state of the air 2022

BC LUNG FOUNDATION

CELEBRATING THE CLEAN AIR MONTH OF JUNE

contents

Few British Columbians will forget the summer of 2021: blistering, record breaking heat, out of control wildfires, and smoke blanketing the province. Heat exhaustion and smoke inhalation accounted for the deaths of 740 residents, according to the BC Centre for Disease Control.

The 19th Annual Air Quality and Health Workshop, titled "Gimme Shelter: Adapting the Indoor Environment to Reduce the Harmful Impacts of Climate Change", presented action steps for individuals, builders, and governments to mitigate the effects of a future heat dome in the years to come.

State of the Air 2022 sets out clear facts about our rapidly changing environment, and the urgent need for our climate change strategies. This report examines what we as British Columbians can do, now and in the future, to reduce pollutants and greenhouse gas emissions.

Air quality is fundamental to this report, and there's heartening news about our ever-increasing ability to measure airborne particulate matter, and to forecast where wildfire smoke will travel. In addition, there's innovation in measuring sulphur dioxide, ozone and nitrogen dioxide – the underpinning to our vital role as advocates for cleaner air.

This year, we honour a very deserving Clean Air Champion: Dr. Sarah Henderson, Scientific Director, Environmental Health Services, at the BC Centre for Disease Control. Her award recognizes 20 years of tireless and peerless work in the public policy impacts of wildfire smoke, extreme hot weather, and climate change. Outstanding in her field, Dr. Henderson is impassioned and insightful, convincing, and lucid.

Congratulations are in order, too, to all those who were involved in producing this report, and the hard, complex work that forms its foundation.

On behalf of our Foundation, I thank you all for informing our work and benefitting the one in five British Columbians we serve.

CHRISTOPHER LAM
President and CEO, BC Lung Foundation

Our Changing Climate

Climate change is a defining issue of our time. British Columbians know first-hand the effects of climate-related disasters through extreme flooding, wildfires, and last summer's heat dome.

As the climate changes, we can expect to see long-term shifts in extreme weather conditions across the province. Human activities, like burning fossil fuels, agriculture, and forestry all generate greenhouse gas (GHG) emissions that cause a domino effect in our environment, into the current climate crisis. In B.C., most of these emissions come from transportation, industry, and buildings.

What we're experiencing now are the consequences of past emissions. If all our emissions stopped today, we would still need to adapt to the current climate, and prepare for what's to come.

Taking climate action now

Addressing climate change requires simultaneous actions on two fronts: reducing emissions to lessen the severity of future climate change, and managing the effects of climate change that are already here.

Shifting to zero-emission vehicles (e.g., electric vehicles) reduces GHG emissions, which improves air quality in the long run and results in positive impacts on people's health. Research shows that reducing GHG emissions also reduces localized air pollutants like particulate matter and nitrogen oxides – pollutants that increase the risk of lung disease, asthma, and other respiratory illnesses. With emissions from transportation being one of the greatest contributors to climate change in B.C. as well as a significant contributor to poor air quality, shifting to non-polluting forms of transportation (like zero-emission vehicles, active transportation, and transit) is one of the best ways to improve local air quality.

The CleanBC Roadmap to 2030 includes a wide range of actions that will reduce climate pollution and improve local air quality in communities across B.C. For example, B.C. will require 90% of all new light-duty vehicles sold in 2030 to be zero emissions vehicles. We've already seen zero emission vehicles make up as much as 12% of new sales. There's also a suite of government policies to ensure less natural gas is burned in our homes, buildings, and industry.

While these actions are critical to improving public health and meeting our emissions targets, we still have to adapt to our current reality, which includes wildfire smoke, seasonal shifts, and increased allergens in the air. Wildfire smoke, in particular, can have serious consequences on healthy lungs. We know from research that increased exposure to wildfire smoke can lead to bronchitis, a reduction in lung function, and a higher risk of cardiovascular illness. People with chronic lung conditions are impacted significantly by exposures to wildfire smoke, which exacerbate asthma and other chronic lung diseases. Exposure to wildfire smoke can lead to an increase in emergency room visits and hospital admissions.[1]

The B.C. Government is working on a Climate Preparedness and Adaptation Strategy, informed by the 2019 provincial climate risk assessment, to strengthen our capacity to anticipate and respond to impacts like wildfires, floods, heatwaves, biodiversity loss, seasonal shifts, and rising sea levels.

Working together for a healthy present and future

Together we can create a healthier future in B.C. There are a number of ways you can build climate action into your lifestyle.

Individual climate actions:

- Make your next car an electric vehicle, or use an alternative form of transportation, like biking, walking, or public transit when possible. Drivers who want to go electric can learn about rebates (https://go-electricbc.gov.bc.ca/personal-rebate-offers/passenger-vehicle-rebates/)
- Add a heat pump to your home. This energy-efficient system heats in the winter and cools in the summer, and does the double-duty of reducing emissions while providing clean, filtered air. Learn about installation incentives online.
- Switch from natural gas to electric induction. In-home pollution from natural gas stoves has been linked to respiratory problems and asthma, especially in children. This also decreases you carbon footprint, because 98% of electricity generated in B.C. is from clean sources.

To see other climate actions that you can take, visit the B.C. Government's Get Involved page.

Taking strong climate action requires working together to ensure we can build a better future where everyone benefits from cleaner air, better communities, and new opportunities in the clean economy.

1 https://www.epa.gov/wildfire-smoke-course/health-effects-attributed-wildfire-smoke#:~:text=Fine%20particles%20are%20respiratory%20irritants,lung%20function%2C%20and%20pulmonary%20inflammation

Air Quality Impacts of Extreme Heat of June 2021 in the Lower Fraser Valley

Environment and Climate Change Canada (ECCC) evaluated the circumstances behind the June 2021 air quality episode in the Lower Fraser Valley. While the heatwave driving this air quality event had major impacts for the BC Interior and other localities, the focus of this evaluation is on the the Lower Fraser Valley.

> British Columbia has reported 740 deaths due to the heatwave. Most people who died were living alone in unventilated homes and most had underlying health conditions.

Several days in advance, numerical weather forecast models indicated that conditions would be highly favourable for an ozone event to occur in the Lower Fraser Valley for June 26 to 28, as the center of an upper-level heat dome would be nearly overhead. Favorable factors would be very warm air aloft, very little wind aloft, and the timing - just a few days after the June solstice, when the solar flux would be near its peak.

Temperatures were near or somewhat above seasonal values for Wednesday, June 23 and Thursday, June 24 but ramped up on Friday, June 25 as the upper ridge approached. Particularly noteworthy of the upper ridge was that the air mass aloft for southern B.C. and northern Washington State was the warmest anywhere in North America.

On Saturday, June 26, Abbotsford Airport (YXX) broke its all-time high temperature record, reaching 39.6°C, and the Surrey East monitoring station's hourly high reached 37.2°C. Outflow winds in the eastern Lower Fraser Valley were not strong, but were sufficient to keep ozone concentrations below that of some episodes occurring in recent years.

The large temperature difference between inland areas and the Strait of Georgia yielded a moderate sea breeze of about 20 km/h at Vancouver International Airport (YVR), maintaining relatively good air quality in the more western portions of the Lower Fraser Valley. Thus, short-term ozone exceedances were limited to Coquitlam, Pitt Meadows, and Maple Ridge air quality monitoring stations.

On Sunday, June 27, surface wind patterns were similar, but temperatures continued to increase for inland locations. Abbotsford Airport (YXX) once again broke its all-time high temperature record, reaching 41.5°C and a humidex of 49°C, and the Surrey East station's hourly high reached 39.3°C. In addition to the three stations mentioned for Saturday, Surrey East and Langley also experienced ozone exceedances.

On Monday, June 28, temperatures reached their peak for much of the Lower Fraser Valley. Abbotsford Airport (YXX) yet again broke its all-time high temperature record, reaching 42.9°C with a humidex of 50°C, a higher recording than anywhere in Canada east of Manitoba. The Surrey East station's hourly high reached 40.3°C. In addition to the five stations mentioned in the previous two days, Mission, Abbotsford Airport, and Chilliwack experienced ozone exceedances. Fine particulate concentrations started to increase but were still within the acceptable range.

On Tuesday, June 29, marine inflow (no cloud) significantly cooled the central and eastern Lower Fraser Valley with Surrey East station's hourly highs reaching 31°C. As is often the case, the switch from westerly sea breezes to southeast winds ahead of the marine air bumped up Vancouver International Airport's temperature to set a new June record high of 32.4°C, but this value was still 2°C shy of the record of 34.4°C set on July 30, 2009. Coquitlam and Maple Ridge experienced marginal ozone exceedances. The increased westerly flow shunted the maximum ozone concentrations eastward with exceedances occurring at Chilliwack (for 2 h), Agassiz (for 5 h) and Hope (for 6 h). Fine particulate exceedances developed for Second Narrows, New Westminster, Mission, and Abbotsford-Mill Lake stations. According to the Clear Air BC website, the Visual Air Quality Rating was poor at Burnaby, Pitt Meadows, and Abbotsford, and very poor at Chilliwack.

The was a remarkable event. It is statistically astonishing to have long period all-time temperature records broken by a margin of 5°C in diverse locations such as Abbotsford and Lytton. BC Centre for Disease Control has reported 740 deaths due to the heatwave. Most people who died were living alone in unventilated homes and had underlying health conditions.

HEALing from Climate Change
An Interdisciplinary Research Approach

British Columbia continues to experience extreme weather events resulting from climate change, including wildfires, flooding, storms, and heat domes, with some communities more vulnerable to the effects of climate change. These extreme weather events are affecting our physical and mental health, and we need to develop strategies to adapt to our changing climate in ways that are sensitive to climate-related inequities.

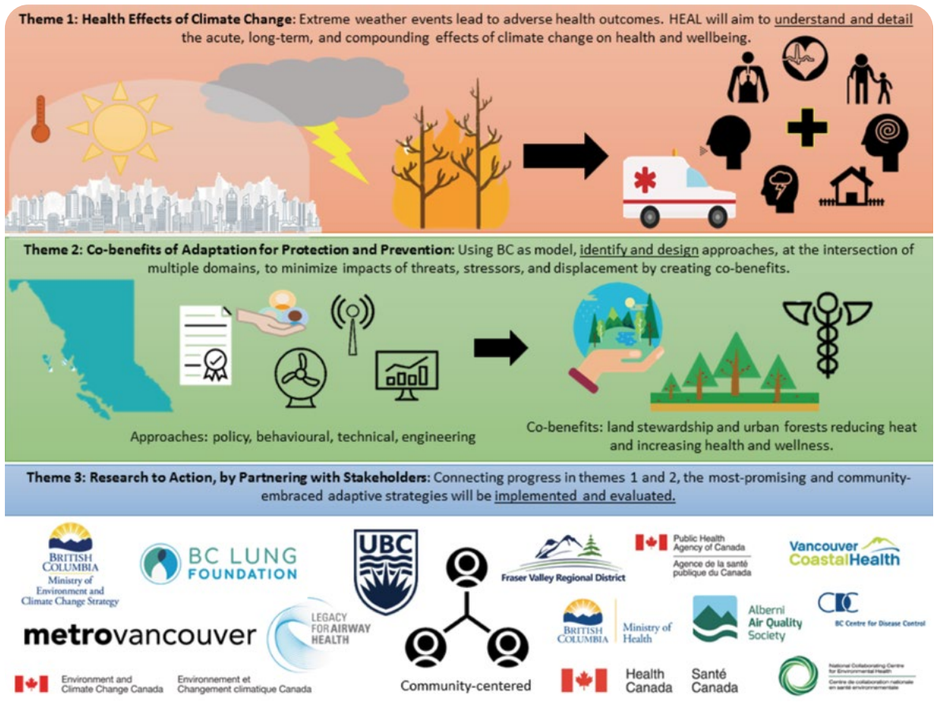
There are known health effects related to events precipitated or accelerated by climate change events. For example, wildfire smoke has negative impacts on airways, heat domes cause heat-related disease, and evacuations (due to fire, smoke, or flooding) cause physical, mental, and financial stress. However, we don't fully understand how these extreme weather events impact our health and wellbeing, nor do we have effective methods to cope and adapt to our changing climate and limit these impacts.

B.C. provides an ideal environment to study the health impacts of extreme weather events and create adaptive solutions to protect our health and environment. Ideally adaptations would provide multiple benefits (co-benefits). An example of an adaptation strategy that could provide co-benefits is to support urban forests through land stewardship, which in turn, helps to absorb heat, create shade, reduce temperature, and support physical and mental health.

A new interdisciplinary research group called Climate Change Health Effects, Adaptation, and ResiLience (HEAL) at the University of British Columbia has been created to address the effects of climate change on health. The goals are to identify and describe the health effects of extreme weather events from climate change, and to develop adaptation interventions that provide co-benefits.

The research group is financially supported by UBC Research and Innovation Grants for Catalyzing Research Clusters and is currently made up of researchers with diverse expertise: Drs. Chris Carlsten, Lorien Nesbitt, Michael Brauer, Emily Brigham, Lori Daniels, Jonathan Fink, Amanda Giang, Loretta Li, Adam Rysanek, Michael Schwandt, Martino Tran, Kate Weinberger, and Jiaying Zhao.

In partnership with Legacy for Airway Health, the research group will engage stakeholders, including community advisors, to co-develop a research program to develop sustainable and effective solutions that address equity-related issues.

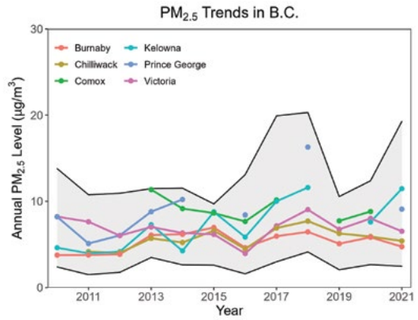


Air Pollution Through the Years

Visualizing annual trends in air pollution levels can help assess our collective efforts in improving air quality. It also helps identify any additional work and room for improvement. The following figures provide 12-year trends in annual concentrations particularly in the most affected and heavily populated areas. Also included are the range of concentrations reported across the province.

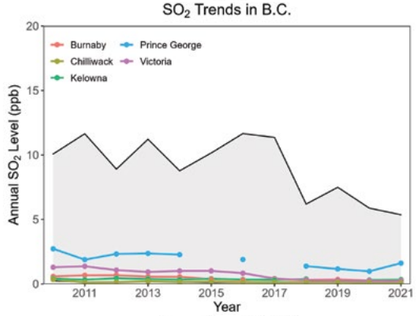
Fine Particulate Matter ($PM_{2.5}$) levels

Over the past decade, wildfire smoke has had an increasing influence on $PM_{2.5}$ levels (shown as annual average concentration) across most of B.C. sites. In 2014 and 2015, the impacts of wildfire smoke on $PM_{2.5}$ levels were localized to areas near the fire (e.g., Prince George, Kelowna). In more recent years, wildfires in Canada and the United States have increased in overall size, magnitude, and frequency of events. Wildfires produced smoke plumes that reached high altitudes, travelled hundreds of kilometers, stayed in the air for several days, and produced widespread increase in $PM_{2.5}$ levels. The three most active wildfire seasons recorded in B.C. are in 2017, 2018, and 2021. These years also had the highest levels of $PM_{2.5}$.



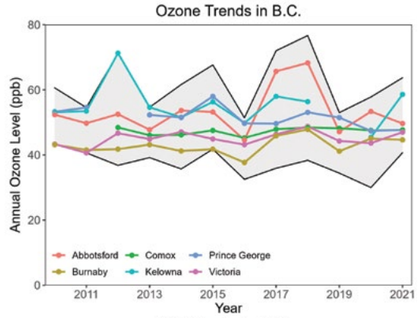
Sulphur Dioxide (SO_2) levels

SO_2 levels (shown as annual average) in urban areas remain low – less than 5 ppb throughout the last decade. This reflects efforts in reducing sulphur emissions from motor vehicles and marine vessels, and industries like petroleum refining, pulp and paper, and cement industries.



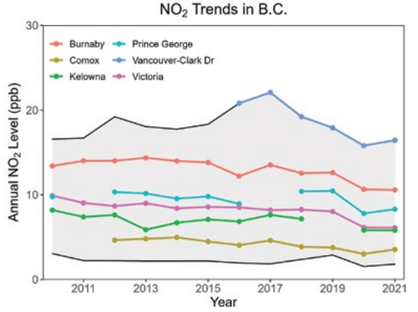
Ground Level Ozone (O_3) levels

Wildfire smoke is also known to influence ozone levels. The long-range transport of wildfire smoke from Siberia in 2012, and wildfires from B.C. and the western United States in 2017 and 2018, are believed to have led to the higher ozone levels in these years.[2],[3] A "heat dome" in 2021 resulted in stable, warm, and sunny conditions that were favourable for ozone formation. As a result, daily ozone values not seen since the 1980s were observed, high enough to move annual ozone levels (reported as 4th highest of the 8-hour daily maximums) above the national standard of 62 ppb. Progressive actions to reduce ozone precursors (VOC, NOx), such as vehicle and fuel standards, have led to ozone reductions throughout the years.



Nitrogen Dioxide (NO_2) levels

NO_2 levels (shown as annual average) have generally declined in urban areas over the past decade, largely due to more stringent vehicle emission and gasoline standards, and other local actions. The trends have started to plateau from 2010 onwards but aggressive initiatives towards lower emission and zero emission vehicles are expected to improve NO_2 levels over the next decade. Reduced traffic in 2020 due to the COVID-19 pandemic resulted in significantly lower NO_2 levels across urban sites. In 2021, the levels have increased slightly.



2 Teakles, A.D., So, R., Ainslie, B. et al. (2017) Impacts of the July 2012 Siberian fire plume on air quality in the Pacific Northwest. Atmos. Chem. Phys. 17, pp. 2593-2611.
3 Influence of 2015 and 2017 wildfire smoke on ozone levels in the Lower Fraser Valley are discussed further in: Lower Fraser Valley Air Zone Report (2017-2019) at: https://gov.bc.ca/airzonereports
4 https://www.canada.ca/en/environment-climate-change/services/top-ten-weather-stories/2021.html#toc2

Pollution Levels How Does B.C. Measure Up?

The 2021 season is known for the historic "heat dome" that brought extreme temperatures across most of B.C. and Western North America.[5] It resulted in the highest recorded temperature in the region, including the highest temperature ever measured in Canada at 49.6°C in Lytton, B.C. The extreme heat event may have also increased B.C.'s risk from wildfires, producing suitable conditions that made the 2021 wildfire season among the worst on record.

During the 2021 wildfire season, approximately 869,000 hectares of land were burned from over 1,642 fires.[6] It was the third worst on record, just behind 2017 and 2018 seasons, and notorious for the catastrophic destruction of the town of Lytton. Almost 90 percent of Lytton was burned within a day of breaking Canada's temperature records.

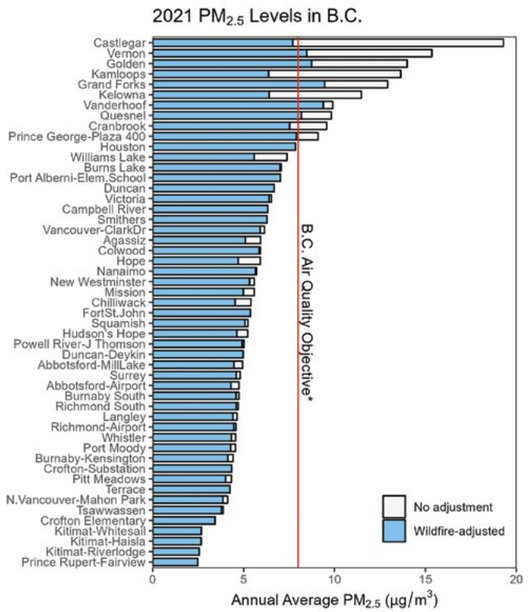
Dense smoke from the massive wildfires and the extreme temperatures caused severe impact on B.C.'s air quality throughout the summer of 2021. As a result, the province issued 74 Smoky Skies Bulletins and Metro Vancouver issued four air quality advisories. Particles from the wildfire smoke caused several reporting stations to exceed the 24-hour provincial air quality objectives.

In the following sections, air quality data collected in 2021 are summarized and compared against provincial or national objectives. Data from all available monitoring sites, except temporary mobile sites and industrial fenceline sites, are summarized in the Technical Appendix.

$PM_{2.5}$ Fine Particulate Matter

Fine particulate matter ($PM_{2.5}$) refers to microscopic particles that are 2.5 micrometres or smaller in diameter. Major sources in B.C. include seasonal wildfires, residential wood combustion, prescribed burning, marine vessels, heavy-duty diesel vehicles, the pulp and paper sector and the mining sector. Travelling deep into the lungs, inhaled $PM_{2.5}$ can cause short-term health effects such as irritation and inflammation of the airways, and can aggravate health conditions such as asthma and heart disease. There is strong evidence that prolonged exposure to $PM_{2.5}$ increases the risk of chronic disease, such as bronchitis and heart disease[7].

In 2021, $PM_{2.5}$ was monitored in more than 50 sites across the province for at least a portion of the year. Average concentrations calculated over a single year ranged from 2.5 µg/m³ in Prince Rupert-Fairview to 19.2 µg/m³ in Castlegar. A total of ten sites exceeded the provincial annual objective[8] of 8 µg/m³ and four other sites exceeded the provincial 24-hour objective[9] of 25 µg/m³. When effects of wildfire are removed from measurements, the provincial annual objective was exceeded in Golden, Grand Forks, Quesnel, Vanderhoof, and Vernon.



5 *Visit: https://www.canada.ca/en/environment-climate-change/news/2021/12/the-impacts-of-a-changing-climate-canadas-top-ten-weather-stories-of-2021.html*
6 *Visit: https://www2.gov.bc.ca/gov/content/safety/wildfire-status*
7 *Gan, W.Q.; Koehoorn, M.; Davies, H.W.; Demers, P.A.; Tamburic, L.;Brauer,M. 2011, "Long-Term Exposure to Traffic-Related Air Pollution and the Risk of Coronary Heart Disease Hospitalization and Mortality", Environmental Health Perspectives,vol.119, no.4, pp. 501-507.*
8 *Based on the mean of daily average over one year*
9 *Based on the annual 98th percentile of daily average over three years*

SO_2 Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless, highly reactive gas with a pungent odour. Major sources of SO_2 include the upstream oil and gas sector, metal smelting facilities, the pulp and paper sector, and marine vessels. Short-term exposures to SO_2 can aggravate asthma and increase respiratory symptoms.

In 2021, SO_2 was monitored at 39 sites, excluding mobile and industrial fenceline sites. One-hour SO_2 levels ranged from 0.6 ppb in Chilliwack to 170 ppb at Trail-Butler Park[10] . The majority of monitoring sites recorded 1-hour levels below 5 ppb. Trail-area sites were the only locations to observe exceedances of the Canadian Ambient Air Quality Standards (CAAQS) national objective of 70 ppb.

O_3 Ground-level Ozone

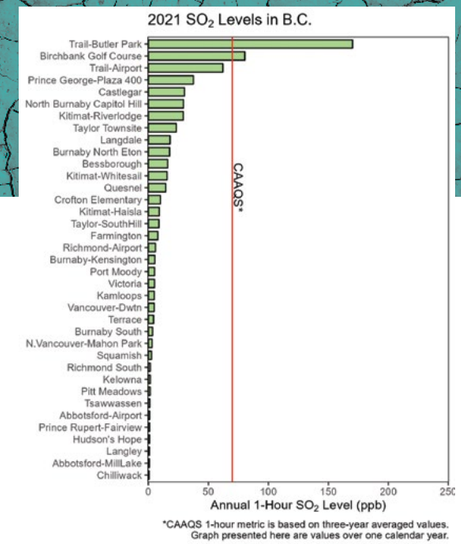
Ground-level ozone (O_3) is a reactive gas created from complex chemical reactions between nitrogen oxides (NOx) and volatile hydrocarbons in the presence of sunlight. A major source of both NOx and hydrocarbons in B.C. is the transportation sector, including motor vehicles. Short-term exposures to ozone can cause breathing difficulties, an aggravation of asthma symptoms and other lung diseases, and premature death. There is growing evidence that long-term exposures may be associated with the development of respiratory effects, especially in the young and the elderly.

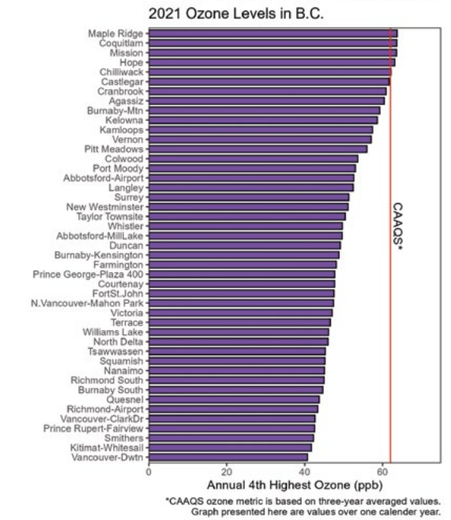
In 2021, ozone was monitored at 45 monitoring sites. Annual concentrations ranged from 41 ppb in downtown Vancouver to 64 ppb in Maple Ridge[11]. The exceptionally warm, sunny days during the "heat dome" produced suitable conditions for ozone formation. As a result, several monitoring stations in the Lower Mainland reported ozone levels that have not been observed since the late 1980s[12]. Annual levels of ozone at five locations in the Lower Mainland exceeded the national standard of 62 ppb[13].

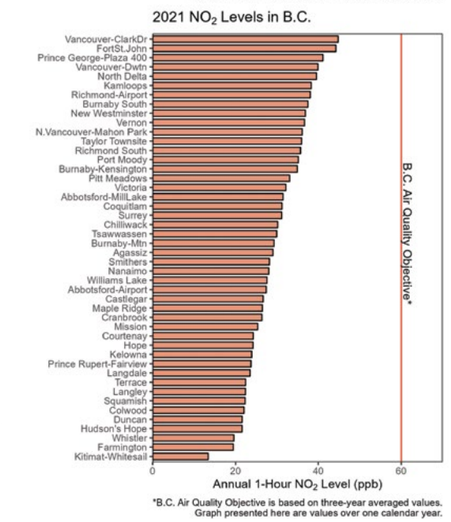
NO_2 Nitrogen Dioxide

Nitrogen Dioxide (NO_2) is a reddish-brown gas that is associated with emissions from high-temperature combustion. NO_2 is mostly formed in the atmosphere from reactions involving nitrogen oxides (NOx) and ground-level ozone. The largest sources of NOx in B.C. include the transportation sector and industry. Short-term exposures to NO_2 are linked to respiratory illness, and there is growing evidence of effects from long-term exposure, including cardiovascular mortality, cancer and reproductive effects.

In 2021, NO_2 levels were monitored at 47 sites. One-hour concentrations ranged from 13 ppb in Kitimat to 45 ppb in Vancouver-Clark Drive.[14] All sites were well below the national 1-hour standard of 60 ppb[15].







10 *Based on the annual 99th percentile of daily one-hour maximum concentrations. The provincial objective of 75 ppb is based on similar statistical form as presented, but averaged over three years. Elevated SO2 levels were also recorded at Trail-Warfield; however, this data is under review and not included in this report.*
11 *Based on the annual 4th highest daily 8-hour maximum concentration over one year.*
12 *Visit: http://www.metrovancouver.org/boards/ClimateAction/CAC_2021-Nov-5_AGE.pdf#page=258*
13 *Achievement of the national standard is based on a similar statistical form as presented, averaged over three years.*
14 *Based on annual 98th percentile of daily one-hour maximum concentration.*
15 *The Canadian Ambient Air Quality Standard (CAAQS) of 60 ppb is based on a three-year average.*

Health Canada's Assessment Report On The Health Impacts Of Climate Change

Climate change is already impacting the health of Canadians, including people living in British Columbia. Levels of long-lived greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), are continuing to increase in the atmosphere, and warming is expected to continue even with near-term reductions in these GHGs.

It's important to understand how climate change is currently impacting Canadians, and what impacts are expected in the future. This allows us to prioritize resources for actions that will have the greatest impact in both mitigating and adapting to climate change.

Health Canada recently completed a comprehensive study of current and projected health risks from climate change for Canadians. The report, "Health of Canadians in a Changing Climate" (https://changingclimate.ca/health-in-a-changing-climate/), was developed in collaboration with a team of subject matter experts from regional and federal health authorities and academic institutions across Canada.

One area of focus for the report is on the link between air quality and climate change. The following is a summary of the key points from the air quality and climate change chapter of the report.

Climate change and air quality are closely linked. Many of the human activities that emit CO_2 also emit air pollutants or precursors to air pollutants. Some of these air pollutants can change the radiative balance of the Earth, affecting climate. These pollutants have a much shorter residence time in the atmosphere than CO_2 and are referred to as short-lived climate forcers (SLCFs).

Overall, climate change is expected to worsen air pollution in Canada. If air pollution emissions remain the same, modelling studies predict that ozone levels will increase in a warming climate, particularly in highly populated and industrialized areas. Studies on the effect of a warming climate on $PM_{2.5}$ levels are less certain. However, $PM_{2.5}$ levels are expected to increase in some parts of the country, including British Columbia, with an increase in the number and severity of wildfires in Canada and other parts of the world.

In a warming climate, the length of airborne allergen seasons and pollen counts are expected to increase.

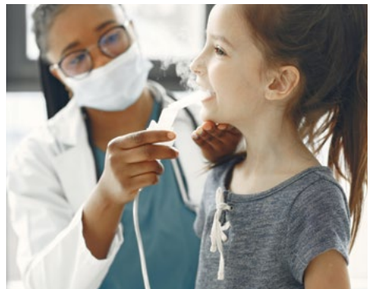
Exposure to air pollutants can cause a range of adverse health effects, including disease and premature death. Even small increases in exposure are associated with an increase in health risk. Air pollution is currently a leading environmental cause of death and illness in Canada, and the health impacts of air pollution are expected to worsen in the future due to the influence of climate change on air quality.

In a warming climate, the length of airborne allergen seasons and pollen counts are expected to increase. The geographical distribution of allergens is also expected to increase in Canada. These changes may lead to increasing costs to the health system associated with respiratory allergies and asthma.

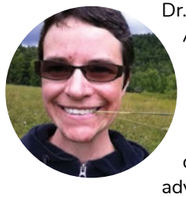
Climate change could also affect indoor air quality through increased infiltration of outdoor pollutants and allergens. Extreme weather events, such as floods, may also impact indoor air quality if water damage in buildings leads to mould growth.

Adaptation strategies will be required to reduce the health burden of climate change. Daily forecasts of air quality, wildfire smoke, and airborne allergens are important tools to protect public health. Adaptation measures may also include providing resources to vulnerable populations to help reduce exposure. This could include providing education on measures to reduce exposure, establishing clean air shelters, and distributing portable air filters during a wildfire smoke event.

Many strategies to reduce GHG emissions, such as reducing the use of fossil fuels, can also improve air quality, resulting in significant health co-benefits. The air quality benefits of climate mitigation measures can help offset the costs of climate action.



Clean Air Champion



Dr. Sarah Henderson was named 2022's Clean Air Champion award-winner. Adjudicated by the B.C. Lung Air Quality and Health Steering Committee, and managed by the B.C. Lung Foundation, the award recognizes people who have made significant contributions to air quality in the form of public health, research, advocacy, and community outreach.

Dr. Henderson was specifically cited for her work with surveillance systems for extreme hot weather and the effects of wildfire smoke. Recognized by Accreditation Canada in "Leading Public Health Practices," she and her team's work has won numerous awards, and is considered a public health model.

Starting her career in the field of climate change 20 years ago, Dr. Henderson can truly be called a pioneer. "Twenty years ago, one of the challenging things about climate change is that a lot of us spent a good decade debating it. We've moved well past that point now – it's just not debatable. We are, however, still debating the underlying drivers – or some people are, because there are so many things that contribute to an individual's carbon footprint" she says, citing greenhouse gases, North American consumerism, and a number of other factors.

Asked about what we can expect from the climate in the next ten years, she answered in two words: more variability. "Overall, we always knew what would happen, in terms of traditional weather. But now, with heat domes and atmospheric rivers, there's no longer that certainty. In a lot of ways, B.C. 2021 was the 'poster child' for changing climate: a heat dome, drought, wildfire, flooding – and all in a six-month period. It really was kind of a perfect storm."

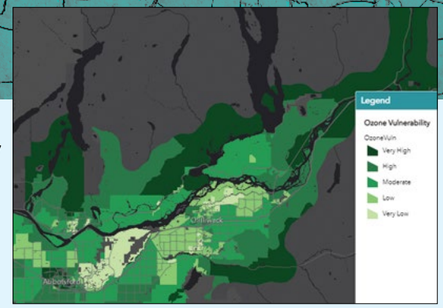
> I can't think of a more deserving recipient of recognition as a clean air champion than Sarah Henderson. Building on a career that started in climate science, she is now one of the foremost experts in providing service to the public in helping them deal with the very real impacts of climate change.
>
> Roger G. Quan, P.Eng., *Director, Air Quality and Climate Change, Metro Vancouver*

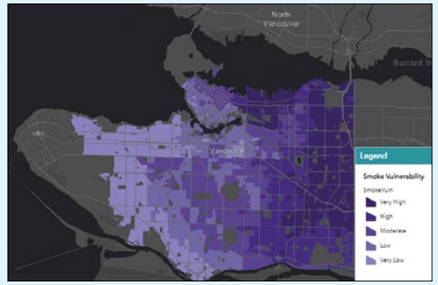
> British Columbians are incredibly fortunate to have an individual of Sarah Henderson's caliber working tirelessly to minimize the health impacts of climate change and poor air quality. She is a rare combination of an innovative world-class scientist dedicated to serving the public interest. We all benefit from her contributions.
>
> Dr. Michael Brauer, *Professor, School of Population and Public Health, UBC*

Modest to a fault, Dr. Henderson was asked who, in her field, does she admire? "The climate scientists who just keep at it. They've been ringing the alarm bells for 40 or 50 years: they seem tireless, and I don't know how they do it. Those are the folks I admire."

Above all, Dr. Sarah Henderson is motivated by an ingrained sense of public servitude. "I'm a public servant, at core. I want to serve the public in a way that's useful and not detrimental. At the end of the day, I have to be able to go home, and live with myself and the work that I did that day. That's what drives me. I need to think 'Okay, was I useful today, and not detrimental?' Check mark. That's good, now keep on going."

Mapping Vulnerability to Climate Hazards





By working in partnership with researchers from UBC, Vancouver Coastal Health and Fraser Health have released a series of maps that spatially represent community vulneratiblity to four climate hazards: heat, smoke, ozone, and flooding. The maps were originally inspired by similar work by the San Francisco Department of Public Health and are meant to advance our collective understanding of what makes individuals and communities vulnerable to the health-related impacts of climate change. These maps can open and guide conversations about community climate resilience, and support action to mitigate negative impacts.

Vancouver Coastal Health and Fraser Health have shared the maps and related vulnerability index with municipalities, regional districts, community organizations, and other partners. This has included sharing GIS shape files for use in municipal planning processes, including exposure layers of wildfire smoke and ground-level ozone that were developed collaboratively with several partners. Our partners have also been interested in the lists of variables that were used to measure sensitivity and adaptive capacity, and the health authorities have been invited to give presentations on the results and what they mean for community planning.

The project's findings are available to the public and can be viewed through an interactive, user-friendly website that walks visitors through each hazard, allowing users to view the maps for their specific communities. https://storymaps.arcgis.com/stories/7bf7141bb6fd41fb9b61a02cfbc61ecd

Highlights from the Air Quality and Health Workshop

With a changing climate, many locations in Canada are already experiencing more extreme weather events, including extreme heat, drought and wildfires. In the future, heat events are expected to become more frequent and intense, and the wildfire season is expected to become longer with more frequent and severe fires. Canadians spend the majority of our time indoors, and we can leverage our indoor environment to protect us from the health effects associated with extreme heat and air pollution.

The 19th Annual Air Quality and Health Workshop was held on June 16th, 2022 at the Sheraton Wall Centre in Vancouver. The theme of the workshop was "Gimme Shelter – Adapting the Indoor Environment to Reduce the Harmful Impacts of Climate Change". Topics covered included the health effects of heat and wildfire smoke, tools for adapting our indoor environments, case studies, and the importance of equity considerations.

Dr. Sarah Henderson from the B.C. Centre for Disease Control started the day off with a keynote presentation on the changing face of summer in B.C., including a review of recent extreme weather events and projections for the future. She provided an overview of the 2021 heat dome as well as wildfire smoke events from the previous five years. She outlined risk factors and protective factors associated with heat-related illness, and provided information on who is most vulnerable to heat-related illness and to the health effects associated with wildfire smoke. Dr. Henderson concluded by noting that the indoor environment is where we spend the majority of our time, and it has the potential to protect us from our changing outdoor environment if we design it well.

Dr. Elliot Gall from Portland State University then gave an overview of indoor environments, how they're impacted by outdoor environments, and what systems are in place to modulate our exposures to heat and smoke. He highlighted the importance of healthy indoor environments, the need to rapidly decarbonize our buildings, and the need to design for multiple extremes. He also highlighted the need for a vulnerability and exposure framework, and both top-down and bottom-up approaches to driving change.

Dr. Jeffrey Siegel from University of Toronto spoke about filtration and ventilation as tools to support a healthy indoor environment, particularly during smoke events. He noted that we already have tools to make a home resilient to wildfire smoke and heat, but there are challenges with implementing these tools. He detailed many of these challenges and highlighted the importance of addressing systematic disparities and equity issues.

Building on previous presentations, Kevin Delahunt from BGE Indoor Air Quality Solutions provided a talk on smoke-proofing buildings. He outlined challenges associated with existing infrastructure, strategies to minimize smoke infiltration into a building, and highlighted the need to prioritize health and wellness of occupants as the most important building metric.

Dr. Glen Kenny from the University of Ottawa started off the afternoon with a focus on extreme heat. He provided an overview of the human response to heat stress, and summarized factors that affect an individual's ability to respond to heat. He concluded with guidelines for indoor temperature limits to protect vulnerable populations and recommendations for future work.

Dr. Adam Rysanek from UBC then spoke about how to design buildings for thermal comfort with less reliance on mechanical cooling. He highlighted the potential climate-related implications associated with addressing projected increased demands for cooling using mechanical ventilation air conditioning. Dr. Rysanek provided examples of novel approaches to cooling, and proposed a need for changes to codes and policies to support healthy, climate resilient buildings.

Jenny Green from the Interior Health Authority provided an overview of the process used by the village of Ashcroft to develop a Heat Alert & Response System (HARS). She described the community response plan, communications plan, and evaluation plan, and highlighted the lessons learned. She also highlighted multiple resources, including an Interior Health HARS toolkit that was developed based on the lessons learned in Ashcroft.

Magdalena Szpala of BC Housing (BCH) provided an overview of recent work at BCH to build resilience to heat and smoke in both their clients and their building stock. She highlighted key components of the BCH heat and smoke response plan, and described a variety of projects and activities, including research, education, updates to guidance, and several pilot projects that are part of the Mobilizing Building Adaptation & Resilience program.

Rebekka Schnitter from the Public Health Agency of Canada closed the day out with a talk about equity. She outlined three areas where equity and climate change intersect: 1. health risks are distributed unequally, 2. outcomes of adaptation may not benefit everyone, and 3. participation in adaptation and planning may not include important voices and perspectives. She described a framework for understanding the link between climate change and health, and highlighted tools to enhance the integration of health equity considerations when assessing vulnerability to climate change. She also provided examples of opportunities to promote health equity through adaptation efforts.

The recordings from the workshop are available on-line: https://bclung.ca/health-professionals/air-quality-health-workshop

UPDATES From Partner Agencies

Environment and Climate Change Canada

Low-Cost PM Sensor Pilot Project

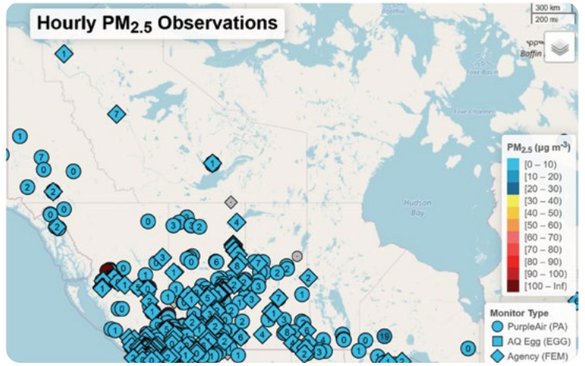
Environment Climate Change Canada (ECCC) initiated a pilot project in 2018 using low-cost PM sensors to measure $PM_{2.5}$ during high PM events such as forest fires in western Canada. It has now expanded to a nation-wide pilot project. The project is a collaboration with universities, provinces and territories, communities, First Nations and air quality groups. Several brands of monitors were evaluated and the PurpleAir monitors were chosen for their correlation with regulatory PM measurements, ease of use, low-cost and open data. A mapping tool for the low-cost PM sensor data was developed through a collaboration between the University of Northern British Columbia (UNBC) with Dr. Peter Jackson and ECCC scientists. Air Quality Egg data is also available on the mapping tool. The two figures below show the improved spatial coverage using data from the low-cost PM monitors added to the current regulatory monitors from NAPS (National Air Pollution Surveillance) and provincial programs. The mapping tool available to the public (https://cyclone.unbc.ca/aqmap) includes real time observations, time series, model outputs, health messaging (excluding Quebec), and other information for people to make informed decisions about air quality. The web site was shown to be very useful for forecasters, emergency managers, health authorities and the public during the intense forest fire season of 2021.

Ventilation Index

ECCC continues to work on updating the science behind its B.C.-based Ventilation Index forecast. ECCC has held many meetings with stakeholders from government, industry, and academia in order to better understand how the forecast is used and how it could be improved. These meetings were followed up by a user survey which helped consolidate its plans to create an improved and national venting forecast. ECCC researchers in Vancouver and Edmonton are working on characterizing venting using output from dispersion models, while staff in eastern Canada are determining the forecast service standards and development timelines.

Smoke Ensemble Forecasting

ECCC is exploring the use of the Meteorological Service of Canada's regional forecast ensemble system to produce an ensemble smoke forecast. The project is in its initial stages and makes use of ECCC's experimental Automatic Simulations of Forest Fire Smoke in Canada product: https://eer.cmc.ec.gc.ca/mandats/AutoSim/Fire/ to simulate the impact of meteorological forecast uncertainty on smoke impacts over forecast regions in western Canada. ECCC hopes to have experimental ensemble forecasts available to Edmonton and Vancouver forecasters during this year's summer wild fire season.



(Updates From Partner Agencies Cont'd from p.11)

BRITISH COLUMBIA | Ministry of Environment and Climate Change Strategy

Regulatory Updates

The Ministry of Environment and Climate Change Strategy (ENV) adopted new Provincial Air Quality Objectives for Nitrogen Dioxide (NO_2). This strengthens the objectives from 100 parts per billion (ppb) to 60 ppb for the 1-hour objective and from 32 ppb to 17 ppb for the annual objectives. For details, visit: gov.bc.ca/airqualityobjectives.

The British Columbia Air Quality Dispersion Modelling Guideline has been updated with a supplemental guidance document made specifically for NO_2. The "Guidance on NO_2 Dispersion Modelling in British Columbia" clarifies assumptions and guides the use of methods towards more accurate models. ENV also developed a web tool for retrieving modelled weather data. This data serves as required input in air quality dispersion models. The guidance document and web tool can help facilitate model review process. For details on the guidance document and the interactive map tool, visit: gov.bc.ca/airqualitymodels.

Provincial Wood Stove Exchange Program

The B.C. Community Wood Stove Reduction Program (CWSRP)—formerly known as the Wood Stove Exchange Program) has helped replace around 500 wood stoves in 2021, bringing the total number of appliance replacements to 10,000. Approximately 60% of the replacements in 2021 were for non-wood burning options, while the rest were for certified wood-burning appliances. Among the non-wood burning options, 5.7% of replacements were for heat pumps, representing a 1.7% increase from 2020.

ENV is working closely with the B.C. Lung Foundation to implement several key recommendations that were identified during a third-party evaluation of the program. These include:

- Increasing rebate amounts to focus on reducing $PM_{2.5}$ emissions in red zone communities.
- Creating incentive levels and developing a new proposal template for First Nation Communities.
- Improving accessibility to First Nations with the help of Housing Managers and existing local programs that operate within their geographic area.
- Developing educational outreach materials (brochures, infographics, door hangers) about wood smoke and its health effects, and CWSRP.
- Organizing meetings among coordinators to facilitate communication, peer-to-peer learning, and continuous program improvement.
- Piloting an online course to help local programs educate the public about clean-burning techniques.
- Introducing CleanBC Better Homes to local CWSRP programs and encouraging replacements for heat pumps to reduce GHG emissions.
- Updating the program guideline to include all changes.

Considering B.C.'s climate commitments and new policies outlined in the CleanBC Roadmap to 2030, 2022 is the last year that propane and natural gas stoves will be eligible for rebates from the Wood Stove Exchange Program. For details on the Provincial Wood Stove Exchange Program, visit: gov.bc.ca/woodstoveexchange.

Airshed Management Activities

In 2021, ENV and the Ministry of Energy, Mines, and Low Carbon Innovation (EMLI) partnered to support the Village of Valemount in studying the dust episodes from the nearby Kinbasket Reservoir. Using air quality data, the study found dust events happening in short durations (1-2 hours), around two to four times per year, when reservoir levels are dropping (late winter to spring). These dust events were linked to elevated levels of particulate matter but represent less than 1% of the hours with above-average concentrations. Dust events also do not lead to exceedances of the provincial air quality objectives. The data findings indicate that other local sources drive episodes of poor air quality and exceedances of provincial air quality objectives in the community. To read the report, visit: https://valemount.ca/uploads/210618_Final_Valemount-Air-Quality-Data-Review_Final_v2.0.pdf. ENV is currently supporting the Valemount Clean Air Task Force to develop an Air Quality Management Plan that aims to reduce local emission sources and support the continuous improvement of air quality.

The Comox Valley has long been prone to poor air quality, mainly due to wood smoke from residential heating and open burning activities. Levels of fine particulate matter ($PM_{2.5}$) are especially elevated during the cold season when increased wood burning combines with frequently poor venting conditions. With $PM_{2.5}$ levels exceeding the Canadian Ambient Air Quality Standards (CAAQS), Comox Valley communities have been in a "Red Zone" for several years under the national Air Quality Management System (AQMS). However, notable improvements in local air quality have recently shifted the Comox Valley to an "Orange Zone", indicating that more action is still needed to further reduce $PM_{2.5}$ pollution.

To address these challenges, the Comox Valley Regional District (CVRD) launched an Airshed Roundtable in 2020. The Roundtable includes representatives from municipalities (Comox, Courtenay, Cumberland), ENV, Ministry of Forests, Islands Health, a diverse range of businesses and economic sectors, and members of the general public. With the Roundtable's active participation and guidance from a Steering Committee, a comprehensive Wood Smoke Reduction Strategy has been developed and will soon be implemented. The Strategy includes a multitude of actions to improve air quality mainly through: reducing emissions from existing wood burning appliances and transitioning away from such appliances; reducing emissions from recreational fires and eliminating yard waste burning; expanding air quality data collection and research to inform actions; promoting and advocating for alternatives to open burning, as well as expanding opportunities for public education.

In addition to the Wood Smoke Reduction Strategy, the CVRD has been an active participant in the Wood Stove Exchange Program (WSEP) since 2016, replacing 220 old wood stoves in the region with cleaner heating options. Furthermore, member municipalities in the CVRD have each taken their own action to improve air quality, mainly through bylaws on open burning and wood stoves.

In October 2020, representatives from the District of Kitimat, the Haisla Nation, Rio Tinto, LNG Canada, Kitimat Chamber of Commerce, Unifor2301, Northern Health, Kitimat Terrace Clean Air Coalition, community members, ENV, and surrounding First Nations held their first formal meeting as members of the Kitimat Airshed Group. The group aims to facilitate communications and collaboration on air quality between interested parties. The group recently published its official website: https://www.kitimatairshedgroup.com/air-quality/kitimat/

A collaborative effort in Williams Lake between the Atlantic Power Corporation, Pinnacle Pellet Inc., the Scout Island Nature Centre, local interested citizens and the Ministry of Environment and Climate Change Strategy (ENV) has resulted in a one-year community-based study of fine particulate matter. This study is being conducted using multiple PurpleAir sensors distributed carefully across the city to provide a more comprehensive picture of fine particulate matter concentrations across the city. The study goal is to better understand how fine particulate concentrations change through space and time across the community and to identify any hot spots of concern that stand out from the rest of the community.

These sensors will provide real time particulate matter data that will allow for careful analysis of changes both across the physical community but also changes between seasons, days of the week and time of day.

Health Canada | Santé Canada

Health Canada works with Environment and Climate Change Canada, provinces, municipalities and stakeholders to improve air quality through regulations, standards, guidelines, outreach and public information. Some highlights of the last year are presented below.

Health Based Air Quality Objectives (HBAQOs)

Canadian Ambient Air Quality Standards have been set for four major air pollutants. They are health and environmental-based air quality objectives intended to drive air quality improvement across the country. In 2022 Health Canada completed a health science assessment of $PM_{2.5}$ (https://publications.gc.ca/site/eng/9.907208/publication.html) in support of the next update of the CAAQS for $PM_{2.5}$.

However, there are other pollutants in outdoor air that can be harmful to human health. Recently Health Canada has begun work on additional health based air quality objectives intended to support all levels of government and other partners in assessing human health risks from exposure to pollutants in air. These objectives will designate the highest safe exposure levels for certain outdoor air pollutants, and will consider only health effects.

Following consultation with federal, provincial, territorial and municipal governments and other air partners, Health Canada selected a group of priority candidate pollutants for the first cycle of HBAQO development. These air pollutants are arsenic, benzene, carbon monoxide, formaldehyde and PM10 (particulate matter with a diameter of 10 microns and smaller). Work is beginning to conduct full health risk assessments and develop objectives for these pollutants.

Traffic Related Air Pollution (TRAP)

In the last year Health Canada has continued research and risk assessment activities on TRAP, to inform the development of regulatory and information policies and initiatives at all levels of government. Recent publications include an umbrella review (review of systematic reviews) of TRAP and cancer, (https://publications.gc.ca/collections/collection_2022/sc-hc/H144-97-2022-eng.pdf), a health impact analysis of TRAP in Canada (https://publications.gc.ca/site/eng/9.904974/publication.html), and an assessment of population proximity to roadways (https://publications.gc.ca/site/eng/9.907080/publication.html). These assessments have found that TRAP causes lung cancer in adults, likely causes leukemia in children, and current research suggests that there is link between TRAP, and breast cancer. 1200 deaths per year can be attributed to TRAP and the health burden of TRAP in 2015 was assessed as having

(Cont'd on p.14)

(Updates From Partner Agencies Cont'd from p.13)

a socio-economic value of $9.5B. The exposure analysis showed that four in ten Canadians live within 250 metres of a high traffic roadway. In spite of increasingly stringent regulations and the renewal of the vehicle fleet, TRAP remains a population health challenge. Health Canada will continue to research and assess TRAP and health including investigations of particulate matter released from tire and brake wear.

Indoor Air Quality

On July 7, 2021, the final Formaldehyde Emissions from Composite Wood Products Regulations were published in the Canada Gazette, Part II. The regulations help reduce exposure of Canadians to formaldehyde emissions in indoor air from composite wood products sold, offered for sale, or imported into Canada.

Health Canada conducts research and risk assessments on indoor air quality in different environments and develops guidelines and guidance related to indoor environments. In 2021, a series of investigations led to the publication of Best Practices for Improving Air Quality in Ice Arenas https://www.canada.ca/en/health-canada/services/publications/healthy-living/factsheet-improving-air-quality-ice-arenas.html. Research in Canadian subways provided data for the publication of Guidance for improving subway air quality https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-improving-subway-air-quality.html. A proposed Residential Indoor Air Quality Guideline for Xylene (https://www.canada.ca/en/health-canada/programs/consultation-proposed-residential-indoor-air-quality-guidelines-xylenes/document.html) was published for public consultation adding to the 10 existing residential indoor air quality guidelines.

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

New Regional Clean Air Plan

Metro Vancouver's Clean Air Plan, which contains actions meant to provide deep reductions in regional greenhouse gas emissions, and yield air quality health benefits estimated at up to $1.6 billion, was approved in September 2021. Urgent action is needed to accelerate greenhouse gas reductions to meet ambitious, science-based climate targets, while continuing to implement policies and programs to improve regional air quality. The plan includes 29 foundational "big moves" that should be started as soon as possible, and cover areas such as transportation, buildings, industry, agriculture, health, and equity.

Modelling indicates the plan's actions could reduce regional greenhouse gas emissions by about two million tonnes by 2030. Actions over the next nine years will evolve through Climate 2050, Metro Vancouver's long-term strategy to address climate change in the region, and will be updated in order to achieve the 2030 target.

Climate 2050 Roadmaps – Path to a Carbon Neutral Region

Climate 2050 is an overarching long-term strategy that will guide our region's policies and collective actions to transition to a carbon neutral and resilient region over the next 30 years, using a series of roadmaps. Each Roadmap presents a suite of actions to be implemented by Metro Vancouver along with our partners and stakeholders throughout the region.

The first two roadmaps for buildings and transportation were completed in 2021. Draft roadmaps have also been completed for agriculture, industry and business, energy, and nature and ecosystems: Metro Vancouver will gather feedback on the roadmaps during 2022. To provide input, visit metrovancouver.org and search 'Climate 2050 Roadmaps'.

For more, visit www.metrovancouver.org and search 'Clean Air Plan' or 'Climate 2050', to see how these plans explore the most effective actions for improving air quality and preparing our communities for a changing climate.

Metro Vancouver's Air Quality Advisory Service Helps Protect Public Health

When temperatures rise and skies get smoky during wildfire season, Metro Vancouver has a dedicated team of experts ready to alert the public to changes to air quality. Metro Vancouver operates an air quality advisory service for the entire Lower Fraser Valley airshed, including Metro Vancouver and the Fraser Valley Regional District. It relies on data from a comprehensive network of air quality monitoring stations.

If air quality is degraded or expected to become degraded, an advisory is emailed to subscribers, media, health authorities, and other agencies, and posted to metrovancouver.org and social media. The information in these advisories can help members of the public reduce their exposure to degraded air quality. The advisory service is delivered in collaboration with Environment and Climate Change Canada, BC Ministry of Environment and Climate Change Strategy, Fraser Valley Regional District, Vancouver Coastal Health, Fraser Health Authority, First Nations Health Authority, and the BC Centre for Disease Control. Search 'current air quality' at metrovancouver.org.

Residential Indoor Wood Burning Requirements in Metro Vancouver

In 2020, the Residential Indoor Wood Burning Bylaw was adopted in Metro Vancouver, to reduce impacts to health and the environment from residential wood smoke. Everyone in Metro Vancouver who is responsible for a residential indoor wood burning appliance, including a fireplace or woodstove, must comply with best burning practices. Indoor wood burning is also prohibited (with some exceptions) between May 15 and September 15 every year.

By September 15, 2022, those responsible for a residential indoor wood burning appliance will need to submit a best burning practice declaration to Metro Vancouver. Residents within Metro Vancouver's Urban Containment Boundary will also need to register eligible appliances by September 15, 2022 and renew and confirm declarations and registrations at least every three years. For more information, visit metrovancouver.org and search 'residential wood burning.'

Updated Non-Road Diesel Engine Bylaw

An updated bylaw is aiming to further reduce harmful emissions by encouraging owners to retrofit or retire their non-road diesel engines used in construction equipment and other machinery. In October 2021, the Metro Vancouver Board adopted the Non-Road Diesel Engine Bylaw, which builds on the existing non-road diesel engine regulatory program and will phase in additional requirements, for all tiers of non-road diesel engines starting in 2023.

Key elements of the bylaw include restrictions on older engines operating near hospitals, elementary schools, daycares, or community care facilities; requirements for emergency engines; registration requirements for more engines; and other enhancements. Learn more at metrovancouver.org (search 'non-road diesel engine expansion').

Simplifying Open Burning Authorizations

Open burning, or open-air burning, is any burning outside of a structure that does not vent through a chimney or stack. Emissions from burning vegetative debris, such as leaves and branches, in the open air are currently authorized through site-specific approvals. In 2021 and early 2022, Metro Vancouver engaged residents, businesses, First Nations, member jurisdictions, and other government organizations on a proposed regulation to manage these emissions. The proposed regulation will continue to protect public health and the environment while offering a simpler, more efficient, and less costly authorization process. To learn more, visit metrovancouver.org and search 'open-air burning.'

New Regulatory Fees for Air Contaminant Emissions

In October 2021, the Metro Vancouver Board adopted updated fees for air contaminant emissions. Starting in 2022, Metro Vancouver will be increasing air quality permit and regulatory fees. The new fees reflect updated information on the health costs of air contaminants, and support the additional resources needed to manage and protect regional air quality. Metro Vancouver charges fees for permits according to the maximum amount and types of air contaminants that a facility is authorized to emit. These fees encourage facilities to reduce emissions, and also recover the costs of air quality regulatory services like inspections and enforcement.

The changes will be phased in between 2022 and 2028. To learn more, visit metrovancouver.org and search 'air quality fees.'

For additional updates on Metro Vancouver's engagement activities, visit www.metrovancouver.org/services/air-quality/engagement.

Caring for the Air

Metro Vancouver's annual Caring for the Air Report has more air quality and climate change stories at www.metrovancouver.org/services/air-quality/about/caring-for-the-air.

Fraser Valley Regional District (FVRD)

FVRD Air Quality Management Plan

The Fraser Valley Regional District (FVRD) produced its first Air Quality Management Plan (AQMP) in 1998. Since then, new comprehensive air quality data has become available, as has new research on air pollution effects, signalling the need to revise the AQMP. The updated FVRD AQMP has recently been finalized after a multi-year process of collecting emission trends, identifying issues, prioritizing actions, and stakeholder input.

The FVRD AQMP represents FVRD's long-standing commitment to the improvement of regional air quality. The focus is on reducing emissions, raising awareness, and promoting sustainability, so FVRD residents and visitors can enjoy clean air, beautiful vistas, and healthy living.

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(Updates From Partner Agencies Cont'd from p.15)

Radon Awareness and Testing

The FVRD is partnering with Take Action on Radon, the B.C. Lung Foundation, and municipalities within the region to bring radon awareness and testing to our communities. Test kits will be distributed in November for Chilliwack, Mission, Hope, Kent/Harrison, and Cultus Lake for a three-month measurement period. Results will be used to assess community risk, create radon awareness, and help reduce community radon exposure.

Air Quality Education in the Classroom

The FVRD runs an outreach and education program for grades 5 and 10 classrooms throughout the region. Love Our Air offers grade-appropriate education on many of the important air quality issues that faces FVRD. During the early months of the COVID-19 pandemic, the program was amended to become an online delivery format and continued to be offered. This online format continued into the 2021/22 school year until in-person lessons could again be offered in April, 2022. The curriculum has been provided to 56 classes this school year, continuing to raise awareness about air quality in the FVRD.

Contact Information of Agencies

BRITISH COLUMBIA LUNG FOUNDATION
www.bclung.ca
2675 Oak St., Vancouver, B.C. V6H 2K2
(604) 731-5864 or toll-free at
1-800-665-5864 (in B.C. but outside the Lower Mainland)

BC MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY
www.gov.bc.ca/bcairquality
525 Superior Street
Victoria, B.C. V8W 9M1
(250) 387-9537

HEALTH CANADA ENVIRONMENTAL HEALTH PROGRAM-BC REGION
www.hc-sc.gc.ca/ewh-semt/air/index-eng.php
Federal Building Sinclair Centre
420-757 Hastings St. W
Vancouver, B.C. V6C 1A1
(604) 666 – 2083

BC CENTRE FOR DISEASE CONTROL
www.bccdc.ca
655 West 12th Ave
Vancouver, B.C. V5Z 4R4
(604) 707-2400

ENVIRONMENT AND CLIMATE CHANGE CANADA
www.canada.ca/en/environment-climate-change
401 Burrard Street
Vancouver, B.C. V6C 3S5
(604) 664-9100

METRO VANCOUVER
www.metrovancouver.org
Metrotower III, 4515 Central Boulevard
Burnaby, B.C. V5H 0C6
(604) 432-6200

FRASER VALLEY REGIONAL DISTRICT
www.fvrd.ca
45950 Cheam Ave.
Chilliwack, B.C. V2P 1N6
(604) 702-5000
1-800-528-0661

BC MINISTRY OF HEALTH
www2.gov.bc.ca/gov/content/health/keeping-bc-healthy-safe
Health Protection Branch
PO BOX 9412 STN PROV GOVT
Victoria, BC, V8W 9V1
(250) 952-1911

NORTHERN HEALTH AUTHORITY
www.northernhealth.ca
Suite 600, 299 Victoria St.
Prince George, B.C. V2L 5B8
(250) 565-2649

ISLAND HEALTH AUTHORITY
www.viha.ca
1952 Bay Street
Victoria, B.C. V8R 1J8
(250) 370- 8699

VANCOUVER COASTAL HEALTH AUTHORITY
www.vch.ca
601 West Broadway, 11th Floor,
Vancouver, B.C. V5Z 4C2
(604) 736-2033 or
1-866-884-0888

FRASER HEALTH AUTHORITY
www.fraserhealth.ca
Suite 400, Central City Tower
13450 – 102nd Ave
Surrey, B.C. V3T 0H1
(604) 587-4600 or
1-877- 935-5699

INTERIOR HEALTH AUTHORITY
www.interiorhealth.ca
220 – 1815 Kirschner Rd.
Kelowna, B.C. V1Y 4N7
(250) 862-4200

FIRST NATIONS HEALTH AUTHORITY
www.fnha.ca
501-100 Park Royal South
Coast Salish Territory
West Vancouver, B.C. V7T 1A2
(250) 862-4200

LEGACY FOR AIRWAY HEALTH
www.legacyairwayhealth.ca
Diamond Health Care Centre
The Lung Centre, Rm 7267
2775 Laurel Street, Vancouver, BC.
Canada, V5Z 1M9
(604)-875-4111 x 23137

We welcome your feedback!
Please send correspondence to:
Dr. Menn Biagtan, biagtan@bclung.ca
(604) 731-5864
B.C. Lung Foundation, 2675 Oak Street,
Vancouver, BC V6H 2K2

Working Group:
Menn Biagtan
Michael Brauer
Craig Brown
Chris Carlsten
Derek Jennejohn
John Morton
Corinne Schiller
Erin Shellington
Jerome Robles
Meghan Roushorne
Matthew Wong

2022 state of the air

technical appendix

2022 BC Lung State of the Air Report -- Technical Appendix

Data Source:
B.C. Ministry of Environment and Climate Change Strategy, Metro Vancouver, Prince Rupert Port Authority

Units:
All data presented in ppb except $PM_{2.5}$, which is presented in micrograms per cubic metre

Monitoring sites:
Monitoring is often conducted to address various objectives that may include measuring concentrations representative of: community exposure, industrial impacts, background concentrations, etc.
For the State of Air Report, monitoring sites immediately adjacent to industrial facilities were not included unless these sites were also near areas of high population density.

Data completeness:
Data completeness criteria have been relaxed relative to previous reports to enable reporting of data from more stations.
In this report, a valid day has data for at least 18 hours (75%).
A valid year has data for at least 60% of days in each quarter and 75% of of hours over an entire year, with the following exceptions.
For peak (4th highest) 8-hour ozone levels, a valid 8-hour period has data for at least 6 hours, a valid day has data for at least 18 hours, and a valid year has at least 75% of days in the second and third quarters (April 1 to September 30).
For peak (1-hour) SO_2 and NO_2 levels, a valid daily maximum includes those days where less than 18 hours are available in a day but the maximum concentration exceeds the objective level.
Annual mean $PM_{2.5}$ levels are based on the annual mean of daily PM2.5 concentrations.
Where data completeness requirements are not met, only number of hours per year, maximum value and number of exceedances are shown.

Collocated monitors:
Where more than one $PM_{2.5}$ monitor is operating at a single site, data are shown for the monitor currently considered the primary reporting monitor and/or the monitor reporting a complete year of data.

Disclaimer:
While the information in these data summaries are believed to be accurate, the data summaries are provided as is without any warranty, and may be subject to change as changes to the underlying database occur.

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Summary of 2021 PM2.5 Data

Site	Year	No. Valid Hrs	Annual Avg	Percentiles (1h)					Max 1h	No. Valid Days	24h Average			No. of Days		% of Valid Days Per Quarter				CAAQS Metrics for PM2.5*	
				25th	50th	75th	98th	99th			Annual Avg	Annual 98th Percentile*	Annual Max	>27 µg/m^3	>25 µg/m^3	Q1	Q2	Q3	Q4	Annual	24-Hour
Abbotsford-Airport	2021	8696	4.8	2	3	6	17	25	158	362	4.7	12	87	3	3	100	100	98.9	97.8	5.7	18
Abbotsford-MillLake	2021	8702	5.0	2	4	6	16	22	148	363	4.9	11	97	3	3	100	98.9	98.9	100	5.3	14
Agassiz	2021	8650	5.9	3	4	7	18	30	173	362	5.9	19	129	4	5	100	100	100	96.7	6	26
Burnaby-Kensington	2021	8586	4.4	2	3	6	15	19	165	357	4.4	11	79	2	2	100	100	97.8	93.5	5	24
Burnaby South	2021	8610	4.7	2	4	6	15	19	166	355	4.7	12	61	1	1	100	95.6	97.8	95.7	5.2	14
Burns Lake	2021	8719	7.1	2	5	9	29	35	111	364	7.1	20	31	1	1	98.9	100	100	100	7.6	20
Castlegar	2021	8696	19.3	3	7	12	221	322	1308	362	19.3	236	392	35	36	100	100	97.8	98.9	12.3	105
Chilliwack	2021	8707	5.4	2	4	6	17	26	198	362	5.4	14	156	4	4	97.8	98.9	100	100	5.9	16
Colwood	2021	8663	5.9	3	5	8	19	23	81	363	5.9	14	34	1	1	100	100	98.9	98.9	6.6	29
Courtenay	2021	6897	7.0	3	5	8	32	39	100	285	7.0	22	28	1	2	34.4	94.5	92.4	90.2	8.3	26
Cranbrook	2021	8619	9.5	2	5	11	55	76	156	357	9.6	56	77	15	19	97.8	95.6	97.8	100	6.9	29
Crofton Elementary	2021	8566	3.5	1	3	5	13	17	57	361	3.4	10	26	0	1	97.8	100	97.8	100	4.4	34
Crofton-Substation	2021	8576	4.4	2	4	6	14	18	77	362	4.3	10	26	0	1	100	100	96.7	100	5.4	22
Duncan	2021	8563	6.7	3	6	9	23	28	111	361	6.7	19	28	1	2	100	100	95.7	100	7.4	25
Duncan-Deykin	2021	8592	5.0	2	4	6	18	21	45	357	5.0	13	20	0	0	97.8	100	94.6	98.9	6.7	24
Campbell River	2021	8367	6.3	3	5	8	23	29	172	349	6.3	15	23	0	0	97.8	95.6	95.7	93.5	6.9	20
FortSt.John	2021	8515	5.4	2	3	6	32	41	99	359	5.4	28	46	8	9	100	98.9	94.6	100	5.2	21
Golden	2021	8547	13.9	3	7	14	96	119	199	353	14.0	92	130	30	32	96.7	100	97.8	92.4	10.5	48
Grand Forks	2021	8704	13.2	4	8	15	71	97	253	362	12.9	57	154	30	33	100	100	96.7	100	11.4	49
Harmac	2021	8572	7.1	3	5	9	28	36	150	360	7.0	20	46	4	4	96.7	97.8	100	100	7.8	30
Hope	2021	8536	5.9	2	4	6	19	54	202	352	5.9	16	160	6	6	95.6	97.8	96.7	95.7	5.6	15
Horseshoe Bay	2021	7524	3.5	2	3	4	12	16	115	309	3.5	10	39	2	2	98.9	49.5	98.9	91.3	4.6	27
Houston	2021	8747	7.9	2	4	9	46	58	189	365	7.9	29	42	10	16	100	100	100	100	8.9	30
Hudson's Hope	2021	8632	5.2	1	3	6	34	41	97	360	5.2	26	45	7	8	98.9	100	97.8	97.8		
Kamloops	2021	8614	13.6	3	6	10	134	173	335	357	13.6	106	188	33	33	100	100	100	91.3	9.4	47
Kelowna	2021	8736	11.5	3	5	10	115	174	296	365	11.5	100	213	24	25	100	100	100	100	9.6	62
Kitimat-Haisla	2021	8529	2.6	0	2	4	10	12	35	356	2.7	7	16	0	0	100	100	91.3	98.9	3.5	9
Kitimat-Riverlodge	2021	8663	2.6	0	2	4	9	12	230	365	2.6	7	18	0	0	100	100	100	100	3.5	9
Kitimat-Whitesail	2021	8325	2.7	0	2	4	10	13	37	346	2.7	9	14	0	0	93.3	96.7	90.2	98.9	3.3	9
Langdale (BAM1020)	2021	5486	6.0	3	5	8	21	25	94	232	6.0	18	47	1	1	95.6	100	59.8	0	5	31
Langdale (T640)	2021	3891	5.2	3	4	6	16	30	71	162	5.2	16	35	2	2	0	0	76.1	100		
Langley	2021	8694	4.7	2	3	5	18	25	148	363	4.6	14	89	1	2	97.8	100	100	100	5.6	24
Mission	2021	8702	5.6	2	4	7	21	31	151	361	5.6	14	127	3	3	100	98.9	97.8	98.9	6.3	28
Nanaimo	2021	8716	5.7	3	5	8	16	20	58	365	5.7	12	30	1	2	100	100	100	100	5.4	22
New Westminster	2021	8581	5.7	3	5	7	15	20	149	357	5.6	11	69	2	2	100	96.7	94.6	100	6.1	15
North Delta	2021	6980	5.4	3	4	7	15	20	146	291	5.3	12	81	1	1	100	97.8	100	21.7	6.1	19
N.Vancouver-Mahon Park	2021	8705	4.1	2	3	5	13	18	133	364	4.1	12	63	2	2	100	98.9	100	100	4.8	27
N.Vancouver-2nd Narrows***	2021	8134	6.1	3	5	8	18	24	123	337	6.1	17	58	3	4	82.2	100	96.7	90.2		
Penticton Industrial Place	2021	5342	12.8	3	6	11	119	156	225	222	12.9	113	186	19	19	0	45.1	96.7	100		
Pitt Meadows	2021	8596	4.3	2	3	6	14	19	151	357	4.3	11	81	2	2	93.3	97.8	100	100	5.3	24
Port Alberni-Elem.School	2021	8243	7.0	3	5	8	28	34	67	342	7.0	19	25	0	0	96.7	97.8	100	80.4	8.2	23
Port Moody	2021	8493	4.6	2	4	6	14	18	112	353	4.6	11	63	2	2	100	95.6	92.4	98.9	5.4	25
Powell River-J Thomson	2021	8595	5.0	3	4	6	20	28	78	358	5.0	11	42	3	3	100	100	92.4	100	5.7	20
Prince George-Plaza 400	2021	8738	9.1	3	5	10	45	80	254	365	9.1	36	97	15	18	100	100	100	100		
Prince Rupert-Fairview	2021	8597	2.5	1	2	3	9	10	27	356	2.5	6	14	0	0	100	100	92.4	97.8	2.9	8
Quesnel****	2021	8266	9.8	3	6	11	48	72	171	342	9.8	42	122	14	16	78.9	100	98.9	96.7	9.4	34
Richmond South	2021	8655	4.7	2	4	6	14	18	124	358	4.7	12	45	1	1	98.9	98.9	94.6	100	5.9	19
Smithers	2021	8595	6.3	2	4	8	28	34	66	355	6.3	18	31	1	2	100	97.8	96.7	94.6	7.2	20
Sparwood	2021	729	6.7	2	5	9	27	32	64	31	6.7	18	18	0	0	0	0	0	33.7		
Squamish	2021	8648	5.3	2	4	7	18	24	80	360	5.2	17	36	2	2	100	96.7	100	97.8	5.8	25
Surrey	2021	8678	4.8	2	4	6	15	19	135	360	4.8	11	81	1	1	97.8	100	96.7	100	5.9	22
Terrace	2021	8637	4.3	1	3	5	22	29	78	358	4.2	12	17	0	0	100	95.6	96.7	100	4.9	14
Tsawwassen	2021	8670	3.9	2	3	5	13	15	142	361	3.9	10	41	1	1	97.8	98.9	98.9	100	4.6	12
Valemount	2021	6859	15.6	2	5	14	117	157	297	284	15.5	83	113	48	49	96.7	100	68.5	46.7		63
Vancouver-ClarkDr	2021	8707	6.1	3	5	8	18	21	158	364	6.1	12	67	2	2	100	98.9	100	100	7.1	26
Richmond-Airport	2021	8674	4.6	2	4	6	14	17	132	362	4.6	10	47	1	1	97.8	100	98.9	100	5.3	20
Vanderhoof	2021	8093	9.9	5	8	12	34	43	193	335	9.9	27	67	7	7	81.1	96.7	92.4	96.7		29
Vernon	2021	8678	15.4	4	7	13	148	210	365	361	15.3	159	254	28	29	98.9	100	96.7	100	10.8	69
Victoria	2021	8732	6.5	4	6	8	21	28	55	365	6.5	15	30	2	2	100	100	100	100	7.1	27
Whistler	2021	8380	4.6	1	3	6	24	31	80	360	4.6	15	39	4	5	100	94.5	100	100	5.5	22
Williams Lake	2021	8465	7.4	2	4	7	46	86	289	350	7.4	38	131	11	12	100	100	97.8	85.9	6.5	25

*CAAQS metrics for PM2.5 includes an annual metric based on the average of daily values and a 24-hour metric based on the 98th percentile of the daily concentrations, averaged over three consecutive years. Data are normally adjusted for transboundary flow and exceptional events (e.g., wildfires) for air zone management purposes under the national Air Quality Management System. Data in this table were NOT adjusted for transboundary flow and exceptional events. For details, visit: https://gov.bc.ca/.

**Based on incomplete data but included due to the 98th percentile exceeding the CAAQS 1-hour standard.

***Measurements were impacted by local activity (i.e., construction of the Second Narrows Water Supply Tunnel)

****Measurements were taken from two monitoring stations: Quesnel Kinchant St., and Quesnel Johnston Ave.

Summary of 2021 SO2 Data

Site	Year	No. Valid Hrs	Annual Avg	Percentiles (1h)					Max	Annual 99th Percentile of D1HM*	No. of Days			% of Valid Days Per Quarter				CAAQS SO2 Metrics*	
				25th	50th	75th	98th	99th			>65 ppb	>70 ppb	>75 ppb	Q1	Q2	Q3	Q4	Annual	1-Hour
Abbotsford-Airport	2021	8655	0.2	0.1	0.2	0.3	0.7	0.8	4.4	1.2	0	0	0	96.7	100	100	97.8	0.2	2.3
Abbotsford-MillLake	2021	8666	0.2	0.1	0.2	0.2	0.5	0.6	1.1	0.9	0	0	0	100	95.6	100	98.9	0.2	2.1
Bessborough	2021	7997	0.3	0.1	0.2	0.4	1.9	2.7	26.9	16.2	0	0	0	98.9	94.5	81.5	93.5	0.3	24.3
Birchbank Golf Course	2021	8308	4.1	0.2	0.5	4	30.5	38.6	100.4	80.4	6	5	5	98.9	100	100	100	4.1	87.1
Burnaby North Eton	2021	8624	0.6	0.1	0.3	0.6	3.4	4.2	52.5	17.8	0	0	0	100	100	98.9	96.7	0.6	12.2
Burnaby South	2021	8738	0.2	0.1	0.1	0.3	1.2	1.5	4.4	3.6	0	0	0	100	100	100	100	0.2	3.7
Burnaby-Kensington	2021	8675	0.3	0.1	0.2	0.4	1.2	1.7	16.7	5.4	0	0	0	100	100	97.8	100	0.3	5.5
Castlegar	2021	8212	1.2	0	0.1	0.6	12.7	16.1	61.4	30.2	0	0	0	90	100	100	100	1.2	35.4
Chilliwack	2021	8717	0.1	0	0.1	0.1	0.3	0.4	1.3	0.6	0	0	0	97.8	100	100	100	0.1	1.7
Crofton Elementary	2021	8145	0.6	0.2	0.4	0.7	2.6	3.6	15.2	10.1	0	0	0	98.9	100	100	89.1	0.6	
Farmington	2021	8185	0.5	0.2	0.3	0.6	1.6	2.1	16.7	8	0	0	0	98.9	86.8	98.9	96.7	0.5	8
FortSt.John	2021	6252	0.6	0.2	0.4	0.7	1.7	1.8	4.6	3.1	0	0	0	100	15.4	84.8	98.9		5.1
Hudson's Hope	2021	8634	0.4	0.1	0.3	0.5	1	1	1.2	1.1	0	0	0	98.9	100	100	100	0.4	
Kamloops	2021	8381	0.4	0.2	0.3	0.4	1.2	1.7	10.4	4.9	0	0	0	100	100	100	98.9	0.4	4.3
Kelowna	2021	8379	0.3	0.2	0.3	0.4	0.7	0.9	1.9	1.6	0	0	0	100	100	100	100	0.3	1.6
Kitimat-Haisla	2021	8392	0.2	0	0.1	0.1	1.2	2.1	23.7	9.1	0	0	0	100	100	98.9	97.8	0.2	15.6
Kitimat-Riverlodge	2021	8436	0.4	0.1	0.1	0.2	3.7	5.7	45.2	29.2	0	0	0	100	100	98.9	100	0.4	28.7
Kitimat-Whitesail	2021	8353	0.3	0.1	0.2	0.2	2.2	3.7	50.3	15.6	0	0	0	97.8	98.9	98.9	97.8	0.3	18.7
Langdale	2021	8190	0.8	0.2	0.3	0.7	5.4	7.2	22	18.1	0	0	0	90	100	100	100	0.8	14.3
Langley	2021	8701	0.1	0	0	0.1	0.4	0.5	1.6	0.9	0	0	0	97.8	100	100	100	0.1	2.3
N.Vancouver-2nd Narrows**	2021	8621	0.3	0.1	0.2	0.4	1	1.2	17.1	3.5	0	0	0	100	100	100	93.5		
N.Vancouver-Mahon Park	2021	8687	0.3	0.1	0.2	0.3	1	1.3	69.5	3.2	1	0	0	97.8	98.9	100	100	0.3	3.6
North Burnaby Capitol Hill	2021	8743	0.4	0.1	0.1	0.3	2.7	5.4	113.7	29.3	1	1	1	100	100	100	100	0.4	25
Pitt Meadows	2021	8681	0.1	0	0.1	0.2	0.7	0.8	1.7	1.5	0	0	0	98.9	98.9	100	100	0.1	3
Port Moody	2021	8719	0.2	0	0.1	0.2	1.9	2.5	44.7	5.1	0	0	0	100	100	100	100	0.2	5.1
Prince George-Jail	2021	8356	2.2	0.2	0.5	1.3	19.3	29.3	84.9	74.7	5	5	3	100	100	100	97.8	2.2	71.4
Prince George-Plaza 400	2021	8305	1.6	0.5	0.9	1.6	9.7	13.8	60.6	37.5	0	0	0	95.6	100	98.9	100	1.6	33.8
Prince Rupert-Fairview	2021	8312	0.1	0.1	0.1	0.2	0.4	0.5	2.3	1.1	0	0	0	100	96.7	97.8	97.8	0.1	1.6
Quesnel***	2021	8107	0.4	0.2	0.3	0.4	1.5	2.3	18.1	14.4	0	0	0	88.9	98.9	100	96.7	0.4	9.3
Richmond South	2021	8720	0.1	0	0.1	0.1	0.6	0.8	1.7	1.6	0	0	0	100	98.9	100	100	0.1	2.1
Richmond-Airport	2021	8734	0.2	0.1	0.1	0.3	0.9	1.1	9.6	5.9	0	0	0	100	100	100	100	0.2	4.8
Squamish	2021	8391	0.3	0.2	0.3	0.4	1.1	1.3	3.2	2.7	0	0	0	100	100	100	100	0.3	4
Taylor Townsite	2021	7843	0.5	0.1	0.2	0.4	4.7	7.1	52	23.2	0	0	0	100	86.8	88	100	0.5	37.6
Taylor-SouthHill	2021	8399	0.3	0.1	0.2	0.4	1.7	2.3	12.8	8.8	0	0	0	100	100	100	100	0.3	14.3
Terrace	2021	8318	0.5	0.2	0.4	0.6	2.2	2.6	4.6	4.4	0	0	0	100	96.7	100	97.8	0.5	4.5
Trail-Airport	2021	8371	3	0.5	0.9	3	19.1	24.3	73.9	62.1	2	2	0	100	100	100	100	3	58
Trail-Butler Park	2021	8296	5.4	0.5	1.5	4.9	40	54.6	434	170.1	39	32	30	97.8	98.9	98.9	98.9	5.4	174.6
Tsawwassen	2021	8738	0.2	0.1	0.1	0.2	0.4	0.6	1.6	1.3	0	0	0	100	100	100	100	0.2	2.6
Vancouver-Dwtn	2021	8694	0.4	0.1	0.2	0.5	1.6	2.1	28.9	4.8	0	0	0	100	98.9	100	97.8	0.4	4.8
Victoria	2021	8292	0.2	0.1	0.1	0.3	1.3	1.8	6.3	5.1	0	0	0	100	100	97.8	97.8	0.2	5.2

*CAAQS metrics for SO2 includes an annual metric based on the average of all 1-hour concentrations over the year, and a 1-hour metric based on the 99th percentile of the daily maximum 1-hour concentration averaged over three years.

**Measurements were impacted by local activity (i.e., construction of the Second Narrows Water Supply Tunnel)

***Measurements were taken from two monitoring stations: Quesnel Kinchant St., and Quesnel Johnston Ave.

Summary of 2021 O3 Data

Site	Year	No. Valid Hrs	Annual Avg.	Percentiles (1h)						Daily 8h Max		No. Days >62 ppb	% of Valid Days Per Quarter					CAAQS 8-Hr Metric*
				25th	50th	75th	98th	99th	1h Max	Annual Max	Annual 4th Highest		Q1	Q2	Q3	Q4	Q2+Q3	
Abbotsford-Airport	2021	8701	22.7	13.5	23.3	31.9	44.2	48.6	112.7	81.2	52.6	2	100	100	100	97.8	100	52
Abbotsford-MillLake	2021	8650	21.7	12.5	21.5	30.9	44.9	48.8	130	73.9	49.7	1	100	95.6	100	98.9	97.8	50
Agassiz	2021	8704	20.3	10	19.5	30	45.6	52.4	107.4	86.3	60.4	3	100	98.9	100	97.8	99.5	54
Burnaby South	2021	8737	19.2	11.6	19.5	26.5	38.5	41.1	69	46.6	44.6	0	100	100	100	100	100	44
Burnaby-Kensington	2021	8592	20.5	11.8	20.6	28.6	41.8	45	82.2	57.9	48.8	0	93.3	100	100	100	100	46
Burnaby-Mtn	2021	8718	29.8	23.9	30	35.4	48.3	51.6	105.2	77.5	59.3	2	100	100	100	98.9	100	53
Castlegar	2021	8146	21	10.4	18.8	29.9	49.3	54.4	109.4	75.5	61.7	3	88.9	100	96.7	100	98.4	52
Chilliwack	2021	8653	20.6	10	20.2	30	46.7	52.5	104.2	82.2	62.1	4	97.8	100	100	96.7	100	57
Colwood	2021	8283	24	14.9	24.3	33.6	44.2	47	68.7	60.2	53.7	0	100	100	100	95.7	100	51
Coquitlam	2021	8659	19	9.3	18.3	27.5	44.4	50.5	112.2	80.8	63.6	4	100	100	97.8	96.7	98.9	54
Courtenay	2021	6915	20.5	11.4	20.7	29.1	41.4	43.4	66.6	59.6	47.7	0	34.4	100	95.7	100	97.8	48
Cranbrook	2021	8358	24	16	23.6	30.6	51.4	56.5	71.3	67.8	60.9	3	100	100	97.8	100	98.9	53
Duncan	2021	8270	20.1	9.4	19.9	30.2	42.7	45.5	56.1	50.9	49.1	0	97.8	100	96.7	100	98.4	49
Farmington	2021	8201	26	19.3	27.4	34.2	44.1	45.9	69.6	64	48.1	1	98.9	86.8	98.9	98.9	92.9	50
FortSt.John	2021	7681	24.4	17.8	25.1	31.3	43.4	46.2	54.9	50.8	47.5	0	87.8	85.7	100	100	92.9	50
Hope	2021	8644	20	8.2	19.4	30.4	47.8	54.7	95.8	80.9	63.1	5	96.7	98.9	100	97.8	99.5	56
Kamloops	2021	8382	23.1	12.5	22.9	33.5	48.4	51.8	73.5	62.2	57.5	1	100	100	100	98.9	100	51
Kelowna	2021	8380	22.7	13.2	23	31.6	46.5	51.7	77.9	68	58.6	1	100	100	100	100	100	52
Kitimat-Whitesail	2021	7888	20.6	13.4	20.7	28.3	37.3	38.8	49.2	44.6	41.7	0	98.9	100	75	92.4	87.4	42
Langley	2021	8692	23.1	14.5	23.6	31.7	44.7	49.1	114.9	85.5	52.4	2	96.7	100	100	100	100	52
Maple Ridge	2021	8726	21.7	12.3	21.5	30.4	45.8	50.7	150.6	102.2	63.7	5	100	98.9	100	100	99.5	57
Mission	2021	8646	23.9	15.6	23.9	31.9	48.4	54.7	148.7	95.9	63.6	5	97.8	100	98.9	95.7	99.5	58
N.Vancouver-2nd Narrows**	2021	8645	14.4	13.5	21.7	29.8	41.2	43.8	81.1	51.1	35.9	0	100	100	100	95.7	100	
N.Vancouver-Mahon Park	2021	8665	19.9	3.9	13.7	25.2	43.1	46.3	79.5	53.4	47.4	0	100	98.9	100	97.8	99.5	45
Nanaimo	2021	8258	24.4	7.1	13.9	20.8	32.7	34.5	51.1	41.9	45.1	0	94.4	100	98.9	100	99.5	45
New Westminster	2021	8714	15.7	11.4	20.1	27.8	41.4	43.9	79	57.4	51.1	0	100	98.9	98.9	100	98.9	47
North Delta	2021	6443	21.4	18.2	24.1	30.6	41.2	42.8	59.3	49.6	46	0	98.9	100	76.1	19.6	88	45
Pitt Meadows	2021	8658	19.9	9.5	20.7	29.5	42.9	47.8	132.5	88.3	55.9	3	96.7	100	100	100	100	50
Port Moody	2021	8717	15.7	5.4	14.5	24.5	39.1	42.6	84.4	60.3	53	0	100	100	100	100	100	48
Prince George-Plaza 400	2021	8090	21.3	11	22.5	31	43.1	45.3	62.5	50.1	47.7	0	100	100	78.3	96.7	89.1	49
Prince Rupert-Fairview	2021	7994	22.2	13.3	22.8	31.7	40	41.3	49.1	47.1	42.6	0	86.7	93.4	97.8	97.8	95.6	41
Quesnel***	2021	8337	18.3	8.9	17.5	26.8	39.7	41.5	76.9	62.5	43.7	1	100	98.9	100	96.7	99.5	46
Richmond South	2021	8647	19.5	9.9	20.1	28.9	41.1	42.9	53.7	45.8	45	0	94.4	98.9	100	100	99.5	45
Richmond-Airport	2021	8689	19.6	3.5	12.6	22.2	38.1	40.1	66.4	44.9	43.3	0	100	100	100	97.8	100	44
Smithers	2021	8285	15.7	8.7	20.1	29.8	42.3	44.2	56.5	48.7	42.3	0	98.9	100	98.9	94.6	99.5	44
Sparwood	2021	711	26.1	5.2	14.6	24.1	38.9	40.6	48.1	46.7	40.1	0	0	0	0	33.7	0	
Squamish	2021	8714	18.5	17.5	28.6	35.1	41.7	43.3	46.8	44.7	45.2	1	98.9	100	100	100	100	44
Surrey	2021	8712	22.4	9.3	18.3	27	39.7	42.8	76.9	64.7	51.3	2	97.8	100	100	100	100	50
Taylor Townsite	2021	8284	23.8	14.4	22.6	30.8	44.1	48.4	105.4	80.1	50.4	0	100	97.8	100	100	98.9	51
Terrace	2021	8211	21.1	14.6	24.2	32.6	46.1	48.3	68.3	55.3	46.6	0	91.1	98.9	100	100	99.5	44
Tsawwassen	2021	8699	24.8	12.9	21.4	29.3	41.7	43.6	51.7	48.2	45.3	0	98.9	98.9	100	100	99.5	46
Vancouver-ClarkDr	2021	8598	14	17.6	25.5	32.7	42.9	44.5	58.6	46.2	42.7	0	93.3	100	100	100	100	41
Vancouver-Dwtn	2021	8706	13.9	4.3	12.3	21.8	36.6	38.6	64	45.8	40.7	0	100	98.9	100	100	99.5	38
Vernon	2021	8386	21.2	8.9	20.3	32.7	47	50.7	70.6	65.6	57.1	1	100	100	100	100	100	52
Victoria	2021	8239	22.4	15.1	23	30.5	40.3	43.2	74.4	61.4	47	0	100	93.4	97.8	100	95.6	45
Whistler	2021	8722	22.1	12.3	22.1	31.3	45.4	48.1	59.5	52.3	49.7	0	100	100	100	100	100	49
Williams Lake	2021	7895	21.6	11.1	21.8	31.3	44.6	46.3	54.1	52.3	46.2	0	92.2	78	97.8	100	88	49

*CAAQS metrics for ozone is an 8-hour metric based on the annual 4th highest of the daily maximum 8-hour averaged concentration averaged over three years. Data are normally adjusted for transboundary flow and exceptional events (e.g., wildfires) for air zone management purposes under the national Air Quality Management System. Data in this table were NOT adjusted for transboundary flow and exceptional events. For details, visit: https://gov.bc.ca/.

**Measurements were impacted by local activity (i.e., construction of the Second Narrows Water Supply Tunnel)

***Measurements were taken from two monitoring stations: Quesnel Kinchant St., and Quesnel Johnston Ave.

Summary of 2021 NO2 Data

Site	Year	No. Valid Hrs	Annual Avg	Percentiles (1h)					Max 1h	Annual 98th Percentile of Daily 1-Hour Maximum	No. Days		% of Valid Days Per Quarter				CAAQS NO2 Metrics*	
				25th	50th	75th	98th	99th			>42 ppb	>60 ppb	Q1	Q2	Q3	Q4	Annual	1-Hour
Abbotsford-Airport	2021	8708	6.2	2.5	4.6	8.6	19.2	21.2	34.6	27.4	0	0	100	100	100	97.83	6.2	28.4
Abbotsford-MillLake	2021	8655	7.4	3.4	5.8	10	21.9	24.8	36.1	31.5	0	0	100	95.6	100	98.91	7.4	33.3
Agassiz	2021	8729	7.1	3.1	5.5	10	21	23	34.6	29.1	0	0	100	100	100	100	7.1	28.4
Burnaby South	2021	8665	10.6	5.5	9	14.1	28.3	31.2	40.1	37.5	0	0	100	100	100	100	10.6	38
Burnaby-Kensington	2021	8712	8.9	4.8	7.5	11.5	25.1	28.3	42.3	34.9	1	0	100	100	100	100	8.9	35.1
Burnaby-Mtn	2021	8725	6	3	5	8	18.4	21.5	38.4	29.3	0	0	100	100	100	98.91	6	31.6
Castlegar	2021	8319	5.9	2.4	4.5	8.1	18.7	21.2	48	26.7	3	0	97.78	100	100	97.83	5.9	25.7
Chilliwack	2021	8715	7.2	3.4	5.8	9.7	20.6	22.9	40.9	30.1	0	0	97.78	100	100	100	7.2	28.8
Colwood	2021	8334	3.8	1.1	2.6	5.1	14.9	17.2	25.6	22.1	0	0	98.89	100	98.91	98.91	3.8	23.3
Coquitlam	2021	8723	8.3	4.1	6.8	11.1	23.8	26	34.1	31.2	0	0	100	100	100	100	8.3	32.9
Courtenay	2021	8320	3.5	1.2	2.3	4.6	15	17.8	30.1	24.3	0	0	100	100	96.74	100	3.5	23.4
Cranbrook	2021	8348	4.3	1.4	2.6	5.7	18.5	20.9	33.3	26.4	0	0	100	100	97.83	97.83	4.3	28.2
Duncan	2021	8352	4.2	1.8	3.3	5.8	13.3	15.2	34.3	21.6	0	0	100	100	100	100	4.2	22.1
Farmington	2021	8200	2.6	0.7	1.6	3.5	10.8	13.1	24.2	19.5	0	0	98.89	86.81	98.91	100	2.6	19
Hope	2021	8636	6	2.8	4.8	8.2	17.4	19.5	27.5	24.2	0	0	96.67	98.9	100	96.74	6	23.5
Horseshoe Bay	2021	7331	9.4	3.6	7.5	13.4	29.3	33.9	57.1	45.8	12	0	37.78	100	96.74	97.83		
Hudson's Hope	2021	8480	2.3	0.4	1.1	2.8	12.8	15.4	30.3	21.6	0	0	93.33	100	100	100	2.3	
Kamloops	2021	8378	10.5	4.3	8.1	15	31.3	33.8	47.3	38.3	2	0	100	100	100	98.91	10.5	38.3
Kelowna	2021	8381	5.8	2.4	4.4	8.1	17.8	19.9	33	23.9	0	0	100	98.9	100	100	5.8	25.5
Kitimat-Whitesail	2021	8356	1.8	1	1.4	2	6.8	8.6	20.6	13.4	0	0	98.89	98.9	96.74	97.83	1.8	14.3
Langdale	2021	8154	4	1.8	3.1	5.3	12.8	15.5	33.4	23.5	0	0	90	98.9	93.48	100	4	21.8
Langley	2021	8636	5.3	2.5	4	6.9	16.2	18.2	27.5	22.4	0	0	94.44	100	100	100	5.3	23.3
Maple Ridge	2021	8722	6.5	3	5.1	8.5	20.2	22.4	38.4	26.5	0	0	100	98.9	100	100	6.5	30.7
Mission	2021	8713	5.5	2.5	4.1	7.1	18	20.3	27.2	25.3	0	0	100	100	98.91	98.91	5.5	28.8
N.Vancouver-2nd Narrows**	2021	8636	12.9	7	10.9	16.7	35.5	39.8	84.2	62.1	30	8	98.89	100	100	95.65		
N.Vancouver-Mahon Park	2021	8697	9.6	4.6	7.9	12.9	27.2	29.7	40.1	36.1	0	0	100	97.8	100	100	9.6	37.4
Nanaimo	2021	8023	4.9	1.8	3.8	6.7	17	19.7	36.2	28.1	0	0	84.44	100	98.91	97.83	4.9	26.4
New Westminster	2021	8712	13.9	8.1	13	18.8	29.9	31.8	48.9	36.9	1	0	100	98.9	98.91	100	13.9	40
North Delta	2021	8608	10.5	4.6	8.4	14.4	30.9	33.4	46.4	39.6	4	0	100	98.9	93.48	100	10.5	40.1
Pitt Meadows	2021	8718	7.3	2.7	5.9	10.3	24.1	26.3	41.1	33.1	0	0	100	100	100	100	7.3	36
Port Moody	2021	8716	10.8	5.9	9.6	14.6	26.6	29.3	43	35.2	1	0	100	100	100	100	10.8	36.5
Prince George-Plaza 400	2021	8379	8.3	2.6	5.6	11.5	31.8	35.5	55.3	41.1	6	0	100	100	100	100	8.3	43.4
Prince Rupert-Fairview	2021	8058	3.9	1.1	2.6	5.6	14.9	17.4	30.3	23.7	0	0	100	83.52	97.83	97.83	3.9	24.8
Quesnel***	2021	8150	8.1	3.4	6	10.5	27.2	29.7	43	34.7	1	0	90	100	100	96.74	8.1	38.1
Richmond South	2021	8717	10.1	3.3	7.7	15.4	29.3	31.5	45.1	35.7	1	0	100	98.9	100	100	10.1	37.1
Richmond-Airport	2021	8725	11.1	4.3	8.6	16.3	32	34.3	43.9	38	1	0	100	100	100	100	11.1	41.1
Smithers	2021	8329	6.3	2.8	4.7	8.4	20.5	22.5	33.7	28.2	0	0	98.89	100	98.91	94.57	6.3	29.4
Sparwood	2021	716	8.1	2.8	5.8	12.2	25.8	26.7	33.6	33.6	0	0	0	0	0	33.7		
Squamish	2021	8532	5.1	2.5	4.3	6.7	14.9	17.3	28.2	22.3	0	0	100	91.21	100	100	5.1	23
Surrey	2021	8703	7.3	3.3	5.7	9.8	22.6	25.5	38	31.1	0	0	97.78	100	100	100	7.3	33
Taylor Townsite	2021	8205	5.4	1.2	3.2	7.1	24.8	28.6	49.3	35.9	1	0	96.67	93.41	96.74	96.74	5.4	37.1
Terrace	2021	8377	2.7	0.7	1.3	3	14.3	17.1	28.1	22.5	0	0	100	98.9	100	100	2.7	23
Tsawwassen	2021	8742	5.4	1.9	3.5	7	21	23.6	34.6	29.9	0	0	100	100	100	100	5.4	29.6
Vancouver-ClarkDr	2021	8601	16.4	9.4	15.9	22.3	36.1	38.7	49.5	44.8	14	0	93.33	100	100	100	16.4	47.6
Vancouver-Dwtn	2021	8707	15.8	9.5	15.3	21.2	32.2	34.2	44.1	39.9	2	0	100	98.9	100	100	15.8	39.9
Vernon	2021	8384	10	4.4	7.9	13.9	28.8	31.2	41.4	36.7	0	0	100	100	100	100	10	35
Victoria	2021	8306	6.1	2.4	4.5	8.2	21.6	25	41.8	32.1	0	0	100	98.9	96.74	100	6.1	34.3
Whistler	2021	8407	2.7	0.9	1.8	3.3	11.8	13.7	26.5	19.6	0	0	84.44	98.9	100	100	2.7	21.1
Williams Lake	2021	8354	9.7	6.3	8.9	12.5	21.4	23.3	32.5	27.6	0	0	100	100	97.83	100	9.7	32.3

*CAAQS metrics for NO2 includes an annual metric based on the average of all 1-hour concentrations over the year, and a 1-hour metric based on the 98th percentile of the daily maximum 1-hour concentration averaged over three years.

**Measurements were impacted by local activity (i.e., construction of the Second Narrows Water Supply Tunnel)

***Measurements were taken from two monitoring stations: Quesnel Kinchant St., and Quesnel Johnston Ave.