Fraser Basin Council

Fraser Valley Regional District

Teacher Resources on Air Quality in the Fraser Valley

Clear Skies, Clean Air
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Introduction
Air Quality: A Matter of Life and Health

Life begins, and ends, with a breath.

Our need for clean air is even more basic than water, food and shelter. After all, we can live a few days without water or food, but only two to three minutes without air.

Most of us take the air we breathe for granted, yet air quality affects our lives every day.
In some heavily populated and industrialized centres around the world, entire cities are smothered by smog so thick residents can't see the sun, even on a sunny day.

While the situation is not so dire in the Fraser Valley, the region nevertheless has air quality challenges. The air may seem clear on many days, but in fact, it contains a range of pollutants from natural and human-made sources.

Evidence of this can be seen as haze or smog on hot, calm summer days, or when there is an inversion. Smog does more than obscure beautiful views of the local mountains. Poor air quality can harm the environment, waterways and agricultural crops, as well as human health, particularly in people with heart disease or chronic lung conditions such as asthma.

The Ministry of Health in British Columbia reports that outdoor air pollution now takes a greater toll on human life in the province than HIV/AIDS.[1]

An August 2008 study on air pollution by the Canadian Medical Association, entitled *No Breathing Room: National Illness Costs of Pollution*, said that in 2008 alone, up to 21,000 Canadians would die from air pollution – specifically from ground-level ozone and particulate matter.
With respect to British Columbia, the CMA report says that in that year air pollution would cause:

- 306 acute premature deaths;
- 1,158 hospital admissions;
- 8,763 emergency department visits;
- 2,526,900 minor illnesses;
- 62,112 doctor's office visits.

[1] www.bcairquality.ca/health

Many B.C. communities have periods of unacceptable air quality – with adverse effects on human health, the environment and visibility. Ground-level ozone largely caused by emissions from transportation sources is a major air pollution problem in the Lower Mainland, along with particulate matter.

Improving air quality could bring significant health benefits to B.C. residents. The 2009 *British Columbia Air Quality and Health Benefits Report* concluded that improving air quality by implementing provincial climate and air quality action plans would avoid 70 premature deaths per year by 2020, as well as a large number of illnesses.[2]

The Lower Fraser Valley Airshed – an airshed is defined as a mass of air that may be geographically confined in and defined by features such as mountains – is unique in various ways.

The LFV Airshed is funnel-shaped, wide at its west end closest to the Strait of Georgia, and narrow toward its eastern end at Hope. Most days the prevailing winds blow east, carrying emissions from Vancouver and the other urban centres to concentrate in the eastern parts of the valley. At night, the air currents reverse, flowing east to west, out of the valley and to the ocean.

Emissions carried in to the Fraser Valley include nitrogen oxides, sulphur oxides, carbon monoxide, volatile organic compounds and particulate matter. On particularly warm days, some of these pollutants interact in the heat and create new combinations including ammonia and ground-level ozone. Such conditions can lead to smog and air quality advisories.

The lessons within the *Clear Skies, Clean Air – Teacher Resources on Air Quality in the Fraser Valley* introduce students to issues regarding air quality in the region. The lessons for middle to senior school grades identify types of air pollutants, their sources and their impacts, as well as possible actions and solutions that they can take as individuals, or with their community.

The units in science, social studies, mathematics, and physical education are project-based and are linked to B.C. Curriculum prescribed learning outcomes. The material assists students to understand the relevance of air quality in their own lives, in their community and in the wider world.
We have included website links for teachers to related information, and connections to local organizations in the region that could provide further learning opportunities through speakers, field trips or activities.

The Fraser Valley Regional District, in partnership with the Fraser Basin Council, is pleased to bring this resource package to educators in the region to help expand and instill the concept of air quality

[2] www.bcairquality.ca/health

sustainability in our young people.

The content and lesson plans were originally developed by Clean Air Champions, a national charity committed to educating Canadians, particularly youth, about the connections between environmental and health issues. It offers free curriculum-connected programs to schools and communities across Canada. Learn more at www.clearairchampions.ca.

For additional lessons and to complete an evaluation survey, visit: www.fvrd.ca/airquality

Background

Air Quality and Our Health

What is air quality?

Air quality refers to the state of the air around us. Clear, clean, unpolluted air is considered to have good air quality. The presence of airborne pollutants, whether from natural or human causes, can reach high concentrations that may result in poor air quality. Air quality describes the state of the health and safety of the atmosphere.

What is smog?

Pollution is usually unseen or invisible. However, at times the pollutants in an airshed can reach such high concentrations that the air may actually appear polluted. Near larger urban centres, particularly in the summer, pollution may form smog, a brownish-yellow or greyish-white haze hovering over the skyline. Smog consists of particulate matter and ground-level ozone

This is a view of Mt. Baker taken on a hot, clear August day in 2014 from the summit of Sumas Mountain, overlooking Sumas Prairie. Photo credit – Steve Oldroyd

What is particulate matter?

Particulate matter (PM) refers to tiny solid or liquid particles in the air. PM_{10} is comprised of particles less than 10 microns (micrometres) in diameter (about 1/5 the width of a human hair) and includes substances such as dust, pollen and smoke. $PM_{2.5}$ or fine PM consists of particles less than 2.5 microns in diameter (about 1/20 the width of a human hair), and a significant source of this particle size are products from fossil fuel combustion. Major sources of PM are vehicles, factories, construction activity, fires, naturally occurring windblown dust and vegetation.

Other hazardous air pollutants, such as metals, may adhere to PM and increase its toxicity. PM can also be formed in the air by the chemical reaction of gases such as nitrogen oxides, sulphur dioxide and carbon monoxide. PM, especially $PM_{2.5}$, can penetrate deep into the lungs, damaging lung tissue and reducing lung function.

What is ground-level ozone?

Ground-level ozone or O_3 is a main component of smog. It is an air pollutant of concern in the Fraser Valley as high levels are often measured here, especially during warm summer months. Ground-level ozone is a compound formed in the lower atmosphere through the reaction of nitrogen oxides (NO_X) and volatile organic compounds (VOCs), another type of air contaminant, in the presence of ultraviolet light. Ground-level ozone is the same as the ozone in the upper atmosphere. The only difference is elevation. Up high, the ozone layer protects the Earth from too much ultraviolet radiation. Conversely, ground-level ozone impacts health and can irritate the eyes, nose and throat as well as can decrease lung function and physical performance.

How is air quality measured?

There are six air quality monitoring stations in the Fraser Valley. The newest one became operational at Mission Secondary School in 2014. Others are located near the Abbotsford Airport (east side), off Primrose Street near Abbotsford's Mill Lake, at the Chilliwack Airport, downtown Agassiz, at Cheam Avenue and Hwy. 9 (Agassiz-Rosedale Hwy.), and at the Hope Airport, off Flood Hope Road. Together with monitors in the Metro Vancouver regional district, there are 28 air monitoring stations in the Lower Fraser Valley monitoring network, extending from Horseshoe Bay to Hope.

Pollutants measured in the Fraser Valley include particulate matter ($PM_{2.5}$, PM_{10}), sulphur dioxide (SO_2), nitrogen oxides (NO_X), ozone (O_3), carbon monoxide (CO), ammonia (NH_3) and volatile organic compounds (VOCs). Data from the monitoring sites is collected by Metro Vancouver and published by Metro Vancouver and the Ministry of Environment. Air quality readings are updated throughout the day and are accessible at: gis.metrovancouver.org/airmap or www.bcairquality.ca/readings/index.html.

How does air pollution affect health?

Your lungs breathe in the air around you. The average adult takes about 20,000 breaths per day, and children breathe even more. Fine particles or $PM_{2.5}$ can be made up of a mixture of microscopic solids, combustion products, metals and other toxins. This mixture is cause for a serious concern, especially combined with other pollutants that also impact health. The small particles we breathe can travel deep into the lungs to the alveoli, the gas exchange region, eventually damaging lung function and even other organs. Even low concentrations of $PM_{2.5}$ and ozone can cause an array of both short- and long-term health effects.

Individuals with sensitivity to air pollution may experience a variety of symptoms that range from discomfort to life threatening. People with pre-existing illness such as diabetes, lung disease (asthma, chronic bronchitis, emphysema, lung cancer) or heart disease will have greater sensitivity to air pollution than the average Canadian.

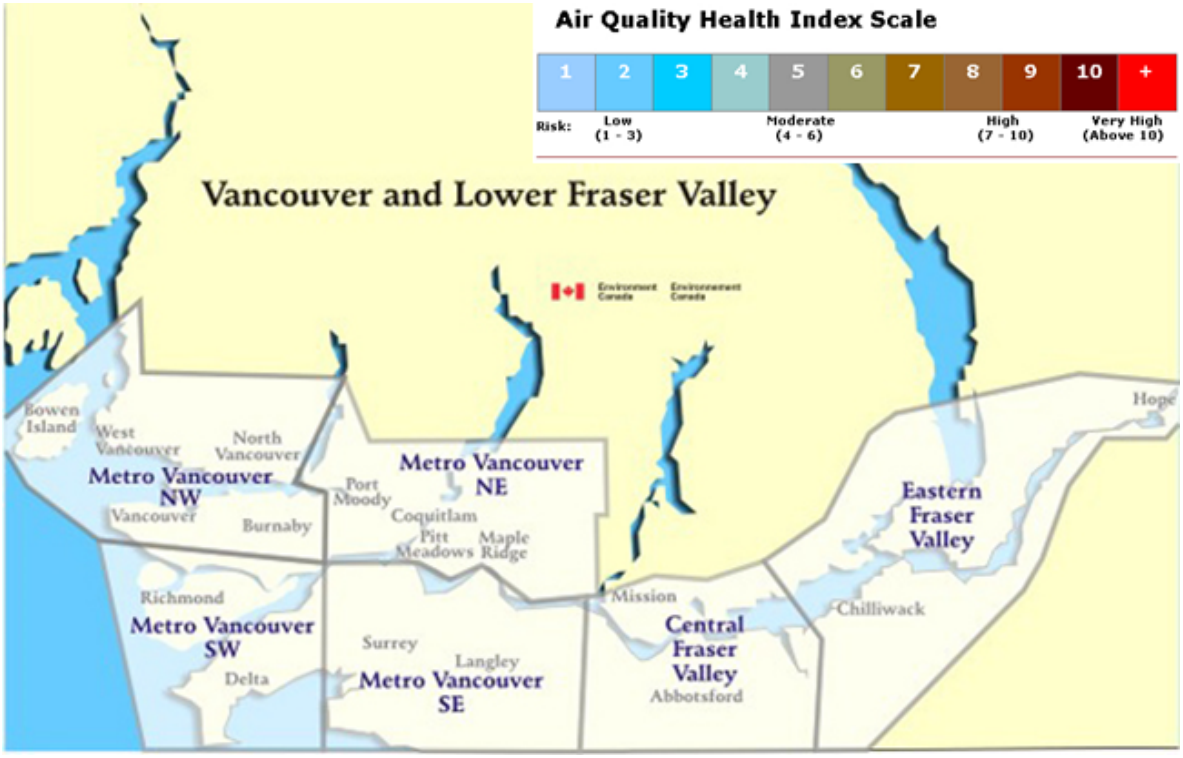
Other groups of people at higher risk include the elderly, children and athletes. With age comes the weakening of the heart, lungs and immune system and increases in health problems such cardiovascular disease or respiratory illness.

A child's respiratory system and immunity is less developed and air intake is greater per kilogram of body weight than an adult. Youth have a tendency to spend more time being physically active outdoors, which can increase their exposure to air pollution. Similarly, athletes who may train and perform strenuous activity outdoors breathe more deeply and rapidly, allowing more potentially polluted air to enter the lungs. Symptoms they may experience could include coughing, difficulty breathing and irritation of the throat, nose and eyes.

What is the Air Quality Health Index?

The Air Quality Health Index (AQHI) is a scale to help the public increase their understanding of how air quality can impact health. It is a tool designed to help people make decisions to protect personal health. The AQHI is particularly useful to those who are sensitive to air pollution or who are considered to be at risk. The Fraser Valley AQHI is provided in two forecast areas: the Central Fraser Valley and Eastern Fraser Valley.

The AQHI is calculated from concentrations of ozone (O_3), particulate matter ($PM_{2.5}$/ PM_{10}), and nitrogen dioxide (NO_2). Find current readings at: www.airhealth.ca



Air Quality in the Fraser Valley, British Columbia

The Fraser Valley Regional District (FVRD) has air quality planning authority in this region and operates under the 1998 Air Quality Management Plan. A revised air quality and greenhouse gas management plan is being developed. The FVRD collaborates with Metro Vancouver to monitor air quality in the Lower Fraser Valley Airshed. Air discharges are regulated by the B.C. Ministry of Environment.

The FVRD is committed to researching, monitoring, recommending and implementing air quality improvements and to promoting public awareness and education in the Fraser Valley, with the objective of improving the air quality.

What is an airshed?

The B.C. Ministry of Environment defines an airshed as an area where the movement of air may be hindered by the area's geographical features such as mountains and by weather conditions. The most common example is a mountain valley.

An airshed management plan is the blueprint that defines a community's air quality priorities that guide development and control of air contaminant sources. In addition, an airshed plan ensures that the air quality goals of various levels of government are met. Community-based airshed plans are key to meeting B.C.'s obligations under Canada's Air Quality Management System for particulate matter and ozone.

Lower Fraser Valley Airshed

The FVRD is located in the Lower Fraser Valley (LFV) Airshed, bounded by the Coast Mountains to the north and Cascade Mountains to the east and south (see following image). It includes the FVRD, Metro Vancouver, and Whatcom County in the United States.The airshed is shaped like a funnel that narrows from west to east, which can restrict air movement and pollutant dispersion. Coastal wind patterns also push pollutants east at times, which can result in accumulation at the narrow end of the valley.

The FVRD, Metro Vancouver and other agencies in Canada and Washington have formed the Lower Fraser Valley Air Quality Coordinating Committee, which collaborates on air quality programs and actions for the LFV airshed. These and other agencies also work together on the larger Georgia Basin – Puget Sound International Airshed Strategy.

Lower Fraser Valley Airshed. Image source: 2005 Lower Fraser Valley Emissions Inventory and Forecast and Backcast

FVRD Air Quality Initiatives and Projects

The FVRD, in collaboration with other agencies, undertakes many initiatives to better understand and improve air quality in our region, including:

Air Quality Monitoring Network

- Hosting and funding a growing network of air quality monitoring stations, with locations in Abbotsford, Agassiz, Chilliwack, Hope and Mission. The Agassiz and Mission stations were added in 2013 and 2014 respectively.

Wood Stove Exchange Program

- Since the program's inception in the FVRD in 2009, 154 wood stove exchanges were made, reducing fine particulate matter emissions by about 9.5 tonnes.

Reducing Emissions from Transportation Sources

- Participating for over twenty years in AirCare, a light duty vehicle inspection and maintenance program to reduce emissions, and now investigating options to decrease emissions from heavy duty diesel vehicles.
- Compiling best management practices for reducing exposure and health burden from traffic emissions.
- Hosting electric vehicle charging stations and creating an electric vehicle strategy.
- Improving transit to lower traffic emissions – a new bus route, the Fraser Valley Express connecting Chilliwack to Abbotsford and Langley became operational in 2015.

Regional Ground-Level Ozone Strategy

- Developed a strategy to reduce ground-level ozone concentrations in the Lower Fraser Valley Airshed.

B.C. Visibility Coordinating Committee

- Contributing to the understanding and public knowledge of visual air quality (www.clearairbc.ca).

Additional participation in interagency air quality and health, agriculture nutrient and air committees

Some Improvements and Challenges to Fraser Valley Air Quality:

The 2013 Lower Fraser Valley Air Quality Monitoring Report shows significant improvements in air pollutant concentrations since the 1990s when considering both annual averages and short-term peak measurements for most contaminants measured, except ground-level ozone:

- Nitrogen dioxide: approximately 30% decrease in concentrations since 1994
- Sulphur dioxide: approximately 80% decrease in concentrations since 1994
- Carbon monoxide: approximately 66% decrease in concentrations since 1994
- Fine particulate matter: approximately 12% decrease in concentrations since 1994

For ground-level ozone, despite significant reductions in emissions of precursors (NO_X and VOCs):

- Short-term peak concentrations have remained about the same since 1994
- Annual average concentrations have increased slightly, by about 5% since 1994

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