Annual Review of Appendix O MAACs

2014

TRPS
7/31/2015

The Technical Projects & Resources Section of the Air Quality Division is charged with an annual review of the toxic air contaminants (TAC) Maximum Acceptable Ambient Concentrations (MAAC) found in Appendix O of the Air Quality Regulations. This review consists of recommending any changes to Appendix O, and updating the documentation for each TAC and its corresponding MAAC.

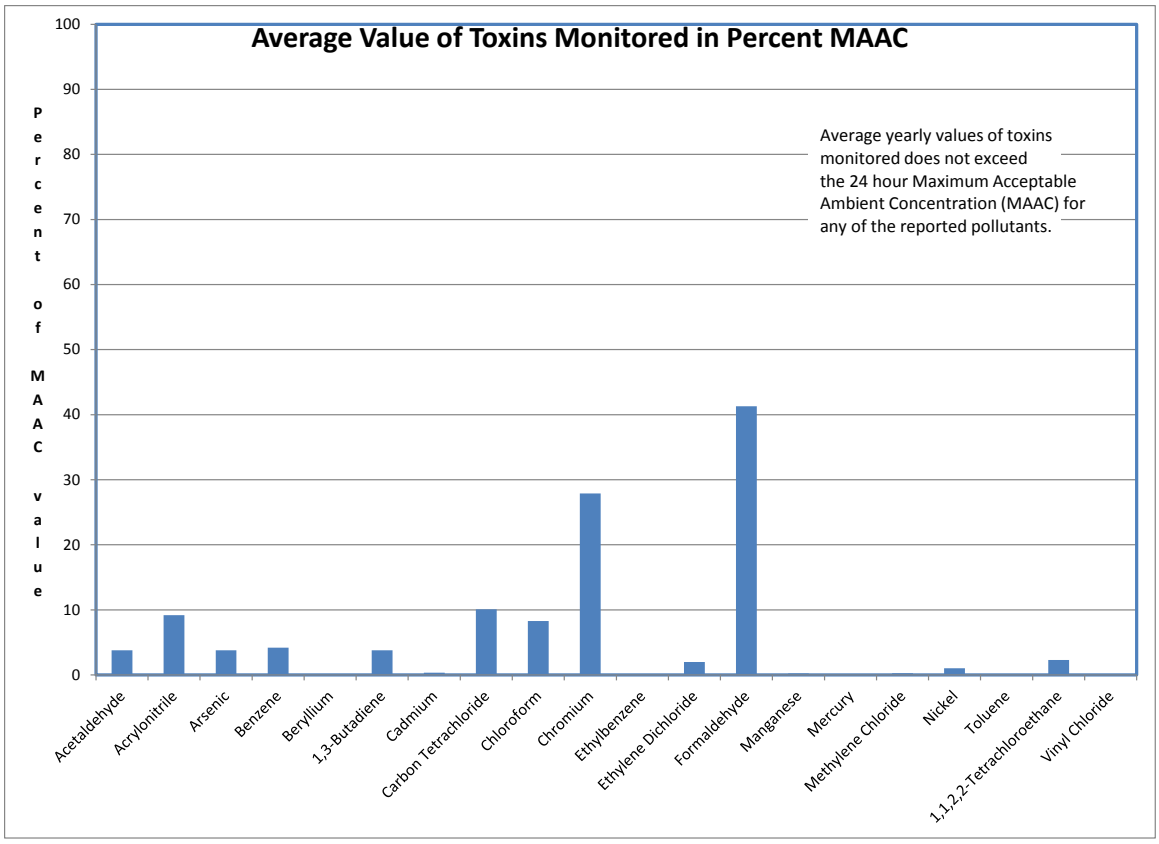
For 2014, no changes are recommended. Nothing has changed that would require removing a TAC, and the only obvious addition would be acrolein. However, acrolein has no approved or consensus monitoring method. We (AQD) are currently monitoring acrolein with a method that may be acceptable but so far EPA has not approved that method. Subchapter 42 requires that a TAC have an approved monitoring method before it is added to Appendix O.

No changes were recommended to the actual MAAC levels because nothing has been updated in the IRIS (Integrated Risk Information System) managed by EPA. EPA has requested and received a very large increase in funding to update the IRIS system, so considerable changes could be coming in the next few years.

GIS maps were added to assist the reader in understanding data distribution and impact. Maps are updated yearly to reflect the most recent Oklahoma Emissions Inventory and Monitoring data.

10 year annual summation charts for Emissions Inventory and Monitoring data were also added. Charts display long term trends in data to better evaluate the impact of air toxins in Oklahoma over time.

The following pages contain the individual TAC reviews. For more detailed information, please contact the Air Toxics program at (405) -702-4100.


Average Value of Toxins Monitored in Percent MAAC
Percent of MAAC value
100
90
80
70
60
50
40
30
20
10
0
Average yearly values of toxins monitored does not exceed the 24 hour Maximum Acceptable Ambient Concentration (MAAC) for any of the reported pollutants.
Acetaldehyde
Acrylonitrile
Arsenic
Benzene
Beryllium
1,3-Butadiene
Cadmium
Carbon Tetrachloride
Chloroform
Chromium
Ethylbenzene
Ethylene Dichloride
Formaldehyde
Manganese
Mercury
Methylene Chloride
Nickel
Toluene
1,1,2,2-Tetrachloroethane
Vinyl Chloride

.

ACETALDEHYDE

CAS # 75-07-0

SYNONYMS: acetic aldehyde, ethyl aldehyde

DESCRIPTION: formula C_2-H_4-O, mol. wt. = 44.06 Colorless, fuming liquid with pungent odor, fruity smell at lower concentrations.

CARCINOGEN status (IRIS): PROBABLE

MAAC: 28 ppb (50 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

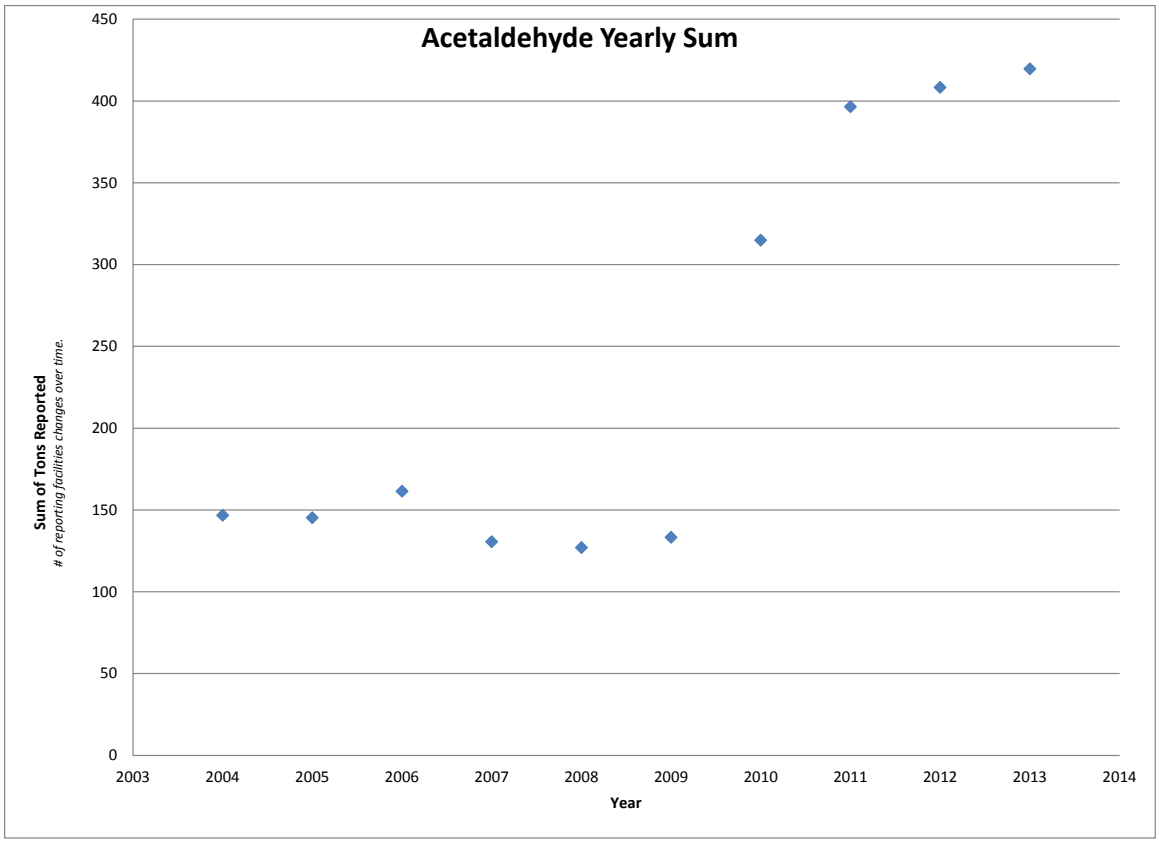
SOURCES: Many industrial, chemical, and manufacturing processes, combustion processes and especially gasoline combustion. Acetaldehyde is also formed by photochemical oxidation and naturally through plant respiration. The 2013 Air Quality Emission Inventory showed 419 tons reported. The AQD does not have accurate inventories for the mobile, photochemical and biogenic emissions.

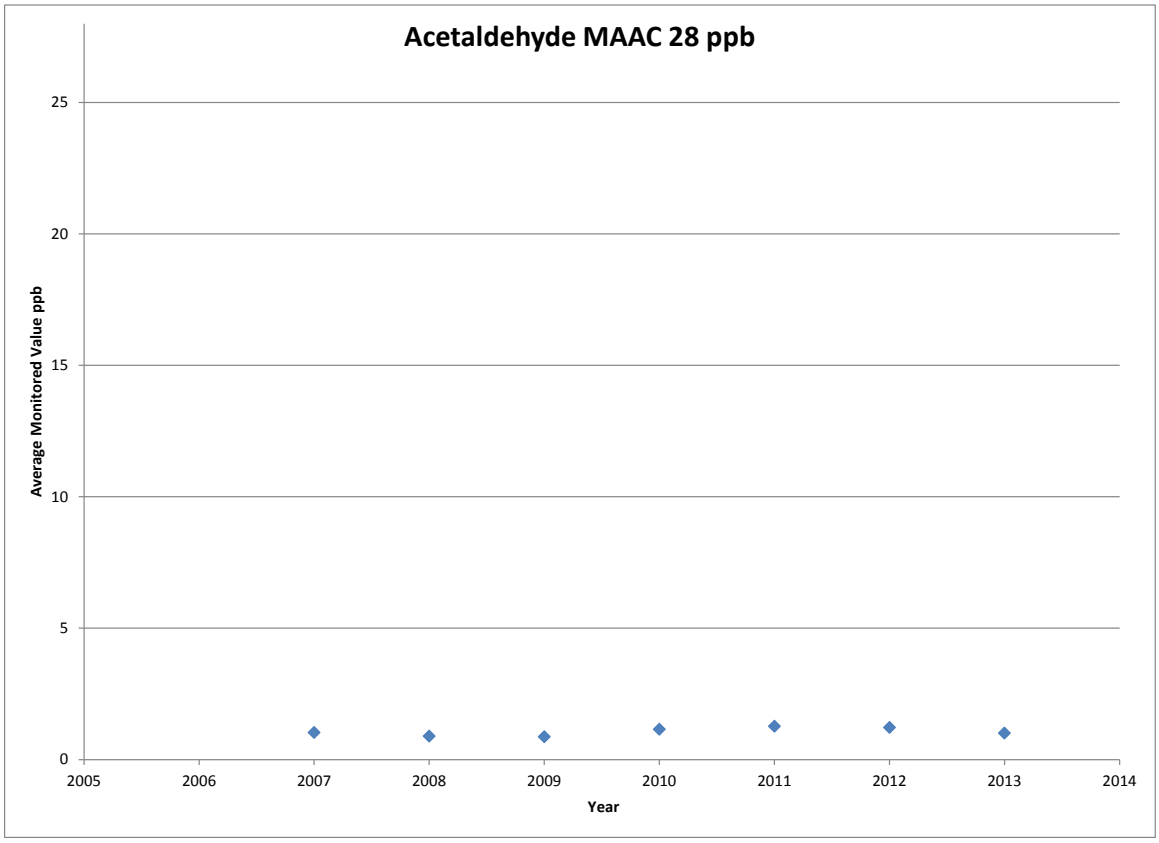
HEALTH EFFECTS: Acetaldehyde is listed as a probable human carcinogen (nasal) based on animal studies. Non-cancer health effects are irritation of eye, skin and respiratory tract, with prolonged exposure leading to more serious effects.

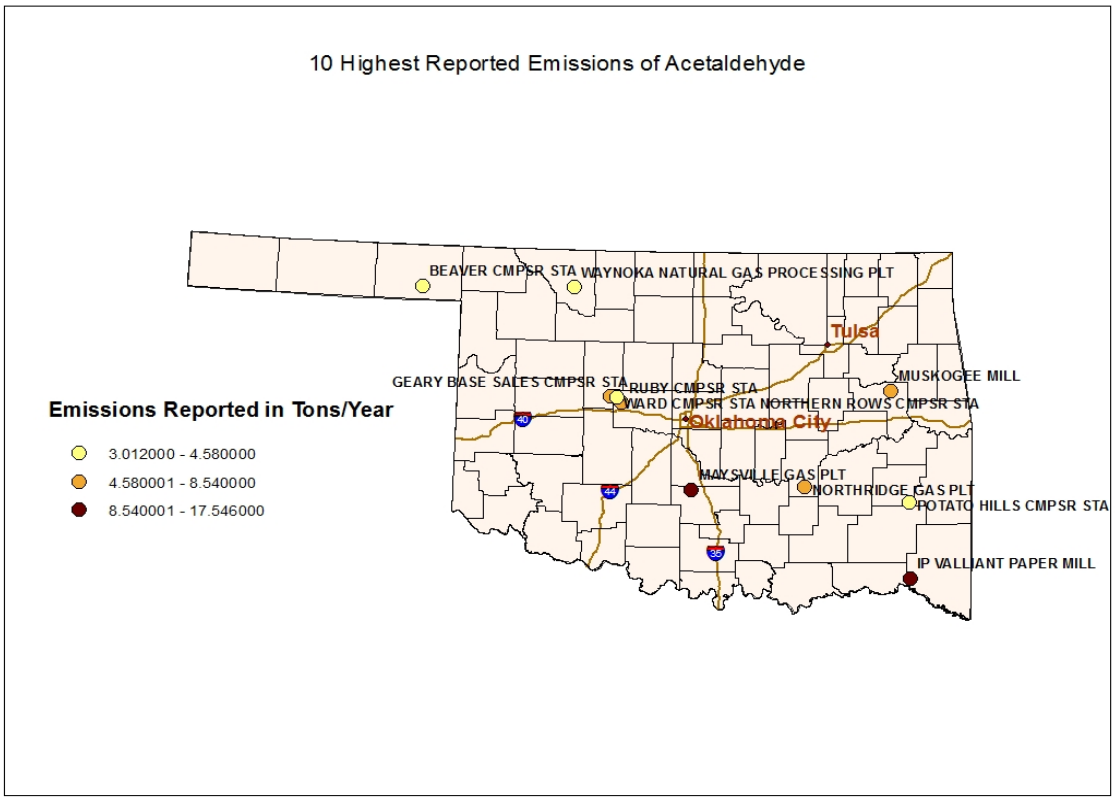
MONITORING METHODS: EPA TO-11A. The accepted Method Detection Limit (MDL) is 0.004 ppb.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

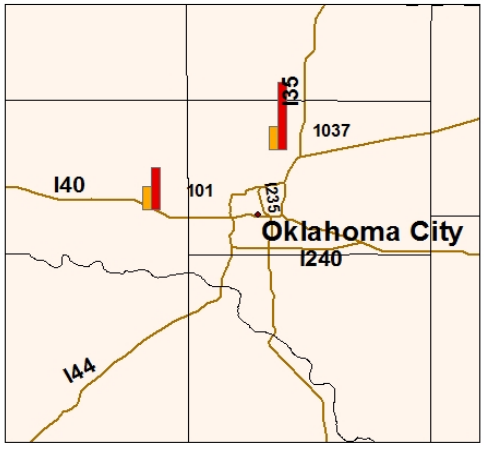
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 1.15 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 1.27 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 1.22 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 1.01 ppb

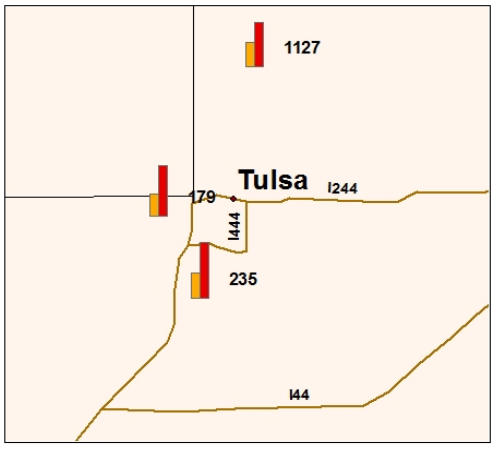

Acetaldehyde Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
450
400
350
300
250
200
150
100
50
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Acetaldehyde MAAC 28 ppb
Average Monitored Value ppb
25
20
15
10
5
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Acetaldehyde





Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	2.93	1.01	39
YUOK	101	1.83	0.98	30
Tulsa 1	235	2.45	1.12	61
Tulsa 2	1127	1.94	1.06	51
Tulas Riverside	179	2.16	0.94	45

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

ACRYLONITRILE

CAS # 107-13-1

SYNONYMS: 2-propenenitrile; vinyl cyanide; cyanoethylene; Acritet; Fumigrain

DESCRIPTION: formula C_3-H_3-N, mol. wt. = 53.06 Colorless, very volatile liquid, somewhat explosive.

CARCINOGEN status (IRIS): PROBABLE

MAAC: 0.5 ppb (1.0 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

SOURCES: Production of acrylic fibers, other industrial, chemical, and manufacturing processes, and gasoline combustion. The 2013 Air Quality Emission Inventory showed 2.77 tons reported. The AQD does not have an accurate emission inventory for acrylonitrile from mobile sources.

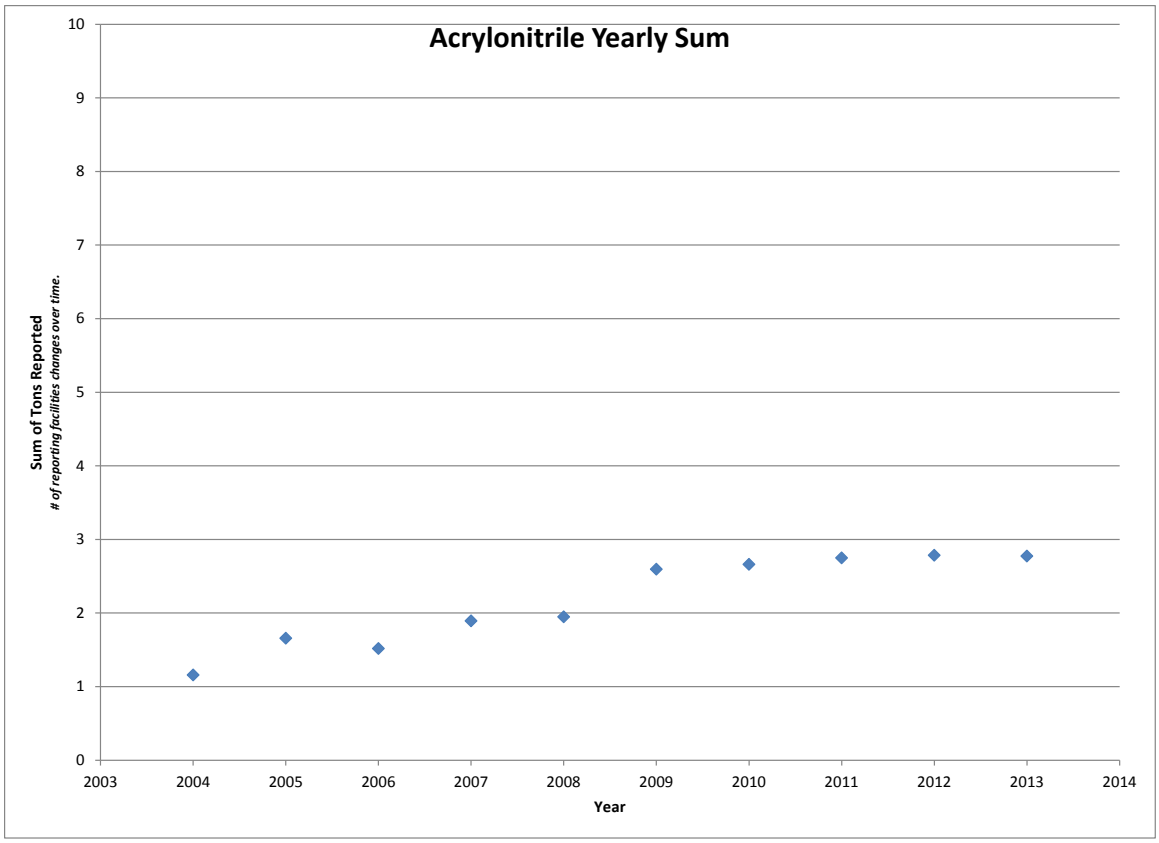
HEALTH EFFECTS: Acrylonitrile is listed as a probable human carcinogen (lung cancer) based on some worker exposure and animal studies. Non-cancer health effects: Acrylonitrile is a central nervous system depressant and a respiratory irritant that is metabolized to cyanide. Symptoms include headache, dizziness, nausea, feelings of apprehension and nervous irritability, muscle weakness, cyanosis, and convulsions.

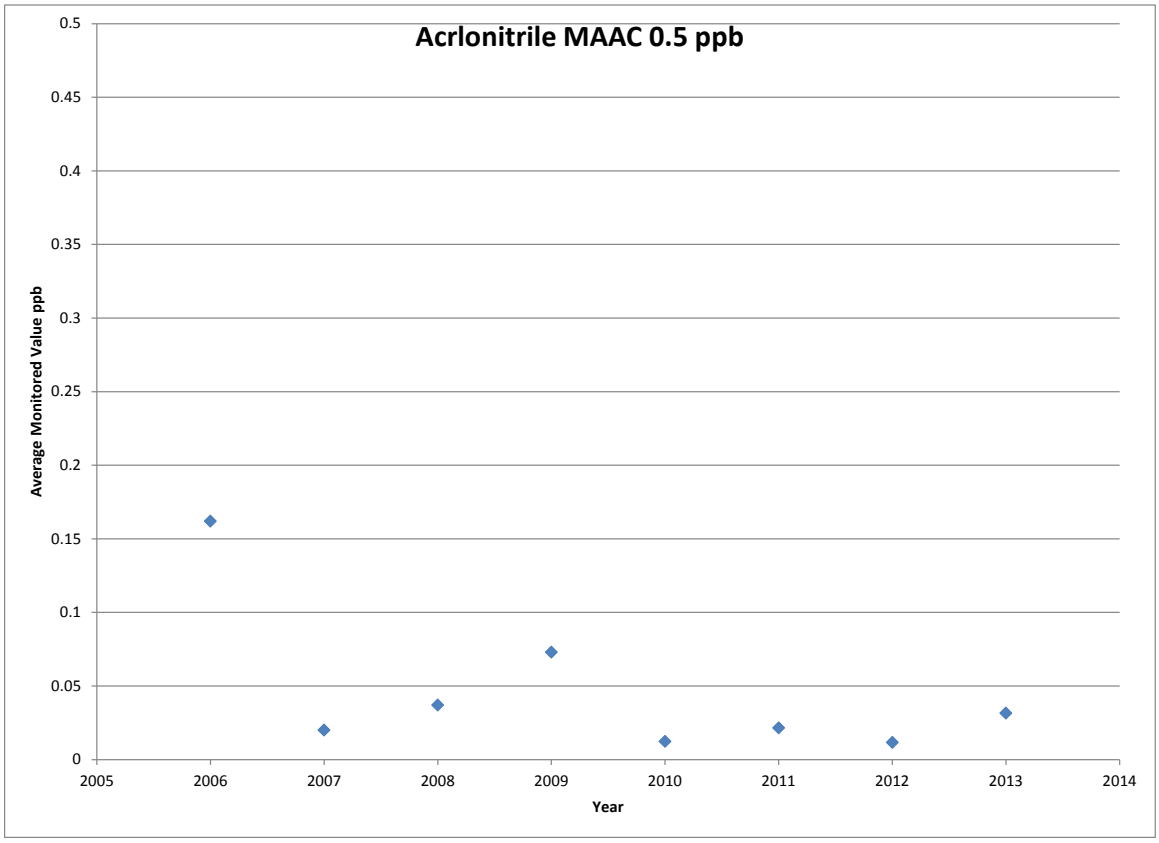
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.027 ppb.

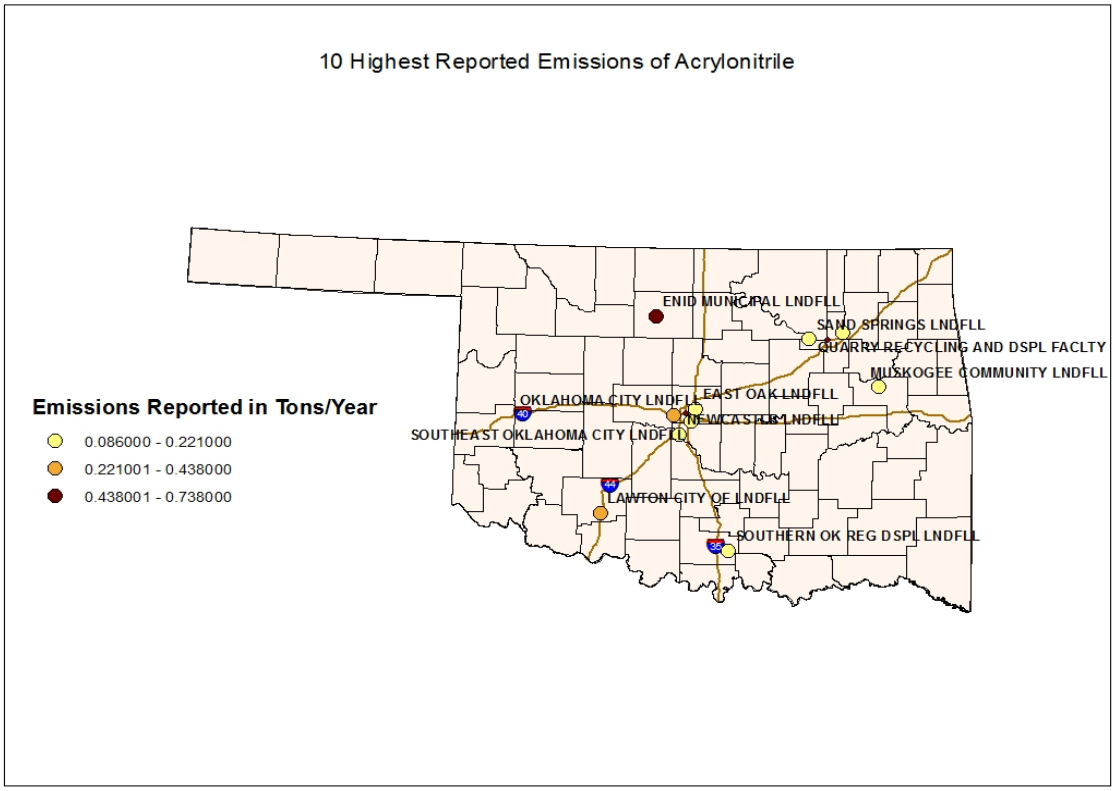
ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.124 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.216 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.117 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.0316 ppb

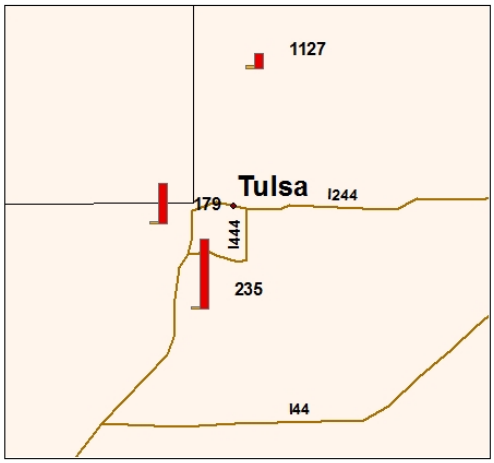
Averages for acrylonitrile were calculated using the method prescribed in the Air Toxics Risk Assessment (ATRA) Reference Library as required in Subchapter 42. This method substitutes ½ the Method Detection Limit (MDL) for non-detected samples, and is used when most of the sampled values are below the MDL.


Acrylonitrile Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Acrlonitrile MAAC 0.5 ppb
Average Monitored Value ppb
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Acrylonytrile



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.76	0.03	61
YUOK	101	0.14	0.02	30
Tulsa 1	235	1.06	0.04	60
Tulsa 2	1127	0.24	0.05	60
Tulsa Riverside	179	0.6	0.02	62

Air Toxics Risk Assessment Method (ATRA) Subchapter 42 method used.

AMMONIA

CAS # 7664-41-7

SYNONYMS: anhydrous ammonia

DESCRIPTION: formula H_3-N, mol. wt. = 17.03 Colorless, corrosive alkaline gas with very pungent odor.

CARCINOGEN status (IRIS): NA

MAAC: 2,500 ppb (1742 $^{\mu g}/m^3$) 24-hour average

The MAAC would be based on the No-Observed Adverse Effect Level (NOAEL) Human Equivalent Concentration (HEC) (2700 ppb), but in 2005 the MAAC set by SC 41 was 2500 ppb. To avoid "back-sliding" the level was kept at the SC 41 MAAC of 2500 ppb in Appendix O.

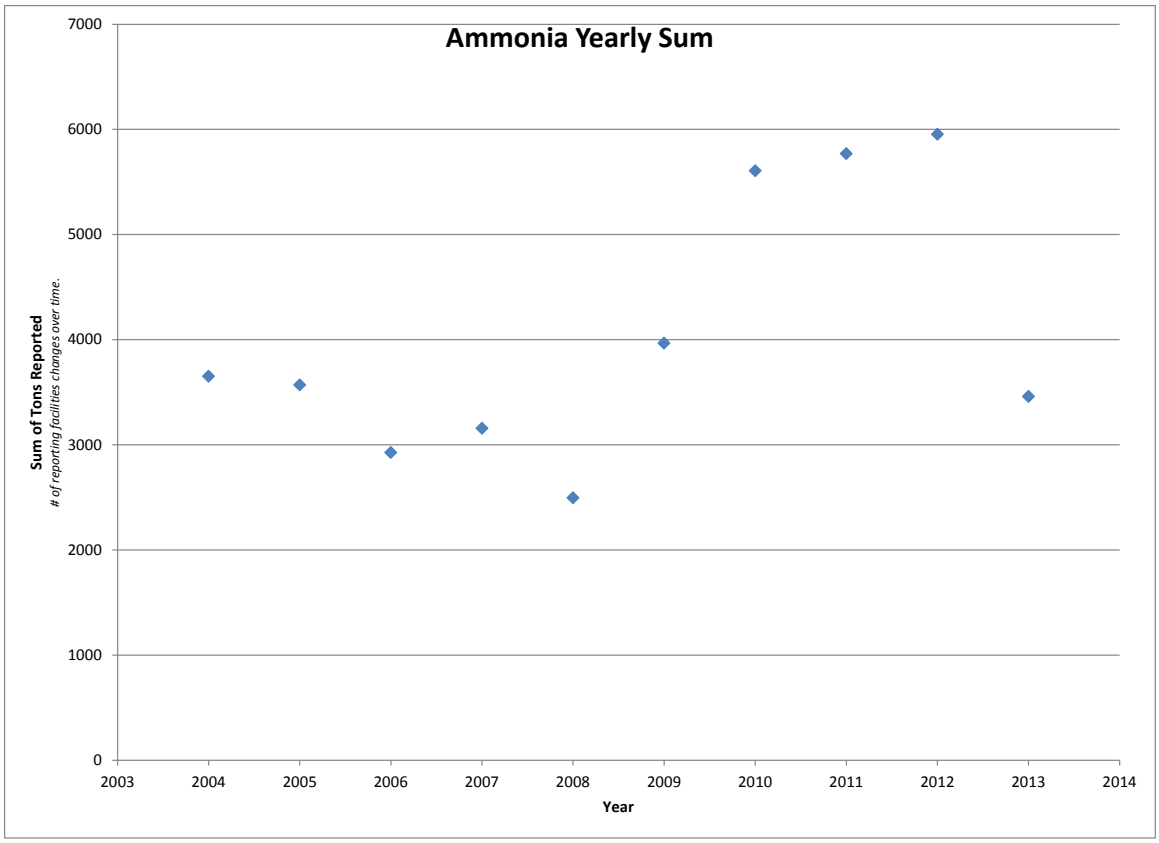
SOURCES: Many industrial, chemical, and manufacturing processes, especially fertilizer production and agricultural processes. The 2013 Air Quality Emission Inventory showed 3459 tons reported.

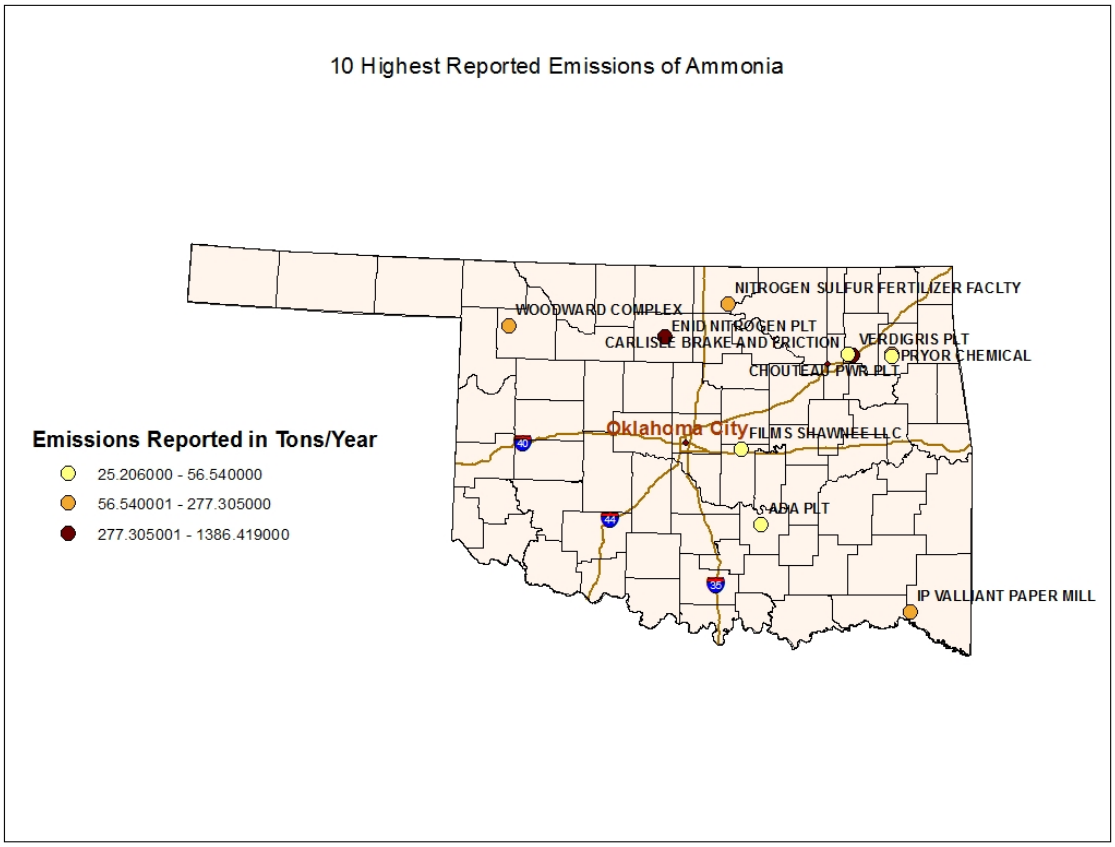
HEALTH EFFECTS: Strong irritant to eye and respiratory tract, with higher exposures leading to more severe effects.

MONITORING METHODS: EPA IO-4 and 4.2 (Manual Diffusion Denuder System) The accepted Method Detection Limit (MDL) is 1.0 ppb or less.

ACTUAL MONITORED VALUES: Air Quality operated monitors in Holdenville and Seiling. The averaged annual values for sampling events conducted between Dec. 18th 2005 and Dec. 31st 2006 are as follows:

Holdenville Stations Averaged Values = 1.8 ppb
Seiling Station Averaged Values = 2.3 ppb
Total Station Averaged Values = 2.1 ppb


Ammonia Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
7000
6000
5000
4000
3000
2000
1000
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


10 Highest Reported Emissions of Ammonia
NITROGEN SULFUR FERTILIZER FACLTY
WOODWARD COMPLEX
ENID NITROGEN PLT
CARLISLE BRAKE AND FRICTION
VERDIGRIS PLT
PRYOR CHEMICAL
CHOUTEAU PWR PLT
Oklahoma City
FILMS SHAWNEE LLC
ADA PLT
IP VALLIANT PAPER MILL
Emissions Reported in Tons/Year
25.206000 - 56.540000
56.540001 - 277.305000
277.305001 - 1386.419000

ARSENIC Compounds

CAS # NOT APPLICABLE - Group

SYNONYMS: no common synonyms

DESCRIPTION: formula As- There are many inorganic compounds of arsenic.

CARCINOGEN status (IRIS): KNOWN

MAAC: 0.02 $^{\mu g}/m^3$ 24-hour average (no equivalent ppm value because the MAAC is for a group of compounds)

MAAC is based on IRIS 10^{-4} inhalation risk value.

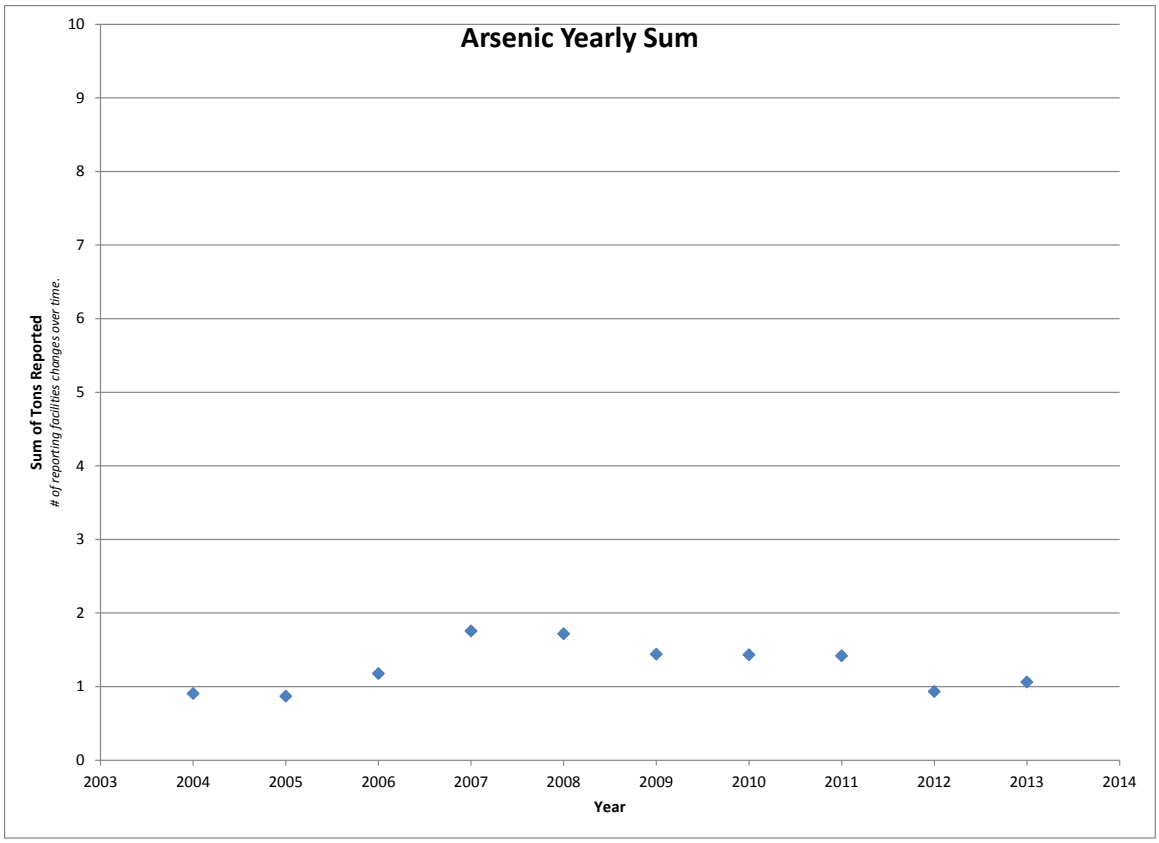
SOURCES: Combustion and high-temperature processes, some metal-working processes. Organic arsenic compounds are used in pesticides. The 2013 Air Quality Emission Inventory showed 1.05 ton reported. No significant mobile sources.

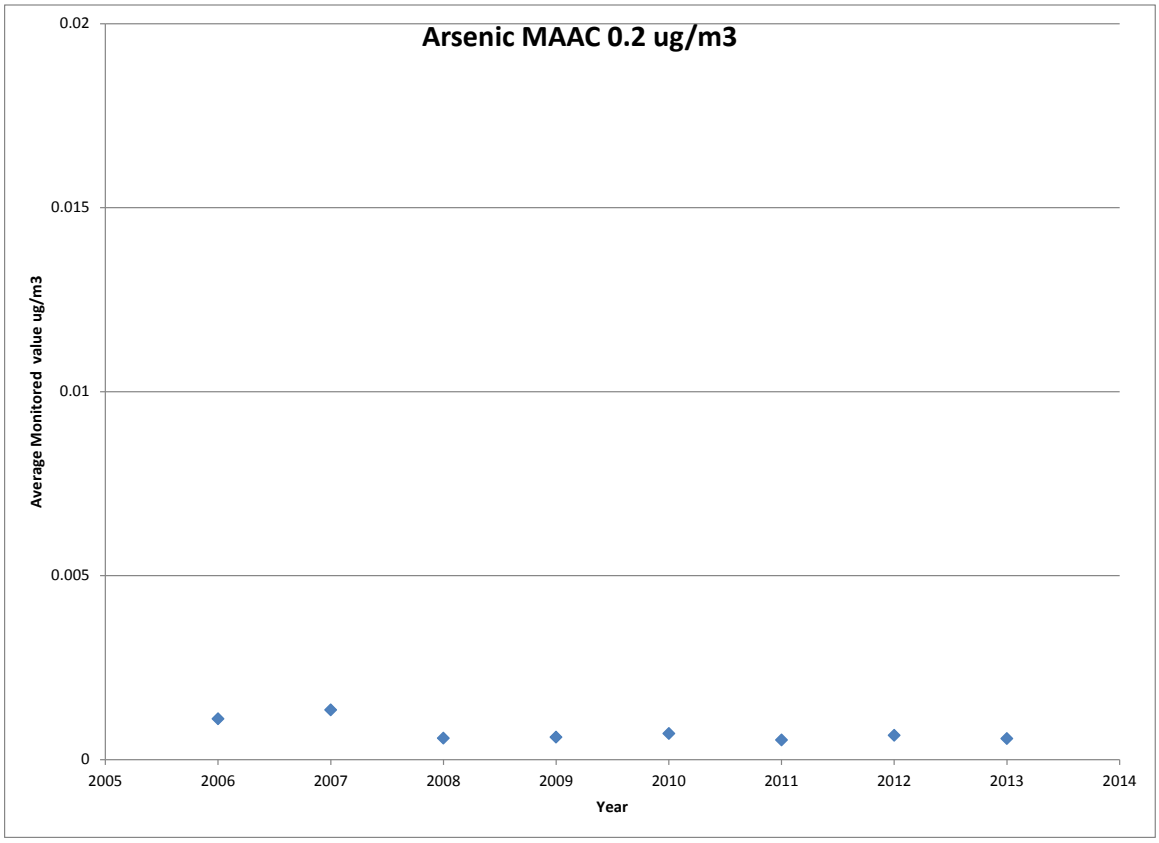
HEALTH EFFECTS: Well-documented carcinogen, especially respiratory cancers.

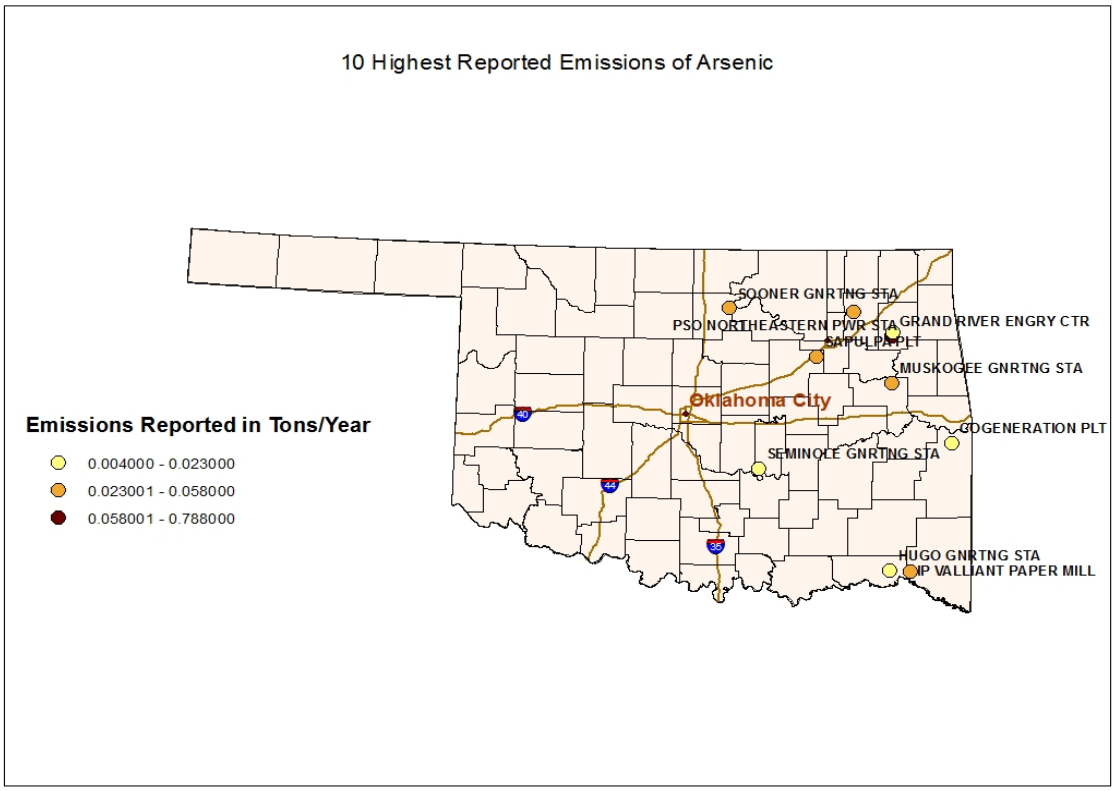
MONITORING METHODS: EPA IO-2 Hi-Vol and EPA IO-3.5 ICP/MS. The accepted Method Detection Limit (MDL) is 0.040 ng/m^3.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

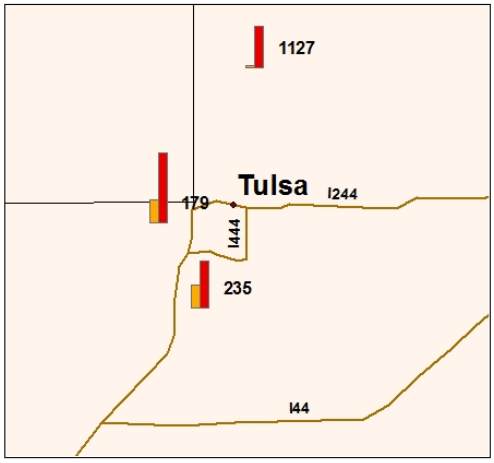
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00071 ug/m^3
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00053 ug/m^3
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00066 ug/m^3
2013 (Tulsa, Oklahoma City, Yukon) = 0.00057 ug/m^3


Arsenic Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Arsenic MAAC 0.2 ug/m3
Average Monitored value ug/m3
0.02
0.015
0.01
0.005
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Arsenic



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	1.19	0.51	43
YUOK	101	0.9	0.43	31
Tulsa 1	235	1.51	0.76	60
Tulsa 2	1127	1.35	0.07	32
Tulsa Riverside	179	2.25	0.74	34

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

BENZENE

CAS # 71-43-2

SYNONYMS: no common synonyms

DESCRIPTION: formula C_6-H_6, mol. wt. = 78.12 Colorless, volatile liquid with strong aromatic odor.

CARCINOGEN status (IRIS): KNOWN

MAAC: 10 ppb (30 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value. Benzene is unique because the IRIS 10^{-4} inhalation risk value is stated as a range of 4 ppb to 14 ppb. The MAAC is the midpoint of that range.

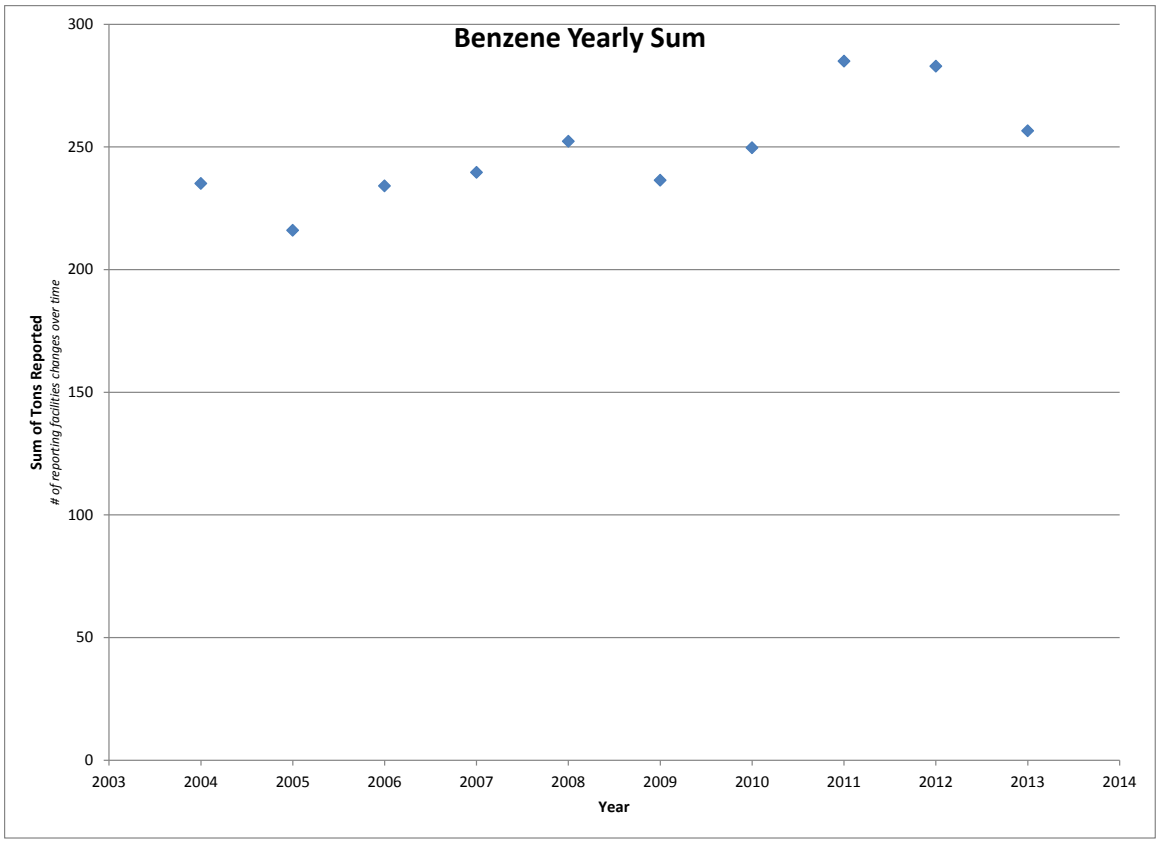
SOURCES: Many industrial, chemical, and manufacturing processes and gasoline combustion. The 2013 Air Quality Emission Inventory showed 257 tons reported. The AQD does not have an accurate emission inventory for benzene from mobile sources.

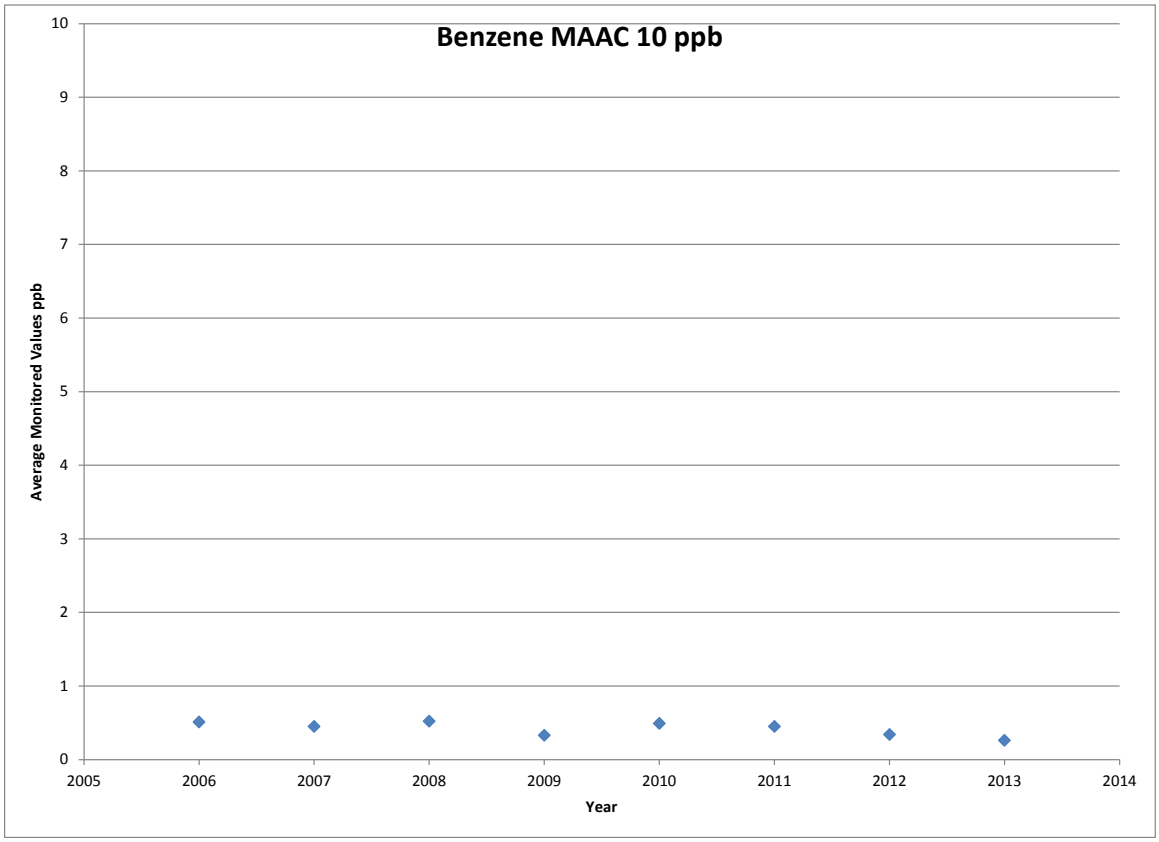
HEALTH EFFECTS: Well-documented carcinogen, especially leukemia.

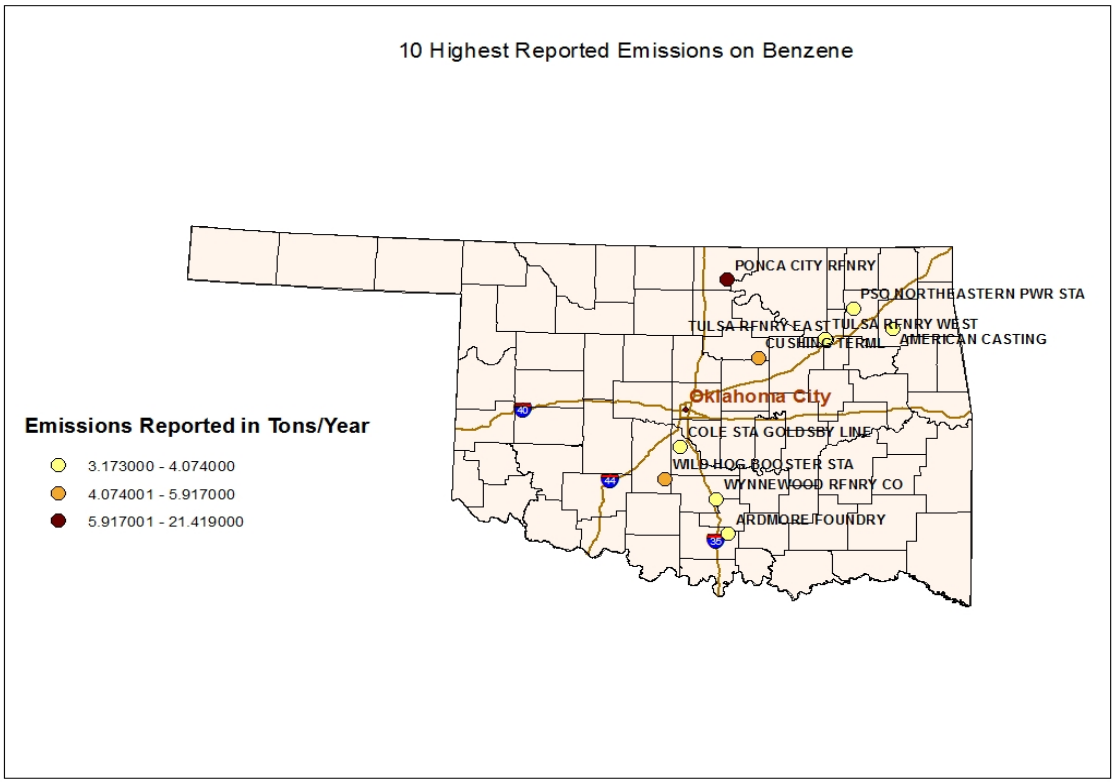
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.019 ppb.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

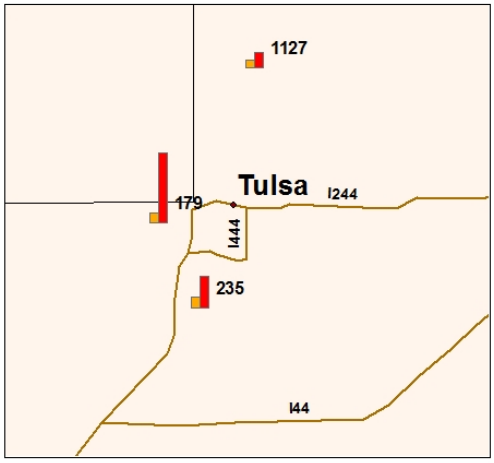
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.49 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.45 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.34 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.26 ppb


Benzene Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time
300
250
200
150
100
50
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Benzene MAAC 10 ppb
Average Monitored Values ppb
10
9
8
7
6
5
4
3
2
1
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Benzene



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.41	0.2	49
YUOK	101	0.23	0.16	30
Tulsa 1	235	1.06	0.37	60
Tulsa 2	1127	0.53	0.25	41
Tulsa Riverside	179	2.32	0.32	62

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

BERYLLIUM Compounds

CAS # NOT APPLICABLE - Group

SYNONYMS: no common synonyms

DESCRIPTION: formulas Be-, there are many compounds of beryllium.

CARCINOGEN status (IRIS): PROBABLE

MAAC: 0.02 $^{\mu g}/m^3$ 24-hour average (no equivalent ppm value because the MAAC is for a group of compounds)

The MAAC would be based on the IRIS 10^{-4} inhalation risk value (0.04 $^{\mu g}/m^{3)}$, but in 2005 the MAAC set by SC 41 was 0.02$^{\mu g}/m^3$. To avoid "back-sliding" the level was kept at the SC 41 MAAC of 0.02$^{\mu g}/m^3$ in Appendix O.

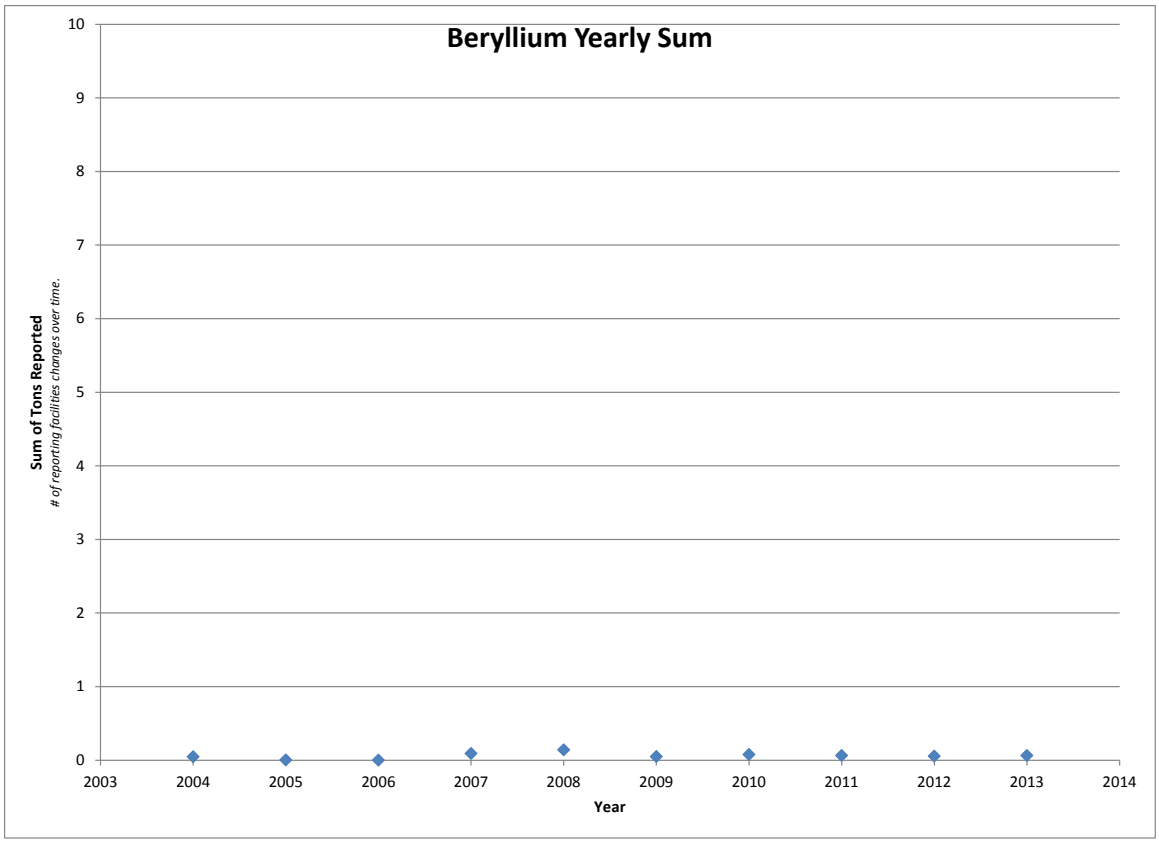
SOURCES: Many industrial, chemical, and manufacturing processes, and gasoline/coal combustion. The 2013 Air Quality Emission Inventory showed 0.061 tons reported. The AQD does not have an accurate emission inventory for beryllium from mobile sources.

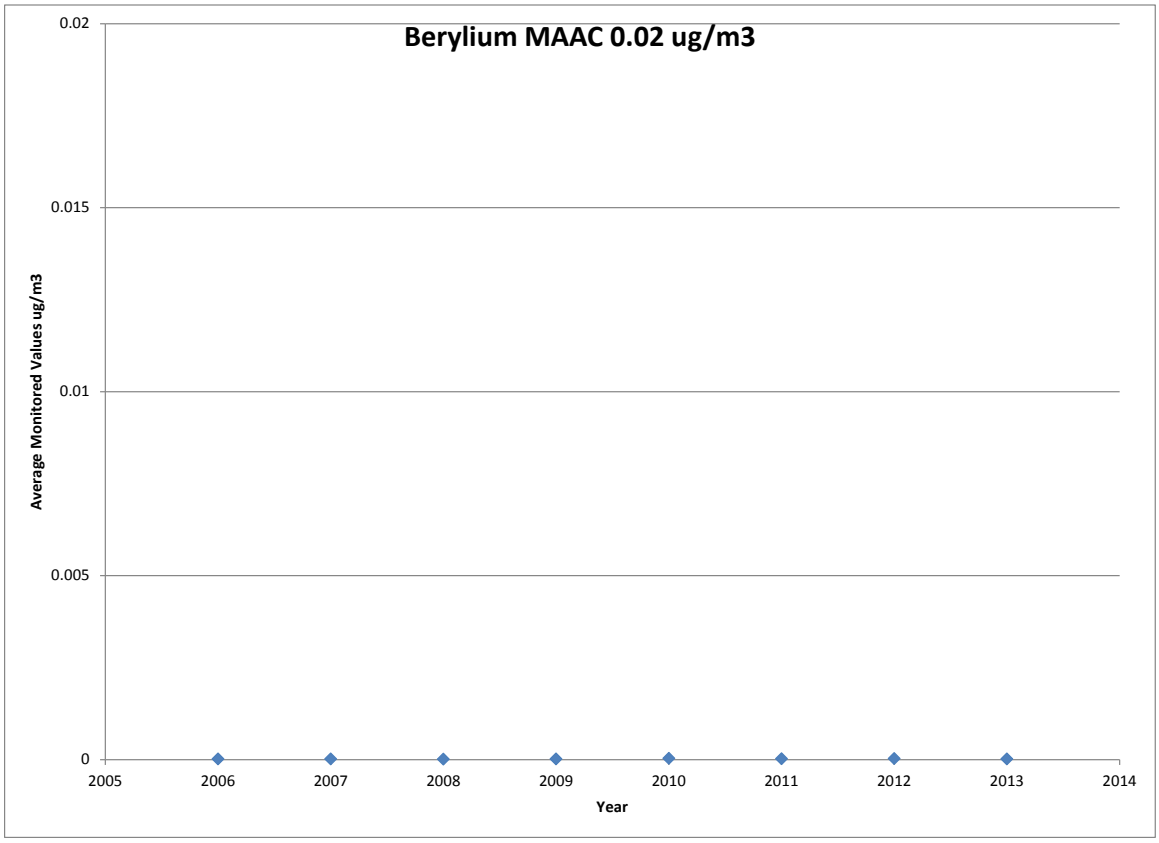
HEALTH EFFECTS: Beryllium is listed as a probable human carcinogen (lung cancer) based on animal studies. Non-cancer health effects: Acute inhalation of high levels of beryllium can cause inflammation of the lungs in humans; these symptoms may be reversible after exposure ends. Long-term exposure may cause chronic beryllium disease (berylliosis), in which granulomatous lesions develop in the lung.

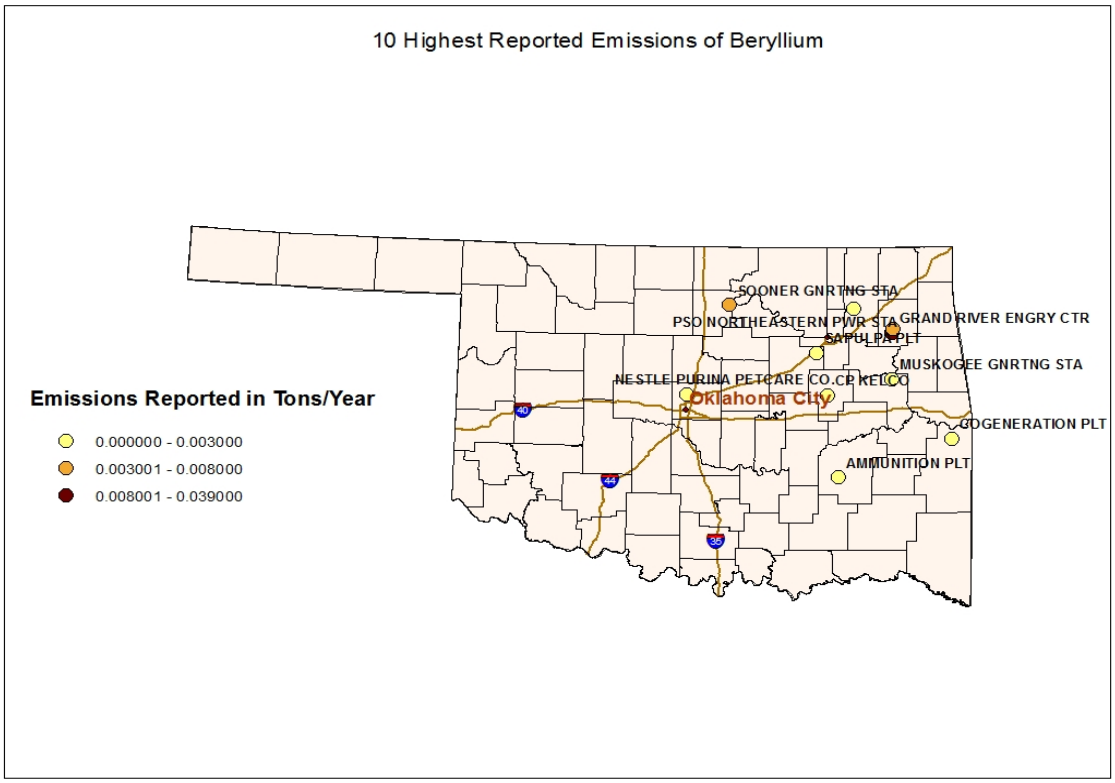
MONITORING METHODS: EPA IO-2 Hi-Vol and EPA IO-3.5 ICP/MS. The accepted Method Detection Limit (MDL) is 0.0009 ng/m^3.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

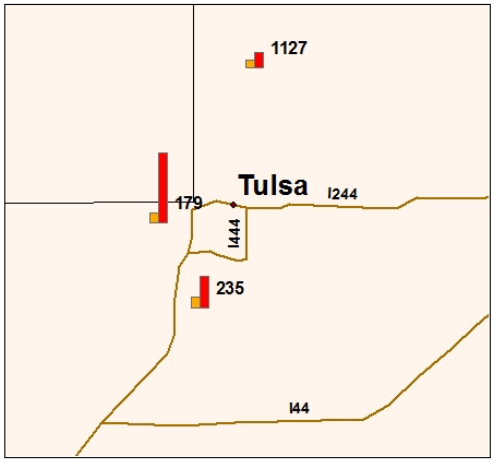
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.000031 ug/m^3
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.000023 ug/m^3
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.000028 ug/m^3
2013 (Tulsa, Oklahoma City, Yukon) = 0.000017 ug/m^3


Beryllium Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Berylium MAAC 0.02 ug/m3
Average Monitored Values ug/m3
0.02
0.015
0.01
0.005
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Benzene



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.41	0.2	49
YUOK	101	0.23	0.16	30
Tulsa 1	235	1.06	0.37	60
Tulsa 2	1127	0.53	0.25	41
Tulsa Riverside	179	2.32	0.32	62

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

1,3-BUTADIENE

CAS # 106-99-0

SYNONYMS: bivinyl, divinyl, erythrene, vinylethylene, biethylene, pyrrolylene

DESCRIPTION: formula C_4-H_6, mol. wt. = 54.09 Colorless, flammable gas with strong aromatic odor.

CARCINOGEN status (IRIS): KNOWN

MAAC: 1 ppb (3 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

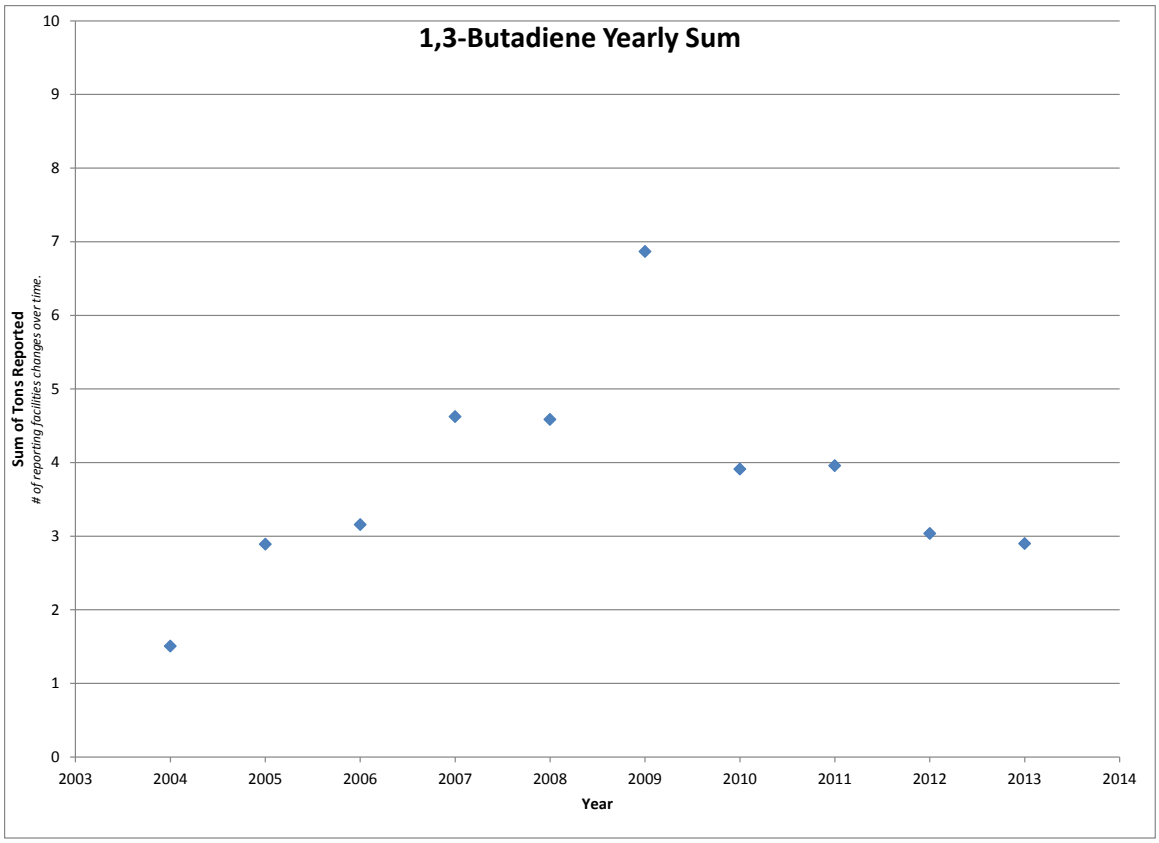
SOURCES: Many industrial, chemical, and manufacturing processes, but especially fuel combustion. The 2013 Air Quality Emission Inventory showed 2.89 tons reported. The AQD does not have an accurate emission inventory for 1,3-butadiene from mobile sources, but mobile source contributions are probably significant.

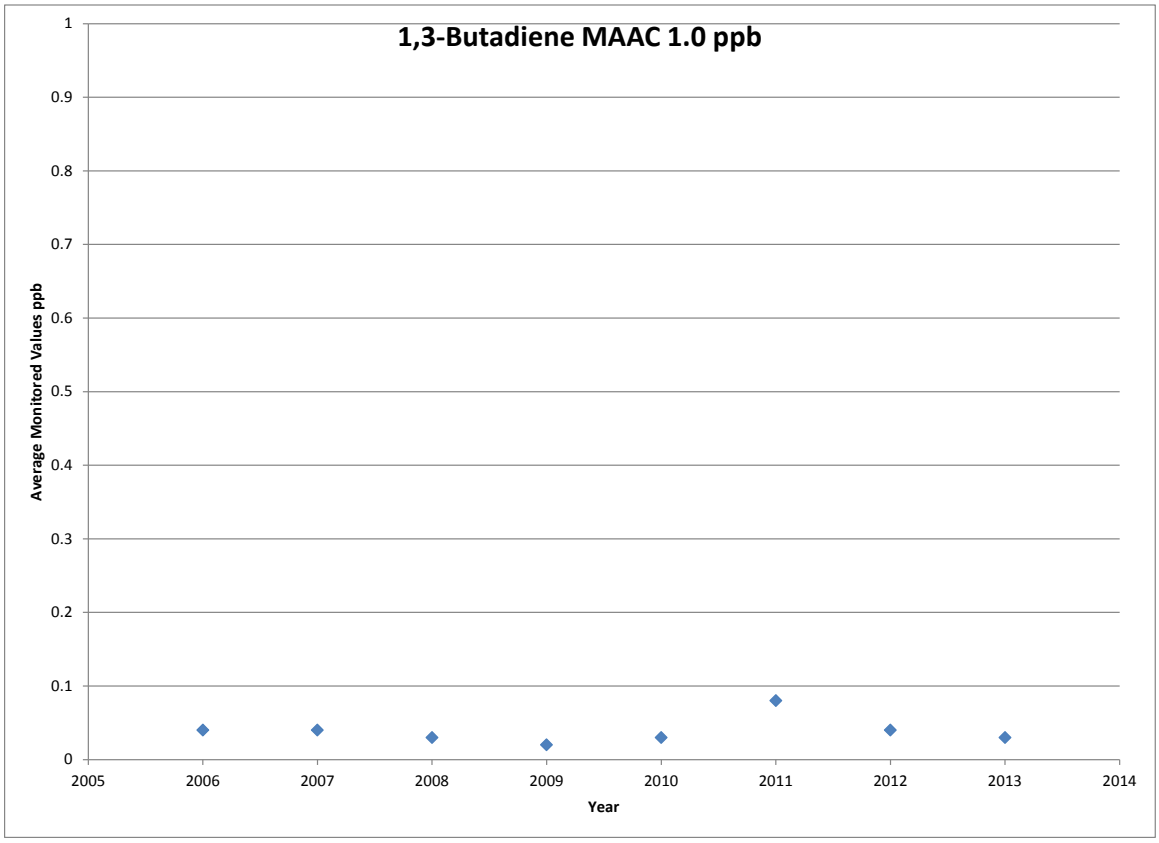
HEALTH EFFECTS: Well-documented carcinogen, especially leukemia and other lymphomas.

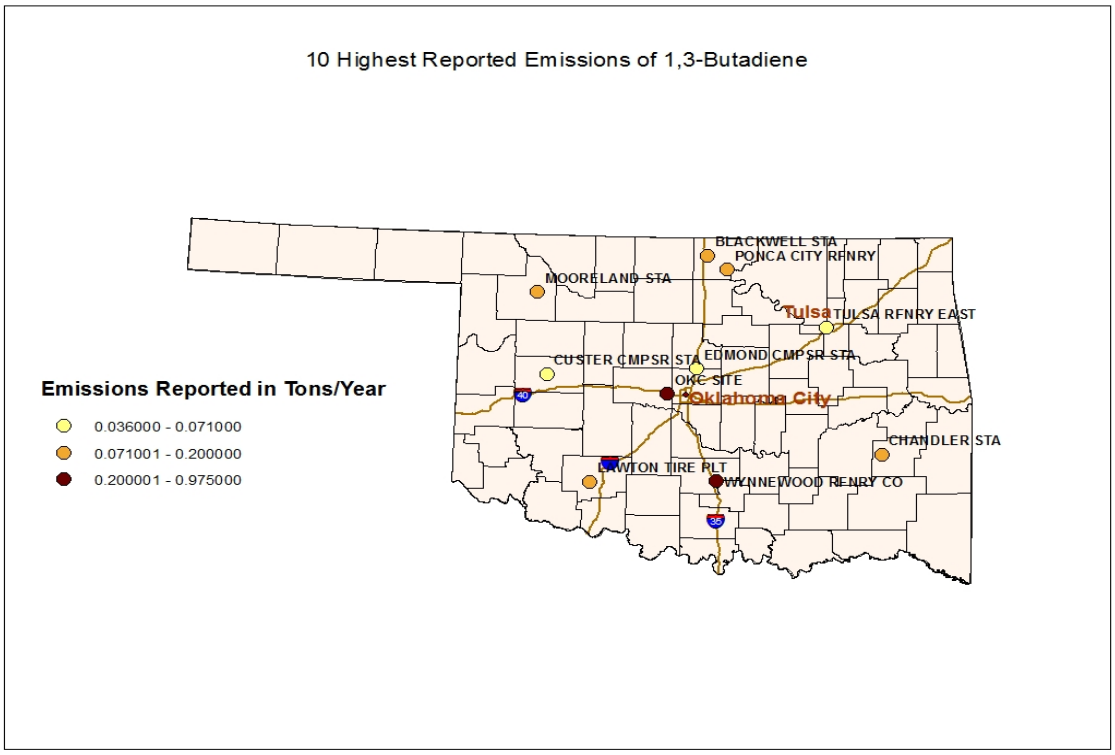
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.01 ppb.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

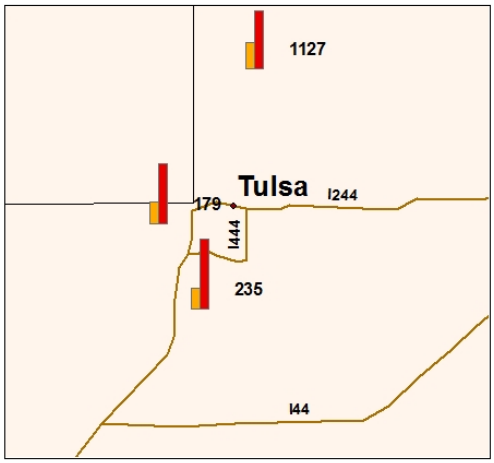
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.03 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.08 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.04 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.03 ppb


1,3-Butadiene Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


1,3-Butadiene MAAC 1.0 ppb
Average Monitored Values ppb
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values 1.3 Butadiene



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.06	0.02	35
YUOK	101	0.05	0.02	22
Tulsa 1	235	0.12	0.04	55
Tulsa 2	1127	0.1	0.05	37
Tulsa Riverside	179	0.1	0.04	58

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

CADMIUM Compounds

CAS # NOT APPLICABLE - Group

SYNONYMS: no common synonyms

DESCRIPTION: formula Cd-, There are many cadmium compounds.

CARCINOGEN status (IRIS): PROBABLE

MAAC: 0.06 $^{\mu g}/m^3$ 24-hour average (no equivalent ppm value because the MAAC is for a group of compounds)

MAAC is based on IRIS 10^{-4} inhalation risk value.

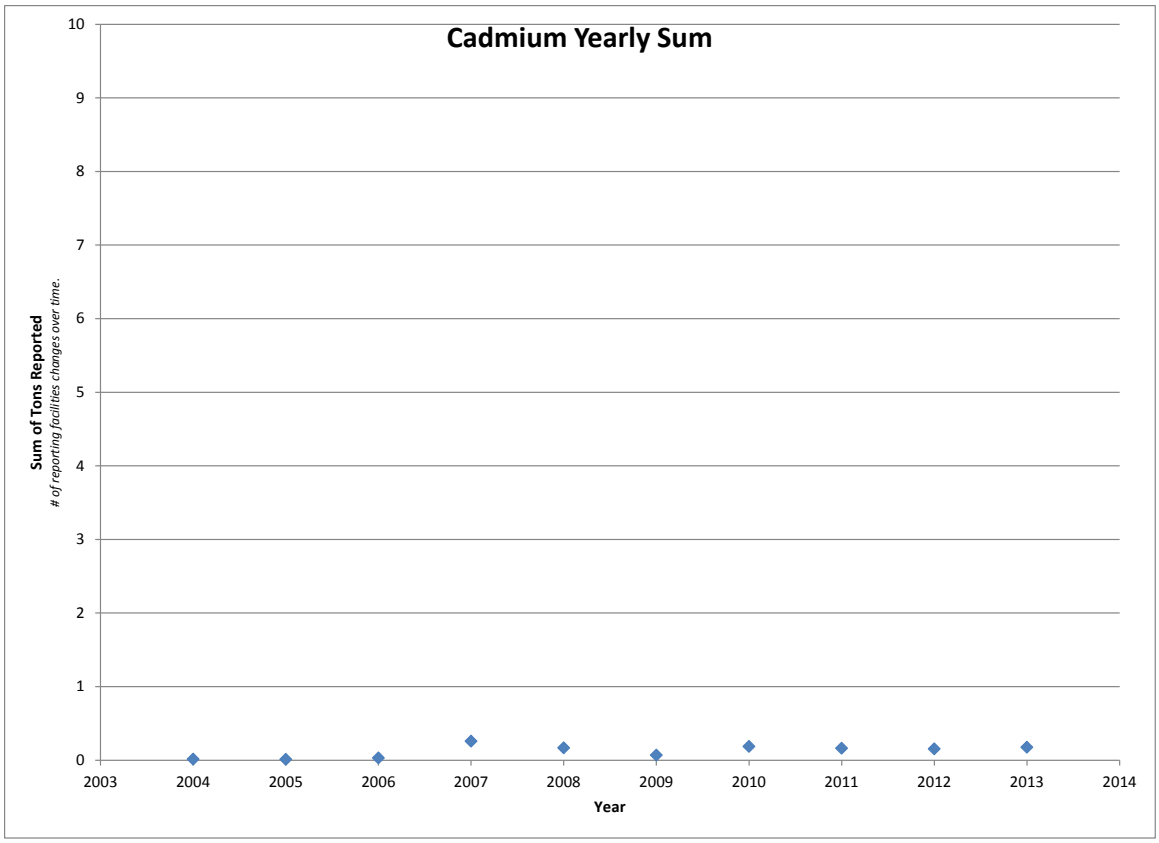
SOURCES: Many industrial, chemical, and manufacturing processes and gasoline combustion. The 2013 Air Quality Emission Inventory showed 1.17 tons reported. The AQD does not have an accurate emission inventory for cadmium from mobile sources.

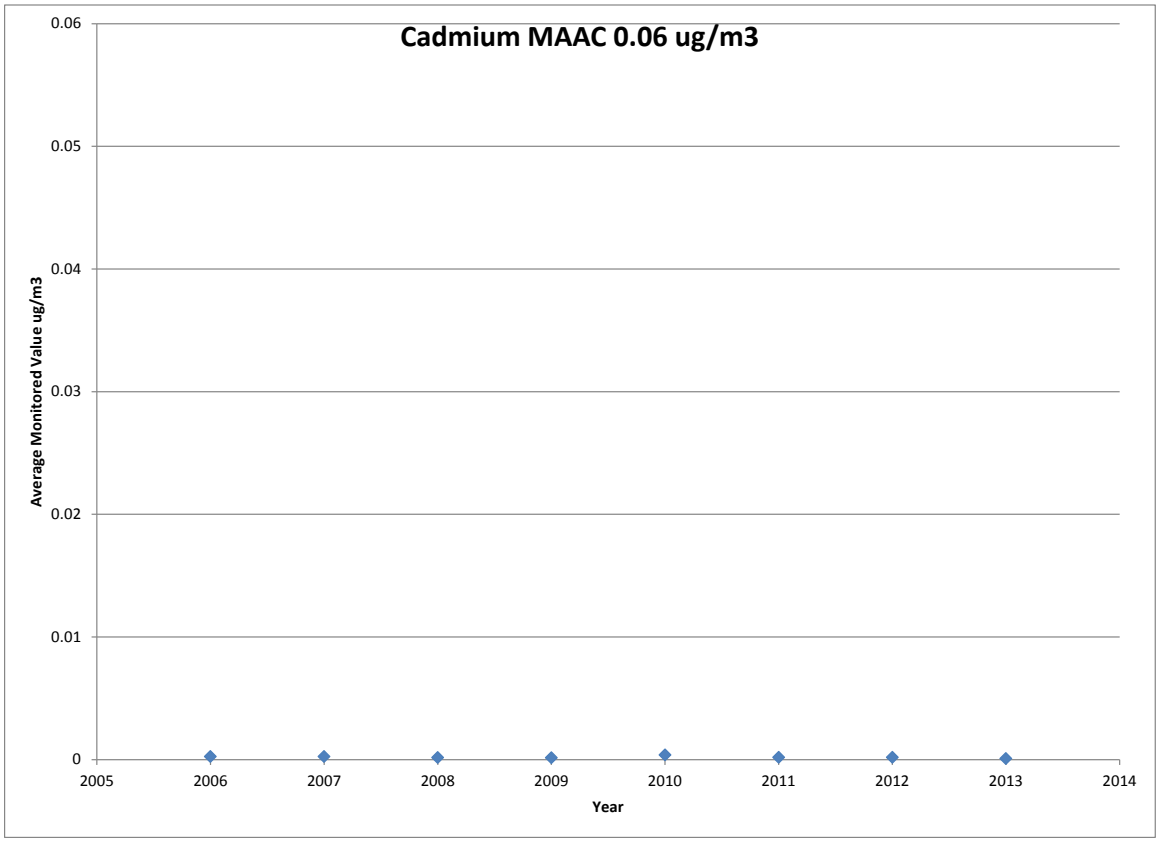
HEALTH EFFECTS: Listed as probable human carcinogen, especially respiratory cancers. Non-cancer effects: Subchronic and chronic exposures to cadmium have been associated with renal, cardiovascular, endocrine, hepatic, bone, hematological, and immunological effects. Respiratory conditions include bronchiolitis and emphysema.

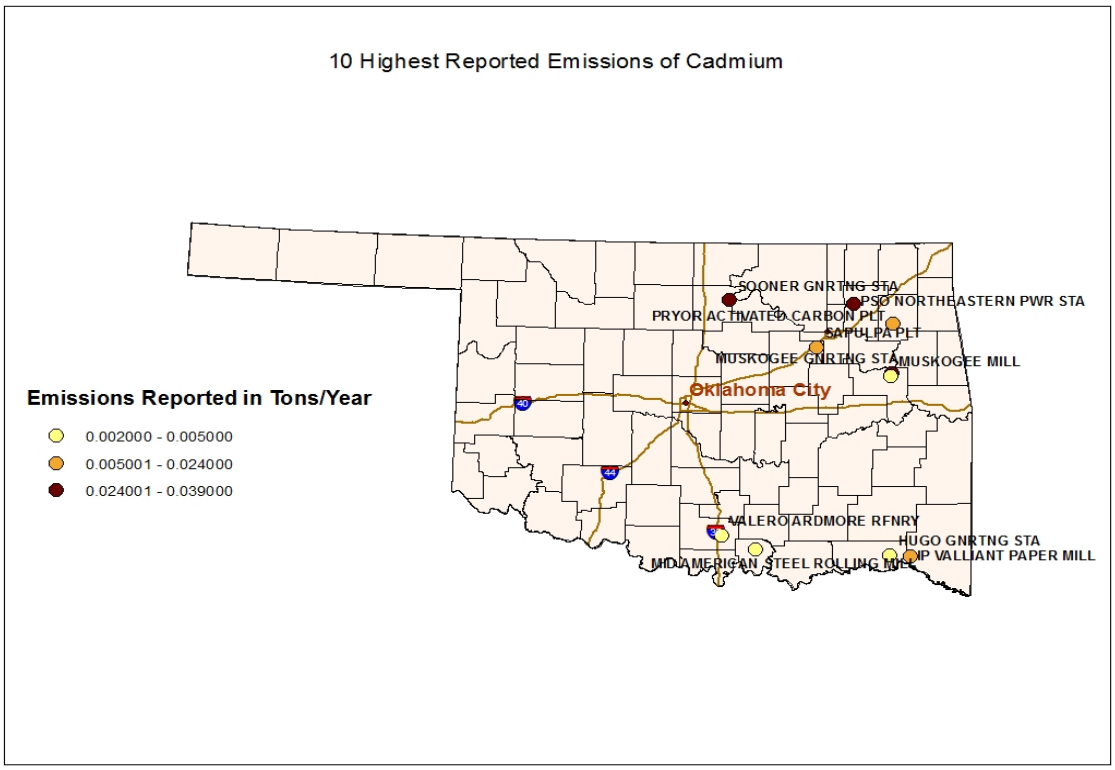
MONITORING METHODS: EPA IO-2 Hi-Vol and EPA IO-3.5 ICP/MS. The accepted Method Detection Limit (MDL) is 0.058 ng/m^3.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

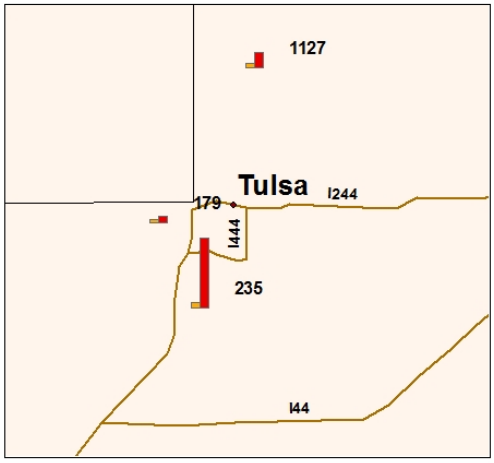
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00038 ug/m^3
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00018 ug/m^3
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00018 ug/m^3
2013 (Tulsa, Oklahoma City, Yukon) = 0.00009 ug/m^3


Cadmium Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Cadmium MAAC 0.06 ug/m3
Average Monitored Value ug/m3
0.06
0.05
0.04
0.03
0.02
0.01
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Cadmium



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.59	0.12	43
YUOK	101	0.31	0.11	31
Tulsa 1	235	3.71	0.29	60
Tulsa 2	1127	0.85	0.22	32
Tulsa Riverside	179	0.34	0.15	34

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

CARBON TETRACHLORIDE

CAS # 56-23-5

SYNONYMS: carbon chloride; carbon tet; methane tetrachloride; perchloromethane; tetrachlorocarbon; tetrachloromethane; Benzinoform; Univerm; Necatorina

DESCRIPTION: formula CCl_4, mol. wt. = 153.24 Carbon tetrachloride is a nonflammable, colorless, clear, heavy liquid. It has a sweetish, aromatic, moderately strong ethereal odor resembling that of chloroform.

CARCINOGEN status (IRIS): PROBABLE

MAAC: 1 ppb (7.0 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

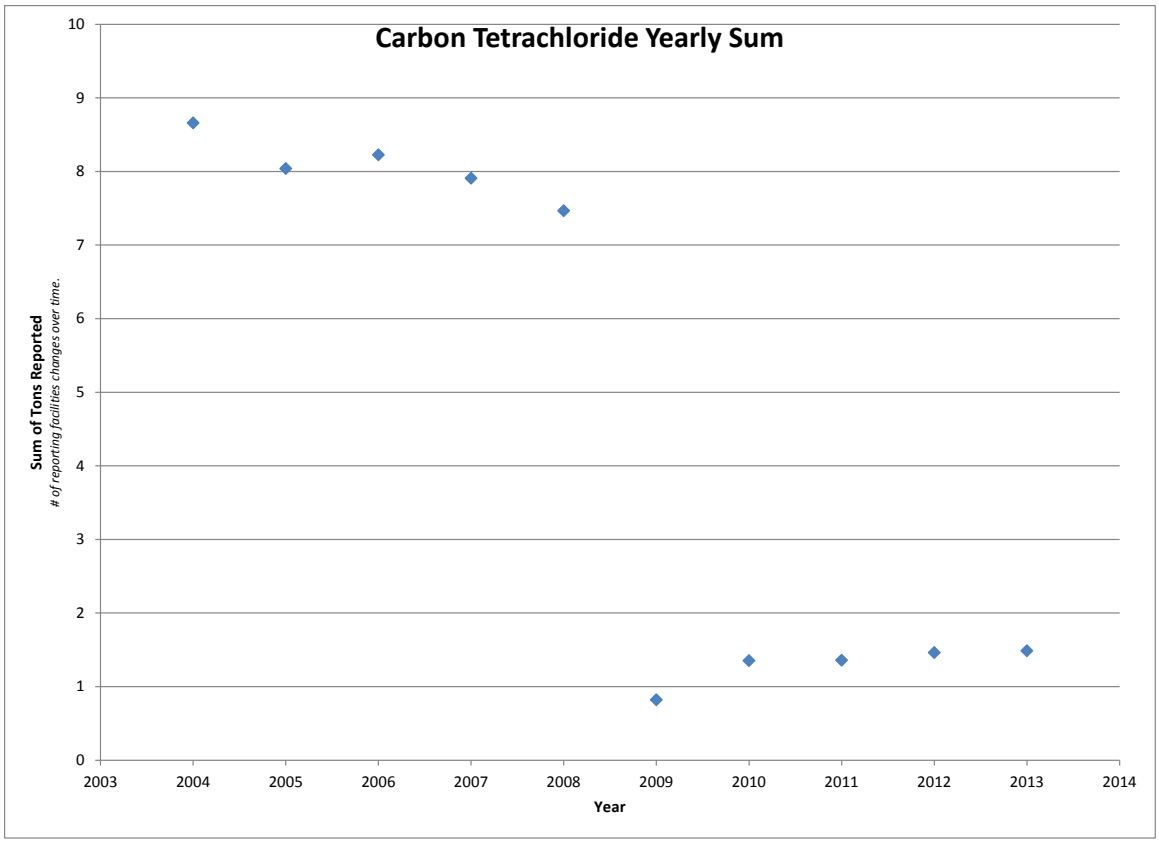
SOURCES: Uses have declined drastically, but carbon tetrachloride is still emitted from chemical and refining processes. The 2013 Air Quality Emission Inventory showed 1.49 tons reported. Carbon tetrachloride is a "global" pollutant with a background concentration of about 0.010 ppb.

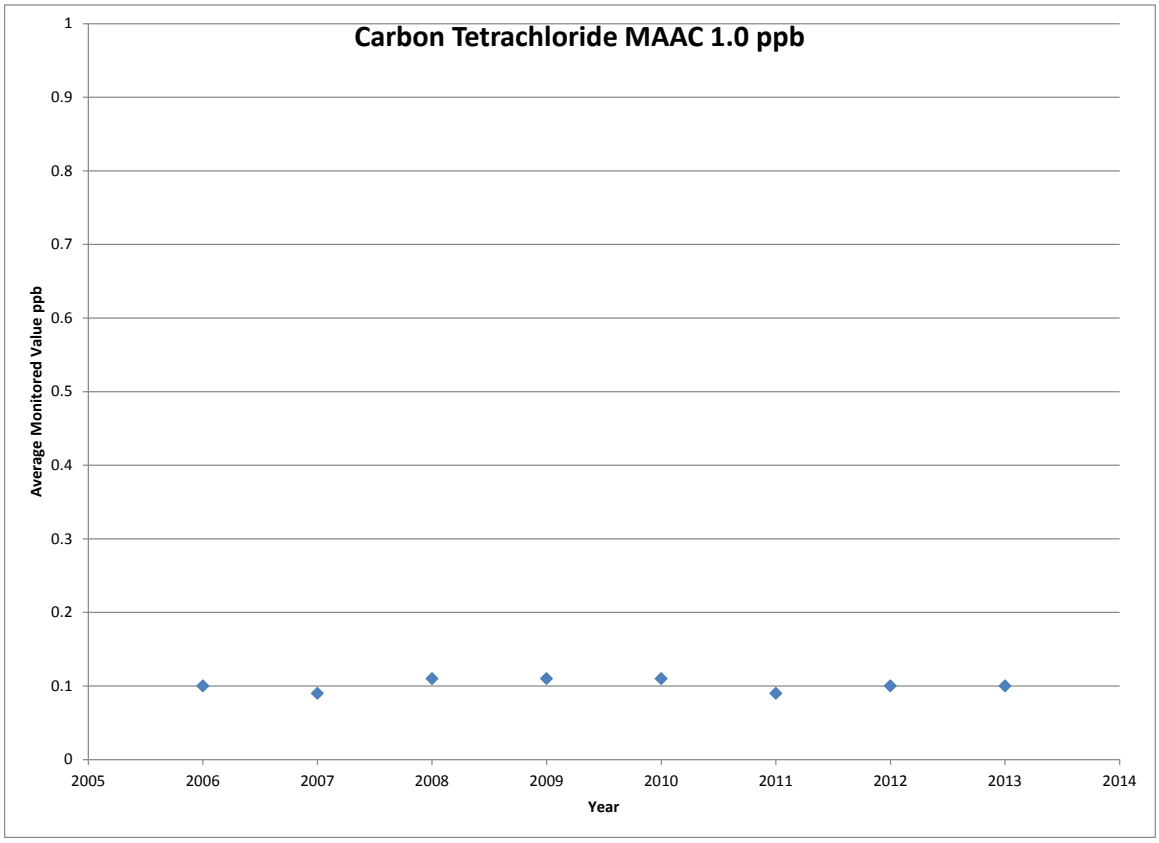
HEALTH EFFECTS: Probable carcinogen (liver cancer) based on some human but mainly animal testing. Non-cancer effects: Carbon tetrachloride is a central nervous system depressant and mild eye and respiratory tract irritant. It is highly hepato- and nephro- toxic.

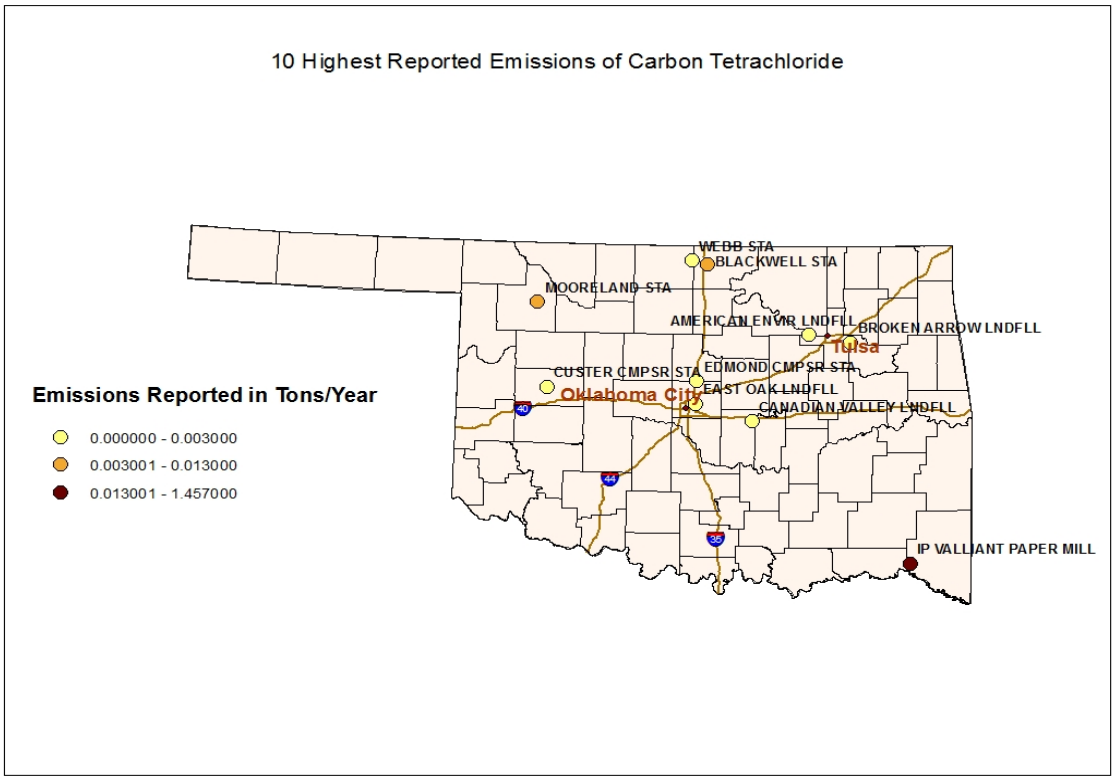
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.024 ppb.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

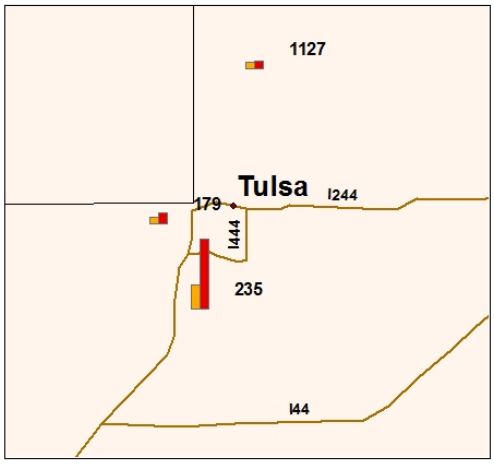
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.11 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.09 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.10 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.10 ppb


Carbon Tetrachloride Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Carbon Tetrachloride MAAC 1.0 ppb
Average Monitored Value ppb
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Carbon Tetrachloride



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.12	0.1	49
YUOK	101	0.12	0.1	30
Tulsa 1	235	1.06	0.37	60
Tulsa 2	1127	0.13	0.1	41
Tulsa Riverside	179	0.15	0.1	62

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

CHLOROFORM

CAS # 67-66-3

SYNONYMS: trichlormethane; methane trichloride; methenyl chloride; trichloroform; TCM; methyl trichloride; methenyl trichloride

DESCRIPTION: formula $CHCl_3$, mol. wt. = 119.38 Chloroform is a clear colorless volatile liquid with an ethereal scent that is nonflammable and does not form explosive mixtures at atmospheric temperatures and pressures.

CARCINOGEN status (IRIS): PROBABLE

MAAC: 0.8 ppb (4.0 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

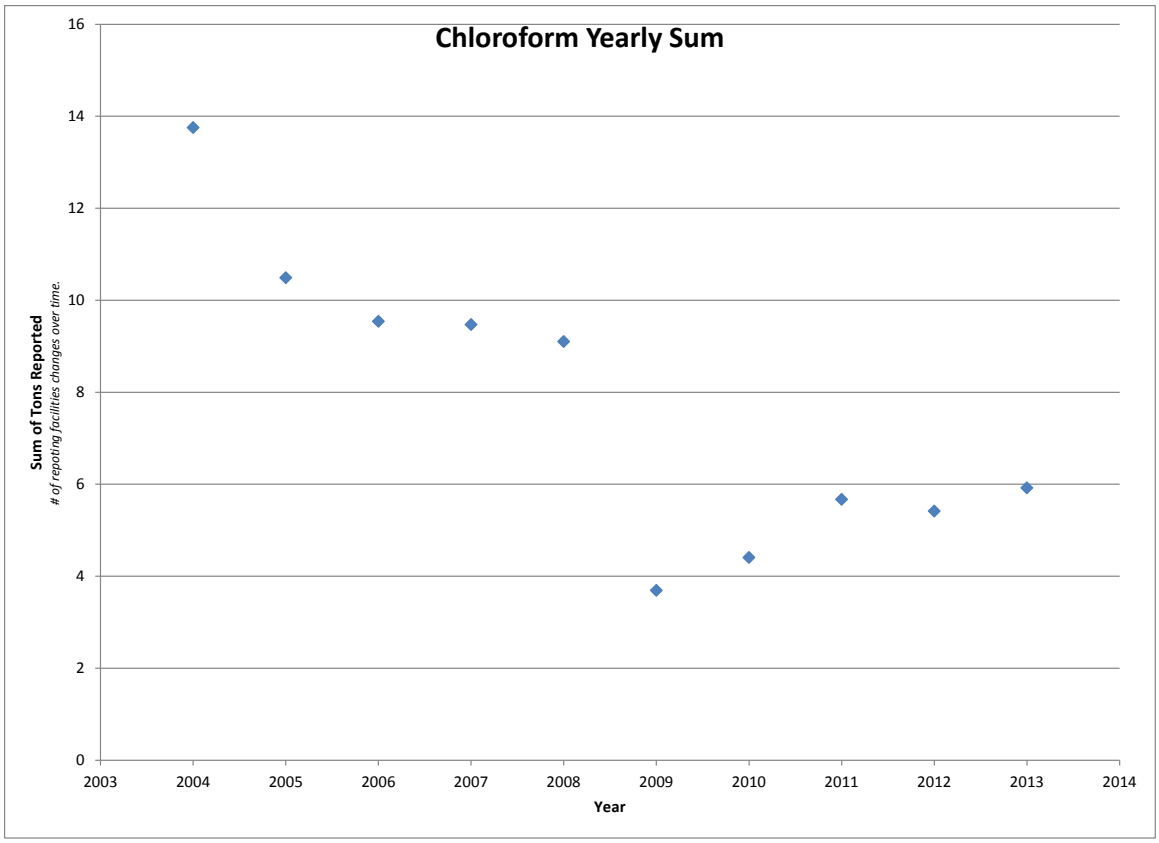
SOURCES: Many industrial, chemical, and manufacturing processes, especially pulp and paper. The 2013 Air Quality Emission Inventory showed 5.92 tons reported.

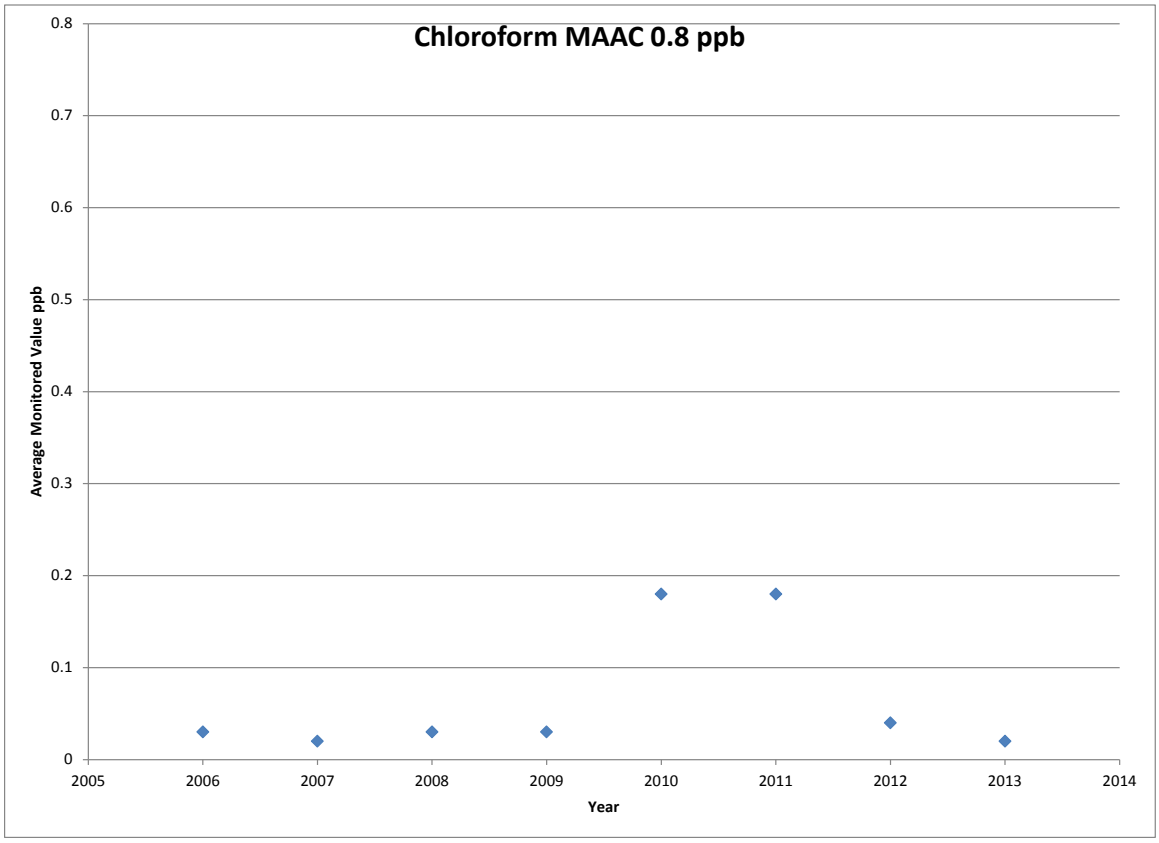
HEALTH EFFECTS: Chloroform has been shown to be carcinogenic in animals after oral exposures resulting in kidney and liver tumors. Non-Cancer effects: The vapors are irritating to the eyes and respiratory tract. Chloroform is a central nervous system depressant. At high levels it can also produce cardiac arrhythmias by sensitization to adrenaline. Chronic inhalation exposure to chloroform can damage the liver.

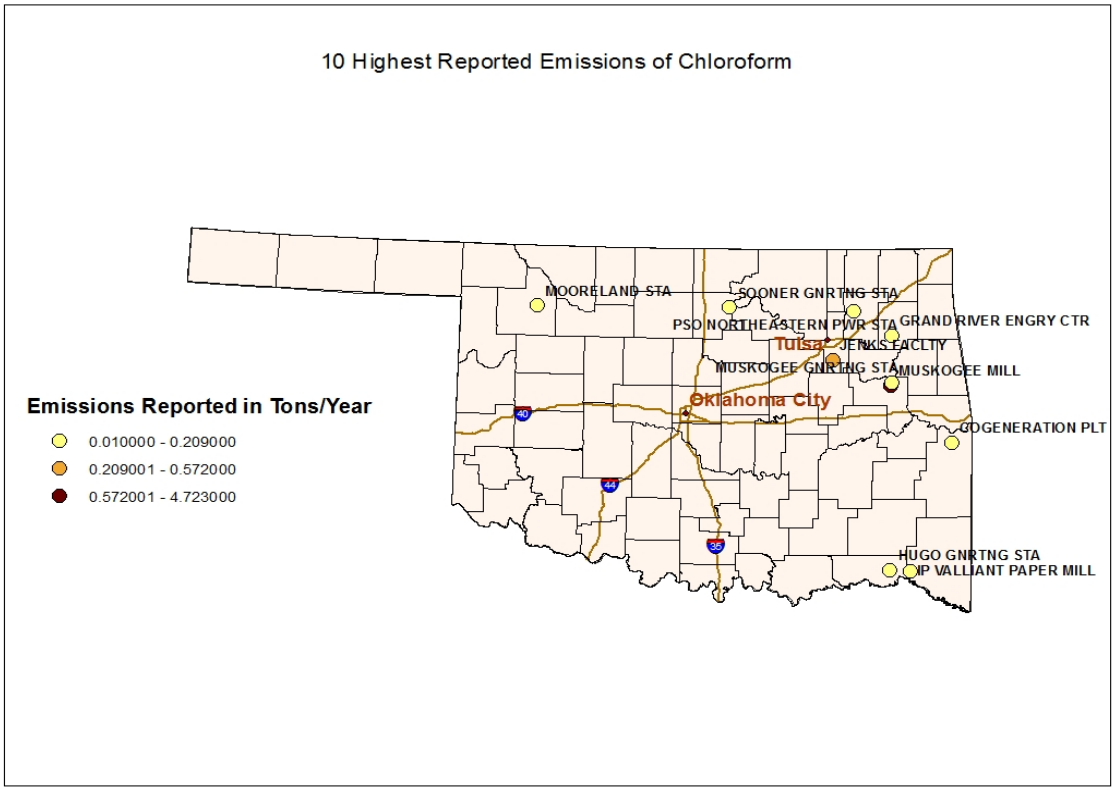
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.017 ppb

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

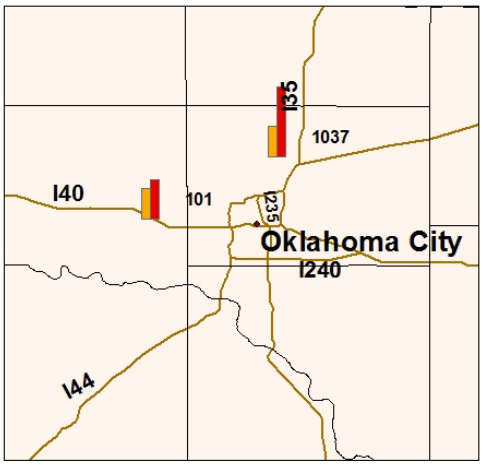
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.18 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.18 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.04 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.02 ppb

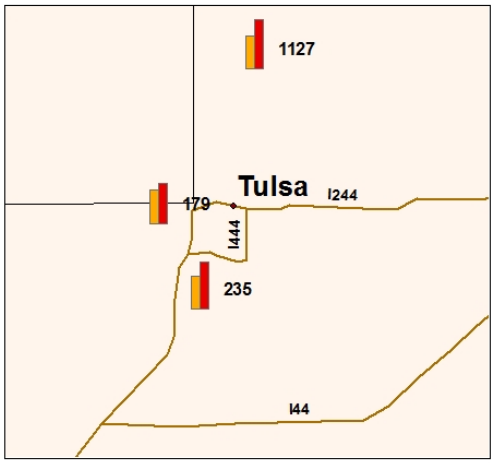

Chloroform Yearly Sum
Sum of Tons Reported
# of repoting facilities changes over time.
16
14
12
10
8
6
4
2
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Chloroform MAAC 0.8 ppb
Average Monitored Value ppb
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Chloroform





Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.05	0.02	34
YUOK	101	0.03	0.02	12
Tulsa 1	235	0.04	0.03	23
Tulsa 2	1127	0.04	0.02	28
Tulsa Riverside	179	0.03	0.02	30

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

CHROMIUM Compounds (HEXAVALENT)

CAS # NOT APPLICABLE - Group

SYNONYMS: no common synonyms

DESCRIPTION: formula Cr^{+6}, a very large group of compounds.

CARCINOGEN status (IRIS): KNOWN

MAAC: 0.008 $^{\mu g}/m^3$ 24-hour average (no equivalent ppm value because the MAAC is for a group of compounds)

MAAC is based on IRIS 10^{-4} inhalation risk value.

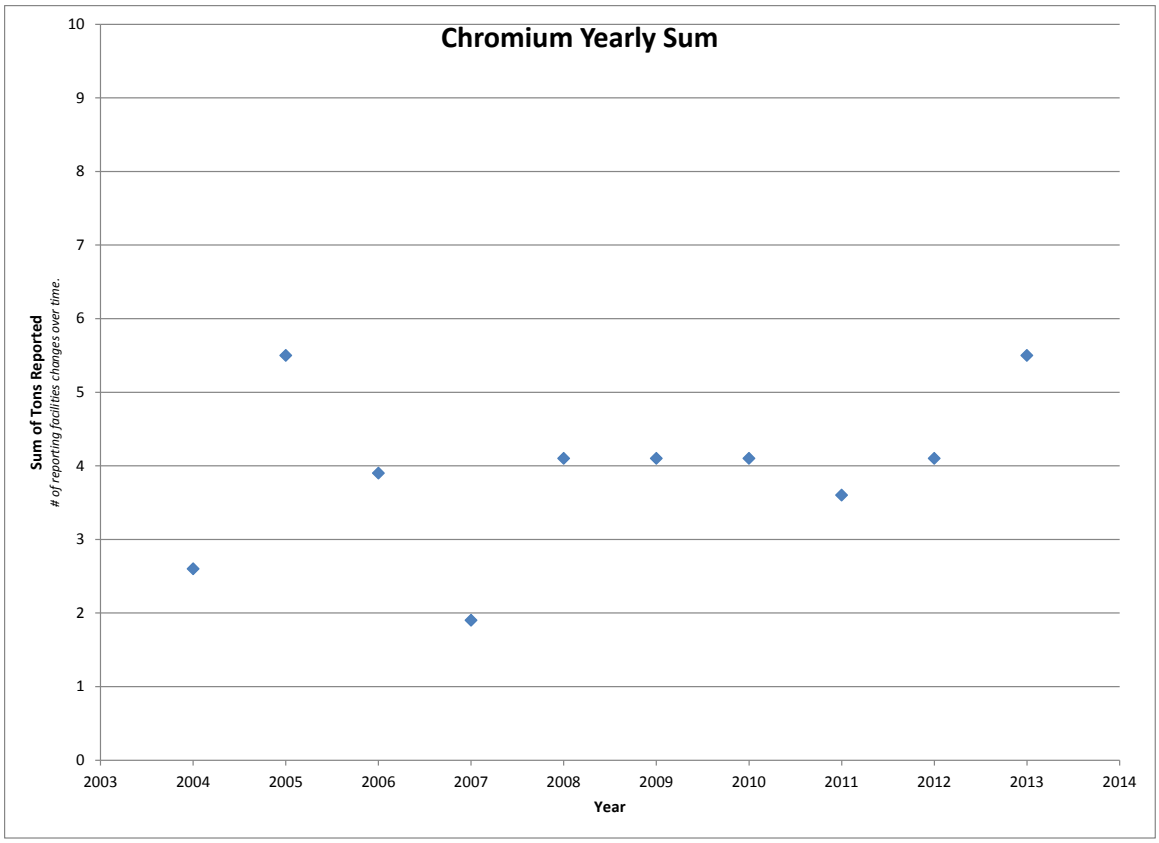
SOURCES: Many industrial, chemical, and manufacturing processes, especially plating and anodizing. The 2013 Air Quality Emission Inventory showed 5.5 tons of all chromium compounds reported.

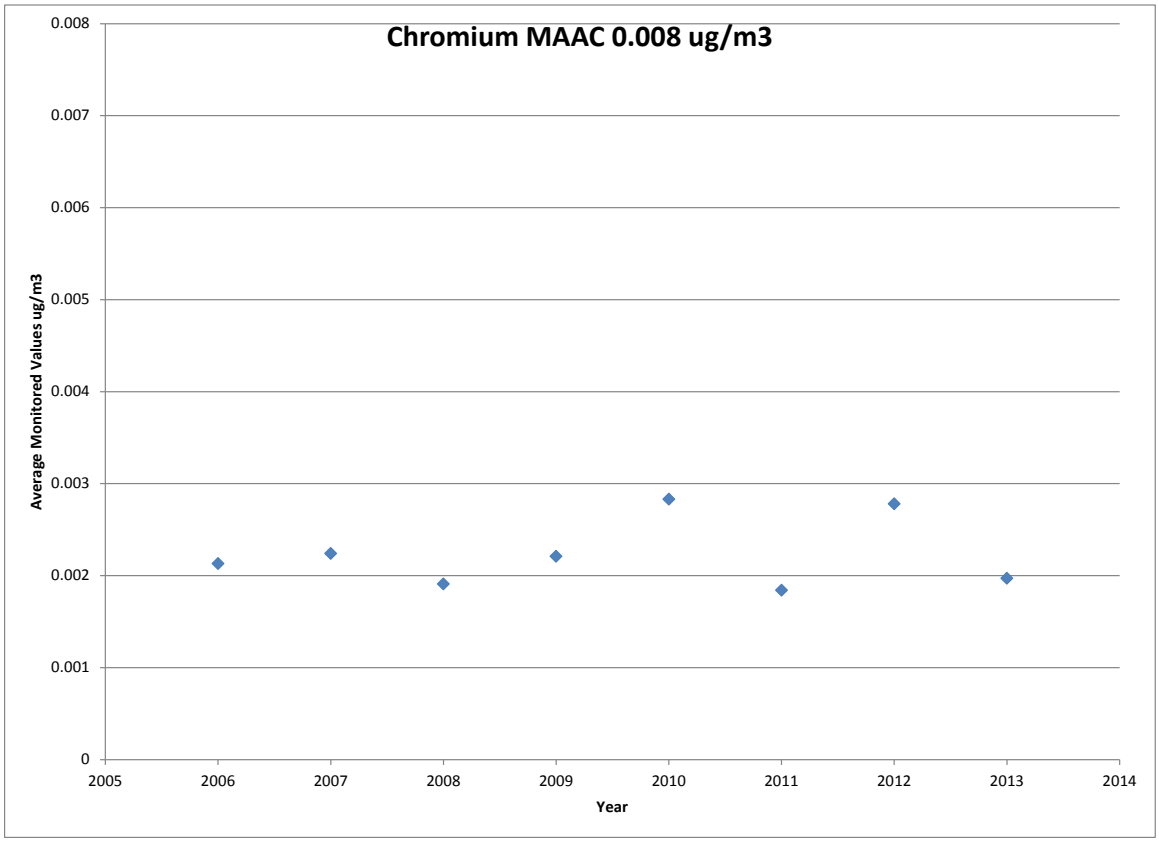
HEALTH EFFECTS: Well-documented carcinogen, lung cancer.

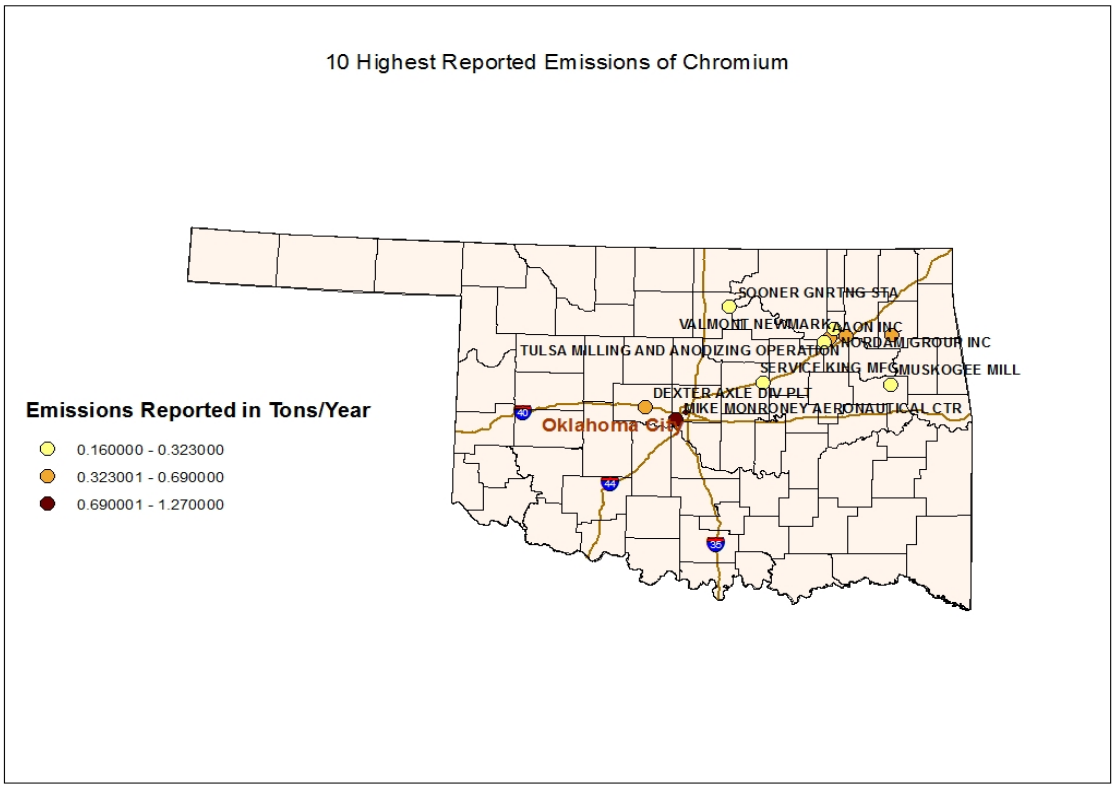
MONITORING METHODS: Modified CARB Method for hexavalent chromium compounds. The accepted Method Detection Limit (MDL) for hexavalent chromium is 2.11 ng/m^3.

ACTUAL MONITORED VALUES: Air Quality samples for total Chromium compounds and uses that as a surrogate for Hexavalent Chromium. Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

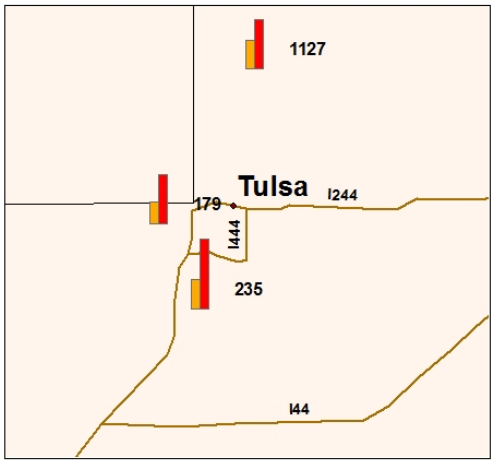
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00283 ug/m^3
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00184 ug/m^3
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00278 ug/m^3
2013 (Tulsa, Oklahoma City, Yukon) = 0.00197 ug/m^3


Chromium Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Chromium MAAC 0.008 ug/m3
Average Monitored Values ug/m3
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	2.69	1.9	43
YUOK	101	2.73	1.92	31
Tulsa 1	235	6.42	2.75	60
Tulsa 2	1127	4.48	2.65	32
Tulsa Riverside	179	4.42	1.97	34

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

ETHYLBENZENE

CAS # 100-41-4

SYNONYMS: phenylethane

DESCRIPTION: formula C_8-H_{10}, mol. wt. = 106.16 Colorless, flammable liquid with strong aromatic odor.

CARCINOGEN status (IRIS): Not Classifiable

MAAC: 10, 000 ppb or 10 ppm (43,427 $^{\mu g}/m^3$) 24-hour average

MAAC would be based on the No-Observed Adverse Effect Level (NOAEL) Human Equivalent Concentration (HEC) (100 ppm) but in 2005 the MAAC set by SC 41 was 10 ppm. To avoid "back-sliding" the level was kept at the SC 41 MAAC of 10 ppm in Appendix O.

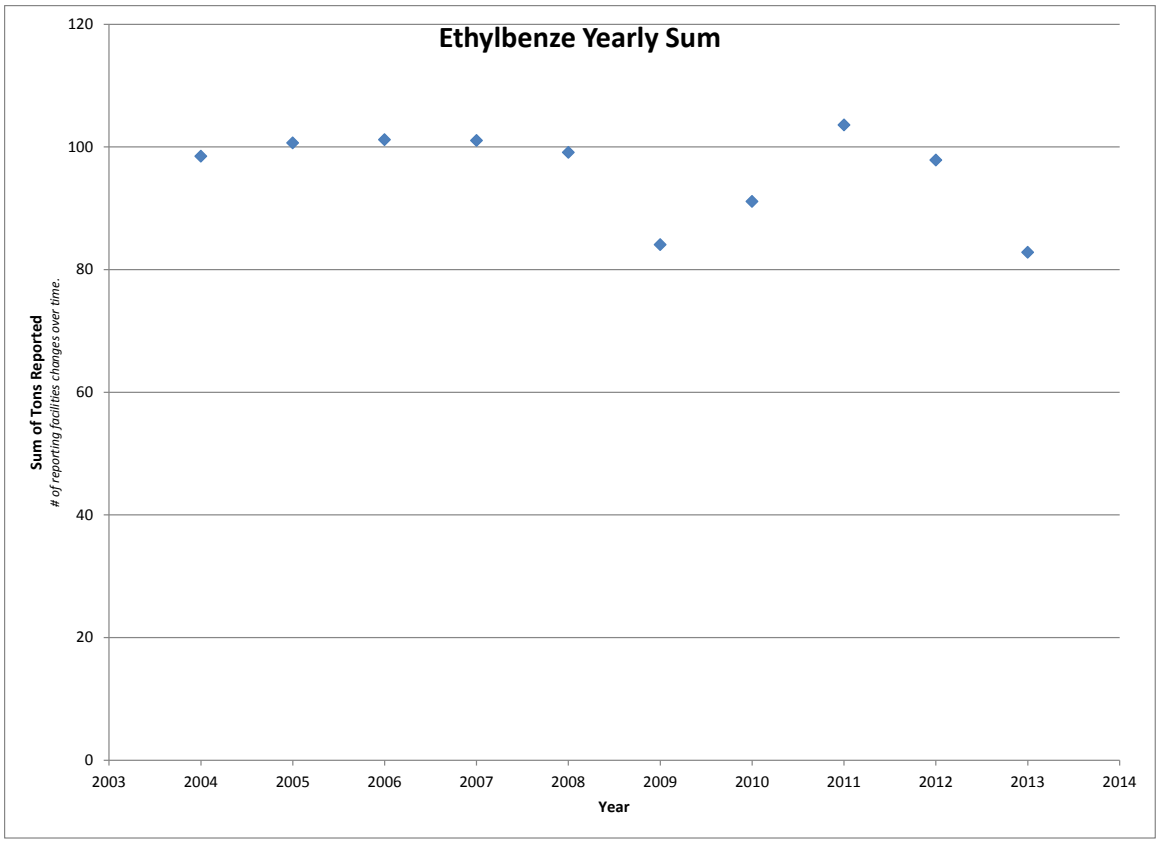
SOURCES: Many industrial, chemical, and manufacturing processes, especially in styrene production and as a solvent, and gasoline combustion. The 2013 Air Quality Emission Inventory showed 82.8 tons reported. The AQD does not have an accurate emission inventory for ethylbenzene from mobile sources.

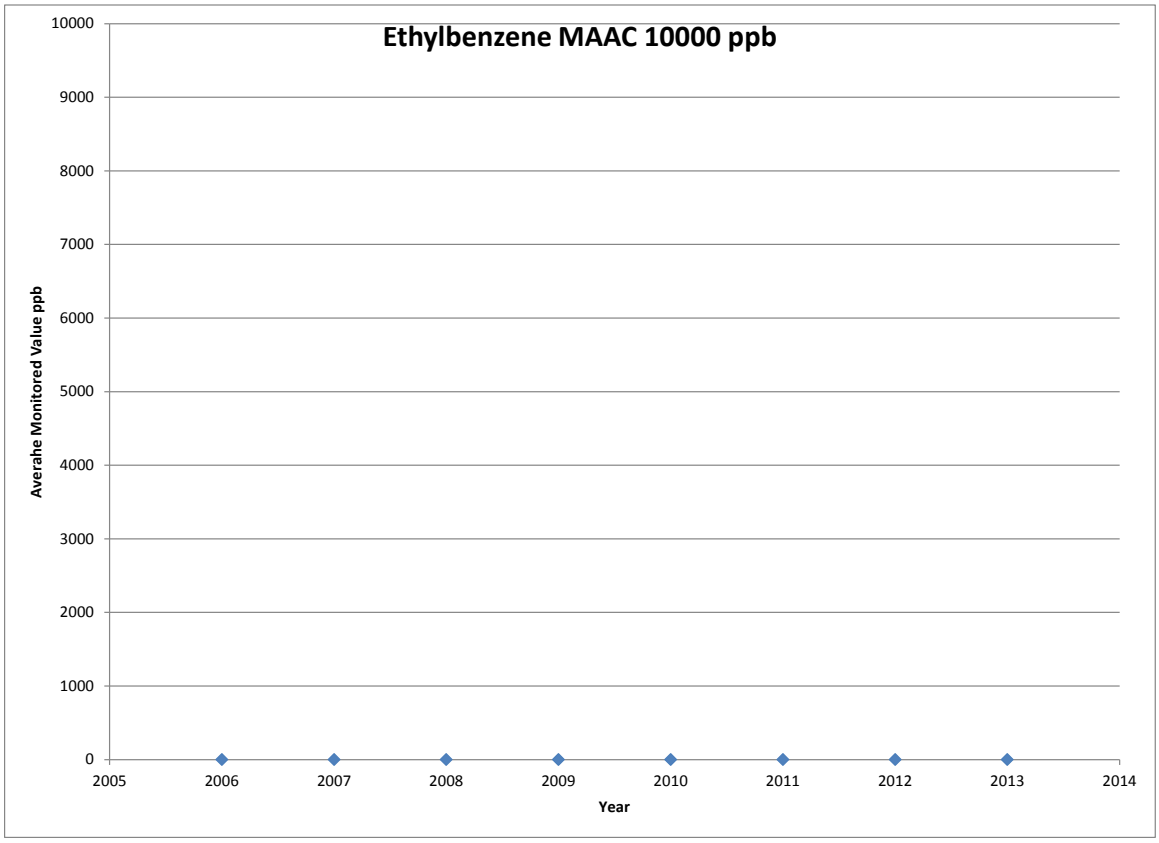
HEALTH EFFECTS: Ethylbenzene is a central nervous system depressant at high levels of exposure. Ethylbenzene is also irritating to the eyes and respiratory tract. Animal studies have shown effects on the blood, liver and kidneys from chronic inhalation exposure to ethylbenzene.

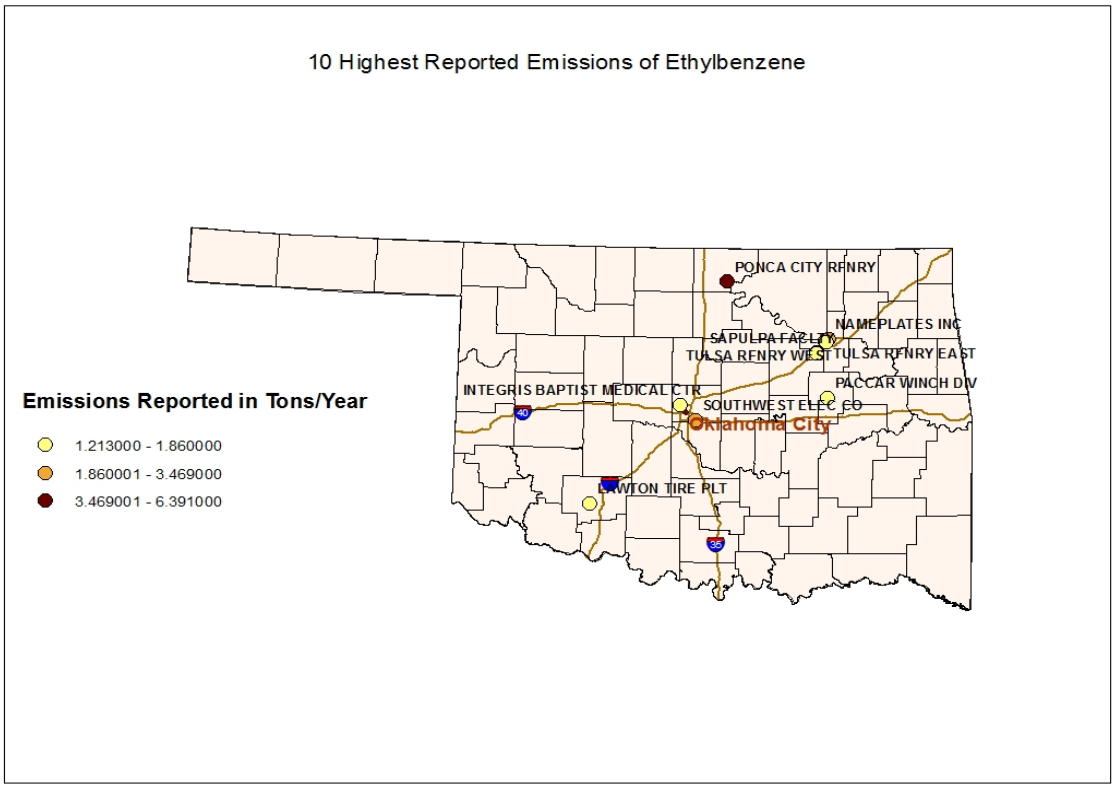
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.012 ppb .

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

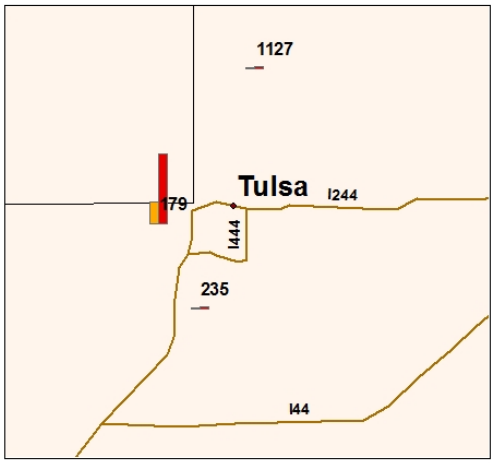
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.08 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.09 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.06 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.05 ppb


Ethylbenze Yearly Sum
Sum of Tons Reported
# of reporting facilites changes over time.
120
100
80
60
40
20
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Ethylbenzene MAAC 10000 ppb
Averahe Monitored Value ppb
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Ethylbenzene



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.06	0.01	11
YUOK	101	0.09	0.05	30
Tulsa 1	235	0.01	0.01	12
Tulsa 2	1127	0.01	0.01	13
Tulsa Riverside	179	0.31	0.09	62

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

ETHYLENE DICHLORIDE

CAS # 107-06-2

SYNONYMS: 1,2-dichloroethane; sym-dichloroethane; ethylene chloride; EDC; Dutch liquid; Brocide; 1,2-ethylene dichloride; ethane dichloride; Freon 150; Di-chlor-mulsion; glycol dichloride

DESCRIPTION: formula C_2-H_4-Cl_2, mol. wt. = 98.96 Ethylene dichloride is a heavy, oily, liquid which burns with a smoky flame. Usually it is colorless but it will darken in the presence of air, moisture, and light. It has a chloroform-like odor and irritating vapors.

CARCINOGEN status (IRIS): PROBABLE

MAAC: 1 ppb (4 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

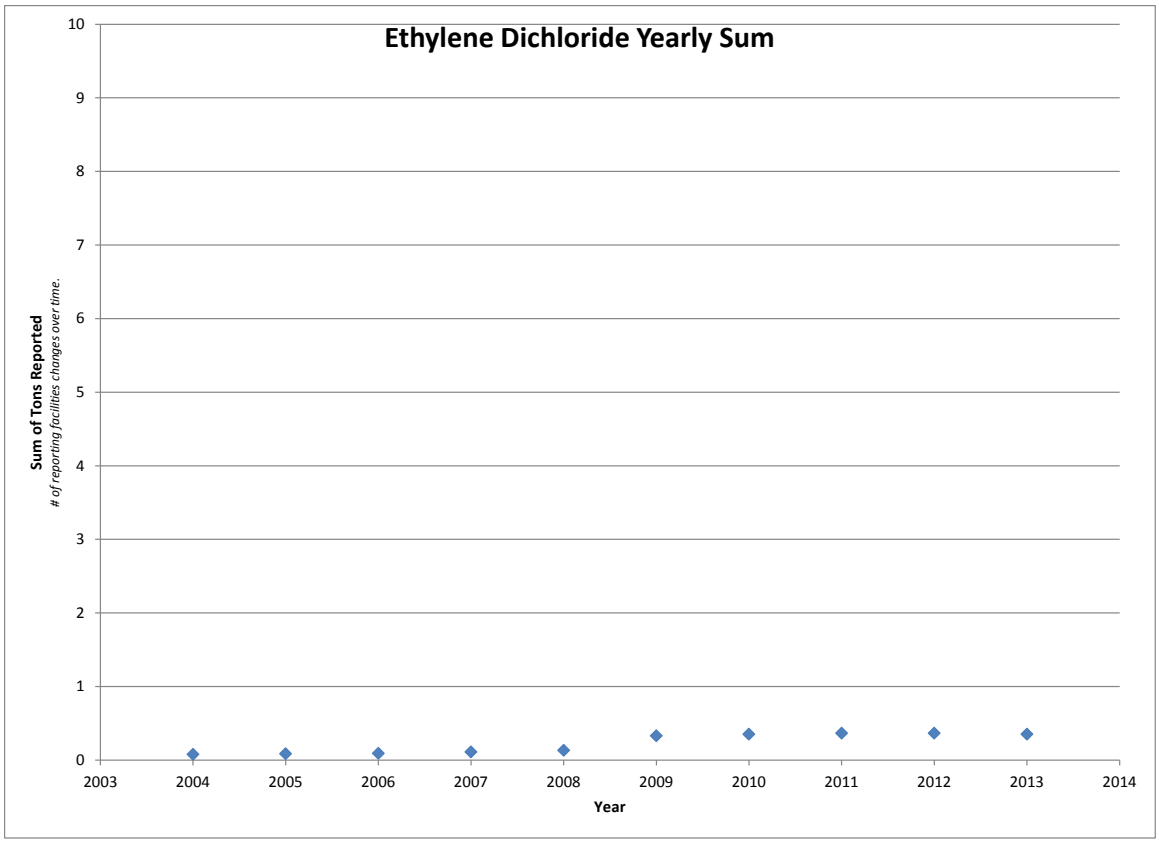
SOURCES: Many industrial, chemical, and manufacturing processes, previously in leaded gasoline combustion. The 2013 Air Quality Emission Inventory showed 0.351 tons reported.

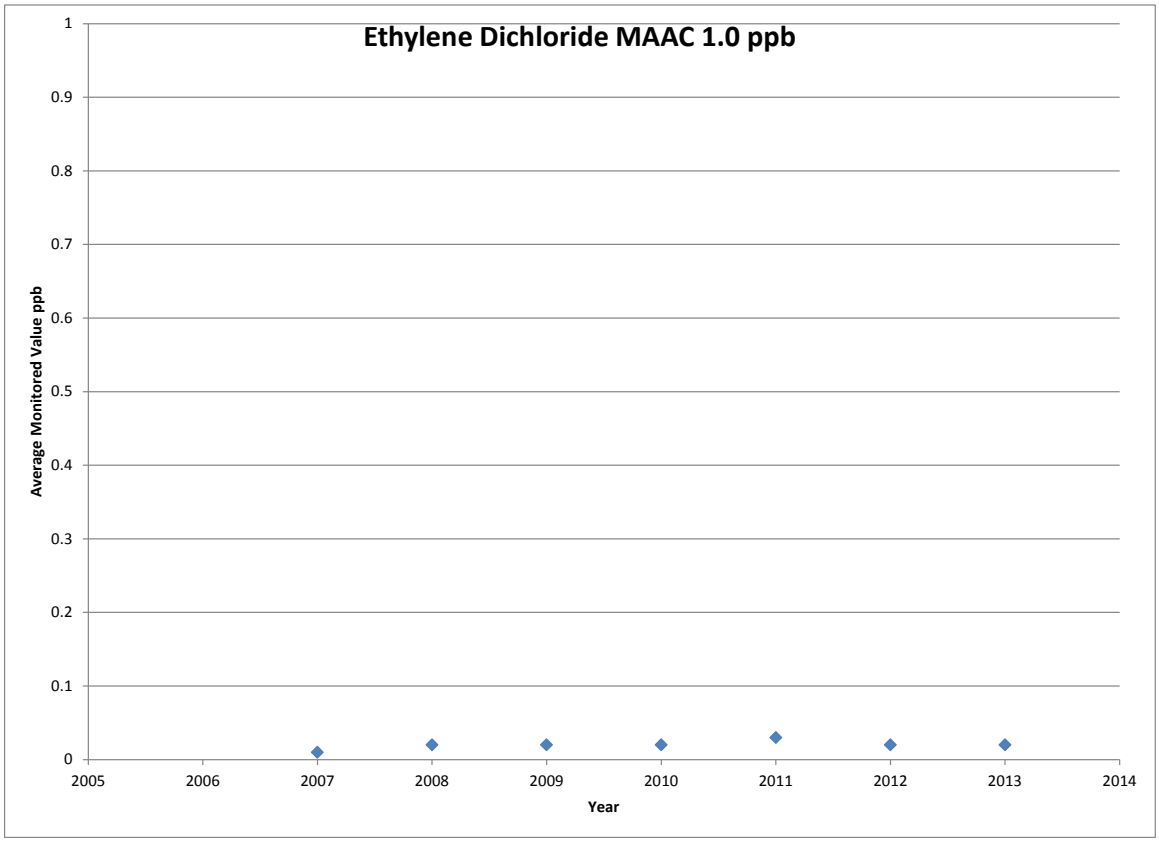
HEALTH EFFECTS: Probable carcinogen (colon and renal) based on animal studies and limited epidemiological information. Vapors are irritating to eyes and respiratory tract. Ethylene dichloride is highly nephrotoxic and hepatotoxic and a central nervous system (CNS) depressant at high levels.

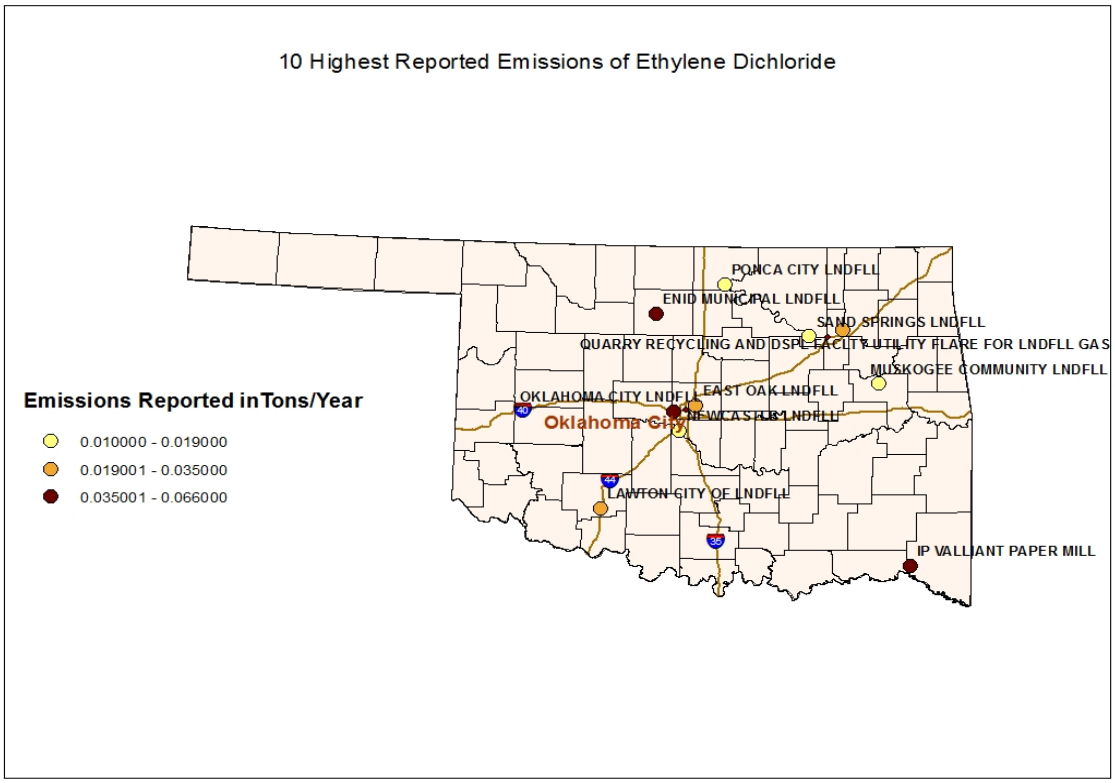
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.015 ppb.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

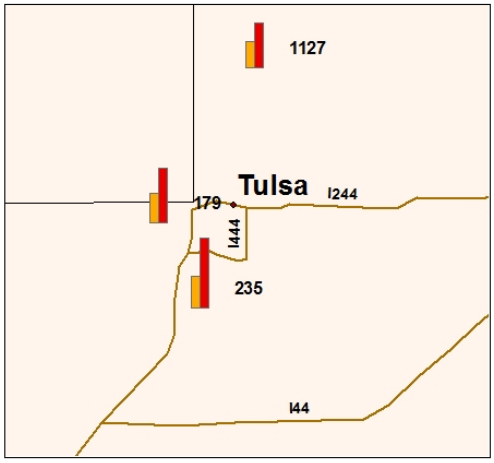
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.02 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.03 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.02 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.02 ppb


Ethylene Dichloride Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Ethylene Dichloride MAAC 1.0 ppb
Average Monitored Value ppb
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Ethylene Dichloride



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.03	0.02	43
YUOK	101	0.03	0.02	19
Tulsa 1	235	0.06	0.03	32
Tulsa 2	1127	0.04	0.02	35
Tulsa Riverside	179	0.05	0.03	38

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

FORMALDEHYDE

CAS # 50-00-0

SYNONYMS: methanal; formic aldehyde; oxomethane; oxymethylene; methylene oxide; methyl aldehyde; formalin; formic aldehyde; formal; morbici

DESCRIPTION: formula CH_2O, mol. wt. = 30.03. A colorless gas at room temperature with pungent odor.

CARCINOGEN status (IRIS): PROBABLE

Note: The International Agency for Research on Cancer (IARC) classifies formaldehyde as a known carcinogen

MAAC: 7 ppb (8 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

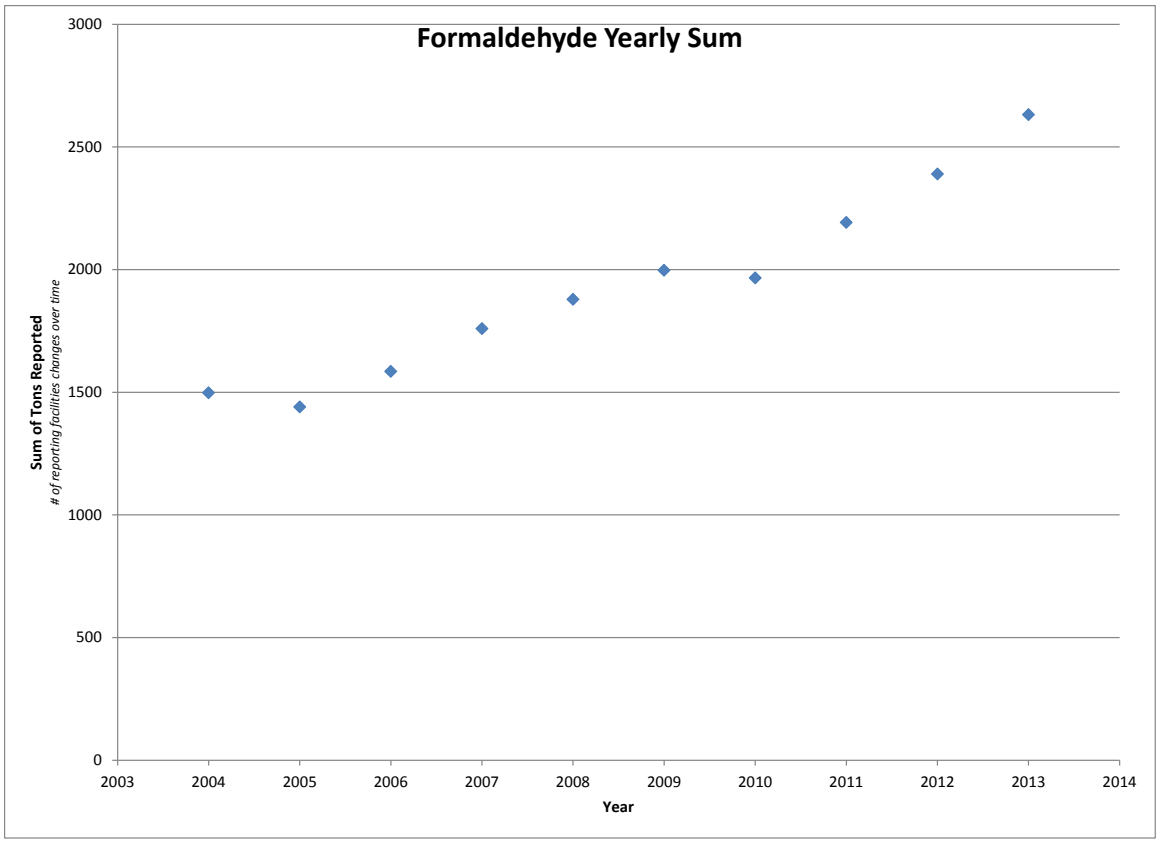
SOURCES: Many industrial, chemical, and manufacturing processes and any fuel combustion sources; it is also formed by photochemical processes. The 2013 Air Quality Emission Inventory showed 2628 tons reported. The AQD does not have an accurate emission inventory for formaldehyde from mobile sources.

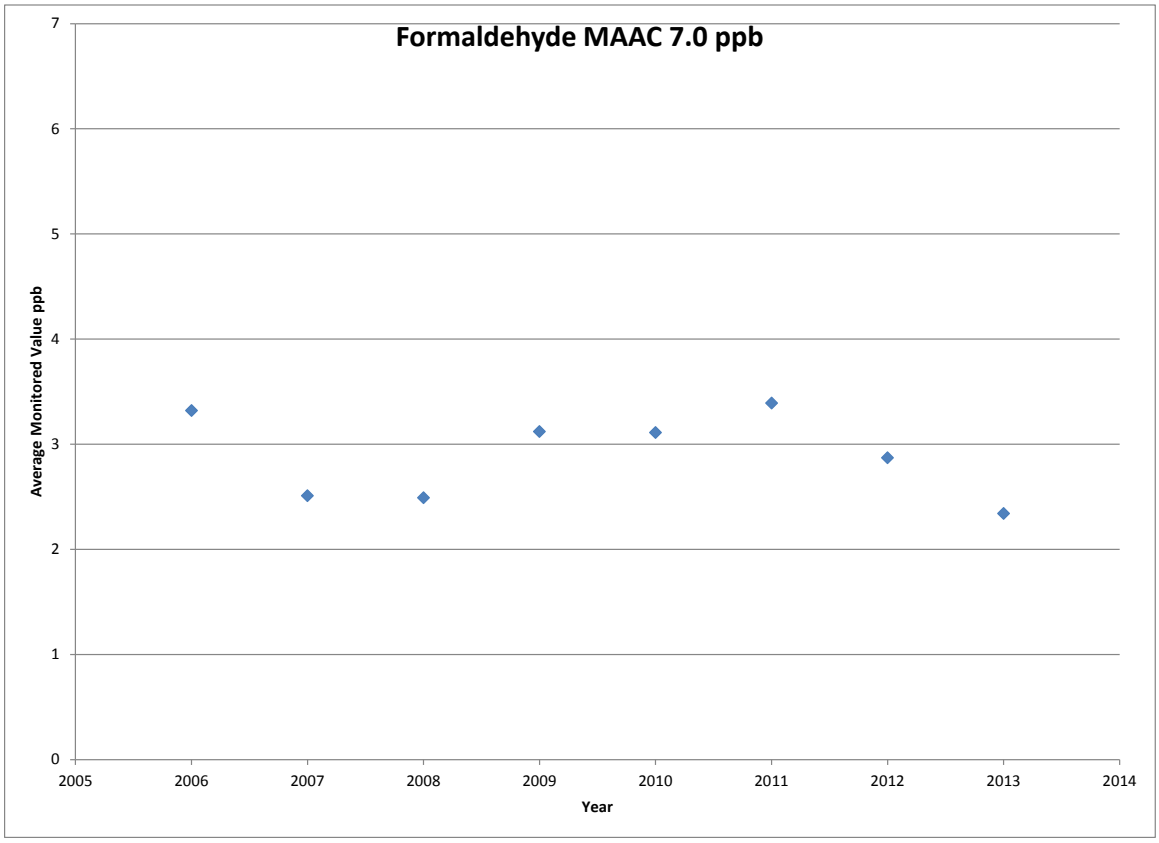
HEALTH EFFECTS: Probable human carcinogen based on limited human and animal testing, for lung and nasopharyngeal cancer. Non-Cancer effects: Vapors are highly irritating to the eye and respiratory track. Acute effects include nausea, headaches, and difficulty breathing. Formaldehyde can also induce or exacerbate asthma.

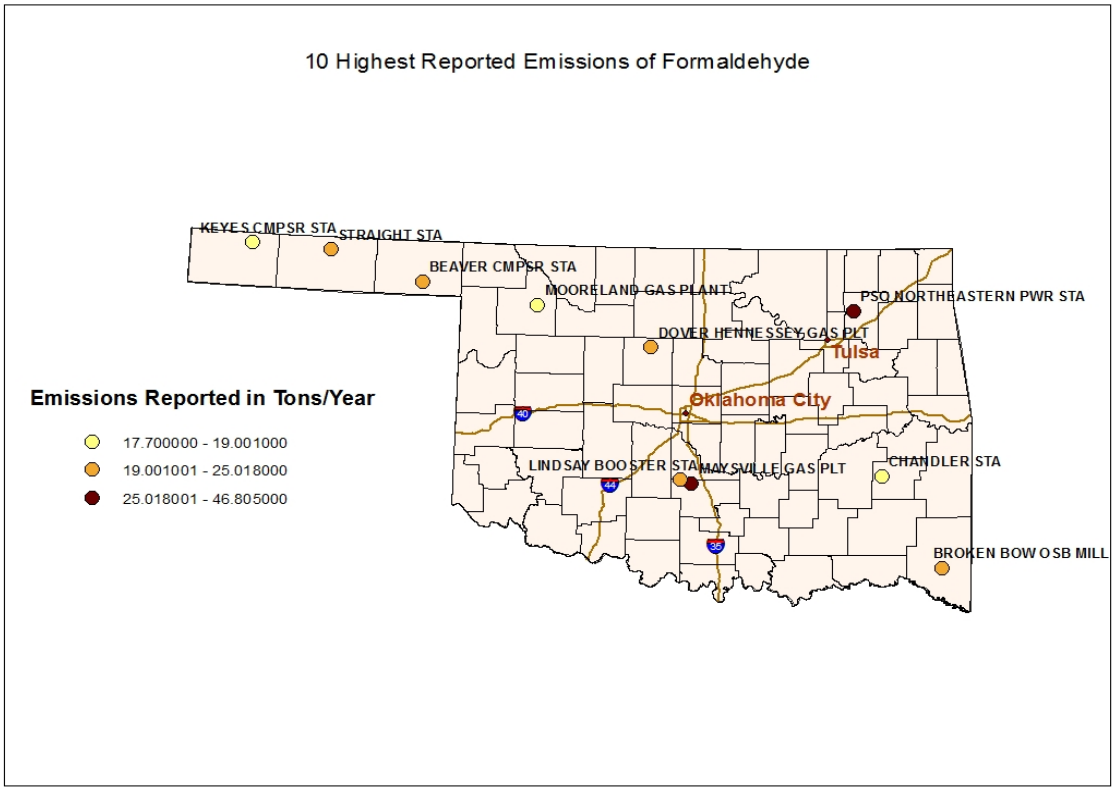
MONITORING METHODS: EPA TO-11A. This method currently has a Method Detection Limit (MDL) of 0.003 ppb.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

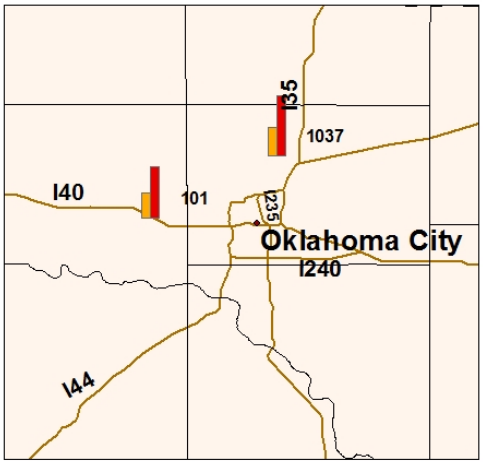
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 3.11 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 3.39 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 2.87 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 2.34 ppb

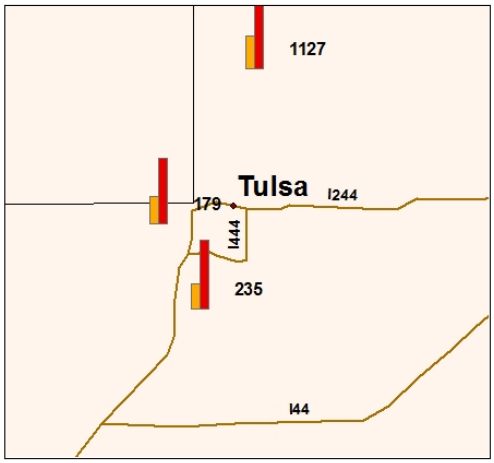

Formaldehyde Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time
3000
2500
2000
1500
1000
500
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Formaldehyde MAAC 7.0 ppb
Average Monitored Value ppb
7
6
5
4
3
2
1
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Formaldehyde





Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	5.61	2.72	39
YUOK	101	4.78	2.35	30
Tulsa 1	235	6.43	2.33	61
Tulsa 2	1127	6.51	3.11	51
Tulsa Riverside	179	6.06	2.49	45

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

MANGANESE Compounds

CAS # NOT APPLICABLE - Group

SYNONYMS: no common synonyms

DESCRIPTION: formula Mn-. There are many compounds of manganese

CARCINOGEN status (IRIS): NA

MAAC: 50 $^{\mu g}/m^3$ 24-hour average (no equivalent ppm value because the MAAC is for a group of compounds)

MAAC is based on the IRIS inhalation Lowest Observed Adverse Effect Level (LOAEL) Human Equivalent Concentration (HEC).

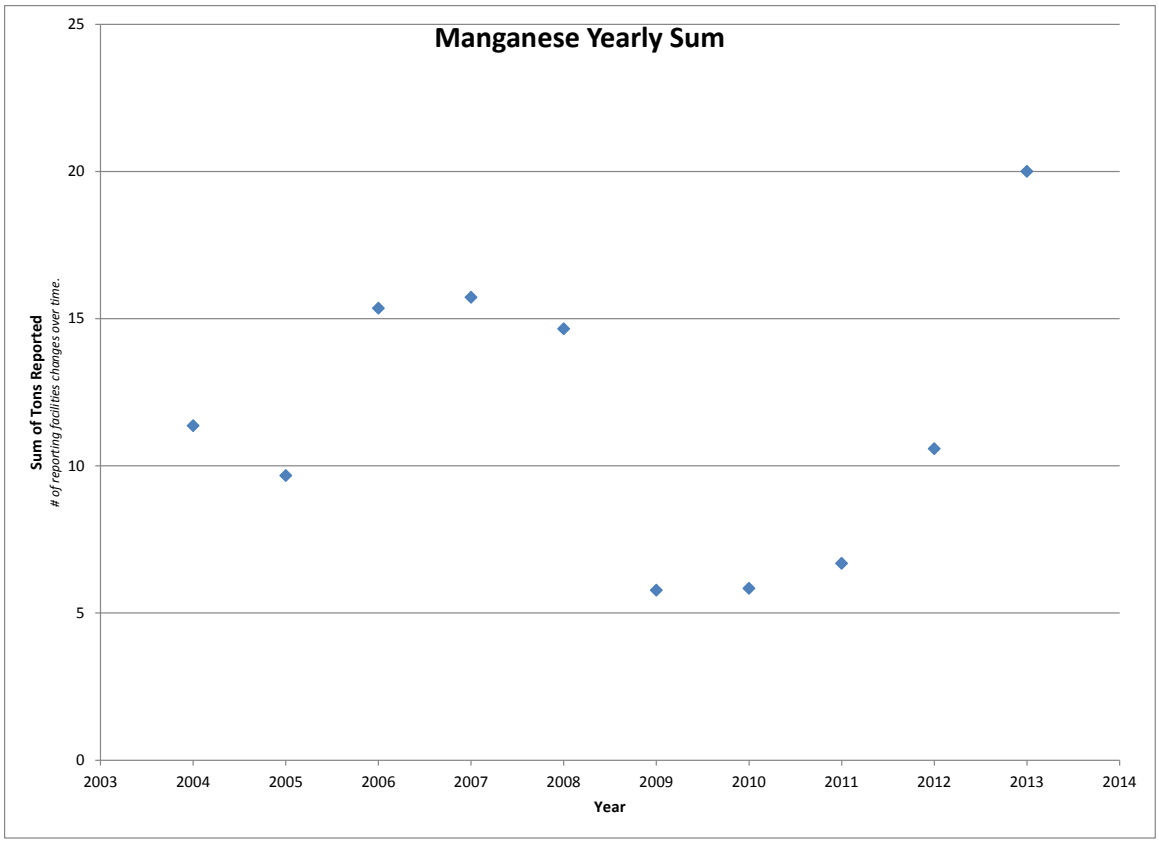
SOURCES: Many industrial processes, rock crushing, electric services, and petroleum refining. The 2013 Air Quality Emission Inventory showed 19.99 tons reported.

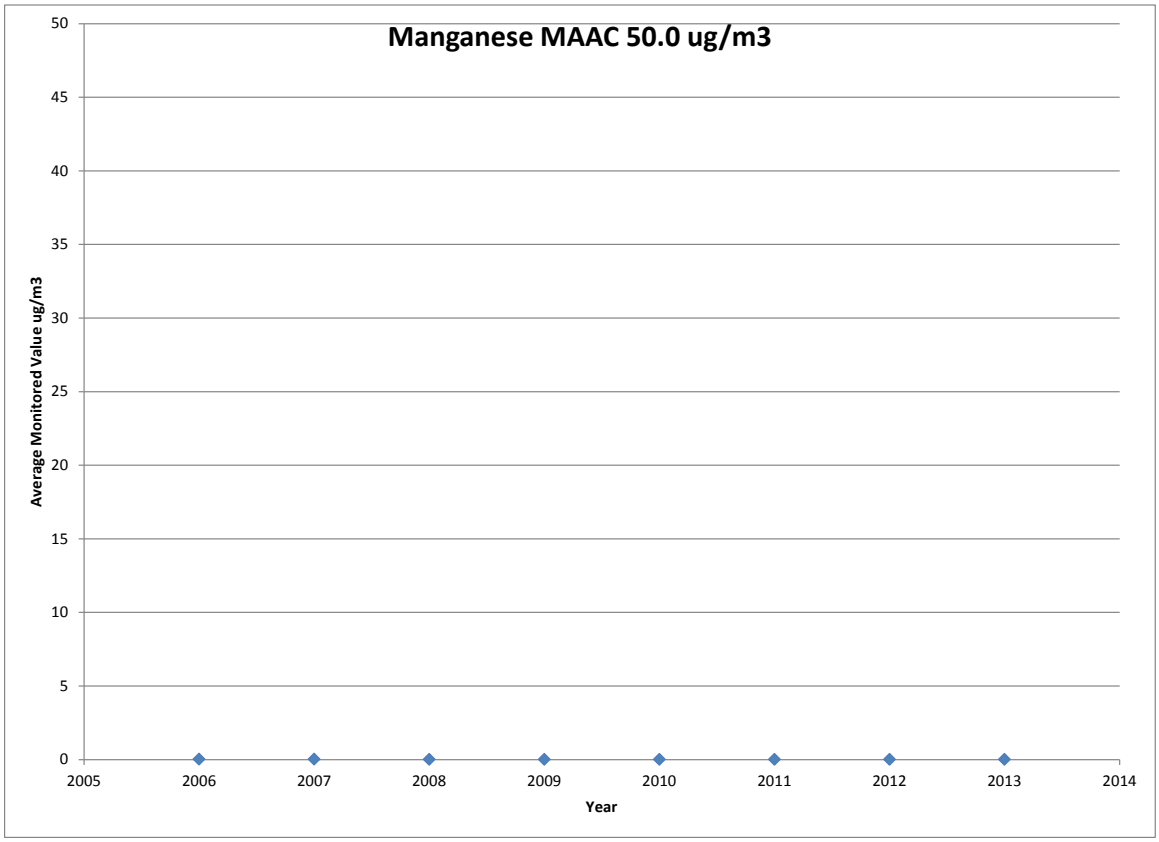
HEALTH EFFECTS: Affects respiratory, central, and peripheral nervous systems.

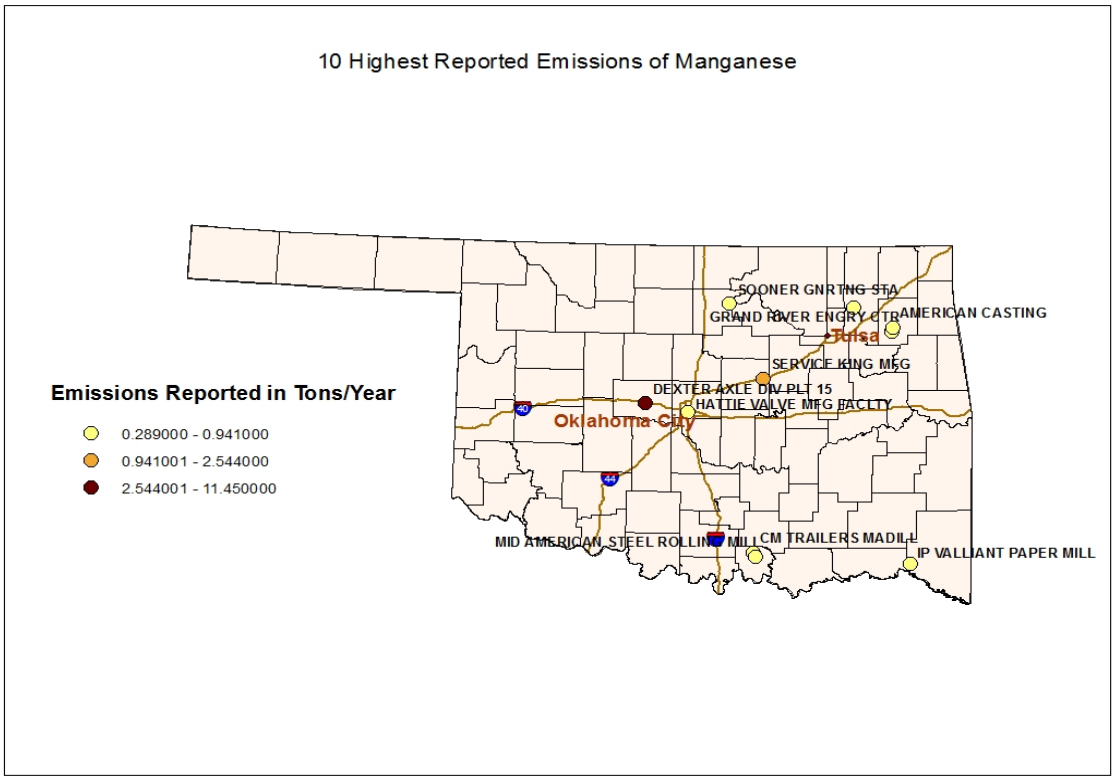
MONITORING METHODS: EPA IO-2 Hi-Vol and EPA IO-3.5 ICP/MS. The accepted Method Detection Limit (MDL) is 0.254 ng/m^3.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

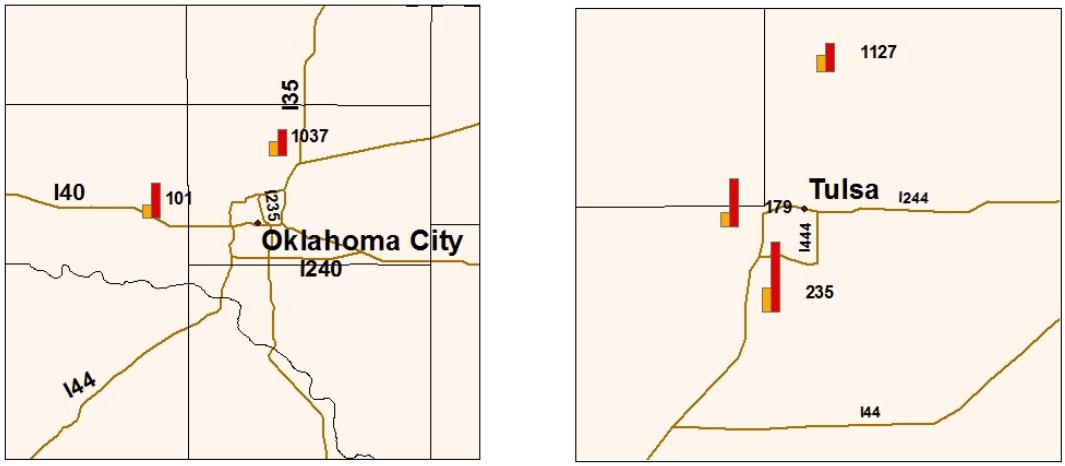
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0202 ug/m^3
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0179 ug/m^3
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0207 ug/m^3
2013 (Tulsa, Oklahoma City, Yukon) = 0.0160 ug/m^3


Manganese Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
25
20
15
10
5
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Manganese MAAC 50.0 ug/m3
Average Monitored Value ug/m3
50
45
40
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Manganese



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	29.6	15.75	43
YUOK	101	38.8	14.95	31
Tulsa 1	235	77.7	26.63	60
Tulsa 2	1127	31.5	18.15	32
Tulsa Riverside	179	52.6	15.19	34

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

MERCURY Compounds

CAS # NOT APPLICABLE - Group

SYNONYMS: no common synonyms

DESCRIPTION: formula Hg-, several compounds exist.

CARCINOGEN status (IRIS): NA

MAAC: 0.3 $^{\mu g}/m^3$ 24-hour average (no equivalent ppm value because the MAAC is for a group of compounds)

MAAC is based on the IRIS Inhalation Reference Concentration (RfC) value.

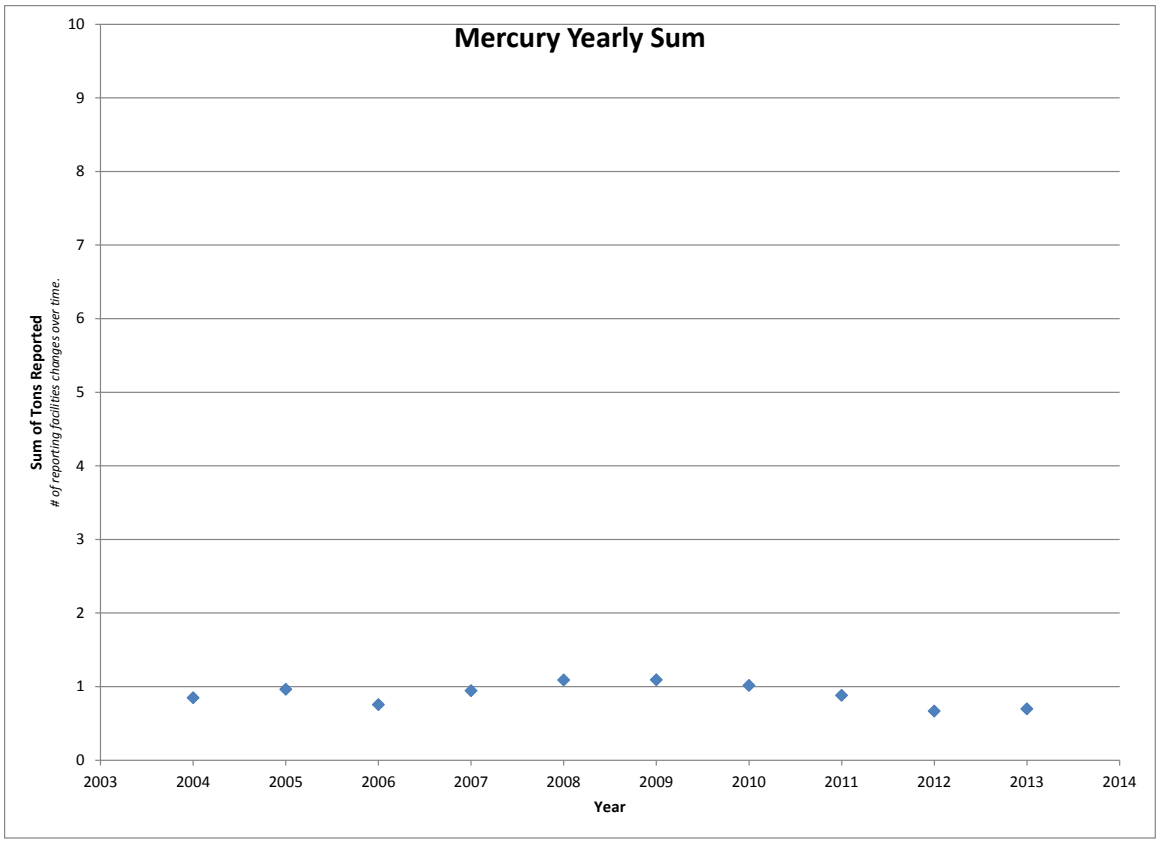
SOURCES: Used in the manufacture of dry cell batteries, fluorescent light bulbs, agricultural pesticides, antifouling paint, electrical apparatus, electrolytic preparation of chlorine and caustic soda, as a catalyst in the oxidation of organic compounds, electrical services, hydraulic cement manufacturing, and petroleum production. Mercury is also a globally transported pollutant. The 2013 Air Quality Emission Inventory showed 0.69 tons reported.

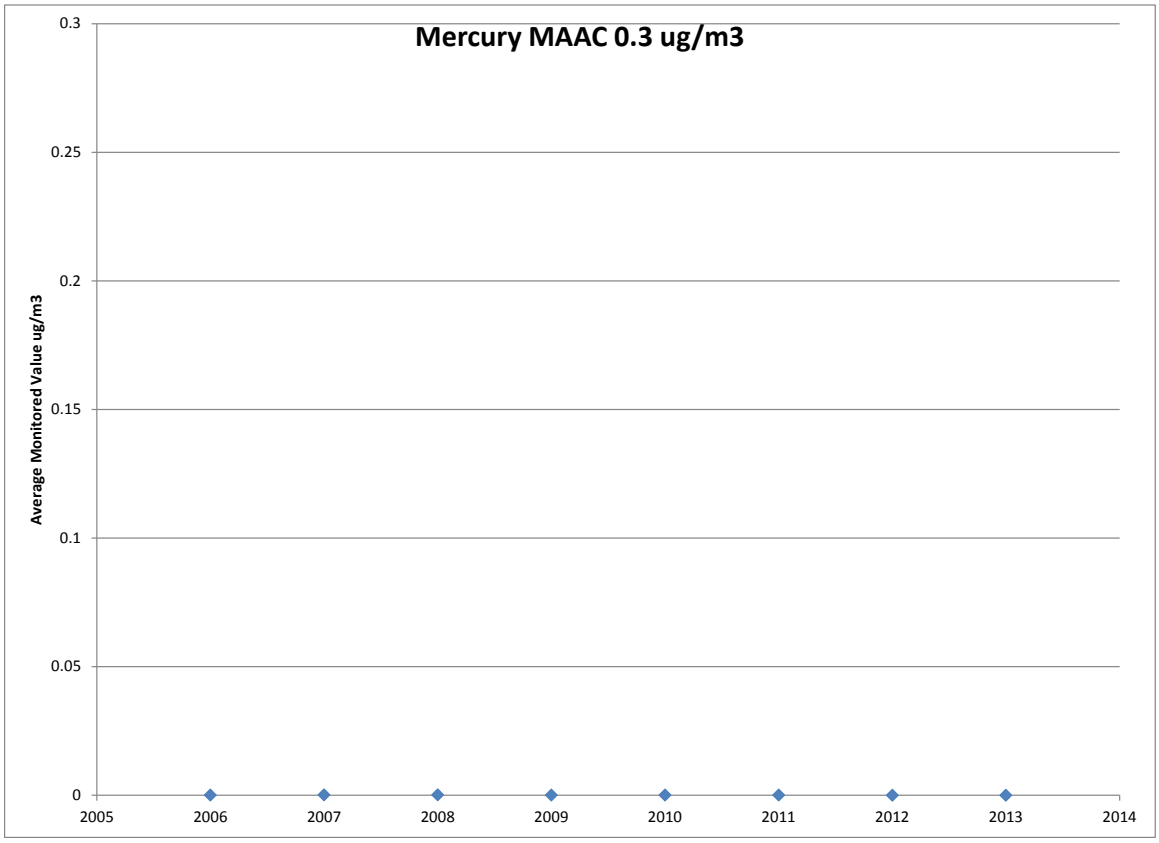
HEALTH EFFECTS: Increased incidence of tumors in rats and mice. Very well-documented toxin to renal and especially central nervous systems.

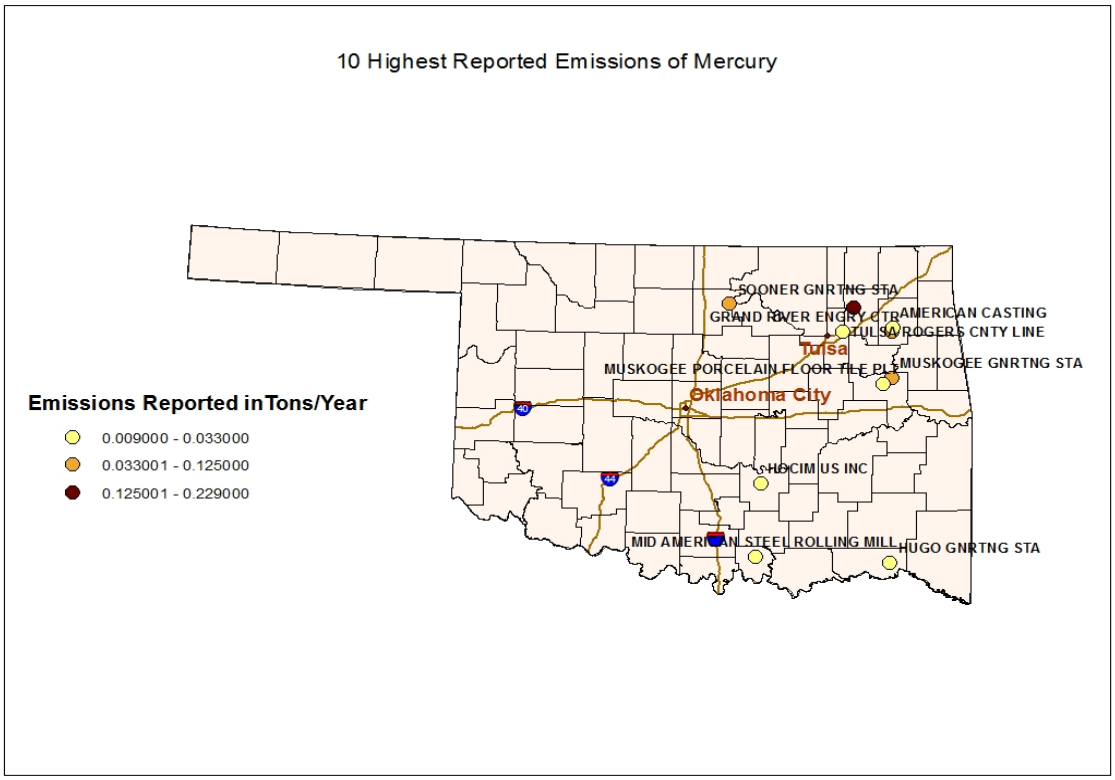
MONITORING METHODS: EPA IO-2 Hi-Vol and EPA IO-3.5 ICP/MS. The accepted Method Detection Limit (MDL) is 0.008 ng/m^3.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

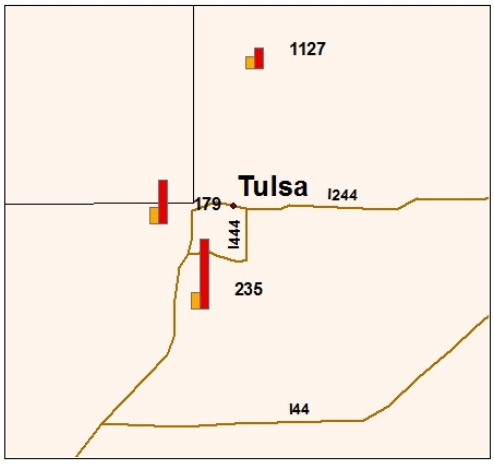
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00002 ug/m^3
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00005 ug/m^3
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00001 ug/m^3
2013 (Tulsa, Oklahoma City, Yukon) = 0.00001 ug/m^3


Mercury Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Mercury MAAC 0.3 ug/m3
Average Monitored Value ug/m3
0.3
0.25
0.2
0.15
0.1
0.05
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014



Monitoring Site Toxics Values Mercury



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.03	0.01	43
YUOK	101	0.02	0.01	31
Tulsa 1	235	0.09	0.02	60
Tulsa 2	1127	0.03	0.02	32
Tulsa Riverside	179	0.06	0.02	34

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

METHYLENE CHLORIDE

CAS # 75-09-2

SYNONYMS: dichloromethane; methylene dichloride; Freon 30; Aerothene NM; Solmethine; methylene bichloride

DESCRIPTION: formula CH_2Cl_2, mol. wt. = 84.94. Volatile, nonflammable, colorless, liquid with a sweetish smell.

CARCINOGEN status (IRIS): PROBABLE

MAAC: 58 ppb, (200 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

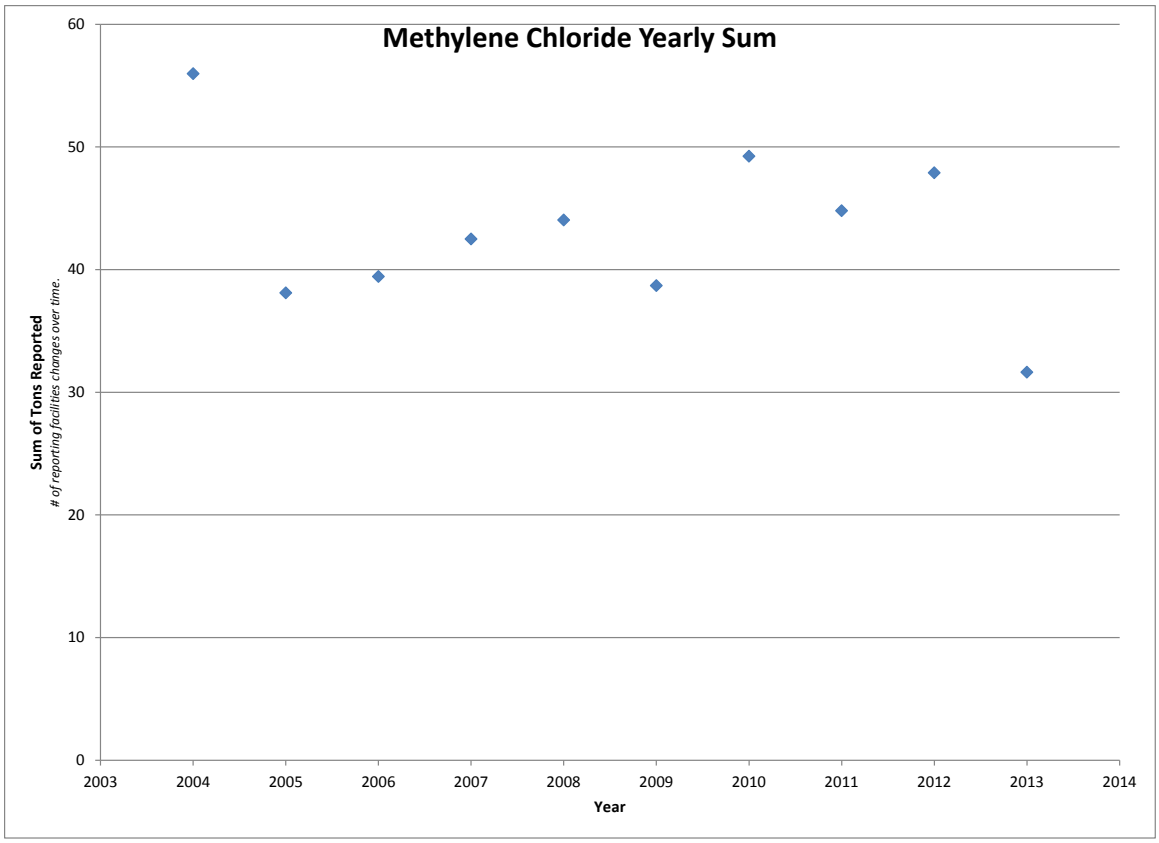
SOURCES: Used as a solvent, a blowing and cleaning agent in the manufacture of polyurethane foam and plastic fabrication, and in paint stripping operations. Other sources of emissions are landfills and wastewater treatment. The 2013 Air Quality Emission Inventory showed 31.64 tons reported. The AQD does not have an accurate emission inventory for methylene chloride from mobile sources.

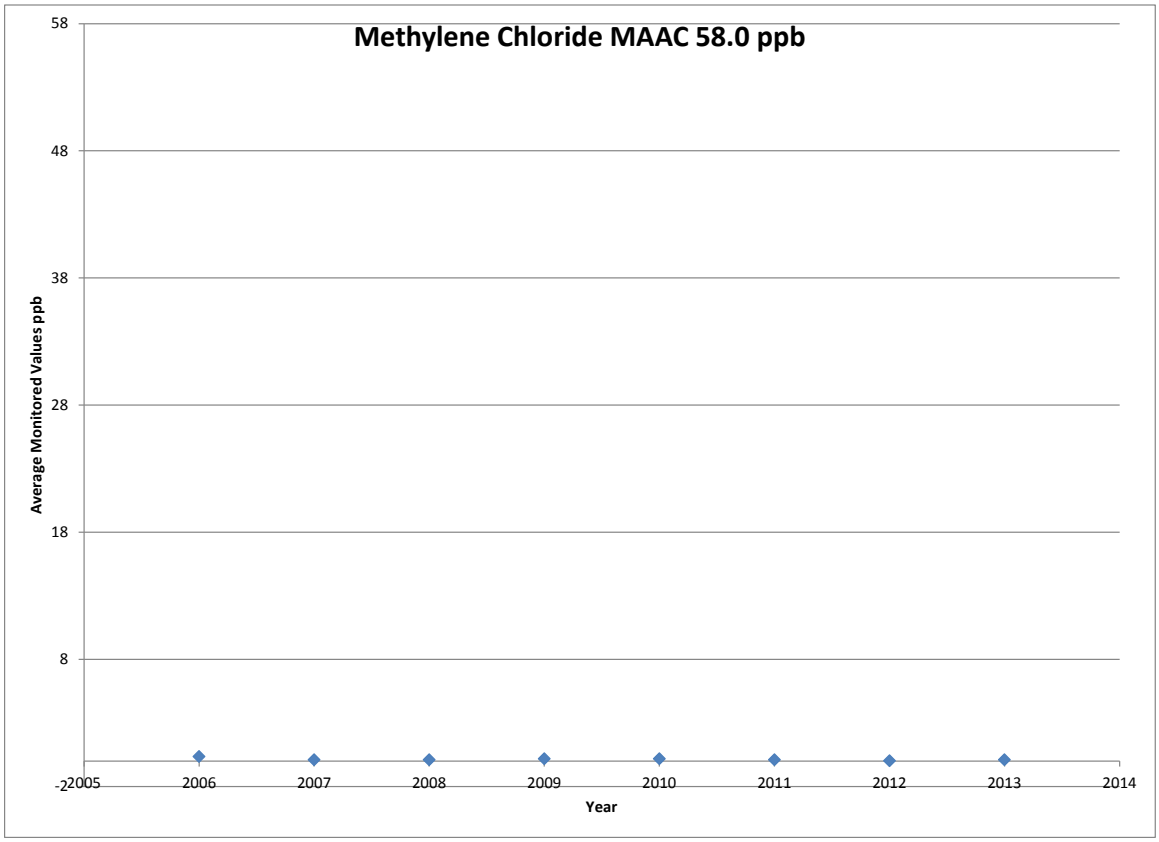
HEALTH EFFECTS: Liver and lung tumors in animals. Non-Cancer effects: Methylene chloride vapor is irritating to the eyes, respiratory tract, and skin. It is also a central nervous system depressant including decreased visual and auditory functions and may cause headache, nausea, and vomiting.

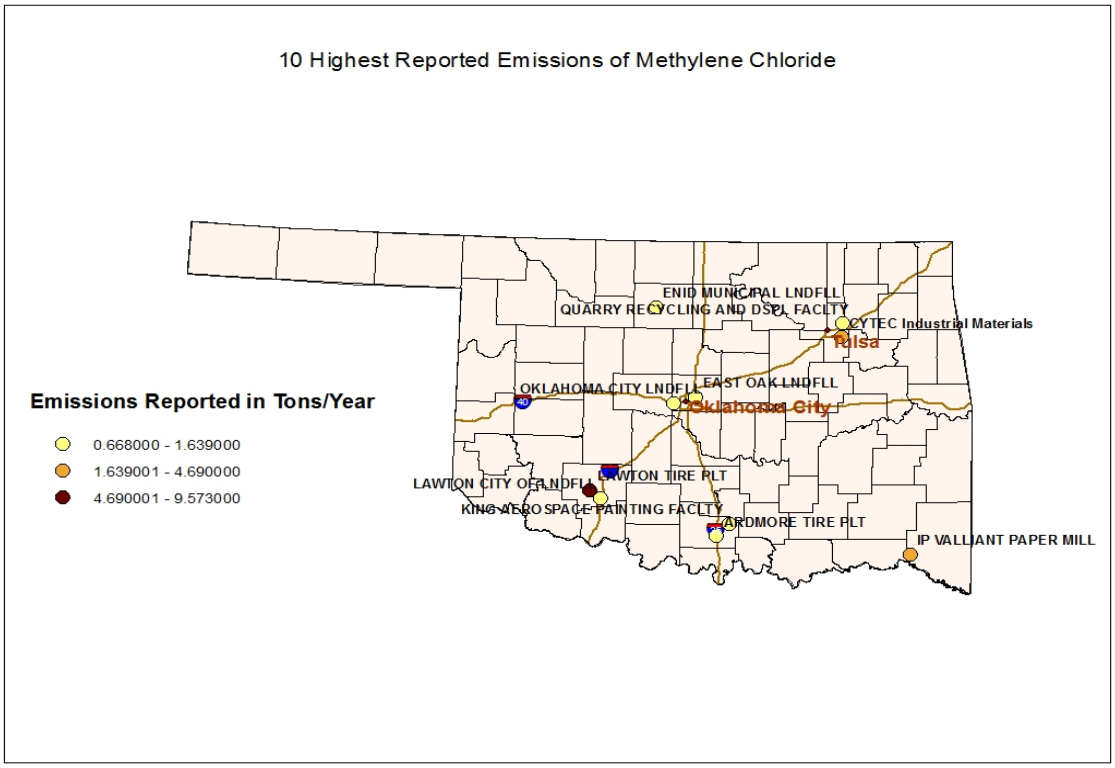
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.023 ppb.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

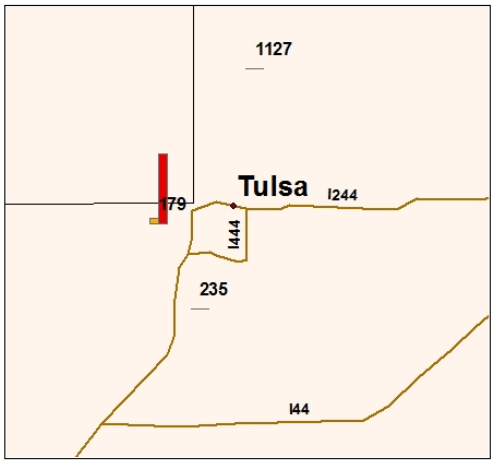
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.19 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.10 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.02 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.10 ppb


Methylene Chloride Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
60
50
40
30
20
10
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Methylene Chloride MAAC 58.0 ppb
Average Monitored Values ppb
58
48
38
28
18
8
-2
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Methylene Chloride



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	0.02	0.02	49
YUOK	101	0.37	0.12	30
Tulsa 1	235	0.03	0.02	60
Tulsa 2	1127	0.02	0.02	41
Tulsa Riverside	179	2.51	0.17	62

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

NICKEL Compounds

CAS # NOT APPLICABLE - Group

SYNONYMS: no common synonyms

DESCRIPTION: formula Ni-, many compounds of nickel

CARCINOGEN status (IRIS): PROBABLE (Note that while certain nickel compounds are known carcinogens, the overall group of nickel compounds is classified as a probable carcinogen.)

MAAC: 0.15 $^{\mu g}/m^3$ 24-hour average (no equivalent ppm value because the MAAC is for a group of compounds)

The MAAC would be based on IRIS 10^{-4} inhalation risk value (0.4 $^{\mu g}/m^3$), but in 2005 the MAAC set by SC 41 was 0.15 $^{\mu g}/m^3$. To avoid "back-sliding" the level was kept at the SC 41 MAAC of 0.15 $^{\mu g}/m^3$ in Appendix O.

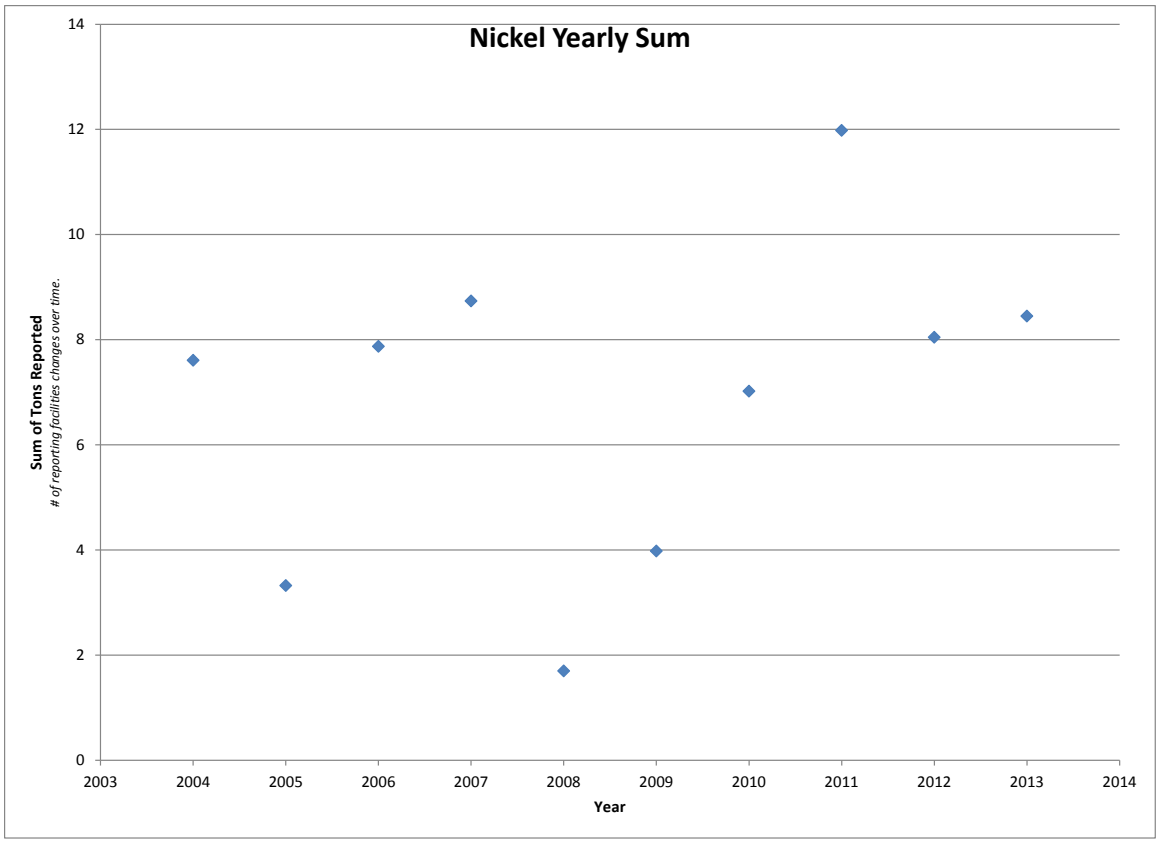
SOURCES: Used for the production of various metal alloys, cast irons, and electroplated goods and as a catalyst in the petroleum, plastic, and rubber industries. The 2013 Air Quality Emission Inventory showed 8.42 tons reported. The AQD does not have an accurate emission inventory for nickel compounds from mobile sources.

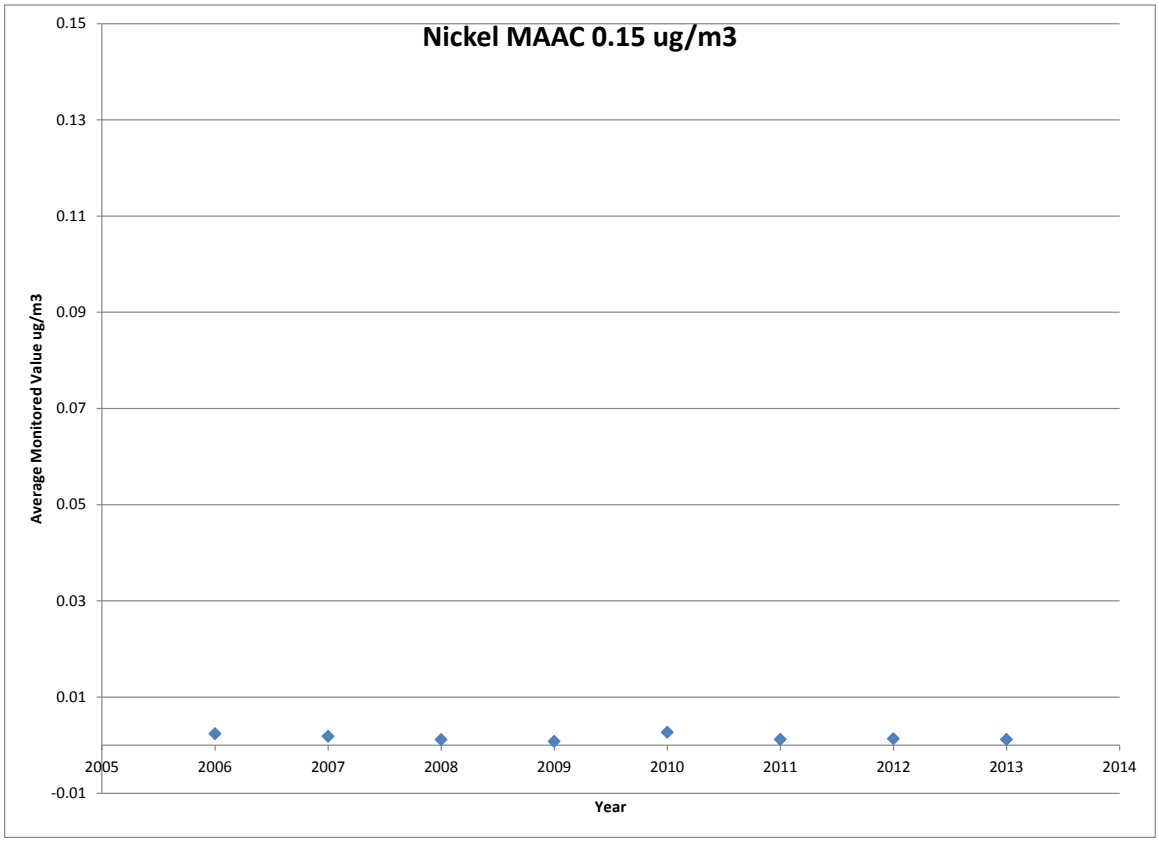
HEALTH EFFECTS: Inhalation exposure to nickel refinery dust and nickel subsulfide has been shown to cause nasal and lung cancer. Non-Cancer effects: The effects from long-term exposure to nickel include respiratory tract irritation and immune alterations such as dermatitis ("nickel itch") and asthma.

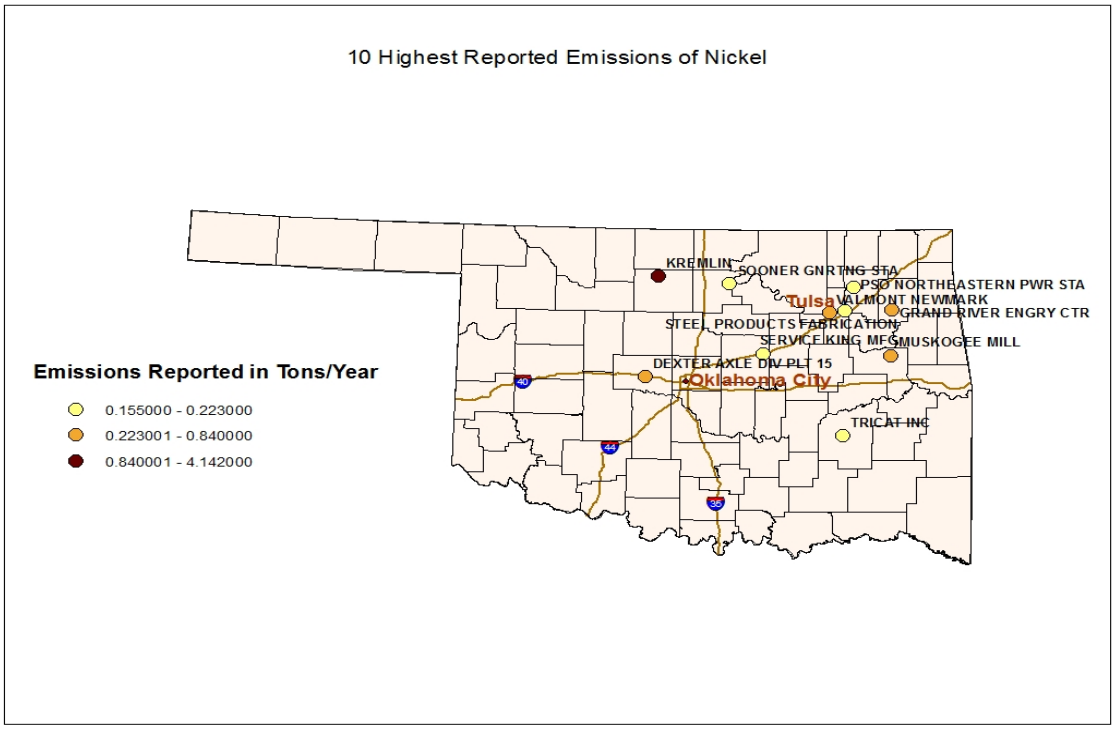
MONITORING METHODS: EPA IO-2 Hi-Vol and EPA IO-3.5 ICP/MS. The accepted Method Detection Limit (MDL) is 1.27 ng/m^3.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

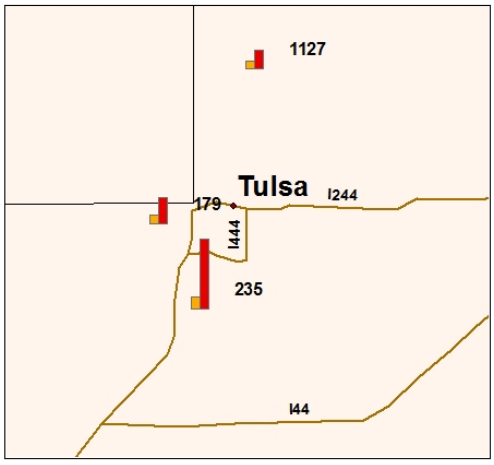
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00266 ug/m^3
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00122 ug/m^3
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.00132 ug/m^3
2013 (Tulsa, Oklahoma City, Yukon) = 0.00119 ug/m^3


Nickel Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
14
12
10
8
6
4
2
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Nickel MAAC 0.15 ug/m3
Average Monitored Value ug/m3
0.15
0.13
0.11
0.09
0.07
0.05
0.03
0.01
-0.01
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Nickel



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
Oklahoma Christian University	1037	1.59	0.9	43
YUOK	101	1.63	0.79	31
Tulsa 1	235	11.1	2.03	60
Tulsa 2	1127	2.94	1.16	32
Tulsa Riverside	179	4.14	1.25	34

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

TOLUENE

CAS # 108-88-3

SYNONYMS: methacide; methylbenzene; methylbenzol; phenylmethane; toluol

DESCRIPTION: formula C_7-H_8, mol. wt. = 92.13. Colorless, flammable, non-corrosive liquid.

CARCINOGEN status (IRIS): NA

MAAC: 10,000 ppb or 10 ppm (37,668 $^{\mu g}/m^3$) 24-hour average

MAAC would be based on the IRIS inhalation Lowest Observed Adverse Effect Level (LOAEL) Human Equivalent Concentration (HEC) (32 ppm), but in 2005 the MAAC set by SC 41 was 10 ppm. To avoid "back-sliding" the level was kept at the SC 41 MAAC of 10 in Appendix O.

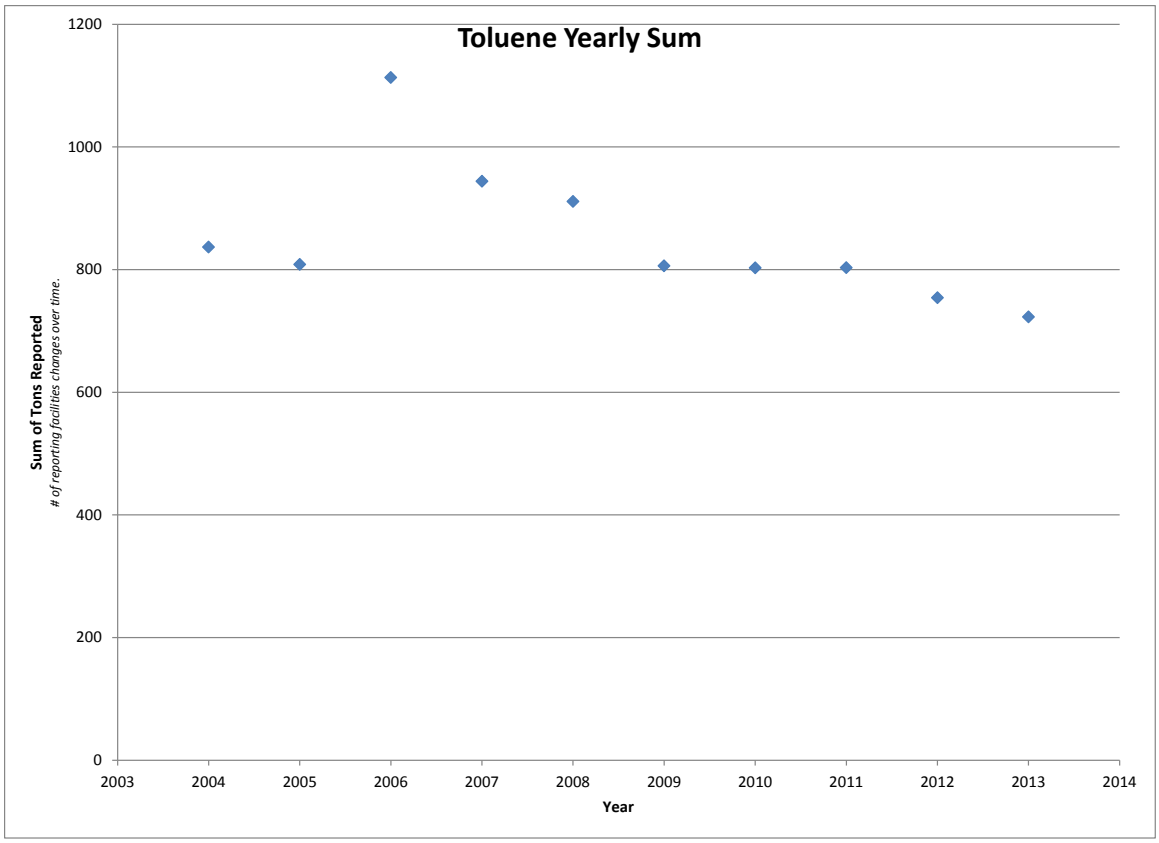
SOURCES: Used in aviation gasoline and high-octane blending stock, and as a solvent for paints, coatings, gums and resins. Other sources include petroleum production, used as a chemical intermediate, and for styrene production. The 2013 Air Quality Emission Inventory showed 722 tons reported. The AQD does not have an accurate emission inventory for toluene from mobile sources.

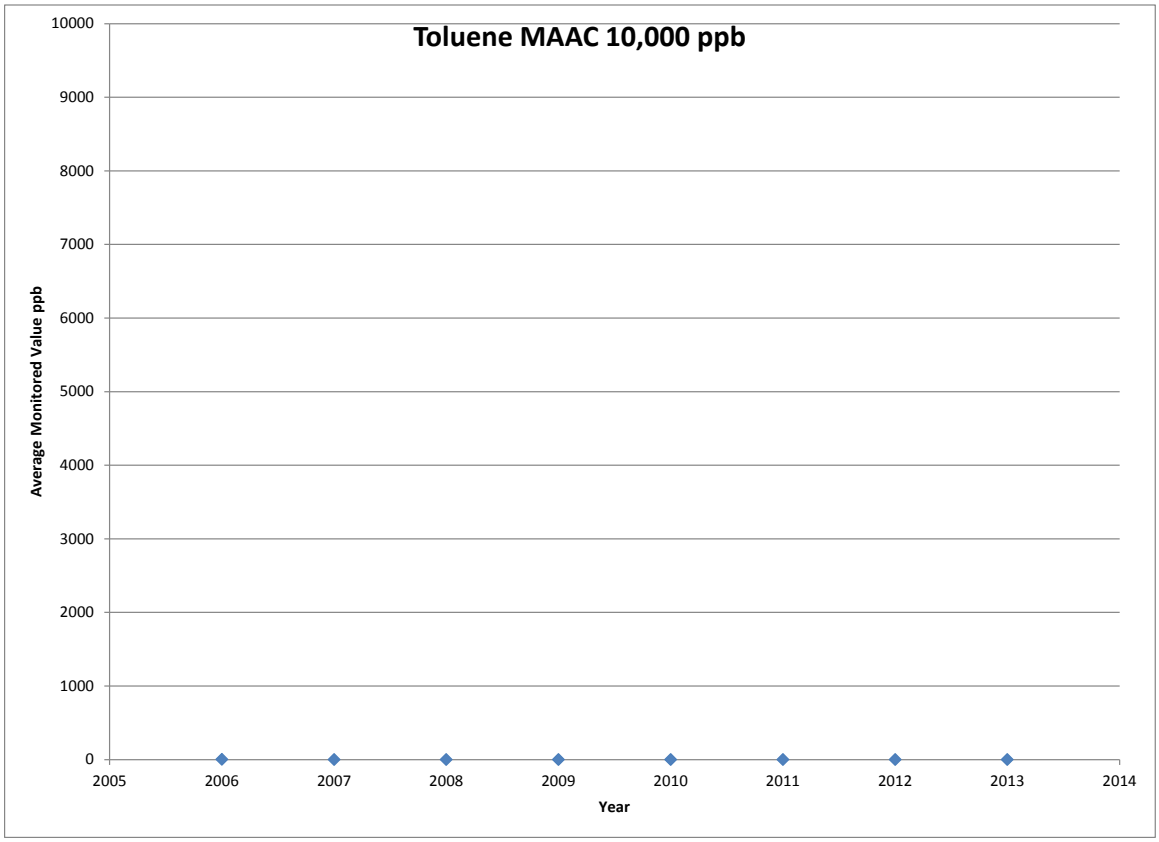
HEALTH EFFECTS: Acute and chronic exposures depress the Central Nervous System. May cause kidney and liver injury.

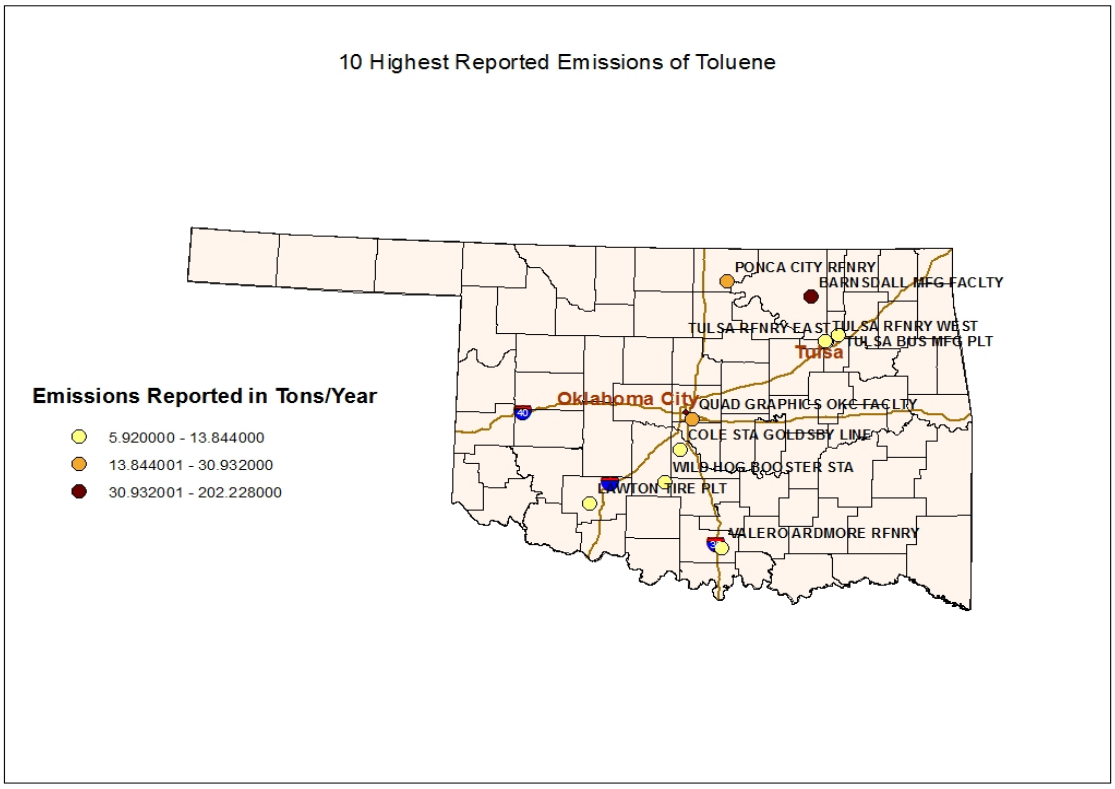
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.013 ppb.

ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

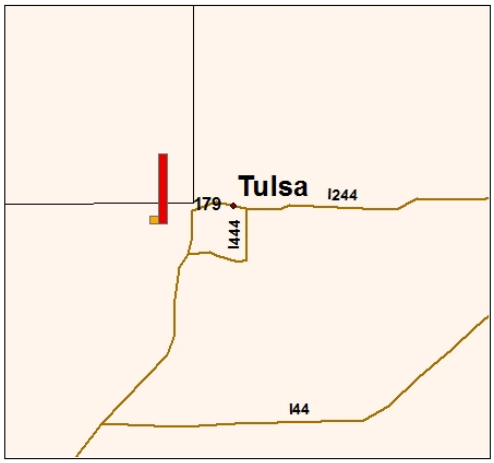
2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.68 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.68 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.70 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.54 ppb


Toluene Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
1200
1000
800
600
400
200
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Toluene MAAC 10,000 ppb
Average Monitored Value ppb
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Toluene



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
YUOK	101	0.48	0.24	30
Tulsa Riverside	179	7.88	0.84	62

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

1,1,2,2-TETRACHLOROETHANE

CAS # 79-34-5

SYNONYMS: tetrachloroethane; sym-tetrachloroethane; acetylene tetrachloride; Cellon; Bonoform

DESCRIPTION: formula $C_2H_2Cl_4$, mol. wt. = 167.86. Nonflammable, heavy liquid

CARCINOGEN status (IRIS): POSSIBLE

MAAC: 0.3 ppb (2 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

SOURCES: Used in the manufacture of trichloroethylene and perchloroethylene, as a metal degreasing agent, in paint, in varnish, in rust removers, in photographic film, as an alcohol denaturant, as an extractant, as a solvent, and as a chemical intermediate. The 2013 Air Quality Emission Inventory showed 1.21 tons reported.

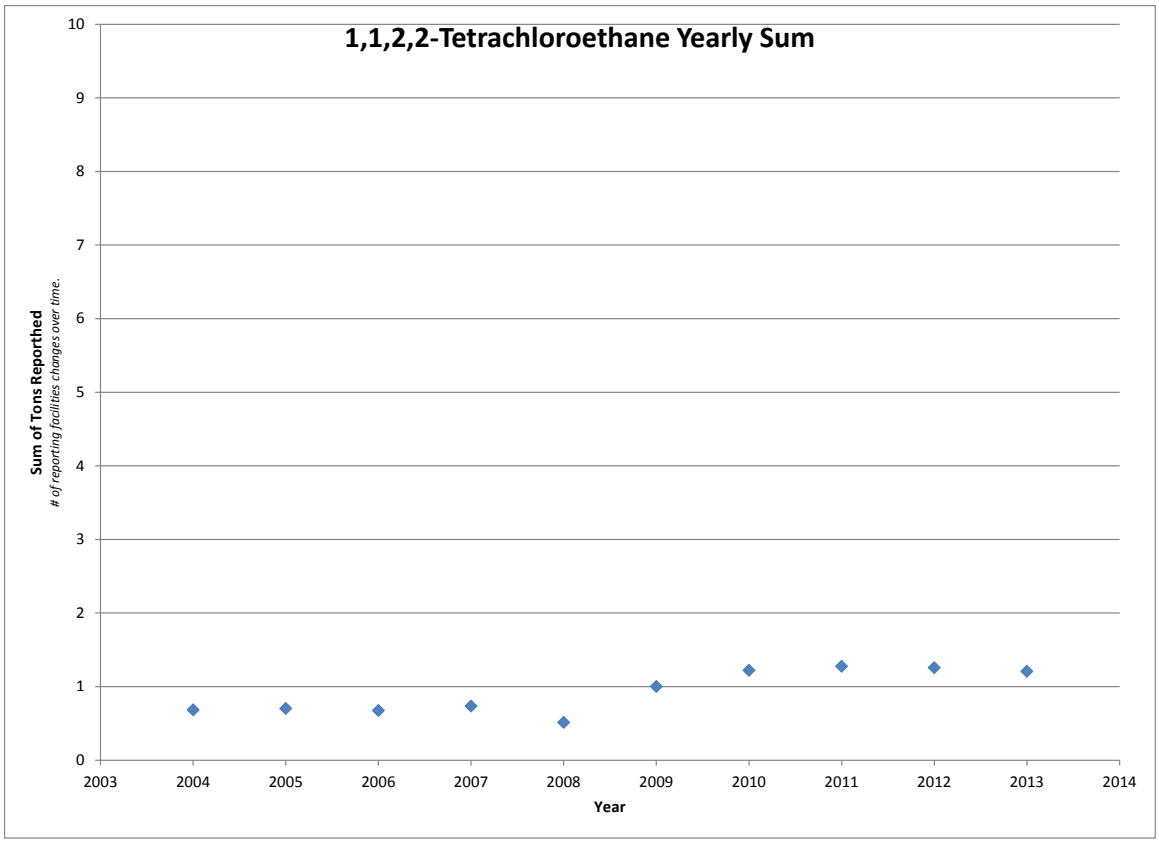
HEALTH EFFECTS: Increased incidence of hepatocellular carcinomas in mice. Non-cancer effects: Chronic exposure by inhalation may cause jaundice, liver enlargement, headaches, tremors, dizziness, numbness, loss of appetite, nervousness, and drowsiness.

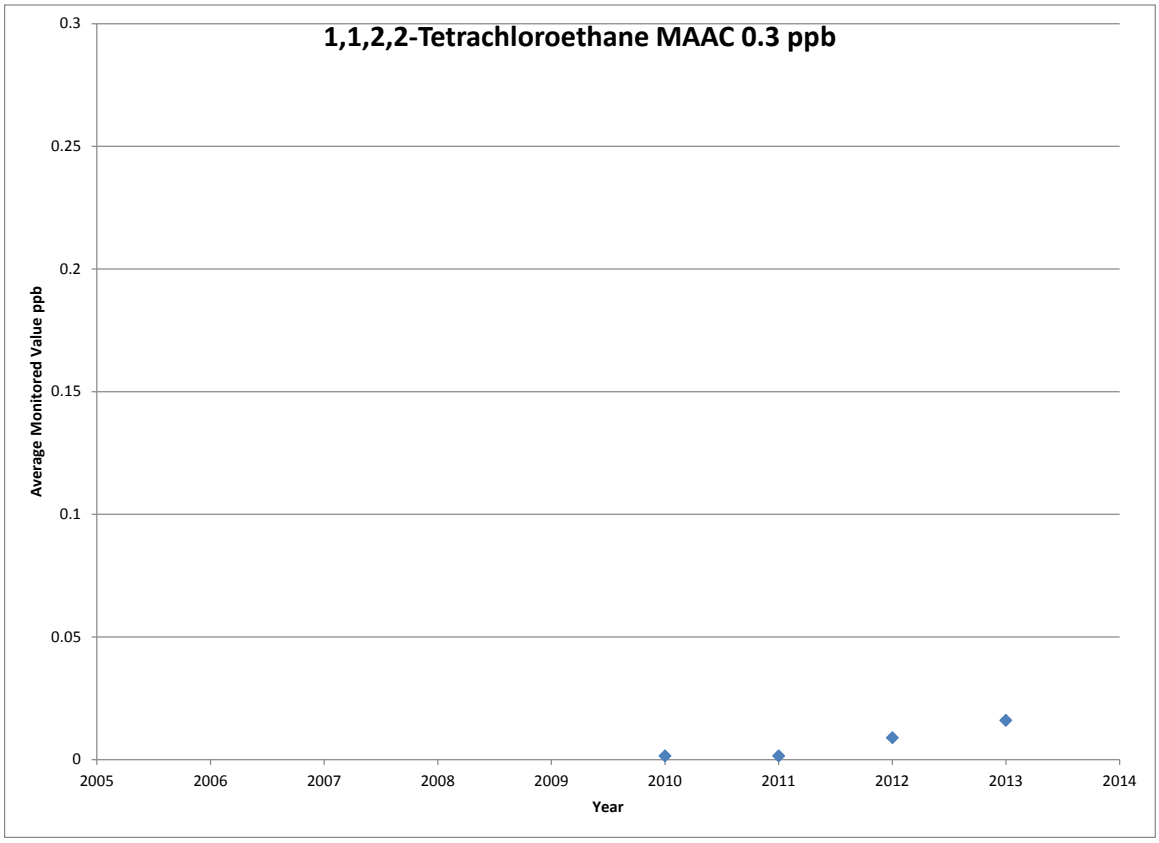
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.011 ppb.

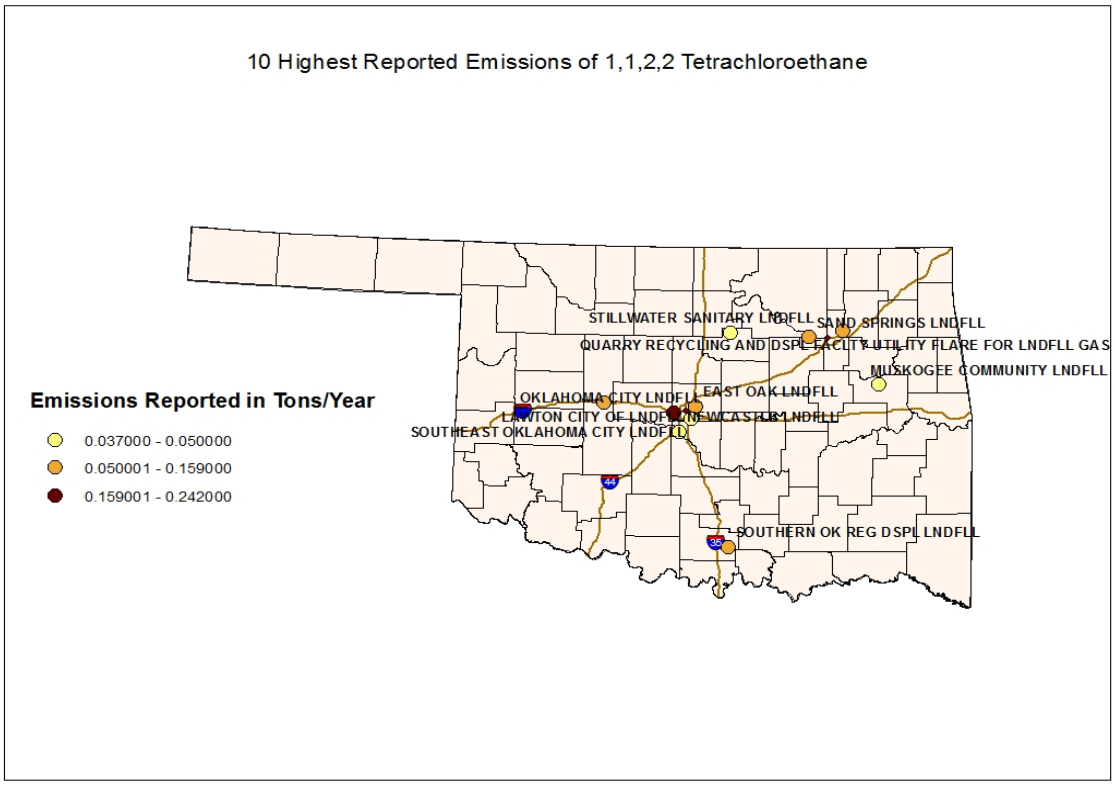
ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows:

2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0015 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0015 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0089 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.016 ppb

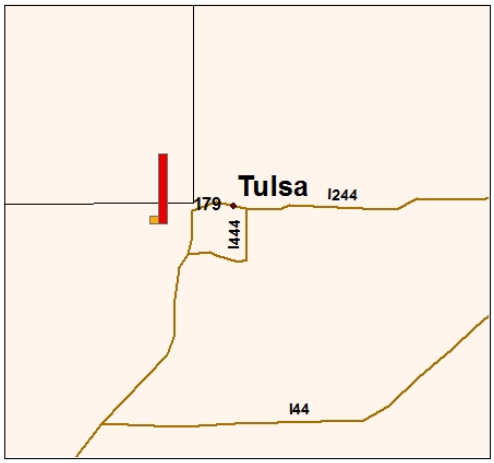
Averages for 1,1,2,2- tetrachloroethane were calculated using the method prescribed in the Air Toxics Risk Assessment (ATRA) Reference Library as required in Subchapter 42. This method substitutes ½ the Method Detection Limit (MDL) for non-detected samples, and is used when most of the sampled values are below the MDL.


1,1,2,2-Tetrachloroethane Yearly Sum
Sum of Tons Reporthed
# of reporting facilities changes over time.
10
9
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


1,1,2,2-Tetrachloroethane MAAC 0.3 ppb
Average Monitored Value ppb
0.3
0.25
0.2
0.15
0.1
0.05
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values Toluene



Mean

Max

Site Location	Site Number	Max Value	Mean Value	* Number of Readings
YUOK	101	0.48	0.24	30
Tulsa Riverside	179	7.88	0.84	62

* Number of readings is defined as the number of readings above minimum detectable level associated with monitoring method used.

VINYL CHLORIDE

CAS # 75-01-4

SYNONYMS: chloroethene; chloroethylene; chlorethene; ethylene monochloride; Trovidur

DESCRIPTION: formula C_2H_3Cl, mol. wt. = 62.5. Colorless, flammable gas at ambient temperature with sweet odor.

CARCINOGEN status (IRIS): KNOWN

MAAC: 9 ppb (23 $^{\mu g}/m^3$) 24-hour average

MAAC is based on IRIS 10^{-4} inhalation risk value.

SOURCES: Used in the production and fabrication of PVC pipes, pipe fittings, and plastics. Landfills, wastewater treatment and PVC production are the primary sources. The 2013 Air Quality Emission Inventory showed 4.04 tons reported.

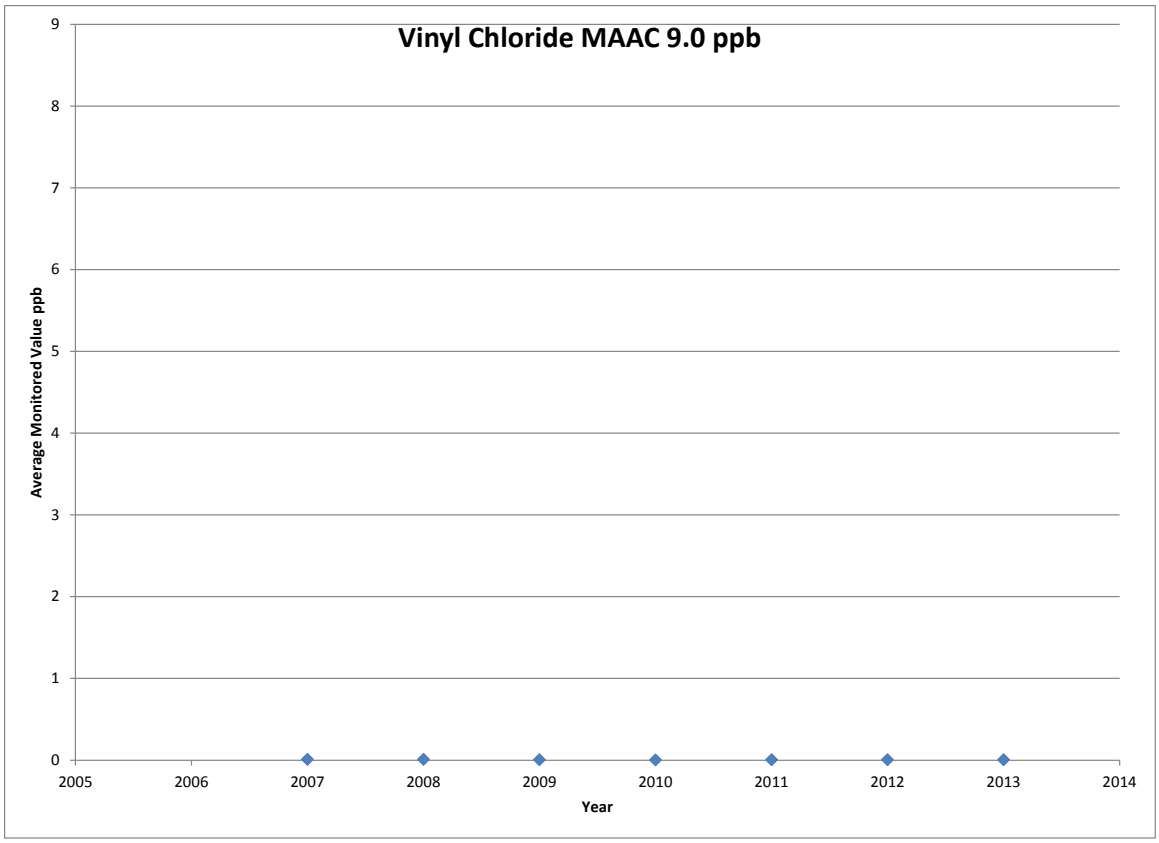
HEALTH EFFECTS: Development of a rare cancer, liver angiosarcoma, and a possible relationship between exposure and lung and brain cancers.

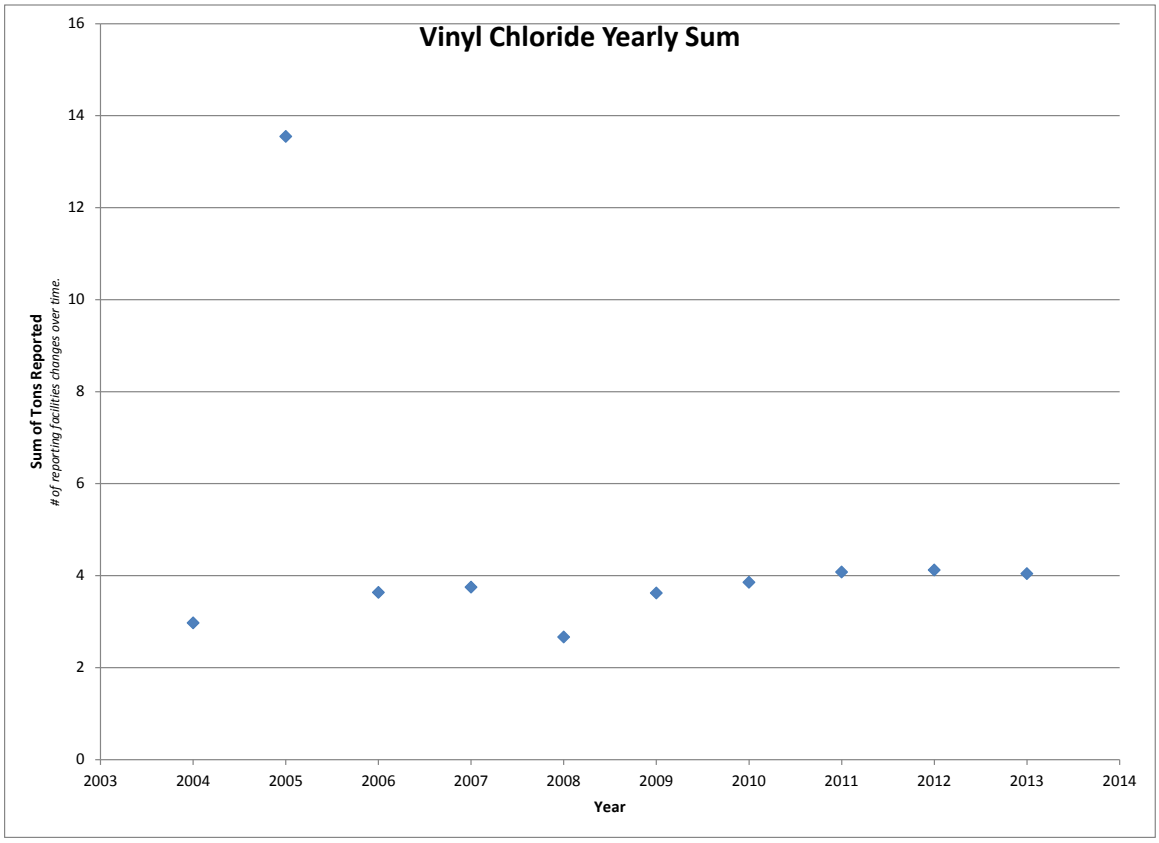
MONITORING METHODS: EPA TO-15. AQD is currently sampling using a Method Detection Limit (MDL) of 0.014 ppb.

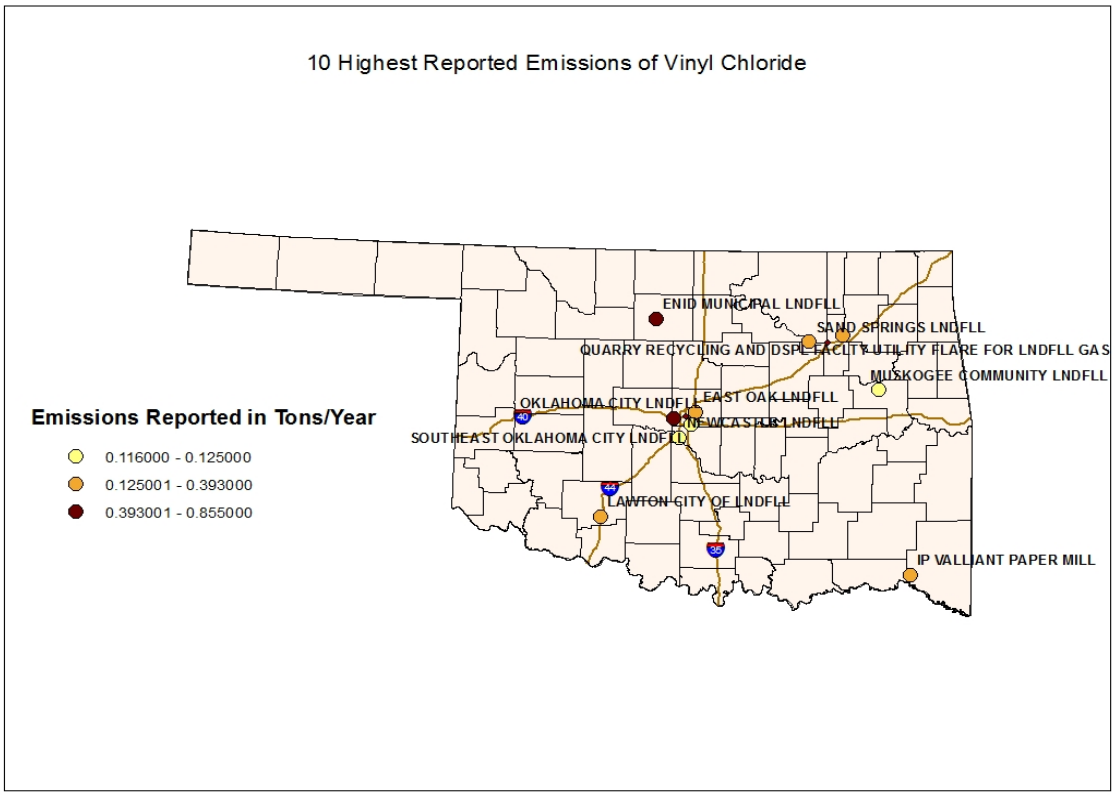
ACTUAL MONITORED VALUES: Since 2006, Air Quality has operated monitors in Tulsa, added a Pryor site in 2008, and in 2009 expanded with sites in Oklahoma City and Midwest City**.** Averaged annual values are as follows

2010 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0014 ppb
2011 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0042 ppb
2012 (Tulsa, Pryor, Midwest City, Oklahoma City) = 0.0055 ppb
2013 (Tulsa, Oklahoma City, Yukon) = 0.0055 ppb

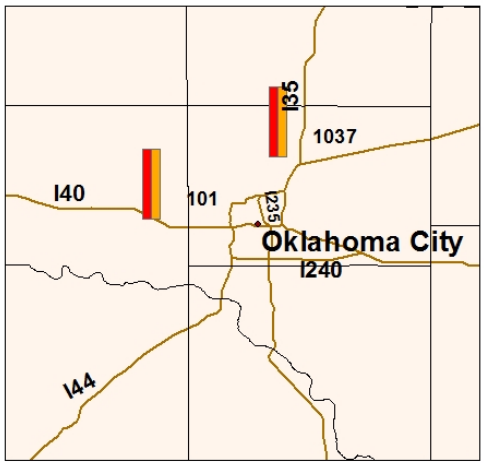
Averages for vinyl chloride were calculated using the method prescribed in the Air Toxics Risk Assessment (ATRA) Reference Library as required in Subchapter 42. This method substitutes ½ the Method Detection Limit (MDL) for non-detected samples, and is used when most of the sampled values are below the MDL.

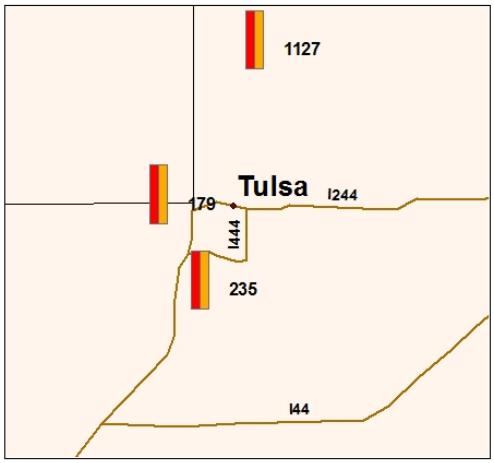

Vinyl Chloride MAAC 9.0 ppb
Average Monitored Value ppb
0
1
2
3
4
5
6
7
8
9
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Vinyl Chloride Yearly Sum
Sum of Tons Reported
# of reporting facilities changes over time.
0
2
4
6
8
10
12
14
16
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Monitoring Site Toxics Values





Mean

Max

Site Location	Site Number	Max Value	Mean Value	Number of Readings
Oklahoma Christian University	1037	0.01	0.01	61
YUOK	101	0.01	0.01	30
Tulsa 1	235	0.01	0.01	60
Tulsa 2	1127	0.01	0.01	60
Tulas Riverside	179	0.01	0.01	62

Air Toxics Risk Assessment Method (ATRA) Subchapter 42 method used.