

2.7 Air Quality

Introduction

Air Quality in the Cowichan Valley Regional District

Air quality is directly related to human and ecosystem health. The effects of air pollution on human health include compromised breathing, the aggravation of existing respiratory and cardiac conditions, reduced lung function, and premature death. Poor air quality harms ecosystem diversity when the deposition of pollutants inhibits the functioning of plants, animals and aquatic life.

Some of the main sources of air pollution in the Cowichan Region include: light and heavy-duty vehicle emissions, open burning of woody debris from forest harvesting operations and land clearing, woodstove and backyard burning emissions, agricultural operations, and commercial/industrial emissions.¹⁰¹

Local air quality is also compromised by what goes on outside the boundaries of the region; Cowichan's airshed is part of the much larger Georgia Basin–Puget Sound airshed (Figure 2.37). Weather patterns within this larger airshed circulate air pollution from surrounding jurisdictions into the Cowichan Region and vice versa.

FIGURE 2.37: The Georgia Basin–Puget Sound airshed



Source: Environment Canada.

¹⁰¹ Environment Canada.

Measuring Air Quality

Reliable ways of measuring air quality in the Cowichan Region include monitoring levels of particulate matter, ground-level ozone and other key emissions in all segments of the region, and tracking respiratory-related hospital admission rates for children.¹⁰²

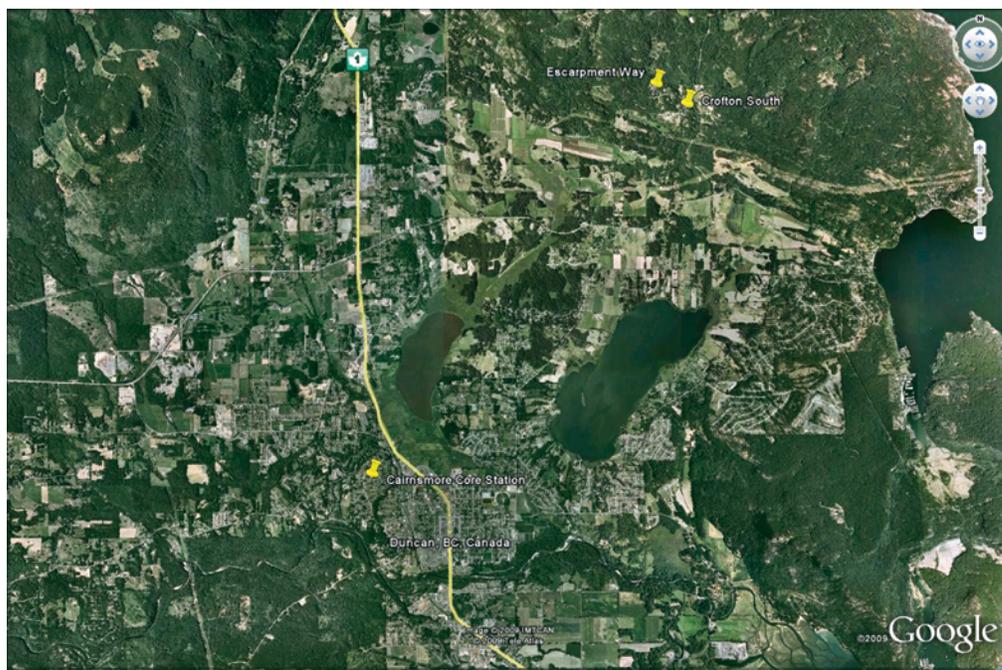
Crofton's Catalyst Paper mill operates three monitoring stations in the Crofton/Maple Bay area as part of its emission permit. The Ministry of Environment operates a fourth station, on Cairnsmore Street in Duncan (Figure 2.38). These stations record emissions such as fine particulate matter, ground-level ozone and nitrogen dioxide. Note: The Crofton South monitoring station was closed in 2008, and replaced with the Escarpment Way station.

The Vancouver Island Health Authority tracks hospital admissions for children with respiratory problems.

Indicators included in this report are:

- > Air Quality Index (AQI)
- > Fine particulate matter (PM_{2.5})
- > Hospital admissions (for children aged 0-14 years)

FIGURE 2.38: Air quality monitoring station locations in the Cowichan Region



Source: Ministry of Environment.

102 Ozone is considered to be a very good indicator of respiratory health (whereas fine particulate matter, or PM_{2.5}, is a good measure of cardiovascular health), Glen Okrainetz, Director of Air, Health Protection Branch, BC Ministry of Healthy Living and Sport, personal communication, 2010.

Air Quality Index

Indicator and Measures

The BC Ministry of Environment has been collecting Air Quality Index (AQI) data since the mid- to late-1990s at three monitoring stations: Crofton Substation, Deykin Avenue and Crofton South (replaced in late 2008 by Escarpment Way). In November 2009, the Ministry of Environment installed a new station on Cairnsmore Avenue in Duncan to collect urban air quality data using BC's new Air Quality Health Index (AQHI).

The Air Quality Index (AQI) continually measures six parameters, and reports out daily on the highest single parameter, relative to its objective or break-point (Table 2.13). By comparison, the new Air Quality Health Index (AQHI) reports out every three hours, and is an amalgamation of all measured pollutants.¹⁰³

The AQI is interpreted using the following scale: good (0 to 25), fair (26 to 50), poor (51 to 100) and very poor (100+).

TABLE 2.13: Air Quality Index parameters and objectives

Parameter	Sulphur Dioxide		Carbon Monoxide		Nitrogen Dioxide	Ozone	Particulates <10 micrometers	Particulates <2.5 micrometers
	Averaging Time	1 Hour	24 Hours	1 Hour	8 Hours	1 Hour	1 Hour	24 Hours
Unit of Measure	ppm	ppm	ppm	ppm	ppm	ppm	ug/m ³	ug/m ³
Break-point:								
AQI = 25	0.17	0.06	13	5.0	0.105	0.05	25	15
AQI = 50	0.34	0.11	30	11.0	0.210	0.08	50	25
AQI = 100	2.00	0.30	64	17.4	0.530	0.15	100	50

Source: BC Ministry of Environment a100.gov.bc.ca/pub/aqiis/aqi.bulletin

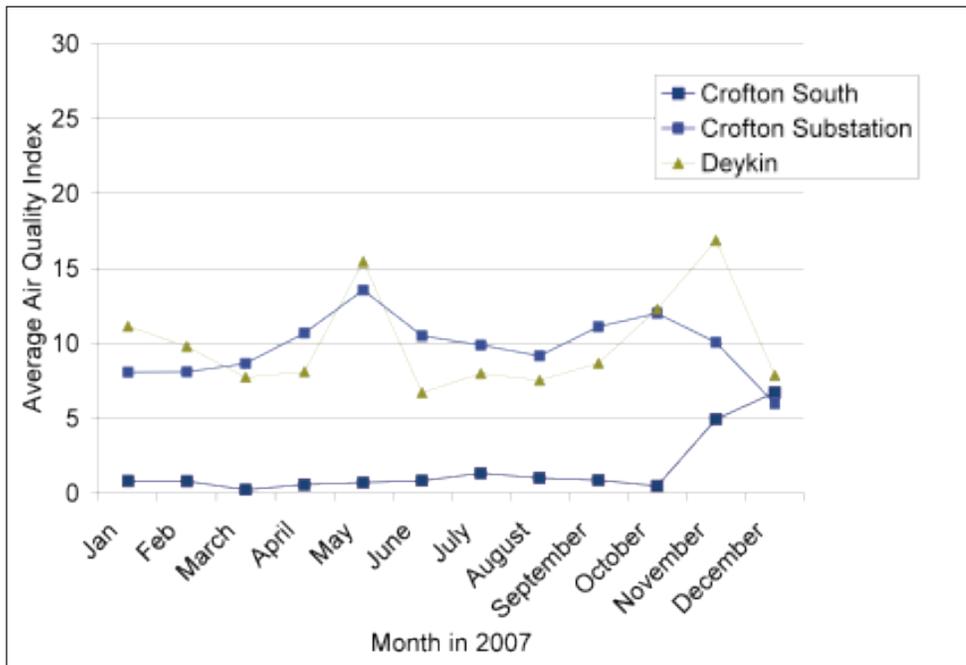
The AQI data is reliable and repeatable, and will be enhanced by AQHI data from the Duncan monitoring station.

103 BC's new Air Quality Health Index measures the combined effect of three contaminants felt to have the most direct impact on human health: nitrogen dioxide, ozone, and fine particulate matter (PM_{2.5} and PM₁₀). Measurements are reported over a shorter term (the AQHI has a 3-hour running average versus the Air Quality Index's 24-hour average), and are therefore felt to provide more timely information for people with respiratory problems.

Findings

The most current and complete annual Air Quality Index (AQI) information available was for the year 2007. The data for 2007 indicate that the region's overall air quality is "good" according to the AQI scale (AQI=0 to 25). A monthly breakdown of data shows AQI readings well below the 25 mark (Figure 2.39). Hourly readings show that air quality only occasionally moves into the "fair" range (AQI=26 to 50) (Table 2.14).

FIGURE 2.39: Air Quality Index monthly readings for 2007



Source: Ministry of Environment.

TABLE 2.14: Number of "hourly maximums" in 2007 when AQI surpassed break-point of 25

Month	Crofton South	Crofton Substation	Deykin Avenue	Percentage of hourly AQI readings over break-point of 25
Jan	0	0	25	3.4%
Feb	0	0	26	3.9%
March	0	0	0	0%
April	0	33	0	4.6%
May	0	18	43	8.2%
June	1	25	0	3.6%
July	0	0	0	0%
August	0	0	0	0%
September	0	0	0	0%
October	0	0	19	2.6%
November	7	0	86	13%
December	19	0	0	2.6%
Total	27	76	199	3.4%

Note: Air Quality Index readings are taken every hour of every day, for a total of 24 readings per day and approximately 720 readings per month. This means there can be up to 24 hourly maximums that surpass an AQI of 25 in one day.

For example, all but one of the instances where the AQI surpassed the break-point of 25 at the Deykin Avenue monitoring station could have occurred in a single day.

Source: Ministry of Environment Air Quality Index readings, 2007.

Fine Particulate Matter (PM_{2.5})

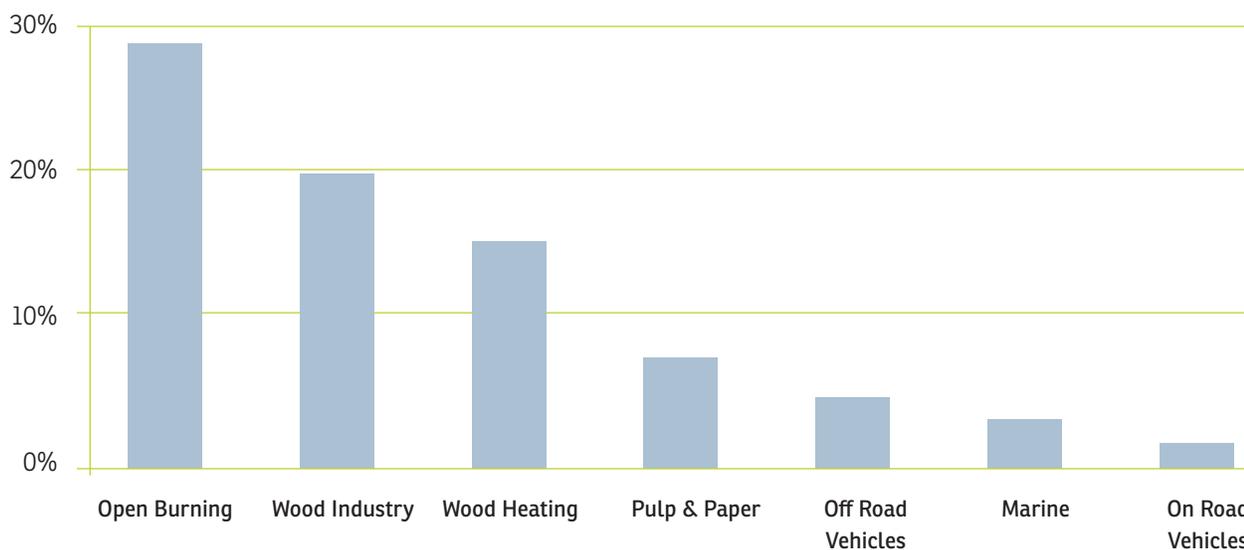
Indicator and Measure

Fine particulate matter (also called PM_{2.5} due to the size of the particles¹⁰⁴) is one of the most important outdoor air pollutants in BC from a human health perspective, likely due to the fact that these very fine particles are easily inhaled and go deep into the lungs. PM_{2.5} exposure is linked to a range of health impacts, including inflammation of the airways, more frequent use of medications, increased emergency room visits, hospitalizations and premature mortality.¹⁰⁵ People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure.¹⁰⁶

PM_{2.5} comes from combustion sources, such as exhaust from vehicles (cars, trucks, buses), emissions from factories, and smoke from burning wood, land-clearing debris and garbage. Fine particulates also come from the reactions that transform some of the pollutant gases into solid or liquid particles (Figure 2.40).

FIGURE 2.40: Largest sources of PM_{2.5} emissions in BC, 2005

Percentage of 2005 Provincial Fine Particulate Matter Emissions



Source: BC Lung Association State of the Air report, 2009.

PM_{2.5} is measured using units of micrograms per cubic metre, and hourly readings are rolled up into a 24-hour average in order to compare to daily criteria.

104 The size of PM_{2.5} particles is about 1/20th the width of a human hair.

105 BC Ministry of Healthy Living and Sport, June 2009.

106 US Environmental Protection Agency, accessed December 2009.

While no safe health thresholds for $PM_{2.5}$ have been identified¹⁰⁷, the provincial and federal governments have established $PM_{2.5}$ air quality objectives (Table 2.15). In addition, the Federal/Provincial Advisory Committee on Air Quality Objectives and Guidelines has developed an unofficial "Health Reference Level" for $PM_{2.5}$ that is an estimate of the lowest ambient $PM_{2.5}$ level at which statistically significant increases in health responses can be detected, based on available data and current technology.¹⁰⁸

Two monitoring stations have been measuring $PM_{2.5}$ levels in the Cowichan Region since 2005: Crofton South (in operation from February 2005 to February 2008) and Escarpment Way (in operation since October 2008).

In addition, a temporary air quality monitoring site (called E-Sampler) affixed to the Cowichan Valley Regional District building in downtown Duncan collected $PM_{2.5}$ data from April 2008 to August 2009. This site has now been shut down, but its findings were useful in justifying the need for the new air quality monitoring site on Cairnsmore Street in Duncan. The Cairnsmore site is the first Air Quality Health Index monitoring site in the region, and has been gathering data, including $PM_{2.5}$ levels, since November 2009.

TABLE 2.15: $PM_{2.5}$ objectives

	Daily (24-hour period)	Annual mean	Annual voluntary planning goal
British Columbia standards	25 ug/m ³	8 ug/m ³	6 ug/m ³
Canada-wide standards	30 ug/m ³		
World Health Organization guidelines	25 ug/m ³	10 ug/m ³	
Health Reference Level	15 ug/m ³		

Note: The Canada-wide standards are based on the 98th percentile annual ambient measurement over 3 consecutive years.

Source: BC Ministry of Environment, Environment Canada, World Health Organization.

The $PM_{2.5}$ data is accurate and reliable, and will be enhanced by new information currently being generated by the urban monitoring station on Cairnsmore Street in Duncan, and results from the CVRD's mobile aethalometer¹⁰⁹ testing, taking place in 2010.

107 BC Ministry of Healthy Living and Sport, June 2009.

108 National Ambient Air Quality Objectives for Particulate Matter. Part 1: Science Assessment Document. A report by the CEPA/FPAC Working Group on Air Quality Objectives and Guidelines.

109 An aethalometer is an instrument that provides a real-time readout of the concentration of soot particles in an air stream. These particles are emitted from all types of combustion, including diesel exhaust from vehicles and wood burning stoves.

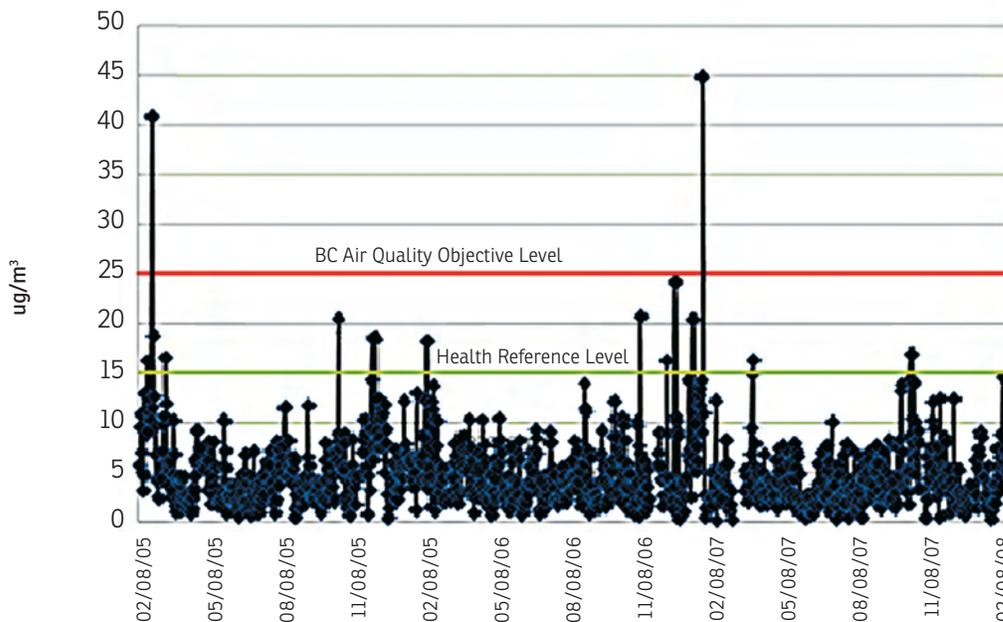
Findings

Levels of fine particulate matter (PM_{2.5}) are well below allowable levels, with some seasonal variation. Constant sources of PM_{2.5} throughout the year include emissions from commercial/industrial processes and vehicle exhaust. In the fall and winter months, when additional sources of combustion are present (e.g., forest harvesting and land-clearing open-burning activities, woodstove use and backyard burning) and air inversions trap pollution at lower altitudes, air quality can diminish significantly. In spite of these seasonal pressures, levels of PM_{2.5} remain within daily and annual objectives.

Daily levels of PM_{2.5} measured at the Crofton South station have only exceeded provincial objectives two times in the last four years, and only in the winter months: in February 2005 (PM_{2.5} = 40.88 µg/m³) and in February 2007 (PM_{2.5} = 44.67 µg/m³) (Figure 2.41). Readings at the Escarpment Way monitoring station (which replaced Crofton South in 2008) have not exceeded provincial objectives, and surpassed the Health Reference Level on one occasion only (Figure 2.42).

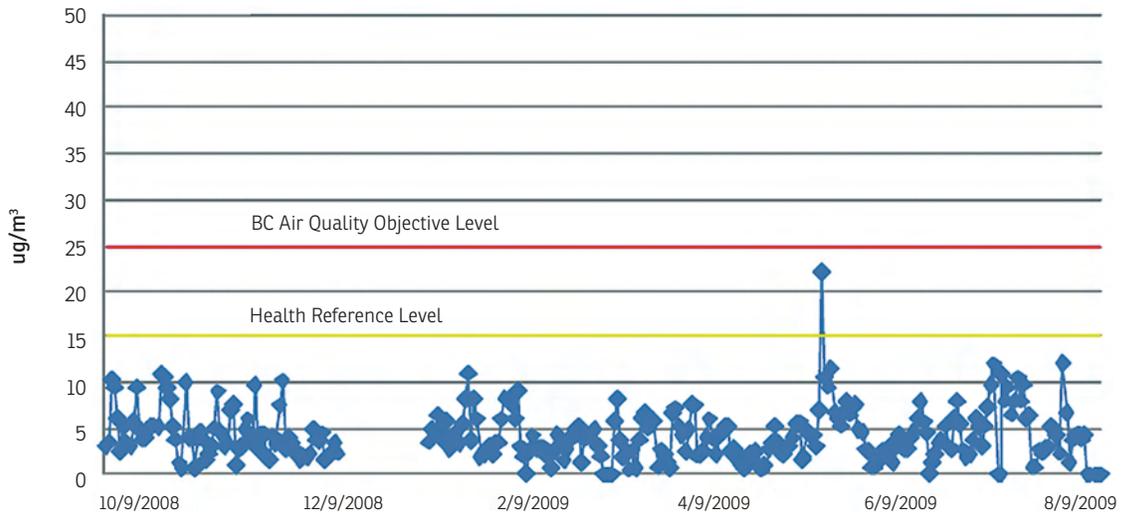
The E-Sampler station on the CVRD building recorded higher levels of PM_{2.5} during the winter months, and had one reading in excess of provincial objectives in December 2008 (PM_{2.5} = 36.67 µg/m³) (Figure 2.43). The Health Reference Level is frequently exceeded during the fall and winter months.

FIGURE 2.41: Crofton South daily PM_{2.5} readings (February 2005 to February 2008)



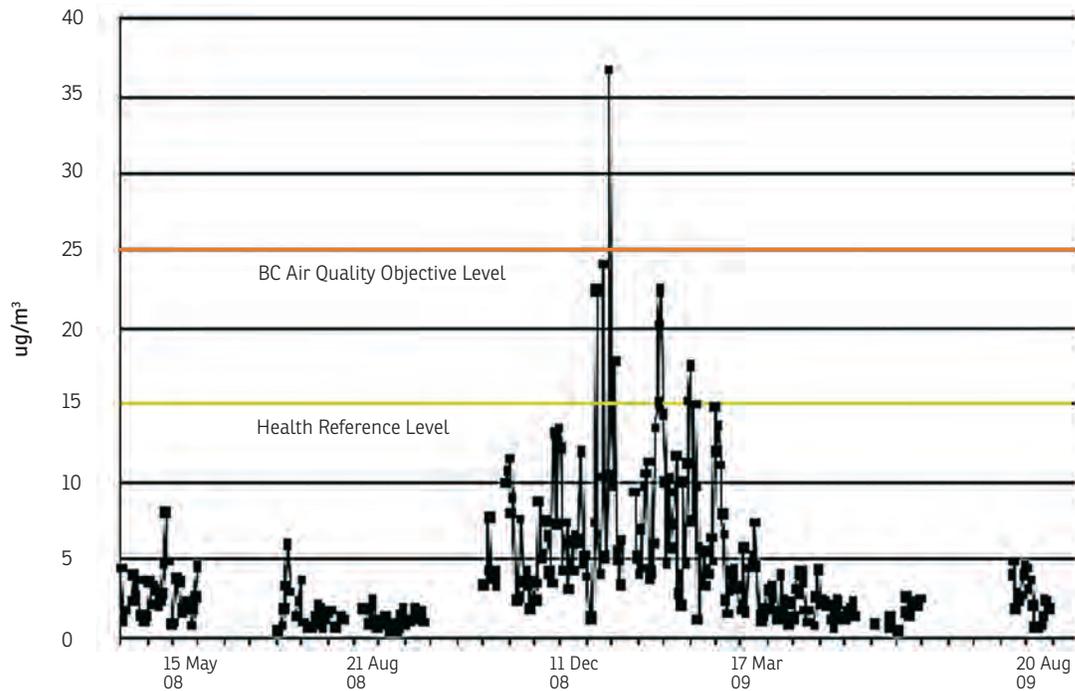
Source: Ministry of Environment.

FIGURE 2.42: Escarpment Way daily $PM_{2.5}$ readings (October 2008 to August 2009)



Source: Ministry of Environment.

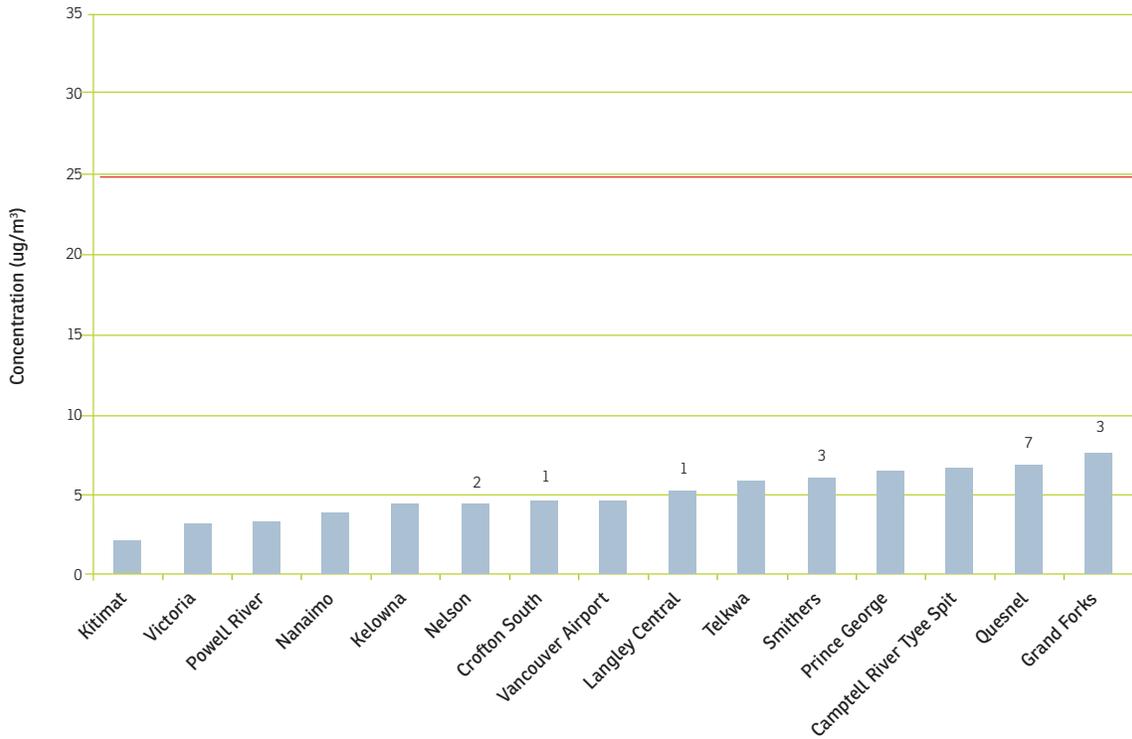
FIGURE 2.43: E-Sampler daily $PM_{2.5}$ readings (April 2008 to August 2009)



Source: Ministry of Environment.

The 2007 annual $PM_{2.5}$ level from the Crofton South station was $4.6 \mu\text{g}/\text{m}^3$, below BC's annual goal of $8 \mu\text{g}/\text{m}^3$. Using 2007 data from other BC communities, the Cowichan Region's air quality compares favourably, although it is generally higher than places such as Nanaimo and Powell River (Figure 2.44).¹¹⁰

FIGURE 2.44: Comparison of average concentrations of $PM_{2.5}$ in communities around BC, 2007



Note: The numbers at the top of the columns indicate the number of days in 2007 when $PM_{2.5}$ exceeded the provincial standard of $25 \mu\text{g}/\text{m}^3$.

Source: Ministry of Environment, Provincial $PM_{2.5}$ readings, 2007.

¹¹⁰ In order to determine whether or not a year of data is valid, the Ministry of Environment uses the "75% rule" that stipulates that each quarter of the year must have at least 75% data capture. Using this rule, the most current $PM_{2.5}$ data available for the Cowichan Region is for 2007.

Hospital Admissions (0-14 years)

Indicator and Measure

Air pollution causes measurable increases in the rates of hospitalization for people with respiratory and cardiovascular diseases, and for others who are considered more vulnerable to airborne pollutants, including children and seniors.¹¹¹

Children respond to air pollution in different ways than adults, mainly because they take in more air – and thus more air pollution – per unit body weight when exercising than adults (20–50% more). In addition, children generally spend more time outside than adults. The impacts of poor air quality on children include respiratory problems such as airway irritation, coughing, and pain when taking a deep breath; wheezing and breathing difficulties during exercise or outdoor activities; aggravation of asthma¹¹² and increased susceptibility to respiratory illnesses like pneumonia and bronchitis; and suppressed lung growth.¹¹³

For these reasons, it is useful to assess air pollution levels by looking at the number of hospital admissions for children with respiratory problems.

The Vancouver Island Health Authority tracks annual hospital admissions for people between the ages of 0 and 14 years with “diseases and disorders of the respiratory system.” This information is gathered at the region’s three hospitals, and then broken out by patient geography and local health area.

The hospital admissions data is accurate and reliable, and could be enhanced by further disaggregation (e.g., by month, by respiratory disorder).

111 Health Canada website: www.hc-sc.gc.ca/ewh-semt/air/out-ext/effe/health_effects-effets_sante-eng.php#a6

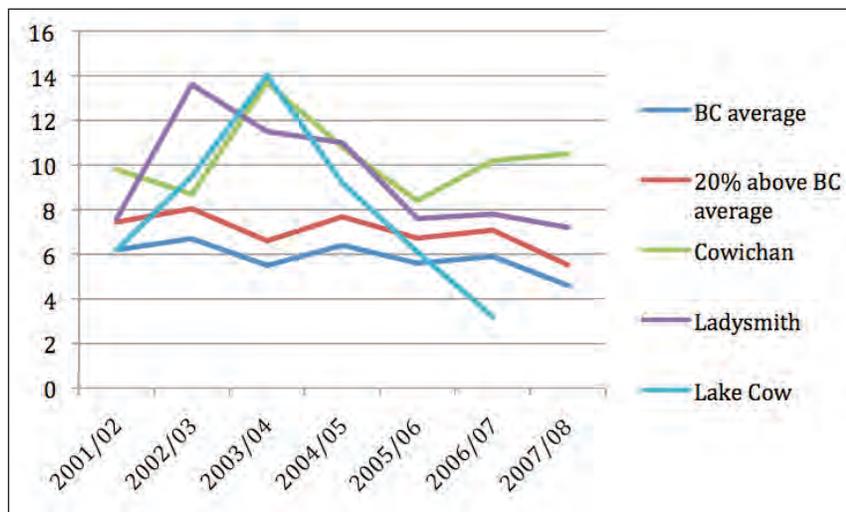
112 Children with asthma may be particularly vulnerable to air pollution at levels below current air quality standards. NIH/National Institute of Allergy and Infectious Diseases, *Air Pollution Affects Respiratory Health In Children With Asthma*, April 17, 2008.

113 US Environmental Protection Agency www.epa.gov/groundlevelozone/health.html. See also: *Outdoor Air Quality—A Primer for Physicians (and Appendix)*, 2009. Prepared by the UBC School of Environmental Health and Centre for Health and Environment Research; BC Centre for Disease Control; BC Lung Association; and Ministry of Healthy Living and Sport. www.bc.lung.ca/airquality/airquality_primer.html

Findings

Hospital admission rates for children with respiratory problems in the Cowichan Region are higher than the provincial average – at times by a significant amount (Figure 2.45). The Vancouver Island Health Authority (VIHA) considers it problematic when admissions rates are at least 20% higher than the BC average.

FIGURE 2.45: Annual number of admissions per 1,000 people (case rate), by local health area, 2001 to 2008



Note: Lake Cowichan's case rate for 2007/08 was lower than the scale of this chart (meaning less than 1,000 people admitted).

Source: Vancouver Island Health Authority.

Summary

Air quality in the Cowichan Region is generally good, and pollution levels are well within provincial standards. However, there are no safe levels of air pollution, so significant human health impacts can occur even in relatively clean airsheds.¹¹⁴

Hospital admission rates for children with respiratory problems in the Cowichan Region seem to signal a problem. Admission rates are consistently more than 20% higher than the provincial average, and at times are twice this average.

114 A 2005 scientific study for the British Columbia Lung Association found that, even in areas with relatively low levels of air pollution, public health effects can be substantial and costly. This is because effects can occur at very low levels and a large number of people can potentially breathe in such pollutants. The study predicts that a 1% improvement in ambient PM_{2.5} and ozone concentrations could result in \$29 million in health care savings in the Lower Fraser Valley in 2010.

Seasonal variances in air quality are also of concern. Air quality diminishes significantly in the fall and winter months, due to increases in seasonal combustion (open burning and woodstove use). Sources of low-level air pollution throughout the year include vehicle exhaust and commercial/industrial emissions.¹¹⁵

Climate change has the potential to compound regional air quality. Predictions of drier, hotter summers and an increased possibility of forest fires could result in greater amounts of harmful dust and smoke particles.

Pressures on the Cowichan Region's air quality will continue to increase with a rising population and more economic activity. Mitigation of these pressures could come in the form of additional restrictions on backyard burning, "burn smart" public education campaigns, and region-wide support for smart growth principles that encourage compact, urban development and reduce reliance on vehicles.

The impacts of air pollution on Cowichan's ecosystem health appear to be negligible at present, however they are unquantified at this time.¹¹⁶

Missing information

Air quality monitoring stations are largely clustered around industrial activities in the Crofton area, and – with the exception of the new station in Duncan – do not capture information from other parts of the region. Future air quality monitoring stations and studies should be situated near major transportation corridors and areas of high woodstove use to capture other substantial sources of emissions. The CVRD's mobile aethalometer testing conducted in January 2010 will indicate whether a need exists for additional monitoring stations throughout the region.

Until recently, ground-level ozone has not been monitored in the Cowichan Region. The new Air Quality Health Index monitoring site on Cairnsmore Street in Duncan started measuring ground-level ozone in November 2009. Data generated from this site will provide vital information for subsequent State of the Environment reports. Ground-level ozone is a key determinant of human and ecosystem health, and can have devastating impacts on local economies, including significant crop damage. Ground-level ozone levels are at their worst during the summer months, when strong sunlight and hot weather trigger a chemical reaction that results in harmful concentrations.

¹¹⁵ This is based on modeling. Particle speciation can pinpoint actual sources of air pollution, but to date this technique has only been conducted in BC communities known to have serious air pollution problems, such as Prince George and Quesnel.

¹¹⁶ It is unlikely that current levels of air pollution are impacting the natural environment. Two measures of deposition-related impacts are acidification and nitrogen oxide emissions. A recent summary of data about Quamichan Lake water quality, compiled by the Ministry of Environment, suggests that acidification (measured by low pH levels) is not a concern. The BC Lung Association's 2009 Annual Report shows low levels of nitrogen dioxide in the Crofton area (less than 7 µg/m³, which is well below the national objective of 60 µg/m³). These findings were validated via personal communication in 2010 with Earle Plain, Ministry of Environment Air Quality Meteorologist, who stated that regional sulphur and nitrogen oxide levels (contributors to acid rain or acidification) are extremely low and not problematic.

The usefulness of data on respiratory-related hospital admissions for children might be enhanced if records were available on a monthly basis. This might allow a more direct comparison with seasonal fluctuations in air quality (higher PM_{2.5} in the fall and winter, potentially higher ground-level ozone in the summer).

VIHA is presently setting up the Cowichan Regional Health Network in order to identify health priorities. This network will bring together a wide variety of community leaders and health representatives, and will – among other things – try to identify the specific factors that are contributing to the Cowichan Region's higher-than-average respiratory admission rates.¹¹⁷

Health Canada is currently conducting a modeling study of the effects on human health of air emissions from the Canadian Pulp and Paper Industry. Crofton's Catalyst Mill is participating in the study. Findings should be available by mid- 2010, and may provide additional insight into regional health impacts of air pollution.¹¹⁸

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Vancouver Island Health Authority. 2001–2008. Hospital Admissions Rates for Children Aged 0–14 with Respiratory Problems.

¹¹⁷ Mike Pennock, Population Health Epidemiologist and Co-Director of the Population and Public Health Observatory at the Vancouver Island Health Authority, personal communication, 2009.

¹¹⁸ Michelle Vessey, Manager, Environment and Technical Development, Catalyst Paper, personal communication 2009. See also: Air Quality Assessment of the Pulp and Paper Industry, PowerPoint Presentation by Gregory Crooks, M.Eng., P.Eng., July 14, 2009.