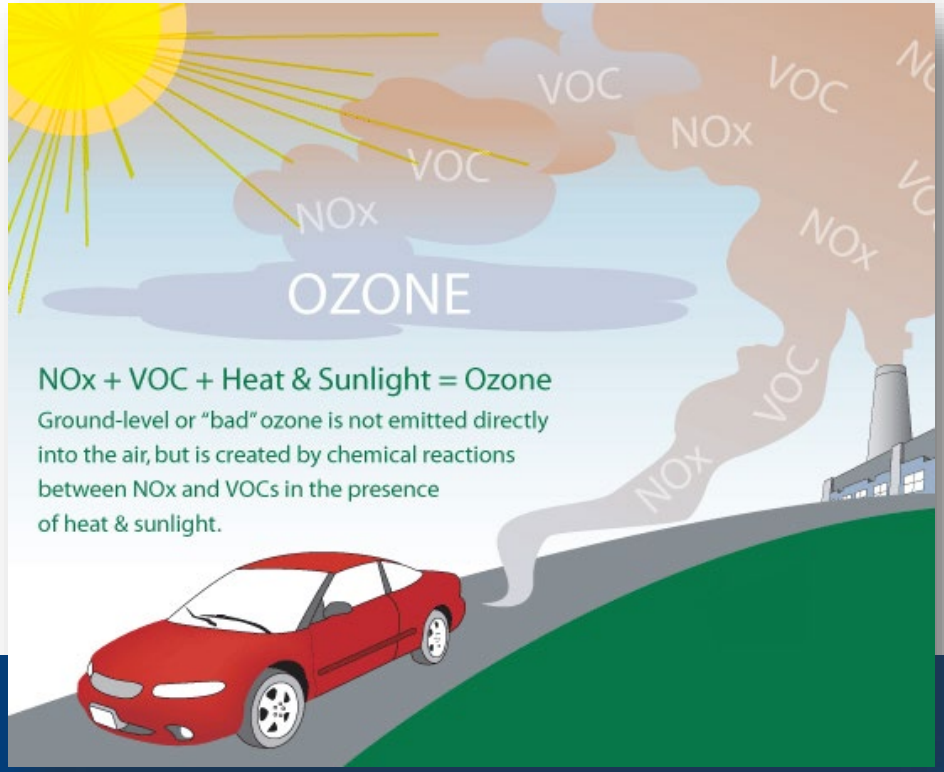
Ozone and Air Toxics:
Monitoring and Planning

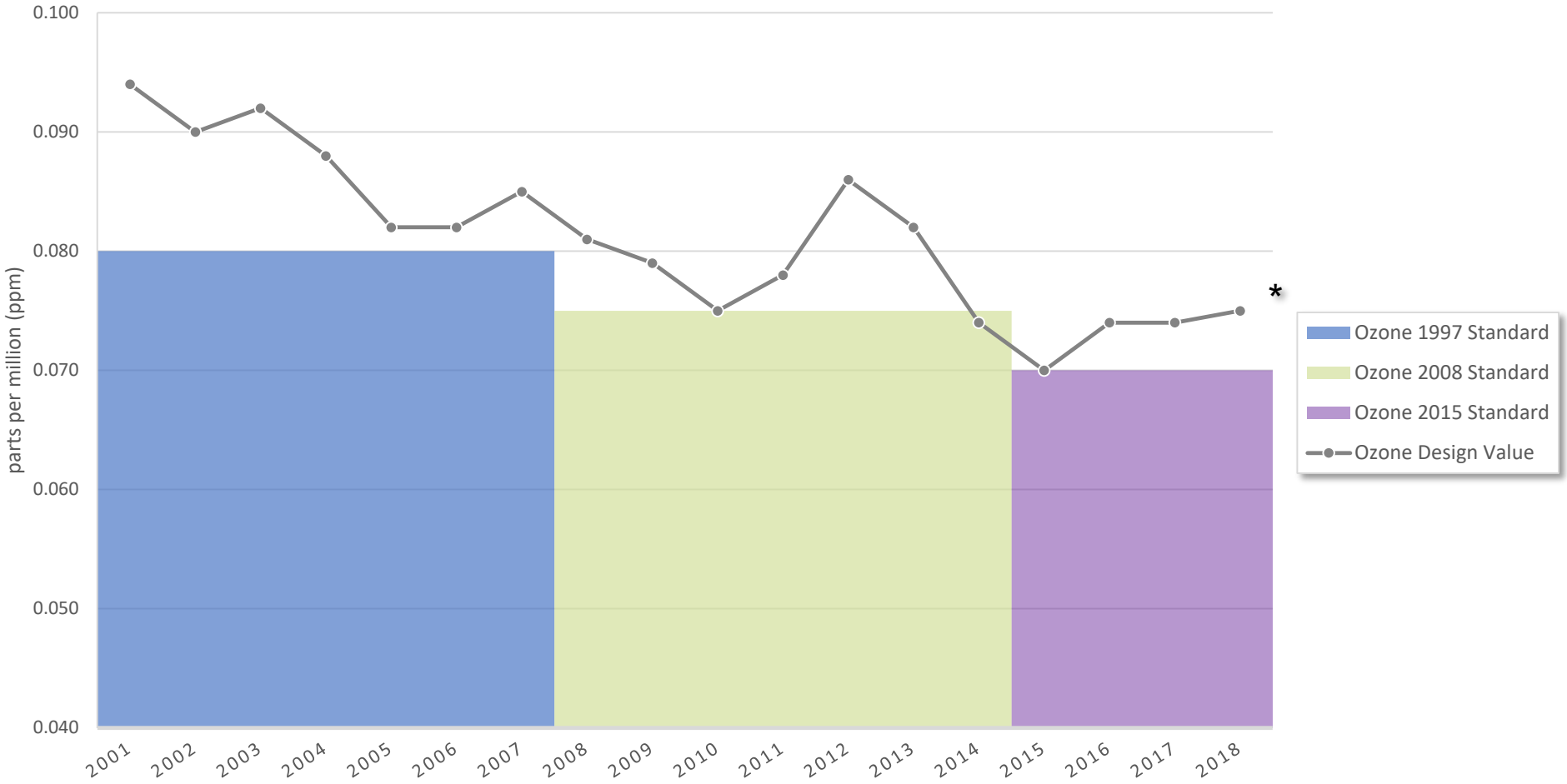
Air Pollution Control District
August 20, 2019

Ozone (O_3)

- Created via a chemical reaction:
  NOx + VOCs + Sunlight = O_3
- Louisville's Ozone season:
  March-October
- Health effects:
  - Shortness of breath
  - Inflame airways
  - Aggravate lung disease
  - Increase frequency of asthma attacks

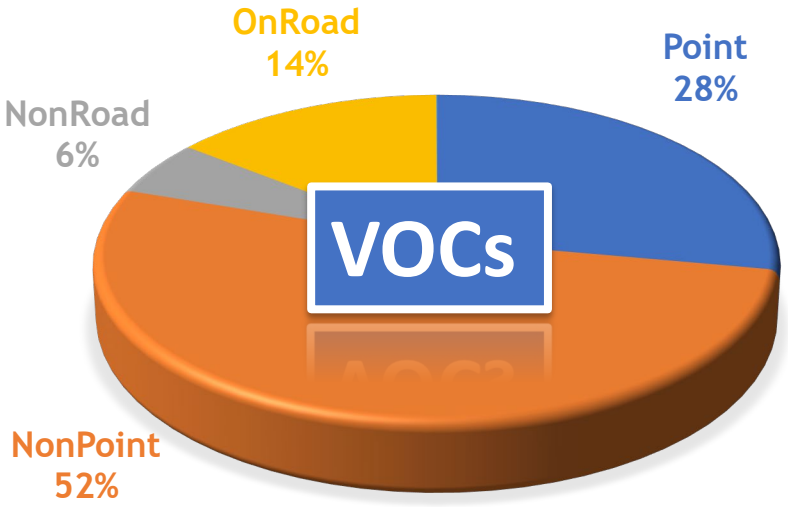


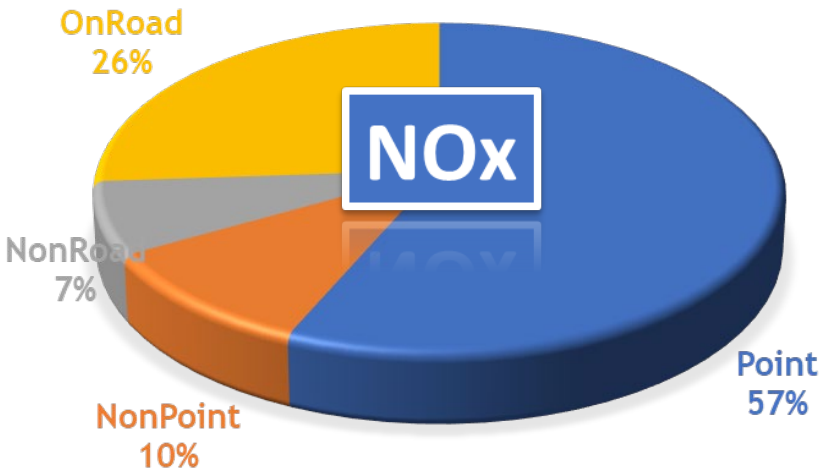
Louisville's Ozone History



* 2018 Design Value – 0.075ppm

What are the sources of ozone precursor emissions in Louisville?





Data from 2014 National Emissions Inventory

Louisville Air Toxics

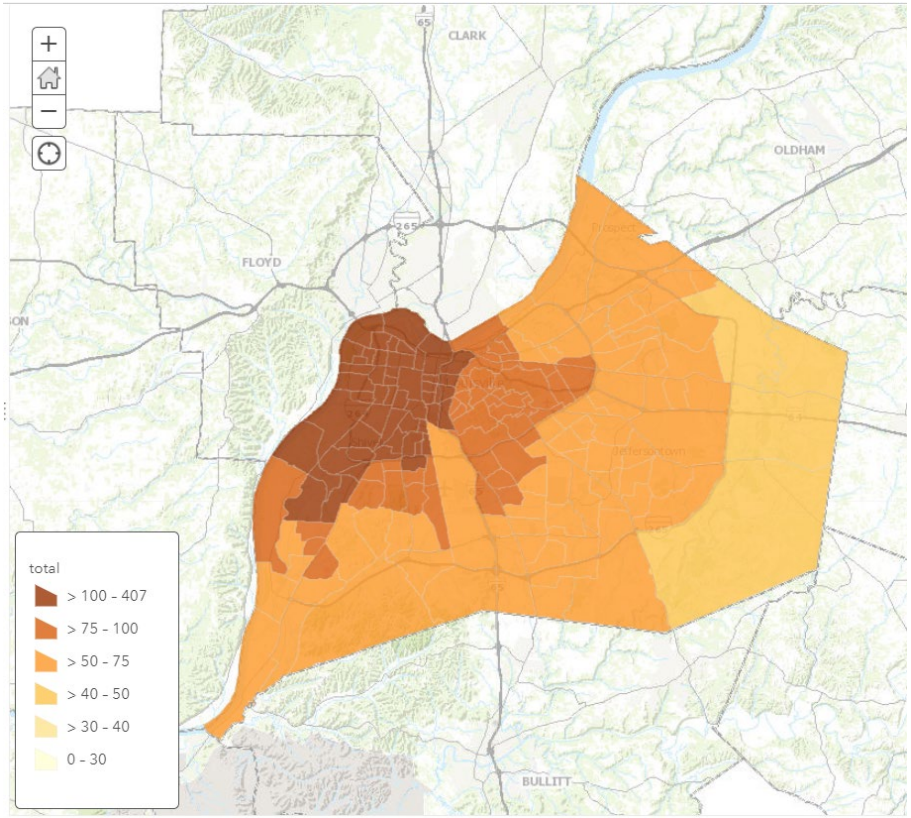
Total Air Toxics
2005 - 2017

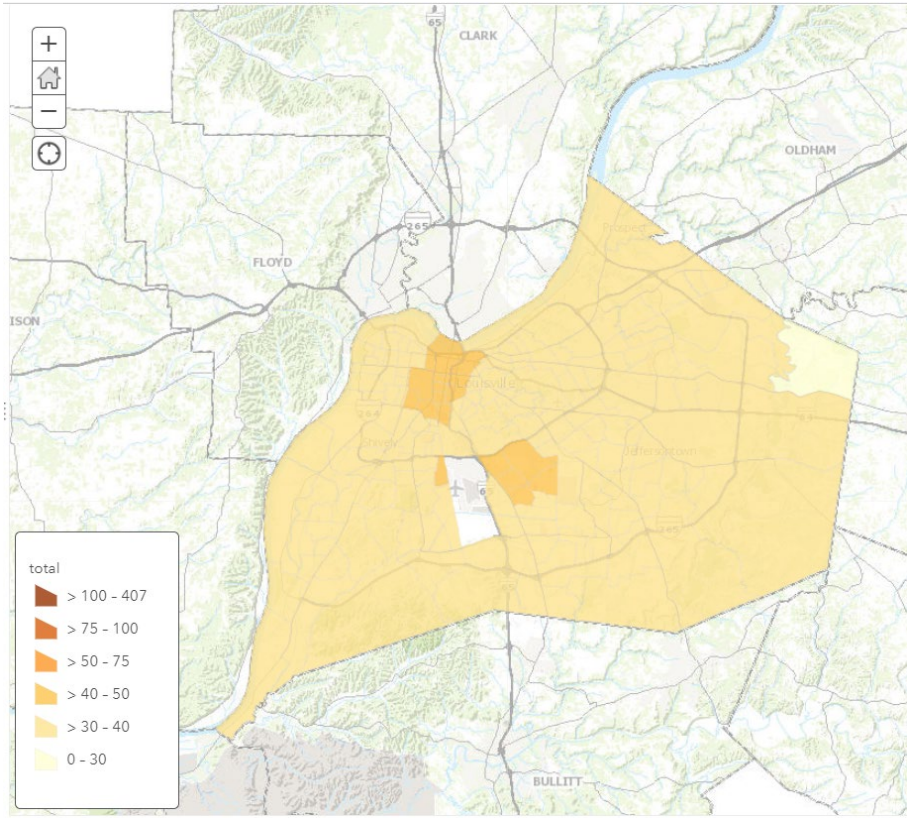
Jefferson County, KY Sources	2005 Total Air Releases in Pounds	2017 Total Air Releases in Pounds	% Change
Electric Generating Utilities (EGUs)	4,703,167	851,342	-82% Decrease
Non-EGUs	3,443,604	1,309,085	-62% Decrease
Total	8,146,770	2,160,427	-73% Decrease

Source: EPA Toxics Release Inventory

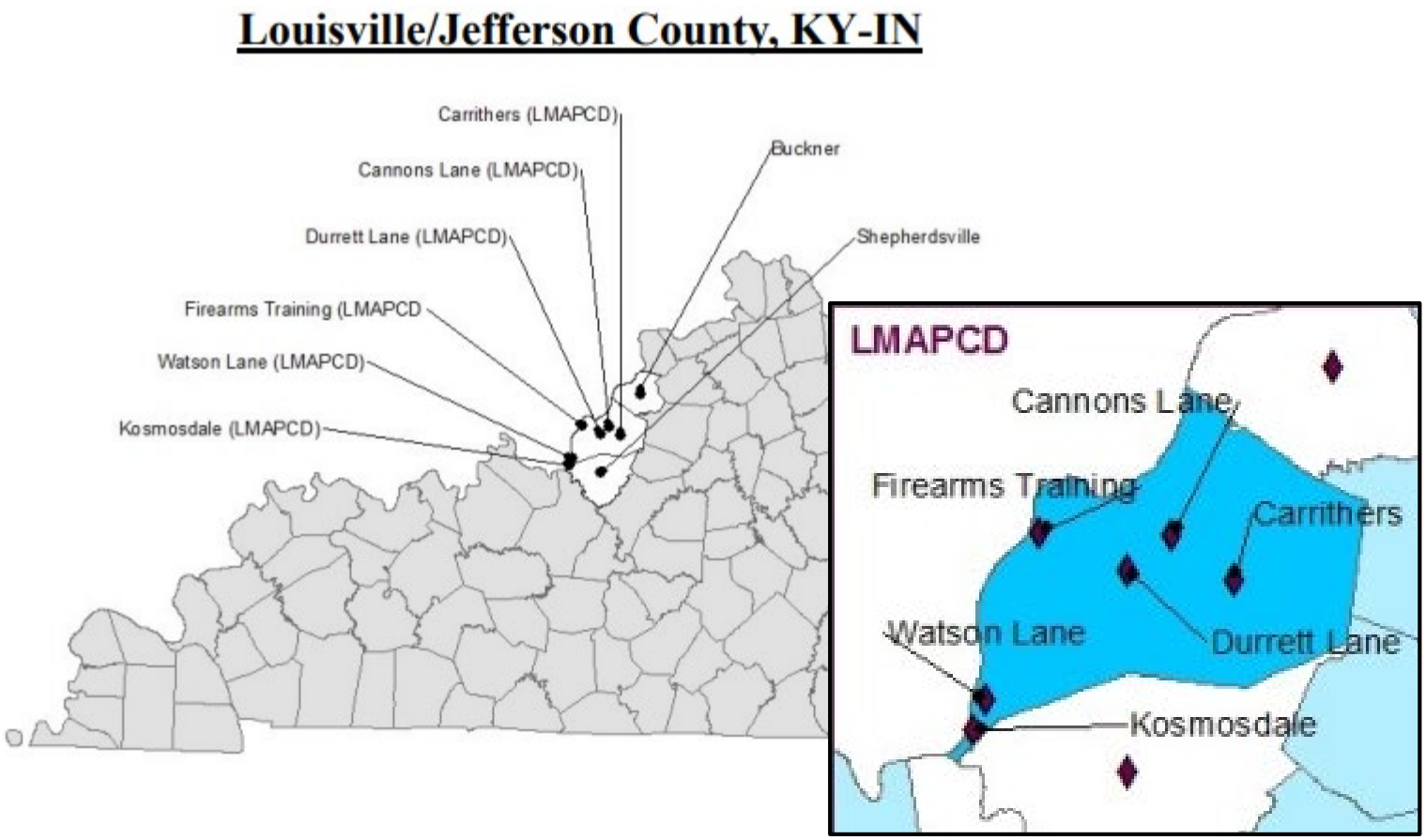
Progress to Date

2005 v 2014 National Air Toxics Assessment – Total





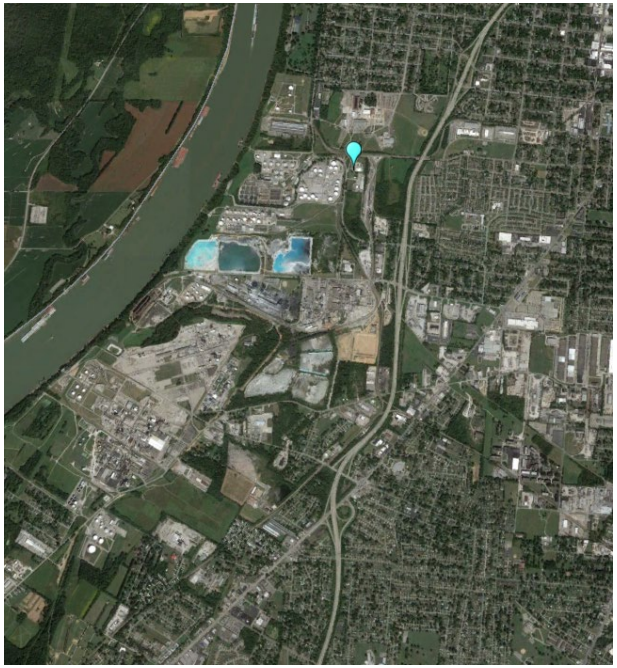
Monitoring for Jefferson County, KY

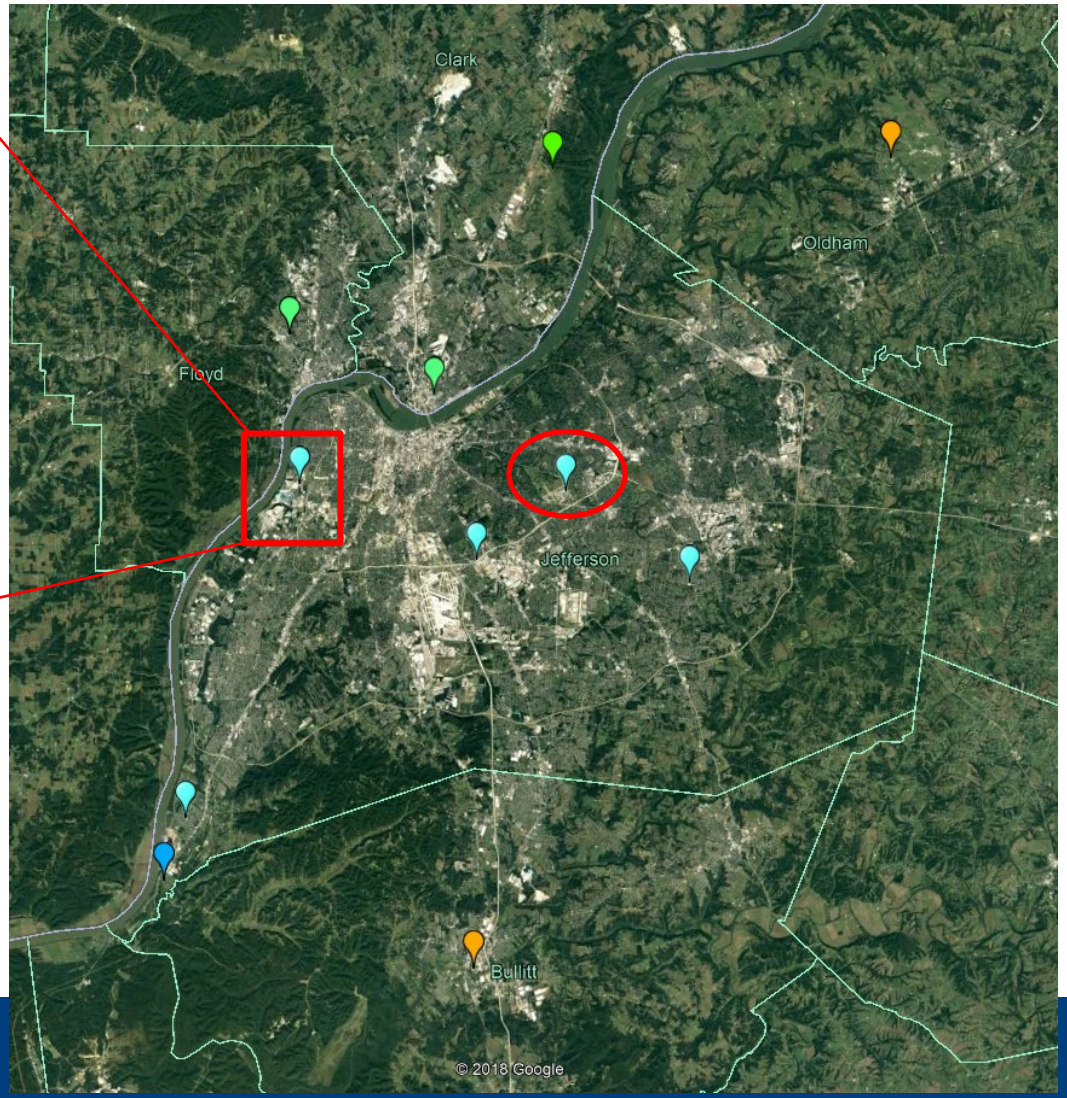


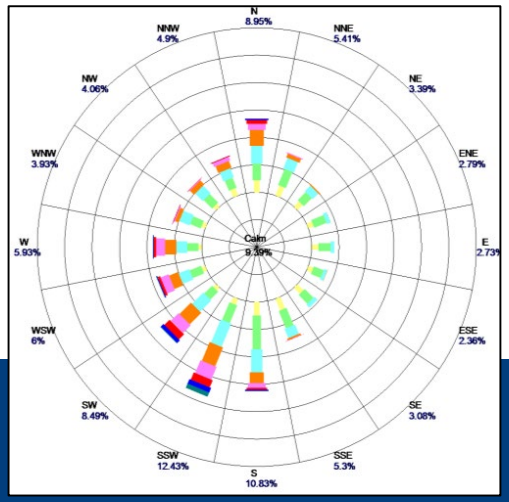
NCore Multipollutant Monitoring Network

- Trace Level Carbon Monoxide
- Trace Level Sulfur Dioxide
- Oxides of Nitrogen (NOx)
- Total Oxides of Nitrogen (NOy)
- Ozone
- PM2.5 Mass and Speciation
- PM2.5 Carbon Speciation
- PM10 – PM2.5 (PMCoarse)
- Meteorological
- RadNet

Air Toxics / PAMS Monitoring







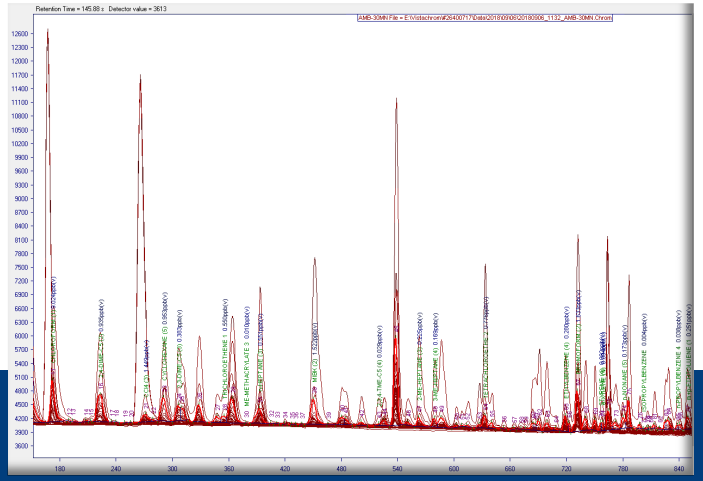
Air Toxics / PAMS Monitoring

- Traditional Method
  - Manual collection using canisters
  - Samples typically collected once every 6 or 12 days
  - Samples shipped to lab for analysis
  - Samples represents 24-hr period

- Modern Method
  - Automated Gas Chromatography
    - Two Auto GCs – Dual FIDs
  - Samples collected every hour
  - Samples analyzed in near real time
  - Raw data available within the hour
  - While temporal resolution is improved, additional challenges exist

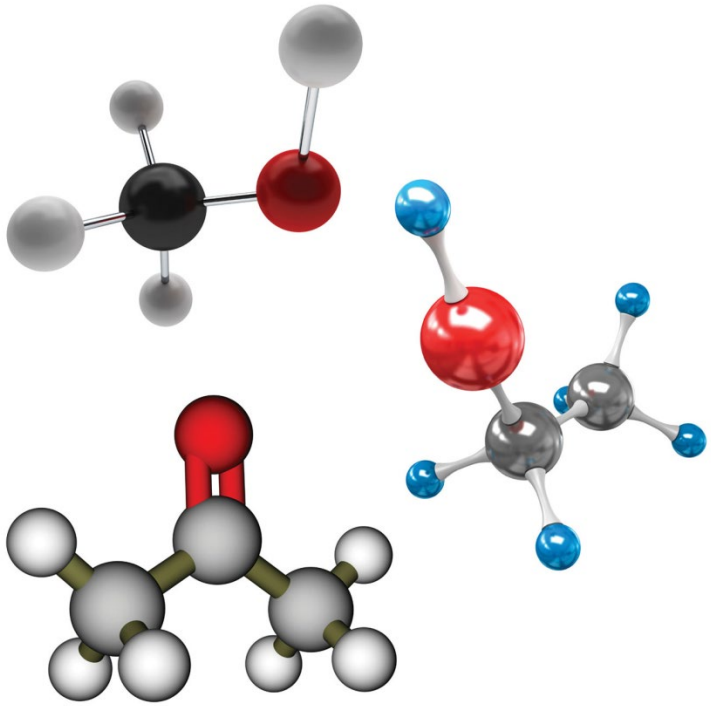
Air Toxics / PAMS Monitoring

- Auto GC technology is complex and produces large amounts of data
- APCD is the 2nd AQ agency in the country to operate Chromatotec Auto GC
- Continuous refinement of methodologies expected
- APCD staff have worked extensively with manufacturer and participated in national workgroup calls to improve/ refine method



What will be monitored?

- Compounds include Toxic Air Contaminants that were found to exceed health risk goals in previous air monitoring studies.
- VOCs known to be common drivers of ozone formation.



Firearms Training
Air Monitoring Site Air Toxics:

CAS No.	Compound	TAC No.
107-13-1	Acrylonitrile	1
71-43-2	Benzene	1
75-25-2	Bromoform	1
106-99-0	1,3 Butadiene	1
56-23-5	Carbon tetrachloride	1
67-66-3	Chloroform	1
106-46-7	1,4 Dichlorobenzene	1
75-09-2	Methylene chloride (Dichloromethane)	1

CAS No.	Compound	TAC No.
127-18-4	Perchloroethylene (Tetrachloroethylene)	1
79-01-6	Trichloroethylene	1
75-01-4	Vinyl Chloride	1
108-88-3	Toluene	1
100-41-4	Ethylbenzene	2
108-10-1	Methyl isobutyl ketone (4-Methyl-2-pentanone)	4
100-42-5	Styrene	4
80-62-6	Methyl methacrylate	4
140-88-5	Ehtyl acrylate	4

Photochemical Assessment Monitoring Station:

PAMS Target Parameters

The data collected at the PAMS sites include measurements of O_3, NO_x, a target list of VOCs including several carbonyls as well as surface and upper air meteorology. Most PAMS sites measure 56 target hydrocarbons on either a hourly or 3-hour basis during the O_3 season. The Type 2 sites also collect data on 3 carbonyl compounds (formaldehyde, acetaldehyde, and acetone) every three hours during the O_3 monitoring period. Included in the monitored VOC species are ten compounds classified as hazardous air pollutants (HAPs). All stations must measure O_3, NO_x, and surface meteorological parameters on an hourly basis. Below are the parameters monitored at the surface PAMS sites.

Ozone, nitrogen oxides, VOC sums		*Surface Meteorological*	
Ozone	44201	Temperature	62101
		Wind Speed	61101/3
Nitric Acid	42601	Wind Direction	61102/4
Nitrogen Dioxide	42602	Relative Humidity	62201
Oxides of Nitrogen	42603	Solar Radiation	63301
		uv Radiation	63302/4
Total NMOC	43102	Barometric Pressure	64101
Sum of Targeted HCs	43000	Precipitation	65102
Hydrocarbons (HCs) – listed in elution sequence			
Ethylene	43203	2,3-dimethylpentane	43291
Acetylene	43206	3-methylhexane	43249
Ethane	43202	2,2,4-trimethylpentane	43250
Propylene	43205	n-Heptane	43232
Propane	43204	Methylcyclohexane	43261
Isobutane	43214	2,3,4-trimethylpentane	43252
1-Butene	43280	Toluene	45202
n-Butane	43212	2-methylheptane	43960
t-2-Butene	43216	3-methylheptane	43253
c-2-Butene	43217	n-Octane	43233
Isopentane	43221	Ethylbenzene	45203
1-Pentene	43224	m&p-Xylenes	45109
n-Pentane	43220	Styrene	45220
Isoprene	43243	o-Xylene	45204
t-2-pentene	43226	n-Nonane	43235
c-2-pentene	43227	Isopropylbenzene	45210
2,2-Dimethylbutane	43244	n-Propylbenzene	45209
Cyclopentane	43242	m-Ethyltoluene	45212
2,3-dimethylbutane	43284	p-Ethyltoluene	45213
2-methylpentane	43285	1,3,5-Trimethylbenzene	45207
3-Methylpentane	43230	o-Ethyltoluene	45211
2-Methyl-1-Pentene	43246	1,2,4-trimethylbenzene	45208
n-hexane	43231	n-Decane	43238
Methylcyclopentane	43262	1,2,3-trimethylbenzene	45225
2,4-dimethylpentane	43247	m-Diethylbenzene	45218
Benzene	45201	p-Diethylbenzene	45219
Cyclohexane	43248	n-Undecane	43954
2-methylhexane	43263		
Carbonyls			
Formaldehyde	43502		
Acetone	43551		
Acetaldehyde	43503		

PAMS

- Volatile Organic Compounds
- Carbonyls
- Direct NO_2
- Cloud Height (Ceiliometer)
- Additional Meteorology

Firearms Training
Air Monitoring Site:
Air Toxics

- **Monitoring objectives include:**
  - Generating near real time, quality-assured data
  - Providing air pollution data to the community in a timely way
  - Supporting academic and scientific research
  - Improving access to data via APCD's website and U.S. EPA's Air Quality System (AQS) database

Firearms Training
Air Monitoring and NCORE Sites:
Ozone Precursors

- **Monitoring objectives include:**
  - Developing a better understanding of photochemically reactive precursors in the area of maximum emissions
  - Assessing relative contribution of emissions observed at Firearms Training with observations from federally required PAMS monitoring at APCD's Cannons Lane NCore Air Monitoring Site
  - Evaluating ambient trends of speciated VOCs and meteorological conditions

Ozone Formation Study

Goal	Outcomes
• Refine understanding for the regional drivers of ozone formation to make strategic policy decisions	• Comprehensive inventory of compounds contributing to the formation of ozone • Refined understanding of Ozone sensitivity to NOx/VOC reductions • Scale of relative reactivities of VOCs in the ambient air of Jefferson County

Multi-Pollutant Risk-Based AQ Management Strategy Project

Goal(s)	Outcomes
• Evaluate and prioritize control strategies to reduce ozone and come into attainment with NAAQS • Explore co-benefits of ozone reduction strategies to air toxics and fine particulate emissions • Use BenMAP to quantify the anticipated health benefits of air quality improvements	• Prioritized emission reduction strategies • Quantified health outcome improvements and associated benefits • Stakeholder input

Questions?

Louisville Metro
Air Pollution Control District

701 W. Ormsby Ave.
Ste. 303
Louisville, Ky. 40203

(502) 574-6000
www.louisvilleky.gov/APCD