

Provincial Ambient Air Quality Criteria for PM_{2.5} Ministry Intentions Paper

1. Introduction

The Ministry of Environment intends to establish provincial ambient air quality criteria for particulate matter 2.5 micrometres (µm) or smaller (PM_{2.5}) – addressing objectives for 24-hour and annual averages, and longer-term planning goals.

Ambient air quality criteria are used to:

- ◆ Report on the state of the atmospheric environment;
- ◆ Report on hourly air quality through the air quality index;
- ◆ Establish approval conditions for the permitting of new or modified sources;
- ◆ Assess compliance for permitted sources;
- ◆ Develop and institute episode management strategies such as air quality advisories;
- ◆ Develop long-term air management strategies and evaluate progress; and
- ◆ Inform regulatory development.

The process for establishing provincial ambient air quality criteria for PM_{2.5} consists of the following stages:

- ◆ **Scoping** – including a review of the science and regulatory approaches in other jurisdictions.
- ◆ **Early consultations** – with affected stakeholders, signaling the ministry’s intent to develop new provincial criteria for PM_{2.5} and early options.
- ◆ **Ministry intentions paper** – outlining the ministry’s proposed air quality criteria and associated information.
- ◆ **Consultation** – with affected stakeholders and the general public, using the intentions paper and response forms posted on the ministry website, and other means as required.
- ◆ **Implementation** – including development of additional guidance for ministry staff and external stakeholders on implementation of new criteria.

The purpose of this paper is to communicate ministry intentions, and to seek responses and comments

from stakeholders and the general public on the proposed ambient air quality criteria for PM_{2.5}.

This paper provides a summary of ministry and government goals, background information concerning particulate matter and health concerns, a summary of the process for establishing provincial ambient air quality criteria for PM_{2.5} to date, and ministry intentions with supporting rationale. The final section of this paper describes the avenues for providing comments as the criteria are confirmed and implemented in government policy and direction.

2. Ministry and Government Goals and Related Initiatives

The ministry provides leadership in environmental management through innovative legislation and programs, compliance activities and shared stewardship initiatives. The mandate of the ministry is to protect human health and safety, and maintain and restore the diversity of native species, ecosystems and habitats. Through partnerships across government, and with First Nations, the private sector and communities, we work to enhance the protection and stewardship of water and air resources, advance sustainable use of environmental resources, and provide exceptional outdoor park and wildlife services and opportunities.

In its 2006 budget speech, the government set a goal “To lead the world in sustainable environmental management, with the best air and water quality, and the best fisheries management, bar none.”¹

2.1 Complementary government initiatives

The province is currently developing a number of initiatives in support of government goals. These include:

- ◆ Retrofitting diesel buses;
- ◆ Establishing mandatory emission reductions from heavy duty diesel vehicles;
- ◆ Sponsoring a provincial woodstove exchange program;

¹ See: www.bcbudget.gov.bc.ca/2006/sp/env.

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- ♦ Initiating “Green Fleets B.C.” – a partnership initiative led by the Fraser Basin Council to reduce fleet emissions in the province;
- ♦ Phasing-out beehive burners; and
- ♦ Encouraging industry to adopt improved emission technologies.

These programs are intended to support reduced provincial PM_{2.5} emissions, and to contribute to the achievement of new provincial ambient air quality criteria for PM_{2.5}.

The ministry is also presently developing codes of practice and reviewing regulations under the *Environmental Management Act*.² The Primary Wood Manufacturing Industry Code of Practice, and the review of the Open Burning Smoke Control Regulation, will be of particular importance for management and control of PM_{2.5} in B.C.³

2.2 Air management in Metro Vancouver

Under the *Environmental Management Act*, the Greater Vancouver Regional District (now known as “Metro Vancouver”) has delegated authority to manage air quality within its boundaries. This includes the establishment of ambient air quality criteria that may be different but no less stringent than requirements established by the province. Should the province adopt more stringent criteria, Metro Vancouver would be expected to align their ambient air quality criteria with those of the province.

3. Background Information

3.1 Fine particulates and human health

The particles comprising PM_{2.5} are emitted by a range of combustion sources (e.g., gas and diesel vehicles, marine transportation, prescribed burning and wood stoves) and industrial activities. PM_{2.5} is also a secondary pollutant, formed in the atmosphere from reactions involving precursor gases such as nitrogen oxides, sulphur dioxide, volatile organic compounds and ammonia. Exposure to

PM_{2.5} is linked to a range of health impacts including inflammation of the airways, more frequent use of medications, increased emergency room visits, hospitalization and even death. No safe thresholds, below which there are no effects, have been identified. The elderly, the young and those with existing cardiopulmonary problems are most at risk. Very fine particulates (PM_{2.5}) also scatter light, resulting in a reduction in visibility.

In response to the above concerns, Canada-wide standards (CWS) for PM_{2.5} and ozone were established in 2000 by the Council of Canadian Ministers of the Environment (CCME). The CWS were intended to be achievable targets based on sound science while also taking socio-economic factors into consideration. The numerical target for the PM_{2.5} CWS is 30 µg/m³ (24-hour average), to be achieved by 2010 (based on the annual 98th percentile value, averaged over three consecutive years). As a basic requirement, CWS achievement applies to population centres over 100,000. Recognizing that achievement of the standards are only a first step toward minimizing health risks due to this pollutant, the CWS also contain provisions for “Continuous Improvement and Keeping Clean Areas Clean” to protect areas where air quality is better than the CWS. All of the continuous monitoring sites in B.C. were below the CWS for PM_{2.5} in 2006. However, non-continuous sites in Vanderhoof, Valemount and Prince George exceeded the standard (see Figure 1 below).

While representing a step forward, in practice the CWS have been challenging to apply within the local context. The three-year averaging period to demonstrate achievement, for example, is not amenable to day-to-day management decisions. As a result, the province continues to use its PM₁₀ objective of 50 µg/m³ (24-hour average) as the basis for regulatory decisions and decisions to issue air quality advisories. The latter is particularly problematic during periods in the winter when PM_{2.5} concentrations are at levels that lead to health complaints, but PM₁₀ levels may not trigger the issuance of an advisory.

The lack of short-term management targets has led to the use of the health reference level of 15 µg/m³ (24-hour average) by some agencies in reviewing

² See: www.env.gov.bc.ca/epdiv/ema_codes_of_practice.

³ See:

www.env.gov.bc.ca/epdiv/ema_codes_of_practice/open_burning/index.html

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environmental assessments.⁴ Developed by the Federal-Provincial Working Group on Air Quality Objectives and Guidelines, the health reference levels were intended to represent the lowest ambient PM level at which statistically significant increases in health responses can be detected based upon available data and current technology.⁵ These levels, however, were not intended for use as management targets.

3.2 Review of science and regulatory approaches in other jurisdictions

The BC Lung Association Air Quality/Health Steering Committee commissioned a review in 2005 that provided an assessment of current PM_{2.5} levels in the province, current monitoring technologies, health effects literature, criteria and approaches used to manage PM_{2.5} in other jurisdictions in Canada, the U.S., Australia, New Zealand and Europe, and the role of cost-benefit analysis in objective-setting.⁶

This review drew on major studies recently conducted by the World Health Organization,^{7,8} the CCME⁹ and the BC Lung Association Expert

Panel,¹⁰ as well as standard-setting processes in Europe, the U.S. and elsewhere.

The review found that most sites in the province never exceed the CWS level, but that a number exceed a daily concentration of 25 µg/m³ at least periodically (see Figure 1 on page 5). The authors also noted that the TEOM¹¹ instrument, which is widely used in B.C., tends to under-measure relative to gravimetric, filter-based measurements such as dichotomous or Partisol samplers, with the differences more pronounced during the cooler months.

The review of recent health studies confirmed previous findings of a strong association between PM_{2.5} and health impacts, and a stronger link between PM_{2.5} exposure and health effects (especially cardio-respiratory effects) than previously known.

Although the CWS was identified as the most stringent management level at present, the authors of the review noted that more stringent guidelines or interim standards have been proposed elsewhere. Air quality criteria used in surveyed jurisdictions are summarized in Table 1. Note that Ontario and Quebec do not have provincial objectives for PM_{2.5}, but have developed 3-hour trigger levels for the purposes of air quality index reporting. These and other criteria based on averaging periods other than those shown in Table 1 may be found in the review report.

⁴ R.B. Caton and D.V. Bates (2003) "Updating Provincial Air Quality Objectives – An Options Discussion Paper." Prepared for Ministry of Water, Land and Air Protection. See: www.env.gov.bc.ca/air/airquality/pdfs/aqo_paper.pdf.

⁵ CEPA/FPAC Working Group on Air Quality Objectives and Guidelines (1999) "National Ambient Air Quality Objectives for Particulate Matter. Part. 1: Science Assessment Document." Prepared by the CEPA/FPAC Working Group on Air Quality Objectives and Guidelines for Health Canada and Environment Canada.

⁶ SENES (2005) "Summary Report. Development of Options for a New Provincial PM_{2.5} Air Quality Objective." Prepared by SENES Consultants Ltd. For the British Columbia Lung Association, December 2005.

⁷ WHO (2004) "Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide." Presented to a meeting in Bonn, Germany, EUR/03/5042688.

⁸ WHO (2004) "Health Aspects of Air Pollution – Answers to Follow-up Questions from CAFE." Report on a WHO working group meeting, Bonn, Germany.

⁹ CCME (2004) "Human Health Effects of Fine Particulate Matter. Update in Support of the Canada-wide Standards for Particulate Matter and Ozone." Prepared for the Canadian Council of Ministers of the Environment by Health Canada, www.ccme.ca/assets/pdf/prrvw_pm_fine_rvsd_e.pdf.

¹⁰ Bates D.V., Koenig J. and M. Brauer (2002) "Health and Air Quality 2002 – Phase 1." R. Caton and D. Crowley, eds. Prepared for the British Columbia Lung Association.

¹¹ Tapered Element Oscillating Microbalance.

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Jurisdiction	24-hour Average Criteria	Annual Average Criteria	Comments
Canada	30 µg/m ³	n/a	CWS, based on annual 98 th percentile averaged over 3 consecutive years
Newfoundland	25 µg/m ³		Standard
Alberta	20-30 µg/m ³		Range for monitoring and non-mandatory planning
	15-20 µg/m ³		Range for monitoring
Metro Vancouver	25 µg/m ³	12 µg/m ³	Air quality objective
Capital Regional District	25 µg/m ³	n/a	Monitoring and reporting guideline
Quesnel	18-20 µg/m ³	n/a	Goals to be achieved by 2007-2010; based on annual 98 th percentile averaged over 3 consecutive years
United States	35 µg/m ³	15 µg/m ³	National Ambient air Quality Standard; 24-hour standard based on annual 98 th percentile averaged over 3 consecutive years
Puget Sound	25 µg/m ³	15 µg/m ³	Regional health goal
California	n/a	12 µg/m ³	State standard
WHO Guidelines	25 µg/m ³	10 µg/m ³	24-hour guideline based on annual 99 th percentile
Australia	25 µg/m ³	8 µg/m ³	Advisory reporting standards
New Zealand	25 µg/m ³	n/a	Interim monitoring guideline

Table 1: Ambient PM_{2.5} criteria in surveyed jurisdictions

3.3 Early consultations on options for provincial air quality objectives

The ministry prepared an information package and held consultations on proposed options for provincial air quality objectives and an airshed planning framework in early 2006. The purpose of these early consultations was to signal the ministry's intent to develop new criteria, and to identify the level of support and key concerns from stakeholders.

During consultation meetings held in Prince George and Vancouver diverging opinions were expressed regarding appropriate stringency of criteria and the role of communities in setting objectives, however, the following common advice was noted:

- ◆ There is little support for a two-tier system, where degraded areas are allowed more time to meet objectives (or conversely, where clean areas are initially required to meet more stringent objectives);
- ◆ A percentage of allowable exceedances (when referring to a daily objective) should be incorporated in the objectives – to accommodate unusual events;
- ◆ The timeline for adopting criteria initially proposed by the ministry was seen as too ambitious (although most communities in the province would currently meet the proposed criteria); and
- ◆ More stringent air quality criteria would be acceptable over time, as long as implementation was adequately resourced by the ministry.¹²

¹² A more detailed summary of the consultation process and comments can be found at:

www.env.gov.bc.ca/air/airquality/pdfs/aqconsult_summary.pdf.

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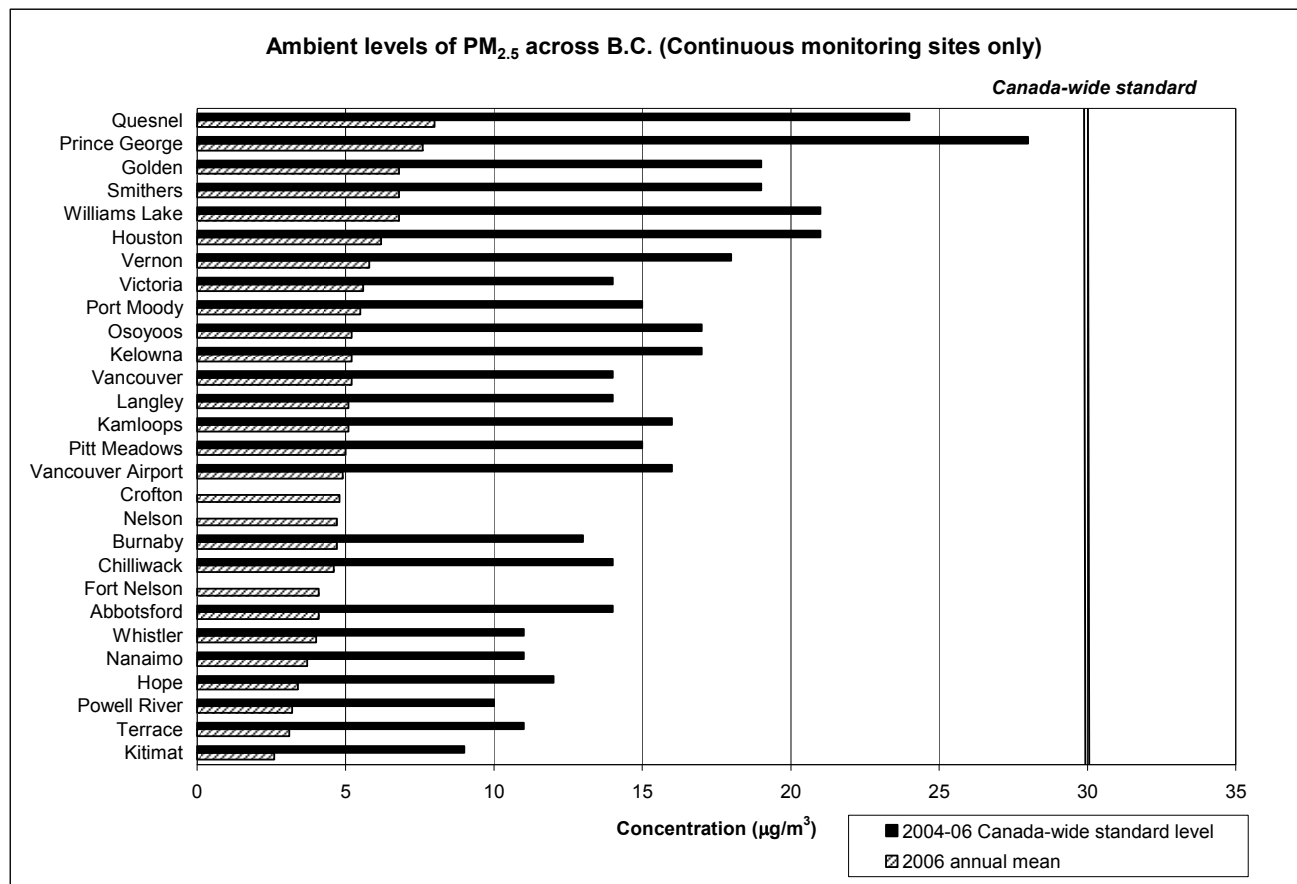


Figure 1: CWS and annual mean PM_{2.5} levels at TEOM sites in B.C. (2006 data)

4. Ministry Direction

4.1 Proposed air quality criteria for PM_{2.5}

The ministry intends to establish air quality criteria for the management of PM_{2.5} that will be applied on a province-wide basis. These will be used to guide the ministry's regulatory approach and direction, and ministry service planning and actions.

The proposed framework of provincial ambient air quality criteria for PM_{2.5} is comprised of:

- ♦ **A 24-hour average objective:** to address day-to-day management issues such as issuing air quality advisories, initiating open burning restrictions in accordance with the Open Burning Smoke Control Regulation, and triggering mandatory emission

reduction strategies in conjunction with local municipal bylaws;

- ♦ **An annual average objective:** to support overall reduction in exposure and facilitate reporting, as well as guide regulatory decisions; and
- ♦ **A planning goal:** voluntary long-term goal, established in concert with community airshed planning processes, to support continuous improvement and airshed planning.

It is intended that the air quality objectives represent the baseline measures applied across the province. The air quality objectives would be the primary tool for air management in B.C. and used as benchmarks for assessing new and existing facilities that are subject to major changes or permit reviews. Under such applications, an annual 98th percentile would be used to determine achievement of the 24-hour objective

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(allowing a maximum of 7 exceedances per year, based on daily monitoring).

A. 24-hour average objective

The ministry intends to establish a 24-hour air quality objective of 25 µg/m³ for PM_{2.5}.

This objective is consistent with best practices in other jurisdictions within and beyond British Columbia (e.g., Metro Vancouver, Newfoundland, Puget Sound (health goal), Australia and New Zealand). It is also consistent with recommendations of the World Health Organization and supports the province's goal "to lead the world in sustainable management, with the best air and water quality...bar none" (see section 2 of this paper).

For the purpose of actions to manage short-term air quality events, such as air quality advisories, the numeric level of the 24-hour air quality objective (rolling average) would be used.

B. Annual average objective

The ministry is proposing an annual air quality objective of 8 µg/m³ for PM_{2.5}.

Scientific studies indicate that higher mortality rates are associated with longer-term exposure as opposed to short-term episodic conditions. An annual average objective supports a reduction in long-term exposure, and also provides a more easily understood measure of air quality that is simple to communicate to the public and to compare with other jurisdictions.

As well as facilitating reporting, the annual average objective would be used to guide regulatory decisions, supporting an overall reduction in exposure.

This objective is also consistent with the best practices identified in other jurisdictions, (e.g., Australia's advisory reporting standard).

C. Planning goal

The ministry's primary motive in proposing an air quality long-term planning goal of 6 µg/m³ for PM_{2.5} is to encourage a reduction in long-term exposure. For

this reason, the ministry is proposing targets based on annual rather than 24-hour averages.

A planning goal is a means to encourage those communities already below the proposed objectives to reduce ambient concentrations to the extent practical. This is in recognition of: the fact that PM_{2.5} is a non-threshold pollutant; that the major population centres would likely fall below proposed air quality objectives; and that significant public health benefits can be accrued by improving air quality in urban areas of the province. The intention is further supported by recent valuation studies in which a 10% reduction in annual average PM_{2.5} concentrations was estimated to result in annual health benefits of \$174 million in the Lower Fraser Valley (from a baseline of 5.1 µg/m³)¹³ and \$16.6 million in the Central Okanagan Regional Districts (from a baseline of 6.8 µg/m³).¹⁴

In the four most populated areas of the province (i.e., the Lower Fraser Valley, Victoria, Nanaimo and Kelowna), annual concentrations averaged 5 µg/m³ at TEOM sites (2004-2006). By proposing a planning target of 6 µg/m³, the ministry is encouraging these high-growth areas to maintain or improve on current air quality levels as a means to protect public health.

For the purposes of airshed planning, the ministry will work with communities in exceedance of the proposed air quality objectives to develop and implement an airshed plan to achieve the air quality objectives. For those communities in achievement of the air quality objectives, the proposed goal may be used as additional guidance in the airshed planning process to reduce PM_{2.5} levels to the extent practicable. Communities would determine how quickly and to what degree they would work toward that goal.

¹³ RWDI (2005) "Final Report. Health and Air Quality 2005-Phase 2: Valuation of Health Impacts From Air Quality in the Lower Fraser Valley Airshed," Prepared by RWDI Air Inc. for the British Columbia Lung Association. July 15, 2005. www.bc.lung.ca/pdf/health_and_air_quality_2005.pdf.

¹⁴ Parker T. (2006) "Health Effects and Benefits Associated with Air Quality Improvements Particulate Matter (PM_{2.5}) and Ground Level Ozone." Prepared for the Central Okanagan Regional District and the North Okanagan Regional District, 28 February 2006.

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4.2 Monitoring requirements

Achievement of the proposed criteria will be based on data collected using approved monitoring technologies that are operated in accordance with standard ministry operating procedures.

Changes will take place to the existing PM_{2.5} monitoring network in British Columbia and elsewhere in Canada over the next few years as older TEOM instruments are upgraded or replaced to address issues around volatilization and subsequent under-measurement relative to filter-based samplers (see section 3.2 of this paper). It is anticipated that this change will result in higher measured concentrations (all other conditions remaining the same), although the extent of these changes will vary from community to community and from season to season. The true extent of these changes will not likely be known until 2010 and beyond, and will be addressed in future reviews of provincial PM_{2.5} air quality objectives.

4.3 Implementation

The ministry intends to prepare and disseminate additional guidance for government agencies and stakeholders to further clarify how the ambient air quality objectives will be applied with respect to permit decisions and other uses.

4.4 Consultation with First Nations

Information concerning consultation with First Nations with respect to the proposed air quality criteria for PM_{2.5} will be developed in accordance with legal requirements, ministry policy and government direction.

5. Providing Comment on Ministry Intentions

The ministry is intending to finalize and implement air quality criteria for PM_{2.5} in 2008. Comments regarding the proposed criteria are being solicited and will be carefully considered. The ministry welcomes all suggestions with respect to each of the proposed criteria.

Submissions will be compiled and summarized, without specific attribution, and the summary posted on the

ministry website. Following review of comments and submissions, the ministry will formally adopt and begin implementing the air quality criteria.

Those interested are invited to submit comments on the proposal – using the instructions and questions provided on the response form. Individuals or organizations may also make written submissions to the ministry without following the format set out in the response form – as desired.

Comments to the ministry should be made on or before February 29, 2008.

All submissions will be reviewed for inclusion in a consultation summary report. Comments received will be treated with confidentiality by ministry staff and contractors when preparing consultation reports. Please note that comments you provide and information that identified you as the source of those comments may be made publicly available if a freedom of information (FOI) request is made under the *Freedom of Information and Protection of Privacy Act*.

If you have any questions or comments regarding the consultation process, review the information posted on the ministry's website, or contact Cindy Bertram of C. Rankin & Associates, who has been contracted to manage consultation comments, at:

Email: cindybertram@shaw.ca

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Thank you for your time and comments!