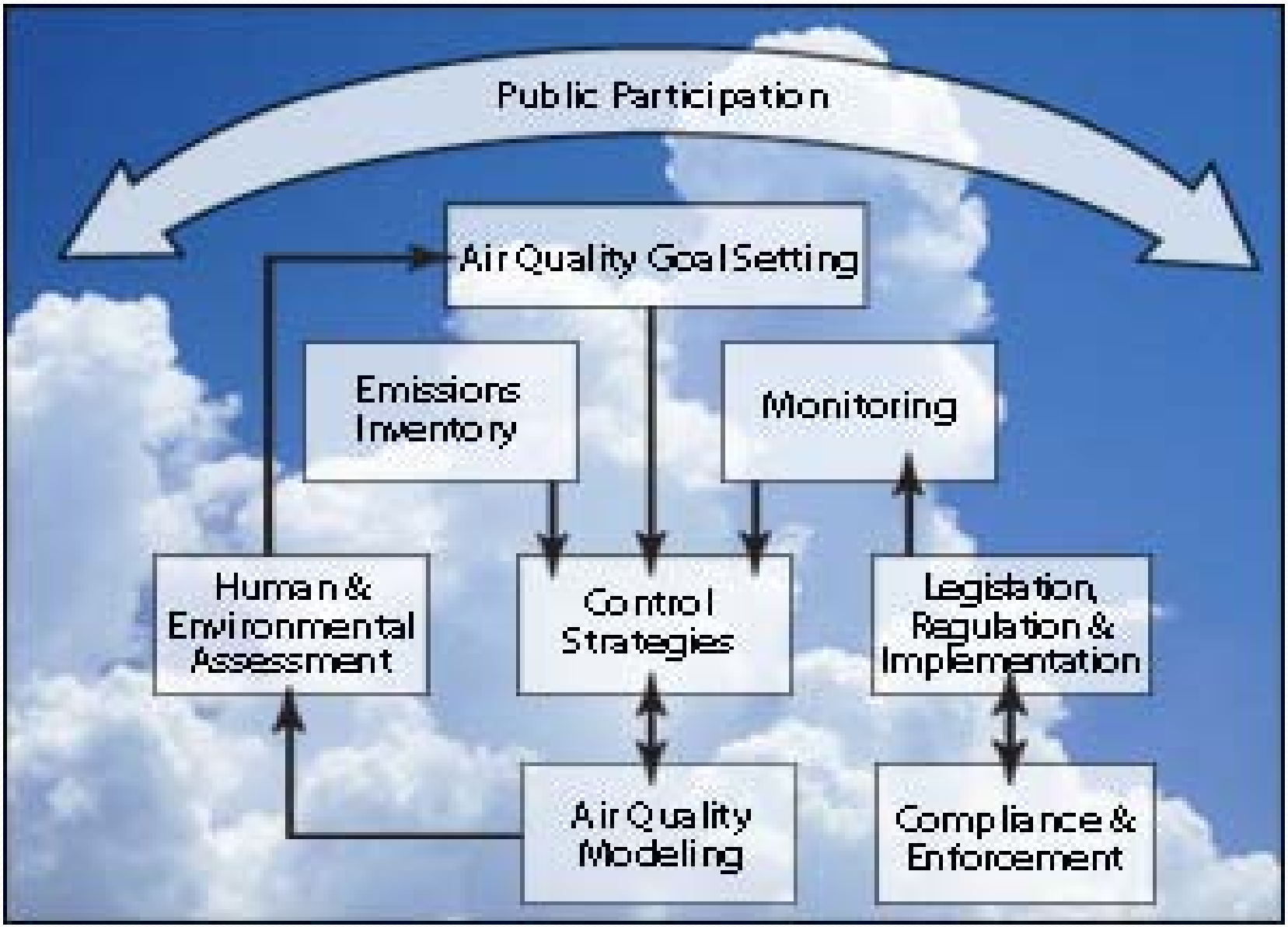
Air Quality Management in Garfield County

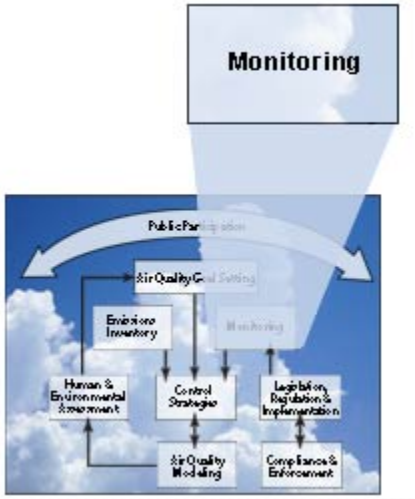
February 7, 2013

Energy Advisory Board Meeting

Air Quality Management



Air Quality Monitoring Objectives

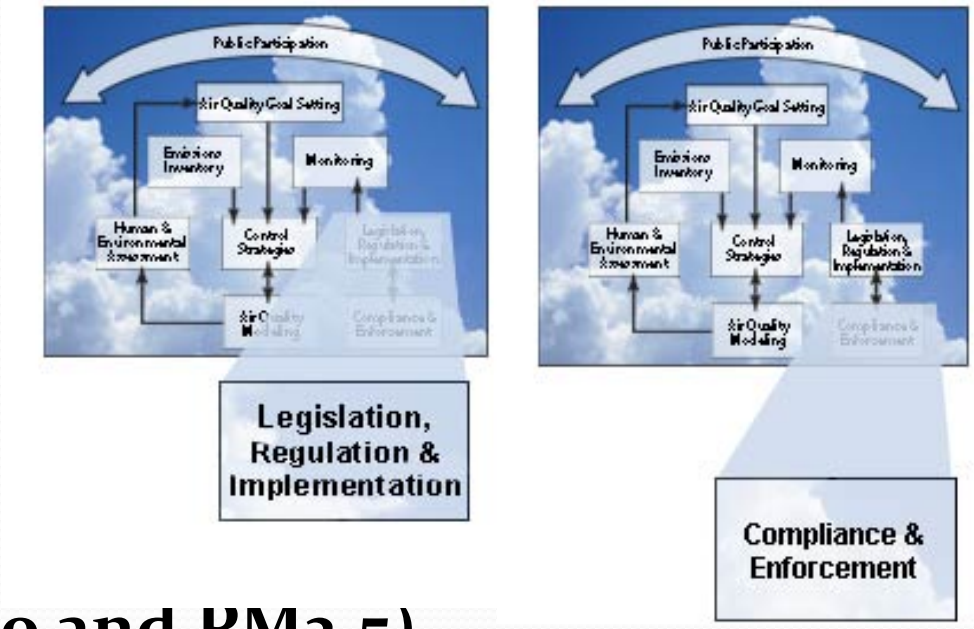


- **What is in the air?**
- **How much of X pollutants are in the air?**
- **Comparing existing conditions vs. added influences over time (trends)**
- **Identify pollution contributions from various sources**
- **Track air quality to ensure conditions are protective of health and welfare of residents**
- **Monitor aesthetic air quality conditions (visibility, etc.)?**

Regulated Air Pollutants

EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. These criteria pollutants are:

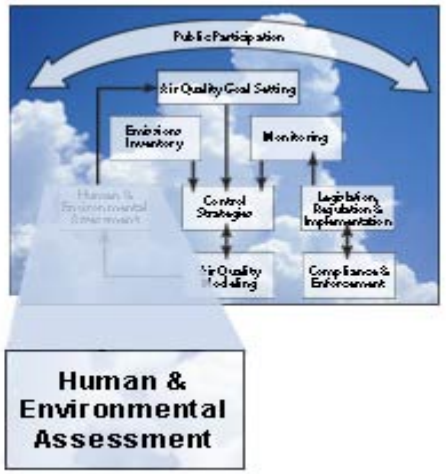
- **carbon monoxide (CO)**
- **sulfur dioxide (SO_2)**
- **nitrogen dioxide (NO_2)**
- **ozone (O_3)**
- **lead (Pb)**
- **particulate matter (PM_{10} and $PM_{2.5}$)**



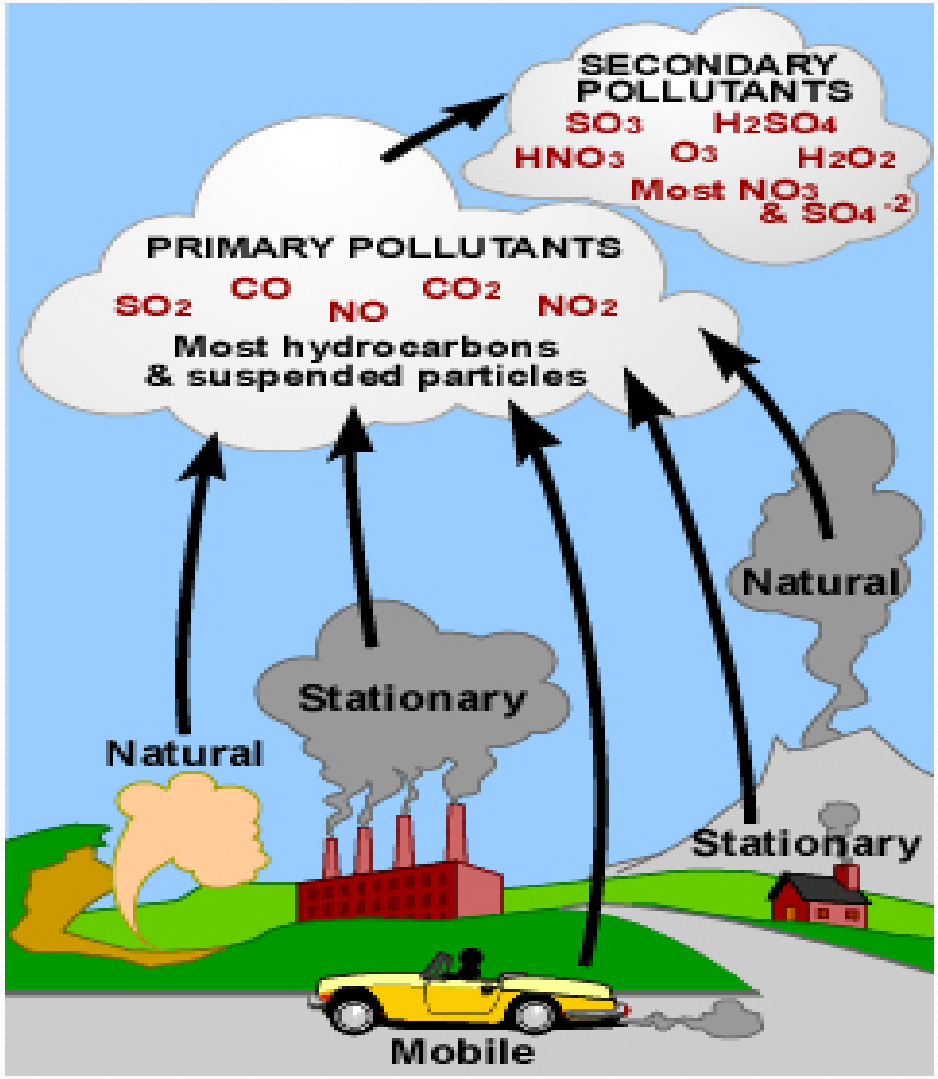
Hazardous Air Pollutants

HAPs are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects.

- EPA is required to control 187 hazardous air pollutants
- There are no national ambient air quality standards for hazardous air pollutants

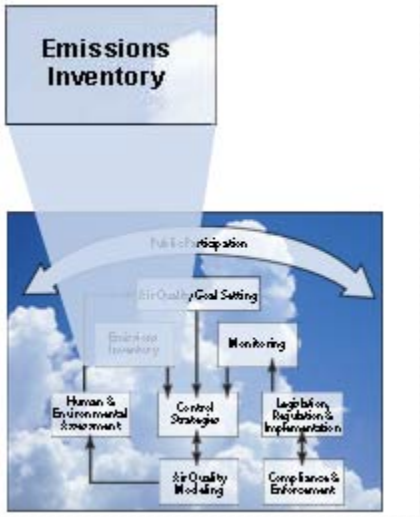


Pollutants in Ambient Air



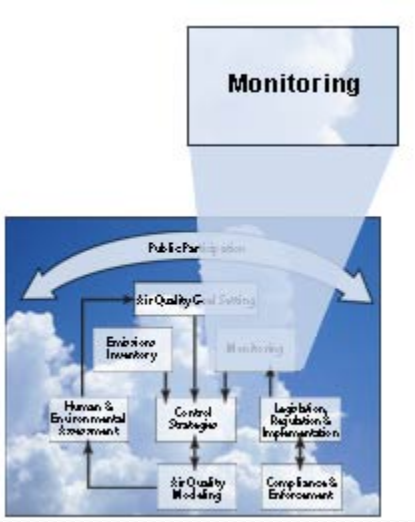
Primary pollutants: emitted into the atmosphere directly from the source of the pollutant and retains the same chemical form

Secondary pollutants: undergo a chemical change once they reach the atmosphere

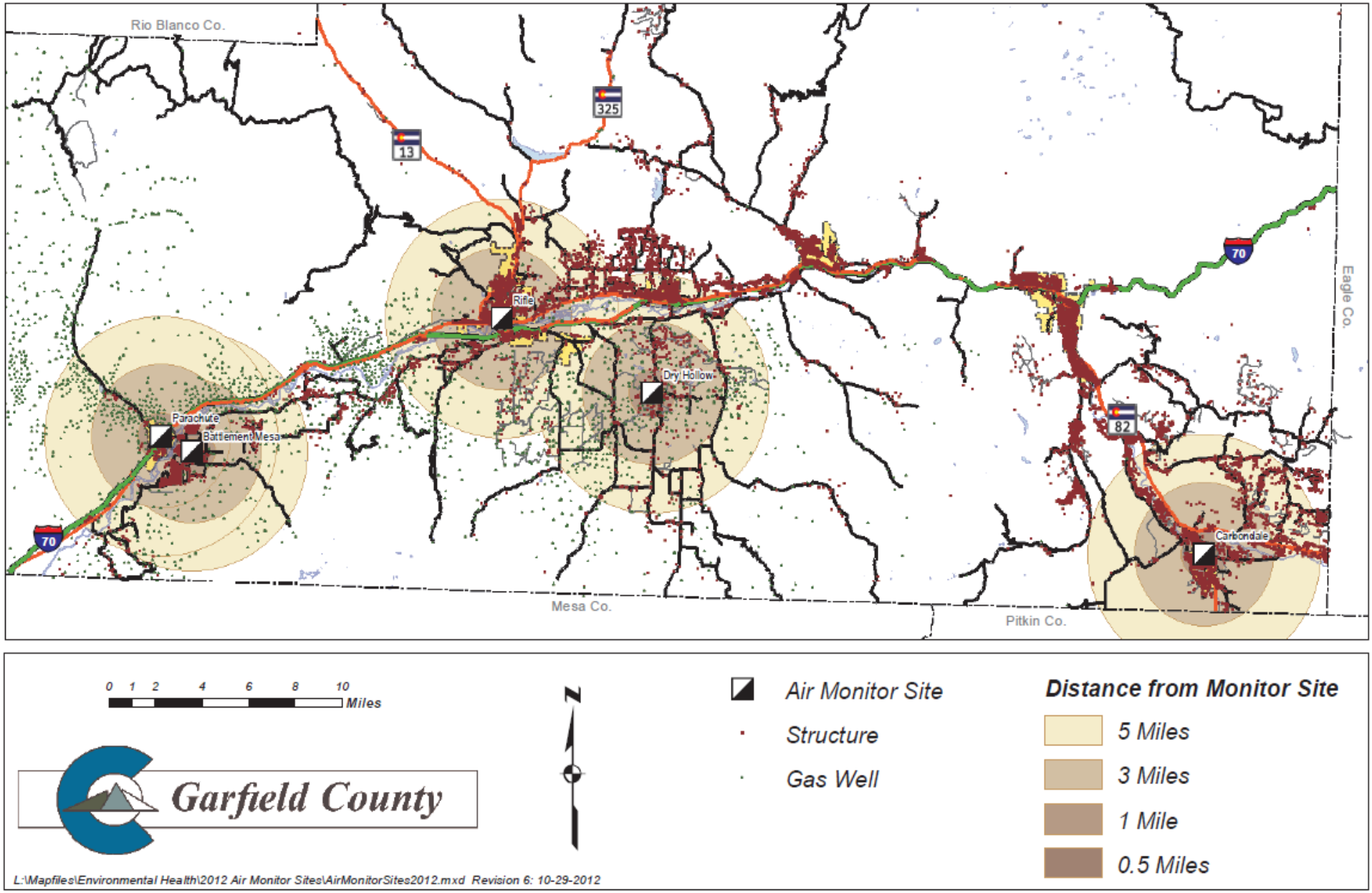


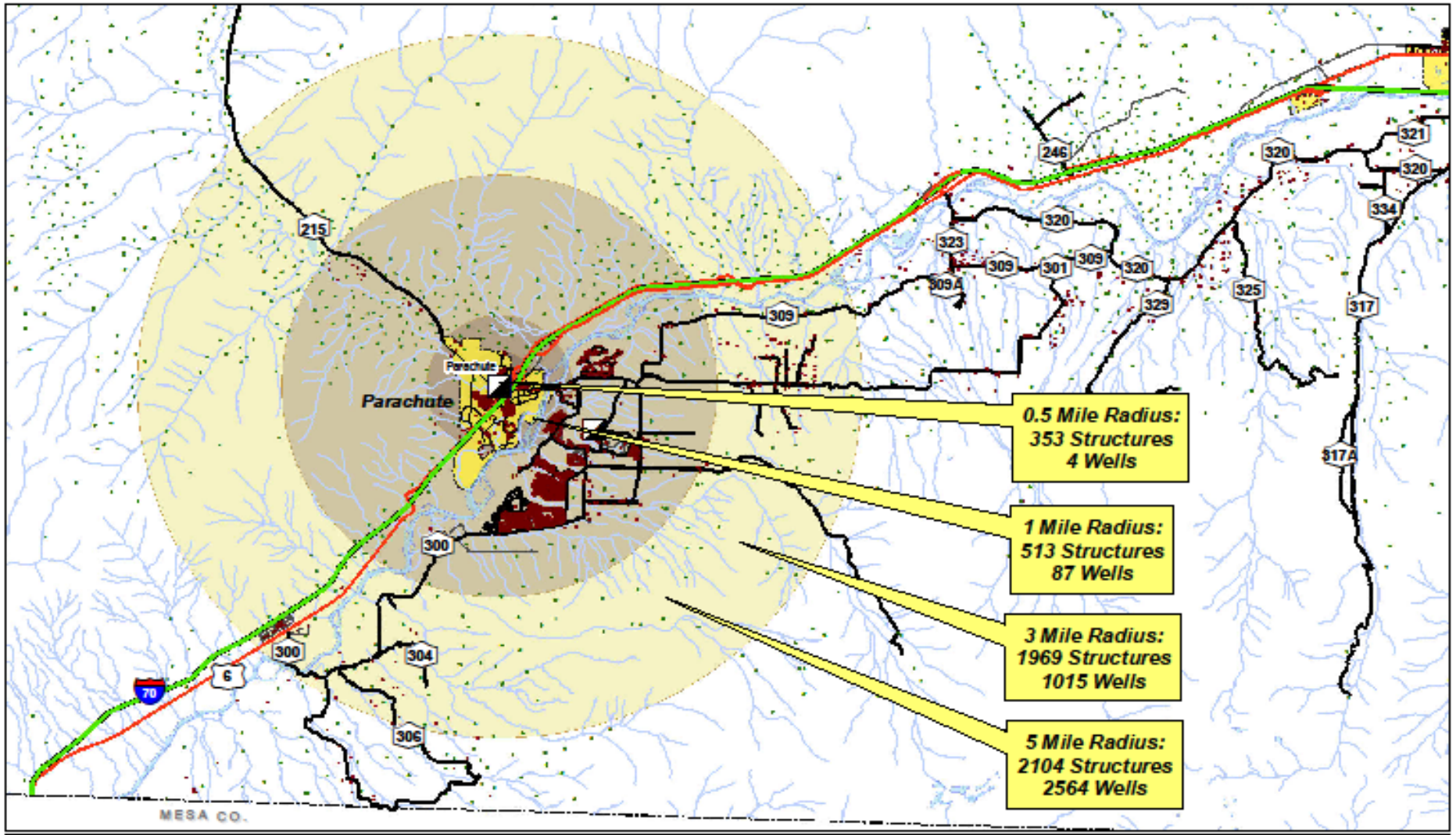
Air Monitoring History in Garfield Co.

- **Limited Air Monitoring Prior to 2005**
- **2005-2007 Air Monitoring Begins in Garfield County**
- **2008-pres: Air Monitoring Modifications/Upgrades**
- **2008 State funded Air Monitoring Begins**
- **2008 EPA Regional Geographic Initiatives Grant**
- **2010: Upgrades to Battlement Mesa Site**
- **2012: Begin Carbondale Air Monitoring Site**
- **2012-2014: CSU Oil and Gas Emissions Study**



2013 Garfield County Air Monitoring Sites





2012 Air Monitoring Sites: Parachute

Garfield County

Air Monitor Site
Structure
Gas Well

Distance from Monitor Site
5 Miles
3 Miles
1 Mile
0.5 Miles

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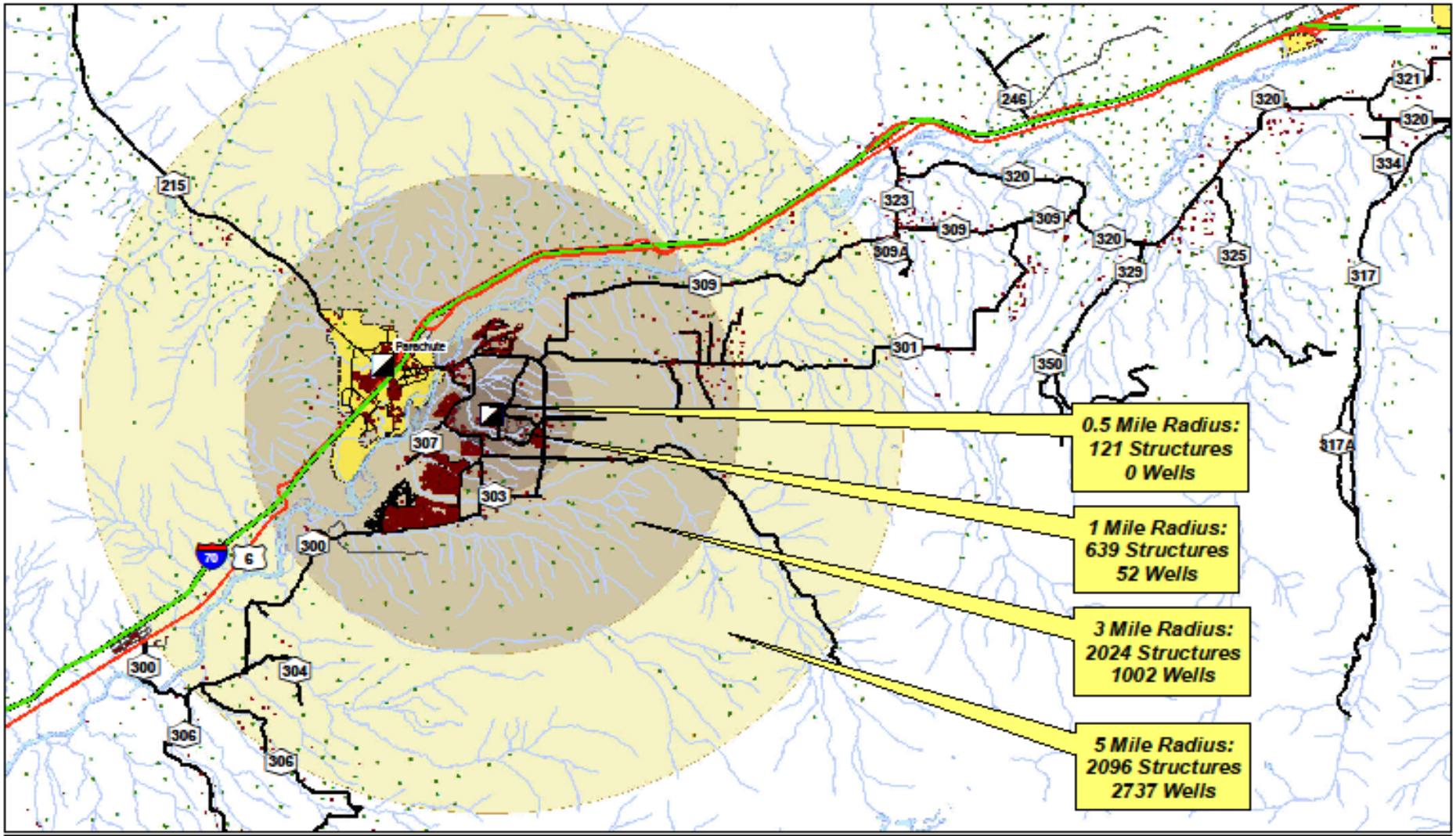

2012 Air Monitoring Sites: Battlement Mesa

Garfield County

Air Monitor Site
Structure
Gas Well

Distance from Monitor Site
5 Miles
3 Miles
1 Mile
0.5 Miles

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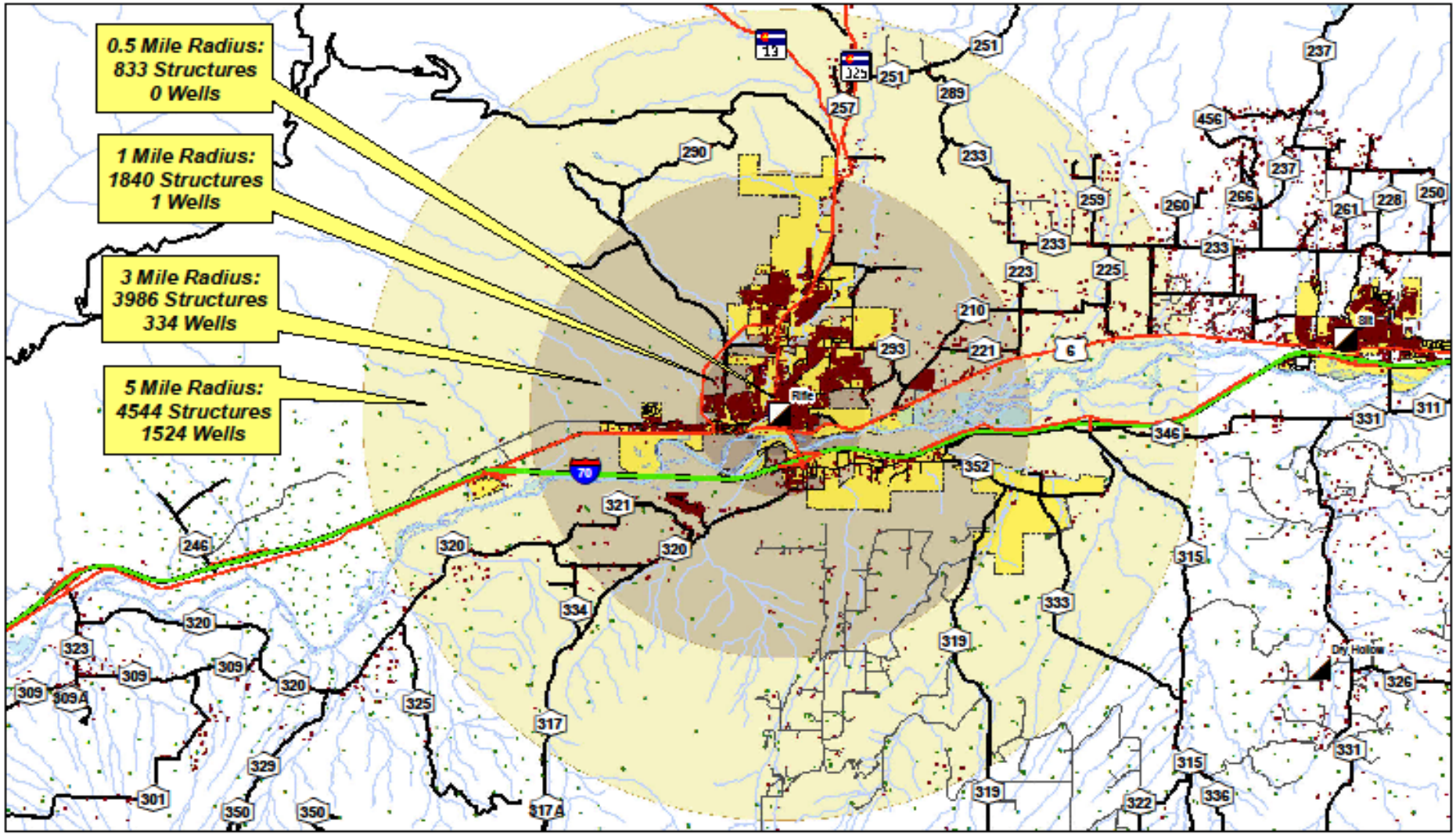

2012 Air Monitoring Sites: Rifle

Garfield County

Air Monitor Site
Structure
Gas Well

Distance from Monitor Site
5 Miles
3 Miles
1 Mile
0.5 Miles

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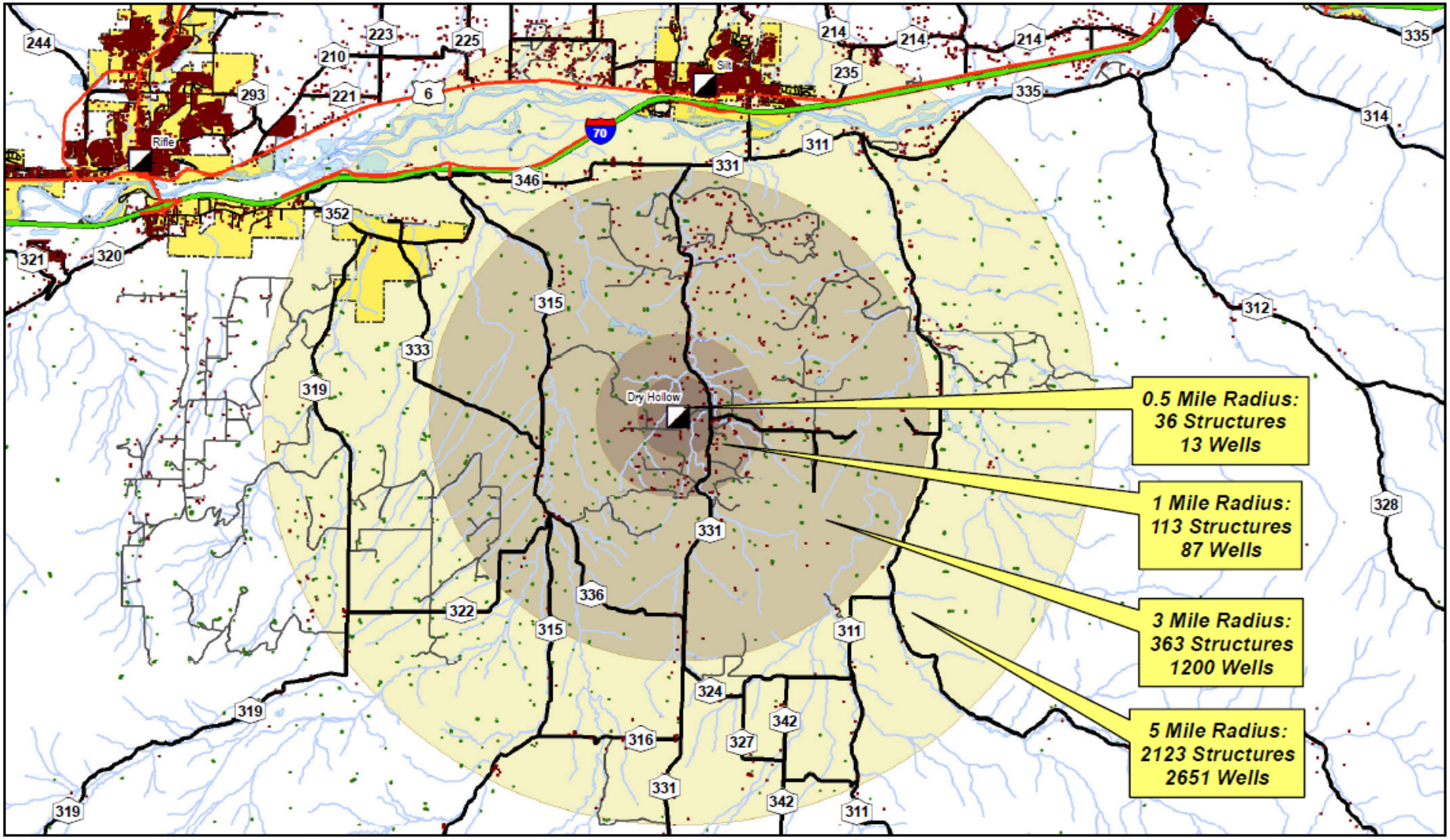

2012 Air Monitoring Sites: Dry Hollow

Garfield County

N

Air Monitor Site
Structure
Gas Well

Distance from Monitor Site

5 Miles
3 Miles
1 Mile
0.5 Miles

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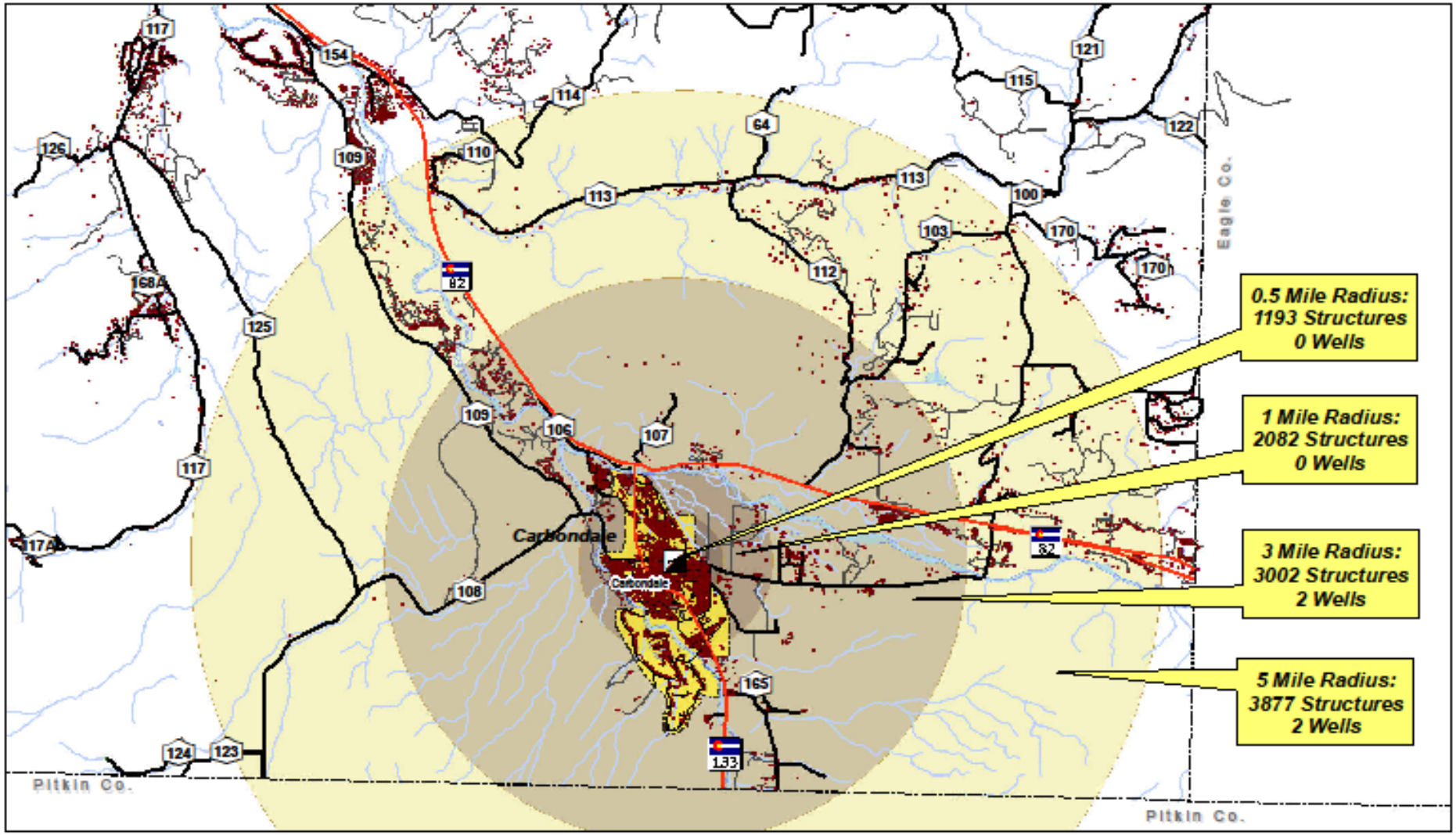

2012 Air Monitoring Sites: Carbondale

Garfield County

Air Monitor Site
Structure
Gas Well

Distance from Monitor Site
5 Miles
3 Miles
1 Mile
0.5 Miles

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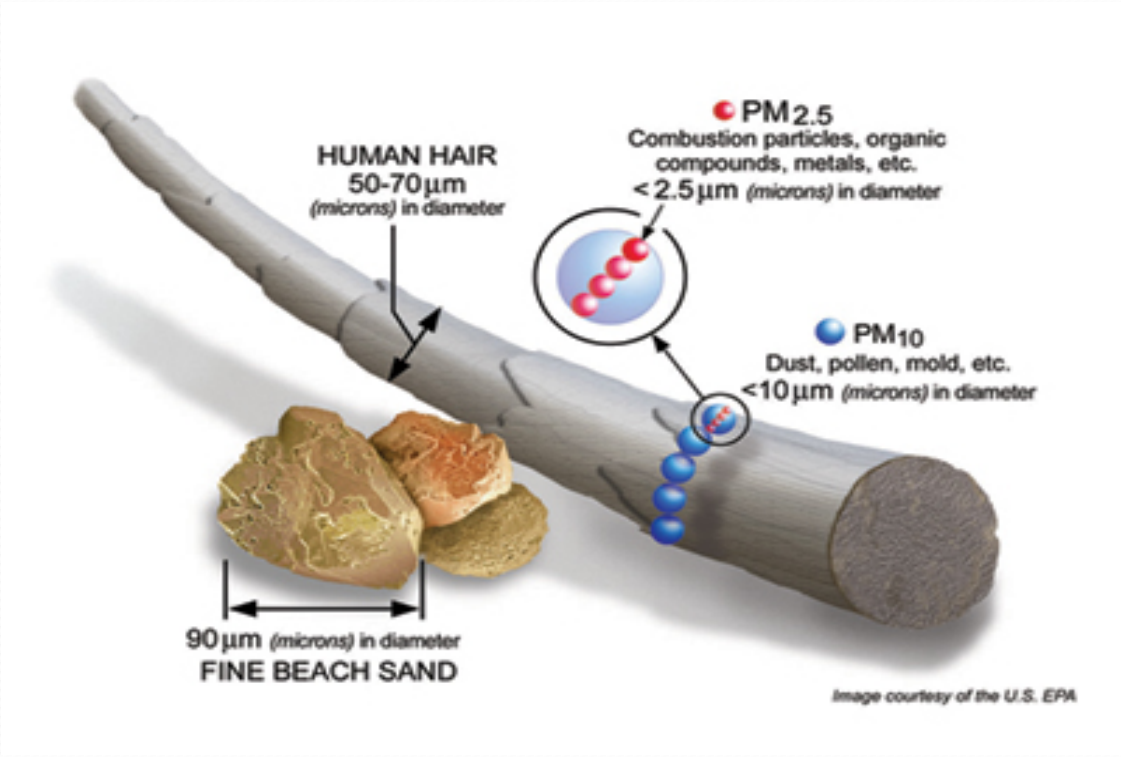
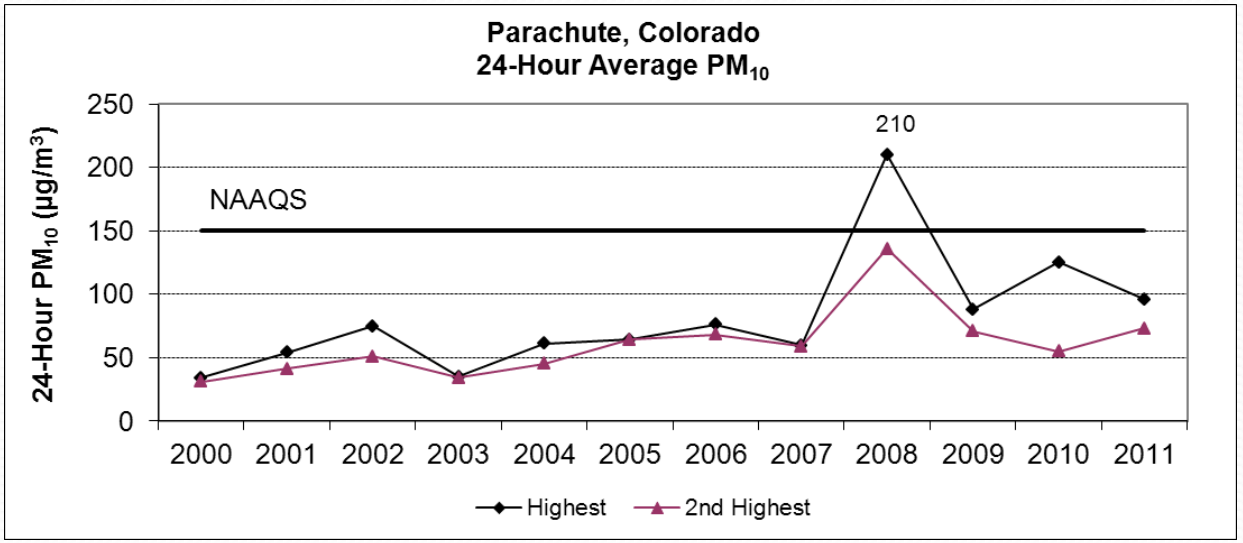
Criteria Pollutants Measured in GarCo

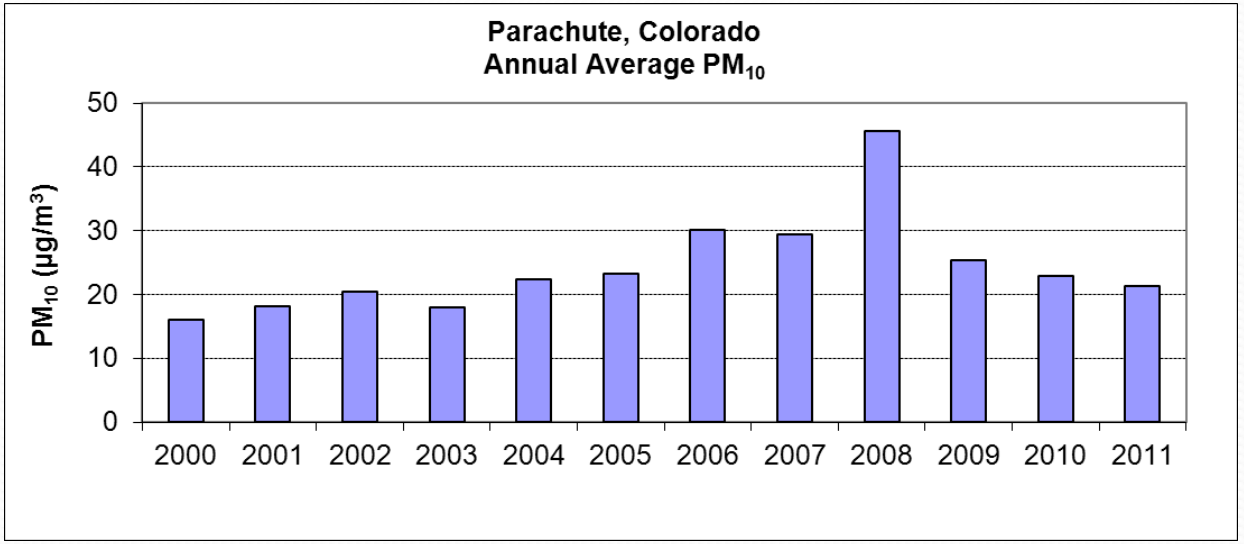
- **<u>Particulate Matter:</u>** is the general term used for a heterogeneous mixture of solid particles and liquid droplets found in the air, including dust, dirt, soot, smoke, and liquid droplets.
  - <u>Sources:</u> cars, trucks, buses, industry, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood.



Particulate Matter ≤ 10 µm (PM_{10}) Summary

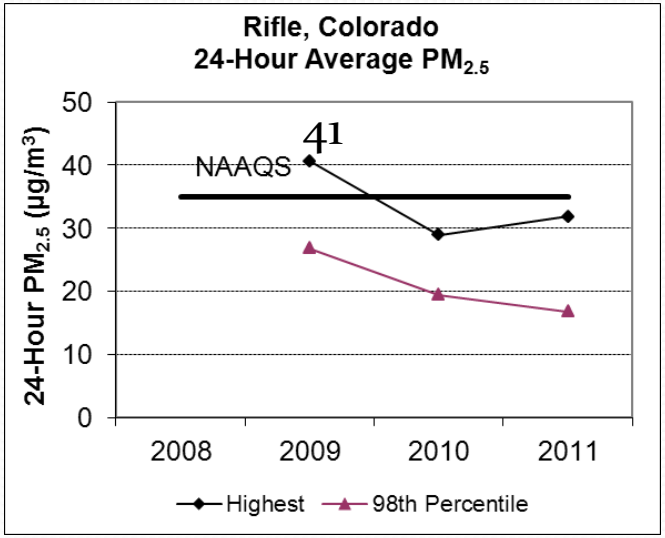
- Comparisons to National Ambient Air Quality Standards
  - Exceedance: 24-Hour average > 150 µg/m³
  - Violation: > 1 Average > 150 µg/m³ in a 3-year period
  - The Parachute site has recorded one exceedance, but no violations

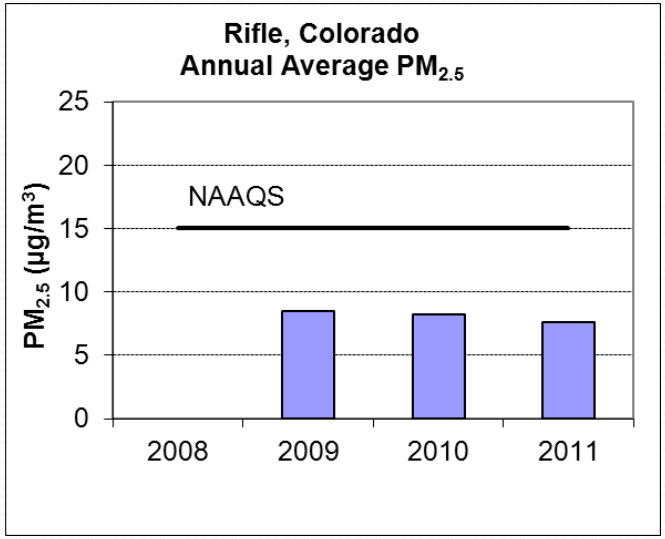




Particulate Matter ≤ 2.5 µm ($PM_{2.5}$) Summary

- Comparisons to National Ambient Air Quality Standards
  - Exceedance:
    24-Hour average
    > 35 µg/m³ or Annual average
    > 15 µg/m³
  - Violation:
    3-year average of 98th percentile 24-hour > 35 µg/m³ or 3-year average of annual mean > 15 µg/m³
  - The Rifle site has recorded one exceedance, but no violations





Criteria Pollutants Measured in GarCo

Ozone (O_3)

- Formed by a chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOCs) in the presence of heat and sunlight.
- "Good" ozone occurs naturally in the stratosphere and forms a layer that protects life on earth from the sun's harmful rays or ultraviolet radiation.
- In the earth's lower atmosphere, or troposphere, ground-level ozone is considered "bad".
- Ozone is the most prevalent chemical found in photochemical air pollution, or smog.

Ozone (O_3) Summary

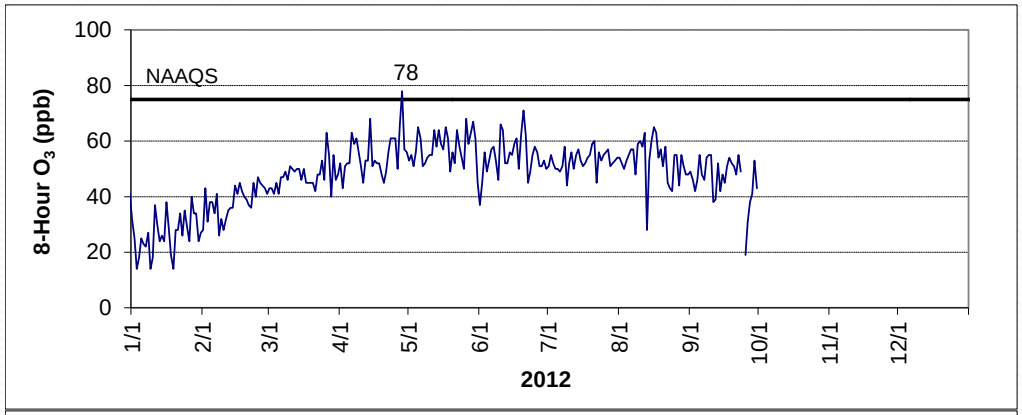
- Comparisons to National Ambient Air Quality Standards
  - Exceedance: 8-Hour average > 75 ppb
  - Violation: 3-year average of the 4th highest daily maximum > 75 ppb
  - The Rifle site has recorded two O_3 exceedances, but no violations

Rifle Data

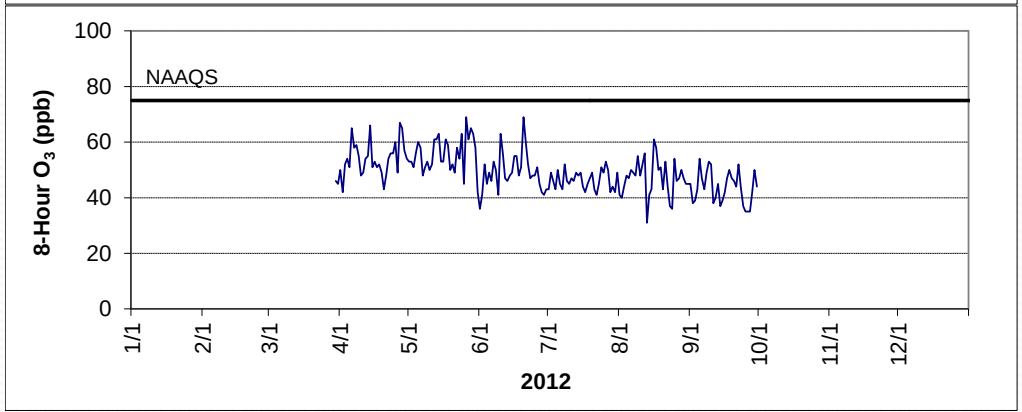
Year	Highest 8-hour average (ppb)	4th highest 8-hour average (ppb)
2008	76	66
2009	64	62
2010	69	66
2011	68	66
2012	78	68

2012 Daily Maximum 8-Hour Average

Rifle



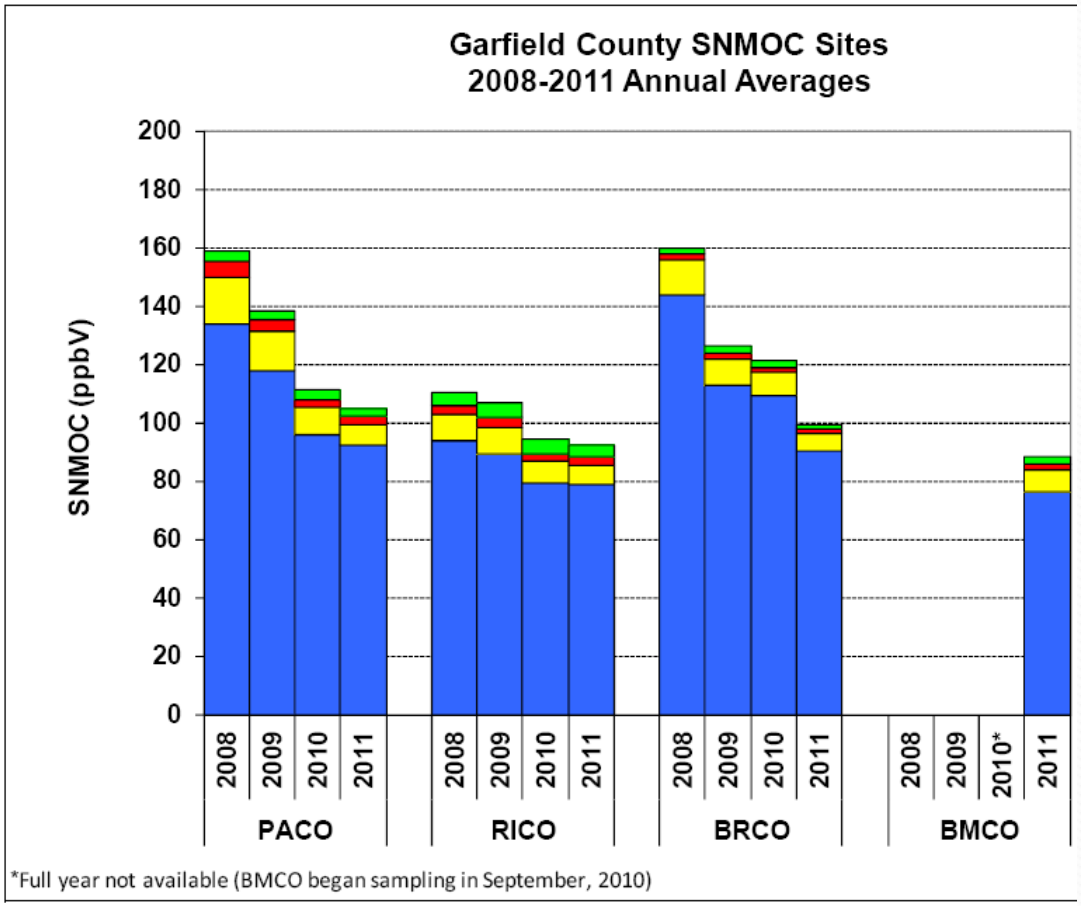
Carbondale



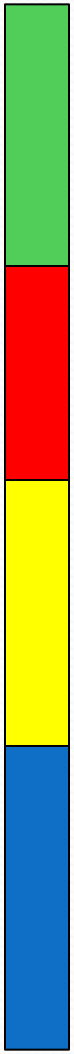
Volatile Organic Compounds

- Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids.
- VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.
- VOCs are emitted by a wide array of:
  - Products (e.g. paints, lacquers, cleaning supplies)
  - Sources (e.g. cars, industry, naturally)

Speciated Non-Methane Hydrocarbon (SNMOC) Summary



PACO=Parachute
RICO=Rifle
BRCO=Dry Hollow
BMCO=Battlement Mesa



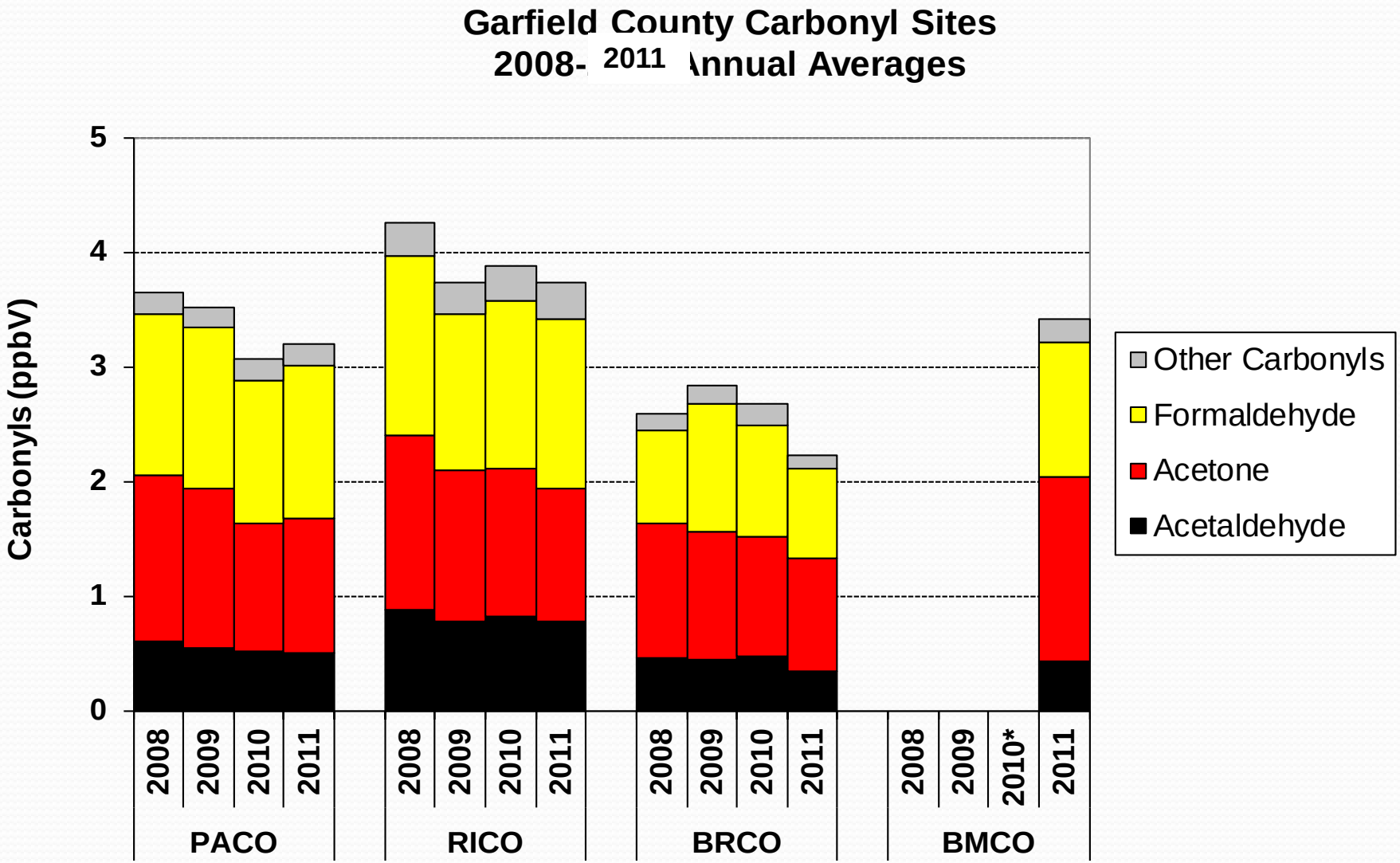
Alkenes: Complex compounds; sources include refineries and biogenic emissions

Aromatics: e.g. BTEX compounds; sources include gas-fire engines

Heavy Alkanes: Simple, long chain carbon compounds; sources include crude oil, diesel

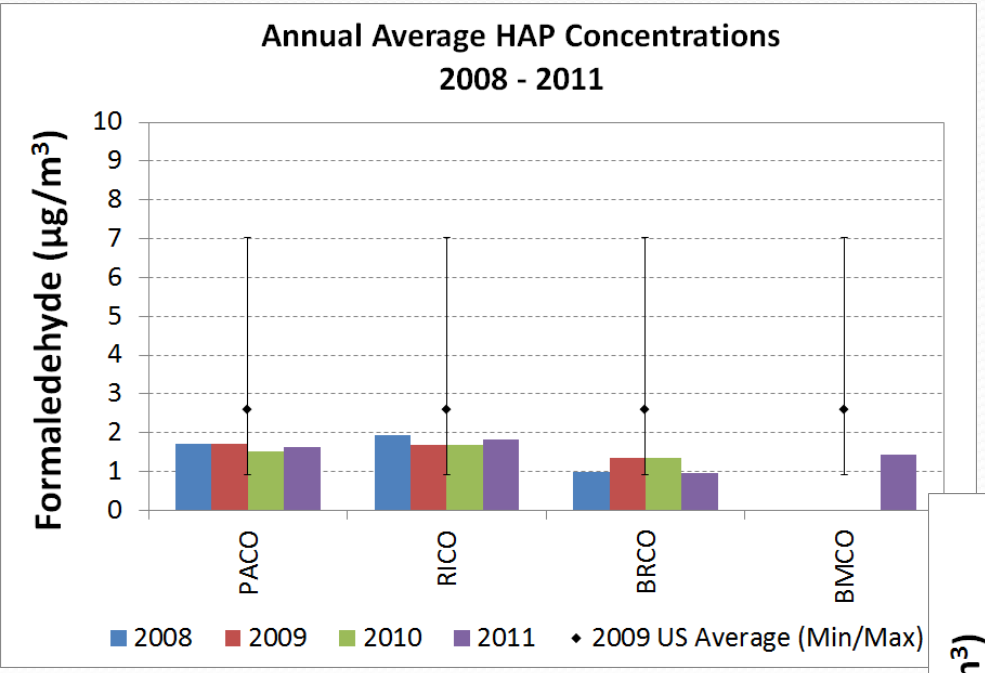
Light Alkanes: Simple, short chain compounds (e.g. ethane, propane, iso/n-butane and iso/n-pentane); primary components of natural gas

Carbonyl Compound Summary

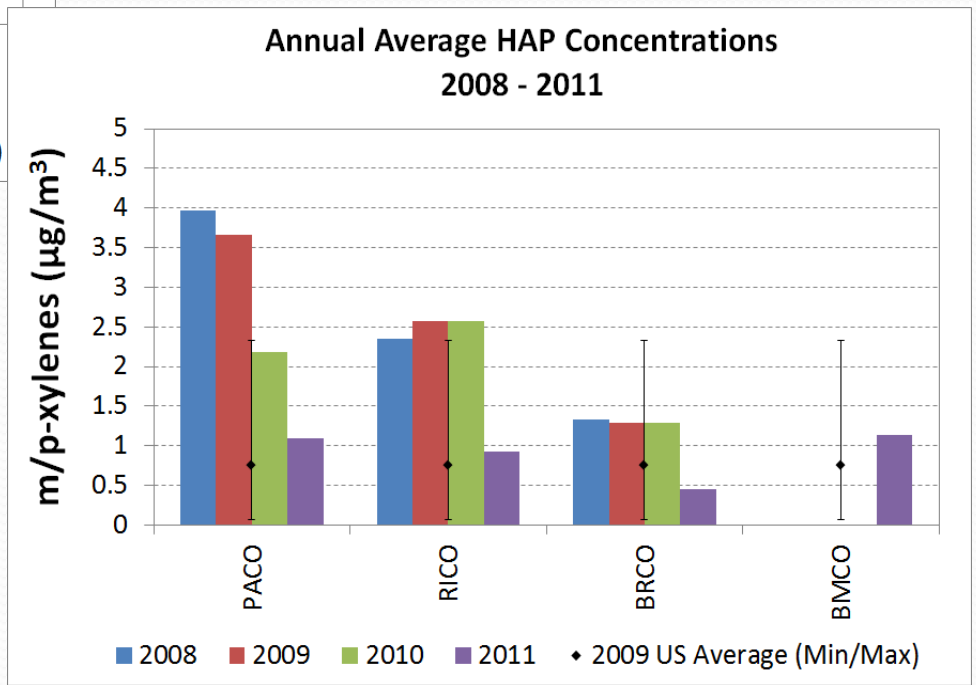


*Full year not available (BMCO began sampling in September, 2010)

Hazardous Air Pollutant (HAPs) Summary

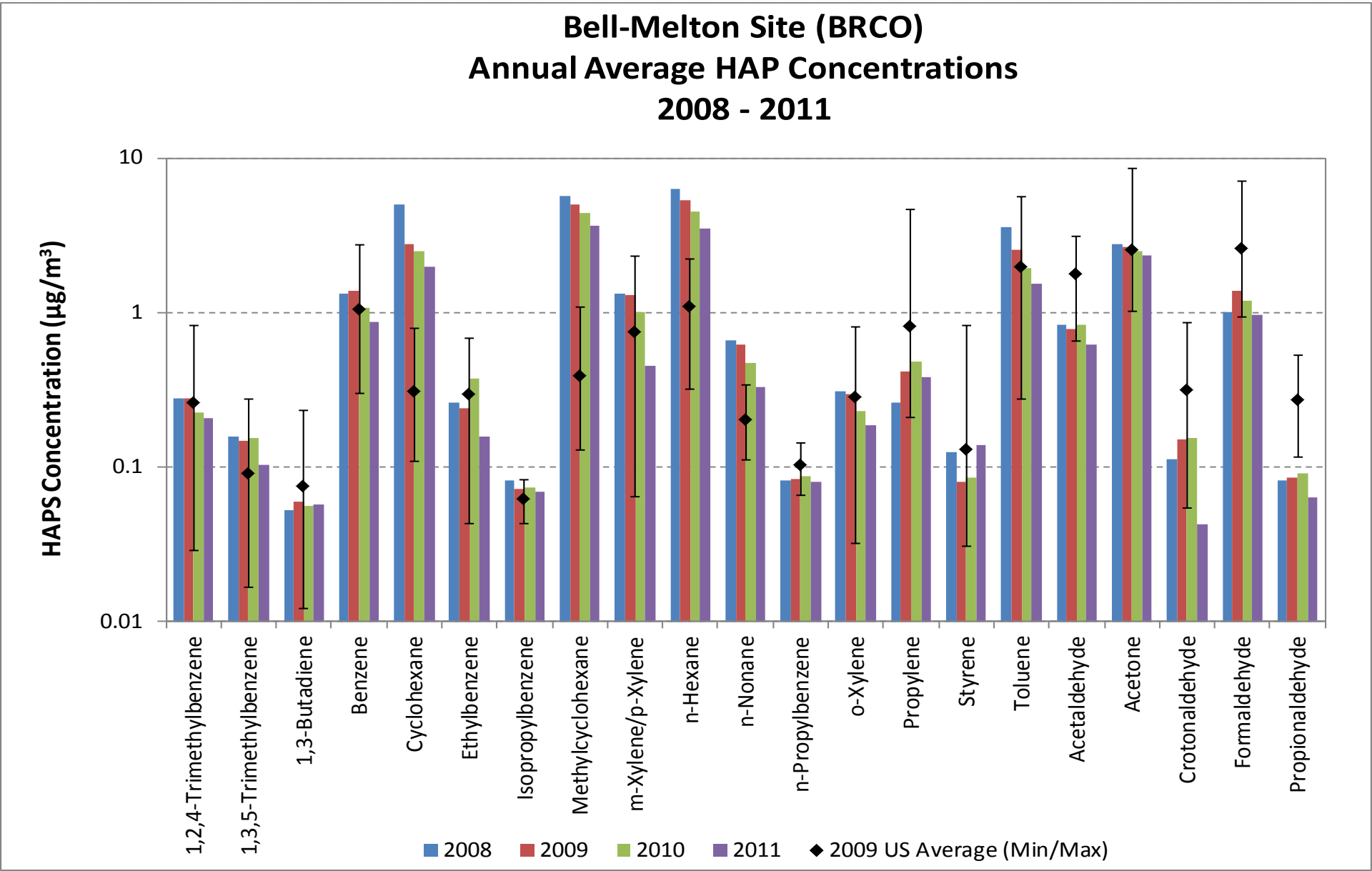


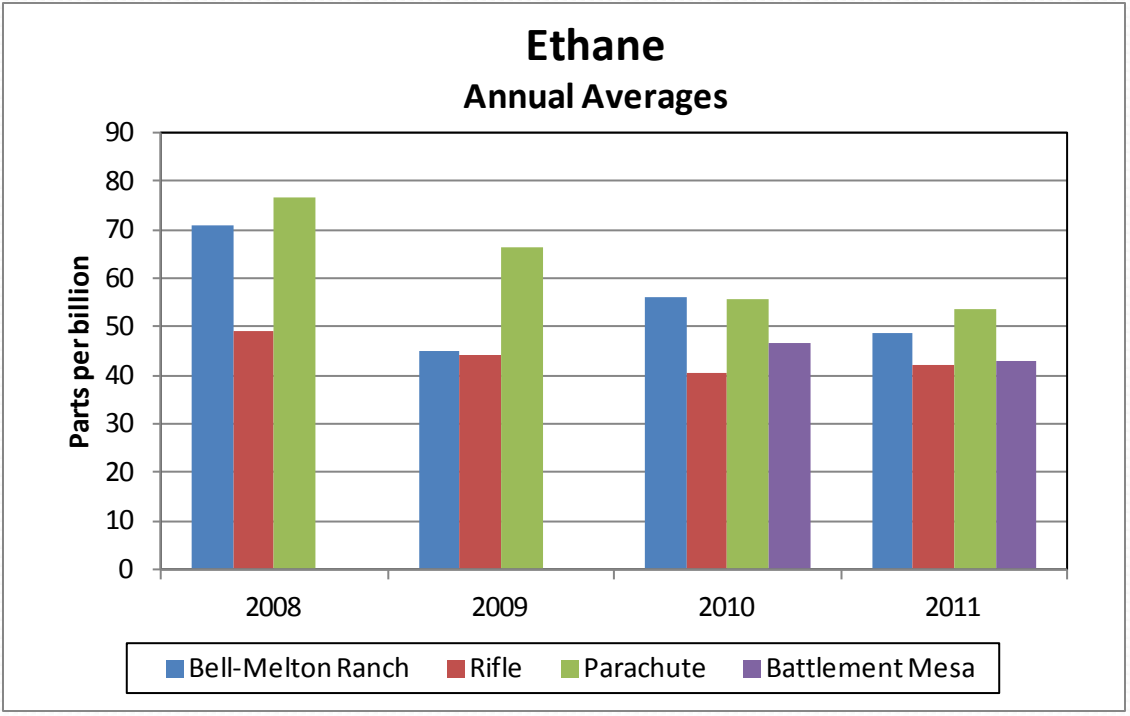
- 2009 US Average =
  - Annual average, max. and min. from 45 urban sites
  - Same analysis, same lab



- Formaldehyde
  - Lower than average, highest in Rifle (RICO)
- m/p-xylenes (the X in BTEX)
  - Higher than average 2008-2010, but dropped in 2011

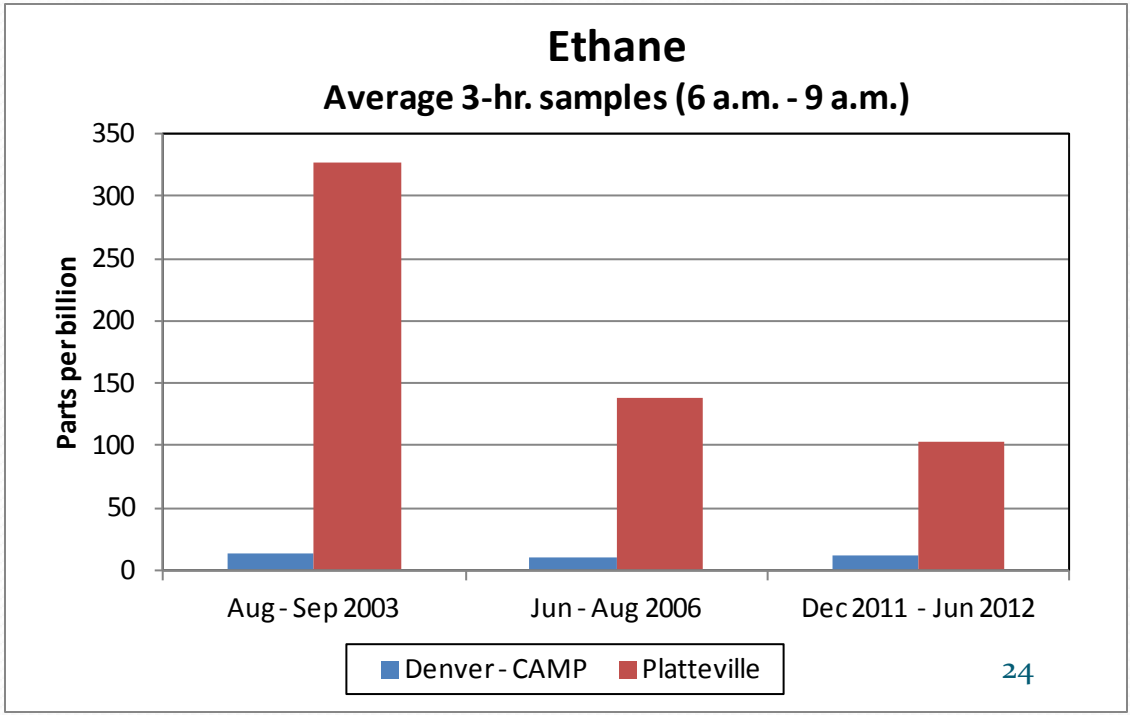
Dry Hollow Site vs. US Averages

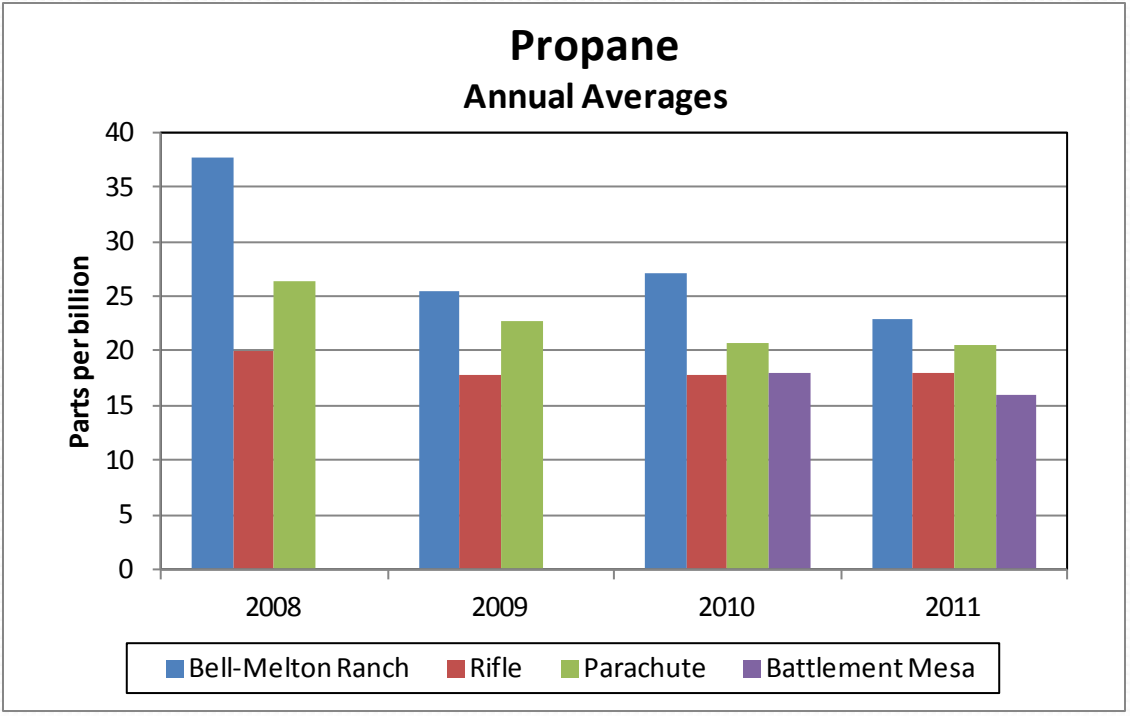




Select organics that are typically O&G-related

(Note difference in scale and time averages between graphs)





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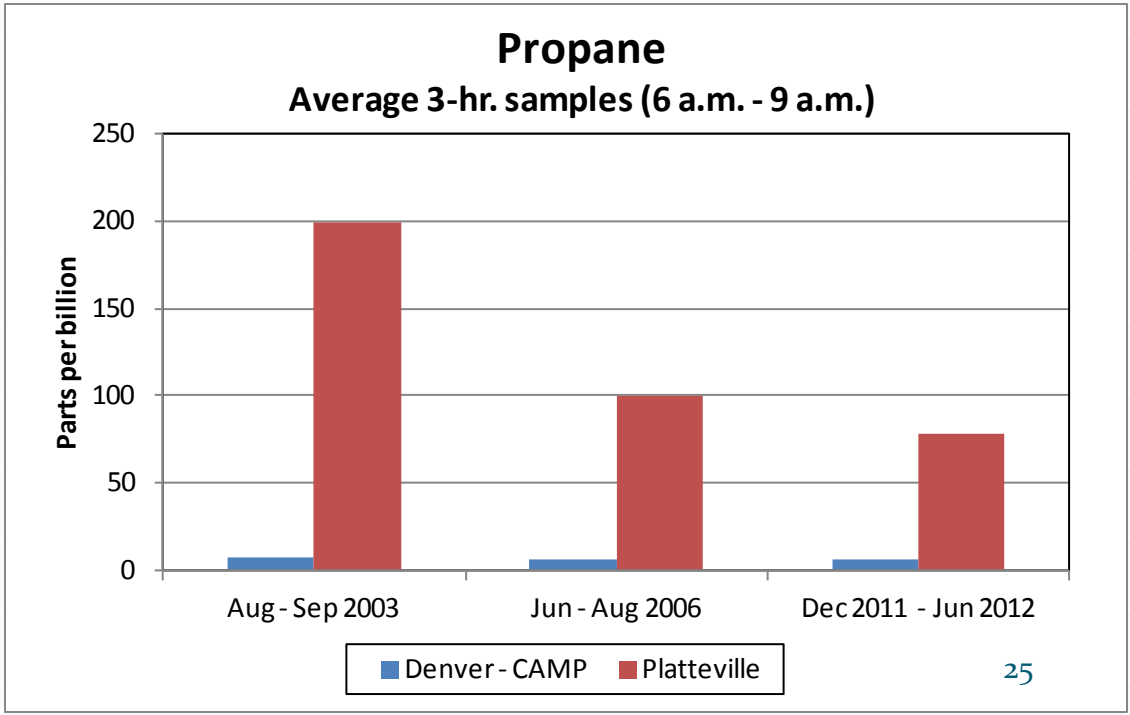
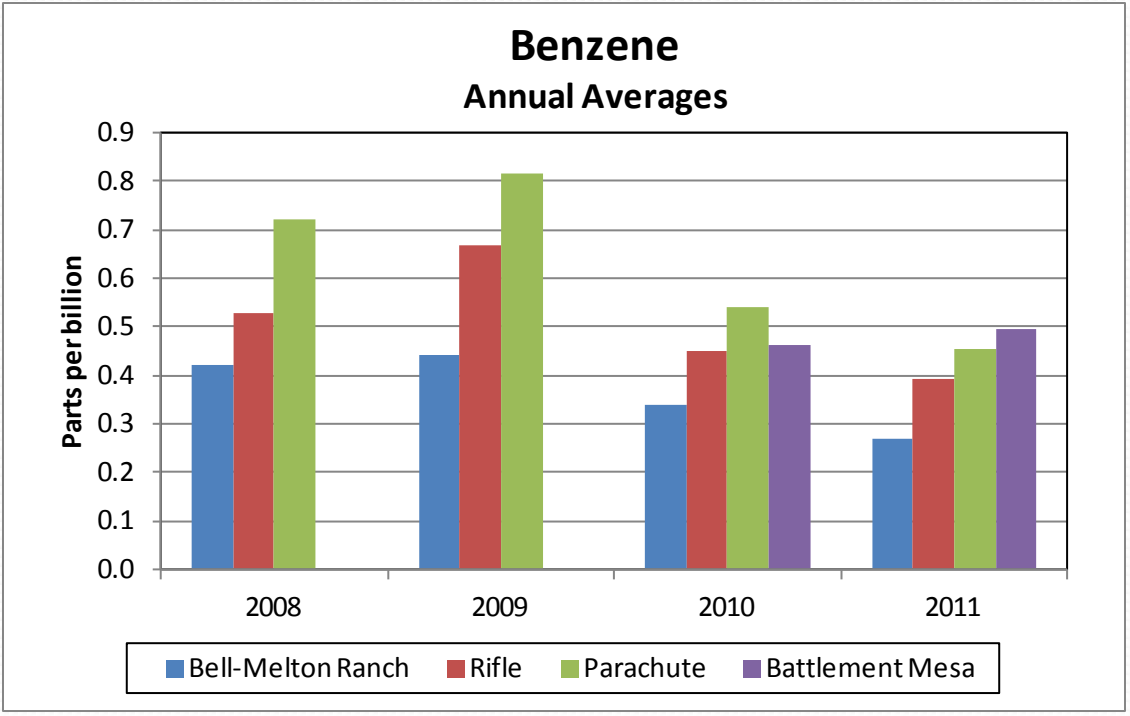
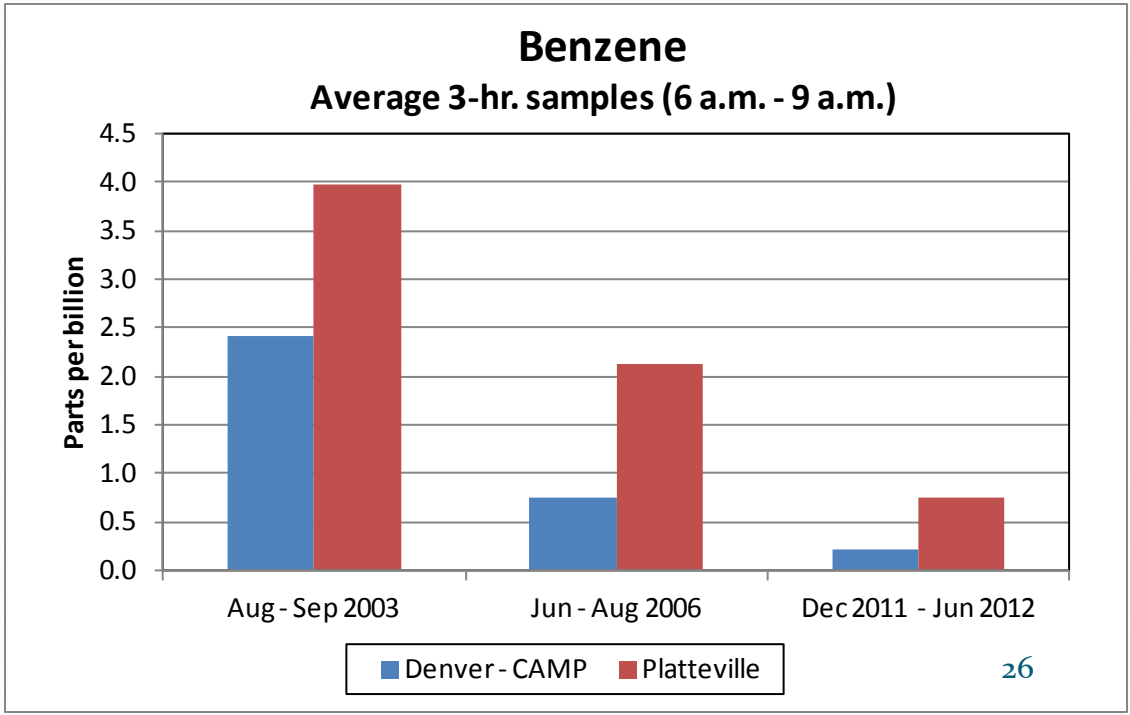
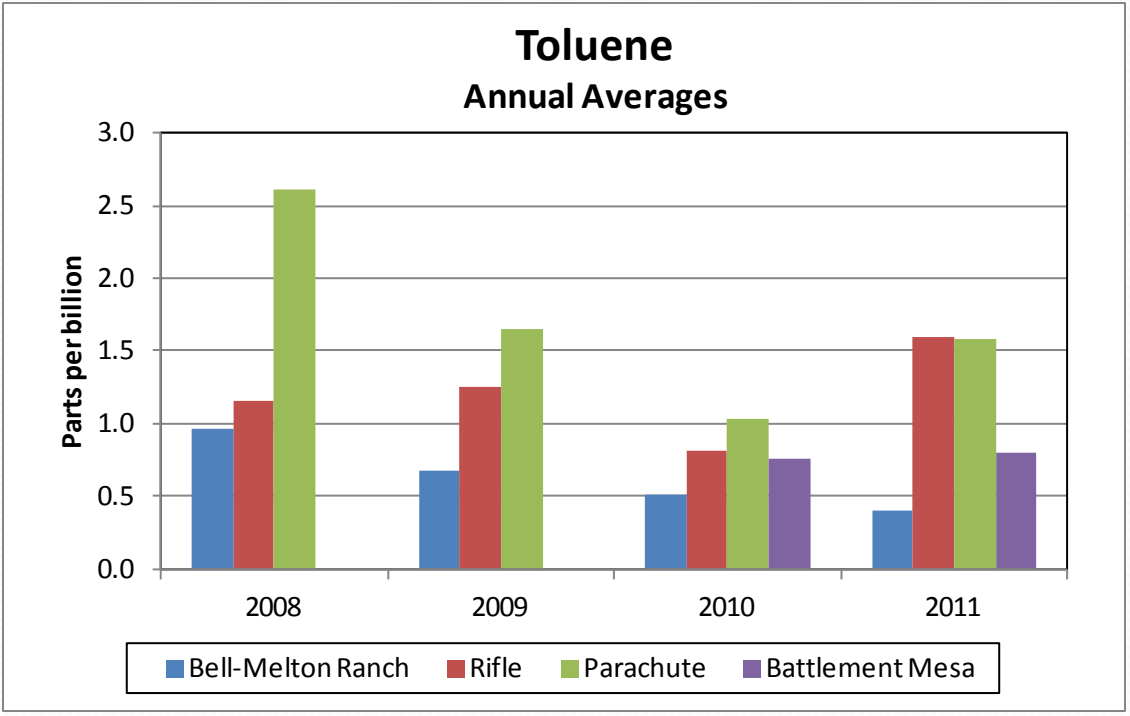




Select organics that are urban and O&G-related

(Note difference in scale and time averages between graphs)





Select organics that are urban and O&G-related

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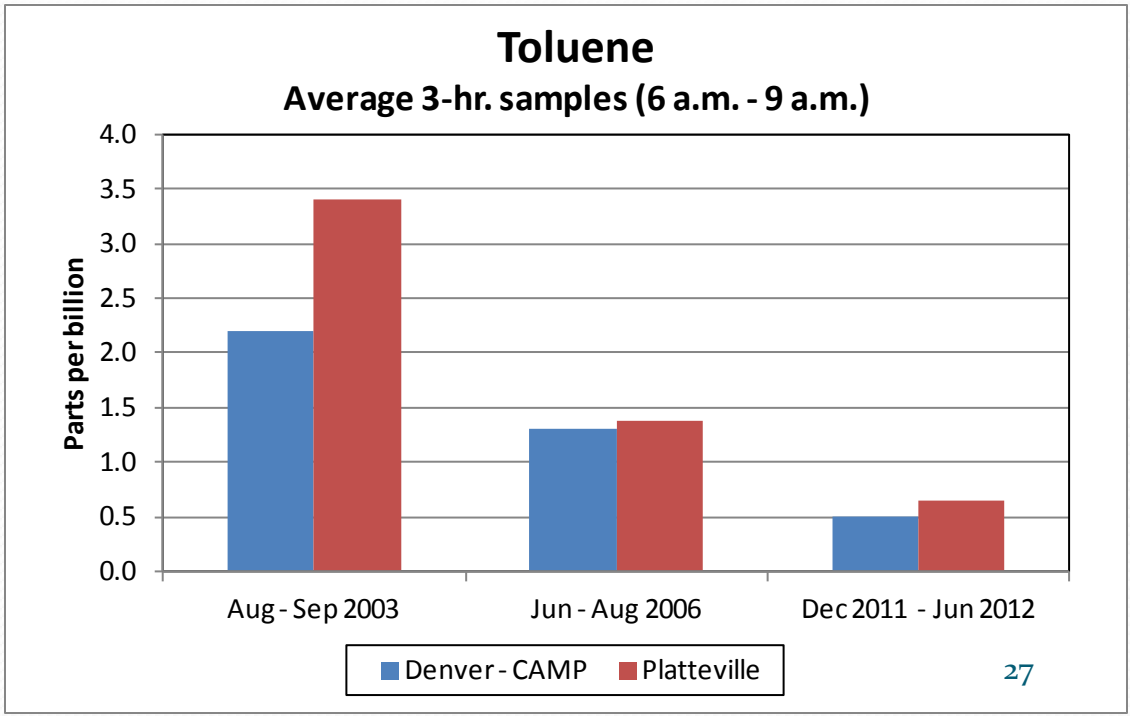
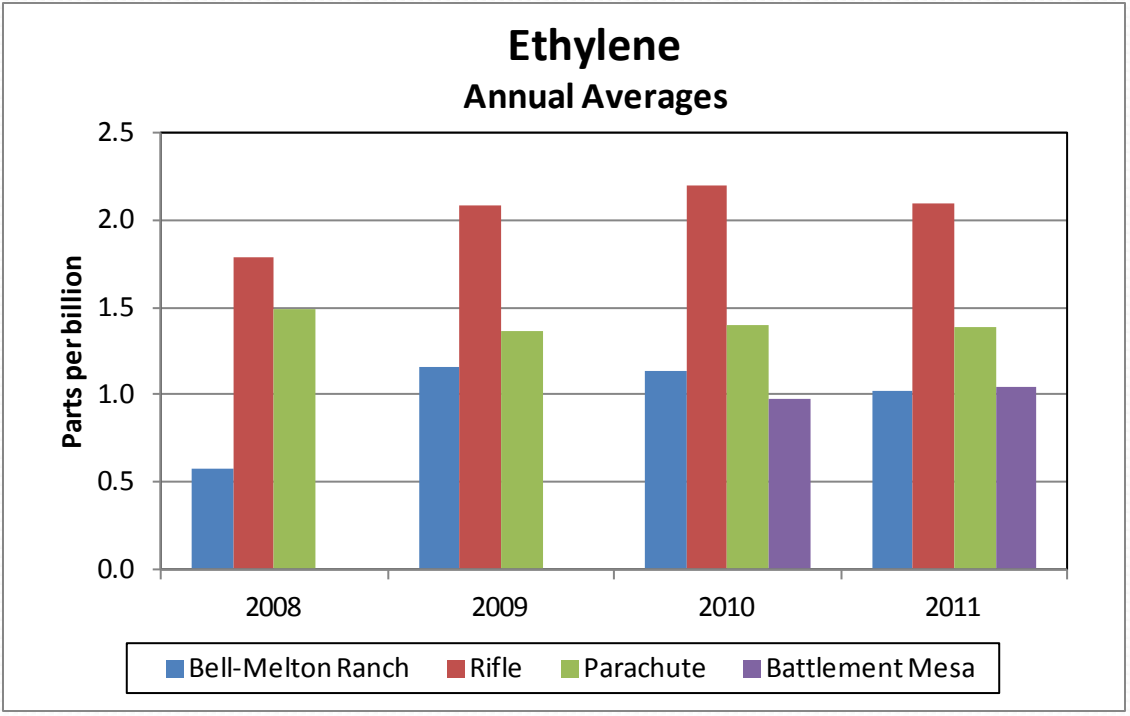
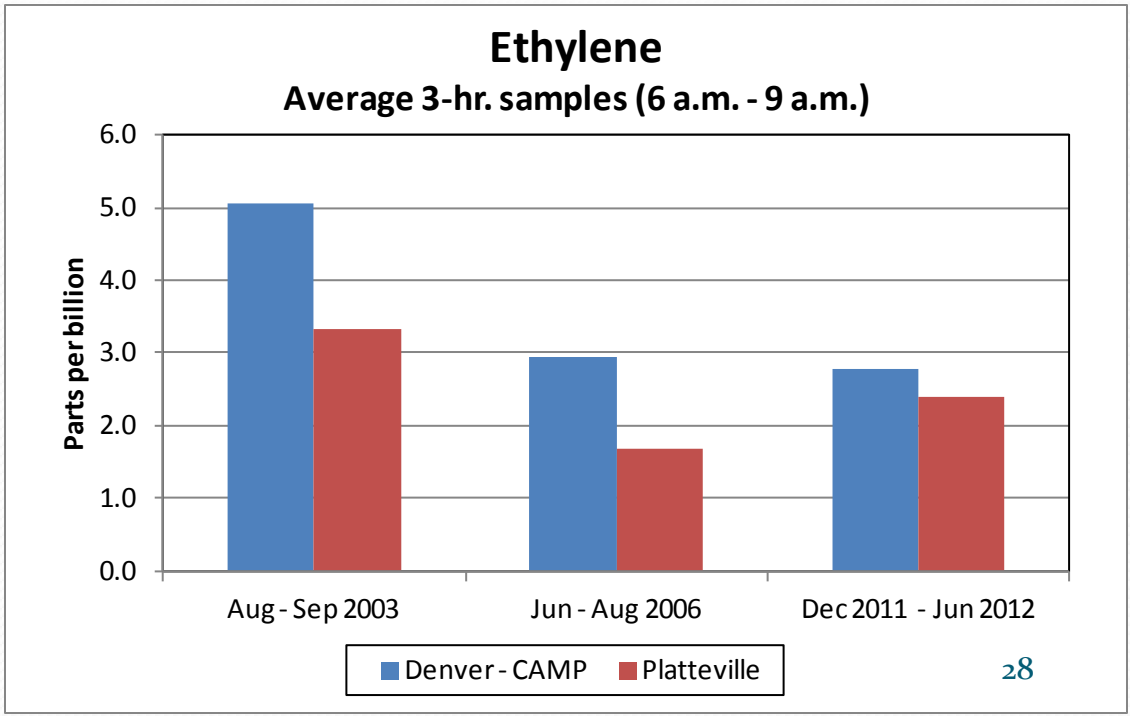
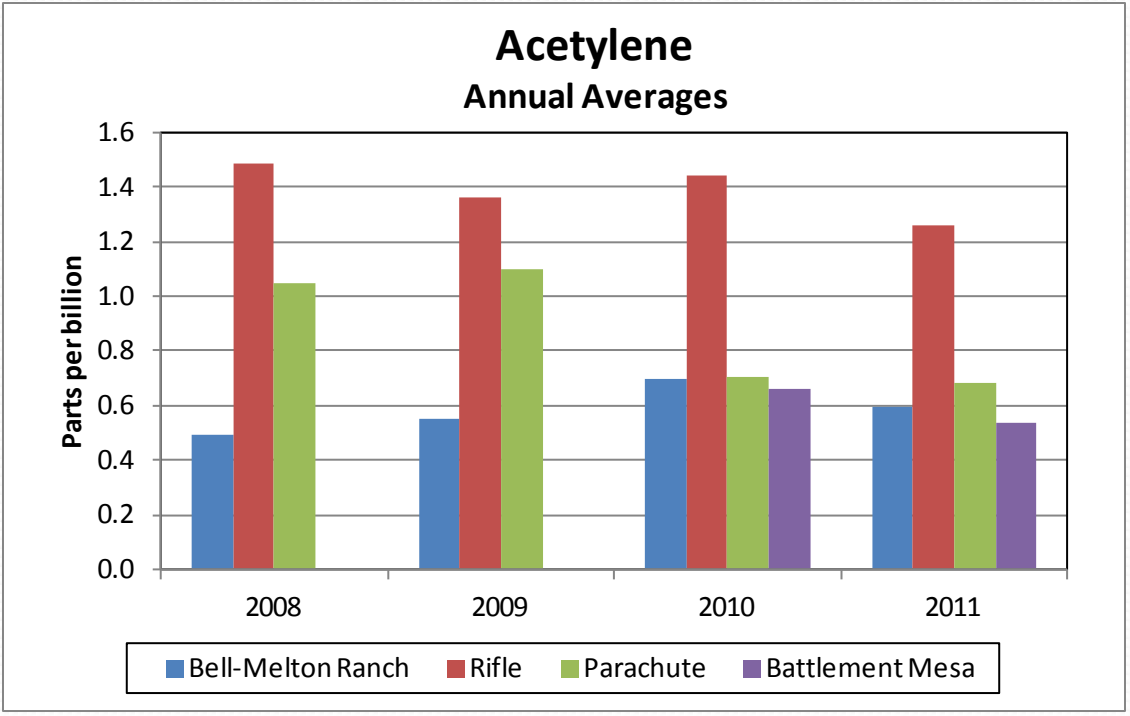




Select organics that are typically urban-related

(Note difference in scale and time averages between graphs)





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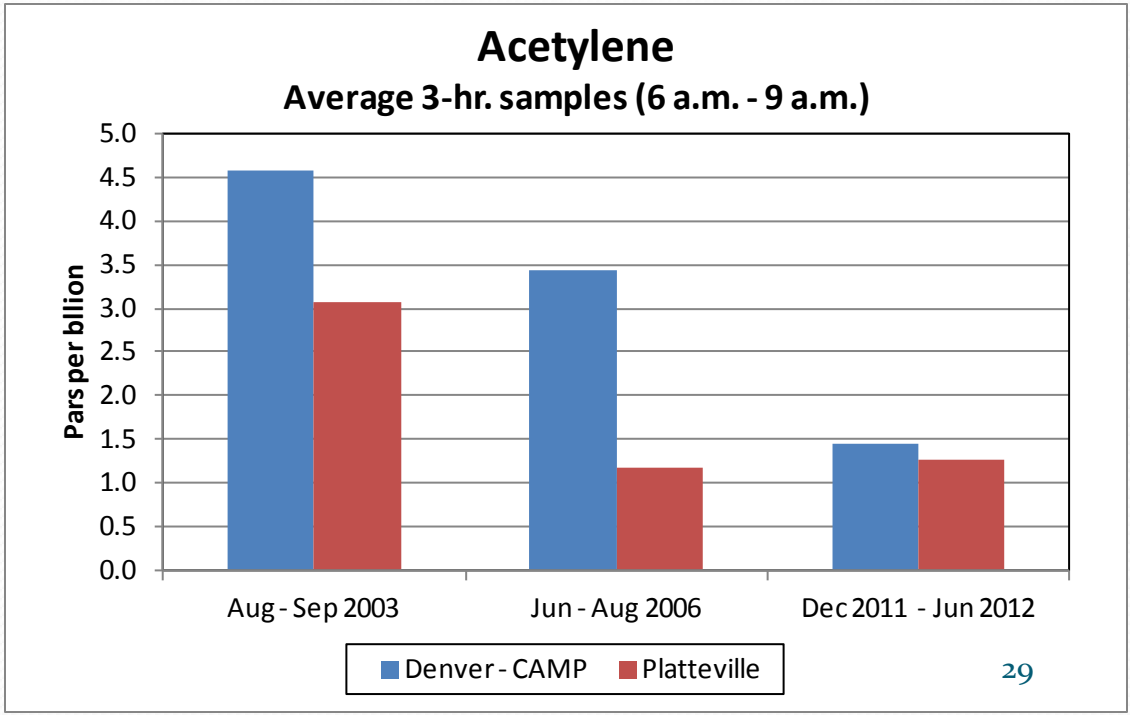
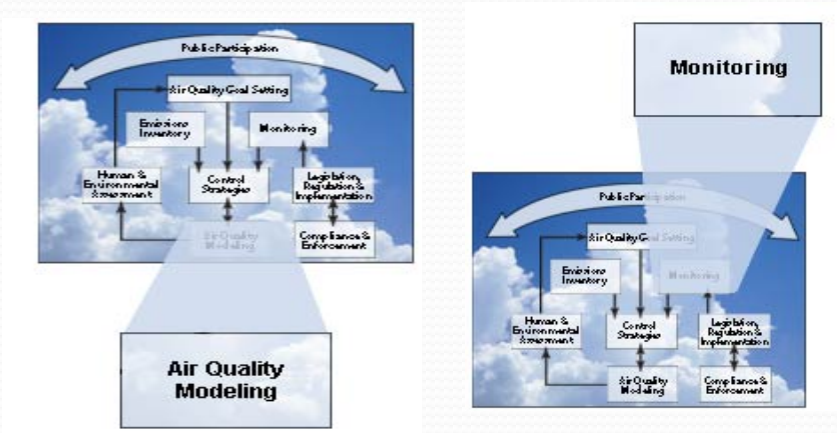


Summary of Efforts and Conclusion

Air Monitoring (2005-current)	• No violation of national ambient air quality standards (ozone, particulates) • Overall, concentrations of some volatile organic compounds (VOC) appear to have decreased over time • Typical oil and gas related compounds tend to be higher in rural areas where most of the development is occurring (relative to urban areas) • Typical urban and urban/oil & gas related compounds tend to be higher in urban areas (relative to rural areas)
Emissions Inventories (State, WRAP)	• O& G emissions are significant contributors to oxides of nitrogen (NOx) and VOC • Major particulate matter (PM) sources are associated with recent growth and energy development
Health Risk Assessments (2007 – 2009)	• At present, there is not a public health crisis in GARCO (low-health hazard); Screening risk levels are within EPA "acceptable" ranges • Numerous gaps and uncertainties in our understanding of pollution from O&G operations on the estimated cancer risks and non-cancer hazards

2012-2014: CSU Oil and Gas Air Emissions Study

Air emissions from natural gas development operations are not well characterized



Main Objectives

- quantify emissions of chemical compounds (especially VOCs) during well development operations
- characterize how these compounds are dispersed in the atmosphere in the downwind plume near the site

Types of Operations Studied

- Preparation of Well Pad→Well Drilling→Hydraulic Fracturing→Flowback→Well Completion

GARFIELD COUNTY AIR QUALITY MANAGEMENT PROGRAM PLAN

OVERARCHING VISION: CLEAN AIR IN GARFIELD COUNTY

Elements of our Vision:

Promote Innovative Solutions	Reduce Public Health Risks	Coordinate Use of Resources	Dynamic Comprehensive Data Plan	Leadership In Regulatory Clarity	Active Community Engagement	Integrate Air Quality Issues into Community Planning

STRATEGIES

- Develop and Implement a Comprehensive Education Plan
- Develop and Implement a Comprehensive Communication Plan
- Engage Community Input and Feedback Mechanisms to Ensure Continuous Improvement
- Coordinate Efforts Regionally
- Identify and Leverage Available Resources
- Identify and Implement Feasible Clean Air Strategies

- Develop and Implement a Comprehensive Data Management Plan
- Sustain the Air Quality Plan Through Coordinated Stakeholder Involvement

STRATEGIC DIRECTION

- *Facilitating an Effective Information Exchange*
- *Maintaining Clean Air*
- *Establishing A Scientific Basis For Making Decisions*
- *Fostering A Sustainable Air Quality Management Process*

Annual Data Summary Reports

- Prepared each year since 2008
- Publicly available on Garfield County Air Quality Management Website
- **http://www.garfield-county.com/air-quality**

Questions?

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