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
  - Ethylene oxide added in 2020
- For the NATTS Network Assessment (2003-2022):
  - 16 of 17 Method Quality Objective (MQO) Core HAPs were included in the national trends
    - Beryllium (PM_{10}): Completeness less than 75% for 2021
  - 313 of 322 pollutant datasets were suitable for trends analysis
  - Annual Average and 3-Year Rolling Average Concentrations were decreasing for benzene, 1,3-butadiene, cadmium (PM_{10}), lead (PM_{10}), naphthalene, nickel (PM_{10}), tetrachloroethylene, and trichloroethylene.
  - 100% Reporting of Datasets
- Method Quality Objectives (MQO): 2003-2022
  - Completeness: Met 85% completeness in 296 of 322 pollutant datasets
  - Method Detection Limits: Met MDL Target Ratio of 1.00 in 321 of 330 pollutant datasets
  - Bias: Met ±25% for 271 of 281 pollutant datasets
  - Overall Method Precision: Met ≤15% CV for 183 of 259 pollutant datasets
  - Analytical Method Precision: Met ≤15% CV for 171 of 211 pollutant datasets
- Analytical Laboratories for 2022

VOC	Carbonyl	PM_{10} Metals	PAHs
RIDOH	MADEP	ERG	ERG

- Equipment Year Deployed

Equipment Type	VOC	Carbonyl	PM_{10} Metals	PAHs
Sampler	2022	2022	2007	2021
Analytical	2005	2019	2017	2021
Preconcentrator	2021	NA	NA	NA
Standards Preparation	2019	NA	NA	NA
Canister Cleaning	2006	NA	NA	NA
Extraction	NA	NA	2011	2019

National Summary: NATTS data were collected at 27 locations across the United States, with sites beginning in 2003 or later (Figure 1) for 20 core HAPs. Over 670,000 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., 2017-2019 vs. 2020-2022) to determine if the NATTS Trends DQO was being met:

To be able to detect a 15 percent difference (trend) between the annual mean concentrations of successive 3-year periods within acceptable levels of decision error.

Of the 20 core HAPs. 17 were assessed for the NATTS Trends DQO. Due to sampling and analytical issues, acrolein and ethylene were not considered for trends analysis (Table 2). Additionally, hexavalent chromium was discontinued as a required pollutant . The assessment showed that across the network, 11 of those 17 pollutants were decreasing between the 3-year blocks, while four of those pollutants were increasing between the 3-year blocks. Two pollutants did not exhibit a noticeable trend.

Figure 1. NATTS Site and Year Established

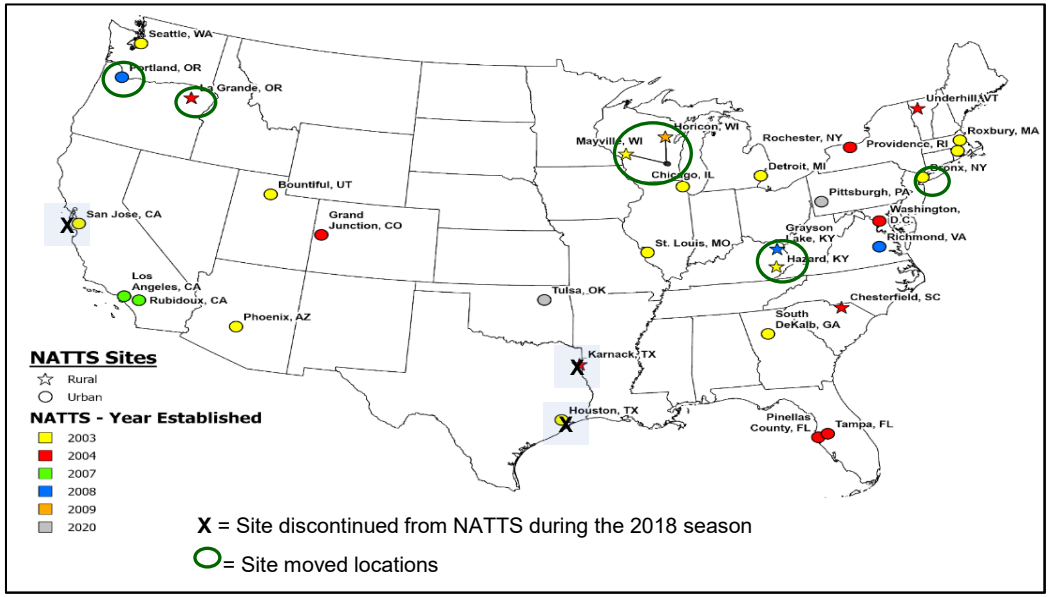


Table 1. NATTS Network Assessment: Count and Percentage of Suitable Datasets by Pollutant Group

Pollutant Group	A-rated		B-rated		Does Not Meet	
	#	%	#	%	#	%
VOCs	1,968	58%	864	25%	572	17%
Carbonyls	668	68%	231	24%	77	8%
PM_{10} Metals	1,906	66%	775	27%	217	7%
PAHs	571	77%	144	19%	29	4%
Total = 8,704	5,113	64%	2,014	25%	895	11%

Table 2. Three-Year Block Averages for National Trends

Pollutant[a,b]	Units	# Sites	Block 1	Block 2	% Difference
Acetaldehyde	$\mu g/m^3$	16	1.48	1.34	-9.2%
Arsenic (PM_{10})	ng/m^3	18	0.68	0.64	-6.6%
Benzene	$\mu g/m^3$	16	0.529	0.525	-0.8%
Benzo(a)pyrene	ng/m^3	18	0.086	0.072	-16.6%
Beryllium (PM_{10})	ng/m^3	18	0.008	0.010	15.0%
Butadiene, 1,3-	$\mu g/m^3$	15	0.057	0.054	-5.1%
Cadmium (PM_{10})	ng/m^3	20	0.087	0.090	3.7%
Carbon Tetrachloride	$\mu g/m^3$	15	0.53	0.50	-5.3%
Chloroform	$\mu g/m^3$	16	0.173	0.165	-4.8%
Formaldehyde	$\mu g/m^3$	15	2.809	2.482	-11.7%
Lead (PM_{10})	ng/m^3	20	2.44	2.43	-0.5%
Manganese (PM_{10})	ng/m^3	20	6.69	7.31	9.2%
Naphthalene	ng/m^3	17	42.00	35.10	-16.4%
Nickel (PM_{10})	ng/m^3	19	0.87	0.83	-3.7%
Tetrachloroethylene	$\mu g/m^3$	15	0.12	0.12	1.5%
Trichloroethylene	$\mu g/m^3$	14	0.019	0.022	16.3%
Vinyl Chloride	$\mu g/m^3$	16	0.004	0.001	-69.0%

[a] Acrolein and ethylene oxide were not assessed due to sampling and analytical issues

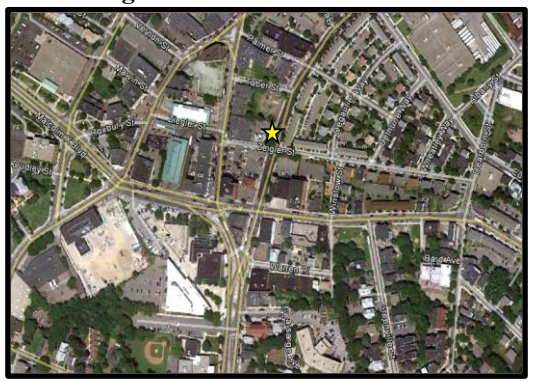
[b] Hexavalent chromium (not assessed) was discontinued in 2013

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
CBSA Population (2023)	768,425

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	2019	2020	2021	2022
Acetaldehyde	N(a)	Y	Y	Y	Y	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	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	Y	Y	Y	Y (T)	Y (T)	Y (T)	Y (T)	Y (T)	Y (T)
Benzo(a)pyrene	--	--	--	--	--	--	Y	Y	Y	Y	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	Y	Y	Y	Y	Y	Y	Y	N(b)	Y
Butadiene, 1,3-	Y	Y	Y	Y	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	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	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	Y	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	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	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	Y	Y	Y	Y (T)	Y (T)	Y (T)	Y (T)	Y (T)	Y (T)
Naphthalene	--	--	--	--	--	--	Y	Y	Y	Y	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	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	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	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	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

[b]: Completeness was less than 75% based on 1-in-6 day sampling.

Table 3. NATTS Network Assessment Data (2003-2022) - 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	22,000	100%	1.73 ± 0.02	0.50	0.65	0.95	1.42	2.15	3.19	3.96
	µg/m^3	Rural	6,392	100%	1.17 ± 0.03	0.36	0.45	0.65	0.92	1.35	1.98	2.67
	µg/m^3	All Sites	28,392	100%	1.61 ± 0.02	0.45	0.58	0.85	1.29	1.97	2.99	3.79
Arsenic (PM_{10})	ng/m^3	Urban	21,944	95%	0.87 ± 0.03	0.03	0.16	0.32	0.56	0.96	1.65	2.37
	ng/m^3	Rural	6,385	96%	0.49 ± 0.02	0.03	0.08	0.16	0.35	0.58	0.93	1.30
	ng/m^3	All Sites	28,329	96%	0.78 ± 0.02	0.03	0.13	0.27	0.51	0.87	1.51	2.16
Benzene	µg/m^3	Urban	22,246	99%	0.85 ± 0.01	0.23	0.29	0.42	0.64	1.02	1.62	2.20
	µg/m^3	Rural	5,932	90%	0.52 ± 0.01	ND	0.06	0.20	0.38	0.67	1.08	1.51
	µg/m^3	All Sites	28,178	97%	0.78 ± 0.01	0.16	0.23	0.36	0.58	0.95	1.52	2.07
Benzo(a)pyrene	ng/m^3	Urban	17,810	73%	0.10 ± 0.01	ND	ND	ND	0.04	0.10	0.23	0.35
	ng/m^3	Rural	4,735	37%	0.07 ± 0.01	ND	ND	ND	ND	0.02	0.19	0.38
	ng/m^3	All Sites	22,545	65%	0.09 ± 0.01	ND	ND	ND	0.03	0.09	0.22	0.35
Beryllium (PM_{10})	ng/m^3	Urban	21,786	77%	0.042 ± 0.004	ND	ND	0.0005	0.005	0.015	0.043	0.098
	ng/m^3	Rural	6,062	49%	0.018 ± 0.002	ND	ND	ND	ND	0.004	0.012	0.041
	ng/m^3	All Sites	27,848	71%	0.037 ± 0.003	ND	ND	ND	0.003	0.011	0.038	0.083
Butadiene, 1,3-	µg/m^3	Urban	22,220	78%	0.092 ± 0.002	ND	ND	0.018	0.051	0.110	0.215	0.317
	µg/m^3	Rural	5,940	29%	0.017 ± 0.001	ND	ND	ND	ND	0.011	0.054	0.104
	µg/m^3	All Sites	28,160	68%	0.076 ± 0.002	ND	ND	ND	0.039	0.092	0.190	0.283
Cadmium (PM_{10})	ng/m^3	Urban	21,954	93%	0.184 ± 0.014	ND	0.019	0.043	0.081	0.160	0.354	0.572
	ng/m^3	Rural	6,067	89%	0.092 ± 0.005	ND	ND	0.026	0.055	0.099	0.179	0.270
	ng/m^3	All Sites	28,021	92%	0.164 ± 0.011	ND	0.012	0.039	0.075	0.143	0.300	0.518
Carbon Tetrachloride	µg/m^3	Urban	22,202	98%	0.556 ± 0.002	0.336	0.423	0.486	0.550	0.638	0.725	0.784
	µg/m^3	Rural	5,909	84%	0.494 ± 0.010	ND	ND	0.342	0.533	0.629	0.728	0.807
	µg/m^3	All Sites	28,111	95%	0.543 ± 0.003	ND	0.363	0.475	0.547	0.636	0.726	0.788
Chloroform	µg/m^3	Urban	22,218	88%	0.243 ± 0.016	ND	ND	0.094	0.129	0.205	0.398	0.630
	µg/m^3	Rural	5,942	56%	0.062 ± 0.002	ND	ND	ND	0.049	0.098	0.134	0.228
	µg/m^3	All Sites	28,160	82%	0.205 ± 0.013	ND	ND	0.076	0.110	0.187	0.342	0.543

Table 3. NATTS Network Assessment Data (2003-2022) - 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	22,024	100%	3.03 ± 0.04	0.69	1.00	1.57	2.42	3.72	5.47	6.95
	µg/m^3	Rural	6,432	100%	2.16 ± 0.04	0.49	0.64	1.03	1.67	2.69	4.12	5.34
	µg/m^3	All Sites	28,456	100%	2.83 ± 0.03	0.61	0.86	1.42	2.25	3.50	5.22	6.65
Lead (PM_{10})	ng/m^3	Urban	21,955	100%	3.97 ± 0.10	0.70	0.95	1.46	2.49	4.34	7.87	11.16
	ng/m^3	Rural	6,066	99%	1.93 ± 0.14	0.34	0.45	0.75	1.27	2.14	3.59	4.96
	ng/m^3	All Sites	28,021	100%	3.53 ± 0.09	0.53	0.75	1.22	2.17	3.88	6.99	10.10
Manganese (PM_{10})	ng/m^3	Urban	21,906	100%	9.76 ± 0.25	1.06	1.49	2.53	4.96	10.43	20.40	30.79
	ng/m^3	Rural	6,067	99%	3.79 ± 0.12	0.48	0.74	1.34	2.48	4.49	8.08	11.64
	ng/m^3	All Sites	27,973	100%	8.47 ± 0.20	0.84	1.22	2.16	4.19	8.99	18.13	27.27
Naphthalene	ng/m^3	Urban	17,811	100%	67.25 ± 0.97	13.42	18.03	28.73	49.00	84.13	136.42	180.00
	ng/m^3	Rural	4,732	98%	21.76 ± 1.02	2.79	4.04	6.84	12.47	23.51	45.68	69.01
	ng/m^3	All Sites	22,543	100%	57.70 ± 0.83	5.92	9.77	20.41	40.15	74.11	124.40	167.26
Nickel (PM_{10})	ng/m^3	Urban	21,958	98%	1.76 ± 0.05	0.29	0.40	0.62	1.02	1.86	3.32	5.05
	ng/m^3	Rural	5,989	85%	0.56 ± 0.07	ND	ND	0.10	0.26	0.53	0.96	1.63
	ng/m^3	All Sites	27,947	95%	1.50 ± 0.04	0.00	0.17	0.45	0.84	1.59	2.92	4.47
Tetrachloroethylene	µg/m^3	Urban	22,209	84%	0.24 ± 0.05	ND	ND	0.05	0.12	0.22	0.43	0.68
	µg/m^3	Rural	5,936	38%	0.07 ± 0.02	ND	ND	ND	ND	0.04	0.12	0.31
	µg/m^3	All Sites	28,145	75%	0.21 ± 0.04	ND	ND	ND	0.08	0.20	0.38	0.61
Trichloroethylene	µg/m^3	Urban	22,204	43%	0.040 ± 0.008	ND	ND	ND	ND	0.043	0.096	0.152
	µg/m^3	Rural	5,922	19%	0.019 ± 0.003	ND	ND	ND	ND	ND	0.029	0.124
	µg/m^3	All Sites	28,126	38%	0.036 ± 0.006	ND	ND	ND	ND	0.033	0.085	0.148
Vinyl Chloride	µg/m^3	Urban	22,021	18%	0.0046 ± 0.0003	ND	ND	ND	ND	ND	0.0126	0.0251
	µg/m^3	Rural	5,940	13%	0.0070 ± 0.0008	ND	ND	ND	ND	ND	0.0125	0.0304
	µg/m^3	All Sites	27,961	17%	0.0051 ± 0.0003	ND	ND	ND	ND	ND	0.0126	0.0253

[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	1,142	100%	1.49 ± 0.04	0.70	0.83	1.07	1.39	1.79	2.30	2.55
Arsenic (PM_{10})	ng/m^3	1,192	100%	0.48 ± 0.02	0.12	0.15	0.25	0.39	0.58	0.88	1.08
Benzene	µg/m^3	1,163	100%	0.72 ± 0.03	0.25	0.30	0.40	0.59	0.90	1.31	1.62
Benzo(a)pyrene	ng/m^3	863	96%	0.10 ± 0.01	0.02	0.03	0.05	0.08	0.13	0.20	0.27
Beryllium (PM_{10})	ng/m^3	1,186	88%	0.006 ± 0.001	ND	ND	0.002	0.004	0.007	0.011	0.016
Butadiene, 1,3-	µg/m^3	1,160	100%	0.074 ± 0.004	0.02	0.02	0.03	0.05	0.09	0.15	0.20
Cadmium (PM_{10})	ng/m^3	1,192	100%	0.17 ± 0.02	0.03	0.04	0.05	0.10	0.17	0.30	0.49
Carbon Tetrachloride	µg/m^3	1,163	100%	0.55 ± 0.01	0.42	0.45	0.49	0.54	0.59	0.66	0.71
Chloroform	µg/m^3	1,160	100%	0.105 ± 0.002	0.06	0.07	0.08	0.10	0.12	0.14	0.16
Formaldehyde	µg/m^3	1,157	100%	2.93 ± 0.09	1.20	1.45	1.92	2.59	3.52	4.87	5.75
Lead (PM_{10})	ng/m^3	1,192	100%	3.31 ± 0.16	0.86	1.08	1.72	2.69	3.96	5.95	7.70
Manganese (PM_{10})	ng/m^3	1,192	100%	4.46 ± 0.16	1.50	1.87	2.64	3.80	5.52	7.54	9.32
Naphthalene	ng/m^3	863	100%	48.42 ± 2.10	16.21	19.32	27.21	40.00	59.97	87.58	106.93
Nickel (PM_{10})	ng/m^3	1,192	100%	1.85 ± 0.18	0.51	0.60	0.79	1.13	1.85	3.36	4.88
Tetrachloroethylene	µg/m^3	1,161	100%	0.18 ± 0.01	0.04	0.05	0.08	0.12	0.21	0.35	0.48
Trichloroethylene	µg/m^3	1,160	89%	0.032 ± 0.003	ND	ND	0.01	0.02	0.03	0.06	0.09
Vinyl Chloride	µg/m^3	1,160	40%	0.0013 ± 0.0001	ND	ND	ND	ND	0.00	0.00	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
PAHs						ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG

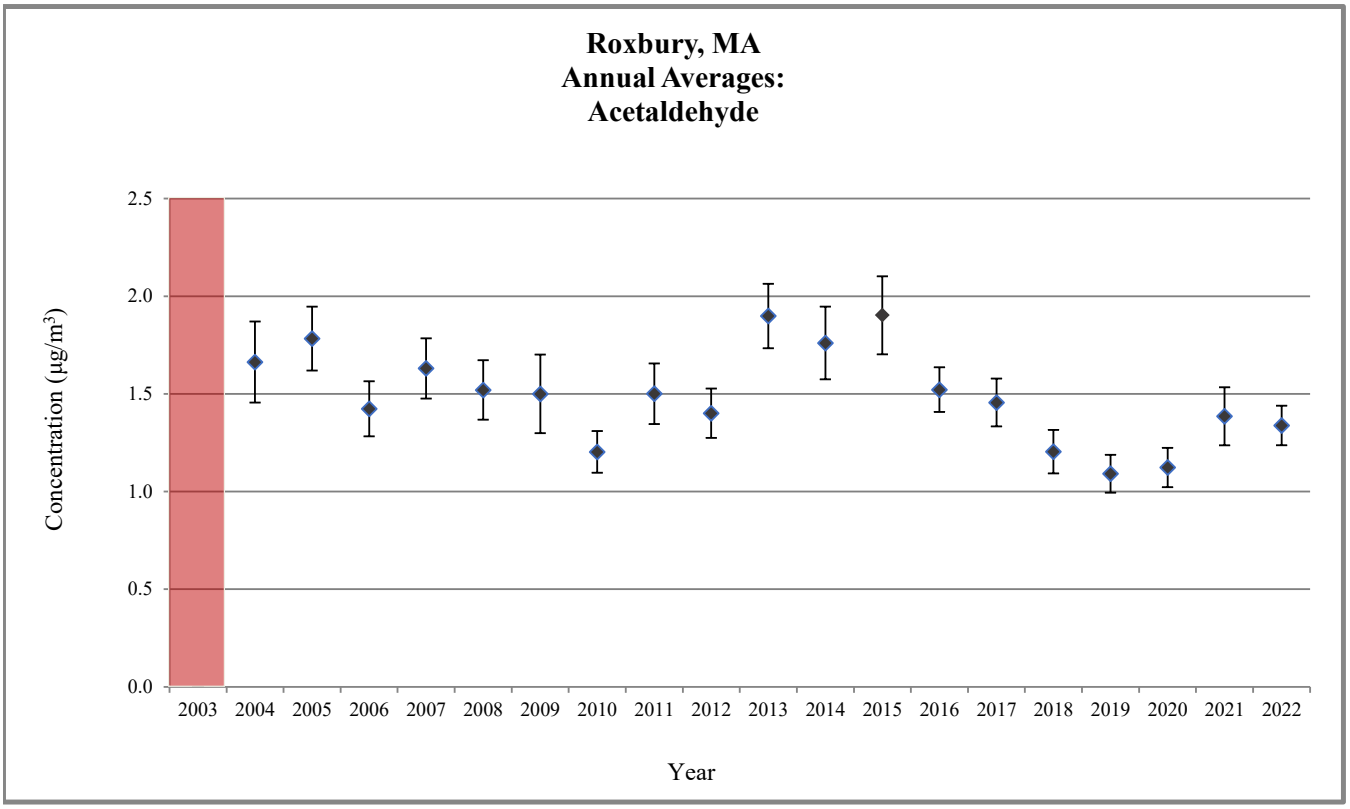
Pollutant Group	2019	2020	2021	2022
VOCs	RIDOH	RIDOH	RIDOH	RIDOH
Carbonyls	MADEP	MADEP	MADEP	MADEP
PM_{10} Metals	ERG	ERG	ERG	ERG
PAHs	ERG	ERG	ERG	ERG

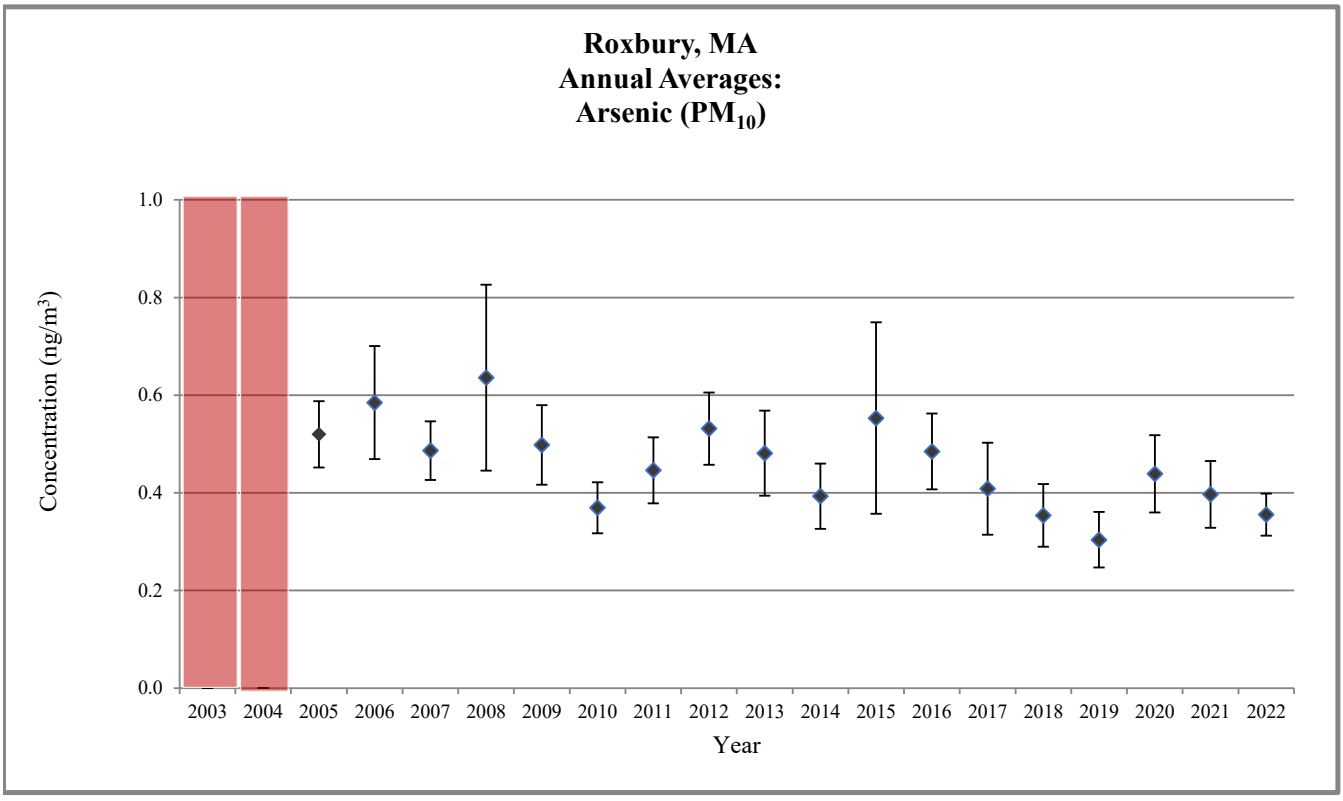
RIDOH: Rhode Island Department of Health

MADEP: Massachussetts Department of Environmental Protection

ERG: Eastern Research Group, Inc.

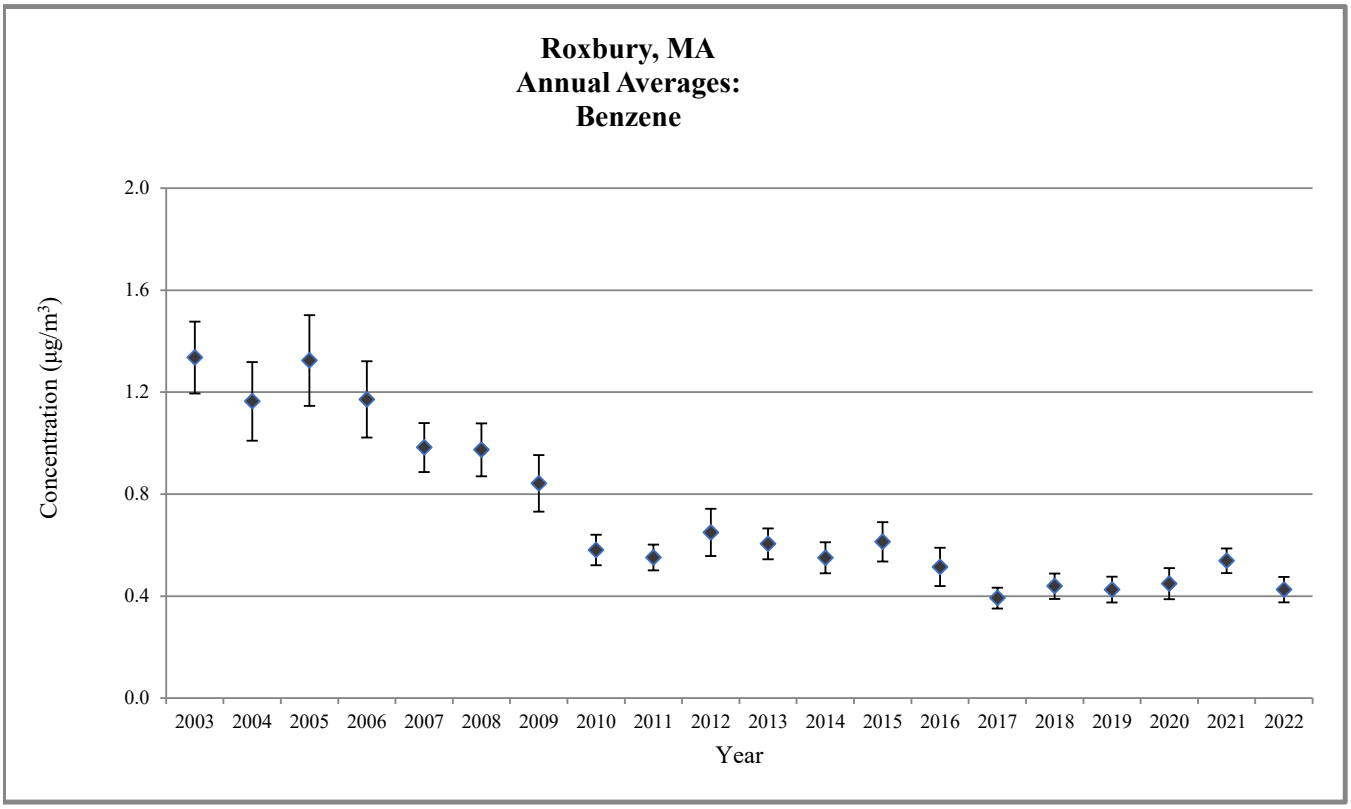
Figure 3. Roxbury, MA Annual Average Concentrations

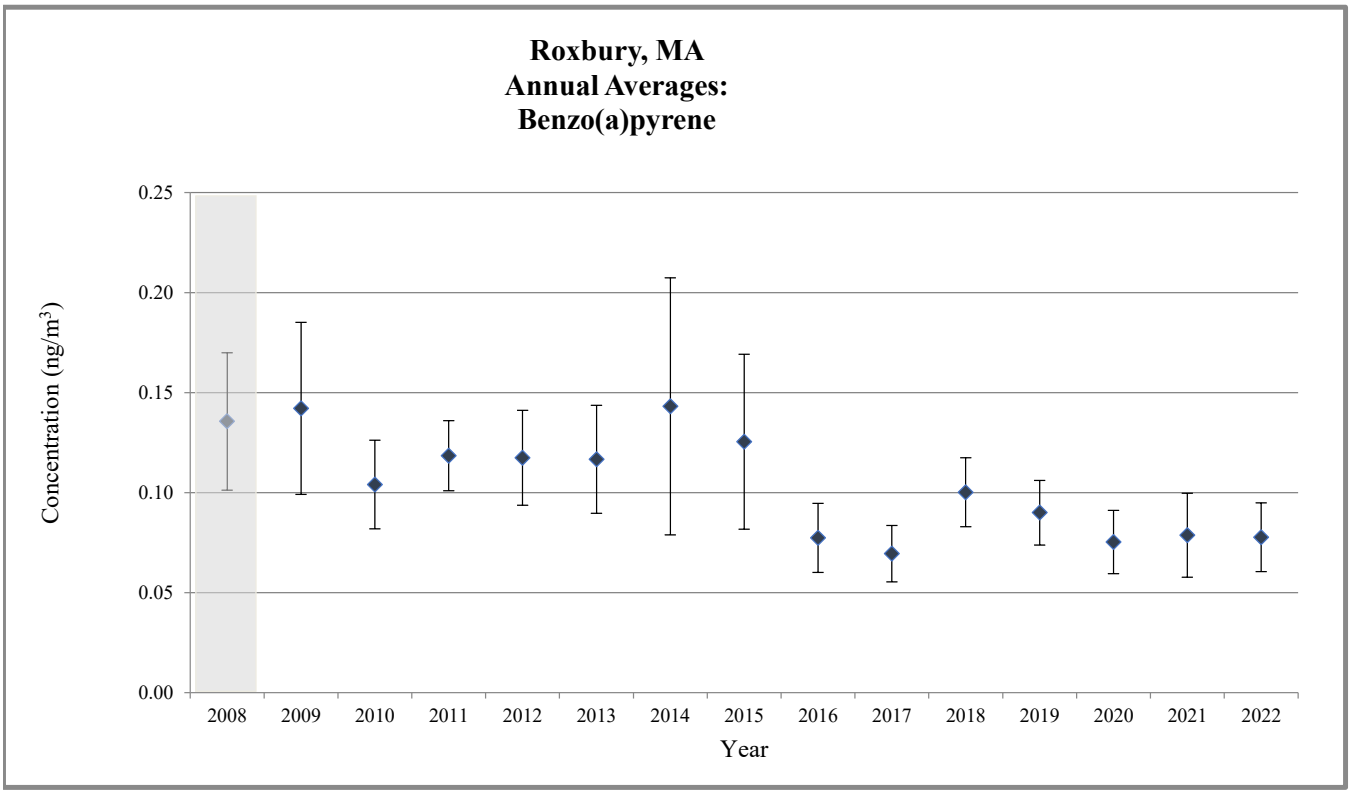




Sampling began midway through the year.
Does not meet MQO

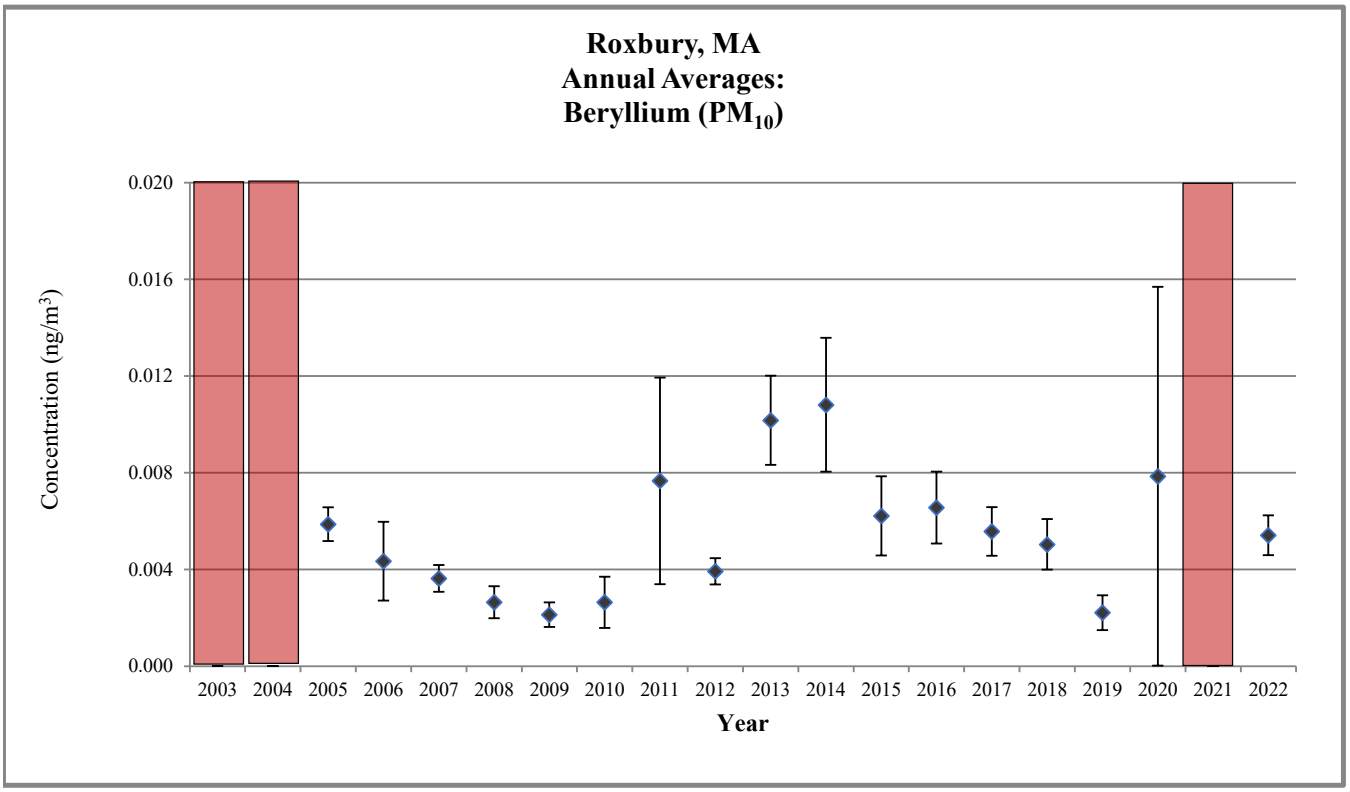
Figure 3. Roxbury, MA Annual Average Concentrations

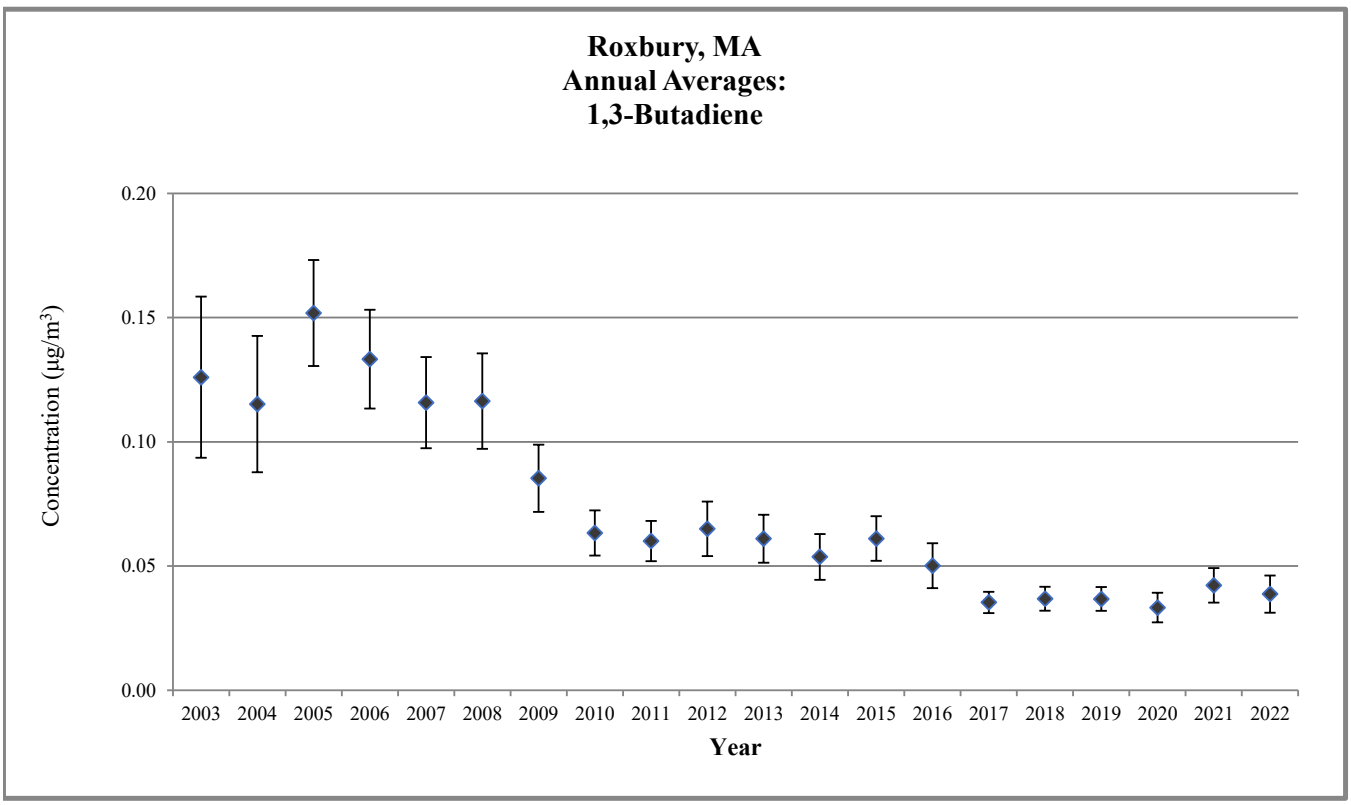




Sampling began midway through the year.
Does not meet MQO

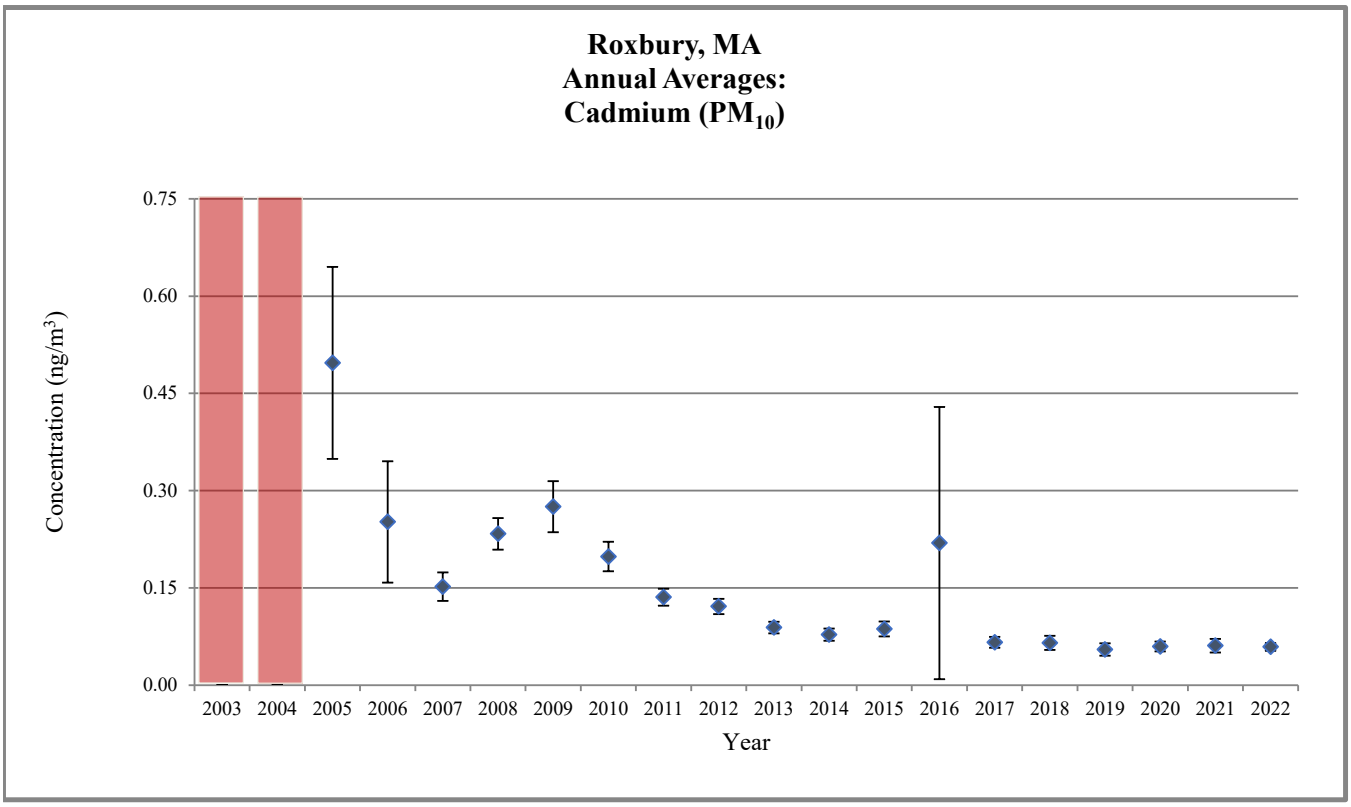
Figure 3. Roxbury, MA Annual Average Concentrations

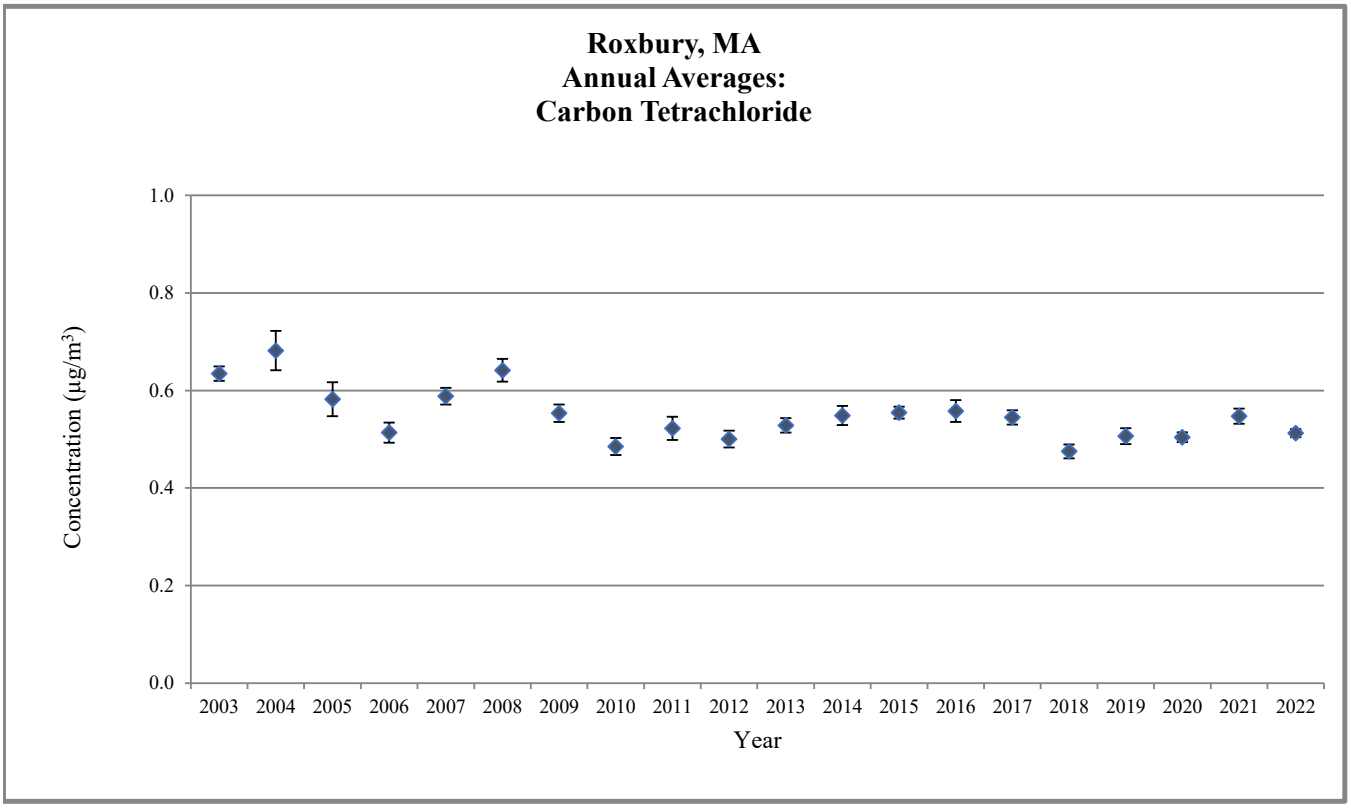




Sampling began midway through the year.
Does not meet MQO

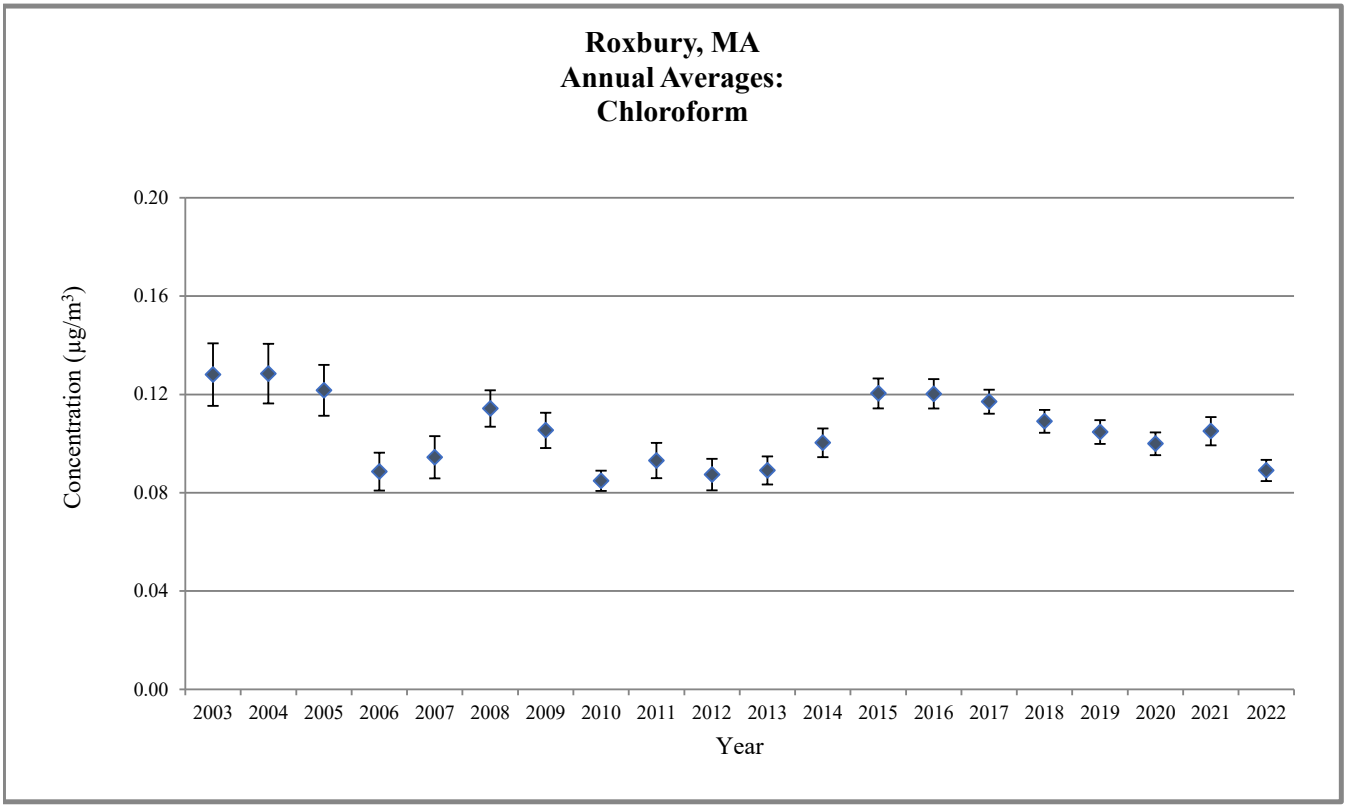
Figure 3. Roxbury, MA Annual Average Concentrations

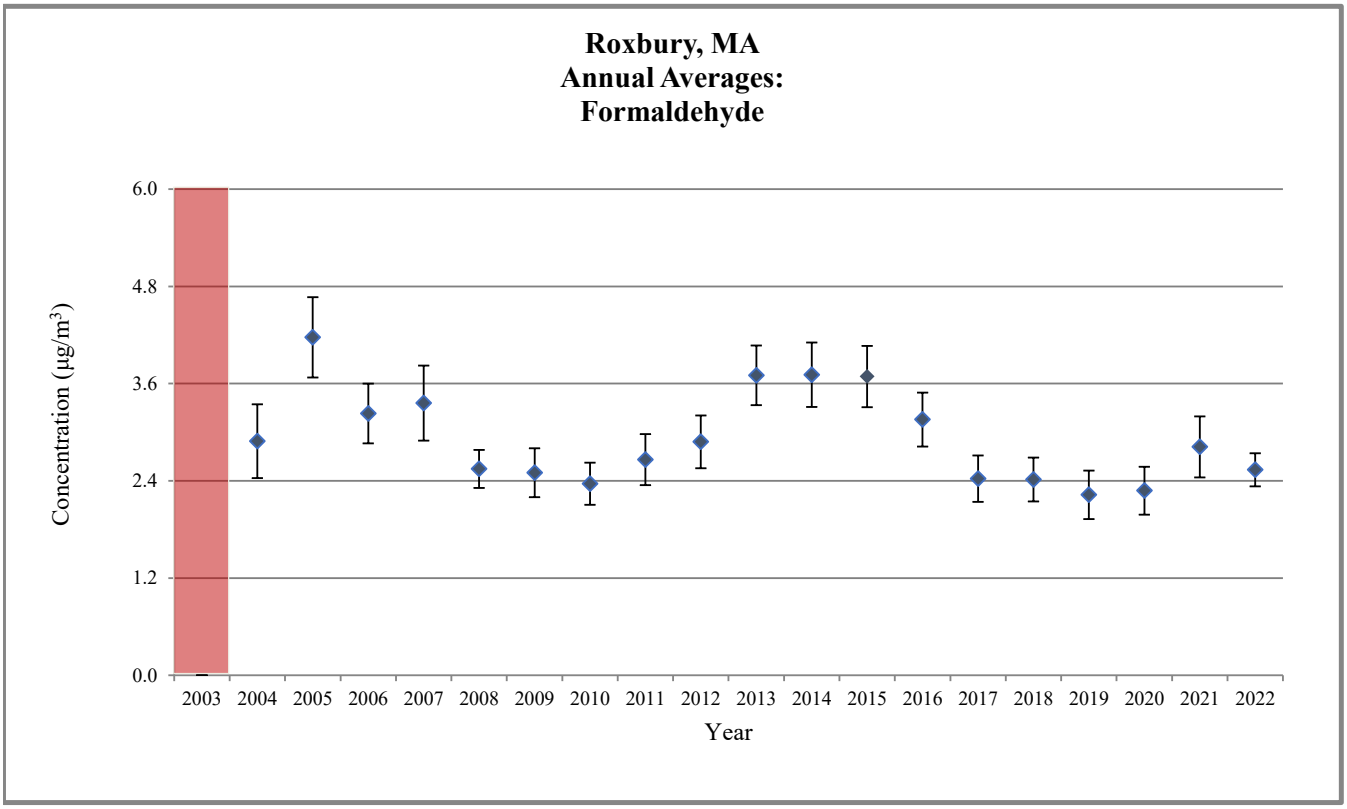




Sampling began midway through the year.
Does not meet MQO

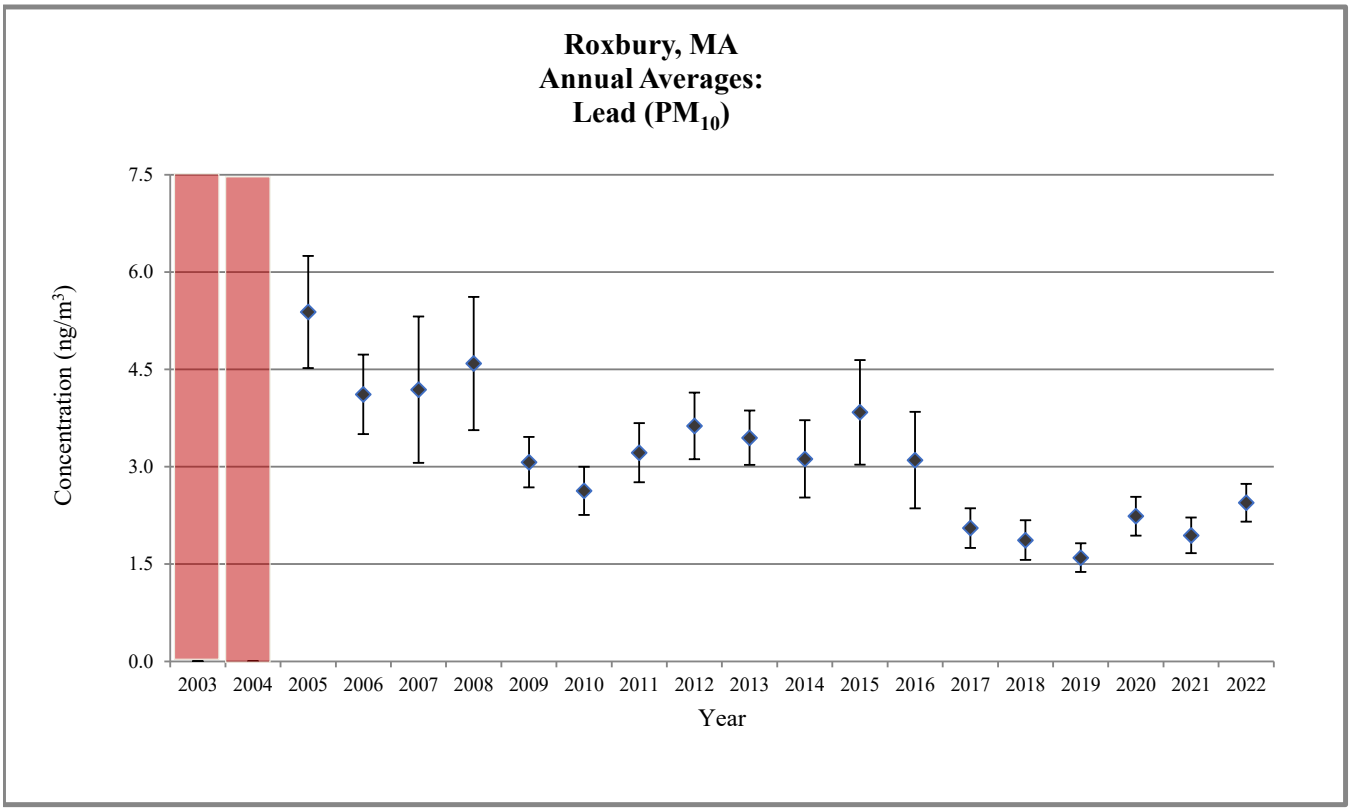
Figure 3. Roxbury, MA Annual Average Concentrations

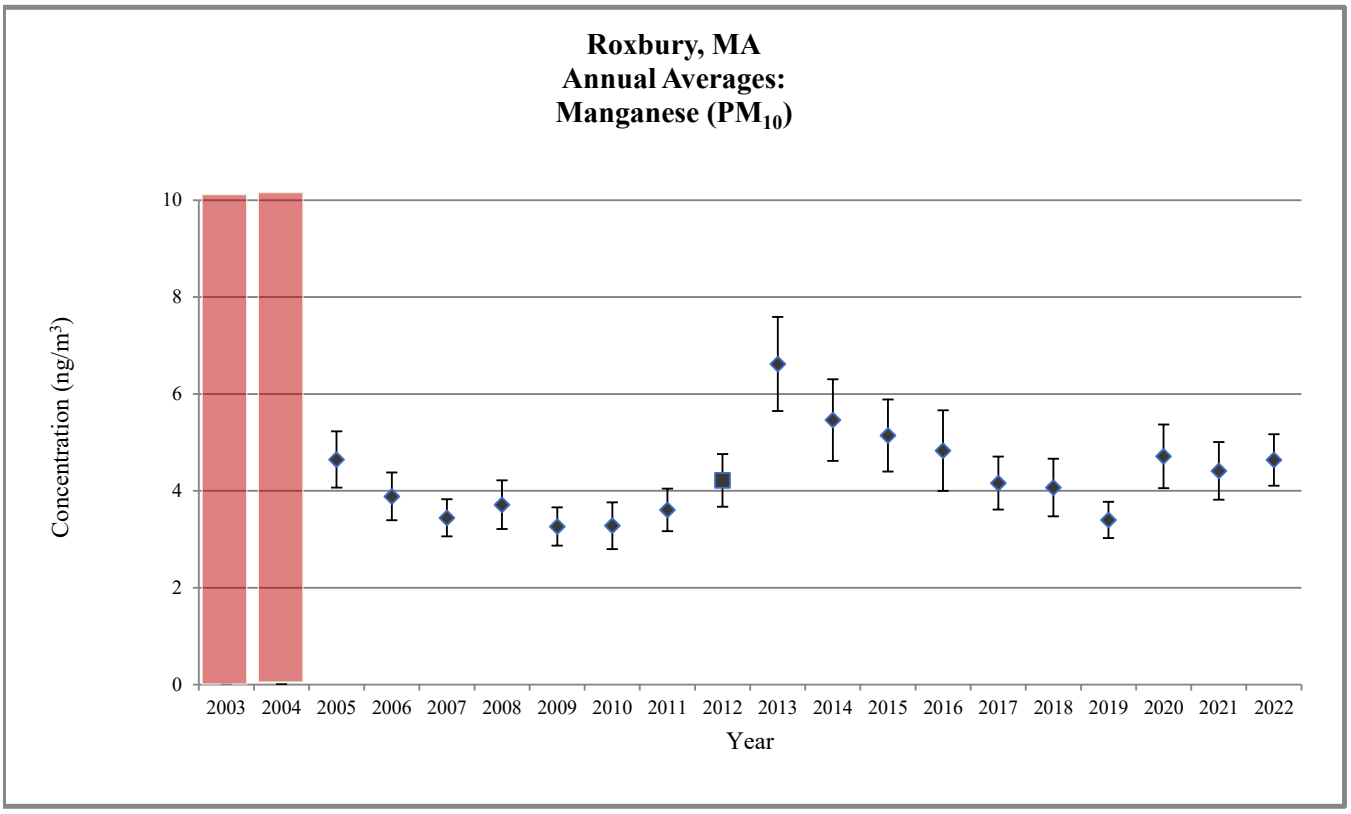




Sampling began midway through the year.
Does not meet MQO

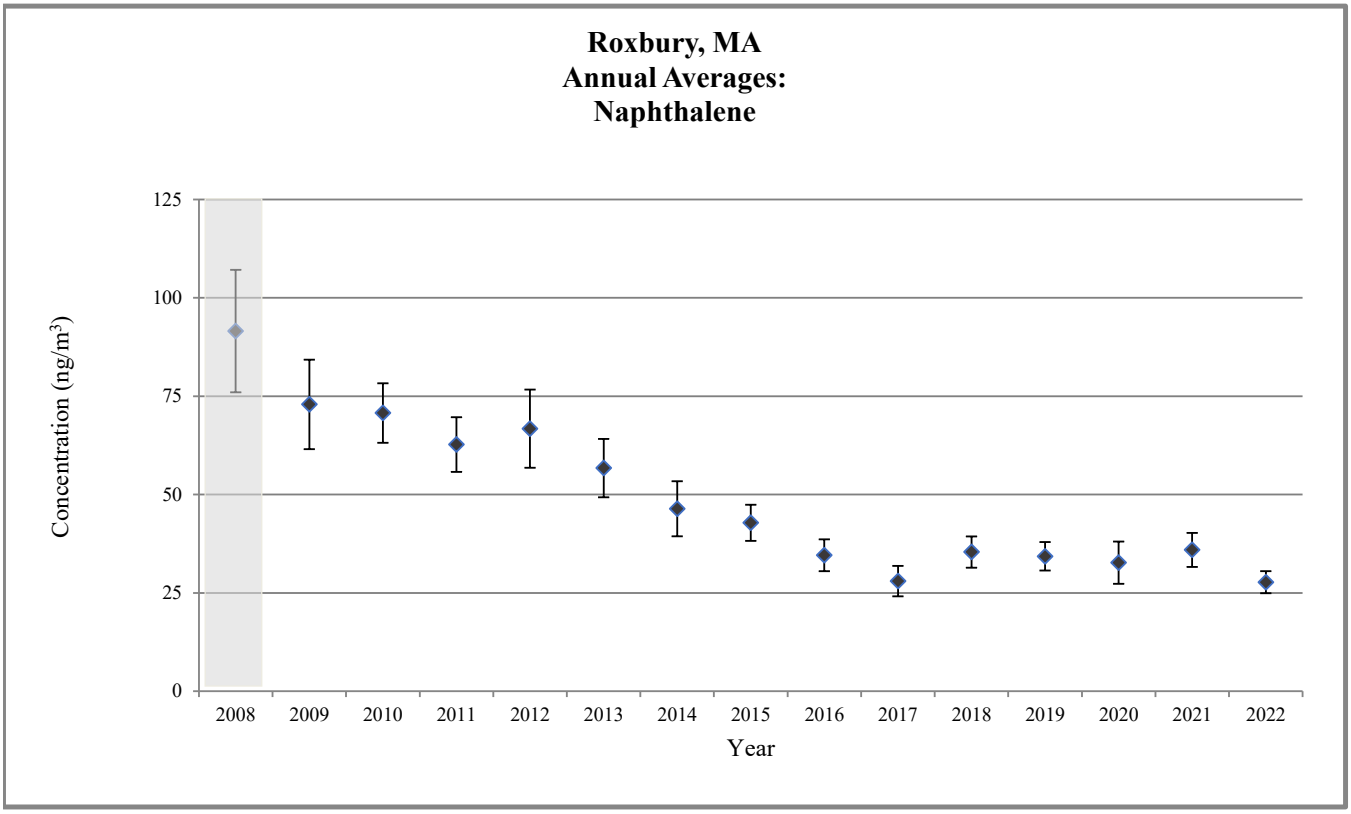
Figure 3. Roxbury, MA Annual Average Concentrations

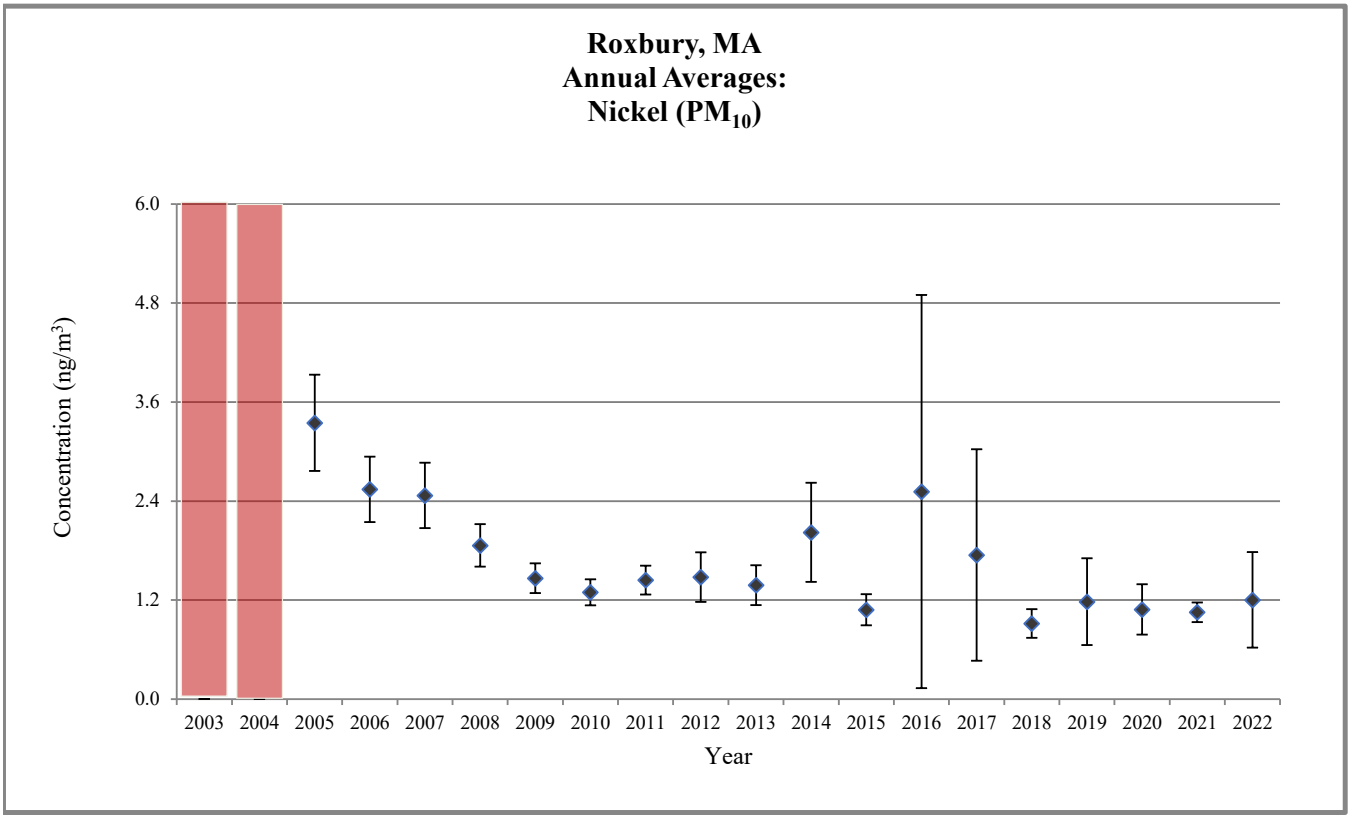




Sampling began midway through the year.
Does not meet MQO

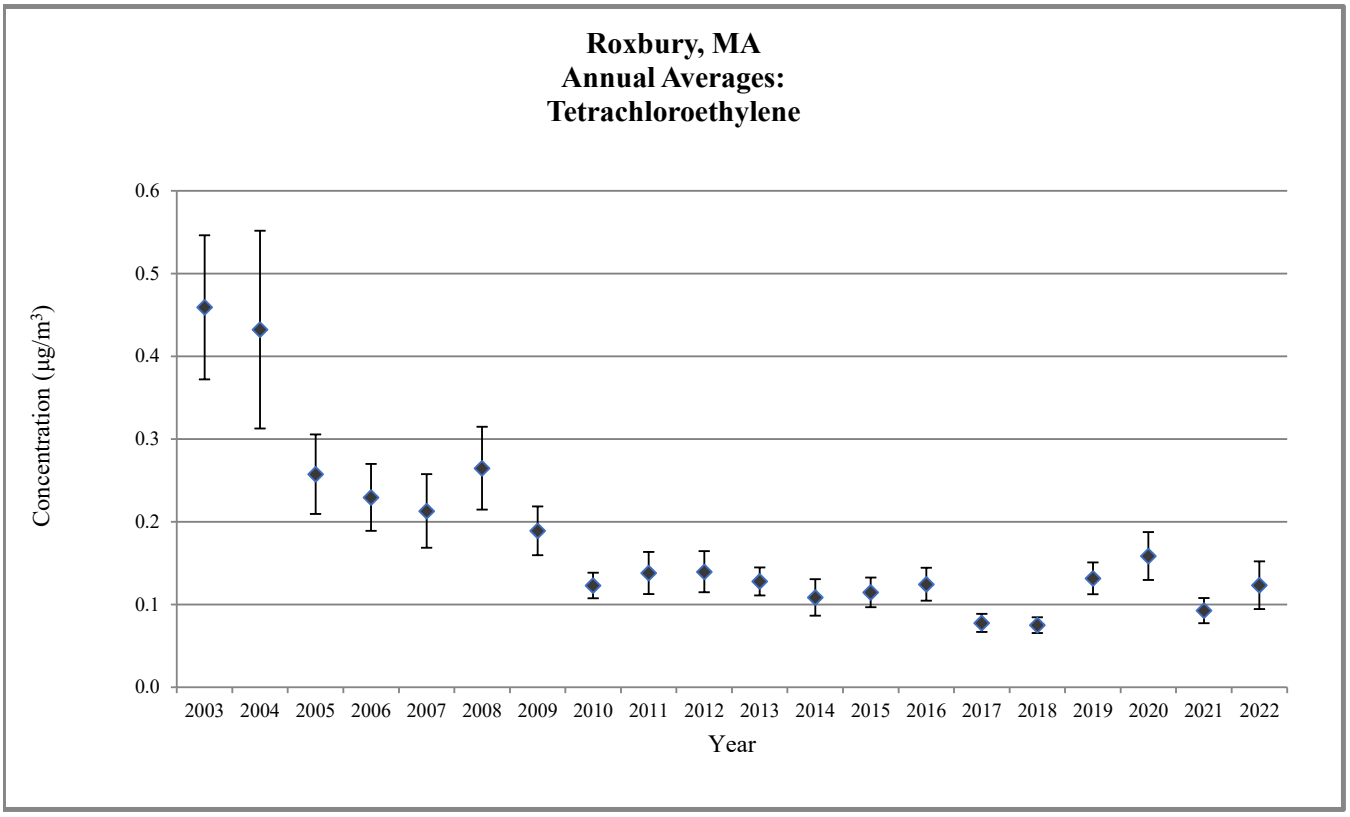
Figure 3. Roxbury, MA Annual Average Concentrations

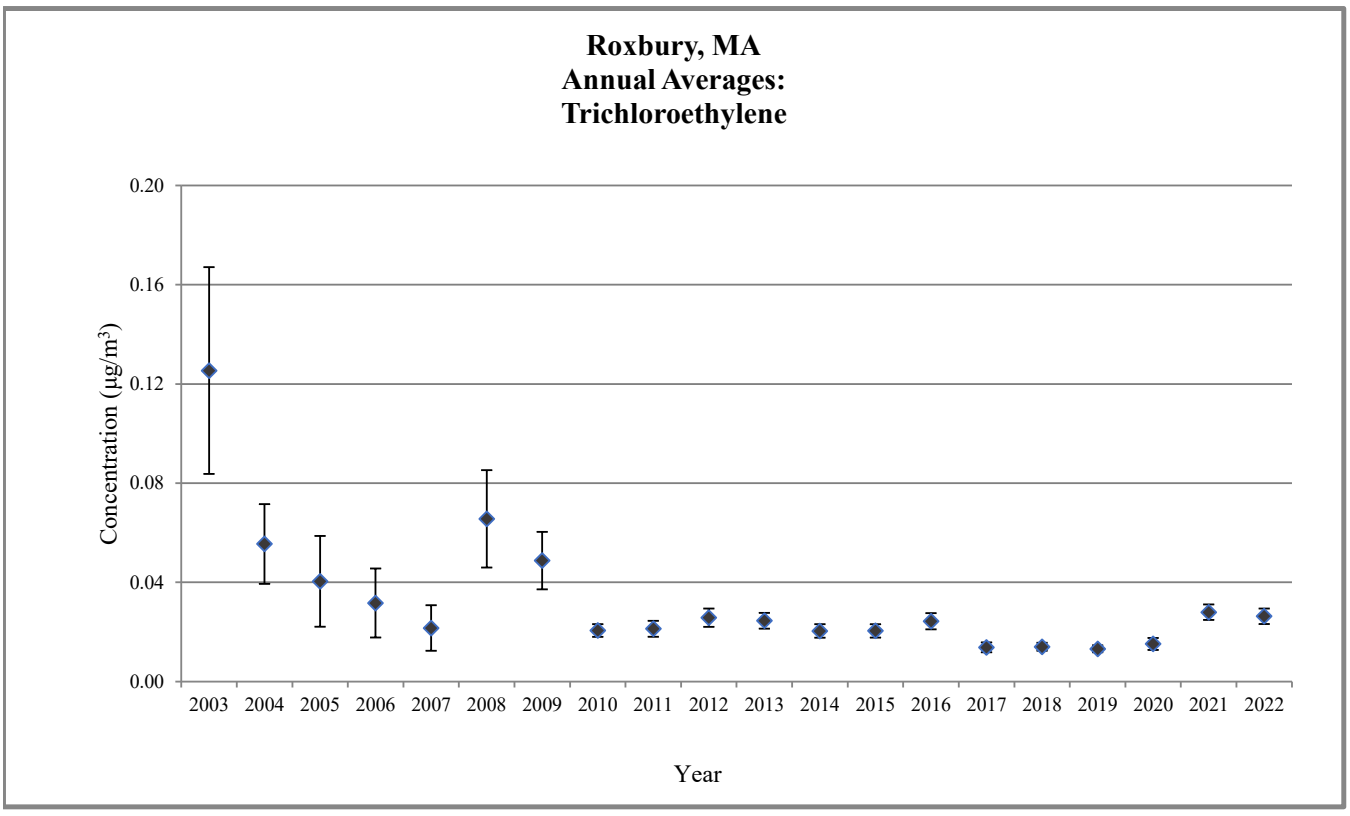




Sampling began midway through the year.
Does not meet MQO

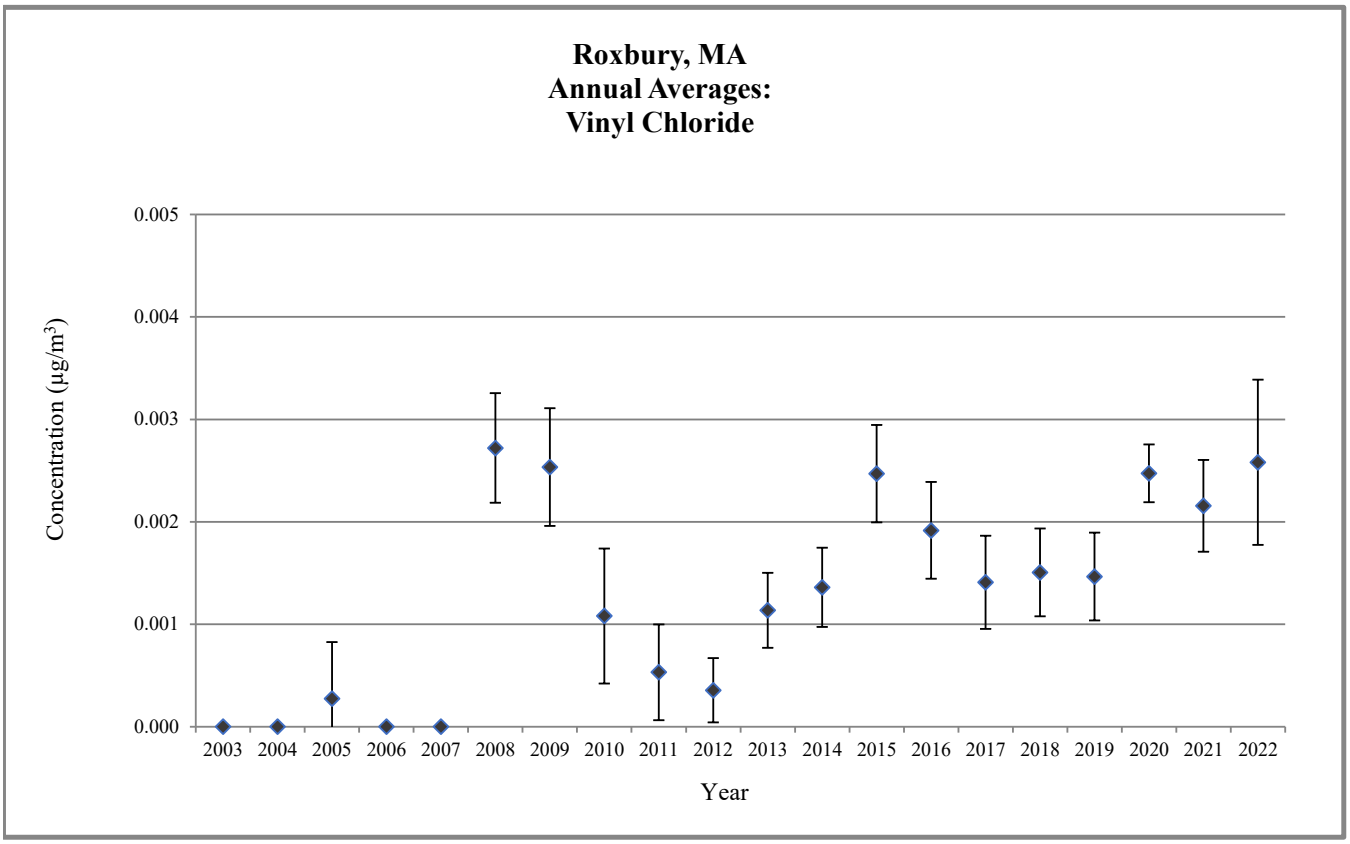
Figure 3. Roxbury, MA Annual Average Concentrations





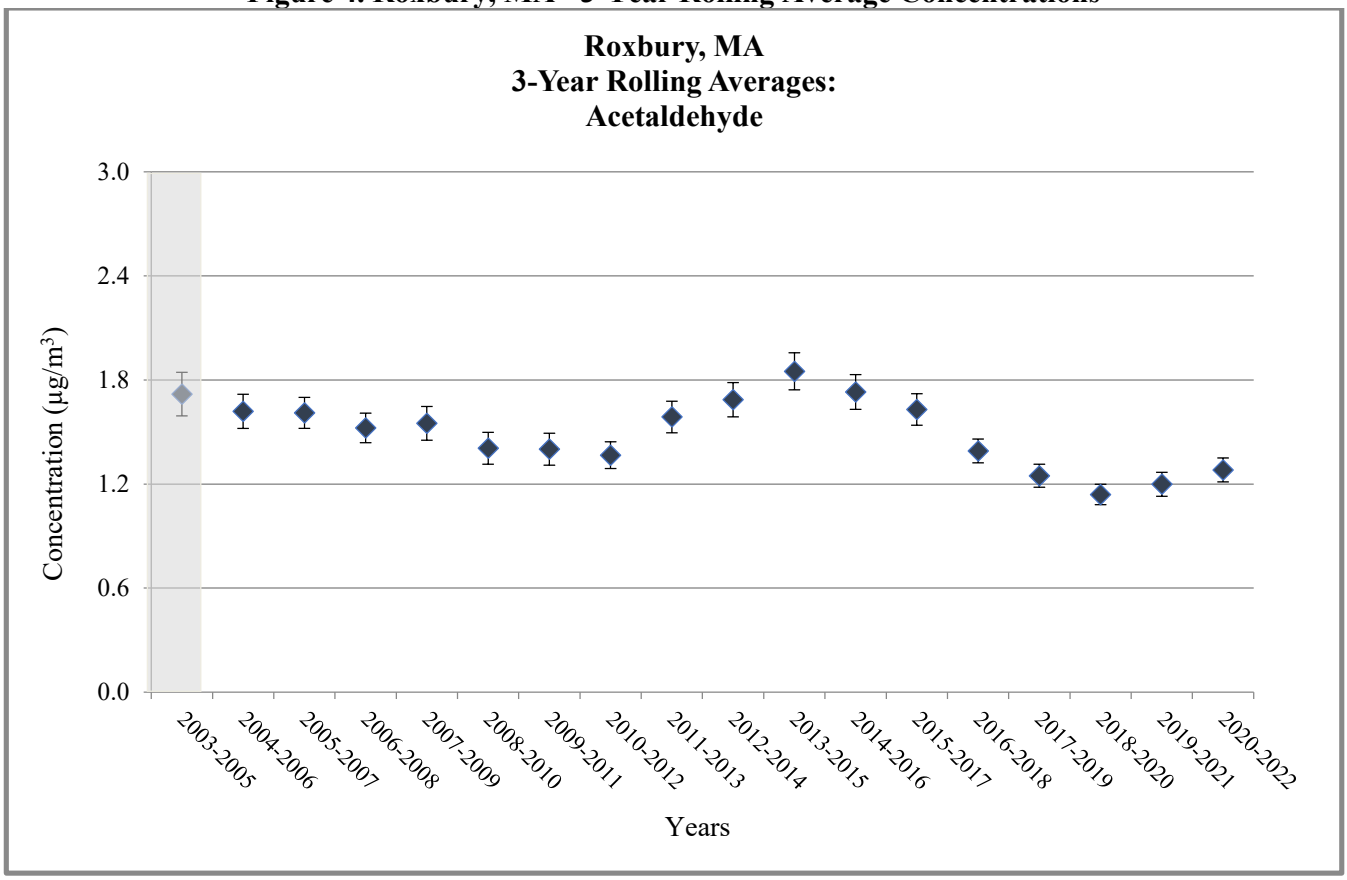
Sampling began midway through the year.
Does not meet MQO

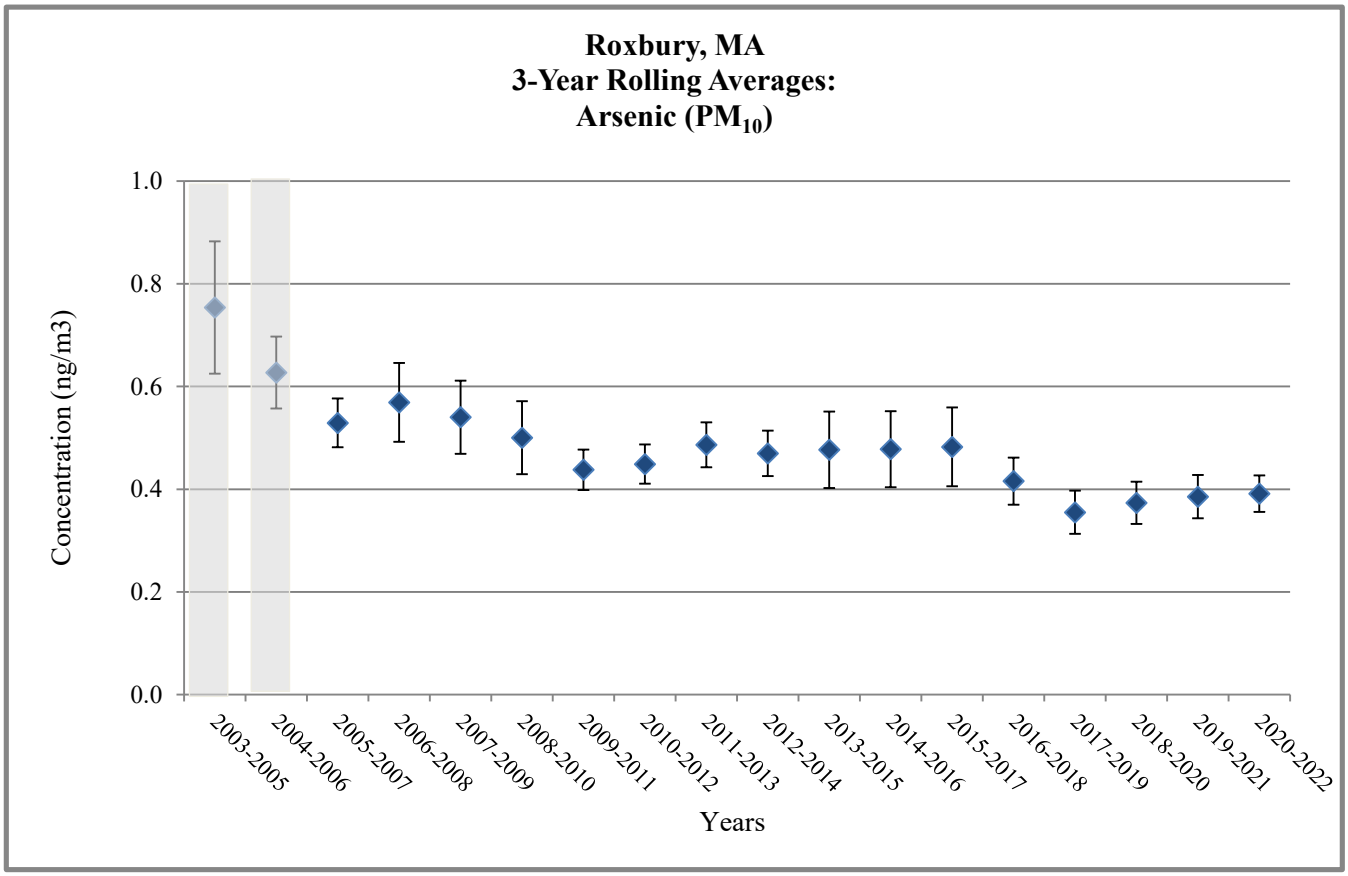
Figure 3. Roxbury, MA Annual Average Concentrations



Sampling began midway through the year.
Does not meet MQO

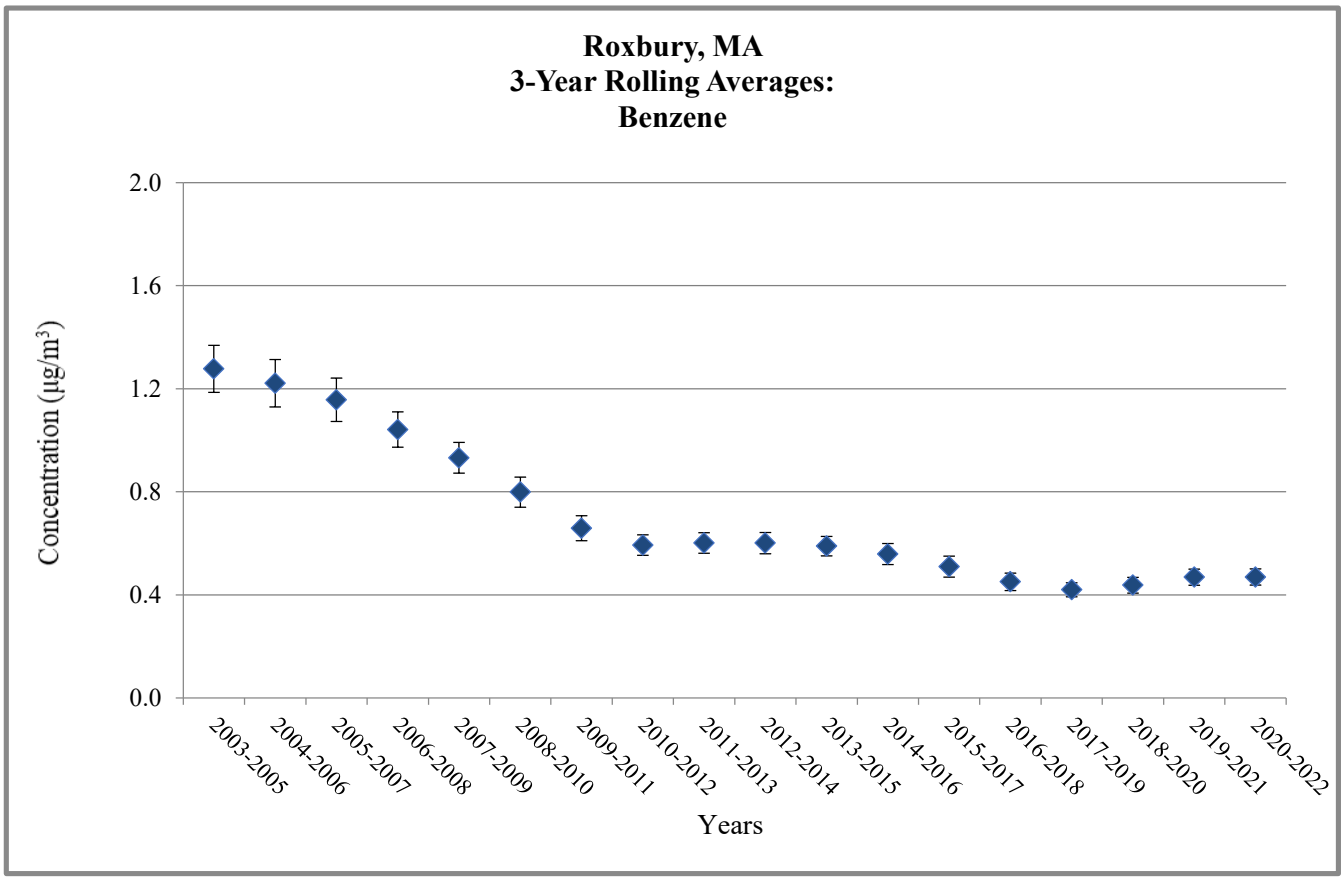
Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations

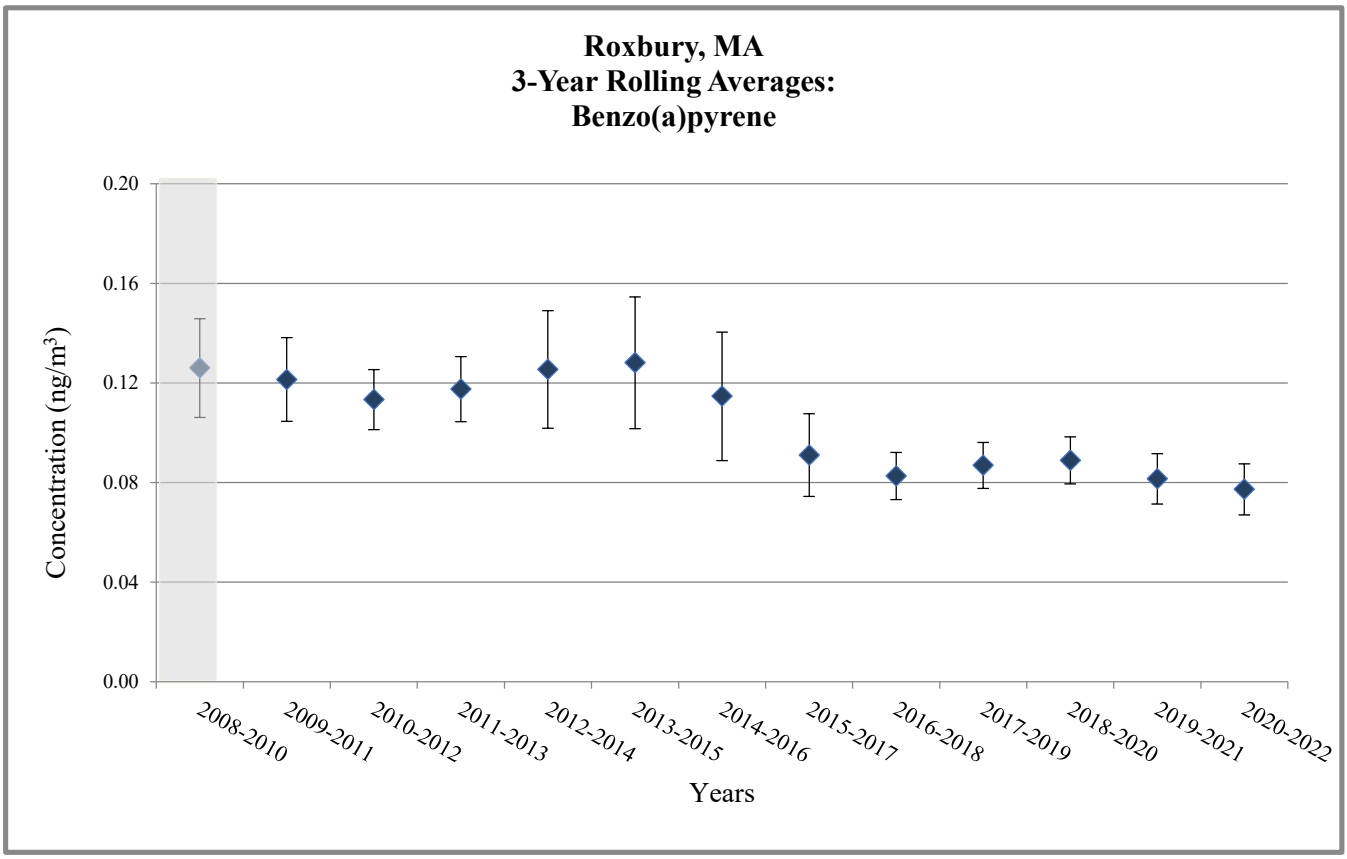




Does not meet MQO or wasn't able to collect enough samples

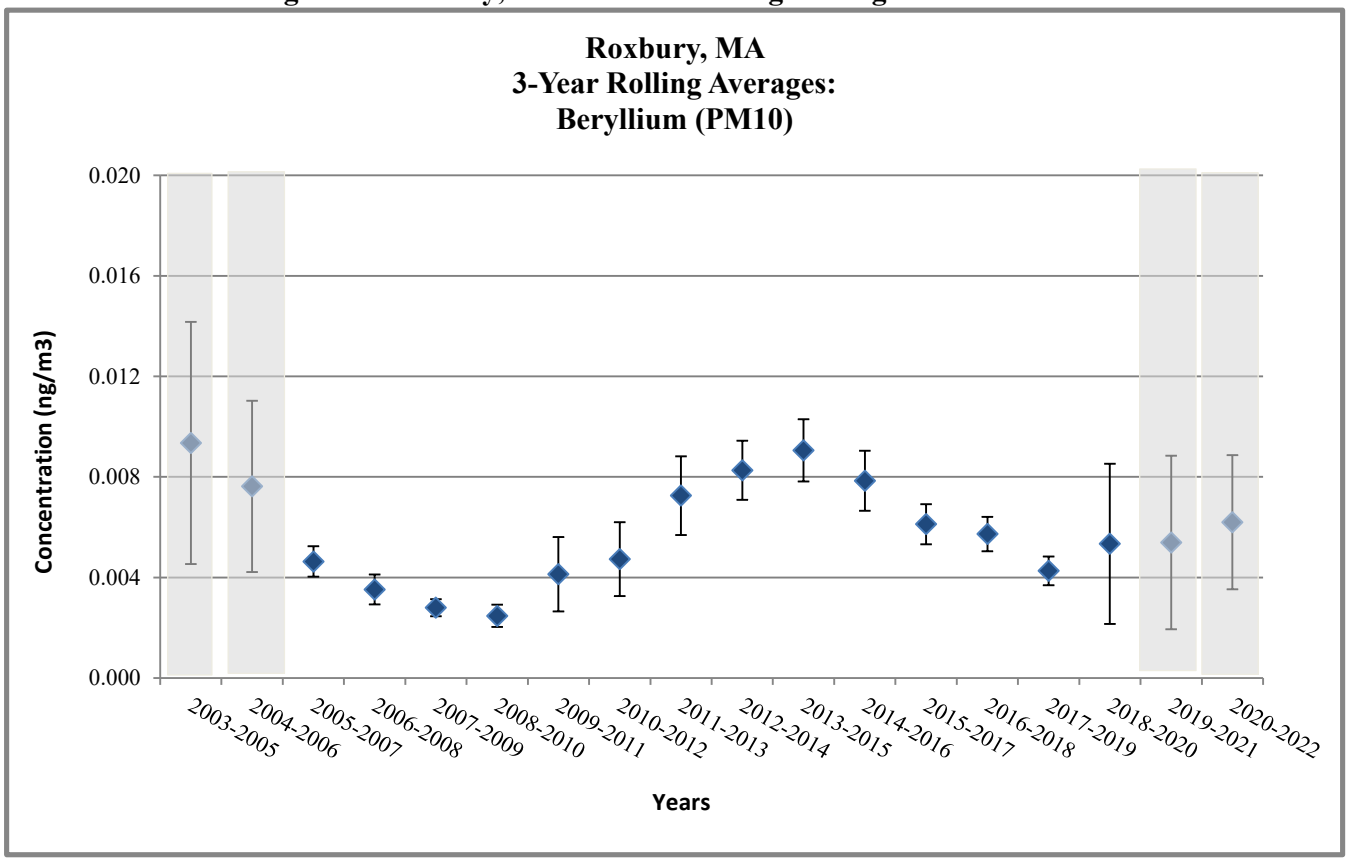
Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations

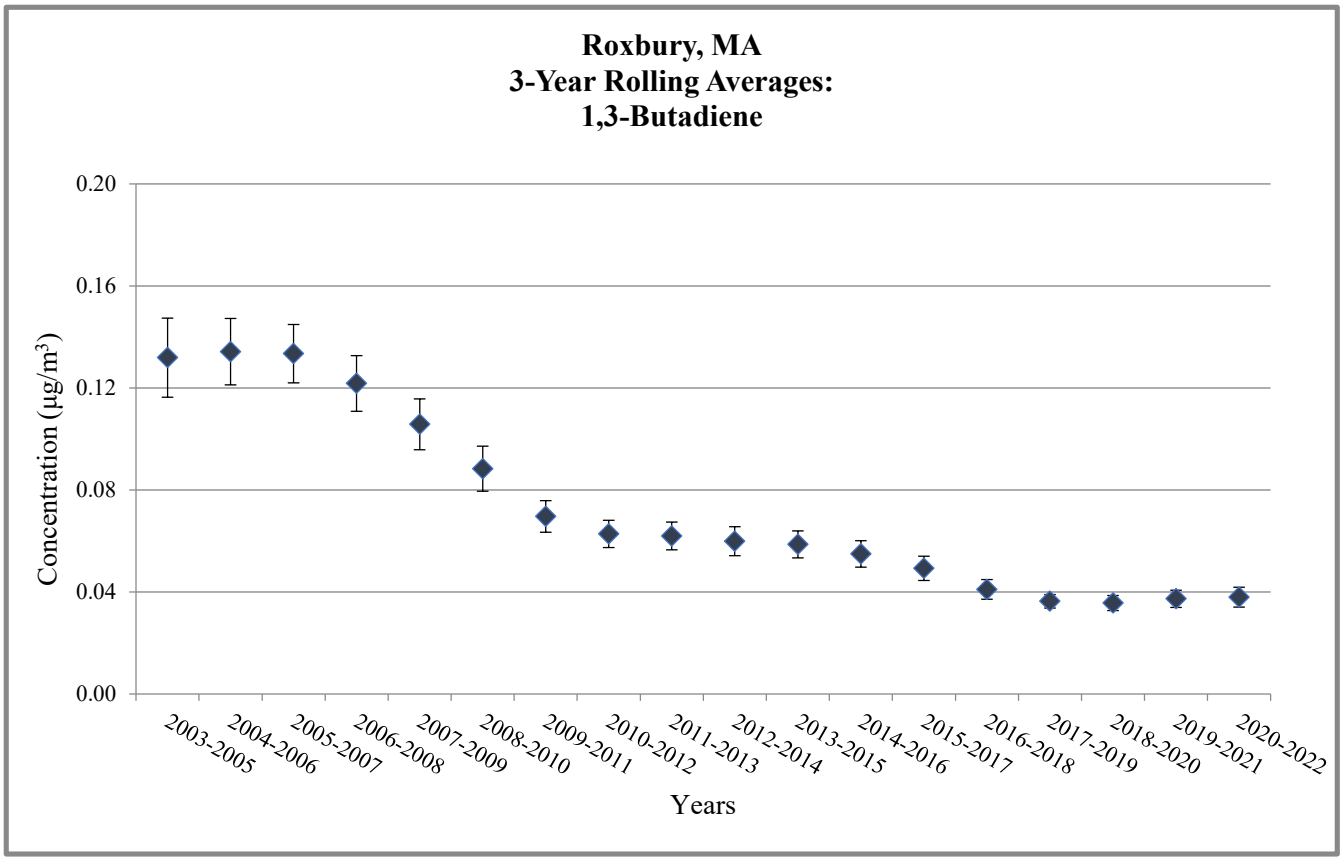




Does not meet MQO or wasn't able to collect enough samples

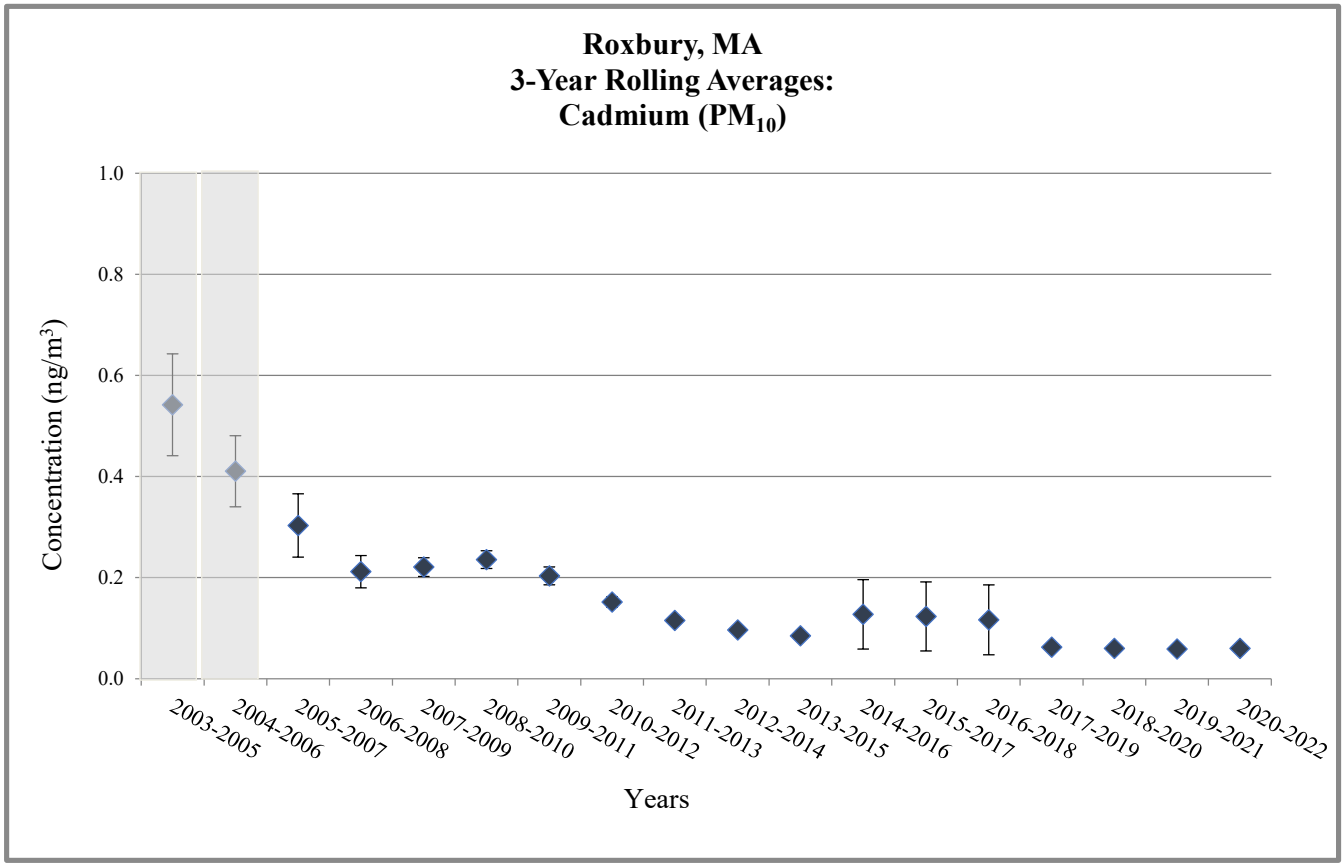
Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations

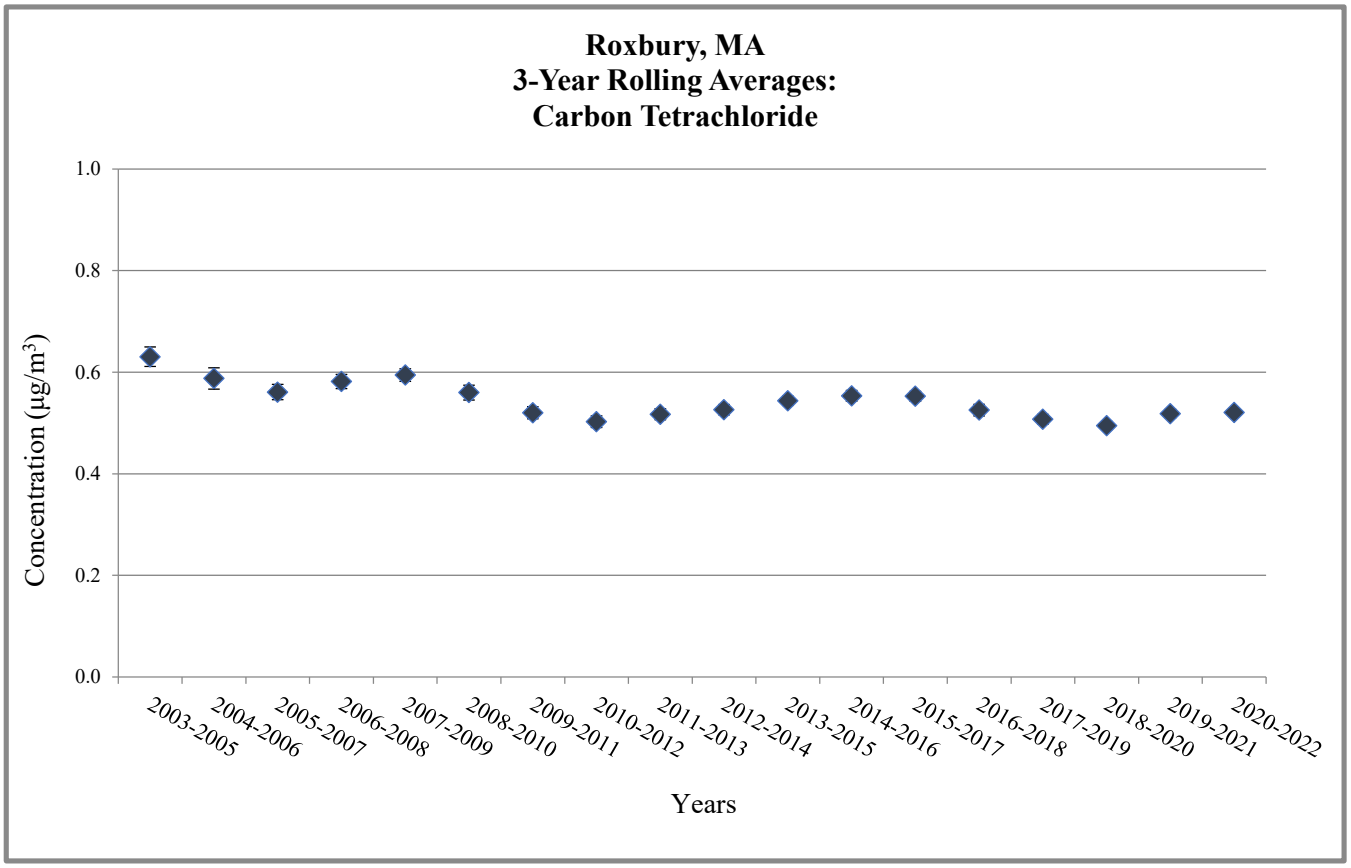




Does not meet MQO or wasn't able to collect enough samples

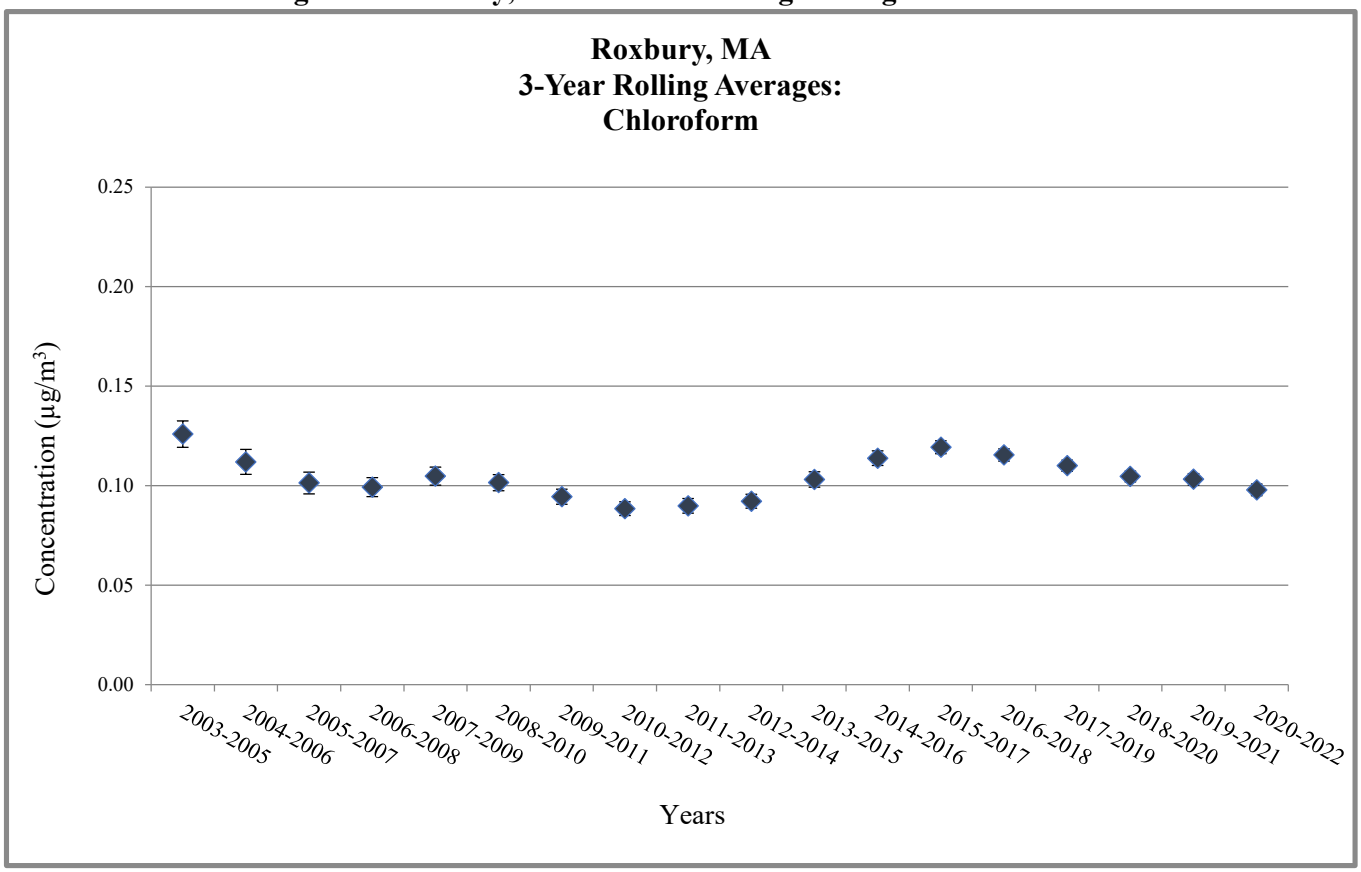
Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations

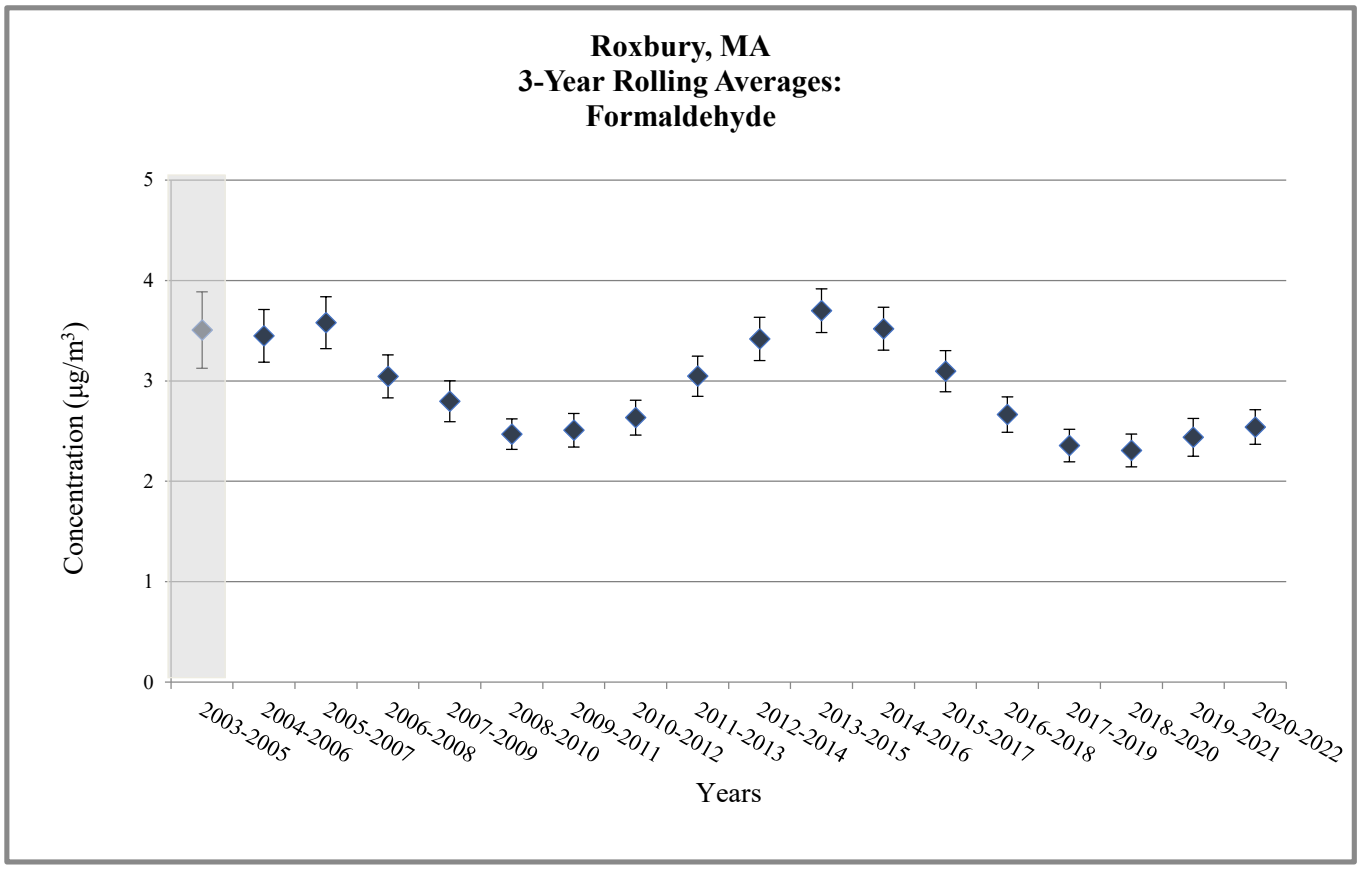




Does not meet MQO or wasn't able to collect enough samples

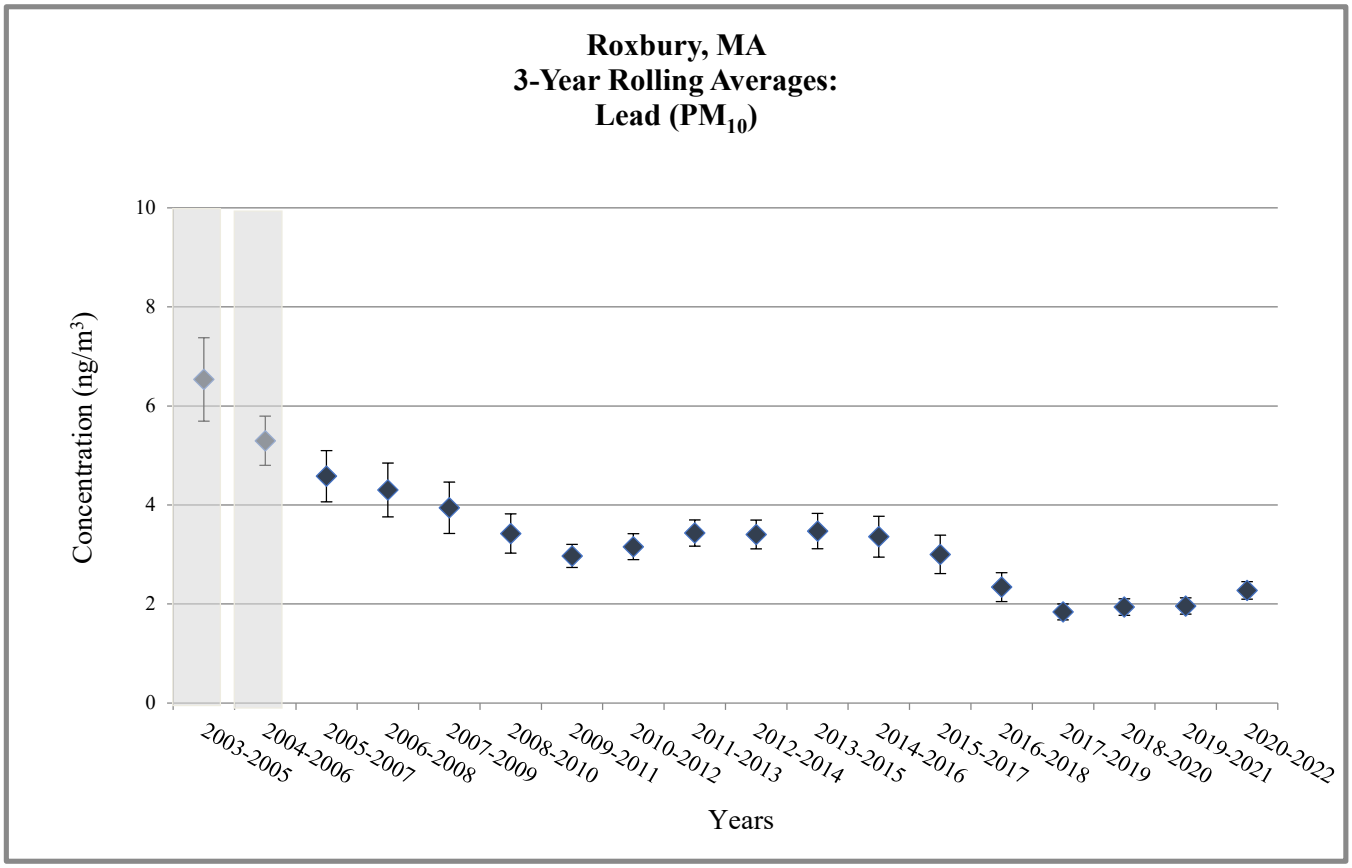
Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations

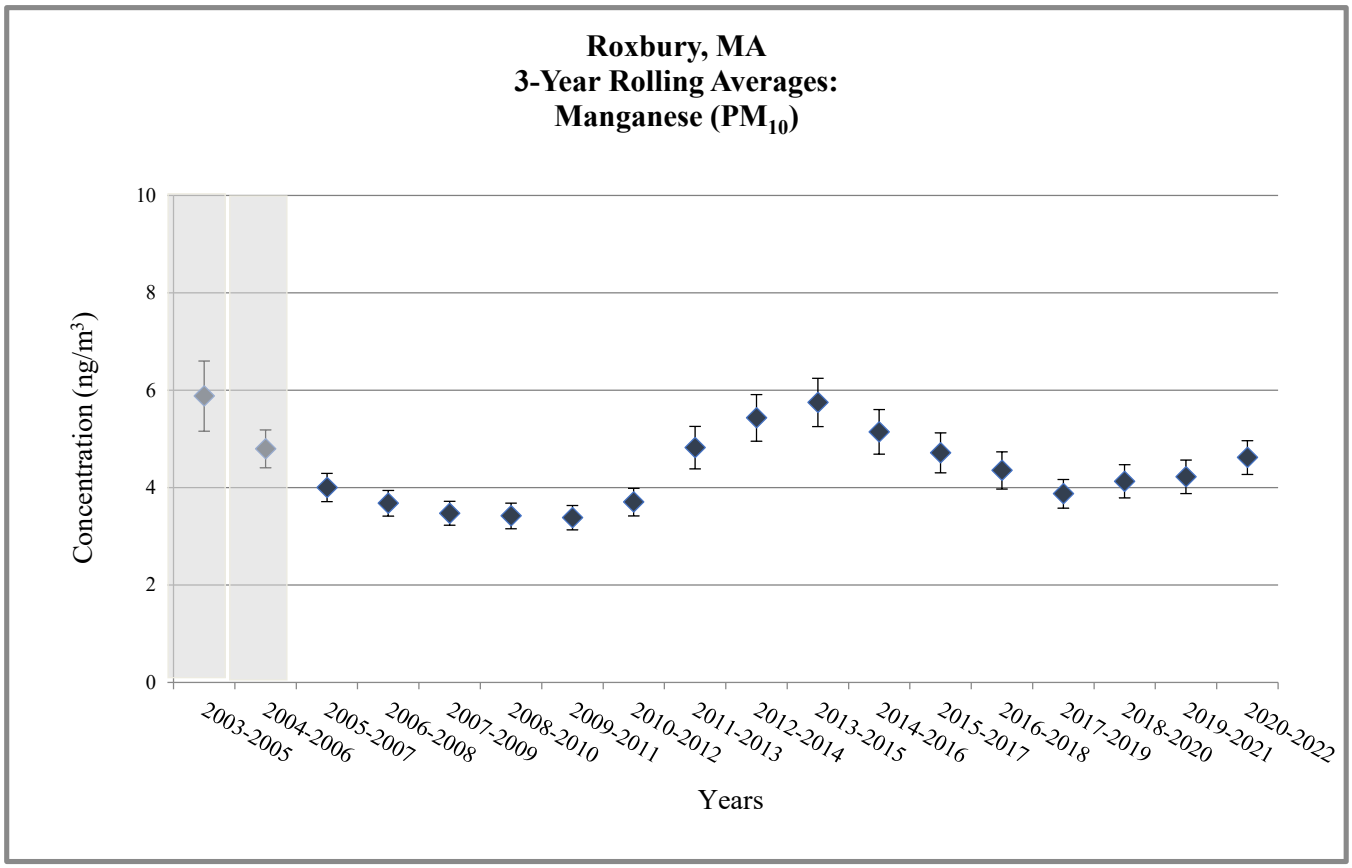




Does not meet MQO or wasn't able to collect enough samples

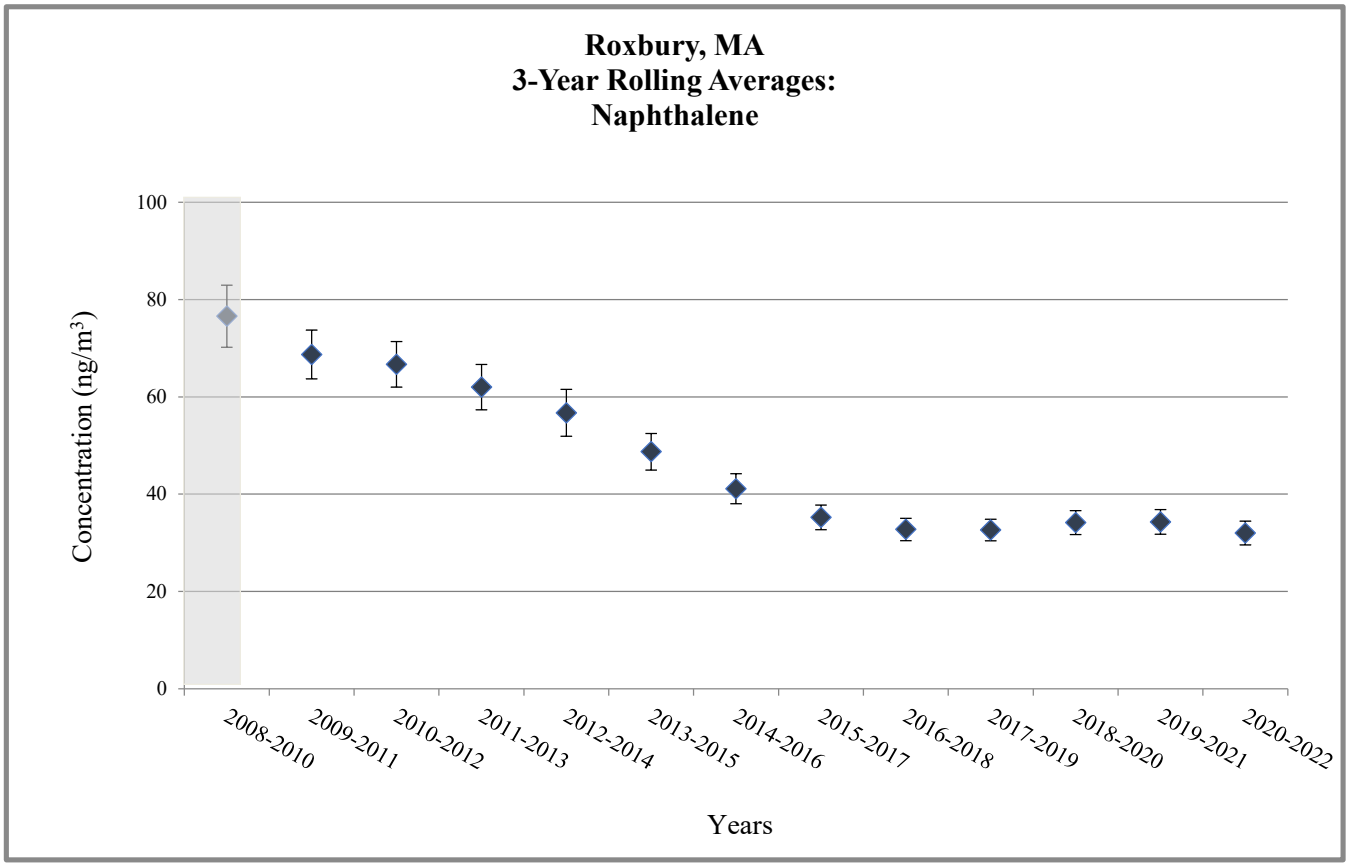
Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations

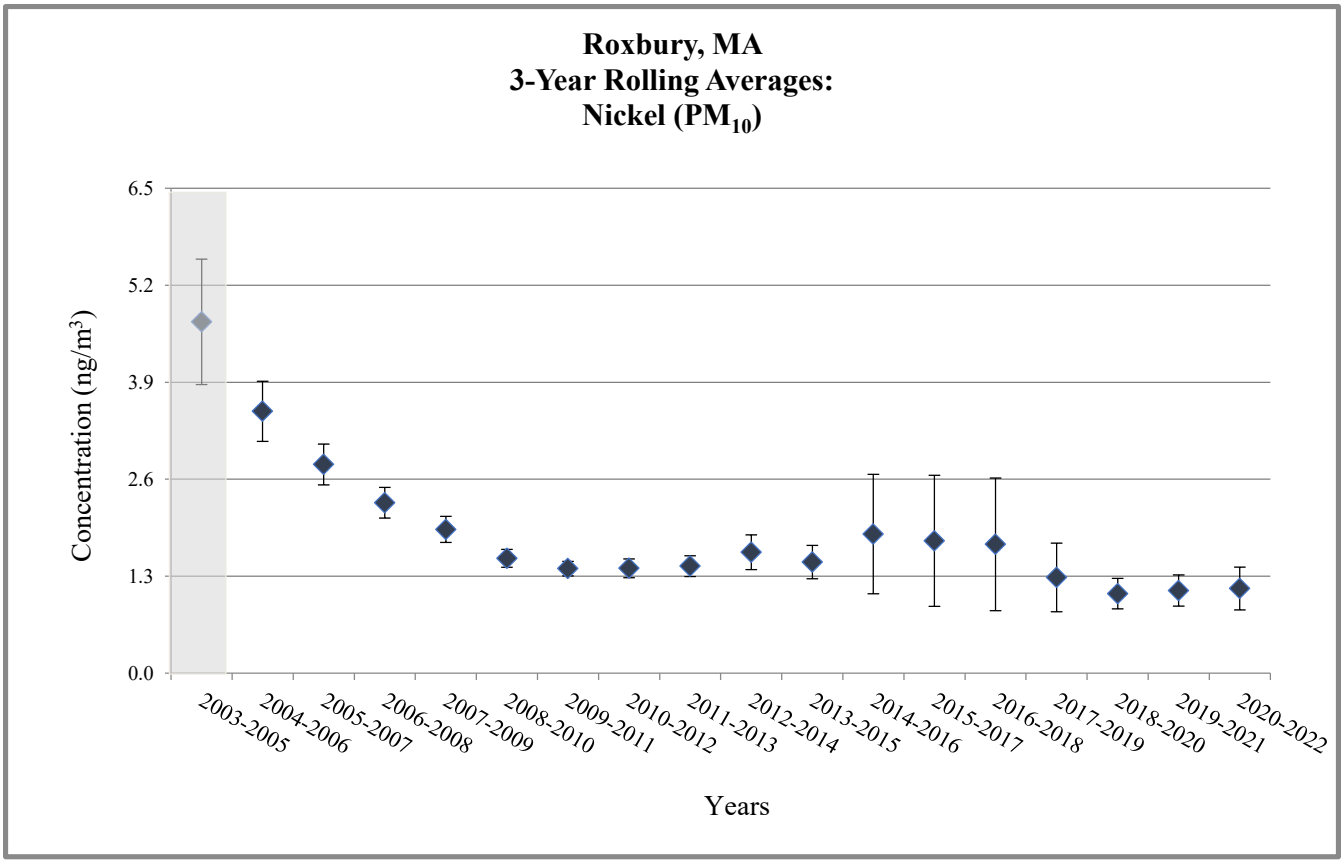




Does not meet MQO or wasn't able to collect enough samples

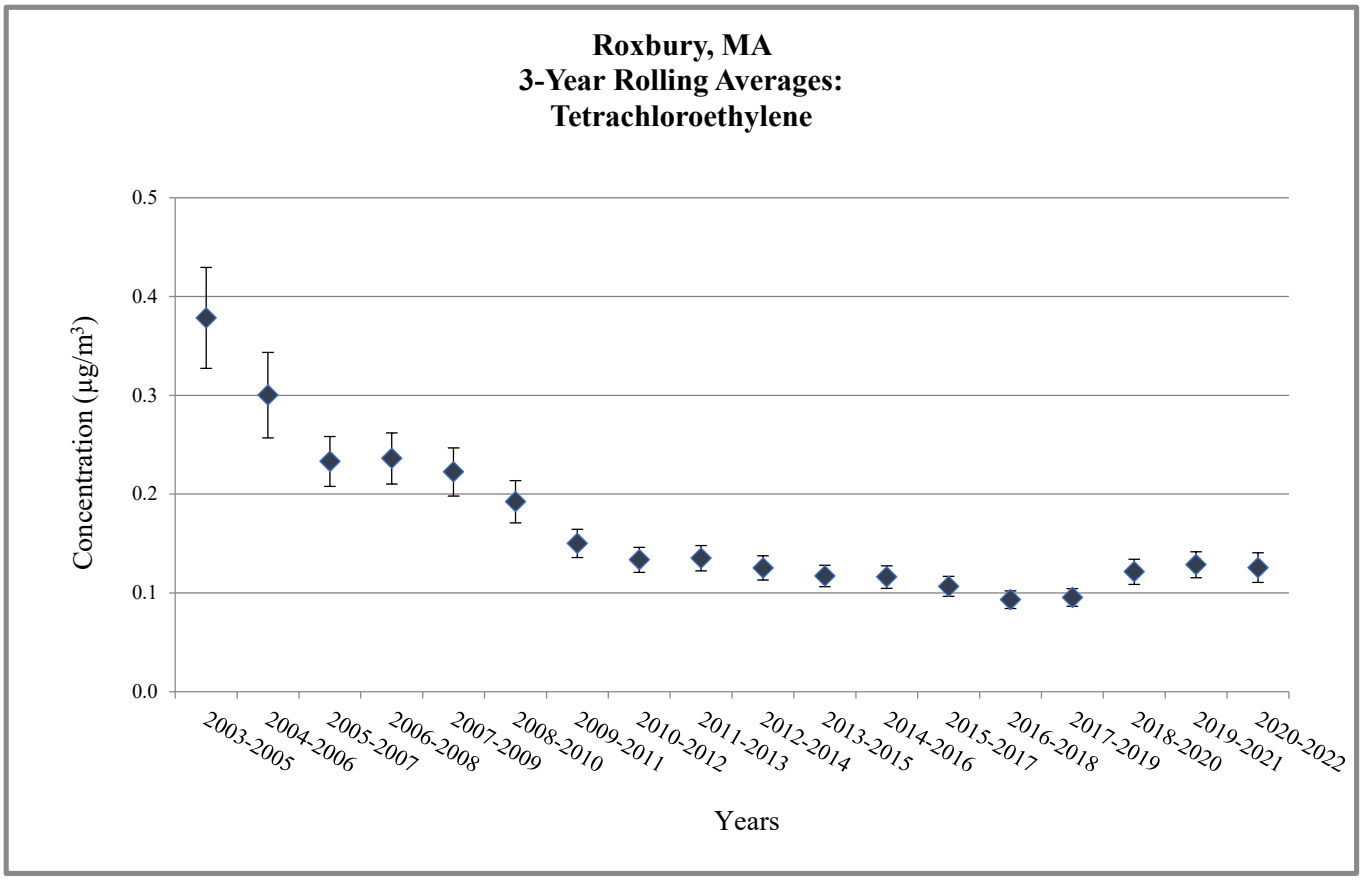
Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations

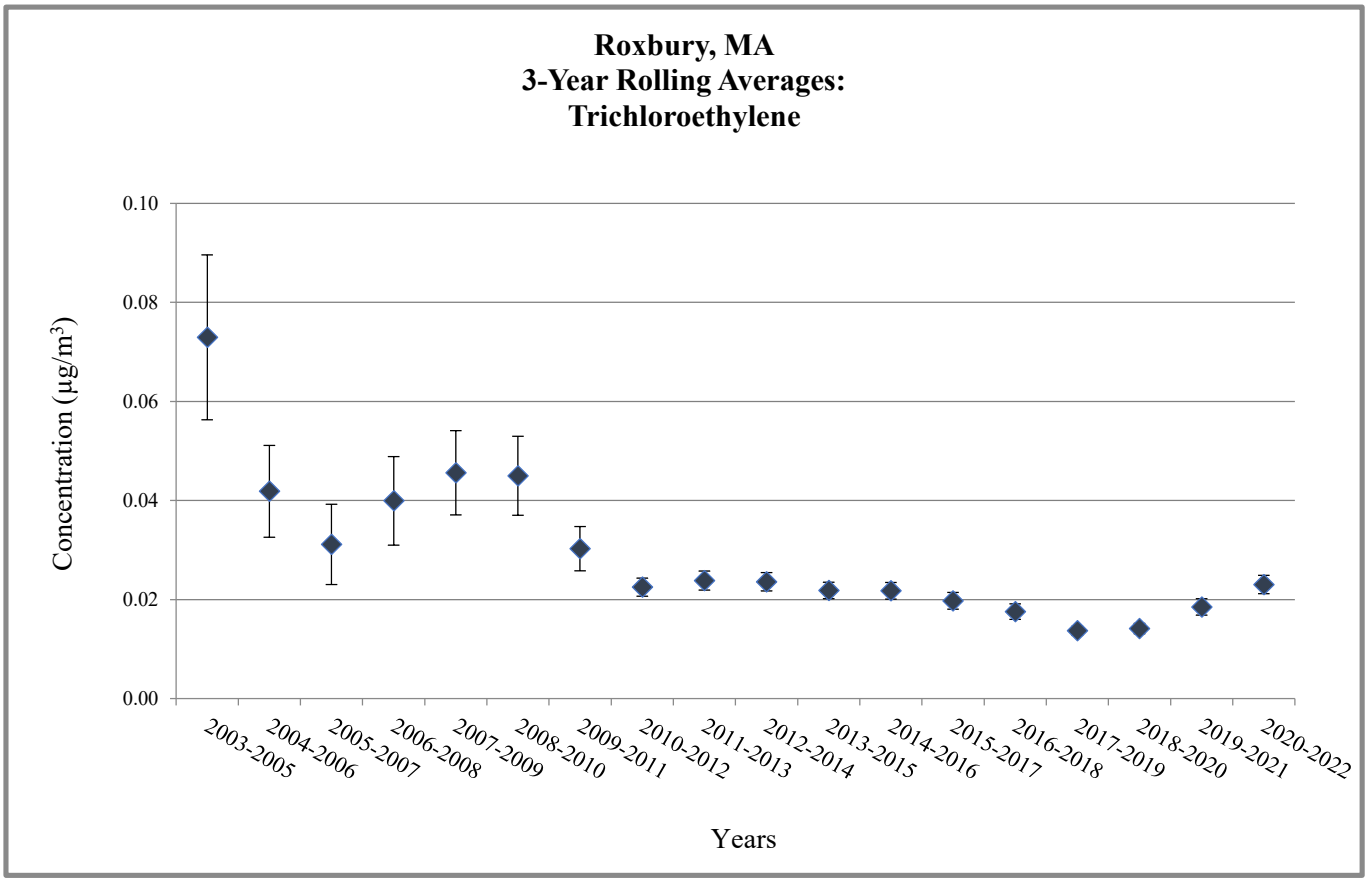




Does not meet MQO or wasn't able to collect enough samples

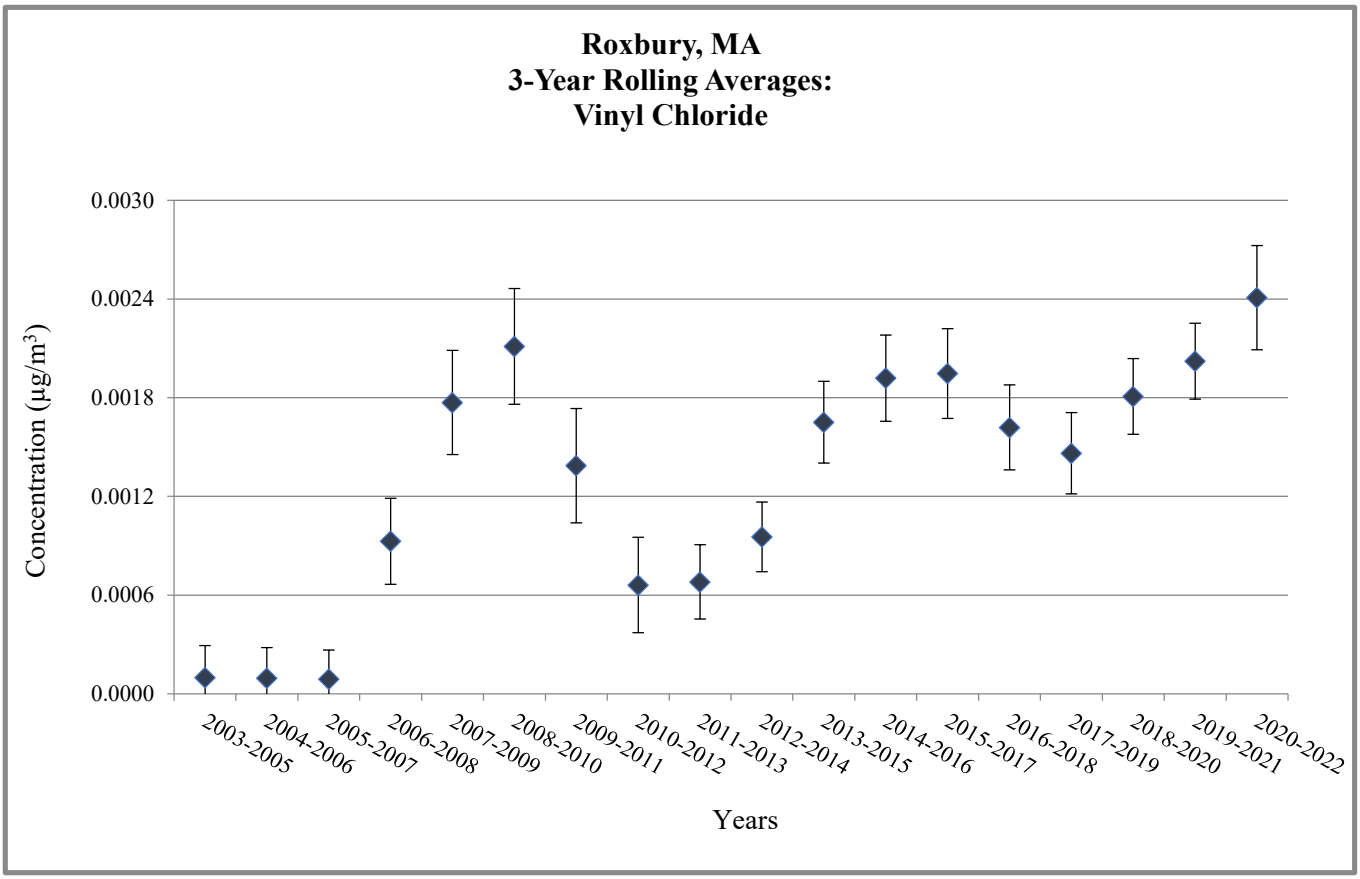
Figure 4. Roxbury, MA - 3-Year Rolling Average Concentrations





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

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



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

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

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Roxbury, MA (AQS Site Code: 25-025-0042)																	
2003	85	85	85	85	85	85	85	58	58	--a	--a	--a	--a	--a	--a	--	--
2004	82	82	82	82	82	82	82	84	84	74	74	74	74	74	74	--	--
2005	93	93	93	93	93	93	93	97	95	100	100	100	100	100	100	--	--
2006	97	97	97	97	97	97	97	100	100	92	92	92	92	92	92	--	--
2007	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	--	--
2008	100	100	100	100	100	100	100	97	98	98	98	98	98	98	98	--a	--a
2009	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	97	97
2010	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	98	98
2011	98	98	98	98	98	98	98	100	100	98	98	98	98	98	98	100	100
2012	95	95	95	95	95	95	95	84	98	100	100	100	100	100	100	97	97
2013	100	100	100	100	100	100	100	77	84	100	100	100	100	100	100	100	100
2014	100	95	100	95	97	95	95	100	100	95	95	95	95	95	95	93	93
2015	98	98	98	98	98	98	98	100	100	100	100	100	100	100	100	100	100
2016	100	100	100	100	100	100	100	95	97	95	95	95	95	95	95	100	100
2017	89	89	89	89	89	89	89	95	95	97	97	97	97	97	97	93	93
2018	98	98	98	98	98	98	98	100	100	95	95	95	95	95	95	100	100
2019	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	97	97
2020	95	95	95	95	95	95	95	100	100	133	133	133	133	133	133	90	90
2021	89	89	89	89	89	89	89	97	97	82	72	82	82	82	82	92	92
2022	93	93	93	93	93	93	93	100	100	189	189	189	189	189	189	97	97

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

[a]: Scheduled sampling began midway through the year, thus, the site did not have the opportunity to collect enough samples to meet the 85% MQO.

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

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Roxbury, MA (AQS Site Code: 25-025-0042)																	
2003	0.25	0.44	1.85	0.29	0.80	0.21	0.46	--a	--a	2.76	0.03	0.06	0.01	0.15	0.03	--	--
2004	0.11	0.28	0.34	0.06	0.21	0.10	0.22	0.16	0.05	0.09	0.06	0.04	0.10	0.04	0.10	--	--
2005	0.30	0.32	1.47	0.20	0.71	0.22	0.55	0.16	0.06	0.07	0.05	0.03	0.00	0.03	0.08	--	--
2006	0.22	0.27	0.59	0.15	1.06	0.26	0.37	0.08	0.04	0.096	0.060	0.034	0.0045	0.025	0.088	--	--
2007	0.09	0.16	0.08	0.03	0.12	0.04	0.15	0.08	0.04	0.04	0.05	0.01	0.001	0.00	0.04	--	--
2008	0.09	0.16	0.08	0.03	0.12	0.04	0.15	0.08	0.05	0.04	0.03	0.01	0.001	0.00	0.04	0.08	0.016
2009	0.17	0.14	0.32	0.07	0.35	0.09	0.20	0.24	0.08	0.04	0.00	0.05	0.004	0.01	0.06	0.06	0.008
2010	0.17	0.13	0.30	0.08	0.36	0.10	0.19	0.24	0.08	0.05	0.00	0.13	0.053	0.07	0.77	0.04	0.037
2011	0.25	0.18	0.30	0.06	0.40	0.10	0.14	0.12	0.08	0.22	0.01	0.01	0.006	0.02	0.17	0.04	0.003
2012	0.25	0.18	0.30	0.06	0.40	0.10	0.14	0.12	0.11	0.26	0.01	0.01	0.008	0.07	0.21	0.05	0.005
2013	0.42	0.15	0.44	0.11	0.64	0.32	0.21	0.12	0.88	0.77	0.04	0.02	0.006	0.02	0.11	0.05	0.007
2014	0.05	0.07	0.07	0.02	0.12	0.05	0.05	0.34	0.88	0.84	0.04	0.02	0.002	0.02	0.08	0.03	0.012
2015	0.07	0.09	0.07	0.03	0.12	0.05	0.07	0.34	0.88	0.06	0.002	0.013	0.002	0.02	0.10	0.13	0.005
2016	0.07	0.02	0.04	0.02	0.08	0.05	0.02	0.12	0.88	0.15	0.002	0.003	0.002	0.02	0.09	0.06	0.023
2017	0.12	0.02	0.04	0.02	0.08	0.05	0.02	0.12	1.04	0.14	0.002	0.003	0.002	0.02	0.10	0.02	0.059
2018	0.12	0.02	0.04	0.02	0.08	0.05	0.02	0.12	1.04	0.14	0.003	0.008	0.004	0.03	0.50	0.01	0.053
2019	0.22	0.13	0.26	0.08	0.32	0.16	0.14	0.12	1.04	0.13	0.006	0.024	0.004	0.06	0.29	0.01	0.034
2020	0.20	0.13	0.22	0.05	0.32	0.16	0.07	0.06	0.52	0.13	0.006	0.008	0.004	0.06	0.28	0.01	0.031
2021	0.10	0.11	0.22	0.03	0.20	0.16	0.07	0.12	0.71	0.13	0.008	0.008	0.004	0.06	0.28	0.01	0.025
2022	0.10	0.11	0.04	0.03	0.20	0.16	0.09	0.09	0.66	0.10	0.008	0.013	0.004	0.06	0.13	0.01	0.026

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.

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

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Roxbury, MA (AQS Site Code: 25-025-0042)																	
2004	6.0	21.5	32.9	7.3	4.1	11.6	-3.5	4.7	8.7	-11.3	20.0	--a	--a	--a	--a	--	--
2005	6.6	-1.9	3.3	-3.4	-10.7	-6.2	-19.2	8.0	5.7	8.1	13.6	-1.1	-1.9	-2.8	-12.9	--	--
2006	1.7	-2.8	-3.6	-5.4	-12.7	-2.4	-12.4	0.2	-3.5	5.2	6.4	-0.2	-2.4	-10.2	-6.3	--	--
2007	-3.0	-3.7	0.6	-7.5	-3.9	-3.4	3.1	-8.9	-6.7	11.5	18.9	5.3	-1.5	-13.8	-8.5	--	--
2008	1.5	-1.4	24.2	-2.9	7.6	4.2	2.8	2.9	12.0	8.4	4.8	5.1	4.7	-25.3	8.6	--b	--b
2009	0.4	-11.9	-9.2	-3.4	-9.7	-13.7	-10.3	-10.9	-9.6	-14.8	-5.5	-16.2	-30.6	-37.7	-28.9	-1.7	-7.7
2010	-8.8	3.7	-2.0	-7.2	-8.6	-12.8	-11.8	-9.0	-8.2	7.3	11.2	4.9	-3.5	0.6	4.7	-2.3	-17.1
2011	15.4	1.9	-3.6	-10.7	0.4	-11.9	-7.0	-7.6	-8.4	1.4	-8.2	-5.7	-6.3	-3.8	-6.8	-2.1	-13.9
2012	--b	--b	--b	--b	--b	--b	--b	--b	--b	15.7	17.5	16.6	19.9	21.5	11.4	25.2	21.4
2013	9.2	4.9	-7.8	-9.1	-0.2	2.2	-11.0	-6.1	-0.7	-3.0	-2.0	1.4	0.1	-6.2	-1.2	-5.7	25.5
2014	0.6	-4.5	-3.0	-2.2	3.3	2.8	0.7	1.4	-1.9	1.9	--c	--c	2.2	13.2	--d	-16.3	0.7
2015	-4.3	4.4	15.7	-0.6	-0.7	2.2	-1.5	--b	--b	--b	--b	--b	--b	--b	--b	-14.2	-11.4
2016	-10.9	-6.9	10.5	-0.3	-9.7	-10.9	-5.4	-4.8	-12.6	-2.3	-0.4	3.9	-1.6	3.9	26.5	-10.5	-9.5
2017	-12.0	-19.0	-1.0	4.1	-15.5	-10.1	-5.3	-14.3	-11.2	-1.4	3.7	2.8	-0.4	1.3	21.2	-22.4	-11.6
2018	-7.6	-2.5	-7.3	-6.9	-10.5	-11.4	-16.0	-23.3	-13.8	-3.4	0.5	3.0	-1.9	2.6	10.6	-14.8	-20.7
2019	-2.8	2.2	3.7	0.8	-5.5	0.5	-3.8	-2.0	3.6	3.4	6.9	4.6	3.2	6.5	1.6	29.3	18.5
2020	-12.8	8.6	4.5	4.7	-6.1	4.1	4.5	3.3	7.2	4.4	-0.2	4.6	-3.5	2.2	5.1	13.1	15.8
2021	16.4	5.5	9.1	-0.2	-4.2	-1.3	5.9	-11.7	-8.7	6.8	2.7	7.7	0.0	5.8	3.1	0.1	-2.0
2022	5.7	8.9	5.7	1.2	1.9	-8.6	6.4	-31.7	-9.7	--b	--b	--b	--b	--b	--b	--b	--b

A-rated:±25%

B-rated: Between 25% to 35% or between -25% to -35%

Does not meet:>35% or <35%

-- No data available

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

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

[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 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

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Roxbury, MA (AQS Site Code: 25-025-0042)																	
2003	--	--	--	--	--	--	--	--	--	15.8	16.5	45.8	3.7	7.2	27.3	--	--
2004	9.2	60.9	4.6	5.6	11.9	6.5	--a	--	--	25.4	--a	36.2	10.9	19.3	17.4	--	--
2005	5.5	26.4	4.8	7.8	10.8	18.4	--a	--	--	6.3	--a	49.6	8.6	6.9	8.4	--	--
2006	2.7	11.7	3.4	5.2	4.7	--a	--a	--	--	13.8	--a	35.8	15.0	15.3	15.3	--	--
2007	4.5	36.6	2.5	6.3	12.2	--a	--a	21.9	11.5	4.1	--a	18.0	8.3	5.7	13.8	--	--
2008	6.0	29.3	2.3	7.5	10.4	32.5	--a	13.4	7.0	2.5	--a	16.4	7.8	6.7	4.3	--	--
2009	4.8	27.3	3.2	3.6	5.3	7.7	--a	28.5	7.5	3.0	14.7	27.9	5.9	5.9	8.7	--	--
2010	6.3	29.6	4.5	5.7	7.4	--a	--a	10.9	8.0	3.0	24.2	23.3	5.0	2.4	3.5	--	--
2011	3.4	23.7	2.9	4.9	3.5	6.7	--a	13.2	12.5	4.1	18.0	18.1	6.4	3.7	4.9	--	--
2012	10.1	21.0	2.7	16.0	25.8	5.2	--a	5.9	8.8	3.0	12.0	27.9	3.8	2.4	8.0	--	--
2013	2.2	13.7	1.7	3.0	3.6	--a	--a	7.5	7.0	21.4	20.0	20.0	3.9	3.5	30.2	--	--
2014	6.1	20.0	9.1	1.7	3.3	13.3	--a	6.7	6.0	27.0	18.5	27.3	5.9	4.7	32.7	--	--
2015	7.6	13.6	1.6	2.5	4.6	7.1	--a	6.8	4.1	25.0	23.7	16.2	13.9	14.3	36.7	--	--
2016	6.0	16.4	4.1	4.7	4.3	9.8	17.8	25.1	9.4	10.5	20.2	20.7	5.6	7.1	50.0	--	--
2017	5.3	17.8	3.3	4.9	11.1	8.8	16.7	8.1	5.8	6.7	15.7	17.5	9.7	9.1	32.1	--	--
2018	4.6	12.9	4.3	4.1	7.1	14.5	0.0	15.2	6.2	10.0	9.3	16.0	3.5	7.6	2.8	--	--
2019	5.9	8.9	5.1	5.8	9.1	--a	--a	13.2	7.4	6.5	12.4	14.0	4.3	5.7	19.3	--	--
2020	10.6	18.0	3.8	3.7	6.3	9.3	--a	5.7	10.5	4.0	18.7	23.4	7.1	6.0	42.8	--	--
2021	7.5	32.0	3.5	3.2	5.1	8.1	--a	6.2	7.6	7.7	18.1	23.4	15.3	7.9	36.9	--	--
2022	7.0	26.1	1.0	4.3	6.8	5.1	--a	8.0	6.7	15.9	10.5	28.4	22.2	22.4	40.8	--	--

Green = precision ≤ 15%

Yellow = precision > 15% to ≤ 25%

Red = precision > 25%

-- Gray = dataset was not rated

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

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

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Roxbury, MA (AQS Site Code: 25-025-0042)																	
2003	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2007	--	--	--	--	--	--	--	--	--	4.6	--a	1.8	1.7	2.1	2.8	--	--
2008	--	--	--	--	--	--	--	--	--	0.7	--a	0.7	1.9	2.9	0.7	--	--
2009	--	--	--	--	--	--	--	--	--	1.1	12.5	12.4	0.5	1.1	1.2	--	--
2010	--	--	--	--	--	--	--	--	--	2.3	16.1	6.3	1.3	1.2	0.7	--	--
2011	--	--	--	--	--	--	--	--	--	1.6	14.8	7.3	0.9	1.2	1.9	--	--
2012	--b	--b	--b	--b	--b	--b	--b	--b	--b	2.2	6.6	5.5	1.1	1.7	4.3	1.9	3.5
2013	--b	--b	--b	--b	--b	--b	--b	--b	--b	20.3	15.1	7.7	0.8	0.9	2.1	3.8	4.2
2014	--b	--b	--b	--b	--b	--b	--b	--b	--b	17.5	31.8	7.6	5.0	1.5	6.4	4.2	4.1
2015	11.3	12.6	7.9	1.4	3.3	11.1	--a	2.0	1.8	23.6	11.3	14.0	10.7	2.7	22.1	1.3	0.8
2016	3.6	10.0	2.3	3.1	3.9	8.5	0.0	8.1	5.5	10.9	14.9	12.0	5.0	1.7	37.4	1.9	1.3
2017	4.0	16.7	4.0	3.6	4.7	14.7	33.3	7.1	7.7	2.2	11.9	3.3	1.2	0.6	1.2	1.7	1.4
2018	4.9	8.7	2.8	1.7	4.9	13.3	0.0	10.5	5.9	9.4	7.3	2.6	1.0	1.3	1.1	1.9	0.9
2019	5.9	6.6	4.2	5.1	6.1	--b	--b	4.6	2.1	3.4	7.2	1.0	0.4	1.1	0.6	1.6	1.0
2020	6.1	7.6	2.2	3.1	4.8	7.4	--a	6.0	4.1	1.9	7.6	3.5	0.7	0.9	1.0	2.8	0.7
2021	5.0	26.9	2.6	2.7	3.0	6.3	--a	4.0	3.5	2.3	1.4	3.9	1.1	2.1	1.7	3.0	1.2
2022	8.3	10.0	1.2	4.3	8.1	5.9	--a	1.5	3.1	3.4	8.4	2.8	1.1	1.4	1.1	1.3	0.1

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

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

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)
	2019	ATEC 2200-2C Toxic Air Sampler (Year Deployed: 2018/2019)
	2020	ATEC 2200-2C Toxic Air Sampler (Year Deployed: 2019)
	2021	ATEC 2200-2C Toxic Air Sampler (Year Deployed: 2021)
	2022	ATEC 2200-2C Toxic Air Sampler (Year Deployed: 2022)
PAHs	2008-2014	Graseby Andersen GMW PS-1 PUF Sampler (Year Deployed: 2006)
	2015-2020	GMW PS-1 PUF Sampler (Year Deployed: 2015)
	2021	Tisch model TE-1000-D (Deployed: 10/07/21)
	2022	Tisch model TE-1000-D (Deployed: 2021)
PM_{10} Metals	2003-2014	Andersen Hi-Volume PM10 Sampler (Year Deployed: 2002)
	2015-2022	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)
	2015-2019	Xontech 910 (Year Deployed: 2010)
	2020	Xonteck 910 Canister Sampler (Year Deployed: 2019)
	2021	Xonteck 910 Canister Sampler (Year Deployed: 2021)
	2022	Xonteck 910 Canister Sampler (Year Deployed: 2022)
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)
	2019-2022	Waters Acquity UPLC H Class w/ PDA Detector, Waters Sample Manager FTN-H w/ Auto Sampler, Waters Quaternary Solvent Manager QSM w/ Pump Module (Year Deployed : 2019)
PAHs	2008-2014	HP/Agilent 5890/5971 GC/MS (Year Deployed: 2008)
	2015-2020	HP/Agilent 7890B/5975C GC/MS (Year Deployed: 2014)
	2021-2022	HP/Agilent 7890B/5975C GC/MS (Year Deployed: 2015); HP/Agilent 6890/5973 GC/MS (Year Deployed: 2021)
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)
	2019-2022	Thermo iCAP Q ICP-MS (Year Deployed: 2015); Thermo iCAP rQ ICP-MS (Year Deployed: 2017)
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)
	2015-2020	Entech 7200 (Year Deployed: 2015)
	2021-2022	GC/MSD 5977B GC 8890 system (Year Deployed: 2021) & Canister auto sampler 7016D (Year Deployed: 2021)
Standards Preparation Equipment		
VOCs	2003-2009	Entech 7100 (dynamic dilution) (Year Deployed: <2000)
	2010-2018	Entech 4100 (dynamic dilution) (Year Deployed: 2010)
	2019-2022	Entech 4700 precision diluter (Year Deployed: 2019)

Appendix A. Equipment Inventory		
Pollutant Type	**Year(s)**	**Manufacturer/Model, Extraction Type, and Year**
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)
	2019-2022	Entech 3100 D (Year Deployed: 2016)
PM_{10} Extraction Equipment		
PM_{10} Metals	2003-2003	Branson 8510 (Sonicator) (Year Deployed: unknown)
	2004-2013	Branson 8510 (Sonicator) (Year Deployed: 2004)
	2014-2022	Environment Express (Hotblock) (Year Deployed: 2011)
PAHs Extraction Equipment		
PAHs	2008-2018	Dionex -300 (ASE) (Year Deployed: 2004)
	2019-2022	Dionex -350 (ASE) (Year Deployed: 2019)