PATS 2017 Pollutant Modeling Summary

Portland Air Toxics Solutions Advisory Committee

January 25, 2011

PATS 2017 MODELING RESULTS

1,3-BUTADIENE

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.03 µg/m³)

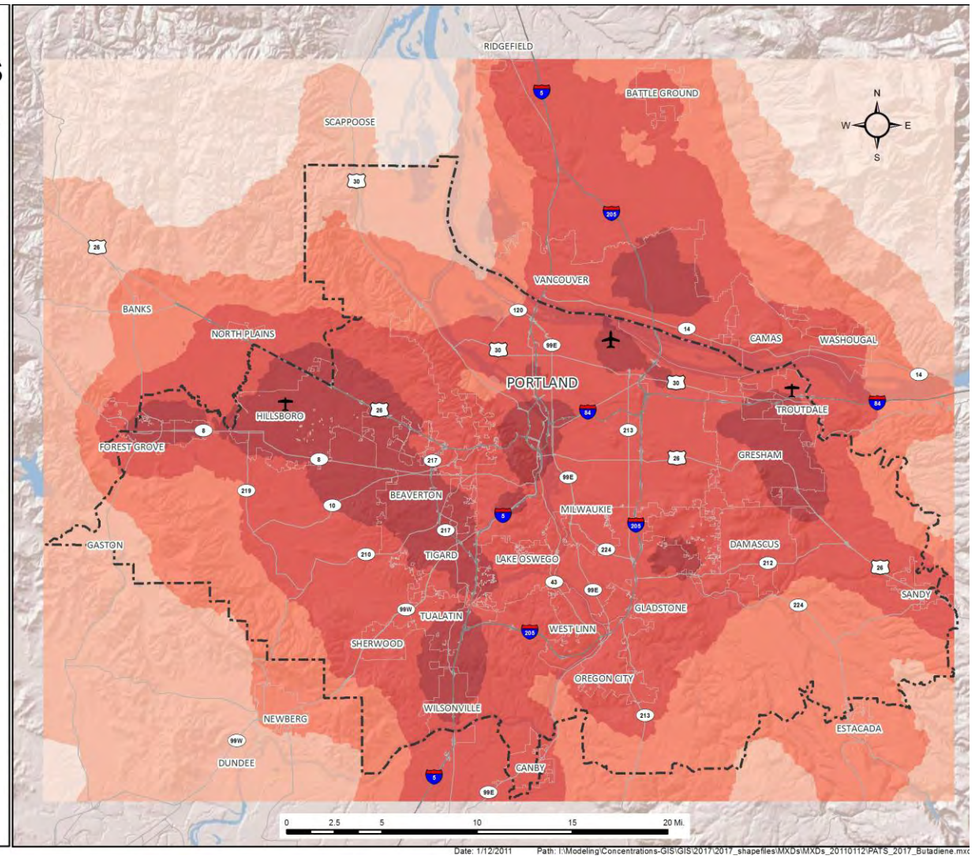
Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

NOTE: Areas beyond the modeling domain (color-shaded region) are beyond the scope of this project.

REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.



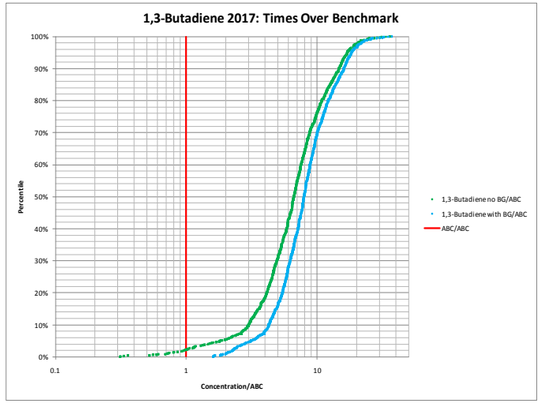
1,3 Butadiene Overview

Benchmark Value:	0.03 ug/m3
Primary health effects:	Probable human carcinogen, possible association with heart diseases
Total emissions in PATS study area:	74.07 tons/year
Average reduction needed for all receptors above ABC:	85%, All receptors above benchmark

Pertinent information: 1,3-butadiene is a colorless gas with a mild gasoline-like odor.

1,3-butadiene comes from incomplete combustion of fuels from cars and trucks, and off-road engines like lawn mowers and boats. Additional sources include petroleum refining, production of rubber and plastics, forest fires and cigarette smoke.

Modeled Distribution of 1,3 Butadiene Concentrations

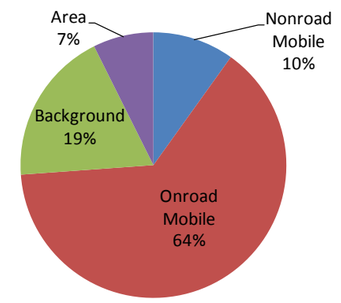


Most Significant Sources of 1,3 Butadiene

Source	TPY	% of Poll	Quality Rating
Area			
1. Res. Wood Comb	23.8	32	C
2. Open Burning/Fires	3.6	5	C
Non-road			
1. Non-road 4-Stroke	13.3	18	D
2. Non-road 2-Stroke	3.2	4	D
3. Aircraft	2.7	4	B
4. Non-road Diesel	0.9	1	D
On-road			
1. On-road Mobile	23.5	32	B/C
2. On-road Diesel	2.1	3	B/C

Point - <1% of Pollutant

Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

BENZENE

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.13 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

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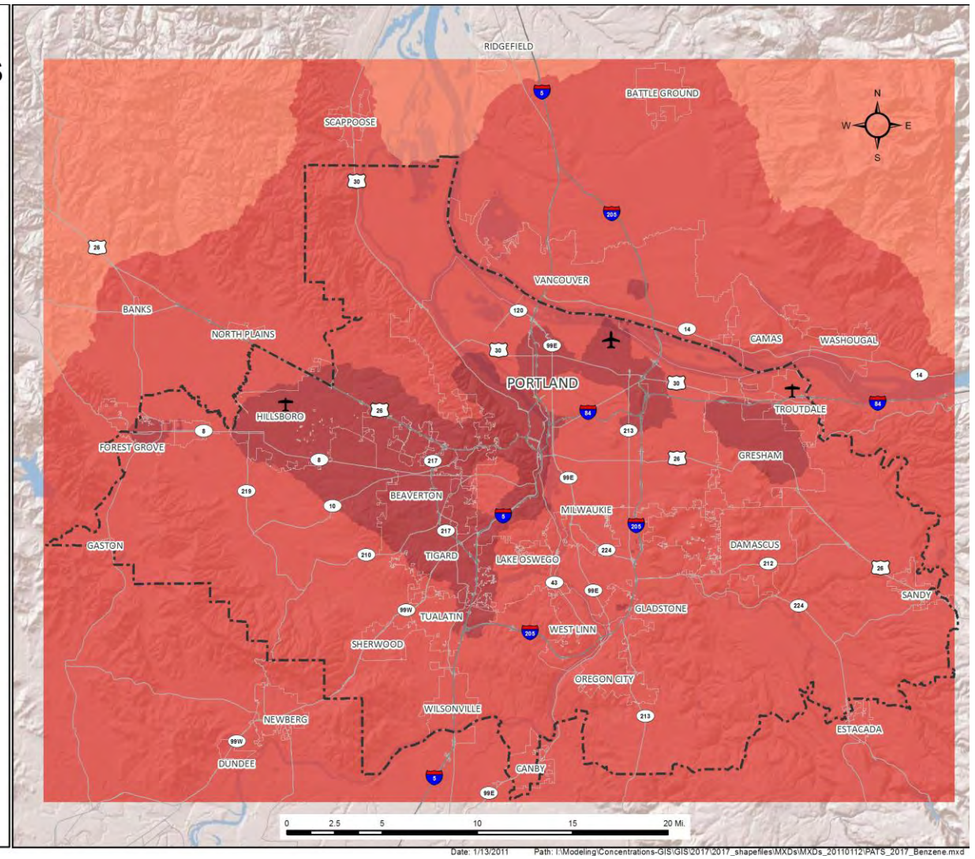
REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.

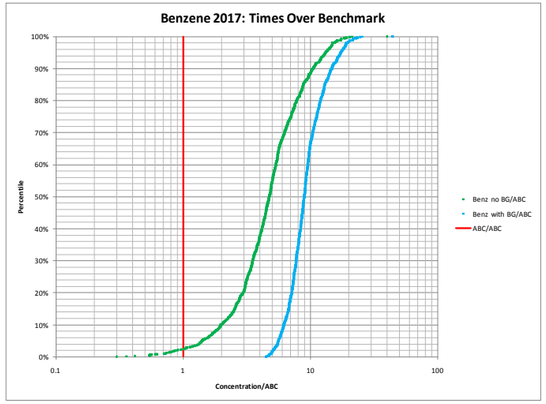


Benzene Overview

Benchmark Value:	0.13 ug/m3
Primary health effects:	Known (Class A) human carcinogen, blood disorders, may cause anemia and genetic damage
Total emissions in PATS study area:	559.9 tons/year
Average reduction needed for all receptors above ABC:	88%, all receptors above benchmark

Pertinent information: Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.
Benzene is found in emissions from cars and trucks, wood smoke, evaporation from service stations, and industrial solvents. Tobacco smoke contains benzene.

Modeled Distribution of Benzene Concentrations

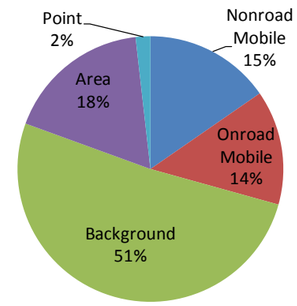


Most Significant Sources of Benzene

Source	TPY	% of Poll	Quality Rating
Area			
1. Res Wood Comb	126.6	23	C
2. Miscellaneous	39.8	7	D
3. Open Burn/Fires	21.7	4	C
4. Consumer Products	11.1	2	D
Non-road			
1. Non-road 4-Stroke	77.8	14	D
2. Non-road Diesel	10.0	2	D
On-road			
1. On-road Mobile	189.1	34	B/C
2. On-road Diesel	16.9	3	B/C

Point - <1% of Pollutant

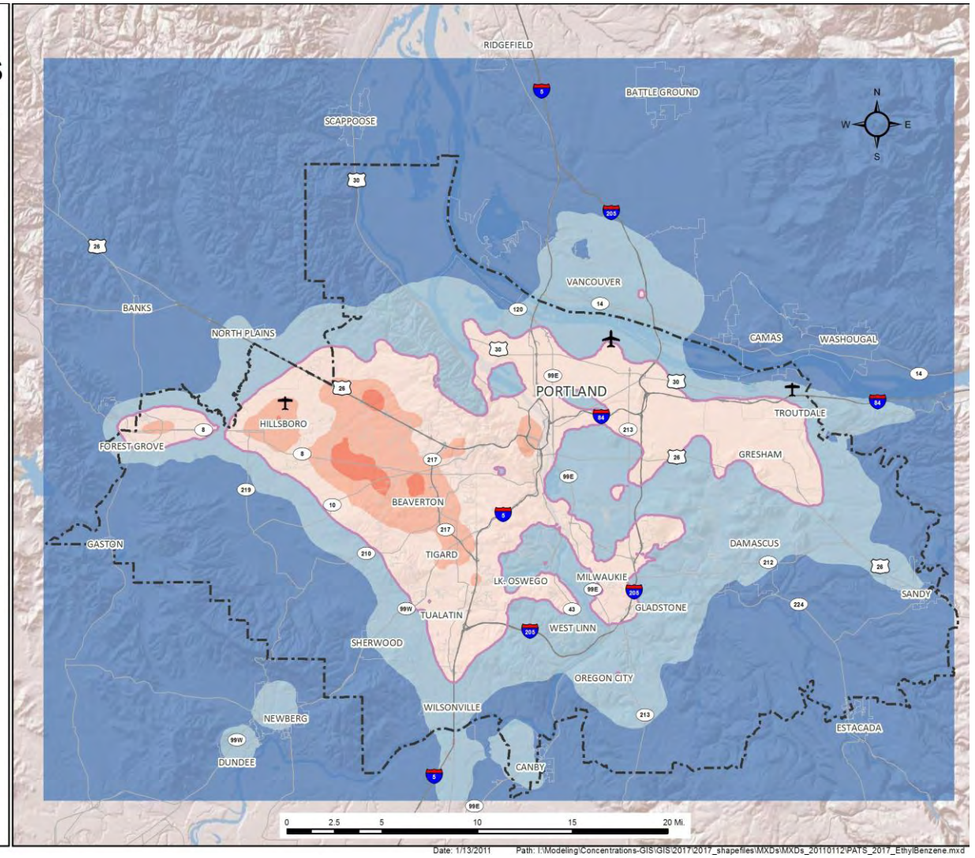
Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

ETHYLBENZENE

ALL SOURCES



PATS Study Area boundary

Benchmark contour (0.4 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

NOTE: Areas beyond the modeling domain (color-shaded region) are beyond the scope of this project.

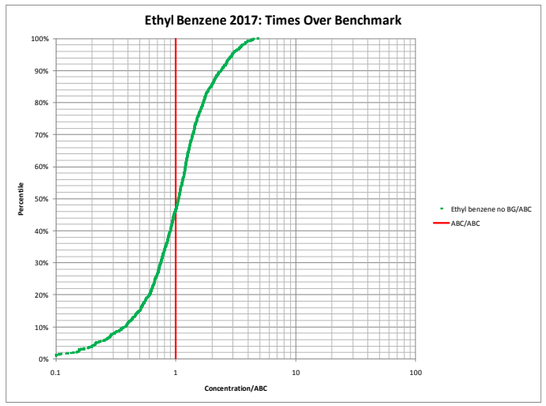
REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.

Ethylbenzene Overview

Benchmark Value:	0.40 ug/m3
Primary health effects:	Possible human carcinogen, effects on blood, liver, and kidneys
Total emissions in PATS study area:	294.2 tons/year
Average reduction needed for all receptors above ABC:	42%, 738 receptors above benchmark

Pertinent information: Ethylbenzene is a colorless, flammable liquid that smells like gasoline. It is naturally found in coal tar and petroleum and is also found in manufactured products such as inks, pesticides, and paints.
The main sources of ethylbenzene in the Portland area are gasoline engines, gasoline evaporation and painting operations. Ethylbenzene is also used in the production of styrene (used to make polystyrene plastic).

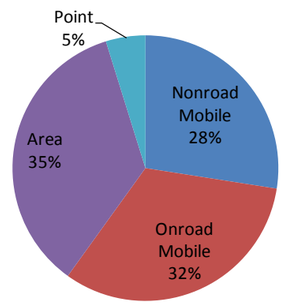
Modeled Distribution of Ethylbenzene Concentrations



Most Significant Sources of Ethylbenzene

Source	TPY	% of Poll	Quality Rating
Point			
1. Surface Coating	12.4	4	A
Area			
1. Solvent/Coating Use	83.0	28	C
2. Consumer Products	16.8	6	D
Non-road			
1. Non-road 2-Stroke	41.6	14	D
2. Non-road 4-Stroke	29.5	10	D
On-road			
1. On-road Mobile	78.6	27	B/C
2. On-road Diesel	7.0	2	B/C

Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

DIESEL PARTICULATE MATTER

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.1 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

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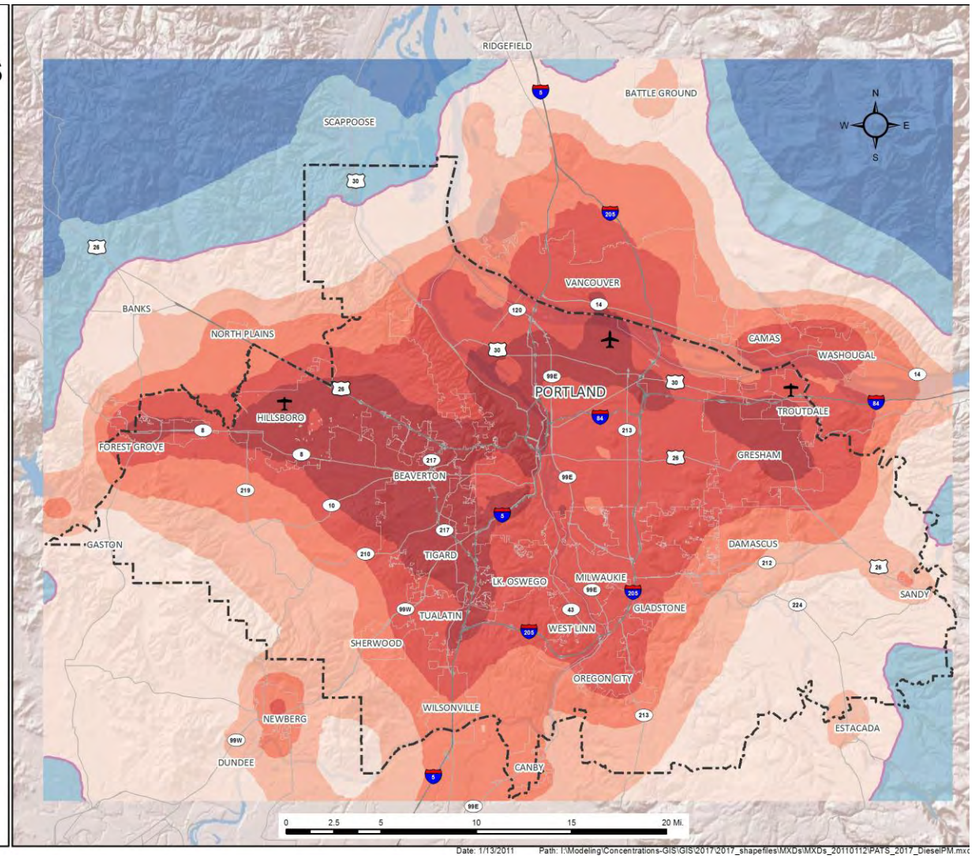


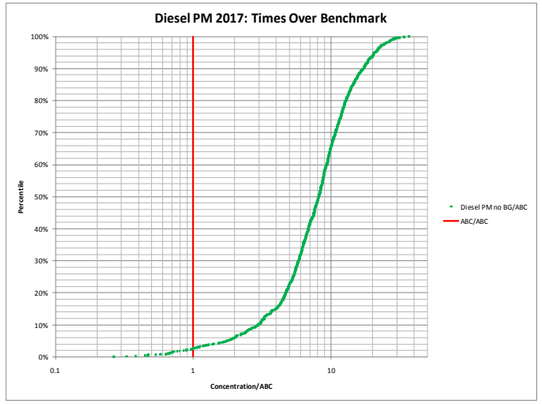
Diesel PM Overview

Benchmark Value:	0.1 ug/m3
Primary health effects:	Associated with increased lung cancer, breathing and heart problems
Total emissions in PATS study area:	528.7 tons/year
Average reduction needed for all receptors above ABC:	86%, 2049 receptors above benchmark

Pertinent information: Diesel particulate matter is not a specific chemical. It is a complex mixture of particles and various chemical compounds in, on, or around the particles.

Diesel particulate matter comes mainly from on and off road diesel engines, including cars and trucks, construction equipment, ships, and rail sources.

Modeled Distribution of Diesel PM Concentrations

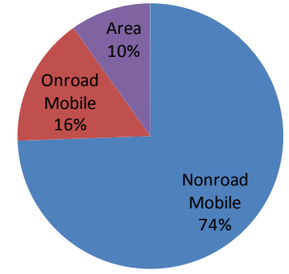


Most Significant Sources of Diesel PM

Source	TPY	% of Poll	Quality Rating
Area			
1. Industrial Fuel Use	24.7	5	D
2. Commercial Fuel Use	14.1	3	D
3. Residential Heating	8.8	2	D
Non-road			
1. Non-road Diesel	344.8	65	D
2. Rail	38.8	7	B/C
3. Boats – Commercial	7.5	1	B
On-road			
1. On-road Diesel	81.7	15	B/C

Point - <1% of Pollutant

Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

15 PAH

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.0009 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

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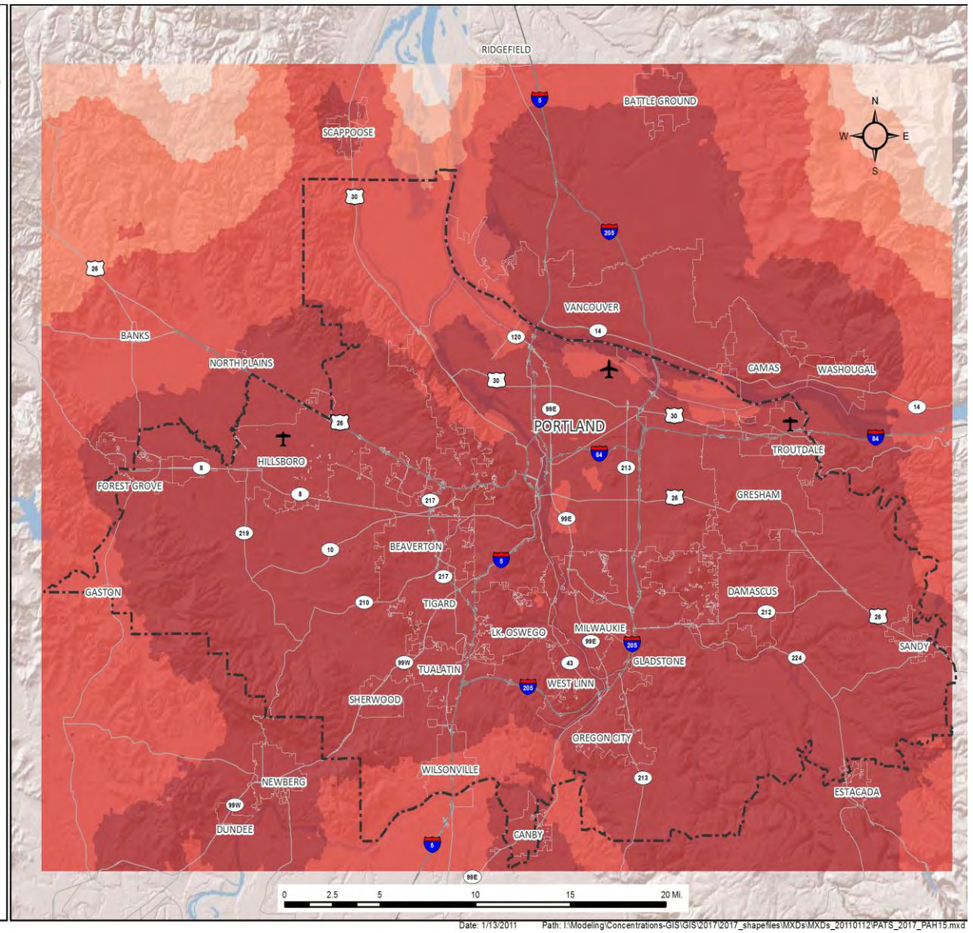


15-PAH Overview

Benchmark Value:	0.0009 ug/m3
Primary health effects:	One known carcinogen, seven probable (Class B2) human carcinogens
Total emissions in PATS study area:	16.68 tons/year
Average reduction needed for all receptors above ABC:	94%, 2372 receptors above benchmark

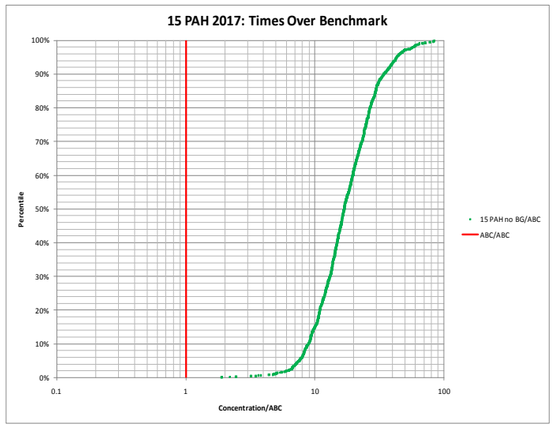
Pertinent information: Polycyclic aromatic hydrocarbons, also called PAHs, are a group of chemicals that are formed during the incomplete burning of carbon-containing substances: wood, coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs, which are 4,000 or more individual chemical compounds, are usually found as a mixture containing two or more of these compounds.

Most Significant Sources of 15-PAH

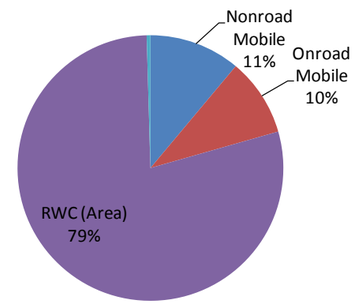
Source	TPY	% of Poll	Quality Rating
Area			
1. Res Wood Comb	12.4	74	C
2. Miscellaneous	0.8	5	D
3. Open Burn/Fires	0.8	5	C
Non-road			
1. Non-road 4-Stroke	0.6	3	D
2. Non-road 2-Stroke	0.3	2	D
3. Non-road Diesel	0.2	1	D
4. Aircraft	0.15	1	B
On-road			
1. On-road Mobile	1.0	6	B/C

Point - <1% of Pollutant

Modeled Distribution of 15-PAH Concentrations



Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

NAPHTHALENE

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.03 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

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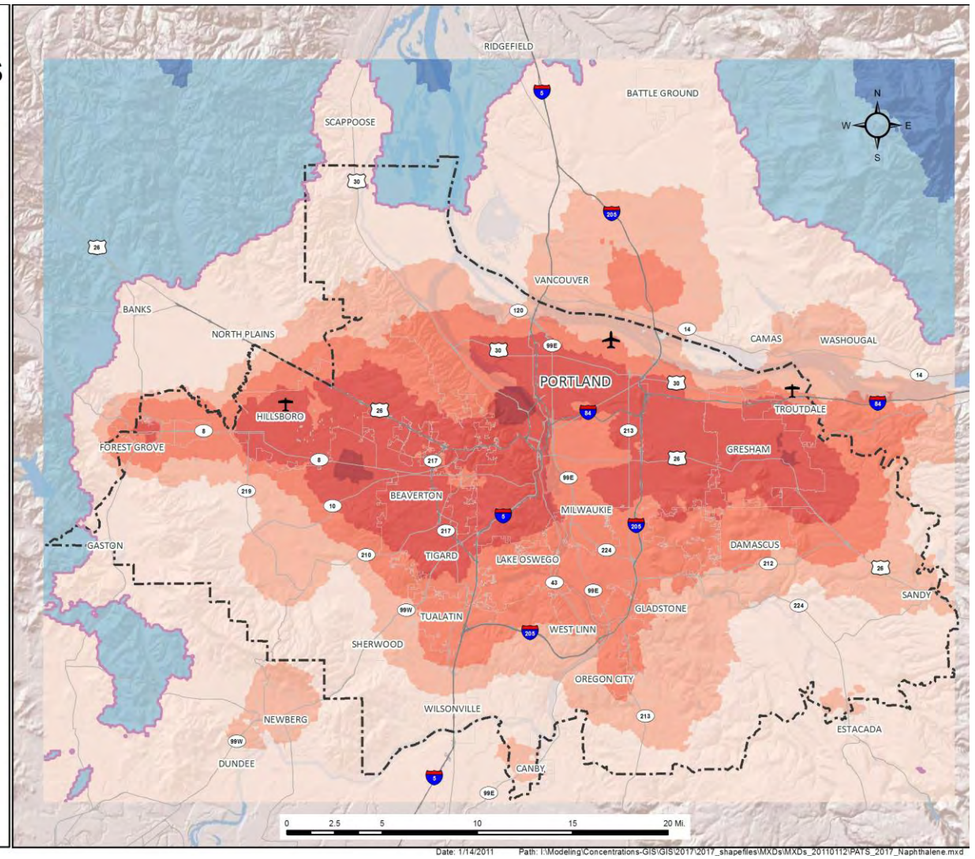
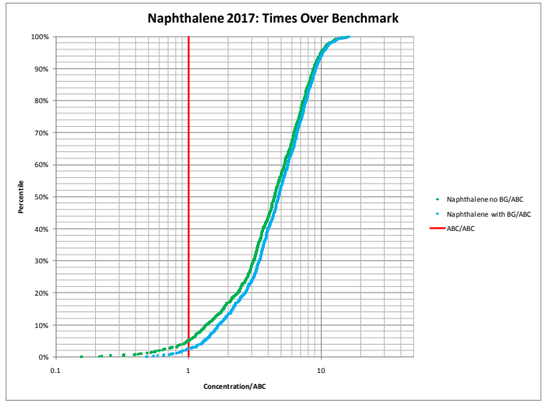


Naphthalene Overview

Benchmark Value:	0.03 ug/m3
Primary health effects:	Possible (Group C) carcinogen
Total emissions in PATS study area:	111.3 tons/year
Average reduction needed for all receptors above ABC:	77%, 2032 receptors above benchmark

Pertinent information: Naphthalene is a white solid that evaporates easily. Fuels such as petroleum and coal contain naphthalene. Burning tobacco or wood produces naphthalene. It has a strong, but not unpleasant smell. The major *commercial* use of naphthalene is in the manufacture of polyvinyl chloride (PVC) plastics. Its major *consumer* use is in moth repellents and toilet deodorant blocks.
Naphthalene is released to the air from the burning of coal and oil and from the use of mothballs.

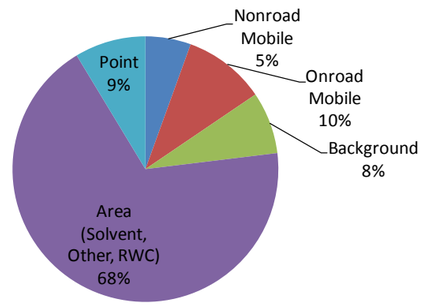
Modeled Distribution of Naphthalene Concentrations



Most Significant Sources of Naphthalene

Source	TPY	% of Poll	Quality Rating
Point			
1. Surface Coating	1.2	1	A
Area			
1. Consumer Products	43.2	39	D
2. Res Wood Comb	24.9	22	C
3. Asphalt	22.5	20	D
Non-road			
1. Non-road 4-Stroke	4.1	4	D
2. Aircraft	1.5	1	B
On-road			
1. On-road Mobile	8.4	8	B/C

Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

ARSENIC

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.0002 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

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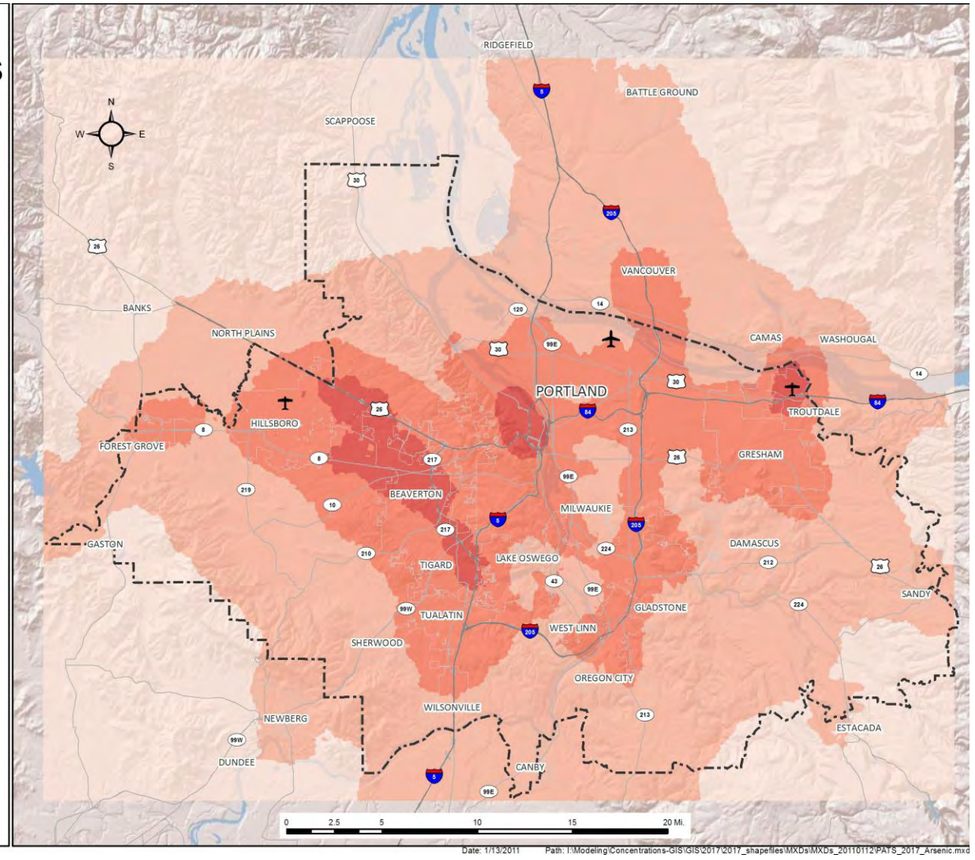


Arsenic Overview

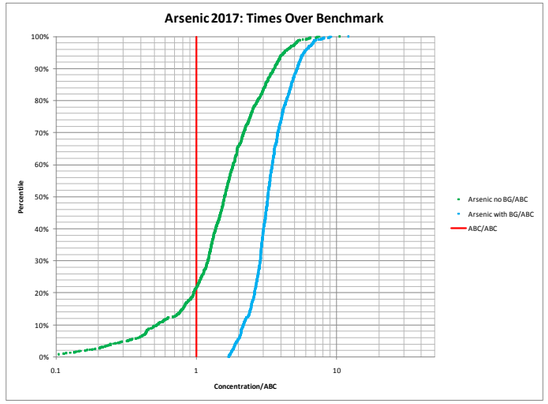
Benchmark Value:	0.0002 ug/m3
Primary health effects:	Known (Class A) human carcinogen
Total emissions in PATS study area:	0.22 tons/year
Average reduction needed for all receptors above ABC:	66%, all receptors above benchmark

Pertinent information: Sources of arsenic are both human caused and natural. Our soils in the Pacific Northwest are naturally high in arsenic because of their volcanic origins. In Oregon, metal processing, agricultural pesticides, and soil dust are sources of arsenic. Oil and natural gas combustion and on-road and non-road engines are important sources of arsenic.

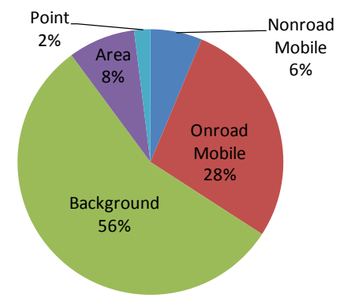
Most Significant Sources of Arsenic

Source	TPY	% of Poll	Quality Rating
Point			
1. Metals	0.01	5	A
2. Industrial Fuel Use	0.007	4	A
Area			
1. Residential Heating	0.015	7	D
2. Industrial Fuel Use	0.015	7	D
Non-road			
1. Aircraft	0.006	3	B
On-road			
1. On-road Mobile	0.12	53	B/C
2. On-road Diesel	0.01	5	B/C

Modeled Distribution of Arsenic Concentrations



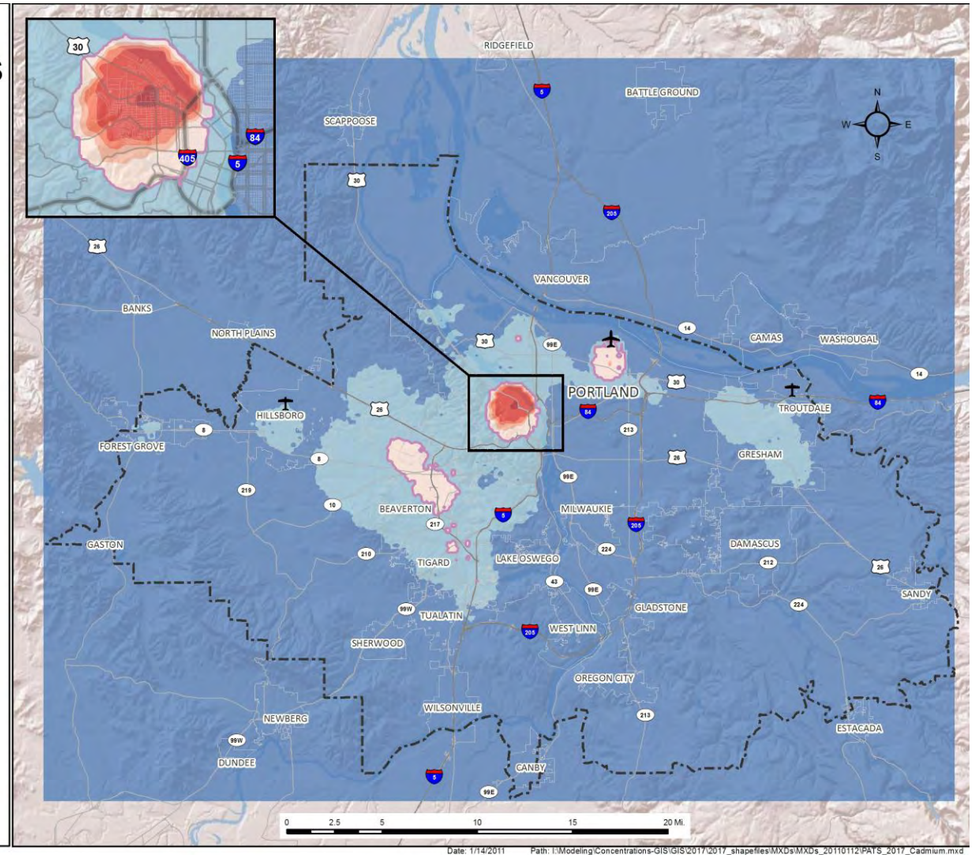
Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

CADMIUM

ALL SOURCES



PATS Study Area boundary

Benchmark contour (0.0006 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

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REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.

Cadmium Overview

Benchmark Value:	0.0006 ug/m3
Primary health effects:	Probable (Class B2) human carcinogen
Total emissions in PATS study area:	0.187 tons/year
Average reduction needed for all receptors above ABC:	70%, 62 receptors above benchmark

Pertinent information: Cadmium is a relatively abundant soft, bluish-white metal. It is usually found as a mineral combined with other elements.

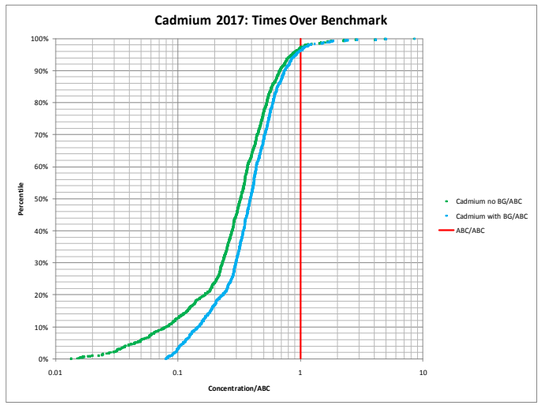
Burning natural gas for both residential and industrial use and prescribed forest burning are major sources of cadmium in Portland's air. Cadmium is also used to make batteries, pigments, metal coatings, and plastic.

Most Significant Sources of Cadmium

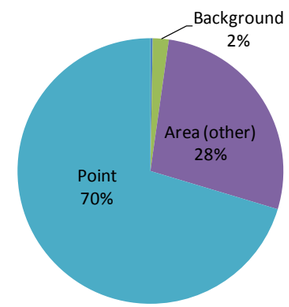
Source	TPY	% of Poll	Quality Rating
Point			
1. Metals	0.030	16	A
2. Industrial Fuel Use	0.013	7	A
3. Glass Manufacturing	0.010	6	A
Area			
1. Residential Heating	0.057	30	D
2. Open Burn/Fires	0.037	19	-
3. Industrial Fuel Use	0.022	12	D
4. Commercial Fuel Use	0.013	7	D
Non-road			
1. Rail	0.002	1	B/C

On-road - <1% of Pollutant

Modeled Distribution of Cadmium Concentrations



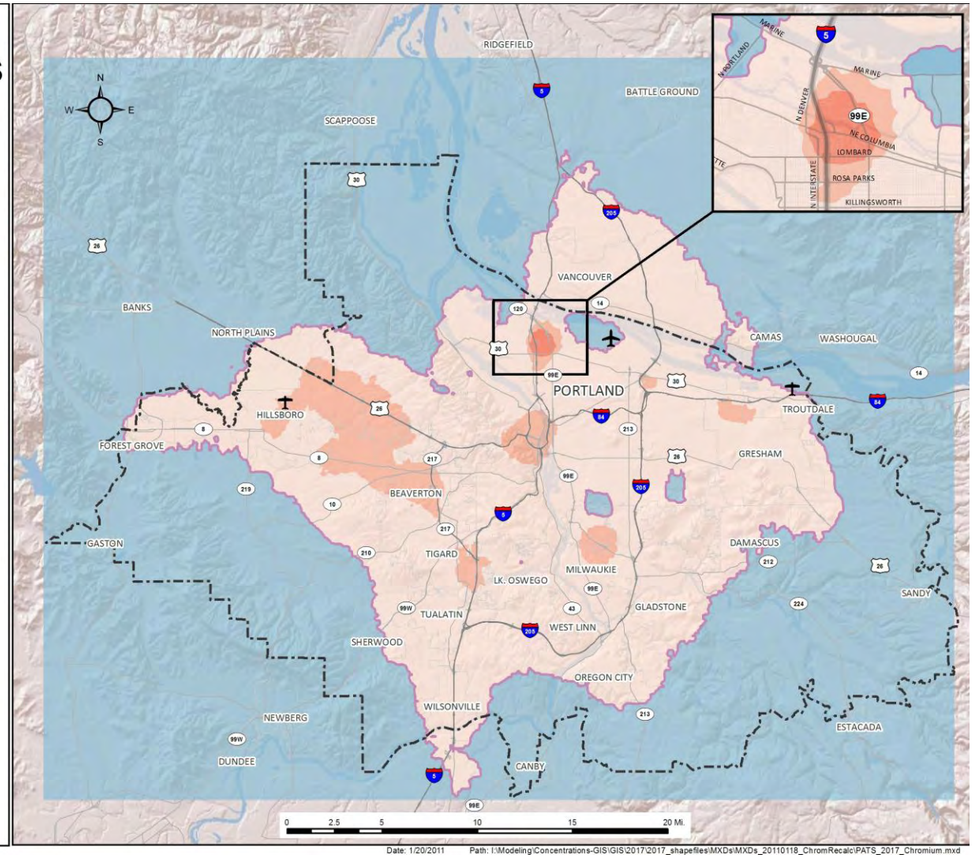
Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

CHROMIUM 6

ALL SOURCES



DEQ State of Oregon Department of Environmental Quality

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Basemap from Metro and ESRI data.

Chromium VI Overview

Benchmark Value:	0.00008 ug/m3
Primary health effects:	Known (Class A) human carcinogen, damage to the respiratory tract
Total emissions in PATS study area:	0.047 tons/year
Average reduction needed for all receptors above ABC:	37%, 1155 receptors above benchmark

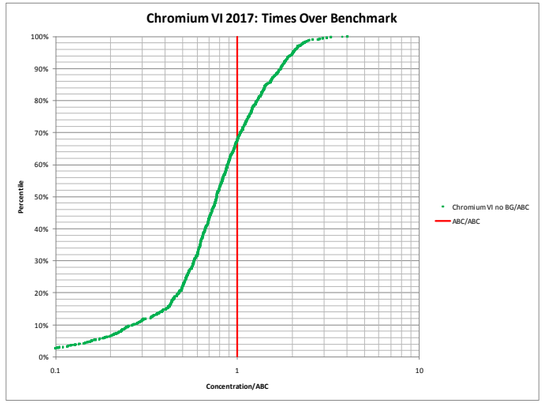
Pertinent information: Chromium is a naturally occurring metal found in rocks, animals, plants, soil, and volcanic dust and gases. Because of its ability to react with other elements, it can produce hard coatings, which is why it is used in paints for cars, boats and airplanes. Chromium comes in several forms. Hexavalent Chromium - also called chromium VI - is a form of chromium that can occur naturally but is most commonly produced by industrial processes.

Most Significant Sources of Chromium VI

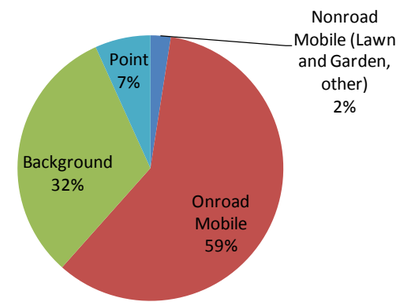
Source	TPY	% of Poll	Quality Rating
Point			
1. Metals	0.0074	16	A
2. Industrial Fuel Use	0.0043	9	A
Non-road			
1. Non-road 4-Stroke	0.0013	3	D
On-road			
1. On-road Mobile	0.031	65	B/C
2. On-road Diesel	0.0027	6	B/C

Area - <1% of Pollutant

Modeled Distribution of Chromium VI Concentrations



Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

MANGANESE

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.09 µg/m³)

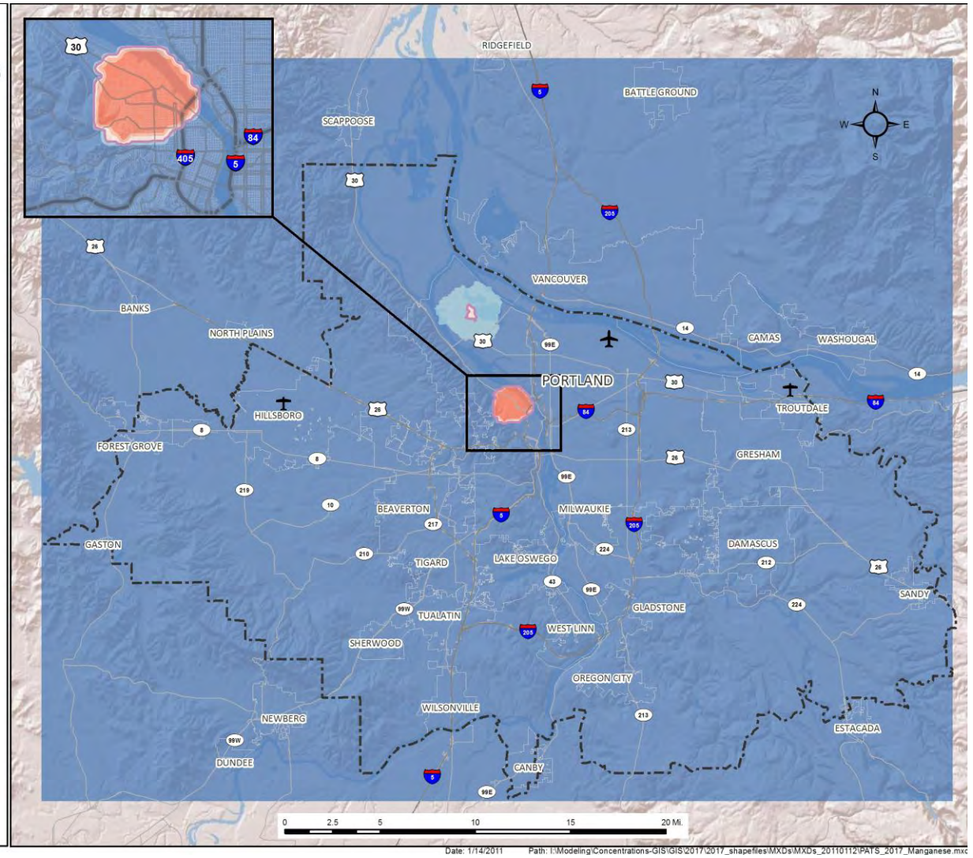
Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

NOTE: Areas beyond the modeling domain (color-shaded region) are beyond the scope of this project.

REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.



Manganese Overview

Benchmark Value:	0.09 ug/m3
Primary health effects:	May result in central nervous system problems
Total emissions in PATS study area:	4.36 tons/year
Average reduction needed for all receptors above ABC:	84%, 8 receptors above benchmark

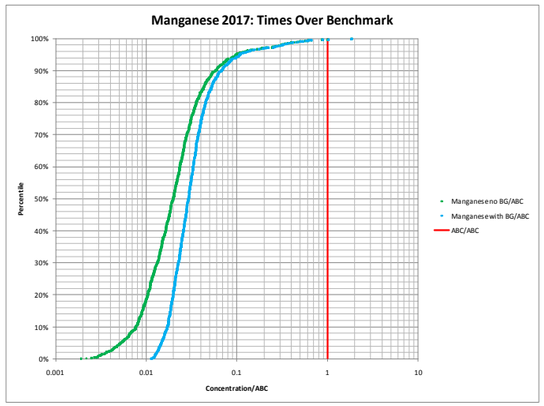
Pertinent information: Manganese is a metal used primarily in steel production to improve hardness, stiffness, and strength. Manganese dioxide is used in the production of dry-cell batteries, matches, fireworks, and the production of other manganese compounds.
The main source of manganese pollution in Portland comes from the smelting of steel and iron. Manganese is also emitted from power plants, coke ovens and dust from mining operations. It is also a component of some pesticides and is used as a fuel additive in some gasoline.

Most Significant Sources of Manganese

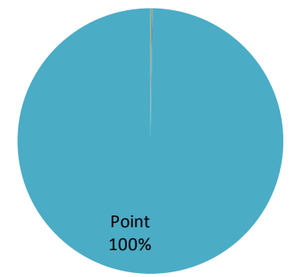
Source	TPY	% of Poll	Quality Rating
Point			
1. Surface Coating	2.04	47	A
2. Metals	1.68	38	A
3. Industrial Fuel Use	0.45	10	A
4. Asphalt Manufacturing	0.04	1	A
Area			
1. Industrial Fuel Use	0.07	2	D
2. Residential Heating	0.03	1	D
On-road			
1. On-road Mobile	0.03	1	B/C

Non-road - <1% of Pollutant

Modeled Distribution of Manganese Concentrations



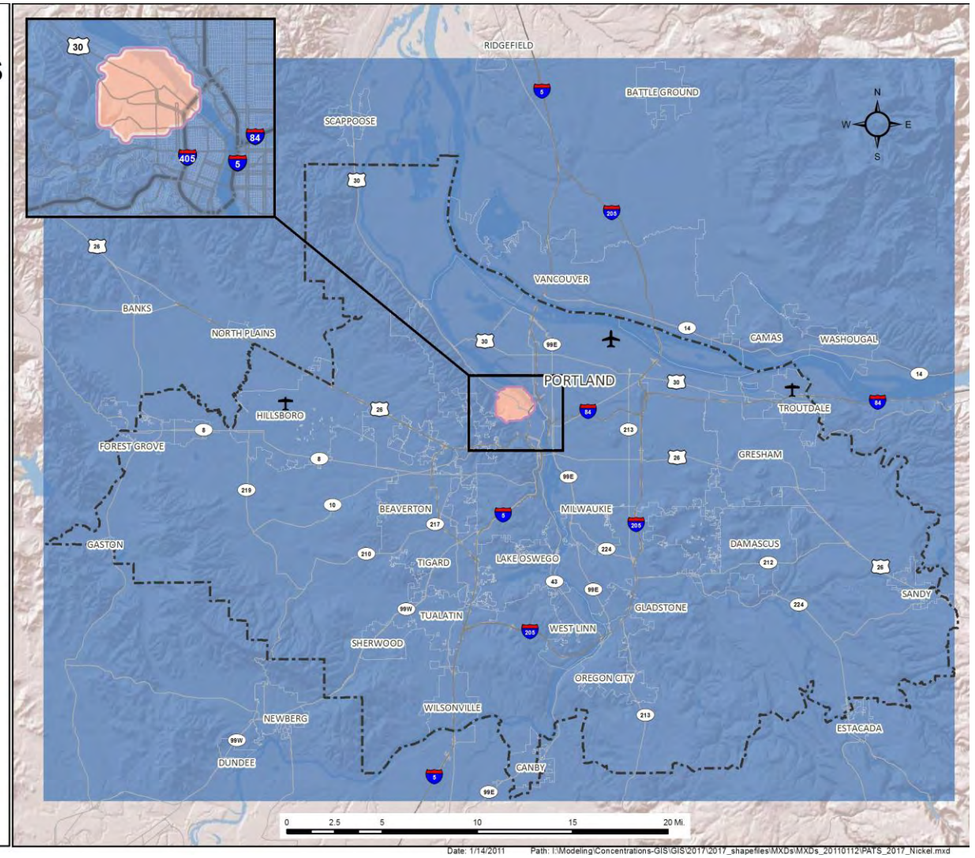
Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

NICKEL

ALL SOURCES



PATS Study Area boundary

Benchmark contour (0.05 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

NOTE: Areas beyond the modeling domain (color-shaded region) are beyond the scope of this project.

REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.

Nickel Overview

Benchmark Value:	0.05 ug/m3
Primary health effects:	Two forms are known (Class A) human carcinogens, toxic to the respiratory system
Total emissions in PATS study area:	2.64 tons/year
Average reduction needed for all receptors above ABC:	90%, 3 receptors above benchmark

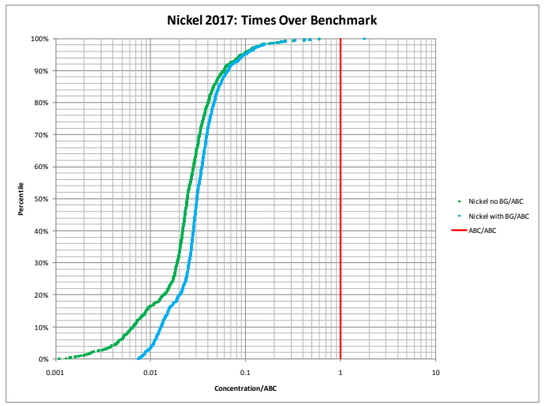
Pertinent information: Nickel is an abundant natural element found in soil and emitted from volcanoes. Nickel is most often used to make stainless steel and nickel compounds are used for nickel plating, to make some batteries, and as catalysts.
Nickel is released into the air by industries that make or use nickel or nickel compounds. It is also released by oil- and coal-burning power plants and trash incinerators.

Most Significant Sources of Nickel

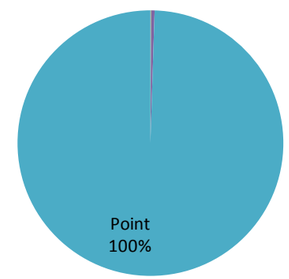
Source	TPY	% of Poll	Quality Rating
Point			
1. Metals	2.0	76	A
2. Industrial Fuel Use	0.08	3	A
3. Surface Coating	0.08	3	A
Area			
1. Industrial Fuel Use	0.21	8	D
2. Residential Heating	0.11	4	D
3. Commercial Fuel Use	0.08	3	D
On-road			
1. On-road Mobile	0.06	2	B/C

Non-road - <1% of Pollutant

Modeled Distribution of Nickel Concentrations



Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

DICHLOROBENZENE

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.09 µg/m³)

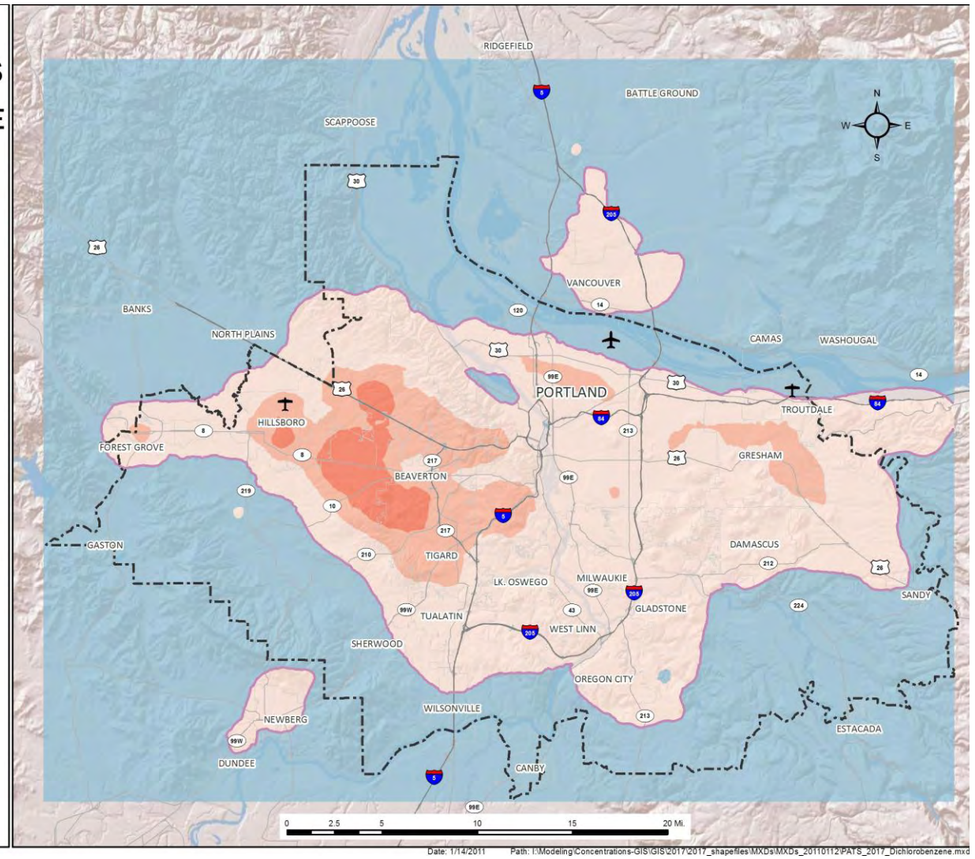
Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

NOTE: Areas beyond the modeling domain (color-shaded region) are beyond the scope of this project.

REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.



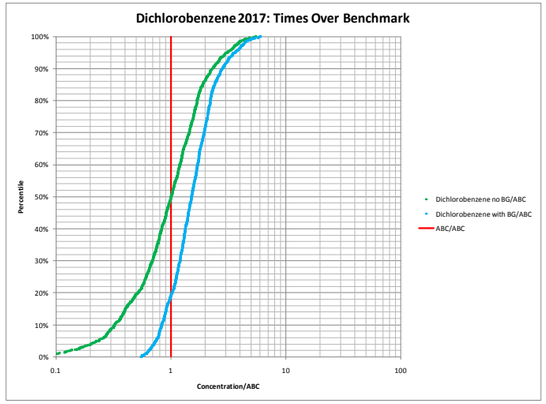
Dichlorobenzene Overview

Benchmark Value:	0.09 ug/m3
Primary health effects:	Possible (Group C) human carcinogen, can result in liver, skin, and central nervous system problems
Total emissions in PATS study area:	80.8 tons/year
Average reduction needed for all receptors above ABC:	45%, 1216 receptors above benchmark

Pertinent information: 1,4-Dichlorobenzene, also called para-dichlorobenzene, is a colorless solid with a strong, distinctive smell.

1,4-Dichlorobenzene is used as a fumigant to control moths, molds and mildew. It is also used as a disinfectant in waste containers and restrooms and is the characteristic smell associated with urinal cakes.

Modeled Distribution of Dichlorobenzene Concentrations



Most Significant Sources of Dichlorobenzene

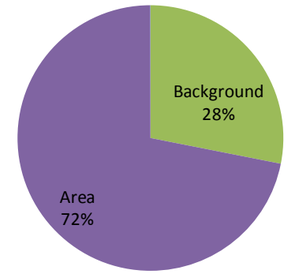
Source	TPY	% of Poll	Quality Rating
Area			
1. Consumer Products	80.7	100	-

Point - <1% of Pollutant

On-road - <1% of Pollutant

Non-road - <1% of Pollutant

Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

ACETALDEHYDE

ALL SOURCES

PATS Study Area boundary

Benchmark contour (0.45 µg/m³)

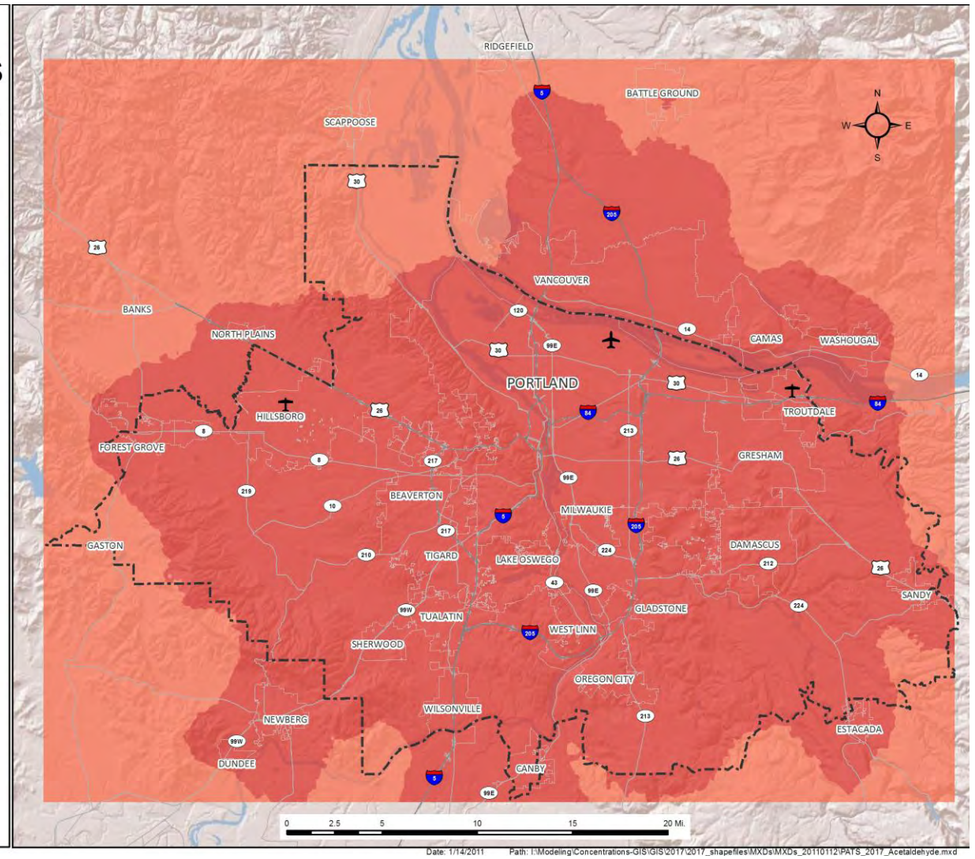
Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

NOTE: Areas beyond the modeling domain (color-shaded region) are beyond the scope of this project.

REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.



Acetaldehyde Overview

Benchmark Value:	0.45 ug/m3
Primary health effects:	Probable (Class B2) human carcinogen
Total emissions in PATS study area:	220.9 tons/year
Average reduction needed for all receptors above ABC:	81%, all receptors above benchmark

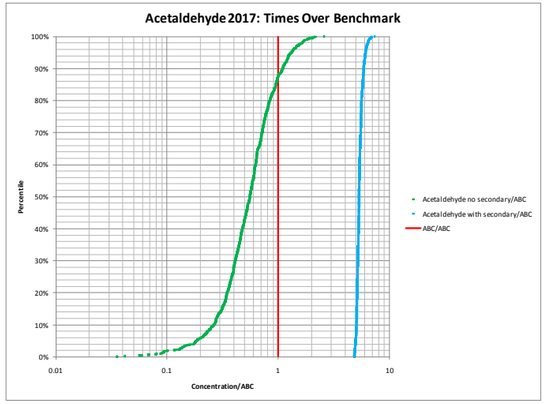
Pertinent information: Acetaldehyde is a colorless, flammable liquid that evaporates easily into the air. It is a product of incomplete combustion of fuels and wood, and is also used in the manufacture of other chemicals and products including perfumes and dyes.

The dominant source of acetaldehyde in the Portland area is smoke from residential wood stoves and fireplaces, but much is also produced by engines.

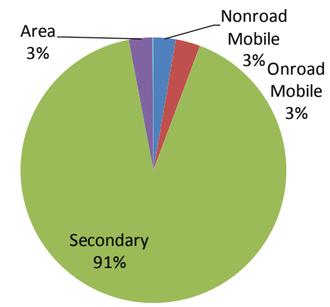
Most Significant Sources of Acetaldehyde

Source	TPY	% of Poll	Quality Rating
Point			
1. Wood Products	15.9	7	A
2. Metals	3.4	2	A
Area			
1. Res Wood Comb	74.7	34	C
2. Open Burn/Fires	7.9	4	C
Non-road			
2. Non-road Diesel	26.2	12	D
1. Non-road 4-Stroke	11.5	5	D
On-road			
1. On-road Mobile	54.2	25	B/C
2. On-road Diesel	4.9	2	B/C

Modeled Distribution of Acetaldehyde Concentrations



Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

FORMALDEHYDE (DEQ BENCHMARK) ALL SOURCES

PATS Study Area boundary

Benchmark contour (3.0 µg/m³)

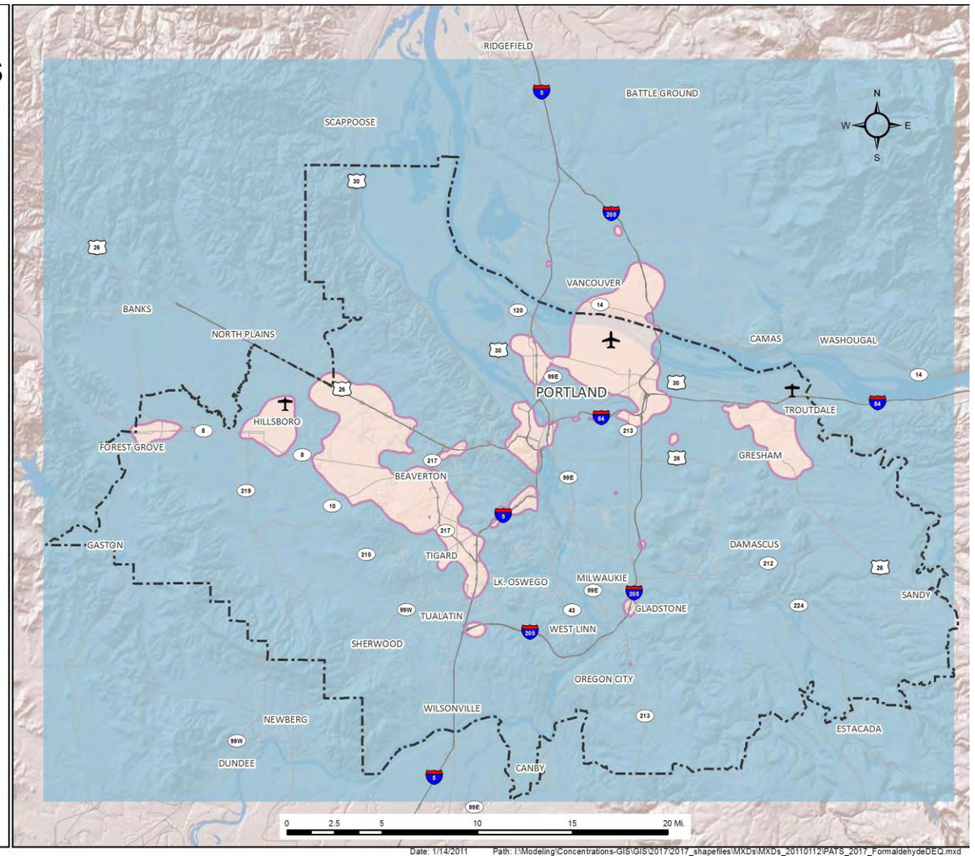
Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

NOTE: Areas beyond the modeling domain (color-shaded region) are beyond the scope of this project.

REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.



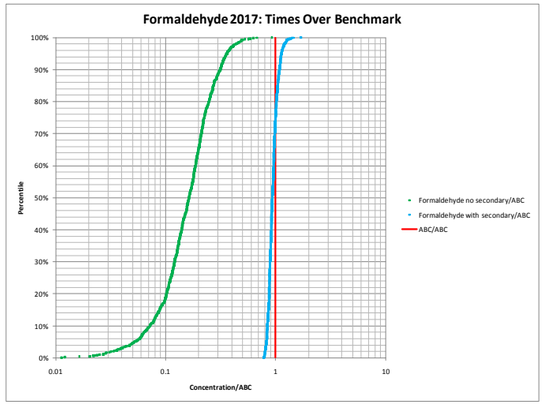
NOTE: Graph represents all sources of Formaldehyde with respect to the DEQ benchmark concentration.

Formaldehyde Overview

Benchmark Value:	0.009 ug/m3 (EPA) 3.0 ug/m3 (DEQ)
Primary health effects:	Probable (Class B1) human carcinogen
Total emissions in PATS study area:	426.1 tons/year
Average reduction needed for all receptors above ABC:	10%, 325 receptors above benchmark

Pertinent information: Formaldehyde comes from incomplete fuel combustion from industry, on and off-road engines, construction equipment, diesel fuel combustion, railroads, and airports, as well as from wood burning. It is used as a concrete and plaster additive, as a disinfectant, and as a wood preservative. The highest levels of airborne formaldehyde have been detected in indoor air, where it is released from various consumer products including paneling and carpets.

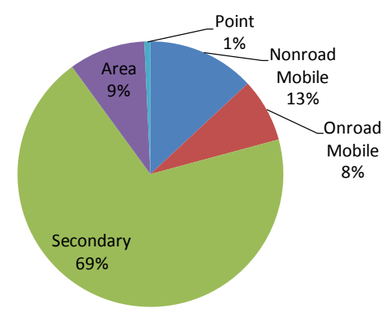
Modeled Distribution of Formaldehyde Concentrations



Most Significant Sources of Formaldehyde

Source	TPY	% of Poll	Quality Rating
Point			
1. Industrial Fuel Use	10.6	3	A
Area			
1. Res Wood Comb	159.8	37	C
2. Open Burn/Fires	32.8	8	C
3. Miscellaneous	10.8	3	D
Non-road			
1. Non-road Diesel	58.2	14	D
2. Non-road 4-Stroke	22.3	5	D
On-road			
1. On-road Mobile	74.2	17	B/C

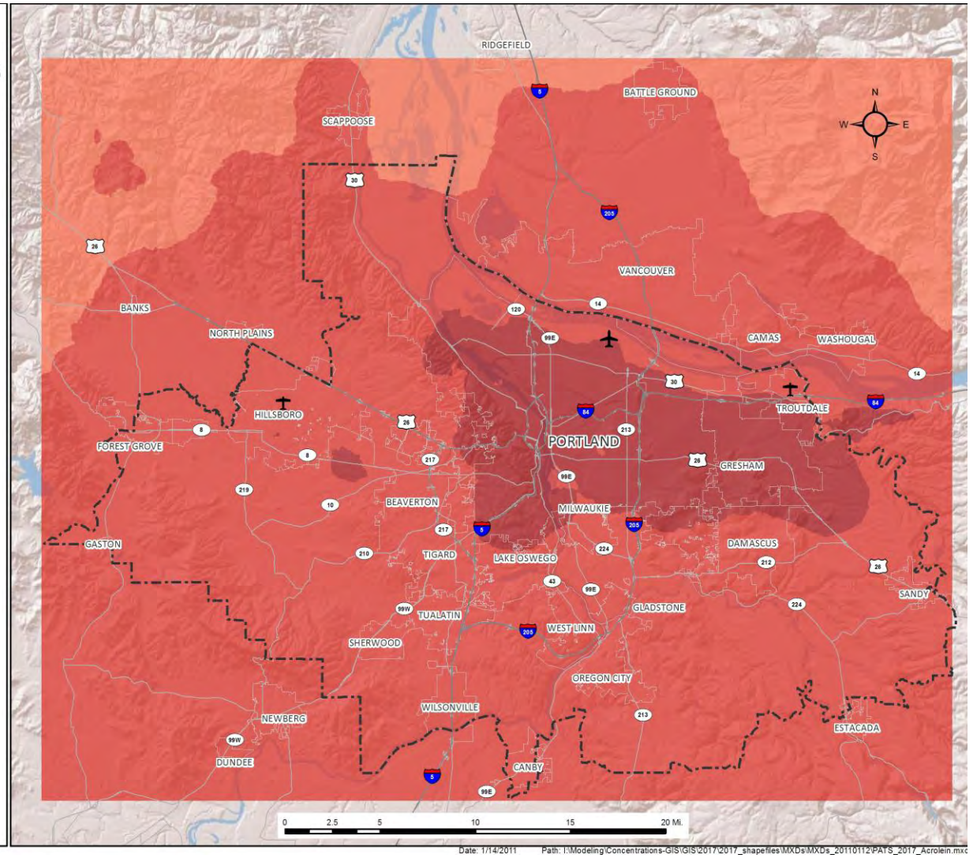
Pie Chart of Receptors above ABC



PATS 2017 MODELING RESULTS

ACROLEIN

ALL SOURCES



PATS Study Area boundary

Benchmark contour (0.02 µg/m³)

Annual average concentration

- < ½X benchmark
- ½X - 1X benchmark
- 1X - 2X benchmark
- 2X - 3X benchmark
- 3X - 5X benchmark
- 5X - 10X benchmark
- > 10X benchmark

DEQ State of Oregon Department of Environmental Quality

NOTE: Areas beyond the modeling domain (color-shaded region) are beyond the scope of this project.

REFERENCES:
Concentration data from DEQ Portland Air Toxics Study (PATS)
Basemap from Metro and ESRI data.

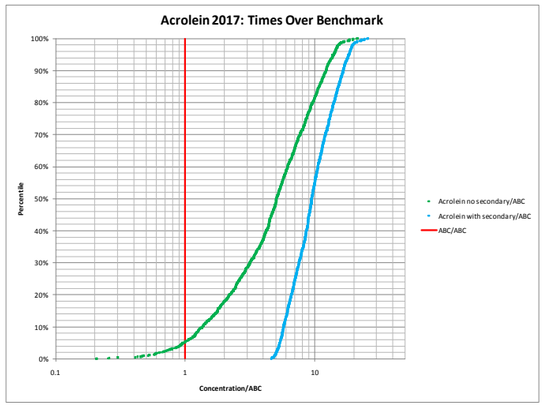
Acrolein Overview

Benchmark Value:	0.02 ug/m3
Primary health effects:	General respiratory congestion and eye, nose, and throat irritation
Total emissions in PATS study area:	78.9 tons/year
Average reduction needed for all receptors above ABC:	88%, all receptors above benchmark

Pertinent information: Acrolein is a colorless or yellow liquid that evaporates quickly and burns easily. Acrolein has a strong, unpleasant odor. It reacts quickly when exposed to other substances.

Acrolein enters the air mainly from wood burning, structural (house and building) fires and construction. Tobacco smoke is another source of acrolein.

Modeled Distribution of Acrolein Concentrations



Most Significant Sources of Acrolein

Source	TPY	% of Poll	Quality Rating
Point			
1. Industrial Fuel Use	2.5	3	A
Area			
1. Open Burn/Fires	59.9	76	C
2. Res Wood Comb	8.2	10	C
Non-road			
1. Non-road Diesel	1.5	2	D
2. Non-road 4-Stroke	1.0	1	D
3. Non-road 2-Stroke	0.6	1	D
On-road			
1. On-road Mobile	3.8	5	B/C

Pie Chart of Receptors above ABC