

**Alberta Ambient Air Quality Objectives and Guidelines – Nitrogen Dioxide -
DRAFT**

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Alberta ambient air quality objectives are issued by Alberta Environment and Parks, under Section 14 (1), the *Environmental Protection and Enhancement Act*, 1992.

- The 1-hour average Alberta Ambient Air Quality Objective for nitrogen dioxide is 150 µg m⁻³ (80 ppb) based on human health effects.
- The annual average Alberta Ambient Air Quality Objective for nitrogen dioxide is 32 µg m⁻³ (17 ppb) based on human and ecosystem health effects.
- **Effective January 1, 2025**, the annual average Alberta Ambient Air Quality Objective for nitrogen dioxide is 23 µg m⁻³ (12 ppb) based on human and ecosystem health effects.

Characteristics

Nitrogen dioxide (NO₂) is a reddish-orange-brown gas with an irritating, acrid, characteristic pungent odour. At temperatures below 21.15°C, nitrogen dioxide exists as a brown liquid and at temperatures below -11°C, as a colourless solid. Nitrogen dioxide is corrosive, highly oxidizing and non-combustible.

Nitrogen dioxide occurs naturally in the environment as a result of forest fires, atmospheric lightning discharges and biogenic oxidation of nitrogen containing compounds present in soil.

Anthropogenic emissions of NO₂ are mainly the result of combustion processes, such as the combustion of fuel for vehicles or the combustion of coal, oil and natural gas for industrial processes. Nitrogen dioxide can be directly released to air but more often, it is produced by the conversion of nitric oxide released from combustion processes. In sunlight, nitrogen dioxide can lead to the formation of ozone, nitric acid and nitrate-containing particles. Emissions of NO₂ may also result from its use in industrial processes. Nitrogen dioxide is used as a chemical intermediate in the production of nitric acid, as a nitrating agent, as an oxidizing agent, as a catalyst (e.g. in the production of sulphuric acid), as an oxidizer for rocket fuels and as a polymerization inhibitor for acrylates. It has also been used in the manufacturing of oxidized cellulose compounds (hemostatic cotton) and in bleaching flour.

Effects

Human Health

Inhalation of NO₂ can affect respiratory function and has also been linked to effects on the cardiovascular system, on fetal growth and birth weight, and premature death. Airway inflammation and alterations in lymphocytes (host defense) appear to be sensitive responses of healthy individuals acutely exposed to NO₂. Individuals with asthma, chronic obstructive pulmonary disorder (COPD) or chronic bronchitis have a greater sensitivity to acute NO₂ exposures compared to healthy individuals. Pre-exposure to NO₂ can increase the responsiveness of mildly asthmatic individuals to inhaled allergens (e.g. house dust mite, pollen). According to Health Canada (2016), no safe threshold level has been identified with exposures to NO₂. Efforts should be made to minimize NO₂ in the ambient air to prevent incremental risks of adverse health effects that include mortality.

Vegetation

The uptake of the majority of gaseous NO₂ is the leaf through the stomatal openings, with a minority absorbed through the leaf cuticle. A large number of studies have been done on the effects of NO₂ on plants but the effects observed depend on a number of factors, which include but are not limited to: the sensitivity of the species, duration and concentration of the exposure, and stage of growth when exposed. Some of the effects that have been observed are: increase in shoot to root ratio, which results in drought susceptibility; decreased growth; increased shoot nitrogen, which leads to increased susceptibility to pathogen and insect attack; and advanced bud-break, which could lead to frost damage. NO₂ also leads to the production of compounds that can contribute to acidification and eutrophication, both of which can be damaging to ecosystems.

Objectives in Other Jurisdictions

Table 1 lists ambient objectives currently in place for several jurisdictions. The metric calculation applied to each objective is noted below the table.

Table 1 Summary of Selected Air Quality Standards and Guidelines for Nitrogen Dioxide in Other Jurisdictions

Agency	Objective Title	Objective Value $\mu\text{g m}^{-3}$ (ppb)		
		Averaging Time		
		1 hour	24 hour	Annual
Canada	Ambient Air Quality Standard	(60)* 2025: (42)*		(17)** 2025: (12)**
Ontario	Ambient Air Quality Criteria	400 (200)	200 (100)	
British Columbia	Ambient Air Quality Objective	113 (60)*		32 (17)**
US EPA	Ambient Air Quality Standard	100*		53
WHO	Air Quality Guideline	200†		40

* Three-year average of the annual 98th percentile of the daily-maximum 1-hour average concentrations

** Average over a single calendar year of all the 1-hour average concentrations

† Daily maximum 1-hr average

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