

Additional Air Monitoring in Paterson Study (AAMPS)

Final Report

to

United States Environmental Protection Agency, Region 2

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Executive Summary

In anticipation of community concerns regarding approximately two months of elevated levels of p-dichlorobenzene observed during the Urban Community Air Toxics Monitoring Project, Paterson City, NJ (UCAMPP), NJDEP applied to USEPA for funds for an additional year of monitoring in Paterson. Sampling for UCAMPP occurred from November 2005 through December 2006. The elevated levels of p-dichlorobenzene were observed from October 2006 to the first part of December 2006. Levels returned to normal before the end of sampling. The main goal of the Additional Air Monitoring in Paterson Study (AAMPS) was to investigate whether the elevated levels observed during UCAMPP were a one-time occurrence or would recur periodically. A secondary goal was to see if spatial saturation sampling at and around 176 Broadway could identify potential sources of selected air toxics. Sampling with the TO-15 method occurred about every 12 days over a 1 year period from April 2010 to May 2011. TO-15 can measure 60 different VOCs. In addition to the TO-15 method, 5 spatial saturation sampling (SSS) campaigns were carried out over the course of the year of monitoring. For the SSS, Organic Vapor Monitors (OVM) passive badges were deployed for 3 days at 23 locations at and around the main monitoring location. The OVM samples were analyzed for benzene, ethyl benzene, carbon tetrachloride, chloroform, tetrachloroethylene, and p-dichlorobenzene. During each saturation sampling campaign, a collocated TO-15 measurement was obtained for the same time period, i.e., 3 days to allow for a comparison of methods. A total of 38 canister samples and 155 badge samples, including quality control samples, were collected during the year of monitoring. All sample results were within the expected values based on UCAMPP and other NJDEP statewide data. In contrast to the sampling in 2006, elevated levels of p-dichlorobenzene were not detected. Spatial saturation sampling did not reveal any patterns that could identify potential sources of the selected air toxics. Seven air toxics (benzene, 1,3-butadiene, carbon tetrachloride, chloroform, chloromethane, p-dichlorobenzene, tetrachloroethylene) that were measured with the TO-15 method were above the health benchmark in Paterson and most were above the health benchmark at NJDEP's other air toxics monitoring stations. Benzene and 1,3-butadiene accounted for the majority of the risk and these air toxics are generated from mobile sources.

1. Introduction:

Ambient air toxics contain a large group of compounds, including volatile organic compounds (VOCs), aldehydes, and polycyclic aromatic hydrocarbons (PAHs). They can be emitted from a single source or a wide variety of stationary and mobile sources. Mobile sources, particularly trucks and buses, are the largest sources contributing to ambient air toxics in urban areas (USEPA, 2005 <http://www.nj.gov/dep/airtoxics/sourceso05.htm>). Epidemiological studies have shown an association between exposure to elevated concentrations of air toxics and adverse health effects, including respiratory and cardiovascular diseases, carcinogenic, neurological, reproductive, and developmental effects (Bascom et al. 1996; Delfino 2002; Dockery et al. 1993; Hagen et al. 2000; Leikauf 1992; Norback et al. 1995).

In the previous Paterson study, the Urban Community Air Toxics Monitoring Project, Paterson City, NJ (UCAMPP), significantly elevated levels of p-dichlorobenzene were observed at one of the three monitoring locations (176 Broadway) in Paterson for a two month period compared to the other monitoring locations in Paterson and around the state. Seven other air pollutants (benzene, ethyl benzene, 1,3-butadiene, carbon tetrachloride, chloroform, chloromethane, and tetrachloroethylene) were also elevated at all three sites in Paterson as well as at other air monitoring locations around the state. The levels of these air pollutants were above NJDEP health guidelines in Paterson and at the other New Jersey sites.

As a result, NJDEP and USEPA determined that further study was needed to determine if the two month elevation of concentrations of p-dichlorobenzene was a one time event or whether the elevated levels are an ongoing occurrence. To verify previous observations and potentially identify sources of the above mentioned species around the area, we conducted the Additional Air Monitoring in Paterson Study (AAMPS), a one-year air monitoring project at the Commercial site (176 Broadway, where the elevated levels of p-dichlorobenzene were observed during UCAMPP) using the EPA TO-15 method. Five “Spatial Saturation Sampling” (SSS) campaigns were also conducted using Organic Vapor Monitors (OVM 3500, 3 M Company, Maplewood, MN) at 23 sites (including Commercial site and 1 comparison site 1.5 miles away in a park) located within ~1 mile of the commercial site during the period. The goals of AAMPS are to 1) determine whether the levels of p-dichlorobenzene remain elevated or whether the two-month elevation in p-dichlorobenzene levels observed during UCAMPP was a one-time event; 2) determine if there were any patterns in the levels of six additional air pollutants that would assist in determining potential sources.

By placing the Organic Vapor Monitors in a grid like fashion around the Commercial site, AAMPS attempted to: 1) characterize concentrations and concentration gradients of six air toxics of concern (benzene, carbon tetrachloride, chloroform, ethylbenzene, p-dichlorobenzene, and tetrachloroethylene) at and around the Commercial site in Paterson; 2) characterize spatial variations; 3) compare the two methods, TO-15, an active sampling method and the passive sampling method (SSS) by collection of side-by-side samples by the two sampling methods; and 4) provide information and develop tools so that the New Jersey Department of Environmental Protection (NJDEP) and the local community can better address exposure and risk issues related to those pollutants.

2. Sampling and Analyses Methods

2.1 Sampling

Two types of VOC samples were collected in Paterson. One type of sample was collected at the same location (176 Broadway) and in the same way (TO-15 method) as was done in the earlier UCAMPP study and at the other three air toxics monitoring locations around the state (Chester, New Brunswick and Elizabeth). This sample was collected every twelve days, which coincides with measurements obtained at the three other monitoring locations around the state. If a sample could not be collected on the regularly scheduled day, a sample was taken 6 days later in order to coincide with the 1 in 6 days sampling scheme at the three permanent air toxics monitoring stations around the state. This type of sample allows NJDEP to compare the levels at the Commercial site to the data collected during the previous UCAMPP study and at the other 3 monitoring sites around the state.

In addition, SSS were conducted in a grid like fashion at and around the commercial site to identify the concentration gradients of the six VOCs mentioned above. It was planned to conduct SSS campaigns every other month over the course of the year. During each campaign, Organic Vapor Monitors (OVM 3500, 3 M Company, Maplewood, MN) were deployed at 23 sites (including the Commercial site and 1 comparison site at East Side Park) by 2 teams within 1-2 hours to ensure as best as possible, simultaneous sampling at all sampling sites. Twenty-two SSS sampling sites were located within a 1 mile around 176 Broadway and the comparison/background site was 1.5 miles away.

Sampling at the Commercial site (where the elevated levels of p-dichlorobenzene were previously detected) began on April 26, 2010 and ended on May 15, 2011. 33 regular 24-hour canister samples (including 2 quality control samples) were successfully collected, consistent with the planned sampling schedule. In addition, 5 three-day canister samples (sampled for 72 hours for comparison to saturation samples) were collected during the 5 SSS campaigns, but only 4 were analyzed due to a laboratory error. Therefore, over the course of the project a total of 38 canister samples were collected and 37 of these were analyzed by ERG. Saturation sampling was delayed in the beginning due to the lack of the samplers from the vendor (A large quantity of the samplers were sent to the Gulf area for air monitoring after the BP oil spill). Additionally, the inclement weather we experienced in the winter in 2011 prohibited sampling, so the campaigns were not able to be deployed every other month.

From August 10, 2010 to May 12, 2011, five saturation sampling campaigns were conducted. The five sampling periods are 8/10-8/13/2010, 10/8-10/11/2010, 12/6-12/9/2010, 4/18-/4/21/2011, and 5/9-5/12/2011. In summary, 155 passive sampling badges (included quality control samples) from the 23 locations at and around 176 Broadway were successfully retrieved and analyzed for the 6 VOCs of concern (benzene, ethylbenzene, carbon tetrachloride, chloroform, tetrachloroethylene, and p-dichlorobenzene). Please see Tables 2 and 3.

2.2 Sample Analysis

The canister samples were analyzed by ERG, the national contract lab who performed the analysis during UCAMPP using TO-15, see <http://www.epa.gov/ttnamti1/files/ambient/airtox/to-15r.pdf> for more information.

The SSS badges were analyzed by a modified OSHA 7 method. Briefly, each charcoal pad was carefully removed from the holder and transferred to the labeled glass vial. The vials were labeled with the unique sample ID assigned to each sample. The pad was removed using cleaned Teflon tape wrapped stainless steel forceps, and was carefully folded with the aid of a similar pair of forceps so it fitted through the neck of the 1.8-mL glass vial. The vial was then capped.

Once all the pads had been transferred to vials, each vial was then reopened; 1 mL of CS₂/acetone (1:2) solution with surrogates (5 ng/μL) of p-dichlorobenzene-d₄ and 1-Bromo-4-fluorobenzene in CS₂/acetone [1:2, v/v solution] was added (using a dedicated gas tight syringe) and the vial was then tightly capped. When all the pads in a batch of samples to be extracted were prepared, the vials were placed in a holding tray which was placed in an ultrasound bath. Water with a small amount of crushed ice was added to reach the solvent meniscus but to not touch the bottom of the vial caps. The pads were then extracted by sonication for 40 minutes, solvent blanks, field blanks, and laboratory blanks were similarly treated.

After sonication, a 200-μL aliquot of the extract was pipetted into a 2-mL amber glass vial containing 5 μL of internal standards (100 ng/μL of bromochloromethane, chlorobenzene d-5 and 1, 4-difluorobenzene in methanol). One μL sample extract was then analyzed by an HP 6890 GC/5973 MSD for determination of the target VOCs. Sample extracts were immediately analyzed.

2.3 Quality Assurance/Quality Control (QA/QC)

The QA/QC procedures have been established at both ERG (TO-15 analyses) and EOHSI (for field sampling and SSS sample analysis). Since ERG is a USEPA national contract lab, all QA/QC procedures have been documented with USEPA. The analytical QA/QC, and procedures for the passive sampler analysis at EOHSI include: 1) analysis of a calibration check and solvent blank before each daily run and after a run of ten samples; 2) analysis of solvent blank prior to use for extraction and with every set of samples for passive samplers analyzed at EOHSI; 3) validation of GC-MS working status before each run using manufacturer recommended procedures; and 4) analysis of 15% of the extracts as replicates injection (n = 24) and 10% as split extracts (duplicates, n = 15). A bound lab notebook, which includes name, date and page number, was used for passive badge analysis, and the records for instrument status, run logs, and calibrations were kept. In addition, the calibration standards were obtained from two separate sources to ensure the analysis accuracy. One vendor was AccuStandard Inc. (M-502-10X.) and one was RESTEK (624 Calibration Mix #2 and #3, 2000 μg/mL each in P&T methanol, 1mL/ampul, weblink at <http://www.restek.com/restek/prod/5630.asp>). Two surrogates (1, 4-Dichlorobenzene-d₄ and 1-Bromo-4-fluorobenzene) and three internal standards (bromochloromethane, chlorobenzene d-5 and 1, 4-difluorobenzene) were also obtained from Sigma-Aldrich for quantification.

For field sampling, field blanks for passive samplers (n=10), duplicate canisters (n=3) and passive samples (n=15) were collected. Good precision was obtained from both canister and passive samples. The percent difference for 3 canister duplicates was 8.8-24.6% and was 1.5-21.5% for duplicate passive samples. The percent difference for duplicate and replicate injections were 10% and 5%, respectively. However, very poor precision was observed when comparing the SSS samples to the 3 day canister samples.

This could be due to any number of factors, e.g., the Standard Operating Procedure for the TO-15 method requires a 24-hour sampling period and these canisters sampled for 3 days to match the sampling time of the badges, and the fact that there were very few samples to compare (n=4). Percent difference for chloroform ranged from -3 to 97%, carbon tetrachloride was -42 to 23%, benzene was -123 to 19%, tetrachloroethylene was -41 to 49%, ethylbenzene was -58 to 29% and p-dichlorobenzene was -48 to 144%. Benzene and tetrachloroethylene had the best precision in that both (n=3) had percent differences that were similar and ranged from 5-19% and 13-23%.

The field blank levels of most target compounds are below detection, excluding benzene. For the 1st and 2nd sampling campaigns, customized badges were deployed. These badges were customized by not having a label directly on the badge. The labels contain benzene at detectable levels for ambient sampling. Benzene contamination occurred during the 3rd, 4th and 5th campaigns because the company stopped customizing the samplers, i.e., labels were put on the badges by the manufacturer. Thus, elevated benzene was observed for those field blanks and other field samples during the last 3 campaigns so blank subtraction was applied to those samples.

2.4 Data Analysis

Summary statistics were calculated for both canister and passive sampling results. For passive sampling results, benzene background varied from batch to batch. All the analyses were performed using SAS (version 9.1; SAS Institute Inc., Cary, NC). For the SSS data, statistics which looked at site differences were applied to these data.

3. Results

3.1 TO-15 Results

No elevated levels of p-dichlorobenzene were observed in any of the samples collected. The concentrations measured by the TO-15 methods during AAMPS were similar to those measured in the earlier UCAMPP study, excluding the 2-month elevation in levels of p-dichlorobenzene. Please see Table 4.

3.2 SSS Results

The results from the SSS are present in Table 4 and Section 8. No elevated levels of p-dichlorobenzene were observed during the SSS. The results indicated that there are no significant sources of p-dichlorobenzene in the monitoring area during the monitoring period. There was one value for tetrachloroethylene, 24 ug/m³, that was higher than those observed during the rest of the project (other values were <1 ug/m³). The site where the elevated level of tetrachloroethylene was measured was near an auto repair shop. Tetrachloroethylene is commonly used by the automotive industry as a degreaser (http://www.ehow.com/way_5637599_use-perchloroethylene-cleaning-metal.html), so it is possible this chemical was used by that company. However, this value did not pose an immediate threat to human health as the short term health benchmark is 20,000 ug/m³.

There was no noncancer risk from these measured concentrations as the reference concentration is $35 \mu\text{g}/\text{m}^3$.

4. Risk Assessment

The air toxics that were measured above the NJDEP health benchmark for cancer risk (1×10^{-6}) were the same as those in UCAMPP and at the three permanent NJDEP air toxics. The air toxics above the health benchmark are: benzene, 1,3-butadiene, carbon tetrachloride, chloroform, chloromethane (methyl chloride) p-dichlorobenzene, and tetrachloroethylene (PERC). Across New Jersey, these compounds typically have a slightly greater risk than the NJDEP health benchmark. A health benchmark is a chemical-specific air concentration reflecting a policy-based determination of a level of *de minimus* health risk. For cancer-causing chemicals, the health benchmark is the air concentration that would contribute a one-in-a-million increase in the risk of getting cancer over a lifetime. The risks were calculated using the data obtained from TO-15 at 176 Broadway since it is a USEPA approved analytical method and the data was generated from a USEPA approved laboratory. The risks ranged from 2×10^{-6} for chloroform to 1×10^{-5} for benzene. This level of risk is similar to other parts of the state. Table 1 compares the cancer risks and risk ratios in Paterson with those of the three NJDEP permanent air monitoring stations around the state. The risk ratio is a comparison of an air concentration to a chemical's health benchmark, in this case 1×10^{-6} lifetime cancer risk. Please see Table 1 in Section 7.

5. Discussion

No elevated levels of p-dichlorobenzene were observed during this follow-up study. The spatial saturation sampling did not reveal any patterns that could be associated with potential sources. The source or sources of the p-dichlorobenzene observed in the UCAMPP study could not be identified in the AAMPS study. Based upon the investigation by NJDEP's Compliance and Enforcement program area, on-the-ground knowledge of the facilities by NJDEP inspectors and prevailing wind direction, the most likely source would have been Galaxy Chemical. This facility shut down and no records are available from 2006. Thus, there is a good possibility that the source of the p-dichlorobenzene no longer exists. The health risk from exposure to the air toxics that were measured in Paterson is similar to other parts of the state.

There was one measurement from the SSS that was elevated relative to the rest of the measurements for tetrachloroethylene, $24 \mu\text{g}/\text{m}^3$ versus $<1 \mu\text{g}/\text{m}^3$. This one elevated measurement was well below the short term health benchmark of $20,000 \mu\text{g}/\text{m}^3$. The investigation by NJDEP Compliance and Enforcement program area revealed that an auto body shop, located right next to the sampling locations, does brake jobs. Brake jobs traditionally require a full 12 oz spray can of brake cleaner per car. Tetrachloroethylene recently was a common component of brake cleaner. Tetrachloroethylene brake cleaner is mostly discontinued and NJAC 7:27-24.4(o) bans use of tetrachloroethylene for automotive consumer products starting December 31, 2011. Brake jobs could have potentially been a source of the elevated concentration that was observed. The maps in section 8 show the monitoring locations relative to schools. Other maps contain the mean

and concentration range of each of the air toxics that were measured with the OVM badges. Visual observation and statistical analyses indicated that there were no patterns that could be attributed to sources. In general, the concentrations were relatively consistent across the sampling area.

6. Conclusions

This study showed that the target VOC levels are similar to those found in UCAMPP and other urban areas in NJ, excepting the elevated levels of p-dichlorobenzene during that 2 month period of UCAMPP. For p-dichlorobenzene, no elevated levels were observed by either the canister samples collected at the 176 Broadway or the 23 spatial sampling sites located at and around the 176 Broadway site. Although AAMPS could not explain the phenomena of the elevated p-dichlorobenzene observed in UCAMPP, a likely explanation of the 2006 source is a local chemical company that was no longer in business during this study. In addition, the 2010/2011 emissions inventory did not list any p-dichlorobenzene sources. The AAMPS results indicate that there are no significant sources of this compound in Paterson that may pose a risk to local community health. Finally, the SSS method of sampling is an easy, inexpensive screening method for detecting air toxics in communities.

7. Tables

Table 1: Comparison of Cancer Risk and Risk Ratios for AAMPS and Other NJDEP Monitoring Sites using 2010 annual averages or the Average of the First Five Months of 2011, whichever is highest.

Air Contaminant	AAMPS	AAMPS risk ratio *	New Brunswick	New Brunswick risk ratio *	Chester	Chester risk ratio *	Elizabeth	Elizabeth risk ratio *
Benzene	1E-05	10	6E-06	6	4E-06	4	8E-06	8
1,3-Butadiene	7E-06	7	2E-06	2	3E-07	<1	4E-06	4
Carbon Tetrachloride	4E-06	4	8E-06	8	4E-06	4	4E-06	4
Chloroform	4E-06	4	3E-06	3	2E-06	2	3E-06	3
Chloromethane (methyl chloride)	2E-06	2	2E-06	2	2E-06	2	2E-06	2
p-Dichloro-benzene	3E-06	3	5E-07	<1	1E-07	<1	9E-07	<1
Tetrachloro-ethylene	2E-06	2	7E-07	<1	4E-07	<1	1E-06	1

* The risk ratio is a comparison of an air concentration to a chemical's health benchmark, in this case 1×10^{-6} lifetime cancer risk.

Table 2: Summary of valid samples collected for the project

Sample Type	Number
Canister sample	37
SSS sample	155 (5 campaigns)

Table 3: Total SSS samples collected during the study

Sampling Date	Sample Number ¹	Note
8/10/10 - 8/13/10	30	1st SSS
10/8/10 - 10/11/10	30	2nd SSS
12/6/10 - 12/9/10	36	3rd SSS
4/18/11 - 4/21/2011	31	4th SSS
5/9/11 - 5/12/2011	28	5th SSS

¹includes duplicates, triplicates and blanks

Table 4: Descriptive Statistics for AAMPS and UCAMPP. Units are in $\mu\text{g}/\text{m}^3$.

	N	Mean	SD	Med	Min	P10	P25	P75	P90	Max	%> MDL
1,1,1-Trichloroethane											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	0.12	0.36	15
UCAMPP	45	0.23	0.16	0.16	0.05	0.11	0.11	0.33	0.38	0.98	100
1,2,4-Trichlorobenzene											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	0.29	6
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	0.07	0.15	2
1,2,4-Trimethylbenzene											
AAMPS	34	0.85	0.54	0.71	0.03	0.03	0.54	1.33	1.52	2.11	88
UCAMPP	45	0.95	0.70	0.79	0.15	0.34	0.54	1.08	1.67	4.38	100
1,3,5-Trimethylbenzene											
AAMPS	34	0.25	0.15	0.22	0.02	0.02	0.15	0.37	0.43	0.62	85
UCAMPP	45	0.30	0.20	0.25	0.05	0.10	0.20	0.34	0.44	1.23	100
1,3-Butadiene											
AAMPS	34	0.22	0.15	0.20	0.01	0.01	0.15	0.27	0.37	0.71	85
UCAMPP	45	0.29	0.24	0.27	0.04	0.09	0.13	0.35	0.46	1.35	100
Acetonitrile											
AAMPS	34	0.24	0.14	0.27	0.01	0.01	0.16	0.34	0.45	0.48	85
UCAMPP	45	0.28	0.40	0.22	ND	ND	ND	0.39	0.54	2.34	56
Acetylene											
AAMPS	34	1.45	0.95	1.30	0.01	0.01	0.90	2.04	2.74	3.54	85
UCAMPP	45	1.76	1.72	1.16	0.34	0.52	0.72	1.96	2.81	8.22	100
Acrylonitrile											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	0.05	6
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	ND	0.30	2
Benzene											
AAMPS	34	1.31	0.67	1.32	0.03	0.03	1.02	1.61	1.92	3.32	88
SSS3	115	2.32	2.03	1.50	0.35	0.77	1.06	2.13	6.35	7.66	
UCAMPP	45	1.81	1.15	1.44	0.54	0.90	1.02	2.14	3.61	6.52	100
Bromomethane											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	1.77	47
UCAMPP	45	0.07	0.07	0.04	ND	0.04	0.04	0.08	0.12	0.35	93
Carbon Disulfide¹											
AAMPS	34	0.06	0.1	0.04	0.00	0.00	0.00	0.07	0.10	0.43	59
UCAMPP	43	0.11	0.09	0.09	ND	ND	0.00	0.16	0.22	0.31	72
Carbon Disulfide²											
AAMPS	34	0.09	0.09	0.07	0.03	0.03	0.05	0.10	0.10	0.43	59
UCAMPP	43	0.11	0.08	0.09	ND	ND	ND	0.16	0.22	0.31	72
CarbonTetrachloride¹											
AAMPS	34	0.47	0.26	0.57	0.00	0.00	0.41	0.61	0.75	0.89	82
SSS3	115	0.66	0.14	0.69	0.19	0.47	0.53	0.77	0.82	1.05	95
UCAMPP	45	0.61	0.17	0.63	0.19	0.44	0.50	0.76	0.82	1.01	100
CarbonTetrachloride²											
AAMPS	34	0.50	0.22	0.57	0.03	0.15	0.41	0.61	0.75	0.89	82
UCAMPP	45	0.61	0.17	0.63	0.19	0.44	0.50	0.76	0.82	1.01	100
Chlorobenzene											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	0.24	0.80	3
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	ND	0.05	0

	N	Mean	SD	Med	Min	P10	P25	P75	P90	Max	%> MDL
Chloroethane											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	2.01	38
UCAMPP	45	0.07	0.10	0.05	ND	ND	0.03	0.08	0.11	0.58	71
Chloroform¹											
AAMPS	34	0.12	0.14	0.11	0.00	0.00	0.00	0.20	0.28	0.57	56
SSS ³	115	0.15	0.07	0.14	0.02	0.06	0.09	0.20	0.25	0.35	82
UCAMPP	45	0.33	0.33	0.20	ND	ND	0.10	0.44	0.83	1.52	78
Chloroform²											
AAMPS	34	0.15	0.11	0.11	0.04	0.04	0.08	0.20	0.28	0.57	56
UCAMPP	45	0.33	0.32	0.20	ND	ND	0.10	0.44	0.83	1.52	78
Chloromethane											
AAMPS	34	1.23	0.87	1.24	0.02	0.02	1.09	1.34	1.49	5.47	88
UCAMPP	45	1.14	0.22	1.12	0.56	0.85	0.99	1.33	1.39	1.55	100
Chloromethylbenzene											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	0
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	0
cis-1,2-Dichloroethylene											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	0.70	3.0
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	0
Dibromochloromethane											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	0
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	ND	0.09	2
Dichlorodifluoromethane											
AAMPS	34	2.47	1.22	2.89	0.00	0.00	2.69	3.08	3.26	4.52	82
UCAMPP	45	3.04	0.93	2.93	1.19	2.18	2.53	3.37	3.87	7.59	100
Dichloromethane											
AAMPS	34	1.05	0.88	0.91	0.04	0.04	0.57	1.28	1.76	4.36	85
UCAMPP	45	1.15	1.26	0.80	0.17	0.38	0.49	1.25	1.81	7.18	100
Dichlorotetrafluoroethane¹											
AAMPS	34	0.11	0.05	0.13	0.00	0.00	0.11	0.14	0.15	0.18	82
UCAMPP	45	0.11	0.03	0.14	0.07	0.07	0.07	0.14	0.14	0.14	100
Dichlorotetrafluoroethane²											
AAMPS	34	0.12	0.03	0.13	0.06	0.08	0.11	0.14	0.15	0.18	82
UCAMPP	45	0.11	0.03	0.14	0.07	0.07	0.07	0.14	0.14	0.14	100
Ethylbenzene											
AAMPS	34	0.55	0.32	0.56	0.03	0.03	0.35	0.82	0.88	1.25	85
SSS ³	115	0.71	0.45	0.21	0.05	0.08	0.10	0.29	0.35	0.45	95
UCAMPP	45	1.28	1.50	0.83	0.17	0.39	0.61	1.39	3.13	9.04	100
Hexachloro-1,3-butadiene											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	1.04	3.0
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	ND	0.21	0
Methyl Ethyl Ketone											
AAMPS	34	1.43	0.90	1.50	0.03	0.04	0.76	2.02	2.27	3.93	85
UCAMPP	45	2.76	2.12	2.27	ND	0.62	1.30	3.81	5.37	10.03	96
Methyl Isobutyl Ketone											
AAMPS	34	0.32	0.22	0.28	0.02	0.02	0.19	0.41	0.59	1.02	88
UCAMPP	45	0.77	0.71	0.57	ND	0.20	0.37	0.86	1.60	3.57	96
Methyl Methacrylate											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	0.15	1.09	18
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	0

	N	Mean	SD	Med	Min	P10	P25	P75	P90	Max	%> MDL
Methyl Tert-Butyl Ether¹											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	0
UCAMPP	45	0.72	1.45	0.18	ND	0.04	0.11	0.76	1.48	7.93	91
m-Dichlorobenzene											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	0.12	3.0
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	0.12	0.30	18
m,p-Xylene¹											
AAMPS	34	1.47	0.96	1.41	0.00	0.00	0.83	0.83	2.68	3.27	82
UCAMPP	45	4.62	6.99	2.39	0.43	0.91	1.74	4.34	10.38	40.88	100
m,p-Xylene²											
AAMPS	34	1.49	0.93	1.41	0.06	0.06	0.83	0.83	2.68	3.27	82
UCAMPP	45	4.62	6.99	2.39	0.43	0.91	1.74	4.34	10.38	40.88	100
n-Octane¹											
AAMPS	34	0.28	0.18	0.26	0.00	0.00	0.14	0.40	0.49	0.64	82
UCAMPP	45	0.33	0.25	0.28	0.05	0.14	0.19	0.37	0.61	1.50	100
n-Octane²											
AAMPS	34	0.29	0.17	0.26	0.06	0.06	0.14	0.40	0.49	0.64	82
UCAMPP	45	0.33	0.25	0.28	0.05	0.14	0.19	0.37	0.61	1.50	100
o-Dichlorobenzene											
Background	34	N/A	N/A	ND	ND	ND	ND	ND	ND	3.27	6
Commercial	45	N/A	N/A	ND	ND	ND	ND	ND	0.12	0.18	13
o-Xylene											
AAMPS	34	0.58	0.35	0.61	0.02	0.02	0.34	0.88	0.99	1.16	85
UCAMPP	45	1.20	1.19	0.87	0.17	0.35	0.65	1.30	1.91	6.65	100
p-Dichlorobenzene¹											
AAMPS	34	0.20	0.22	0.17	0.00	0.00	0.00	0.34	0.46	0.77	62
SSS ³	115	0.21	0.11	0.21	0.05	0.08	0.10	0.29	0.35	0.45	95
UCAMPP	45	18.68	45.19	0.54	0.12	0.30	0.36	12.05	55.49	205.44	100
p-Dichlorobenzene²											
AAMPS	34	0.26	0.18	0.21	0.04	0.06	0.16	0.34	0.46	0.77	62
UCAMPP	45	18.68	45.19	0.54	0.12	0.30	0.36	12.05	55.49	205.44	100
Propylene											
AAMPS	34	1.31	0.73	1.29	0.02	0.02	0.98	1.72	2.62	2.67	85
UCAMPP	45	1.65	1.17	1.34	0.34	0.57	0.96	2.24	2.91	6.90	100
Styrene¹											
AAMPS	34	0.24	0.43	0.18	0.00	0.00	0.11	0.23	0.31	2.63	82
UCAMPP	45	0.28	0.24	0.21	ND	0.09	0.13	0.34	0.60	0.98	96
Styrene²											
AAMPS	34	0.25	0.43	0.18	0.04	0.04	0.11	0.23	0.31	2.63	82
UCAMPP	45	0.28	0.24	0.21	ND	0.09	0.13	0.34	0.60	0.98	96
Tetrachloroethylene¹											
AAMPS	34	0.26	0.21	0.23	0.00	0.00	0.13	0.42	0.53	0.78	79
SSS3	115	0.59	2.20	0.34	0.09	0.12	0.21	0.53	0.70	23.83	95
UCAMPP	45	0.75	0.83	0.54	0.14	0.20	0.34	0.88	1.23	5.10	100
Tetrachloroethylene²											
AAMPS	34	0.28	0.19	0.23	0.03	0.07	0.13	0.42	0.53	0.75	79
UCAMPP	45	0.75	0.83	0.54	0.14	0.20	0.34	0.88	1.23	5.10	100
Toluene											
AAMPS	34	7.35	16.05	2.67	0.02	0.02	1.47	4.9	9.73	85.59	85
UCAMPP	45	7.98	6.06	6.37	1.06	2.94	3.85	9.80	16.36	32.39	100

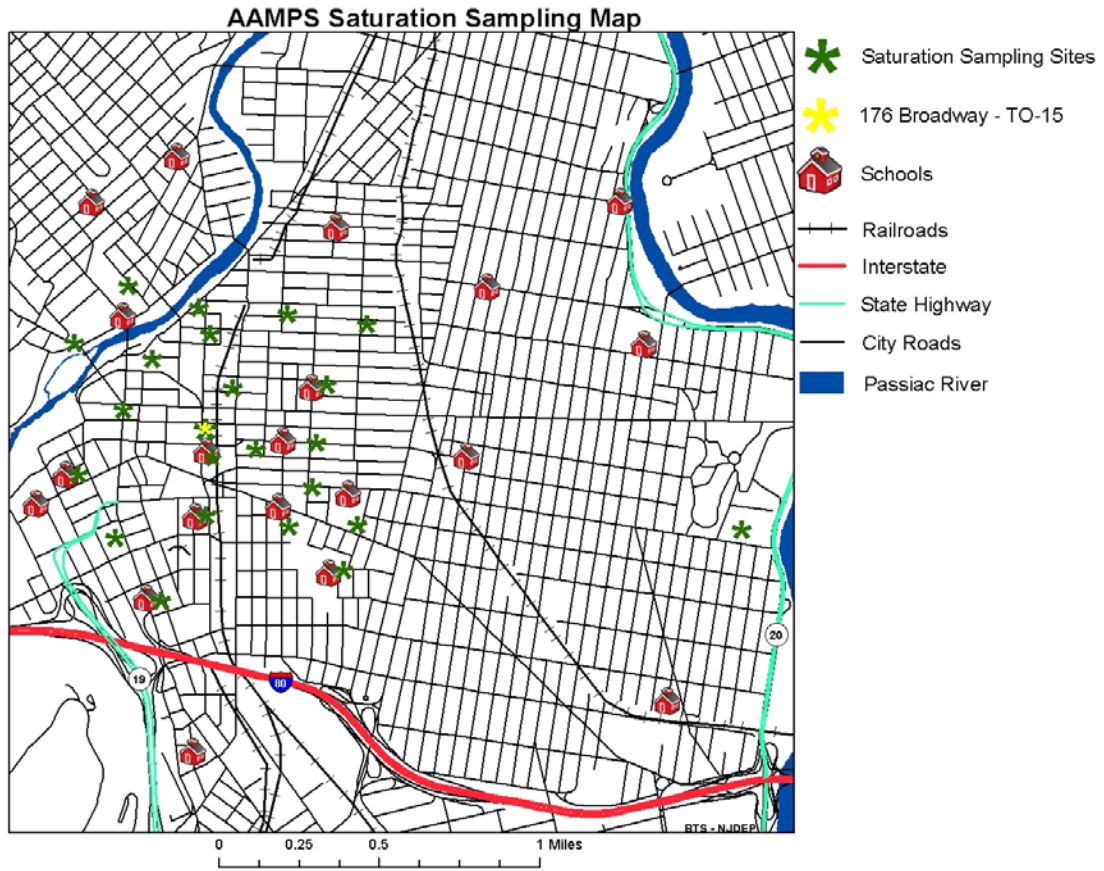
	N	Mean	SD	Med	Min	P10	P25	P75	P90	Max	%> MDL
Trichloroethylene											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	0.13	3.96	12
UCAMPP	45	N/A	N/A	0.05	ND	ND	ND	0.16	0.16	0.59	53
Trichlorofluoromethane¹											
AAMPS	34	1.90	1.31	1.87	0.00	0.00	1.50	2.59	3.04	6.99	82
UCAMPP	45	3.10	2.07	2.31	0.68	1.41	1.80	3.66	5.24	11.16	100
Trichlorofluoromethane²											
AAMPS	34	1.92	1.31	1.87	0.06	0.07	1.50	2.59	3.04	6.99	82
UCAMPP	45	3.10	2.07	2.31	0.68	1.41	1.80	3.66	5.24	11.16	100
Trichlorotrifluoroethane											
AAMPS	34	0.75	0.70	0.72	0.05	0.05	0.66	0.78	0.84	4.44	85
UCAMPP	45	0.78	0.17	0.77	0.38	0.61	0.69	0.85	0.92	1.31	100
Vinyl Chloride											
AAMPS	34	N/A	N/A	ND	ND	ND	ND	ND	ND	0.72	9
UCAMPP	45	N/A	N/A	ND	ND	ND	ND	ND	0.03	0.05	20

¹ NDs are substituted with zero for computation of statistics

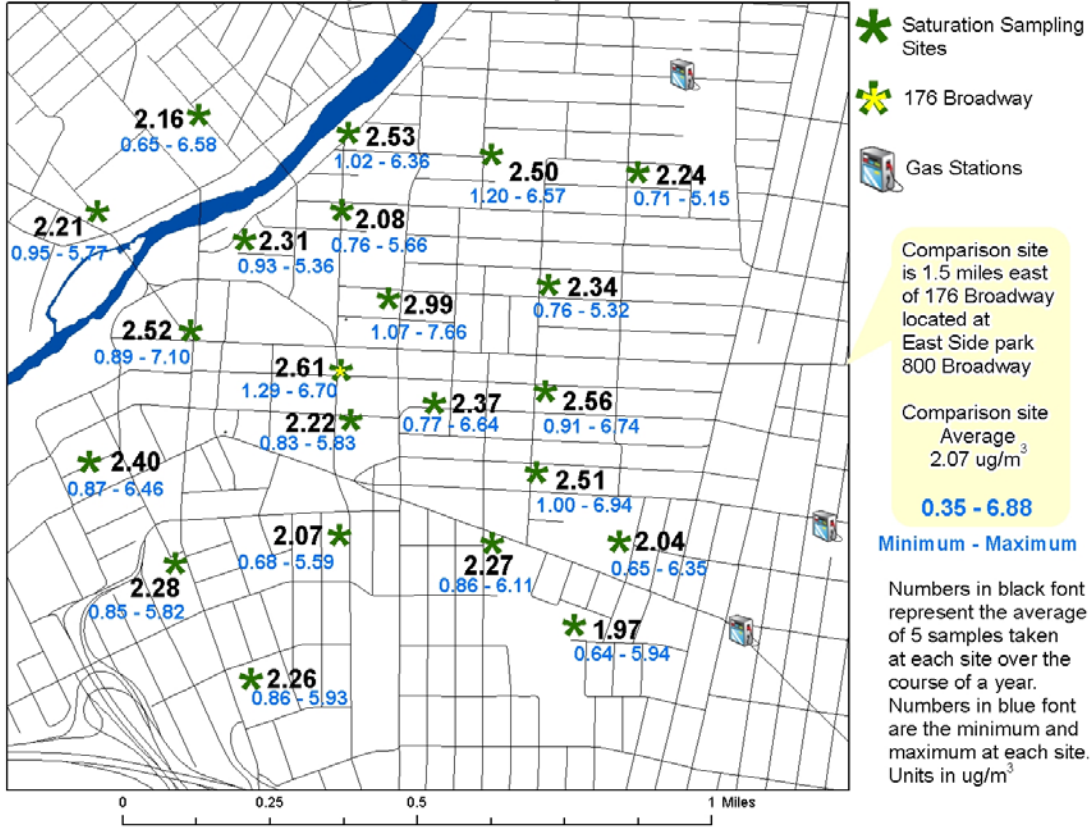
² NDs are substituted with MDL for computation of statistics

³ NDs are substituted with 1/2 MDL for computation of statistics

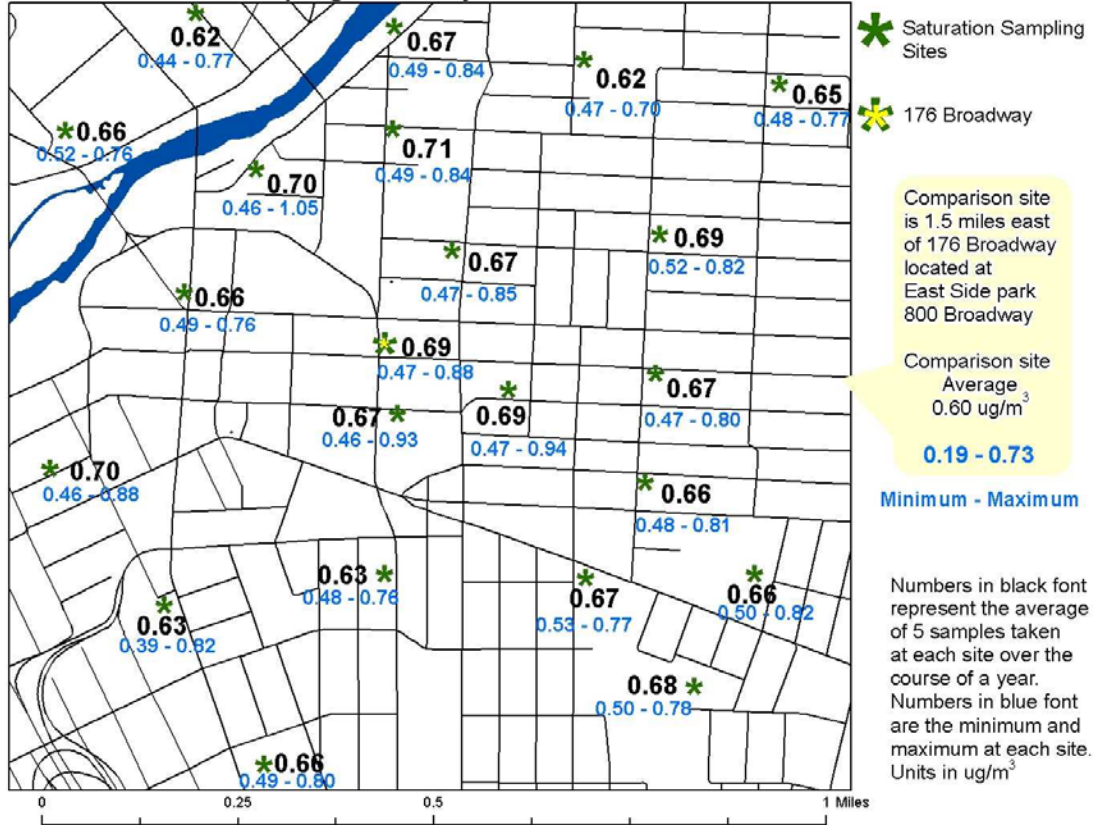
8. Maps



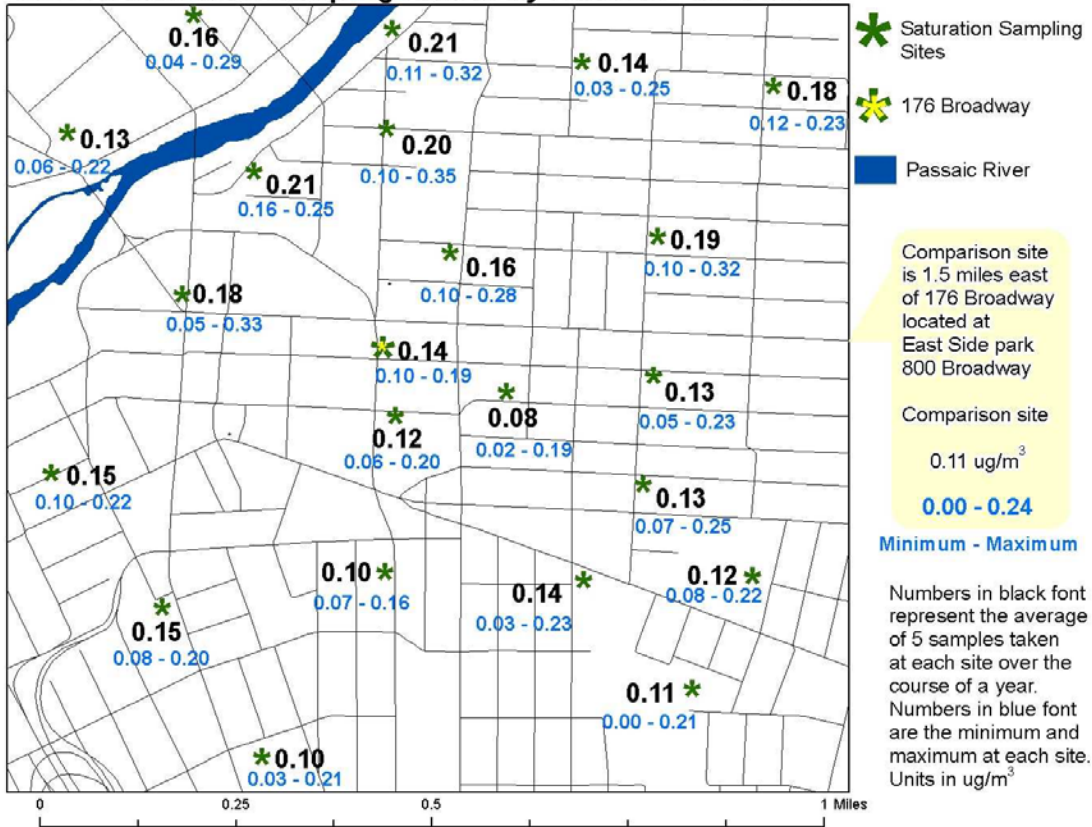
AAMPS Saturation Sampling Results by Location - Benzene



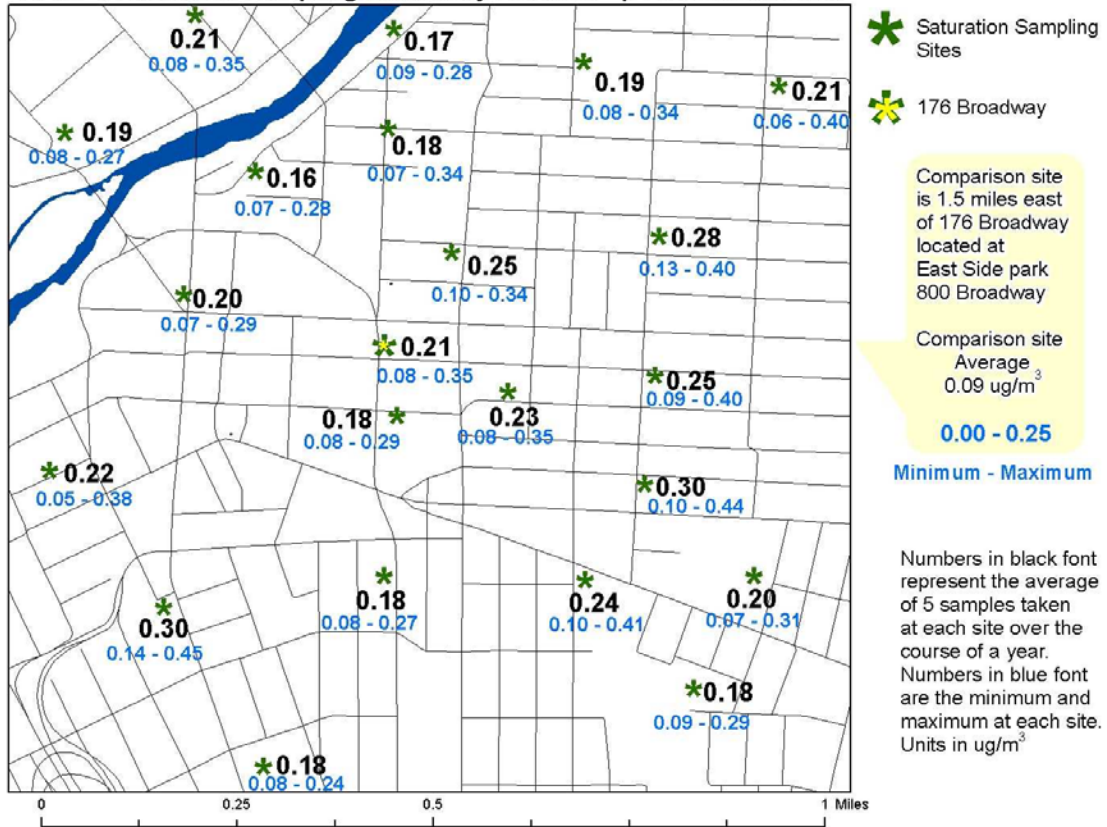
AAMPS Saturation Sampling Results by Location - Carbon Tetrachloride



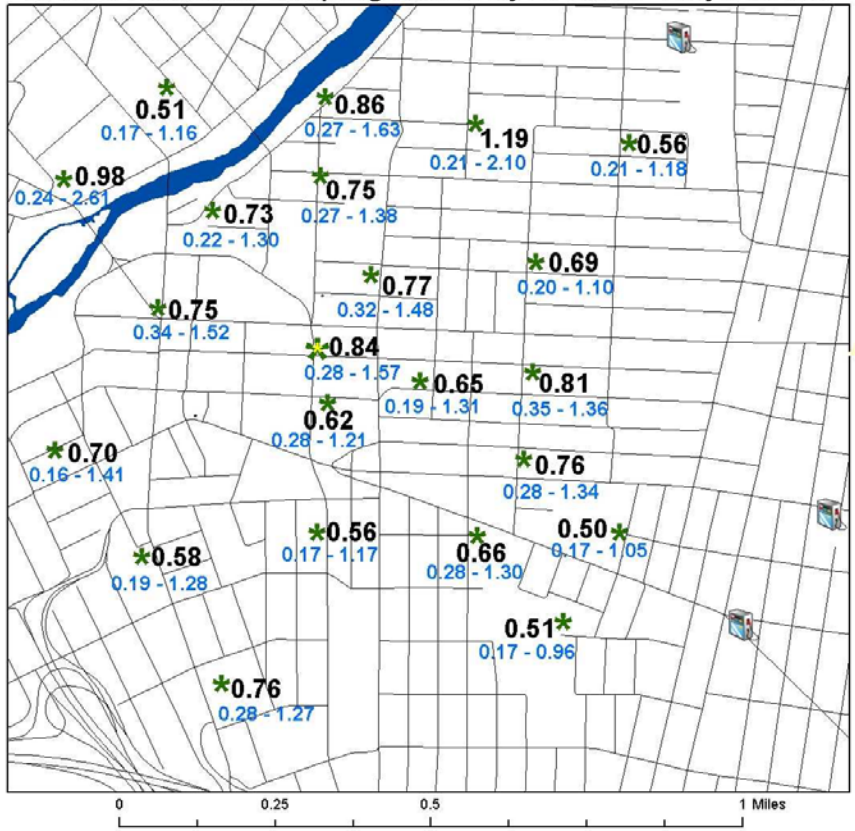
AAMPS Saturation Sampling Results by Location - Chloroform



AAMPS Saturation Sampling Results by Location - p-Dichlorobenzene



AAMPS Saturation Sampling Results by Location - Ethylbenzene



Saturation Sampling Sites

176 Broadway

Gas Stations

Comparison site is 1.5 miles east of 176 Broadway located at East Side park 800 Broadway

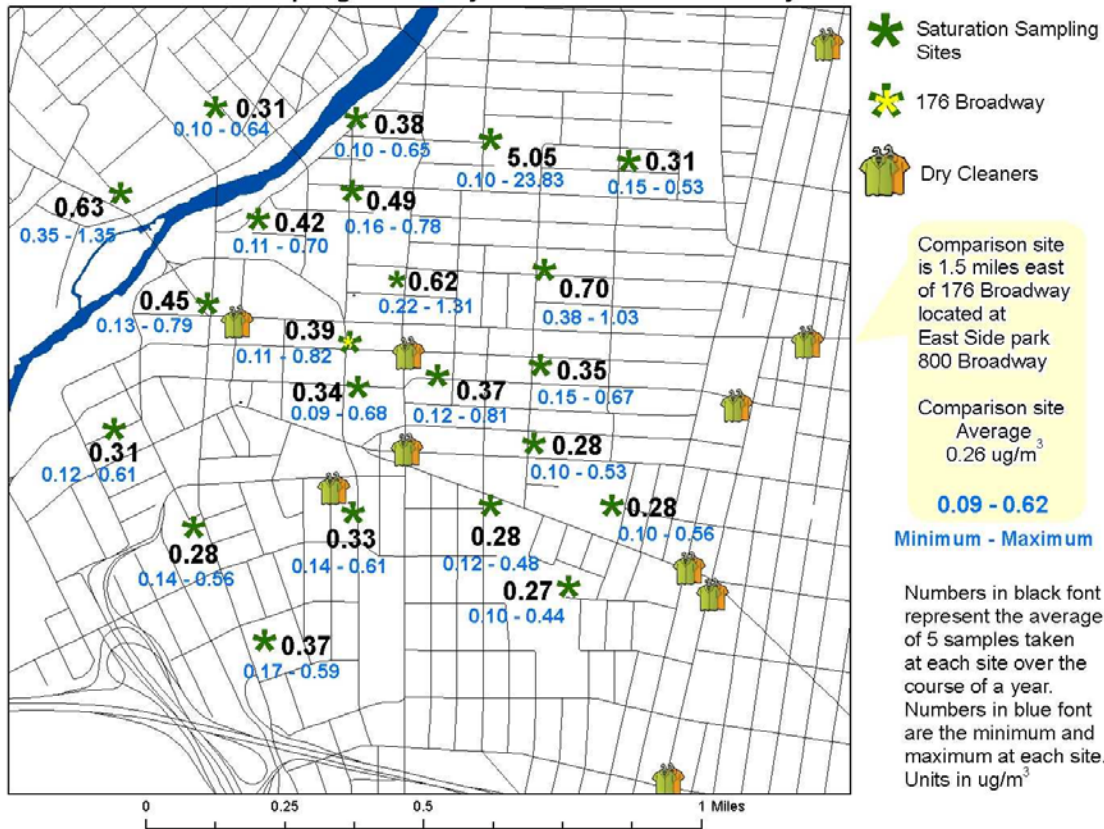
Comparison site Average 0.38 ug/m³

0.16 - 0.86

Minimum - Maximum

Numbers in black font represent the average of 5 samples taken at each site over the course of a year. Numbers in blue font are the minimum and maximum at each site. Units in ug/m³

AAMPS Saturation Sampling Results by Location - Tetrachloroethylene



6. References

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