Air Quality Evaluation - St. Stephen, New Brunswick

FINAL REPORT

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Department of Environment and Local Government

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Data for this study was collected in partnership with Environment and Climate Change Canada using equipment provided through the National Air Pollution Surveillance (NAPS) program.

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1.0 Executive Summary

In 2023 an air quality evaluation was initiated in St. Stephen, New Brunswick (NB), in response to citizen complaints related to air pollution emissions from the Arauco Canada Ltd. composite (wood) products mill.

Air quality monitoring equipment was deployed to the area on April 27, 2023, with the goal of collecting data for a period of one year. Data collection concluded approximately one year later on April 26, 2024.

Monitoring focused on air contaminants associated with the mill, based on available emissions data. This entailed the use of real-time continuous monitoring equipment for all monitored contaminants except formaldehyde. Formaldehyde sampling was conducted via integrated sampling (with subsequent laboratory analysis of sample media). This report provides results and analysis of the findings from this monitoring work.

For all contaminants monitored there were no exceedance of regulated provincial air quality objectives. There was a single event, which occurred on February 9, 2024, when respirable particulate (PM_{10}) levels slightly exceeded a guideline value (a guideline based on an Ontario air quality criterion). Wind data and surveillance video collected throughout the period of the event indicate that wind-blown road dust was the primary cause of the elevated PM_{10} levels.

2.0 Introduction

2.1 BACKGROUND

Arauco Canada Ltd. operates a wood composite products manufacturing mill in St. Stephen, Charlotte County, NB. The facility produces medium density fibreboard (MDF) and urea formaldehyde resin.

The mill is regulated by the Department of Environment and Local Government (DELG) and its emissions are tracked. It is a known emissions source for several contaminants. Based on available emissions data, the key contaminant (i.e., the contaminant with greatest potential for local air quality impacts) is fine particulate matter ($PM_{2.5}$). Nevertheless, based on reported emissions rates the potential for air quality issues from this facility is considered low. There is no ongoing/permanent offsite ambient air quality monitoring for this area.

In response to citizen complaints from the community, DELG has undertaken a general air quality evaluation at a location near the mill.

2.2 AREA EMISSION SOURCES

The only major industrial air pollution emitter in St. Stephen is the Arauco Canada Ltd. mill. The mill is located immediately west of the light-urban core of the municipality of St. Stephen in a lightly populated forested area.

Emissions from the Arauco Canada Ltd. mill include combustion products related to its boilers, which burn fuel oil; exhaust gases from wood composite production processes; formaldehyde and other volatile organic compounds from its urea formaldehyde resin plant; vehicle (trucking) exhaust; and windblown dust from the property. It should be noted that the mill is subject to regulation under the *Air Quality Regulation* (N.B. Regulation 97-133) - *Clean Air Act*, and operates a variety of pollution control equipment to reduce air pollution emissions from the facility.

Air quality in St. Stephen can also be affected by emissions from the Woodland Pulp LLC mill, which operates approximately 8 kilometers west of the Arauco Canada Ltd. mill, in the State of Maine.

As St. Stephen and its bordering community Calais (State of Maine) are a regional population center, air quality in St. Stephen may also be affected by many smaller emissions sources (small industry, vehicles, residential wood smoke, etc). Air quality at the Arauco Canada Ltd. mill may also be affected by vehicle emissions from a major highway (Route 1), which is located immediately north and northwest of the facility.

As is the case for all of New Brunswick, St. Stephen also experiences long-range (transboundary) air pollution impacts (primarily fine particulates and ground level ozone) from pollution sources elsewhere in the World.

2.3 PROJECT DESIGN AND LOCATION

Based on a review of emissions data for the Arauco Canada Ltd. mill, a selection of air contaminants were chosen for the evaluation. The list of the included pollutant parameters is provided in Appendix A along with the rationale for the inclusion of each.

The work was carried out at a property immediately west of the Arauco Canada Ltd. mill at 172 Old Church Street, St. Stephen, NB.

The monitoring location was selected to be representative of a "highly impacted" area with respect to emissions from the Arauco Canada Ltd. mill. This was determined based on assessment of available wind data and air pollution dispersion modelling. The site was also selected based on accessibility requirements.

The DELG mobile air quality monitoring unit was positioned at the project site (approximately 45°11'09.82"N 67°18'45.70"W), which is approximately 125 meters west of the Arauco Canada Ltd. mill. Due to the size of the mill property, the facility grounds span almost the entire northeast to southeast quadrant as viewed from the project site (spanning approximately 45 degrees to 135 degrees). The project site and surrounding area is pictured in Figures 1 and 2.

2.4 PROJECT TIMING

DELG began data collection with its mobile air quality monitoring unit at the Old Church Street location on April 27, 2023 and concluded operations on April 26, 2024.

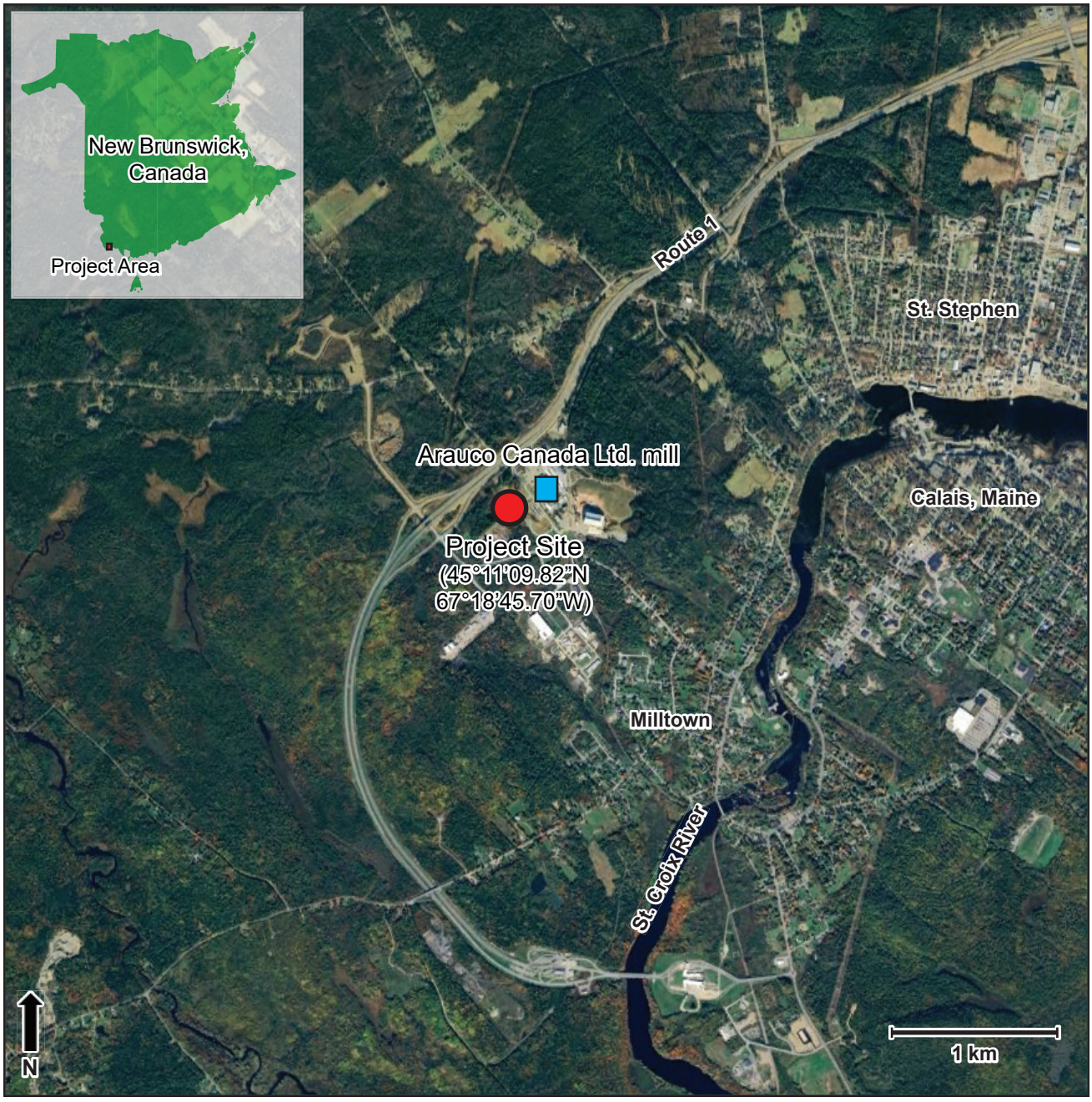

Figure 1. Project Site and the St. Stephen Area (Image courtesy of Google Earth)

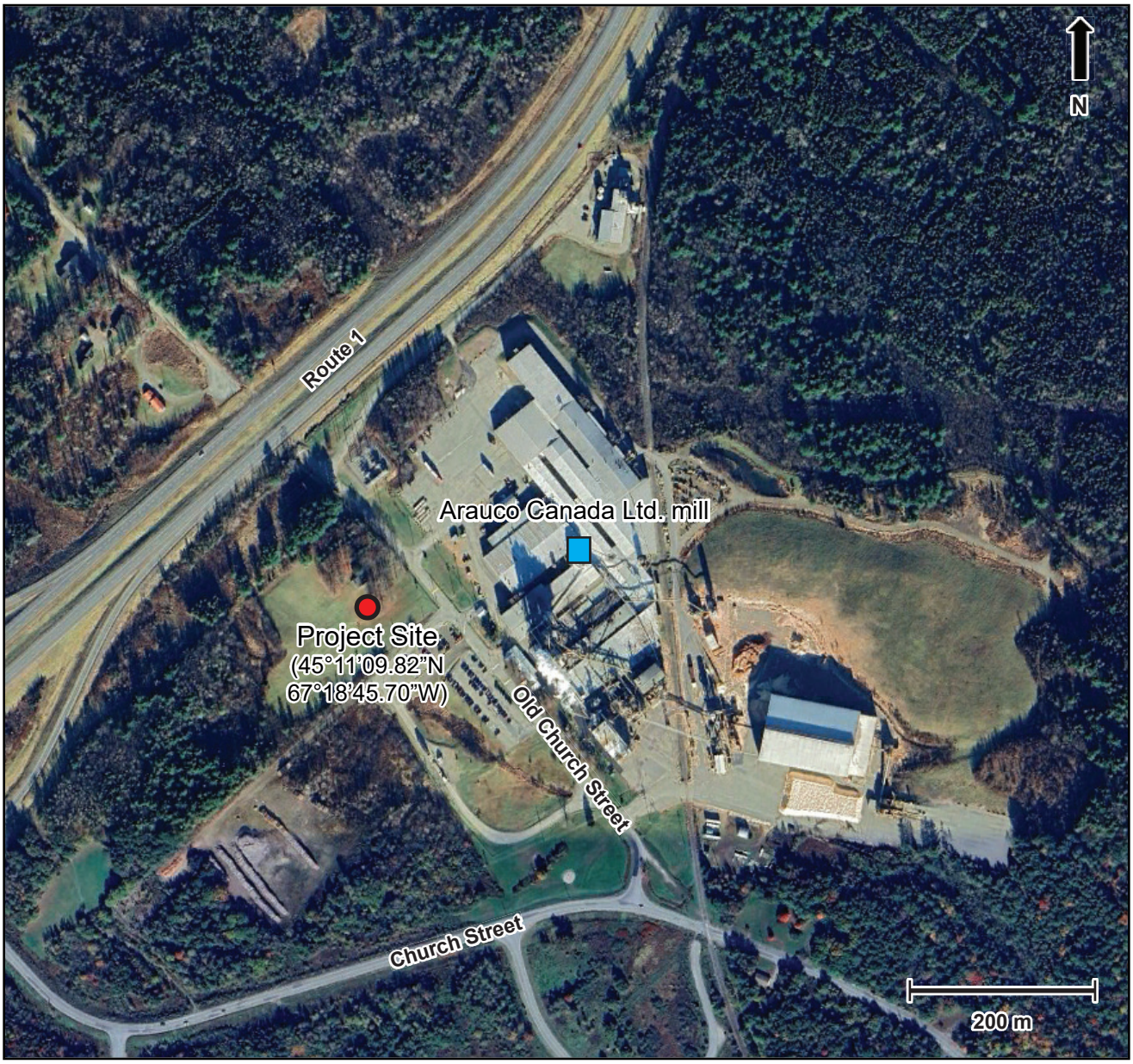

Figure 2. Project Site and Nearby Surroundings (Image courtesy of Google Earth)

3.0 Methodology

3.1 METEOROLOGY EQUIPMENT

Meteorological equipment (Vaisala model WXT520) was deployed at the project site to provide wind speed and wind direction data. The meteorological unit also collected relative humidity, temperature, and barometric pressure data.

All monitored meteorological parameters were logged as one-minute averages and retrieved automatically on an hourly basis.

3.2 CONTINUOUS AIR QUALITY MONITORING EQUIPMENT

Continuous monitors provide objective measurements of air quality at all times, and do not rely on modelling or statistical approximations. With the exception of brief, intermittent, calibration cycles and occasional malfunctions, there are no gaps in coverage. Air is constantly drawn through the monitors.

Continuous monitoring equipment was deployed to the mobile unit to measure ambient (outside air) concentrations of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ground level ozone (O_3), fine particulate matter ($PM_{2.5}$), respirable particulate (PM_{10}), and carbon monoxide (CO).

All continuously monitored parameters at the project site were logged as one-minute averages and retrieved automatically on an hourly basis.

Technical specifications for all continuous instruments are provided in Appendix B.

3.3 INTEGRATED SAMPLING

Integrated sampling involves the collection of a single sample over an extended period of time. These samples are subsequently analyzed by a laboratory. The collected values represent the "average" concentration of the monitored contaminant experienced over the sample collection period.

Integrated sampling was undertaken for formaldehyde using *581 TraceAir II Aldehyde High Sampling Rate Monitors* (with rain shelter) which collect formaldehyde by absorption to 2,4-dinitro-phenylhydrazine (DNPH) treated fibreglass "badges". Samplers were deployed for 24-hour exposure periods over the June 20, 2023 to July 27, 2023 period. Sampling followed a four-day-per-week schedule, but was interrupted in early July to avoid sampling during a mill shut-down period. Sampling started again when the mill resumed operations later in July. A total of 12 samples were collected.

Collected samples were analyzed for formaldehyde concentration by Assay Technologies (laboratory) using Occupational Health and Safety Administration (OSHA) method 1007 by High Pressure Liquid Chromatography (HPLC) (method equivalent to United States Environmental Protection Agency (USEPA) Method TO-11).

3.4 QUALITY ASSURANCE

Data collection and validation for continuous air quality monitoring equipment was conducted in accordance with the Canadian Council of Ministers of Environment (CCME) *Ambient Air Monitoring and Quality Assurance/Quality Control Guidelines, 2019* (ISBN 978-1-77202-056-4 PDF).

Integrated sampling was undertaken in accordance with the quality assurance and validation requirements prescribed for the method (see subsection 3.3).

4.0 Results

4.1 METEOROLOGY - WIND

Winds at the project site originated predominantly from either the northwest (approximately 17% of the time) or north northwest (approximately 16% of the time) during the project period. North northeasterly winds were least frequent, occurring only 2% of the time. Winds from the general direction of the mill (combined frequency of all northeasterly through southeastly winds) occurred approximately 25% of the time. Average wind conditions for the project period are further illustrated in Appendix C.

For the integrated sampling periods wind direction was variable. The most favourable day (50% of observations indicating winds from the northeast through southeast) during the integrated sampling period occurred on June 29-30, 2023. The least favourable day (3% of observations indicating favourable winds) occurred on June 22-23, 2023. Favourable wind occurrence for each day of integrated sampling is detailed in Table 1.

Table 1: Northeasterly (45 degrees) Through Southeasterly (135 degrees) Wind Occurrence During Integrated Sampling

Integrated Sampling Date	Northeasterly Through Southeasterly Wind Occurrence (% of Time)
June 20 to 21, 2023	6
June 21 to 22, 2023	6
June 22 to 23, 2023	3
June 26 to 27, 2023	48
June 27 to 28, 2023	10
June 28 to 29, 2023	8
June 29 to 30, 2023	50
July 4 to 5, 2023	45
July 24 to 25, 2023	11
July 25 to 26, 2023	5
July 26 to 27, 2023	5
July 27 to 28, 2023	5

4.2 CONTINUOUS MONITORS

Summary statistics for each of the continuously monitored parameters are provided in Table 2.

Additional data for each parameter is illustrated graphically in Appendix D.

Table 2: Summary Statistics - Continuously Monitored Parameters

Parameter	Average Concentration (1- year)	Peak Concentration (24-hour Running Average)	Peak Concentration (1-hour Average)
Sulphur Dioxide (SO_2)	0.1 ppb	0.3 ppb	2.8 ppb
Nitrogen Dioxide (NO_2)	1.5 ppb	6.6 ppb	39.5 ppb
Ground Level Ozone (O_3)	23.7 ppb	38.7 ppb	60.5 ppb
Fine Particulate ($PM_{2.5}$)	5.6 µg/m^3	26.8 µg/m^3	48.3 µg/m^3
Respirable Particulate (PM_{10})	11.6 µg/m^3	38.0 µg/m^3	166.9 µg/m^3
Carbon Monoxide (CO)	0.2 ppm	0.4 ppm	1.2 ppm

4.3 Integrated Sampling

Summary statistics for formaldehyde monitoring via integrated sampling are provided in Table 3.

Table 3: Summary Statistics - Integrated Sampling of Formaldehyde via Passive Absorption

Parameter	Overall Average Concentration (12 days over 5 weeks)	Peak Concentration (24-hour average)
Formaldehyde	2.2 µg/m^3	6.8 µg/m^3

5.0 Analysis

5.1 WIND DIRECTION & PROJECT LOCATION

Wind direction data indicates that the mobile unit was generally "downwind" of the mill property approximately 25% of time during the project period. However, northwesterly winds (west northwesterly through north northwesterly are the most common at this location (occurring approximately 40% of the time). This suggests that the mobile unit was positioned to frequently experience impacts from mill property, but not ideally so. Areas southeast of the mill may experience air quality impacts from mill emissions more frequently than the project site.

Wind data during the integrated formaldehyde sampling period suggest that the samplers were well placed to receive impacts under a variety of wind scenarios. This includes three days where the samplers were well placed to receive impacts from the mill (June 26-27, 2023, June 29-30, 2023, and July 4, 2023).

5.2 COMPARISONS TO OBJECTIVES, STANDARDS, AND GUIDELINES

The following analysis compares the monitored values against established air quality objectives, standards, and guidelines. New Brunswick has adopted "Maximum Permissible Ground Level Concentrations" under the *Air Quality Regulation* (New Brunswick Regulation #97-133) - *Clean Air Act* for some contaminants. However, the Regulation does not address all contaminants. In these cases, concentrations are evaluated against standard or guideline values that have been adopted by policy (*e.g.*, national standards, standards adopted by other jurisdictions, or guidelines adopted by various national or international agencies).

Note that air quality standards take a variety of statistical forms (*e.g.*, hourly averages, daily averages, annual averages, daily maximum, etc.). These various forms have been crafted to support specific environmental or public health goals. However, it is beyond the scope of this report to explore the underlying rationale for each. This analysis is limited to a simple comparison against the standards and guidelines that are relevant to the evaluation.

In order to compare results against regulated standards and guidelines the data must sometimes be converted into the correct form. For instance, by averaging 24 one-hour averages together to create a 24-hour average. In some cases, the data collected cannot be converted into the appropriate form. However, extrapolations, interpolations or approximations can sometimes be applied (*e.g.*, comparing data collected over a single year against a standard that is based on a three-year average).

Continuous monitoring results from the project site are compared against standards and guideline values in Table 4. Results from integrated sampling are compared against standards and guideline values in Table 5.

As indicated in Tables 4 and 5 results for most parameters were below (i.e., better than) established objectives, standards, and guidelines. However, peak values exceeded the guideline level for respirable particulate (PM_{10}). Detailed analysis of the PM_{10} results is provided in subsection 5.3.

Table 4: Comparisons to Standards and Guidelines - Continuous Monitors

Parameter	Standard/ Guideline Value	Standard/Guide-line Source	Monitored Value	Notes
Sulphur Dioxide (SO_2)	169.5 ppb (1-hour average)	N.B. Reg. 97-133, *Clean Air Act*	2.8 ppb (Highest 1-hour value recorded)	
	56.5 ppb (24-hour average)	N.B. Reg. 97-133, *Clean Air Act*	0.3 ppb (Highest 24-hour running average recorded)	
	11.5 ppb (Annual average)	N.B. Reg. 97-133, *Clean Air Act*	0.1 ppb (Annual average)	
	70 ppb (99th percentile daily maximum one-hour average, three year average)	Canadian Ambient Air Quality Standard	1.5 ppb (99th percentile daily maximum one-hour average, single year)	See subsection 5.5
	5.0 ppb (Annual average)	Canadian Ambient Air Quality Standard	0.1 ppb (Annual average)	

Table 4: Comparisons to Standards and Guidelines - Continuous Monitors (continued)

Parameter	Standard/ Guideline Value	Standard/Guide-line Source	Monitored Value	Notes
Nitrogen Dioxide (NO_2)	210 ppb (1-hour average)	N.B. Reg. 97-133, *Clean Air Act*	39.5 ppb (Highest 1-hour value recorded)	
	105 ppb (24-hour average)	N.B. Reg. 97-133, *Clean Air Act*	6.9 ppb (Highest 24-hour running average recorded)	
	52 ppb (Annual average)	N.B. Reg. 97-133, *Clean Air Act*	1.5 ppb (Annual average)	
	60 ppb (98th percentile daily maximum one-hour average, three year average)	Canadian Ambient Air Quality Standard	13.6 ppb (98th percentile daily maximum one-hour average, single year)	See subsection 5.5
	17 ppb (Annual average)	Canadian Ambient Air Quality Standard	1.5 ppb (Annual Average)	
Ground Level Ozone (O_3)	80 ppb (1-hour average)	Ontario Ambient Air Quality Criteria[1]	60.5 ppb (Highest 1-hour value recorded)	
	63 ppb (Fourth worst daily 8-hour average, averaged over three years)	Canadian Ambient Air Quality Standard	50.3 ppb (Fourth worst daily 8-hour average, single year)	See subsection 5.5
Fine Particulate ($PM_{2.5}$)	27 µg/m^3 (98th percentile daily average, three year average)	Canadian Ambient Air Quality Standard	15.5 µg/m^3 (98th percentile daily average, single year average)	See subsection 5.5
	8.8 µg/m^3 (3-year annual average)	Canadian Ambient Air Quality Standard	5.6 µg/m^3 (Annual average)	

Table 4: Comparisons to Standards and Guidelines - Continuous Monitors (continued)

Parameter	Standard/ Guideline Value	Standard/Guide-line Source	Monitored Value	Notes
Fine Particulate ($PM_{2.5}$)	80 µg/m^3 (1-hour average)	Alberta Ambient Air Quality Guideline[2]	48.3 µg/m^3 (Highest 1-hour value recorded)	
	29 µg/m^3 (24-hour average)	Alberta Ambient Air Quality Objective[2]	26.8 µg/m^3 (Highest 24-hour value recorded)	
Respirable Particulate (PM_{10})	50 µg/m^3 (24-hour average)	Ontario Ambient Air Quality Criteria[1]	54.4 µg/m^3 (Highest 24-hour value recorded)	
Carbon Monoxide (CO)	30 ppm (1-hour average)	N.B. Reg. 97-133, *Clean Air Act*	1.2 ppm (Highest 1-hour value recorded)	
	13 ppm (8-hour average)	N.B. Reg. 97-133, *Clean Air Act*	0.6 ppm (Highest 8-hour value recorded)	

Table 5: Comparisons to Standards and Guidelines - Integrated Sampling

Parameter	Standard/Guideline Value	Standard/Guide-line Source	Monitored Value	Notes
Formaldehyde (via 581 TraceAir II passive absorption sampling)	65 µg/m^3 (24-hour average)	Ontario Ambient Air Quality Criteria[1]	6.8 µg/m^3 (Highest 24-hour value recorded)	

[1] Human Toxicology and Air Standards Section, Technical Assessment and Standards Development Branch, Ontario Ministry of the Environment, Conservation and Parks (MECP). 2020. Ambient Air Quality Criteria. MECP, Toronto, ON, Canada. ISBN: 978-1-4868-4498-2. (Online). https://files.ontario.ca/mecp-ambient-air-quality-criteria-list-en-2020-05-01.pdf

[2] Alberta Ambient Air Quality Objectives and Guidelines Summary, Alberta Environment and Parks, Air Policy, 2016, No. 2, January 31, 2019. (Online). https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf

5.3 EXCEEDANCES OF OBJECTIVES, STANDARDS, AND GUIDELINES

Only one exceedance event (exceedance of a guideline value) was detected during the project. The Ontario air quality criterion[1] for PM_{10} (50 µg/m^3 24-hour average) was exceeded on February 9, 2024. The running 24-hour average (incremented hourly) was exceeded each hour between 11:00 AM and 7:00 PM that day. The peak 24-hour average value (54.4 µg/m^3) was reached at 4:00 PM. The running 24-hour average PM_{10} values for the affected period are illustrated in Figure 3.

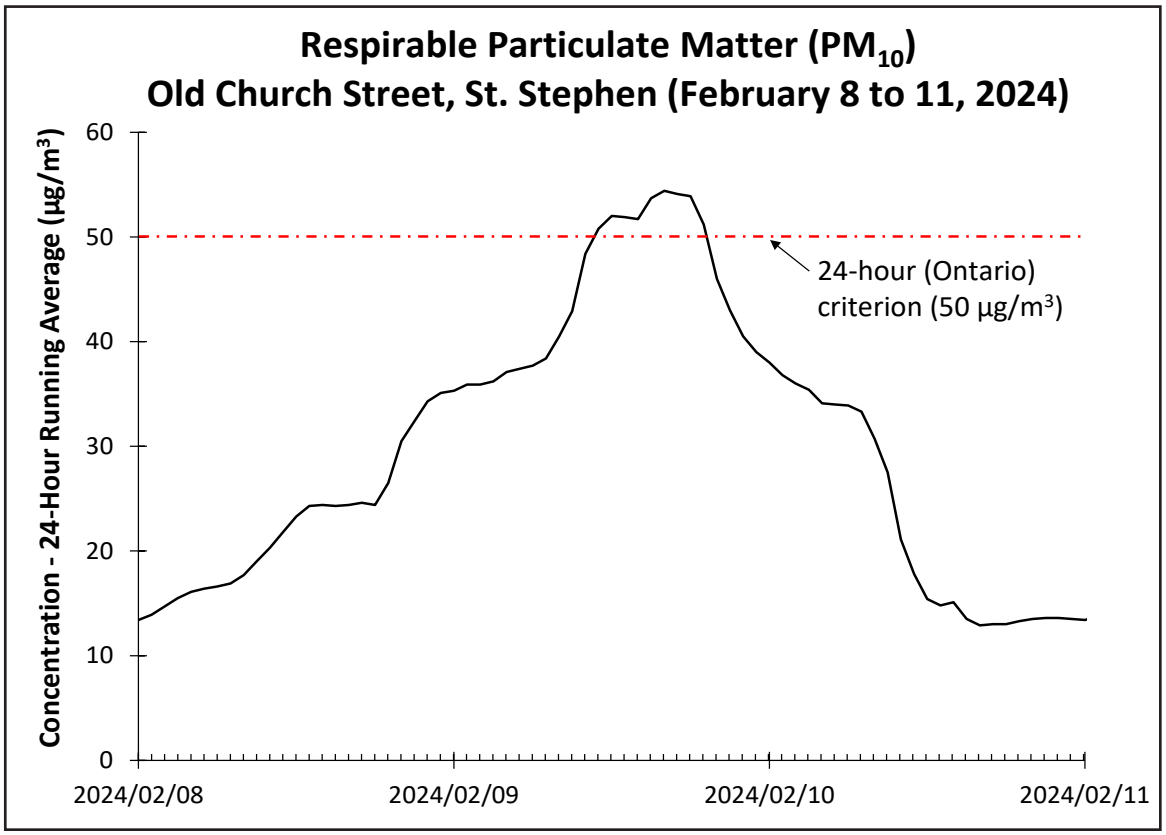

Figure 3: 24-Hour Running Average Respirable Particulate Matter Concentration - Old Church Street, St. Stephen, February 8, 2024 to February 11, 2024.

The February 9, 2024 guideline exceedance was driven by a 6-hour spike in hourly average values, which peaked at 166.9 µg/m^3 (hourly average) at 10:00 AM.

Wind direction was variable during the event, originating from the south, southwest, west and northwest. Wind speed was light (approximately 5 km/h on average).

Video surveillance and staff logs (both provided by Arauco Canada Ltd.) suggest that windblown road dust (dried salt and sand) was the cause of these elevated values.

[1] Human Toxicology and Air Standards Section, Technical Assessment and Standards Development Branch, Ontario Ministry of the Environment, Conservation and Parks (MECP). 2020. Ambient Air Quality Criteria. MECP, Toronto, ON, Canada. ISBN: 978-1-4868-4498-2. (Online). https://files.ontario.ca/mecp-ambient-air-quality-criteria-list-en-2020-05-01.pdf

5.4 PARAMETERS WITH NEGLIGIBLE IMPACT

No further analysis is provided for the continuously monitored parameters for which no exceedances of objectives, standards, or guidelines were observed (SO_2, NO_2, O_3, $PM_{2.5}$, and CO). Ample data was collected, under a wide variety of atmospheric conditions, throughout the 1-year monitoring period. As such, confidence is high that the potential for exceedances related to these parameters in this area is negligible. No further analysis of these parameters is warranted.

5.5 CANADIAN AMBIENT AIR QUALITY STANDARDS CONSIDERATIONS

Table 4 includes comparisons to certain Canadian Ambient Air Quality Standards (CAAQS). Some of these standards are based on statistics that require three years of data (an annual statistic that is repeated three times and the three years averaged together). However, only a single year of data is available from the current project. In these cases, although the results are not suitable for formal comparison to the CAAQS values, the comparison provided herein is nevertheless useful, and is based on the assumption that the single year of data is a reasonable basis for projecting/estimating air quality over a longer period (barring changes in local emissions). That is, to the extent that the current year is representative of a typical year at this location, we can be confident in a comparison of the calculated one-year value versus the three-year CAAQS standard. Based on available information, it does not appear that the 1-year period of the current project was exceptional or unusual for this location. As such, the comparison to the CAAQS statistics provide reasonable approximations of the values that would be generated if monitoring was to continue for the full three years required for these statistics.

Details with respect to the calculation of CAAQS statistics are available via the following Canadian Council of Ministers of Environment (CCME) guidance documents:

Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone, PN 1483, ISBN 978-1-896997-91-9 PDF, Canadian Council of Ministers of the Environment, 2012.

Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Sulphur Dioxide, PN 1610, ISBN 978-1-77202-063-2 PDF, Canadian Council of Ministers of the Environment, 2020.

Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Nitrogen Dioxide, PN 1608, ISBN 978-1-77202-061-8 PDF, Canadian Council of Ministers of the Environment, 2020.

Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Ozone, PN 1617, ISBN 978-1-77202-067-0 PDF, Canadian Council of Ministers of the Environment, 2021.

5.6 INTEGRATED SAMPLING OF FORMALDEHYDE - WIND ANALYSIS

Formaldehyde monitoring results revealed no exceedances of the relevant standard (Ontario Air Quality Criterion). However, in consideration of the limited sampling (12 days), it is worthwhile to further examine the results and compare against available wind data.

The individual formaldehyde results are compared against the wind favourability data (previously provided in subsection 4.1) in Table 6 below. Regression analysis of the two data sets revealed a weak correlation between favourable winds and formaldehyde concentration (coefficient of determination (r^2) value of 0.5).

Table 6: Southeasterly Wind Occurrence and Integrated Formaldehyde Sampling Results

Date	Southeasterly Winds (% of Time)	Formaldehyde Concentration (24-hour Average)
June 20 to 21, 2023	6	1.0 µg/m^3
June 21 to 22, 2023	6	1.0 µg/m^3
June 22 to 23, 2023	3	1.2 µg/m^3
June 26 to 27, 2023	48	4.1 µg/m^3
June 27 to 28, 2023	10	2.5 µg/m^3
June 28 to 29, 2023	8	1.7 µg/m^3
June 29 to 30, 2023	50	6.8 µg/m^3
July 4 to 5, 2023	45	1.4 µg/m^3
July 24 to 25, 2023	11	1.1 µg/m^3
July 25 to 26, 2023	5	1.4 µg/m^3
July 26 to 27, 2023	5	1.9 µg/m^3
July 27 to 28, 2023	5	2.4 µg/m^3

6.0 Discussion

For most of the pollutants monitored (SO_2, NO_2, $PM_{2.5}$, O_3, CO, and formaldehyde), concentrations detected at Old Church Street, St. Stephen were found to be well within (better than) applicable standards and guidelines, where suitable standards or guidelines exist.

With respect to PM_{10}, there was one event (spanning 9 hours on February 9, 2024), when monitored values exceeded the guideline value (the Ontario 24-hour average criterion). PM_{10} concentrations otherwise remained within the guideline levels throughout the project. This suggests that although there is potential for PM_{10} exceedances at this location, actual exceedances are likely rare.

Wind data collected during the PM_{10} exceedance event indicated that wind direction was variable (southerly through northwesterly) throughout the period. As this is the opposite direction from the Arauco Canada Ltd. mill, the facility itself is not implicated in the high PM_{10} values observed. However, southerly winds align with a portion of the roadway used by trucks and other vehicles servicing the plant. Video surveillance and wind analysis suggest that road dust generated by these trucks (by raising dried winter road salt and sand) contributed to the values recorded. However, it is also possible that levels were impacted by similar conditions on the nearby highway (Route 1).

With respect to formaldehyde levels, wind correlation analysis revealed that levels were higher when winds were originating from the direction of the facility. However, the correlation was weak and peak levels remained well below the guideline concentration. This suggests a negligible potential for formaldehyde exceedances in this area.

7.0 Data Limitations

The data collected represents conditions during the evaluation period and does not reflect all possible variations in ambient air quality conditions that may be possible at this location.

This project involved the collection of ambient air quality data under field conditions. Consequently, unforeseen and unavoidable disruptions (e.g., weather, electrical power failures, equipment malfunctions, etc.) resulted in temporary data interruptions at various points throughout the evaluation period.

The project analyzed air quality at a single fixed location. The results provide a quantitative assessment of air quality at that location only.

The project location may have been impacted by air pollutants from multiple sources during the evaluation period. Meteorology data can suggest likely sources for the contaminants detected during a given period. However, the data is insufficient for comprehensive “source apportionment” (i.e., it is not sufficient for discerning and quantifying the specific impacts of individual pollution sources).

Data was collected for a period of 12 months. However, some comparisons are made to objectives, standards, or guideline values that require a longer observation period (e.g., 3 years). See subsection 5.5 for details.

8.0 Glossary of Abbreviations

API	(Teledyne) Advanced Pollution Instrumentation
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of Environment
CO	Carbon monoxide
DELG	Department of Environment and Local Government
DNPH	2,4-dinitro-phenylhydrazine
HPLC	High Pressure Liquid Chromatography
ISBN	International Standard Book Number
km/h	Kilometers per hour
MDF	Medium Density Fibreboard
MECP	Ministry of the Environment, Conservation and Parks (Ontario)
NAPS	National Air Pollution Surveillance (program)
NB	New Brunswick
NO_2	Nitrogen dioxide
O_3	Ozone (ground level ozone)
PDF	Portable Document Format
$PM_{2.5}$	Fine particulate matter (particulates with a diameter ≤ 2.5 microns)
PM_{10}	Respirable Particulate matter (particulates with a diameter ≤ 10 microns)
PN	Publication Number (CCME)
PPB	Parts per billion
PPM	Parts per million
r^2	Coefficient of determination
SO_2	Sulphur dioxide
USEPA	United States Environmental Protection Agency
$\mu g/m^3$	Micrograms per cubic meter

Appendix A: Pollutant Parameters

Table A1: Rationale for Inclusion of Monitored Parameters

Air Contaminant	Rationale for Inclusion
Sulphur Dioxide (SO_2)	Emissions tracking for the mill indicates that SO_2 is being emitted from the facility. Inclusion of this parameter in the study provides quantification of ambient air quality impacts from these emissions.
Nitrogen Dioxide (NO_2)	Emissions tracking for the mill indicates that NO_2 is being emitted from the facility. Inclusion of this parameter in the study provides quantification of ambient air quality impacts from these emissions.
Ground Level Ozone (O_3)	Ozone is not usually directly emitted by pollution sources. Rather, it is formed in the air by reactions between certain pollutants (principally between volatile organic compounds and nitrogen dioxide). Ground level ozone concentrations change in predictable ways in response to the presence of these other contaminants. Monitoring this parameter along with NO_2 allows inferences to be made about local volatile organic compound emissions.
Particulate Matter (PM_{10} and $PM_{2.5}$)	Emissions tracking for the mill indicates that particulates are being emitted from the facility. Inclusion of these parameters in the study provides quantification of ambient air quality impacts from these emissions and determination of the size-distribution of the particles.
Formaldehyde	Formaldehyde is produced by the mill's drying activities and its urea formaldehyde plant. This is verified by the facility's emissions reporting. Inclusion of this parameter in the study provides quantification of ambient air quality impacts from these emissions.
Carbon Monoxide (CO)	Carbon monoxide (CO) is a product of incomplete combustion. Elevated levels signify combustion inefficiency. CO is known to be emitted from the mill. However, relative to applicable standards, significant amounts are not expected to be detected in the ambient environment. This parameter is included to verify this assumption.

Appendix B: Technical Specifications - Continuous Monitors

Table B1: Technical Specifications of Continuous Air Quality Monitors

Parameter	Instrument	Lower Detection Limit	Resolution
Sulphur Dioxide (SO_2)	Thermo Environmental Instruments Pulsed Fluorescence SO_2 Analyzer, Model 43*iQ*	1 ppb (60 second average of 300 millisecond samples)	± 0.5 ppb (noise) ± 1.0 ppb (precision)
Nitrogen Dioxide (NO_2)	Thermo Environmental Instruments Chemiluminescence NO-NO_2-NO_X Analyzer, Model 42*iQ*.	0.4 ppb	± 0.2 ppb (noise) ± 0.4 ppb (precision)
Ground Level Ozone (O_3)	Thermo Environmental Instruments Ultraviolet Photometric Ozone Gas Analyzer, Model 49*i*	0.5 ppb	± 0.25 ppb (noise) ± 1.0 ppb (precision)
Fine and Respirable Particulate Matter ($PM_{2.5}$ and PM_{10})	Teledyne API Model T640 Mass Monitor	0.1 µg/m^3 (hourly)	± 0.5 µg/m^3
Carbon Monoxide (CO)	Thermo Environmental Instruments Non Dispersive Infrared (NDIR) with gas filter correlation CO Analyzer, Model 48*i*-TLE	0.04 ppm	± 0.1 ppm (noise)

Appendix C: Wind Rose

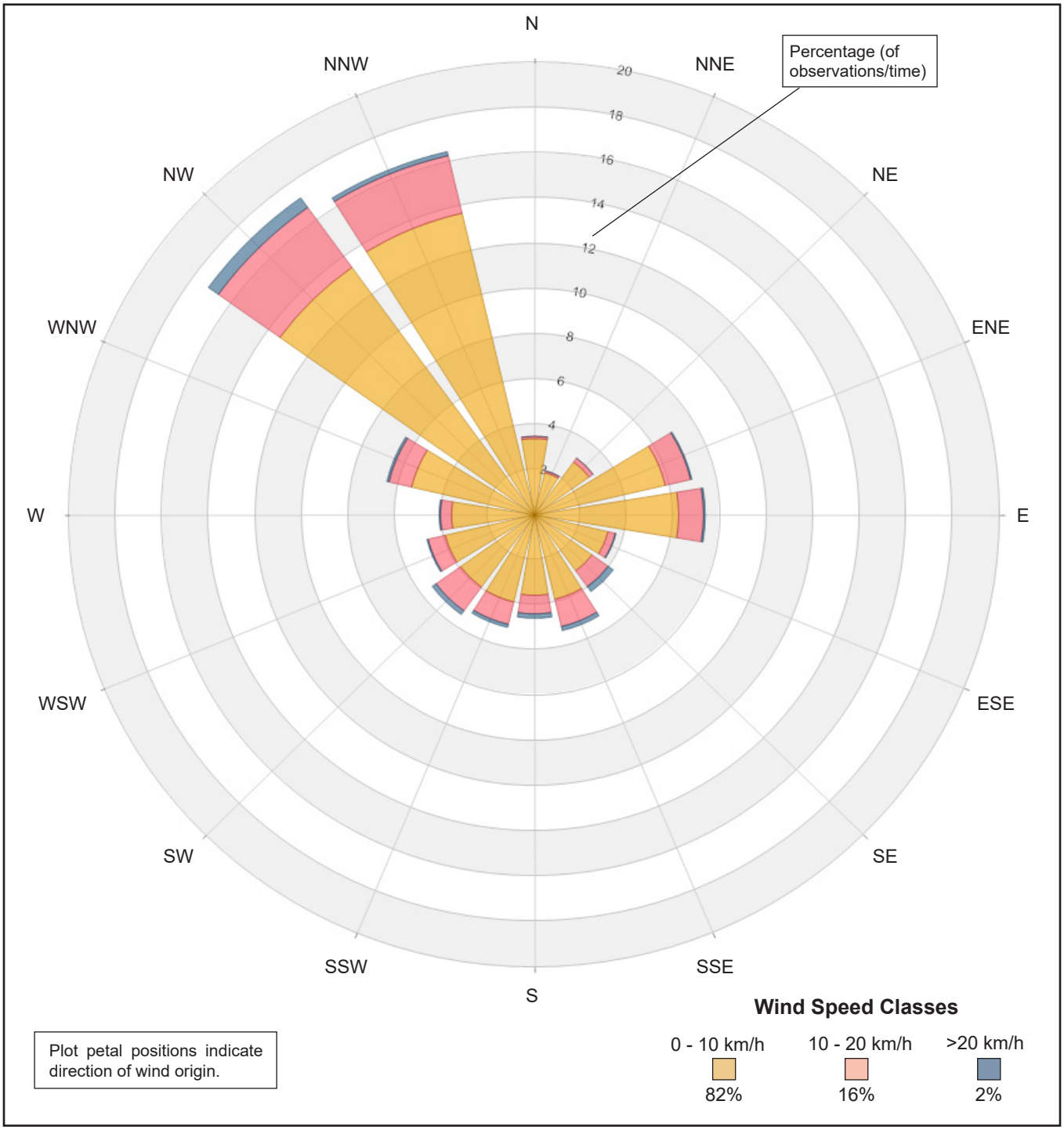

Figure C1: Wind Rose Diagram Indicating Frequency of Wind Direction and Speed - Old Church Street, St. Stephen, April 27, 2023 to April 26, 2024.

Appendix D: Continuous Monitors - Additional Data

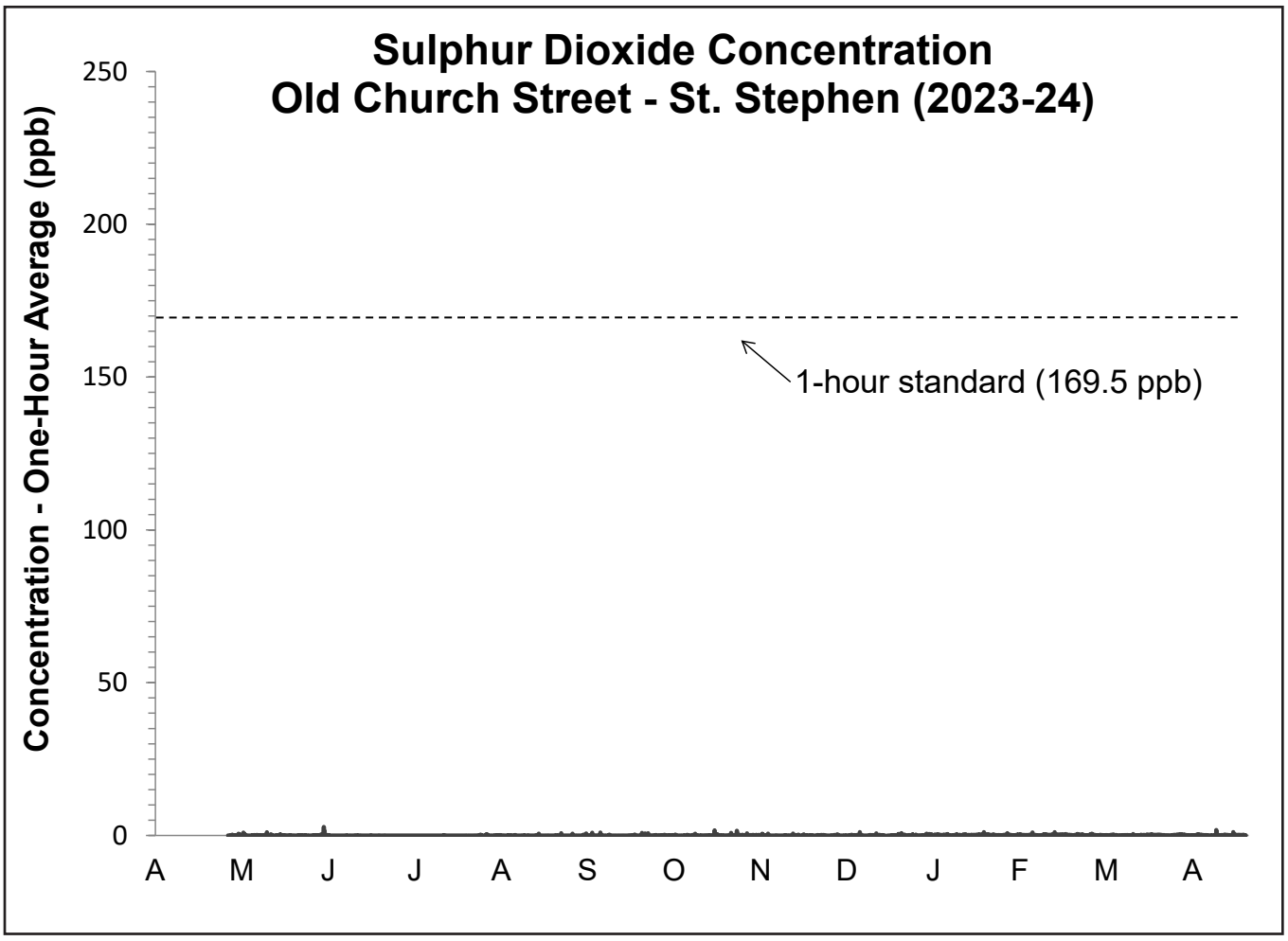

Figure D1: Hourly Average Sulphur Dioxide Concentration - Old Church Street, St. Stephen April 27, 2023 to April 26, 2024.

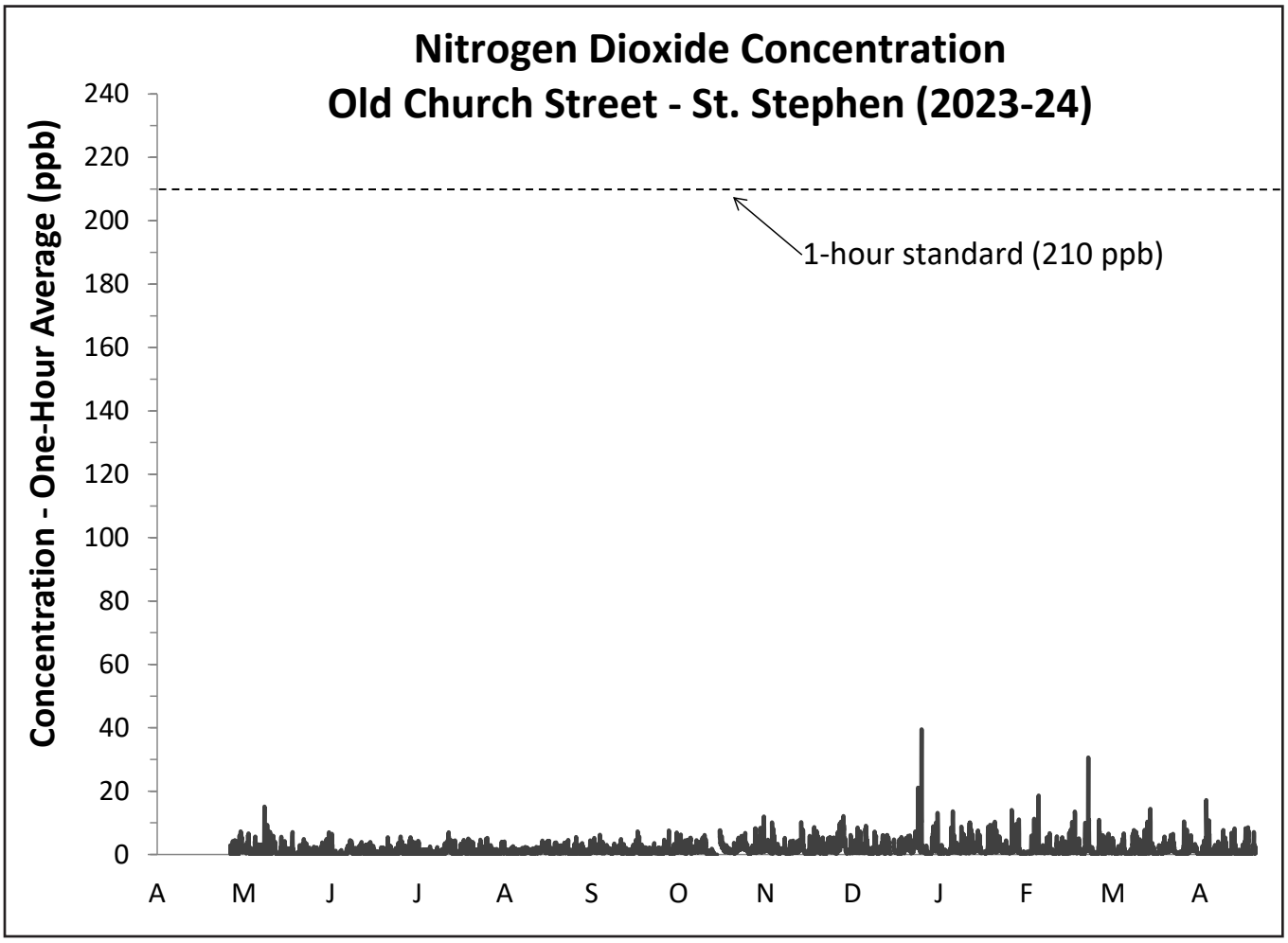

Figure D2: Hourly Average Nitrogen Dioxide Concentration - Old Church Street, St. Stephen, April 27, 2023 to April 26, 2024.

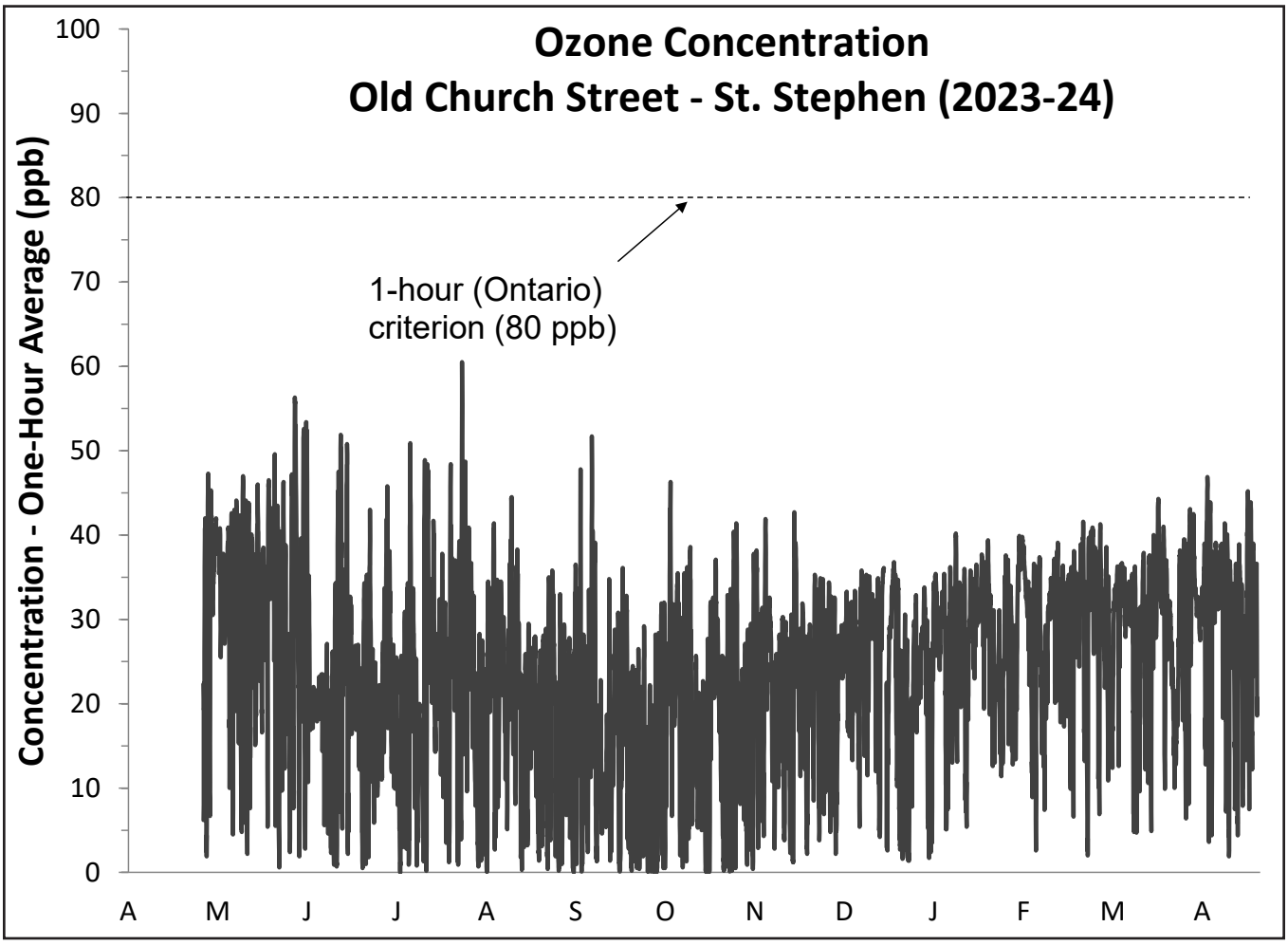

Figure D3: Hourly Average Ozone Concentration - Old Church Street, St. Stephen, April 27, 2023 to April 26, 2024.

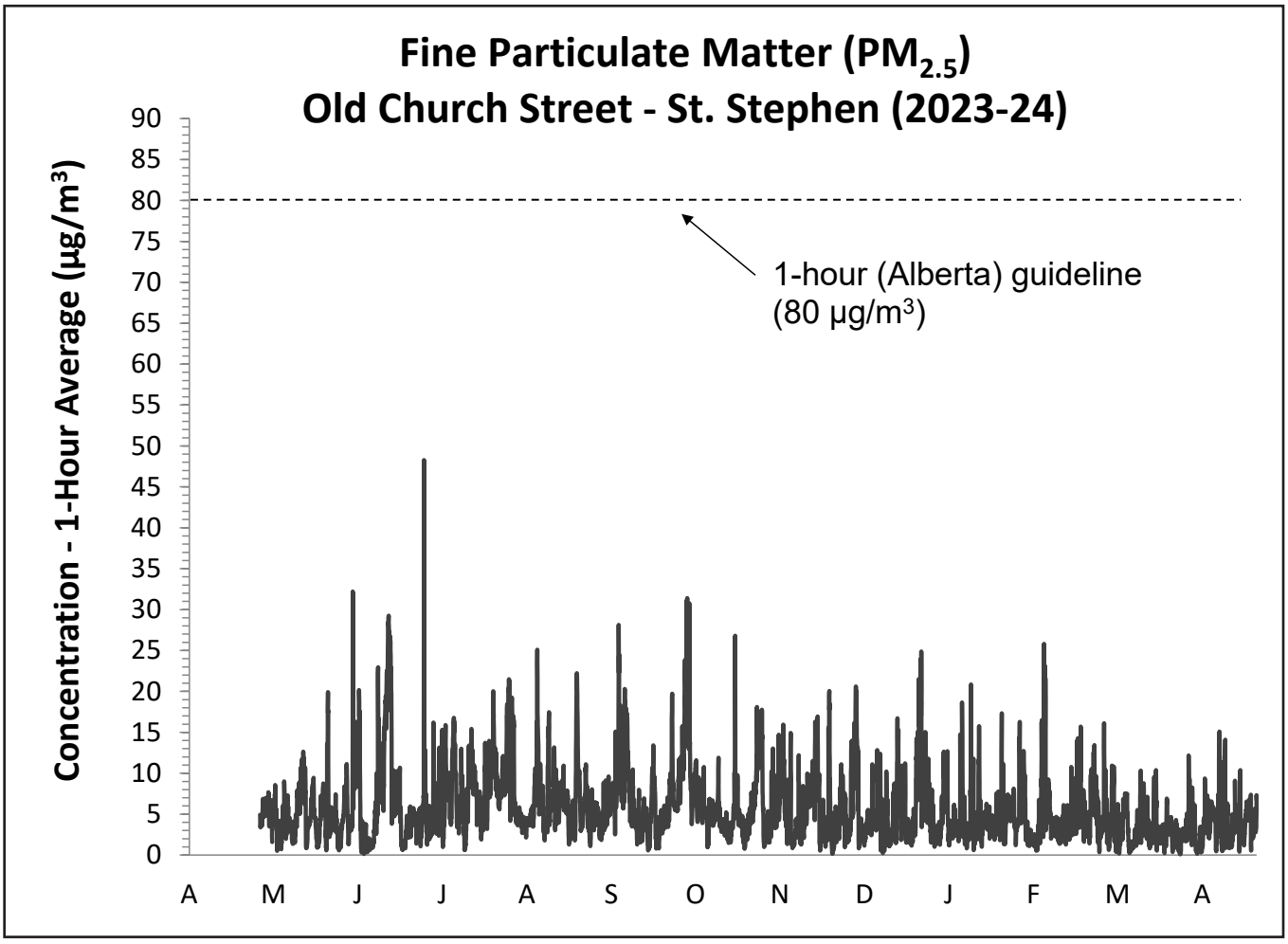

Figure D4: Hourly Average Fine Particulate Matter Concentration - Old Church Street, St. Stephen, April 27, 2023 to April 26, 2024.

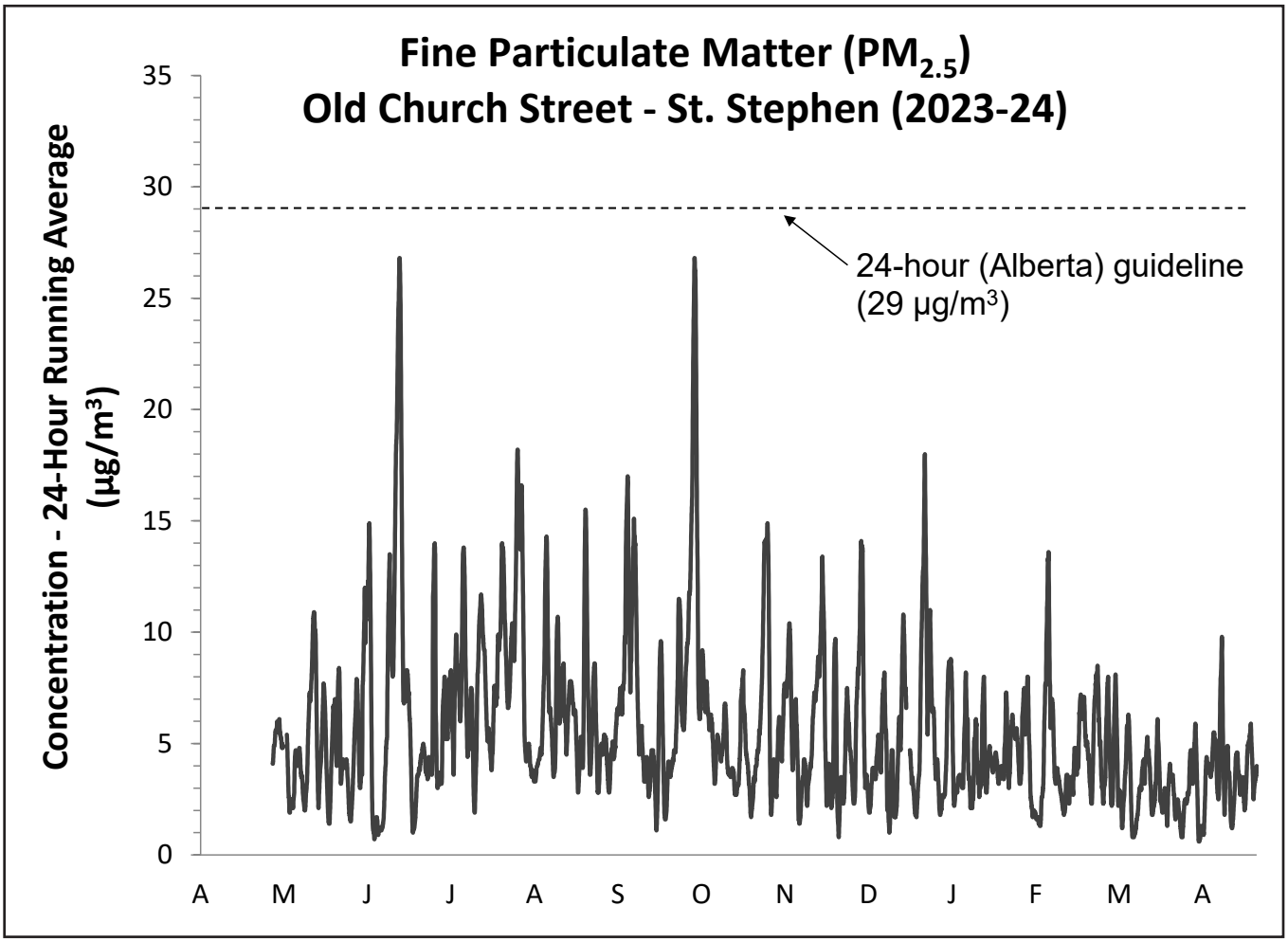

Figure D5: 24-Hour Running Average Fine Particulate Matter Concentration - Old Church Street, St. Stephen, April 27, 2023 to April 26, 2024.

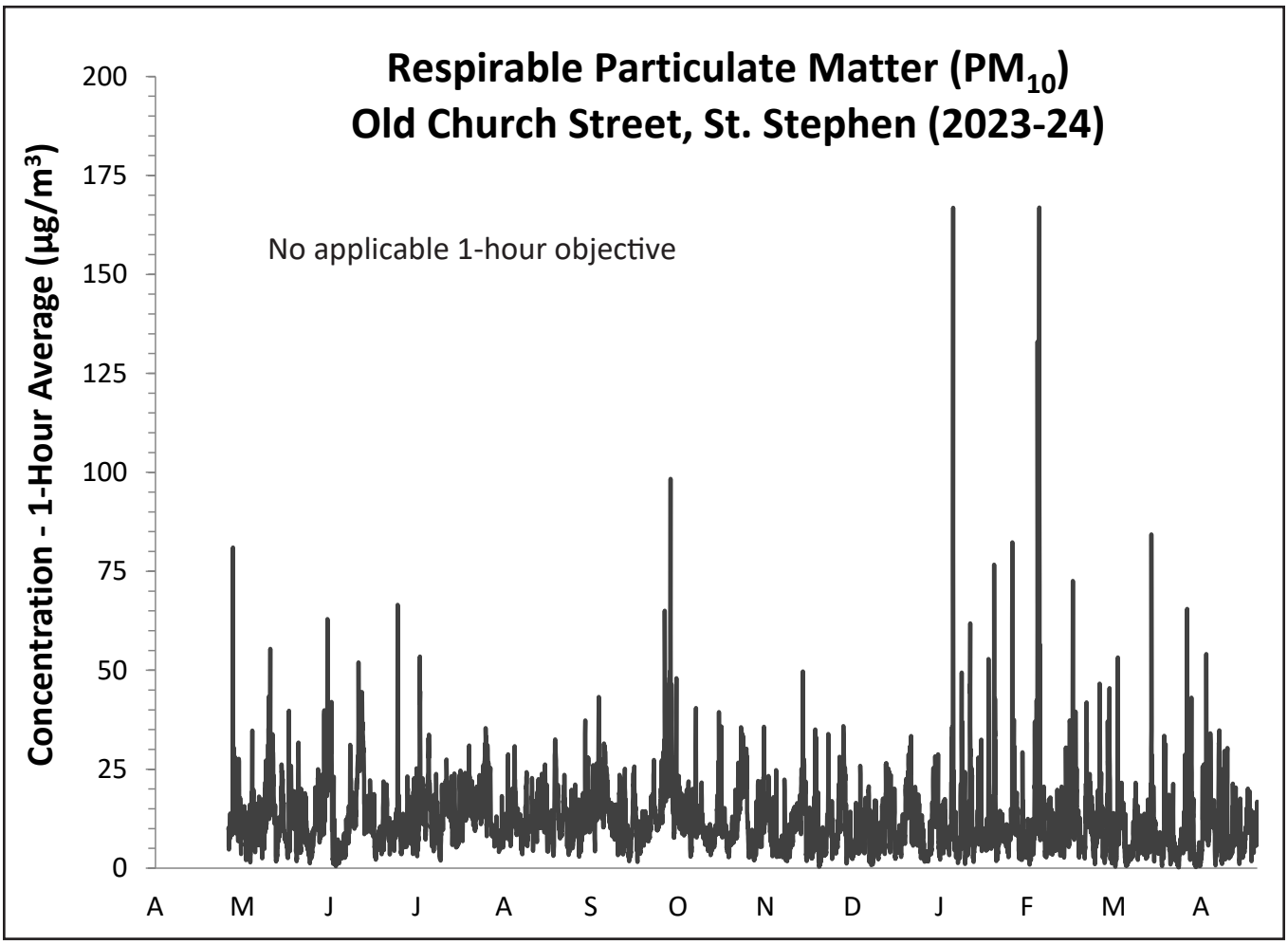

Figure D6: Hourly Respirable Particulate Matter Concentration - Old Church Street, St. Stephen, April 27, 2023 to April 26, 2024.

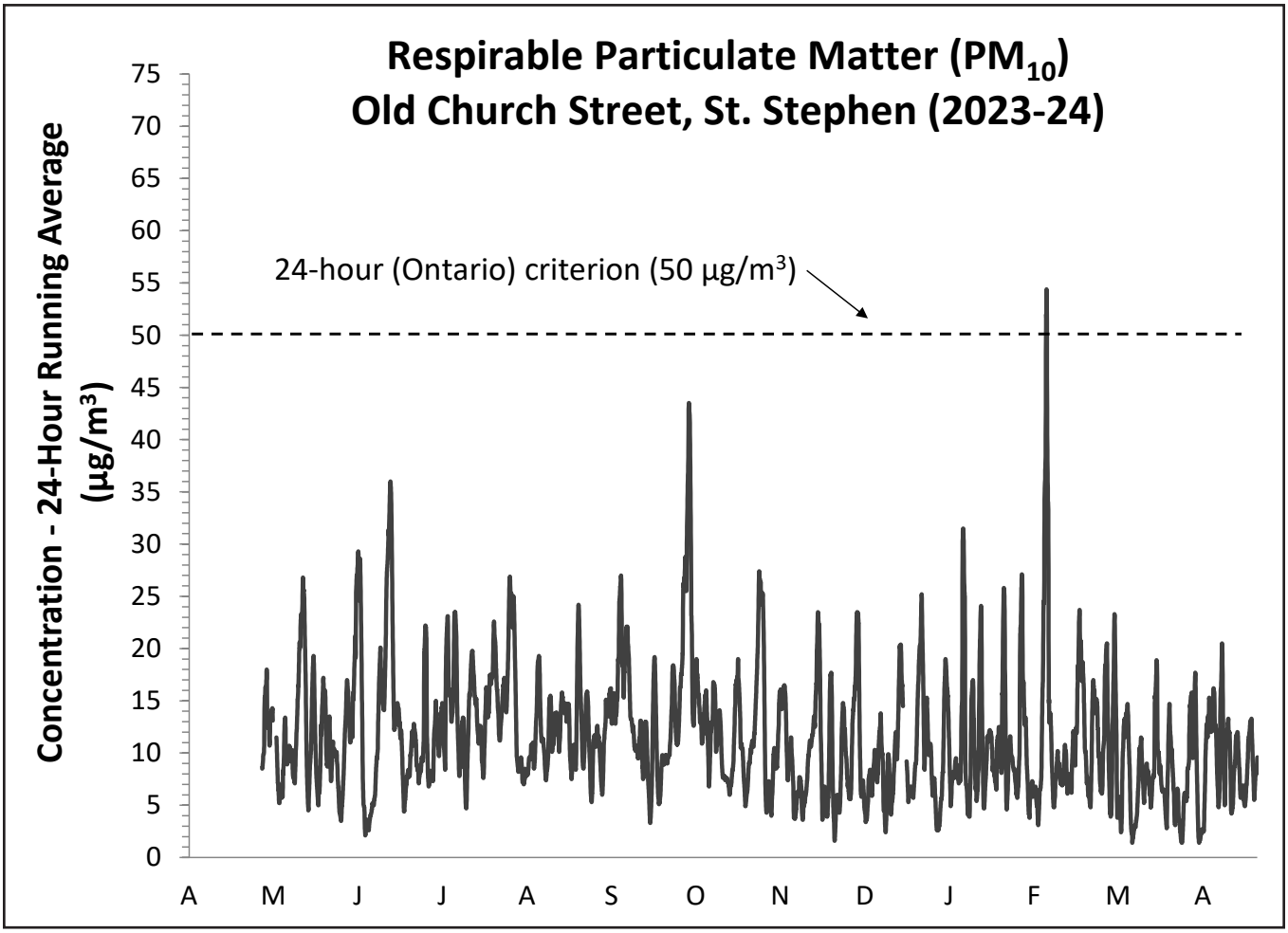

Figure D7: 24-Hour Running Average Respirable Particulate Matter Concentration - Old Church Street, St. Stephen, April 27, 2023 to April 26, 2024.

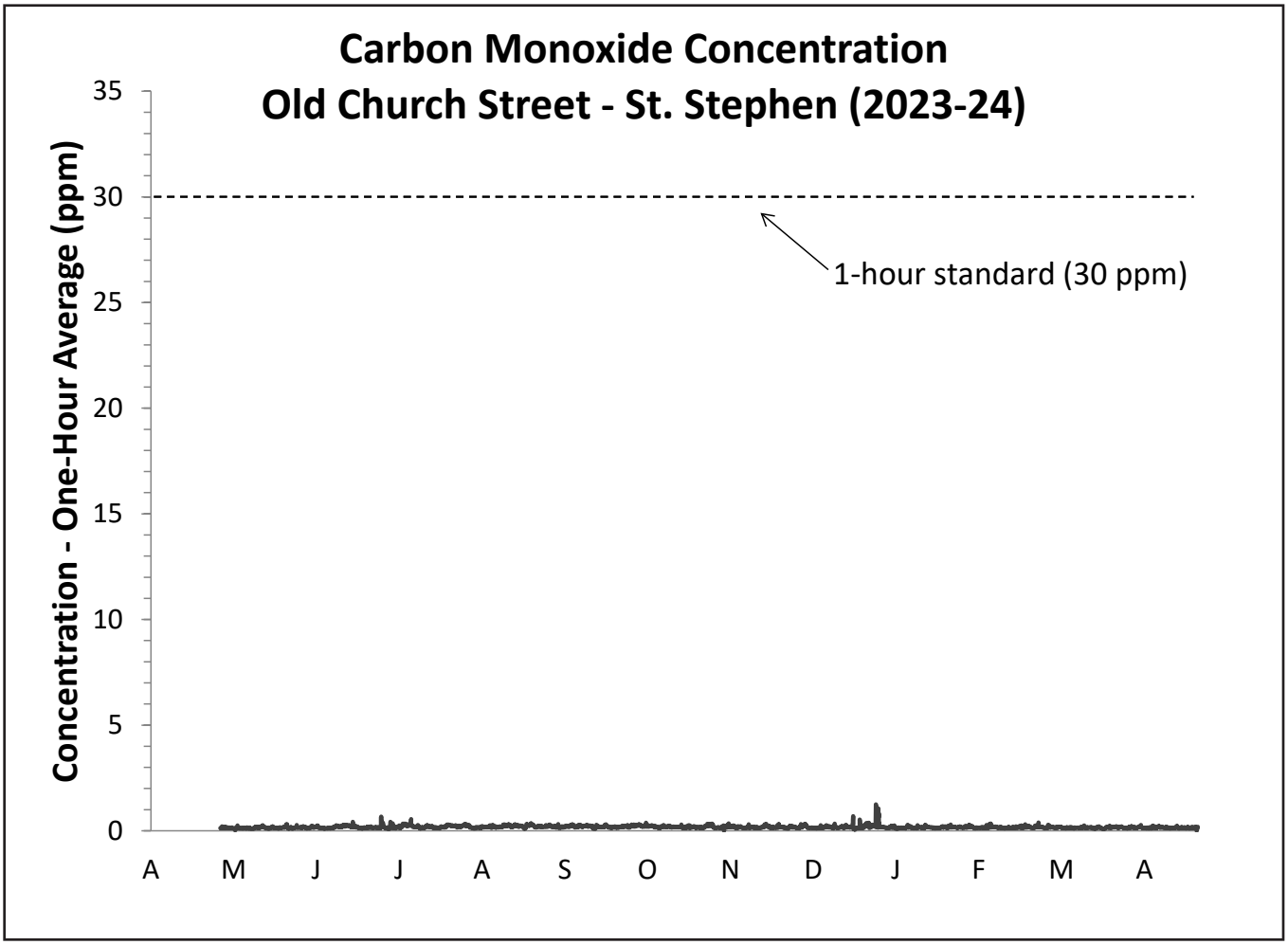

Figure D8: Hourly Average Carbon Monoxide Concentration - Old Church Street, St. Stephen, April 27, 2023 to April 26, 2024.