GEORGETOWN SOUTH SERVICE EXPANSION AND UNION-PEARSON RAIL LINK

Draft

Ambient Air Monitoring and Reporting Plan

December 10, 2009

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1. INTRODUCTION

This draft work plan was prepared to address Conditions 11-18 outlined in the Provincial Minister's Notice to Proceed with the Georgetown South Service Expansion and Union-Pearson Rail Link Project dated October 5, 2009. The Federal Environment Assessment (EA) decision rendered on November 19th, 2009 also included a requirement a follow-up program under section 38 of the *Canadian Environmental Assessment Act* (CEAA) in relation to Air Quality. The Responsible Authorities have delegated the design and implementation of a follow-up program to the proponent; therefore the draft workplan has also been developed to meet this requirement as well.

The MOE Conditions require Metrolinx to develop and obtain approval of an Ambient Air Quality Monitoring and Reporting Plan. The conditions state that this plan shall include:

- At least three sampling locations at any point in time;
- Continuous monitoring for respirable particulate matter, nitrogen oxides, carbon monoxide, and sulphur dioxide;
- 24 hour samples for total suspended particulates, metals, and polycyclic aromatic hydrocarbons using high volume samplers on the six day National Air Pollution Surveillance (NAPS) cycle;
- 24 hour samples of VOC using Method TO-15 canister method on the six day NAPS cycle;
- 24-hour samples of acrolein using Method TO-11 DNPH coated absorption tube on the six day NAPS cycle; and,
- Additional air modeling to determine source apportionment of area emissions.

The plan was developed in consultation with a Working Group that includes Environment Canada, Toronto Medical Officer of Health, representatives from the adjacent community, and any other relevant government agencies. The other agencies were the Ontario Ministry of the Environment (MOE) and Transport Canada.

The purpose of this Working Group was to:

- Provide input on the monitoring requirements included in Condition 12;
- Assist in identifying appropriate monitoring locations; and,
- Assist in determining reporting requirements.

This draft report will be made available for a 30 day public review period. Following that, it will be submitted to the MOE Regional Director, Central Region for approval. Once the work plan is approved the study will commence within three months. The monitoring will continue until such a date as the Regional Director, Central Region and Transport Canada in consultation with Environment Canada determines that the ambient air monitoring program is no longer required. On an annual basis, Metrolinx will review the findings with the MOE and Transport Canada in consultation with Environment Canada and discuss whether or not to continue with the monitoring in whole or part.

The objective of the ambient air monitoring and reporting plan is to provide monitored and measured data from the study area that will:

- Provide accurate and reliable measured air pollutant concentration and meteorological data, to verify and support the dispersion modelling calculations completed as part of the Environmental Assessment.
- Assess air contaminant concentrations in relation to ministry standards and limits, including O. Reg. 419/05 standards, point of impingement (POI) guidelines, ambient air quality criteria (AAQC), interim guidelines, or any other Canada-wide standards;
- Provide data to assess local population and ecosystem exposure to air contaminants; and
- Justify adaptive management, or further mitigiation, in relation to air quality, if required.

2. SCOPE OF WORK

This ambient air quality monitoring program will take place within the Georgetown South Corridor (GSC) or at properties adjacent to the GSC. **Figure 1** is a key map illustrating initial suggestions on potential sampling areas. The rationale for each areas was based on the changes in levels of services provided in the corridor. The following summarize the rationale for each area:

- Sample Area 1 was identified to capture the service levels north of the West Toronto Diamond. This includes GO Georgetown, the proposed GO Bolton service, and the UPRL service. The specific area identified on the key map was selected since it is adjacent to the Weston community and has the highest concentration of residential development adjacent to the corridor north of the West Toronto Diamond.
- Sample Area 2 was identified to capture the service levels between the Newmarket Subdivision (GO Barrie Line) and the West Toronto Diamond. This includes GO Georgetown, GO Bolton, GO Milton and the UPRL service.
- Sample Area 3 was identified to capture the service levels south of the Newmarket Subdivision (GO Barrie Line). This includes GO Georgetown, GO Bolton, GO Milton, GO Barrie service and the UPRL service.

The exact locations for a monitoring station within each of the 3 sample areas was developed in consultation with the Working Group and considered MOE siting requirements for ambient monitoring stations as well as practical constraints such as availability of property, ease of site access, and availability of power supply.

A portion of the sampling program will be completed on a continuous basis while a portion will be completed on a non-continuous basis with 24 hour samples following the six day National Air Pollution Surveillance (NAPS) cycle. Sampling will consist of the following parameters:

1) Continuous monitoring:
    a. Respirable particulate matter ($PM_{2.5}$); and,
    b. Nitrogen oxides (NO_x)
    c. Carbon monoxide (CO)
    d. Sulphur dioxide (SO_2)
2) Non-continuous monitoring:
    a. Total suspended particulates (TSP);
    b. Metals;
    c. Polycyclic aromatic hydrocarbons (PAHs);
    d. Volatile organic compounds (VOCs); and,
    e. Acrolein.

The ambient measurement program will encompass a time frame that is deemed appropriate by the Regional Director, Central Region and Transport Canada in consultation with Environment Canada. Annual reports will be issued and the need for this monitoring program will be assessed. All sample methods will following the methodologies as outlined in the MOE *Operations Manual for Point Source Air Quality Monitoring*, March 2008. The samples will all be taken concurrently at each of the three stations located within or adjacent to the GSC.

A 10 metre meteorological tower will be installed for at least one of the locations to measure localized wind speed and direction data along the corridor on an hourly basis throughout the monitoring period. The location for the meteorological tower will be selected in consultation with the Ontario Ministry of the Environment. Measurements of rainfall, temperature and relative humidity will also be collected at this station. Wind speed and direction at the other monitoring locations may also be required depending on local terrain that could create inconsistent localized wind directions and speeds.

Equipment at all monitoring stations will operate in compliance with the City of Toronto noise by-law.

2.1 Continuous Monitoring

This program includes monitoring for respirable particulate matter ($PM_{2.5}$) and nitrogen oxides (NO_x), carbon monoxide (CO), and sulphur dioxide (SO_2) to be completed on a continuous basis over the duration of the ambient air monitoring and reporting program. The monitoring methods would comply with the methods specified by MOE *Operations Manual for Point Source Air Quality Monitoring*, March 2008. In addition, all equipment used will comply with the United States Environmental Protection Agency (USEPA) Federal Equivalency Method (FEM) designation.

The $PM_{2.5}$ analyzer and data acquisition system would consist of an R&P TEOM (or equivalent) and a data acquisition system (DAS) capable of recording continuous measurements on a one minute averaging period.

The NO_x analyzer and data acquisition system would consist of a Thermo Environmental (or equivalent) and a DAS capable of recording continuous measurements on a one minute averaging period.

The CO analyzer and data acquisition system would consist of a Thermo Environmental (or equivalent) and a DAS capable of recording continuous measurements on one minute averaging periods.

The SO_2 analyzer and data acquisition system would consist of a Thermo Environmental (or equivalent) and a DAS capable of recording continuous measurements on one minute averaging periods.

The DAS will record data on one minute averaging periods to be used to average over 24 hour, 1 hour and ½ hourfor comparison of the measured values to applicable criteria and standards. The equipment will be housed in a climate controlled trailer within or adjacent to the GSC.

2.2 Non-continuous Monitoring

2.2.1 Total suspended particulates (TSP) and metals

All stations will collect a 24 hour duration sample (midnight to midnight) once every six days in concurrence with the NAPS cycle.

The samples will be collected using General Metal Works standard High-Volume air samplers (or equivalent) and will be operated according to the MOE *Operations Manual for Air Quality Monitoring in Ontario*, March 2008.

The TSP filters will consist of Teflon coated glass fibre filters that will be supplied and conditioned by an accredited laboratory. Exposed filters will be stored until the individual calendar month samples have been completed and then sent to an accredited laboratory. The TSP filters will be conditioned and pre and post weighed by an accredited laboratory. The TSP filters will undergo further analysis for metals using Atomic Emission Spectroscopy/Inductively Coupled Plasma (AES/ICP). The analytical list will include the following:

- Arsenic
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Manganese
- Mercury
- Nickel
- Selenium
- Vanadium
- Zinc

2.2.2 Polycyclic aromatic hydrocarbons (PAHs)

All of the sampling and analytical techniques for PAHs will be based on the protocols defined by the U.S. EPA Method TO-13 and as per the methods defined in the MOE *Operations Manual for Air Quality Monitoring in Ontario*, March 2008.

The samples will be collected using a General Metal Works PS-1 samplers (or equivalent) which are listed as reference devices for the methods. The samplers use a collection filter that is “backed up” by a polyurethane foam (PUF) plug. The airborne compounds present in the particulate phase are collected on the filter. Any compounds present in a vapour phase are

adsorbed in the PUF plug. The filter and PUF plug will be analyzed separately to determine collected PAH concentrations. Reporting will segregate the PAH concentrations for the filter, PUF plug, and total. Segregation of the filter and PUF plug PAH concentrations will be assessed through the results of the quarterly reports and continuation decided upon by the MOE Regional Director, Central Region and Transport Canada in consultation with Environment Canada.

All filters, glassware, PUF will be prepared, cleaned and proofed by an accredited laboratory. The samples will be stored and transported in proper coolers before and after exposure.

The samples will be collected over a 24 hour duration (midnight to midnight) and will be taken on the six day NAPS cycle. The samples will be analysed for a variety of PAHs. The PAHs to be examined in the study are listed below:

- Tetralin
- Pyrene
- Biphenyl
- Fluorene
- Perylene
- Anthracene
- Picene
- Coronene
- o-Terphenyl
- m-Terphenyl
- p-Terphenyl
- Naphthalene
- Quinoline
- Phenanthrene
- Benzo(a)fluorene
- Benzo(b)fluorene
- Benz(a)anthracene
- Benz(b)anthracene
- Benzo(a)pyrene
- Benzo(e)pyrene
- Acenaphthylene
- Acenaphthene
- Dibenz(a,e)pyrene
- Dibenz(a,i)pyrene
- Fluoranthene
- 2-Methylanthracene
- 2-Methylnaphthalene
- 1-Methylnaphthalene
- 9,10-Dimethylanthracene
- 7,12-dimethylbenz(a)anthracene
- 2,6 & 2,7-Dimethylnaphthalene
- Dibenz(ac)+(ah)anthracene
- 1,2-Dimethylnaphthalene
- 1-Methylphenanthrene
- 9-Methylphenanthrene
- Benzo(b)fluoranthene
- Benzo(k)+(j)fluoranthene
- Indeno-1,2,3(c,d)pyrene
- 3-Methylcholanthrene
- Triphenylene/Chrysene
- Benzo(g,h,i)perylene
- 2-Chloronaphthalene

2.2.3 Volatile organic compounds (VOCs)

All of the sampling and analytical techniques for VOCs will be based on the protocols defined by the U.S. EPA Method TO-15 and as per the methods defined in the MOE *Operations Manual for Air Quality Monitoring in Ontario,* March 2008.

Ambient sampling of VOC's will conform to U.S. EPA Ambient Method TO-15. The samples will be collected in Stainless Steel SUMA Canisters. Flow into the canisters will be regulated using a flow restrictor with a pressure drop indicator. An air sample is drawn through a stainless steel sample line from a height of approximately 1.5 m (nose height) above ground level. The samples will be collected over a 24 hour duration (midnight to midnight) and will be taken on the six day NAPS cycle.

The sample canisters will be provided and analyzed by an accredited laboratory. The existing on-site meteorological station will record the meteorological conditions during all the sampling events. The VOCs to be examined in the study from TO-15 are listed below:

- 2,2,4-Trimethylpentane
- Carbon Disulfide
- Vinyl Bromide
- Dichlorodifluoromethane (FREON 12)
- 1,2-Dichlorotetrafluoroethane
- Chloromethane
- Vinyl Chloride
- Chloroethane
- 1,3-Butadiene
- Trichlorofluoromethane (FREON 11)
- Trichlorotrifluoroethane
- Ethanol
- Methyl Ethyl Ketone (2-Butanone)
- Methyl Isobutyl Ketone
- Methyl Butyl Ketone (2-Hexanone)
- Methyl t-butyl ether (MTBE)
- Ethyl Acetate
- 1,2-Dichloropropane
- Methylene Chloride (Dichloromethane)
- cis-1,2-Dichloroethylene
- trans-1,2-Dichloroethylene
- Chloroform
- Carbon Tetrachloride
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- Ethylene Dibromide
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- 1,1,2,2-Tetrachloroethane
- cis-1,3-Dichloropropene
- trans-1,3-Dichloropropene
- Bromomethane
- Bromoform
- Bromodichloromethane
- Dibromochloromethane
- Heptane
- Trichloroethylene
- Tetrachloroethylene
- 1,3,5-Trimethylbenzene
- 1,2,4-Trimethylbenzene
- 1,1-Dichloroethylene
- Benzene
- Toluene
- Ethylbenzene
- p+m-Xylene
- o-Xylene
- Styrene
- 4-ethyltoluene
- Chlorobenzene
- Benzyl chloride
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,2-Dichlorobenzene
- 1,2,4-Trichlorobenzene
- Hexachlorobutadiene
- Hexane
- Cyclohexane
- Tetrahydrofuran
- 1,4-Dioxane
- Xylene (Total)
- 2-propanol
- 2-Propanone
- Propene
- Vinyl Acetate

2.2.4 Acrolein

Acrolein will be sampled based on the protocols defined by the U.S. EPA Method TO-11. This involves collecting the acrolein on DNPH-coated tubes. Samples will be collected for a 24-hour duration and will coincide with the VOC sampling.

2.3 Siting Requirements

The specific sites for the ambient air monitoring stations will be identified in accordance with the MOE *Operations Manual for Air Quality Monitoring in Ontario,* March 2008.

Siting of the ambient stations should include the potential to measure the air contaminants where they are believed to be at their highest levels. The stations should be positioned downwind of the corridor from the local predominant wind direction. The stations should also be positioned so as to capture air contaminants where the locomotives would have their greatest emission (*i.e.* cold starts, acceleration, elevation changes, etc.).

As noted earlier **Figure 1** illustrates the proposed three sampling areas within which a specific monitoring site will be selected.

A preliminary review of the sampling areas was conducted and several locations were identified as possible monitoring sites (**Figures 2 to 5)**. The potential site locations were identified on the basis of the following criteria:

- Availability of property. An open property is required to accommodate approximately a 3 m x 3 m fixed installation;
- Field Technician ease of accessibility. The monitoring station has to be visited regularly;
- Availability of a power supply and LAN connection; and
- Location of site adjacent to the corridor

All of the potential site locations suggested are directly adjacent to the corridor with minimal interruption between the "source" of emissions and the monitoring stations and provide adequate space requirement for the monitoring station.. Additionally, all of the locations are near a roadway which enables easy accessibility for the field technicians and easier hook-ups to the power grid and LAN connection. Several of the locations are less ideal than others on the basis of the location with respect to the corridor. The potential site locations which are on the downwind side of the corridor are preferred to better capture emissions from operations along the corridor.

Of the site options identified, the generally preferred ones, based on Working Group Meetings that occurred on Nov. 26 and Dec. 8, 2009, are:

- location 1 (with location 3 as a back-up)
- location 6
- location 10

They were considered the best in terms of being downwind of the corridor for prevailing winds, away from major structures that might affect local wind flow, and relatively well separated from residences that might be impacted by the noise. These sites also cover a range of rail traffic volume conditions on the corridor.

These locations will need to be further evaluated in the field to confirm property availability, security, power, and nearby obstacles. The following table is taken directly from the MOE *Operations Manual for Air Quality Monitoring in Ontario*, March 2008 and will be used to assess the sites and finalize the preferred location:

Table 2.3.1: Sample Probe Siting Criteria

Pollutant	Height Above Ground (m)	Distance from supporting structure (m)		Other Spacing Criteria
		Vertical	Horizontal	
NO_x	3 – 15	>1	>1	a. >20 m from trees; b. Distance from sampler to airflow obstacle must be >2x height of obstacle above the sampler; c. Unrestricted airflow in three of four wind quadrants; and d. No nearby furnace/incineration flues. e. Spacing from roadway varies with road traffic.
SO_2	3-15	>1	> 1	a. >20 m from trees; b. Distance from sampler to airflow obstacle must be >2x height of obstacle above the sampler; c. Unrestricted airflow in three of four wind quadrants; and d. No nearby furnace/incineration flues.
TSP	2 – 15	>1	>1	a. >20 m from trees; b. Distance from sampler to airflow obstacle must be >2x height of obstacle above the sampler; c. Unrestricted airflow in three of four wind quadrants; and d. No nearby furnace/incineration flues. e. Distance of sampler from major roadways should be >20-25 m for sampler inlet heights of 2-5 m
$PM_{2.5}$	2 – 15	>1	>2	a. >20 m from trees; b. Distance from sampler to airflow obstacle must be >2x height of obstacle above the sampler; c. Unrestricted airflow in three of four wind quadrants; d. >5 m from chimneys with natural gas combustion emissions; and e. >20-25 m from major roadways.
PAHs/ VOCs	3 – 15	>1	>2	a. No nearby sources of PAHs and VOCs which could interfere with sample results

Monitoring for CO is not included in the MOE *Operations Manual for Air Quality Monitoring in Ontario*, March 2008, but the same rules that govern NO_x siting would be used to site the CO probe inlet as well.

2.4 Modelling Requirements

Condition 13 of the notice of approval requires air modelling to determine source apportionment of area emissions. This is understood to mean that modelling is required that will separate the contribution of the rail corridor and, in particular, the proposed increase in rail traffic from background sources of emission in the study area (the so-called "area emissions"). The previous dispersion modelling predicted overall impacts of the rail corridor and vehicle traffic on major local roadways in combination with background pollutant levels associated with other sources. It did not, however, break out the incremental contributions from various users of the rail corridor, separate from each other and from vehicle traffic on the major local roadways. Condition 13 is intended to provide this additional information.

Apportionment will be carried out using meteorological data, namely wind direction, and the use of the four Toronto area Air Quality Index stations (Toronto North, Toronto West, Toronto Downtown and Toronto East) in conjunction with monitoring data collected under this work plan (to the extent available at the time).

2.4.1 Pollutants of Concern

Condition 13 did not specify which pollutants should be studied. However, the results of the previous dispersion modelling can be used to make a preliminary identification of the appropriate pollutants. This identification of pollutants will be reviewed at the start of the modelling work, taking into consideration available results of the monitoring program at that time, and revised as needed. The previous modelling predicted the overall contribution of all trains on the rail corridor (future full-build scenario) plus traffic on major local roadways. Pollutants whose contribution from these sources was found to be far below applicable health criteria need not be studied further. In addition, those whose contribution from these sources was found to be very small compared to background levels also need not be studied.

Table 2.4.1.1 summarizes the maximum predicted concentrations from the previous dispersion modelling, at the worst-affected receptor. The results are presented in percentage form. Results in mass concentration units, as well as background concentrations and values of applicable criteria can be found in the detailed report on the previous air quality assessment. The applicable criteria have been updated to include proposed new criteria for certain contaminants (Benzene, 1,3-butadience and acrolein).

Highlighted pollutants in Table 2.4.1.1 are those whose predicted maximum contribution is sizeable in relation background, and whose predicted maximum cumulative concentration approaches or exceeds the applicable criterion. On a preliminary basis, these are the pollutants that should be carried forward for further study, i.e., NO_X & NO_2, $PM_{2.5}$, acrolein, benzo(a)pyrene and benzene. These pollutants will be modelled for all relevant averaging times (i.e., those averaging times for which MOE air quality criteria and WHO guidelines are applicable). Other pollutants need not be considered further. PM10 is excluded since $PM_{2.5}$ is considered to be an adequate representative of fine particulate matter on its own.

Further support for this list of pollutants that should be carried forward in the analysis is provided in Appendix A. Appendix A provides a comprehensive list of contaminants that may be emitted in diesel exhaust, as identified in published data bases. For each contaminant, Appendix

A shows published estimates of emission rates. It also shows applicable MOE air quality criteria, as well as air quality criteria from other jurisdictions (as set out in the MOE's Jurisdictional Substance List, or JSL) and WHO guidelines. Finally, Appendix A shows the ratios of estimated emission rate to applicable criterion, and those that have a high ratio compared to other substances on the list are the ones that should be carried forward.

Table 2.4.1.1: Predicted Maximum Concentrations at Worst-Affected Receptor

Averaging time and Pollutant	Maximum contribution (% of background)		Maximum cumulative concentration (% of criterion)
	Average background	90th percentile background	
1-hr NO_X (as NO_2)	764%	350%	250%
1-hr NO_2	300%	73%	65%
1-hr CO	52%	36%	5.9%
1-hr SO_2	132%	79%	6.5%
1-hr Acrolein	547%	310%	14%
24-hr NO_X (as NO_2)	225%	104%	115%
24-hr NO_2	197%	111%	102%
24-hr SO_2	32%	19%	11%
24-hr $PM_{2.5}$	43%	18%	98.5%
24-hr PM_{10}	24%	10%	92%
24-hr benzene	39%	20%	146%
24-hr butadiene	240%	120%	9%
24-hr acrolein	78%	44%	57%
24-hr acetaldehyde	20%	11%	0.6%
24-hr formaldehyde	24%	13%	8%
Annual SO_2	9%	-	30%
Annual benzene	11%	-	346%
Annual butadiene	65%	-	17%
Annual benzo(a)pyrene	10%	-	36%

2.4.2 Modelling Approach

The Notice of Approval requires Metrolinx to submit and implement an air monitoring program within three months. Monitoring must commence within three months after receiving MOE approval. Condition 13 requires that the source apportionment modelling be conducted within 18 months of completion of construction. The time of completion of construction is unknown at this time, but will after the monitoring program commences. Therefore, a significant

quantity of data from the air monitoring program will be available prior to the time when Condition 13 must be fulfilled. These data, as well as coincident data from existing MOE and NAPS monitoring sites in the surrounding area will be useful to develop a combined modelling/monitoring approach to fulfill Condition 13.

The proposed approach, then, involves a combination of dispersion modelling and analysis of monitoring data.

1. Statistically analyze monitoring data to estimate incremental contribution of the rail corridor:
    a. Sort monitoring data by wind direction and statistically compare upwind samples to samples that were downwind of the rail corridor;
    b. Statistically compare data from the new monitoring stations, which will be adjacent to the rail corridor, to corresponding data from existing MOE and NAPS stations that are in regionally representative locations.
2. Run dispersion model to predict incremental contribution of rail corridor:
    a. Run the model based on actual rail traffic volumes and locomotive mix operating during the period of the available monitoring data (i.e., existing condition);
    b. Separate out the predicted contributions of each operator (GO, VIA, CPR, CNR) and also show the combined total.
3. Assess model performance by comparing the model-predicted incremental contribution to observed estimates based on monitoring data.
4. Adjust model to improve performance if needed.
5. Use the results to back out the rail corridor contribution from the monitoring data, thereby determining the contribution from background area emissions.
6. Re-run the adjusted model for the future full-build and no-build scenarios, based on the Tier 4 requirements of the Notice of Approval:
    a. provide a frequency distribution plot of measured versus predicted concentrations (paired analysis) illustrating the background contribution, Future Build and Future No Build predictions at selected sensitive receptors (similar to Figure 15 of the final Air Quality Impact Assessment);
    b. Summarize the breakdown of the total Future Build in tabular or graphic format indicating the GO, UPRL, and other rail impact contributions at each of the selective sensitive receptors;
    c. The breakdown will also include the contribution from major local roadways together with other background sources.;

d. Provide modeled annual average, 24 hour 90th percentile and maximum concentrations and maximum background concentrations for the pollutants of concern occurring within the modelling domain;
e. Provide an assessment of the modeled versus monitored annual average, 24 hour 90th percentile and maximum concentrations occurring within the modelling domain, with and without background concentrations for the pollutants of concern within the modelling domain;
f. a limited number of receptors were identified within approximately 600 metres of the rail line in the previous modelling – a larger number of receptors, extending to 500 m will be added in consultation with the MOE and the Medical Officer of Health.
g. Additional road links will be incorporated into the modelling domain to improve the modelling of contributions from major roadways in the area.

The dispersion modelling will be based the dispersion model set-up as used previously (CAL3QHCR).

3. QUALITY CONTROL/ASSURANCE

A number of common quality assurance measures will be taken to ensure the integrity of the sampling program. In general, these measures include detailed documentation of field activities, minimum quarterly calibrations of sampling equipment, daily automated span and zero checks on continuous analyzers, analyses of blanks, and numerous laboratory related measures including sample handling procedures and so on.

With respect to field documentation, all activities are documented with written field notes including observations of sample location, general weather observations as well as photographic records.

All samplers are bench-tested and calibrated prior to field deployment and, in many cases, calibrated again in the field before use. There will be done at minimum quarterly calibrations on all sampling equipment to ensure reliability in the data sets.

Chain of custody forms will be completed and submitted along with exposed samples to the laboratory. When a canister is installed in a sampler, a record of the identification number is

kept in a logbook to ensure that the canister was placed back in its original container. Each sample filter will be returned to its original packaging prepared by the laboratory and sent to the back for post weighing and metals analysis.

Throughout the sampling program, a number of travel and field blank samples will be submitted for analysis. The total number of blank canisters that are submitted to the laboratory will be equal to not less than ten percent of the total number of samples (canisters and filters).

The MOE *Operations Manual for Air Quality Monitoring in Ontario,* March 2008 outlines the sample validity requirements for non-continuous and continuous sampling. This manual will be adhered to throughout the testing program and it will take precedence unless otherwise directed through this work plan. Key elements of the Operations Manual that will be adhered to are:

- Minimum rate of recovery of good data from all monitors and samplers (both continuous and discrete sampling) will be 75 %, seasonally and annually.
- Zero drifts for SO_2 and NO_x beyond 5 ppb require an off-set adjustment.

4. REPORTING AND DELIVERABLES

Two types of reports are proposed to be to be generated. These include:

- Annual Report
- Quarterly Report

An annual report is a summary of the entire year of operations at the stations and must be submitted to the MOE and Transport Canada in consultation with Environment Canada by Metrolinx. This report will also be made public via the Metrolinx website. In addition, where it can be obtain a copy of results will also be posted on the CEAR by Transport Canada The annual report will include a summary of all collected data and interpretation of the data. A comparison to previous data collected at the station(s) and apportionment of the emissions will be

investigated as part of this report. A comparison to defined limits and standards will also be included and a recommendations section provided to incorporate adaptive management and mitigation measures to decrease observed emissions when exceedances are reported. The data sets are not required to be submitted as part of this report. The entire report will include:

- A map showing key locations of emission concern, relevant boundary lines, and the monitoring station locations; scaling and north arrow must be included;
- The overall station operations – e.g. Summary of parameters monitored with equipment/model numbers, frequency of site visits and calibrations, confirmation of data backup and archiving, and a description of all significant data losses experienced at the stations and modes of remediation;
- The assessment of data losses will include an indication of whether or not significant stagnant or other key weather conditions have been missed;
- Statistical summaries, including – Annual Arithmetic Mean; Maximum Collected Averages; Number of Valid Hours, Percent Valid Data, and number and frequency of exceedances against standards and limits;
- Pollution and wind roses to evaluate wind speed/direction data for source contribution assessment;
- Comparison to historical data collected from the station(s); and
- Evaluation of effects (if any) on monitoring results by abatement actions.

A quarterly report will be prepared for submission to the MOE, Metrolinx Transport Canada and Environment Canada.. The report will be made public the Metrolinx website. In addition, Transport Canada will post where copies of the report can be obtained will be posted on the CEAR The raw 1-minute average data and edited ½-hour, 1-hour, and 24-hour averages will be submitted electronically along with the quarterly summary report; hard copies of the data are not required as part of the quarterly report. Data will also be available for incorporation into the MOE database. The formal report will include a covering page that will discuss quarterly AAQM station information and events. Included within the report will be percent valid data collected for each parameter, all routine and unscheduled activities that have taken place at the AAQM stations throughout the quarter, a missing data summary, maximum events recorded at the

station, and correlation between data collected and factors that may contribute to reported events. The following statistical results for each measured pollutant parameter will be included in the AAQM summary:

- Period Arithmetic Mean;
- Monthly Arithmetic Mean;
- Maximum for any averaging period used for comparison to statutory or regulatory limits as well as exceedances within the quarter; and
- Percent valid hours.