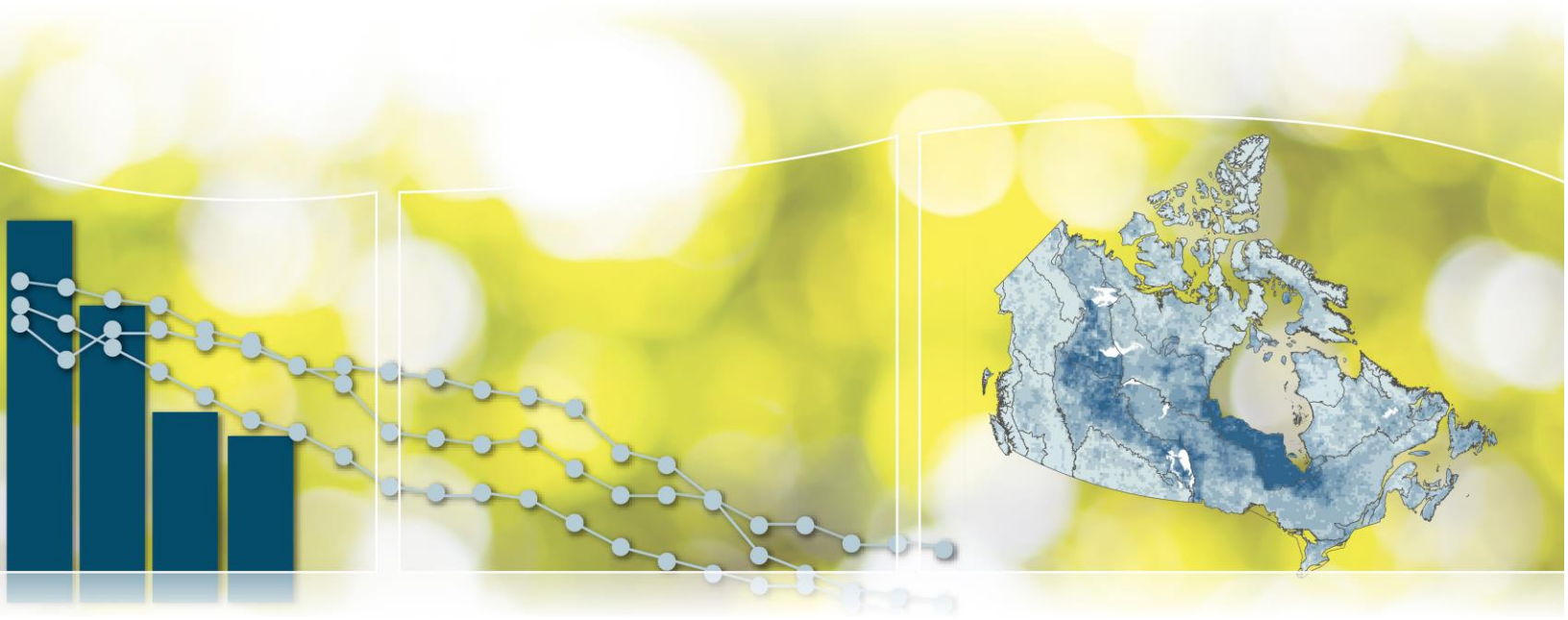
Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canadian Environmental Sustainability Indicators

Air quality



Canada

Suggested citation for this document: Environment and Climate Change Canada (2018) Canadian Environmental Sustainability Indicators: Air quality. Consulted on *Month day, year*.
Available at: www.canada.ca/en/environment-climate-change/services/environmental-indicators/air-quality.html.

Cat. No.: En4-144/57-2018E-PDF
ISBN: 978-0-660-28053-0

Environment and Climate Change Canada
Public Inquiries Centre
12th floor, Fontaine Building
200 Sacré-Coeur boul.
Gatineau, QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-938-3860
Fax: 819-938-3318
Email: ec.enviroinfo.ec@canada.ca

Aussi disponible en français

Canadian Environmental Sustainability Indicators

Air quality

October 2018

Table of Contents

List of Figures

List of Tables

Air quality

Air quality problems such as smog and acid rain result from the release of pollutants into the atmosphere. The majority of these pollutants come from human activities, such as transportation, the burning of fuels for electricity and heating, and industry. Natural sources such as forest fires can sometimes be substantial. Air pollutants cause adverse health and environmental effects.

The Air quality indicators present the annual averages of 5 key air pollutants for Canada and 5 large regions. Comparison of the averages to the Canadian Ambient Air Quality Standards (the standards) is for illustrative purposes only. An average that is below the standards does not imply that air pollutant levels are below the standards in all areas of Canada. Please consult the Canadian Council of Ministers of the Environment State of the air report for information on how air pollutant levels in areas of Canada compare to the standards.

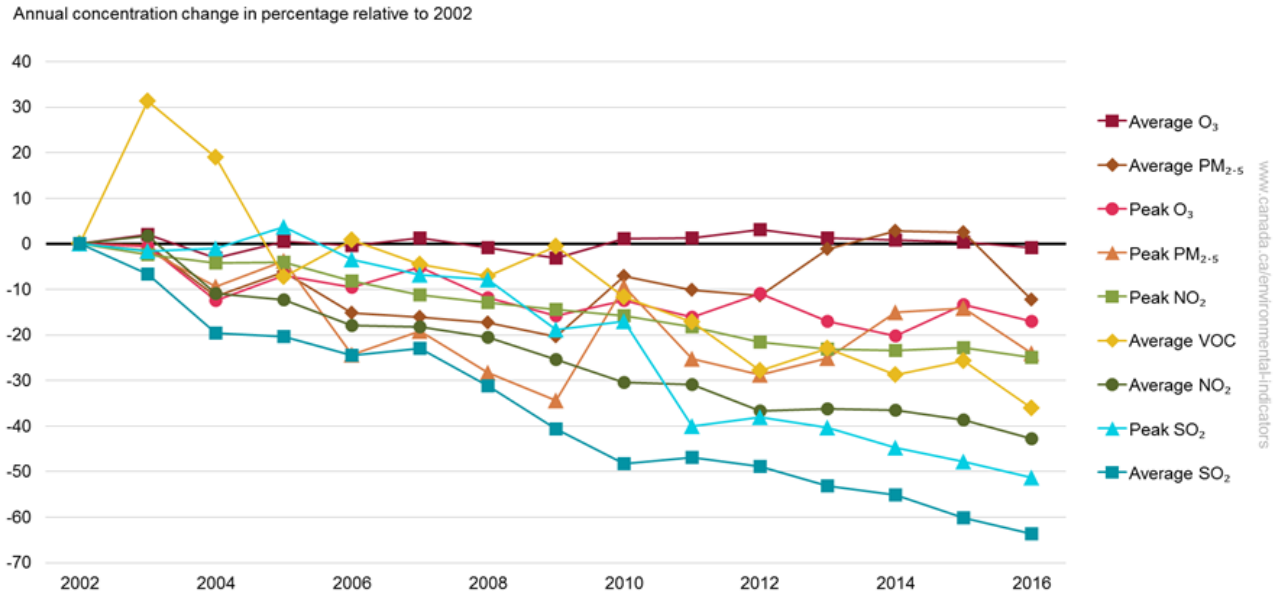
Air quality trends in Canada

Key results

Between 2002 and 2016

- nitrogen dioxide (NO_2), sulphur dioxide (SO_2), volatile organic compound (VOC) and peak ground-level ozone (O_3) concentrations decreased
- average O_3 concentrations showed almost no change
- fine particulate matter ($PM_{2.5}$) concentrations exhibit variable results

Figure 1. Air pollutant concentrations, Canada, 2002 to 2016



Data for Figure 1

Note: For more information on the Air quality indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

In 2016, average SO_2 concentrations were 64% lower than in 2002. Peak SO_2 concentrations fell below the 2002 level in 2006 and by 2016, were 52% below the 2002 concentration.

The average O_3 concentration has not changed substantially since 2002. In 2016, it was 1% lower than in 2002. In 2016, the peak O_3 level was 17% below the 2002 concentration.

The average $PM_{2.5}$ concentrations were higher in 2014 and 2015 than in 2002. In 2016, the average $PM_{2.5}$ concentration was 12% lower than in 2002. In 2016, the peak $PM_{2.5}$ concentration was 24% below the 2002 levels.

Average and peak NO_2 concentrations, respectively, were 43% and 25% lower in 2016 than in 2002.

VOC concentrations were below the 2002 level except in 2003, 2004 and 2006. In 2016, the VOC concentration was 36% below the 2002 level.

The levels of these pollutants in outdoor air are influenced by many factors, including the proximity to local emission sources, weather conditions, chemical reactions in the air and the transport of air pollutants over long distances by wind. Part of the increase in the fine particulate matter concentrations recorded since 2009 may be due to the progressive introduction of monitoring equipment based on newer technologies and to increase in forest fire events in the past decade. This is especially true for the peak fine particulate matter concentrations recorded in Western Canada.

Air quality concentrations relative to the Canadian Ambient Air Quality Standards

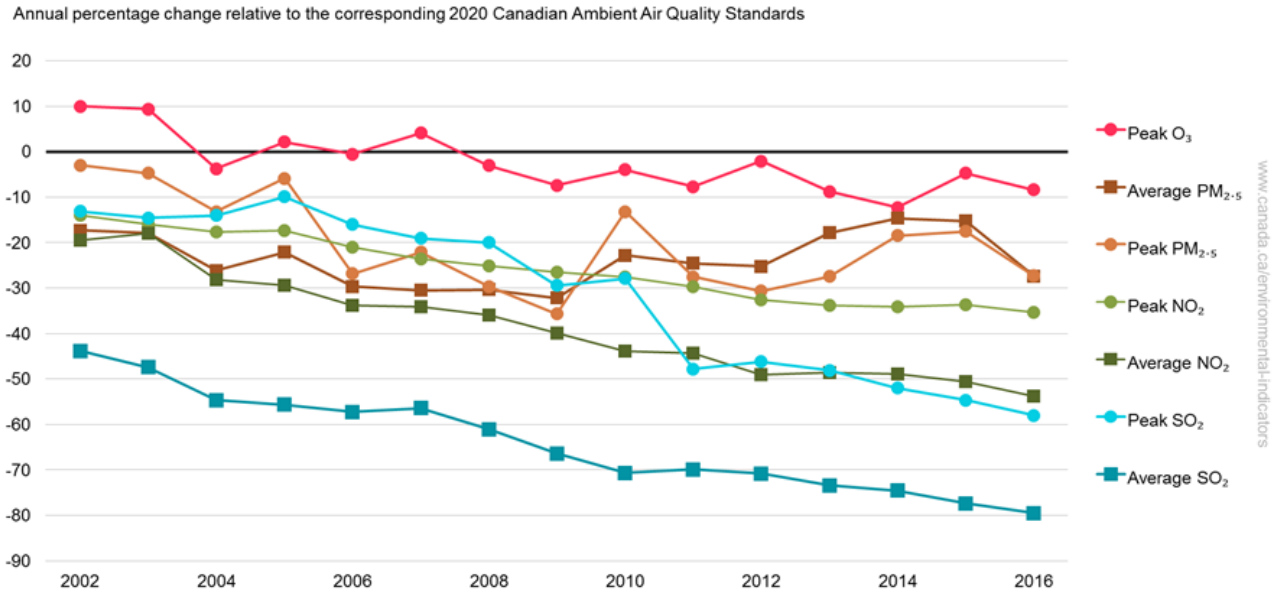
Key results

When compared to the 2020 Canadian Ambient Air Quality Standards[1]

- national concentrations of fine particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) have been below their respective standards since 2002
- peak ozone (O_3) concentrations were above the standard only at the beginning of the period

[1] The $PM_{2.5}$, SO_2, NO_2 and the O_3 peak air quality indicators are reported relative to the corresponding 2020 Canadian Ambient Air Quality Standards (the standards). In May 2013, the O_3 and $PM_{2.5}$ standards were established as objectives under the Canadian Environmental Protection Act, 1999, while SO_2 and NO_2 standards were established as objectives in October 2017 and December 2017, respectively. Comparisons of the national and regional concentrations to Canadian Ambient Air Quality Standards are provided for illustrative purposes only.

Figure 2. Air pollutant concentrations relative to the Canadian Ambient Air Quality Standards, Canada, 2002 to 2016



Data for Figure 2

Note: The horizontal line at 0% represents the reference level of the 2020 Canadian Ambient Air Quality Standards. Comparison of the national concentrations to the Canadian Ambient Air Quality Standards is provided for illustrative purposes only. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Peak O_3 concentrations were mainly above the standard before 2008 but have been below the standard since then. In 2016, the peak concentration was 8% below the standard.

In 2016, average and peak levels of $PM_{2.5}$ were 27% below the corresponding standards. Average and peak levels of sulphur dioxide were 80% and 58% below the respective standards, while the average and peak levels of nitrogen dioxide were 54% and 35% below their respective standards.

The indicators are shown relative to the Canadian Ambient Air Quality Standards for illustrative purposes only and not for assessing the achievement status of the standards.[2]

[2] While the standards are usually based on 3-year averages, the indicators presented here are calculated as 1-year averages. For more information, consult the Table 3. Air quality indicators definitions.

Fine particulate matter

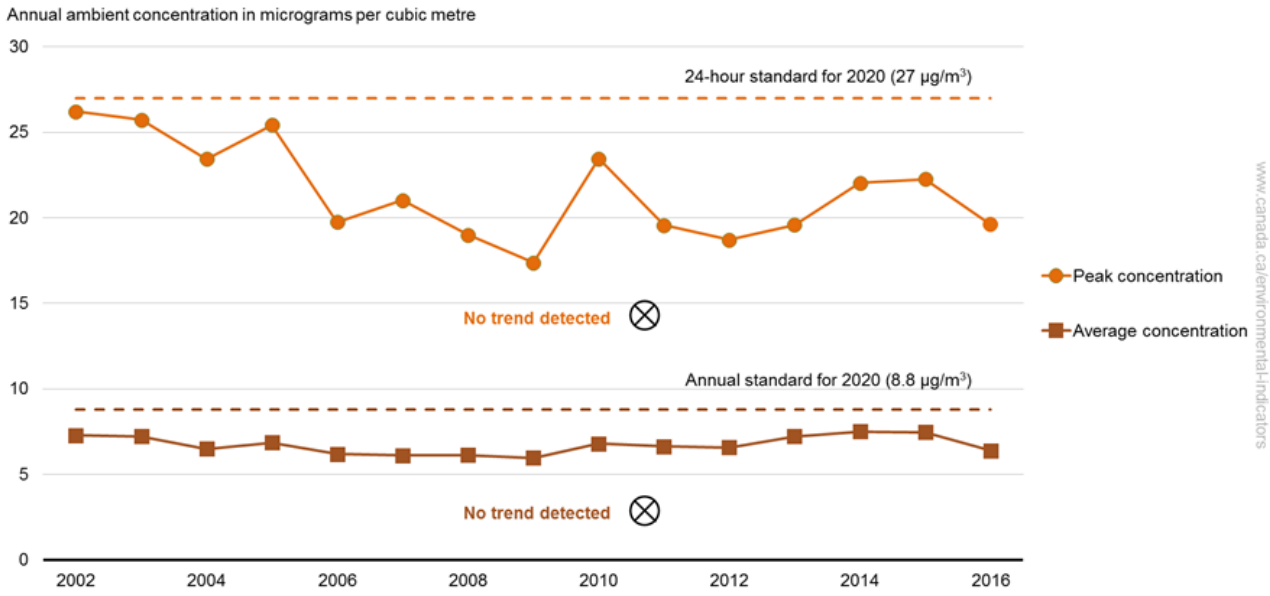
Fine particulate matter ($PM_{2.5}$) is emitted to the air and can also form in the air through the interactions of other pollutants. The particles can be in solid or liquid form. Fine particulate matter is one of the major components of smog. When inhaled deeply into the lungs, even small amounts of $PM_{2.5}$ can cause serious health problems. The particles can also damage vegetation and structures, contribute to haze and reduce visibility.

Key results[3]

Between 2002 and 2016

- the annual average and annual peak concentration of $PM_{2.5}$ were below their respective 2020 standards[4]
- no trends, either increasing or decreasing, were found over the period

Figure 3. Fine particulate matter concentrations, Canada, 2002 to 2016



Data for Figure 3

Note: The average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations for $PM_{2.5}$ recorded at 109 monitoring stations across Canada. The national peak indicator is based on the 98th percentile of the daily 24-hour average concentrations for $PM_{2.5}$ recorded at 114 monitoring stations across Canada. The horizontal dashed lines represent the 2020 Canadian Ambient Air Quality Standards. The Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

[3] From the mid-2000s to 2013, new $PM_{2.5}$ monitoring equipment was progressively introduced across Canada to replace older monitoring equipment. These new instruments measure an additional portion (semi-volatile) of the fine particulate matter mass not captured by the older instruments. Concentrations measured with the new monitors may not be directly comparable with measurements from years in which older instruments were used.

[4] Comparisons of national concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards.

In 2016, the national average concentration of $PM_{2.5}$ was 6.4 micrograms per cubic metre (µg/m^3), a level 14% lower than in 2015. The national peak concentration of $PM_{2.5}$ in 2016 was 19.6 µg/m^3, which is 12% lower than in 2015.

Changes in $PM_{2.5}$ levels may be related to changes in the quantity of emissions and to annual variations in weather conditions. Weather conditions influence the formation, dispersion and regional transport of $PM_{2.5}$ as well as transboundary movement of $PM_{2.5}$ from the United States. The variations observed in the concentrations of $PM_{2.5}$ were also influenced by the progressive introduction of monitoring equipment based on newer technologies.

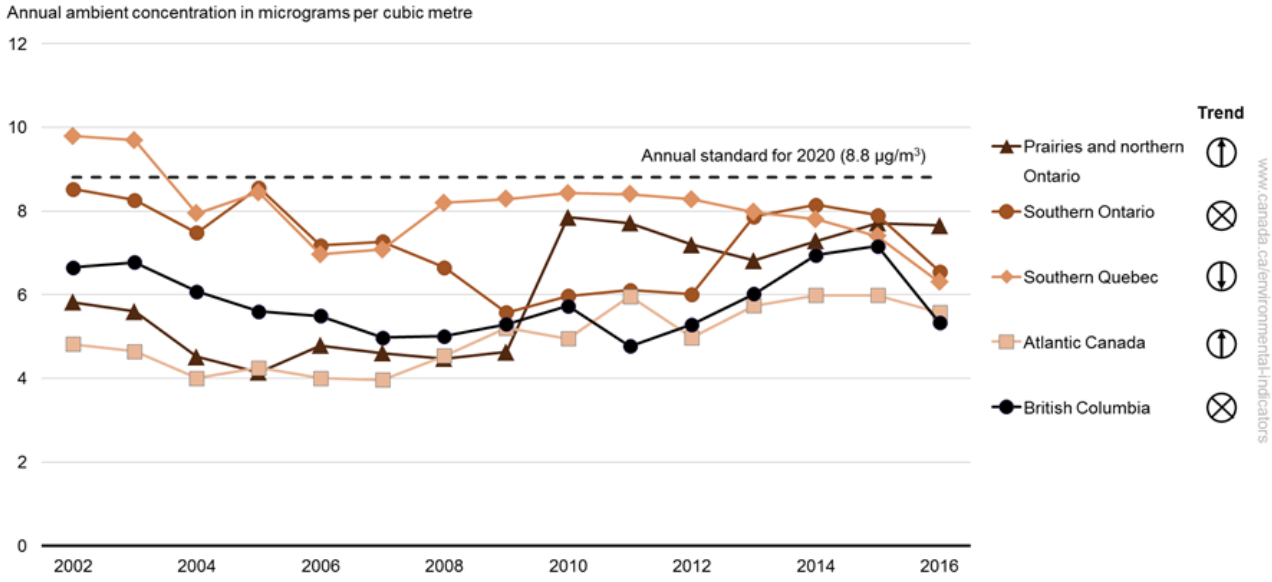
Average concentrations of fine particulate matter

Regional ambient levels

Key results

- Since 2002, average $PM_{2.5}$ concentrations have consistently remained below the 2020 standard[5] across all regions of Canada, except for the first 2 years in southern Quebec
- An increasing trend was detected for the average $PM_{2.5}$ concentrations in Atlantic Canada and the Prairies and northern Ontario region. A decreasing trend was found for southern Quebec

Figure 4. Regional average fine particulate matter concentrations, Canada, 2002 to 2016



Data for Figure 4

Note: The average $PM_{2.5}$ concentration indicator is based on concentrations recorded at 8 monitoring stations in Atlantic Canada, 28 in southern Quebec, 33 in southern Ontario, 20 in the Prairies and northern Ontario region, and 19 in British Columbia. The horizontal dashed line represents the annual standard of the 2020 Canadian Ambient Air Quality Standards. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standard. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more

[5] Comparisons of regional concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

In 2016, the Prairies and northern Ontario region had the highest $PM_{2.5}$ concentration, at 7.7 µg/m^3. British Columbia had the lowest concentration, at 5.3 µg/m^3. Forest fires in the Fort McMurray area in 2016 may have contributed to the higher levels in the Prairies and northern Ontario region.

All regions had lower concentrations in 2016 than in 2015. In 2016, British Columbia and southern Ontario recorded the largest reductions in concentrations, with a decrease of 26% and 17%, respectively, from the 2015 level. For British Columbia, very high levels were recorded in the previous 2 years, possibly due to extensive forest fires. Southern Quebec recorded a decrease of 15% in 2016 while Atlantic Canada and the Prairies and northern Ontario region posted reductions of 7% and 1%, respectively.

No trends were detected for southern Ontario or British Columbia. While a decreasing trend of 0.1 µg/m^3 per year was observed in southern Quebec, increasing trends were detected in Atlantic Canada and in the Prairies and northern Ontario region, with values of 0.1 µg/m^3 per year and 0.2 µg/m^3 per year, respectively.

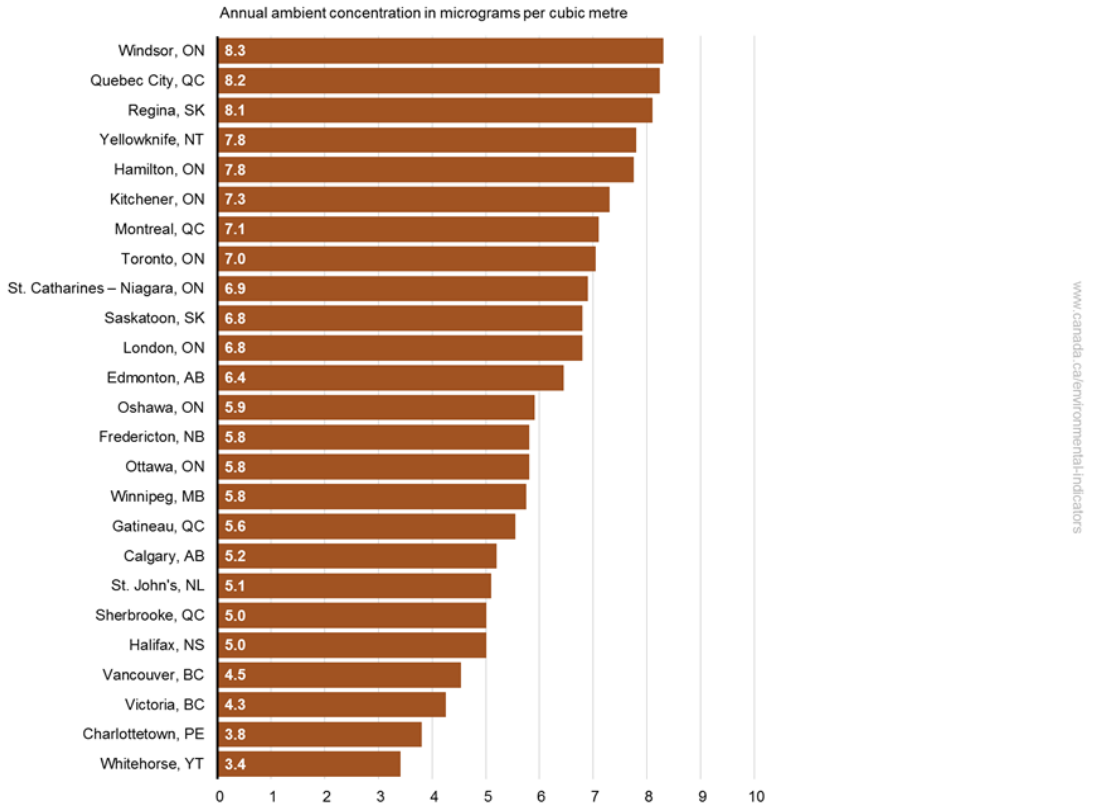
Urban areas

Key results

In 2016, among the selected urban areas

- Windsor, Quebec City and Regina recorded the highest average concentrations of $PM_{2.5}$
- Whitehorse, Charlottetown and Victoria recorded the lowest concentrations

Figure 5. Average fine particulate matter concentrations, selected Canadian urban areas, 2016



Data for Figure 5

Note: Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included. The Charlottetown concentration is for the year 2015. Concentrations for the years 2002 to 2016 are reported in the data table for this chart.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

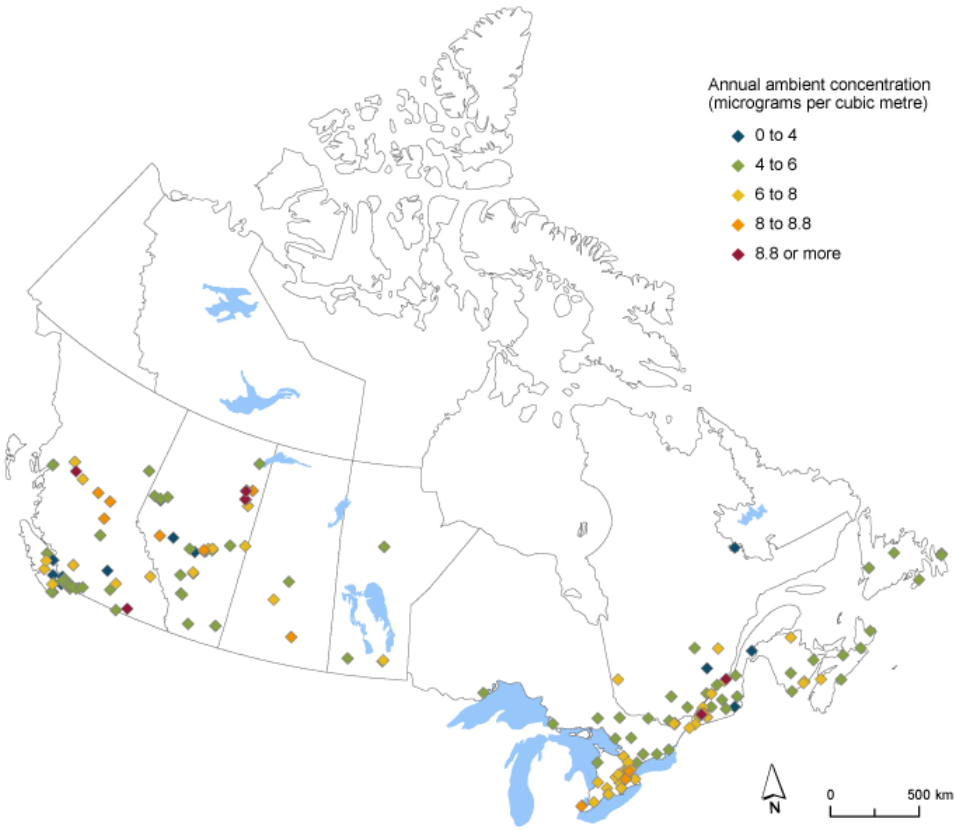
Fine particulate matter concentrations in Canadian urban areas differ from one location to another and from one year to the next. These differences are partly due to differences in emissions of pollutants, variations in weather conditions that influence $PM_{2.5}$ formation, dispersion and regional transport, and variations in transboundary flows of pollution mainly from the United States. Exceptional events, such as forest fires, can also impact the average $PM_{2.5}$ concentrations measured in urban areas.

Average fine particulate matter concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the average $PM_{2.5}$ concentrations at specific monitoring stations.

Figure 6. Average fine particulate matter concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

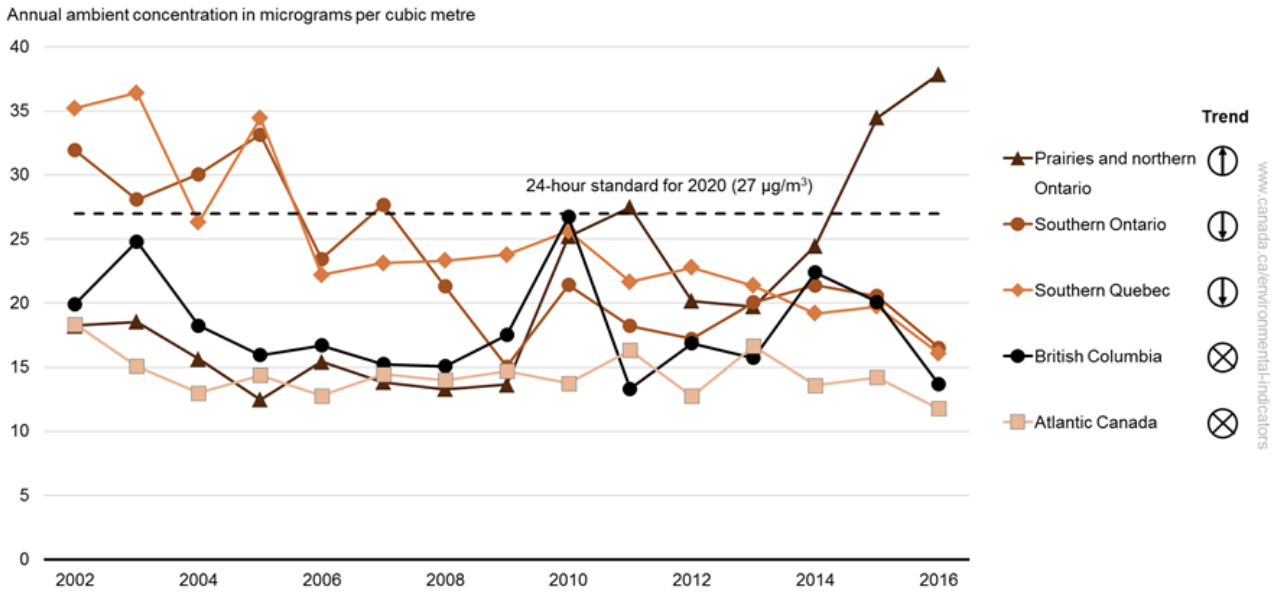
Peak concentrations of fine particulate matter

Regional ambient levels

Key results

- In 2016, peak concentrations of $PM_{2.5}$ were below the 2020 standard[6] in all regions except the Prairies and northern Ontario region
- Over the 2002 to 2016 period, southern Quebec and southern Ontario recorded decreasing trends in $PM_{2.5}$ peak concentration, whereas the Prairies and northern Ontario region posted an increase

Figure 7. Regional peak fine particulate matter concentrations, Canada, 2002 to 2016



Data for Figure 7

Note: The peak $PM_{2.5}$ indicator is based on the concentrations recorded at 8 monitoring stations in Atlantic Canada, 28 in southern Quebec, 35 in southern Ontario, 20 in the Prairies and northern Ontario region, and 19 in British Columbia. The horizontal dashed line represents the 24-hour standard of the 2020 Canadian Ambient Air Quality Standards. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standard. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

In 2016, the highest concentration was found in the Prairies and northern Ontario region, at 37.9 µg/m^3, which is 10% higher than in 2015. Atlantic Canada had the lowest annual peak concentration of $PM_{2.5}$, at 11.8 µg/m^3, which is 17% lower than in 2015. Forest fires in the Fort McMurray area in 2016 likely contributed to the increased levels in the Prairies and northern Ontario region.

Between 2002 and 2016, peak concentrations of $PM_{2.5}$ were below the standard in 2 regions, specifically Atlantic Canada and British Columbia. Concentrations in southern Quebec and southern

[6] Comparisons of regional concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

Ontario were above the standard in most years between 2002 and 2007, but remained below the standard from 2008 to 2016, while the Prairies and northern Ontario region posted concentrations above the standard in 2011 and in the last 2 years of the time series. Forest fires are the main reason why the concentrations exceeded the standards in the Prairies.

No trends were detected for Atlantic Canada and British Columbia. A decreasing trend of 1.0 µg/m^3 and 1.1 µg/m^3 per year, respectively, was found in southern Ontario and southern Quebec, while an increasing trend was detected in the Prairies and northern Ontario region (1.1 µg/m^3 per year).

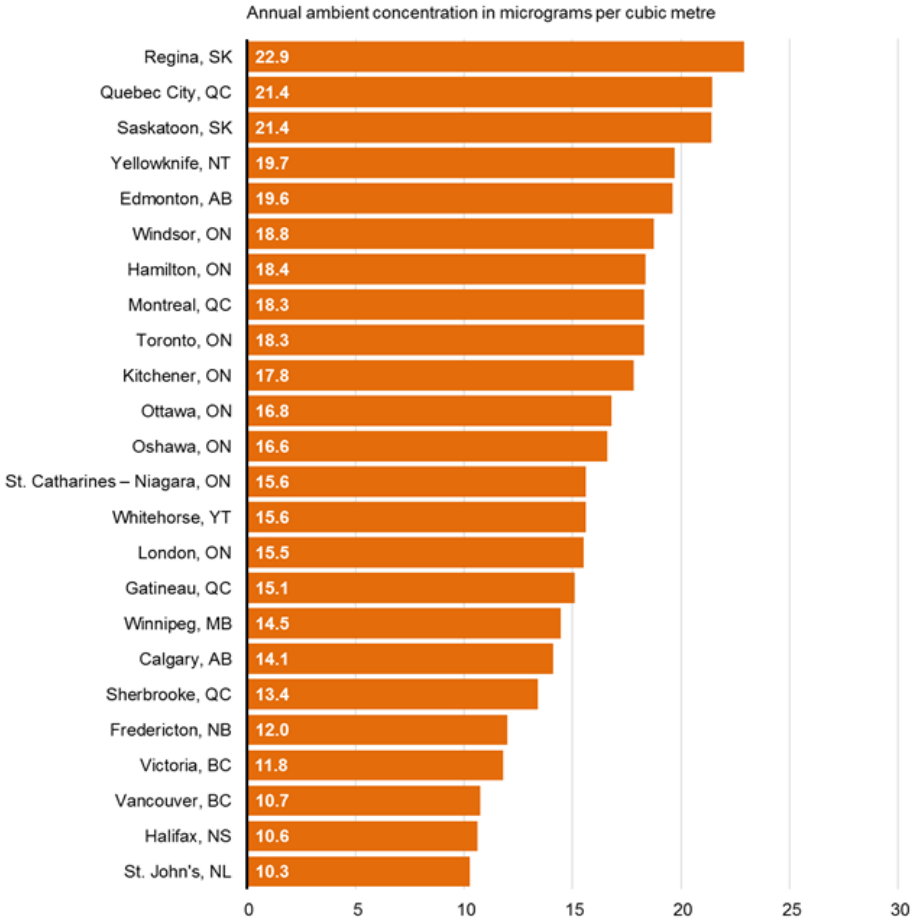
Urban areas

Key results

In 2016, among the selected urban areas

- Regina, Quebec City and Saskatoon had the highest peak concentrations of $PM_{2.5}$ in Canada
- urban areas in Atlantic Canada and British Columbia had the lowest concentrations

Figure 8. Peak fine particulate matter concentrations, selected Canadian urban areas, 2016



Data for Figure 8

Note: Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included. Concentrations for the years 2002 to 2016 are reported in the data table for this chart.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

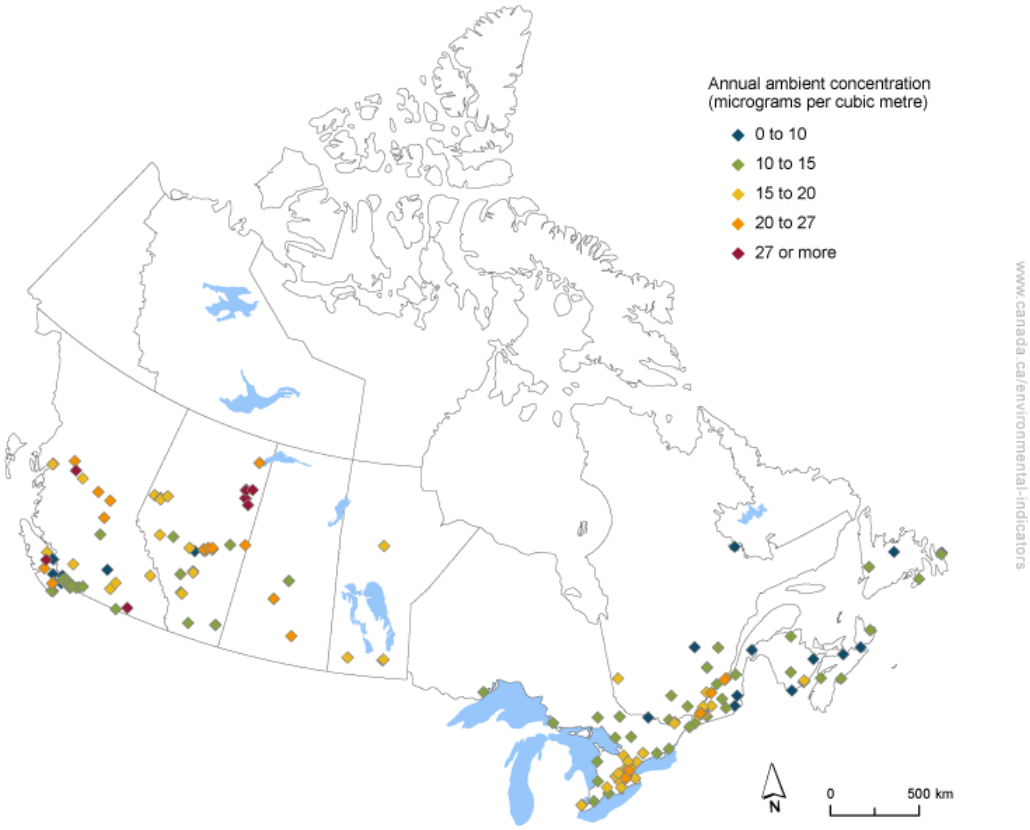
Fine particulate matter concentrations in Canadian urban areas differ from one location to another and from one year to the next. These differences are partly due to emissions of pollutants, variations in weather conditions that influence $PM_{2.5}$ formation, dispersion and regional transport, and variations in transboundary flows of pollution mainly from the United States. Exceptional events, such as forest fires, can also have a significant influence on the peak $PM_{2.5}$ concentrations in urban areas. Forest fires in the Fort McMurray area in 2016 likely contributed to the higher levels in the Prairies (Regina and Saskatoon).

Peak fine particulate matter concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the peak $PM_{2.5}$ concentrations at specific monitoring stations.

Figure 9. Peak fine particulate matter concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

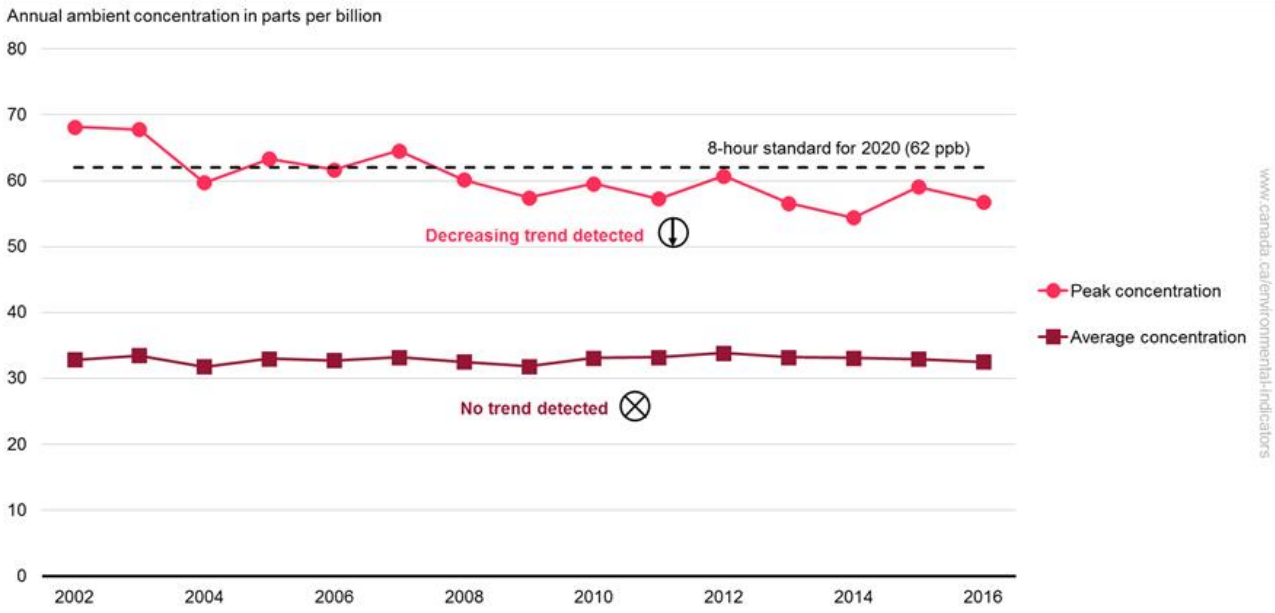
Ground-level ozone

Ozone (O_3) in the upper atmosphere (10 to 50 kilometres above the earth's surface) protects the earth from the sun's harmful ultraviolet radiation. In the lower atmosphere and at ground level, O_3 is harmful to human health, contributes to smog and can damage vegetation and materials such as rubber or surface coatings.

Key results

- Although the peak O_3 concentration was frequently above the 2020 standard[7] before 2008, it has been consistently below it since then
- Between 2002 and 2016, a decreasing trend was detected in the peak O_3 concentration but the average O_3 concentrations remained stable

Figure 10. Ozone concentrations, Canada, 2002 to 2016



Data for Figure 10

Note: The national average concentration indicator is based on the annual average O_3 concentrations of the daily maximum 8-hour averages recorded at 153 monitoring stations across Canada. The national peak indicator is based on the annual 4th-highest daily maximum 8-hour average concentrations for O_3 recorded at 155 monitoring stations across Canada. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing of the achievement status of the standard. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Peak O_3 concentration in 2016 was 56.8 parts per billion (ppb), which is 4% lower than in 2015. Since 2002, a decreasing trend of 0.8 ppb per year has been detected in the peak O_3 concentration. The

[7] For ozone, there is one Canadian Ambient Air Quality Standard, which is based on an 8-hour averaging period. The metric of the standard is defined as the 3-year average of the annual 4th-highest daily maximum 8-hour average concentrations. The peak O_3 indicator is aligned with the O_3 standard; however, the standard is based on a 3-year average while the peak O_3 indicator is calculated for a single calendar year. Comparisons of national concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

reduction in Canadian and U.S. emissions of ground-level O_3 precursor gases (nitrogen oxides [NO_X] and volatile organic compounds [VOCs]) is an important factor in this downward trend.

In 2016, the average O_3 concentration was 32.5 ppb. No trend was detected in the average O_3 concentration between 2002 and 2016.

Ozone is not directly emitted, but is formed in the lower atmosphere when precursor gases such as NO_X and VOCs react in sunlight. Ground-level O_3 is one of two major components of summertime smog, the other being fine particulate matter.

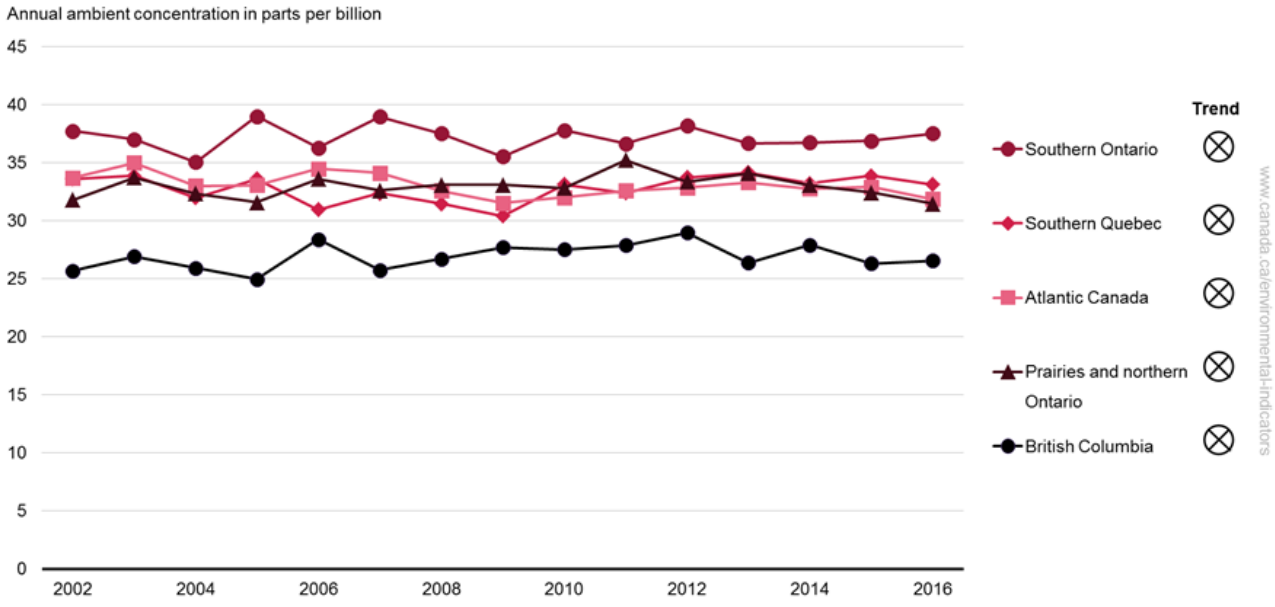
Average concentrations of ozone

Regional ambient levels

Key results

- In 2016, the annual average concentrations of O_3 in the air varied by region, from 26.8 ppb in British Columbia to 36.8 ppb in southern Ontario
- From 2002 to 2016, no trends were detected

Figure 11. Regional average ozone concentrations, Canada, 2002 to 2016



Data for Figure 11

Note: The regional average O_3 concentration indicator is based on concentrations recorded at 17 monitoring stations in Atlantic Canada, 40 in southern Quebec, 38 in southern Ontario, 29 in the Prairies and northern Ontario region, and 28 in British Columbia. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Annual average concentrations were higher in 2016 than in 2015 in southern Ontario and British Columbia. Between 2015 and 2016, the annual average concentration of O_3 increased by 2% in southern Ontario and by 1% in British Columbia.

In 2016, concentrations were 3% lower than the previous year in Atlantic Canada and in the Prairies and northern Ontario region, and 2% lower in southern Quebec.

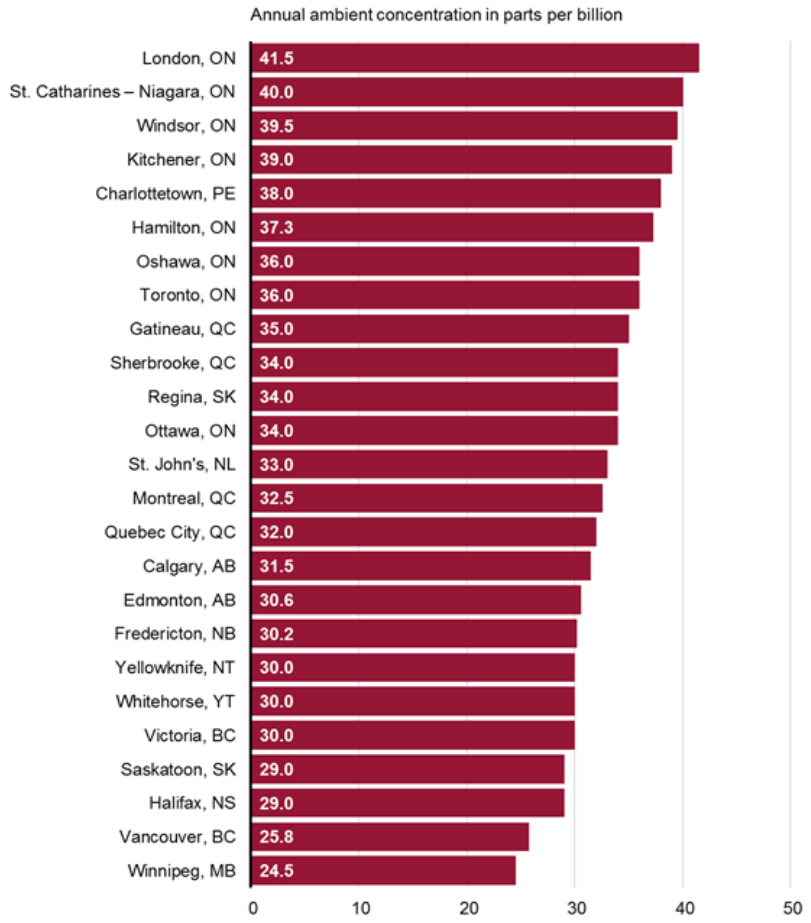
Urban areas

Key results

In 2016, among the selected urban areas

- urban areas in Ontario had the highest O_3 concentrations and Winnipeg had the lowest concentrations

Figure 12. Average ozone concentrations, selected Canadian urban areas, 2016



Data for Figure 12

Note: Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included. The Charlottetown concentration is for the year 2015. Concentrations for the years 2002 to 2016 are reported in the data table for this chart.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

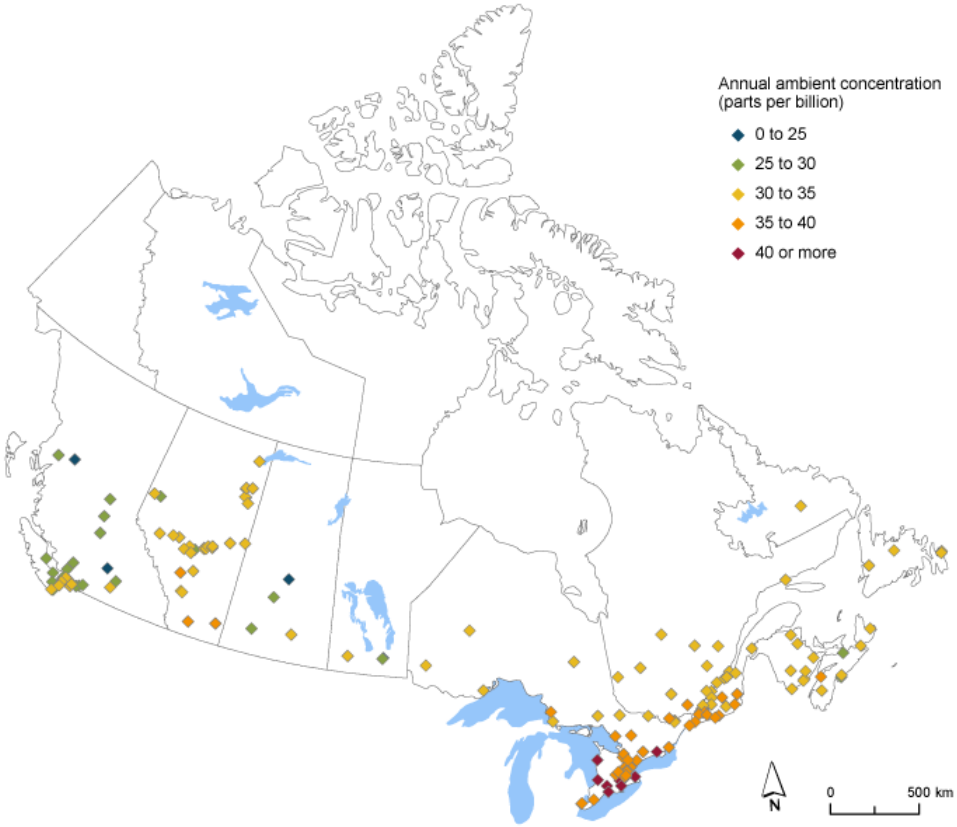
Ozone is a pollutant that mostly forms in the air (secondary pollutant) as only negligible amounts are emitted directly. Ozone concentrations in selected Canadian urban areas vary from one location to another and from one year to the next. These differences are partly due to variations in local emissions of O_3 precursors (mostly NO_X and VOCs), variations in weather conditions that influence O_3 formation, and variations in transboundary flows of pollution mainly from the United States.

Average ozone concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the average O_3 concentrations at specific monitoring stations.

Figure 13. Average ozone concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

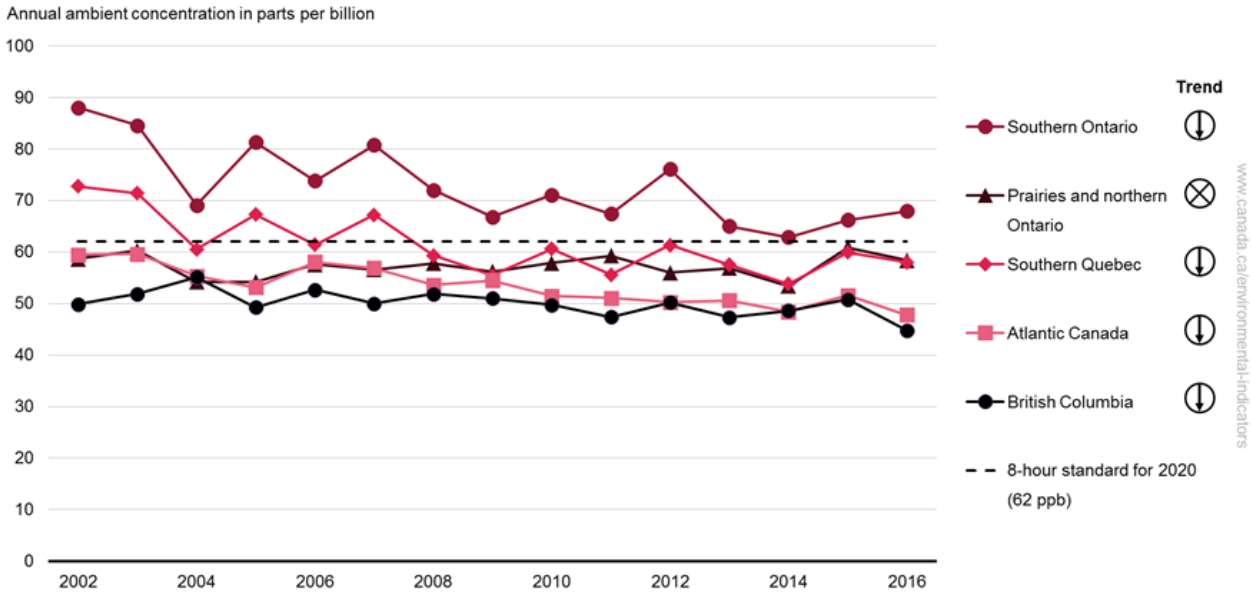
Peak concentrations of ozone

Regional ambient levels

Key results

- Peak O_3 concentrations were below the 2020 standard[8] in all regions except southern Ontario and the earliest years in southern Quebec
- From 2002 to 2016, decreasing trends were detected in all regions, except the Prairies and northern Ontario region

Figure 14. Regional peak ozone concentrations, Canada, 2002 to 2016



Data for Figure 14

Note: The regional peak O_3 indicator is based on concentrations recorded at 18 monitoring stations in Atlantic Canada, 40 in southern Quebec, 38 in southern Ontario, 29 in the Prairies and northern Ontario region, and 29 in British Columbia. The horizontal dashed line represents the 8-hour standard of the 2020 Canadian Ambient Air Quality Standards. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standard. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

In 2016, the highest annual peak concentration of O_3 was recorded in southern Ontario, at 67.9 ppb, which is 3% higher than in 2015. British Columbia recorded the lowest concentration level, at 44.8 ppb, which is 12% lower than in 2015. Annual peak concentrations of O_3 were 3% to 7% lower in the other regions compared to 2015.

Over the 2002 to 2016 period, peak O_3 concentrations were below the 2020 standard in the Prairies and northern Ontario region, British Columbia and Atlantic Canada. Peak O_3 concentrations in

[8] Comparisons of regional concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

southern Quebec were higher than the standard for most of the years before 2008. Peak concentrations in southern Ontario remained above the standard for all years.

From 2002 to 2016, decreasing trends of 0.8 ppb, 1.0 ppb, 1.4 ppb and 0.4 ppb per year were detected in Atlantic Canada, southern Quebec, southern Ontario and British Columbia, respectively. No trend was detected in the Prairies and northern Ontario region.

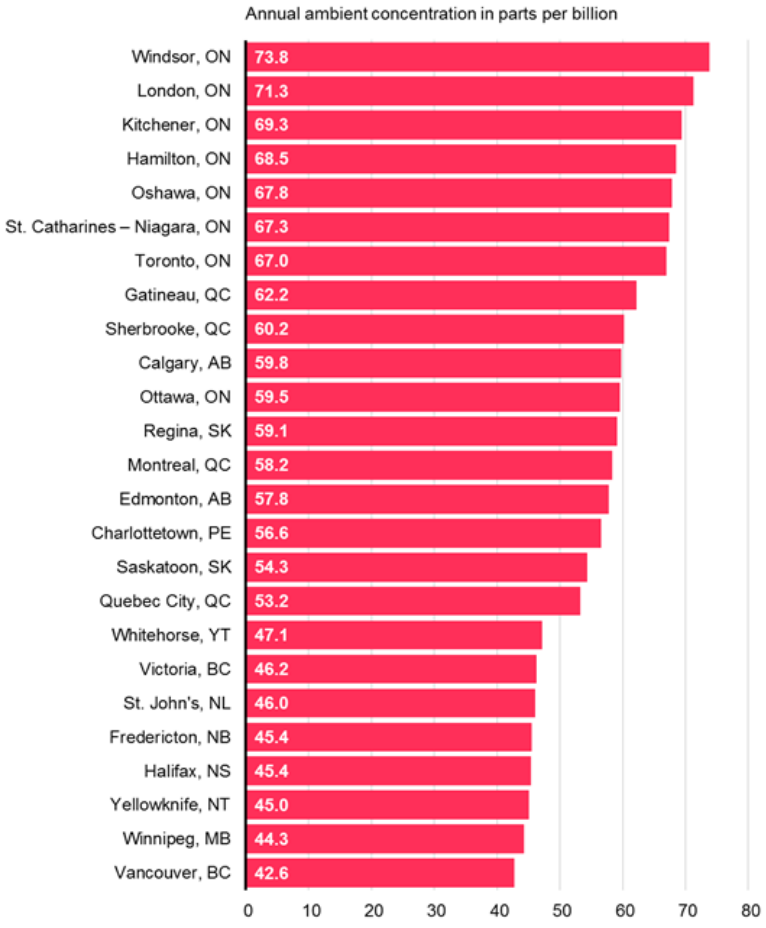
Urban areas

Key results

In 2016, among the selected urban areas

- Most of the highest concentrations of peak O_3 in Canada were reported in Ontario and the lowest concentration was recorded in Vancouver

Figure 15. Peak ozone concentrations, selected Canadian urban areas, 2016



Data for Figure 15

Note: Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included. The Charlottetown concentration is for the year 2015. Concentrations for the years 2002 to 2016 are reported in the data table for this chart.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

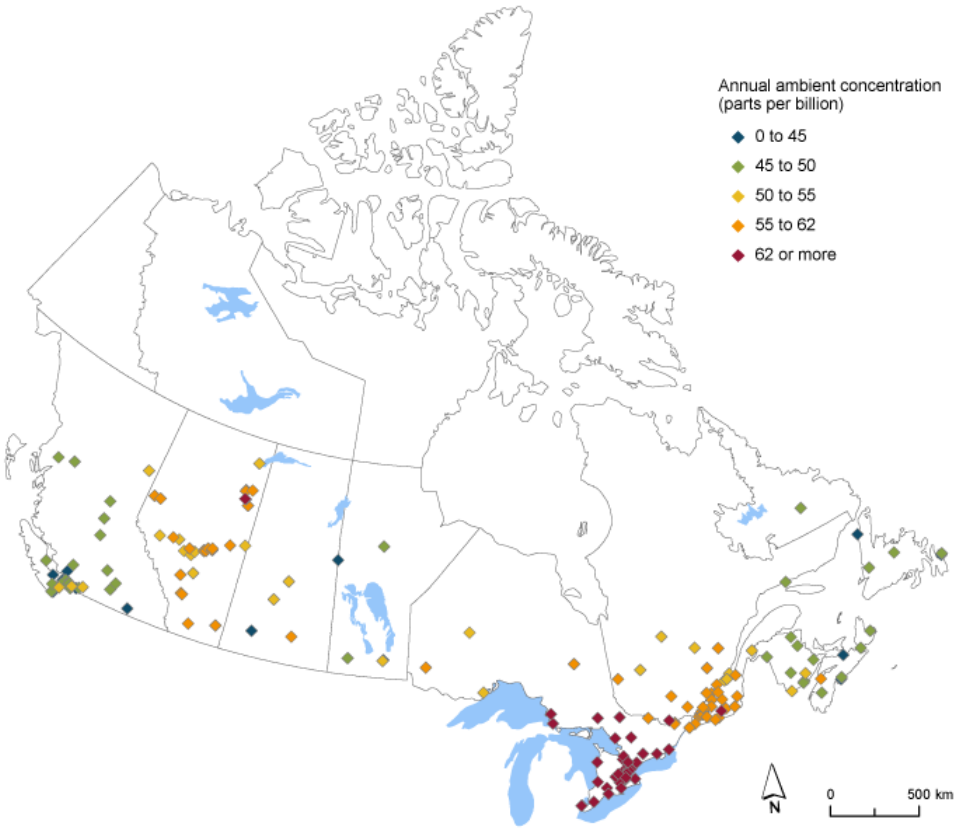
Ozone is a secondary pollutant that mostly forms in the air through the chemical interactions of precursors. Only negligible amounts of O_3 are emitted directly. Ozone concentrations in selected Canadian urban areas vary from one location to another and from one year to the next. These differences are partly due to variations in local emissions of O_3 precursors (mostly NO_X and VOCs), variations in weather conditions that influence O_3 formation, and variations in transboundary flows of pollution mainly from the United States.

Peak ozone concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the peak O_3 concentrations at specific monitoring stations.

Figure 16. Peak ozone concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Nitrogen dioxide

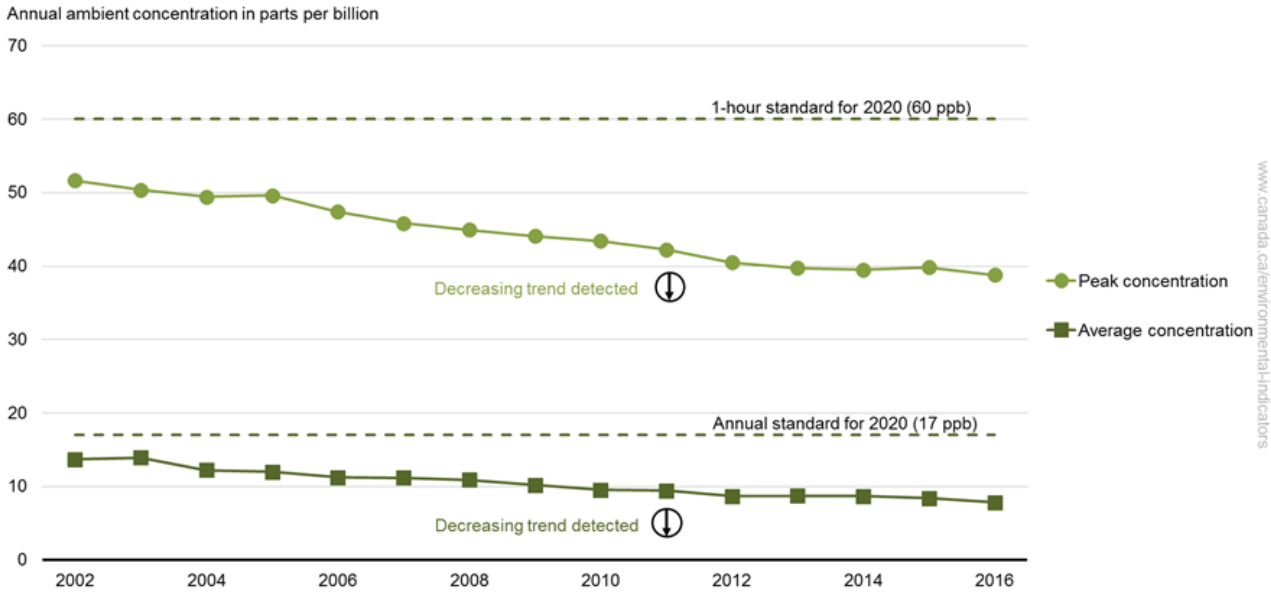
Nitrogen dioxide (NO_2) plays an important role in the formation of ozone in the atmosphere. It is also a precursor to fine particulate matter, and contributes to acid deposition and eutrophication. Nitrogen dioxide has adverse health effects: it can irritate the lungs, decrease lung function and increase susceptibility to allergens for people with asthma.

Key results

Between 2002 and 2016

- the average and peak concentrations of NO_2[9,10] were consistently below the standards
- a decreasing trend in both the average and peak concentrations of NO_2 was detected.

Figure 17. Nitrogen dioxide concentrations, Canada, 2002 to 2016



Data for Figure 17

Note: The national average NO_2 concentration indicator is based on the annual average concentrations of the hourly averages recorded at 101 monitoring stations across Canada while the national peak indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations for NO_2 recorded at 89 monitoring stations across Canada. The horizontal dashed lines represent the 2020 Canadian Ambient Air Quality Standards. The Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

[9] Nitrogen dioxide is not directly measured by the monitors. The NO_2 indicator is estimated by subtracting the measured nitrogen monoxide (NO) concentration from the measured nitrogen oxides (NO_X) concentration.

[10] For NO_2, there are 2 Canadian Ambient Air Quality Standards. The metric of the 1-hour standard is defined as the 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations, while the metric of the annual standard is based on the annual average of the hourly concentrations. The indicators are aligned with the NO_2 standards, except that the 1-hour standard is based on a 3-year average while the NO_2 indicators are calculated for a single calendar year. Comparisons of national concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

In 2016, the national average concentration of NO_2 was 7.8 parts per billion (ppb), which is 7% lower than in 2015. The annual peak NO_2 concentration in 2016 was 38.8 ppb, which is 3% lower than in 2015.

Since 2002, a decreasing trend of 0.4 ppb per year has been detected in the average NO_2 concentration. A trend was also detected in the peak NO_2 concentrations: a decrease of 1.0 ppb per year. These trends are mainly attributable to the federal government introducing progressively more stringent emissions standards for cars and trucks.

Nitrogen dioxide (NO_2) belongs to a group of substances called nitrogen oxides (NO_X).[11] Nitrogen oxides are emitted into the atmosphere from high-temperature combustion processes such as vehicle engines, power plants and industrial processes. The main sources of nitrogen oxides in Canada are on-road and off-road vehicles, the oil and gas industry, and the use of fuel for electricity generation and heating.

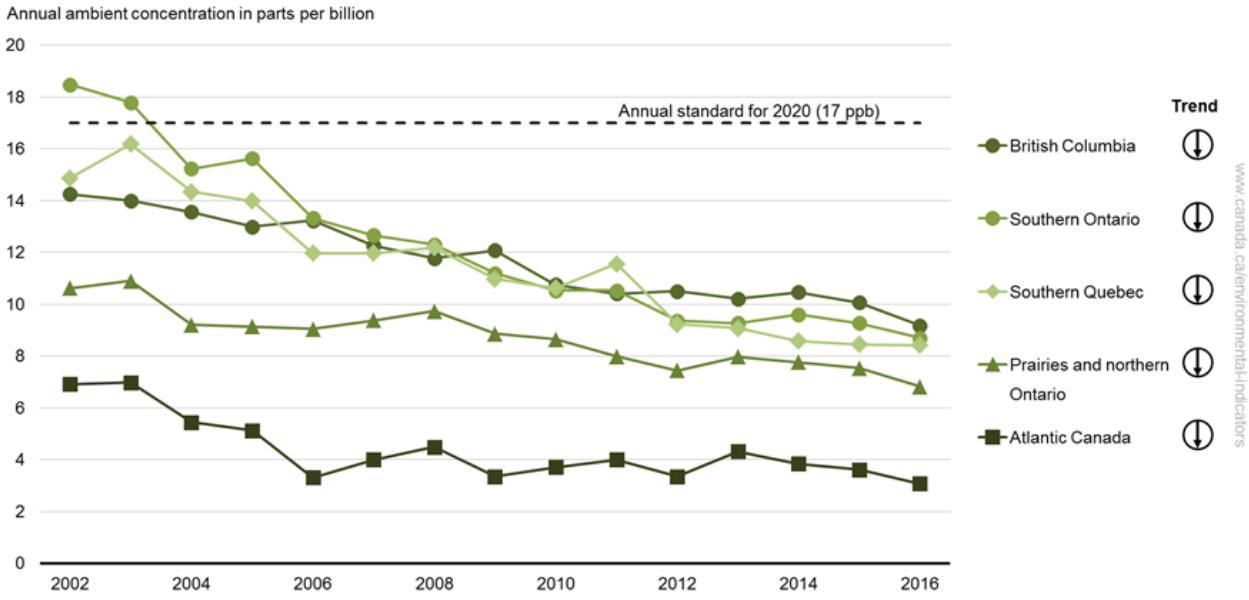
Average concentrations of nitrogen dioxide

Regional ambient levels

Key results

- All regions across Canada had NO_2 concentrations that were consistently below the 2020 standard,[12] except southern Ontario in 2002 and 2003
- Between 2002 and 2016, a decreasing trend in the average concentration of NO_2 was detected in all regions

Figure 18. Regional average nitrogen dioxide concentrations, Canada, 2002 to 2016



Data for Figure 18

[11] Although the majority of the emitted NO_X is nitrogen monoxide (NO), once in the atmosphere NO reacts with volatile organic compounds and ozone to form NO_2.

[12] Comparisons of regional concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

Note: The regional average NO_2 indicator is based on the concentrations recorded at 7 monitoring stations in Atlantic Canada, 15 in southern Quebec, 25 in southern Ontario, 27 in the Prairies and northern Ontario region, and 26 in British Columbia. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

In 2016, the annual average concentrations of NO_2 varied by region, from 3.1 ppb in Atlantic Canada to 9.2 ppb in British Columbia. In Atlantic Canada and British Columbia, the annual average concentrations of NO_2 in 2016 were 15% and 9% lower than in 2015. The concentrations in the Prairies and northern Ontario region, southern Ontario and southern Quebec were, respectively, 10%, 6% and 0.2% lower in 2016 than in 2015.

Between 2002 and 2016, southern Ontario, southern Quebec and British Columbia experienced the most rapid decreases in average NO_2 concentrations. Decreasing trends of 0.7 ppb, 0.5 ppb and 0.4 ppb per year were detected for southern Ontario, southern Quebec and British Columbia, respectively. A decreasing trend of 0.2 ppb per year was also observed for Atlantic Canada and the Prairies and northern Ontario region.

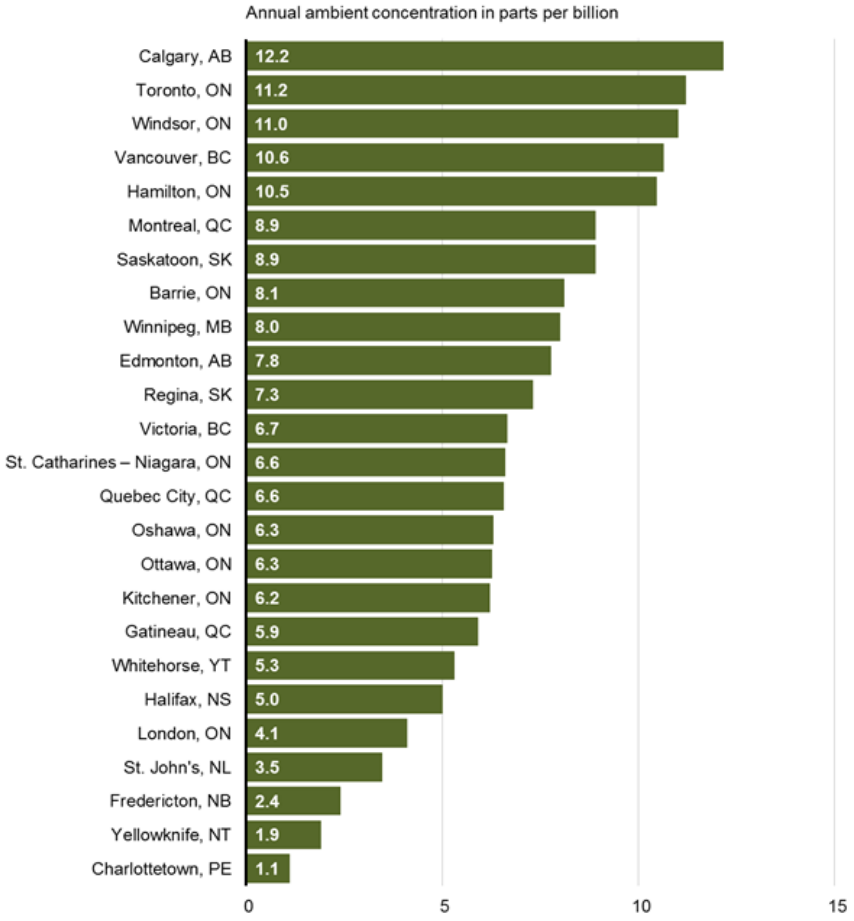
Urban areas

Key results

In 2016, among the selected urban areas

- concentrations of NO_2 were the highest in Calgary, Toronto, Windsor, Vancouver and Hamilton, while Charlottetown, Yellowknife and Fredericton had the lowest concentrations

Figure 19. Average nitrogen dioxide concentrations, selected Canadian urban areas, 2016



Data for Figure 18

Note: Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included. The Charlottetown and Whitehorse concentrations are for the year 2015. Concentrations for the years 2002 to 2016 are reported in the data table for this chart.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

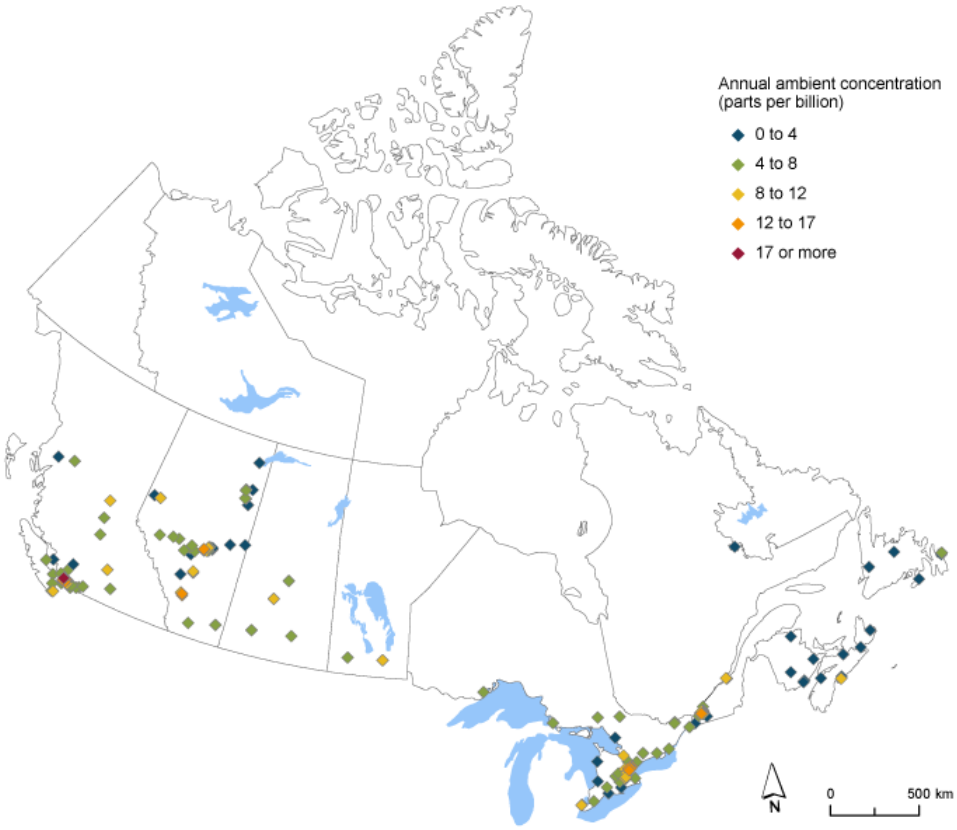
Nitrogen dioxide concentrations in selected Canadian urban areas vary from one location to another. Urban areas in proximity to important sources of NO_2 such as large road networks and highways may explain the differences between cities.

Average nitrogen dioxide concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the NO_2 concentrations at specific monitoring stations.

Figure 20. Average nitrogen dioxide concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

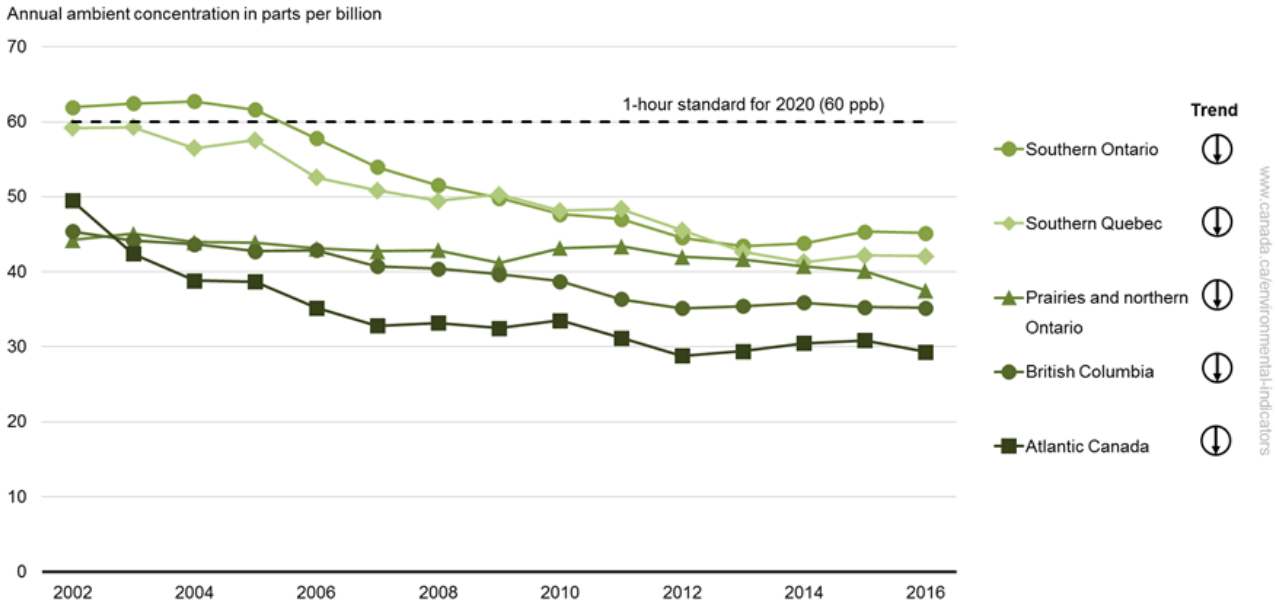
Peak concentrations of nitrogen dioxide

Regional ambient levels

Key results

- All regions across Canada had peak concentrations of NO_2 that were consistently below the 2020 standard,[13] except southern Ontario in the first 4 years
- Between 2002 and 2016, a decreasing trend in the peak concentration of NO_2 was detected in all regions

Figure 21. Regional peak nitrogen dioxide concentrations, Canada, 2002 to 2016



Data for Figure 21

Note: The regional peak NO_2 indicator is based on the concentrations recorded at 6 monitoring stations in Atlantic Canada, 15 in southern Quebec, 22 in southern Ontario, 21 in the Prairies and northern Ontario region, and 25 in British Columbia. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

In 2016, the annual peak concentrations of NO_2 varied by region, from 29.3 ppb in Atlantic Canada to 45.1 ppb in southern Ontario. In the Prairies and northern Ontario region and Atlantic Canada, respectively, the annual peak concentrations of NO_2 were 6.4% and 5% lower in 2016 than in 2015. Peak concentrations were less than 1% lower in 2016 than in 2015 in British Columbia, southern Ontario and southern Quebec.

[13] Comparisons of regional concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

Between 2002 and 2016, southern Ontario, southern Quebec and Atlantic Canada experienced the most rapid decreases in peak NO_2 concentrations. Decreasing trends of 1.7 ppb, 1.4 ppb and 0.9 ppb per year were detected for southern Ontario, southern Quebec and Atlantic Canada, respectively. Decreasing trends of 0.8 ppb and 0.3 ppb per year were observed for British Columbia and for the Prairies and northern Ontario region, respectively.

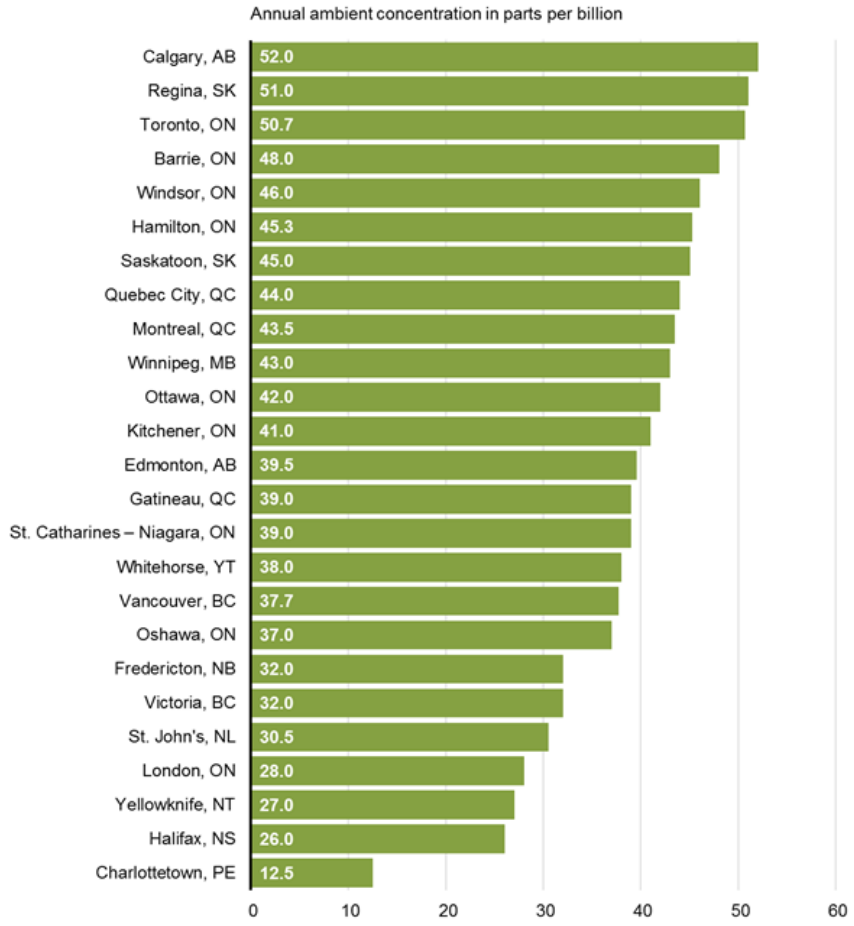
Urban areas

Key results

In 2016, among the selected urban areas

- the highest peak concentrations of NO_2 were recorded in Calgary, Regina and Toronto, and the lowest concentrations were recorded in Charlottetown, Halifax, Yellowknife and London

Figure 22. Peak nitrogen dioxide concentrations, selected Canadian urban areas, 2016



Data for Figure 22

Note: Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included. The Charlottetown and Whitehorse concentrations are for the year 2015. Concentrations for the years 2002 to 2016 are reported in the data table for this chart.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

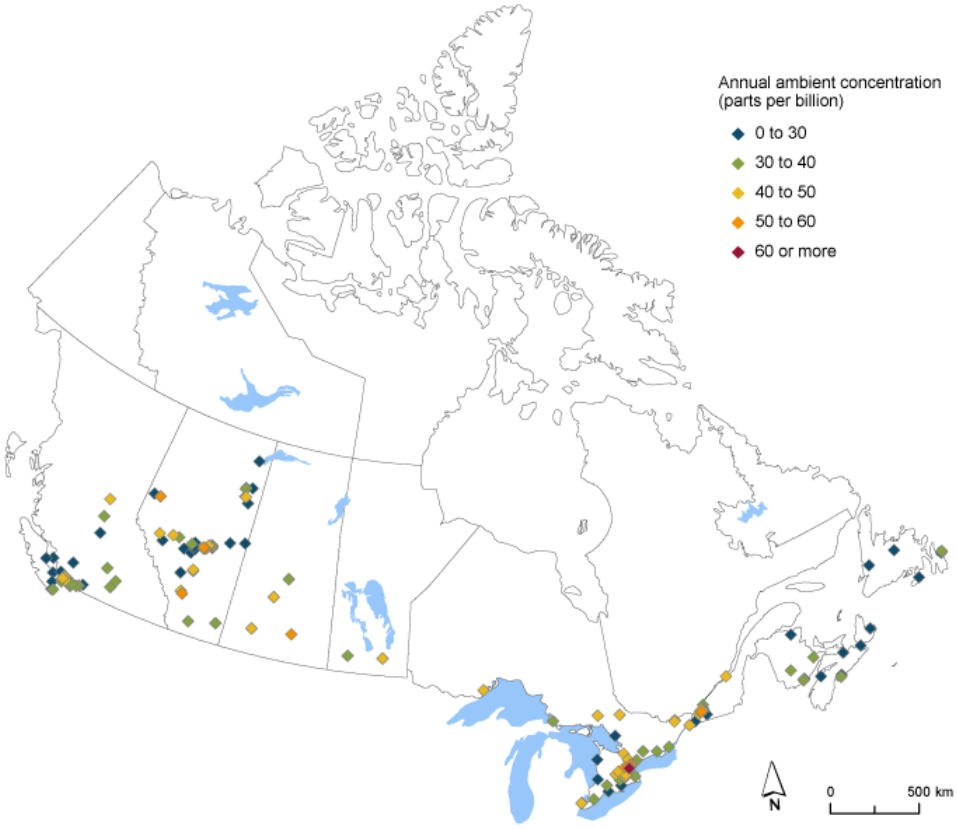
Nitrogen dioxide concentrations in selected Canadian urban areas vary from one location to another. Urban areas in proximity to important sources of NO_2 such as large roads network and highways may explain the differences between cities.

Peak nitrogen dioxide concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the peak NO_2 concentrations at specific monitoring stations.

Figure 23. Peak nitrogen dioxide concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Sulphur dioxide

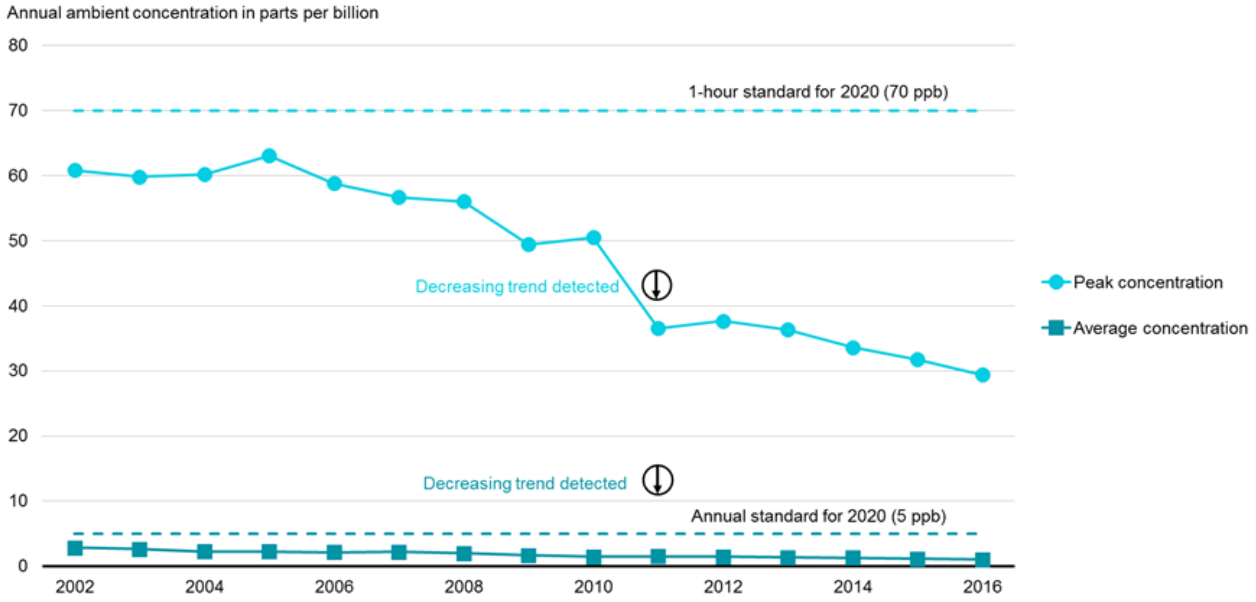
Sulphur dioxide (SO_2) is emitted when a fuel or raw material containing sulphur is burned or used in industrial processes such as metal ore smelting. Sulphur dioxide emissions contribute to acid deposition and are a major precursor to fine particulate matter. High concentrations of SO_2 can adversely affect the respiratory systems of humans and animals and can damage vegetation and materials.

Key results

Between 2002 and 2016

- the average and peak concentrations of SO_2 were consistently below the standards[14]
- a decreasing trend in both the average and peak concentrations of SO_2 was detected

Figure 24. Sulphur dioxide concentrations, Canada, 2002 to 2016



Data for Figure 24

Note: The national average SO_2 concentration indicator is based on the annual average concentrations of the hourly averages recorded at 65 monitoring stations across Canada while the national peak indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations for SO_2 recorded at 68 monitoring stations across Canada. The horizontal dashed lines represent the 2020 Canadian Ambient Air Quality Standards. The Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

[14] For SO_2, there are 2 Canadian Ambient Air Quality Standards. The metric of the 1-hour standard is defined as the 3-year average of the annual 99th percentile of the daily maximum 1-hour average concentrations, while the metric of the annual standards is based on the annual average of the hourly concentrations. The indicators are aligned with the SO_2 standards, except that the 1-hour standard is based on a 3-year average, while the SO_2 indicators are calculated for a single calendar year. Comparisons of national concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

In 2016, the national average concentration of SO_2 was 1.0 part per billion (ppb), which is 9% lower than in 2015. The annual peak SO_2 concentration in 2016 was 29.4 ppb, which is 7% lower than in 2015.

Since 2002, a decreasing trend of 0.1 ppb per year has been detected in the average SO_2 concentration. A trend was also detected for the peak SO_2 concentrations, specifically a decrease of 2.5 ppb per year. These trends are mainly attributable to reductions in sulphur oxide (SO_X) emissions in Canada and the United States resulting from efforts to curb acid rain and ambient particulate matter. Efforts also included the implementation of federal regulations related to sulphur content in fuels.

The main sources of sulphur oxide emissions in Canada are the combustion of fuel for electricity generation and heating, processes in the non-ferrous mining and smelting industry, and the oil and gas industry.

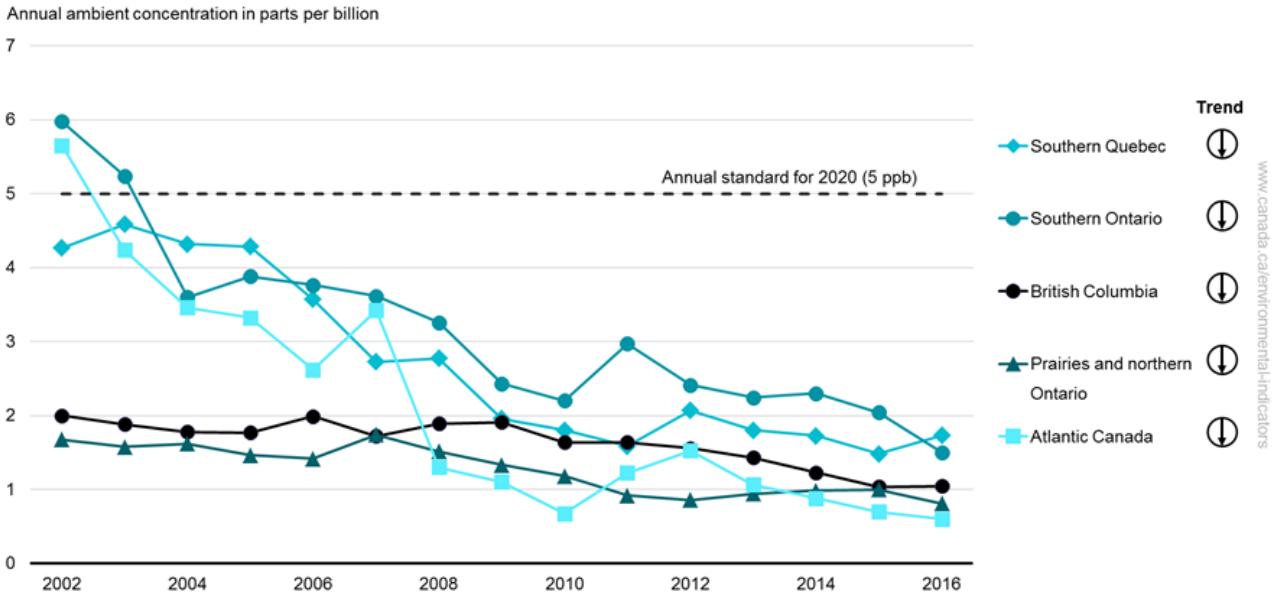
Average concentrations of sulphur dioxide

Regional ambient levels

Key results

- Since 2004, SO_2 concentrations in all regions across Canada have consistently been below the 2020 standard[15]
- Between 2002 and 2016, a decreasing trend in the average concentration of SO_2 was detected in all regions

Figure 25. Regional average sulphur dioxide concentrations, Canada, 2002 to 2016



Data for Figure 25

Note: The regional average SO_2 indicator is based on the concentrations recorded at 5 monitoring stations in Atlantic Canada, 7 in southern Quebec, 7 in southern Ontario, 24 in the Prairies and northern Ontario region, and 21 in British Columbia. The

[15] Comparisons of regional concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

In 2016, the annual average concentrations of SO_2 varied by region, from 0.6 ppb in Atlantic Canada to 1.7 ppb in southern Quebec. In southern Ontario and in Atlantic Canada, respectively, the annual average concentration of SO_2 in 2016 was 27% and 14% lower than in 2015. Southern Quebec and British Columbia recorded concentrations that were 17% and 1% higher, respectively, than in 2015. The Prairies and northern Ontario region reported levels 19% lower than in 2015.

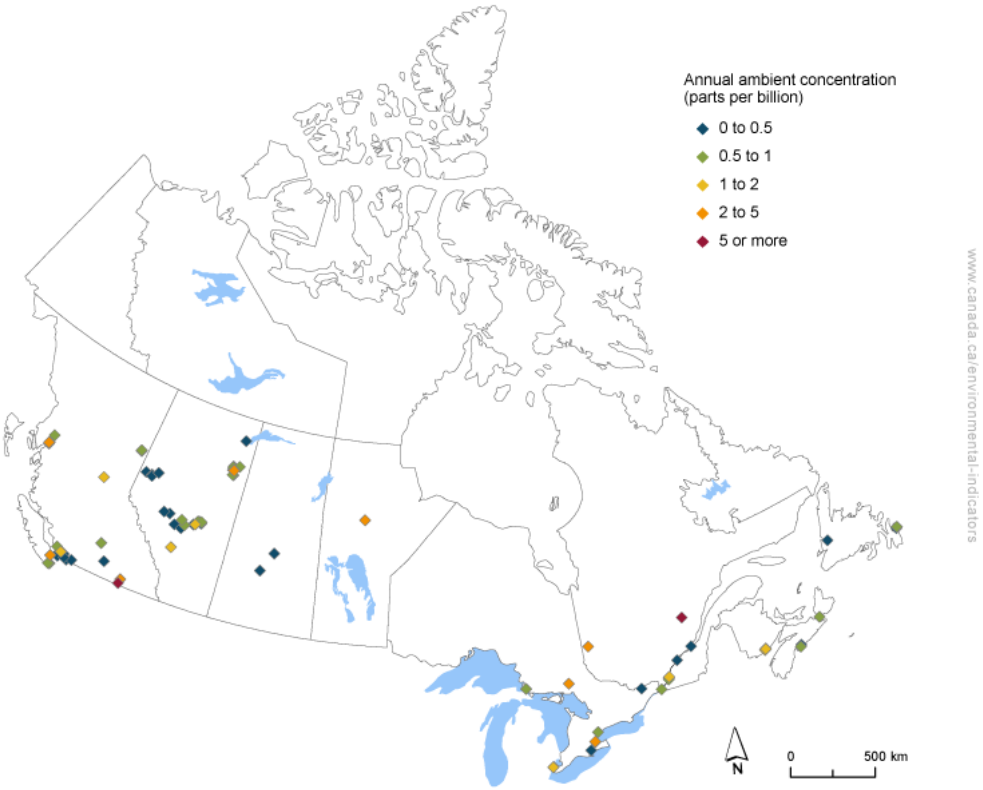
Between 2002 and 2016, Atlantic Canada, southern Quebec and southern Ontario experienced the most rapid decreases in average SO_2 concentrations. Decreasing trends of 0.3 ppb, 0.2 ppb and 0.2 ppb per year were detected for Atlantic Canada, southern Quebec and southern Ontario, respectively. A decreasing trend of 0.1 ppb per year was observed for the Prairies and northern Ontario region and for British Columbia.

Average sulphur dioxide concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the SO_2 concentrations at specific monitoring stations.

Figure 26. Average sulphur dioxide concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

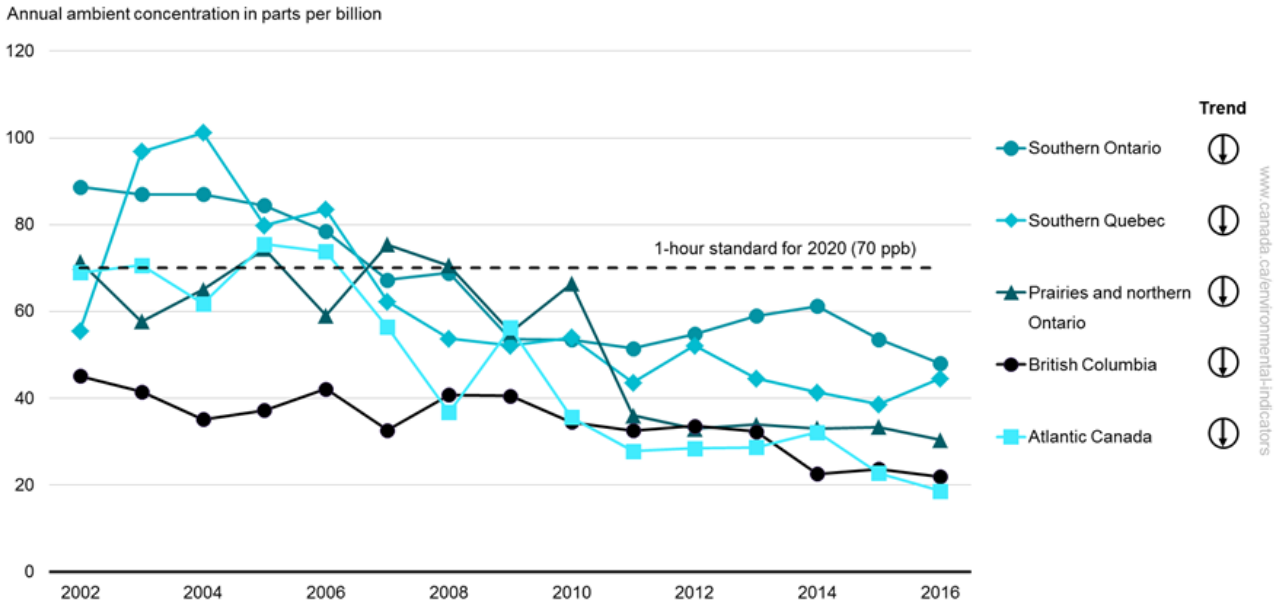
Peak concentrations of sulphur dioxide

Regional ambient levels

Key results

- Since 2009, the peak SO_2 concentrations were below the 2020 standard[16] in all regions
- From 2002 to 2016, decreasing trends were detected in all regions

Figure 27. Regional peak sulphur dioxide concentrations, Canada, 2002 to 2016



Data for Figure 27

Note: The peak SO_2 indicator is based on the concentrations recorded at 6 monitoring stations in Atlantic Canada, 7 in southern Quebec, 6 in southern Ontario, 18 in the Prairies and northern Ontario region, and 22 in British Columbia. The horizontal dashed line represents the 1-hour standard of the 2020 Canadian Ambient Air Quality Standards. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

In 2016, the highest peak concentration of SO_2 was recorded in southern Ontario, at 48.0 ppb, while the lowest concentration was recorded in the Prairies and northern Ontario region, at 30.4 ppb.

Compared to the previous year, the peak concentration of SO_2 in 2016 was 10% lower in southern Ontario, 9% lower in the Prairies and northern Ontario region, 18% lower in Atlantic Canada, and 7% lower in British Columbia. Southern Quebec's peak concentration was 15% higher than in 2015.

From 2002 to 2016, decreasing trends of 1.4 ppb, 2.9 ppb, 3.0 ppb, 3.2 ppb and 4.0 ppb per year were detected for British Columbia, southern Ontario, the Prairies and northern Ontario region, southern Quebec, and Atlantic Canada, respectively.

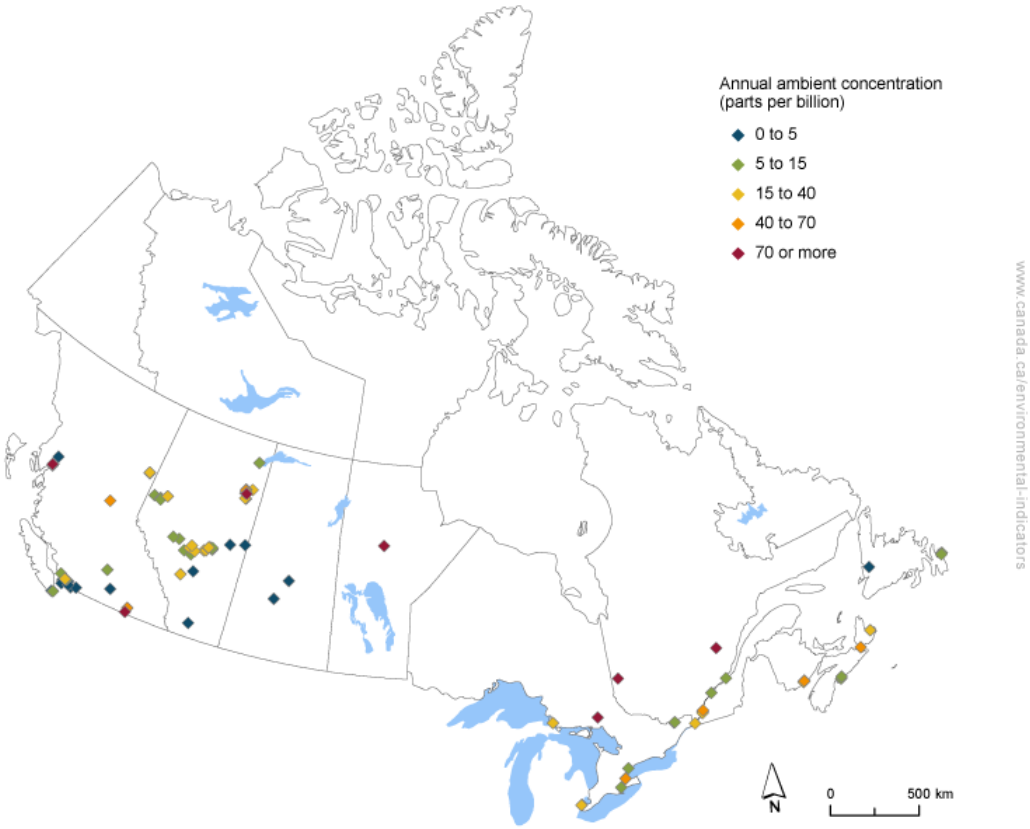
[16] Comparisons of regional concentrations to the Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.

Peak sulphur dioxide concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the peak SO_2 concentrations at specific monitoring stations.

Figure 28. Peak sulphur dioxide concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

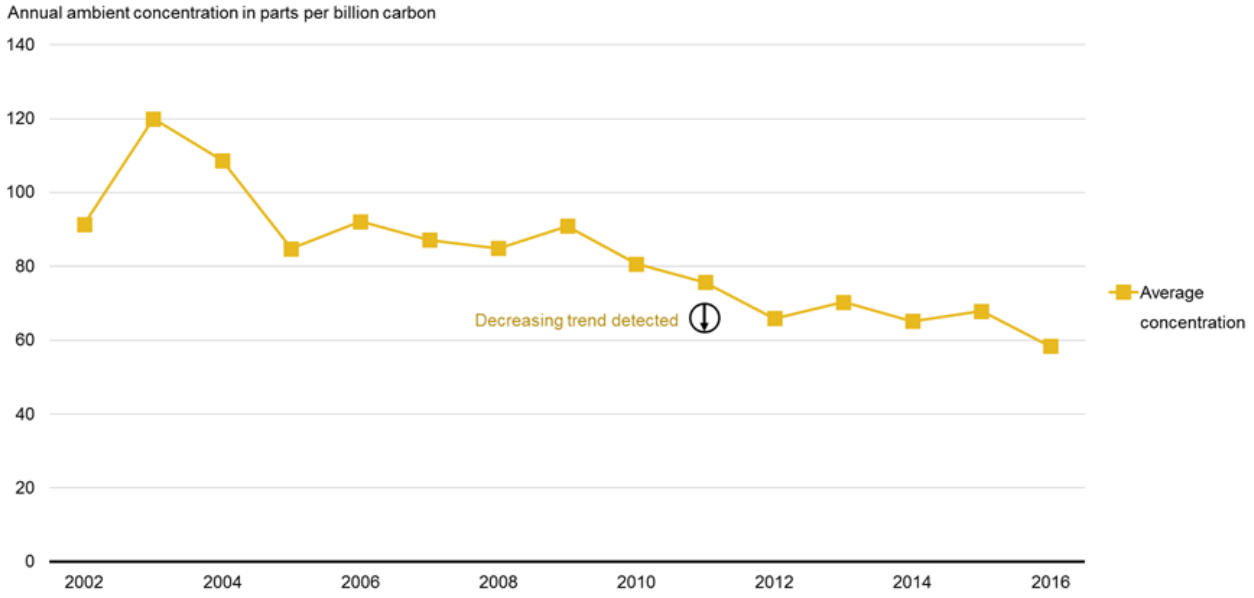
Volatile organic compounds

Volatile organic compounds (VOCs) are carbon-containing gases and vapours that are found in many common products such as gasoline and solvents.[17] Volatile organic compounds are emitted from the oil and gas industry, solvent usage and transportation. Some VOCs can cause cancer and serious health problems. VOCs contribute to the formation of fine particulate matter ($PM_{2.5}$) and ozone (O_3), which are the main components of smog.

Key results

- In 2016, the average concentration of VOCs was 58 parts per billion carbon (ppbC), which is 36% lower than in 2002
- Between 2002 and 2016, a decreasing trend was observed in the average concentration of VOCs

Figure 29. Volatile organic compounds concentrations, Canada, 2002 to 2016



Data for Figure 29

Note: The national average VOC concentration indicator is based on the annual average of the daily concentrations recorded at 38 monitoring stations across Canada. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

The national average concentration of VOCs in the air was 14% lower in 2016 than the previous year. Since 2002, a decreasing trend of 3.3 ppbC per year has been detected. This is consistent with the reduction in VOC emissions from cars and trucks, which is attributable to the introduction of more stringent emissions standards and from reduction measures related to the production and use of solvents and paints.

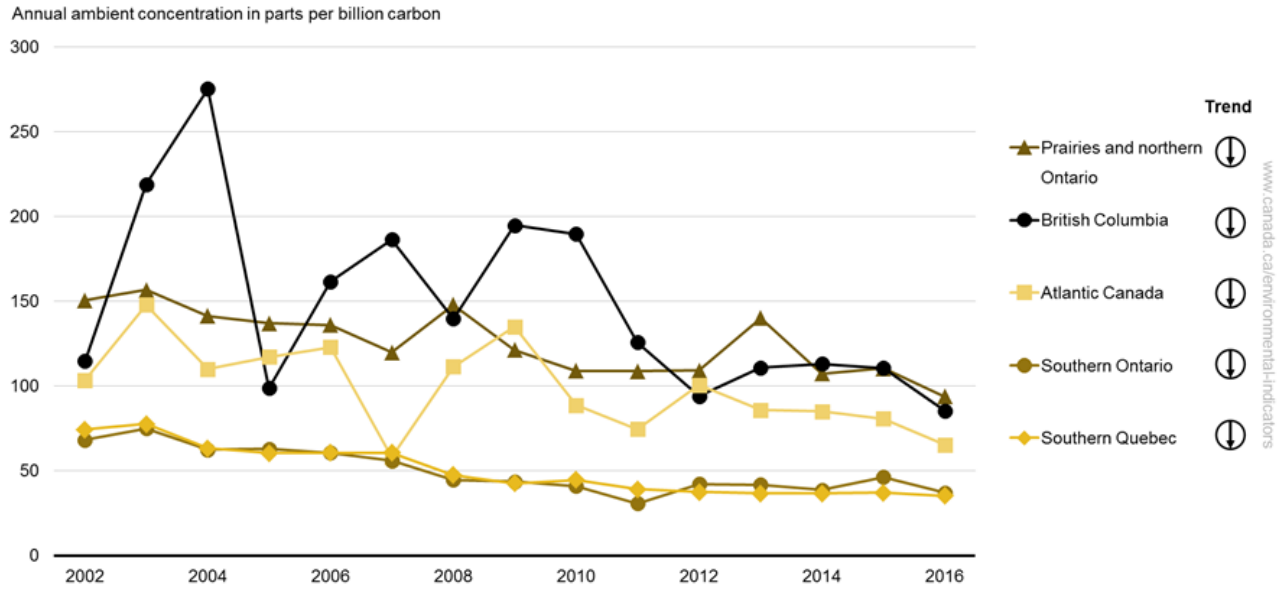
[17] Volatile organic compounds do not include carbon dioxide, carbon monoxide, methane or chlorofluorocarbon compounds.

Regional ambient levels

Key results

- In 2016, annual average concentrations of VOCs in the air varied by region, from 35.2 ppbC in southern Quebec to 93.8 ppbC in the Prairies and northern Ontario region
- From 2002 to 2016, decreasing trends in average VOC concentrations were observed in all regions

Figure 30. Regional average volatile organic compounds concentrations, Canada, 2002 to 2016



Data for Figure 30

Note: The average VOC concentration indicator is based on the concentrations recorded at 5 monitoring stations in Atlantic Canada, 9 in southern Quebec, 13 in southern Ontario, 5 in the Prairies and northern Ontario region, and 6 in British Columbia. An up arrow indicates an increasing trend, a down arrow a decreasing trend, and an "X" no trend. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Concentrations of VOCs were lower in 2016 than in 2015 for all regions. The annual average concentration of VOCs recorded for Atlantic Canada was 19% lower in 2016 than in 2015. The Prairies and northern Ontario region and British Columbia[18] had VOC concentrations that were 15% and 23% lower than in 2015. Southern Quebec and Southern Ontario recorded lower concentrations in 2016 than in 2015, with decreases of 5% and 20%, respectively.

From 2002 to 2016, decreasing trends of 3.7 ppbC, 3.0 ppbC, 2.5 ppbC, 3.9 ppbC and 7.2 ppbC per year were detected for Atlantic Canada, southern Quebec, southern Ontario, the Prairies and northern Ontario region, and British Columbia, respectively.

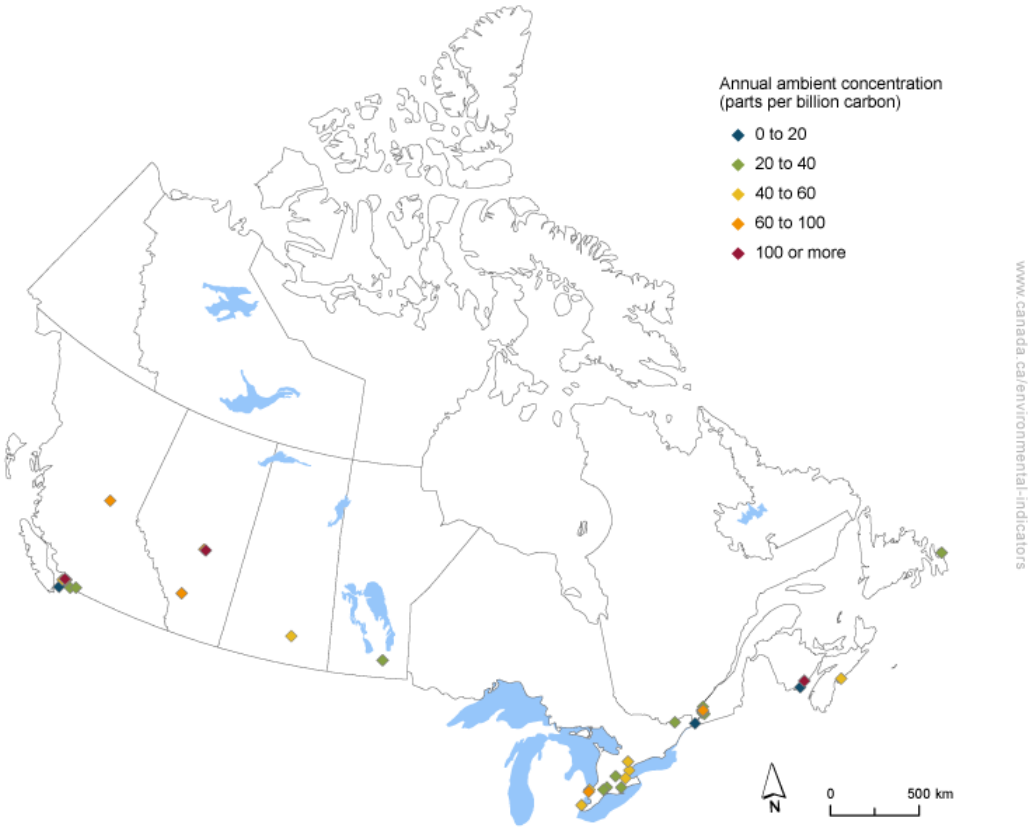
Volatile organic compounds concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

[18] All stations used for the British Columbia region are located in the Metro Vancouver area.

The Canadian Environmental Sustainability Indicators provide this information through an interactive map. With the interactive map, you can drill down to the VOC concentrations at specific monitoring stations.

Figure 31. Average volatile organic compounds concentrations by monitoring station, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

About the indicators

What the indicators measure

The Air quality indicators track ambient concentrations of fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and volatile organic compounds (VOCs) at the national, regional and urban levels and at local monitoring stations. The national and regional indicators are presented with their corresponding Canadian Ambient Air Quality Standard when available.

Why these indicators are important

Canadians are exposed to air pollutants on a daily basis, and this exposure can cause adverse health and environmental effects. Fine particulate matter ($PM_{2.5}$) and ozone (O_3), 2 of the most widespread air pollutants, are key components in the formation of smog. Exposure to these pollutants, even at low concentrations, has been associated with pulmonary and cardiovascular diseases. Furthermore, science indicates that there is no known threshold below which these 2 pollutants will not cause adverse health effects.

While causing adverse health effects of its own, SO_2 also contributes to the formation of $PM_{2.5}$ and acid deposition. Similarly, NO_2 contributes to the formation of O_3 and $PM_{2.5}$, acid deposition and eutrophication. Volatile organic compounds are one of the main contributors to O_3 and also contribute to the formation of $PM_{2.5}$. There are thousands of individual VOC species. Some of the VOCs meet the definition of toxic under the Canadian Environmental Protection Act, 1999. Over a life-time, exposure to these pollutants can increase the risk of developing cancer and other serious health issues.

Consult the Air pollution: drivers and impacts web page for information on the human health, environmental and economic impacts of air pollution.

Related indicators

The International comparison of urban air quality indicators present and compare the air quality in selected Canadian urban areas with a population greater than one million to the air quality in selected international urban areas having comparable data

The Air pollutant emissions indicators track emissions from human-related sources of sulphur oxides (SO_X), nitrogen oxides (NO_X), volatile organic compounds (VOCs), ammonia (NH_3), carbon monoxide (CO) and fine particulate matter ($PM_{2.5}$).

The Air health trends indicator provides an overview of the public health impacts attributable to outdoor air pollution in Canada.

Safe and healthy communities

These indicators support the measurement of progress towards the following 2016–2019 Federal Sustainable Development Strategy long-term goal: All Canadians live in clean, sustainable communities that contribute to their health and well-being.

Data sources and methods

Data sources

The Air quality indicators are calculated from the air concentrations in the Canada-wide Air Quality Database. The database is maintained by Environment and Climate Change Canada's National Air Pollution Surveillance Program. It contains data collected through the following monitoring networks:

- the National Air Pollution Surveillance Network, a collaboration established in 1969 between Environment and Climate Change Canada and provincial, territorial and regional (Metro Vancouver, ville de Montréal) governments
- for ground-level ozone, the Canadian Air and Precipitation Monitoring Network operated by Environment and Climate Change Canada
    - the Canadian Air and Precipitation Monitoring Network stations were established to research and monitor air pollution outside urban areas
- other provincial, territorial and municipal monitoring stations that report their air quality data to the Canada-wide Air Quality Database

More information

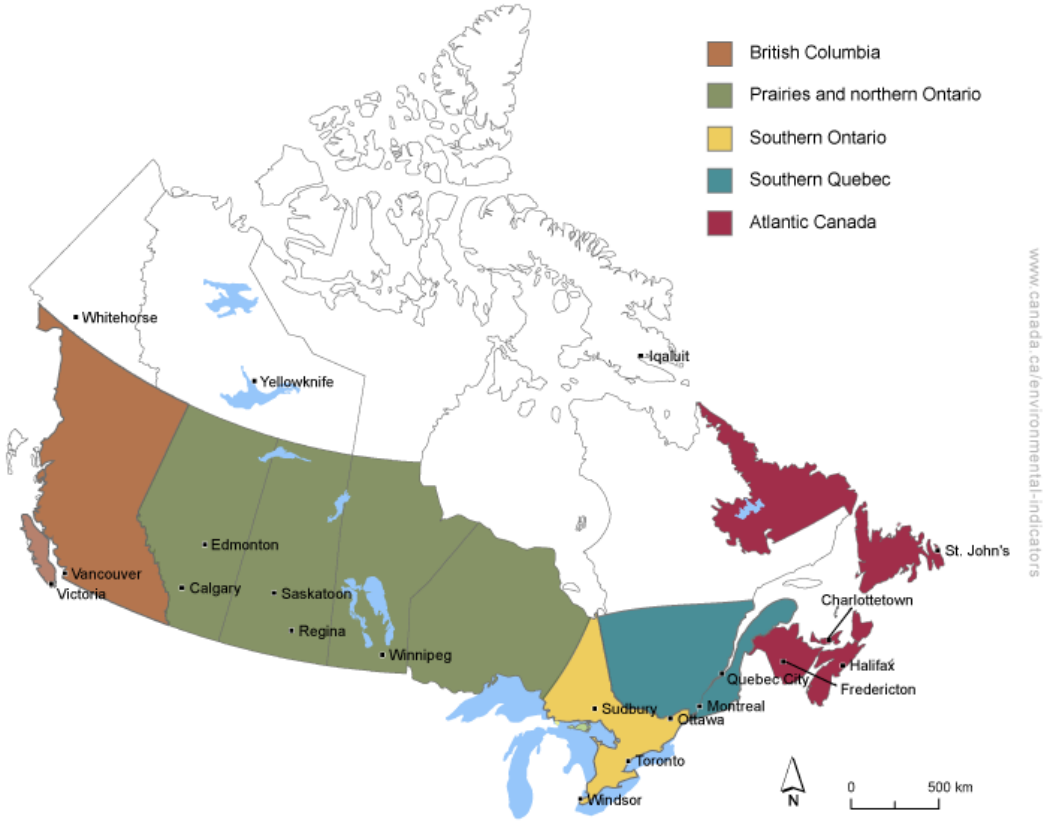
Air quality monitoring stations are spread across the country, but are more concentrated in urban areas. The indicators for fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and volatile organic compounds (VOCs) are provided nationally and by region. The regions used for these indicators are listed and shown in the following table and map. See Annex B for the full list of stations used to calculate the national and regional indicators.

Table 1. Regions used for the regional Air quality indicators

Region	Region code
Atlantic Canada	ATL
Southern Quebec	SQC
Southern Ontario	SON
Prairies and northern Ontario	PNO
British Columbia[A]	BCO

Note: [A] For volatile organic compounds, only stations from the Metro Vancouver area were available to be used for the British Columbia regional indicator.

Figure 32. Regions used for the regional Air quality indicators



The Air quality indicators are also reported for the larger urban areas in Canada and the capitals of the provinces and territories when data are available. An urban area follows the definition of the Statistic Canada's census metropolitan area and census agglomeration. See Annex G for the full list of stations used to calculate the urban area indicators. Ambient levels of $PM_{2.5}$, O_3, SO_2, NO_2 and VOCs by monitoring station are also shown in the Canadian Environmental Sustainability Indicators' interactive indicator maps.

Data quality assurance and quality control for the National Air Pollutant Surveillance program

Monitoring agencies contributing to the National Air Pollution Surveillance program all strive to adhere to established quality assurance and quality control standards, which are developed by Environment and Climate Change Canada in consultation with the provincial, territorial and regional governments participating in the program.

Ensuring data quality involves identifying the appropriate data quality objectives and the methodologies that can be used to meet these objectives. The key data quality objectives for the National Air Pollution Surveillance program are:

- representativeness, referring to the degree to which data measurements represent a pollutant concentration of interest
- comparability, a measure of confidence with which one data set or method can be compared to another at other participating National Air Pollutant Surveillance program sites across Canada
- accuracy, the assessment of the overall agreement of a measurement with a known value

    - accuracy can include assessments of agreement among repeated measurements (precision) and measures of positive or negative systematic errors (bias)
- completeness, the assessment as to whether enough information is being collected to ensure confidence in conclusions or decisions made on the basis of data

Table 2. Accuracy data quality objectives for air pollutant samples

Parameter	Accuracy
Fine particulate matter	± 15%
Ground-level ozone	± 15%
Sulphur dioxide	± 15%
Nitrogen dioxide	± 15%
Volatile organic compounds	Species-dependent

Routine assessments of network operations provide assurance that the monitoring systems and data processing procedures produce an acceptable level of data quality to meet National Air Pollution Surveillance guidelines and to identify areas where improvements may be required. Three (3) main streams of audits and assessment are used in the National Air Pollution Surveillance network:

- performance and systems audits, which are conducted externally either by an Environment and Climate Change Canada auditor or by another agency separate from the monitoring agency
    - these audits are performed using independently verified reference standards, and provide an unbiased quantitative assessment to defend the quality of the data
- interagency measurement program, which involves analysis by the monitoring agency of an unknown sample concentration provided by Environment and Climate Change Canada
    - these tests help verify instrument accuracy, and help determine data comparability across sites
- data quality assessments, which involve the statistical analysis of environmental data to determine if collected and reported data meet network and data quality objectives

Additional audits and assessments are performed by Environment and Climate Change Canada's air quality laboratories in Ottawa for the analysis of integrated VOC samples. Consult the NAPS Monitoring and Quality Assurance and Quality Control Guidelines report for more information.[19]

[19] Environment and Climate Change Canada (pending).

Methods

The Air quality indicators are calculated using air pollutant concentrations measured at monitoring sites and stored in the Canada-wide Air Quality Database. The concentrations are then averaged to estimate the national, regional and urban indicators. Further analysis is done to determine the presence of significant trends for the national and regional indicators.

More information

Table 3. Air quality indicators definitions

Indicator	Definition	Concentration measurement unit[A]
Average $PM_{2.5}$	Annual average of the daily 24-hour average concentrations	$\mu g/m^3$
Peak $PM_{2.5}$	Annual 98th percentile of the daily 24-hour average concentrations	$\mu g/m^3$
Average O_3	Annual average of the daily maximum 8-hour average concentrations	ppb
Peak O_3	Annual 4th-highest of the daily maximum 8-hour average concentrations	ppb
Average SO_2	Annual average of the hourly concentrations	ppb
Peak SO_2	Annual 99th percentile of the daily maximum 1-hour average concentrations	ppb
Average NO_2	Annual average of the hourly concentrations	ppb
Peak NO_2	Annual 98th percentile of the daily maximum 1-hour average concentrations	ppb
Average VOC	Annual average of the daily 24-hour average concentrations	ppbC

Note: [A] Units: $\mu g/m^3$ = micrograms per cubic metre, ppb = parts per billion, ppbC = parts per billion carbon.

Average indicators are used to capture prolonged or repeated exposures over longer periods or chronic exposure while peak indicators are used to capture immediate or acute short-term exposures.

Canadian Ambient Air Quality Standards

In October 2012, the Ministers of the Environment, with the exception of Quebec,[20] agreed to begin implementing the new Air Quality Management System. This system provides a comprehensive, cross-Canada framework for collaborative action to further protect human health and the environment through continuous improvement of air quality. The Canadian Ambient Air Quality Standards (the standards) drive air quality management across the country. The standards are health and environment based air quality objectives for pollutant concentrations in outdoor air. Together with the management levels,[21] the standards act as a benchmark to support continuous improvement of air quality. In May 2013 for $PM_{2.5}$ and O_3, in

[20] Although it will not implement the Air Quality Management System, Quebec supports its general objectives and collaborates with other jurisdictions on developing some elements of the system, notably air zones and air sheds.

[21] Management levels refer to the air zone management framework and threshold values. More information can be found in the Canadian Council of Ministers of the Environment's Guidance document on air zone management (PDF; 226 kB).

October 2016 for SO_2 and in November 2017 for NO_2, the federal government established the standards as objectives under the Canadian Environmental Protection Act, 1999.

Calculation of the Air quality indicators follow the same data-handling conventions as those used in calculating the values of the standards. It is important to note that the achievement of the standards for $PM_{2.5}$, O_3, SO_2 and NO_2 is calculated using 3-year averages of the measured concentrations at the local level, while the indicator values are calculated at the national and regional levels using a single year only. As such, comparisons of the indicator values to the standards are provided for illustrative purposes only and not for assessing whether the standards are achieved. Furthermore, the indicators are not adjusted for exceptional events or for pollution from transboundary flows. The following table provides details of the standards.

Table 4. Canadian Ambient Air Quality Standards for fine particulate matter, ground-level ozone, sulphur dioxide and nitrogen dioxide.

Pollutant	Averaging time	2020 Standard (numerical value)	Statistical form
$PM_{2.5}$	24-hour (calendar day)	27 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
$PM_{2.5}$	Annual (calendar year)	8.8 µg/m^3	The 3-year average of the annual average of the daily 24-hour average concentrations
O_3	8-hour	62 ppb	The 3-year average of the annual 4th-highest of the daily maximum 8-hour average concentrations
SO_2	1-hour	70 ppb	The 3-year average of the annual 99th percentile of the daily maximum 1-hour average concentrations
SO_2	Annual (calendar year)	5.0 ppb	The arithmetic average over a single calendar year of all 1-hour average concentrations
NO_2	1-hour	60 ppb	The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
NO_2	Annual (calendar year)	17.0 ppb	The arithmetic average over a single calendar year of all 1-hour average concentrations

Data collection and validation

Data obtained from National Air Pollution Surveillance monitoring stations are converted to a format compatible with the Canada-wide Air Quality Database. All data in the Canada-wide Air Quality Database have a comparable level of quality because jurisdictions adhere to established quality assurance and quality control procedures as outlined in the National Air Pollution Surveillance Monitoring and Quality Assurance/Quality Control Guidelines. These procedures include site and sampling system design, use of monitoring methods that meet defined minimum performance specifications, operation, maintenance and calibrations, and data validation techniques. National Air Pollution Surveillance monitoring organizations are responsible for submitting quality-assured data, as per the specifications in the Guidelines, to the Canada-wide Air Quality Database. Data submitted to the National Air Pollution

Surveillance database are in the hour-ending format (that is, minute data collected between 01:01 and 02:00 are averaged and reported as the 02:00 hour).

Data completeness criteria

The following criteria are used to determine which stations have sufficient hourly and daily measurements in each year to be considered valid for inclusion in the indicators. These are largely based on the specifications set out in the Canadian Council of Ministers of the Environment's Guidance Document on Achievement Determination: Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (PDF; 265 kB).

For fine particulate matter ($PM_{2.5}$):

- a valid day has data for at least 18 hours (75%)
- a station is included only when
    - at least 75% of days in the calendar year are valid and
    - at least 60% of days in each quarter (3 months)[22] of a calendar year are valid

For the peak (98th percentile) 24-hour $PM_{2.5}$ indicator, a station is also included if it exceeds the 24-hour standard of 28.0 micrograms per cubic metre ($\mu g/m^3$), even if the above data completeness criteria are not satisfied.

For ground-level ozone (O_3):

- a valid 8-hour period has data for at least 6 hours (75%)
- a valid day requires data for at least 18 hours (75%)
- a station is included only when at least 75% of days in the combined second and third quarters (April 1 to September 30) are valid

For the peak (4th-highest) 8-hour O_3 indicator, a station is also included if it exceeds the 8-hour standard of 63 parts per billion (ppb), even if the above data completeness criteria are not satisfied.

For average sulphur dioxide (SO_2):

- a station is included only when at least 75% of hourly averages in the calendar year are valid and
- at least 60% of hourly averages in each quarter (3 months) of a calendar year are valid

For peak (99th percentile) 1-hour sulphur dioxide (SO_2):

- a valid daily maximum 1-hour average has hourly data for at least 18 hours (75%)
- a station is included only when
    - at least 75% of days in the calendar year are valid
    - at least 60% of days in each quarter (3 months) of a calendar year are valid

For the peak (99th percentile) 1-hour SO_2 indicator, a station is also included if it exceeds the 1-hour standard of 70 ppb, even if the above data completeness criteria are not satisfied.

For average nitrogen dioxide (NO_2):

- a station is included only when at least 75% of hourly averages in the calendar year are valid and
- at least 60% of hourly averages in each quarter (3 months) of a calendar year are valid

[22] The quarters are as follows: quarter 1 from January 1 to March 31; quarter 2 from April 1 to June 30; quarter 3 from July 1 to September 30 and quarter 4 from October 1 to December 31.

For peak (98th percentile) 1-hour nitrogen dioxide (NO_2):

- a valid daily maximum 1-hour average has hourly data for at least 18 hours (75%)
- a station is included only when
    - at least 75% of days in the calendar year are valid and
    - at least 60% of days in each quarter (3 months) of a calendar year are valid

For the peak (98th percentile) 1-hour NO_2 indicator, a station is also included if it exceeds the 1-hour standard of 60 ppb, even if the above data completeness criteria are not satisfied.

There are fewer data for volatile organic compounds (VOCs), and therefore data completeness criteria are different. At urban monitoring stations, VOC samples are usually collected over a 24-hour period once every 6 days, and, at rural stations, samples are collected over a 4-hour sampling period (12:00 to 16:00) once every 3 days. For VOCs, data completeness criteria are as follows:

- a valid day requires data for a consecutive period of 24 hours at an urban station and for a consecutive 4 hours at a rural station
- a valid quarter (3 months) requires data for at least 5 samples
- a station is included only if the year has 3 valid quarters

Table 5. Number of stations that satisfied the data completeness criteria for 2016

Indicator	Number of stations
Peak (98th percentile) 24-hour $PM_{2.5}$	187
Average $PM_{2.5}$	187
Peak (4th-highest) 8-hour O_3	199
Average O_3	190
Peak (99th percentile) 1-hour SO_2	97
Average SO_2	91
Peak (98th percentile) 1-hour NO_2	154
Average NO_2	159
VOCs	38

After the data completeness criteria have been met, the pollutant concentrations are calculated for the selected stations.

Pollutant-specific calculations

Fine particulate matter

The $PM_{2.5}$ average and peak (98th percentile) 24-hour indicators are based on the 24-hour daily average concentrations (daily average) for the whole year. The daily average value for $PM_{2.5}$ is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid daily averages and dividing by the number of valid days. The peak (98th percentile) 24-hour indicator is obtained by determining the 98th percentile value of all 24-hour daily values for a given year. The 98th percentile value corresponds to the concentration for which 98% of all the daily 24-hour values are less than it and 2% are greater than or equal to it. For example, the 98th percentile value of 25 µg/m^3 at a given station means that 98% of all daily 24-hour average concentrations are less than 25 µg/m^3, and only 2% are equal to or greater than 25 µg/m^3. The following table provides the rank of the 98th percentile value based on the number of available daily measurements.[23]

Table 6. 98th percentile rank based on the number of available measurements

Number of available daily measurements in a year	98th percentile rank
274 to 300	6th highest
301 to 350	7th highest
351 to 366	8th highest

The urban area, regional and national indicators (average and peak [98th percentile] 24-hour) for $PM_{2.5}$ are calculated by averaging the station-level annual average and station-level annual peak values for selected stations within either the urban area, the region or Canada as a whole.

Ground-level ozone

Ozone concentrations are calculated in parts per billion (ppb). There are 24 consecutive 8-hour average concentrations (8-hour rolls) that can possibly be calculated for each day. The highest value of the 24 averaged concentrations is the daily maximum. An illustration of the 8-hour averages is provided in Figure 33.

[23] To obtain the 98th percentile values shown in this table, the calculation method proposed in section 4.1.2 of the Canadian Council of Ministers of the Environment's Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (PDF; 264 kB) was used.

Figure 33. Calculation of the ground-level ozone daily maximum 8-hour average concentration

Date	Hour	1-hour (parts per billion)	8-hour (parts per billion)	Daily maximum 8-hour (parts per billion)
03/25	17:00	44		
	18:00	45		
	19:00	44		
	20:00	42		
	21:00	39		
	22:00	33		
	23:00	20		
	24:00	14		
03/26	01:00	11	31.0	45.6
	02:00	11	26.8	
	03:00	15	23.1	
	04:00	13	19.5	
	05:00	19	17.0	
	06:00	21	15.5	
	07:00	19	15.4	
	08:00	11	15.0	
	09:00	30	17.4	
	10:00	36	20.5	
	11:00	39	23.5	
	12:00	42	27.1	
	13:00	44	30.3	
	14:00	46	33.4	
	15:00	47	36.9	
	16:00	47	41.4	
	17:00	47	43.5	
	18:00	46	44.8	
	19:00	46	45.6	
	20:00	42	45.6	
	21:00	39	45.0	
	22:00	38	44.0	
	23:00	38	42.9	
	24:00	35	41.4	

For each station, the average O_3 indicator is calculated by taking the average of the daily maximum 8-hour (ending) averages for the period from January 1 to December 31. The urban area, regional and national averages for O_3 are obtained by averaging the station-level annual averages for selected stations within the urban area, the region or Canada as a whole.

For each station, the peak (4th-highest) 8-hour O_3 indicator is based on the 4th-highest of the daily maximum 8-hour average concentrations measured over a given year. All of the daily maximum 8-hour average concentrations are ordered in an array from highest to lowest, with equal values repeated as often as they occur. Each value is assigned a rank. For a given year, the 4th-highest ranking value in the array is identified as the annual peak (4th-highest) 8-hour O_3 concentration for that station. The urban area, regional and national peak O_3 indicators are obtained by averaging all 4th-highest values from selected stations within the urban area, the region or Canada as a whole.

Sulphur dioxide

The SO_2 average is based on the annual average of the hourly concentrations while the peak (99th percentile) 1-hour indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations. The daily maximum 1-hour average value for SO_2 is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid hourly averages and dividing by the number of total hours. The peak (99th percentile) 1-hour indicator is obtained by determining the 99th percentile value of all 24-hour daily maximum values for a given year. The 99th percentile value corresponds to the concentration for which 99% of all

the daily 24-hour maximum values are less than it and 1% is greater than or equal to it. For example, the 99th percentile value of 65 ppb at a given station means that 99% of all daily maximum 1-hour average concentrations are less than 65 ppb, and only 1% are equal to or greater than 65 ppb. The following table provides the rank of the 99th percentile value based on the number of available daily measurements.

Table 7. 99th percentile rank based on the number of available measurements

Number of available daily measurements in a year	99th percentile rank
274 to 300	3rd highest
301 to 366	4th highest

The national, regional and urban area indicators (average and peak [99th percentile] 1-hour) for SO_2 are calculated by averaging the station-level annual average and station-level annual peak values for selected stations within the urban area, the region or throughout Canada.

Nitrogen dioxide

The NO_2 average is based on the annual average of all hourly concentrations while the peak (98th percentile) 1-hour indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations. The daily maximum 1-hour average value for NO_2 is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid hourly averages and dividing by the number of total hours. The peak (98th percentile) 1-hour indicator is obtained by determining the 98th percentile value of all daily maximum values for a given year. The 98th percentile value corresponds to the concentration for which 98% of all the daily maximum values are less than it and 2% is greater than or equal to it. For example, the 98th percentile value of 25 ppb at a given station means that 98% of all daily maximum 1-hour average concentrations are less than 25 ppb, and only 2% are equal to or greater than 25 ppb. The national, regional and urban area indicators (average and peak [98th percentile] 1-hour) for NO_2 are calculated by averaging the station-level annual average and station-level annual peak values for selected stations within the urban area, the region or Canada as a whole.

Volatile organic compounds

Urban VOC station indicators are calculated from daily average concentrations (24-hour average concentrations) while rural VOC station indicators are calculated from daily 4-hour average (from 12:00 to 16:00) concentrations. The daily 24-hour average concentrations are based on measurements taken from midnight to midnight. For a station, the average indicator is calculated by taking the average of the daily concentrations for a given year.

The national, regional and urban area average indicators for VOCs are obtained by averaging the station-level annual averages from selected stations within the urban area, the region and throughout Canada.

While the concentration unit for individual VOCs is usually ppb, parts per billion carbon (ppbC) are used in these indicators to assess the quantity of mixed VOC species.

Station selection criteria for inclusion in national and regional indicators (time-series)

Station-level indicators were calculated for the years 2002 to 2016 for all air pollutants. Each station was then assessed for its suitability (sufficient data, no large gaps at the beginning or end) for inclusion in the national and regional time series. The specific criteria are as follows:

- for the national and regional time series, a station is included if it satisfies the data completeness criteria for at least 11 of the 15 years
- stations are excluded if data are missing for at least 2 consecutive years at the beginning or end of the time series
    - this measure avoids the use of data from stations that were commissioned or decommissioned at the beginning or end of the time series

In addition to the time series selection criteria, a minimum of 3 monitoring stations are required to calculate the indicator for a region, for a given year.

Station selection results

The following table indicates the number of monitoring stations that satisfied the selection criteria (data completeness and time series) and were thus included in the national and regional Air quality indicators for the time series. Further details on the stations selected are available in Annex B.

Table 8. Number of stations selected for the national and regional Air quality indicators for 2016

Indicator	Canada	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
Peak (98th percentile) 24-hour $PM_{2.5}$	114	8	30	35	20	19
Average $PM_{2.5}$	109	8	28	33	20	19
Peak (4th-highest) 8-hour O_3	155	18	40	38	29	29
Average O_3	153	17	40	38	29	28
Peak (99th percentile) 1-hour SO_2	68	6	7	8	25	21
Average SO_2	65	5	7	7	24	21
Peak (98th percentile) 1-hour NO_2	89	6	15	22	21	25
Average NO_2	101	7	15	25	27	26
VOCs	38	5	9	13	5	6

Note: The sum of the regional stations do not match all the time the national station numbers because stations from the Northwest Territories and Yukon were added to the national totals.

Local (station-level) indicators for O_3, $PM_{2.5}$, SO_2, NO_2 and VOCs are also presented in the Canadian Environmental Sustainability Indicators' interactive indicator maps. All stations displayed on the map satisfy the data completeness criteria.

Imputation

Stations that do not have enough measurements to meet the time series criteria for every year are excluded from the national and regional indicators. However, in some cases, monitoring stations are located close enough to others to allow data from neighbouring stations to be used to supplement missing data. Stations that were moved but remain relatively close to their previous location were also imputed. Annex C provides details on the stations that were used for imputation in the calculation of the time series.

Monitoring equipment

Fine particulate matter monitoring equipment

Five (5) types of monitoring equipment are used to monitor ambient $PM_{2.5}$ concentrations:

- older technology: Rupprecht & Patashnick tapered element oscillating microbalance (TEOM) monitor
- current technology: Thermo Scientific TEOM 1400a with the Series 8500C Filter Dynamics Measurement System (FDMS) monitor
- current technology: Met One BAM-1020 Beta Attenuation Mass monitor
- current technology: Thermo Scientific 5030 or 5030i SHARP (Synchronized Hybrid Ambient Real-time Particulate) monitor
- current technology: GRIMM Environmental Dust Monitor model EDM 180 and 365

The current technologies have been approved by the United States Environmental Protection Agency as Class III federal equivalent methods and have been deployed across the National Air Pollution Surveillance network replacing older tapered element oscillating microbalance instruments that have been found to exclude a portion of the $PM_{2.5}$ mass from measurement. Further details on this technological transition are available in Annex D.

Ground-level ozone monitoring equipment

Ozone measurements are made using ultraviolet photometry. Sample air passes through a beam of light from an ultraviolet lamp, which is absorbed by O_3. The amount of ultraviolet light absorbed is proportional to the amount of O_3 in the sample.

Sulphur dioxide monitoring equipment

Sulphur dioxide measurements are made using pulse-fluorescence ultraviolet adsorption instruments. This technology is based on the principle that SO_2 molecules absorb ultraviolet light at one wavelength and emit ultraviolet light at a different wavelength. The intensity of the emitted light is proportional to the number of SO_2 molecules in the sample gas.

Nitrogen dioxide monitoring equipment

Nitrogen dioxide is measured by subtraction following measurement of the total of nitrogen oxides (NO_X)[24] and nitrogen monoxide (NO) alone. NO concentrations are determined photometrically by measuring the light intensity from the chemiluminescent reaction of NO mixed with excess O_3. The chemiluminescence method detects only NO, therefore, NO_2 must first be converted to NO for measurement purposes. Sample flow either is directed through a converter to reduce NO_2 to NO, or it bypasses the converter to allow detection of only NO. The sample stream with reduced NO_2 is a measurement of NO plus NO_2, which is expressed as NO_X. The difference between NO_X and NO detection is taken as the NO_2 concentration.

[24] $NO_X = NO_2 + NO$.

Volatile organic compound monitoring equipment

The air samples are collected in either 6-litre or 3.2-litre stainless steel canisters. The canisters are then shipped to the Environment and Climate Change Canada analysis laboratory in Ottawa. A combined gas chromatography-flame ionization detector system is used for quantification of VOCs containing 2 carbons, while a combined gas chromatography-mass selective detector system operating in selected ion monitoring mode is used for quantification of VOCs containing 3 to 12 carbons. Approximately 120 VOCs (including a number of biogenic species such as isoprene and pinenes) are targeted for quantification in the samples, but not all VOCs are detectable in each sample. The total concentration of VOCs in parts per billion carbon is calculated from the total mass of all species detected in the sample. The list of VOCs targeted for quantification is provided in Annex E.

Statistical analysis

Non-parametric statistical tests were carried out on temporal concentration data to detect the presence of a linear trend and, if present, to determine the orientation (positive or negative) and magnitude of the rate of change (slope). The standard Mann-Kendall trend test was used to detect trend presence and orientation, while the Sen's pairwise slope method was used to estimate the slope. Results of the tests are available in Annex F. Both tests were applied to the regional and national data for O_3, $PM_{2.5}$, SO_2, NO_2 and VOCs. A trend was reported when the Mann-Kendall test indicated the presence of a trend at the 95% confidence level over the 15-year time series.

The following table presents the rate of change per year (slopes expressed in median annual percentage change, relative to the value in the first year of each time series) for the national and regional Air quality indicators over the reported time series from 2002 to 2016.

Table 9. Rate of change per year for the national and regional Air quality indicators, 2002 to 2016

Indicator	National (median annual percent change)	Atlantic Canada (median annual percent change)	Southern Quebec (median annual percent change)	Southern Ontario (median annual percent change)	Prairies and northern Ontario (median annual percent change)	British Columbia (median annual percent change)
$PM_{2.5}$ average	[A]	3.36	-1.48	[A]	3.59	[A]
$PM_{2.5}$ peak (98th percentile) 24-hour	[A]	[A]	-3.32	-3.3	10.37	[A]
O_3 average	[A]	[A]	[A]	[A]	[A]	[A]
O_3 peak (4th-highest) 8-hour	-1.15	-1.65	-1.7	-1.81	[A]	[A]
SO_2 average	-4.44	-6.72	-5.28	-4.84	-3.69	-3.2
SO_2 peak (99th percentile) 1-hour	-3.89	-5.36	-4.02	-3.22	-4.2	-3.1
NO_2 average	-3.09	-3.31	-3.47	-4	-2.2	-2.49
NO_2 peak (98th percentile) 1-hour	-1.94	-2.23	-2.31	-2.66	-0.76	-1.74
VOCs average	-3.13	-2.89	-4.25	-3.61	-2.62	-3.77

Note: [A] Indicates that the Mann-Kendall method failed to reject the null hypothesis at the 95% confidence level, meaning a trend was not detected.

Calculation of Air quality indicators for urban areas

Urban areas are municipalities or cities defined by the census metropolitan area or the census agglomerations from Statistics Canada. A census metropolitan area or a census agglomeration is an area consisting of one or more neighbouring municipalities situated around a core. A census metropolitan area must have a total population of at least 100 000 of which 50 000 or more live in the core. A census agglomeration must have a core population of at least 10 000.

All the monitoring stations located within the census metropolitan area or census agglomeration are considered in the calculation only if they meet the same selection criteria used for the national and regional indicators. See the section on data completeness criteria.

Annual ambient levels from all monitoring stations found in the urban area are averaged. The average is a simple arithmetic average and is not weighted by the population covered by each station. This calculation is repeated for each indicator.

Only the urban areas for the most populated communities in Canada and the provincial and territorial capitals are reported for these indicators if they have sufficient data. Data for sulphur dioxide and volatile organic compounds were considered too sparse to allow for appropriate urban comparisons. For a complete list of the urban areas and monitoring stations found in these urban areas, consult Annex G.

Recent changes

The stations used to calculate the indicators vary slightly between different editions of the indicators. For more information, consult the caveats and limitations section under Revisions to station selections. Some air quality data of previous years were reassessed and corrected.

New SO_2 and NO_2 air quality indicators based on the Canadian Ambient Air Quality Standards were added to the set of indicators. The peak SO_2 indicator is provided for the first time and is based on the annual 99th percentile of the daily maximum 1-hour average concentrations. The peak NO_2 indicator is also provided for the first time and is based on the annual 98th percentile of the daily maximum 1-hour average concentrations. The average SO_2 and NO_2 indicators based on the annual average of the hourly concentrations are the same than the previous SO_2 and NO_2 indicators.

New Air quality indicators estimated by urban area for $PM_{2.5}$, O_3 and NO_2 were added for the present release.

Caveats and limitations

Data completeness

Some data collected at stations cannot be used in calculating the indicators because the data do not meet the data completeness criteria. These criteria are based on standard practices supported by expert opinion and are used by a number of organizations, such as the World Health Organization, the Canadian Council of Ministers of the Environment and the United States Environmental Protection Agency. The criteria allow for some gaps in data.

Revisions to station selections

Monitoring stations are selected based on the 15-year time series criteria for the calculation of the Air quality indicators. As this is a rolling 15-year time period, the number of stations selected may vary from one edition of the indicators to the next and may change the historical trends. Caution is should be exercised when comparing different editions of the Air quality indicators.

The following table shows the number of stations removed, added, relocated or combined for $PM_{2.5}$, O_3, SO_2, NO_2 and VOC indicators.

Table 10. Number of stations removed and number of new stations compared to December 2016 release of the Air quality indicators

Indicator	Number of stations removed[A]	Number of new or relocated stations	Total number of stations used for the imputation	Number of combined stations after imputation[B]
Peak (98th percentile) 24-hour $PM_{2.5}$	3	52	36	17
Average $PM_{2.5}$	6	50	29	14
Peak (4th-highest) 8-hour O_3	10	24	51	23
Average O_3	10	24	47	21
Peak (99th percentile) 1-hour SO_2	n/a	n/a	10	5
Average SO_2	16	11	8	4
Peak (98th percentile) 1-hour NO_2	n/a	n/a	24	10
Average NO_2	6	26	29	14
VOCs	2	9	18	9

Note: n/a = not applicable. [A] These stations no longer respect the time series criteria and were removed from the calculation of the national and regional indicators for the whole time series. [B] These stations were included in the calculation of the national and regional indicators. Annex C provides details on the stations that were used for imputation.

Regional air quality indicators

The number of available monitoring stations and pollutants measured varies from region to region. In certain years, regions that have close to the minimum number of monitoring stations required may record an unusual value if a particular monitoring station did not meet the completeness criteria for that year. This is especially true when the value obtained differs greatly from those obtained at other stations (overshadowing all the other stations). For this reason, the regional indicators may be subject to annual fluctuations.

Effect of new fine particulate matter measurement technologies

Since 2005, the Rupprecht & Patashnick tapered element oscillating microbalance monitors used in the National Air Pollution Surveillance program have gradually been replaced by newer monitoring technologies (federal equivalency method-approved instruments). Many studies conducted in Canada, the United States and other countries have found that the tapered element oscillating microbalance monitors under-report concentrations compared with the newer monitors, especially when the air contains a large proportion of semi-volatile particulate matter. This may be the case during cooler seasons when the air contains a greater proportion of ammonium nitrate and semi-volatile organic compounds.

Some of the year-to-year variations in the $PM_{2.5}$ air quality indicators may be due, in part, to the introduction of the newer monitoring technologies across the National Air Pollution Surveillance Network rather than to changes in actual ambient concentrations only. As such, trends in $PM_{2.5}$ concentrations may not be a true reflection of the changes that have occurred over the time period concerned (see Annex D).

Resources

References

Canadian Council of Ministers of the Environment (2011) Ambient Air Monitoring Protocol for $PM_{2.5}$ and Ozone (PDF; 787 kB). Retrieved on May 4, 2018.

Canadian Council of Ministers of the Environment (2014) Air Quality Management System. Retrieved on May 4, 2018.

Environment and Climate Change Canada (2013) National Air Pollution Surveillance Program. Retrieved on May 4, 2018.

Dann T (2012) CESI $PM_{2.5}$ Air Indicator Using Transformed Data. Prepared for Environment Canada.

Dann T (2013) Comparison of CESI $PM_{2.5}$ Air Indicators with Transformed Data (FEM Basis). Prepared for Environment Canada.

Related information

Air pollution: drivers and impacts

Canadian Council of Ministers of the Environment – Canada's air

Canadian Smog Science Assessment Highlights and Key Messages

Smog: causes and effects

Annexes

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. Air pollutant concentrations, Canada, 2002 to 2016

Year	Ground-level ozone average 8-hour concentration (percentage change relative to 2002)	Ground-level ozone peak (4th highest) 8-hour concentration (percentage change relative to 2002)	Fine particulate matter average concentration (percentage change relative to 2002)	Fine particulate matter peak (98th percentile) 24-hour concentration (percentage change relative to 2002)	Sulphur dioxide average concentration (percentage change relative to 2002)	Sulphur dioxide peak (99th percentile) 1-hour concentration (percentage change relative to 2002)	Nitrogen dioxide average concentration (percentage change relative to 2002)	Nitrogen dioxide peak (98th percentile) 1-hour concentration (percentage change relative to 2002)	Volatile organic compounds concentration (percentage change relative to 2002)
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	2.0	-0.6	-0.7	-1.5	-6.5	-1.7	1.8	-2.4	31.3
2004	-3.1	-12.4	-10.7	-8.7	-19.3	-1.1	-10.9	-4.2	18.9
2005	0.5	-7.1	-5.8	-2.3	-21.0	3.7	-12.3	-3.9	-7.2
2006	-0.3	-9.5	-14.9	-23.8	-23.9	-3.4	-17.9	-8.2	0.9
2007	1.1	-5.3	-16.0	-18.8	-22.5	-6.9	-18.3	-11.2	-4.6
2008	-0.9	-11.8	-15.8	-27.1	-30.7	-7.9	-20.5	-13.0	-7.1
2009	-3.1	-15.8	-18.3	-33.0	-40.2	-18.8	-25.4	-14.6	-0.5
2010	0.9	-12.6	-6.6	-10.1	-47.8	-17.0	-30.4	-15.9	-11.7
2011	1.2	-16.0	-8.7	-24.9	-46.4	-40.0	-31.0	-18.2	-17.2
2012	3.1	-10.9	-9.6	-27.5	-48.0	-38.1	-36.7	-21.6	-27.9
2013	1.3	-17.0	-0.7	-24.4	-52.7	-40.3	-36.2	-23.1	-23.0
2014	0.9	-20.2	3.3	-15.0	-54.7	-44.7	-36.6	-23.5	-28.7
2015	0.3	-13.4	2.5	-14.2	-59.7	-47.8	-38.6	-22.9	-25.7
2016	-0.9	-16.7	-12.2	-24.4	-63.5	-51.7	-42.7	-24.8	-36.1

Note: For more information on the Air quality indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.2. Data for Figure 2. Air pollutant concentrations relative to the Canadian Ambient Air Quality Standards, Canada, 2002 to 2016

Year	Ground-level ozone peak (4th highest) 8-hour concentration (percentage change relative to the 2020 standard)	Fine particulate matter average concentration (percentage change relative to the 2020 standard)	Fine particulate matter peak (98th percentile) 24-hour concentration (percentage change relative to the 2020 standard)	Sulphur dioxide average concentration (percentage change relative to the 2020 standard)	Sulphur dioxide peak (99th percentile) 1-hour concentration (percentage change relative to the 2020 Standard)	Nitrogen dioxide average concentration (percentage change relative to the 2020 standard)	Nitrogen dioxide peak (98th percentile) 1-hour concentration (percentage change relative to the 2020 standard)
2002	10.0	-17.3	-4.0	-43.8	-13.1	-19.4	-13.9
2003	9.3	-17.9	-5.5	-47.4	-14.5	-18.0	-16.0
2004	-3.7	-26.1	-12.4	-54.7	-14.0	-28.2	-17.6
2005	2.1	-22.1	-6.3	-55.6	-9.9	-29.3	-17.3
2006	-0.5	-29.6	-26.9	-57.2	-16.0	-33.9	-21.0
2007	4.1	-30.5	-22.1	-56.4	-19.0	-34.2	-23.6
2008	-3.0	-30.3	-30.0	-61.0	-20.0	-35.9	-25.1
2009	-7.4	-32.4	-35.7	-66.4	-29.4	-39.9	-26.5
2010	-3.9	-22.8	-13.8	-70.7	-27.9	-43.9	-27.6
2011	-7.7	-24.5	-28.0	-69.9	-47.8	-44.4	-29.6
2012	-2.1	-25.3	-30.5	-70.8	-46.2	-49.0	-32.5
2013	-8.8	-17.9	-27.5	-73.4	-48.1	-48.6	-33.8
2014	-12.2	-14.6	-18.4	-74.5	-52.0	-48.9	-34.2
2015	-4.8	-15.2	-17.7	-77.4	-54.6	-50.5	-33.6
2016	-8.4	-27.4	-27.4	-79.5	-58.0	-53.8	-35.3
Standard	**62 parts per billion**	**8.8 micrograms per cubic metre**	**27 micrograms per cubic metre**	**5 parts per billion**	**70 parts per billion**	**17 parts per billion**	**60 parts per billion**

Note: Comparison of the national concentrations to the Canadian Ambient Air Quality Standards is provided for illustrative purposes only. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.3. Data for Figure 3. Fine particulate matter concentrations, Canada, 2002 to 2016

Year	Average concentration (micrograms per cubic metre)	Peak (98th percentile) 24-hour concentration (micrograms per cubic metre)
2002	7.3	25.9
2003	7.2	25.5
2004	6.5	23.6
2005	6.9	25.3
2006	6.2	19.7
2007	6.1	21.0
2008	6.1	18.9
2009	6.0	17.4
2010	6.8	23.3
2011	6.6	19.5
2012	6.6	18.8
2013	7.2	19.6
2014	7.5	22.0
2015	7.5	22.2
2016	6.4	19.6
2020 standard	**8.8**	**27.0**
Annual trend	**No trend**	**No trend**

Note: The average fine particulate matter concentration indicator is based on the annual average of the daily 24-hour average concentrations for fine particulate matter recorded at 109 monitoring stations across Canada. The national peak indicator is based on the 98th percentile of the daily 24-hour average concentrations for fine particulate matter recorded at 114 monitoring stations across Canada. The Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.4. Data for Figure 4. Regional average fine particulate matter concentrations, Canada, 2002 to 2016

Year	Atlantic Canada average concentration (micrograms per cubic metre)	Southern Quebec average concentration (micrograms per cubic metre)	Southern Ontario average concentration (micrograms per cubic metre)	Prairies and northern Ontario average concentration (micrograms per cubic metre)	British Columbia average concentration (micrograms per cubic metre)
2002	4.8	9.8	8.5	5.8	6.6
2003	4.6	9.7	8.3	5.6	6.8
2004	4.0	7.9	7.5	4.5	6.1
2005	4.3	8.4	8.6	4.1	5.6
2006	4.0	7.0	7.2	4.8	5.5
2007	4.0	7.1	7.3	4.6	5.0
2008	4.5	8.2	6.6	4.5	5.0
2009	5.0	8.3	5.6	4.6	5.3
2010	5.0	8.4	6.0	7.8	5.7
2011	6.0	8.4	6.1	7.7	4.8
2012	5.0	8.3	6.0	7.2	5.3
2013	5.7	8.0	7.9	6.8	6.0
2014	6.0	7.8	8.1	7.3	6.9
2015	6.0	7.4	7.9	7.7	7.2
2016	5.6	6.3	6.6	7.7	5.3
2020 standard	**8.8**	**8.8**	**8.8**	**8.8**	**8.8**
Annual trend	**0.13**	**-0.14**	**No trend**	**0.18**	**No trend**

Note: The average fine particulate matter concentration indicator is based on concentrations recorded at 8 monitoring stations in Atlantic Canada, 28 in southern Quebec, 33 in southern Ontario, 20 in the Prairies and northern Ontario region, and 19 in British Columbia. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standard. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.5. Data for Figure 5. Average fine particulate matter concentrations, selected Canadian urban areas, 2016

Urban area	2002 (micrograms per cubic metre)	2003 (micrograms per cubic metre)	2004 (micrograms per cubic metre)	2005 (micrograms per cubic metre)	2006 (micrograms per cubic metre)	2007 (micrograms per cubic metre)	2008 (micrograms per cubic metre)	2009 (micrograms per cubic metre)	2010 (micrograms per cubic metre)	2011 (micrograms per cubic metre)	2012 (micrograms per cubic metre)	2013 (micrograms per cubic metre)	2014 (micrograms per cubic metre)	2015 (micrograms per cubic metre)	2016 (micrograms per cubic metre)
Whitehorse, YT	2.4	2.4	4.8	2.8	n/a	n/a	1.8	n/a	1.9	2.5	5.6	6.2	n/a	5.5	3.4
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.8	n/a
Victoria, BC	6.1	5.2	5.8	5.8	5.7	5.1	4.1	5.3	8.2	7.9	7.0	7.5	5.9	6.3	4.3
Vancouver, BC	5.5	5.5	5.4	5.5	4.9	4.6	4.5	5.0	4.0	4.2	4.1	6.1	6.1	6.1	4.5
Halifax, NS	4.1	n/a	5.7	4.4	n/a	3.1	3.6	4.5	4.5	6.0	5.4	6.7	7.0	4.3	5.0
Sherbrooke, QC	n/a	n/a	7.6	7.9	6.9	6.5	7.0	6.2	6.8	6.8	7.1	6.5	6.8	6.4	5.0
St. John's, NL	4.8	4.3	3.7	4.0	3.5	2.8	3.3	4.5	5.0	5.9	3.8	5.3	7.0	5.8	5.1
Calgary, AB	6.3	8.1	6.4	5.5	6.6	5.7	5.7	8.1	11.4	10.9	10.0	8.1	8.2	8.5	5.2
Gatineau, QC	n/a	n/a	6.8	7.5	6.1	6.0	5.9	5.1	6.0	7.2	8.3	6.8	6.8	6.1	5.6
Winnipeg, MB	6.0	5.5	4.4	4.6	4.9	4.7	4.5	4.4	5.8	7.2	6.7	6.2	5.8	6.0	5.8
Ottawa, ON	7.5	7.2	6.5	7.5	6.1	5.9	5.2	4.5	4.4	4.7	4.9	7.1	6.9	6.9	5.8
Fredericton, NB	n/a	5.1	4.1	4.3	4.4	3.8	3.9	3.8	3.9	5.2	4.8	4.2	5.2	5.8	5.8
Oshawa, ON	9.1	7.8	7.9	n/a	6.8	6.8	6.3	5.2	5.6	5.4	5.5	7.4	7.7	7.5	5.9
Edmonton, AB	6.3	6.6	5.5	4.9	5.6	5.4	5.8	5.9	10.0	7.0	6.5	6.6	7.7	7.1	6.4
London, ON	n/a	9.4	9.2	10.3	8.0	6.9	6.8	5.7	5.9	6.1	6.1	8.3	8.5	8.2	6.8
Saskatoon, SK	n/a	n/a	3.7	3.6	4.1	3.6	4.0	4.0	6.9	5.4	5.8	6.4	8.2	10.6	6.8
St. Catharines – Niagara, ON	n/a	7.8	7.3	8.6	7.8	8.2	7.4	6.0	6.5	6.3	6.3	8.5	n/a	8.5	6.9
Toronto, ON	8.6	8.4	7.8	9.0	7.6	7.7	7.1	5.6	6.1	6.4	6.3	8.3	8.8	8.5	7.0
Montreal, QC	10.0	10.5	8.7	10.0	7.7	7.5	11.6	10.9	10.3	10.2	9.8	9.8	8.8	8.5	7.1
Kitchener, ON	n/a	8.2	8.1	9.5	7.7	8.0	7.1	5.8	6.3	6.2	6.1	8.7	n/a	8.8	7.3
Hamilton, ON	11.2	9.6	8.7	9.6	8.3	8.0	7.5	6.3	6.7	7.0	7.1	9.3	10.0	9.7	7.8
Yellowknife, NT	n/a	n/a	n/a	3.3	1.4	1.9	5.1	4.3	n/a	6.2	6.2	6.4	15.8	8.5	7.8
Regina, SK	7.3	7.3	4.5	4.2	4.6	4.5	4.6	4.9	7.3	7.7	6.1	6.6	6.6	11.0	8.1

Urban area	2002 (micrograms per cubic metre)	2003 (micrograms per cubic metre)	2004 (micrograms per cubic metre)	2005 (micrograms per cubic metre)	2006 (micrograms per cubic metre)	2007 (micrograms per cubic metre)	2008 (micrograms per cubic metre)	2009 (micrograms per cubic metre)	2010 (micrograms per cubic metre)	2011 (micrograms per cubic metre)	2012 (micrograms per cubic metre)	2013 (micrograms per cubic metre)	2014 (micrograms per cubic metre)	2015 (micrograms per cubic metre)	2016 (micrograms per cubic metre)
Quebec City, QC	7.8	8.0	7.8	9.3	8.1	6.7	7.1	n/a	9.8	9.2	10.1	9.3	9.2	9.1	8.2
Windsor, ON	n/a	9.0	9.0	10.5	8.7	9.7	8.6	7.3	7.8	7.8	7.5	9.6	10.4	9.5	8.3

Note: n/a = not available. Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.6. Data for Figure 7. Regional peak fine particulate matter concentrations, Canada, 2002 to 2016

Year	Atlantic Canada peak (98th percentile) concentration (micrograms per cubic metre)	Southern Quebec peak (98th percentile) concentration (micrograms per cubic metre)	Southern Ontario peak (98th percentile) concentration (micrograms per cubic metre)	Prairies and northern Ontario peak (98th percentile) concentration (micrograms per cubic metre)	British Columbia peak (98th percentile) concentration (micrograms per cubic metre)
2002	18.4	35.2	31.9	18.3	19.9
2003	15.1	36.4	28.1	18.6	24.8
2004	13.0	26.3	30.1	15.6	18.2
2005	14.4	34.4	33.1	12.5	15.9
2006	12.7	22.2	23.5	15.4	16.7
2007	14.5	23.1	27.7	13.8	15.2
2008	14.0	23.3	21.3	13.3	15.1
2009	14.9	23.8	15.0	13.6	17.5
2010	13.8	25.6	21.4	25.2	26.7
2011	16.3	21.6	18.2	27.5	13.3
2012	12.7	22.8	17.2	20.2	16.9
2013	16.6	21.4	20.1	19.7	15.7
2014	13.6	19.2	21.4	24.5	22.4
2015	14.2	19.7	20.6	34.5	20.1

Year	Atlantic Canada peak (98th percentile) concentration (micrograms per cubic metre)	Southern Quebec peak (98th percentile) concentration (micrograms per cubic metre)	Southern Ontario peak (98th percentile) concentration (micrograms per cubic metre)	Prairies and northern Ontario peak (98th percentile) concentration (micrograms per cubic metre)	British Columbia peak (98th percentile) concentration (micrograms per cubic metre)
2016	11.8	16.1	16.5	37.9	13.7
2020 standard	**27.0**	**27.0**	**27.0**	**27.0**	**27.0**
Annual trend	**No trend**	**-1.06**	**-1.01**	**1.13**	**No trend**

Note: The peak fine particulate matter indicator is based on the concentrations recorded at 8 monitoring stations in Atlantic Canada, 28 in southern Quebec, 35 in southern Ontario, 20 in the Prairies and northern Ontario region, and 19 in British Columbia. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standard. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.7. Data for Figure 8. Peak fine particulate matter concentrations, selected Canadian urban areas, 2016

Urban area	2002 (micrograms per cubic metre)	2003 (micrograms per cubic metre)	2004 (micrograms per cubic metre)	2005 (micrograms per cubic metre)	2006 (micrograms per cubic metre)	2007 (micrograms per cubic metre)	2008 (micrograms per cubic metre)	2009 (micrograms per cubic metre)	2010 (micrograms per cubic metre)	2011 (micrograms per cubic metre)	2012 (micrograms per cubic metre)	2013 (micrograms per cubic metre)	2014 (micrograms per cubic metre)	2015 (micrograms per cubic metre)	2016 (micrograms per cubic metre)
St. John's, NL	11.1	12.2	9.5	10.1	8.1	7.1	9.0	12.8	12.8	11.5	9.7	14.6	15.2	12.4	10.3
Halifax, NS	15.0	n/a	15.4	14.9	n/a	15.3	9.7	13.9	14.6	15.4	13.7	16.8	13.9	11.3	10.6
Vancouver, BC	15.6	16.1	14.6	14.7	13.3	12.6	13.0	13.6	12.1	9.9	12.3	14.4	15.9	16.1	10.7
Victoria, BC	16.4	12.9	13.7	13.3	13.0	16.1	10.4	14.8	20.0	21.5	16.2	21.8	18.8	18.4	11.8
Fredericton, NB	n/a	18.8	13.5	16.1	15.4	16.8	14.8	15.6	15.0	16.6	15.3	14.5	13.0	16.2	12.0
Sherbrooke, QC	n/a	n/a	27.5	26.6	21.4	20.3	18.5	17.7	20.9	17.5	16.9	16.6	16.9	16.4	13.4
Calgary, AB	18.8	35.3	17.6	13.2	18.3	16.2	14.5	18.5	30.8	24.0	21.9	20.8	21.2	26.1	14.1
Winnipeg, MB	19.5	14.1	13.1	14.7	14.5	12.0	13.0	12.3	16.4	18.0	19.5	21.3	18.0	20.6	14.5
Gatineau, QC	n/a	n/a	25.1	34.6	20.5	20.8	18.7	15.3	20.6	19.1	21.2	19.6	16.6	17.1	15.1
London, ON	n/a	30.3	33.7	34.0	24.3	27.1	22.2	15.9	20.9	17.6	16.9	20.4	21.1	20.5	15.5
Whitehorse, YT	7.6	8.5	46.5	12.8	n/a	n/a	7.6	n/a	6.3	7.5	17.8	19.9	n/a	18.3	15.6
St. Catharines –	32.6	24.5	28.5	32.6	28.0	32.1	21.7	15.2	23.2	18.5	16.5	19.5	n/a	20.3	15.6

Urban area	2002 (micrograms per cubic metre)	2003 (micrograms per cubic metre)	2004 (micrograms per cubic metre)	2005 (micrograms per cubic metre)	2006 (micrograms per cubic metre)	2007 (micrograms per cubic metre)	2008 (micrograms per cubic metre)	2009 (micrograms per cubic metre)	2010 (micrograms per cubic metre)	2011 (micrograms per cubic metre)	2012 (micrograms per cubic metre)	2013 (micrograms per cubic metre)	2014 (micrograms per cubic metre)	2015 (micrograms per cubic metre)	2016 (micrograms per cubic metre)
Niagara, ON															
Oshawa, ON	34.3	25.0	30.0	n/a	24.3	29.1	20.8	14.4	22.5	17.5	15.3	20.4	18.9	20.4	16.6
Ottawa, ON	28.1	26.3	23.3	33.6	19.9	20.4	16.8	13.2	16.0	13.3	14.6	21.2	20.1	19.9	16.8
Kitchener, ON	n/a	29.1	33.0	34.5	23.3	29.5	22.0	15.2	21.0	17.5	17.2	22.5	n/a	23.2	17.8
Toronto, ON	31.7	30.5	32.6	34.6	24.7	28.7	22.3	14.6	22.2	18.7	17.7	20.7	24.5	22.8	18.3
Montreal, QC	35.7	39.2	27.6	42.0	23.9	24.4	31.8	30.7	30.4	26.0	27.6	25.3	22.6	23.0	18.3
Hamilton, ON	33.3	30.0	32.6	33.8	26.1	29.0	24.5	16.0	23.6	20.7	20.6	23.3	24.6	24.0	18.4
Windsor, ON	37.2	29.6	32.1	32.3	24.4	29.4	22.8	18.3	22.8	21.8	19.0	22.8	24.2	22.4	18.8
Edmonton, AB	20.8	20.6	18.7	13.0	16.4	15.0	17.6	16.5	34.4	21.0	18.6	21.1	22.6	22.0	19.6
Yellowknife, NT	n/a	n/a	43.2	11.0	4.6	12.8	28.5	11.2	n/a	25.8	15.2	31.9	130.9	31.6	19.7
Saskatoon, SK	n/a	n/a	10.2	8.7	15.1	10.6	10.4	10.3	20.4	14.5	17.4	17.3	22.7	36.4	21.4
Quebec City, QC	29.0	28.2	23.5	34.1	22.8	23.7	20.5	n/a	27.6	22.9	28.5	25.7	22.6	25.4	21.4
Regina, SK	17.9	17.9	12.0	12.0	17.0	12.6	10.8	12.0	19.8	16.4	13.9	14.3	18.2	76.8	22.9

Note: n/a = not available. Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.8. Data for Figure 10. Ozone concentrations, Canada, 2002 to 2016

Year	Average concentration (parts per billion)	Peak (4th-highest) 8-hour concentration (parts per billion)
2002	32.8	68.2
2003	33.5	67.8
2004	31.8	59.7
2005	33.0	63.3
2006	32.7	61.7
2007	33.2	64.5

Year	Average concentration (parts per billion)	Peak (4th-highest) 8-hour concentration (parts per billion)
2008	32.5	60.1
2009	31.8	57.4
2010	33.1	59.6
2011	33.2	57.2
2012	33.8	60.7
2013	33.2	56.6
2014	33.1	54.4
2015	32.9	59.0
2016	32.5	56.8
2020 standard	**n/a**	**62**
Annual trend	**No trend**	**-0.75**

Note: n/a = not applicable. The national average concentration indicator is based on the annual average ground-level ozone concentrations of the daily maximum 8-hour averages recorded at 153 monitoring stations across Canada. The national peak indicator is based on the annual 4th-highest daily maximum 8-hour average concentrations for ground-level ozone recorded at 155 monitoring stations across Canada. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing of the achievement status of the standard. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.9. Data for Figure 11. Regional average ozone concentrations, Canada, 2002 to 2016

Year	Atlantic Canada average concentration (parts per billion)	Southern Quebec average concentration (parts per billion)	Southern Ontario average concentration (parts per billion)	Prairies and northern Ontario average concentration (parts per billion)	British Columbia average concentration (parts per billion)
2002	33.7	33.6	37.8	31.8	25.7
2003	34.8	33.9	37.0	33.7	26.9
2004	33.0	32.0	35.1	32.4	25.9
2005	33.1	33.6	39.0	31.6	25.0

Year	Atlantic Canada average concentration (parts per billion)	Southern Quebec average concentration (parts per billion)	Southern Ontario average concentration (parts per billion)	Prairies and northern Ontario average concentration (parts per billion)	British Columbia average concentration (parts per billion)
2006	34.5	31.0	36.3	33.6	28.4
2007	34.1	32.4	39.0	32.6	25.8
2008	32.6	31.5	37.5	33.1	26.7
2009	31.5	30.4	35.5	33.1	27.7
2010	32.0	33.1	37.8	32.8	27.5
2011	32.6	32.4	36.7	35.3	27.9
2012	32.9	33.7	38.2	33.4	29.0
2013	33.3	34.2	36.7	34.1	26.4
2014	32.8	33.2	36.7	33.1	27.9
2015	33.0	33.9	36.9	32.4	26.3
2016	31.9	33.1	37.5	31.5	26.6
Annual trend	**No trend**	**No trend**	**No trend**	**No trend**	**No trend**

Note: The regional average ground-level ozone concentration indicator is based on concentrations recorded at 17 monitoring stations in Atlantic Canada, 40 in southern Quebec, 38 in southern Ontario, 29 in the Prairies and northern Ontario region, and 28 in British Columbia. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.10. Data for Figure 12. Average ozone concentrations, selected Canadian urban areas, 2016

Urban area	2002 (parts per billion)	2003 (parts per billion)	2004 (parts per billion)	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)
Winnipeg, MB	28.0	30.5	25.5	27.0	30.5	30.0	28.0	28.0	32.5	33.5	34.0	34.0	31.0	31.0	24.5
Vancouver, BC	23.5	24.7	23.8	22.7	26.6	23.4	24.5	25.6	26.3	26.5	27.3	24.5	26.4	25.5	25.8
Halifax, NS	31.0	29.0	28.5	25.0	32.0	34.5	30.7	31.5	31.5	32.0	31.3	33.7	31.0	31.0	29.0
Saskatoon, SK	28.0	28.0	28.0	29.0	27.0	26.0	28.0	30.0	30.0	33.0	30.0	34.0	32.0	32.0	29.0
Victoria, BC	25.0	29.5	28.0	27.3	33.3	29.0	30.5	29.3	26.0	27.0	31.0	28.0	31.0	28.5	30.0

Urban area	2002 (parts per billion)	2003 (parts per billion)	2004 (parts per billion)	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)
Fredericton, NB	33.8	29.3	32.8	32.9	34.7	37	34.6	32.7	32.7	31.1	32.0	32.8	33.2	32.3	30.2
Whitehorse, YT	36.0	n/a	n/a	33.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	31.0	33.0	30.0
Yellowknife, NT	n/a	28.0	29.0	32.0	31.0	29.0	28.0	27.0	30.0	29.0	31.0	29.0	29.0	30.0	30.0
Edmonton, AB	32.2	32.6	32.2	31.7	33.3	33.4	33.7	34.7	31.3	35.7	32.3	34.5	32.9	32.6	30.6
Calgary, AB	29.7	30.0	28.7	27.7	29.7	30.0	32.5	33.7	30.0	33.5	31.0	34.0	32.5	36.0	31.5
Quebec City, QC	33.2	32.8	30.6	31.4	30.5	31.2	29.6	29.3	31.3	30.3	31.8	33.2	31.8	32.8	32.0
Montreal, QC	30.6	31.1	28.6	31.5	28.5	31.1	30.4	29.1	31.2	30.9	31.9	32.6	31.6	32.8	32.5
St. John's, NL	34.0	35.0	33.0	33.5	35.0	34.0	34.5	24.5	33.5	33.0	34.5	32.0	33.0	35.0	33.0
Ottawa, ON	34.0	29.0	31.0	33.0	32.0	35.0	35.0	32.0	34.5	32.5	34.5	33.5	33.5	34.0	34.0
Regina, SK	18.0	29.0	28.0	23.0	22.0	n/a	29.0	30.0	29.0	34.0	28.0	26.0	33.0	34.0	34.0
Sherbrooke, QC	39.0	39.0	35.5	36.5	33.0	34.5	34.0	33.0	35.5	35.0	37.0	37.0	36.0	36.0	34.0
Gatineau, QC	35.5	35.5	34.0	35.5	31.0	33.0	31.5	31.0	33.5	33.5	36.0	34.0	35.0	35.0	35.0
Toronto, ON	36.9	35.0	32.8	36.5	33.8	36.4	35.1	33.9	35.4	34.2	36.6	34.7	34.8	34.9	36.0
Oshawa, ON	35.0	34.0	33.0	n/a	35.0	39.0	35.0	34.0	37.0	36.0	37.0	36.0	36.0	35.0	36.0
Hamilton, ON	36.7	35.7	32.0	36.3	35.3	37.7	36.7	34.7	37.3	36.0	37.0	35.5	35.3	36.3	37.3
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	34.5	38.0	n/a
Kitchener, ON	39.0	40.0	35.0	40.0	37.0	40.0	38.0	36.0	38.0	37.0	39.0	n/a	37.0	38.0	39.0
Windsor, ON	35.5	35.5	33.0	39.5	36.5	39.5	38.0	36.0	38.5	38.5	40.0	37.5	38.0	38.0	39.5
St. Catharines – Niagara, ON	36.0	36.0	34.0	38.0	37.0	40.0	38.0	35.0	38.0	38.0	39.0	38.0	38.0	38.0	40.0
London, ON	38.0	43.0	38.5	41.5	38.5	41.5	40.5	37.0	40.5	39.0	40.5	40.5	40.0	40.5	41.5

Note: n/a = not available. Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.11. Data for Figure 14. Regional peak ozone concentrations, Canada, 2002 to 2016

Year	Atlantic Canada peak (4th-highest) 8-hour concentration (parts per billion)	Southern Quebec peak (4th-highest) 8-hour concentration (parts per billion)	Southern Ontario peak (4th-highest) 8-hour concentration (parts per billion)	Prairies and northern Ontario peak (4th-highest) 8-hour concentration (parts per billion)	British Columbia peak (4th-highest) 8-hour concentration (parts per billion)
2002	59.5	72.8	88.0	58.6	49.8
2003	59.6	71.4	84.5	60.2	51.9
2004	55.3	60.6	69.1	54.2	55.2
2005	53.1	67.3	81.3	54.2	49.2
2006	58.1	61.4	73.8	57.6	52.7
2007	56.9	67.2	80.8	56.6	50.0
2008	53.6	59.3	72.0	57.8	51.8
2009	54.5	55.5	66.8	56.2	51.0
2010	51.5	60.6	71.1	57.9	49.7
2011	51.1	55.6	67.4	59.3	47.4
2012	50.2	61.3	76.1	56.0	50.2
2013	50.6	57.5	65.0	56.9	47.3
2014	48.4	53.8	62.9	53.4	48.6
2015	51.6	59.9	66.2	60.9	50.8
2016	47.8	58.0	67.9	58.4	44.8
Annual trend	**-0.8**	**-1.0**	**-1.4**	**No trend**	**-0.4**

Note: The regional peak ground-level ozone indicator is based on concentrations recorded at 18 monitoring stations in Atlantic Canada, 40 in southern Quebec, 38 in southern Ontario, 29 in the Prairies and northern Ontario region, and 29 in British Columbia. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standard. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.12. Data for Figure 15. Peak ozone concentrations, selected Canadian urban areas, 2016

Urban area	2002 (parts per billion)	2003 (parts per billion)	2004 (parts per billion)	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)
Vancouver, BC	46.0	47.6	53.8	46.1	49.8	46.8	48.9	47.5	48.0	45.2	46.0	45.1	46.0	47.6	42.6
Winnipeg, MB	52.9	57.8	43.2	52.0	52.0	51.7	50.6	49.8	63.9	53.0	58.7	55.7	54.3	60.1	44.3
Yellowknife, NT	40.3	46.1	43.1	53.3	52.9	46.4	48.8	42.0	44.3	48.0	50.6	49.5	44.9	44.4	45.0
Halifax, NS	55.1	50.0	49.8	42.9	55.4	52.3	49.9	55.1	57.6	57.1	50.6	48.9	51.3	46.3	45.4
Fredericton, NB	59.9	60	61.6	52.6	64.6	63.8	58.3	54.1	50.4	48.1	50.1	50.6	48.4	55.3	45.4
St. John's, NL	55.8	52.4	50.5	47.0	49.0	51.2	53.0	46.9	47.0	51.9	49.8	50.1	45.6	54.3	46.0
Victoria, BC	46.4	48.7	49.2	49.2	53.5	53.9	51.7	50.6	43.4	44.5	48.9	47.2	47.8	46.6	46.2
Whitehorse, YT	55.8	n/a	n/a	47.5	n/a	n/a	50.8	n/a	n/a	n/a	49.6	n/a	53.1	55.1	47.1
Quebec City, QC	72.2	66.9	53.6	60.3	59.3	66.3	54.3	53.4	58.3	51.4	55.9	56.3	51.7	56.1	53.2
Saskatoon, SK	51.3	47.3	53.5	50.6	44.8	44.6	45.9	51.6	56.0	58.5	48.0	54.6	50.0	58.1	54.3
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	52.1	56.6	n/a
Edmonton, AB	69.0	61.0	57.5	54.7	61.5	61.6	62.0	62.8	59.9	61.8	54.4	60.2	53.4	61.6	57.8
Montreal, QC	72.6	73.1	58.8	67.5	60.0	66.9	58.5	55.5	60.8	55.9	62.3	56.3	52.5	61.0	58.2
Regina, SK	32.6	66.1	48.5	40.5	38.9	n/a	52.5	51.1	53.8	59.4	47.6	50.9	54.6	62.0	59.1
Ottawa, ON	75.7	67.1	55.0	72.4	67.3	70.3	66.7	59.0	61.9	54.6	65.2	58.5	53.0	61.9	59.5
Calgary, AB	58.3	56.3	53.0	48.6	54.2	55.4	53.7	58.1	53.8	55.3	53.5	59.2	52.5	62.7	59.8
Sherbrooke, QC	77.5	74.1	66.0	71.0	59.7	67.4	64.2	58.1	60.8	58.2	60.5	59.3	56.1	60.7	60.2
Gatineau, QC	75.8	79.8	67.7	78.1	65.4	69.5	66.5	56.5	63.2	55.0	68.1	61.0	57.4	64.0	62.2
Toronto, ON	86.2	85.0	68.0	79.5	72.6	80.0	71.0	67.9	71.0	65.2	74.2	65.1	61.7	65.9	67.0
St. Catharines – Niagara, ON	91.0	91.5	68.6	82.6	75.0	84.0	70.0	64.5	67.9	68.3	73.3	65.0	61.8	66.4	67.3
Oshawa, ON	83.4	82.9	60.8	84.5	70.0	86.4	64.7	63.4	75.5	65.5	71.1	63.1	60.6	62.8	67.8
Hamilton, ON	87.9	86.0	67.4	79.7	73.6	78.0	71.7	66.6	69.5	66.7	70.7	64.9	61.4	63.4	68.5
Kitchener, ON	93.5	87.4	69.5	79.4	73.1	77.4	70.9	65.1	66.9	65.6	73.5	n/a	64.9	65.1	69.3
London, ON	101.1	94.4	73.8	83.8	78.9	83.2	78.1	67.9	75.1	72.7	78.9	73.3	68.8	69.0	71.3

Urban area	2002 (parts per billion)	2003 (parts per billion)	2004 (parts per billion)	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)
Windsor, ON	95.7	92.0	73.0	91.1	79.7	92.4	77.7	69.0	73.0	80.6	82.7	66.7	69.1	69.5	73.8

Note: n/a = not available. Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.13. Data for Figure 17. Nitrogen dioxide concentrations, Canada, 2002 to 2016

Year	Average concentration (parts per billion)	Peak (98th percentile) 1-hour concentration (parts per billion)
2002	13.7	51.6
2003	13.9	50.4
2004	12.2	49.5
2005	12.0	49.6
2006	11.2	47.4
2007	11.2	45.8
2008	10.9	44.9
2009	10.2	44.1
2010	9.5	43.4
2011	9.5	42.2
2012	8.7	40.5
2013	8.7	39.7
2014	8.7	39.5
2015	8.4	39.8
2016	7.8	38.8
2020 standard	**17.0**	**60**
Annual trend	**-0.41**	**-1.00**

Note: The national average nitrogen dioxide concentration indicator is based on the annual average concentrations of the hourly averages recorded at 101 monitoring stations across Canada while the national peak indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations for nitrogen dioxide recorded at

89 monitoring stations across Canada. The Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.14. Data for Figure 18. Regional average nitrogen dioxide concentrations, Canada, 2002 to 2016

Year	Atlantic Canada average concentration (parts per billion)	Southern Quebec average concentration (parts per billion)	Southern Ontario average concentration (parts per billion)	Prairies and northern Ontario average concentration (parts per billion)	British Columbia average concentration (parts per billion)
2002	6.9	14.9	18.5	10.6	14.3
2003	7.0	16.2	17.8	10.9	14.0
2004	5.5	14.3	15.2	9.2	13.6
2005	5.1	14.0	15.6	9.1	13.0
2006	3.3	12.0	13.3	9.0	13.2
2007	4.0	12.0	12.7	9.4	12.3
2008	4.5	12.2	12.3	9.7	11.8
2009	3.4	11.0	11.2	8.9	12.1
2010	3.7	10.6	10.5	8.6	10.8
2011	4.0	11.6	10.5	8.0	10.4
2012	3.4	9.2	9.4	7.4	10.5
2013	4.3	9.1	9.3	8.0	10.2
2014	3.8	8.6	9.6	7.8	10.5
2015	3.6	8.5	9.3	7.5	10.1
2016	3.1	8.4	8.7	6.8	9.2
Annual trend	**-0.19**	**-0.52**	**-0.66**	**-0.23**	**-0.35**

Note: The regional average nitrogen dioxide indicator is based on the concentrations recorded at 7 monitoring stations in Atlantic Canada, 15 in southern Quebec, 25 in southern Ontario, 27 in the Prairies and northern Ontario region, and 26 in British Columbia. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.15. Data for Figure 19. Average nitrogen dioxide concentrations, selected Canadian urban areas, 2016

Urban area	2002 (parts per billion)	2003 (parts per billion)	2004 (parts per billion)	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.1	1.1	n/a
Yellowknife, NT	n/a	n/a	4.5	3.9	3.9	2.8	1.9	2.1	4.7	3.0	2.2	3.2	2.8	3.1	1.9
Fredericton, NB	3.9	4.8	4.1	n/a	3.1	3.6	3.3	n/a	2.8	3.4	2.4	3.4	3.2	3.2	2.4
St. John's, NL	n/a	5.6	4.6	4.7	4.0	n/a	4.7	2.8	4.3	4.0	3.8	4.5	3.9	3.2	3.5
London, ON	n/a	n/a	13.7	14.1	12.3	11.7	10.8	9.0	8.8	8.3	6.3	6.4	6.9	4.8	4.1
Halifax, NS	n/a	n/a	n/a	n/a	15.7	n/a	8.7	n/a	12.5	7.0	6.5	6.0	1.7	5.8	5.0
Whitehorse, YT	0.7	0.2	n/a	3.6	n/a	n/a	n/a	n/a	n/a	n/a	5.9	5.2	n/a	5.3	n/a
Gatineau, QC	11.1	11.3	10.6	10.0	8.2	7.9	8.6	7.9	6.6	6.9	6.1	6.3	5.6	5.6	5.9
Kitchener, ON	n/a	n/a	13.1	12.9	10.8	9.7	9.0	8.6	7.7	7.7	7.1	6.7	7.0	6.8	6.2
Ottawa, ON	27.1	17.9	16.8	9.8	8.6	8.3	9.8	7.6	6.8	7.3	7.2	7.3	6.7	6.6	6.3
Oshawa, ON	17.2	16.2	14.2	n/a	8.9	8.1	n/a	7.4	7.2	7.0	5.6	5.9	6.8	6.6	6.3
Quebec City, QC	14.1	15.4	13.5	12.6	n/a	12.4	13.2	11.2	7.9	8.4	9.1	8.8	9.1	8.7	6.6
St. Catharines – Niagara, ON	n/a	n/a	n/a	n/a	11.7	12.0	10.4	9.9	9.1	8.5	8.0	7.7	7.3	7.3	6.6
Victoria, BC	10.4	8.4	n/a	8.2	5.4	6.3	6.5	10.6	9.9	6.8	7.0	7.2	6.7	8.6	6.7
Regina, SK	13.9	13.9	11.6	12.1	14.7	12.0	10.8	10.1	10.9	9.4	9.3	9.3	11.0	n/a	7.3
Edmonton, AB	17.2	16.9	11.8	10.8	10.1	9.6	10.2	10.5	10.2	8.2	7.6	8.5	8.0	8.3	7.8
Winnipeg, MB	12.1	12.0	11.0	9.9	10.1	10.4	11.7	11.6	8.1	9.7	7.8	7.6	5.9	7.0	8.0
Barrie, ON	14.4	14.8	13.3	13.8	12.6	11.4	10.8	9.9	8.7	8.6	8.1	7.8	8.1	7.4	8.1
Montreal, QC	16.1	17.7	15.8	15.3	13.0	13.1	13.4	11.8	11.1	11.7	10.1	9.9	9.3	8.5	8.9
Saskatoon, SK	11.7	11.7	11.8	9.9	10.5	n/a	8.5	10.3	11.1	11.4	10.5	11.1	9.7	8.2	8.9
Hamilton, ON	19.4	17.9	16.1	18.3	16.6	15.0	12.9	12.0	11.3	12.1	10.9	11.3	11.3	11.0	10.5
Vancouver, BC	16.2	16.0	14.9	15.3	14.4	13.8	13.3	13.7	11.9	11.5	11.6	11.6	11.5	11.1	10.6
Windsor, ON	19.4	23.3	18.0	17.0	16.5	16.7	15.7	13.8	15.1	13.7	12.3	12.0	12.9	11.8	11.0
Toronto, ON	20.0	21.1	18.5	19.2	17.1	16.6	15.4	15.2	13.7	13.7	12.2	11.9	12.3	11.9	11.2

Urban area	2002 (parts per billion)	2003 (parts per billion)	2004 (parts per billion)	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)
Calgary, AB	22.4	23.5	20.7	20.1	19.7	19.0	21.5	18.8	17.6	17.3	12.1	13.7	15.0	15.4	12.2

Note: n/a = not available. Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.16. Data for Figure 21. Regional peak nitrogen dioxide concentrations, Canada, 2002 to 2016

Year	Atlantic Canada peak (98th percentile) 1-hour concentration (parts per billion)	Southern Quebec peak (98th percentile) 1-hour concentration (parts per billion)	Southern Ontario peak (98th percentile) 1-hour concentration (parts per billion)	Prairies and northern Ontario peak (98th percentile) 1-hour concentration (parts per billion)	British Columbia peak (98th percentile) 1-hour concentration (parts per billion)
2002	49.5	59.2	61.9	44.3	45.4
2003	42.4	59.3	62.4	45.0	44.2
2004	38.8	56.5	62.8	44.0	43.7
2005	38.7	57.6	61.6	43.9	42.7
2006	35.2	52.6	57.8	43.1	42.9
2007	32.8	50.9	54.0	42.7	40.8
2008	33.2	49.5	51.5	42.9	40.4
2009	32.5	50.3	49.8	41.2	39.6
2010	33.5	48.1	47.7	43.2	38.7
2011	31.2	48.4	47.0	43.4	36.3
2012	28.8	45.5	44.5	42.0	35.1
2013	29.4	42.6	43.4	41.7	35.4
2014	30.5	41.3	43.8	40.8	35.9
2015	30.8	42.2	45.4	40.1	35.3
2016	29.3	42.1	45.1	37.5	35.2
Annual trend	**-0.91**	**-0.37**	**-1.66**	**-0.34**	**-0.78**

Note: The regional peak nitrogen dioxide indicator is based on the concentrations recorded at 6 monitoring stations in Atlantic Canada, 15 in southern Quebec, 22 in southern Ontario, 21 in the Prairies and northern Ontario region, and 25 in British Columbia. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.17. Data for Figure 22. Peak nitrogen dioxide concentrations, selected Canadian urban areas, 2016

Urban area	2002 (parts per billion)	2003 (parts per billion)	2004 (parts per billion)	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12.5	n/a
Halifax, NS	67.0	n/a	n/a	n/a	64.0	64.0	n/a	n/a	n/a	45.0	29.0	27.5	27.0	28.0	26.0
Yellowknife, NT	n/a	n/a	n/a	35.0	33.0	30.0	27.0	24.0	24.0	25.0	28.0	30.0	28.0	28.0	27.0
London, ON	73.0	n/a	n/a	53.0	52.0	51.0	48.0	46.0	45.0	45.0	39.0	n/a	37.0	38.0	28.0
St. John's, NL	47.0	46.0	33.0	32.5	31.0	27.0	30.0	29.0	30.0	30.0	30.0	30.5	32.5	32.5	30.5
Victoria, BC	38.0	41.0	42.0	37.0	30.0	n/a	23.5	41.0	40.0	38.0	30.5	31.0	32.5	32.0	32.0
Fredericton, NB	n/a	35.0	35.0	38.0	34.0	32.0	34.0	37.0	37.0	34.0	33.0	34.0	33.0	35.0	32.0
Oshawa, ON	63.0	62.0	59.0	60.0	n/a	39.0	n/a	38.0	36.0	38.0	35.0	33.0	32.0	36.0	37.0
Vancouver, BC	47.8	47.3	46.9	46.5	45.6	44.5	43.0	42.8	41.0	38.9	37.4	37.6	38.4	37.6	37.7
Whitehorse, YT	n/a	5.0	5.0	15.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	40.0	40.0	38.0	n/a
St. Catharines – Niagara, ON	67.0	n/a	n/a	n/a	n/a	49.0	48.0	47.0	43.0	40.0	38.0	38.0	39.0	40.0	39.0
Gatineau, QC	48.0	49.0	48.0	49.0	47.0	44.0	43.0	43.0	42.0	40.0	36.0	36.0	36.0	37.0	39.0
Edmonton, AB	58.8	59.0	58.0	54.7	45.5	46.8	47.9	48.6	52.5	45.2	43.4	41.8	41.8	42.2	39.5
Kitchener, ON	48.0	59.0	66.0	64.0	58.0	52.0	47.0	46.0	46.0	45.0	41.0	40.0	40.0	43.0	41.0
Ottawa, ON	76.0	85.5	82.0	55.0	46.0	45.0	46.5	46.0	45.0	41.5	40.5	41.5	42.0	43.0	42.0
Winnipeg, MB	51.0	50.0	48.0	47.5	46.0	49.0	49.5	63.0	55.0	54.0	48.0	48.0	43.5	41.5	43.0
Montreal, QC	63.5	62.8	58.8	60.1	54.5	52.7	51.3	52.3	49.8	48.8	46.3	44.6	43.2	44.4	43.5
Quebec City, QC	59.0	58.0	58.0	59.0	57.0	55.0	57.0	56.0	53.0	43.3	47.0	46.0	43.0	43.0	44.0
Saskatoon, SK	n/a	49.0	49.0	49.0	47.0	n/a	40.0	43.0	46.0	52.0	51.0	50.0	48.0	45.0	45.0
Hamilton, ON	60.0	63.0	61.0	60.0	58.0	58.0	53.7	51.3	48.7	46.7	45.0	45.0	45.3	46.5	45.3

Urban area	2002 (parts per billion)	2003 (parts per billion)	2004 (parts per billion)	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)
Windsor, ON	64.0	66.0	65.5	63.0	57.5	54.5	53.0	52.0	53.5	54.5	53.0	49.5	48.5	48.5	46.0
Barrie, ON	n/a	64.0	62.0	67.0	61.0	59.0	55.0	52.0	50.0	46.0	43.0	41.0	43.0	45.0	48.0
Toronto, ON	66.3	65.8	67.1	66.3	63.6	62.1	58.9	56.3	53.2	52.2	50.1	48.8	50.0	51.0	50.7
Regina, SK	55.0	54.0	51.0	51.0	59.0	59.0	59.0	52.0	54.0	51.0	48.0	45.0	n/a	n/a	51.0
Calgary, AB	69.3	70.7	71.3	68.7	67.0	64.0	65.3	62.5	67.0	67.0	59.5	58.0	56.5	56.5	52.0

Note: n/a = not available. Census metropolitan areas and census agglomerations were used to define the larger urban areas for this indicator. Only the 25 urban areas with sufficient data for the most populated municipalities in Canada and the provincial and territorial capitals are included.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.18. Data for Figure 24. Sulphur dioxide concentrations, Canada, 2002 to 2016

Year	Average concentration (parts per billion)	Peak (99th percentile) 1-hour concentration (parts per billion)
2002	2.8	60.8
2003	2.6	59.8
2004	2.3	60.2
2005	2.2	63.1
2006	2.1	58.8
2007	2.2	56.7
2008	1.9	56.0
2009	1.7	49.4
2010	1.5	50.5
2011	1.5	36.5
2012	1.5	37.6
2013	1.3	36.3
2014	1.3	33.6
2015	1.1	31.8
2016	1.0	29.4
2020 standard	**5.0**	**70**
Annual trend	**-0.11**	**-2.51**

Note: The national average sulphur dioxide concentration indicator is based on the annual average concentrations of the hourly averages recorded at 65 monitoring stations across Canada while the national peak indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations for sulphur dioxide recorded at 68 monitoring stations across Canada. The Canadian Ambient Air Quality Standards are provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.19. Data for Figure 25. Regional average sulphur dioxide concentrations, Canada, 2002 to 2016

Year	Atlantic Canada average concentration (parts per billion)	Southern Quebec average concentration (parts per billion)	Southern Ontario average concentration (parts per billion)	Prairies and northern Ontario average concentration (parts per billion)	British Columbia average concentration (parts per billion)
2002	5.7	4.3	6.0	1.7	2.0
2003	4.2	4.6	5.2	1.6	1.9
2004	3.5	4.3	3.6	1.6	1.8
2005	3.3	4.3	3.9	1.5	1.8
2006	2.6	3.6	3.8	1.4	2.0
2007	3.4	2.7	3.6	1.7	1.7

Year	Atlantic Canada average concentration (parts per billion)	Southern Quebec average concentration (parts per billion)	Southern Ontario average concentration (parts per billion)	Prairies and northern Ontario average concentration (parts per billion)	British Columbia average concentration (parts per billion)
2008	1.3	2.8	3.3	1.5	1.9
2009	1.1	2.0	2.4	1.3	1.9
2010	0.7	1.8	2.2	1.2	1.6
2011	1.2	1.6	3.0	0.9	1.6
2012	1.5	2.1	2.4	0.9	1.6
2013	1.1	1.8	2.2	0.9	1.4
2014	0.9	1.7	2.3	1.0	1.2
2015	0.7	1.5	2.0	1.0	1.0
2016	0.6	1.7	1.5	0.8	1.0
Annual trend	**-0.38**	**-0.26**	**-0.28**	**-0.08**	**-0.05**

Note: The regional average sulphur dioxide indicator is based on the concentrations recorded at 5 monitoring stations in Atlantic Canada, 7 in southern Quebec, 7 in southern Ontario, 24 in the Prairies and northern Ontario region, and 21 in British Columbia. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.20. Data for Figure 27. Regional peak sulphur dioxide concentrations, Canada, 2002 to 2016

Year	Atlantic Canada peak (99th percentile) 1-hour concentration (parts per billion)	Southern Quebec peak (99th percentile) 1-hour concentration (parts per billion)	Southern Ontario peak (99th percentile) 1-hour concentration (parts per billion)	Prairies and northern Ontario peak (99th percentile) 1-hour concentration (parts per billion)	British Columbia peak (99th percentile) 1-hour concentration (parts per billion)
2002	69.0	55.5	88.7	71.4	45.1
2003	70.7	96.9	87.0	57.7	41.5
2004	61.8	101.2	87.0	65.0	35.1
2005	75.5	79.9	84.4	74.4	37.2
2006	73.8	83.4	78.4	59.0	42.1
2007	56.4	62.3	67.3	75.4	32.7
2008	36.8	53.7	68.9	70.5	40.8
2009	56.2	52.1	53.6	55.2	40.5
2010	35.7	54.0	53.5	66.4	34.5
2011	27.8	43.6	51.5	36.0	32.5
2012	28.5	52.1	54.8	33.0	33.6
2013	28.7	44.5	59.0	33.9	32.3

Year	Atlantic Canada peak (99th percentile) 1-hour concentration (parts per billion)	Southern Quebec peak (99th percentile) 1-hour concentration (parts per billion)	Southern Ontario peak (99th percentile) 1-hour concentration (parts per billion)	Prairies and northern Ontario peak (99th percentile) 1-hour concentration (parts per billion)	British Columbia peak (99th percentile) 1-hour concentration (parts per billion)
2014	32.2	41.4	61.3	33.0	22.6
2015	22.7	38.6	53.6	33.3	23.7
2016	18.6	44.6	48.0	30.4	21.9
Annual trend	**-4.0**	**-3.2**	**-2.9**	**-3.0**	**-1.4**

Note: The peak sulphur dioxide indicator is based on the concentrations recorded at 6 monitoring stations in Atlantic Canada, 7 in southern Quebec, 6 in southern Ontario, 18 in the Prairies and northern Ontario region, and 22 in British Columbia. The Canadian Ambient Air Quality Standard is provided for illustrative purposes only and not for assessing the achievement status of the standards. Reporting of the achievement of the standards is done within specific jurisdictions using 3-year averages. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.21. Data for Figure 29. Volatile organic compounds concentrations, Canada, 2002 to 2016

Year	Average concentration (parts per billion carbon)
2002	91.3
2003	119.9
2004	108.6
2005	84.8
2006	92.2
2007	87.2
2008	84.9
2009	90.9
2010	80.7
2011	75.7
2012	65.9
2013	70.3
2014	65.1
2015	67.8
2016	58.4
Annual trend	**-3.3**

Note: The national average volatile organic compounds concentration indicator is based on the annual average of the daily concentrations recorded at 38 monitoring stations across Canada. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Table A.22. Data for Figure 30. Regional average volatile organic compounds concentrations, Canada, 2002 to 2016

Year	Atlantic Canada average concentration (parts per billion carbon)	Southern Quebec average concentration (parts per billion carbon)	Southern Ontario average concentration (parts per billion carbon)	Prairies and northern Ontario average concentration (parts per billion carbon)	British Columbia average concentration (parts per billion carbon)
2002	103.6	74.4	68.3	150.6	114.9
2003	148.1	77.8	75.0	156.7	219.1
2004	110.0	63.4	62.6	141.5	275.5
2005	117.3	60.6	62.9	137.1	98.8
2006	123.1	60.8	60.7	136.1	161.8
2007	58.0	60.8	56.0	119.9	186.5
2008	111.5	47.6	44.7	148.0	139.8
2009	135.0	42.7	43.7	121.4	195.0
2010	88.7	44.8	41.1	109.1	189.9
2011	74.5	39.3	30.8	108.9	125.9
2012	100.7	37.6	42.3	109.2	94.1
2013	85.8	36.8	41.9	140.1	110.9
2014	85.1	36.7	38.7	107.4	113.1
2015	80.8	37.2	46.3	110.5	110.6
2016	65.5	35.2	37.1	93.8	85.4
Annual trend	**-3.7**	**-3.0**	**-2.5**	**-3.9**	**-7.2**

Note: The average volatile organic compoundsconcentration indicator is based on the concentrations recorded at 5 monitoring stations in Atlantic Canada, 9 in southern Quebec, 13 in southern Ontario, 5 in the Prairies and northern Ontario region, and 6 in British Columbia. For more information on the indicators, consult the Air quality indicators definitions in the Methods section.
Source: Environment and Climate Change Canada (2018) National Air Pollution Surveillance Program.

Annex B. Monitoring stations used for the national and regional indicators

Table B.1. Legend for Table B.3. Air quality monitoring stations used in calculation of national and regional indicators

Column	Description
NAPS ID	National Air Pollution Surveillance monitoring station identifier. Please consult the National Air Pollution Surveillance Data Products web page for the location and parameters of the National Air Pollution Surveillance stations.
Average fine particulate matter	The station contributes data to the time series trend analysis for annual average fine particulate matter in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Peak fine particulate matter	The station contributes data to the time series trend analysis for annual peak (98th percentile) 24-hour fine particulate matter in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Average ozone	The station contributes data to the time series trend analysis for annual average ozone in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Peak ozone	The station contributes data to the time series trend analysis for annual peak (4th-highest) 8-hour ozone in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Average sulphur dioxide	The station contributes data to the time series trend analysis for annual average sulphur dioxide in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Peak sulphur dioxide	The station contributes data to the time series trend analysis for annual peak (99th percentile) 1-hour sulphur dioxide in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Average nitrogen dioxide	The station contributes data to the time series trend analysis for annual average nitrogen dioxide in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Peak nitrogen dioxide	The station contributes data to the time series trend analysis for annual peak (98th percentile) daily maximum 1-hour nitrogen dioxide in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Volatile organic compounds	The station contributes data to the time series trend analysis for annual average volatile organic compounds in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).

Table B.2. Acronyms for Table B.3. Air quality monitoring stations used in calculation of national and regional indicators

Description	Acronym
Atlantic Region regional indicator	ATL
Southern Quebec regional indicator	SQC
Southern Ontario regional indicator	SON
Prairies and northern Ontario regional indicator	PNO
British Columbia regional indicator	BCO
Stations only used in calculation of the national indicator	NAT

Table B.3. Air quality monitoring stations used in calculation of national and regional indicators

NAPS ID	City	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak sulphur dioxide	Average sulphur dioxide	Peak nitrogen dioxide	Average nitrogen dioxide	Volatile organic compounds
10102	St. John's	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL
10301	Corner Brook	ATL[A]	ATL[A]	ATL[A]	ATL[A]	n/a	n/a	ATL[A]	ATL[A]	n/a
10401	Mount Pearl	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL	n/a
10602	Corner Brook	ATL[A]	ATL[A]	ATL[A]	ATL[A]	n/a	n/a	ATL[A]	ATL[A]	n/a
30118	Halifax	n/a	n/a	ATL	ATL	ATL[A]	ATL[A]	n/a	n/a	ATL
30120	Halifax	ATL	ATL	n/a	n/a	ATL[A]	ATL[A]	n/a	n/a	n/a
30302	Sydney	n/a	n/a	ATL[A]	ATL[A]	n/a	n/a	n/a	n/a	n/a
30310	Sydney	n/a	n/a	ATL[A]	ATL[A]	n/a	ATL	n/a	n/a	n/a
30501	Kejimkujik	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
30701	Aylesford	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
30901	Pictou	n/a	n/a	n/a	ATL	n/a	n/a	n/a	n/a	n/a
40103	Fredericton	ATL	ATL	ATL	ATL	n/a	n/a	ATL	ATL	n/a
40203	Saint John	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL
40206	Saint John	n/a	n/a	ATL	ATL	ATL	ATL	ATL	ATL	n/a
40207	Saint John	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
40208	Saint John	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	ATL
40302	Moncton	ATL	ATL	ATL	ATL	n/a	n/a	ATL	n/a	n/a
40501	Point Lepreau	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	ATL
40701	Norton - Kings County	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
40901	St. Andrews	ATL	ATL	ATL	ATL	n/a	n/a	n/a	n/a	n/a
41101	St. Leonard	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
41201	Lower Newcastle	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
50103	Montreal	n/a	n/a	SQC	SQC	SQC	SQC	SQC	SQC	SQC
50104	Montreal	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	SQC[A]	SQC[A]
50105	Montreal	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a

NAPS ID	City	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak sulphur dioxide	Average sulphur dioxide	Peak nitrogen dioxide	Average nitrogen dioxide	Volatile organic compounds
50109	Montreal	SQC	SQC	SQC	SQC	n/a	n/a	SQC	SQC	n/a
50110	Montreal	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	SQC[A]	n/a
50113	Laval	SQC	SQC	SQC	SQC	n/a	n/a	SQC	SQC	n/a
50115	Montreal	n/a	n/a	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC	SQC[A]
50116	Montreal	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	SQC	n/a
50119	Longueuil	n/a	n/a	SQC	SQC	n/a	n/a	SQC	SQC	n/a
50121	Longueuil	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC	SQC	SQC	SQC	SQC[A]
50122	Brossard	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	SQC[A]
50126	Montreal	SQC	SQC	SQC	SQC	n/a	n/a	SQC	SQC	n/a
50128	Montreal	SQC	SQC	SQC	SQC	n/a	n/a	SQC	SQC	n/a
50129	Montreal	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	SQC
50131	Montreal	SQC	SQC	n/a	n/a	n/a	n/a	n/a	n/a	n/a
50134	Montreal	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	SQC[A]	SQC[A]
50135	Montreal	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	SQC[A]	n/a
50136	Montreal	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	SQC[A]
50138	Montreal	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	n/a	n/a
50204	Gatineau	SQC	SQC	SQC	SQC	SQC	SQC	SQC	SQC	n/a
50308	Quebec City	SQC	SQC	SQC	SQC	SQC	SQC	SQC	SQC	n/a
50309	Quebec City	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
50310	Quebec City	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
50311	Quebec City	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
50404	Sherbrooke	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
50504	Saguenay	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
50604	Rouyn-Noranda	SQC	SQC	SQC	SQC	SQC	SQC	n/a	n/a	n/a
50801	Trois-Rivières	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
50802	Trois-Rivières	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
50803	Trois Rivières	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
50902	Saguenay	n/a	n/a	n/a	n/a	SQC	SQC	n/a	n/a	n/a
51501	St. Zephirin-de-Courval	n/a	n/a	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52001	Charette	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52201	Saint-Simon	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52301	Saint-Faustin-Lac-Carre	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52401	La Peche	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52601	Varennes	n/a	n/a	SQC	SQC	n/a	n/a	SQC	SQC	n/a
53201	La Dore	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53301	Deschambault	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53501	Saint-François	n/a	n/a	SQC	SQC	n/a	n/a	n/a	n/a	n/a

NAPS ID	City	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak sulphur dioxide	Average sulphur dioxide	Peak nitrogen dioxide	Average nitrogen dioxide	Volatile organic compounds
53601	Notre-Dame-du-Rosaire	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53701	St-Hilaire-de-Dorset	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53801	Tingwick	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53901	Lac-Edouard	n/a	n/a	SQC	SQC	n/a	n/a	n/a	n/a	n/a
54102	Sutton	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	SQC
54401	Saint-Anicet	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	SQC
54501	L'Assomption	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	SQC
54801	Stukely-Sud	n/a	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
54901	La Patrie	n/a	n/a	SQC	SQC	n/a	n/a	n/a	n/a	n/a
55001	Ferme Neuve	n/a	n/a	SQC	SQC	n/a	n/a	n/a	n/a	n/a
55201	Lemieux	n/a	SQC	SQC	SQC	n/a	n/a	n/a	n/a	SQC
55301	Saint-Jean-sur-Richelieu	SQC	SQC	SQC	SQC	n/a	n/a	SQC	SQC	n/a
60104	Ottawa	SON	SON	SON	SON	SON	SON	SON	SON	SON
60204	Windsor	SON	SON	SON	SON	SON	SON	SON	SON	n/a
60211	Windsor	SON	SON	SON	SON	n/a	n/a	SON	SON	SON
60302	Kingston	n/a	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60303	Kingston	n/a	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60304	Kingston	n/a	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60410	Toronto	SON	SON	SON	SON	n/a	n/a	SON	SON	n/a
60413	Toronto	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	SON
60415	Mississauga	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	n/a	n/a
60421	Toronto	SON	SON	SON	SON	n/a	n/a	SON	SON	n/a
60424	Toronto	n/a	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	n/a
60427	Toronto	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	SON
60428	Brampton	SON	SON	SON	SON	n/a	n/a	SON	SON	SON
60429	Toronto	n/a	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	SON[A]
60430	Toronto	SON	SON	SON	SON	SON	SON	SON	SON	n/a
60432	Mississauga	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60433	Toronto	SON	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	n/a
60434	Mississauga	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	n/a	n/a
60435	Toronto	n/a	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	SON[A]
60512	Hamilton	SON	SON	SON	SON	SON	SON	SON	SON	SON
60513	Hamilton	SON	SON	SON	SON	SON	SON	SON	n/a	n/a
60607	Sudbury	n/a	n/a	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60609	Sudbury	n/a	n/a	SON[A]	SON[A]	n/a	SON[A]	n/a	n/a	n/a
60610	Sudbury	n/a	n/a	SON[A]	SON[A]	n/a	SON[A]	n/a	n/a	n/a

NAPS ID	City	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak sulphur dioxide	Average sulphur dioxide	Peak nitrogen dioxide	Average nitrogen dioxide	Volatile organic compounds
60707	Sault Ste. Marie	n/a	n/a	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	n/a
60709	Sault Ste. Marie	SON	SON	SON[A]	SON[A]	SON	SON	SON[A]	SON[A]	n/a
60807	Thunder Bay	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a	n/a	PNO[A]	PNO[A]	n/a
60809	Thunder Bay	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a	n/a	PNO[A]	PNO[A]	n/a
60903	London	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	SON[A]
60904	London	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	SON[A]
61004	Sarnia	SON	SON	SON	SON	SON	SON	SON	SON	SON[A]
61009	Sarnia	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	SON[A]
61104	Peterborough	SON	SON	SON	SON	n/a	n/a	SON	SON	n/a
61201	Cornwall	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
61302	St. Catharines	SON	SON	SON	SON	n/a	n/a	n/a	SON	n/a
61402	Brantford	SON	SON	SON	SON	n/a	n/a	SON	n/a	n/a
61502	Kitchener	SON	SON	SON	SON	n/a	n/a	SON	SON	SON
61602	Oakville	n/a	n/a	SON[A]	SON[A]	n/a	n/a	n/a	SON[A]	n/a
61603	Oakville	SON	SON	SON[A]	SON[A]	n/a	n/a	SON	SON[A]	n/a
61701	Oshawa	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	n/a
61702	Oshawa	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	n/a
61802	Guelph	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
62001	North Bay	SON	SON	SON	SON	n/a	n/a	SON	n/a	n/a
62501	Tiverton	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
62601	Simcoe	SON	SON	SON	SON	n/a	n/a	n/a	n/a	SON
63001	Burlington	SON	SON	SON	SON	n/a	n/a	SON	SON	n/a
63201	Stouffville	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	SON[A]
63301	Dorset	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
63601	Longwoods	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	SON
63701	Grand Bend	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
64001	Exp. Lakes Area	n/a	n/a	PNO	PNO	n/a	n/a	n/a	n/a	n/a
64101	Algoma	n/a	n/a	SON	SON	n/a	n/a	n/a	n/a	n/a
64401	Egbert	n/a	n/a	SON	SON	n/a	n/a	n/a	n/a	n/a
65001	Barrie	SON	SON	SON	SON	n/a	n/a	SON	SON	n/a
65101	Newmarket	SON	SON	SON	SON	n/a	n/a	SON	SON	SON[A]
65201	Parry Sound	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
65301	Port Stanley	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
65401	Belleville	SON	SON	SON	SON	n/a	n/a	SON	SON	n/a
70118	Winnipeg	PNO	PNO	PNO	PNO	n/a	n/a	PNO	PNO	n/a
70119	Winnipeg	PNO	PNO	PNO	PNO	n/a	n/a	PNO	PNO	PNO
70203	Brandon	PNO	PNO	PNO	PNO	n/a	n/a	PNO	PNO	n/a
70301	Flin Flon	n/a	n/a	n/a	n/a	PNO	PNO	n/a	n/a	n/a

NAPS ID	City	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak sulphur dioxide	Average sulphur dioxide	Peak nitrogen dioxide	Average nitrogen dioxide	Volatile organic compounds
80110	Regina	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]
80111	Regina	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]
80211	Saskatoon	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90121	Edmonton	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO
90130	Edmonton	PNO	PNO	PNO	PNO	n/a	n/a	PNO	PNO	PNO
90222	Calgary	PNO	PNO	PNO	PNO	n/a	n/a	PNO	PNO	n/a
90227	Calgary	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a	n/a	PNO[A]	PNO[A]	PNO[A]
90228	Calgary	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a	n/a	PNO[A]	PNO[A]	PNO[A]
90230	Calgary	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a	n/a	PNO[A]	n/a	n/a
90302	Red Deer	PNO	PNO	PNO	PNO	n/a	PNO	PNO	PNO	n/a
90402	Medicine Hat	n/a	n/a	PNO	PNO	n/a	n/a	n/a	n/a	n/a
90502	Lethbridge	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a
90601	Fort Saskatchewan	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90602	Fort Saskatchewan	n/a	n/a	n/a	n/a	PNO	PNO	PNO	n/a	n/a
90603	Fort Saskatchewan	n/a	n/a	n/a	n/a	PNO	PNO	PNO	n/a	n/a
90701	Fort McMurray	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90702	Fort McMurray	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90801	Fort MacKay	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90802	Fort MacKay	n/a	n/a	n/a	n/a	PNO	PNO	n/a	n/a	n/a
90803	Fort MacKay	n/a	n/a	n/a	n/a	PNO	PNO	n/a	n/a	n/a
90804	Fort MacKay	n/a	n/a	n/a	n/a	PNO	PNO	n/a	n/a	n/a
90805	Fort MacKay	n/a	n/a	n/a	n/a	PNO	PNO	n/a	n/a	n/a
90806	Fort MacKay	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a
91001	Esther	n/a	n/a	PNO	PNO	n/a	n/a	n/a	n/a	n/a
91101	Elk Island	PNO	PNO	PNO	PNO	n/a	n/a	n/a	n/a	n/a
91301	Tomahawk	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91401	Violet Grove	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91501	Beaverlodge	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91601	Carrot Creek	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91801	Fort Chipewyan	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91901	Caroline	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a
92001	Grande Prairie	n/a	n/a	PNO	PNO	n/a	n/a	n/a	n/a	n/a
92201	Lamont	n/a	n/a	PNO	PNO	PNO	PNO	PNO	n/a	n/a
92301	Redwater	n/a	n/a	n/a	n/a	PNO	PNO	PNO	n/a	n/a
100110	Metro Vancouver – Burnaby	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100111	Metro Vancouver – Port Moody	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	BCO
100112	Metro Vancouver –	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a

NAPS ID	City	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak sulphur dioxide	Average sulphur dioxide	Peak nitrogen dioxide	Average nitrogen dioxide	Volatile organic compounds
	Vancouver									
100118	Metro Vancouver – Vancouver	n/a	n/a	n/a	n/a	n/a	n/a	BCO	BCO	n/a
100119	Metro Vancouver – Burnaby	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO
100121	Metro Vancouver – North Vancouver	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100125	Metro Vancouver – Delta	n/a	n/a	BCO	BCO	n/a	n/a	BCO	BCO	n/a
100126	Metro Vancouver – Burnaby	n/a	n/a	BCO	BCO	n/a	n/a	BCO	BCO	n/a
100127	Metro Vancouver – Surrey	n/a	n/a	BCO	BCO	n/a	n/a	BCO	BCO	n/a
100128	Metro Vancouver – Richmond	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100132	Metro Vancouver – North Vancouver	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100133	Metro Vancouver – Burnaby	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	BCO
100134	Metro Vancouver – Richmond	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO
100135	Metro Vancouver – Coquitlam	n/a	n/a	BCO	BCO	n/a	n/a	BCO	BCO	n/a
100136	Metro Vancouver – Burnaby	n/a	n/a	n/a	n/a	BCO	BCO	n/a	n/a	n/a
100137	Metro Vancouver – Burnaby	n/a	n/a	n/a	n/a	BCO	BCO	n/a	n/a	BCO
100138	Metro Vancouver – West Vancouver	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
100202	Prince George	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100304	Victoria	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100401	Kamloops	BCO[A]	BCO[A]	n/a	BCO[A]	BCO[A]	BCO[A]	n/a	n/a	n/a
100402	Kamloops	BCO[A]	BCO[A]	n/a	BCO[A]	BCO[A]	BCO[A]	n/a	n/a	n/a
100701	Kelowna	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
101003	Metro Vancouver – Abbotsford	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
101101	Metro Vancouver – Chilliwack	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
101202	Metro Vancouver – Pitt Meadows	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
101301	Metro Vancouver – Langley	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
101401	Metro Vancouver – Hope	n/a	n/a	BCO	BCO	n/a	n/a	BCO	BCO	n/a

NAPS ID	City	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak sulphur dioxide	Average sulphur dioxide	Peak nitrogen dioxide	Average nitrogen dioxide	Volatile organic compounds
101501	Metro Vancouver – Maple Ridge	n/a	n/a	BCO	BCO	n/a	n/a	BCO	BCO	n/a
101701	Quesnel	BCO	BCO	BCO	BCO	n/a	n/a	BCO	n/a	n/a
101702	Quesnel	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
102001	Saturna	n/a	n/a	BCO	BCO	n/a	n/a	n/a	n/a	BCO
102102	Nanaimo	BCO	BCO	BCO	BCO	n/a	n/a	n/a	n/a	n/a
102201	Trail	n/a	n/a	n/a	n/a	BCO	BCO	n/a	n/a	n/a
102301	Powell River	n/a	n/a	n/a	n/a	n/a	n/a	BCO	BCO	n/a
102401	Smithers	n/a	n/a	BCO	BCO	n/a	n/a	n/a	n/a	n/a
102701	Williams Lake	BCO	BCO	BCO	BCO	n/a	n/a	BCO	n/a	n/a
103202	Golden	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
103901	Kitimat	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
104003	Vernon	BCO	BCO	BCO	BCO	n/a	n/a	BCO	BCO	n/a
104301	Taylor	n/a	n/a	n/a	n/a	BCO	BCO	n/a	n/a	n/a
105001	Whistler	n/a	n/a	BCO	BCO	n/a	n/a	n/a	n/a	n/a
105101	Houston	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
105301	Langdale	n/a	n/a	n/a	n/a	BCO	BCO	n/a	BCO	n/a
119003	Whitehorse	TER[A]	TER[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
119004	Whitehorse	TER[A]	TER[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
129002	Yellowknife	n/a	n/a	n/a	TER[A]	n/a	n/a	n/a	n/a	n/a
129003	Yellowknife	n/a	TER	TER	TER[A]	TER	TER	TER	n/a	n/a

Note: n/a = not available. [A] The pollutant concentrations for the station were merged for imputation with concentrations from stations located nearby to satisfy data completeness criteria. See Annex C for details.

Annex C. Monitoring station imputations

Table C.1. Imputations of neighbouring stations for the national and regional average fine particulate matter indicators

NAPS ID	Province	City	Combination grouping ID
10301	Newfoundland And Labrador	Corner Brook	A
10602	Newfoundland And Labrador	Corner Brook	A
50105	Quebec	Montreal	B
50110	Quebec	Montreal	C
50121	Quebec	Longueuil	D
50122	Quebec	Brossard	D
50135	Quebec	Montreal	C
50136	Quebec	Montreal	B
50801	Quebec	Trois-Rivières	E
50802	Quebec	Trois-Rivières	E
50803	Quebec	Trois Rivières	E
60415	Ontario	Mississauga	F
60432	Ontario	Mississauga	F
60434	Ontario	Mississauga	F
60807	Ontario	Thunder Bay	G
60809	Ontario	Thunder Bay	G
60903	Ontario	London	H
60904	Ontario	London	H
61701	Ontario	Oshawa	J
61702	Ontario	Oshawa	J
80110	Saskatchewan	Regina	K
80111	Saskatchewan	Regina	K
90227	Alberta	Calgary	L
90228	Alberta	Calgary	L
90230	Alberta	Calgary	L
100401	British Columbia	Kamloops	M
100402	British Columbia	Kamloops	M
119003	Yukon	Whitehorse	N
119004	Yukon	Whitehorse	N

Table C.2. Imputations of neighbouring stations for the national and regional peak (98th percentile) 24-hour fine particulate matter indicators

NAPS ID	Province	City	Combination grouping ID
10301	Newfoundland And Labrador	Corner Brook	A
10602	Newfoundland And Labrador	Corner Brook	A
50105	Quebec	Montreal	B
50136	Quebec	Montreal	B
50110	Quebec	Montreal	C
50135	Quebec	Montreal	C
50121	Quebec	Longueuil	D
50122	Quebec	Brossard	D
50801	Quebec	Trois-Rivières	E
50802	Quebec	Trois-Rivières	E
50803	Quebec	Trois Rivières	E
60302	Ontario	Kingston	F
60303	Ontario	Kingston	F
60304	Ontario	Kingston	F
60429	Ontario	Toronto	G
60435	Ontario	Toronto	G
60415	Ontario	Mississauga	H
60432	Ontario	Mississauga	H
60434	Ontario	Mississauga	H
60424	Ontario	Toronto	I
60433	Ontario	Toronto	I
60807	Ontario	Thunder Bay	K
60809	Ontario	Thunder Bay	K
60903	Ontario	London	L
60904	Ontario	London	L
61701	Ontario	Oshawa	M
61702	Ontario	Oshawa	M
80110	Saskatchewan	Regina	N
80111	Saskatchewan	Regina	N
90227	Alberta	Calgary	O
90228	Alberta	Calgary	O
90230	Alberta	Calgary	O
100401	British Columbia	Kamloops	P
100402	British Columbia	Kamloops	P

NAPS ID	Province	City	Combination grouping ID
119003	Yukon	Whitehorse	Q
119004	Yukon	Whitehorse	Q

Table C.3. Imputations of neighbouring stations for the national and regional average ground-level ozone indicators

NAPS ID	Province	City	Combination grouping ID
10301	Newfoundland And Labrador	Corner Brook	A
10602	Newfoundland And Labrador	Corner Brook	A
30302	Nova Scotia	Sydney	B
30310	Nova Scotia	Sydney	B
50104	Quebec	Montreal	C
50134	Quebec	Montreal	C
50110	Quebec	Montreal	D
50135	Quebec	Montreal	D
50115	Quebec	Montreal	E
50136	Quebec	Montreal	E
50116	Quebec	Montreal	F
50138	Quebec	Montreal	F
50121	Quebec	Longueuil	G
50122	Quebec	Brossard	G
50309	Quebec	Quebec City	H
50311	Quebec	Quebec City	H
50801	Quebec	Trois-Rivières	I
50802	Quebec	Trois-Rivières	I
50803	Quebec	Trois Rivières	I
60302	Ontario	Kingston	J
60303	Ontario	Kingston	J
60304	Ontario	Kingston	J
60429	Ontario	Toronto	K
60435	Ontario	Toronto	K
60415	Ontario	Mississauga	L
60432	Ontario	Mississauga	L
60434	Ontario	Mississauga	L
60424	Ontario	Toronto	M
60433	Ontario	Toronto	M
60607	Ontario	Sudbury	N
60609	Ontario	Sudbury	N

NAPS ID	Province	City	Combination grouping ID
60610	Ontario	Sudbury	N
60707	Ontario	Sault Ste. Marie	O
60709	Ontario	Sault Ste. Marie	O
60807	Ontario	Thunder Bay	P
60809	Ontario	Thunder Bay	P
60903	Ontario	London	Q
60904	Ontario	London	Q
61602	Ontario	Oakville	R
61603	Ontario	Oakville	R
61701	Ontario	Oshawa	S
61702	Ontario	Oshawa	S
80110	Saskatchewan	Regina	T
80111	Saskatchewan	Regina	T
90227	Alberta	Calgary	U
90228	Alberta	Calgary	U
90230	Alberta	Calgary	U

Table C.4. Imputations of neighbouring stations for the national and regional peak (4th-highest) 8-hour ground-level ozone indicators

NAPS ID	Province	City	Combination grouping ID
10301	Newfoundland And Labrador	Corner Brook	A
10602	Newfoundland And Labrador	Corner Brook	A
30302	Nova Scotia	Sydney	B
30310	Nova Scotia	Sydney	B
50110	Quebec	Montreal	C
50135	Quebec	Montreal	C
50115	Quebec	Montreal	D
50136	Quebec	Montreal	D
50116	Quebec	Montreal	E
50138	Quebec	Montreal	E
50121	Quebec	Longueuil	F
50122	Quebec	Brossard	F
50104	Quebec	Montreal	G
50134	Quebec	Montreal	G
50309	Quebec	Quebec City	H
50311	Quebec	Quebec City	H
50801	Quebec	Trois-Rivières	I

NAPS ID	Province	City	Combination grouping ID
50802	Quebec	Trois-Rivières	I
50803	Quebec	Trois Rivières	I
60302	Ontario	Kingston	J
60303	Ontario	Kingston	J
60304	Ontario	Kingston	J
60429	Ontario	Toronto	K
60435	Ontario	Toronto	K
60415	Ontario	Mississauga	L
60432	Ontario	Mississauga	L
60434	Ontario	Mississauga	L
60424	Ontario	Toronto	M
60433	Ontario	Toronto	M
60607	Ontario	Sudbury	N
60609	Ontario	Sudbury	N
60610	Ontario	Sudbury	N
60707	Ontario	Sault Ste. Marie	O
60709	Ontario	Sault Ste. Marie	O
60807	Ontario	Thunder Bay	P
60809	Ontario	Thunder Bay	P
60903	Ontario	London	Q
60904	Ontario	London	Q
61602	Ontario	Oakville	R
61603	Ontario	Oakville	R
61701	Ontario	Oshawa	S
61702	Ontario	Oshawa	S
80110	Saskatchewan	Regina	T
80111	Saskatchewan	Regina	T
90227	Alberta	Calgary	U
90228	Alberta	Calgary	U
90230	Alberta	Calgary	U
100401	British Columbia	Kamloops	V
100402	British Columbia	Kamloops	V
129002	Northwest Territories	Yellowknife	W
129003	Northwest Territories	Yellowknife	W

Table C.5. Imputations of neighbouring stations for the national and regional average sulphur dioxide indicators

NAPS ID	Province	City	Combination grouping ID
30118	Nova Scotia	Halifax	A
30120	Nova Scotia	Halifax	A
50115	Quebec	Montreal	B
50136	Quebec	Montreal	B
80110	Saskatchewan	Regina	C
80111	Saskatchewan	Regina	C
100401	British Columbia	Kamloops	D
100402	British Columbia	Kamloops	D

Table C.6. Imputations of neighbouring stations for the national and regional peak (99th percentile) 1-hour sulphur dioxide indicators

NAPS ID	Province	City	Combination grouping ID
30118	Nova Scotia	Halifax	A
30120	Nova Scotia	Halifax	A
50115	Quebec	Montreal	B
50136	Quebec	Montreal	B
60609	Ontario	Sudbury	C
60610	Ontario	Sudbury	C
80110	Saskatchewan	Regina	D
80111	Saskatchewan	Regina	D
100401	British Columbia	Kamloops	E
100402	British Columbia	Kamloops	E

Table C.7. Imputations of neighbouring stations for the national and regional average nitrogen dioxide indicators

NAPS ID	Province	City	Combination grouping ID
10301	Newfoundland And Labrador	Corner Brook	A
10602	Newfoundland And Labrador	Corner Brook	A
50104	Quebec	Montreal	B
50134	Quebec	Montreal	B
50110	Quebec	Montreal	C
50135	Quebec	Montreal	C
50115	Quebec	Montreal	D
50136	Quebec	Montreal	D
50116	Quebec	Montreal	E

NAPS ID	Province	City	Combination grouping ID
50138	Quebec	Montreal	E
60429	Ontario	Toronto	F
60435	Ontario	Toronto	F
60415	Ontario	Mississauga	G
60434	Ontario	Mississauga	G
60424	Ontario	Toronto	H
60433	Ontario	Toronto	H
60707	Ontario	Sault Ste. Marie	I
60709	Ontario	Sault Ste. Marie	I
60807	Ontario	Thunder Bay	J
60809	Ontario	Thunder Bay	J
60903	Ontario	London	K
60904	Ontario	London	K
61701	Ontario	Oshawa	L
61702	Ontario	Oshawa	L
80110	Saskatchewan	Regina	M
80111	Saskatchewan	Regina	M
90227	Alberta	Calgary	N
90228	Alberta	Calgary	N
90230	Alberta	Calgary	N

Table C.8. Imputations of neighbouring stations for the national and regional peak (98th percentile) 1-hour nitrogen dioxide indicators

NAPS ID	Province	City	Combination grouping ID
10301	Newfoundland And Labrador	Corner Brook	A
10602	Newfoundland And Labrador	Corner Brook	A
50104	Quebec	Montreal	B
50134	Quebec	Montreal	B
50110	Quebec	Montreal	C
50135	Quebec	Montreal	C
60429	Ontario	Toronto	D
60435	Ontario	Toronto	D
60424	Ontario	Toronto	E
60433	Ontario	Toronto	E
60707	Ontario	Sault Ste. Marie	F
60709	Ontario	Sault Ste. Marie	F
60807	Ontario	Thunder Bay	G

NAPS ID	Province	City	Combination grouping ID
60809	Ontario	Thunder Bay	G
60903	Ontario	London	H
60904	Ontario	London	H
61602	Ontario	Oakville	I
61603	Ontario	Oakville	I
61701	Ontario	Oshawa	J
61702	Ontario	Oshawa	J
80110	Saskatchewan	Regina	K
80111	Saskatchewan	Regina	K
90227	Alberta	Calgary	L
90228	Alberta	Calgary	L

Table C.9. Imputations of neighbouring stations for the national and regional average volatile organic compounds indicators

NAPS ID	Province	City	Combination grouping ID
50104	Quebec	Montreal	A
50134	Quebec	Montreal	A
50115	Quebec	Montreal	B
50136	Quebec	Montreal	B
50121	Quebec	Longueuil	C
50122	Quebec	Brossard	C
60429	Ontario	Toronto	D
60435	Ontario	Toronto	D
60903	Ontario	London	E
60904	Ontario	London	E
61004	Ontario	Sarnia	EE
61009	Ontario	Sarnia	EE
63201	Ontario	Stouffville	F
65101	Ontario	Newmarket	F
80110	Saskatchewan	Regina	G
80111	Saskatchewan	Regina	G
90227	Alberta	Calgary	H
90228	Alberta	Calgary	H

Annex D. Fine particulate matter measurement technological transition

Five (5) types of fine particulate matter ($PM_{2.5}$) monitors are used to measure the 1-hour concentrations of $PM_{2.5}$:

- older technology: Rupprecht & Patashnick tapered element oscillating microbalance (TEOM) monitor
- current technology: Thermo Scientific TEOM 1400a with the Series 8500C Filter Dynamics Measurement System (FDMS) monitor
- current technology: Met One BAM-1020 Beta Attenuation Mass monitor
- current technology: Thermo Scientific 5030 or 5030i SHARP (Synchronized Hybrid Ambient Real-time Particulate) monitor
- current technology: GRIMM Environmental Dust Monitor model EDM 180 and 365

The Thermo Scientific 1400a, Met One BAM-1020, Thermo SHARP and GRIMM monitors have been approved by the United States Environmental Protection Agency as Class III federal equivalent methods and have been deployed across the National Air Pollution Surveillance network replacing older tapered element oscillating microbalance instruments, which in some circumstances may under report the $PM_{2.5}$ mass concentrations relative to the National Air Pollution Surveillance $PM_{2.5}$ Reference Method. Since 2005, the tapered element oscillating microbalance monitors have gradually been replaced by the federal equivalent methods monitors. The federal equivalent methods monitors measure a portion (semi-volatile) of the $PM_{2.5}$ mass not captured by the older instruments. Because of these measurement differences between the new and the old monitoring equipment, concentrations measured with the new monitors may not be directly comparable with the measurements from years in which older instruments were used.

The following table lists the stations used for the national and regional indicators that are operating with new technologies, along with the type of equipment and the first year when data was provided from a new installation.

Table D.1. Stations included in the national and regional indicators that use new monitoring technologies for fine particulate matter

NAPS ID	Province	City	New equipment, first year data provided
10102	Newfoundland and Labrador	St. John's	BAM, 2010
10401	Newfoundland and Labrador	Mount Pearl	BAM, 2010
10602	Newfoundland and Labrador	Corner Brook	BAM, 2010
30120	Nova Scotia	Halifax	BAM, 2009
40103	New Brunswick	Fredericton	BAM, 2008
40203	New Brunswick	Saint John	BAM, 2008
40302	New Brunswick	Moncton	BAM, 2008
40901	New Brunswick	St. Andrews	BAM, 2008
50109	Quebec	Montreal	FDMS, 2008– SHARP, 2016
50113	Quebec	Laval	BAM, 2009
50122	Quebec	Brossard	BAM, 2016
50126	Quebec	Montreal	FDMS, 2008 – SHARP, 2016

NAPS ID	Province	City	New equipment, first year data provided
50128	Quebec	Montreal	FDMS, 2008 – SHARP, 2016
50129	Quebec	Montreal	FDMS, 2008 – SHARP, 2016
50131	Quebec	Montreal	FDMS, 2008 – GRIMM, 2016
50135	Quebec	Montreal	FDMS, 2014 – SHARP, 2016
50136	Quebec	Montreal	SHARP, 2016
50204	Quebec	Gatineau	BAM, 2010
50308	Quebec	Quebec City	BAM, 2009
50310	Quebec	Quebec City	BAM, 2010
50404	Quebec	Sherbrooke	BAM, 2009
50504	Quebec	Saguenay	BAM, 2011
50604	Quebec	Rouyn-Noranda	BAM, 2004
50803	Quebec	Trois-Rivières	BAM, 2015
52001	Quebec	Charette	BAM, 2004
52201	Quebec	Saint-Simon	BAM, 2004
52301	Quebec	Saint-Faustin-Lac-Carré	BAM, 2004
52401	Quebec	La Pêche	BAM, 2004
53201	Quebec	La Doré	BAM, 2004
53301	Quebec	Deschambault	BAM, 2004
53601	Quebec	Notre-Dame-du-Rosaire	BAM, 2004
53701	Quebec	St-Hilaire-de-Dorset	BAM, 2004
53801	Quebec	Tingwick	BAM, 2004
54401	Quebec	Saint-Anicet	BAM, 2008
54501	Quebec	L'Assomption	BAM, 2008
54801	Quebec	Stukely-Sud	BAM, 2004
55201	Quebec	Lemieux	BAM, 2004
55301	Quebec	Saint-Jean-sur-Richelieu	BAM, 2008
60104	Ontario	Ottawa	SHARP, 2013
60204	Ontario	Windsor	SHARP, 2013
60211	Ontario	Windsor	SHARP, 2013
60304	Ontario	Kingston	SHARP, 2014
60410	Ontario	Toronto	SHARP, 2013
60421	Ontario	Toronto	SHARP, 2013
60428	Ontario	Brampton	SHARP, 2013
60430	Ontario	Toronto	SHARP, 2013
60433	Ontario	Toronto	SHARP, 2013
60434	Ontario	Mississauga	SHARP, 2013

NAPS ID	Province	City	New equipment, first year data provided
60435	Ontario	Toronto	SHARP, 2013
60512	Ontario	Hamilton	SHARP, 2013
60513	Ontario	Hamilton	SHARP, 2013
60709	Ontario	Sault Ste. Marie	SHARP, 2013
60809	Ontario	Thunder Bay	SHARP, 2013
60904	Ontario	London	SHARP, 2013
61004	Ontario	Sarnia	SHARP, 2013
61104	Ontario	Peterborough	SHARP, 2013
61201	Ontario	Cornwall	SHARP, 2013
61302	Ontario	St. Catharines	SHARP, 2013
61402	Ontario	Brantford	SHARP, 2013
61502	Ontario	Kitchener	SHARP, 2013
61603	Ontario	Oakville	SHARP, 2013
61702	Ontario	Oshawa	SHARP, 2013
61802	Ontario	Guelph	SHARP, 2013
62001	Ontario	North Bay	SHARP, 2013
62501	Ontario	Tiverton	SHARP, 2013
62601	Ontario	Simcoe	SHARP, 2013
63001	Ontario	Burlington	SHARP, 2013
63301	Ontario	Dorset	SHARP, 2013
63701	Ontario	Grand Bend	SHARP, 2013
65001	Ontario	Barrie	SHARP, 2013
65101	Ontario	Newmarket	SHARP, 2013
65201	Ontario	Parry Sound	SHARP, 2013
65301	Ontario	Port Stanley	SHARP, 2013
65401	Ontario	Belleville	SHARP, 2013
70118	Manitoba	Winnipeg	SHARP, 2011
70119	Manitoba	Winnipeg	SHARP, 2011
70203	Manitoba	Brandon	SHARP, 2011
80111	Saskatchewan	Regina	BAM, 2014
80211	Saskatchewan	Saskatoon	BAM, 2013
90121	Alberta	Edmonton	FDMS, 2010
90130	Alberta	Edmonton	FDMS, 2010
90222	Alberta	Calgary	FDMS, 2010
90230	Alberta	Calgary	SHARP, 2016

NAPS ID	Province	City	New equipment, first year data provided
90302	Alberta	Red Deer	FDMS, 2010–2013, SHARP, 2014
90502	Alberta	Lethbridge	SHARP, 2016
90601	Alberta	Fort Saskatchewan	SHARP, 2013
90701	Alberta	Fort McMurray	SHARP, 2013
90702	Alberta	Fort McMurray	SHARP, 2013
90801	Alberta	Fort MacKay	SHARP, 2012
90806	Alberta	Fort MacKay	SHARP, 2013
91101	Alberta	Elk Island	SHARP, 2013
91301	Alberta	Tomahawk	SHARP, 2015
91801	Alberta	Fort Chipewyan	SHARP, 2014[A]
100110	British Columbia	Metro Vancouver – Burnaby	SHARP, 2014
100119	British Columbia	Metro Vancouver – Burnaby	SHARP, 2014
100134	British Columbia	Metro Vancouver – Richmond	SHARP, 2014
100138	British Columbia	Metro Vancouver – West Vancouver	SHARP, 2013
100202	British Columbia	Prince George	SHARP, 2014
100304	British Columbia	Victoria	BAM, 2010
100401	British Columbia	Kamloops	BAM, 2010
100701	British Columbia	Kelowna	SHARP, 2014[A]
101101	British Columbia	Metro Vancouver – Chilliwack	SHARP, 2013
101202	British Columbia	Metro Vancouver – Pitt Meadows	SHARP, 2013
101301	British Columbia	Metro Vancouver – Langley	SHARP, 2014
101701	British Columbia	Quesnel	SHARP, 2014[A]
102102	British Columbia	Nanaimo	BAM, 2014[A]
102701	British Columbia	Williams Lake	SHARP, 2014[A]
103202	British Columbia	Golden	SHARP, 2016
103901	British Columbia	Kitimat	BAM, 2014–2015
104003	British Columbia	Vernon	SHARP, 2015
105101	British Columbia	Houston	SHARP, 2014
119004	Yukon	Whitehorse	SHARP, 2012, BAM, 2016
129003	Northwest Territories	Yellowknife	BAM 2003

Note: [A] These stations changed technology during the indicated year.

Annex E. Volatile organic compounds targeted for quantification

Table E.1. Volatile organic compounds targeted for quantification

Compound	CAS registry number
1,1,1-Trichloroethane	71-55-6
1,1,2,2-Tetrachloroethane	79-34-5
1,1,2-Trichloroethane	79-00-5
1,1-Dichloroethane	75-34-3
1,1-Dichloroethylene	75-35-4
1,2,3-Trimethylbenzene	526-73-8
1,2,4-Trichlorobenzene	120-82-1
1,2,4-Trimethylbenzene	95-63-6
1,2-Dichlorobenzene	95-50-1
1,2-Dichloroethane	107-06-2
1,2-Dichloropropane	78-87-5
1,3,5-Trimethylbenzene	108-67-8
1,3-Butadiene	106-99-0
1,3-Dichlorobenzene	541-73-1
1,3-Diethylbenzene	141-93-5
1,4-Dichlorobenzene	106-46-7
1,4-Diethylbenzene	105-05-5
1-Butene/Isobutene	106-98-9/115-11-7
1-Heptene	592-76-7
1-Hexene/2-Methyl-1-Pentene	592-41-6/763-29-1
1-Pentene	109-67-1
2,2,4-Trimethylpentane	540-84-1
2,2-Dimethylbutane	75-83-2
2,3,4-Trimethylpentane	565-75-3
2,3-Dimethylbutane	79-29-8
2,3-Dimethylpentane	565-59-3
2,4-Dimethylhexane	589-43-5
2,4-Dimethylpentane	108-08-7
2,5-Dimethylhexane	592-13-2
2-Ethyltoluene	611-14-3
2-Methyl-1-butene	563-46-2
2-Methyl-2-butene	513-35-9
2-Methylheptane	592-27-8
2-Methylhexane	591-76-4

Compound	CAS registry number
2-Methylpentane	107-83-5
3-Ethyltoluene	620-14-4
3-methyl-1-Butene	563-45-1
3-Methylheptane	589-81-1
3-Methylhexane	589-34-4
3-Methylpentane	96-14-0
4-Ethyltoluene	622-96-8
4-Methylheptane	589-53-7
Acetylene	74-86-2
a-Pinene	80-56-8
Benzene	71-43-2
Benzylchloride	100-44-7
b-Pinene	127-91-3
Bromoform	75-25-2
Bromomethane	74-83-9
Butane	106-97-8
Camphene	79-92-5
Carbontetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
Chloroform	67-66-3
Chloromethane	74-87-3
cis-1,2-Dimethylcyclohexane	2207-01-04
cis-2-Butene	590-18-1
cis-2-Hexene	7688-21-3
cis-2-Pentene	627-20-3
cis-3-Methyl-2-Pentene	922-62-3
cis-4-Methyl-2-Pentene	691-38-3
Cyclohexane	110-82-7
Cyclopentane	287-92-3
Decane	124-18-5
Dichloromethane	1975-09-02
d-Limonene	5989-27-5
Dodecane	112-40-3
Ethane	74-84-0
Ethylbenzene	100-41-4
Ethylene	74-85-1
Freon 11	75-69-4

Compound	CAS registry number
Freon 114	76-14-2
Freon 12	75-71-8
Freon 22	75-45-6
Heptane	142-82-5
Hexachlorobutadiene	87-68-3
Hexane	110-54-3
Indane	496-11-7
Isobutane	75-28-5
Isopentane	78-78-4
Isoprene	78-79-5
iso-Propylbenzene	98-82-8
m and p-Xylene	179601-23-1
Methylcyclohexane	108-87-2
Methylcyclopentane	96-37-7
MTBE	1634-04-4
Naphthalene	91-20-3
Nonane	111-84-2
n-Propylbenzene	103-65-1
Octane	111-65-9
o-Xylene	95-47-6
p-Cymene	99-87-6
Pentane	109-66-0
Propane	74-98-6
Propylene	115-07-1
Styrene	100-42-5
Tetrachloroethylene	127-18-4
Toluene	108-88-3
trans-2-Butene	624-64-6
trans-2-Hexene	4050-45-7
trans-2-Octene	13389-42-9
trans-2-Pentene	646-04-8
trans-3-Methyl-2-pentene	616-12-6
Trichloroethene	1979-01-06
Undecane	1120-21-4
Vinylchloride	1975-01-04

Annex F. Mann-Kendall and Sen's pairwise statistical parameters used for the analysis of trends

Table F.1. Legend for tables in Annex F

Field	Description
First year	Starting year of each time series.
Last year	Ending year of each time series.
n	Number of annual values in the calculation, excluding missing values.
Test Z	The absolute value of Z is compared to the standard normal cumulative distribution to define if there is a trend at the selected level α of significance. A positive (negative) value indicates an upward (downward) trend.
Significant	The smallest significance level α at which the test shows that the null hypothesis of no trend can be rejected. For the three tested significance levels, the following symbols are used: [A] if trend at α = 0.001 level of significance, [B] if trend at α = 0.01 level of significance, and [C] if trend at α = 0.05 level of significance.
Q	Sen's estimator for the true slope of linear trend, that is, change per unit time period (in this case a year).
Qmin95	The lower limit of the 95% confidence interval of Q (α = 0.05).
Qmax95	The upper limit of the 95% confidence interval of Q (α = 0.05).

Table F.2. Mann-Kendall and Sen's tests results for the national and regional average fine particulate matter indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	0.20	2.77	-2.18	-1.29	1.98	-0.20
Significant	No	Yes[B]	Yes[A]	No	Yes[A]	No
Q	0.01	0.13	-0.14	-0.09	0.18	-0.02
Qmin95	-0.07	0.05	-0.21	-0.26	0.01	-0.15
Qmax95	0.11	0.21	-0.01	0.08	0.36	0.10

Table F.3. Mann-Kendall and Sen's tests results for the national and regional peak (98th percentile) 24-hour fine particulate matter indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	-1.78	-1.19	-3.66	-2.97	2.28	-0.89
Significant	No	No	Yes[C]	Yes[B]	Yes[A]	No
Q	-0.34	-0.11	-1.06	-1.01	1.13	-0.22
Qmin95	-0.76	-0.31	-1.56	-1.48	0.19	-0.78
Qmax95	0.01	0.13	-0.51	-0.47	2.13	0.34

Table F.4. Mann-Kendall and Sen's tests results for the national and regional average ground-level ozone indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	0.49	-1.83	0.74	0.00	0.15	1.29
Significant	No	No	No	No	No	No
Q	0.01	-0.12	0.03	0.00	0.04	0.09
Qmin95	-0.05	-0.22	-0.11	-0.17	-0.13	-0.06
Qmax95	0.10	0.02	0.25	0.17	0.19	0.27

Table F.5. Mann-Kendall and Sen's tests results for the national and regional peak (4th-highest) 8-hour ground-level ozone indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	-3.37	-3.76	-2.77	-3.07	0.20	-2.18
Significant	Yes[C]	Yes[C]	Yes[B]	Yes[B]	No	Yes[A]
Q	-0.75	-0.81	-1.02	-1.40	0.05	-0.36

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
Qmin95	-1.09	-1.02	-1.55	-2.06	-0.28	-0.74
Qmax95	-0.35	-0.52	-0.28	-0.52	0.41	-0.03

Table F.6. Mann-Kendall and Sen's tests results for the national and regional average sulphur dioxide indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	-4.949	-4.05795	-3.91428	-4.25590	-3.46410	-3.76102
Significant	Yes[C]	Yes[C]	Yes[C]	Yes[C]	Yes[C]	Yes[C]
Q	-0.12	-0.28	-0.23	-0.23	-0.06	-0.07
Qmin95	-0.13	-0.42	-0.31	-0.32	-0.09	-0.09
Qmax95	-0.10	-0.18	-0.16	-0.16	-0.05	-0.04

Table F.7. Mann-Kendall and Sen's tests results for the national and regional peak (99th percentile) 1-hour sulphur dioxide indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	-4.55282	-3.76102	-3.61699	-3.61699	-3.06820	-3.76102
Significant	Yes[C]	Yes[C]	Yes[C]	Yes[C]	Yes[B]	Yes[C]
Q	-2.51	-4.01	-3.21	-2.86	-3.00	-1.40
Qmin95	-3.17	-5.36	-5.24	-4.25	-4.49	-2.10
Qmax95	-2.05	-2.50	-1.57	-1.91	-1.24	-0.70

Table F.8. Mann-Kendall and Sen's tests results for the national and regional average nitrogen dioxide indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	-4.850	-2.72513	-4.55282	-4.75077	-4.05795	-4.65179
Significant	Yes[C]	Yes[B]	Yes[C]	Yes[C]	Yes[C]	Yes[C]
Q	-0.41	-0.19	-0.52	-0.66	-0.23	-0.35
Qmin95	-0.48	-0.32	-0.62	-0.82	-0.30	-0.42
Qmax95	-0.35	-0.05	-0.41	-0.47	-0.16	-0.31

Table F.9. Mann-Kendall and Sen's tests results for the national and regional peak (98th percentile) 1-hour nitrogen dioxide indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	-4.84974	-4.05795	-4.55282	-4.15692	-3.86000	-4.55282
Significant	Yes[C]	Yes[C]	Yes[C]	Yes[C]	Yes[C]	Yes[C]
Q	-1.00	-0.91	-1.37	-1.66	-0.34	-0.78
Qmin95	-1.09	-1.42	-1.58	-2.01	-0.57	-0.93
Qmax95	-0.89	-0.58	-1.17	-1.24	-0.23	-0.71

Table F.10. Mann-Kendall and Sen's tests results for the national and regional average volatile organic compounds indicators

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First Year	2002	2002	2002	2002	2002	2002
Last Year	2016	2016	2016	2016	2016	2016
n	15	15	15	15	15	15
Test Z	-3.96	-2.38	-4.45	-3.66	-3.27	-2.28
Significant	Yes[C]	Yes[A]	Yes[C]	Yes[C]	Yes[B]	Yes[A]
Q	-3.30	-3.71	-2.95	-2.47	-3.92	-7.18

Statistics	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
Qmin95	-4.46	-6.26	-3.77	-3.55	-4.86	-13.94
Qmax95	-2.19	-1.10	-1.79	-1.56	-1.81	-0.35

Note: The smallest significance level α at which the test shows that the null hypothesis of no trend can be rejected. For the three tested significance levels, the following symbols are used:

[A] Trend at α = 0.001 level of significance.

[B] Trend at α = 0.01 level of significance.

[C] Trend at α = 0.05 level of significance.

Annex G. Monitoring stations used for the urban area indicators

Table G.1. List of monitoring stations used for the urban area indicators

Urban area	NAPS ID	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak nitrogen dioxide	Average nitrogen dioxide
St. John's	10102	X	X	X	X	X	X
St. John's	10401	X	X	X	X	X	X
Charlottetown	20104	X[A]	n/a	X[A]	X[A]	X[A]	X[A]
Charlottetown	20401	X[A]	n/a	X[A]	X[A]	X[A]	X[A]
Halifax	30113	X	X	n/a	n/a	n/a	n/a
Halifax	30118	n/a	n/a	X	X	X	X
Halifax	30120	n/a	n/a	X	X	X	X
New Glasgow	31201	n/a	n/a	n/a	n/a	n/a	n/a
Fredericton	40103	X	X	X	X	X	X
Saint John	40203	n/a	n/a	n/a	n/a	n/a	n/a
Saint John	40207	n/a	n/a	n/a	n/a	n/a	n/a
Saint John	40208	n/a	n/a	n/a	n/a	n/a	n/a
Saint John	40501	n/a	n/a	n/a	n/a	n/a	n/a
Montreal	50103	X	X	X	X	X	X
Montreal	50109	X	X	X	X	X	X
Montreal	50113	X	X	X	X	X	X
Montreal	50119	X	X	X	X	X	X
Montreal	50122	X	X	X	X	n/a	n/a
Montreal	50126	X	X	X	X	X	X
Montreal	50128	X	X	X	X	X	X
Montreal	50129	X	X	X	X	n/a	n/a
Montreal	50133	X	X	n/a	n/a	X	X
Montreal	50134	X	X	X	X	X	X
Montreal	50135	X	X	X	X	X	X
Montreal	50136	X	X	X	X	X	n/a
Montreal	50138	n/a	n/a	X	X	X	n/a
Montreal	52601	n/a	n/a	n/a	X	n/a	n/a
Montreal	54501	X	X	X	X	X	X
Quebec City	50308	X	X	X	X	X	X
Quebec City	50310	X	X	X	X	n/a	n/a
Quebec City	50311	X	X	X	X	n/a	n/a
Quebec City	53501	n/a	n/a	X	X	n/a	n/a

Urban area	NAPS ID	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak nitrogen dioxide	Average nitrogen dioxide
Quebec City	55702	n/a	n/a	X	X	X	n/a
Rouyn-Noranda	50604	n/a	n/a	n/a	n/a	n/a	n/a
Saguenay	50902	n/a	n/a	n/a	n/a	n/a	n/a
Sherbrooke	50404	X	X	X	X	n/a	n/a
Sherbrooke	54801	n/a	n/a	n/a	X	n/a	n/a
Trois-Rivières	55201	n/a	n/a	n/a	n/a	n/a	n/a
Gatineau	50204	X	X	X	X	X	X
Gatineau	52401	X	X	X	X	n/a	n/a
Barrie	65001	n/a	n/a	n/a	n/a	X	X
Greater Sudbury	60610	n/a	n/a	n/a	n/a	n/a	n/a
Hamilton	60512	X	X	X	X	X	X
Hamilton	60513	X	X	X	X	X	X
Hamilton	60515	X	X	X	X	X	X
Hamilton	63001	X	X	X	X	X	X
Kitchener	61502	X	X	X	X	X	X
London	60904	X	X	X	X	X	X
London	63601	n/a	n/a	n/a	n/a	n/a	n/a
London	65301	X	X	X	X	X	X
Norfolk	62601	n/a	n/a	n/a	n/a	n/a	n/a
Oshawa	61702	X	X	X	X	X	X
Ottawa	60104	X	X	X	X	X	X
Ottawa	60106	X	X	X	X	X	X
Sarnia	61007	n/a	n/a	n/a	n/a	n/a	n/a
Sarnia	61009	n/a	n/a	n/a	n/a	n/a	n/a
St. Catharines – Niagara	61302	X	X	X	X	X	X
Toronto	60410	X	X	X	X	X	X
Toronto	60421	X	X	X	X	X	X
Toronto	60428	X	X	X	X	X	X
Toronto	60430	X	X	X	X	X	X
Toronto	60433	X	X	X	X	X	X
Toronto	60434	X	X	X	X	X	X
Toronto	60435	X	X	X	X	X	X
Toronto	61603	X	X	X	X	X	X
Toronto	65101	X	X	X	X	X	X
Windsor	60204	X	X	X	X	X	X

Urban area	NAPS ID	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak nitrogen dioxide	Average nitrogen dioxide
Windsor	60211	X	X	X	X	X	X
Thompson	70501	n/a	n/a	n/a	n/a	n/a	n/a
Winnipeg	70118	X	X	X	X	n/a	n/a
Winnipeg	70119	X	X	X	X	X	X
Regina	80111	X	X	X	X	X	X
Saskatoon	80211	X	X	X	X	X	X
Calgary	90222	X	X	X	X	X	X
Calgary	90228	n/a	n/a	n/a	n/a	n/a	n/a
Calgary	90229	n/a	n/a	n/a	n/a	X	X
Calgary	90230	X	X	X	X	X	n/a
Edmonton	90120	X	X	X	X	X	X
Edmonton	90121	X	X	X	X	X	X
Edmonton	90130	X	X	X	X	X	X
Edmonton	90132	X	X	n/a	n/a	n/a	n/a
Edmonton	90133	X	X	n/a	n/a	X	X
Edmonton	90134	n/a	n/a	n/a	n/a	X	n/a
Edmonton	90135	n/a	n/a	n/a	n/a	X	n/a
Edmonton	90601	X	X	X	X	X	X
Edmonton	90602	n/a	n/a	n/a	n/a	X	X
Edmonton	90603	n/a	n/a	n/a	n/a	X	X
Edmonton	90606	n/a	n/a	n/a	n/a	n/a	X
Edmonton	91101	X	X	X	X	X	X
Edmonton	91301	X	X	X	X	X	X
Edmonton	93101	X	X	X	X	X	X
Edmonton	93801	n/a	n/a	n/a	n/a	X	X
Edmonton	94202	n/a	n/a	n/a	n/a	n/a	X
Wood Buffalo	90701	n/a	n/a	n/a	n/a	n/a	n/a
Wood Buffalo	90702	n/a	n/a	n/a	n/a	n/a	n/a
Wood Buffalo	90801	n/a	n/a	n/a	n/a	n/a	n/a
Wood Buffalo	90802	n/a	n/a	n/a	n/a	n/a	n/a
Wood Buffalo	90804	n/a	n/a	n/a	n/a	n/a	n/a
Wood Buffalo	90805	n/a	n/a	n/a	n/a	n/a	n/a
Wood Buffalo	90806	n/a	n/a	n/a	n/a	n/a	n/a
Wood Buffalo	90807	n/a	n/a	n/a	n/a	n/a	n/a
Wood Buffalo	91801	n/a	n/a	n/a	n/a	n/a	n/a

Urban area	NAPS ID	Peak fine particulate matter	Average fine particulate matter	Peak ozone	Average ozone	Peak nitrogen dioxide	Average nitrogen dioxide
Abbotsford–Mission	101003	n/a	n/a	n/a	n/a	n/a	n/a
Abbotsford–Mission	101005	n/a	n/a	n/a	n/a	n/a	n/a
Chilliwack	101101	n/a	n/a	n/a	n/a	n/a	n/a
Duncan	106702	n/a	n/a	n/a	n/a	n/a	n/a
Kelowna	100701	n/a	n/a	n/a	n/a	n/a	n/a
Nelson	103502	n/a	n/a	n/a	n/a	n/a	n/a
Prince George	100202	n/a	n/a	n/a	n/a	n/a	n/a
Vancouver	100103	n/a	n/a	n/a	n/a	X	n/a
Vancouver	100110	X	X	X	X	X	X
Vancouver	100111	X	X	X	X	X	X
Vancouver	100112	n/a	n/a	X	X	X	X
Vancouver	100119	X	X	X	X	X	X
Vancouver	100121	X	X	X	X	X	X
Vancouver	100125	X	X	X	X	X	X
Vancouver	100126	n/a	n/a	X	X	X	X
Vancouver	100127	X	X	X	X	X	X
Vancouver	100128	X	X	X	X	X	X
Vancouver	100132	X	X	X	X	X	X
Vancouver	100133	n/a	n/a	n/a	n/a	n/a	n/a
Vancouver	100134	X	X	X	X	X	X
Vancouver	100135	n/a	n/a	X	X	X	X
Vancouver	100136	n/a	n/a	n/a	n/a	n/a	n/a
Vancouver	100137	n/a	n/a	n/a	n/a	n/a	n/a
Vancouver	100138	X	X	n/a	n/a	n/a	n/a
Vancouver	100140	X	X	X	X	X	X
Vancouver	101202	X	X	X	X	X	X
Vancouver	101301	X	X	X	X	X	X
Vancouver	101501	n/a	n/a	X	X	X	X
Victoria	100304	X	X	X	X	X	X
Victoria	100308	X	X	X	X	X	X
Whitehorse	119004	X	X	X	X	X[A]	X[A]
Yellowknife	129003	X	X	X	X	X	X

Note: X = station was used in the calculation of the air quality indicator at the urban area level. n/a = not applicable. [A] 2015 concentrations values were used for 2016. [B] Kitchener is the short name for the Kitchener– Cambridge–Waterloo area

Additional information can be obtained at:

Environment and Climate Change Canada
Public Inquiries Centre
12th Floor, Fontaine Building
200 Sacré-Coeur boul.
Gatineau, QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-938-3860
Fax: 819-938-3318
Email: ec.enviroinfo.ec@canada.ca