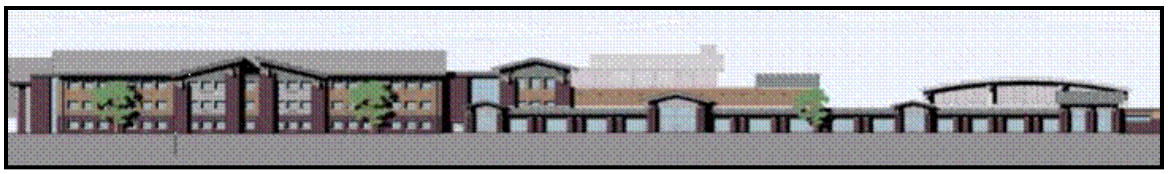
Sampling Results for the Keith Middle School Foundation Vent Stack and Indoor Air for Polychlorinated Biphenyls

December 2014 Monitoring Round



Prepared for:

Department of Environmental Stewardship
City of New Bedford
133 William Street
New Bedford, Massachusetts 02740

Prepared by:

TRC Environmental Corporation
Wannalancit Mills
650 Suffolk Street
Lowell, Massachusetts 01854
(978) 970-5600

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EXECUTIVE SUMMARY

TRC Environmental Corporation (TRC) of Lowell, Massachusetts was retained by the City of New Bedford (the City) to provide sampling support in conducting foundation vent stack and indoor air sampling for polychlorinated biphenyls (PCBs) at the Keith Middle School (KMS) in New Bedford, Massachusetts. This report documents the indoor air and vent stack sampling performed by TRC during December 2014.

The sampling and analysis of vent stack and indoor air for the KMS is described in the *Revised Long-Term Monitoring and Maintenance Implementation Plan* (LTMMIP), revision 5.5, dated August 2012. The indoor air PCB sampling program involved the collection of one indoor air sample from the ground floor of each of the three school building sections (Building A, Building B, and Building C). Concurrently with the indoor air sampling, air sampling of the sub-slab foundation ventilation system for PCBs was performed from four selected rooftop vent stacks, including VS-1 which vents building Section A west side (near the front of the school), VS-4 which vents building Section A east side (near the front of the school), VS-9 which vents Section B (near the kitchen), and VS-14 which vents the gymnasium. The passive sub-slab ventilation system was installed to allow sub-slab soil vapors to migrate from beneath the vapor barrier to the vent stacks, installed through the school building roof. An air sample was also collected immediately outside of the school during this round to provide comparative background results.

The samples were analyzed for PCBs according to EPA Method 680 (PCB homologues) by Pace Analytical Services of Schenectady, New York. This PCB method reliably quantifies total PCB concentrations, making analytical results directly comparable to total PCB concentration data for indoor air at New Bedford High School.

During the December 2014 sampling round, PCBs were detected at the three indoor air sampling locations. However, PCBs were not detected in any of the vent stack air samples or the corresponding outdoor air background sample.

Detected concentrations for PCBs in indoor air samples were generally consistent with urban ambient air background levels. PCB concentrations in indoor air have fluctuated slightly between August 2006 and December 2014, consistent with background conditions, but all detected concentrations are below indoor air concentrations that would be of concern for the health of building occupants.

PCB indoor air concentrations were compared to site-specific outdoor air concentrations and risk-based air concentrations (RBACs). Two PCB RBACs have been developed for the KMS, assuming occupational exposures within the school (8 hours/day, 250 days/year, for 25 years). The first RBAC is the Action Level (AL; 0.05 ug/m^3), which is used as an initial indicator that PCB air concentrations above background levels have been detected. The second RBAC is the Acceptable Long-Term Average Exposure Concentration (ALTAEC; 0.3 ug/m^3), indicative of the air concentration that should not be exceeded for an extended time period. PCB indoor air concentrations were also compared to EPA's Public Health Level (PHL) (USEPA, 2009; 0.45 ug/m^3) developed to be protective of indoor school air exposures for adult employees and 12 to <15 year-old students. Indoor air PCB concentrations were lower than RBACs and EPA's PHL.

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1.0 INTRODUCTION

1.1 Overview

TRC Environmental Corporation (TRC) of Lowell, Massachusetts was retained by the City of New Bedford (the City) to provide sampling support in conducting foundation vent stack and indoor air sampling for polychlorinated biphenyls (PCBs) at the Keith Middle School (KMS) in New Bedford, Massachusetts. This report documents the indoor air and vent stack sampling performed by TRC during December 2014.

Soil gas sampling was performed under the location of the KMS building in December 2001. In addition to PCBs present in soil at this location, volatile organic compounds (VOCs) were also detected in the soil gas samples. The results of the December 2001 soil gas sampling event were evaluated for potential adverse impacts on indoor air quality, assuming no vapor barrier was installed. Despite the conclusion that no significant risk to human health is posed by the measured soil gas concentrations, the City and School Department decided to install a vapor barrier on top of the soil beneath the school building concrete floor as an added layer of protection against intrusion of any gases that may accumulate under the building. Passive ventilation has been installed to allow any sub-slab soil gases to migrate from beneath the vapor barrier to the vent stacks, installed through the school building roof.

Sampling and analysis of vent stack and indoor air was performed between July 2007 and April 2012 as part of United States Environmental Protection Agency (EPA) approved *Long-Term Monitoring and Maintenance Implementation Plan* (LTMMIP), revision 4, dated October 20, 2006. The LTMMIP was prepared by The BETA Group, Incorporated (BETA) in accordance with the August 31, 2005 *Approval for Risk-Based PCB Cleanup and Disposal under 40 CFR §761.6(c)* letter issued by EPA to the City. The LTMMIP set forth a vent stack and indoor air sampling schedule consisting of three monitoring events per year for the first year (July/August, December, April 2007), with the understanding that the City may submit a written request to EPA to reduce the indoor air sampling frequency after the first year of monitoring. However, per the order of the Mayor of the City, vent stack and indoor air monitoring took place monthly during the period of September 2006 to July/August 2007. Following the July/August 2007 sampling event, monitoring was reduced to once every four months, consistent with the 2006 LTMMIP. Monitoring from September 2006 through February 2007 was conducted by BETA and is reported elsewhere.

The sampling program described in the 2006 LTMMIP consisted of the collection of indoor air quality and vent stack samples for the analysis of PCBs and VOCs. Sampling of indoor air quality and vent stack air for PCBs and VOCs has been conducted for 29 monitoring events between July 2007 and April 2012 to confirm the proper functioning of the passive ventilation system. Between 2007 and 2012, PCBs and VOCs were detected in both indoor air and vent stack air samples. However, concentrations of PCBs and VOCs in indoor air samples were lower, in general, than those observed in vent stack air samples. The presence of higher levels of VOCs and PCBs in vent stack air samples is an expected finding for a sub-slab ventilation system and indicates that the passive ventilation system is performing as designed.

Based on the sampling data collected between 2007 and 2012, VOCs were determined to be present in indoor air due to off-gassing from building materials and the storage and use of cleaners, adhesives, paints, and other VOC-containing products indoors at the school. Concentrations of PCBs detected in indoor air samples are consistent with background levels measured in outdoor air samples collected simultaneously. Levels of VOCs detected in indoor air fluctuated and demonstrated noticeable decreasing trends over time.

Although PCBs and VOCs were measured in indoor air and vent stack air samples, the concentrations detected were determined to not pose a significant risk to human health, based on the comparison of concentrations to both background concentrations and applicable risk-based criteria (TRC, 2008a, 2008b, 2008c, 2008d, 2009a, 2009b, 2009c, 2010a, 2010b, 2011a, 2011b, 2011c, 2011d, 2012a and 2012b).

In 2011, the City proposed modifying the 2006 LTMMIP to reflect the detailed understanding of the site conceptual model (e.g., impacts from indoor use of commercially available cleaners, paints, adhesives, etc.), the relationship between vent measurements and historical soil gas measurements that illustrate the proper functioning of the passive sub-slab ventilation system, and long-term downward trends for indoor air and passive vent system concentrations of VOCs originating from building materials.

On August 27, 2012, USEPA approved the City's proposed revision to the LTMMIP, revision 5.5. This report presents monitoring data collected during December 2014, the sixth round of air sampling data collected under the 2012 LTMMIP. The results for the first five rounds of air sampling data collected under the 2012 LTMMIP are presented in TRC, 2012d, TRC, 2013a, TRC,2013b, TRC, 2014a and TRC, 2014b. The 2012 LTMMIP differs from the 2006 LTMMIP in a number of ways that are reflected in this report:

1. Analysis of indoor air and vent stack air samples for VOCs has been eliminated because VOCs are not the principal contaminants in soil and fill, and air monitoring conducted to date indicates that the remedy implemented for the KMS site is functioning as intended.

2. Indoor air and vent stack air sampling frequency has been reduced from three times per year to two times per year because air monitoring conducted to date demonstrates that the remedy implemented for the KMS site is preventing airborne release of PCBs that remain in the soil to the building.

3. The number of background air samples has been reduced from two samples to one sample because the single sample is sufficient to determine outdoor air concentrations of PCBs.

4. PCB analysis of indoor air and vent stack air samples includes quantification of homologue groups, but not Aroclors or individual congeners, because the homologue groups provide a sufficient and accurate measure of total PCB concentrations in air.

5. The comparison of vent stack air samples to health-based air concentrations has been eliminated because vent samples are not representative of the air that people breathe.

Therefore, vent stack air concentrations are not comparable to the health-based air concentrations.

1.2 Scope of Work

Sampling and analysis of vent stack and indoor air is performed as part of United States Environmental Protection Agency (EPA) approved *Long-Term Monitoring and Maintenance Implementation Plan* (LTMMIP), revision 5.5, dated August 2012 and approved by EPA on August 27, 2012.

The December 2014 sampling occurred during the school vacation week. Details concerning the sample collection procedures and analytical methods are described in Appendix A. Sampling data sheets are provided in Appendix B and the reduced data are presented in Appendix C. The calibration certifications can be found in Appendix D. Laboratory analytical results are presented in Appendix E.

Field sampling data were validated by the Field Team Leader and/or the Field Quality Control Coordinator based on their review of adherence to each approved sampling protocol and written sample collection procedure. Details concerning quality assurance procedures are described in Appendix A. The laboratory data validation memoranda can be found in Appendix F.

The following sections describe those features of the field sampling program, quality assurance/quality control (QA/QC) program, and data analysis that are specific to the December 2014 event. Generic information on the sampling and QA/QC programs and data analysis procedures can be found in Appendices A and G, respectively.

2.0 SAMPLING LOCATIONS

2.1 Indoor Air Quality Sample Locations

During the sampling event, one indoor air PCB sample was collected from the ground floor of each of the three school building sections (Building A, Building B, and Building C). Each sampling location was selected to be representative of portions of the school building normally occupied by students and teachers. The Building A sampling location is located within a hallway in an area of student classrooms. The Building B sampling location is located in the school cafeteria. The Building C sampling location is in the hallway between the auditorium and community room. These indoor air sampling locations have remained consistent throughout TRC's sampling program, with the exception of the December 2007 Building B sample which was collected in the school cafeteria at the request of the City. An outdoor air sample and a duplicate sample were collected from near the flagpole area immediately outside of the school to provide comparative background results.

Figure 2-1 presents the approximate locations of indoor air sampling. Table 2-1 summarizes the indoor air samples collected during the December 2014 sampling event. These samples were assigned sample identification numbers that include (1) the letter A, B, or C to identify the building section from which the sample was collected; and (2) a unique sample identification suffix indicating the sampling event number (e.g., A-35).

2.2 Foundation Vent Air Monitoring Sample Locations

The KMS foundation venting system is comprised of six sub-slab vapor collection zones, each vented by two or four vent stacks penetrating the roof. A total of four vent stacks are sampled during each round, including VS-1 and VS-4 which vent from the two collection zones located under building Section A (classrooms), and two other vent stacks which are rotated to cover the remaining collection zones (i.e., VS-9 and VS-14 for this sampling event). A duplicate sample was also collected from the VS-9 sampling location. PCB concentrations in vent stack air were compared to the outdoor air samples described in Section 2.1 that define background conditions.

Figure 2-2 presents the approximate locations of the vent stack sample locations. Table 2-1 summarizes the vent stack samples collected during the December 2014 sampling event. Vent stack samples collected during the December 2014 sampling event were designated with the vent stack number (e.g., VS-4) and a unique sample identification suffix indicating the sampling event number (e.g., VS-4-35).

3.0 QUALITY ASSURANCE

This section highlights the results of the QA/QC review for the December 2014 sampling event. Please refer to Appendix A for additional QA/QC details.

3.1 Data Validation Summary

Limited (Tier II) validation was performed on the data for 10 air samples and two trip blank samples collected at the Keith Middle School in New Bedford, Massachusetts. The samples were collected on December 30, 2014 and submitted to Pace Analytical Services (Pace) in Schenectady, New York for analysis. All air vent samples were collected on polyurethane foam (PUF) cartridges in accordance with EPA method TO-10A; all indoor and background outdoor air samples were collected on particulate filters and PUF cartridges in accordance with EPA method TO-4A. The samples were analyzed for polychlorinated biphenyl (PCB) homologues using EPA method 680. Pace reported the results under job number 13090035.

The sample results were assessed using the *EPA New England Data Validation Functional Guidelines for Evaluating Environmental Analyses*, revised December 1996. Modification of these guidelines was performed to accommodate the non-CLP methodology.

In general, the data appear to be valid as reported and may be used for decision-making purposes. Appendix F contains the complete Laboratory Data Validation Memoranda.

3.2 Collocated Sampler Precision

Samples VS-9-35/VS-9-35-DUP (PUF) and BG-35/BG-35 DUP (PUF/Filter) were submitted as the field duplicate (collocated) pairs with this sample set. PCBs were not detected in samples VS-9-35/VS-9-35-DUP (PUF) and BG-35/BG-35 DUP (PUF/Filter). Tables 3-1 and 3-2 summarize the relative percent differences (RPDs) of the detected analytes in sample pairs BG-35/BG-35 DUP and VS-9-35/VS-9-35 DUP, respectively. As shown in Tables 3-1 and 3-2, RPDs could not be calculated because of non-detect results in both of the collocated sample pairs. All results are usable for project objectives.

4.0 SUMMARY OF RESULTS

Table 2-1 provides a summary of the types, numbers, and locations of the samples collected. Appendices E and F contain the laboratory data reports and data validation memoranda, respectively. Along with the samples, TO-4A and TO-10A trip blanks were analyzed as a quality assurance measure to check for shipping and laboratory-related sources of contamination.

All results represent "total PCB" concentrations. PCBs were not detected in the indoor air quality or vent stack air trip blanks. Low level fluctuations of PCB concentrations in indoor air are generally consistent with urban indoor background levels. Sporadic detected concentrations of PCBs in vent stack air are expected, and indicate that the passive ventilation system is performing as designed.

4.1 Indoor Air Quality Results

On December 30, 2014, TRC collected three indoor and one outdoor background (plus one duplicate) 24-hour TO-4A air samples at the KMS. Table 4-1 provides a summary of PCB indoor air results. Table 4-3 provides a complete list of total PCB indoor air results from August 2006 thru December 2014.

PCBs were detected in the three indoor air samples. However, PCBs were not detected in the background outdoor air sample or in the duplicate sample. PCB concentrations in the indoor air samples ranged from 0.00874 ug/m^3 in the Building B sample to 0.00405 ug/m^3 in the Building A sample. The PCB concentration in the Building B sample is consistent with the maximum concentrations reported in the April 2009, August 2010, April 2011, August 2012, January 2013, August 2013, February 2014 and October 2014 sampling rounds.

4.2 Vent Stack Air Results

On December 30, 2014, TRC collected four (plus one duplicate) vent stack 4-hour TO-10A samples at the KMS. Table 4-2 provides a summary of results for the vent stack samples, and the results of the outdoor background 24-hour TO-4A air sample and its duplicate sample.

PCBs were not detected in the vent stack samples. As previously stated in Section 4.1, PCBs were not detected in the background outdoor air sample or in the duplicate sample.

5.0 COMPARISON OF INDOOR AIR PCB RESULTS TO RISK-BASED AIR CONCENTRATIONS

This section of the report compares PCB concentrations in indoor air to outdoor air and risk-based air concentrations (RBACs). These concentrations are presented in Table 5-1.

A detailed discussion of the RBACs can be found in Appendix G. Two PCB RBACs have been developed for the KMS. The first RBAC is the Action Level (AL; 0.05 ug/m^3) used as an initial indicator that PCB air concentrations above background levels have been detected. The second RBAC is the Acceptable Long-Term Average Exposure Concentration (ALTAEC; 0.3 ug/m^3), indicative of the air concentration that should not be exceeded for an extended time period. The ALTAEC could be exceeded over the short-term and still result in acceptable risk levels. In September 2009, EPA published Public Health Levels (PHLs) which are indoor air concentrations that EPA believes protect building occupants (USEPA, 2009). PHLs were calculated for all ages of children from toddlers in day care to adolescents in high school as well as for adult school employees. In this report, indoor air PCB concentrations are compared to the PHL for adult school employees and children 12 to <15 years old, representative of the middle school age range.

Indoor air sampling results, outdoor air background results, and RBACs are presented in Table 5-1. As noted in Section 4.1, PCBs were detected at all three of the indoor air sampling locations (Buildings A, B, and C), but not in the outdoor air background sample or the duplicate outdoor air background sample. The highest indoor air PCB concentration (Building B sample) was approximately 6-fold lower than the PCB AL and roughly 34-fold lower than the ALTAEC; the Building A and Building C samples displayed concentrations of PCBs up to 12-fold lower than the AL and 74-fold lower than the ALTAEC. Because the PCB AL is used as an initial indicator that PCB air concentrations above background levels for indoor air have been detected and the detected concentrations of PCBs are significantly less than the AL, concentrations of PCBs in indoor air are consistent with levels associated with ambient conditions. The indoor air samples were also between 50- and 110-fold lower than the EPA PHL. Because there are no indoor air PCB concentrations in excess of the RBACs, no specific follow-up actions are recommended at this time.

Temporal trends for PCB indoor air concentrations at the sampling locations in Building A (classrooms), Building B (auditorium), and Building C (faculty dining area) are shown in Figure 5-1. Figure 5-1 also shows concentration trends at the outdoor air background sampling location. Data included on this figure are for the time period August 2006 to December 2014. The highest indoor air PCB concentration was detected during the April 2009 sampling event when the school was likely experiencing lower than normal air exchange (school vacation) and the potential for volatilization of PCBs from outdoor ambient sources is greater due to the warmer weather. The lowest indoor air PCB concentration was detected during the November 2006 sampling event.

No clear trends are noted for PCB concentrations in indoor air. Measured concentrations fluctuate over time, with slightly higher concentrations noted during the summer school vacation period when the building is experiencing lower than normal air exchange and the potential for

volatilization of PCBs from outdoor ambient sources is greatest due to warmer weather. The low level PCB indoor air concentrations are generally consistent with urban ambient background conditions. Based on the PCB indoor air results collected between August 2006 and December 2014, it appears that there is variability in indoor air concentrations and the slightly higher concentrations sporadically detected are not part of a trend. Despite this slight variability, PCBs have never been detected at concentrations above the RBACs or the EPA PHL.

6.0 CONCLUSIONS

Indoor air quality and vent stack air sampling was conducted at the KMS during December 2014 for PCBs. Indoor and vent stack air data were evaluated for quality and reliability, and indoor air concentrations were compared to risk-based air concentrations and analyzed for concentration trends over the period August 2006 to December 2014. The following summarizes the conclusions of the air sampling data evaluation.

In general, all TO-4A and TO-10A data collected during December 2014 were determined to be valid as reported and usable for decision-making purposes.

PCBs were detected in the three indoor air samples, but not in the outdoor air background sample or the duplicate outdoor air background sample. The detected PCB concentrations for the indoor air samples were below risk-based action levels. The low level fluctuations of PCB indoor air concentrations are generally consistent with concentrations found in urban ambient air background.

PCBs were not detected in the four vent stack air samples or the duplicate vent stack air sample. The sporadic presence of PCBs in vent stack air is expected, and indicates that the passive ventilation system is performing as designed.

August 2015 is the date for the next sampling event.

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TABLES

Table 2-1. December 2014 Sample Summary
Keith Middle School
New Bedford, Massachusetts

Sample ID	Sample Location	Sample Collected	Sample Type
A	Building A, center of west hallway	X	IAQ
B	Building B, Auditorium	X	IAQ
C	Building C, Community room (hallway)	X	IAQ
BG	Background, flagpole area outside main entrance to Building A	XX	IAQ
VS-1	Building A, vent stack 1	X	Vent Stack
VS-4	Building A, vent stack 4	X	Vent Stack
VS-5	Building B, vent stack 5		Vent Stack
VS-7	Building B, vent stack 7		Vent Stack
VS-8	Building B, vent stack 8		Vent Stack
VS-9	Building B, vent stack 9	XX	Vent Stack
VS-10	Building B, vent stack 10		Vent Stack
VS-11	Gymnasium , vent stack 11		Vent Stack
VS-12	Gymnasium, vent stack 12		Vent Stack
VS-13	Gymnasium, vent stack 13		Vent Stack
VS-14	Gymnasium, vent stack 14	X	Vent Stack
VS-16	Building A , vent stack 16		Vent Stack
VS-BG	On the ground at main entrance to Building A		Vent Stack

X - Sample collected at this location during this sampling round.
XX - Sample and duplicate collected at this location during this sampling round.

Table 3-1. Comparison of PCB Indoor Air Sample Results - Collocated Sampler Precision
Keith Middle School
New Bedford, Massachusetts

		Dec-14		
Analysis	**Analyte**	**BG-35**	**BG-35 Dup**	**RPD (%)**
PCBs				
(µg/m3)	monochlorobiphenyl	< 0.0000170	< 0.0000140	NC
	dichlorobiphenyl	< 0.0000170	< 0.0000140	NC
	trichlorobiphenyl	< 0.0000170	< 0.0000140	NC
	tetrachlorobiphenyl	< 0.0000330	< 0.0000290	NC
	pentachlorobiphenyl	< 0.0000330	< 0.0000290	NC
	hexachlorobiphenyl	< 0.0000330	< 0.0000290	NC
	heptachlorobiphenyl	< 0.0000500	< 0.0000430	NC
	octachlorobiphenyl	< 0.0000500	< 0.0000430	NC
	nonachlorobiphenyl	< 0.0000830	< 0.0000720	NC
	decachlorobiphenyl	< 0.0000830	< 0.0000720	NC
($\mu g/m^3$)	Total PCBs	< 0.0000830	< 0.0000720	NC

Notes:

RPD - Relative Percent Difference = ABS(Dup-Sample)/((Dup+Sample)/2)*100

NC - Not Calculated; RPD could not be calculated due to a non-detect in one or both of the collocated samples

Detected values are shown in bold

Table 3-2. Comparison of PCB Vent Stack Air Sample Results - Collocated Sampler Precision
Keith Middle School
New Bedford, Massachusetts

		Dec-14		
Analysis	**Analyte**	**VS-9-35**	**VS-9-35 DUP**	**RPD (%)**
PCBs				
(µg/m3)	monochlorobiphenyl	< 0.00820	< 0.00490	NC
	dichlorobiphenyl	< 0.00820	< 0.00490	NC
	trichlorobiphenyl	< 0.00820	< 0.00490	NC
	tetrachlorobiphenyl	< 0.0164	< 0.00980	NC
	pentachlorobiphenyl	< 0.0164	< 0.00980	NC
	hexachlorobiphenyl	< 0.0164	< 0.00980	NC
	heptachlorobiphenyl	< 0.0246	< 0.0147	NC
	octachlorobiphenyl	< 0.0246	< 0.0147	NC
	nonachlorobiphenyl	< 0.0410	< 0.0245	NC
	decachlorobiphenyl	< 0.0410	< 0.0245	NC
(µg/m^3)	Total PCBs	< 0.0410	< 0.0245	NC

Notes:
RPD - Relative Percent Difference = ABS(Dup-Sample)/((Dup+Sample)/2)*100
NC - Not Calculated; RPD could not be calculated due to a non-detect in one or both of the collocated samples
Detected values are shown in bold

Table 4-1. Indoor Air Quality Sample Results - December 2014
Keith Middle School
New Bedford, Massachusetts

		Sample Locations			Background		QA/QC
Analysis	**Analyte**	**A-35**	**B-35**	**C-35**	**BG-35**	**BG-35 Dup**	**Trip Blank**
PCBs							
(µg/m3)	monochlorobiphenyl	< 0.0000140	< 0.0000290	< 0.0000140	< 0.0000170	< 0.0000140	< 0.005 ug
	dichlorobiphenyl	< 0.0000140	< 0.0000290	**0.000379**	< 0.0000170	< 0.0000140	< 0.005 ug
	trichlorobiphenyl	**0.00375**	**0.00874**	**0.00627**	< 0.0000170	< 0.0000140	< 0.005 ug
	tetrachlorobiphenyl	**0.000294**	< 0.0000570	**0.000785**	< 0.0000330	< 0.0000290	< 0.01 ug
	pentachlorobiphenyl	< 0.0000290	< 0.0000570	< 0.0000290	< 0.0000330	< 0.0000290	< 0.01 ug
	hexachlorobiphenyl	< 0.0000290	< 0.0000570	< 0.0000290	< 0.0000330	< 0.0000290	< 0.01 ug
	heptachlorobiphenyl	< 0.0000430	< 0.0000860	< 0.0000430	< 0.0000500	< 0.0000430	< 0.015 ug
	octachlorobiphenyl	< 0.0000430	< 0.0000860	< 0.0000430	< 0.0000500	< 0.0000430	< 0.015 ug
	nonachlorobiphenyl	< 0.0000710	< 0.000143	< 0.0000720	< 0.0000830	< 0.0000720	< 0.025 ug
	decachlorobiphenyl	< 0.0000710	< 0.000143	< 0.0000720	< 0.0000830	< 0.0000720	< 0.025 ug
($\mu g/m^3$)	Total PCBs	**0.00405**	**0.00874**	**0.00744**	< 0.0000830	< 0.0000720	< 0.025 ug

Notes:

$\mu g/m^3$ - micrograms per cubic meter
PCBs - polychlorinated biphenyls
µg - micrograms; trip blank results are presented in micrograms (µg) due to no air volume being collected during analysis.
Reporting Limit for Total PCBs is the highest individual homolog PQL (practical quantitation limit) per sample.
Values in **Bold** indicate the compound was detected.
< - less than laboratory reporting limit
J - Detected result reported is estimated
UJ - Non-Detect result reported is estimated

Table 4-2. Vent Stack Sample Results - December 2014
Keith Middle School
New Bedford, Massachusetts

		Sample Locations					Background		QA/QC
Analysis	**Analyte**	**VS-1-35**	**VS-4-35**	**VS-14-35**	**VS-9-35**	**VS-9-35-DUP**	**BG-35**	**BG-35 Dup**	**Trip Blank-VS**
PCBs									
(µg/m3)	monochlorobiphenyl	< 0.00556	< 0.00725	< 0.00446	< 0.00820	< 0.00490	< 0.0000170	< 0.0000140	< 0.005 ug
	dichlorobiphenyl	< 0.00556	< 0.00725	< 0.00446	< 0.00820	< 0.00490	< 0.0000170	< 0.0000140	< 0.005 ug
	trichlorobiphenyl	< 0.00556	< 0.00725	< 0.00446	< 0.00820	< 0.00490	< 0.0000170	< 0.0000140	< 0.005 ug
	tetrachlorobiphenyl	< 0.0111	< 0.0145	< 0.00893	< 0.0164	< 0.00980	< 0.0000330	< 0.0000290	< 0.01 ug
	pentachlorobiphenyl	< 0.0111	< 0.0145	< 0.00893	< 0.0164	< 0.00980	< 0.0000330	< 0.0000290	< 0.01 ug
	hexachlorobiphenyl	< 0.0111	< 0.0145	< 0.00893	< 0.0164	< 0.00980	< 0.0000330	< 0.0000290	< 0.01 ug
	heptachlorobiphenyl	< 0.0167	< 0.0217	< 0.0134	< 0.0246	< 0.0147	< 0.0000500	< 0.0000430	< 0.015 ug
	octachlorobiphenyl	< 0.0167	< 0.0217	< 0.0134	< 0.0246	< 0.0147	< 0.0000500	< 0.0000430	< 0.015 ug
	nonachlorobiphenyl	< 0.0278	< 0.0362	< 0.0223	< 0.0410	< 0.0245	< 0.0000830	< 0.0000720	< 0.025 ug
	decachlorobiphenyl	< 0.0278	< 0.0362	< 0.0223	< 0.0410	< 0.0245	< 0.0000830	< 0.0000720	< 0.025 ug
($\mu g/m^3$)	Total PCBs	< 0.0278	< 0.0362	< 0.0223	< 0.0410	< 0.0245	< 0.0000830	< 0.0000720	< 0.025 ug

Notes:
$\mu g/m^3$ - micrograms per cubic meter
PCBs - polychlorinated biphenyls
µg - micrograms; trip blank results are presented in micrograms (µg) due to no air volume being collected during analysis.
Reporting Limit for Total PCBs is the highest individual homolog PQL (practical quantitation limit) per sample.
Values in **Bold** indicate the compound was detected.
< - less than laboratory reporting limit
J - Detected result reported is estimated
UJ - Non-Detect result reported is estimated

Table 4-3. Total PCB Results in KMS Indoor Air Quality (IAQ) Samples August 2006 through December 2014 (24hr Sample, Method TO-4A [ug/m3])

Sampling Date	Hallway Building A	Auditorium Building B	Faculty Dining Building C	Background Outside	Background Outside (DUP)
AL	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
ALTAEC	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*
8/5/2006	< 0.0000007	< 0.0000007	< 0.0000007	**0.0006**	NS
8/19/2006	< 0.0000007	**0.00023**	< 0.0000007	**0.00031**	NS
9/15/2006	**0.00273**	**0.0011**	**0.00052**	**0.00989**	**0.00995**
10/24/2006	**0.00087**	**0.00027**	**0.00008**	**0.00007**	NS
11/30/2006	**0.00105**	**0.00079**	**0.00003**	**0.00014**	**0.00014**
12/29/2006	**0.00005**	< 0.0000007 [2]	**0.00005**	**0.00008**	**0.00004**
1/20/2007	NS	NS	NS	NS	NS
3/31/2007	**0.0015**	**0.00064**	**0.00037**	< 0.0001850	< 0.0001900
4/18/2007	**0.0013**	**0.00031**	**0.0016**	< 0.0000950	< 0.0000950
5/19/2007	**0.00038**	**0.001**	**0.00051** [3]	< 0.0001050	< 0.0001000
6/21/2007	**0.003**	**0.0032**	**0.0016**	< 0.0001000	< 0.0001000
8/1/2007	**0.0018**	< 0.0001900	**0.0057**	< 0.0000750	< 0.0000750
12/27/2007	**0.003**	**0.00094** [2]	**0.0011**	< 0.0001850	**0.000035**
4/25/2008	< 0.0000700	< 0.0000360	< 0.0000355	< 0.0000355	< 0.0000355
7/16/2008	**0.0018**	**0.0075**	**0.0017**	< 0.0000700	< 0.0000370
12/29/2008	NS	NS	NS	NS	NS
2/19/2009	< 0.0001900	< 0.0001900	< 0.0000750	< 0.0000400	< 0.0000390
4/23/2009	**0.013**	**0.0034**	**0.0095**	< 0.0000400	< 0.0000400
8/20/2009	**0.00875** [1]	**0.00577**	**0.00366** [3]	**0.000759**	**0.00072**
12/29/2009	**0.00288**	**0.00165**	**0.00616**	< 0.0000389	NS
4/20/2010	**0.006163**	**0.000384**	**0.000882**	**0.0000614**	**0.000226**
8/24/2010	**0.0064**	**0.0049**	**0.0114**	**0.0029**	**0.0029**
12/29/2010	**0.0012**	**0.0027**	**0.0135**	< 0.0000500	NS
4/21/2011	**0.0036**	**0.0040**	**0.0115**	< 0.0000380	**0.0002**
8/24/2011	**0.0062**	**0.0090**	**0.0085**	< 0.0000425	**0.0005**
12/29/2011	**0.0036**	**0.0057**	**0.0054**	< 0.0000340	< 0.0000330
4/18/2012	**0.00499**	**0.0130**	**0.00578**	**0.000832**	< 0.0000330
8/30/2012	**0.00452**	**0.0061**	**0.01090**	**0.00158**	< 0.0000395
1/28/2013	**0.00333**	**0.0039** [2]	**0.00414** [3]	< 0.0000780	NS
8/30/2013	**0.00452**	**0.0054**	**0.00655**	< 0.0000730	< 0.0000710
2/20/2014	**0.00345**	**0.00339**	**0.00407**	< 0.0000730	< 0.0000730
10/14/2014	**0.0114**	**0.0104**	**0.00566** [3]	**0.000104**	< 0.0000180
12/30/2014	**0.00405**	**0.00874**	**0.00744** [3]	< 0.0000830	< 0.0000720

AL = Action Level = 0.05 ug/m^3

ALTAEC = Acceptable Long-Term Average Exposure = 0.3 ug/m^3

NS = Not Sampled

BOLD = Positive Detection

1. Sampler moved to front lobby due to work in halls
2. Sampler moved to cafeteria due to auditorium in use
3. Sampler moved to hallway outside of community room due to room in use.

Table 5-1. Comparison of PCB Indoor Air Quality Sample Results to Risk-Based Air Concentrations - December 2014
Keith Middle School
New Bedford, Massachusetts

		Sample Locations			Background Location		QA/QC			
Analysis	**Analyte**	**A-35**	**B-35**	**C-35**	**BG-35**	**BG-35 Dup**	**Trip Blank**	**Comparison Values**		
PCBs								**AL***	**ALTAEC***	**PHL****
($\mu g/m^3$)	Total PCBs	**0.00405**	**0.00874**	**0.00744**	< 0.0000830	< 0.0000720	< 0.025 ug	0.05	0.3	0.45

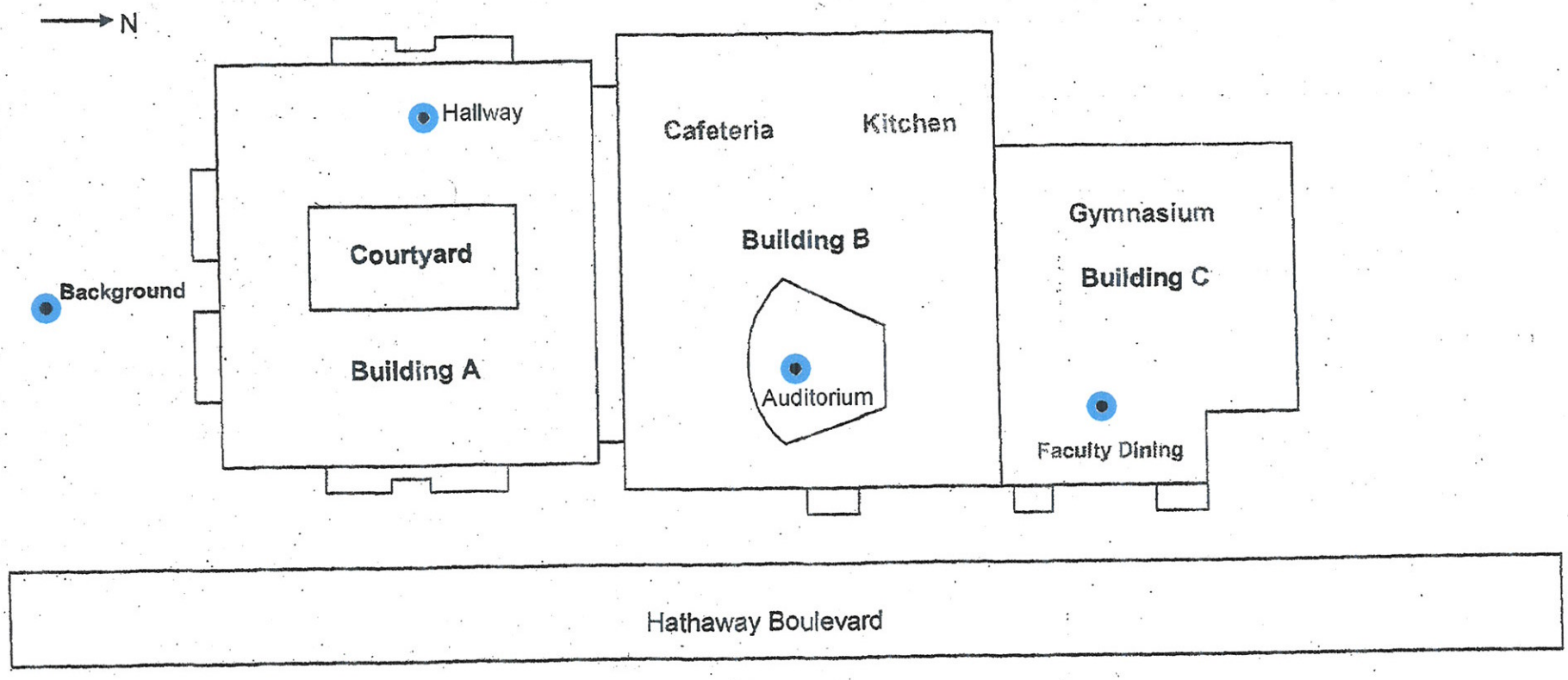
Notes:

$\mu g/m^3$ - micrograms per cubic meter
PCBs - polychlorinated biphenyls
ug - micrograms; trip blank results are presented in micrograms (ug) since no air volume is collected for the trip blank

PCB results for indoor air are compared to contemporary outdoor air (background) sample and MassDEP indoor air background values.
* PCBs are compared to the EPA site specific Action Level (AL) and the Acceptable Long-Term Average Exposure Concentration (ALTAEC).
** PCBs are compared to the lowest of the EPA Public Health Level for PCBs in School Indoor Air (September 2009) for adult employees and children 12-<15 year olds (http://www.epa.gov/pcbsincaulk/)
Reporting Limit for Total PCBs is the highest individual homolog PQL (practical quantitation limit) per sample.

FIGURES

Keith Middle School
Indoor Air Sampling Locations



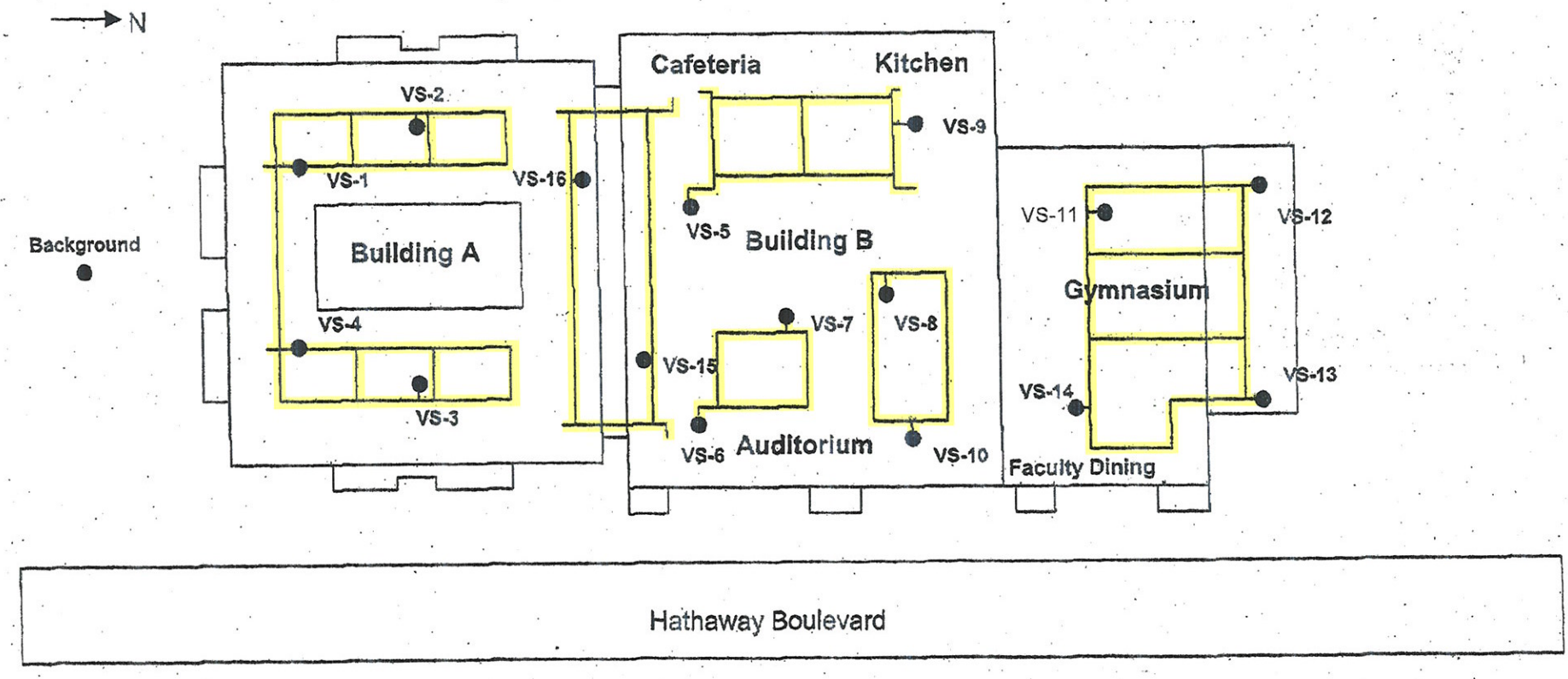
● = Indoor Air Sampling Point

● = Sample Locations

KEITH MIDDLE SCHOOL NEW BEDFORD, MASSACHUSETTS		
INDOOR AIR SAMPLING LOCATIONS		
TRC Wannalancit Mills 650 Suffolk Street Lowell, MA 01854 (978) 970-5600		FIGURE 2-1
DRAWN BY: ---	DATE: MAY 2008	
CHECKED BY: DMS		

FILE: F:\E_CAD\115058\indoorventsys1.dwg

Keith Middle School
Foundation Venting System



● = Vent Riser / Vent Stack Sampling location

═══ = Passive Venting and Collection System

KEITH MIDDLE SCHOOL
NEW BEDFORD, MASSACHUSETTS

VENT STACK SAMPLE LOCATIONS

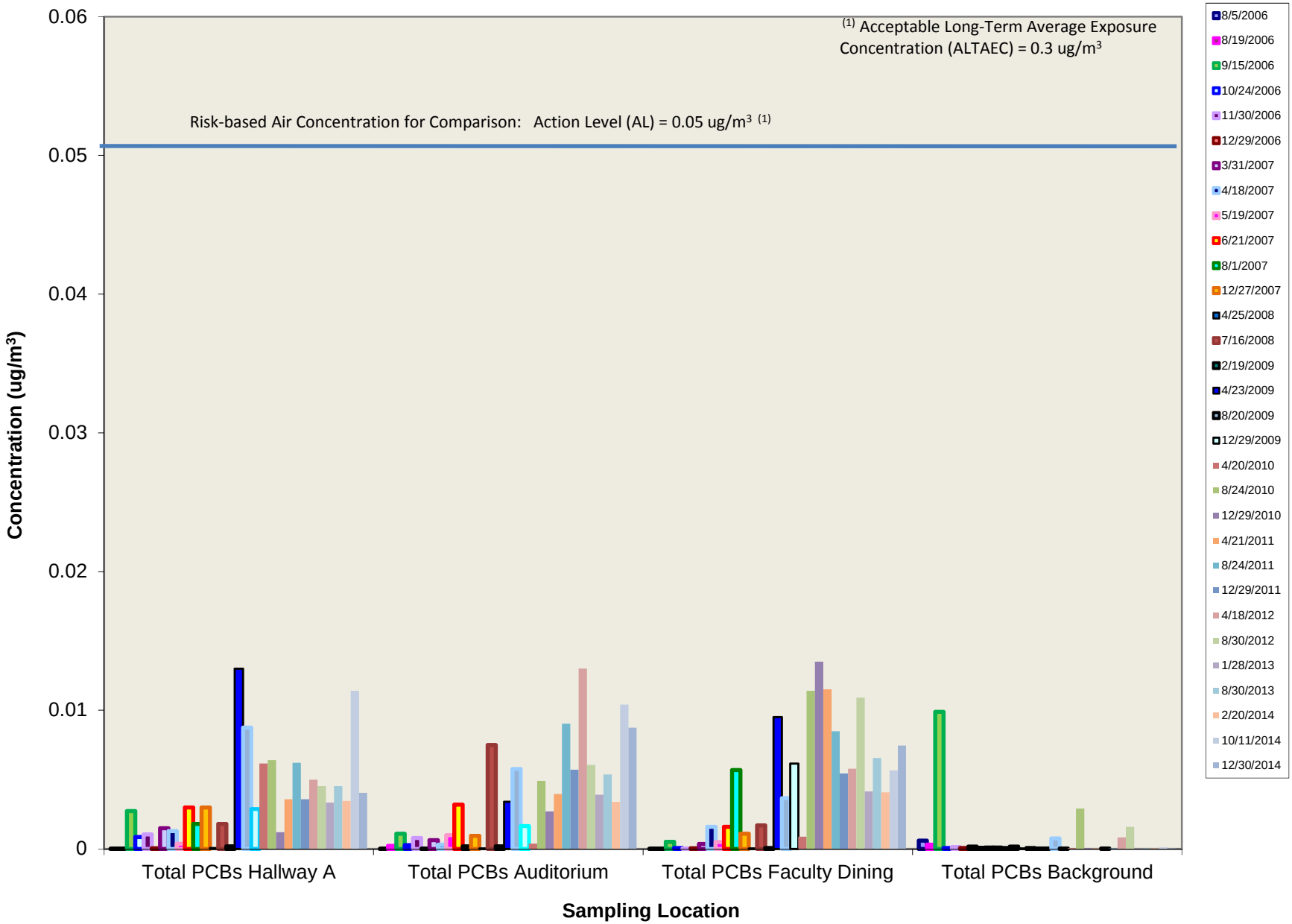
TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
(978) 970-5600

FIGURE 2-2

DRAWN BY: ---
CHECKED BY: DMS
DATE: MAY 2008

FILE: T:\E_CAD\115058\ventsys1A.dwg

Figure 5-1. Total PCB Trends in KMS Indoor Air Quality (IAQ) Samples - August 2006 through December 2014



Each bar represents a single measurement. Bars outlined in black represent values reported by the laboratory as nondetect. For charting purposes these nondetect values are plotted as one half the reporting limit.

APPENDIX A

SUMMARY OF FIELD SAMPLING PROGRAM, ANALYTICAL PROGRAM, AND QUALITY ASSURANCE

1.0 FIELD SAMPLING PROGRAM

1.1 Overview

This section describes the procedures that TRC followed during the field sampling program.

1.2 Indoor Air Quality Sampling

Each of the indoor air quality field samples was collected by TRC over the course of one 24-hour test period. Indoor air quality samples were collected for analysis of PCBs by EPA Method TO-4A.

Indoor air quality (IAQ) samples were collected for PCBs following the procedures described in the EPA Compendium Method TO-4A, ***Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using High Volume Polyurethane Foam (PUF) Sampling followed by Gas Chromatographic/Multi-Detector Detection (GC/MD)***, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition*, USEPA, January 1999.

TRC placed a high volume sampler at each PCB indoor air sampling location. A multi-point calibration was performed on each high volume sampler prior to sample collection using a calibrated orifice. A polyurethane foam (PUF) sampling cartridge was then unsealed and inserted into the high volume sampler and the sampler turned on. The start time, elapsed hours counter reading, and flow rate (magnehelic reading) were then recorded on a data sheet. After 24 hours of sampling, the elapsed hours counter reading and flow rate (magnehelic reading) were recorded on a data sheet along with the stop time. The PUF cartridge was then removed from the sampler, sealed, and labeled. A single-point post sampling calibration audit was performed to document that the high volume sampler remained calibrated.

Following the collection of the TO-4A samples, the total volume of ambient air sampled for each cartridge was calculated based on the duration of sampling and the average flow rate, as determined from the initial and final flow rates.

The data sheets are provided in Appendix B and the reduced data are presented in Appendix C. The calibration certifications of the critical orifice can be found in Appendix D.

1.3 Foundation Vent Air Sampling

Each of the vent air field samples was collected by TRC over the course of a 4-hour test period. Vent air samples were collected for analysis of PCBs by EPA Method TO-10A. Prior to sampling, all of the foundation vents were temporarily capped for approximately 24 hours. Just prior to sampling, TRC removed the caps from all vent stacks that were not being sampled to allow for the inflow of air. This approach is a modification to the procedure outlined in the LTMMIP to improve representativeness by allowing sample air to be drawn from the entire vent stack zone without potential stagnation of flow impacted by capped vent stacks.

Vent stack air samples were collected for PCBs following the procedures described in the EPA Compendium Method TO-10A, ***Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using High Volume Polyurethane Foam (PUF) Sampling followed by Gas Chromatographic/Multi-Detector Detection (GC/MD)***, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition*, USEPA, January 1999.

In order to sample each vent stack without collecting ambient air, a cap with Teflon™ tubing penetrating through it was placed over the vent stack. Prior to capping the stack, a PUF sampling cartridge was unsealed and connected to the length of tubing that would extend inside the vent stack. The tubing on the opposite side of the cap (that would be outside of the vent stack after the cap was installed) was attached to a Dawson® vacuum pump. A vacuum was applied to the tubing and cartridge using the pump and the vacuum was adjusted so that a flow rate of five liters per minute (LPM) of air was flowing through the PUF. The flow rate was confirmed using a Bios Defender™ 520 primary gas flow calibrator. The cap was then placed over the vent stack with the PUF cartridge suspended in the stack. The start time and flow rate was then recorded on a data sheet. After 4 hours of sampling, the flow rate was confirmed using the bubble meter. The final flow rate and stop time are then recorded on the data sheet. The PUF cartridge was then disconnected from the tubing, sealed with the supplied end caps, placed into a sample jar and labeled.

Following the collection of all the TO-10A samples, the total volume of ambient air sampled for each cartridge was calculated based on the duration of sampling and the average flow rate, as determined from the initial and final flow rates.

The data sheets can be found in Appendix B and the reduced data can be found in Appendix C. The calibration certifications of the Bios Defender™ 520 primary gas flow calibrator can be found in Appendix D.

2.0 ANALYTICAL PROGRAM

Samples collected by EPA Method TO-10A and TO-4A were prepared by the Soxhlet Extraction Method (EPA Method 3540C/TO-4A) and analyzed by gas chromatography/mass spectroscopy (EPA Method 680) for PCB Homologue distribution. The homologue analytical method is a reliable method to quantify total PCBs to levels below the EPA Action Level (0.05 $\mu g/m^3$) and Acceptable Long-Term Average Exposure Concentration (0.3 $\mu g/m^3$) described in Section 5 and Appendix G. By quantifying PCB homologues, total PCB air data gathered at the KMS are directly comparable to total PCB air data gathered at the high school since both are based on homologues rather than congeners, which greatly facilitates communication and discussion with the general public on the results of analyses.

Laboratory analytical results are presented in Appendix E.

3.0 QUALITY ASSURANCE

3.1 Overview

TRC management is fully committed to an effective Quality Assurance/Quality Control (QA/QC) Program whose objective is the delivery of a quality product. For much of TRC's work, that product is data developed from field measurements, sampling and analysis activities, engineering assessments, and the analysis of gathered data for planning purposes. TRC's QA/QC Program works to provide complete, precise, accurate, representative data in a timely manner for each project, considering both the project's needs and budget.

This section highlights the specific QA/QC procedures that were followed during this sampling and analysis program.

3.2 Field Quality Control Summary

Calibrations of the field sampling equipment were performed prior to the field sampling effort. Copies of the calibration sheets were submitted to the Field Team Leader to take onsite and placed in the project file. Calibrations were performed as described in the EPA 40 CFR Part 50 Appendix B. All calibrations were available for review during the test program. Copies of the equipment calibration forms can be found in Appendix D. All instrument calibrations met the performance criteria defined in 40 CFR 50 Appendix B.

3.3 Data Reduction and Validation

Specific QC measures were used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in all projects.

3.3.1 Field Data Reduction

Appendix B of this document presents the standardized forms that were used to record field sampling data. The data collected was reviewed in the field by the Field Team Leader and at least one other field crewmember. Errors or discrepancies were noted in the field book.

3.3.2 Data Validation

TRC supervisory and QC personnel used validation methods and criteria appropriate to the type of data and the purpose of the measurement. Records of all data were maintained, including that judged as an "outlying" or spurious value. The persons validating the data have sufficient knowledge of the technical work to identify questionable values.

Field sampling data was validated by the Field Team Leader and/or the Field QC Coordinator based on their review of adherence to each approved sampling protocol and written sample collection procedure.

The following criteria were used to evaluate the field sampling data:

- Use of approved test procedures;
- Proper operation of the process being tested;
- Use of properly operating and calibrated equipment;
- Proper chain-of-custody maintained.

Laboratory analytical data was validated by TRC chemists. The sample results were assessed using the EPA New England Data Validation Functional Guidelines for Evaluating Environmental Analyses, revised December 1996. Modification of these guidelines was performed to accommodate the non-CLP methodology.

Sample data were reviewed for the following parameters:

- Agreement of analyses conducted with TRC requests
- Holding times and sample preservation
- Gas chromatography/mass spectrometry (GC/MS) tunes
- Initial and continuing calibrations
- Method blanks
- System Monitoring Compound recoveries
- Laboratory control sample (LCS) and LCS Duplicate (LCSD) results
- Internal standard performance
- Field duplicate results
- Quantitation limits and sample results

The laboratory data validation memoranda can be found in Appendix F. All data are reported in standard units depending on the measurement and the ultimate use of the data.

3.4 Collocated Sampler Precision

Single collocated sampler pairs were included for both indoor and vent stack air during each sampling event. Collocated samplers were operated for the same duration at near identical flow rates and were in close proximity to each other so as to represent near identical air space. The data resulting from the analyses of the collocated sampler pairs were used to define the precision of the combined sample collection and analyses scheme.

Precision was determined by the collection and analysis of replicate samples and is expressed as the relative percent difference (RPD), which is determined according to the following equation:

$$RPD = \left[\frac{X_1 - X_2}{\frac{X_1 + X_2}{2}} \right] x\ 100$$

where X_1 and X_2 are the measurement results of each replicate sample expressed as an absolute value (always positive).

APPENDIX B

SAMPLING DATA

Keith Middle School Sampling Data Sheet
Ambient / Vent Air Sampling

Setup Date: 12/29/14 **Sampler(s):** JOHN MULHALL

Recovery Date: 12/30/14 **Sampler(s):** STEPHEN BROWN

TO-4A (Ambient)							
Location	Time (clock)		Sampler				
			Serial	Counter (Hrs)		Flow Rate (Mag Reading)	
	Start	Stop	Number	Start	Finish	Initial	Final
BG	1541	1541	0822	728.37	747.86	50	50
BG DUP.	1541	1541	0825	557.47	557.47	49.5	~~56~~ 50
HALL @ RM 167-A	1545	1545	0820	311.60	335.82	50	46
AUD - B	1548	1548	0823	705.40	729.65	50	48
LOUNGE - C	1550	1550	0821	702.89	727.18	50	49

Sample Date: 12/30/14 **Sampler(s):** JOHN MULHALL / STEPHEN BROWN

TO-10A (Vent)					
Location	Time (clock)		Flow Rate (LPM)		
	Start	Stop	Start	Finish	
VS-14	1022	~~1422~~	4.971	2.742	4.331
VS-9	1034	~~1434~~ 1436	5.021	FROZEN	
VS-9DUP	1034	~~1434~~ 1436	5.053	3.381	
VS-4	1047	1452	5.005	0.641	1.997 FROZEN
VS-1	1058	1508	4.995	2.552	

✓DJG

TRC

APPENDIX C

FIELD REDUCED DATA

INDOOR SAMPLING LOCATIONS

Average Temp (oF/ K): 68.0 293.0

Average Baro. Press ("Hg / mmHg): 30.24 768.1

Tuesday, December 30, 2014

Location		Serial #	m_a	b_a	Start Reading ("H2O)	Start Reading (lpm)	Stop Reading ("H2O)	Stop Reading (lpm)	Avg. Reading ("H2O)	RPD of Start and Stop Readings	Avg. Flow (lpm)	Start time (hr)	Start time (clock)	Stop Time (hr)	Stop Time (clock)	Total Sample Time (min)	Total Actual Sample Volume (m^3)
C-34 Lounge hallway	TO-4A	821	0.032	-0.78368	50		49		49.5	2.02	241	702.89	15:50	727.18	15:50	1457.4	350.8
B-34 Aud	TO-4A	823	0.033	-1.06515	50		48		49	4.08	241	705.4	15:48	729.85	15:48	1455	350.1
A-34 hallway, Rm 169	TO-4A	820	0.033	-1.08973	50		46		48	8.33	239	311.6	15:45	335.82	15:45	1453	347.6

✓ DSG 1/5/15

OUTDOOR SAMPLING LOCATIONS

Average Temp (oF/ K): 30.0 271.9

Average Baro. Press ("Hg / mmHg): 30.24 768.1

Tuesday, December 30, 2014

Location		Serial #	m_c	b_c	Start Reading ("H2O)	Start Reading (lpm)	Stop Reading ("H2O)	Stop Reading (lpm)	Avg. Reading ("H2O)	RPD of Start and Stop Readings	Avg. Flow (lpm)	Start time (hr)	Start time (clock)	Stop Time (hr)	Stop Time (clock)	Total Sample Time (min)	Total Actual Sample Volume (m^3)
BG-35	TO-4A	822	0.033	-0.95054	50		50		50	0.00	230	728.37	15:41	747.86	14:41	1312	301.2
BG-35-Dup	TO-4A	825	0.031	-0.85436	49.5		50		49.75	1.01	241	557.47	15:41	557.47	15:41	1440	347.1
VS-9-35	TO-10A					5.02		0.00		200.00	2.51		10:34		14:36	242	0.61
VS-9-35 Dup	TO-10A					5.05		3.38		39.65	4.22		10:34		14:36	242	1.02
VS-14-35	TO-10A					4.97		4.33		13.76	4.65		10:22		14:22	240	1.12
VS-1-35	TO-10A					5.00		2.55		64.74	3.77		10:58		15:08	250	0.94
VS-4-35	TO-10A					5.01		0.64		154.59	2.82		10:47		14:52	245	0.69

Note:
BG-35 motor died near the end of the sampling period.

VDSG 1/5/15

Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (ºF) Air	Dwpt	6 hour Max.	6 hour Min.	Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure altimeter (in)	Pressure sea level (mb)	Precipitation (in.) 1 hr	3 hr	6 hr	
13	9:53	S 9	10	Fair	CLR	60	48			65%	NA	NA	30.36	1028				
13	8:53	Calm	10	Fair	CLR	47	45			93%	NA	NA	30.37	1028.2				
13	7:53	Calm	10	Fair	CLR	39	38	39	34	96%	NA	NA	30.36	1028.1				
13	6:53	Calm	10	Fair	CLR	35	34			96%	NA	NA	30.34	1027.6				
13	5:53	Calm	10	Fair	CLR	34	34			100%	NA	NA	30.33	1027.1				
13	4:53	Calm	10	Fair	CLR	36	34			93%	NA	NA	30.33	1027.2				
13	3:53	Calm	10	Fair	CLR	35	34			96%	NA	NA	30.32	1026.8				
13	2:53	Calm	10	Fair	CLR	36	34			93%	NA	NA	30.32	1026.7				
13	1:53	Calm	10	Fair	CLR	37	35	44	37	93%	NA	NA	30.33	1026.9				
13	0:53	Calm	10	Fair	CLR	38	36			93%	NA	NA	30.32	1026.7				
12	23:53	Calm	10	Fair	CLR	38	37			97%	NA	NA	30.31	1026.5				
12	22:53	Calm	10	Fair	CLR	39	38			96%	NA	NA	30.32	1026.5				
12	21:53	Calm	10	Fair	CLR	41	39			93%	NA	NA	30.31	1026.4				
12	20:53	Calm	10	Fair	CLR	43	41			93%	NA	NA	30.31	1026.3				
12	19:53	Calm	10	Fair	CLR	43	41	62	43	93%	NA	NA	30.3	1026.1				
12	18:53	Calm	10	Fair	CLR	48	40			74%	NA	NA	30.28	1025.4				
12	17:53	SE 7	10	Fair	CLR	54	39			57%	NA	NA	30.26	1024.8				
12	16:53	Calm	10	Fair	CLR	60	36			41%	NA	NA	30.24	1023.9				
12	15:53	Vrbl 5	10	Fair	CLR	61	36			39%	NA	NA	30.24	1023.8				
12	14:53	NE 9	10	Fair	CLR	61	37			41%	NA	NA	30.23	1023.5				
12	13:53	N 8	10	Fair	CLR	61	36	61	42	39%	NA	NA	30.22	1023.2				
12	12:53	N 9	10	Fair	CLR	60	36			41%	NA	NA	30.23	1023.7				
12	11:53	N 6	10	Fair	CLR	58	40			51%	NA	NA	30.25	1024.2				
12	10:53	N 12 G 20	10	Fair	CLR	55	40			57%	NA	NA	30.25	1024.4				
12	9:53	N 5	10	Fair	CLR	51	44			77%	NA	NA	30.25	1024.4				
12	8:53	N 5	10	Fair	CLR	48	43			83%	46	NA	30.24	1023.9				
12	7:53	N 5	10	Fair	CLR	42	39	43	37	89%	39	NA	30.21	1023.1				
12	6:53	NW 3	10	Fair	CLR	40	38			93%	NA	NA	30.19	1022.1				
12	5:53	NW 3	10	Fair	CLR	40	39			97%	NA	NA	30.16	1021.4				
12	4:53	NW 3	10	Fair	CLR	41	39			93%	NA	NA	30.15	1020.8				
12	3:53	Calm	10	Fair	CLR	41	40			96%	NA	NA	30.14	1020.5				
12	2:53	N 3	10	Fair	CLR	41	40			96%	NA	NA	30.13	1020.2				
12	1:53	NW 6	10	Fair	CLR	42	41	46	37	96%	38	NA	30.14	1020.4				
12	0:53	Calm	2.5	Fog/Mist	FEW002	38	37			97%	NA	NA	30.13	1020.2				
11	23:53	Calm	0.5	Fog	CLR	39	38			96%	NA	NA	30.12	1020				
11	22:53	Calm	3	Fog/Mist	CLR	41	40			96%	NA	NA	30.12	1020				
11	21:53	Calm	10	Fair	CLR	45	43			93%	NA	NA	30.11	1019.7				
11	20:53	Calm	10	Fair	CLR	45	43			93%	NA	NA	30.1	1019.3				
11	19:53	N 3	10	Fair	CLR	46	44	51	46	93%	NA	NA	30.09	1018.8			0.01	
11	18:53	Calm	10	Fair	CLR	47	46			97%	NA	NA	30.08	1018.7				
11	17:53	Calm	10	A Few Clouds	FEW012	50	47			89%	NA	NA	30.06	1017.9				
11	16:53	N 5	10	Partly Cloudy	FEW012 SCT120	51	49			92%	NA	NA	30.06	1017.7		0.01		Post cal
11	15:53	Vrbl 3	10	Mostly Cloudy	FEW010 SCT100 BKN120	51	48			89%	NA	NA	30.05	1017.5	0.01			
11	14:53	NE 8	10	Overcast	FEW010 OVC080	51	48			89%	NA	NA	30.04	1017.1				
11	13:53	N 7	10	Light Rain	OVC080	51	49	51	49	92%	NA	NA	30.04	1017.1	0.06		0.35	
11	12:53	NE 3	2	Heavy Rain Fog/Mist	BKN006 OVC013	51	50			96%	NA	NA	30.06	1018	0.15			
11	11:53	N 3	5	Rain Fog/Mist	FEW010 OVC080	51	49			92%	NA	NA	30.08	1018.6	0.06			
11	10:53	NE 5	10	Light Rain	OVC075	51	49			92%	NA	NA	30.09	1019	0.01	0.08		
11	9:53	E 5	10	Light Rain	OVC070	50	48			93%	48	NA	30.08	1018.5	0.03			
11	8:53	NE 3	5	Light Rain Fog/Mist	OVC055	50	47			89%	NA	NA	30.12	1020	0.04			
11	7:53	N 3	10	Light Rain	OVC050	49	47	49	46	93%	NA	NA	30.11	1019.4	0.03		0.05	
11	6:53	Calm	10	Light Rain	OVC050	49	45			86%	NA	NA	30.1	1019.3	0.02			
11	5:53	Calm	10	Light Rain	OVC055	49	46			90%	NA	NA	30.09	1018.9				
11	4:53	Calm	10	Overcast	SCT065 OVC110	48	45			89%	NA	NA	30.09	1018.7				
11	3:53	Calm	10	Overcast	OVC095	47	45			93%	NA	NA	30.09	1018.9				
11	2:53	Calm	10	Overcast	OVC110	47	45			93%	NA	NA	30.09	1018.7				
11	1:53	Calm	10	Mostly Cloudy	BKN110	46	44	53	44	93%	NA	NA	30.11	1019.6				
11	0:53	Calm	10	Overcast	OVC110	45	43			93%	NA	NA	30.11	1019.6				
10	23:53	Calm	10	Mostly Cloudy	BKN100	46	45			96%	NA	NA	30.12	1020				
10	22:53	Calm	10	A Few Clouds	FEW120	47	45			93%	NA	NA	30.12	1020.1				
10	21:53	Calm	10	Overcast	OVC110	49	46			90%	NA	NA	30.12	1019.9				
10	20:53	Calm	10	Fair	CLR	50	46			86%	NA	NA	30.11	1019.7				
10	19:53	Calm	10	Mostly Cloudy	BKN110	53	45	63	53	74%	NA	NA	30.1	1019.2				
10	18:53	Calm	10	Partly Cloudy	SCT120	54	45			72%	NA	NA	30.08	1018.6				
10	17:53	SW 3	10	Fair	CLR	57	41			55%	NA	NA	30.07	1018.2				
10	16:53	W 9	10	Fair	CLR	61	39			44%	NA	NA	30.05	1017.6				Average for sampling period
10	15:53	W 9 G 20	10	Fair	CLR	62	41			46%	NA	NA	30.05	1017.4				30.09 50.6
10	14:53	SW 10 G 18	10	Fair	CLR	61	39			44%	NA	NA	30.05	1017.4				Pre cal
10	13:53	W 8	10	Fair	CLR	63	40	64	43	43%	NA	NA	30.04	1017.1				
10	12:53	SW 10	10	Fair	CLR	62	38			41%	NA	NA	30.06	1018				
10	11:53	W 9	10	Fair	CLR	62	39			43%	NA	NA	30.08	1018.5				
10	10:53	W 10	10	Fair	CLR	59	38			46%	NA	NA	30.09	1018.9				
Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Air	Dwpt	Max.	Min.	Relative Humidity	Wind Chill (°F)	Heat Index (°F)	altimeter (in.)	sea level (mb)	1 hr	3 hr	6 hr	
						Temperature (ºF)		6 hour					Pressure		Precipitation (in.)			

APPENDIX D

EQUIPMENT CALIBRATION SHEETS

MesaLabs

NVLAP Lab Code 200661-0

Calibration Certificate

Certificate No.	5046362	**Sold to:**	TRC Environmental Corporation - CT Wannalancit Mills 650 Suffolk Street Suite 200 Lowell, MA 01854 USA
Product	Defender 530 High Flow		
Serial No.	119011		
Cal. Date	12-Aug-2014		

All calibrations are performed in accordance with ISO 17025 at Mesa Laboratories, Inc., 10 Park Place, Butler, NJ, 07405, 800-663-4977, an ISO 17025:2005 – accredited laboratory through NVLAP. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

As Received Calibration Data

Technician Zenaida Ortiz

Lab. Pressure 754 mmHg
Lab. Temperature 22.4 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
500.78 ccm	500.61 ccm	0.03 % %	1.00%	In Tolerance
4992.3 ccm	5002.85 ccm	-0.21 % %	1.00%	In Tolerance
29774 ccm	30051.5 ccm	-0.92 % %	1.00%	In Tolerance
23.4 °C	22.4 °C	1.0 °C	±0.8°C	Out of Tolerance
755 mmHg	754 mmHg	1.0 mmHg	±3.5mmHg	In Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML 500-44	113761	22-Apr-2014	22-Apr-2015
Precision Thermometer	300907	7-May-2014	7-May-2015
Precision Barometer	2981392	24-Jun-2014	24-Jun-2015

MesaLabs

NVLAP Lab Code 200661-0

As Shipped Calibration Data

Certificate No. 5046362
Technician Zenaida Ortiz

Lab. Pressure 752 mmHg
Lab. Temperature 22.0 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
504.80 ccm	501.075 ccm	0.74 %%	1.00%	In Tolerance
5016.1 ccm	5006.95 ccm	0.18 %%	1.00%	In Tolerance
29875 ccm	30042 ccm	-0.56 %%	1.00%	In Tolerance
22.0 °C	22.0 °C	-	±0.8°C	In Tolerance
752 mmHg	752 mmHg	-	±3.5mmHg	In Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-500-44	113761	22-Apr-2014	22-Apr-2015
Precision Thermometer	305460	27-Aug-2013	27-Aug-2014
Precision Barometer	2981392	24-Jun-2014	24-Jun-2015

Calibration Notes

The expanded uncertainty of flow, temperature, and pressure measurements all have a coverage factor of k = 2 for a confidence interval of approximately 95%.

Flow testing is in accordance with our test number PR18-13 with an expanded uncertainty of 0.27% using high-purity nitrogen or filtered laboratory air.

Pressure testing is in accordance with our test number PR18-11 with an expanded uncertainty of 0.16 mmHg.

Temperature testing is in accordance with our test number PR18-12 with an expanded uncertainty of 0.04 °C.

Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

Technician Notes:

David W. Wilson, Chief Metrologist

TISCH ENVIRONMENTAL, INC.
145 SOUTH MIAMI AVE
VILLAGE OF CLEVES, OH
45002
513.467.9000
877.263.7610 TOLL FREE
513.467.9009 FAX

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5040A

Date - Aug 01, 2014 Rootsmeter S/N 0438320 Ta (K) - 298
Operator Jim Tisch Orifice I.D. - 1125 Pa (mm) - 754.38

PLATE OR VDC #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	6.6060	3.6	2.00
2	NA	NA	1.00	3.9750	10.0	5.50
3	NA	NA	1.00	3.1740	15.5	8.50
4	NA	NA	1.00	2.7030	21.0	11.50
5	NA	NA	1.00	2.3890	26.5	14.50
6	NA	NA	1.00	2.2440	30.2	16.50

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
0.9878	0.1495	1.4090		0.9951	0.1506	0.8888
0.9794	0.2464	2.3365		0.9867	0.2482	1.4740
0.9722	0.3063	2.9047		0.9794	0.3085	1.8324
0.9649	0.3569	3.3786		0.9721	0.3596	2.1314
0.9577	0.4008	3.7938		0.9648	0.4038	2.3933
0.9529	0.4246	4.0470 -		-0.9600	0.4278	2.5530
Qstd slope (m) =		9.53442		Qa slope (m) =		5.97029
intercept (b) =		-0.01678		intercept (b) =		-0.01058
coefficient (r) =		0.99991		coefficient (r) =		0.99991

y axis = SQRT[H2O(Pa/760)(298/Ta)] y axis = SQRT[H2O(Ta/Pa)]

CALCULATIONS

Vstd = Diff. Vol[(Pa-Diff. Hg)/760](298/Ta)
Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa]
Qa = Va/Time

For subsequent flow rate calculations:

Qstd = 1/m{[SQRT(H2O(Pa/760)(298/Ta))]- b}
Qa = 1/m{[SQRT H2O(Ta/Pa)]- b}

Keith Middle School PS1 Calibration Data Sheet

Sampler ID: 0823
Sampler Location: AUD

Initial Calibration
Date: 12/29/14 Time: 1507

Magnehelic Reading	Manometer Left	Manometer Right	total
70	3.65	3.6	7.25
60	3.1	3.1	6.2
50	2.7	2.75	5.45
40	2.2	2.2	4.4
30	1.7	1.75	3.45

Post Calibration
Date: 12/30/14 Time: 1603

Magnahelic Reading	Manometer Left	Manometer Right	total
50	3.2	2.3	5.5

Sampler ID: 0821
Sampler Location: LOUNGE

Initial Calibration
Date: 12/29/14 Time: 1512

Magnehelic Reading	Manometer Left	Manometer Right	total
70	3.6	3.65	7.25
60	3.15	3.2	6.35
50	2.75	2.7	5.45
40	2.2	2.25	4.45
30	1.65	1.7	3.35

Post Calibration
Date: 12/30/14 Time: 1607

Magnahelic Reading	Manometer Left	Manometer Right	total
50	3.4	2.25	5.65

Sampler ID: 0820
Sampler Location: HALL @ RM 167

Initial Calibration
Date: 12/29/14 Time: 1518

Magnehelic Reading	Manometer Left	Manometer Right	total
70	3.75	3.7	7.45
60	3.25	3.3	6.55
50	2.85	2.85	5.7
40	2.3	2.35	4.65
30	1.75	1.8	3.55

Post Calibration
Date: 12/30/14 Time: 1600

Magnahelic Reading	Manometer Left	Manometer Right	total
50	3.3	2.1	5.4

Sampler ID: 0825
Sampler Location: BG DUP

Initial Calibration
Date: 12/29/14 Time: 1524

Magnehelic Reading	Manometer Left	Manometer Right	total
70	3.8	3.95	7.75
60	3.35	3.5	6.85
50	2.75	2.9	5.65
40	2.25	2.45	4.7
30	1.7	1.95	3.65

Post Calibration
Date: 12/30/14 Time: ~~1524~~ 1544

Magnahelic Reading	Manometer Left	Manometer Right	total
50	3.15	2.7	5.85

Sampler ID: 0822
Sampler Location: BG

Initial Calibration
Date: 12/29/14 Time: 1527

Magnehelic Reading	Manometer Left	Manometer Right	total
70	3.6	3.6	7.2
60	3.15	3.25	6.4
50	2.65	2.75	5.4
40	2.15	2.3	4.45
30	1.6	1.8	3.4

Post Calibration
Date: _____ Time: _____

Magnahelic Reading	Manometer Left	Manometer Right	total
50	—	—	

Orifice ID: 1125 Cal. Date: 8/1/14
Initial Cal Temp (in/out): ~~41~~ 68 / ~~68~~ 41 (F) / C
Initial Cal Press: 30.09 (inHg) / mmHg
Post Cal Temp (in/out): ~~29~~ 68 / ~~68~~ 29 (F) / C
Post Cal Press: 30.29 inHg / mmHg

TRC

KPSU

Network: New Bedford | Site: Keith Middle | Serial #: 820 | Station #: Hall (rm 167)

Technician: JM/SPB | Date: 12/29/2014 | OrificeS/N: 1125 | Orif. Cal. Date: 1-Aug-14

Reason for Puff Sampler Calibration: *Monthly Recal*

Amb. Temp, Ta (°C)	20	Bar. Press., Pa (in Hg)	30.09
Amb. Temp, Ta (K)	293.0	Bar. Press., Pa (mmHg)	764.3

Orifice Data

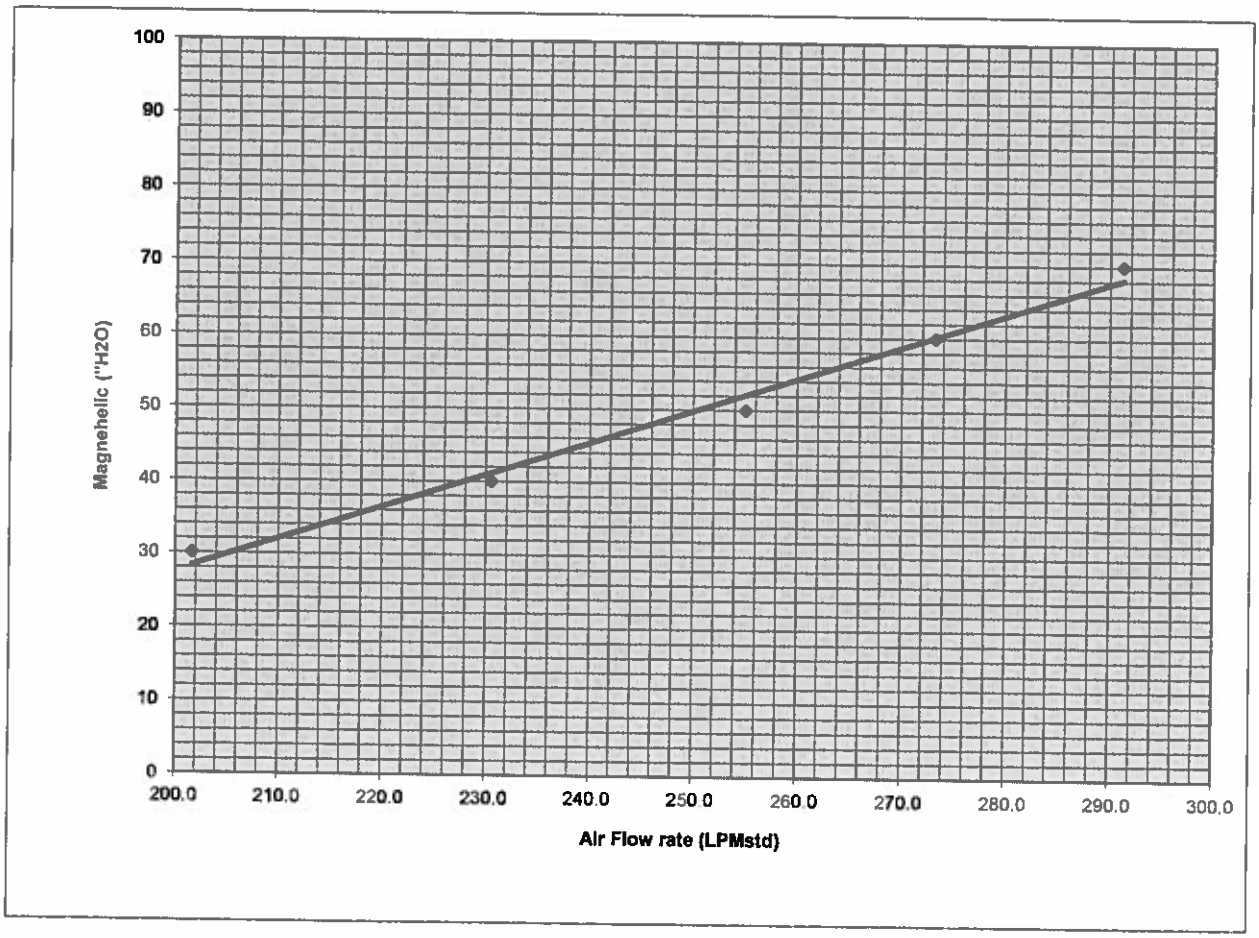
Qstd (m_o) = 9.53442 Qstd (b_o) = -0.01678 Qstd (r_o) = 0.99991

ΔH	Q_{std}	I	I_c
7.45	291.280	70	8.46
6.55	273.230	60	7.83
5.70	255.004	50	7.15
4.65	230.492	40	6.40
3.55	201.615	30	5.54

I_c = sqrt[I x 0.392 x (Pa/Ta)]

Qstd = {(1/mo) x sqrt[DH x (Pa/760) x (298/Ta) - bo]} x 1000

m_s = 0.033 b_s = -1.08973 r_s = 0.99884



Desired Flow Rate (lpm): 250 Sampler Setting: 49.9

m_{mag} = 0.445 b_{mag} = -61.40403 r_{mag} = 0.99413

✓ DJG

Network: **New Bedford** Site: **Keith Middle** Serial #: **823** Station #: **Aud**

Technician: **JM/SPB** Date: **12/29/2014** OrificeS/N: **1125** Orif. Cal. Date: **1-Aug-14**

Reason for Puff Sampler Calibration: *Monthly Recal*

Amb. Temp, Ta (°C)	**20**	Bar. Press., Pa (in Hg)	**30.09**
Amb. Temp, Ta (K)	293.0	Bar. Press., Pa (mmHg)	764.3

Orifice Data

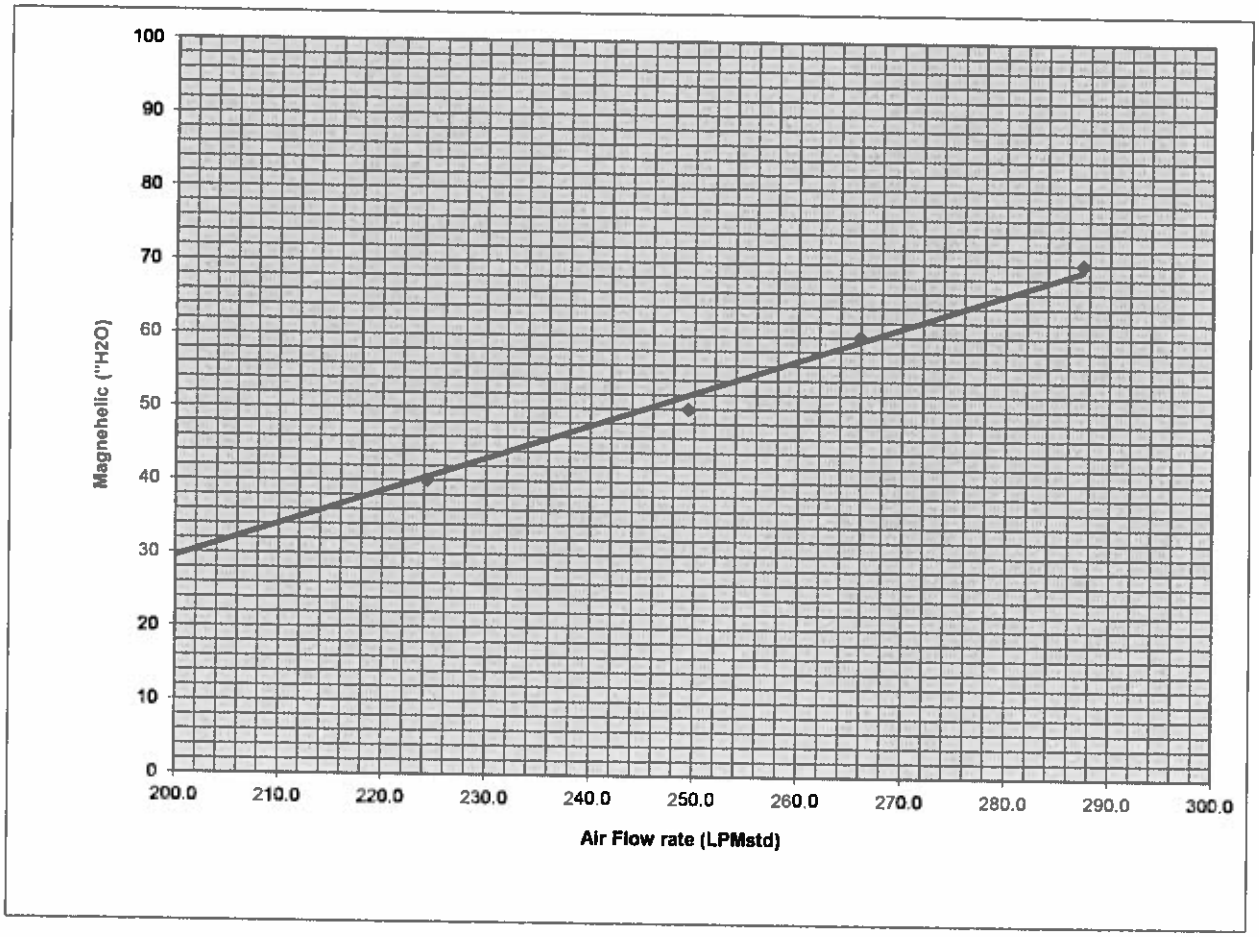
Qstd (m_o) = **9.53442** Qstd (b_o) = **-0.01678** Qstd (r_o) = **0.99991**

ΔH	Q_{std}	I	I_c
7.25	287.368	**70**	8.46
6.20	265.877	**60**	7.83
5.45	249.388	**50**	7.15
4.40	224.259	**40**	6.40
3.45	198.780	**30**	5.54

I_c = sqrt[I x 0.392 x (Pa/Ta)]

Qstd = {(1/mo) x sqrt[DH x (Pa/760) x (298/Ta) - bo]} x 1000

m_s = 0.033 b_s = -1.06515 r_s = 0.99910



Desired Flow Rate (lpm): 250 Sampler Setting: 52.2

m_{mag} = 0.454 b_{mag} = -61.35372 r_{mag} = 0.99694

✓ DJG

Network: **New Bedford** Site: **Keith Middle** Serial #: **821** Station #: **Lounge**

Technician: **JM/SPB** Date: **12/29/2014** OrificeS/N: **1125** Orif. Cal. Date: **1-Aug-14**

Reason for Puff Sampler Calibration: *Monthly Recal*

Amb. Temp, Ta (°C)	**20**	Bar. Press., Pa (in Hg)	**30.09**
Amb. Temp, Ta (K)	293.0	Bar. Press., Pa (mmHg)	764.3

Orifice Data

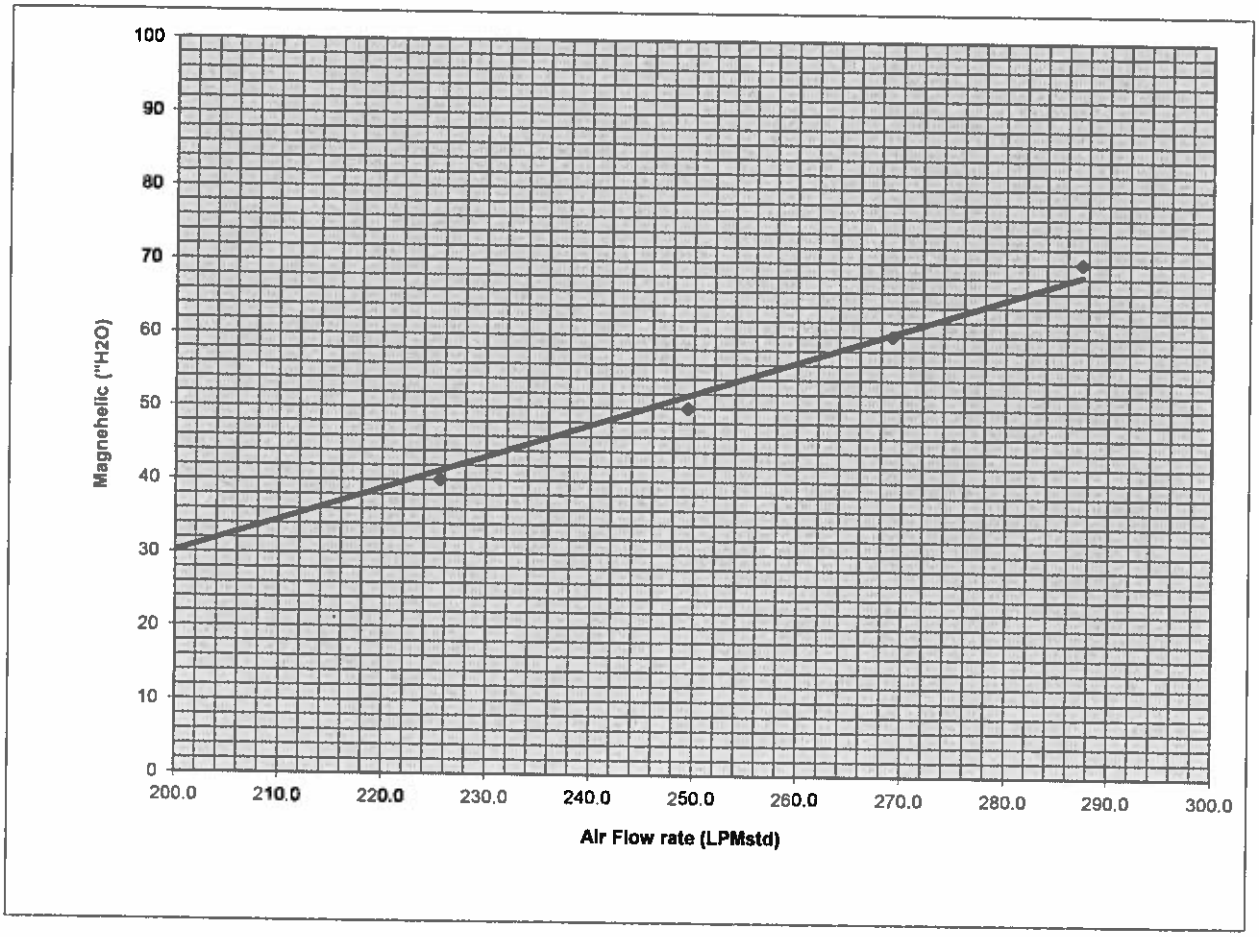
Qstd (m_o) = **9.53442** Qstd (b_o) = **-0.01678** Qstd (r_o) = **0.99991**

ΔH	Q_{std}	I	I_c
7.25	287.368	**70**	8.46
6.35	269.053	**60**	7.83
5.45	249.388	**50**	7.15
4.45	225.519	**40**	6.40
3.35	195.904	**30**	5.54

I_c = sqrt[I x 0.392 x (Pa/Ta)]

Qstd = {(1/mo) x sqrt[DH x (Pa/760) x (298/Ta) - bo]} x 1000

m_s = 0.032 b_s = -0.78368 r_s = 0.99919



Desired Flow Rate (lpm): 250 Sampler Setting: 52.0

m_{mag} = 0.437 b_{mag} = -57.26862 r_{mag} = 0.99485

✓ DJG

Network: **New Bedford** Site: **Keith Middle** Serial #: **822** Station #: **BG**

Technician: **JM/SPB** Date: **12/29/2014** OrificeS/N: **1125** Orif. Cal. Date: **1-Aug-14**

Reason for Puff Sampler Calibration: *Monthly Recal*

Amb. Temp, Ta (°C)	**5**	Bar. Press., Pa (in Hg)	**30.09**
Amb. Temp, Ta (K)	278.0	Bar. Press., Pa (mmHg)	764.3

Orifice Data

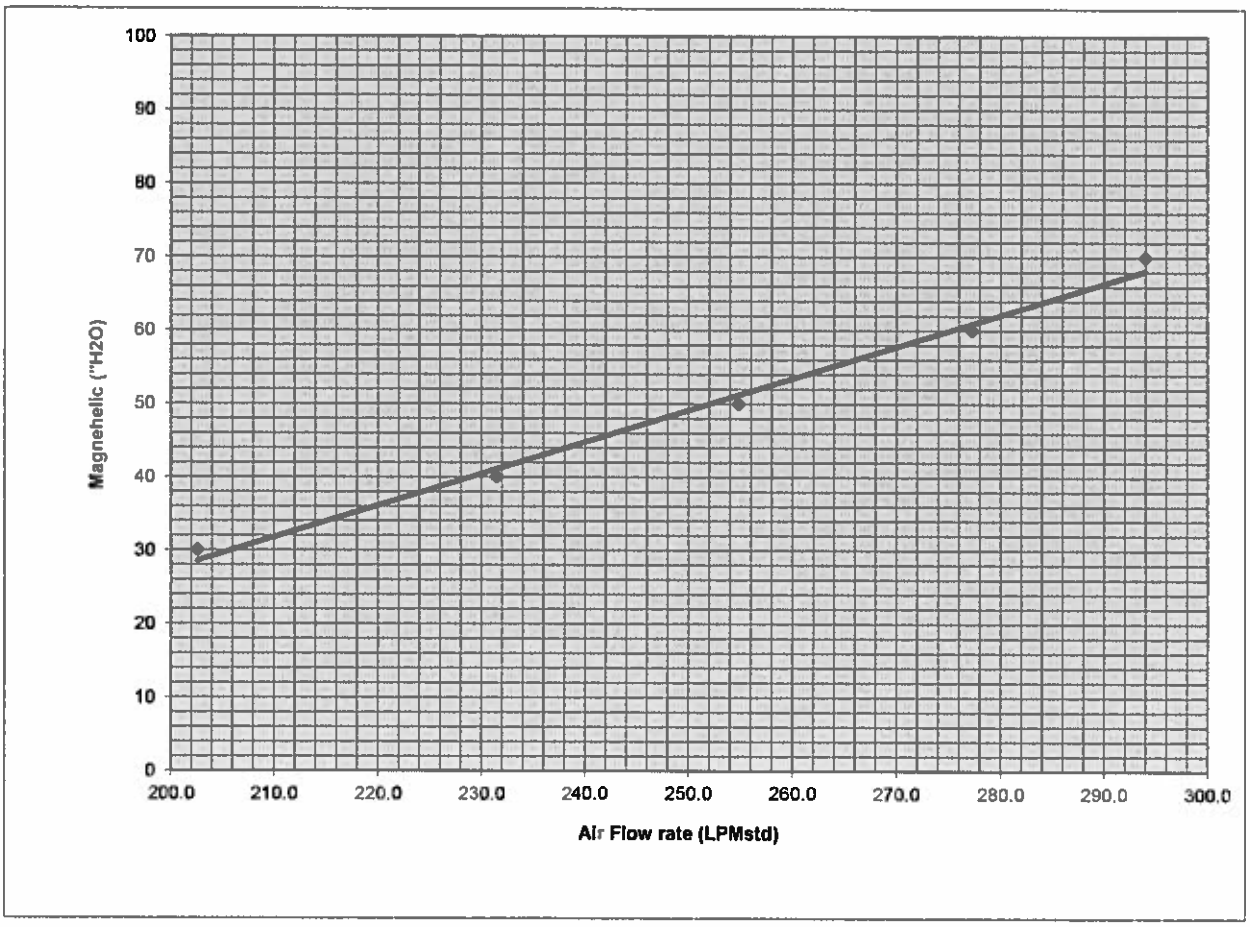
Qstd (m_o) = **9.53442** Qstd (b_o) = **-0.01678** Qstd (r_o) = **0.99991**

ΔH	Q_{std}	I	I_c
7.20	293.959	**70**	8.69
6.40	277.248	**60**	8.04
5.40	254.812	**50**	7.34
4.45	231.477	**40**	6.57
3.40	202.555	**30**	5.69

I_c = sqrt[I x 0.392 x (Pa/Ta)]

Qstd = {(1/mo) x sqrt[DH x (Pa/760) x (298/Ta) - bo]} x 1000

m_s = 0.033 b_s = -0.95054 r_s = 0.99936



Desired Flow Rate (lpm): 250 Sampler Setting: 49.1

m_{mag} = 0.434 b_{mag} = -59.26536 r_{mag} = 0.99552

✓ DJG

Network: **New Bedford** Site: **Keith Middle** Serial #: **825** Station #: **BG Dup.**

Technician: **JM/SPB** Date: **12/29/2014** OrificeS/N: **1125** Orif. Cal. Date: **1-Aug-14**

Reason for Puff Sampler Calibration: *Monthly Recal*

Amb. Temp, Ta (°C)	**5**	Bar. Press., Pa (in Hg)	**30.09**
Amb. Temp, Ta (K)	278.0	Bar. Press., Pa (mmHg)	764.3

Orifice Data

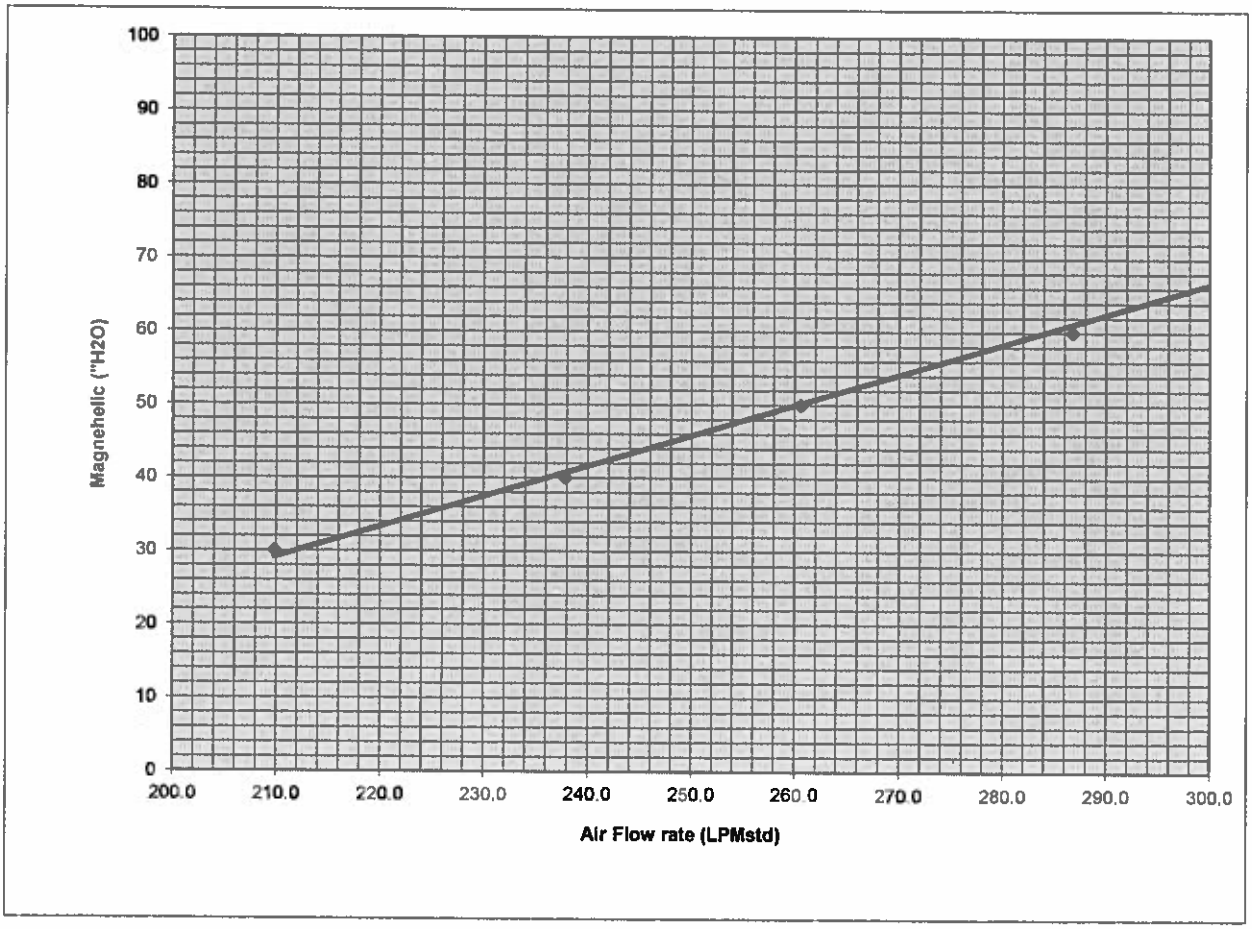
Qstd (m_o) = **9.53442** Qstd (b_o) = **-0.01678** Qstd (r_o) = **0.99991**

ΔH	Q_{std}	I	I_c
7.75	304.914	**70**	8.69
6.85	286.768	**60**	8.04
5.65	260.603	**50**	7.34
4.70	237.841	**40**	6.57
3.65	209.806	**30**	5.69

I_c = sqrt[I x 0.392 x (Pa/Ta)]

Qstd = {(1/mo) x sqrt[DH x (Pa/760) x (298/Ta) - bo]} x 1000

m_s = 0.031 b_s = -0.85436 r_s = 0.99935



Desired Flow Rate (lpm): 250 Sampler Setting: 45.8

m_{mag} = 0.416 b_{mag} = -58.22954 r_{mag} = 0.99776

✓ DJG

PS-1 Post-Sampling Flow Audit

Qstd Orifice (m^3/min) = $(1/m_o)*(SQRT(H_o*(Tstd/Pstd))-b_o)$)
Qstd Sampler (m^3/min) = $(1/m_s)*(SQRT(H_s*(Tstd/Pstd))-b_s)/1000$
% Difference = ((Qact Orifice - Qact Sampler) / Qact Orifice)*100

10/11/2014 Press ("Hg): **30.10** Press - P_a (mmHg): 764.5

	Temp (^oC):	Temp - T_a (K):	Sampler Serial #	Sampler Reading - H_s ("h20)	Orifice Reading - H_o ("h20)	Orifice #	Orifice Slope - m_o	Orifice Intercept - b_o	**Qstd Orifice**	Sampler #	Sampler Slope - m_s	Sampler Intercept - b_s	**Qstd Sampler**	**% Difference**
A-35	20.0	293.0	820	**50**	**5.40**	1125	**9.53442**	**-0.01678**	**0.248**	820	**0.033**	**-1.08973**	**0.250**	**-0.59**
B-35	20.0	293.0	823	**50**	**5.50**	1125	**9.53442**	**-0.01678**	**0.251**	823	**0.033**	**-1.06515**	**0.249**	**0.62**
C-35	20.0	293.0	821	**50**	**5.65**	1125	**9.53442**	**-0.01678**	**0.254**	821	**0.032**	**-0.78368**	**0.248**	**2.34**
BG-35	5.0	278.0	822	**50**	**0.00**	1125	**9.53442**	**-0.01678**	**0.002**	822	**0.033**	**-0.95054**	**0.251**	**-14179.73**
BG-DUP-35	5.0	278.0	825	**50**	**5.85**	1125	**9.53442**	**-0.01678**	**0.265**	825	**0.031**	**-0.85436**	**0.264**	**0.29**

Acceptance Limit <= 10% Difference

APPENDIX E

LABORATORY DATA REPORTS (ON CD)

APPENDIX F

LABORATORY DATA VALIDATION MEMORANDA

Memo

To: David Sullivan

From: Lorie MacKinnon

CC:

Date: 02/17/15

Re: Data Validation Review: Air Samples: Keith Middle School/New Bedford, MA: SDG 15010030

SUMMARY

Limited (Tier II) validation was performed on the data for 10 air samples and two trip blank samples collected at the Keith Middle School in New Bedford, Massachusetts. The samples were collected on December 30, 2014 and submitted to Pace Analytical Services, Inc. in Schenectady, New York for analysis. All air vent samples were collected on polyurethane foam (PUF) cartridges in accordance with EPA method TO-10A; all ambient air samples were collected on particulate filters and PUF cartridges in accordance with EPA method TO-4A. The samples were analyzed for polychlorinated biphenyl (PCB) homolog distribution using EPA method 680. The results were reported under job number 15010030.

The sample results were assessed using the *EPA New England Data Validation Functional Guidelines for Evaluating Environmental Analyses*, revised December 1996. Modification of these guidelines was performed to accommodate the non-CLP methodology.

The data appear to be valid as reported without qualification and may be used for decision-making purposes. All results are usable for project objectives.

SAMPLES

Samples included in this review are listed below:

VS-9-35	VS-9-35-DUP[1]	VS-14-35
VS-1-35	VS-4-35	VS-TB-35
A-35	B-35	C-35
BG-35	BG-35-DUP[2]	TB-35

[1] - Field duplicate of VS-9-35
[2] - Field duplicate of BG-35

REVIEW ELEMENTS

Sample data were reviewed for the following parameters:

- Agreement of analyses conducted with TRC requests
- Holding times and sample preservation
- Gas chromatography/mass spectrometry (GC/MS) tunes
- Initial and continuing calibrations
- Blanks
- Surrogate spike recoveries
- Laboratory control sample (LCS) results
- Internal standard performance
- Field duplicate results
- Quantitation limits and sample results

DISCUSSION

Agreement of Analyses Conducted with TRC Requests

Sample reports were checked to verify that the results corresponded to analytical requests as designated on the chain-of-custody and any correspondence between TRC and the laboratory.

Holding Times and Sample Preservation

All samples were extracted and analyzed within the method-specified holding time.

GC/MS Tunes

The frequency and abundance of all decafluorotriphenylphosphine (DFTPP) tunes were within the acceptance criteria. The samples were analyzed within 12 hours from the DFTPP tunes. Window defining mixtures were analyzed following each DFTPP tune.

Initial and Continuing Calibrations

The %RSDs and %Ds of all PCB homologs used in the initial and continuing calibrations were within the acceptance criteria.

Blanks

Target compounds were not detected in the laboratory method blanks and trip blanks associated with the PCB homologue analyses.

Target compounds were not detected in the VER PUF sample (Lot #s 120314-0, 120314-1, and 53383) and VER Filter sample (Lot # 120314-4) which were analyzed and reported under job numbers 14120445 and 14110033.

Surrogate Spike Recoveries

All recovery criteria were met for the project samples.

LCS Results

LCS and LCS Duplicate (LCSD) samples were extracted and analyzed with each extraction batch. The following table summarizes the analytes recoveries and relative percent differences (RPDs) outside of the control limits.

LCS ID	Compound	Recovery (%)	RPD (%)	Control Limits	Validation Actions
LCS-27	2-Chlorobiphenyl	118	46.9	28.7-78.9/40	Validation action was not required as all affected analyte results were nondetect in the associated samples and therefore not affected by the potential high bias and high precision results.
	2,3-Dichlorobiphenyl	119	49.5	30.8-82.6/40	
	2,4,5-Trichlorobiphenyl	130	51.6	34.4-86.8/40	
	2,2',4,6-Tetrachlorobiphenyl	132	52.9	34.6-86.9/40	
	2,2',3,4,5'-Pentachlorobiphenyl	137	50.3	37.8-91.9/40	
	2,2',4,4',5,6'-Hexachlorobiphenyl	142	49.7	40.9-94.8/40	
	2,2',3,4',5,6,6'-Heptachlorobiphenyl	142	48.5	41.7-98.0/40	
	2,2',3,3',4,5',6,6'-Octachlorobiphenyl	138	46.9	43.2-102/40	
	Decachlorobiphenyl	145	49.6	46.4-102/40	
Associated samples: VS-9-35, VS-9-35-DUP, VS-14-35, VS-1-35, VS-4-35, VS-TB-35					

Internal Standard Performance

All internal standard criteria were met for the project samples.

Field Duplicate Results

Samples VS-9-35/VS-9-35-DUP (PUF) and BG-35/BG-35-DUP (PUF/Filter) were submitted as the field duplicate (collocated) pairs with this sample set. PCBs were not detected in these samples.

Quantitation Limits and Sample Results

The quantitation limits met the requirements in the Sampling Plan for this program.

Due to sample matrix, two fold dilutions were performed on samples A-35, B-35, and C-35. Quantitation limits were elevated accordingly in these samples.

APPENDIX G

DISCUSSION OF RISK-BASED COMPARISON CRITERIA

DISCUSSION OF RISK-BASED COMPARISON CRITERIA

Two PCB risk-based air concentrations (RBACs) have been developed for the KMS, assuming occupational exposures within the school (8 hours/day, 250 days/year, for 25 years). Both non-carcinogenic and carcinogenic health endpoints were considered in the calculation of the RBACs; however, RBACs are based on noncarcinogenic effects as the most sensitive endpoint. The first RBAC is the Action Level (AL; 0.05 ug/m^3) used as an initial indicator that PCB air concentrations above background levels have been detected. The risk basis for the AL is a noncarcinogenic hazard index of approximately 0.2. The second RBAC is the Acceptable Long-Term Average Exposure Concentration (ALTAEC; 0.3 ug/m^3), indicative of the air concentration that should not be exceeded for an extended time period. The ALTAEC could be exceeded over the short-term and still result in acceptable risk levels. The risk basis for the ALTAEC is a noncarcinogenic hazard index of one.

Both RBACs were developed to be applied to a total PCB air concentration. PCB homologues have been quantified and summed to generate total PCB air concentrations. By quantifying PCB homologues, total PCB air data gathered at the KMS are directly comparable to total PCB air data gathered at the high school since both are based on homologues rather than congeners, which greatly facilitates communication and discussion with the general public on the results of analyses.

In September 2009, EPA published Public Health Levels (PHLs) for PCBs which are calculated indoor air concentrations that maintain PCB exposures at a level that EPA believes does not cause harm. PHLs were calculated for all ages of children from toddlers in day care to adolescents in high school as well as for adult school employees. In this report, indoor air PCB concentrations are compared to the PHL (0.45 ug/m^3) for adult school employees and children 12 to <15 years old, representative of the middle school age range. In calculating the PHL, EPA considered average PCB exposures from both school (e.g., school indoor and outdoor air, indoor dust and nearby outside soils) and non-school (e.g., diet, outside soils, indoor dust, and indoor and outdoor air) environments. EPA assumed that middle school children spend 6.5-hours per day at school (with 6 hours spent inside the school) for a 180-day school year.