Air Monitoring and Assessment Strategy for Quesnel BC, 2000 - 2005

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1.0 INTRODUCTION

Ambient air quality monitoring and permitted source monitoring has been in place in various forms in Quesnel BC for the past decade (longer for some permitted sources). Through analysis of ambient fine particulate data less than 10 micrometers in diameter (termed PM_{10}), it has been determined that Quesnel has some of the poorest quality in the province (Plain, 1998).

In December of 1999 a community driven Airshed Management Planning (AMP) process was initiated to study the problem and make recommendations to improve air quality in the community (MELP, 1999; QAQR, 2000). The goal of the air quality assessment is to better understand present air quality, and determine major contributing sources to poor air quality episodes.

A multi-stakeholder committee known as the Quesnel Air Quality Roundtable oversees the Airshed Management Planning process. The Quesnel Environmental Society chairs the committee which includes representation from the following organizations:

Quesnel Environmental Society
BC Environment – Cariboo Region
City of Quesnel
Cariboo Regional District
Ministry of Health – Cariboo Health Unit
Quesnel Community Health Council
Cariboo Pulp and Paper Co.
Quesnel River Pulp
Weldwood of Canada
Slocan Forest Products
North Quesnel Neighborhood Association
Ministry of Forests
Quesnel Waste Disposal
West Fraser Mills Ltd.
Argo Road Maintenance

Ministry of Transportation and Highways
North Cariboo Share
United Concrete and Gravel
School District 28

A number of objectives have been identified in order to meet the overall study goals. The objectives of the monitoring program (ambient and source) in Quesnel are to collect meaningful data that will accomplish the following:

1. Refine the existing emissions inventory for fine particulates in the Quesnel Airshed.
2. Determine the concentrations and constituents of the fine particulates (PM_{10} and $PM_{2.5}$) that contribute to the high ambient values in residential areas of the Quesnel Airshed.
3. Determine the seasonality of these constituents and apportion to sources. Determine which sources contribute to episodes of poor visibility.
4. Determine the constituents and concentrations of fine particulates and link to sources in various parts of the community.
5. Estimate the amount of fine particulate that is due to natural and anthropogenic (man-made) sources. Group these sources by category such as soils, vehicle types, specific industrial sources and activities. (source apportionment).
6. Assess other parameters of interest such as TRS (odour), O_3, NOx, CO, SO_2 and link to sources.

2.0 STUDY RATIONALE

Air pollutants such as Total Reduced Sulphur (TRS), Sulphur Dioxide (SO_2), ground-level Ozone (O_3) Oxides of Nitrogen (NOx) and Carbon Monoxide (CO) also require monitoring and assessment in Quesnel. However, the main focus of this assessment will be on fine particulates due to ongoing elevated levels and the potential impacts on health and visibility (CEPA/FPAC,1999).

In order to improve air quality in the Quesnel Airshed it is necessary to obtain information about the nature and the sources of fine particulates. With this critical information, it will be possible to develop strategies with a sound technical basis to manage those sources which are the largest contributors to the air quality problem. However, sources of fine particulates in the Quesnel Airshed are many and varied. Particulate matter is emitted by anthropogenic (man-made) and natural sources, and by large industrial and small residential sources such as wood stoves (primary particles). Fine particles can also form as a result of chemical and physical transformation of gaseous precursors in the atmosphere (secondary particles). As a result, source apportionment of fine particulates in the Quesnel airshed is a complex matter.

Our knowledge of particulate matter in the Quesnel Airshed is mostly limited to mass measurements of PM_{10}. Little is known about size distribution and chemical composition and how this varies throughout the year, which is a reflection of contributing sources. Emission inventory estimates are available for the Cariboo Region but are not airshed-specific. Although traditional emission inventories provide a starting point for determining source contributions, they have a number of limitations related to the fact that:

a. British Columbia inventories for point sources may be based on permitted emission levels which are generally higher than the actual emission rates, or on emission factors that are often based on limited source measurements made primarily on facilities in the United States.
b. Emission factors are based on empirical relationships that may not adequately reflect the real world (e.g. road dust factors) and are subject to frequent change.
c. PM_{10} and $PM_{2.5}$ emission factors are often derived from Total Suspended Particulate (TSP) emission factors based on a splitting factor. For instance, an approach used to estimate PM_{10} from a particular source where TSP emissions are under permit might be to assume that 60% of TSP is PM_{10} and that 40% of PM_{10} is $PM_{2.5}$.
d. Traditional inventories do not adequately capture biogenic (natural) emissions or fugitive dust emissions, nor do they include secondary particles, which may be significant.

As a result, other techniques must be used in conjunction with traditional emission inventories to determine the best estimates for source contributions. These techniques may include receptor modelling (Lowenthal et. al.; 1994), in which detailed information collected at a receptor is used to ascertain something about the source emissions, and dispersion modelling, in which detailed information at the source is used in conjunction with meteorological and terrain information to determine where and to what degree pollutants will disperse in the atmosphere. Other tools that can be used include such things as continuous fine particulate monitoring (both the coarse and fine fraction of PM_{10}) in different areas of the community, fine particle speciation monitoring (ARB, 1994; Plain and Carmichael, 1998; Chow and Watson, 1998; USEPA, 1999), field observations, remote photography (ARB, 1994), and pollution rose development (combining meteorological information with continuous fine particulate data).

Each technique may have unique requirements for data collection, monitor location, and level of expertise. Several techniques may have to be combined to provide the level of certainty required in meeting the study objectives. These considerations will be evaluated in a scoping exercise to determine the most efficient means of meeting the study objectives to the level of certainty required.

3.0 REACHING THE AIR QUALITY MANAGEMENT GOAL

In order to achieve improved air quality in the community a number of things must be accomplished. The recommended steps are listed below in point form. Ongoing re-evaluation of priorities and management requirements is expected as the process evolves.

A. Based on existing knowledge and on initial results of new continuous $PM_{2.5}$ monitors, prepare and implement preliminary interim steps that can be taken immediately to improve air quality in Quesnel (e.g. road dust control/suppression).

B. Conduct a preliminary scoping exercise to identify the questions that need answering, the level of acceptable certainty, and the potential tools that could be used to provide the answers.

C. Prepare a report on the current status of air quality in the City of Quesnel, including an airshed-specific emissions inventory based on current knowledge (Cheng and Dunlop, 1998). Identify priority contaminants, major sources and data gaps.

D. Based on B & C, prepare and implement an ambient monitoring program to characterize fine particulate (begin with PM_{10} vs. $PM_{2.5}$ in different areas of the city) and quantify concentrations of other priority air contaminants in the Quesnel airshed. It is anticipated that monitoring program revisions may result in additional ambient monitoring requirements for industry.

E. Where necessary, conduct a source monitoring program to 1) refine the emissions inventory and 2) provide accurate source emissions information to be used in a dispersion modeling study. Industry will be responsible for providing data on their emissions.

F. Use dispersion modelling techniques (CALPUFF) to identify source contributions during PM_{10} episodes. Sources to be modelled will be determined based on emissions inventory results (e.g. sources with largest particulate loading to airshed will be evaluated first).

G. At this stage, if the level of certainty is acceptable, proceed to J. If further certainty is required, refine the scoping exercise and prepare and implement an ambient monitoring program to speciate fine particulate in the airshed. Continue with H.

H. Prepare and implement a source monitoring program to provide source profiles (fingerprints) for source apportionment work. This is for point and non-point sources. Possibly retain a consulting firm to carry out sampling and to determine the applicability of existing source profiles to Quesnel. Source profile refinement may be the responsibility of industry.

I. Retain the services of a consultant to run the Chemical Mass Balance (CMB) receptor model and assess results.

J. Based on the work above, identify priority contaminant sources for management action to answer the question of where we should concentrate our efforts to achieve the greatest reductions in contaminants. This may include episode management.

K. Select management options (e.g. Pollution Prevention Planning for industrial sources, etc.).

L. Prepare an Airshed Management Plan.

M. Implement the Airshed Management Plan recommendations and monitor effectiveness through revisions in ambient/source monitoring program.

N. Revise plan when new priorities are identified.

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