



Particulate Matter

Pollutant Briefing Note
for Prince George, BC
March 1, 2013

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Pollutant Description

- Particulate matter (PM) refers to solid particles and liquid droplets suspended in the air. It includes aerosols, smoke, fumes, dust, ash, pollen, and water vapor.
- PM can be emitted directly from an emissions source (Primary PM) or can be formed from chemical and physical reactions of gases in the air (Secondary PM)
- The size of the particles largely determines the extent of environmental and health damage caused. For this reason, PM is classified into several categories including:

PM ₁₀	Airborne particulate matter with a mass median diameter less than 10 µm ("coarse PM"); 1/5 th the diameter of a human hair
PM _{2.5}	Airborne particulate matter with a mass median diameter less than 2.5 µm ("fine PM")
PM _{0.1}	Airborne particulate matter with a mass median diameter less than 0.1 µm ("ultrafine PM")*

* Ultrafine PM is currently not monitored in the Prince George airshed.

Effects on Human Health, the Economy and the Environment

- The greatest human health impacts are caused by the finer PM_{2.5} (including the PM_{0.1} fraction) because they become lodged deep in the lungs, and the finest particles can cross into the bloodstream.
- Numerous health studies have associated fine particle pollution with a variety of health and environmental effects^{1,2,3,4}, including:

Human Health Short-term	Aggravated asthma, bronchitis, and emphysema	
	Increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing Increased emergency room visits and hospital admissions for respiratory and cardiovascular illnesses	
Long-term	Various forms of heart and lung disease Reduced lung development, and development of chronic respiratory diseases in children Premature death in people with heart or lung disease	
	Environmental Health	Contribution to ground-level ozone formation - damaging to people, vegetation, and ecosystems Acid deposition - widespread effects on structures and ecosystems Regional haze - widespread effects on safety, tourism, and recreation

- Long-term exposure to elevated PM_{2.5} results in increased risk of developing chronic health conditions in the entire population and represents the greatest overall health risk.⁵
- People with respiratory diseases, children, and elderly people, are the most sensitive to fine PM.
- Inflammation and oxidative stress are hypothesized to be underlying mechanisms for both short and long term health impacts.⁵
- Proximity to PM emissions sources (exposure) largely determines individual health impacts.
- It is estimated that anthropogenic PM_{2.5} levels in BC (above natural background levels) account for 74 deaths/year in the Northern and Interior Health Areas.⁶ Of the communities studied, Prince George has the highest annual average concentration of PM_{2.5}.
- In 2008, economic costs of air pollution in Canada will top \$8 billion and include over 620,000 doctor's visits. By 2031, these costs will have accumulated to over \$250 billion and over 940,000 medical visits.⁷

¹ <http://www.epa.gov/pm/health.html>

² <http://www.epa.gov/region7/air/quality/pmhealth>

³ <https://northernhealth.ca/YourHealth/EnvironmentalHealth/AirQuality>

⁴ <http://www.hc-sc.gc.ca/ewh-semt/air>

⁵ Henderson S. (2012). PM_{2.5} in the Case of This vs. That. Power Point presentation at the Health Authority Air Quality Council Meeting, Vancouver, BC.

⁶ Elliot, T.C., Copes, R. (2011). Burden of Mortality Due to Ambient Fine Particulate Air Pollution (PM_{2.5}) in Interior and Northern BC. *Can. J. Public Health*. 102(5):390-93.

⁷ Canadian Medical Association. (2008). No Breathing Room: National Illness Costs of Air Pollution. *Summary Report*. (iii)

Emissions Sources

- Industrial Emissions and Mobile sources contribute the majority of PM10 and PM2.5 emissions to the Airshed as a whole.
- In Downtown Prince George, Mobile sources (mainly on-road dust and locomotives) and Background sources (e.g. windblown dust, wildfire smoke) are predicted to contribute the most to PM10 and PM2.5 levels (Table 1)

Table 1 – PM emissions sources and their respective contribution to PM levels in the airshed as a whole (left) versus their contribution to PM levels in the Downtown (right).⁸ Major source contributions are highlighted in **red**.

Category	Sub-Category	Percent Contribution to Total Airshed Emissions Rates (2005 Inventory)		Percent Contribution to Downtown Concentrations (2005 model prediction)	
		PM10	PM2.5	PM10	PM2.5
Industrial (permitted)	Pulp and paper, sawmill, planing & wood products, others	28.5%	54.0%	13.5%	18.4%
	Subtotal Permitted Industrial	28.5%	54.0%	13.5%	18.4%
Commercial	Heating	0.1%	0.2%	0.4%	0.9%
	Misc.	0.5%	1.3%	0.8%	1.7%
	Dust	5.6%	1.7%	2.9%	1.3%
	Restaurants	2.6%	6.2%	6.0%	11.8%
	Subtotal Commercial	8.8%	9.4%	10.1%	15.6%
Residential	Heating	2.2%	5.6%	4.4%	9.2%
	Other	0.2%	0.6%	0.4%	0.9%
	Subtotal Residential	2.4%	6.2%	4.8%	10.1%
Mobile	On-road dust	56.3%	21.0%	30.4%	14.0%
	On-road mobile	0.4%	0.8%	2.5%	3.8%
	Locomotive	2.2%	5.6%	5.4%	10.7%
	Subtotal Mobile	58.9%	27.4%	38.2%	28.5%
Other Sources	City open burning	0.4%	1.0%		
	Province open burning	0.9%	2.0%		
	Subtotal Other Sources	1.3%	3.0%	1.6%	3.2%
Background		*	*	27.20%	14.67%
Secondary Formation		*	*	4.53%	9.58%
Total		100.0%	100.0%	100.0%	100.0%
Total Annual Tonnes Emitted (all sources)		8772	3549		

*Background and Secondary Formation sub-categories cannot be expressed as emissions rates.

Long Term Trend (1995-2012)

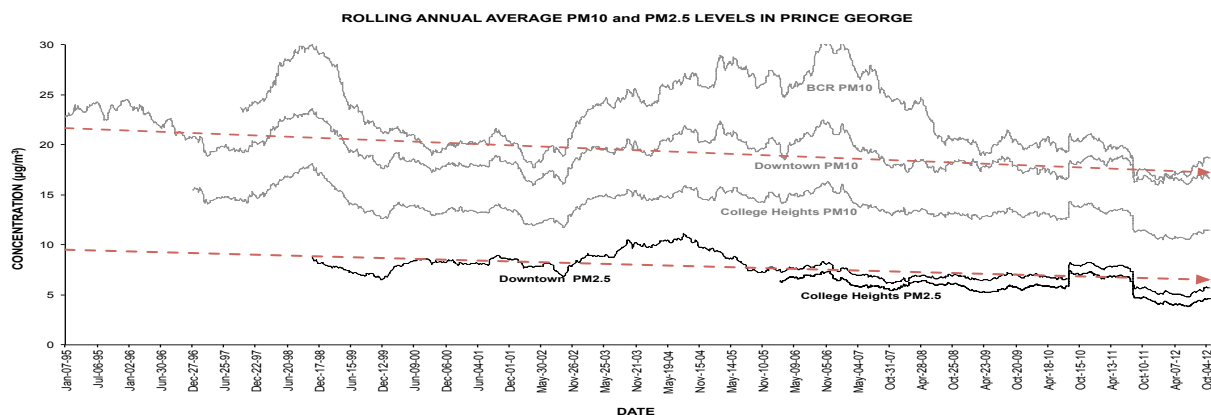


Figure 2 – Long-term trend in PM10 and PM2.5 concentration ($\mu\text{g}/\text{m}^3$) at the Prince George continuous monitoring stations. The red trendlines for the downtown monitoring station indicate a gradual 20% decrease in PM10 [$R^2=0.4$] and 25% decrease in PM2.5 [$R^2=0.3$] since the late 1990's.

⁸ Prince George Air Quality Dispersion Modelling Study - Final Report. Prepared by Stantec. October 8, 2010.

7 Year Trend (2005-2012)

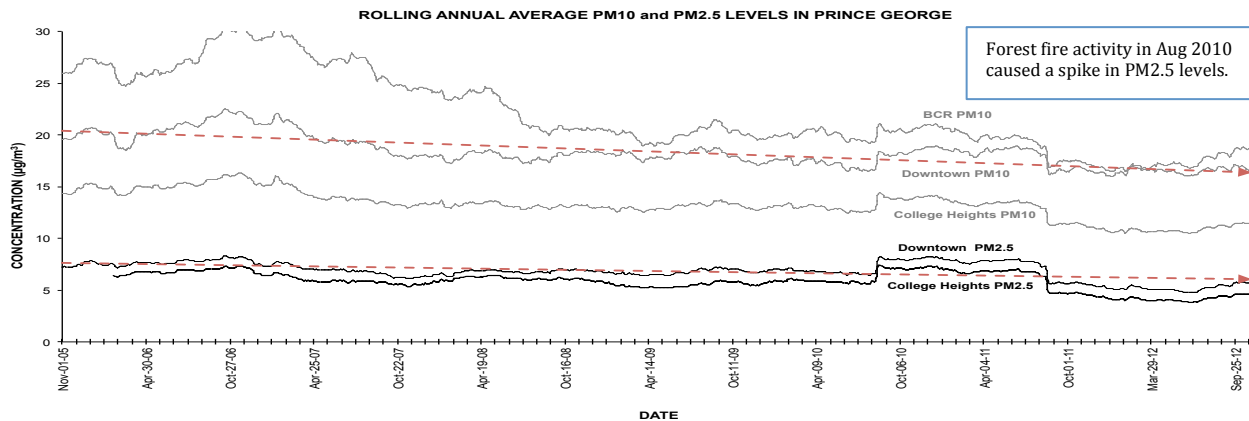


Figure 3 – 7-year trend in PM10 and PM2.5 concentration (ug/m³) at the Prince George continuous monitoring stations. The red trendlines for the downtown monitoring station indicate a gradual 20% decrease in PM10 [R²=0.6] and 21% decrease in PM2.5 [R²=0.3] over the past 7 years.

Annual Air Quality Objective

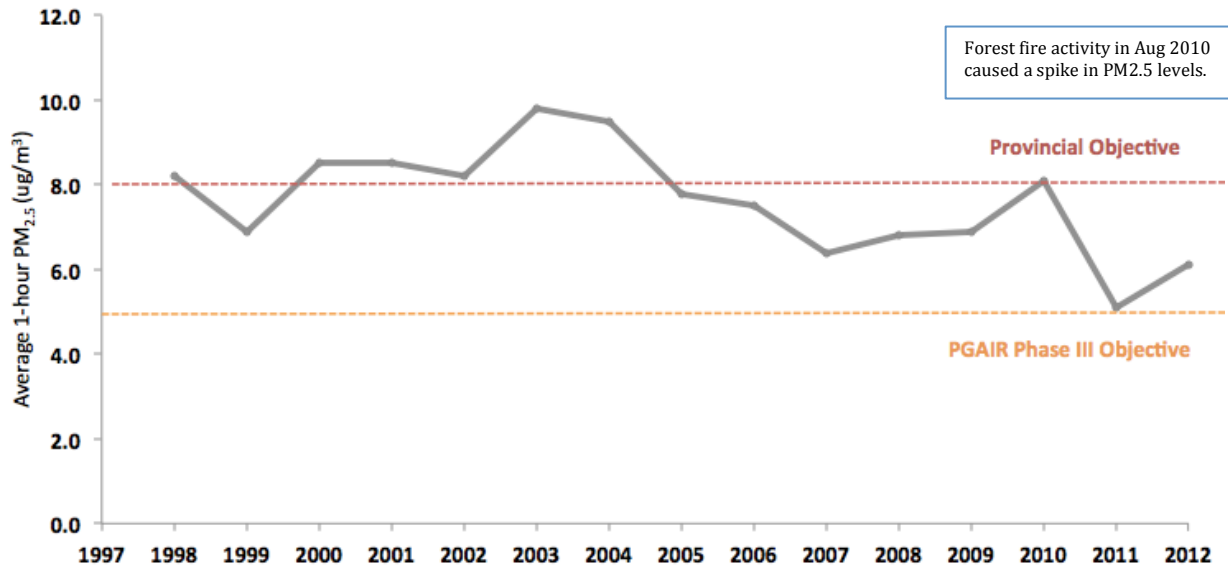


Figure 4 – Annual average PM2.5 concentration at the downtown monitoring site from 1998-2012. Levels in downtown Prince George have been below the Provincial Annual Objective (8 ug/m³, indicated by the red line) since 2005, with the exception of 2010, when high forest fire activity caused the annual average to slightly exceed the Provincial Objective for the year. PGAIR's Community Objective from their Phase III Plan is to see this concentration drop below 5 ug/m³ annually.

Air Quality Advisories

There were 8 air quality advisories issued in 2012 in Prince George: 3 in the spring due to dust; 2 in the summer due to wildfire smoke; and 2 in the fall and 1 in the winter due to high PM levels associated with wood burning and industrial emissions accumulating under stagnant atmospheric conditions.