and heavy-duty diesel vehicles (11% of total) while industrial emissions are mostly from the oil and gas sector (21% of total) (Figure 1).

### ***CAAQS Development Process***

CAAQS are a key element that serves as drivers for actions to protect human health and the environment under the national Air Quality Management System (AQMS). CAAQS are developed through a process that involves federal review of the health and environmental impacts, ambient trends, emissions, and modelling forecasts, a scan of criteria used in other jurisdictions, and estimation of population exposure to ambient levels of specific pollutants. Recommendations on the future of CAAQS are developed by a multi-stakeholder working group and approved for adoption by the Canadian Council of Ministers of the Environment (CCME). This process is periodically reviewed, approximately every five years, to keep CAAQS current and drive continuous improvement of air quality.

CAAQS for fine particulate matter and ground-level ozone were established in 2013 defining 2015 and 2020 targets. In 2017, CAAQS for sulphur dioxide and nitrogen dioxide were developed with 2020 and 2025 targets. In 2019, CAAQS for ozone was updated with a 2025 target. The targets defined in CAAQS are established as objectives for desirable levels of environmental quality under the Canadian Environmental Protection Act of 1999. The roles and responsibilities for meeting this target are shared between federal, provincial, and territorial jurisdictions and defined under the AQMS through an air zone management framework.<sup>7</sup> In B.C., CAAQS are either adopted or applied as reference point in the development of the Provincial Air Quality Objectives as a starting point with B.C.-specific considerations following the "Provincial Framework for Developing Provincial Air Quality Objectives".

### ***Provincial Framework for Developing Provincial Air Quality Objectives***

The Provincial Framework outlines the process and key considerations for developing air quality objectives for B.C.. Updated in February 2020, the framework was developed in the context of guiding the review of air quality objectives for NO<sub>2</sub>. A discussion paper was released in 2019 to gain perspectives from various stakeholders on a proposed approach to review the AQO for NO<sub>2</sub>, and AQO in general. Comments received from both industry and health agencies called for a science-based process and greater transparency in decision-making. There were also suggestions to clarify the application of CAAQS or separate provincial AQO on environmental decision-making, and to consider factors such as vulnerable populations and achievability.

The Provincial Framework lays out an approach for setting AQO relative to the CAAQS. Whenever CAAQS are available, CAAQS and their supporting science assessments form the basis from which the provincial AQO are developed. This circumvents the need for a separate risk assessment and scientific studies considering B.C.'s involvement in the CAAQS development process as a participant in the CAAQS Development and Review Working Group. The process of adopting

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<sup>6</sup> See: <http://www.env.gov.bc.ca/wld/documents/caribou.pdf>

<sup>7</sup> See: <https://www.ccme.ca/en/air-quality-report#slide-2>

AQO involves consideration of B.C.-specific factors that include vulnerable populations and other sensitive receptors, achievability, and clarifications of how AQO will be implemented.

### ***Vulnerable Populations and Sensitive Receptors***

In support of CAAQS development, Health Canada conducted a comprehensive human health risk assessment<sup>8</sup> based on most recent and relevant health studies to investigate the impacts of ambient NO<sub>2</sub> on the vulnerable population. The assessment found health effects from short-term and long-term NO<sub>2</sub> exposures that includes respiratory effects, and short-term mortality particularly from vulnerable individuals with heightened sensitivity. This includes children, older adults, and people with asthma, COPD, and those engaged in vigorous physical activity or spending substantial amounts of time near major roadways. The risks for NO<sub>2</sub>-related health effects are relatively small based on traditional epidemiological standards but they increase due to broad exposure across the general population. The study found asthma-related endpoints are strongly associated to short-term exposure metrics (e.g., daily 1-hour maximum), while respiratory health endpoints including reduced lung function and growth, development of asthma and allergic response, are strongly associated to long-term exposure metrics (e.g., long term average). The health study did not find lower thresholds for health effects. Strong associations and difference in impacts between short-term and long-term exposures supports the establishment of both a short-term and a long-term standard.

Sensitive receptors include ecosystem components which are negatively affected by NO<sub>2</sub> exposures. Lichens for example, are sensitive to combined NO<sub>x</sub>, sulphur dioxide, and ozone exposures. Estimated levels for complete protection from environmental effects of NO<sub>x</sub> is 15 µg/m<sup>3</sup> (approximately 8 ppb if NO<sub>x</sub> is purely NO<sub>2</sub>). This level is very low and not a practical objective but supports an emphasis on continuous improvement.

### ***Achievability Based on Emission Trends***

Among the considerations for AQO adoption, achievability is the most challenging to satisfy whenever more stringent standards are considered. There are multiple elements to characterize achievability of AQO. These include achievability relative to current air quality measurements, current and projected emission trends, and the cost and feasibility of technical requirements to achieve these targets. An analysis of the 2019 NO<sub>2</sub> readings at more than 50 monitoring stations (Figure 2) show that metrics at two monitoring stations exceed 2020 CAAQS. Both stations are in the Lower Fraser Valley air zone on areas dominated by vehicular emissions and under the delegated authority of Metro Vancouver. EMA section 31 gives Metro Vancouver the delegated authority to regulate its air emissions including the adoption of 2020 CAAQS values for its air quality objectives<sup>9</sup>. The more stringent 2025 CAAQS are exceeded at nine monitoring stations across four different air zones.

Statistical analysis of NO<sub>2</sub> readings show that 43 out of the 50 monitoring sites exhibit significant differences between weekday and weekend values with weekends having lower NO<sub>2</sub> levels. The weekday-weekend pattern indicates that most sites are influenced by emissions from gasoline and diesel vehicles that follow this weekly cycle. The overall emissions of NO<sub>x</sub> are expected to decrease in the coming years<sup>10</sup> as a result of existing federal vehicle regulations combined with federal and provincial commitments and policies to reduce greenhouse gas emissions and improve energy consumption such as B.C.'s Zero-Emission Vehicles Act<sup>11</sup> to phase out the sales of light duty, gas-powered vehicles. Technological improvements and innovations such as zero emission vehicles, higher fuel standards, vehicles

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<sup>8</sup> See: <https://www.canada.ca/en/health-canada/services/publications/healthy-living/human-health-risk-assessment-ambient-nitrogen-dioxide.html>

<sup>9</sup> See: <http://www.metrovancouver.org/services/air-quality/AirQualityPublications/CurrentAmbientAirQualityObjectives.pdf>

<sup>10</sup> See: <https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/projections/2019.html>

<sup>11</sup> See: <https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/clean-transportation-policies-programs/zero-emission-vehicles-act>

meeting Tier 2 and 3 emission standards, and updates on industrial equipment and marine vessels are also anticipated to further reduce NO<sub>x</sub>.

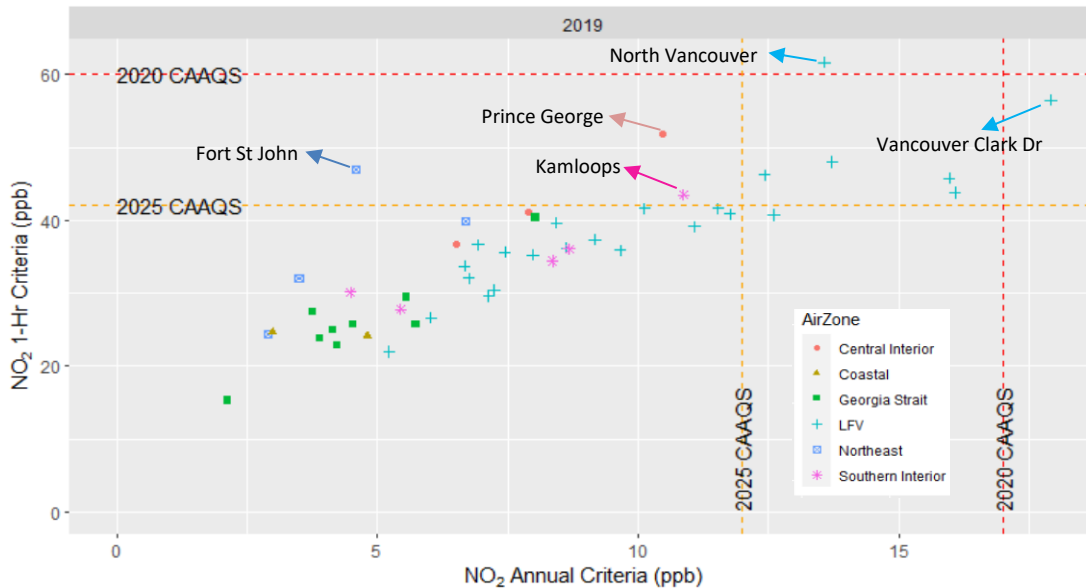


Figure 2. Scatterplot of the annual and the 1-hr metric of NO<sub>2</sub> measured in 2017-2019 at monitoring stations across B.C. air zones of the Central Interior, Coast, Georgia Strait, Lower Fraser Valley, Northeast, and Southern Interior. Stations plotted to the right of the vertical line had metrics exceeding the annual metric, stations plotted above the horizontal line had metrics above the 1-hour standard.

### Recommendation Based on B.C.-Specific Factors

In the review process following the AQO adoption framework and application of B.C.-specific factors, the Ministry is proposing to adopt the 2020 NO<sub>2</sub> CAAQS of 17 ppb for the annual and 60 ppb for the 1-hour standard as the updated provincial AQO. The rationale for this recommendation includes:

- Adoption of AQO based on strong evidence from human health risk assessment on short-term and long-term respiratory effects, and short-term mortality from ambient NO<sub>2</sub> exposures
- For 2020 until 2025, the AQO are consistent with CAAQS which have been endorsed by the CCME
- Considering current ambient levels and NO<sub>x</sub> emissions trends the AQO are achievable in B.C.
- It provides adequate time to evaluate achievability of the 2025 CAAQS, while at the same time maintaining B.C.'s commitment under the AQMS for continuous improvement of air quality

The provincial framework also specified the need to clarify application of AQO. Policy and non-policy applications of the AQO include air quality management, permits and authorized discharges, and air quality dispersion models. The new AQO will be published along with an implementation guide.

### Applications in Air Quality Management

Airshed management is a collaborative process of managing air quality within an airshed – areas defined by geographical features and meteorology that sometimes follows political boundaries. This approach recognizes that local air quality is influenced by the combination of activities and emission sources in places with multiple stakeholders and overlapping

jurisdictions. The complex terrain and weather patterns in B.C. naturally divide the province into a number of airsheds, such as the Fraser Valley, Okanagan Valley and Bulkley Valley. Other airsheds, such as Metro Vancouver, Prince George, Williams Lake, Sea-to-Sky, the Boundary (Grand Forks), Merritt, and Quesnel, are based on individual municipalities or regional districts to reflect the area in which there is support and authority for air quality action.

Airshed plans provide stakeholders with a clear understanding of community air-quality priorities to ensure achievement of air quality goals, and devise strategies on how future growth can be accommodated. Whenever air quality levels approach or exceed ambient air quality objectives, the ministry considers a range of actions to improve air quality for the affected communities, including but not limited to: programs to reduce emissions from non-point sources; more frequent permit reviews and compliance inspections; application of best achievable technology for emissions control; more stringent requirements for regulated sources; and detailed scientific studies to better characterize and quantify the impacts of sources and other influences on air quality. Community-based airshed plans are key to meeting B.C.'s commitment to the national AQMS. AQMS is endorsed by the CCME and applies an air zone management framework to define levels of actions that are applied to communities and airshed that are inside an air zone.

### ***Applications in Air Zone Management***

The Province has been divided into seven broad areas called air zones for the purpose of reporting air quality issues and trends, identify monitoring and reporting requirements, and determine levels of actions specified under AQMS<sup>12</sup>. This facilitates the communication of CAAQS achievement through the annual air zone reports<sup>13</sup> and applies a broader approach to existing airshed management plans. For air zones approaching or exceeding CAAQS, communities and airsheds inside the air zone are to take progressively more stringent levels of action to improve air quality and keep clean areas clean.

Annual air zone reporting of different pollutants is part of B.C.'s commitment under AQMS. For NO<sub>2</sub>, air zone reports are not expected until 2021 when air zones are assessed for 2020 NO<sub>2</sub> CAAQS achievement. At this point, the air zone AQMS management levels for NO<sub>2</sub> are incorporated into existing airshed and community plans with the goal to improve air quality and achieve the air quality objectives.

The air quality objective used as basis during planning needs to be specified because the target metrics between CAAQS and Provincial AQO are different. The recommendation to replace the IAAQO with a new AQO based on the 2020 CAAQS makes the provincial and national objectives consistent and provides a cohesive message for air quality planning.

### ***Applications in Permits and Authorized Discharge***

The issuance of a permit or approval under the *EMA* is based upon a multi-step process described with details in the ministry's guidance document, "Waste Discharge Regulation Implementation Guide."<sup>14</sup> Guidance specific to oil and gas activities can be found in "Guidance For Applications to Discharge Air Contaminants From Oil and Gas Facilities in British Columbia."<sup>15</sup>

As part of the process to apply for a permit or approval, technical information must be provided to the applicable regulatory body (e.g. ENV or Oil and Gas Commission) to describe the source, its potential impacts on the environment, and effects on human health. For high risk or complex authorizations, the proponent is required to submit a detailed technical assessment report following a pre-application meeting where the director clarifies any requirement. For low risk or less complex discharges, supporting technical information attached to the application package may be a sufficient substitute to a full environmental impact technical assessment report.

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<sup>12</sup> For more information, see: <https://www.ccme.ca/en/air-quality-report#slide-2>

<sup>13</sup> See: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/reports/latest-air-zone-reports>

<sup>14</sup> See: <http://www.env.gov.bc.ca/epd/main/ema.htm#2>

<sup>15</sup> See: <https://www.bcogc.ca/node/5944/download>



Where a technical assessment is required, regulatory staff can assist permit applicants in the early stages to clarify regulatory expectations with respect to:

- ambient air quality objectives, including provincial AQO and CAAQS,
- ambient monitoring requirements,
- emission control technology requirements, and
- recommended approach to dispersion modelling, as appropriate and described in “Guidelines for Air Quality Dispersion Modelling in British Columbia” and related technical guidance by the Ministry.<sup>16</sup>

Close collaboration with regulatory staff involved in source management, ambient monitoring and environmental protection ensures that approach is comprehensive, consistent and coordinated. Once completed, regulatory staff conducts a review of the submitted impact assessment and technical report. The Director may then issue a permit subject to conditions considered advisable for the protection of the environment. In determining what is advisable, the Director considers information provided by regulatory staff, the applicant, concerned persons and other agencies.

The Director may consider current or future economic growth and the associated cumulative impacts of multiple emission sources in an airshed when determining an applicant’s maximum allowable impact on that airshed. This extends to undeveloped areas, to ensure that no single source “uses up” the entire capacity of an airshed, as reflected in predicted concentrations approaching or exceeding the ambient air quality objectives. The Director may also require the application of additional ambient air quality criteria beyond established provincial or national ambient air quality objectives or standards, to assess site-specific concerns regarding potential health and environmental impacts.

Where exceedances of ambient air quality objectives are predicted, additional consideration is typically given to the conditions related to the exceedances (e.g. location of maximums relative to populated areas, timing, duration and magnitude of exceedances), and the relative contribution and spatial variation of background levels. The proponent may be asked to apply air quality dispersion models to demonstrate that its project would not impose a significant new burden on human health and the environment. Following these assessments, the Director may require the proponent to develop strategies or options to further mitigate emissions at the facility or within the affected airshed.

### ***Applications in Air Quality Dispersion Models***

An air quality dispersion model is a series of equations that mathematically describe the behaviour of pollutants in the air. It provides a cause-effect link between the emissions into the air and the resulting air pollution concentrations. Dispersion models have traditionally been used for airshed planning and in air quality assessments in support of decisions regarding approvals and permits for regulated sources.

A key component in compliance demonstration during permit application involves using air quality dispersion models to estimate NO<sub>2</sub> metrics relative to the air quality objectives. For NO<sub>2</sub>, this involves modelling the concentrations to calculate the short-term 1-hour and the long-term annual metric. Challenges for modelling are expected due to adoption of more stringent 1-hour objectives. A new modelling guideline specific to NO<sub>2</sub> is currently in development to provide clarity for proponents on the assumptions and methods appropriate for NO<sub>2</sub> models in the province.

### ***Applications in Air Quality Advisories***

Within B.C., air quality advisories are issued by regional offices of ENV and Metro Vancouver to inform the public about degraded air quality, and to trigger actions to reduce or avoid emissions. This occurs when measured air quality levels approach or exceed “acceptable” levels, as defined by ambient air quality objectives or other criteria established based on the AQO. Historically, air quality advisories in the province have been triggered by elevated levels of PM<sub>2.5</sub>, fugitive dust (PM<sub>10</sub>) or ground-level ozone. The spatial scale of these advisories has ranged from community-specific to regional,

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<sup>16</sup> See: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality-management/modelling>

depending on the contaminant, the sources involved and the atmospheric conditions. To date, no advisories have been issued for NO<sub>2</sub> or SO<sub>2</sub>. The need for an NO<sub>2</sub> advisory system will be developed as appropriate, in cooperation with health agencies and stakeholders. If such a system was to be developed, the advisory level will either apply the 1-hour metric for NO<sub>2</sub> or use this as a basis. This approach is similar to existing advisories of using the short-term standard as advisory levels.

## Providing Comments

The ministry welcomes comments on the information and proposals outlined in this Intentions Paper, and has provided the following opportunities for feedback:

- Email your comments to: [BCAirQualityObjectives@gov.bc.ca](mailto:BCAirQualityObjectives@gov.bc.ca)
- Mail your comments to:

*Ministry of Environment and Climate Change Strategy –  
Clean Air, Integrated Pest Management and Industry  
PO Box 9341 Stn Prov Govt  
Victoria, BC V8W 9M1*

All submissions will be treated with confidentiality by ministry staff and contractors when preparing consultation reports. Please note however that comments you provide and information that identifies you as the source of those comments may be publicly available if a Freedom of Information request is made under the *Freedom of Information and Protection of Privacy Act*.

If you have any questions or comments regarding this information contact the ministry at:  
[BCAirQualityObjectives@gov.bc.ca](mailto:BCAirQualityObjectives@gov.bc.ca).

Comments to the ministry should be made on or before June 18, 2021.

Thank you for your time and comments.