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of the Environment      Le Conseil canadien  
des ministres  
de l'environnement

## **GUIDANCE DOCUMENT ON AIR ZONE MANAGEMENT**

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The Canadian Council of Ministers of the Environment (CCME) is the primary, minister-led intergovernmental forum for collective action on environmental issues of national and international concern.

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## EXECUTIVE SUMMARY

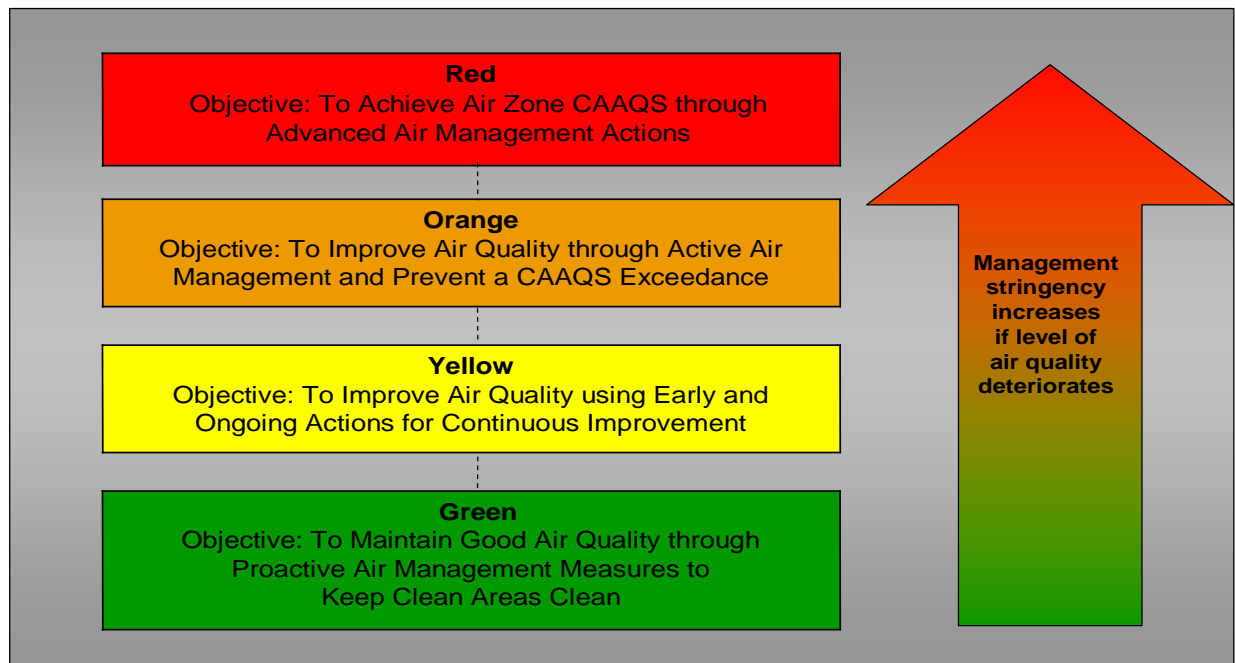
This document has been prepared to provide guidance on air zone management under the Air Quality Management System (AQMS). Information on other aspects of air zones under AQMS can be found in the *Guidance Document on Achievement Determination: Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone*.

### About the Air Zone Management Framework

The Air Zone Management Framework (AZMF) provides guidance on the nature of the management, monitoring and reporting actions to be implemented at an air zone level under the AQMS. By providing guidance on the sorts of actions to be implemented under various air quality conditions, the AZMF aims to assist jurisdictions to achieve Canadian Ambient Air Quality Standards (CAAQS), keep clean areas clean, encourage continuous improvement and communicate their air management actions to the public.

Under the AZMF, progressively more rigorous actions are to be implemented at an air zone level as air quality approaches or exceeds the CAAQS. Four “Management Levels”, covering all PM<sub>2.5</sub> and ozone concentrations, provide general guidance on the nature of the management, monitoring and reporting actions to be implemented in air zones. The general structure of the AZMF is illustrated in the diagram below.

**Figure I: The Air Zone Management Framework at a Glance**



## The Threshold Values

Under the AZMF, each of the four Management Levels are separated by “Threshold Values.” Each of the three CAAQS (PM<sub>2.5</sub> annual, PM<sub>2.5</sub> 24 hour and ozone), have their own unique set of Threshold Values (summarized in Table 1 below) set on the following basis:

Highest Threshold Value – set at the CAAQS.

Middle Threshold Value – set at 50% of the way between the CAAQS and the lowest Threshold Value for each pollutant.

Lowest Threshold Value – based on an analysis of 10 years of data from the “cleanest” monitoring sites across Canada, on the “cleanest” days.

For simplicity the Middle and Lowest Threshold Values would be the same for 2015 and 2020, based on the 2020 CAAQS.

**Table I: Air Management Threshold Values and Actions**

Management Level	Management Actions	Proposed Air Management Threshold Values					
		Ozone (ppb)		PM <sub>2.5</sub> Annual (µg/m <sup>3</sup> )		PM <sub>2.5</sub> 24h (µg/m <sup>3</sup> )	
		2015	2020	2015	2020	2015	2020
RED	<b>Actions for Achieving Air Zone CAAQS</b>						
Threshold		63 ppb	62 ppb	10.0 µg/m <sup>3</sup>	8.8 µg/m <sup>3</sup>	28 µg/m <sup>3</sup>	27 µg/m <sup>3</sup>
ORANGE	<b>Actions for Preventing CAAQS Exceedance</b>						
Threshold		56 ppb		6.4 µg/m <sup>3</sup>		19 µg/m <sup>3</sup>	
YELLOW	<b>Actions for Preventing AQ Deterioration</b>						
Threshold		50 ppb		4.0 µg/m <sup>3</sup>		10 µg/m <sup>3</sup>	
GREEN	<b>Actions for Keeping Clean Areas Clean</b>						

## Implementing the AZMF

The AZMF is to be implemented on an air zone basis, with Management Levels determined based on air zone metric values using the approach outlined in the *Guidance Document on Achievement Determination: Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone*. Prior to determining Management Levels, jurisdictions have the option of

analyzing the impacts of transboundary flows and exceptional events (TF/EE) and adjusting their air zone metric values accordingly. These arrangements aim to ensure that jurisdictions are responsible for managing only the emissions sources they can control.

The Management Levels for PM<sub>2.5</sub> should be combined based on the higher of the PM<sub>2.5</sub> annual and the PM<sub>2.5</sub> 24 hour Management Levels. For example, if an air zone is in the Orange Management Level for PM<sub>2.5</sub> 24-hour, and the Yellow Management Level for PM<sub>2.5</sub> annual, the air zone would be classified as being in the Orange Management Level for PM<sub>2.5</sub>. While the PM<sub>2.5</sub> Management Levels should be consolidated for reporting purposes, jurisdictions can implement measures to address *both* metrics through air zone management.

The timeline for implementation of air zone management is as follows:

- Air zone reporting is to commence in 2014 based on 2011-2013 data.
- Air zone Management Levels to be set starting in 2014.
- The air zone will remain in a particular Management Level until management actions have been implemented *and* it can be demonstrated that levels have fallen below the applicable Threshold Value. However, if an air zone moves into a higher Management Level during a subsequent reporting period, this higher level would apply.
- Jurisdictions would roll-out air zone management progressively, focusing on achieving the 2015 and 2020 CAAQS.

## **Management Actions**

Under the AZMF each of the four colour-coded Management Levels has been assigned a range of management, monitoring and reporting actions that jurisdictions may consider for implementation. The full range of actions associated with each Management Level is outlined in Section 5 of this document.

Consistent across all Management Levels is the expectation that jurisdictions would undertake air monitoring, reporting and public education. The intensity of active air zone management would be expected to increase from Yellow, to Orange to the Red Management Level.

## **Communicating AZMF Information**

The final part of the document discusses issues associated with effectively communicating AZMF information.

In the interests of clarity, air zone reports should clearly separate air quality and Management Level reporting for each province or territory. Air quality reporting communicates CAAQS achievement determination as well as observed air quality issues and trends, whereas Management Level reporting communicates management actions and expectations.

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## GLOSSARY AND ACRONYMS

Air Zone Management Framework (AZMF)	A colour-coded system of air pollution concentration ranges that prompts a corresponding range of management actions to be implemented at an air zone level
Management Level	A colour-coded category of air zone management, with each Management Level associated with a suite of air quality management actions. There are four Management Levels under the AZMF
Air zone metric value for a given pollutant	Is the calculated PM <sub>2.5</sub> or ozone numerical value in the form of the metric at a given CAAQS-reporting station, per GDAD specifications
AQMS	Air Quality Management System
CAAQS	Canadian Ambient Air Quality Standards
CAMS	Comprehensive Air Management System
GDAD	<i>Guidance Document on Achievement Determination: Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone</i>
CCME	Canadian Council of Ministers of the Environment
CWG	CAAQS Working Group
CWS	Canada-wide Standard for PM and Ozone
daily 8hr-O <sub>3</sub> -max	Daily maximum 8-hour average ozone concentration (in ppb)
daily 24hr-PM <sub>2.5</sub>	Daily 24-hour average PM <sub>2.5</sub> concentration (in µg/m <sup>3</sup> )
EE	Exceptional Events
Threshold Value	A specific air pollutant concentration that separates one air management level from another.
PM <sub>2.5</sub>	Particulate Matter less than or equal to 2.5 microns in diameter
ppb	Parts per billion (by volume)
TF	Transboundary Flows
µg/m <sup>3</sup>	Micrograms per cubic metre
1hr-O <sub>3</sub>	1-hour average ozone concentration
8hr-O <sub>3</sub>	8-hour average ozone concentration

## **1. INTRODUCTION**

On October 20, 2010 the Canadian Council of Ministers of the Environment (CCME) agreed to move forward with a new collaborative Air Quality Management System (AQMS) to better protect human health and the environment.

The AQMS contains several key elements, including Canadian Ambient Air Quality Standards (CAAQS), air zone management, a system of regional airshed coordination, base-level industrial emission requirements (BLIERs) for industry, and collaborative action to address mobile source emissions.

The Air Zone Management Framework (AZMF) provides guidance on how provinces and territories can implement air zone management in order to help achieve the CAAQS, drive continuous improvement and keep clean areas clean.

Under the AQMS, provinces and territories will be delineated into a number of air zones which will provide a focal point for stakeholders and governments to work together in order to improve air quality. An air zone is a finite geographic area, within a particular province or territory, that typically exhibits similar air quality issues and trends throughout. It will be up to provinces and territories to delineate and manage their air zones based on local circumstances. The federal government will take the lead role for areas that fall under federal authority and will collaborate with provinces and territories on air quality management within relevant air zones.

This Guidance Document is intended as a reference tool for jurisdictions and the public, providing details of the Air Zone Management Framework under the AQMS.

The specific objectives of the document are to:

- clarify the role of the AZMF under the AQMS,
- set out AZMF Threshold Values to separate the four Management Levels,
- outline the suggested management actions associated with the AZMF,
- present a method to address transboundary air pollution and exceptional events in the context of the AZMF, and
- outline the main expectations for communicating information on air zone management.

## **2. ABOUT THE AIR ZONE MANAGEMENT FRAMEWORK**

### **Overview of the Air Zone Management Framework**

Under the AQMS, each province and territory will be delineated into a number of air zones covering the entire jurisdiction which will provide a focal point for stakeholders and governments to work together in order to improve air quality and achieve the CAAQS. An air zone is a finite geographic area that typically exhibits similar air quality characteristics, issues and trends throughout. It will be up to provinces and territories to delineate and manage their air zones based on local circumstances.



Air zone management will be guided by the AZMF. Under the AZMF, as air pollution concentrations approach or exceed the CAAQS, jurisdictions will implement progressively more stringent measures to improve air quality.

The main objectives of the AZMF are to help jurisdictions:

- Achieve the CAAQS by providing guidance on the general nature of air management, monitoring and reporting actions to be implemented in air zones.
- Ensure continuous improvement in air quality by preventing the CAAQS from being exceeded in air zones where the PM<sub>2.5</sub> or ozone levels are approaching the levels of the CAAQS.
- Prevent air quality deterioration and keep clean areas clean in air zones with PM<sub>2.5</sub> and ozone levels well below the CAAQS levels.
- Prevent the CAAQS from becoming “pollute up to levels” by formalizing an expectation that governments would do more than just focus on achieving the CAAQS, since for PM<sub>2.5</sub> and ozone there are no concentrations without effects on human health.
- Inform the public on the general nature of air management, monitoring and reporting actions that could be undertaken at the four Management Levels.

The AZMF consists of four separate air pollution concentration ranges, called *Management Levels*, for each of the three CAAQS metrics. Each management level is colour-coded, and associated with a suite of air management, monitoring and reporting actions that become progressively more rigorous as air quality approaches the CAAQS.

**Table 1: The Structure of the AZMF**

Management Level	Objective
Red	Achieve air zone CAAQS through advanced air zone management actions
Orange	Improve air quality through active air management and prevent a CAAQS exceedance
Yellow	Improve air quality using early and ongoing actions for continuous improvement
Green	Maintain good air quality through proactive air management measures

### 3. THE MANAGEMENT LEVELS

Under the AZMF, each colour-coded Management Level is separated by a different “Threshold Value.” A Threshold Value is a specific air pollution concentration that marks the start of a new Management Level. Each of the three CAAQS metrics has a different set of Threshold Values, but each is set based on the same approach.

#### 3.1 Threshold Values

Table 2 illustrates the Threshold Values under the AZMF.

**Table 2: Threshold Values**

	Ozone (ppb)		PM2.5 Annual (µg/m3)		PM2.5 24h (µg/m3)	
	2015	2020	2015	2020	2015	2020
<b>Red</b>						
<b>Highest Threshold Value</b>	63	62	10.0	8.8	28	27
<b>Orange</b>						
<b>Middle Threshold Value</b>	56		6.4		19	
<b>Yellow</b>						
<b>Lowest Threshold Value</b>	50		4.0		10	
<b>Green</b>						

#### *The Highest Threshold Value*

The highest Threshold Value is equal to the CAAQS.

#### *The Middle Threshold Value*

The middle Threshold Value, separating the Yellow and Orange Management Levels, is set half way between the 2020 CAAQS value and the lowest Threshold Value.

#### *The Lowest Threshold Value*

The lowest threshold value corresponds to “baseline” concentrations. The term “baseline” refers to air quality data that is least influenced by local and regional anthropogenic sources, as far as possible reflecting natural source emissions and very long range (intercontinental) anthropogenic emissions. Baseline concentrations provide the basis for determining the lowest Threshold Value because they can be grounded in actual Canadian air quality data. The lowest Threshold Value represents the cleanest sites across Canada.

An analysis of the Canadian air monitoring data for the sites least impacted by anthropogenic emissions, on the “cleanest” days, was used to determine baseline concentration levels related to the CAAQS metrics for ozone, 24 hr PM<sub>2.5</sub> and annual PM<sub>2.5</sub>. Every effort has been made to ensure that these proposed lowest Threshold Levels are informed by rigorous scientific analysis but also give consideration to limitations in instrumentation and analysis. Some uncertainties exist in these Threshold Values since the baseline measures represent surrogates of the CAAQS metrics; however, a conservative approach was taken to setting the threshold levels in order to account for these uncertainties. For example, where available, baseline concentrations at the high end of the data range were chosen.

A more detailed description of the scientific basis for the recommended green-yellow threshold values can be found in the Appendix.

### **3.2 Differences in Threshold Values between 2015 and 2020**

The same values for 2015 and 2020 for the middle and lowest Threshold Values are used for the following reasons:

- Since the lowest Threshold Values are based on concentration levels across Canada that are minimally influenced by local, regional or North American anthropogenic sources, future reviews using similar analysis would likely produce very similar results. It is not anticipated that the lowest Threshold Values will change significantly over time, and the same values will be used for 2015 and 2020.
- Adopting the same middle Threshold Values will make it easier for jurisdictions to determine their Management Levels and will simplify communicating the system to the public. From a practical perspective, it also makes very little difference to the Threshold Values.<sup>1</sup>

The highest Threshold Values are proposed to change between 2015 and 2020, in line with the CAAQS.

## **4. IMPLEMENTATION**

This section discusses the general principles for determining Management Levels, and how the approach for determining Management Levels differs from the approach for CAAQS air quality reporting. The important points to note are that:

- For air quality and CAAQS achievement determination, “air zone metric values” are reported on an “as is” basis.
- To determine Management Levels, air zone metric values are adjusted to remove “Transboundary Flows and Exceptional Events” (TF/EE) (if applicable).

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<sup>1</sup> For example the difference in the middle Threshold Value in using the 2020 CAAQS as opposed to the 2015 CAAQS for ozone is 1 ppb, for PM<sub>2.5</sub> Annual it is 0.1 µg/m<sup>3</sup>, and for PM<sub>2.5</sub> 24 hour it is 0.5 µg/m<sup>3</sup>.

## 4.1 Determining Management Levels

Provinces and territories should refer to the *Guidance Document on Achievement Determination: Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone* (GDAD) for methods, procedures and requirements that need to be followed in calculating the air zone metric values.

An air zone metric value will be obtained for each air zone and for each of the three pollutants. TF/EE influenced events will then be determined in accordance with the procedures outlined in Section 4.3. The air zone metric value will be recalculated after removing the TF/EE influenced events and then comparing that figure to the Threshold Values (outlined in Section 3) to determine the Management Level for the given pollutant. A particular Management Level will apply to an air zone if the air zone metric value is less than or equal to the higher Threshold Value.

For example, the ozone Management Level for a hypothetical air zone in 2015 is illustrated in Table 3 below. Note in particular that the influence of TF/EE is considered *prior* to determining the air zone Management Level.

**Table 3: Determining Management Levels**

Air Zone	Air Zone Metric	Air Zone Metric with TF/EE Influence Removed	Air Zone Management Level
A	56 ppb	54 ppb	Yellow
B	57 ppb	57 ppb	Orange

## 4.2 The Approach for PM<sub>2.5</sub>

Management Levels will be determined for each air zone for each of the three CAAQS metrics, but for management purposes, the two PM<sub>2.5</sub> metrics will be consolidated into one. This means that there will be one Management Level set for ozone, and one Management Level set for PM<sub>2.5</sub>.

The reason for this consolidation of the PM<sub>2.5</sub> Management Levels is to simplify communications and to streamline air zone management. It is likely to be confusing for members of the public if an air zone is in different Management Levels for each of the PM<sub>2.5</sub> metrics. Furthermore, the management of PM<sub>2.5</sub> will be more efficient when measures to address both metrics are incorporated into the same air zone management plan.

The approach for determining PM<sub>2.5</sub> Management Levels is illustrated in the hypothetical air zone data contained in Table 4. As the table shows, the PM<sub>2.5</sub> Management Level will be based on the higher of the PM<sub>2.5</sub> annual or the PM<sub>2.5</sub> 24 hour Management Levels.

**Table 4: Determining PM<sub>2.5</sub> Management Levels**

Air Zone	Air Zone Metric	Air Zone Metric with TF/EE Influence Removed	Air Zone Management Level
A	24 µg/m <sup>3</sup> (24-hour)	22 µg/m <sup>3</sup>	Orange
A	11 µg/m <sup>3</sup> (annual)	7 µg/m <sup>3</sup>	

### 4.3 Demonstrating the Influence of Transboundary Flows and Exceptional Events (TF/EE)

In air zones where air quality is impacted by TF and EE, air zone metric values can be recalculated after the removal of TF/EE influenced days based on the Weight of Evidence (WOE) approach outlined in the GDAD. The recalculated metric value would then be compared to the Threshold Values to determine the Management Level.

The GDAD discusses the procedures that provinces and territories may follow to demonstrate the influence of TF/EE on the non-achievement of a given CAAQS. The same procedures are to be used for demonstrating the influence of TF/EE for Management Level purposes, and these procedures would be applicable across *all* Management Levels (and not just in cases of CAAQS non-achievement as outlined in the GDAD).

In the case of determining the Management Level for the PM<sub>2.5</sub> Annual metric when there is TF/EE, references to the ‘annual standard’ in section 7.3.2 of the GDAD would be replaced with the ‘next highest Management Level.’ The intent here is to allow the application of the WOE approach across all PM<sub>2.5</sub> Annual Management Levels, using the same rigorous approach specified in the GDAD.

Refer to the GDAD for a more detailed discussion of the approach to assessing TF/EE.

### 4.4 Timelines for Implementation

Annual air zone reporting will commence in 2014 based on 2011-2013 data. Management Levels will be set in 2014 when air zone reporting commences.

Provinces and territories have the option of initially using existing Canada-wide Standards for PM and Ozone reporting areas until air zones have been delineated.

Jurisdictions will implement air zone management plans to achieve the 2015 and 2020 CAAQS focusing on priority areas with particular air quality challenges or high population densities. Jurisdictions will be responsible for managing their air zones to achieve the CAAQS, guided by the actions associated with each Management Level (as outlined in Section 5).

A particular air zone will remain in a management level until management actions have been implemented *and* it can be demonstrated that levels have fallen below the applicable Threshold Value. However, if an air zone moves into a higher Management Level during a subsequent reporting period, this higher level will apply. In such cases the air zone management plan would be reassessed and the actions adjusted accordingly.

In some cases the air quality in an air zone may hover around a Threshold Value (bouncing in and out of a Management Level). In these cases the higher Management Level would be assigned to the air zone but jurisdictions would analyze the trends and determine the level of action that is appropriate.

## 5. SUGGESTED MANAGEMENT ACTIONS

Each Management Level is associated with a number of suggested actions, as outlined in Table 5. These actions are provided for guidance in implementing air zone management. Ultimately it is up to each jurisdiction to determine how it manages its air quality, and is of course free to implement additional measures.

**Table 5: Summary of Suggested Management Actions**

<b>Green</b>			
Objective: Maintain good air quality through proactive air management measures and keep clean areas clean			
<b>Category of Action</b>	<b>Suggested Actions</b>	<b>Description</b>	<b>Primary Responsibility</b>
Air Zone Characterization	Air Quality Monitoring	Basic air quality monitoring or surveillance, potentially via remote sensing or modeling.	Provinces and territories, with assistance from federal science and technical experts where possible
Reporting	Prepare Air Zone Reports	Prepare annual reports summarizing current air quality and trends.	Provinces and territories
Education	Public Education	Educate the public on local air quality, publish air quality reports and progress assessments.	Provinces and territories

**Yellow**

**Objective: Improve air quality using early and ongoing actions for continuous improvement**

<b>Category of Action</b>	<b>Suggested Actions</b>	<b>Description</b>	<b>Primary Responsibility</b>
Air Zone Characterization	Air Quality Monitoring	Ensure monitoring devices for PM <sub>2.5</sub> and ozone within an air zone are sufficient to accurately characterize air quality.	Provinces and territories, with assistance from federal science and technical experts where possible
	Emissions Inventory	Compile an air zone-specific emissions inventory, derived from the national emissions inventory and supplemented with location specific data as required.	Provinces and territories, with assistance from federal science and technical experts where possible
Collaboration	Stakeholder Engagement	Local stakeholders engaged as appropriate for local conditions.	Provinces and territories
Air Zone Management Planning	Develop an Air Zone Management Plan to Prevent Air Quality Deterioration	Develop an Air Zone Management Plan if required to prevent air quality deterioration. Plans may consider current and likely future directions in air quality; defined air zone goals, role of stakeholders, priority emission sources, mechanisms to achieve air quality improvements, and any additional monitoring and inventory required.	Provinces and territories to lead the development of Air Zone Management Plans, and all levels of government have responsibility to ensure CAAQS achievement
Implementation	Implement Management Plan	Implement the Management Plan (if required), with roles and responsibilities for all participants, timelines, and process for review.	Provinces and territories to lead the implementation of Air Zone Management Plans, and all levels of government have responsibility to ensure CAAQS achievement
Reporting	Prepare Air Zone Reports	Prepare annual reports summarizing current air quality and trends.	Provinces and territories
	Progress Assessments	Assess the effectiveness of the management actions implemented and track the implementation of the action plans. Assessment to also forecast impacts based on projected air zone growth. Air Zone Management Plan to be revised as needed to achieve continuous improvement in air quality.	Provinces and territories
Education	Public Education	Educate the public on local air quality, and publish air quality reports and progress assessments.	Provinces and territories

## Orange

Objective: Improve air quality through active air management and prevent a CAAQS exceedance

Category of Action	Suggested Actions	Description	Primary Responsibility
Air Zone Characterization	Monitor air quality	Ensure monitoring devices for PM and ozone within an air zone are sufficient to accurately characterize air quality.	Provinces and territories, with assistance from federal science and technical experts where possible
	Emissions Inventory	Compile an air zone-specific emissions inventory, derived from the national emissions inventory and supplemented with location specific data as required.	Provinces and territories, with assistance from federal science and technical experts where possible
Collaboration	Stakeholder Engagement	Local stakeholders engaged, with roles and deliverables identified.	Provinces and territories
	Airshed Coordination	Engage airshed coordination if there are transboundary air pollution issues.	Federal government
Air Management Planning	Develop an Air Zone Management Plan to Improve Air Quality	Develop a comprehensive Air Zone Management Plan to improve air quality. The Plan may identify key emissions sources, consider current and likely future directions in air quality, set out actions to be undertaken by governments and stakeholders to reduce emissions, and include short, medium and long-term milestones and targets.	Provinces and territories, all levels of government have responsibility to ensure CAAQS achievement.
	Publish Air Zone Management Plan	Provinces and territories review and publish the Air Zone Management Plan, ensuring it is achievable and consistent with provincial/territorial policies.	Provinces and territories
Implementation	Implement Air Management Plan	Implement the Management Plan, with roles and responsibilities for all participants, timelines, and process for review.	Provinces and territories, all levels of government have responsibility to ensure CAAQS achievement.
Reporting	Prepare Air Zone Reports	Prepare annual reports summarizing current air quality and trends.	Provinces and territories
	Progress Assessments	Assess progress in implementing management actions, track the implementation of the action plans, and demonstrate how the management actions contribute to improved air quality. Air Zone Management Plan to be revised as needed to achieve continuous improvement in air quality.	Provinces and territories
Education	Public Education	Educate the public on air quality, and publish air quality reports and progress assessments.	Provinces and territories



<b>Red</b>			
<b>Objective: Achieve air zone CAAQS through advanced air zone management actions</b>			
<b>Category of Action</b>	<b>Suggested Actions</b>	<b>Description</b>	<b>Primary Responsibility</b>
Air Zone Characterization	Monitor Air Quality	Ensure monitoring devices for PM and ozone within an airzone are sufficient to accurately characterize air quality.	Provinces and territories, with assistance from federal science and technical experts where possible
	Emissions Inventory	Compile an air zone-specific emissions inventory, derived from the national emissions inventory and supplemented with location specific data as required.	Provinces and territories, with assistance from federal science and technical experts where possible
Collaboration	Stakeholder Engagement	Local stakeholders engaged with roles and deliverables identified.	Provinces and territories
	Airshed Coordination	Engage airshed coordination if there are transboundary air pollution issues.	Federal government
Air Management Planning	Develop Air Zone Management Plan to Achieve the CAAQS	Develop a comprehensive Air Zone Management Plan to achieve the CAAQS. The Plan may consider current and likely future directions in air quality, and include: actions to be undertaken by governments and stakeholders to reduce emissions with short, medium and long-term milestones and targets, and detailed modeling to show how planned actions will improve air quality.	Provinces and territories, all levels of government have responsibility to ensure CAAQS achievement.
	Publish Air Zone Management Plan	Provinces and territories review and publish the Air Zone Management Plan, ensuring it is achievable and consistent with provincial/territorial policies.	Provinces and territories
Implementation	Implement Air Management Plan	Implement the Management Plan, with clear role and responsibilities for all participants, timelines, and process for review.	Provinces and territories, all levels of government have responsibility to ensure CAAQS achievement.
Reporting	Prepare Air Zone Reports	Prepare annual reports summarizing current air quality and trends.	Provinces and territories
	Progress Assessments	Assess progress in implementing management actions, track the implementation of the action plans, and demonstrate how the management actions contribute to improved air quality.	Provinces and territories
Education	Public Education	Educate the public on air quality, and publish air quality reports and progress assessments.	Provinces and territories

## 6. COMMUNICATING AIR ZONE MANAGEMENT FRAMEWORK INFORMATION

In order to help the public understand the impacts of TF and EE, air zone reports should clearly distinguish between air quality reporting and Management Level reporting. The first part of air

zone reports should discuss air quality issues and trends with air quality reported “as is” according to the approach outlined in the *Guidance Document on Achievement Determination: Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone* for each air zone. The second part of these reports should focus on Management Level information, outlining the colour-coded Management Levels for each air zone. This will help avoid confusion in cases where accounting for TF/EE results in a difference between the air quality levels and the corresponding Management Level.

Governments will work together to develop a consistent template for air zone reporting to effectively communicate both CAAQS achievement and Management Level information.

## **APPENDIX 1 – Technical Approach for Setting the Green-Yellow Threshold Values for Ozone and PM<sub>2.5</sub>**

The green-yellow threshold values are based on baseline concentrations levels derived from monitoring data at sites across Canada that are minimally influenced by anthropogenic sources. The analysis that follows, and on which the green-yellow threshold values are based, is an analysis of baseline levels at the “cleanest” monitoring sites (*i.e.*, sites least impacted by anthropogenic emissions) across Canada. An effort was made to ensure that the green-yellow threshold values were informed by scientific analysis but also gave consideration to limitations in instrumentation and analysis, through the following approaches:

- The analysis used actual measured baseline concentrations, and while this approach may not be optimally suited to the CAAQS metrics, it provided a concrete basis for setting the threshold values. Uncertainties exist in the threshold values since the baseline measures represent surrogates of the CAAQS metrics; however, a conservative approach was taken to setting the threshold levels in order to account for the inherent uncertainties; and
- Consideration was given to current instrumentation limitations and estimates of measurement uncertainty.

The green-yellow threshold values are as follows:

Ozone:	50 ppb
PM <sub>2.5</sub> (24h):	10 µg/m <sup>3</sup>
PM <sub>2.5</sub> (annual):	4.0 µg/m <sup>3</sup>

The green-yellow threshold values use the same form (metric) as the corresponding CAAQS.

A description of the approach taken to arrive at the recommended green-yellow threshold values follows.

### **Ozone Green-Yellow Threshold Value – 50 ppb**

An analysis of North American baseline ozone concentrations from 1997-2006 was performed by Environment Canada scientists and published in a peer reviewed scientific journal article<sup>2</sup>. The analysis investigated measurements from 96 non-urban sites across Canada and the United States and used back trajectory analysis to identify 6 hr average concentration levels that were minimally influenced by North American anthropogenic sources. The baseline ozone levels were found to vary geographically and by season. The results presented in the paper are based on annual average baseline concentration levels, which do not correspond to the ozone CAAQS metric.

In order to recommend the green-yellow threshold value for ozone, it was necessary to use the published baseline 6 hr average ozone concentration data as a surrogate for 8 hr daily maximum concentrations in order to relate the results to the CAAQS metric. The baseline ozone

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<sup>2</sup> Chan E and Vet R (2010). Baseline levels and trends of ground level ozone in Canada and the United States. *Journal of Atmospheric Chemistry and Physics*, (10): 8629-8647. Doi: 10.5194/acp-10-8629-2010

concentrations, and the annual 4<sup>th</sup> highest CAAQS metric of these concentrations, are known to vary geographically across Canada. 50 ppb represents the high end of the range observed.

### Considerations

**Metric** – The CAAQS metrics for the ozone and 24 hr PM<sub>2.5</sub> standards and threshold values are both measures of peak concentration levels observed during a given year. It is challenging to express baseline concentrations using such a metric. This peak type of metric typically represents the most anthropogenically-affected air measured at a given monitoring site, even at remote sites. This is seen at sites such as ELA and Algoma (both in Ontario), where even though they are quite remote, the CAAQS metric is driven by very high concentrations due to transboundary transport of pollutants from the United States.

**Geographic variation** – The results of this analysis showed differences in baseline ozone concentrations across Canada, and differences in the CAAQS ozone metric across Canada. Nationwide generalizations of baseline concentrations are difficult to make. The recommended Green-Yellow Threshold value of 50 ppb is the upper end of the range of baseline concentrations that were observed.

**Urban lows in ozone** – In urban areas, where there are high emissions of ozone precursor pollutants, low ozone concentrations are often observed. This is due to the complex and dynamic relationship between ozone and its precursor pollutants. High ozone levels, resulting from urban precursor emissions, are observed in the areas downwind. Some Canadian urban areas may experience ozone levels below the green-yellow threshold value of 50 ppb. From an air quality management perspective it will be important to recognize that urban Green Zones for ozone are not representative of pristine air quality, and emissions from these urban areas will need to be managed in order to reduce elevated ozone levels downwind.

### **PM<sub>2.5</sub> 24 hour Green-Yellow Threshold Value – 10 µg/m<sup>3</sup>**

An analysis similar to that described above for the determination of baseline ozone levels was carried out for PM<sub>2.5</sub> as part of the Canadian Smog Science Assessment.<sup>3</sup> For PM<sub>2.5</sub>, there is a lack of Canadian non-urban monitoring sites available from which to draw on for data, which limited the analysis to 7 regionally-representative rural sites using 6 hr average concentration data from 1996-2005 (note that one site was American and was located very close to the US-Ontario border in northern Minnesota). Back trajectory analysis was used to identify the data that were least influenced by anthropogenic sources, and therefore most representative of baseline PM<sub>2.5</sub> levels. The average of the annual 95<sup>th</sup> percentile of the baseline measurements across the seven monitoring sites was determined to be 8 µg/m<sup>3</sup>.

The CAAQS metric for the 24 hr PM<sub>2.5</sub> standard uses the annual 98<sup>th</sup> percentile of the 24 hr measurements and therefore does not fully align with the analysis discussed above. In an effort to relate the PM<sub>2.5</sub> baseline measurements to the same metric as the CAAQS, an empirical multiplicative factor of 1.25 was used based on a comparison of 95<sup>th</sup> and 98<sup>th</sup> percentile values from 2000-2009 (*i.e.*, the ratio of 98<sup>th</sup> to 95<sup>th</sup> percentile values over this period). A value of 1.25

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<sup>3</sup> Government of Canada. *Canadian Smog Science Assessment: Highlights and Key Messages*. 2012

was the median factor relating these two percentiles and has been applied to the 95<sup>th</sup> percentile baseline value of 8 ug/m<sup>3</sup> (*i.e.*, multiply 8 ug/m<sup>3</sup> by 1.25 to relate the baseline value to the 98<sup>th</sup> percentile). This results in the recommended PM<sub>2.5</sub> 24 hr green-yellow threshold value of 10 ug/m<sup>3</sup>.

### Considerations

**Metric** – The CAAQS metric for the 24 hr PM<sub>2.5</sub> standard and threshold values are representative of peak concentrations observed during a given year. As stated in the previous section on ozone baseline levels, it is challenging to express baseline PM<sub>2.5</sub> using such a metric which typically is representative of anthropogenically-influenced air even at remote monitoring locations. Also, in order to carry out the trajectory analysis needed to identify baseline concentrations, it was necessary to use 6 hr average PM<sub>2.5</sub> concentrations, as opposed to the CAAQS 24 hr averages. It is likely that the 98<sup>th</sup> percentile values of the 6 hr average concentrations are greater than the 98<sup>th</sup> percentile of the 24 hr concentrations, suggesting the green-yellow threshold value can be considered conservative.

**Monitoring data** – Canada's PM<sub>2.5</sub> monitoring network has been designed to focus on urban and sub-urban areas, and there are few sites that were appropriate to include in the analysis of baseline PM<sub>2.5</sub> concentrations. The limited number of sites used in this analysis means that the variation in baseline levels occurring across Canada may not be captured fully.

**Instrumentation** – This analysis utilized unadjusted TEOM measurements (TEOM measurements are affected by cold-temperature mass losses), which means that the baseline results may be lower than if the analysis had been performed using adjusted data.

### **PM<sub>2.5</sub> Annual Green-Yellow Threshold Value – 4.0 ug/m<sup>3</sup>**

The same analysis discussed above for the PM<sub>2.5</sub> 24 hr baseline levels was also used to determine PM<sub>2.5</sub> annual average baseline levels. The median baseline PM<sub>2.5</sub> value from the 7 sites investigated was determined to be 3.2 ug/m<sup>3</sup> and the mean 3.6 ug/m<sup>3</sup>.

The detection limit for TEOMs, the instrumentation currently most commonly used for continuous monitoring of PM<sub>2.5</sub> in Canada, is approximately 2 ug/m<sup>3</sup>. As measurements approach the detection limit of the instrument, the uncertainty associated with the measured concentration increases. The baseline levels observed in the 7-site analysis are relatively close to the TEOM detection limit. Based on advice from the managers of the National Air Pollutant Surveillance network, it is recommended that an adjustment of 0.8 ug/m<sup>3</sup> be added to the analytically derived annual median baseline level to account for instrumentation limitations and measurement uncertainty. Therefore, the recommended annual average PM<sub>2.5</sub> green-yellow Threshold value is 4.0 ug/m<sup>3</sup>.

### Considerations

**Monitoring data** – As discussed above, there are limited monitoring sites available in Canada to draw from to determine baseline PM<sub>2.5</sub> levels. Therefore, the results may not be fully representative of the variation in baseline PM<sub>2.5</sub> measurements seen across the country.

Additionally, in order to carry out the trajectory analysis needed to identify baseline concentrations, it was necessary to use 6 hr average PM<sub>2.5</sub> concentrations, as opposed to the CAAQS 24 hr averages. This will have little effect on annual average PM<sub>2.5</sub> green-yellow threshold value as the mean of the 6 hr average concentrations is expected to be the same as the mean of the 24 hr average concentrations.

**Instrumentation** – The annual average PM<sub>2.5</sub> baseline levels across Canada approach the detection limit of current instrumentation. An effort has been made to account for the potential influence of measurement uncertainty within the recommended green-yellow threshold value. However, as mentioned above, this analysis utilized unadjusted TEOM measurements (affected by cold-temperature mass losses) and the baseline levels would be somewhat higher if adjusted data had been used.