Lower Fraser Valley Ambient Air Quality Report 2001

Greater Vancouver Regional District

Policy and Planning Department

October 2002

FVRD

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Executive Summary

This annual report summarizes the 2001 operation of the Lower Fraser Valley (LFV) Air Quality Monitoring Network and presents the monitoring results for 2001. Programs that are operated in conjunction with the federal and provincial governments are also described.

For the 2001 monitoring year, the Lower Fraser Valley Air Quality Monitoring Network consisted of 27 stations, located across 16 communities in the Lower Fraser Valley, and is operated by the GVRD on behalf of the network partners. A Memorandum of Understanding between the network partners was signed in 1998, which recognized the monitoring network, and confirmed its joint management by the Greater Vancouver and Fraser Valley regional districts (GVRD and FVRD). Air quality data from 24 of these network stations are continuously transmitted to the Air Quality Monitoring System (AQMS) computer at the GVRD.

Regular audits of air quality monitoring equipment and stations are conducted to assure data accuracy. In 2001, 300 instrument audits were conducted with 82.0% being within 5% of true values and 97.7% being within 10%. Quality control and quality assurance activities resulted in a data capture rate above 97% for the network.

The network evaluates air quality by comparing the monitored data to national and provincial guidelines or objectives, established to protect public health and the environment. These objectives are used to describe three levels of air quality: Desirable, Acceptable and Tolerable. In addition, where no appropriate objectives exist, the GVRD has set its own objectives for pollutants of concern within the region.

New national air quality standards, termed Canada-Wide Standards (CWS), for particulate matter (PM) and ozone (O_3) were endorsed by the Canadian Council of Ministers of the Environment (CCME) on June 5-6, 2000. Measured concentrations were also compared to the new standards, where applicable.

Data from a subset of air quality monitoring stations representing different areas of the LFV are used to calculate an Air Quality Index (AQI). The AQI provides a qualitative description of the concentrations of the measured pollutants. Air quality is characterized as Good, Fair and Poor. When 'Poor' air quality is forecast for the following day, an air quality advisory is issued.

In 2001, air quality in the GVRD was measured as 'Good' 98.4% of the time, with 'Fair' and 'Poor' readings occurring 1.6% and less than 0.1% of the time, respectively. These readings are equivalent to or better than conditions recorded during the past few years. During 2001, there was one air quality advisory issued..

Summary of Monitoring Results

Sulphur Dioxide. Mean sulphur dioxide readings continue to remain at very low levels, averaging 2 ppb over the year, compared to the 1-year Desirable Objective of 10 ppb. 1-hour maximum concentrations remained below the 1-hour Desirable Objective of 170 ppb. Maximum 24-hour averages recorded at all stations during 2001 were below the 24-hour Desirable Objective of 60 ppb. The highest readings continue to be recorded in the northwestern portion of the airshed, particularly close to the major point sources along Burrard Inlet. In the LFV region, average and peak levels have decreased nearly 50% in the past 10 years.

Total Reduced Sulphur. Mean total reduced sulphur levels continued to be near or below detectable limits. However, 1-hour exceedances of the Desirable and Acceptable Objectives do still occur. These occurrences are usually short in duration and are generally associated with adverse meteorological conditions that trap pollutants near the ground. During 2001, the Desirable Objective was exceeded for a total of twenty-four hours, during which time the Acceptable Objective was also exceeded for four hours

Nitrogen Dioxide. All nitrogen dioxide measurements in 2001 continued to be well below the most stringent objective. Highest levels continue to be recorded in areas of heavy vehicular traffic. In the LFV region, average and peak levels have decreased about 15% since 1992, although the decline appears to have leveled off in recent years.

Carbon Monoxide. In 2001, mean carbon monoxide levels remained low throughout the region. Showing a similar pattern similar to nitrogen dioxide, highest measurements for this pollutant occur close to major roads during peak traffic hours. In the LFV region, both average and peak levels have decreased more than 30% in the last 10 years.

Ozone. As a result of favourable meteorological conditions, ground-level ozone reached 'poor' levels on two occasions during 2001. The Canada-Wide Standard for ground-level ozone was not exceeded at any of the monitoring sites. In the LFV region, average ground-level ozone levels have risen slightly in the last 10 years, while peak levels have decreased slightly.

Inhalable Particulate. The 24-hour inhalable particulate Acceptable Objective was exceeded for 19 hours at the Chilliwack site on December 27, 2001. These were the only exceedances of the objective observed during the year. Maximum 24-hour concentrations ranged from 31-64 $\mu g/m^3$ during 2001, while annual means were between 10-14 $\mu g/m^3$. In the LFV region, both average and peak inhalable particulate levels have declined slightly since continuous monitoring began in 1994.

Fine Particulate. Fine particulate levels were generally about one-half of inhalable particulate readings during 2001. The Canada-Wide Standard for fine particulate was not exceeded at any of the monitoring sites.

Coefficient of Haze. During 2001, coefficient of haze (soiling index) monitoring was conducted at two stations, one of which did not have inhalable particulate monitoring. Based on the two reporting stations, coefficient of haze values indicate that 2001 levels were similar to those recorded in 2000.

Total Suspended Particulate. A total of 463 total suspended particulate samples were collected from eight sites during 2001. Of these, one exceeded the 24-hour objective. Annual geometric means for the pollutant continue to be well below the Desirable Objective.

Metals in Suspended Particulate. Total suspended particulate can also be analyzed for concentrations of various metals. Currently, only objectives for lead and zinc exist. In 2001, the maximum 24-hour level and the annual mean for lead and zinc levels were well below the relevant Desirable Objectives. All other metal concentrations were similar to those noted for lead and zinc.

Dustfall. Mean monthly dustfall levels in 2001 were generally similar to those measured during 2000, with the exception of two samples which were measured above the 1-day Acceptable Objective.

Volatile Organic Compounds (VOCs). VOC concentrations have been monitored within the GVRD since 1990. Annual average VOC concentrations increased from 1990 to 1992, and then decreased until 1996, at which time concentrations appeared to level. Excepting 1998, average VOC concentrations in 2001 were lower than all years since 1990.

Other Sampling

During 2001, the Mobile Air Monitoring Unit (MAMU) completed a two-year quarterly sampling program for ozone, nitrogen dioxide and inhalable particulate in Mission to assess air quality in this Fraser Valley community. In a second study, MAMU2 was deployed to collect longer-term meteorological data in the vicinity of a major agricultural operation in the Lower Fraser Valley. This work was in support of the air quality regulatory enforcement and complaint function.

A monitoring program was initiated in Horseshoe Bay (in cooperation with the District of West Vancouver) to respond to concerns surrounding the expansion of the existing ferry terminal. A particulate sampler was operated at Gleneagles Elementary school every sixth day, while MAMU was deployed for one week periods to three different sites within the area every quarter. Results of the monitoring were posted on the GVRD website on a regular basis. This program will continue through 2003-2004.

During 2001, a program of particulate sampling was conducted as part of ongoing environmental studies surrounding a major engineering project at the Capilano Lake Reservoir in North Vancouver. The sampler was located at various sites during the study with all data being made available to the public in a timely fashion.

During the fall of 2001, a permanent meteorological station was installed at the Ashcroft Ranch in support of the Ashcroft Ranch Landfill Project. The station is maintained by GVRD staff with data transferred to the Air Quality Data Acquisition System on a regular basis.

Joint Programs

The network continued to provide field services for two long-term nationwide federal sampling programs: (i) a national canister sampling program for volatile organic compounds and (ii) a national program studying the fine and coarse fractions of inhalable particulate.

During August of 2001, a major particulate research program was conducted in the region (Pacific 2001). This program, led by Environment Canada, involved many researchers from universities, government agencies, and the private sector. The GVRD provided both logistical and technical support to this effort and contributed to the planning and operation of the programs. Results will provide for major scientific input to the development of air quality management plans within the region.

The Toxic Substances Research Initiative is a research effort of Environment Canada looking at the concentrations of various air toxics in Toronto and Vancouver. GVRD staff has been providing operational and maintenance support to this program which has operated several specialized air quality monitors at one site in the region.

Introduction

This report presents information and data from air quality monitoring programs for the year 2001 and, where appropriate, looks at long-term trends of specific contaminants in the Lower Fraser Valley.

The information is used to:

- compare air quality levels to federal, provincial and regional objectives
- assess the impact of specific emission sources
- provide daily air quality reports to the public
- provide an advisory service during periods of poor air quality
- evaluate trends in regional air quality
- provide a basis for developing air management strategies
- assess the impact of air quality management strategies
- assess spatial and temporal variations in regional air quality
- support research on the effects of pollutants on health, property and vegetation.

Network History

Air monitoring in the region began in 1949, when the City of Vancouver established a dustfall monitoring network. Monitoring for total suspended particulate was added in later years. In 1970, provincial air programs began under the Pollution Control Act (1967) and monitoring of these two parameters was added to other areas of the region.

In 1972, provincial and municipal air quality responsibilities were transferred to the Greater Vancouver Regional District (GVRD). Operation of all monitoring programs was also transferred to the GVRD. The monitoring network was consolidated to ensure that all areas of the District had basic monitoring services provided to them.

In 1998, a Memorandum of Understanding (MOU) was signed which recognized the monitoring network, and confirmed its joint management by the Greater Vancouver and Fraser Valley regional districts (GVRD and FVRD). The GVRD continues to operate and maintain this network, known as the LFV Air Quality Monitoring Network, on behalf of all partners.

Continuous monitoring of gaseous pollutants began in 1972 under the auspices of the federal National Air Pollution Surveillance (NAPS) program. Several new stations were established to measure sulphur dioxide, ozone, carbon monoxide, nitrogen oxides and hydrocarbons. The focus of these stations was to monitor general urban air quality, although some had a greater commercial and industrial exposure.

Over the years, stations and equipment have been added or removed in order to be responsive to changing air quality management priorities. Mobile Air Monitoring Units provide added flexibility to carry out measurements at many locations. Some monitoring is part of co-operative programs with industry and other governments.

Figure 1 illustrates the distribution of continuous monitoring stations in the region at the end of 2001. A detailed listing of all stations is presented in Table 1, together with a summary of the parameters that are monitored at each site.

2001 Report

This report is a summary of gaseous, particulate and meteorological measurements during 2001 from all stations and monitors identified in Figure 1 and Table 1. Detailed results are included in a separate Appendix which is available upon request (see back cover of this report for contact information). Following is a description of each Section of the report.

Section A – Monitoring Network Operations

- The monitoring network, quality control and quality assurance programs and the air quality data base.

Section B – Air Quality Objectives and Indices

- Air quality objectives and the Air Quality Index system.
- A summary of Air Quality Index readings.
- The air quality advisory service.

Section C – Pollutants Measured by Continuous Monitors

- Gaseous pollutants, inhalable particulate and fine particulate.

Section D – Pollutants Measured by Non-Continuous Samplers

- Total suspended particulate measurements and related chemical analyses, as well as volatile organic compounds and dust fall.

Section E – Joint Programs

- Joint monitoring programs with other agencies.

Section F – Meteorology and Air Quality

- The measurement of selected meteorological elements.

Section G – Canada-Wide Standards

- Achievement of the Canada-Wide Standards for particulate matter and ground-level ozone.

Section H – Measurement Methods

- The measurement methods for each parameter.

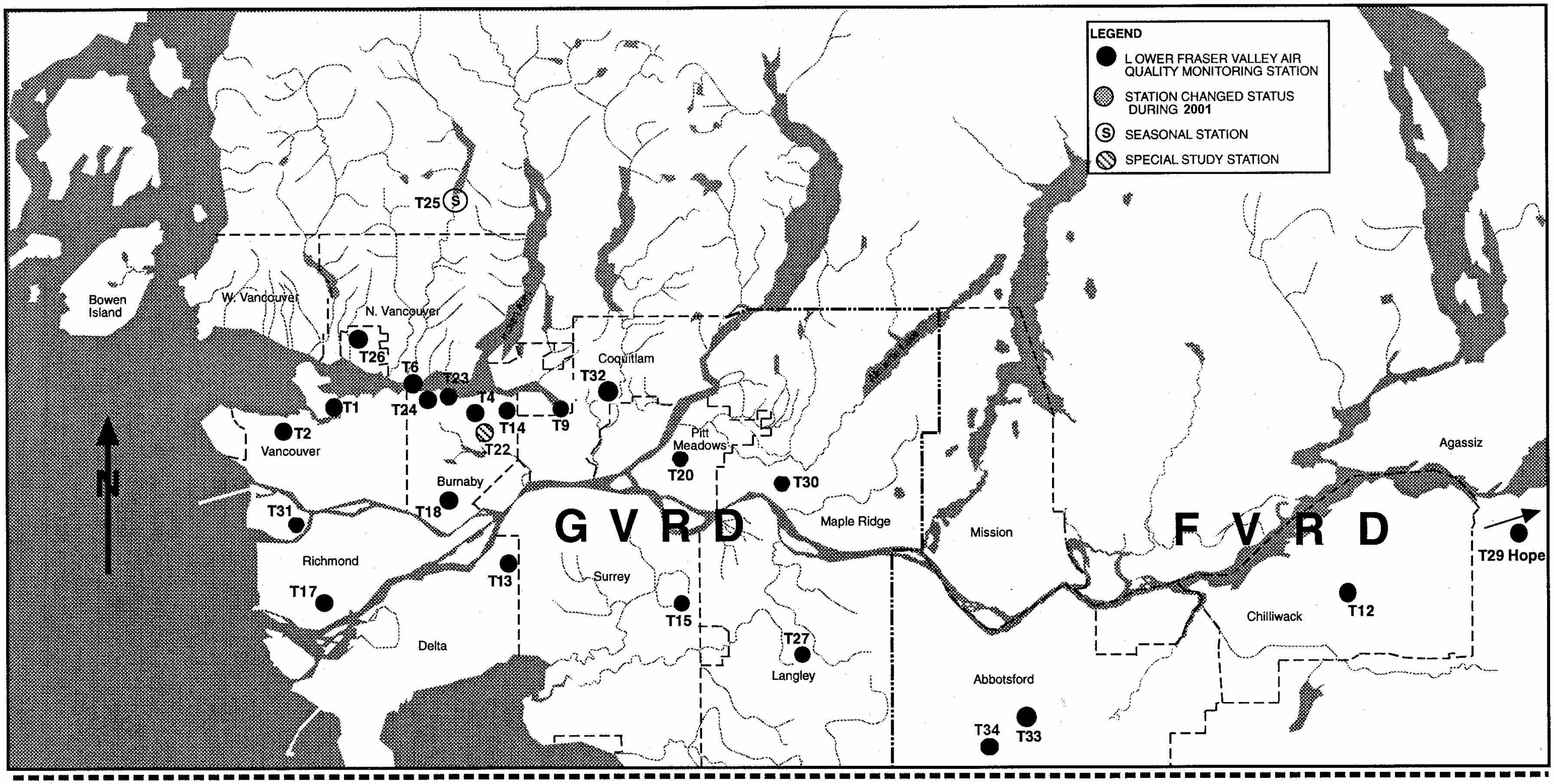


FIGURE 1: Lower Fraser Valley Continuous Air Quality Monitoring Network - 2001

Table 1

2001 Air Quality Monitors

Stations		Air Quality Monitors												Meteorological Monitors					
		Continuous								Non-Continuous									
ID	**Name**	**SO_2**	**TRS**	**NO_2**	**CO**	**O_3**	**PM_{10}**	**$PM_{2.5}$**	**COH**	**VOC**	**TSP**	**Metals**	**DF**	**Wind**	**T**	**SR**	**RH**	**B**	**P**
T1	Downtown Vancouver	M		M	M	M			M	M									M
T2	Kitsilano	M		M	M	M	M							M	M				M
T4	Kensington Park	M	M	M	M	M	M							M					
T6	Second Narrows	M		M	M	M								M					
T9	Rocky Point Park	M	M	M	M	M	M			M	M	M	M	M	M	M			M
T12	Chilliwack			M	M	M	M	M		M				M	M	M	M	M	M
T13	North Delta			M		M								M	M				M
T14	Burnaby Mountain			M		M								M	M				M
T15	Surrey East			M	M	M	M			M				M	M				M
T17	Richmond South	M		M	M	M	M			M	M			M	M				
T18	Burnaby South	M		M	M	M	M		M	M	M	M	M	M	M			M	M
T20	Pitt Meadows	M		M	M	M	M	M						M	M		M	M	M
T22	Burmount (***)		M							M				M	M				
T23	Capitol Hill	M	M											M	M				
T24	Burnaby North	M	M							M				M	M				
T25	Seymour Falls (S)					M					M								
T26	Mahon Park	M		M	M	M	M							M	M	M		M	M
T27	Langley			M	M	M	M				M	M		M	M		M	M	M
T29	Hope Airport			M	M	M	M			M				M	M		M		M
T30	Maple Ridge			M	M	M	M							M	M				M
T31	Vancouver Airport			M	M	M	M	M		M				M	M	M	M	M	M
T32	Coquitlam			M	M	M								M	M				M
T33	Abbotsford	M		M	M	M	M							M	M				M
T34	Aldergrove (*)							M						M	M	M	M	M	M
2	C.N.R. Station										M		M						
20	White Rock										M		M						
24	English Bluff										M		M						
Total Monitoring Units		**12**	**5**	**19**	**17**	**20**	**14**	**4**	**2**	**10**	**8**	**3**	**5**	**22**	**20**	**5**	**6**	**7**	**17**

SO_2 = sulphur dioxide; TRS = total reduced sulphur; NO_2 = nitrogen dioxide; CO = carbon monoxide; O_3 = ozone; PM_{10} = inhalable particulate matter; $PM_{2.5}$ = fine particulate matter; COH = coefficient of haze.

VOC = volatile organic compounds; TSP = total suspended particulate; Metals = metals in TSP; DF = dust fall.

Wind = wind speed and wind direction; T = air temperature; SR = solar radiation; RH = relative humidity; B = barometric pressure; P = precipitation.

M = monitored at this location.

(*) Station started-up during 2001; (**) Station discontinued during 2001; (***) Special study station; (S) Seasonal station.

Quality Assurance and Quality Control

Technicians perform weekly inspections and routine maintenance of the monitoring equipment and stations. In addition, instrument technicians perform major repairs to any instrument in the network, as required.

Through telemetering and the central computer, technicians can check remotely on instruments prior to site visits. This system also allows for calibration of the instruments either automatically or upon demand. Automatic 'zero/span' checks are conducted by the computer on every fourth day.

Portable calibration equipment is used to evaluate equipment performance. Automated analyzers are subject to a performance audit and possible multi-point calibration every fourth month. In addition, all other instruments and samplers in the network are subjected to annual and/or biannual calibrations. All reference materials and quality control procedures meet or exceed Environment Canada and/or U.S. Environmental Protection Agency requirements. Figure 2 provides a summary of the 2001 audit results.

In 2001, 300 audits were conducted. Of these, 97.7% were within 10% of true values and 82.0% were within 5%. Four audits failed to meet the criterion of being within 15% of true values. The results of these quality control and quality assurance activities resulted in a data capture rate of over 97% for the network.

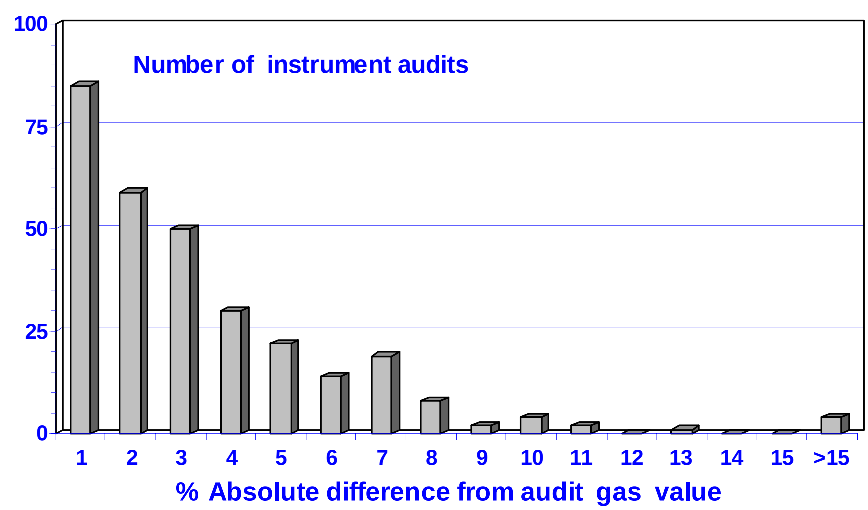
The ambient air quality monitoring data is constantly reviewed and validated. Remedial actions are taken to rectify any problems that may affect the validity of the data.

Data Base

Data from continuous analyzers are transmitted once-a-minute to a central computer using dedicated telephone lines or radio links. The computer calculates hourly averages for each analyzer, from the one minute data, for long term data storage. For a measurement to be considered valid and be stored for further use, at least 75% of the relevant data must be available. Calibration data is also stored on the computer.

Data from non-continuous samplers are entered manually and stored on the computer.

Figure 2: Continuous analyzer audit results.



Section B - Air Quality Objectives and Indices

Air Quality Objectives

Monitoring data are compared to a set of objectives, which have been established to protect public health and the environment. GVRD data are compared to national air quality objectives developed by Environment Canada, in co-operation with the provinces. The Province of B.C. also has objectives for a number of pollutants, which are generally similar to the national objectives. In addition, GVRD objectives exist for pollutants of concern in the Lower Fraser Valley (LFV) where no appropriate objectives exist in Canada.

The federal Canadian Environmental Protection Act provides for three levels of air quality objectives: Desirable, Acceptable and Tolerable. The objectives are based on the following definitions.

Maximum Desirable: defines the long-term goal for air quality and provides a basis for an antidegradation policy for the country and for the continuing development of control technology.

Maximum Acceptable: is intended to provide adequate protection against effects on soil, water, vegetation, material, animals, visibility, and personal comfort and well-being.

Maximum Tolerable: denotes time-based concentrations of air contaminants beyond which, due to a diminishing margin of safety, appropriate action is required without delay to protect the health of the general population.

During 1994, inhalable particulate measurements (PM_{10}) were added to the AQI calculation. A 24-hour ‘Acceptable’ objective of 50 $\mu g/m^3$ was adopted by the GVRD Board of Directors and an AQI value of 50 was assigned to this concentration.

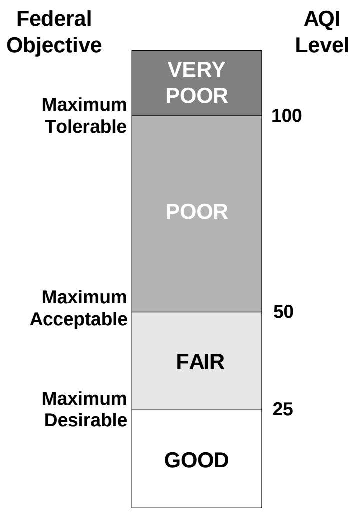
New national air quality standards for particulate matter (PM) and ozone (O_3) were endorsed by the Canadian Council of Ministers of the Environment (CCME) on June 5-6, 2000. These new standards, termed Canada-Wide Standards (CWS) are in addition to those detailed above. Details of Canada-Wide Standards are outlined in Section G of this report.

Air Quality Index Description

Air quality objectives are expressed as a concentration of each pollutant in the air and a variety of measurement units are used to describe these concentrations. To provide a qualitative description of air quality, these concentrations are converted to a standard Air Quality Index (AQI) which is directly related to the three objective levels.

The Maximum Desirable, Acceptable and Tolerable objectives are assigned index values of 25, 50 and 100, respectively. Intermediate index values are determined by interpolating measured pollutant concentrations between these three index values. Standard terms of ‘Good’, ‘Fair’, and ‘Poor’ are used to describe air quality at any point, as indicated in Figure 3.

Figure 3: The Air Quality Index.



Air Quality Index Operation

The GVRD began reporting an AQI to the public in October 1985. It is based on the highest pollutant concentration, relative to the air quality objectives, at each monitoring site. Each hour, sub-indices are calculated for each pollutant, and the maximum sub-index becomes the Air Quality Index for that monitoring site.

The AQI is recorded on an answering machine, to which the public has access through both a local and 1-800 telephone number. A subset of stations, representative of the various areas in the region is used for this purpose. The AQI is updated in the morning and afternoon on weekdays and in the morning on weekends. During the summer ozone season the AQI is updated twice daily, seven days a week. If an air quality advisory is in effect, the AQI message is updated more frequently until the air quality improves. In 2001, over 7,400 calls were made to the index message machine.

The Air Quality Index is available by dialing 604-436-6767 or 1-800-665-1118. It is published daily in the Vancouver Sun and Province newspapers and broadcast hourly on cable television. It is also used on a regular basis by several radio and television stations and community newspapers.

Starting in 2002, the AQI will also be available on the GVRD Website. The air quality index for each station in the network will be updated hourly. The site will also calculate a sub-index for each pollutant and the user will have the ability to scroll back seven days. The user may access this service by computer at *http://www.gvrd.bc.ca/aqi.*

Air Quality Index Levels (2001)

During 2001, air quality was reported as 'Good' 98.4% of the time, with 'Fair' and 'Poor' readings occurring 1.6% and less than 0.1% of the time, respectively. These readings are equivalent to or better than conditions recorded during the past few years.

Air Quality Advisories

The GVRD operates a public air quality advisory service in co-operation with the Fraser Valley Regional District, B.C. Ministry of Water, Land and Air Protection and Environment Canada. When 'Poor' air quality is forecast for the following day, a public advisory is broadcast to all media outlets and public health offices in the region. The forecast is based upon existing air quality levels and predicted air quality and weather conditions for the next 12 to 24 hours. The advisories inform the public of pending poor air quality and encourage them to reduce emissions until air quality improves. Individuals with respiratory ailments are also encouraged to curtail activities that might aggravate their symptoms during these periods of degraded air quality.

During 2001, there was one air quality advisory issued. The advisory was issued on August 11th and was cancelled on August 16th. The advisory was brought on by elevated levels of both ozone and inhalable particulates which resulted in greatly reduced visibility in the region during stagnant meteorological conditions. While neither pollutant was regularly in the "poor" category, both were consistently in the high "fair" range resulting in a degradation of overall air quality over an extended area and period of time.

The Lower Fraser Valley Monitoring Network operations include a public air quality advisory service, in co-operation with the Fraser Valley Regional District, B.C. Ministry of Water, Land and Air Protection and Environment Canada.

Section C - Pollutants Measured by Continuous Monitors

Sulphur Dioxide

Characteristics

Sulphur dioxide is formed primarily by the combustion of fossil fuels containing sulphur. It is a colourless gas with a pungent odour, and can be detected by taste and odour at concentrations as low as 0.3 to 1 ppm. Sulphur dioxide reacts in the atmosphere to form sulphur trioxide, sulphuric acid and particulate sulphates which, in turn, are major contributors to acid rain. Sulphur oxides can also combine with other air contaminants to form particulates, which may reduce visibility in the region.

Brief exposure to high concentrations of sulphur dioxide and its byproducts can irritate the upper respiratory tract and aggravate existing cardiac and respiratory disease. Long-term exposure may increase the risk of developing chronic respiratory disease.

Sources

Local sulphur dioxide emissions are low relative to cities of similar size because natural gas is used, rather than coal or oil, in almost all residential, commercial and industrial heating. The 2000 GVRD emission inventory indicates that sulphur dioxide represents only 1.6% of the inventory total for the five common air contaminants (CO, NO_X, PM, SO_X and VOCs). An oil refinery is the major industrial source of sulphur dioxide with other significant contributors being marine vessels, motor vehicles and off-road engines. Other sources result primarily from trace amounts of sulphur in fuel used in combustion.

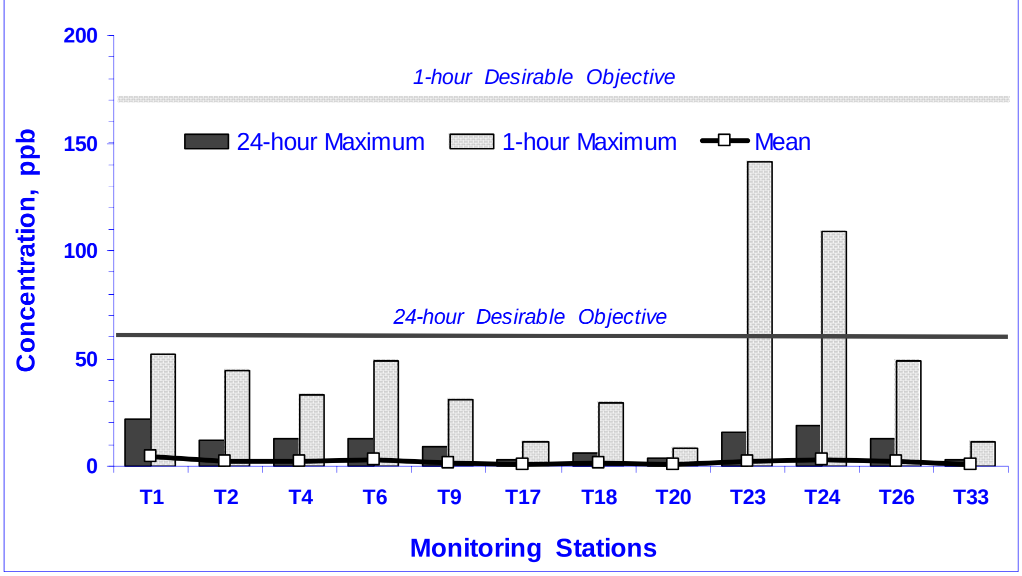
Federal Objectives

Desirable/Acceptable
170/340 ppb (1-hour)
60/110 ppb (24-hour)
10/20 ppb (1-year)

Monitoring Results

Results of sulphur dioxide monitoring during 2001 are illustrated in Figure 4. Mean sulphur dioxide readings continue to remain at very low levels, averaging 2 ppb over the year, compared to the 1-year Desirable Objective of 10 ppb. 1-hour maximum concentrations remained below the 1-hour Desirable Objective of 170 ppb.

Figure 4: Sulphur dioxide monitoring, 2001



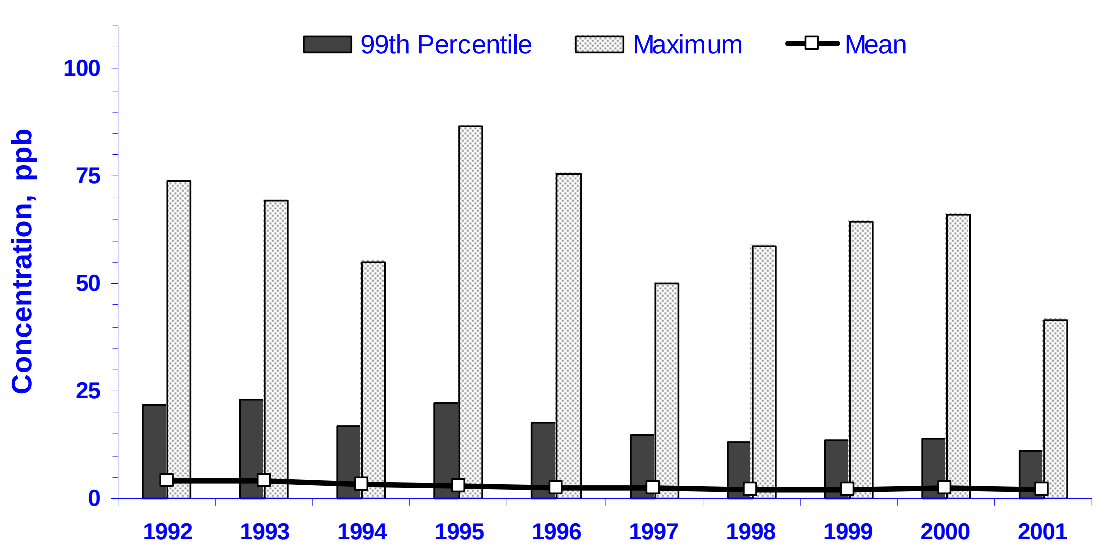
Maximum 24-hour averages recorded at all stations during 2001 were below the 24-hour Desirable Objective of 60 ppb.

The highest readings continue to be recorded in the northwestern portion of the airshed, particularly close to the major point sources along Burrard Inlet. Lower readings are recorded in the southwestern and more eastern regions of the airshed.

Figure 5 illustrates the sulphur dioxide trends in the LFV during the past 10 years. Each value is the average from all sulphur dioxide monitoring stations operating in the years shown. While year-to-year variations are commonly due to meteorological variability, long-term changes in air quality are attributed to changes in emissions. The mean annual sulphur dioxide, the 99th percentile of the 1-hour values (i.e. 99% of all readings are less than or equal to this value) and the maximum 1-hour values indicate a declining trend. In the LFV region, average and peak levels have decreased nearly 50% in the past 10 years.

Mean sulphur dioxide readings continue to remain at very low levels compared to the Desirable Objective.

Figure 5: Regional sulphur dioxide trends



Total Reduced Sulphur

Characteristics

Total reduced sulphur compounds are a group of sulphurous compounds which occur naturally from swamps, bogs and marshes, and are created by human activities in such industrial sources as pulp and paper mills, and petroleum refineries.

These compounds have offensive odours similar to rotten eggs or rotten cabbage, and can cause nausea in some people, at high enough concentrations.

Sources

Most public complaints regarding these odours are associated with the refining industry located along Burrard Inlet. A few periodic inquiries do occur as a result of natural emissions from such locations as Burns Bog in Delta.

GVRD Objectives

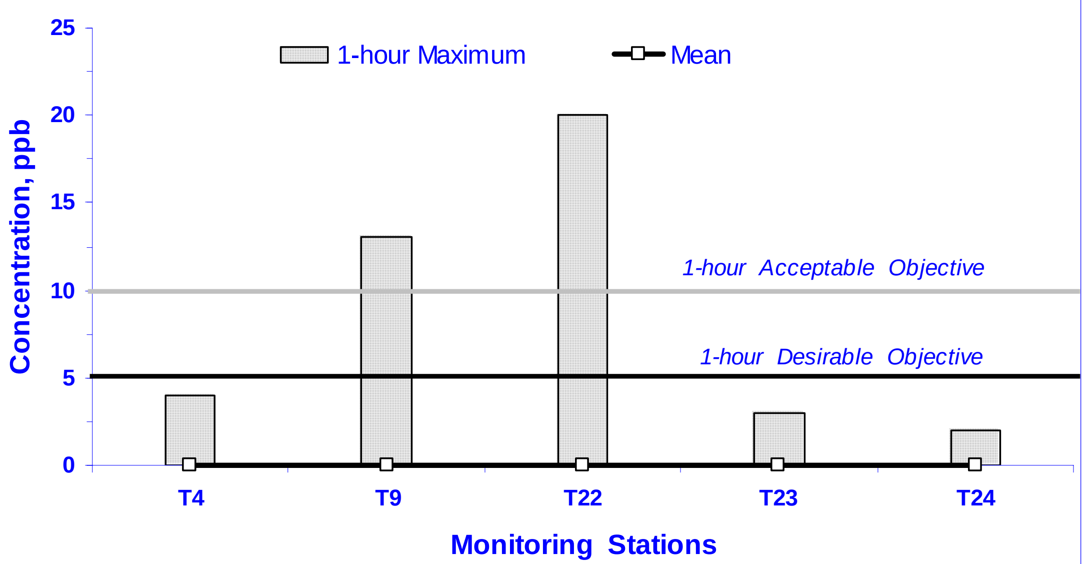
Desirable/Acceptable
5/10 ppb (1-hour)

Monitoring Results

Figure 6 illustrates the results of total reduced sulphur monitoring for 2001. Mean levels continue to be near or below detectable limits. However, 1-hour exceedances of both the Desirable and Acceptable Objective do still occur.

During 2001, the Desirable Objective was exceeded for a total of twenty-four hours, during which time the Acceptable Objective was also exceeded for four hours. Most of these occurrences were short in duration and were associated with adverse meteorological conditions which trapped pollutants near the ground.

Figure 6: Total reduced sulphur monitoring, 2001



Nitrogen Dioxide

Characteristics

Of the various oxides of nitrogen, nitric oxide and nitrogen dioxide are ambient air quality concerns. Both are produced by the high temperature combustion of fossil fuels, and are collectively referred to as nitrogen oxides. Nitric oxide is the predominant nitrogen oxide in combustion emissions, and rapidly undergoes chemical reactions in the atmosphere to produce nitrogen dioxide.

Nitrogen dioxide is a reddish-brown gas with a pungent, irritating odour. It has been implicated in acute and chronic respiratory disease and in the creation of acid rain. It also plays a major role in atmospheric photochemical reactions, ozone formation, and as a precursor to secondary particulate formation, which may reduce visibility in the region.

Sources

Common nitrogen oxide sources include steam boilers, building heating systems and internal combustion engines. In the LFV, transportation sources account for 87% of nitrogen oxide emissions, and stationary and area sources the remaining 13%.

Federal Objectives

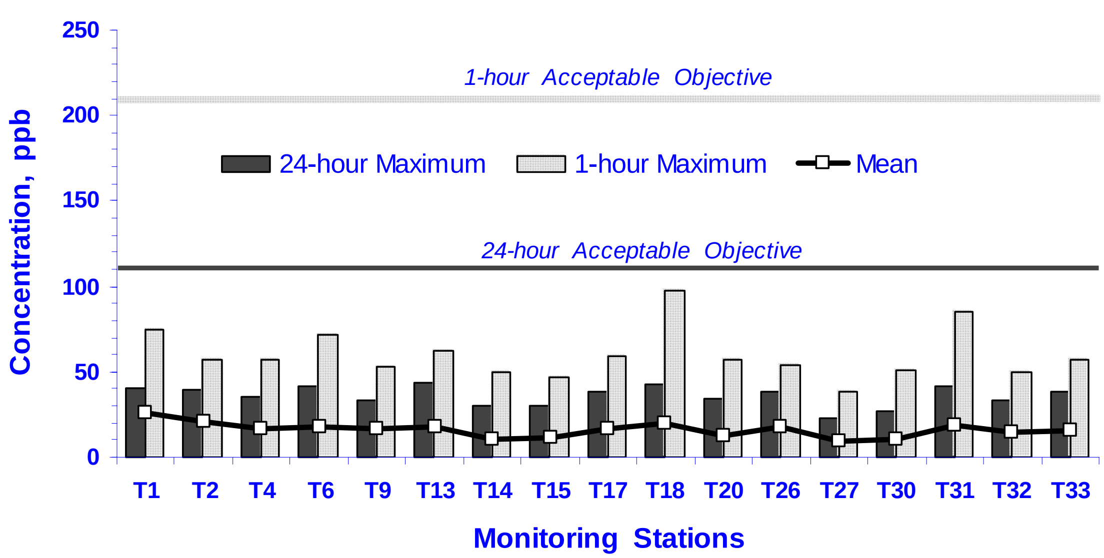
Desirable/Acceptable
---/210 ppb (1-hour)
---/110 ppb (24-hour)
30/50 ppb (1-year)

Monitoring Results

Figure 7 illustrates the results of nitrogen dioxide monitoring for 2001. Note that nitrogen dioxide was monitored at T12 (Chilliwack) and T29 (Hope). On an annual basis, data recovery at each site was not sufficient (>75%) to be summarized in this report. See the Appendix to this report, which is available upon request.

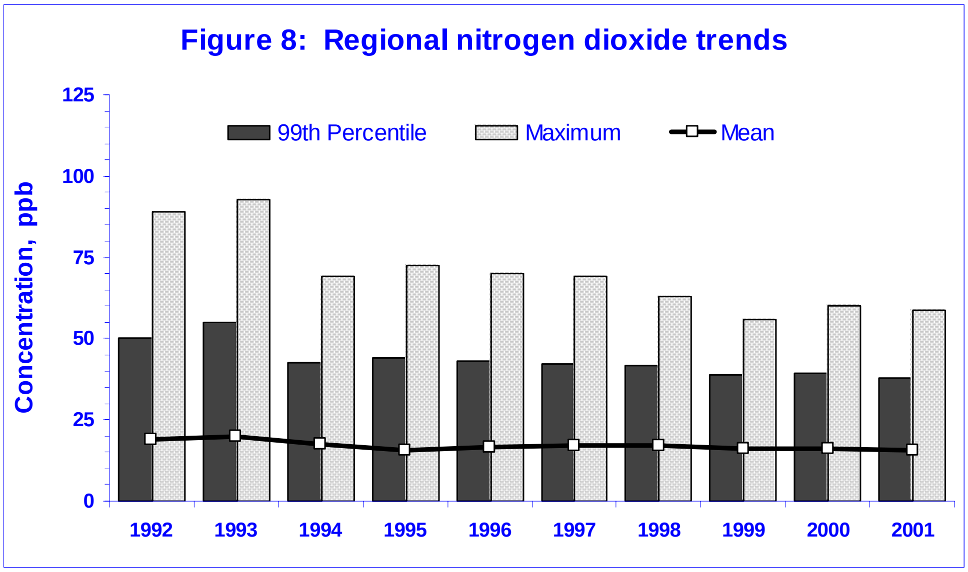
All nitrogen dioxide levels continue to be well

Figure 7: Nitrogen dioxide monitoring, 2001



below objectives. The lowest mean levels were measured in areas where urban influences are lower. Highest levels were recorded where urban influences are more pronounced, such as downtown Vancouver and the airport.

Figure 8 illustrates the 10 year trends in nitrogen dioxide readings in the LFV. Each value is the average from all nitrogen dioxide monitoring stations operating in the years shown. While year-to-year variations are commonly due to meteorological variability, long-term changes in air quality are attributed to changes in emissions. Over the ten-year period, the mean 1-hour, maximum 1-hour and the 99th percentile readings all indicate a decline in measured values. In the LFV region, average and peak levels have decreased about 15% since 1992, although the decline appears to have leveled off in recent years.



Carbon Monoxide

Characteristics

Carbon monoxide is a colourless, odourless and tasteless gas produced by the incomplete combustion of fuels containing carbon. It has a strong affinity for hemoglobin and thus reduces the ability of blood to transport oxygen. Long-term exposure to low concentrations may cause adverse effects in people suffering from cardiovascular disease. Brief exposure to high concentrations seldom result in permanent disability because carbon monoxide is eliminated from the lungs when cleaner air is inhaled.

Sources

Carbon monoxide is the most widely distributed and commonly occurring air pollutant. The principle source is motor vehicle emissions. In the LFV, more than 90% comes from cars, trucks, and buses. Other sources include fuel combustion for building heating and commercial and industrial operations.

Federal Objectives

Desirable/Acceptable
13/30 ppm (1-hour)
5/13 ppm (8-hour)

Monitoring Results

Figure 9 illustrates the results of carbon monoxide monitoring for 2001. High concentrations generally occur close to major roads during peak traffic periods, especially during the fall and winter when light winds and stable meteorological conditions are common.

Mean levels remain low throughout the LFV with the lowest readings being recorded at sites away from major vehicle traffic routes. Spatially, carbon monoxide concentrations have a similar pattern to nitrogen dioxide.

The highest measurements of both 1-hour and 8-hour carbon monoxide tend to occur adjacent to or downwind of major roads. No exceedances of the 1-hour or 8-hour carbon monoxide Desirable Objectives were recorded during 2001.

Figure 9: Carbon monoxide monitoring, 2001

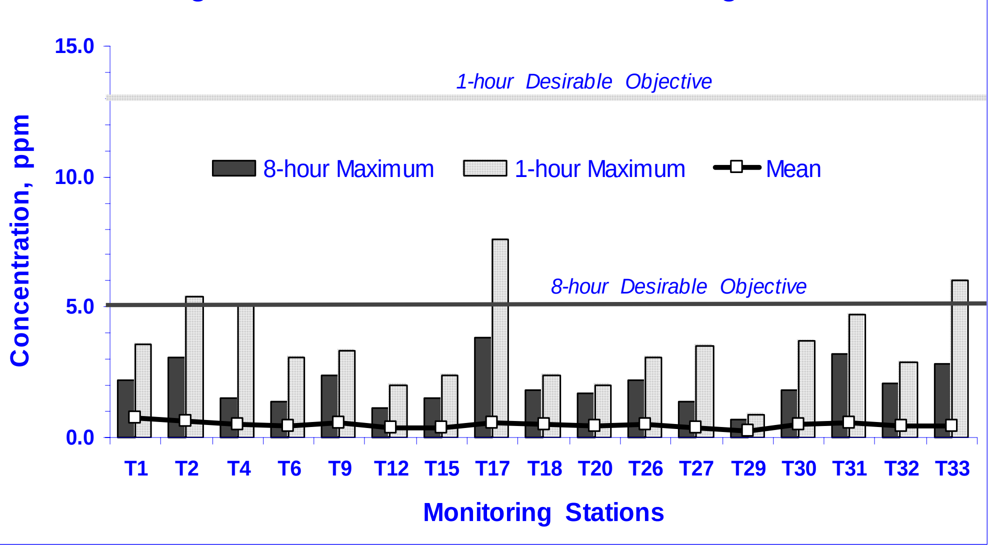


Figure 10: Regional carbon monoxide trends

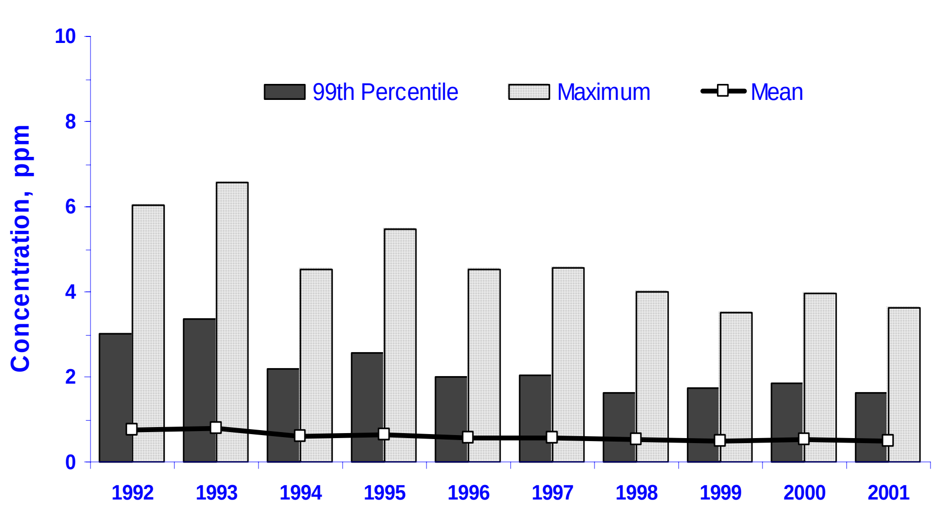


Figure 10 illustrates the long-term trend of carbon monoxide readings in the LFV. Each value is the average from all carbon monoxide monitoring stations operating in the years shown. While year-to-year variations are commonly due to meteorological variability, long-term changes in air quality are attributed to changes in emissions. In the LFV region, both average and peak levels have decreased more than 30% in the last 10 years.

Ozone

Characteristics

Ozone is a reactive form of oxygen. It is the major photo-chemical oxidant compound formed when nitrogen oxides and reactive volatile organic compounds (VOCs) chemically react in the presence of sunlight. Because sunlight plays a major role in ozone production, maximum ozone levels generally occur in summer months between noon and early evening.

Ozone is a strong oxidizer and can irritate the eyes, nose and throat and decrease athletic performance. High concentrations can also increase the susceptibility to respiratory disease and reduce crop yields.

While ozone at ground level is a major environmental and health concern, the naturally occurring ozone in the stratosphere shields the earth from harmful ultraviolet radiation.

Sources

Ozone is usually not directly discharged to the air. Since it is formed from pollutants such as nitrogen oxides and reactive VOCs, ozone levels depend on the rate of emission of these 'precursor' pollutants, which are normally associated with motor vehicle operation, fuel combustion and industrial processes.

Federal Objectives

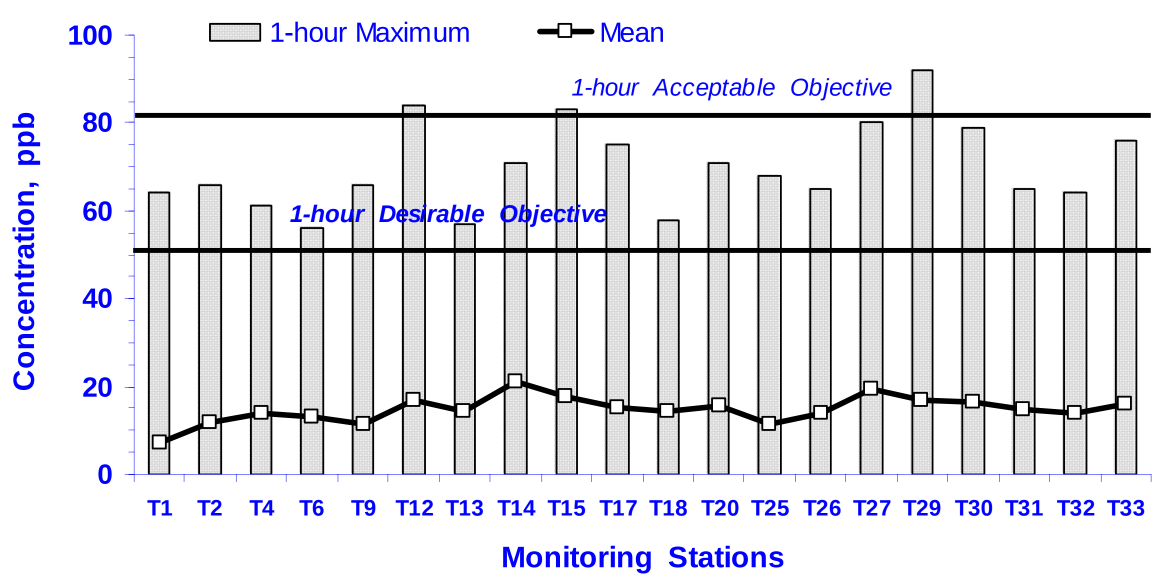
Desirable/Acceptable
51/82 ppb (1-hour)

Canada-Wide Standards
65 ppb, over an 8-hour averaging time, by the year 2010. Achievement is to be based on the 4th highest measurement annually, averaged over 3 consecutive years (see Section G).

Monitoring Results

Figure 11 illustrates the results of ozone monitoring for 2001. In 2001, meteorological conditions were

Figure 11: Ozone monitoring, 2001

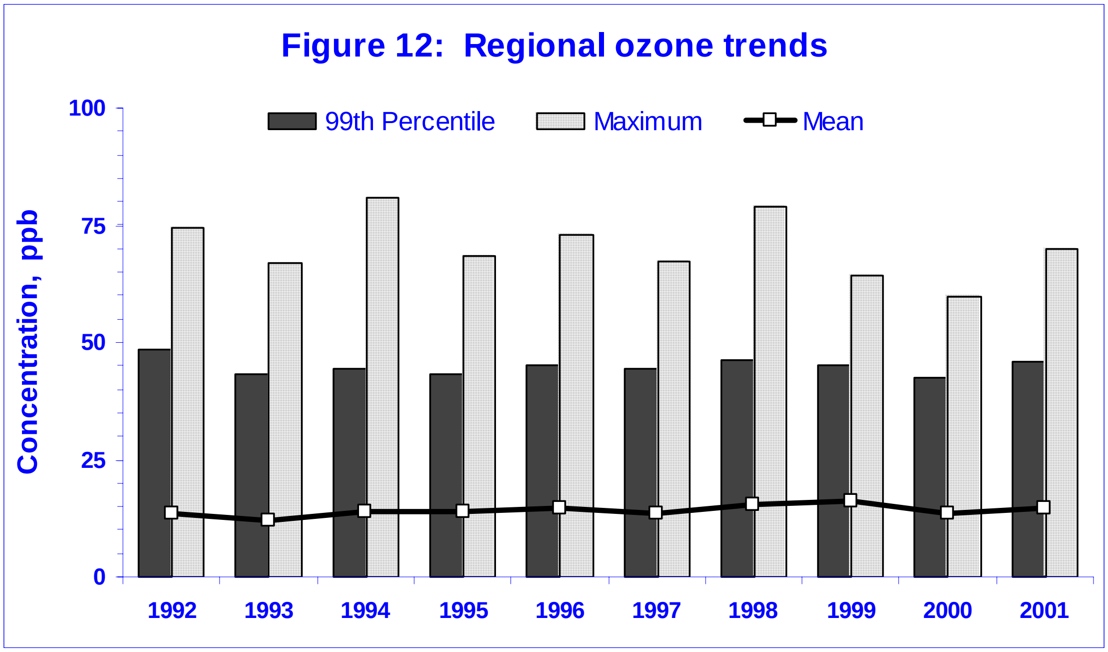


favourable for the production of ground-level ozone levels above the Acceptable Objective. During two separate summer episodes, ground-level ozone readings reached 'poor' levels. During 2001, one air quality advisory was issued on August 11th and was cancelled on August 16th. The advisory was brought on by elevated levels of both ozone and inhalable particulates which resulted in greatly reduced visibility in the region.

On average, the 1-hour Desirable Objective was met over 99.6% of the time at each station. Of the exceedances (0.4% of the time), most were recorded in the eastern portion of the region.

The Canada-Wide Standard for ground-level ozone was not exceeded at any of the monitoring sites (see Section G).

Figure 12 illustrates the long term trends of regional ozone. Each value is the average from all ozone monitoring stations operating in the years shown. This figure also illustrates the yearly fluctuations of maximum ozone readings, which are dependent on meteorological conditions. During the 1990's, the summer time periods in the odd years have been typically wetter and cooler, leading to lower than normal maximum ozone measurements, while the even years have experienced the opposite trend. In the LFV region, average ground-level ozone levels have risen slightly in the last 10 years, while peak levels have decreased slightly.



Inhalable Particulate

Characteristics

The term 'PM_{10}' has been given to atmospheric particles with a diameter of 10 micrometers (µm) or less (inhalable particulate). Because of their small size, these particles can be inhaled and deposited in the thoracic region of the lungs.

Exposure to PM_{10} can chronically and acutely affect human health, particularly the pulmonary function. PM_{10} can aggravate existing pulmonary and cardiovascular disease, affect mucocilliary clearance and increase mortality. These effects are enhanced if high PM_{10} levels are associated with higher levels of other pollutants, such as SO_2 .

High PM_{10} levels can also increase corrosion and soiling of materials, and may damage vegetation. The smaller particles can also have a major impact on visibility.

Sources

PM_{10} is emitted from a variety of industrial, mobile and area sources, as a portion of total particulate emissions. Another urban source is road dust, which results from particles emitted from vehicles and other sources, as well as the natural deposition of sand and soil. Other contributions may come from natural sources, such as wind blown soil, forest fires, ocean spray and volcanic activity.

GVRD Objectives

Desirable/Acceptable

---/50 $\mu g/m^3$ (24-hour)

---/30 $\mu g/m^3$ (1-year)

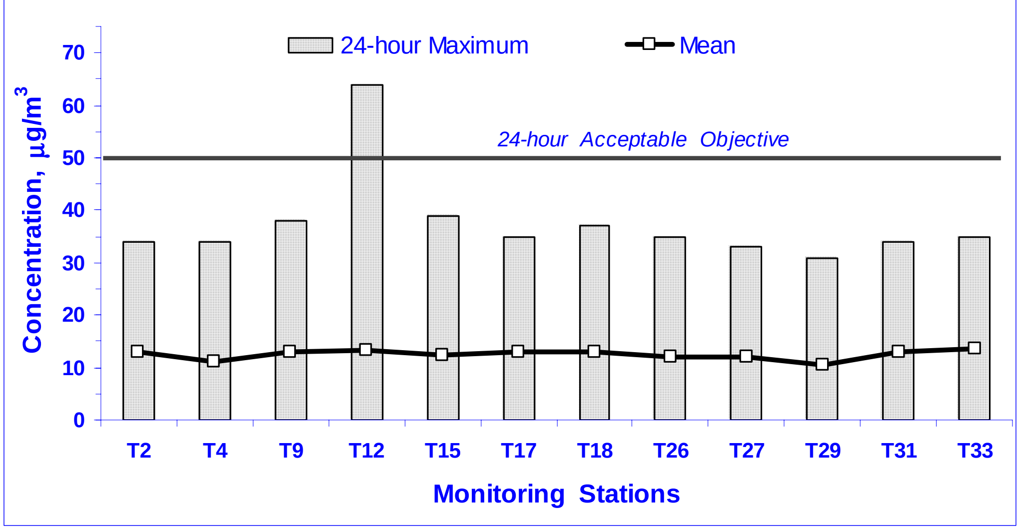
Monitoring Results

Figure 13 illustrates the results of PM_{10} monitoring for 2001. Note that inhalable particulate was monitored for part of the year at T20 (Pitt Meadows) and T30 (Maple Ridge). On an annual basis, data recovery at each site was not sufficient (>75%) to be summarized in this report. See the Appendix to this report, which is available upon request.

Mean PM_{10} readings in the LFV were between 10-14 $\mu g/m^3$ during 2001, while maximum 24-hour values ranged from 31-64 $\mu g/m^3$.

The 24-hour inhalable particulate Acceptable Objective was exceeded for 19 hours at the Chilliwack site on December 27, 2001. These exceedances were the result of strong outflow wind conditions, and were the only exceedances of the objective observed during the year.

Figure 13: Inhalable particulate (PM_{10}) monitoring, 2001

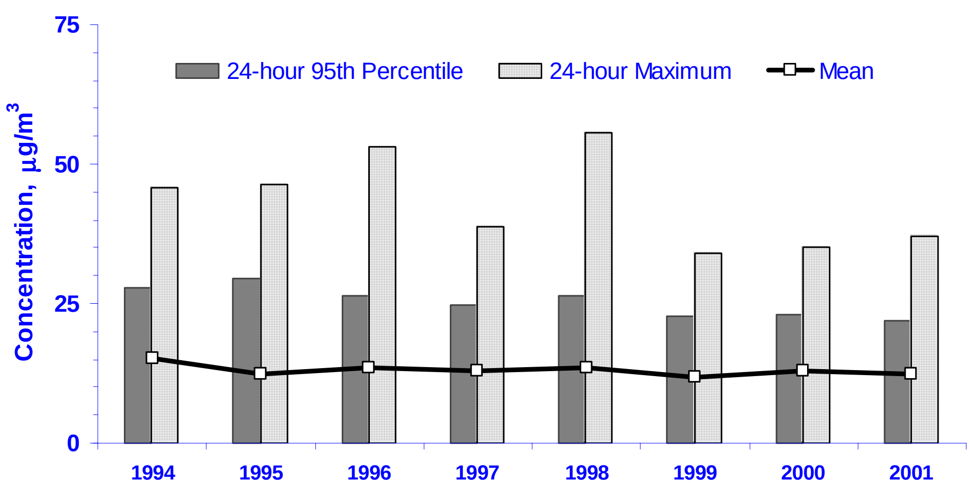


Higher levels of inhalable particulate were infrequent and were generally associated with short term local influences. Mean inhalable particulate levels continue to be highly influenced by meteorological conditions and tend to be slightly elevated during the drier, warmer summer and early fall periods and lower during the cooler, wetter portions of the year.

Exposure to PM_{10} can chronically and acutely affect human health, particularly the pulmonary function.

Figure 14 illustrates trends in inhalable particulate measurements in the region since continuous monitoring started in 1994. Each value is the average from all inhalable particulate monitoring stations operating in the years shown. Variations in the maximum 24-hour values are generally associated with short term episodes brought on by very specific meteorological conditions. For example, during cold, dry periods with strong outflow winds, wind blown dust storms localized in the eastern LFV can occur. In the LFV region, both average and peak levels have declined about 10% to 15% since continuous monitoring began in 1994.

Figure 14: Regional inhalable particulate trends



Fine Particulate

Characteristics

The term 'PM$_{2.5}$' has been given to atmospheric particles with a diameter of 2.5 µm or less (fine particulate). Because of their very small size, these particles can penetrate into the finer structures of the lungs.

As with inhalable particulate, exposure to fine particulate can chronically and acutely affect human health, aggravate pulmonary or cardiovascular disease, affect mucocilliary clearance and increase mortality. A number of fine particles are also effective at scattering and absorbing visible light. It is in this role that they are also a prime constituent in the development of regional haze.

Sources

Fine particulate is emitted from a variety of industrial, mobile and area sources, as a portion of total particulate emissions (see Inhalable Particulate Sources). Within the Lower Fraser Valley, fine particulate emissions represent approximately one-half of the total inhalable particulate emissions, a value typical of other North American urban environments.

Scientific investigations in the Lower Fraser Valley, however, indicate that a considerable proportion of ambient fine particulate is secondary in nature (i.e. created in the atmosphere by the reaction of other constituents). In particular, ammonium nitrate and ammonium sulphate can represent up to two-thirds of the fine particulate in the area at specific times. Therefore, emissions of precursor gases of the secondary fine particles are also important sources in the region.

Objectives

Canada-Wide Standards

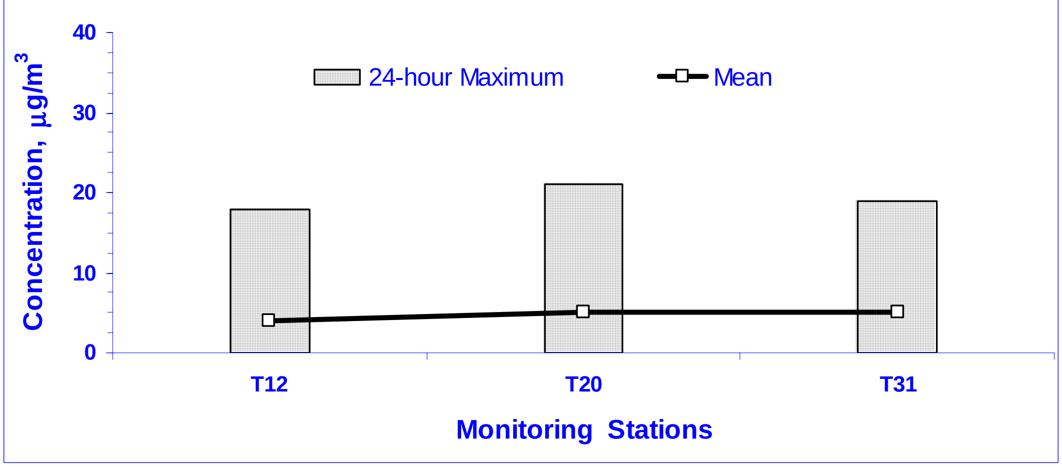
30 µg/m^3, over a 24-hour averaging time, by the year 2010. Achievement is to be based on the 98th percentile ambient measurement annually, averaged over 3 consecutive years (see Section G).

Monitoring Results

A single fine particulate monitor has been operating continuously at the Chilliwack station since mid-1995. Additional monitors were added at Pitt Meadows and Vancouver International Airport during 1999. Plans are underway to further expand monitoring of fine particulate to other parts of the LFV in 2002.

Figure 15 presents maximum 24-hour and mean fine particulate readings from the three stations operating during 2001. The Canada-Wide Standard for fine particulate was not exceeded at any of the

Figure 15: Fine particulate (PM$_{2.5}$) monitoring, 2001



monitoring sites (see Section G).

In general, fine particulate levels tend to increase during the drier and warmer summer months, a period of increased photochemical activity and vegetative emissions, and decrease during the wetter and cooler winter months.

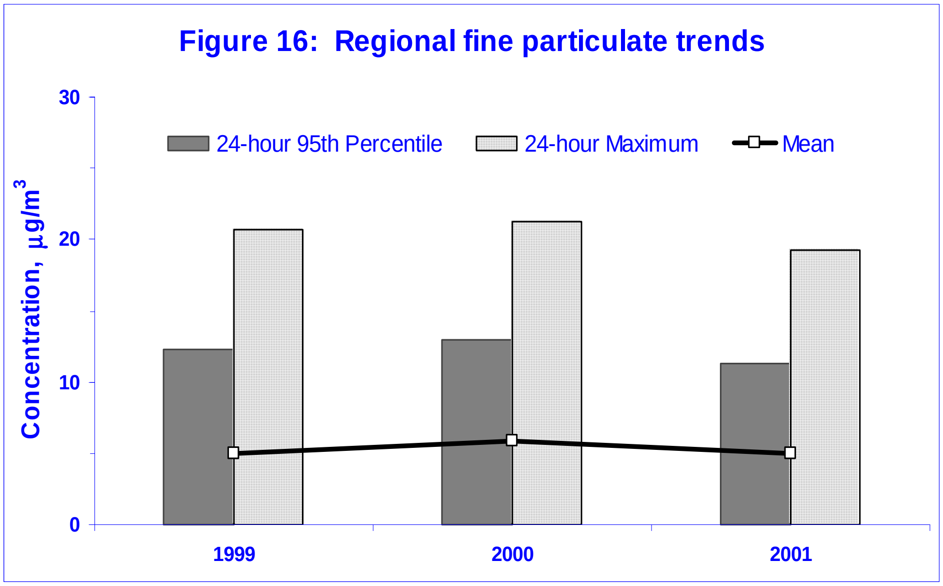


Figure 16 illustrates trends in fine particulate measurements in the region. Each value is the average from all fine particulate monitoring stations operating in the years shown. Based upon the limited data collected to date it is difficult to discern a long-term trend.

Coefficient of Haze

Characteristics

The coefficient of haze (COH), or 'soiling index', is an indirect indication of suspended particulate levels. It measures the darkening or soiling potential of airborne particulate. Particles usually less than 5 micrometres in diameter are collected for the measurement of COH.

Sources

Refer to the Sources section for Inhalable Particulate regarding inhalable particulate emissions.

Objectives

No objectives exist for this parameter.

Monitoring Results

Two coefficient of haze samplers, located at T1 (Downtown Vancouver) and T18 (Burnaby South), were operational during 2001. A listing of 2001 results is presented in the Appendix to this report which is available upon request.

Section D - Pollutants Measured by Non-Continuous Monitors

Total Suspended Particulate

Characteristics

Total suspended particulate is a general term for small airborne particles such as smoke, fume, dust, fly ash and pollen, and consists of particles ranging in diameter from 0.1 micrometres to approximately 40 micrometres.

Health effects depend on the size and the chemical characteristics of the particulate matter. Larger particles may be a nuisance and mild irritation. The greatest health impact is from particles smaller then 10 micrometres in diameter which can penetrate deep into the lungs and cause respiratory problems (see Sections on Characteristics of Inhalable and Fine Particulate).

More serious health effects may be associated with suspended particulate which contains a toxic particulate component or has adsorbed a gaseous pollutant on its surface.

Sources

Major sources of total suspended particulate in the region include industrial operations, fuel burning for space heating, motor vehicles, agricultural activities, forest slash burns, plant pollen and road dust.

Federal Objectives

Desirable/Acceptable

----/120 µg / m³ (24-hour)

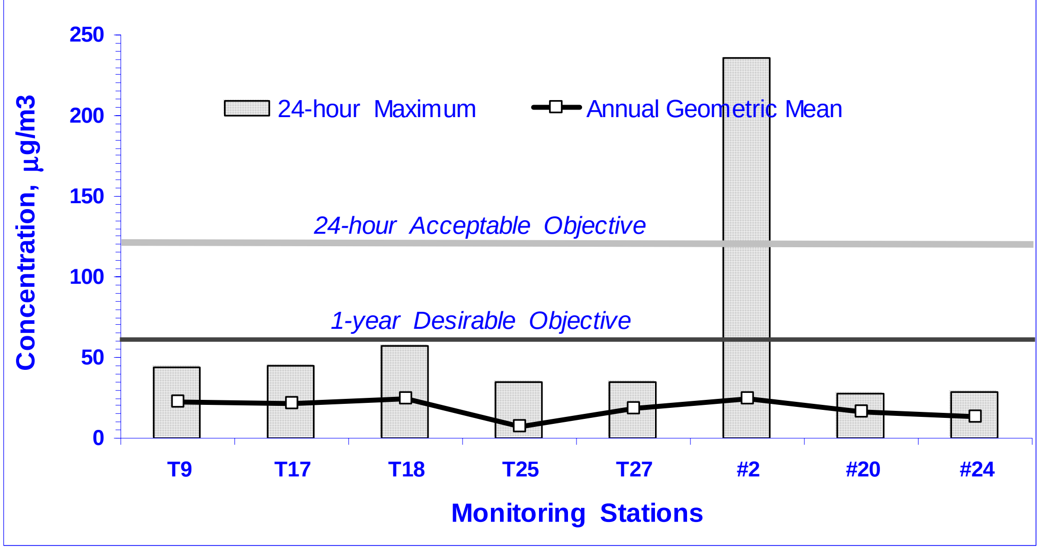
60 /70 µg / m³ (1-year, geometric mean)

Monitoring Results

Total suspended particulate is monitored over a 24-hour period every sixth day. A total of 8 total suspended particulate samplers were in operation during 2001.

Figure 17 presents maximum 24-hour and annual geometric mean total suspended particulate readings from the eight stations operating during 2001. Of 463 samples collected in 2001, one exceeded the 24-hour objective of 120 µg / m³. Annual geometric means continue to be well below the 1-year Desirable Objective.

Figure 17: Total suspended particulate sampling, 2001



Metals in Suspended Particulate

Characteristics

The metal constituents of suspended particulate are of concern because many metals are potentially toxic and can accumulate in the body. This is largely only an issue in the occupational environment, where higher concentrations may occur in such industries as metallurgical smelting and metal reclaiming.

Historically, lead was the only particulate metal with high enough ambient levels to be a potential urban problem. However, other metals are measured in the monitoring program including copper, manganese and zinc.

Sources

Automobile exhaust was a major source of particulate lead, prior to its elimination from gasoline after December 31, 1990. Other metals are emitted in trace quantities from many of the sources which emit particulate. Local metal emissions from industrial sources are relatively small as the area does not have a large metal refining or fabrication industry.

British Columbia Objectives

Desirable/Acceptable

Lead	Zinc	
4/4 $\mu g/m^3$	5/5 $\mu g/m^3$	(24-hour)
2/2 $\mu g/m^3$	3/3$\mu g/m^3$	(1-year)

Monitoring Results

Levels in 2001 were similar to the previous four years. Lead levels have substantially declined, in the past decade, as a result of changes in gasoline composition. The maximum 24-hour level of 0.04 $\mu g/m^3$ was well below the Desirable Objective, as was the annual mean of 0.02 $\mu g/m^3$.

Similarly, the maximum 24-hour and annual zinc levels of 0.07 $\mu g/m^3$ and 0.03 $\mu g/m^3$, respectively, were well below the relevant Desirable Objectives.

All other metal concentrations were similar to the concentrations noted for lead and zinc. A full listing of 2001 results is presented in the Appendix to this report which is available upon request.

Dustfall

Characteristics

Dustfall measures particulate matter that settles out of the atmosphere or is washed from the air by rainfall. Most dustfall particles range in size from 20 to 200 micrometres.

Sources

Dustfall originates from many sources. Much of the particulate classified as suspended particulate will eventually settle or be washed to the ground to become dustfall. Wind-generated dust from outdoor stockpiles of dry material and road dust generated by traffic will increase dustfall levels in downwind areas.

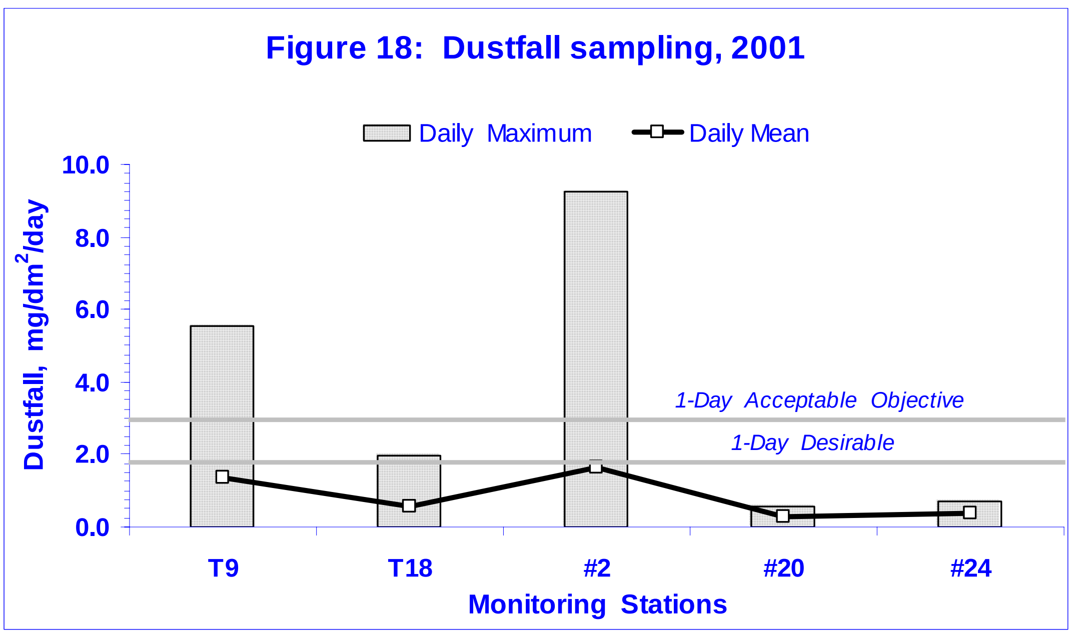
British Columbia Objectives

Desirable/Acceptable
1.75/2.90 mg/dm^2/day

Monitoring Results

Figure 18 presents daily maximum and mean dustfall levels from the five stations operating during 2001. Mean dustfall levels were all below the Desirable Objective and ranged from a low of 0.3 mg/dm^2/day to a high of 1.7 mg/dm^2/day. Mean values were generally similar to those measured in 2000.

All but two of the 55 dustfall samples collected during 2001 were below the Acceptable Objective of 2.90 mg/dm^2/day. Only three of the 55 samples exceeded the Desirable Objective of 1.75 mg/dm^2/day.



Volatile Organic Compounds

Characteristics

Volatile organic compounds (VOCs) are organic substances which can exist in the gaseous, liquid or solid phase. The gaseous VOCs present in the air can originate from direct gaseous emissions and from volatilization (i.e. changing into the gas phase) of substances in the liquid or solid phase.

Locally, some VOCs are part of the contaminants found in urban smog. They are also the precursors of many other contaminants present in the smog (e.g. ground–level ozone and fine particulates). Globally, some VOCs (e.g. greenhouse gases) may contribute to climate change and to the depletion of the stratospheric ozone layer. Other VOCs (e.g. benzene) can pose a human health risk.

Sources

Sources of VOCs in the GVRD include, but are not limited to emissions from the combustion of fossil fuels (e.g. exhaust from motor vehicles), industrial and residential solvents and paints, vegetation, agricultural activities, petroleum refineries, fuel-refilling facilities, the burning of wood and other vegetative materials, and large industrial facilities.

Objectives

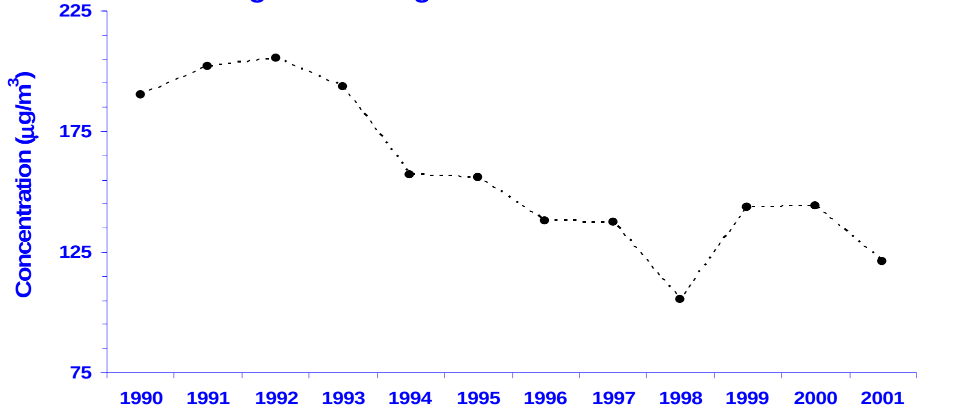
Under the authority of the Canadian Environmental Protection Act (CEPA), fifty-two substances have been listed on the Toxic Substance List – Updated Schedule 1 to May 3, 2002. Also, a report[1] prepared for the GVRD identifies twenty-two substances as *Category 1* hazardous air pollutants. Of these toxic substances and Category 1 HAPs, sixteen are VOCs included in the VOC analysis conducted by the GVRD.

Emissions of VOCs are limited by industry-specific regulations within the GVRD.

Monitoring Results

Figure 19 presents trends in annual average total VOC concentrations measured since the start of the monitoring program in 1990. Annual average VOC concentrations increased from 1990 to 1992, and then decreased until 1996, at which time concentrations appeared to level. Excepting 1998, average VOC concentrations in 2001 were lower than all years since 1990.

Figure 19: Regional total VOC trends



[1] *Assessment of Hazardous Air Pollutants in the Lower Fraser Valley and the Development of Emission Management Options*, Levelton Engineering Ltd., April 24, 1998.

Other Sampling

A Mobile Air Monitoring Unit (MAMU), capable of monitoring gaseous and particulate pollutants, is utilized throughout the year and throughout the region to conduct special air quality studies. In addition, a monitoring trailer (MAMU2) is also used when a small number of measurements is required over an extended period of time.

A two-year program of quarterly mobile sampling was concluded in Mission during 2001. This study was designed to assess the need for a more permanent monitoring facility in this community. Results of the study show that air quality in the Mission area is similar to other nearby areas and that data from nearby stations can be used to assess overall air quality in the Mission area.

A monitoring program was initiated in Horseshoe Bay (in cooperation with the District of West Vancouver) to respond to concerns surrounding the expansion of the existing ferry terminal. A particulate dichotomous sampler (PM_{10} and $PM_{2.5}$) was operated at Gleneagles Elementary school every sixth day, while MAMU was deployed for one week periods to three different sites within the area every quarter. In order to keep the public informed, results of the monitoring were posted on the GVRD website on a regular basis. This program will continue through 2003-2004.

During 2001, a program of particulate sampling was conducted as part of ongoing environmental studies surrounding a major engineering project at the Capilano Lake Reservoir in North Vancouver. The sampler was located at various sites during the study with all data being made available to the public in a timely fashion.

In cooperation with the Ministry of Agriculture and the GVRD Air Quality Regulation program, MAMU2 was deployed in a rural area of the Lower Fraser Valley to monitor winds in the vicinity of a duck farm. This work was carried out in response to numerous odour complaints in the area, and was aimed at determining the source of and the conditions under which these complaints occurred.

During the fall of 2001, a permanent meteorological station was installed at the Ashcroft Ranch in support of the Ashcroft Ranch Landfill Project. The station is maintained by GVRD staff with data transferred to the Air Quality Data Acquisition System on a regular basis.

When requested, in response to short-term air quality concerns, mobile monitoring may be deployed anywhere in the LFV airshed.

Section E - Joint Programs

Federal

The GVRD co-operates with the federal government by providing field services for two major nation-wide long-term sampling programs.

Canister sampling of volatile organic compounds has been conducted in the LFV for over ten years. The federal government supplies the canisters and other sampling apparatus with GVRD staff providing field exchange of canisters, calibrations and routine maintenance of equipment. Canisters are then forwarded to the federal laboratory in Ottawa, for analysis of up to 166 volatile organic compounds (VOCs).

A second study collects dichotomous particulate samples at two sites. This long-term study separates inhalable particulate samples into two size fractions: 10 to 2.5 µm, and under 2.5 µm. These samples are collected every sixth day, and returned to Ottawa for detailed chemical analysis.

Provincial and Regional

As part of their joint responsibility for ambient air quality within the Lower Fraser Valley, the GVRD, the Fraser Valley Regional District (FVRD), the Province of B.C. and Environment Canada co-operate on monitoring efforts within the region.

During 1998, the network partners, including the Northwest Air Pollution Authority (NWAPA) in Washington State, signed a Memorandum of Understanding on air quality monitoring within the airshed. As part of the Memorandum, the Province turned over responsibility for the three provincial stations in the FVRD to the Lower Fraser Valley Air Quality Monitoring Network, jointly managed by the GVRD and FVRD. The GVRD continues to operate and maintain the monitoring stations and equipment, and to collect real-time data on the regional monitoring network, on behalf of all partners.

Pacific 2001

During August of 2001, a major particulate research program was conducted in the region. This program, led by Environment Canada, involved many researchers from universities, government agencies, and the private sector. The program was similar in scope to Pacific ’93 which focused on ozone pollution chemistry.

The GVRD provided both logistical and technical support to this effort and contributed to the planning and operation of the programs. Preliminary results from this research are expected during mid-2002 with final results due in late 2002. Results will provide for major scientific input to the development of air quality management plans within the region.

TSRI

The Toxic Substances Research Initiative is a research effort of Environment Canada looking at the concentrations of various air toxics in Toronto and Vancouver. GVRD staff has been providing operational and maintenance support to this program which has operated several specialized air quality monitors at one site in the region.

Sampling materials are regularly sent to the GVRD for installation and removal upon sample completion. Completed samples are returned to Environment Canada laboratories for analysis.

The three-year program is scheduled to continue until June 2002.

Section F - Meteorology and Air Quality

Characteristics

Meteorology is a major influence on the air quality levels. Factors which affect air pollutant concentrations include:

- wind, which transports and disperses pollutants
- temperature, which affects fuel usage and chemical reactions in the atmosphere
- sunshine, which causes photochemical reactions among air pollutants
- precipitation, which may remove pollutants from the atmosphere
- atmospheric stability, which allows pollutant concentrations to build up in the atmosphere.

These and other meteorological elements greatly influence the concentration of any pollutant in the atmosphere at any one time.

Monitoring Program

Various meteorological elements are monitored as part of the LFV air quality monitoring network (Table 1). Meteorological data from other agencies are also acquired and used.

Wind speed and direction provides real-time information on pollutant transport and is used to assess the relationships between pollutant sources and measurements at ambient monitoring stations. Data are also used in dispersion modeling studies and in studies of sub-regional airflow. Temperature measurements are a key component in determining atmospheric stability. Sensors are distributed at stations located at several different vertical locations between sea level and the 350 metre level. Such information is used daily to assist in forecasting air quality conditions.

Temperature and solar radiation help determine the potential for forming ozone during the summer months. While solar radiation is the catalyst for photo-chemistry, higher temperatures can speed the reaction and increase overall concentrations.

Precipitation washes pollutants out of the atmosphere. Seventeen precipitation monitors are currently connected to the real-time air monitoring system. These data are primarily used by the GVRD Sewerage and Drainage and Watershed Management functions, who also carry out more extensive precipitation monitoring. From an air quality perspective, the monitoring of precipitation helps to explain differences in air quality from one area of the region to another.

Relative humidity is a key component in the formation and growth of visibility reducing particles and its measurement will be essential for future visibility and fine particulate monitoring programs.

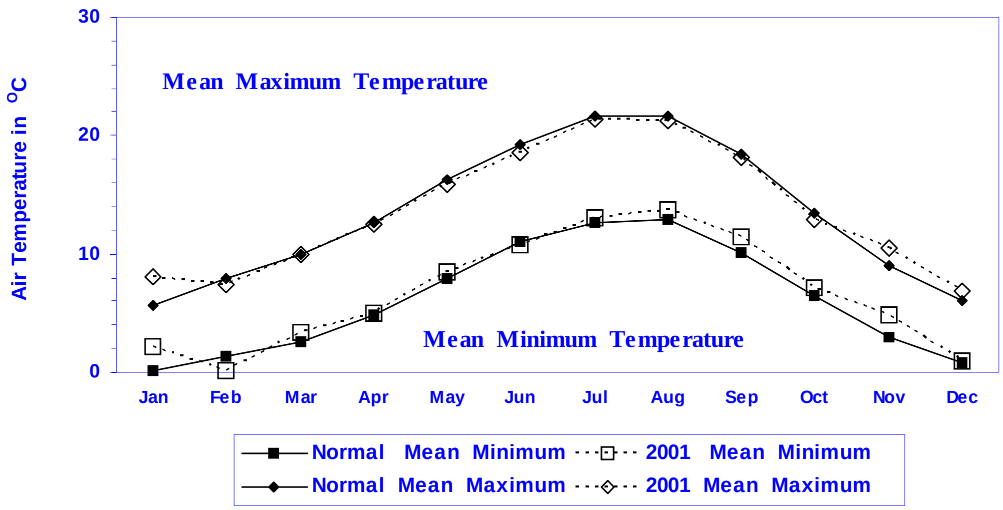
Real-time meteorological measurements are useful in looking at sub-regional variations in atmospheric conditions. In co-operation with the Pacific Weather Centre of Environment Canada, the network has been able to expand the scope and number of monitors deployed in the field. In return, the Pacific Weather Centre has electronic access to the data on the network data acquisition system. This arrangement allows both parties to increase services and eliminate duplication.

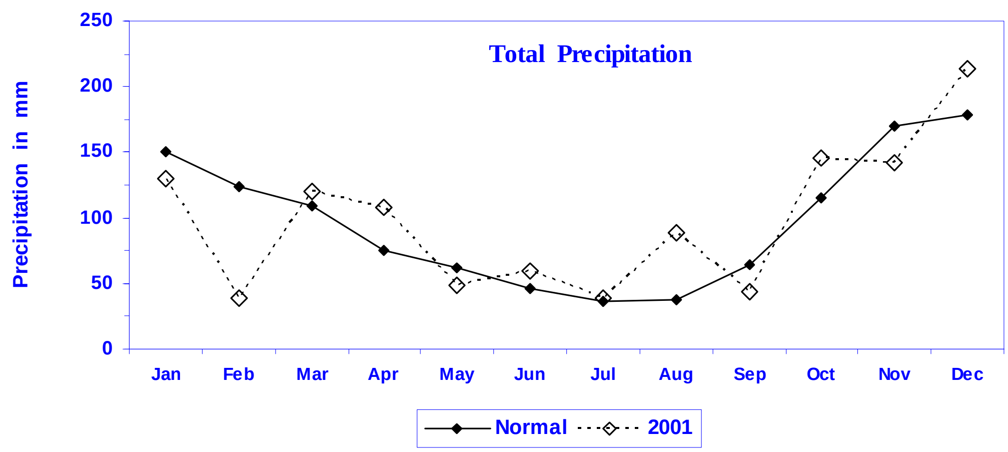
Regional Results

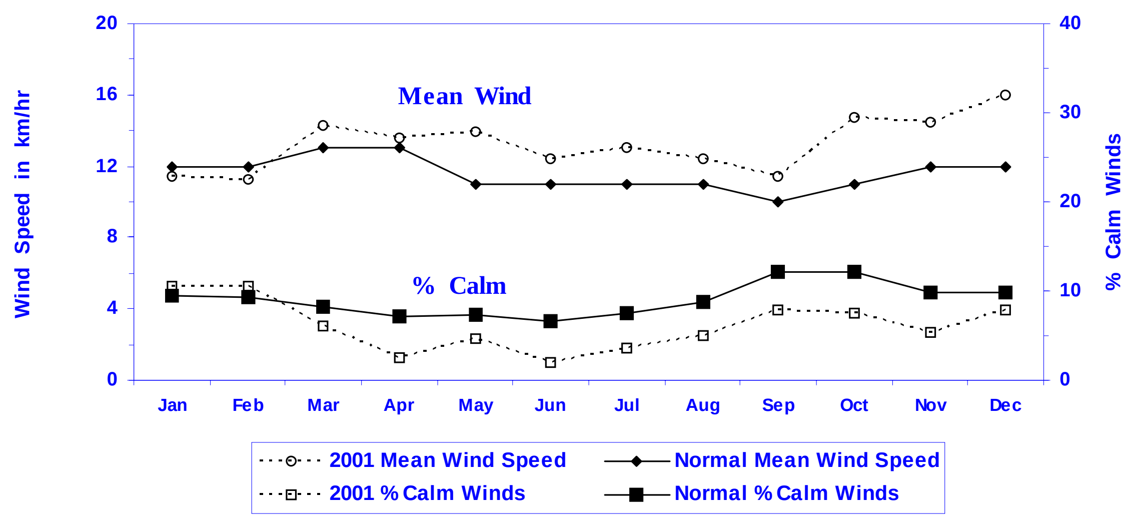
Figure 20 summarizes 2001 meteorological monitoring from the Vancouver International Airport and compares results to long-term normals for the region.

Figure 20: Meteorology, 2001

Recorded at Vancouver International Airport







Section G – Canada-Wide Standards

Background

Canada-Wide Standards (CWS) can include qualitative or quantitative standards, guidelines, objectives and criteria for protecting the environment and reducing risk to human health. CWS include a numeric limit, a commitment and timetable for attainment, a list of preliminary actions to attain the standard and a framework for reporting to the public.

In June 2000, the Canadian Council of Ministers of the Environment (CCME) adopted ambient standards for particulate matter (PM) and ground level ozone (O_3) that commit governments to reach specific targets by the year 2010. A multi-agency Joint Action Implementation Coordinating Committee (JAICC) was established to coordinate the implementation of joint actions to achieve the targets and development of procedures and protocols for the monitoring and reporting on progress toward achievement. The GVRD is a member of this coordinating group.

Numeric Targets

The Canada-Wide Standard for particulate matter (PM) is:

- A CWS for $PM_{2.5}$ of 30 ug/m^3, over a 24-hour averaging time, by the year 2010.
- Achievement is to be based upon the 98th percentile ambient measurement annually, averaged over three consecutive years.

The Canada-Wide Standards for ozone (O_3) is:

- A CWS of 65 ppb, over an 8-hour averaging time, by the year 2010.
- Achievement is to be based upon the 4th highest measurement annually, averaged over three consecutive years.

Guidance

Annex A of the CWS for particulate matter and ozone provides guidance for areas that already meet the CWS targets. For those areas already below the CWS but still above levels with observable health effects, jurisdictions should continue to take remedial actions to reduce emissions from anthropogenic sources, to the extent practicable (i.e. "continuous improvement"). It is also recognized that polluting "up to a limit" is not acceptable and that "keeping clean areas clean" is a strategy to avoid future problems.

The annual Lower Fraser Valley Ambient Air Quality report will continue to present data in a format which will provide the public with a regional view on our progress in addressing these guidance principles through such features as multi-year pollutant trend graphs. Such reporting will form the basis for ongoing efforts in developing and implementing effective air quality management plans for the whole region.

Reporting on Achievement

In major metropolitan areas (such as Greater Vancouver) the PM standard is to be reported by areas rather than by monitoring site. For this CWS reporting purpose, the GVRD is reviewing the division of the GVRD into four areas of approximately equal population and topographic homogeneity. Reporting of achievement for the ozone standard will be by individual monitoring site.

At the current time, equipment to monitor $PM_{2.5}$ is still being acquired and deployed. This deployment should be complete by the end of 2002 thus permitting the collection of three years worth of data prior to the first required CWS reporting date of 2005. Ozone monitoring requirements have been in place within the Lower Fraser Valley for a number of years.

Until widespread $PM_{2.5}$ monitoring is established and sufficient data acquired for comparison to the CWS for PM, this report will present $PM_{2.5}$ data by individual station. This reporting is not designed to meet the requirements of CWS achievement determination at this time, but is to act as an information source to the public on progress toward achievement determination.

Results for 2001

Figure 21 shows the ground-level ozone CWS achievement calculation for 2001 for all ozone monitoring stations in the Lower Fraser Valley. At this time, all stations meet the ground-level ozone CWS, which is based on a 3-year average.

Figure 21: Ozone Canada-Wide Standard, 2001

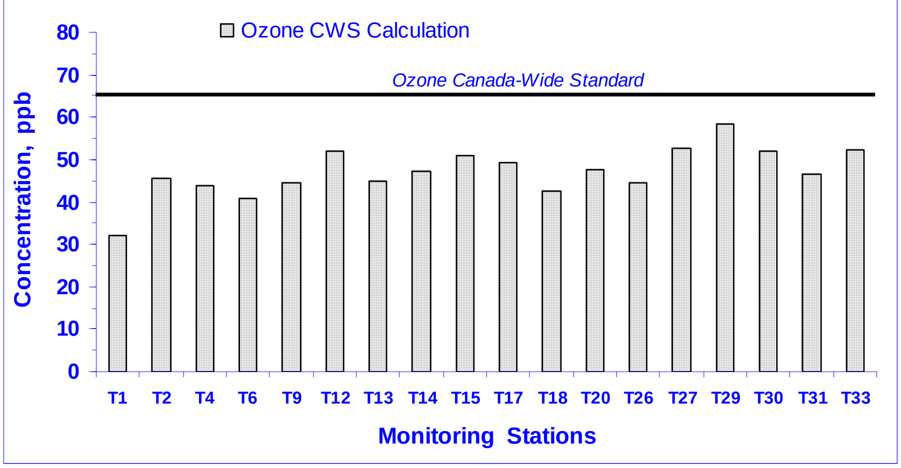
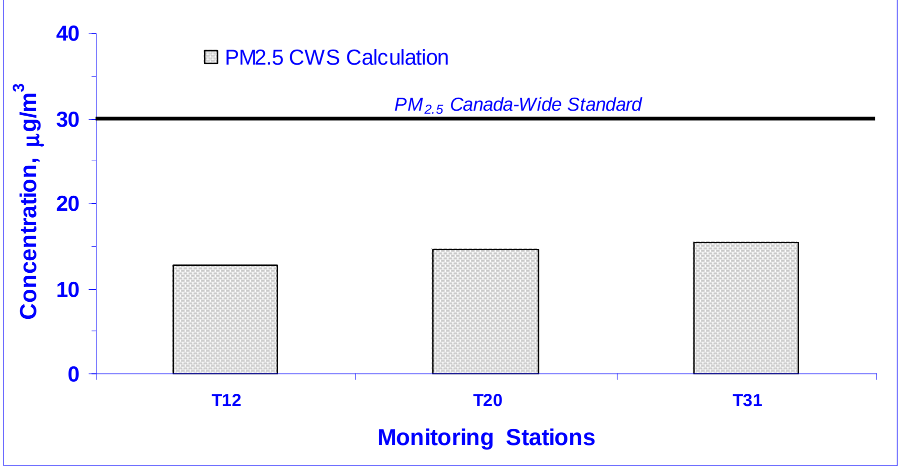


Figure 22 shows the $PM_{2.5}$ CWS achievement calculation for 2001 for all $PM_{2.5}$ stations that have at least a 3-year record. At this time, all stations meet the $PM_{2.5}$ CWS, which is based on a 3-year average.

Figure 22: $PM_{2.5}$ Canada-Wide Standard, 2001



Section H - Measurement Methods

Sulphur Dioxide

The measurement instruments operate on the principle of fluorescent excitation of sulphur dioxide by pulsed ultraviolet light.

Total Reduced Sulphur Compounds

In measuring total reduced sulphur compounds, sulphur dioxide is first removed from the air sample prior to it entering a high temperature oxidizing oven. The total reduced sulphur compounds are converted to sulphur dioxide, which is then measured using a standard sulphur dioxide instrument.

Nitrogen Dioxide

Concentrations of nitric oxide, nitrogen dioxide and total nitrogen oxides are measured utilizing analyzers which work on the principle of chemiluminescence involving a gas phase reaction with ozone. For nitrogen dioxide, the sample passes through a catalytic converter where the nitrogen dioxide is reduced to nitric oxide.

Carbon Monoxide

Carbon monoxide is measured using a variety of different models of instruments. All these instruments operate on the principle of infrared absorption.

Ozone

Ozone analyzers utilize the principle of the absorption of ultraviolet light by the ozone molecule.

Inhalable Particulate

Inhalable particulate is monitored continuously using Tapered Element Oscillating Microbalance monitors, equipped with a PM_{10} size selective inlet.

Fine Particulate

Fine particulate is monitored continuously using Tapered Element Oscillating Microbalance monitors, equipped with a $PM_{2.5}$ size selective inlet.

Coefficient of Haze

Coefficient of haze (COH) is measured using BVM Model I COH analyzers. A known volume of air is continuously drawn through a filter tape, where a "spot" is produced by the particles that deposit on the filter.

The amount of light transmitted through the spot relative to a clean portion of the filter is then expressed as the number of COH units per 1,000 linear feet of air drawn through the filter. One COH unit corresponds to an optical density of 0.01.

Total Suspended Particulate

Total suspended particulate is measured using high volume samplers which draw air through a glass fibre filter at a rate of approximately 1.4 cubic metres per minute. The samplers are operated for a continuous 24-hour period on a frequency of once every six days, in accordance with the National Air Pollution Surveillance (NAPS) Network Schedule. The 24-hour average total suspended particulate concentration is calculated from the total air sample volume and the weight of particulate matter collected on the glass fibre filter.

Metals in Suspended Particulate

Metal analysis is performed on the samples collected in the suspended particulate test using either x-ray fluorescence or atomic absorption spectrophotometry techniques.

Dustfall

Dustfall is measured by exposing open-top containers of specified dimensions for a period of one month. The amount of particulate matter that falls passively into the container is weighed and the results are reported as milligrams per square decimeter per day ($mg/dm^2/day$). Re-entrainment of the collected dust by wind action during the sampling period is prevented by maintaining a liquid in the container.

VOC

VOC samples are collected automatically by drawing ambient air into Summa-polished canisters over a 24-hour period (midnight to midnight).

Units of Measure

km/hr: kilometre per hour.

$mg/dm^{2/}day$: milligram per square decimetre per day.

ppm: part per million (by volume).

ppb: part per billion (by volume).
1 ppm = 1000 ppb.

$\mu g/m^3$: microgram per cubic metre.

COH: coefficient of haze.
1 COH unit corresponds to an optical density of 0.01.

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