



Memorandum

To: Keith Beasley, Environmental Project Manager, Massport

*From: George Siple, QEP
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Date: July 7, 2008, Finalized September 9, 2008

*Subject: Logan Air Quality Monitoring Study – Final Third Quarter
Monitoring Report*

This technical memorandum serves as the third of four quarterly monitoring data reports covering monitoring results for the baseline period at all monitoring locations as part of the Logan International Airport Air Quality Monitoring Study (Study). Camp Dresser & McKee Inc. (CDM) prepared this technical memorandum to provide:

- An overall status of the air quality monitoring program from March 1, 2008 through May 31, 2008.
- A status of meeting the data quality objectives presented in the *Massport, Logan International Air Quality Monitoring Study, Active and Passive Monitoring Quality Assurance Project Plans, September 2007 (QAPPs)*, and
- The raw air quality monitoring and meteorological data for review by Massport, Massachusetts Departments of Environmental Protection (MassDEP), and Public Health (MassDPH).

The following sections of this technical memorandum include an overview discussion of issues affecting the data quality and quantity during this portion of the monitoring program, along with data collection and quality control and quality assurance activities based on the objectives established in the QAPPs. A CD-ROM disk with the raw air quality monitoring and meteorological data is provided as **Appendix A**.

Overview

The monitoring network in this study is composed of 11 monitoring locations based upon the criteria established in the *Massport, Logan International Air Quality Monitoring Study, Final Air Quality Work Plan, September 2007*. Initial monitoring

locations were recommended by the study project team and modified after consultation with the MassDEP and MassDPH. Of these 11 monitoring sites, three “primary” sites were established that use both “active” and “passive” air monitoring methods specifically selected for this study. In addition, seven “satellite” sites and one urban background site were added to expand the study area. These additional sites utilize a combination of passive sampling methods and active PM_{2.5} samplers. The urban background site is located at the MassDEP Harrison Avenue monitoring site. An aerial map showing the 11 monitoring sites is shown in the study work plan referenced above. The Work Plan had identified 13 target pollutants that EPA and FAA classify as toxic air pollutants typically associated with airports. Fine PM (i.e., PM_{2.5}) and black carbon were added to this list to provide a more comprehensive record of pollutants that could originate from Logan. This technical memorandum focuses primarily on the data collection and quality assurance activities related to the monitoring for these target pollutants. However, samples were also analyzed for other potential pollutants. These secondary pollutant concentrations are reported in Appendix A.

CDM began collecting a monthly duplicate carbonyl sample at the Bremen Street site in April 2008. Duplicate VOC sampling at the Bremen Street site and PM_{2.5} minivol sampling (rotating among the 11 monitoring locations) began in May 2008. Duplicate samples will be taken once a month for the remainder of the program.

Data Collection Activities

The following sections present a summary of the percent data recovery and percent data reported below minimum detection limits (MDLs) for both continuous and real-time integrated monitoring data for the target pollutants.

Continuous Data

The pollutant concentrations were measured using continuous ambient air monitoring instruments and time-integrated ambient air sampling equipment. The continuous pollutant data include mass of black carbon (BC) measured using a seven-wavelength aethalometer (Magee Scientific Co.) and mass of particulate matter with an equivalent aerodynamic diameter of 2.5 micrometers (PM_{2.5}) measured using a beta attenuation monitor (BAM) (Met One Instruments, Inc.). In addition to the air pollution data, meteorological data was collected at the three primary sites. This included: wind speed, wind direction, ambient temperature, and relative humidity. Meteorological stations were operated by CDM at two of the sites, and data was collected from a third party at the other site.

Percent Data Recovery for Continuous Data

CDM has developed a database spreadsheet to track the sampling program progress to achieve the percent data recovery goal established for the study. The data

collection period of March through May 2008 included 2,208 hours in total. The goal for the study is to obtain at least 75 percent data recovery, i.e., at least 75 percent of scheduled data samples collected as valid samples. For continuous monitoring instruments, this value would represent 1,656 hours of valid data during the reporting period.

The percent data recovery for the continuous data collected during the reporting period is presented in **Table 1**. In March, the aethalometer at Court Road stopped writing data to the disk and caused data loss. No errors have been observed since this instrument was restarted. The filter tape inside the BAM at Court Road broke in March causing a tape error. In April, the BAMs at Annavoy Street and Court Road experienced flow errors after calibration. The flow has stabilized since then and no errors have been observed.

Black Carbon	Mar	Apr	May	Q3
Annavoy	100%	100%	100%	100%
Bremen	100%	100%	99%	100%
Court	58%	100%	100%	86%
PM_{2.5} BAM				
	Mar	Apr	May	Q3
Annavoy	100%	61%	98%	87%
Bremen	100%	100%	99%	100%
Court	89%	72%	100%	87%
Meteorology				
	Mar	Apr	May	Q3
Annavoy	100%	100%	100%	100%
Bremen	100%	100%	100%	100%
Court	99%	96%	98%	98%
Logan	100%	100%	100%	100%

Percent Data Reported Below Minimum Detection Limit for Continuous Data

One of the parameters reported in air monitoring data reports are minimum detection limits (MDLs) of monitoring equipment. Most air pollutant concentrations tend to be log normally distributed in the ambient air, resulting in a significant proportion of measured values being found at relatively low concentrations and a much lower proportion being found at higher concentrations. Due to analytical limitations, some of the lower concentrations cannot be quantified and must be considered to be below the minimum detection limit of the analytical method. The aethalometer MDL for BC reported by Magee Scientific is 50 nanograms per cubic

meter (ng/m^3) for one-hour average measurements and the BAM MDL for $\text{PM}_{2.5}$ reported by Met One Instruments is 5 micrograms per cubic meter (ug/m^3) for one-hour average measurements. **Table 2** presents the percent of continuous data reported below MDL. For the continuous BC one-hour average measurements, 0.36 to 1.31 percent of the measurements were below the MDL at the three monitoring sites during this period. The percentage below MDL during the first two quarters ranged from 0 to 0.73 percent. For the continuous $\text{PM}_{2.5}$ one-hour average measurements, 16 to 36 percent of the measurements were below the MDL at the three primary monitoring sites during this period. The range of percent of data reported below MDL during the first two quarters was 6 to 25 percent.

	Annavoy	Bremen	Court
Black Carbon	1.04%	0.36%	1.31%
$\text{PM}_{2.5}$ (BAM)	24%	16%	36%

Aethalometer MDL = 50 ng/m^3 based on 1-hour average
BAM MDL = 5 $\mu\text{g}/\text{m}^3$ based on 1-hour average

Time-Integrated Data

The time-integrated samples (samples collected over a measured period of time) were collected for speciated volatile organic compounds (VOC), speciated carbonyl compounds, speciated polynuclear aromatic hydrocarbons (PAH), and $\text{PM}_{2.5}$ mass using active and passive sampling techniques.

Active samples of $\text{PM}_{2.5}$ were collected at the Annavoy Street site once every six days using a federal reference method (FRM) Anderson RAAS $\text{PM}_{2.5}$ sampler. Active samples of $\text{PM}_{2.5}$ were also collected at each of the three primary sites, the seven satellite sites, and one urban background site once every twelve days using an Air Metrics MiniVol™ sampler. Active air samples were collected once every twelve days in passivated fused-silica lined (FSL) canisters for analysis of speciated VOCs at each of the three primary sites. Active samples were also collected once every twelve days on dinitrophenyl-hydrazine medium for analysis of speciated carbonyl compounds. In addition, active samples were collected one day per month on XAD resin with a pre-filter for analysis of speciated PAHs. The active time-integrated samples were collected over designated periods of 24 consecutive hours from midnight to midnight.

All passive samples were collected one time per month over a consecutive fourteen-day period. Passive samples were collected using activated charcoal medium for

analysis of speciated VOCs. Passive samples were also collected on dansylhydrazine medium for analysis of speciated carbonyl compounds. In addition, passive samples were collected using gas chromatographic column medium for analysis of speciated PAHs.

Percent Data Recovery for Time-Integrated Data

During the data collection period from March through May 2008, 16 total samples of PM_{2.5} were scheduled to be collected using the federal reference method at one of the primary sites, eight active samples for PM_{2.5} analysis at each of the 11 sites, eight active samples for VOC and carbonyl analyses at each of the primary sites, three active samples for PAH analysis at two of the primary sites and the one urban background site, and three passive samples each for VOC, carbonyl, and PAH analyses at each of the 11 sites. To meet the 75 percent data recovery goal for time-integrated samples, it was necessary to capture 12 of the 16 scheduled PM_{2.5} samples via the federal reference method, six of the samples scheduled for eight total samples, and all of the samples scheduled for three total samples.

The percent data recovery for the time-integrated data collected during the reporting period is presented in **Table 3**. All time-integrated active samples achieved the quarterly goal of 75% data recovery except for PAH sampling at Court. The controller on the sampler failed after approximately an hour of operation. One out of the eight scheduled PM_{2.5} MiniVol samples were invalid at Annavoy, Harrison, Logan, and Coughlin sites during this sampling period. Since those samples occurred on different days and the percent data recovery for the quarter was above 75%, these sites were not re-sampled.

All time-integrated passive VOC and PAH samples achieved the quarterly goal. During the analysis of carbonyl samples, laboratory personnel at Emory University observed that the limit of detection was more than an order of magnitude greater than usual. The high performance liquid chromatography (HPLC) lamp and column were replaced to resolve the problem. March passive carbonyl samples at Bremen and Logan sites were extracted prior to maintenance and had partially volatilized before the instrument was fixed. Therefore these samples could not be quantified.

**Table 3
 Data Recovery for Time Integrated Monitoring**

Active Samples					Passive Samples				
VOC	Mar	Apr	May	Q3	VOC	Mar	Apr	May	Q3
Annavoy	100%	100%	100%	100%	Annavoy	100%	100%	100%	100%
Bremen	100%	100%	100%	100%	Bremen	100%	100%	100%	100%
Court	100%	100%	100%	100%	Court	100%	100%	100%	100%
Carbonyl					Carbonyl				
Annavoy	100%	100%	100%	100%	Annavoy	100%	100%	100%	100%
Bremen	100%	100%	100%	100%	Bremen	0%	100%	100%	67%
Court	100%	100%	100%	100%	Court	100%	100%	100%	100%
PAH					PAH				
Annavoy	100%	100%	100%	100%	Annavoy	100%	100%	100%	100%
Court	100%	0%	100%	67%	Bremen	100%	100%	100%	100%
Harrison	100%	100%	100%	100%	Court	100%	100%	100%	100%
PM_{2.5} FRM					PM_{2.5} Minivol				
Annavoy	100%	100%	100%	100%	Annavoy	100%	67%	100%	88%
PM_{2.5} Minivol					PAH				
Annavoy	100%	67%	100%	88%	Annavoy	100%	100%	100%	100%
Bremen	100%	100%	100%	100%	Bremen	100%	100%	100%	100%
Court	100%	100%	100%	100%	Court	100%	100%	100%	100%
Harrison	67%	100%	100%	88%	Harrison	100%	100%	100%	100%
Cottage	100%	100%	100%	100%	Cottage	100%	100%	100%	100%
Constitution	100%	100%	100%	100%	Constitution	100%	100%	100%	100%
Jeffries	100%	100%	100%	100%	Jeffries	100%	100%	100%	100%
S.Bos	100%	100%	100%	100%	S.Bos	100%	100%	100%	100%
Logan	100%	100%	50%	88%	Logan	100%	100%	100%	100%
Coughlin	100%	67%	100%	88%	Coughlin	100%	100%	100%	100%
Bayswater	100%	100%	100%	100%	Bayswater	100%	100%	100%	100%

* Less than 75% valid active sampling data collected during the quarter due to sampling or analytical equipment failure.

Table 4				
Active Sample Target Pollutants				
Percent of Time Integrated Data Reported Below MDL*				
VOC	Annavoy	Bremen	Court	MDLs (ppbv)
1,3-Butadiene	100%	100%	100%	0.2
Benzene	63%	11%	63%	0.2
Toluene	50%	0%	75%	0.2
Ethylbenzene	100%	100%	100%	0.2
m&p-Xylene	88%	33%	88%	0.2
o-Xylene	100%	100%	100%	0.2
Styrene	100%	100%	100%	0.2
Acrolein	100%	89%	100%	0.5
Carbonyl	Annavoy	Bremen	Court	
Formaldehyde	0%	0%	0%	0.014
Acetaldehyde	0%	0%	0%	0.019
Propionaldehyde	38%	0%	25%	0.035
PAH	Annavoy	Court	Harrison	
Naphthalene	0%	0%	0%	5.86x10 ⁻⁴
2-Methylnaphthalene	0%	0%	0%	5.3 x10 ⁻⁴
1-Methylnaphthalene	0%	0%	0%	5.3 x10 ⁻⁴

* The results presented in this table represent a small number of the total compounds collected on the sample media. The concentration results for these additional compounds are presented in Appendix A. The MDL values are in units of parts per billion by volume (ppbv).

Table 5
Passive Sample Target Pollutant
Percent of Time Integrated Data Reported Below MDL*

VOC	Benzene	Toluene	Ethyl Benzene	m,p-Xylene	o-Xylene	Styrene
Bremen	0%	0%	0%	0%	0%	100%
Coughlin	67%	0%	0%	0%	0%	100%
Bayswater	67%	0%	0%	0%	0%	100%
All other sites	33%	0%	0%	0%	0%	100%
Detection Limit	0.075 - 0.265	0.021 - 0.061	0.016	0.017	0.016	0.014
Carbonyl	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde		
Cottage	0%	100%	0%	33%		
Constitution	0%	100%	0%	67%		
S Boston	0%	100%	0%	33%		
Coughlin	0%	100%	0%	33%		
All other sites	0%	100%	0%	0%		
Detection Limit	0.004	0.038	0.004	0.005		
PAH	Naphthalene	1-methylnaphthalene	2-methylnaphthalene			
Annavoy	100%	33%	33%			
Bremen	100%	33%	33%			
Court	100%	0%	0%			
Harrison	100%	33%	33%			
Cottage	67%	0%	0%			
Constitution	67%	0%	0%			
Jeffries	67%	0%	0%			
S Boston	33%	0%	0%			
Logan	67%	0%	0%			
Coughlin	33%	0%	0%			
Bayswater	67%	0%	0%			
Detection Limit	0.024	0.016	0.004			

* The results presented in this table represent a small number of the total compounds collected on the sample media. The concentration results for these additional compounds are presented in Appendix A. The MDL values are in units of parts per billion by volume (ppbv).

Percent Data Reported Below Minimum Detection Limit for Time Integrated Data

Tables 4 and 5 present the percent of time-integrated data reported below MDL for both the active and passive sampling program. The results presented in these tables represent a subset of the total number of compounds that were collected and analyzed from the sampling media. The concentration results for the additional compounds are presented in Appendix A.

For the active monitoring program, measurements were above the MDLs for 100 percent of the time for all target PAHs at Annavoy Street and Harrison Avenue monitoring sites. Toluene was above the MDL in all VOC samples collected at the Bremen Street site. None of the samples collected during this quarter had concentrations of 1,3-butadiene, ethylbenzene, o-xylene, or styrene above the MDL of 0.2 ppbv. In addition, acrolein was below the MDL in all samples taken at the Annavoy Street and Court Road sites. The carbonyl measurements were above the MDLs for formaldehyde and acetaldehyde at all three primary sites. The detection limit of the VOC compounds collected via the active method will be lowered by approximately an order of magnitude beginning in mid-June.

Styrene, naphthalene, and acrolein were not detected in the passive samples during this monitoring period. Analysis of known concentrations of styrene indicates that styrene may be too reactive to be collected over 14 days. Naphthalene, 1-methylnaphthalenes, 2-methylnaphthalene, propionaldehyde, and benzene were not detected in all samples. All other target PAHs, VOCs, and carbonyl compounds were detected in all passive samples taken during this monitoring period.

Comparison of Active and Passive Monitoring Data

This section provides a brief summary comparing active and passive monitoring results for the third quarter.

Active and passive VOC concentrations during this monitoring period were in the same order of magnitude.

Naphthalene was detected in the active PAH samples but not in all passive samples. The methylnaphthalenes detected in the active PAH samples were approximately an order of magnitude less than concentrations found in the passive samples.

The average concentration of target carbonyl compounds collected via the passive method were less than those collected via the active method. Formaldehyde and propionaldehyde concentrations in the passive samples were an order of magnitude smaller than those in the active samples.

Quality Control and Assurance Activities

Quality control and quality assurance (QA/QC) activities include routine and non-routine field and laboratory activities that are intended to improve or assure the quality of measured data. These activities include:

- Conduct and analyze field blanks;
- Conduct replicate and duplicate sampling analyses, and
- Conduct an independent performance audit of the monitoring instruments and sampling equipment.

The passive and active QAPPs provide more in-depth discussion of the active and passive monitoring QA/QC procedures.

The following discussion briefly addresses these activities conducted during this monitoring period. Table 6 summarizes the field and laboratory blank and duplicate samples that were analyzed during this monitoring period.

Table 6								
Summary of Samples Collected During the 3rd Quarter with Blanks and Duplicates								
Samples/Blanks/ Duplicates	Active					Passive		
	VOC	Carbonyl	PAH	PM (FRM)	PM (MV)	VOC	Carbonyl	PAH
Field Samples	24	24	9	16	88	33	33	33
Field Blanks	N/A	3	0	1	12	9	9	N/A
Field Duplicates	1	2	N/A	N/A	2	14	24	15
Lab Blanks	8	8	3	0	2	N/A	N/A	9
Lab Duplicates	8	8	N/A	N/A	N/A	N/A	N/A	N/A

N/A = not applicable to method

Field Blanks

The practice of collecting and analyzing field blanks is to provide information about contamination that may be introduced during sample collection, storage, and transport. Field blanks are to be collected on or near the scheduled federal reference method sample day and shipped back to the laboratory for analysis.

For the active sampling portion of the Study during the reporting period, there were three field blanks analyzed for speciated carbonyls. One blank was collected for PM_{2.5} FRM and twelve blanks were collected for PM_{2.5} using the MiniVol. No field blanks are specified for speciated VOCs in the QAPP. A lab blank is analyzed for VOC, carbonyl, and PAH for each sampling event. In addition, two PM_{2.5} filters used for both the FRM and MiniVol sampling were analyzed. Lab and field blanks did not

have quantifiable concentrations (i.e., concentration above the MDL) of the target compounds. Details of the field blank results can be found in the data tables in Appendix A.

For the passive portion of the Study during the reporting period, field blanks were analyzed for speciated VOCs and for speciated carbonyl compounds; there were no field blanks analyzed for speciated PAHs. A total of nine carbonyl blanks and nine VOC blanks were taken at different sites during this reporting period. For PAHs, laboratory blanks were analyzed. Concentrations of target compounds in lab and field blanks were below the detection limits.

Data Precision (Replicate and Duplicate Sampling)

Data precision is one of the measures used to assess the quality of the monitoring data. Data precision is the degree of mutual agreement among individual measurements under identical or substantially similar conditions measured as either the range or as the standard deviation. This can be done by either using the same analytical instrument to make repeated analyses of the same (replicate) sample, or it can be done by collecting, processing and analyzing collocated (duplicate) samples. For integrated samples with subsequent laboratory analysis, precision was determined by laboratory replicate analyses. Laboratory replication involves splitting a single sample in the laboratory and performing replicate tests. For continuous measurements, it is determined by periodic presentation of transfer standards to the measurement system.

For the active portion of the Study during the reporting period, one VOC and two carbonyl collocated (duplicate) samples were collected at the Bremen Street site. The concentrations of the target compounds in the duplicate carbonyl samples were 12 to 66% higher than the concentrations found in the primary sample. VOC target compound concentrations in the duplicate sample were also higher than those in the primary sample. In addition, two duplicate samples of PM_{2.5} were collected using a MiniVol. These duplicate samples also showed PM_{2.5} concentrations that differed by up to 27% from the other collocated samples. It should also be noted that there are collocated active measurements of PM_{2.5} being made at the three primary sites. The Annavoy Street site includes sample collection for PM_{2.5} via a federal reference method as well as via a minivol, and continuous measurement of PM_{2.5} via the BAM. Both the Bremen Street site and the Court Road site include both a minivol and a BAM. However, since the collocated methods at each of these sites represent different methodologies, a direct comparison of the collocated results is not a true measure of precision for PM_{2.5}.

Replicate analysis of one carbonyl and one VOC sample was performed in the laboratory for every sampling event which provides a measure of the precision, or reproducibility, of the sample data. The difference in the results of the replicate

analyses for the three target carbonyl compounds were less than 20 percent; due to the low concentration of the reported sample, this level of precision is considered acceptable.

For the passive portion of the Study, 14 VOC, 15 PAH, and 24 carbonyl duplicate samples were collected during this reporting period. The locations of the duplicates were rotated to avoid collecting duplicates at the same site each month. Because the measured concentrations for all pollutants have been found to be low, precision results are generally greater than 10 percent.

Next Report

The next reporting period will be for June through September 2008. The monitoring report will present the monitoring results and will include a discussion of any changes made to improve the monitoring program. The fourth quarter report will be available at the end of October 2008.

If you have any questions, or would like to discuss further these results, please do not hesitate to contact Asami Tanimoto at (617) 452-6367 or George Siple at (919) 787-5620.

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Appendix A
CD-ROM Disk
Air Quality Monitoring and Meteorological Data