



CleanAir®

Radical Transparency and Air Quality Monitoring at Midstream Facilities

Jim Locke – CNX Resources

Doug Goetz, PhD – CleanAir Engineering

Volker Schmid, PhD – CleanAir Engineering

PIOGATech: Pipeline Seminar

5/21/2024



Why Are We Doing This?

Regulatory Concerns

PA's 43rd Statewide Investigation Grand Jury Report

- Recommendations:
 - Expanding setbacks from 500 feet to 2,500 feet;
 - Public disclosure of all drilling and hydraulic fracturing chemicals
 - Regulation of gathering lines
 - Summation of all regional sources of air pollution
 - Require safer transport of the contaminated waste from frac sites
 - Conducting a comprehensive health response to the effects of living near unconventional drilling sites;
 - Restricting DEP employee future employment in the private sector
 - AG criminal jurisdiction over unconventional oil and gas companies.

Legal actions

- State legislation
- Local ordinances

Setback Impact on Available Natural Gas Development Area

County	500 Feet	1000 Feet	1500 Feet	2500 Feet
Allegheny	59%	33%	17%	5%
Armstrong	66%	35%	16%	2%
Greene	77%	43%	21%	3%
Indiana	66%	33%	15%	4%
Washington	67%	34%	16%	3%
Westmoreland	56%	29%	17%	10%

Area	Bill Number	Sponsor	County
Setbacks	SB581-24	Santarsiero	Bucks
Setbacks	HB170-23	Otten	Chester
Chemical Disclosure	SB997-23	Muth	Berks/Chester/Montgomery
Chemical Disclosure	HB1943-24	McNeill	Lehigh
Parks Ban	2022		Allegheny
Cecil Township	Current		Washington

Why Are We Doing This?

“Research” claims

- **Department of Health Studies**
 - ONGP program
- **University of Pittsburgh Studies**
 - Hydraulic fracturing epidemiology research studies
 - Asthma outcomes
 - Birth outcomes
 - Childhood cancers
- **PADEP Long-Term Marcellus Project**
 - >1 year sampling study
 - Four monitoring sites in Washington County
 - Compared to several permanent DEP monitoring stations
 - No NAAQS exceedances
 - Air Toxic/HAPs comparable to background
 - Inconclusive results:
 - “Health impacts to ambient air from unconventional natural gas operations may be limited...”
 - Calibration issues and
 - “Comparative datasets”
- **Observational vs. Randomized studies**

Figure 1. Total Health Complaints Logged by DOH Division of Environmental Health Epidemiology Since 2011 (N=203)

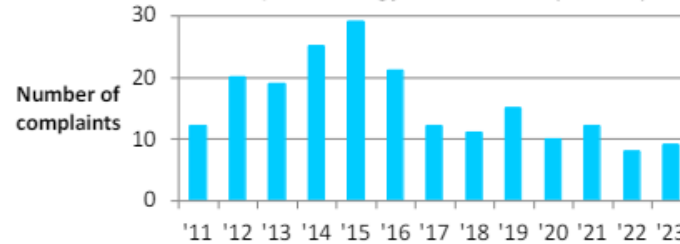


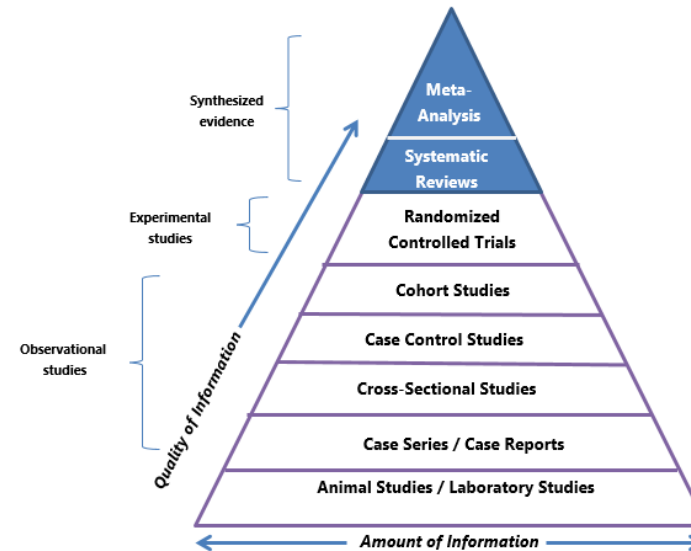
Table 2. Environmental Source of Concern^a (N=203)

Source	Jul-Dec 2023	2023 YTD	Total since 2011	% of total since 2011
Water	0	8	148	72.9%
Air	0	2	110	54.2%
Soil	0	1	35	17.2%
Noise	0	1	60	29.6%
Truck traffic	0	0	54	26.6%
Other ^b	0	0	53	26.1%
Missing	0	0	9	4.4%

^aMore than one environmental source of concern may be selected per complaint.
^bOther category includes light, drilling mud or solid waste, vibrations or seismic testing, etc.

ONGP Report | Quarters 3 & 4, 2023 (July to December)

https://www.health.pa.gov/topics/Documents/Environmental%20Health/Q3-4_2023_ONGP.pdf



Duke School of Medicine Study Design
<https://guides.mclibrary.duke.edu/ebm/studydesign>

CNX Radical Transparency

- **Groundbreaking collaboration**
 - Industry/DEP/Governor's Office
 - Data sharing
 - Emergency funding for DEP equipment
- **Extensive environmental monitoring**
 - Air quality (PM2.5, BTEX, Weather)
 - Chemical disclosure
 - Water quality
 - Radiation protection
- **Ongoing monitoring with development**
 - Monitoring initiated with each new stage
 - Monitoring continuing through six months of production
 - Current:
 - 9 wellpads (1 recently ending)
 - 2 compressor stations
 - Access to two well pads for DEP monitoring



Well Pad Monitoring Locations

Well Pad Monitoring Locations

Status: Active | Townships: -- Select -- | Search | Clear | Map | List

Showing 8 of 8 locations

<p>Active ACAA4 Findlay Twp View Data -></p>	<p>Active BP6 Bell Twp View Data -></p>	<p>Active MAM15 Bell Twp View Data -></p>
<p>Active MAM16 Bell Twp</p>	<p>Active Mamont Station Washington Twp</p>	<p>Active MOR9 Morris Twp</p>

Future Plans

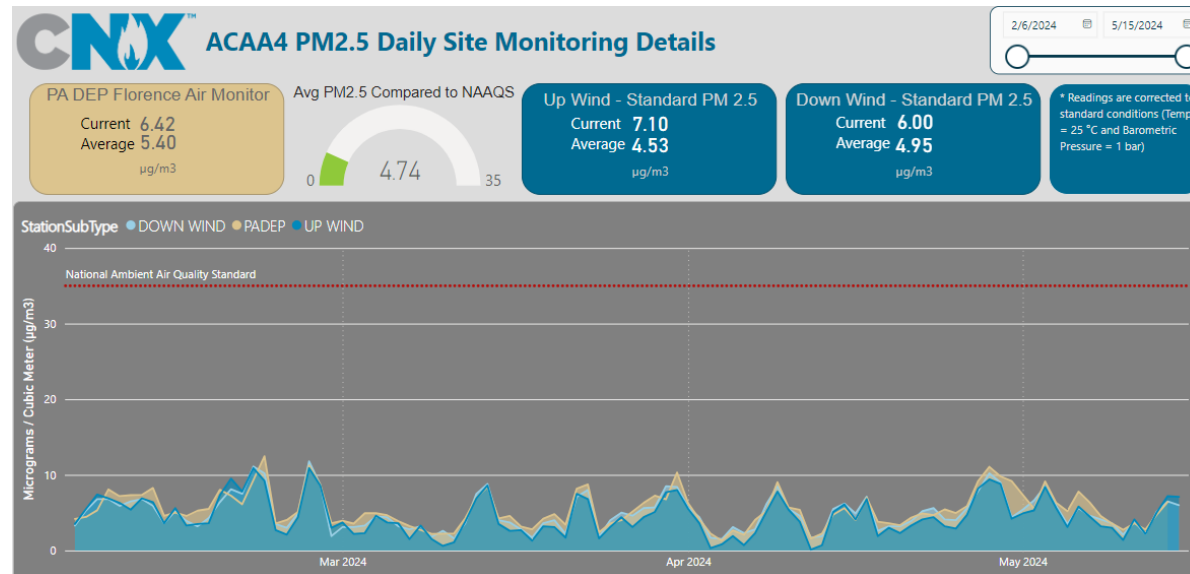
Continued Monitoring Plans

- New development stages
- 6 months of production

Data availability

- Reporting
- Presentations
 - Shale Insight
 - EPA Ambient Air Conference
- Publicly available, real-time:

<https://www.cnxradicaltransparency.com/>



Radical Transparency Air Quality Monitoring

An aerial photograph of an industrial facility, possibly a water treatment plant or a chemical processing plant, situated in a lush green environment. The facility consists of several large, interconnected buildings with white roofs and various pipes and structures. It is surrounded by dense green trees and a large, calm pond to the right. The overall scene is a mix of industrial infrastructure and natural landscape.

Monitoring Objectives:

1. Defensible monitoring of pollutants associated with health risks
2. Understand role of facility emissions to air quality at the fenceline
3. Identify trends and processes associated with AQ contributions

Radical Transparency Air Quality Monitoring

Monitoring Objectives:

1. Defensible monitoring of pollutants associated with health risks
2. Understand role of facility emissions to air quality at the fenceline
2. Identify trends and processes associated with AQ contributions

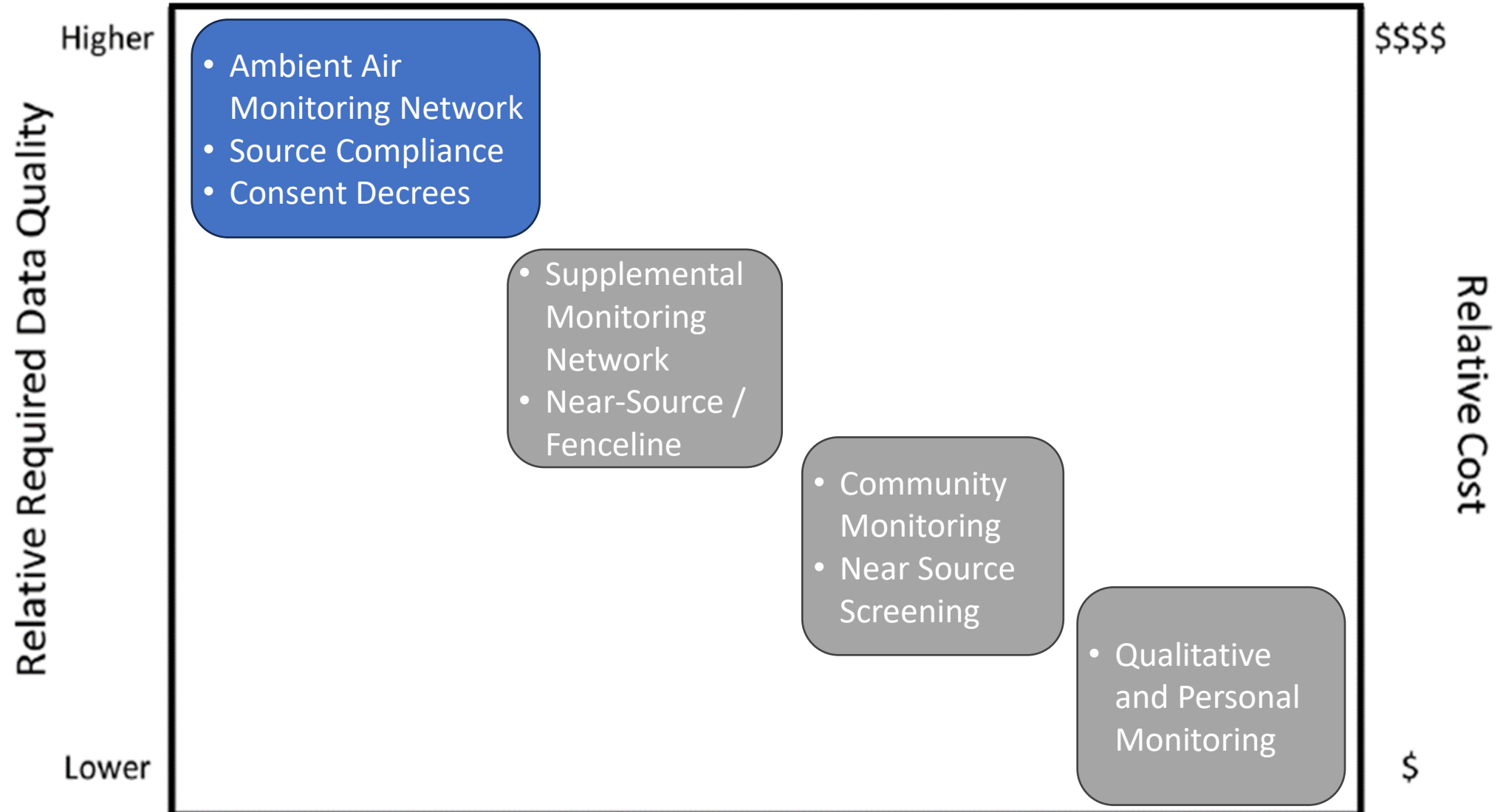


Requirements:

1. Measurements meet EPA standards and equipment
2. Quality controlled and quality assessed data
3. Monitoring locations at the fenceline should be representative of the air entering and exiting the facility

Fine Particulates (PM_{2.5})

Monitoring Method and Instrumentation Selection



Criteria Pollutants
(PM2.5, PM10, SO2,
NO2, O3, CO, Pb)

List of Designated Reference and Equivalent Methods, June 15, 2023



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CENTER FOR ENVIRONMENTAL MEASUREMENTS & MODELING
AIR METHODS & CHARACTERIZATION DIVISION (MD-D205-03)
Research Triangle Park, NC 27711

Office of
Research and Development

LIST OF DESIGNATED REFERENCE AND EQUIVALENT METHODS

Issue Date: June 15, 2023
(www.epa.gov/ttn/amtic/criteria.html)

Federal Reference Methods (FRMs)



- EPA PM 2.5 PTFE Filters
- 46.2 mm
- 2 um Pore Size etc.

Automated Continuous Federal Equivalent Methods (FEM)



- Filter-Based for Source Directed Measurements
- 2 – 3 ug/m³ @ 1 hr
- Trending every 5 min

Federal Reference Methods (FRMs)



- EPA PM 2.5 PTFE Filters
- 46.2 mm
- 2 um Pore Size etc.

MesaLabs
BGI PQ200

24-hour Gravimetric Sample

Automated Continuous Federal Equivalent Methods (FEM)



1-hour Continuous Sampling

- Filter-Based for Source Directed Measurements
- 2 – 3 ug/m³ @ 1 hr
- Trending every 5 min

MetOne BAM-1022

BTEX

Table 1. Prioritized Chronic Dose-Response Values.

CAS NO. = Chemical Abstracts Services number for the compound.
 HAP NO. = Position of the compound on the HAP list in the Clean Air Act (112[b][2]). "999" denotes substances under consideration for listing.
 Sources: IRIS = Integrated Risk Information System; ATSDR = US Agency for Toxic Substances and Disease Registry; CAL = California EPA; P-CAL = Proposed CAL; HEAST = EPA Health Effects Assessment Summary Tables; EPA-OAQPS = EPA Office of Air Quality Planning and Standards; EPA-ORD = EPA Office of Research and Development (preferred consensus values not yet on IRIS, or superseding values on IRIS)

IARC WOE = weight of evidence for carcinogenicity in humans (1 = carcinogenic; 2A = probably carcinogenic; 2B = possibly carcinogenic; 3 = not classifiable; 4 = probably not carcinogenic).

EPA WOE (2005 Guidelines) = weight of evidence for carcinogenicity under 2005 EPA cancer guidelines (CH = carcinogenic to humans; LH = likely to be carcinogenic; SE = suggestive evidence of carcinogenic potential; InI = inadequate information to assess carcinogenic potential; NH = not likely to be carcinogenic).
 EPA MOA (2005 Guidelines) = mode of action for carcinogenicity. M = mutagenic and early life data lacking; m-rpf = relative potency factors were used to derive unit risk values based on the cancer risk of benzo[a]pyrene as the index chemical. In both cases, age-dependent adjustment factors should be applied when assessing risk for ages younger than 16 years per 2005 Supplemental Guidance; see Table1 notes.

EPA WOE (1986 Guidelines) = weight of evidence for carcinogenicity under the 1986 EPA cancer guidelines (A = human carcinogen; B1 = probable carcinogen, limited human evidence; B2 = probable carcinogen, sufficient evidence in animals; C = possible human carcinogen; D = not classifiable; E = evidence of noncarcinogenicity).

Table 1. Prioritized Chronic Dose-Response Values for Screening Risk Assessments

CHEMICAL NAME	CAS NO.	HAP NO.	IARC WOE	CHRONIC INHALATION						CHRONIC ORAL							
				NONCANCER		CANCER				NONCANCER		CANCER					
				mg/m3	SOURCE	EPA WOE	1/(µg/m3)	EPA MOA	SOURCE	mg/kg-d	SOURCE	EPA WOE	1/(mg/kg-d)	EPA MOA	SOURCE		
Acetaldehyde	75-07-0	1	1	0.009	IRIS	B2	0.0000022										
Acetamide	60-35-5	2	2B				0.00002										
Acetonitrile	75-05-8	3		0.06	IRIS	InI											
Acetophenone	98-86-2	4				D											
Acrolein	107-02-8	6	2A	0.00035	CAL	InI											
Acrylamide	79-06-1	7	2A	0.006	IRIS	LH	0.0001	M	IRIS								
Acrylic acid	79-10-7	8	3	0.001	IRIS												
Acrylonitrile	107-13-1	9	2B	0.002	IRIS	B1	0.000068		IRIS								
Allyl chloride	107-05-1	10	3	0.001	IRIS	C	0.000006		CAL								
Aniline	62-53-3	12	2A	0.001	IRIS	B2	0.0000016		CAL								
<i>o</i> -Anisidine	90-04-0	13	2A														
Antimony trioxide	1309-64-4	173	2B	0.0002	IRIS												
Arsenic compounds	7440-38-2	174	1	0.000015	CAL	A	0.0043		IRIS								
Arsine	7784-42-1	174		0.00005	IRIS												
Benzene	71-43-2	15	1	0.03	IRIS	CH	0.0000078		IRIS								
Benzidine	92-87-5	16	1			A	0.067	M	IRIS								
Benzotrichloride	98-07-7	17	2A			B2											
Benzyl chloride	100-44-7	18	2A			B2	0.000049		CAL								

Air Toxics

EPA Office of Air Quality Planning and Standards (OAQPS)

Table 1. Prioritized Chronic Dose-Response Values.

CAS NO. = Chemical Abstracts Services number for the compound.

HAP NO. = Position of the compound on the HAP list in the Clean Air Act (112[b][2]). "999" denotes substances under consideration for listing.

Sources: IRIS = Integrated Risk Information System; ATSDR = US Agency for Toxic Substances and Disease Registry; CAL = California EPA; P-CAL = Proposed CAL; HEAST = EPA Health Effects Assessment Summary Tables; EPA-OAQPS = EPA Office of Air Quality Planning and Standards; EPA-ORD = EPA Office of Research and Development (preferred consensus values not yet on IRIS, or superseding values on IRIS)

IARC WOE = weight of evidence for carcinogenicity in humans (1 = carcinogenic; 2A = probably carcinogenic; 2B = possibly carcinogenic; 3 = not classifiable; 4 = probably not

EPA WOE (2005 Guidelines) = weight of evidence for carcinogenicity under 2005 EPA cancer guidelines (CH = carcinogenic to humans; LH = likely to be carcinogenic; SE = suggestive evidence of carcinogenic potential; InI = inadequate information to assess carcinogenic potential; NH = not likely to be carcinogenic). EPA MOA (2005 Guidelines) = mode of action for carcinogenicity. M = mutagenic and early life data lacking; m-rpf = relative potency factors were used to derive unit risk values based on the cancer risk of benzofalvrene as the index

EPA WOE (1986 Guidelines) = weight of evidence for carcinogenicity under the 1986 EPA cancer guidelines (A = human carcinogen; B1 = probable carcinogen, limited human evidence; B2 = probable carcinogen, sufficient evidence in animals; C = possible human carcinogen; D = not classifiable; E = evidence of noncarcinogenicity).

		CHRONIC INHALATION						CHRONIC ORAL								
		NONCANCER			CANCER			NONCANCER			CANCER					
Table 1. Screenin		mg/m ³	SOURCE	EPA WOE	1/(µg/m ³)	EPA MOA	SOURCE	mg/kg-d	SOURCE	EPA WOE	1/(mg/kg-d)	EPA MOA	SOURCE			
CHEMICAL NAME		CAS NO.	HAP NO.	IARC WOE	mg/m ³	SOURCE	EPA WOE	1/(µg/m ³)	EPA MOA	SOURCE	mg/kg-d	SOURCE	EPA WOE	1/(mg/kg-d)	EPA MOA	SOURCE
Acetaldehyde		75-07-0	1	1	0.009	IRIS	B2	0.0000022		IRIS						
Acetamide		60-35-5	2	2B				0.00002		CAL						
Acetonitrile		75-05-8	3		0.06	IRIS	InI									
Acetophenone							D									
Acrolein						CAL	InI									
Acrylamide						IRIS	LH	0.0001	M	IRIS						
Acrylic acid						IRIS										
Acrylonitrile						IRIS	B1	0.000068		IRIS						
Allyl chloride						IRIS	C	0.000006		CAL						
Aniline						IRIS	B2	0.0000016		CAL						
o-Anisidine																
Antimony trioxide						IRIS										
Arsenic compounds						CAL	A	0.0043		IRIS						
Arsine						IRIS										
Benzene		71-43-2	15	1	0.03	IRIS	CH	0.0000078		IRIS						
Benzidine		92-87-5	16	1			A	0.067	M	IRIS						
Benzotrachloride		98-07-7	17	2A			B2									
Benzyl chloride		100-44-7	18	2A			B2	0.000049		CAL						

- Benzene
- Toluene
- Ethylbenzene
- Xylenes

Air Toxics
EPA Office of Air
Quality Planning
and Standards
(OAAQPS)

ToxGuide™ for Benzene



CAS# 71-43-2
October 2007

U.S. Department of Health and
Human Services
Public Health Service
Agency for Toxic Substances
and Disease Registry
www.atsdr.cdc.gov

Contact Information:
Division of Toxicology
and Environmental Medicine
Applied Toxicology Branch

1600 Clifton Road NE, F-32
Atlanta, GA 30333
1-800-CDC-INFO
1-800-232-4636
www.atsdr.cdc.gov/toxpro2.html

Minimal Risk Levels (MRLs)

Inhalation

- An MRL of **9 PPB** has been derived for acute-duration inhalation exposure (≤ 14 days).
- An MRL of **6 PPB** has been derived for intermediate-duration inhalation exposure (15–364 days).
- An MRL of **3 PPB** has been derived for chronic-duration inhalation exposure (≥ 1 year).

Environmental Levels

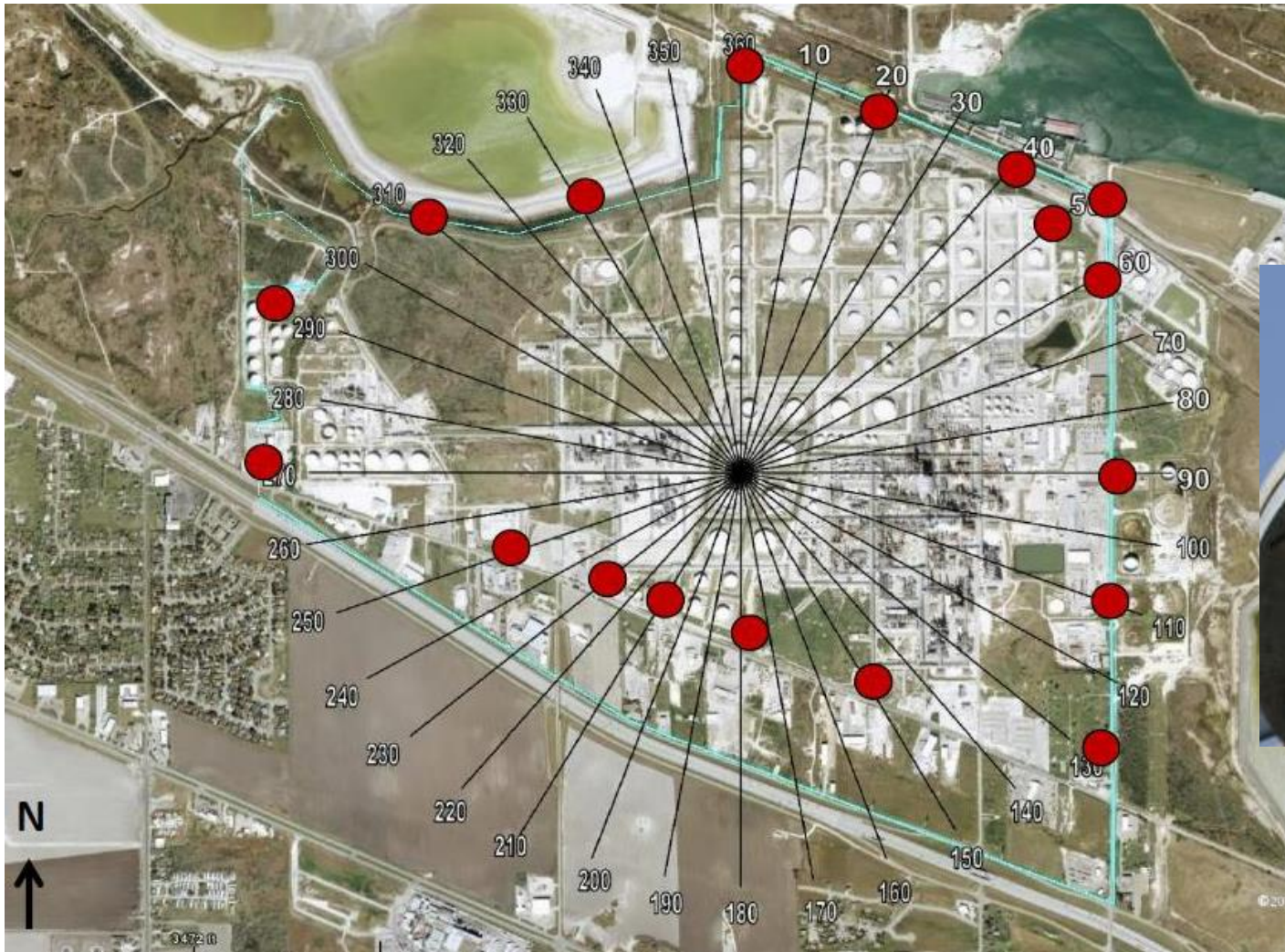
Air

- The concentration of benzene in air samples from metropolitan areas was

0.58 PPB

**Southwestern
PA < 0.2 ppb**

EPA Method 325 A/B - Passive Monitoring



U.S. EPA



- BTEX & 1,3 BUTADIENE
- SENSITIVITY BENZENE:
< 0.1 PPB
- SAMPLING DURATION:
14 DAYS