Roxbury, MA NATTS Network Assessment Review

- Established 2003: Carbonyls and VOCs
  - Chromium VI added in 2005; ended in in 2013
  - PM_{10} Metals added in 2004
  - PAHs added in 2008
- For the NATTS Network Assessment (2003-2018):
  - 18 of 18 Method Quality Objective (MQO) Core HAPs were included in the national trends
  - 254 of 262 pollutant datasets were suitable for trends analysis
  - Annual Average and 3-Year Rolling Average Concentrations were generally flat over time, with the exception of a few pollutants (benzene, 1,3-butadiene, cadmium (PM_{10}), lead (PM_{10}), naphthalene, tetrachloroethylene, and trichloroethylene).
  - 100% Reporting of Datasets
- Method Quality Objectives (MQO): 2003-2018
  - Completeness: Met 85% completeness in 242 of 262 pollutant datasets
  - Method Detection Limits: Met MDL Target Ratio of 1.00 in 263 of 271 pollutant datasets
  - Bias: Met ±25% for 217 of 225 pollutant datasets
  - Overall Method Precision: Met ≤15% CV for 150 of 213 pollutant datasets
  - Analytical Method Precision: Met ≤15% CV for 115 of 154 pollutant datasets
- Analytical Laboratories for 2018

VOC	Carbonyl	PM_{10} Metals	Chromium VI	PAHs
RIDOH	MADEP	ERG	NA	ERG

- Equipment Year Deployed

Equipment Type	VOC	Carbonyl	PM_{10} Metals	Chromium VI	PAHs
Sampler	2010	2016	2007	2005	2015
Analytical	2005	1993	2015	2001	2014
Preconcentrator	2015	NA	NA	NA	NA
Standards Preparation	2010	NA	NA	NA	NA
Canister Cleaning	2000	NA	NA	NA	NA
Extraction	NA	NA	2011	2011	2004

National Summary: NATTS data were collected at 27 locations across the United States, with sites beginning in 2003 or later (Figure 1) for 19 core HAPs. Over 528,000 concentrations (primary, secondary, and replicate) were generated and analyzed for this assessment. Pollutant datasets were scored to assess whether they were suitable for trends analysis. Each pollutant dataset was evaluated against four MQOs: Completeness; Sensitivity; Bias; and Precision. Datasets that were suitable (A- or B-rated) for six consecutive years were used for national trends analysis (Table 1).

National trends were determined by comparing the most recent 3-year blocked averages (e.g., 2013-2015 vs. 2016-2018) to determine if the NATTS Trends DQO was being met:

To be able to detect a a15 percent difference (trend) between the annual mean concentrations of successive 3-year periods within acceptable levels of decision error.

Of the 19 core HAPs. 18 were assessed for the NATTS Trends DQO. Due to sampling and analytical issues, acrolein was not considered for trends analysis (Table 2). This assessment showed that across the network, 15 of those 18 pollutants were decreasing between the 3-year blocks, while two of those pollutants were increasing between the 3-year blocks. One pollutant did not exhibit a trend.

Figure 1. NATTS Site and Year Established

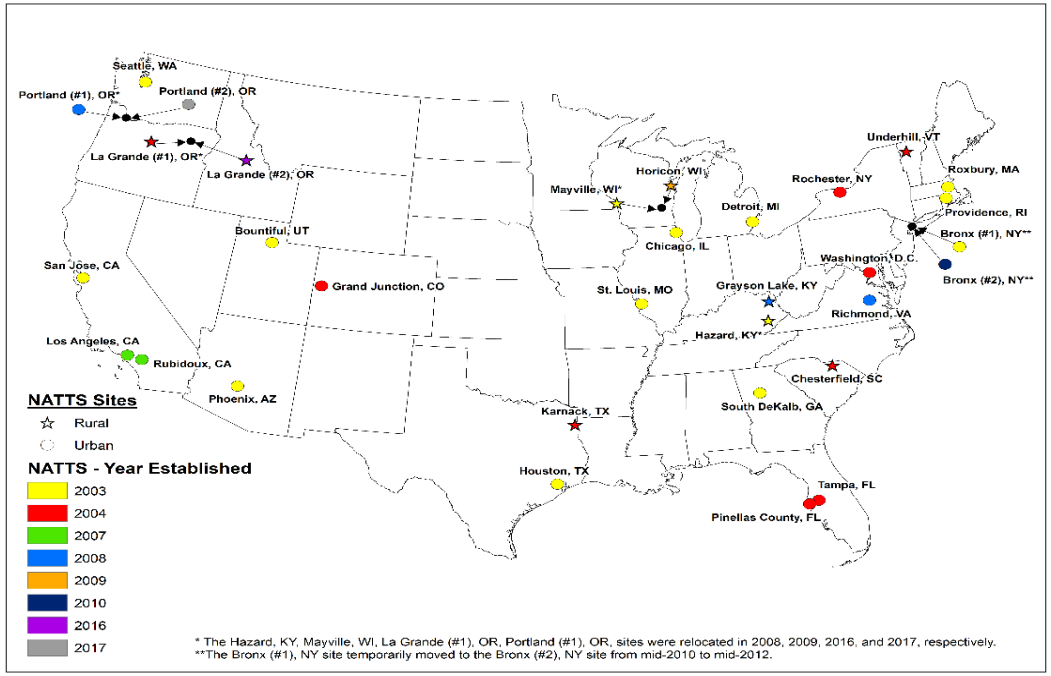


Table 1. NATTS Network Assessment: Count and Percentage of Suitable Datasets by Pollutant Group

Pollutant Group	A-rated		B-rated		Does Not Meet	
	#	%	#	%	#	%
VOCs	1,452	53%	737	27%	555	20%
Carbonyls	523	67%	193	25%	66	8%
PM_{10} Metals	1,418	61%	685	30%	213	9%
Chromium VI	159	74%	29	13%	27	13%
PAHs	410	74%	124	22%	18	3%
Total = 6,609	3,962	60%	1,768	27%	879	13%

Table 2. Three-Year Block Averages for National Trends

Pollutant	Units	# Sites	Block 1	Block 2	% Difference
Acetaldehyde	$\mu g/m^3$	19	1.51	1.39	-7.7%
Arsenic (PM_{10})	ng/m^3	21	0.71	0.68	-3.2%
Benzene	$\mu g/m^3$	19	0.65	0.59	-10.2%
Benzo(a)pyrene	ng/m^3	21	0.113	0.087	-23.2%
Beryllium (PM_{10})	ng/m^3	20	0.012	0.009	-26.4%
Butadiene, 1,3-	$\mu g/m^3$	19	0.071	0.063	-10.9%
Cadmium (PM_{10})	ng/m^3	21	0.170	0.097	-43.0%
Carbon Tetrachloride	$\mu g/m^3$	15	0.59	0.56	-4.7%
Chloroform	$\mu g/m^3$	20	0.256	0.255	-0.4%
Chromium VI	ng/m^3	18	0.029	0.026	-7.7%
Formaldehyde	$\mu g/m^3$	19	2.77	2.68	-3.3%
Lead (PM_{10})	ng/m^3	21	3.08	2.81	-8.9%
Manganese (PM_{10})	ng/m^3	20	8.06	7.93	-1.6%
Naphthalene	ng/m^3	20	66.70	51.08	-23.4%
Nickel (PM_{10})	ng/m^3	19	1.28	1.05	-18.0%
Tetrachloroethylene	$\mu g/m^3$	19	0.149	0.174	17.2%
Trichloroethylene	$\mu g/m^3$	19	0.020	0.022	10.7%
Vinyl Chloride	$\mu g/m^3$	17	0.0051	0.0048	-5.5%

NATTS Monitoring Site Report: Roxbury, MA

Site Information

Region	1
NATTS Site Type	Urban
County	Suffolk
AQS Site Code	25-025-0042
NATTS Operating Agency	MA Dept. of Environmental Protection
Latitude	42.32944
Longitude	-71.0825
AQS Land Use	Commercial
AQS Location Setting	Urban/City Center
10-Mile Population	755,503

Figure 2. NATTS Site Location

Pollutant Datasets Evaluation: Suitable for Trends (Y=yes; Y(T)=yes, and used for DQO Trends; N=No; "--"=not rated

Final Pollutant Name	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Acetaldehyde	N[a]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Arsenic (PM_{10})	--	N[a]	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Benzene	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Benzo(a)pyrene	--	--	--	--	--	--	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Beryllium (PM_{10})	--	N[a]	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Butadiene, 1,3-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Cadmium (PM_{10})	--	N[a]	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Carbon tetrachloride	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Chloroform	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Chromium VI	--	--	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	--	--	--	--	--	--
Formaldehyde	N[a]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Lead (PM_{10})	--	N[a]	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Manganese (PM_{10})	--	N[a]	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Naphthalene	--	--	--	--	--	--	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Nickel (PM_{10})	--	N[a]	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Tetrachloroethylene	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Trichloroethylene	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Vinyl chloride	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)

[a]: Reported MDL to NATTS Target Ratio greater than 2.0

Table 3. NATTS Network Assessment Data (2003-2018) - National Distribution Statistics By Type[a]

Analyte	Units	Site Type	# Data Records	% Detections	Arithmetic Mean[b]	Percentile Value[c]						
						5th	10th	25th	50th	75th	90th	95th
Acetaldehyde	µg/m^3	Urban	15,704	100%	1.77 ± 0.02	0.50	0.66	0.97	1.45	2.19	3.24	4.04
	µg/m^3	Rural	4,930	100%	1.20 ± 0.04	0.36	0.46	0.65	0.93	1.38	2.02	2.76
	µg/m^3	All Sites	20,634	100%	1.63 ± 0.02	0.44	0.58	0.86	1.31	2.00	3.02	3.86
Arsenic (PM_{10})	ng/m^3	Urban	14,968	97%	0.89 ± 0.04	0.10	0.19	0.34	0.58	0.99	1.70	2.41
	ng/m^3	Rural	4,622	96%	0.49 ± 0.02	0.04	0.08	0.17	0.35	0.59	0.94	1.28
	ng/m^3	All Sites	19,590	97%	0.79 ± 0.03	0.06	0.14	0.29	0.52	0.89	1.54	2.19
Benzene	µg/m^3	Urban	15,984	99%	0.86 ± 0.01	0.25	0.30	0.43	0.66	1.05	1.64	2.21
	µg/m^3	Rural	2,494	95%	0.43 ± 0.02	0.04	0.13	0.21	0.33	0.52	0.78	1.01
	µg/m^3	All Sites	18,478	99%	0.81 ± 0.01	0.19	0.26	0.39	0.61	0.98	1.55	2.09
Benzo(a)pyrene	ng/m^3	Urban	12,336	70%	0.096 ± 0.004	ND	ND	ND	0.04	0.11	0.24	0.37
	ng/m^3	Rural	3,179	36%	0.067 ± 0.009	ND	ND	ND	ND	0.02	0.13	0.37
	ng/m^3	All Sites	15,515	63%	0.090 ± 0.004	ND	ND	ND	0.03	0.10	0.23	0.37
Beryllium (PM_{10})	ng/m^3	Urban	15,783	75%	0.051 ± 0.006	ND	ND	0.00003	0.005	0.018	0.050	0.101
	ng/m^3	Rural	4,687	49%	0.023 ± 0.003	ND	ND	ND	ND	0.005	0.017	0.072
	ng/m^3	All Sites	20,470	69%	0.045 ± 0.005	ND	ND	ND	0.003	0.012	0.049	0.100
Butadiene, 1,3-	µg/m^3	Urban	15,388	81%	0.092 ± 0.002	ND	ND	0.025	0.058	0.114	0.215	0.302
	µg/m^3	Rural	2,185	29%	0.012 ± 0.001	ND	ND	ND	ND	0.017	0.046	0.059
	µg/m^3	All Sites	17,573	75%	0.082 ± 0.002	ND	ND	ND	0.049	0.104	0.199	0.287
Cadmium (PM_{10})	ng/m^3	Urban	16,360	92%	0.21 ± 0.02	ND	0.01	0.05	0.09	0.17	0.42	0.63
	ng/m^3	Rural	4,684	87%	0.10 ± 0.01	ND	ND	0.03	0.06	0.11	0.20	0.29
	ng/m^3	All Sites	21,044	91%	0.18 ± 0.01	ND	0.01	0.04	0.08	0.16	0.35	0.56
Carbon Tetrachloride	µg/m^3	Urban	14,713	99%	0.569 ± 0.003	0.361	0.433	0.496	0.562	0.651	0.737	0.798
	µg/m^3	Rural	2,189	92%	0.534 ± 0.016	ND	0.180	0.402	0.537	0.633	0.727	0.798
	µg/m^3	All Sites	16,902	98%	0.565 ± 0.003	0.304	0.408	0.490	0.559	0.649	0.736	0.798
Chloroform	µg/m^3	Urban	16,068	87%	0.265 ± 0.022	ND	ND	0.093	0.132	0.217	0.420	0.668
	µg/m^3	Rural	3,802	43%	0.052 ± 0.003	ND	ND	ND	ND	0.095	0.144	0.230
	µg/m^3	All Sites	19,870	79%	0.224 ± 0.018	ND	ND	0.064	0.113	0.196	0.364	0.586
Chromium VI	ng/m^3	Urban	8,414	74%	0.036 ± 0.002	ND	ND	ND	0.020	0.042	0.081	0.120
	ng/m^3	Rural	2,586	41%	0.018 ± 0.004	ND	ND	ND	ND	0.017	0.031	0.051
	ng/m^3	All Sites	11,000	66%	0.032 ± 0.001	ND	ND	ND	0.016	0.036	0.073	0.114

Table 3. NATTS Network Assessment Data (2003-2018) - National Distribution Statistics By Type[a]

Analyte	Units	Site Type	# Data Records	% Detections	Arithmetic Mean[b]	Percentile Value[c]						
						5th	10th	25th	50th	75th	90th	95th
Formaldehyde	µg/m^3	Urban	16,118	100%	3.11 ± 0.04	0.66	0.99	1.60	2.47	3.84	5.63	7.25
	µg/m^3	Rural	5,002	100%	2.22 ± 0.05	0.53	0.68	1.06	1.69	2.74	4.19	5.45
	µg/m^3	All Sites	21,120	100%	2.90 ± 0.04	0.61	0.86	1.43	2.29	3.59	5.38	6.96
Lead (PM_{10})	ng/m^3	Urban	16,366	100%	4.21 ± 0.13	0.72	0.98	1.55	2.64	4.56	8.35	11.90
	ng/m^3	Rural	4,680	99%	2.10 ± 0.16	0.37	0.50	0.84	1.41	2.37	3.91	5.36
	ng/m^3	All Sites	21,046	99%	3.74 ± 0.11	0.55	0.80	1.31	2.31	4.04	7.41	10.56
Manganese (PM_{10})	ng/m^3	Urban	16,141	100%	9.80 ± 0.32	1.09	1.51	2.52	4.92	10.21	20.10	30.08
	ng/m^3	Rural	4,627	99%	3.96 ± 0.14	0.46	0.73	1.36	2.57	4.75	8.54	12.13
	ng/m^3	All Sites	20,768	100%	8.50 ± 0.25	0.85	1.23	2.15	4.18	8.89	17.98	26.70
Naphthalene	ng/m^3	Urban	12,332	100%	74.63 ± 1.14	15.62	21.27	33.55	55.89	94.64	150.05	196.16
	ng/m^3	Rural	3,301	100%	24.47 ± 1.38	3.74	4.73	7.74	13.86	26.25	50.88	79.17
	ng/m^3	All Sites	15,633	100%	64.04 ± 1.00	6.58	10.92	23.37	45.59	83.31	137.54	181.75
Nickel (PM_{10})	ng/m^3	Urban	16,125	97%	1.85 ± 0.05	0.25	0.41	0.67	1.11	2.00	3.52	5.27
	ng/m^3	Rural	4,623	85%	0.65 ± 0.08	ND	ND	0.10	0.28	0.64	1.15	1.89
	ng/m^3	All Sites	20,748	94%	1.58 ± 0.04	ND	0.15	0.47	0.92	1.73	3.14	4.74
Tetrachloroethylene	µg/m^3	Urban	15,612	86%	0.25 ± 0.01	ND	ND	0.06	0.13	0.25	0.48	0.74
	µg/m^3	Rural	2,272	36%	0.09 ± 0.04	ND	ND	ND	ND	0.04	0.08	0.16
	µg/m^3	All Sites	17,884	79%	0.23 ± 0.01	ND	ND	0.04	0.11	0.22	0.44	0.70
Trichloroethylene	µg/m^3	Urban	15,843	41%	0.040 ± 0.002	ND	ND	ND	ND	0.051	0.107	0.164
	µg/m^3	Rural	3,388	13%	0.021 ± 0.003	ND	ND	ND	ND	ND	0.017	0.250
	µg/m^3	All Sites	19,231	36%	0.037 ± 0.002	ND	ND	ND	ND	0.041	0.105	0.167
Vinyl Chloride	µg/m^3	Urban	14,778	19%	0.0044 ± 0.0003	ND	ND	ND	ND	ND	0.0137	0.0257
	µg/m^3	Rural	2,444	8%	0.0040 ± 0.0009	ND	ND	ND	ND	ND	ND	0.0156
	µg/m^3	All Sites	17,222	17%	0.0043 ± 0.0003	ND	ND	ND	ND	ND	0.0126	0.0254

[a] Statistics presented are from pollutant datasets which were suitable for trends.

[b] The arithmetic mean is the average of all samples results which include actual measured values. If no chemical was registered, then a value of zero is used when calculating the mean.

[c] ND: No results of this chemical were registered by the laboratory analytical equipment.

Table 4. Summary Statistics for Roxbury, MA

Analyte	Units	# Data Records	% Detection	Arithmetic Mean[a]	Percentile Value[b]						
					5th	10th	25th	50th	75th	90th	95th
Acetaldehyde	µg/m^3	901	100%	1.56 ± 0.04	0.73	0.86	1.14	1.44	1.90	2.38	2.69
Arsenic (PM_{10})	ng/m^3	886	100%	0.51 ± 0.03	0.14	0.18	0.27	0.42	0.62	0.94	1.16
Benzene	µg/m^3	934	100%	0.78 ± 0.03	0.27	0.32	0.45	0.66	0.99	1.40	1.70
Benzo(a)pyrene	ng/m^3	634	97%	0.11 ± 0.01	0.02	0.03	0.05	0.08	0.14	0.21	0.27
Beryllium (PM_{10})	ng/m^3	886	91%	0.006 ± 0.001	ND	0.0003	0.002	0.004	0.007	0.011	0.020
Butadiene, 1,3-	µg/m^3	931	100%	0.083 ± 0.004	0.019	0.025	0.038	0.060	0.106	0.169	0.214
Cadmium (PM_{10})	ng/m^3	886	100%	0.20 ± 0.02	0.04	0.05	0.07	0.12	0.20	0.37	0.56
Carbon Tetrachloride	µg/m^3	934	100%	0.56 ± 0.01	0.42	0.44	0.49	0.55	0.60	0.67	0.73
Chloroform	µg/m^3	931	100%	0.106 ± 0.002	0.064	0.071	0.084	0.102	0.122	0.147	0.166
Chromium VI	ng/m^3	515	74%	0.036 ± 0.005	ND	ND	ND	0.020	0.042	0.086	0.143
Formaldehyde	µg/m^3	916	100%	3.05 ± 0.10	1.30	1.55	2.02	2.70	3.60	5.10	6.06
Lead (PM_{10})	ng/m^3	886	100%	3.71 ± 0.20	0.99	1.33	1.98	3.00	4.30	6.66	8.94
Manganese (PM_{10})	ng/m^3	886	100%	4.49 ± 0.19	1.56	1.87	2.64	3.80	5.50	7.89	9.52
Naphthalene	ng/m^3	634	100%	54.13 ± 2.63	17.64	21.23	30.85	46.56	67.37	94.60	114.22
Nickel (PM_{10})	ng/m^3	886	100%	2.09 ± 0.23	0.55	0.66	0.91	1.32	2.14	3.73	5.33
Tetrachloroethylene	µg/m^3	932	100%	0.188 ± 0.012	0.045	0.056	0.078	0.129	0.220	0.378	0.494
Trichloroethylene	µg/m^3	931	86%	0.035 ± 0.004	ND	ND	0.011	0.021	0.035	0.069	0.111
Vinyl Chloride	µg/m^3	931	33%	0.0011 ± 0.0001	ND	ND	ND	ND	0.0026	0.0028	0.0055

[a] :The arithmetic mean is the average of all samples results which included actual measured values. If no chemical was registered, then a value of zero is used.

[b] ND: No results of this chemical were registered by the laboratory analytical equipment.

Table 5. Analytical Labs Supporting this Site

Pollutant Group	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
VOCs	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH	RIDOH
Carbonyls	MADEP	RIDOH	RIDOH	RIDOH	MADEP	MADEP	MADEP	MADEP	MADEP	MADEP	MADEP	MADEP	MADEP	MADEP	MADEP	MADEP
PM_{10} Metals	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG
Chromium VI	--	--	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	--	--	--	--	--
PAHs	--	--	--	--	--	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG

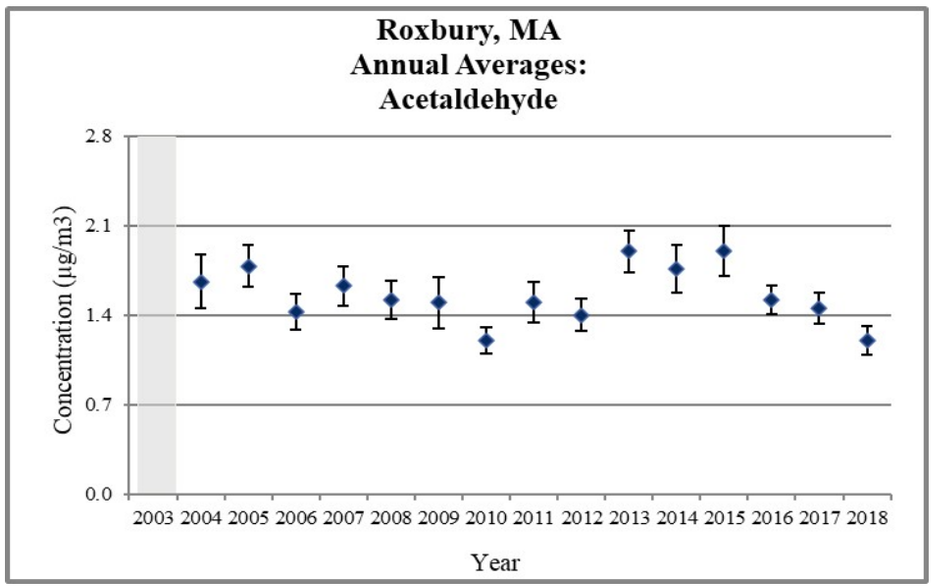
--: Not Applicable

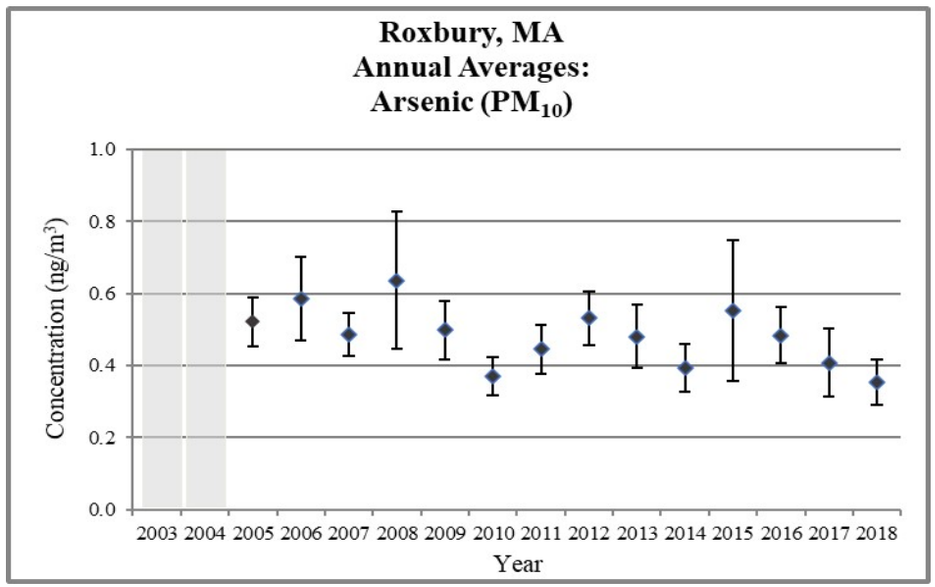
RIDOH: Rhode Island Department of Health

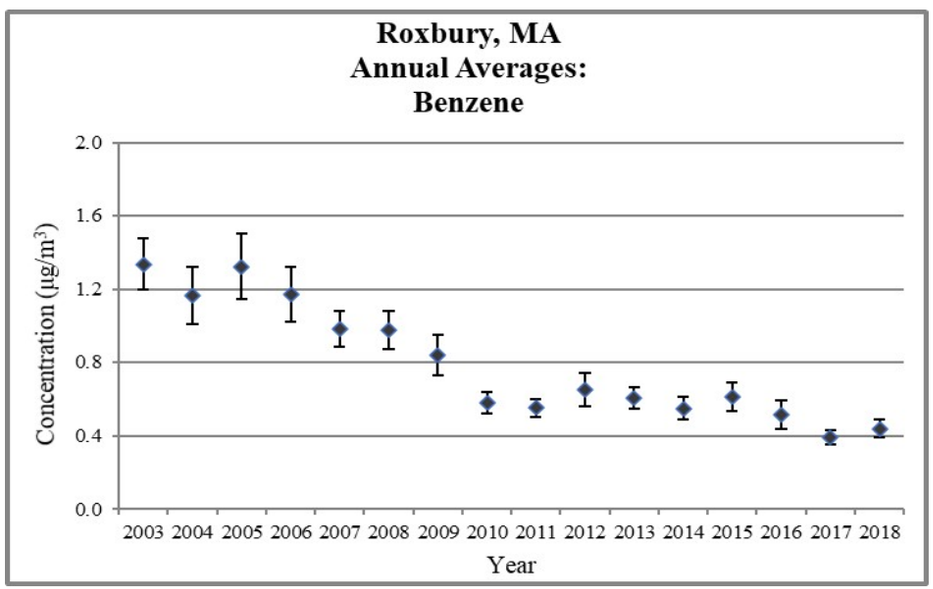
MADEP: Massachussetts Department of Environmental Protection

ERG: Eastern Research Group, Inc.

Figure 3. Roxbury, MA Annual Average Concentrations







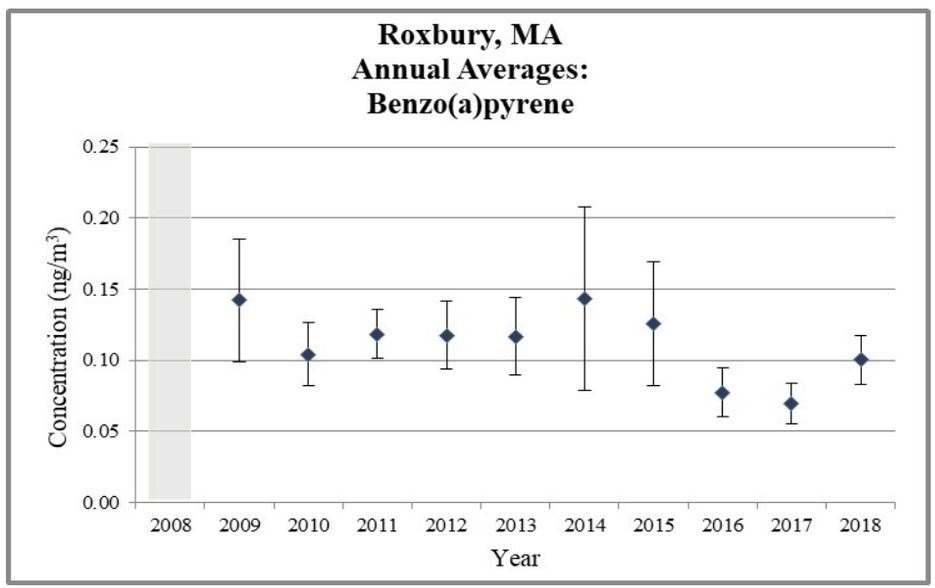
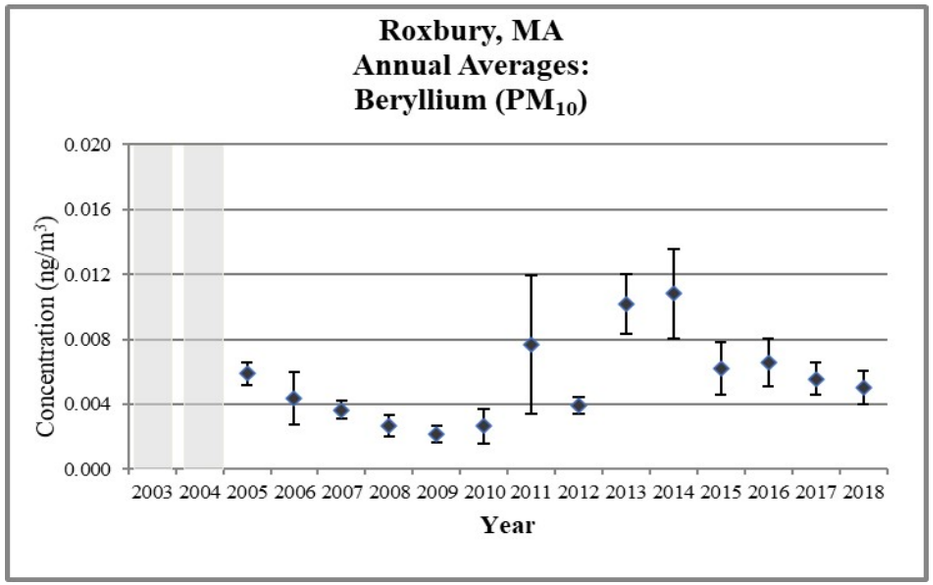
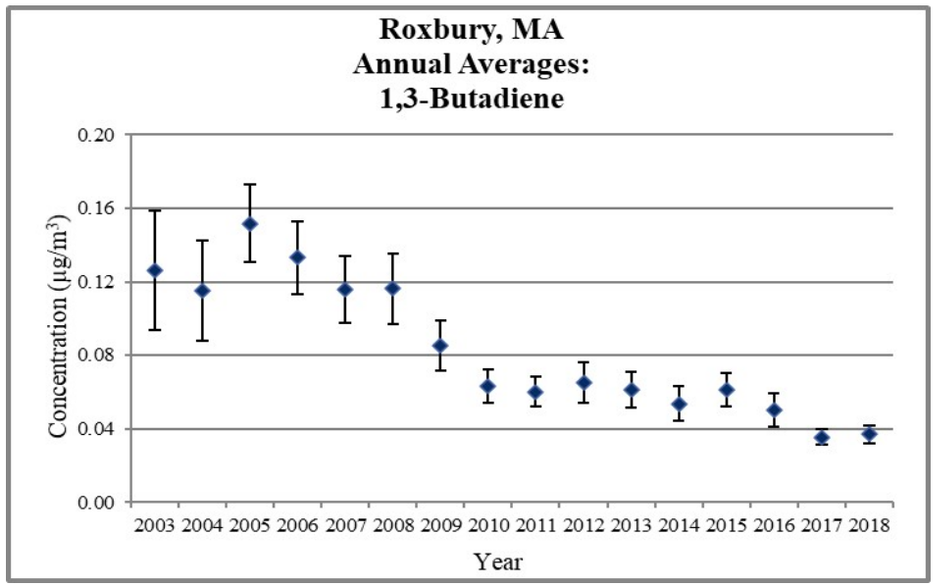
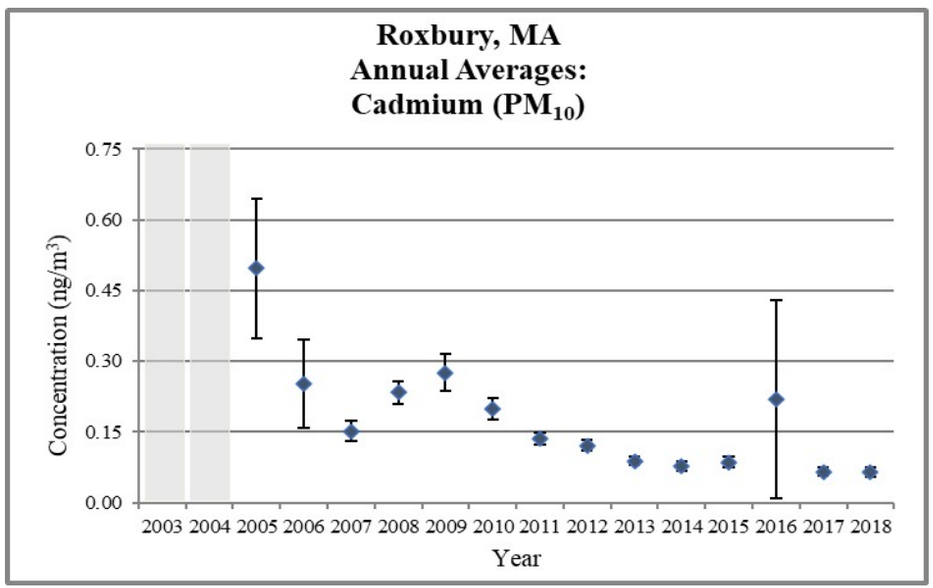


Figure 3. Roxbury, MA Annual Average Concentrations







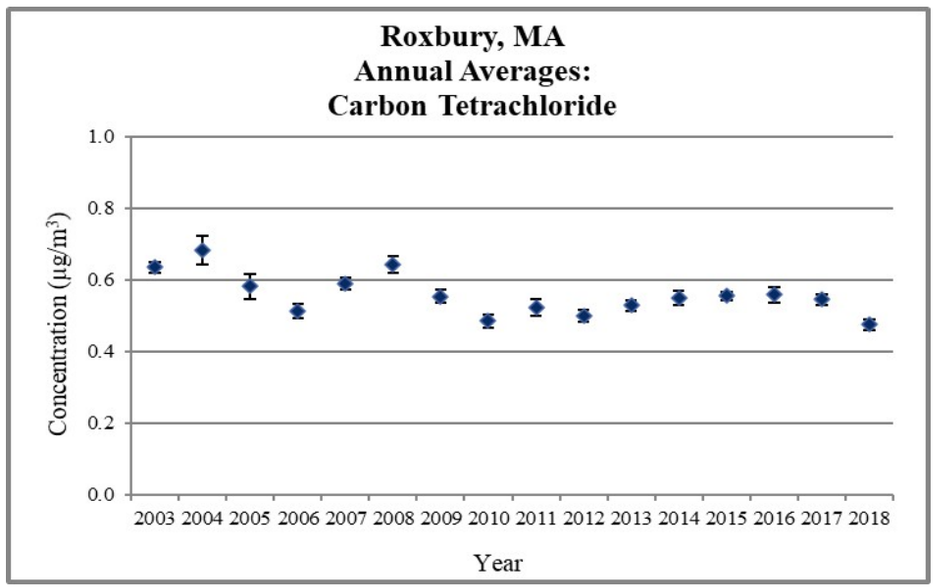
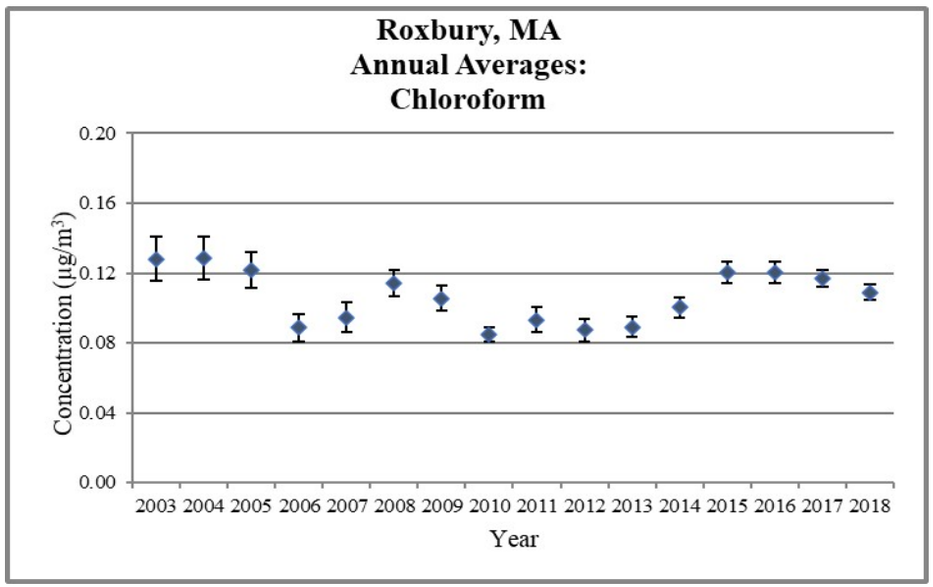
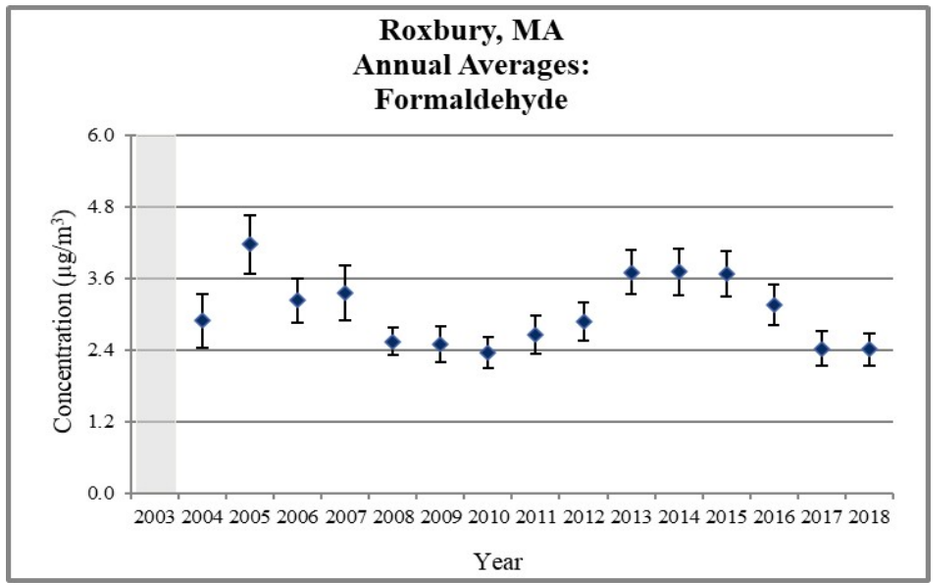
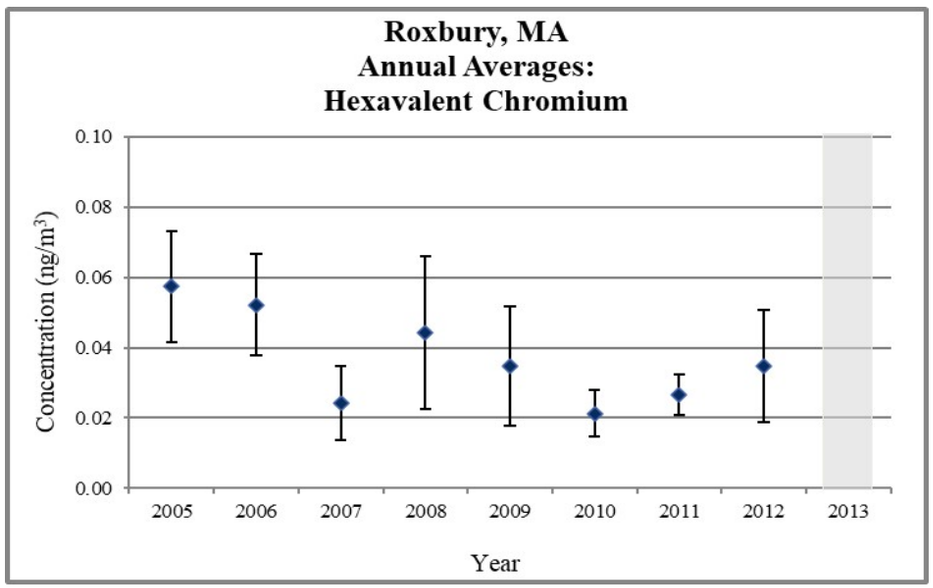
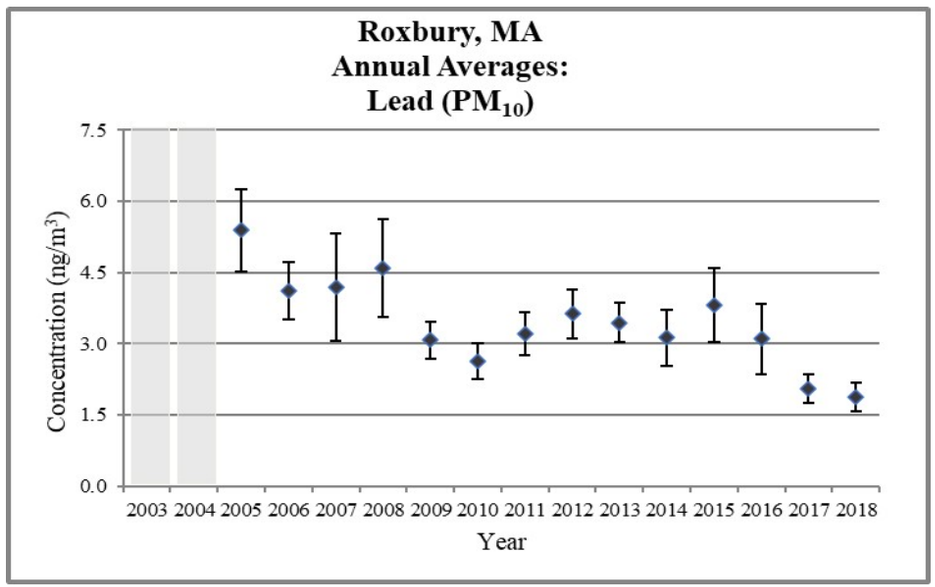


Figure 3. Roxbury, MA Annual Average Concentrations









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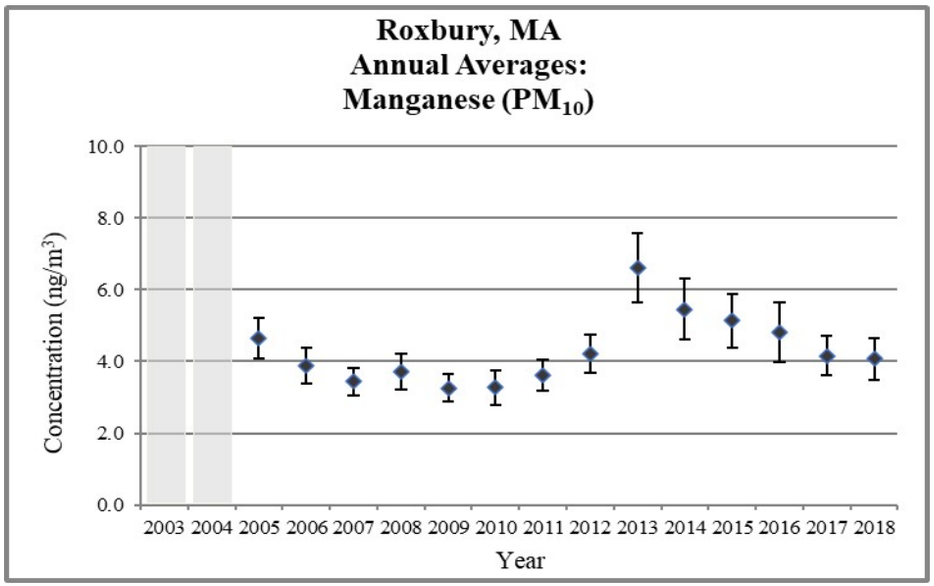

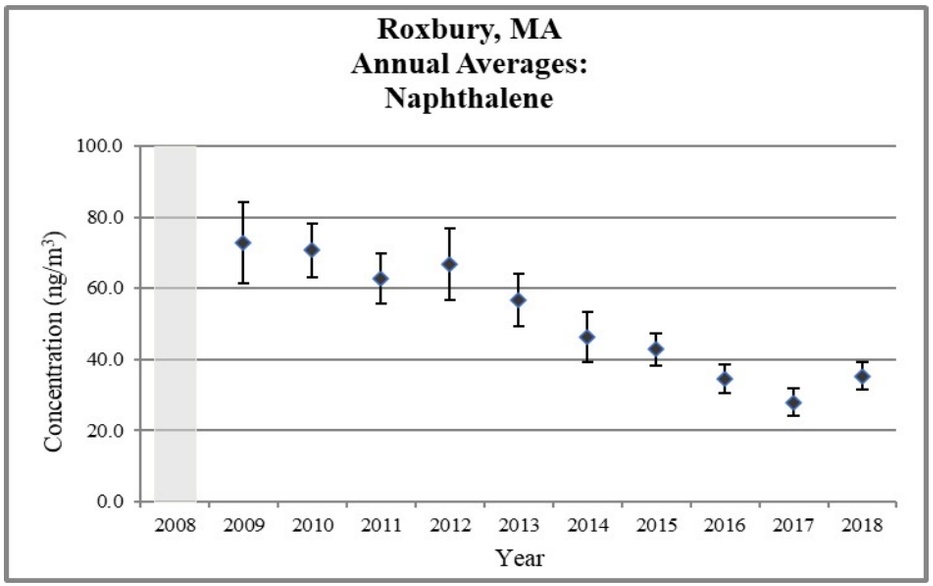

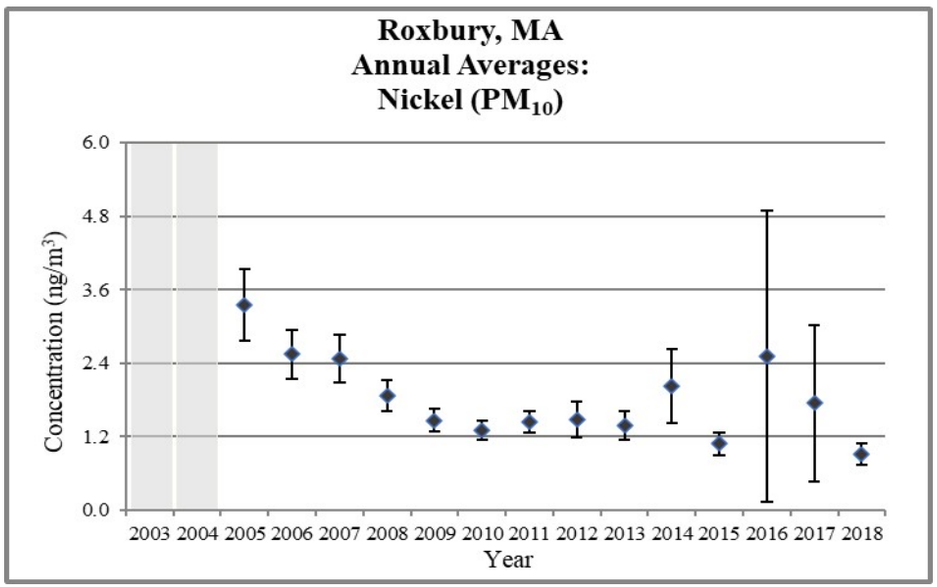

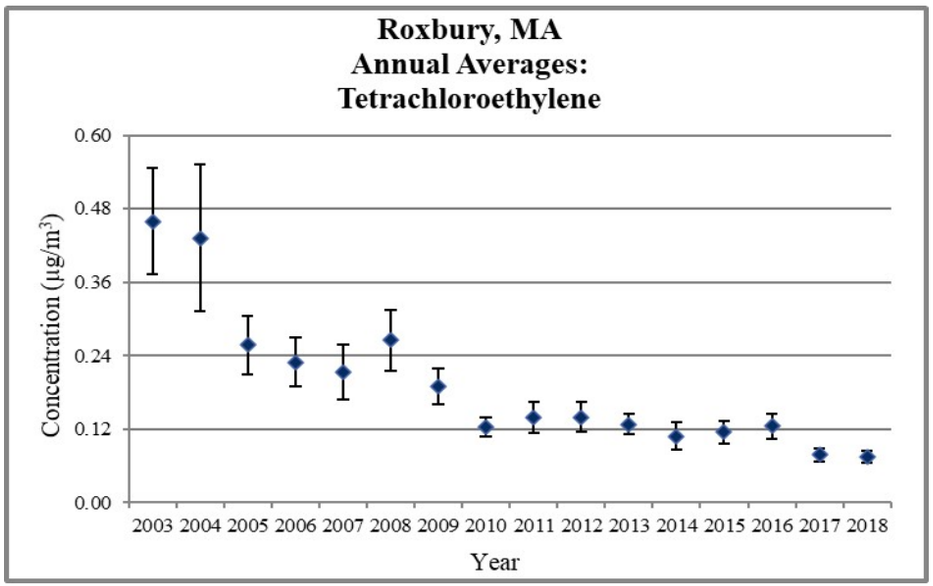

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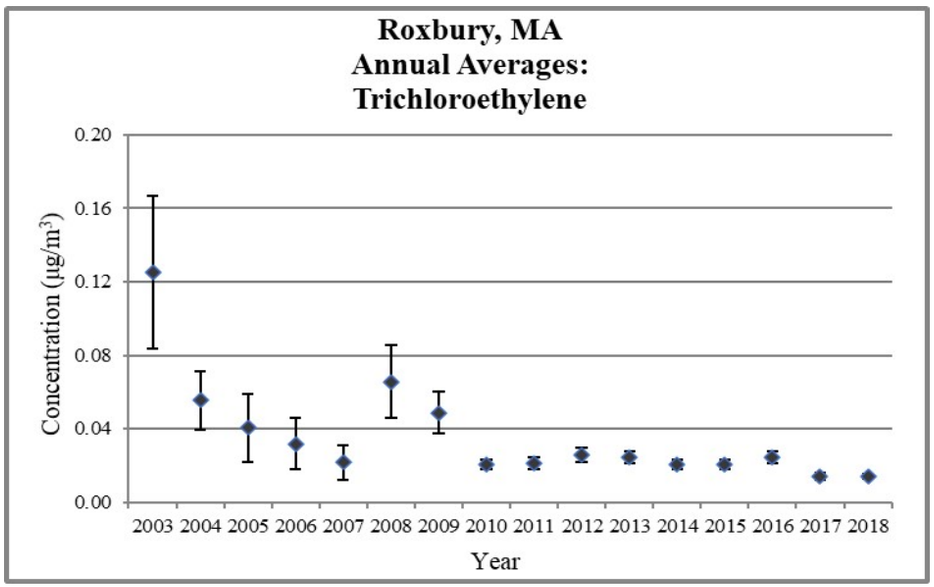
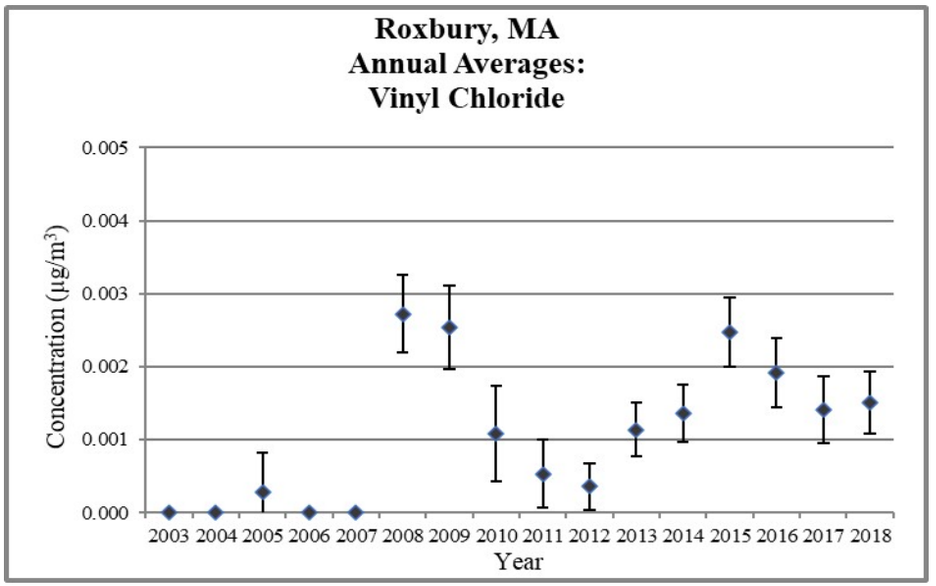
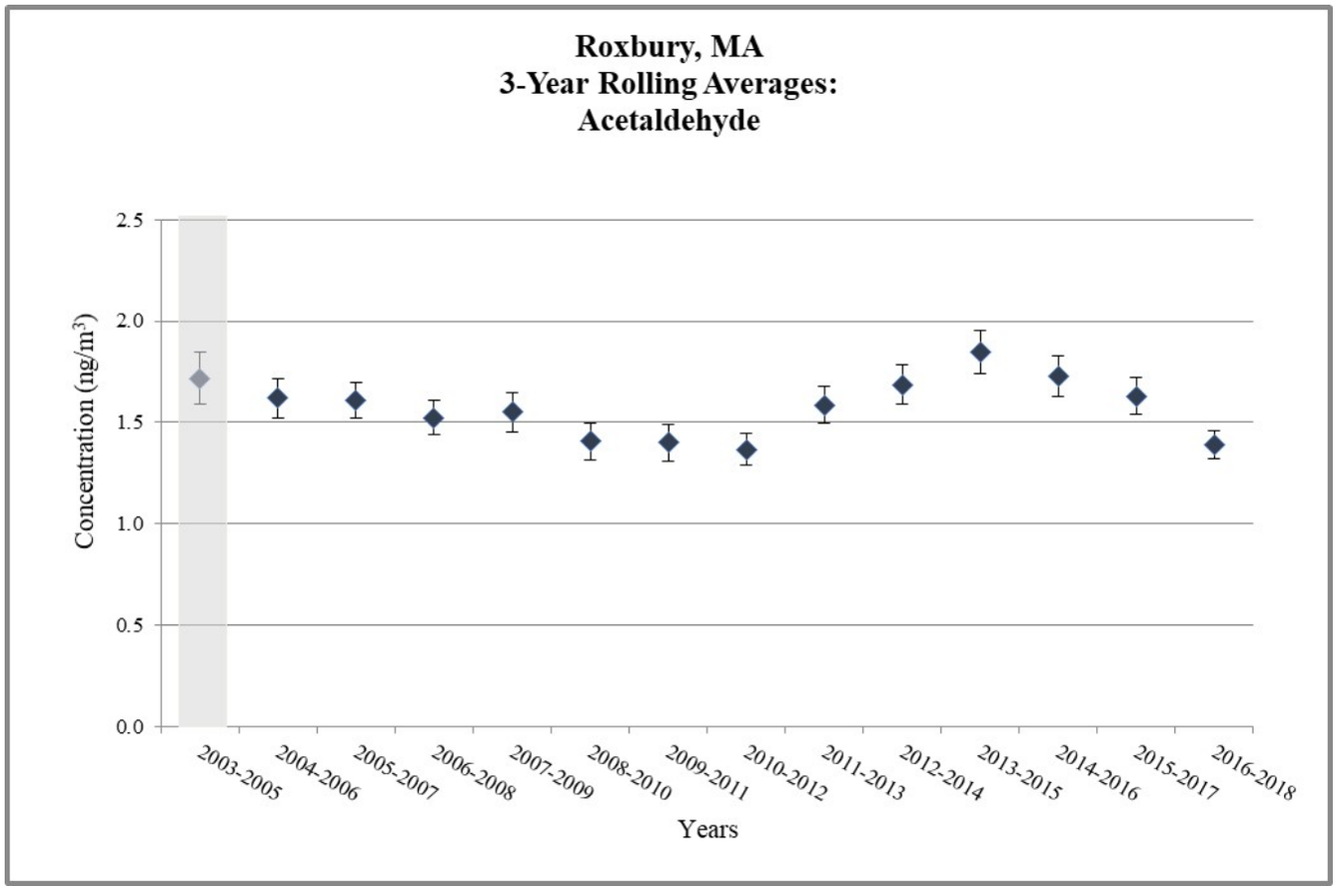
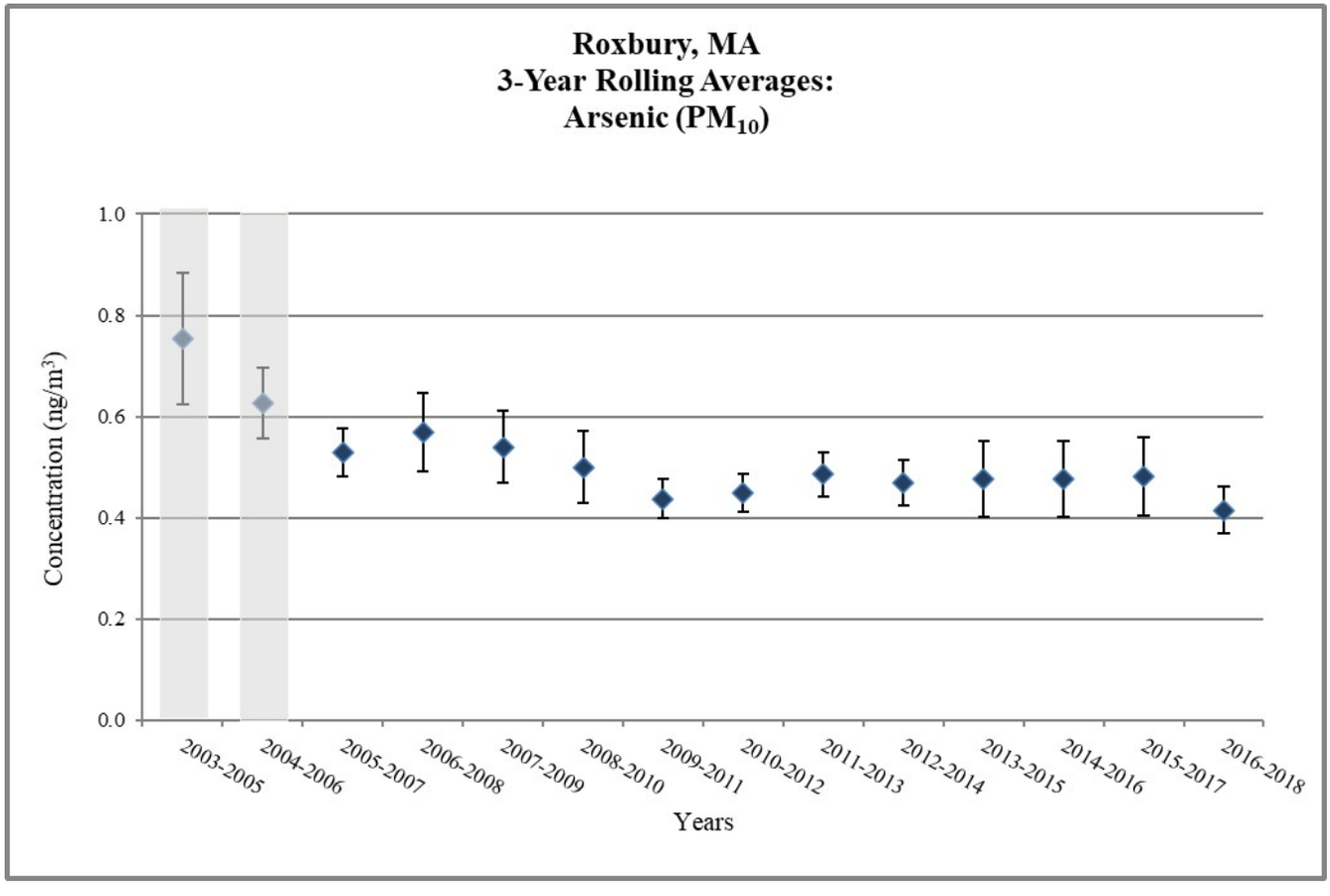




Does not meet MQO

Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations





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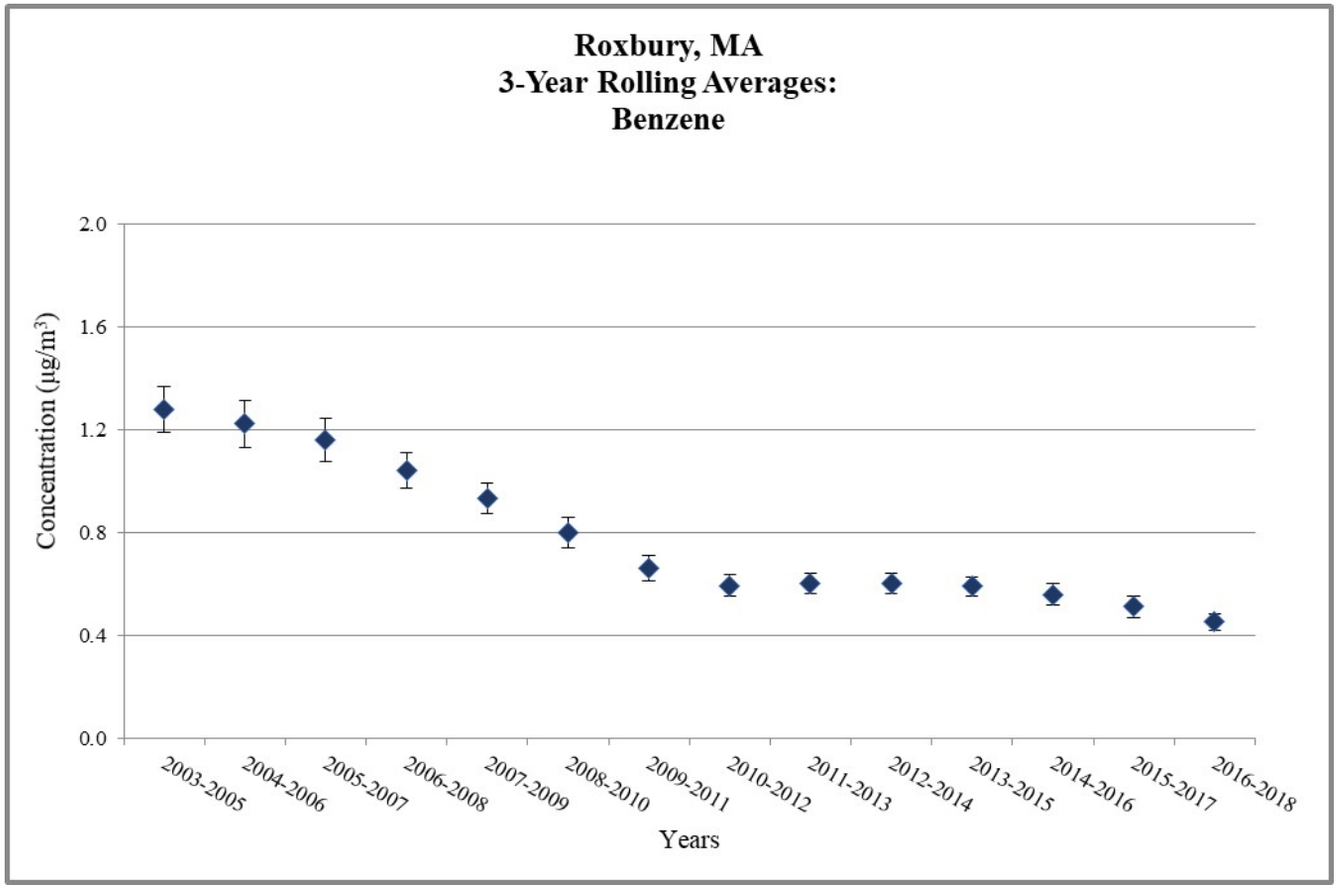

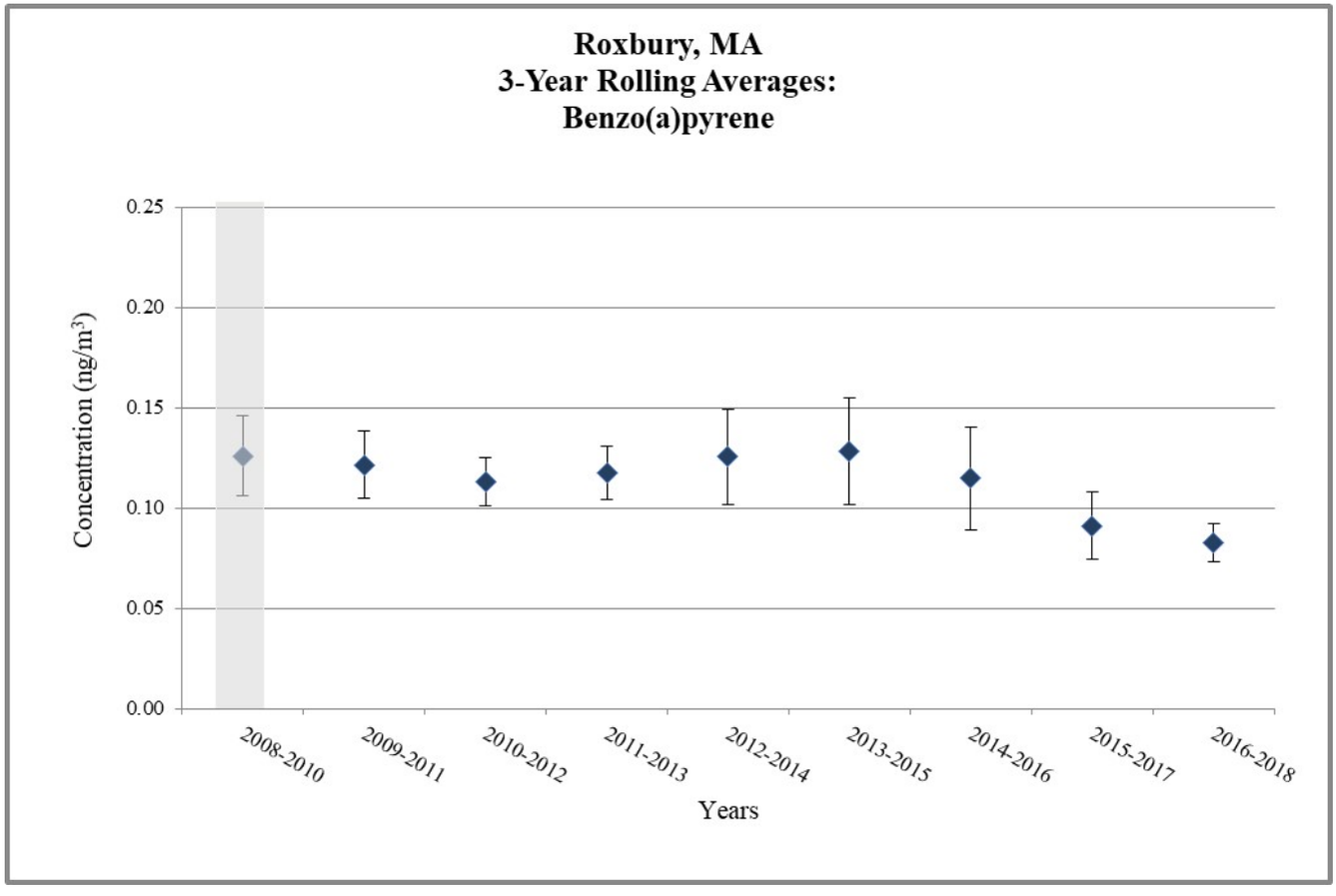

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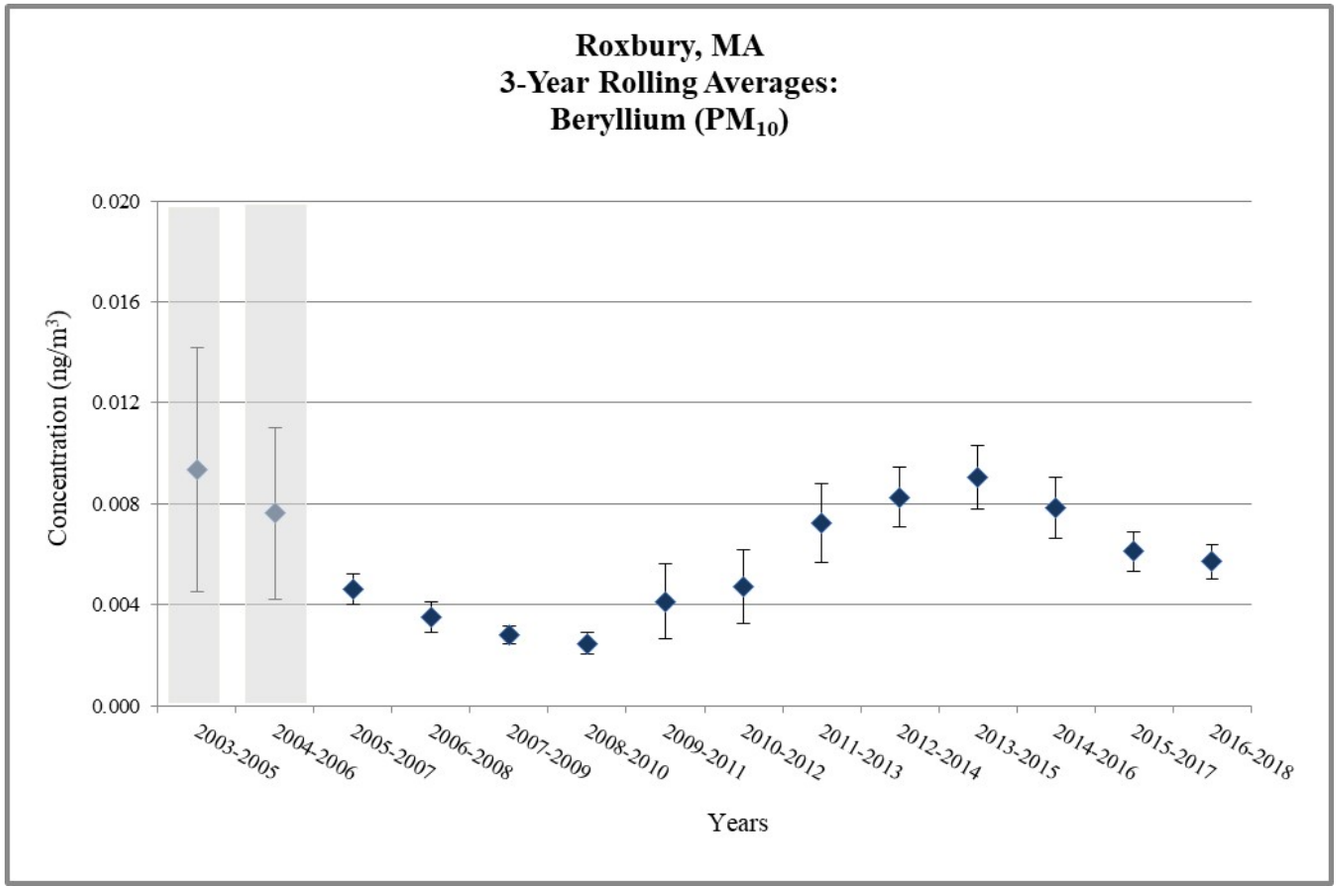

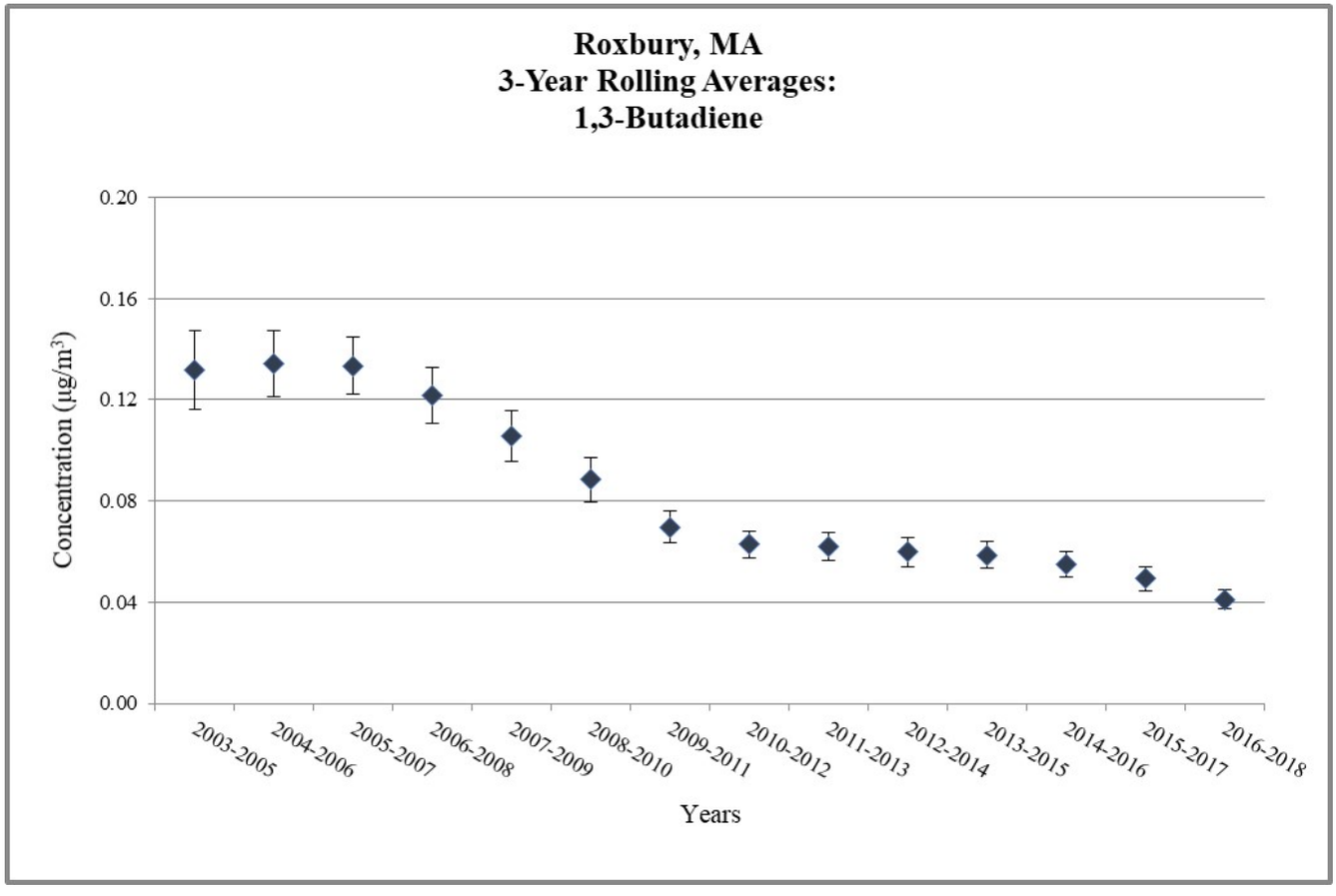

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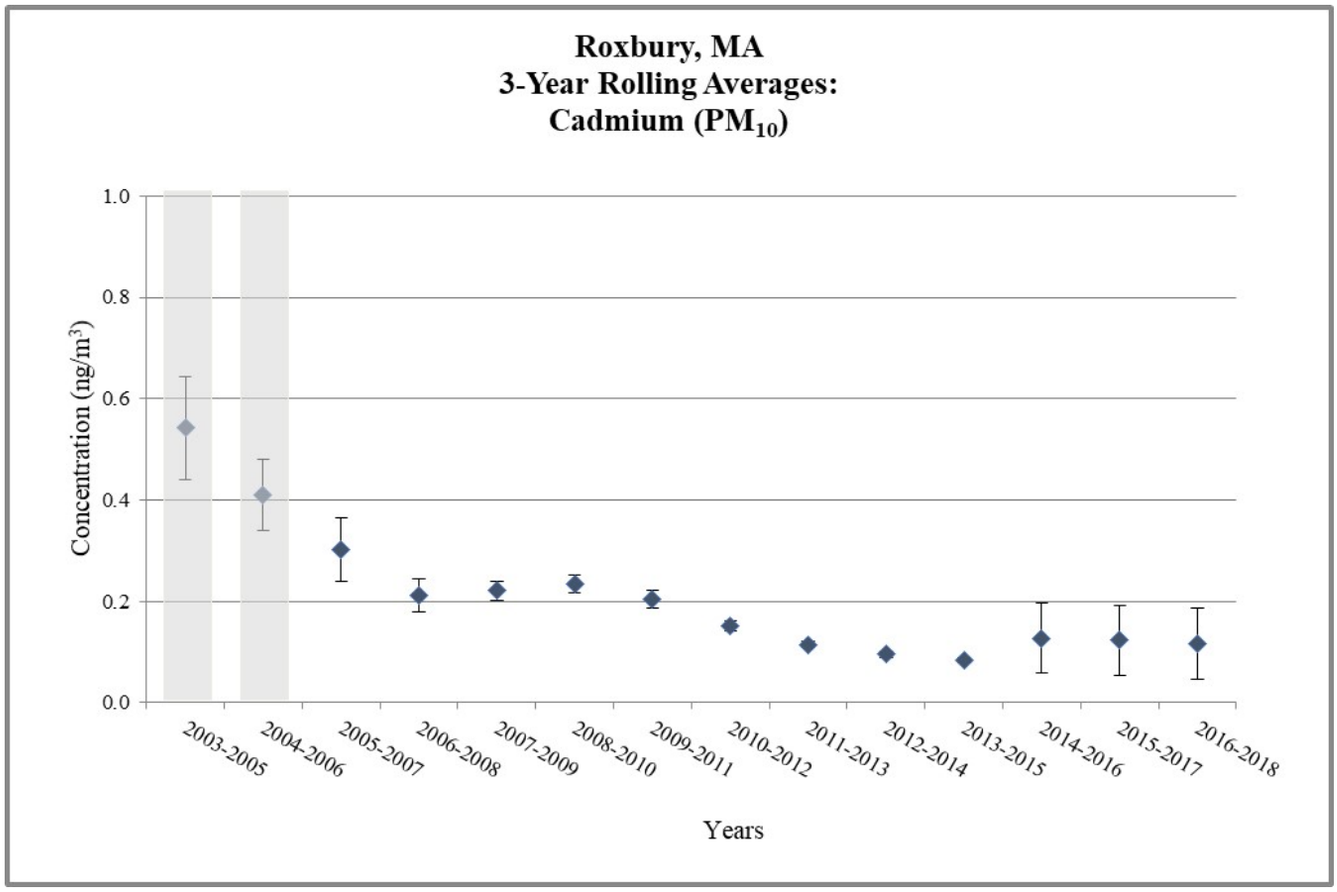

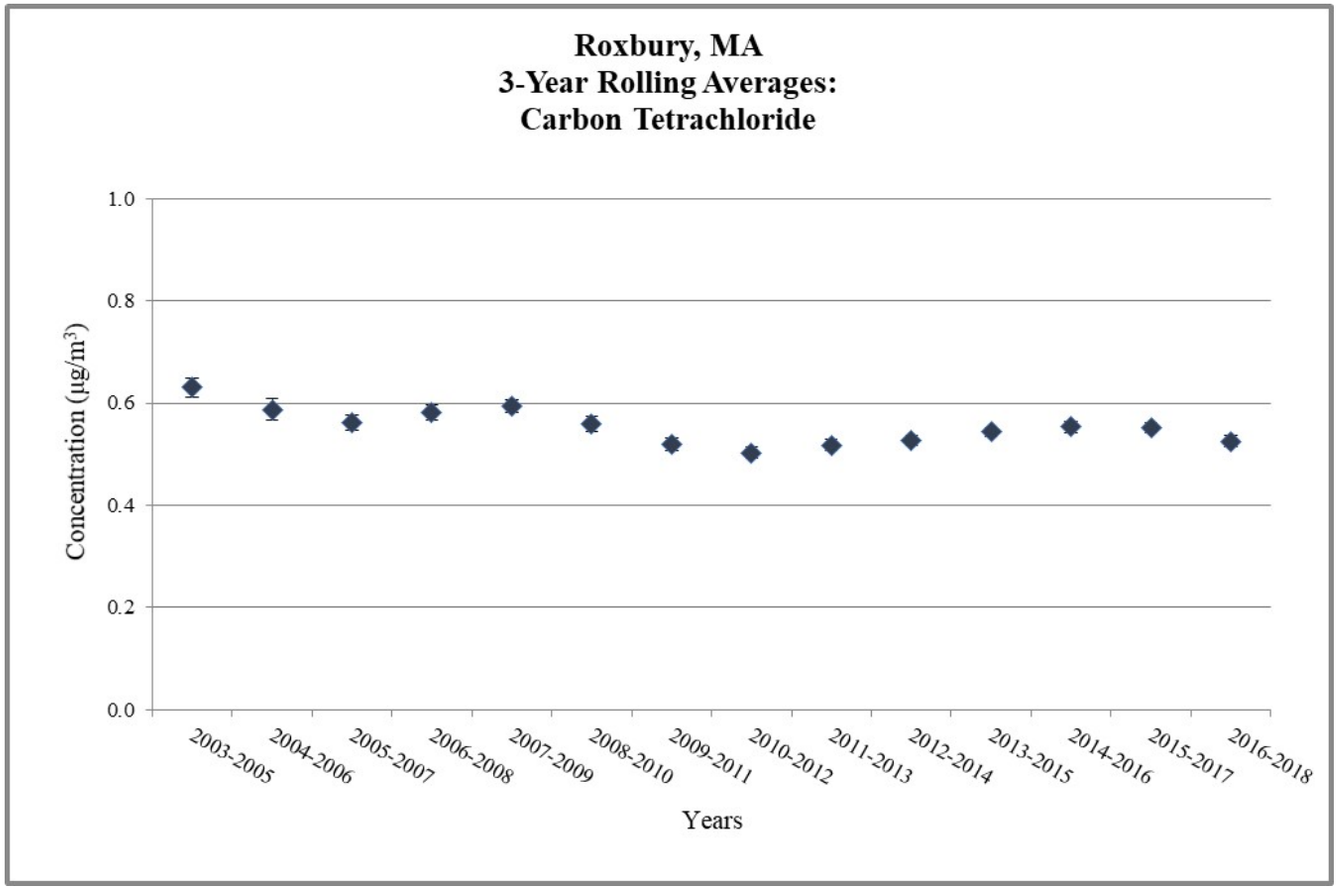

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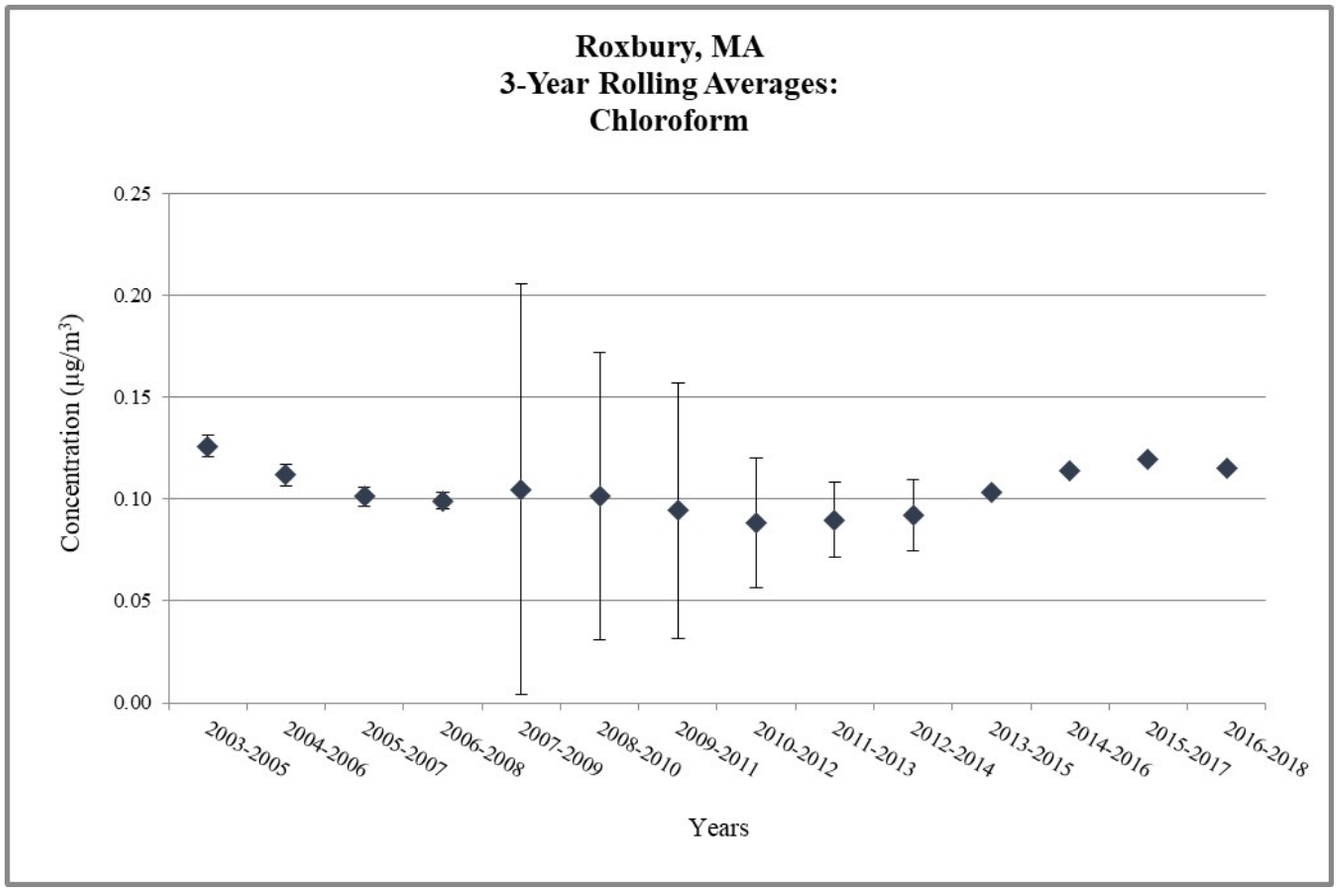

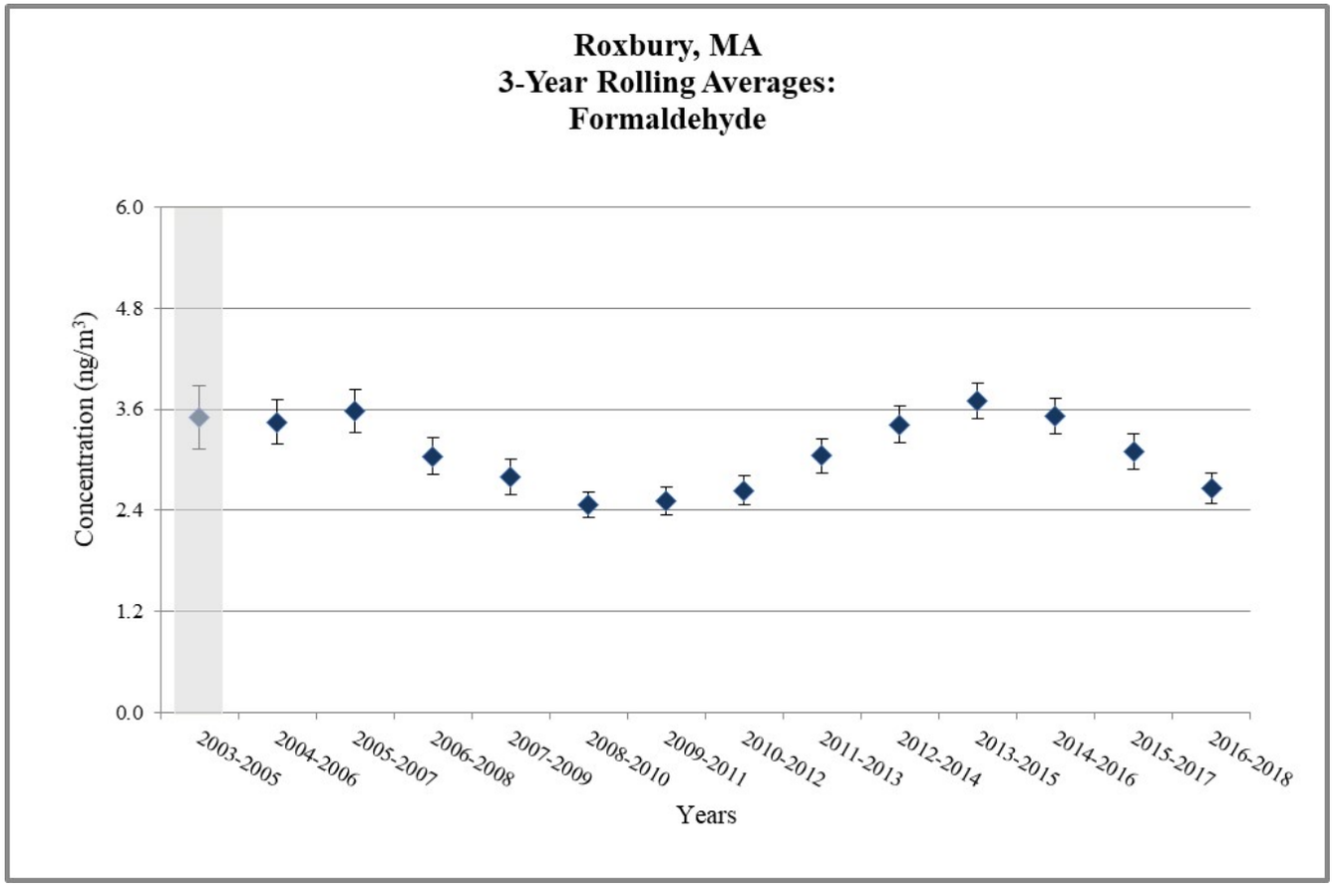

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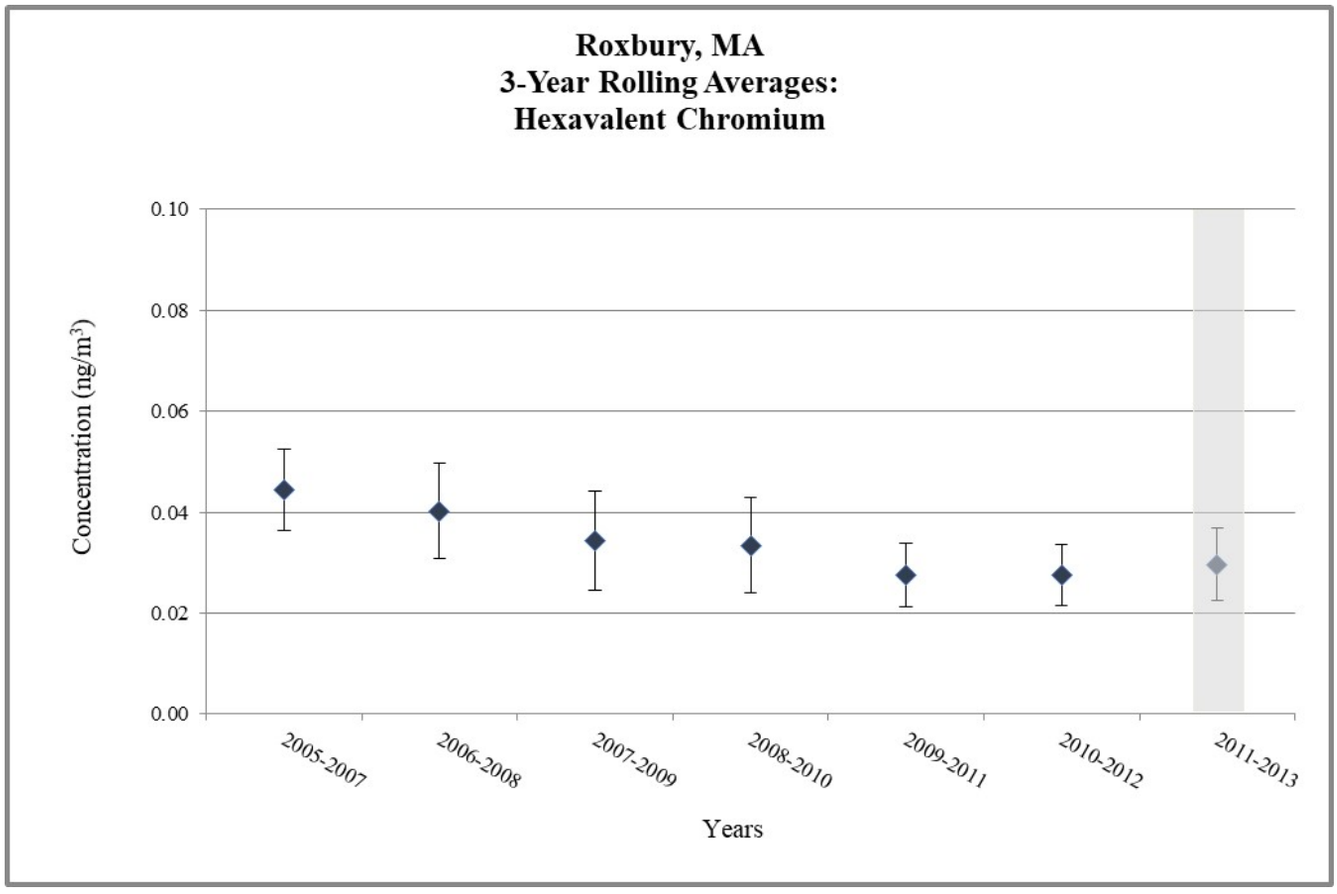

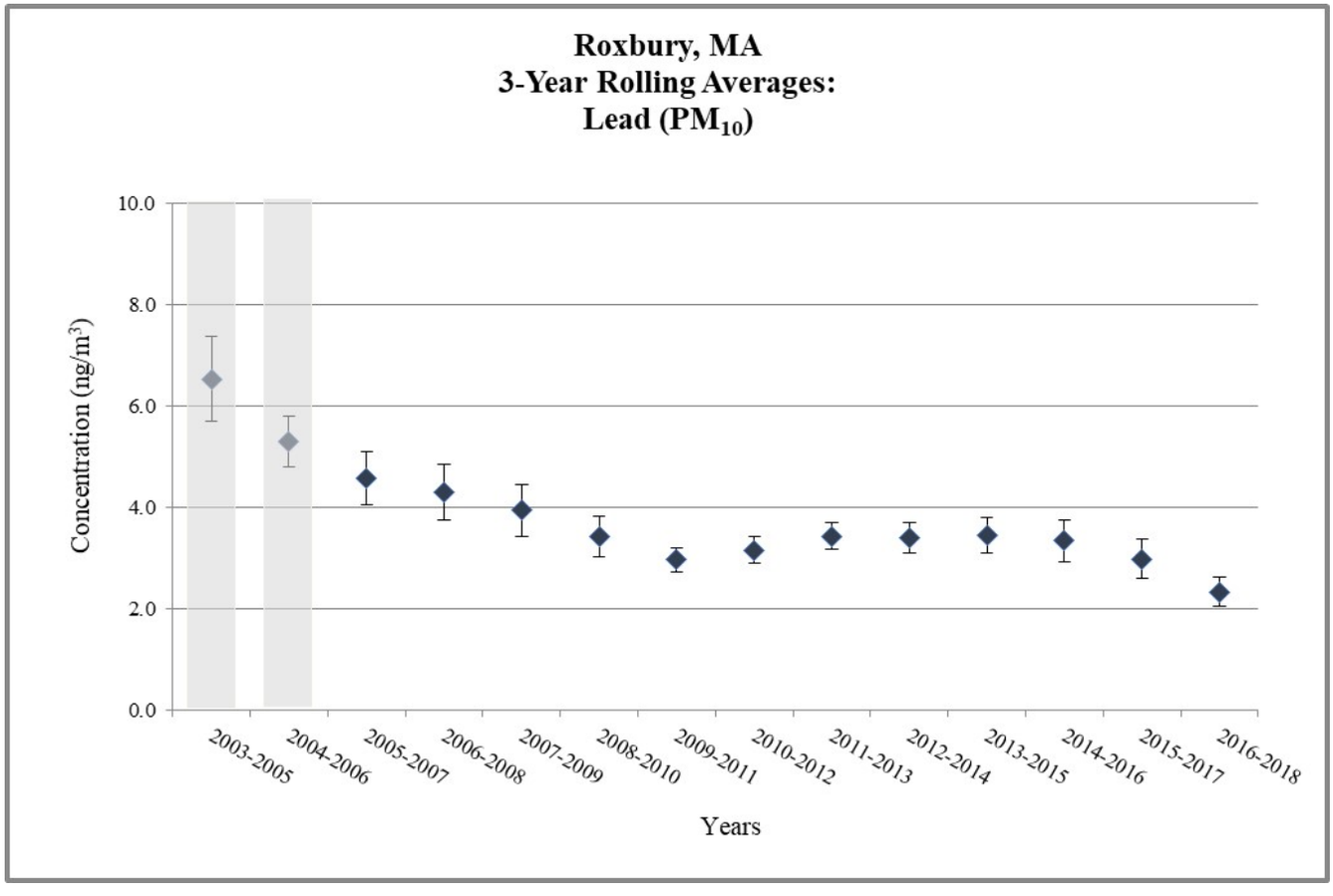

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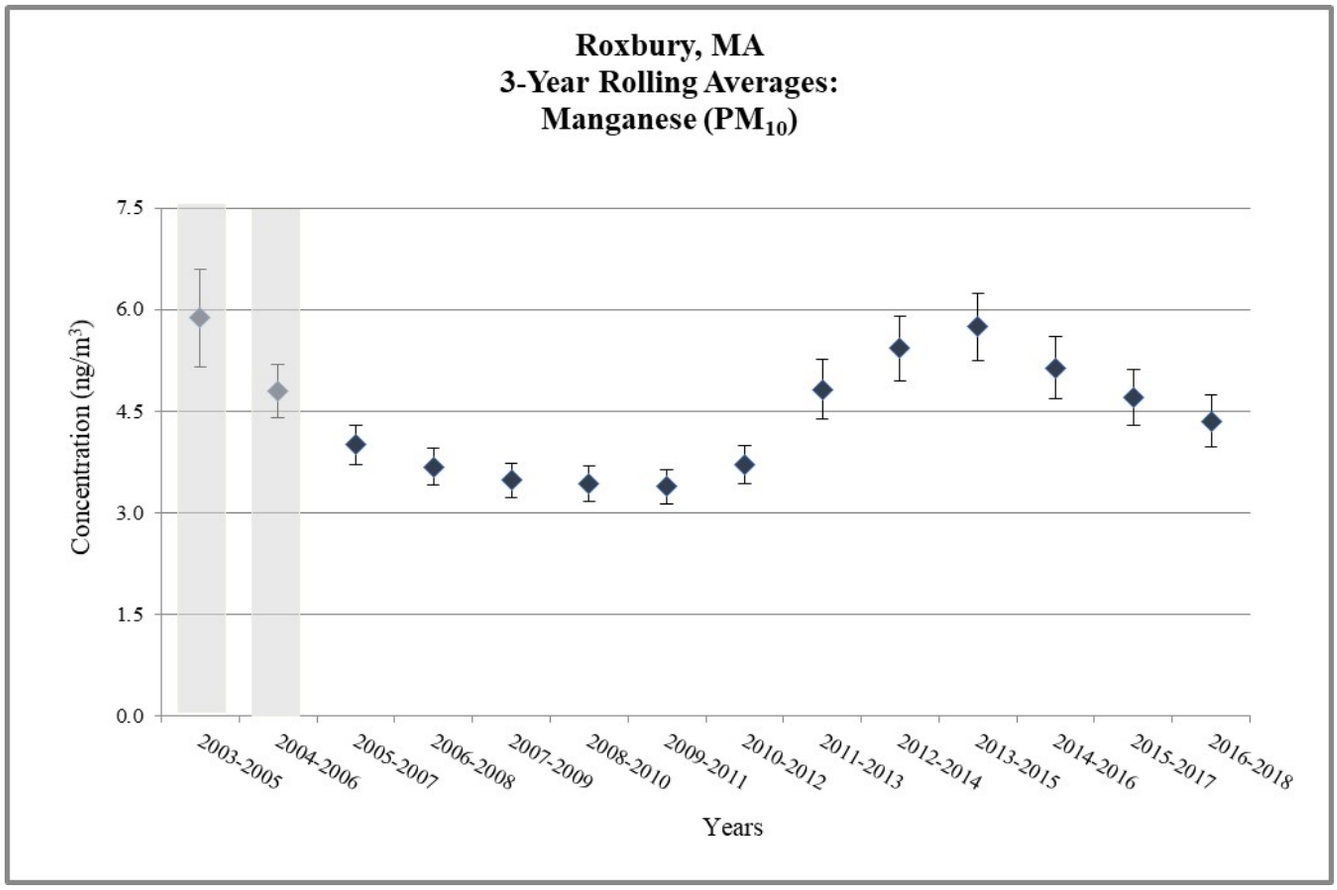

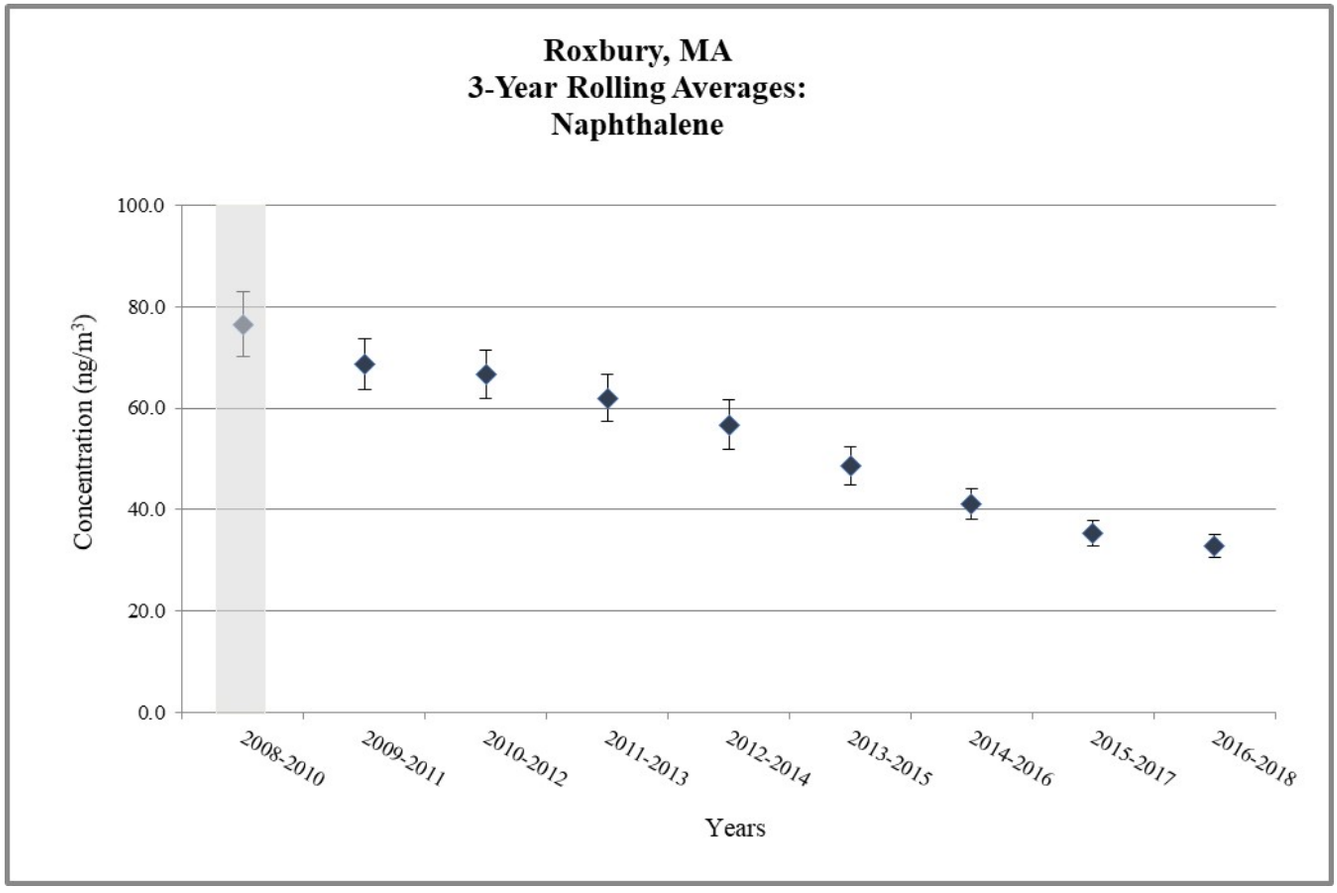

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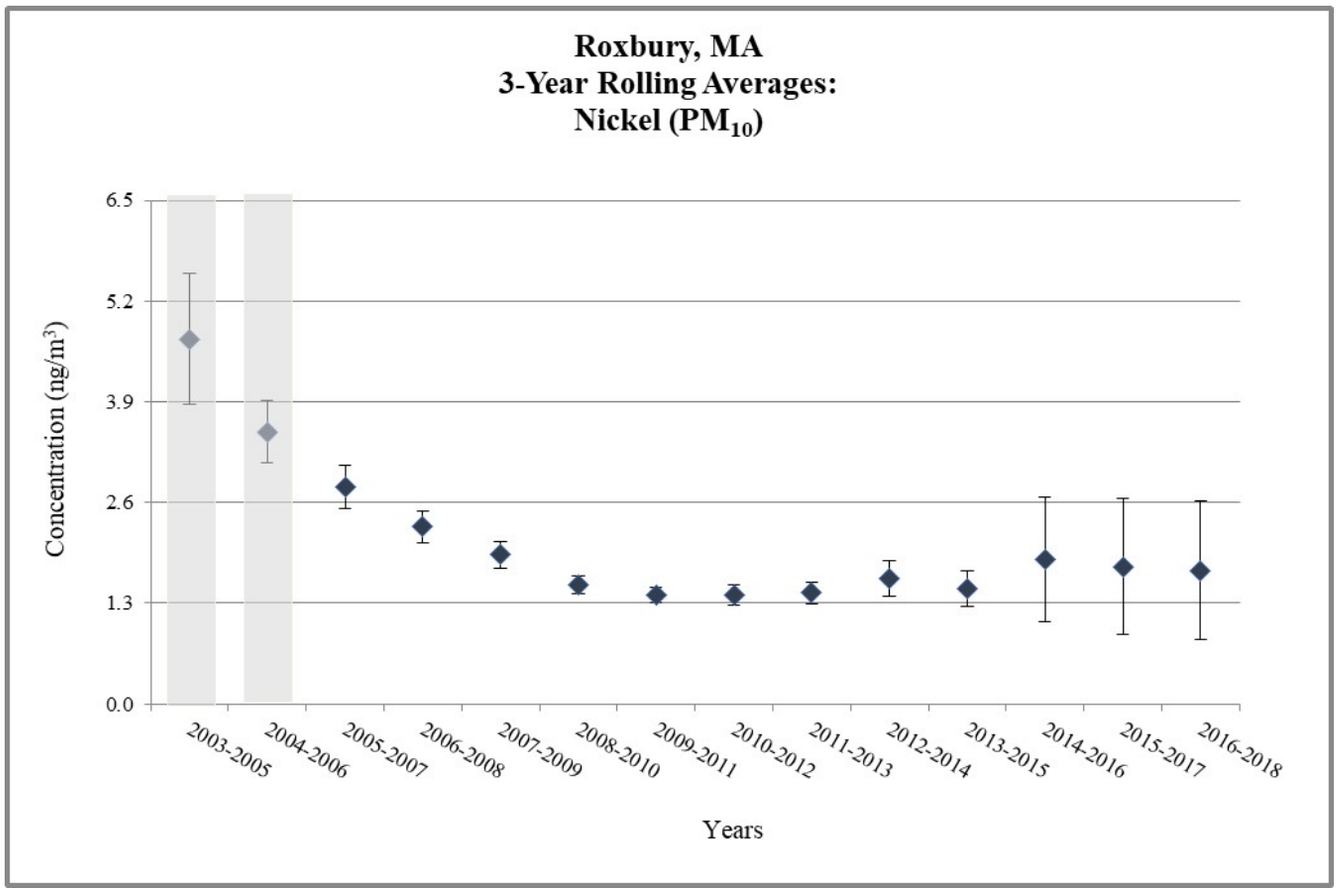

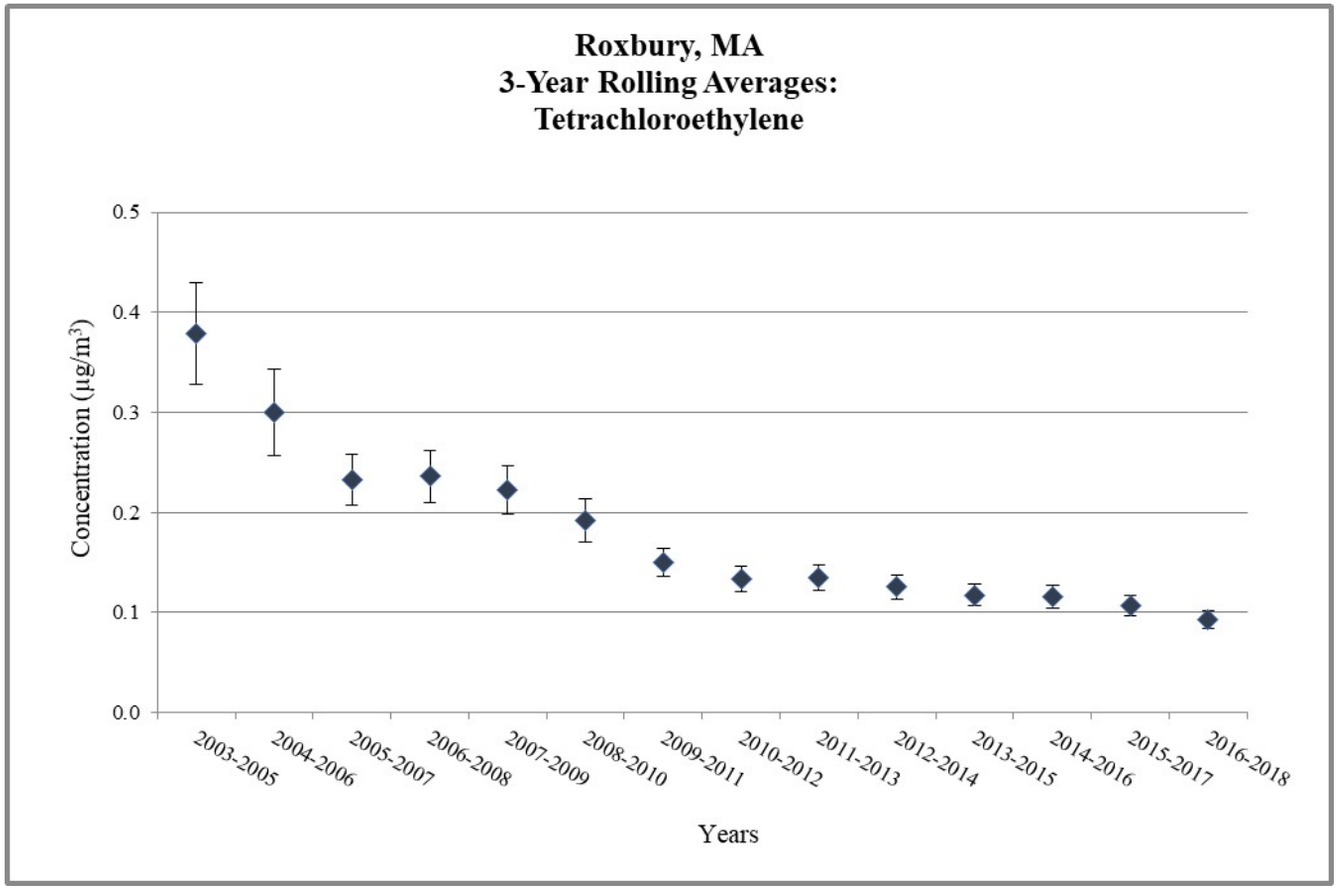

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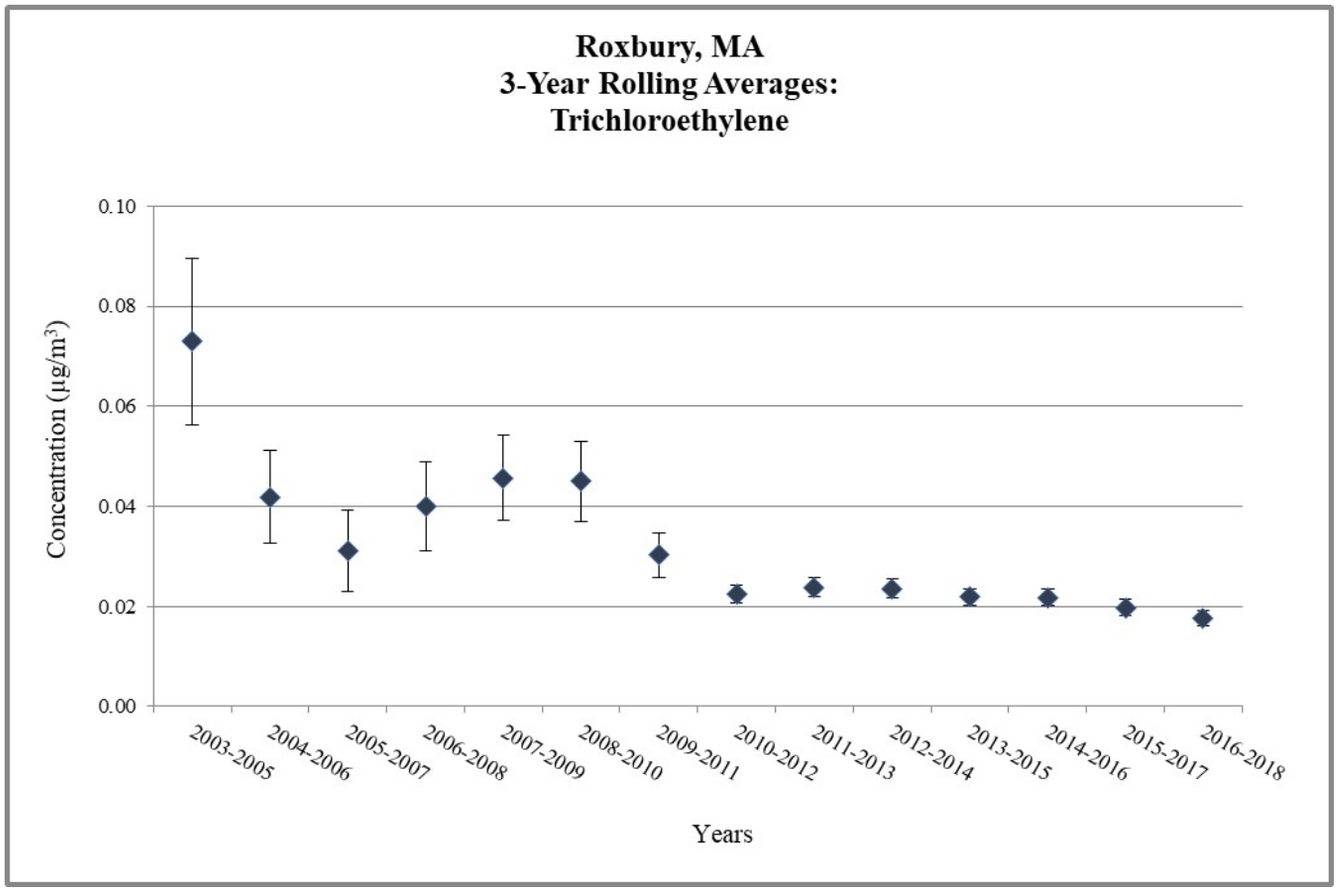

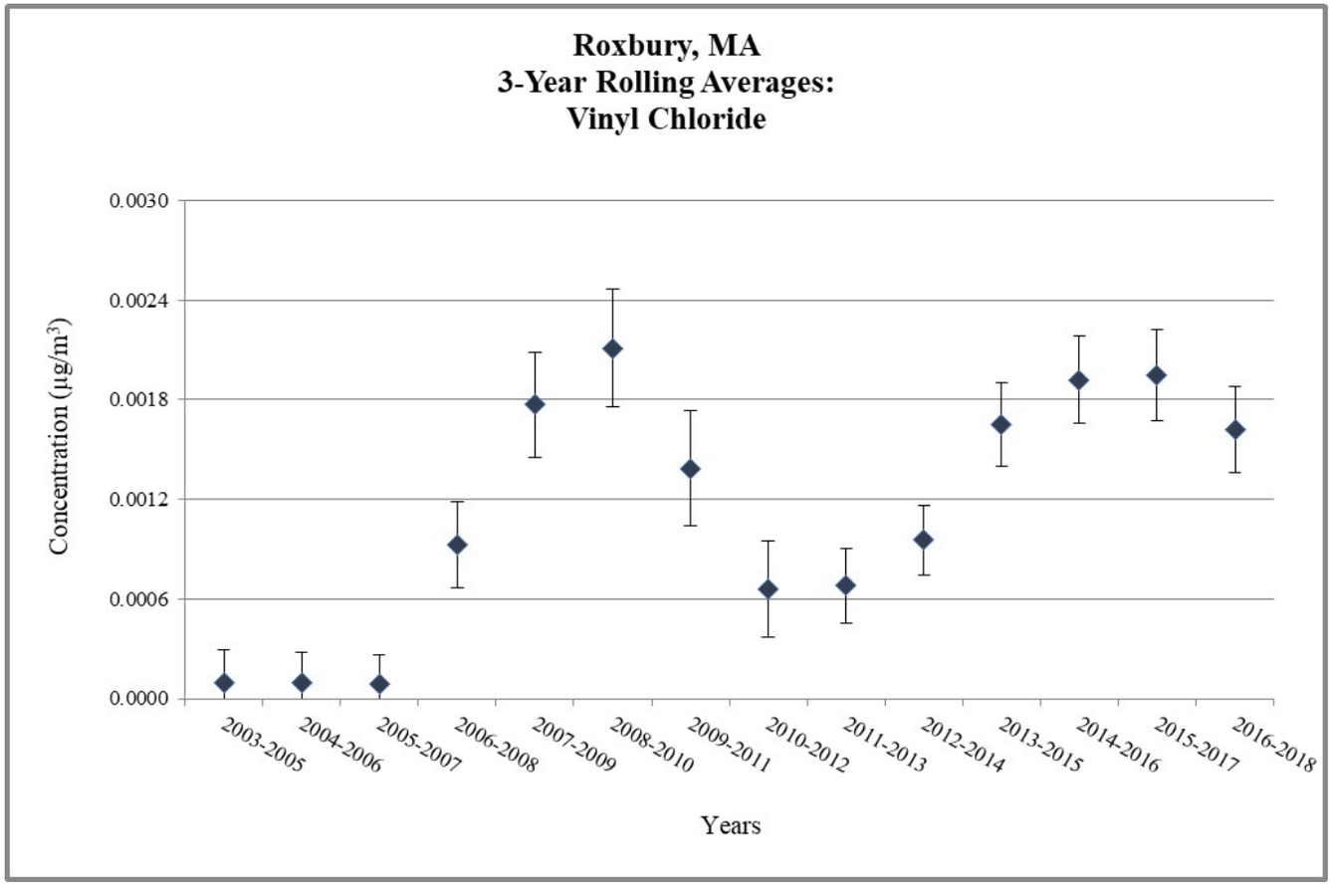

Does not meet MQO or wasn't able to collect enough samples

Table 6. NATTS Network Assessment: MQO#1 - Completeness Percentage at Roxbury, MA

Pollutant Group	Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Carbonyl	Acetaldehyde	58	84	97	100	98	97	98	100	100	84	77	100	100	95	95	100
Carbonyl	Formaldehyde	58	84	95	100	98	98	100	100	100	98	84	100	100	97	95	100
Chromium VI	Chromium VI	--	--	97	100	100	100	100	100	100	100	--	--	--	--	--	--
PAH	Benzo(a)pyrene	--	--	--	--	--	--	97	98	100	97	100	93	100	100	93	100
PAH	Naphthalene	--	--	--	--	--	--	97	98	100	97	100	93	100	100	93	100
PM_{10} Metals	Arsenic (PM_{10})	--	74	100	92	98	98	100	100	98	100	100	95	100	95	97	95
PM_{10} Metals	Beryllium (PM_{10})	--	74	100	92	98	98	100	100	98	100	100	95	100	95	97	95
PM_{10} Metals	Cadmium (PM_{10})	--	74	100	92	98	98	100	100	98	100	100	95	100	95	97	95
PM_{10} Metals	Lead (PM_{10})	--	74	100	92	98	98	100	100	98	100	100	95	100	95	97	95
PM_{10} Metals	Manganese (PM_{10})	--	74	100	92	98	98	100	100	98	100	100	95	100	95	97	95
PM_{10} Metals	Nickel (PM_{10})	--	74	100	92	98	98	100	100	98	100	100	95	100	95	97	95
VOC	Benzene	85	82	93	97	98	100	100	100	98	95	100	100	98	100	89	98
VOC	Butadiene, 1,3-	85	82	93	97	98	100	100	100	98	95	100	95	98	100	89	98
VOC	Carbon tetrachloride	85	82	93	97	98	100	100	100	98	95	100	100	98	100	89	98
VOC	Chloroform	85	82	93	97	98	100	100	100	98	95	100	95	98	100	89	98
VOC	Tetrachloroethylene	85	82	93	97	98	100	100	100	98	95	100	97	98	100	89	98
VOC	Trichloroethylene	85	82	93	97	98	100	100	100	98	95	100	95	98	100	89	98
VOC	Vinyl chloride	85	82	93	97	98	100	100	100	98	95	100	95	98	100	89	98

	A-rated: ≥85%
	B-rated: Between 75% to 85%
	Does not meet: ≤75%
--	No data available

Table 7. NATTS Network Assessment: MQO#2 - Reported Method Detection Limits (MDLs) at Roxbury, MA

Pollutant Group	Pollutant Name	Target MDL	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Carbonyl	Acetaldehyde	0.45	µg/m^3	a	0.16	0.16	0.08	0.08	0.08	0.24	0.24	0.12	0.12	0.12	0.34	0.34	0.12	0.12	0.12
Carbonyl	Formaldehyde	0.98/0.08[b]	µg/m^3	a	0.05	0.06	0.04	0.04	0.05	0.08	0.08	0.08	0.11	0.88	0.88	0.88	0.88	1.04	1.04
Chromium VI	Chromium VI	0.08	ng/m^3	--	--	0.22	0.13	0.09	0.09	0.05	0.01	0.05	0.04	0.06	--	--	--	--	--
PAH	Benzo(a)pyrene	0.91	ng/m^3	--	--	--	--	--	0.08	0.06	0.04	0.04	0.05	0.05	0.03	0.13	0.06	0.02	0.01
PAH	Naphthalene	29.00	ng/m^3	--	--	--	--	--	0.016	0.008	0.037	0.003	0.005	0.007	0.012	0.005	0.023	0.059	0.053
PM_{10} Metals	Arsenic (PM_{10})	0.23	ng/m^3	2.76	0.09	0.07	0.096	0.04	0.04	0.04	0.05	0.22	0.26	0.77	0.84	0.06	0.15	0.14	0.14
PM_{10} Metals	Beryllium (PM_{10})	0.42	ng/m^3	0.03	0.06	0.05	0.060	0.05	0.03	0.005	0.002	0.01	0.01	0.04	0.04	0.002	0.002	0.002	0.003
PM_{10} Metals	Cadmium (PM_{10})	0.56	ng/m^3	0.06	0.04	0.03	0.034	0.01	0.01	0.05	0.13	0.01	0.01	0.02	0.02	0.013	0.003	0.003	0.008
PM_{10} Metals	Lead (PM_{10})	15.0	ng/m^3	0.01	0.10	0.005	0.0045	0.001	0.001	0.004	0.053	0.006	0.008	0.006	0.002	0.002	0.002	0.002	0.004
PM_{10} Metals	Manganese (PM_{10})	5.0	ng/m^3	0.15	0.04	0.03	0.025	0.003	0.003	0.01	0.065	0.02	0.071	0.025	0.025	0.02	0.02	0.02	0.03
PM_{10} Metals	Nickel (PM_{10})	2.1	ng/m^3	0.03	0.10	0.08	0.088	0.04	0.04	0.06	0.77	0.17	0.21	0.11	0.08	0.10	0.09	0.10	0.50
VOC	Benzene	0.13	µg/m^3	0.25	0.11	0.30	0.22	0.09	0.09	0.17	0.17	0.25	0.25	0.42	0.05	0.07	0.07	0.12	0.12
VOC	Butadiene, 1,3-	0.10	µg/m^3	0.44	0.28	0.32	0.27	0.16	0.16	0.14	0.13	0.18	0.18	0.15	0.07	0.09	0.02	0.02	0.02
VOC	Carbon tetrachloride	0.17	µg/m^3	1.85	0.34	1.47	0.59	0.08	0.08	0.32	0.30	0.30	0.30	0.44	0.07	0.07	0.04	0.04	0.04
VOC	Chloroform	0.50	µg/m^3	0.29	0.06	0.20	0.15	0.03	0.03	0.07	0.08	0.06	0.06	0.11	0.02	0.03	0.02	0.02	0.02
VOC	Tetrachloroethylene	0.17	µg/m^3	0.80	0.21	0.71	1.06	0.12	0.12	0.35	0.36	0.40	0.40	0.64	0.12	0.12	0.08	0.08	0.08
VOC	Trichloroethylene	0.5/0.2[b]	µg/m^3	0.21	0.10	0.22	0.26	0.04	0.04	0.09	0.10	0.10	0.10	0.32	0.05	0.05	0.05	0.05	0.05
VOC	Vinyl chloride	0.11	µg/m^3	0.46	0.22	0.55	0.37	0.15	0.15	0.20	0.19	0.14	0.14	0.21	0.05	0.07	0.02	0.02	0.02

A-rated: MDL to Target MDL ratio ≤ 1

B-rated" MDL to Target MDL ratio between 1 and 2

Does Not Meet MDL to Target MDL ratio>2

-- No data available

[a]: Pollutant was sampled, but no MDL data were reported to AQS.

[b]: For the 2012 sampling year, the Target MDL for this pollutant was reduced.

Table 8. NATTS Network Assessment: MQO#3 - Bias Percent Difference at Roxbury, MA

Pollutant Group	Pollutant Name	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Carbonyls	Acetaldehyde	4.7	8.0	0.2	-8.9	2.9	-10.9	-9.0	-7.6	a	-6.1	1.4	a	-4.8	-14.3	-23.3
Carbonyls	Formaldehyde	8.7	5.7	-3.5	-6.7	12.0	-9.6	-8.2	-8.4	a	-0.7	-1.9	a	-12.6	-11.2	-13.8
Chromium VI	Chromium VI	--	a	a	a	a	-5.6[b]	10.5[b]	a	19.5	-6.5	--	--	--	--	--
PAH	Benzo(a)pyrene	--	--	--	--	a	-1.7	-2.3	-2.1	25.2	-5.7	-16.3	-14.2	-10.5	-22.4	-14.8
PAH	Naphthalene	--	--	--	--	a	-7.7	-17.1	-13.9	21.4	25.5	0.7	-11.4	-9.5	-11.6	-20.7
PM_{10} Metals	Arsenic (PM_{10})	-11.3	8.1	5.2	11.5	8.4	-14.8	7.3	1.4	15.7	-3.0	1.9	a	-2.3	-1.4	-3.4
PM_{10} Metals	Beryllium (PM_{10})	20.0	13.6	6.4	18.9	4.8	-5.5	11.2	-8.2	17.5	-2.0	c	a	-0.4	3.7	0.5
PM_{10} Metals	Cadmium (PM_{10})	d	-1.1	-0.2	5.3	5.1	-16.2	4.9	-5.7	16.6	1.4	c	a	3.9	2.8	3.0
PM_{10} Metals	Lead (PM_{10})	d	-1.9	-2.4	-1.5	4.7	-30.6	-3.5	-6.3	19.9	0.1	2.2	a	-1.6	-0.4	-1.9
PM_{10} Metals	Manganese (PM_{10})	d	-2.8	-10.2	-13.8	-25.3	-37.7	0.6	-3.8	21.5	-6.2	13.2	a	3.9	1.3	2.6
PM_{10} Metals	Nickel (PM_{10})	d	-12.9	-6.3	-8.5	8.6	-28.9	4.7	-6.8	11.4	-1.2	e	a	26.5	21.2	10.6
VOC	Benzene	6.0	6.6	1.7	-3.0	1.5	0.4	-8.8	15.4	a	9.2	0.6	-4.3	-10.9	-12.0	-7.6
VOC	Butadiene, 1,3-	21.5	-1.9	-2.8	-3.7	-1.4	-11.9	3.7	1.9	a	4.9	-4.5	4.4	-6.9	-19.0	-2.5
VOC	Carbon tetrachloride	32.9	3.3	-3.6	0.6	24.2	-9.2	-2.0	-3.6	a	-7.8	-3.0	15.7	10.5	-1.0	-7.3
VOC	Chloroform	7.3	-3.4	-5.4	-7.5	-2.9	-3.4	-7.2	-10.7	a	-9.1	-2.2	-0.6	-0.3	4.1	-6.9
VOC	Tetrachloroethylene	4.1	-10.7	-12.7	-3.9	7.6	-9.7	-8.6	0.4	a	-0.2	3.3	-0.7	-9.7	-15.5	-10.5
VOC	Trichloroethylene	11.6	-6.2	-2.4	-3.4	4.2	-13.7	-12.8	-11.9	a	2.2	2.8	2.2	-10.9	-10.1	-11.4
VOC	Vinyl chloride	-3.5	-19.2	-12.4	3.1	2.8	-10.3	-11.8	-7.0	a	-11.0	0.7	-1.5	-5.4	-5.3	-16.0

	A-rated:±25%
	B-rated: Between 25% to 35% or between -25% to -35%
	Does not meet:>35% or <35%
--	No data available

[a]: No Proficiency Test samples were sent for this pollutant and year.

[b]: Proficiency Test results are from the National Contract Lab for EPA's School Air Toxics Monitoring Program. The %Difference was -5.55% in 2009 and 10.53% in 2010.

[c]: Although a Proficiency Test sample was sent to the lab supporting this site and year, the results were nullified by EPA due to QA issues.

[d]: Pollutant not included in the PT sample sent to the lab supporting this site

[e]: Pollutant was sampled at this site and year, but no bias data were reported.

Table 9. NATTS Network Assessment: MQO#4 - Overall Method Precision %CV at Roxbury, MA

Pollutant Group	Pollutant Name	Overall Method precision % CV															
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Carbonyls	Acetaldehyde	--	--	--	--	21.9	13.4	28.5	10.9	13.2	5.9	7.5	6.7	6.8	25.1	8.1	15.2
Carbonyls	Formaldehyde	--	--	--	--	11.5	7.0	7.5	8.0	12.5	8.8	7.0	6.0	4.1	9.4	5.8	6.2
Chromium VI	Chromium VI	--	--	13.6	23.9	19.4	12.2	10.8	2.7	27.6	5.8	8.3	--	--	--	--	--
PAH	Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PAH	Naphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PM_{10} Metals	Arsenic (PM_{10})	15.8	25.4	6.3	13.8	4.1	2.5	3.0	3.0	4.1	3.0	21.4	27.0	25.0	10.5	6.7	10.0
PM_{10} Metals	Beryllium (PM_{10})	16.5	a	a	a	a	a	14.7	24.2	18.0	12.0	20.0	18.5	23.7	20.2	15.7	9.3
PM_{10} Metals	Cadmium (PM_{10})	45.8	36.2	49.6	35.8	18.0	16.4	27.9	23.3	18.1	27.9	20.0	27.3	16.2	20.7	17.5	16.0
PM_{10} Metals	Lead (PM_{10})	3.7	10.9	8.6	15.0	8.3	7.8	5.9	5.0	6.4	3.8	3.9	5.9	13.9	5.6	9.7	3.5
PM_{10} Metals	Manganese (PM_{10})	7.2	19.3	6.9	15.3	5.7	6.7	5.9	2.4	3.7	2.4	3.5	4.7	14.3	7.1	9.1	7.6
PM_{10} Metals	Nickel (PM_{10})	27.3	17.4	8.4	15.3	13.8	4.3	8.7	3.5	4.9	8.0	30.2	32.7	36.7	50.0	32.1	2.8
VOC	Benzene	--	9.2	5.5	2.7	4.5	6.0	4.8	6.3	3.4	10.1	2.2	6.1	7.6	6.0	5.3	4.6
VOC	Butadiene, 1,3-	--	60.9	26.4	11.7	36.6	29.3	27.3	29.6	23.7	21.0	13.7	20.0	13.6	16.4	17.8	12.9
VOC	Carbon tetrachloride	--	4.6	4.8	3.4	2.5	2.3	3.2	4.5	2.9	2.7	1.7	9.1	1.6	4.1	3.3	4.3
VOC	Chloroform	--	5.6	7.8	5.2	6.3	7.5	3.6	5.7	4.9	16.0	3.0	1.7	2.5	4.7	4.9	4.1
VOC	Tetrachloroethylene	--	11.9	10.8	4.7	12.2	10.4	5.3	7.4	3.5	25.8	3.6	3.3	4.6	4.3	11.1	7.1
VOC	Trichloroethylene	--	6.5	18.4	a	a	32.5	7.7	a	6.7	5.2	a	13.3	7.1	9.8	8.8	14.5
VOC	Vinyl chloride	--	a	a	a	a	a	a	a	a	a	a	a	a	17.8	16.7	0

	A-rated:≤ 15% CV
	B-rated: Between 15%CV to25% CV
	Does Not Meet: >25% CV or did not report Precision (required in the NATTS Workplan Template since 2012)
--	No data available

[a]: Although both primary and secondary data were reported, both sets of values were less than the MDL. Thus no %CV was calculated.

Table 10. NATTS Network Assessment: MQO#4 - Analytical Precision %CV at Roxbury, MA

Pollutant Group	Pollutant Name	Analytical Method precision % CV															
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Carbonyls	Acetaldehyde	--	--	--	--	--	--	--	--	--	a	a	a	2.0	8.1	7.1	10.5
Carbonyls	Formaldehyde	--	--	--	--	--	--	--	--	--	a	a	a	1.8	5.5	7.7	5.9
Chromium VI	Chromium VI	--	--	--	10.2	9.3	15.9	8.4	5.1	6.9	1.8	5.9	--	--	--	--	--
PAH	Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	1.9	3.8	4.2	1.3	1.9	1.7	1.9
PAH	Naphthalene	--	--	--	--	--	--	--	--	--	3.5	4.2	4.1	0.8	1.3	1.4	0.9
PM_{10} Metals	Arsenic (PM_{10})	--	--	--	--	4.6	0.7	1.1	2.3	1.6	2.2	20.3	17.5	23.6	10.9	2.2	9.4
PM_{10} Metals	Beryllium (PM_{10})	--	--	--	--	b	b	12.5	16.1	14.8	6.6	15.1	31.8	11.3	14.9	11.9	7.3
PM_{10} Metals	Cadmium (PM_{10})	--	--	--	--	1.8	0.7	12.4	6.3	7.3	5.5	7.7	7.6	14.0	12.0	3.3	2.6
PM_{10} Metals	Lead (PM_{10})	--	--	--	--	1.7	1.9	0.5	1.3	0.9	1.1	0.8	5.0	10.7	5.0	1.2	1.0
PM_{10} Metals	Manganese (PM_{10})	--	--	--	--	2.1	2.9	1.1	1.2	1.2	1.7	0.9	1.5	2.7	1.7	0.6	1.3
PM_{10} Metals	Nickel (PM_{10})	--	--	--	--	2.8	0.7	1.2	0.7	1.9	4.3	2.1	6.4	22.1	37.4	1.2	1.1
VOC	Benzene	--	--	--	--	--	--	--	--	--	a	a	a	11.3	3.6	4.0	4.9
VOC	Butadiene, 1,3-	--	--	--	--	--	--	--	--	--	a	a	a	12.6	10.0	16.7	8.7
VOC	Carbon tetrachloride	--	--	--	--	--	--	--	--	--	a	a	a	7.9	2.3	4.0	2.8
VOC	Chloroform	--	--	--	--	--	--	--	--	--	a	a	a	1.4	3.1	3.6	1.7
VOC	Tetrachloroethylene	--	--	--	--	--	--	--	--	--	a	a	a	3.3	3.9	4.7	4.9
VOC	Trichloroethylene	--	--	--	--	--	--	--	--	--	a	a	a	11.1	8.5	14.7	13.3
VOC	Vinyl chloride	--	--	--	--	--	--	--	--	--	a	a	a	b	0	33.3	0

A-rated:≤ 15% CV

B-rated: Between 15%CV to25% CV

Does Not Meet: >25% CV or did not report Precision (required in the NATTS Workplan Template since 2012)

-- No data available

[a]: Per the NATTS Workplan template, analytical replicates were required to be reported to AQS for this sampling year

[b]: The primary and/or replicate value were less than the MDL, so no calculation could be made.

Appendix A. Equipment Inventory		
Pollutant Type	**Year(s)**	**Manufacturer/Model, Extraction Type, and Year**
Sampling Equipment		
Carbonyls	2003-2015	ATEC 200 Toxic Air Sampler (Year Deployed: 2002)
	2016-2018	ATEC 2200 Toxic Air Sampler (Year Deployed: 2016)
Chormium VI	2005-2013	ERG Chromium VI sampler (Year Deployed: 2005)
PAHs	2008-2014	Graseby Andersen GMW PS-1 PUF Sampler (Year Deployed: 2006)
	2015-2018	GMW PS-1 PUF Sampler (Year Deployed: 2015)
PM_{10} Metals	2003-2014	Andersen Hi-Volume PM10 Sampler (Year Deployed: 2002)
	2015-2018	R&P 2025 Lo-Vol (2) (Year Deployed: 2007)
VOCs	2003-2003	Xontech 910A Canister Sampler (Year Deployed: 2002)
	2004-2004	Meriter MCS-1 Portable Canister Sampler (Year Deployed: unknown)
	2005-2014	Xontech 910A Canister Sampler (Year Deployed: 2004)
	2015-2018	Xontech 910 (Year Deployed: 2010)
Analytical Equipment		
Carbonyls	2003-2006	Waters HPLC/model 2996 PDA (Year Deployed: 1993)
	2007-2014	HP/Agilent HPLC 1200 with UV detection (Year Deployed: 2007)
	2015-2018	Waters 717 autosampler, 600 controller, pump module, 2996 PDA (Year Deployed: 1993)
Chormium VI	2005-2013	Dionex 300 ion chromatography system (Year Deployed: 2001)
PAHs	2008-2014	HP/Agilent 5890/5971 GC/MS (Year Deployed: 2008)
	2015-2018	HP/Agilent 7890B/5975C GC/MS (Year Deployed: 2014)
PM_{10} Metals	2003-2003	PE Sciex ELAN 6100 ICP-MS (Year Deployed: UNKNOWN)
	2004-2014	PE ELAN 9000 ICP-MS (Year Deployed: 2003)
	2015-2018	Thermo iCAP Q ICP-MS (Year Deployed: 2015)
VOCs	2003-2004	Agilent 7890A/5973 GC/MS (Year Deployed: unknown)
	2005-2018	Agilent 7890A/5973 GC/MS (Year Deployed: 2005)
Preconcentrator Equipment		
VOCs	2003-2007	Entech 7100 (Year Deployed: <1995)
	2008-2014	Entech 7100 (Year Deployed: 2008)
	2015-2018	Entech 7200 (Year Deployed: 2015)
Standards Preparation Equipment		
VOCs	2003-2009	Entech 7100 (dynamic dilution) (Year Deployed: <2000)
	2010-2018	Entech 4100 (dynamic dilution) (Year Deployed: 2010)
Canister Cleaning Equipment		
VOCs	2003-2018	Entech 3100 (Hot) (Year Deployed: <2000)
	2014	Restek-Wasson/ECE Instrumentation (Hot) (Year Deployed: 2014)
	2015	Entech 3100A (Hot) (Year Deployed: 2015)
	2016-2018	Entech 3100 (Hot) (Year Deployed: <2000)
PM_{10} Extraction Equipment		
PM_{10} Metals	2003-2003	Branson 8510 (Sonicator) (Year Deployed: unknown)
	2004-2013	Branson 8510 (Sonicator) (Year Deployed: 2004)
	2014-2018	Environment Express (Hotblock) (Year Deployed: 2011)
Chromium VI Extraction Equipment		
Chormium VI	2005-2010	Branson 8510 (Sonicator) (Year Deployed: 2001)
	2011-2011	Branson 8510 Sonicator/ Branson Shaker (Year Deployed: 2001/2011)
	2012-2013	Branson Shaker (Year Deployed: 2011)
PAHs Extraction Equipment		
PAHs	2008-2018	Dionex -300 (ASE) (Year Deployed: 2004)