Garfield County and Northwest Colorado Air Quality Overview

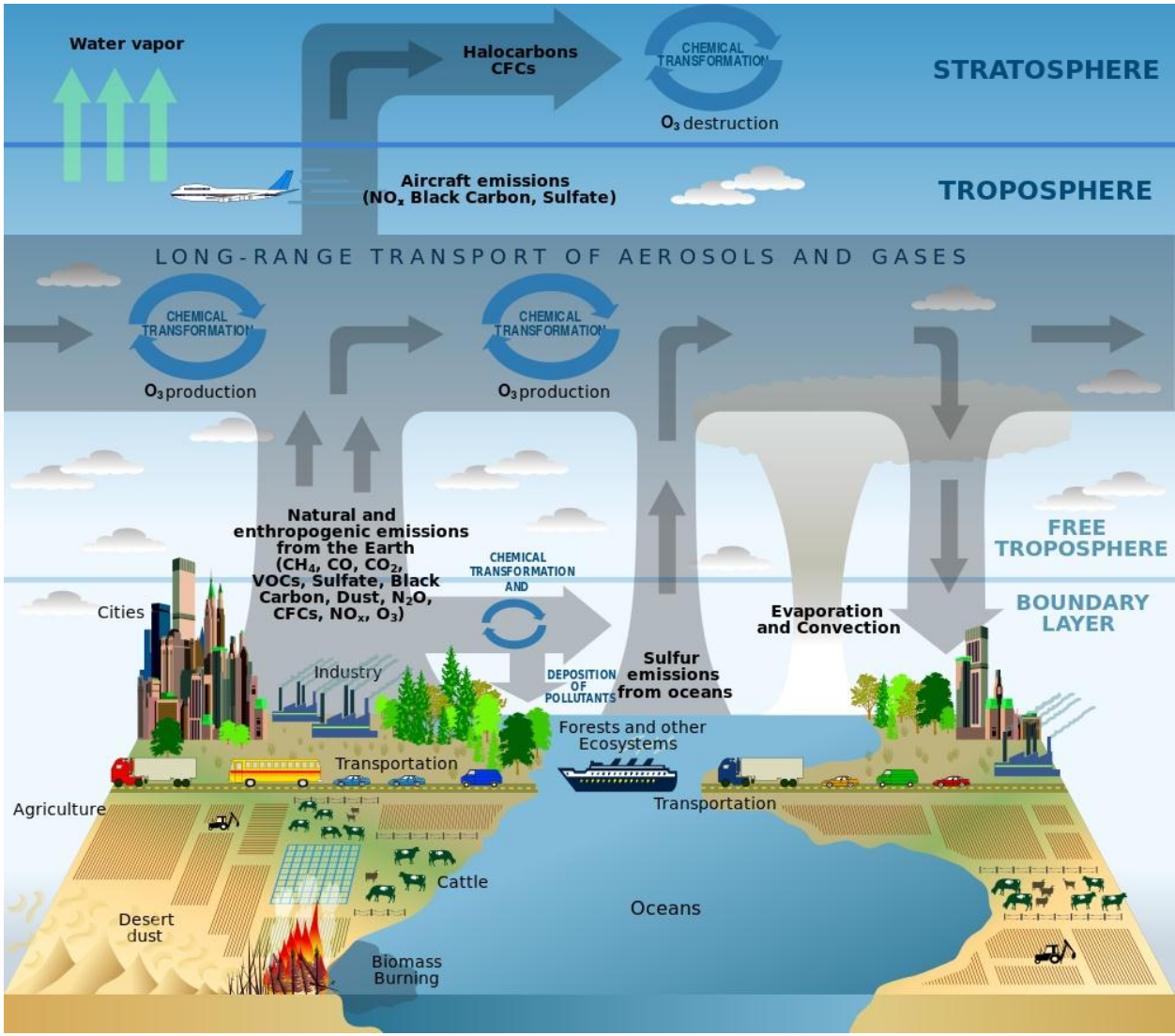
COLORADO
Department of Public Health & Environment

Air Pollution Control Division

Garfield EAB
4 September 2014

The Atmosphere, Emissions and Pollution

- The atmosphere is complex, with many emission sources and types of pollution
- Concerns include:
  - ground level ozone + precursors (VOCs, NOx)
  - particulates
  - greenhouse gases
  - nitrogen deposition



"Air respects no boundaries"

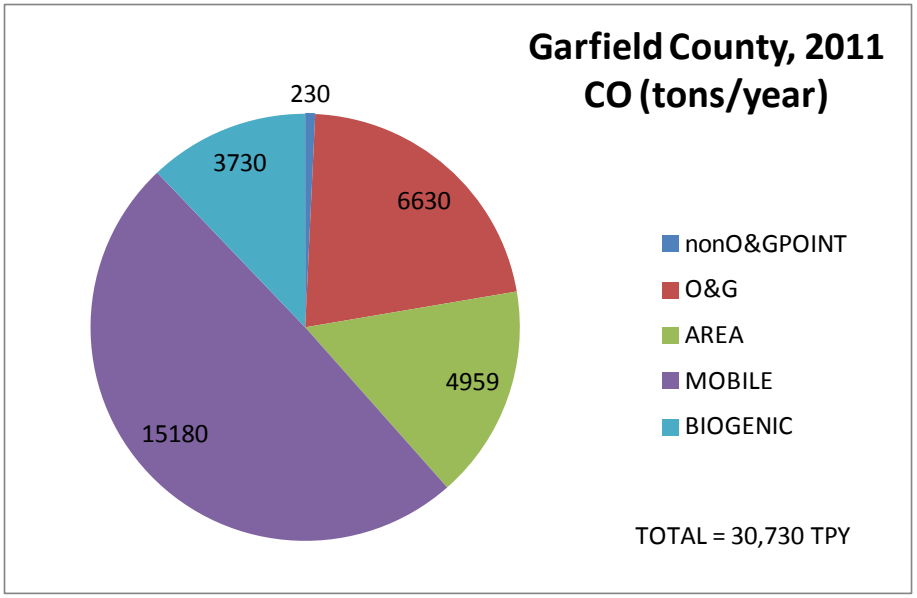
Background

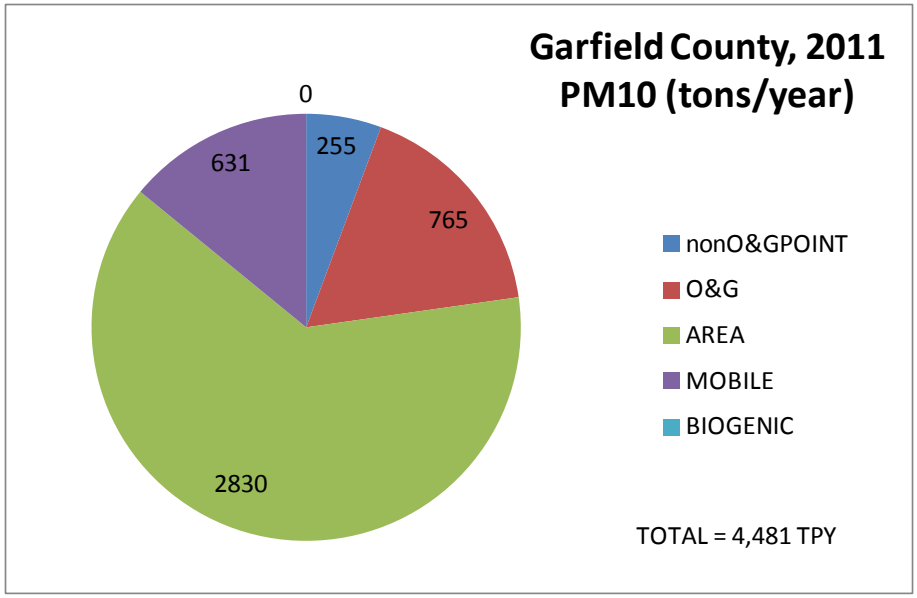
- Colorado has a long history of oil and gas production
- Rapid development in the Piceance Basin in the early 2000s led to a number of citizen concerns and complaints on odors, dust, traffic, water, aesthetics, health
- Air monitoring studies first commenced in 2002
- Garfield County established a routine air monitoring network in 2005
- Increased development in the D-J Basin in the late 2000s led to increased local and citizen complaints and concerns similar to Piceance Basin
- Additional field monitoring studies and regulations
- CDPHE held a series of outreach meetings in 2012-2013
- Local efforts to regulate oil and gas development have also occurred

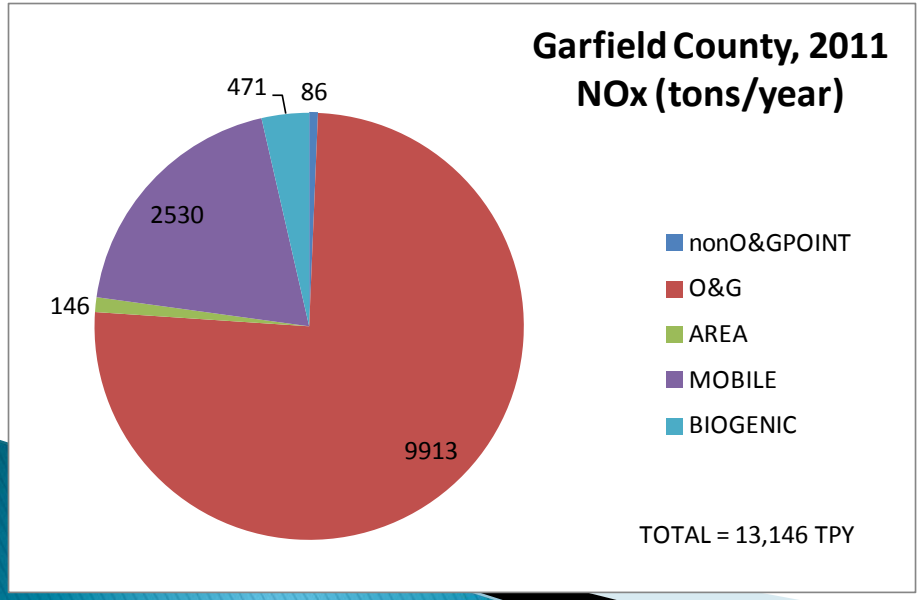
Air Monitoring Overview

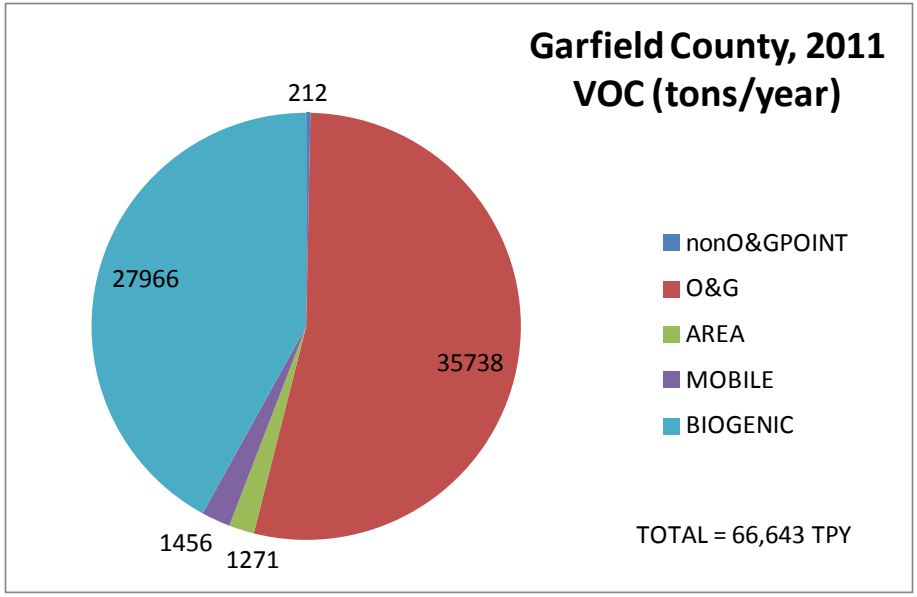
- EPA has 6 "Criteria" pollutants for National Ambient Air Quality Standards (NAAQS) – primary focus for CDPHE/APCD
  - CO, O_3, NO_2, SO_2, PM (PM_{10} & $PM_{2.5}$), Pb
- Designed to protect public health
- Performed across State of Colorado
  - APCD has approximately 60 sites (other agencies also have monitors)
  - Sites added or removed based on needs and concentrations recorded
- Mainly in population centers
- Different types
  - "Continuous" provides hourly values
    - CO, O_3, NO_x/NOy, SO_2, PM_{10}, $PM_{2.5}$, meteorology
  - "Daily" provides 24-hour values
    - PM_{10}, $PM_{2.5}$, air toxics

Emissions Inventory, 2011

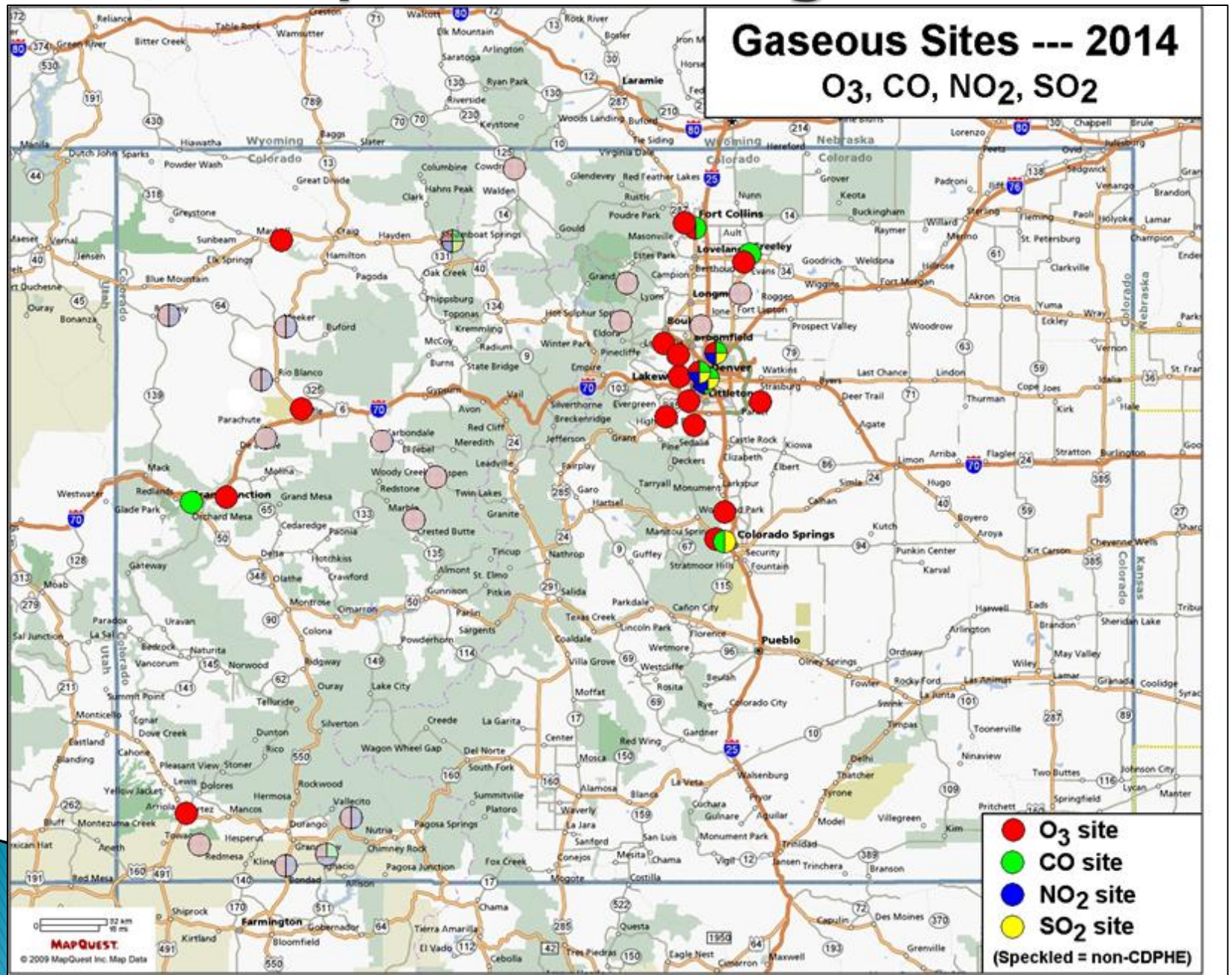




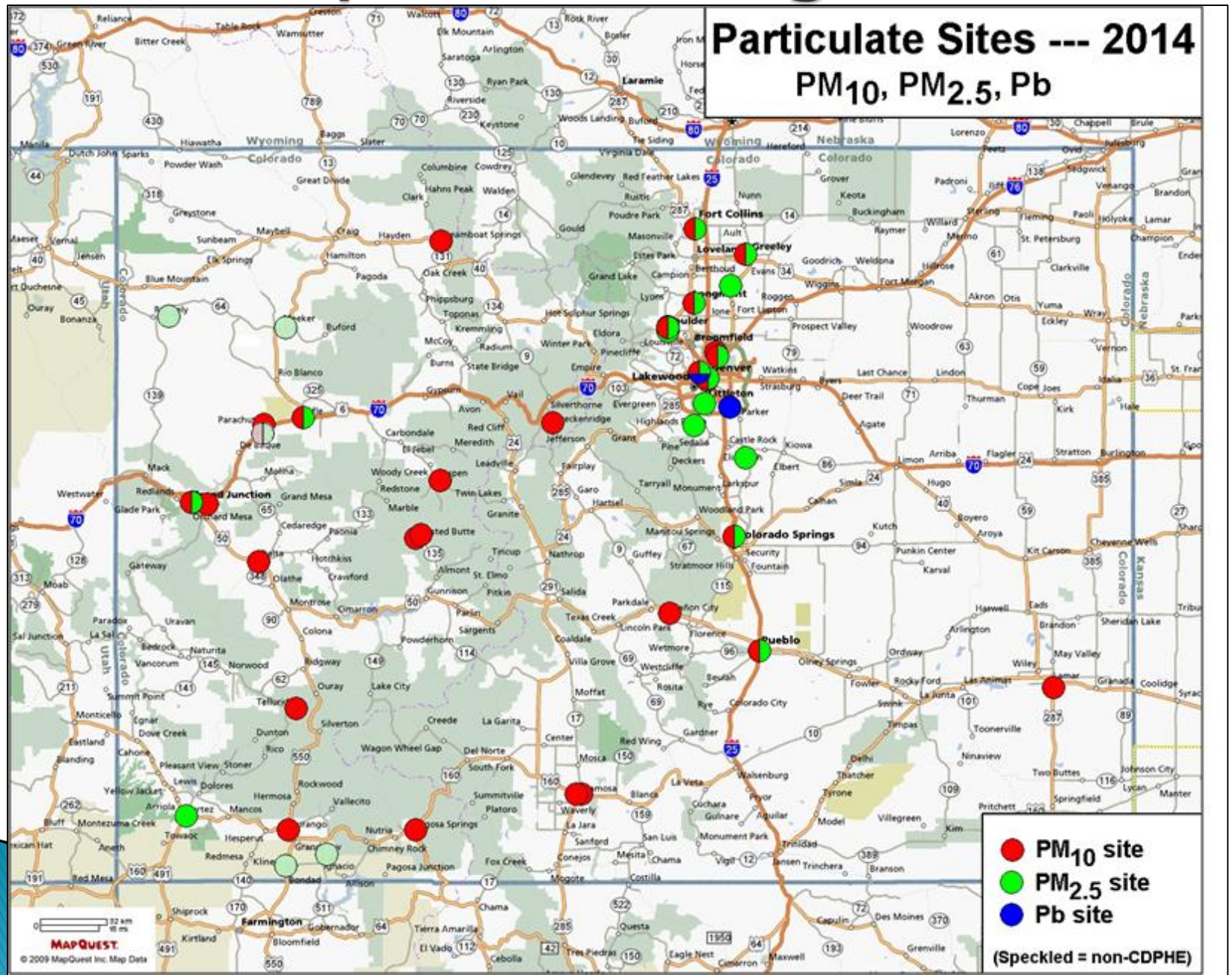




Air Quality Monitoring Sites



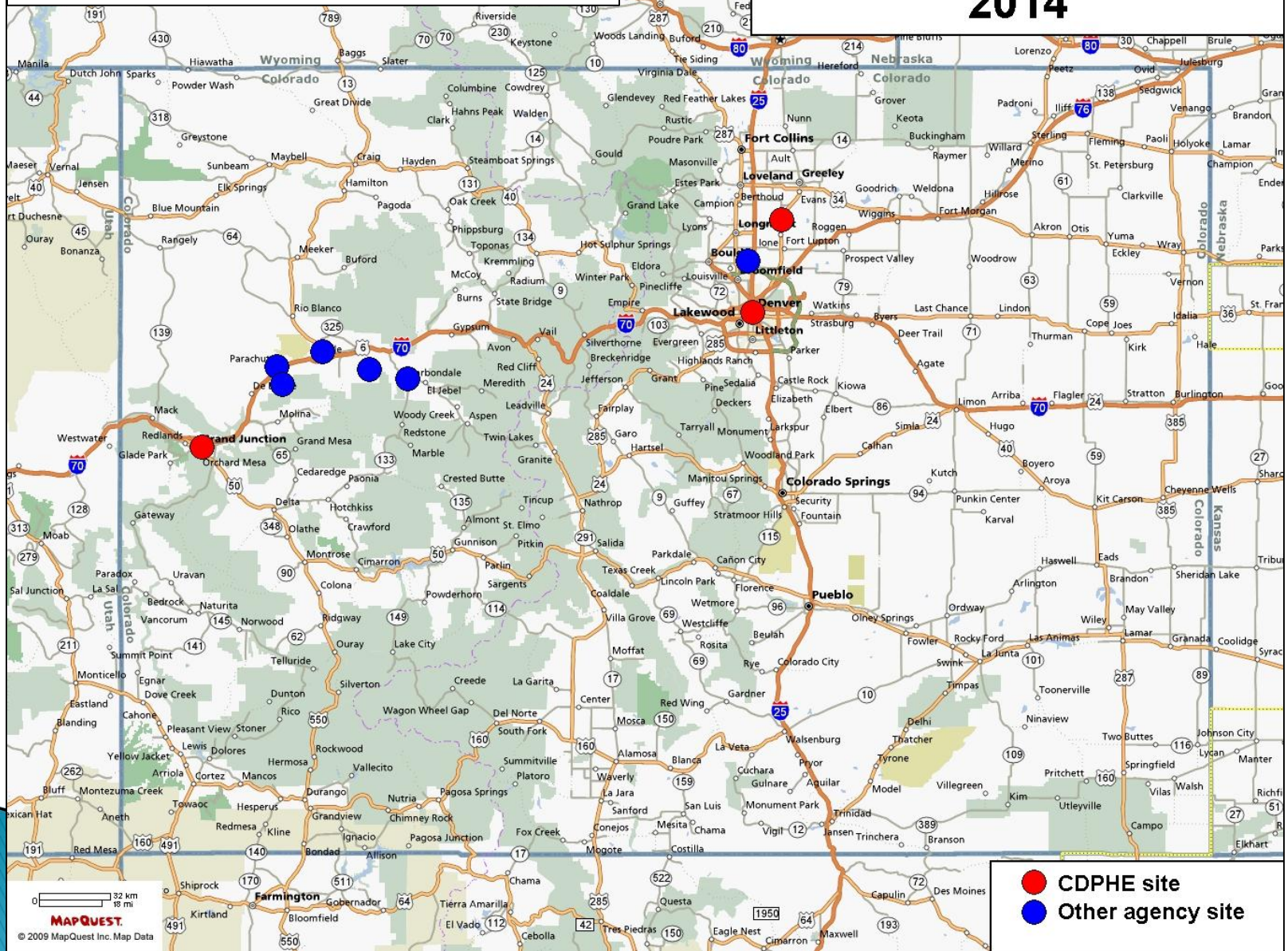
Air Quality Monitoring Sites



Air Quality Monitoring Sites

NOTE: There are no ambient air standards for air toxics/organic compounds

Toxics / Organics sites 2014



Ozone data – Eastern Slope

Three Year Average 4th Maximum Ozone Values

East Slope Sites Site Name	AQS #	2011 8-hr. O3 4th Max. Value (ppm)	2012 8-hr. O3 4th Max. Value (ppm)	2013 8-hr. O3 4th Max. Value (ppm)	2014 * 8-hr. O3 4th Max. Value (ppm)	2011-2013 3-yr. Avg. 4th Max. Value (ppm)	2012-2014 * 3-yr. Avg. 4th Max. Value (ppm)
Welby	08-001-3001	0.075	0.077	0.077	0.066	**0.076**	0.073
Highland	08-005-0002	0.078	0.080	0.079	n/a	**0.079**	---
Aurora East	08-005-0006	0.077	0.074	0.073	0.064	0.074	0.070
S. Boulder Creek	08-013-0011	0.076	0.076	0.079	0.069	**0.077**	0.074
CAMP	08-031-0002	---	0.068	0.067	0.060	---	0.065
La Casa	08-013-0026	---	---	0.071	0.065	---	---
Chatfield State Park	08-035-0004	0.082	0.086	0.083	0.072	**0.083**	**0.080**
USAF Academy	08-041-0013	0.074	0.075	0.074	0.064	0.074	0.071
Manitou Springs	08-041-0016	0.075	0.075	0.072	0.061	0.074	0.069
Welch	08-059-0005	0.077	0.079	0.080	0.064	**0.078**	0.074
Rocky Flats North	08-059-0006	0.081	0.084	0.085	0.074	**0.083**	**0.081**
NREL	08-059-0011	0.083	0.081	0.084	0.074	**0.082**	**0.079**
Aspen Park	08-059-0013	0.072	0.077	0.077	0.067	0.075	0.073
Fort Collins - West	08-069-0011	0.080	0.080	0.082	0.074	**0.080**	**0.078**
Fort Collins - CSU	08-069-1004	0.068	0.074	0.074	0.072	0.072	0.073
Weld County Tower	08-123-0009	0.077	0.080	0.073	0.070	**0.076**	0.074
NPS - Rocky Mtn. NP	08-069-0007	0.077	0.079	0.074	0.069	**0.076**	0.074
NOAA - BAO Tower	n/a	0.076	0.077	0.071	n/a	0.074	---
NOAA - Niwot Ridge	n/a	0.067	0.076	0.072	n/a	0.071	---

* 2014 data thru 7/31

Ozone data – Western Slope

Three Year Average 4th Maximum Ozone Values

West Slope Sites Site Name	AQS #	2011 8-hr. O3 4th Max. Value (ppm)	2012 8-hr. O3 4th Max. Value (ppm)	2013 8-hr. O3 4th Max. Value (ppm)	2014 * 8-hr. O3 4th Max. Value (ppm)	2011-2013 3-yr. Avg. 4th Max. Value (ppm)	2012-2014 * 3-yr. Avg. 4th Max. Value (ppm)
Rifle - Health	08-045-0012	0.066	0.068	0.062	0.061	0.065	0.063
Palisade - Water	08-077-0020	0.066	0.071	0.066	0.062	0.067	0.066
Lay Peak	08-081-0002	---	0.066	0.065	0.062	---	0.064
Cortez	08-083-0006	0.071	0.070	0.064	0.062	0.068	0.065
CASTNET - Gothic	08-051-9991	0.064	0.070	0.064	0.063	0.066	0.065
USFS - Walden	08-057-0003	---	0.059	0.064	0.059	---	0.060
USFS - Shamrock **	08-067-1004	0.077	0.069	0.072	0.064	0.072	0.068
SUIT - Ignacio	08-067-7001	0.072	0.067	0.069	0.073	0.069	0.069
SUIT - Bondad/Hwy 550	08-067-7003	0.069	0.069	0.067	0.070	0.068	0.068
NPS - Mesa Verde NP	08-083-0101	0.070	0.069	0.069	0.065	0.069	0.067
Pitkin Co. - Aspen	08-097-0007	0.064	n/a	n/a	n/a	---	---
BLM - Meeker	08-103-0005	0.063	0.064	0.064	0.062	0.063	0.063
BLM - Rangely	08-103-0006	0.073	0.069	0.091	0.062	**0.077**	0.074

* 2014 data thru 7/31 (** thru 6/30)

Future Ozone NAAQS

- EPA currently reviewing the NAAQS
  - "Policy Assessment for the Review of the Ozone National Ambient Air Quality Standards, Second External Review Draft" released Jan. 2014
  - "Health Risk and Exposure Assessment for Ozone, Second External Review Draft" released Jan. 2014
  - "Welfare Risk and Exposure Assessment for Ozone, Second External Review Draft" released Jan. 2014
- Clean Air Science Advisory Committee (CASAC) review recommends:
  - Primary standard "range between 60-70 ppb, with the caveat that public health protections would be greater at the lower end of the range"
  - Secondary standard based on a "biologically-relevant" W126 index with " a level within the range of 7 ppm-hr to 13 ppm-hr"
- EPA (based on court ruling) will issue a proposal by Dec, 1, 2014 (likely including new monitoring seasons)
- EPA (based on court ruling) will promulgate a final NAAQS by Oct. 1, 2015
- Monitoring season for Colorado likely to be Jan-Dec

APCD Data Availability

- "Continuous" data posted hourly on APCD Technical Services website and uploaded to EPA's AIRNow website
  - http://www.colorado.gov/airquality/
  - http://airnow.gov/
- Final validated data sent to EPA's Air Quality System (AQS)
- Forecasting performed daily and posted on APCD Technical Services website
- Air quality advisories issued as needed
- Annual Data Report published and on APCD website

Colorado Air Pollution Control Division Webpage

COLORADO.gov/AirQuality

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- All Colorado Advisories
- Front Range/Denver Advisories
- Other Colorado Advisories
- Colorado Smoke Outlook
- Air Quality Report View
- Air Quality Map View
- Open Burning Forecast
- Air Quality Today

TSP Resources

Conditions

Forecast - Front Range Air Quality

Expected Air Quality for Your Health (Monday)

MODERATE

Expected Visibility (Tuesday)

POOR

No Air Pollution Advisories
4PM Mon - 4PM Tue

Current - Air Quality Index (AQI) 2PM

Denver Metro	MODERATE
Colorado Springs	GOOD
Ft Collins - Greeley	GOOD
Grand Junction	GOOD
Colo. River Valley	GOOD

Live Image of Denver

Every hour a live image of Denver is archived from the same location where visibility data are collected and calculated as the VSI.

Air Quality Report View

Several reports are available and range from a quick snapshot of air quality, to more detailed customized reports for selected dates.

Colorado Air Quality Map

Real-time monitoring sites appear color coded according to current measurements and AQI calculations. Roll over a site to check the most recent data.

Garfield County Online Air Quality Data

http://www.garfield-county.com/air-quality/index.aspx

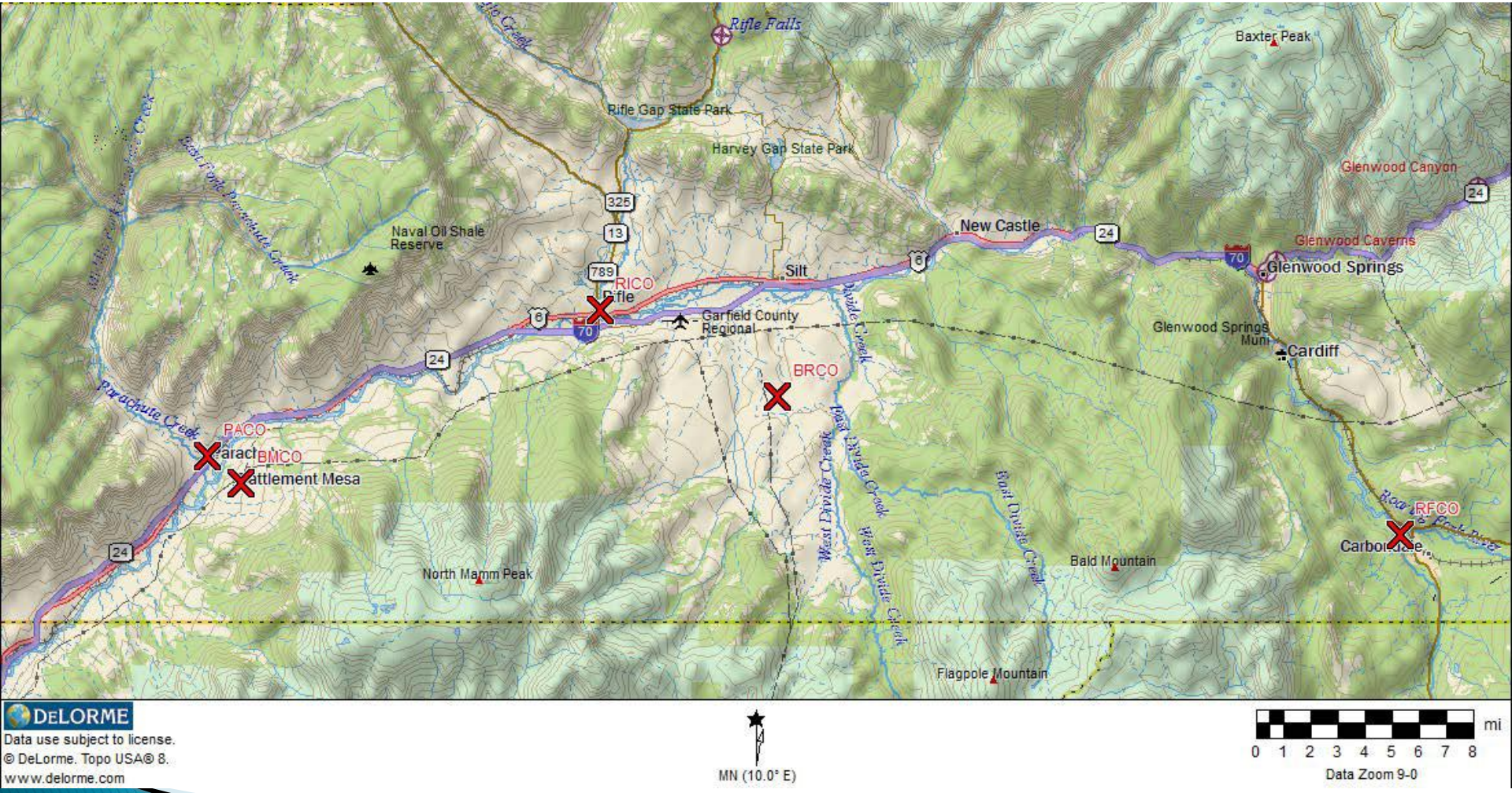
Air Studies in Western Colorado

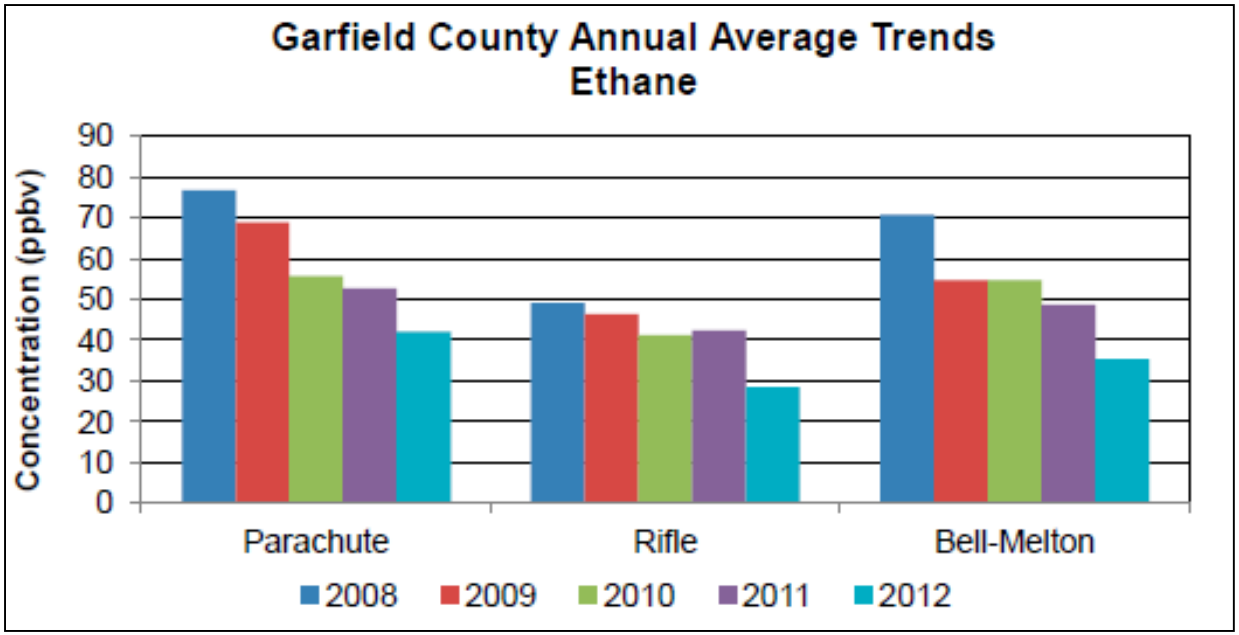
- 2002 EPA Well Study, Garfield County
- 2005 – 2007 Garfield VOC Study
- 2008 Garfield Targeted Well Study
- 2008 – current, Garfield County Monitoring
- 2013 – 2015 Garfield Oil and Gas Emissions and Dispersion Study
- 2010 – current, 3-State Study

2008–current Garfield Monitoring

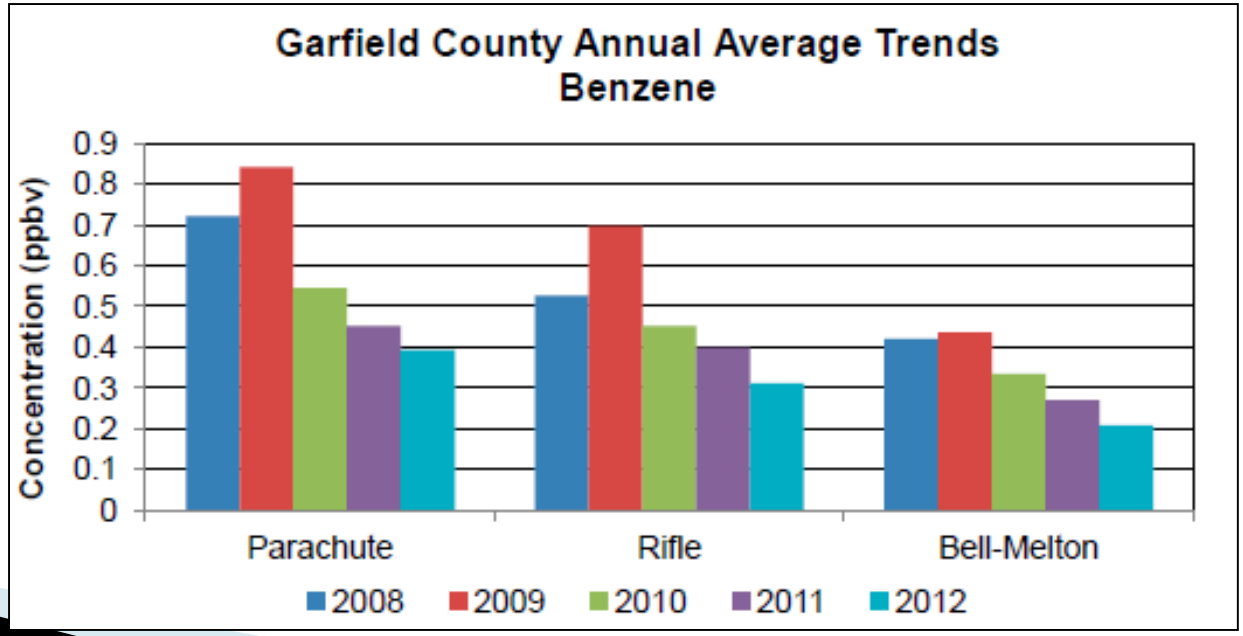
- Led by Garfield County with assistance from CDPHE and Technical Advisory Committee
- Funded by Garfield County and CDPHE
- SNMOC's and carbonyls, 24-hour samples
  - 4-5 sites each year
- Purpose:
  - To evaluate air quality characteristics within Garfield County related to oil and gas development
  - To continue to attempt to address concerns from local citizens about air pollution in the area and potential health effects, primarily due to oil and gas development activities
  - To develop long-term trends in different source areas
  - To gather information on ozone precursors
- Some screening-level risk assessments completed

Garfield County Monitoring Sites





Garfield VOC Trends



2013–2015 Garfield Emissions & Dispersion Study

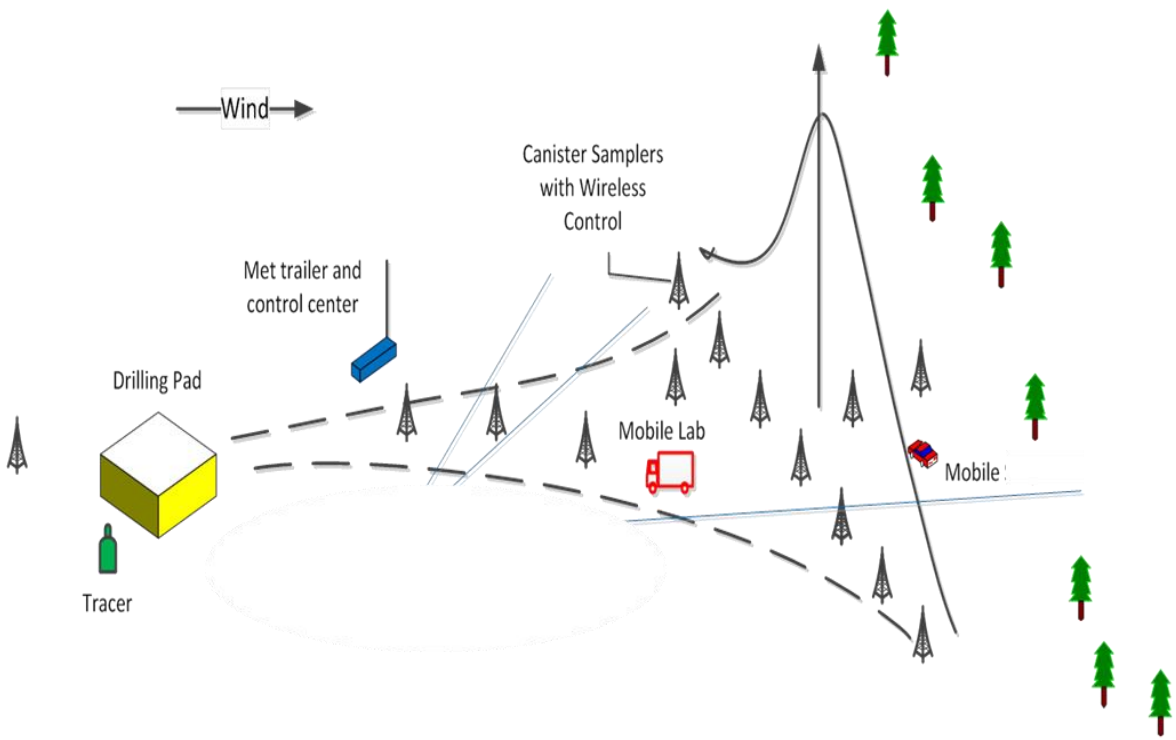
- Conducted by Garfield County via a contract with Colorado State University
- 2013–2015
- Desire to obtain more information related to emissions from oil and gas activities in Garfield County
  - Currently a limited amount of emissions data
  - Many citizens and local governments have expressed concern about potential impacts to air quality and human health associated with increased drilling activity
- $1.0 million Garfield County, $0.7 million from industry partners
- Risk assessment not funded

Garfield Emissions and Dispersion Study – Design

- Designed to:
  - Quantify emissions of chemical compounds
  - characterize how these compounds are dispersed in the atmosphere
- Focus on a variety of oil and gas activities
  - Drilling, fracking/flowback/completion
- Specific activities/compounds for monitoring determined by technical advisory groups that include representatives from federal, state, local, industry

Emissions and Dispersion Studies – General Approach

- Multiple, independent approaches
  - Tracer method
  - Dispersion modeling
- Combination of time-integrated and continuous measurements to observe temporal and spatial variability
- Mobile and fixed sampling platforms



Emissions and Dispersion Studies – Measurements

VOC
Emissions from different processes

- PTRMS
  Real Time
  CSU Mobile Lab
- VOC Canisters
  GC-MS/FID
  Offline
  On tripod mounts and on towers
- TVOC
  ppb RAE (PID)
  ~ 1min
- Carbonyl
  Cartridges
  Offline

Acetylene
Tracer for plume identification

- CRD
  Real Time
  Mobile 4WD Plume Tracker
- Canisters
  GC-FID
  Offline

CH_4

- CRD
  Real Time
  Mobile 4WD Plume Tracker
- Methane/Non-Methane Hydrocarbon Analyzer (FID)
  Mobile Lab

Met and other

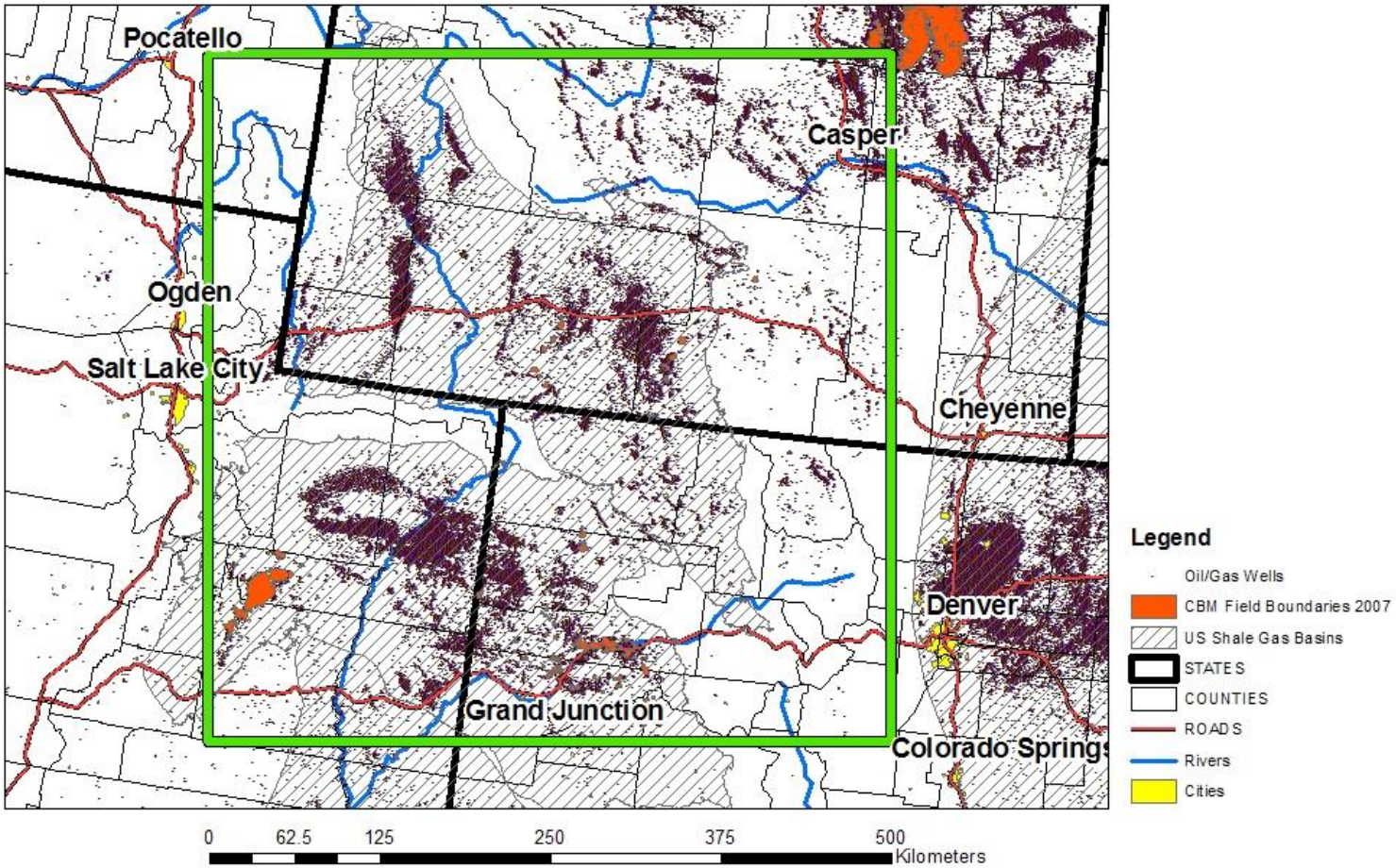
- 15 m crank-up met. tower
- Tripod deployable 3m met. stations
- CO and NO_x

2010–current 3-State Study

- Collaborative effort involving Colorado, Utah, and Wyoming, as well as USFS, NPS, BLM, EPA
- Goal is to reduce redundancy and increase consistency between agencies for air pollution analyses
- Focus is on oil and gas development areas and ozone
- Includes Uinta Basin and Upper Green River Basin
- 3 major parts to the study:
  - Monitoring (3-years minimum)
  - Data warehouse (currently in development)
  - Modeling (base-case and future-year)
- Goal is to have a readily updateable emissions inventory that will output model-ready files for use in state SIP activities as well as NEPA and EIS needs
- Allows for cumulative effects analyses for oil and gas development

3-State Study – general area

Approximate Extent of Proposed Uinta-Piceance and Southwest Wyoming Air Quality Study (DRAFT FOR DISCUSSION PURPOSES)

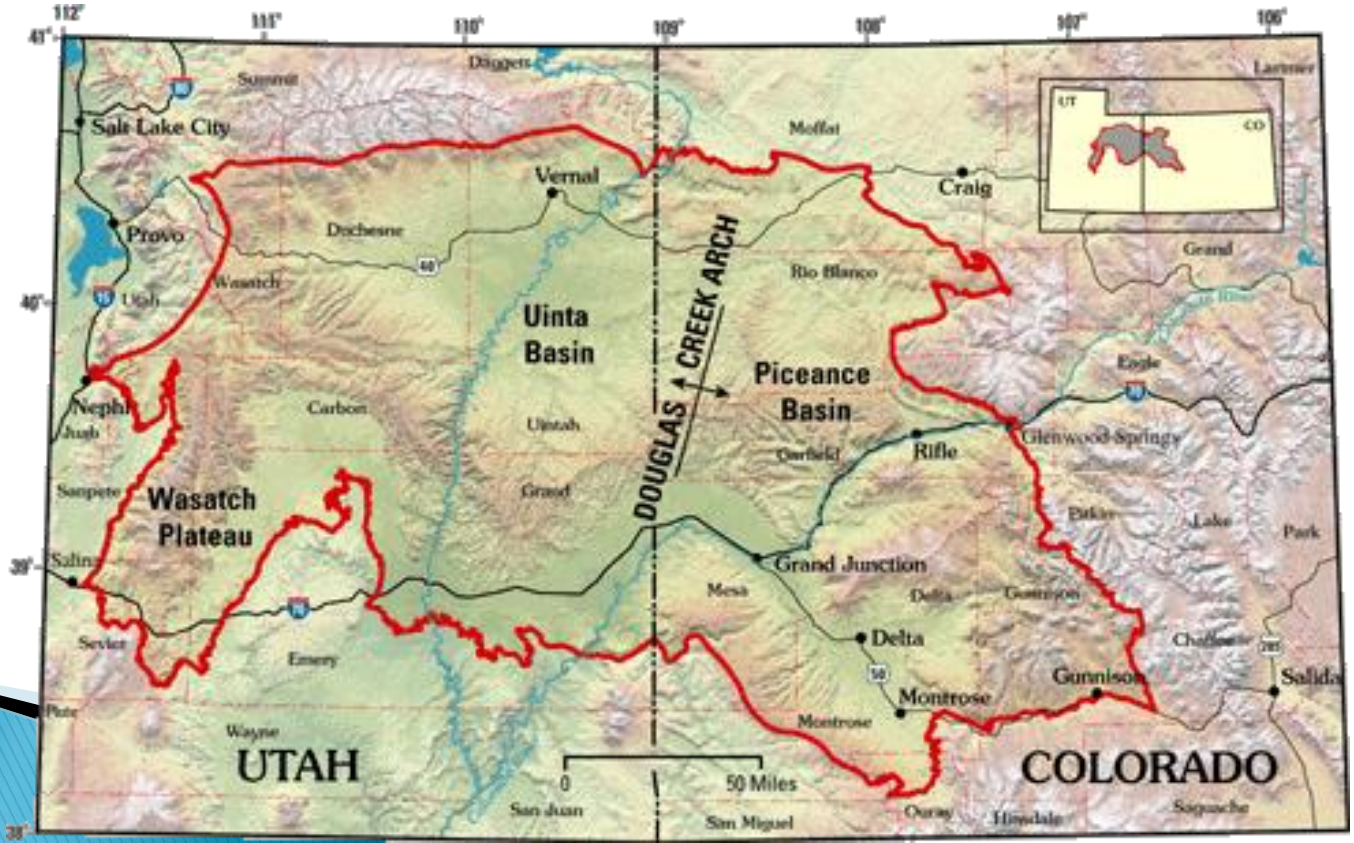


Colorado Department of Public Health and Environment
Air Pollution Control Division

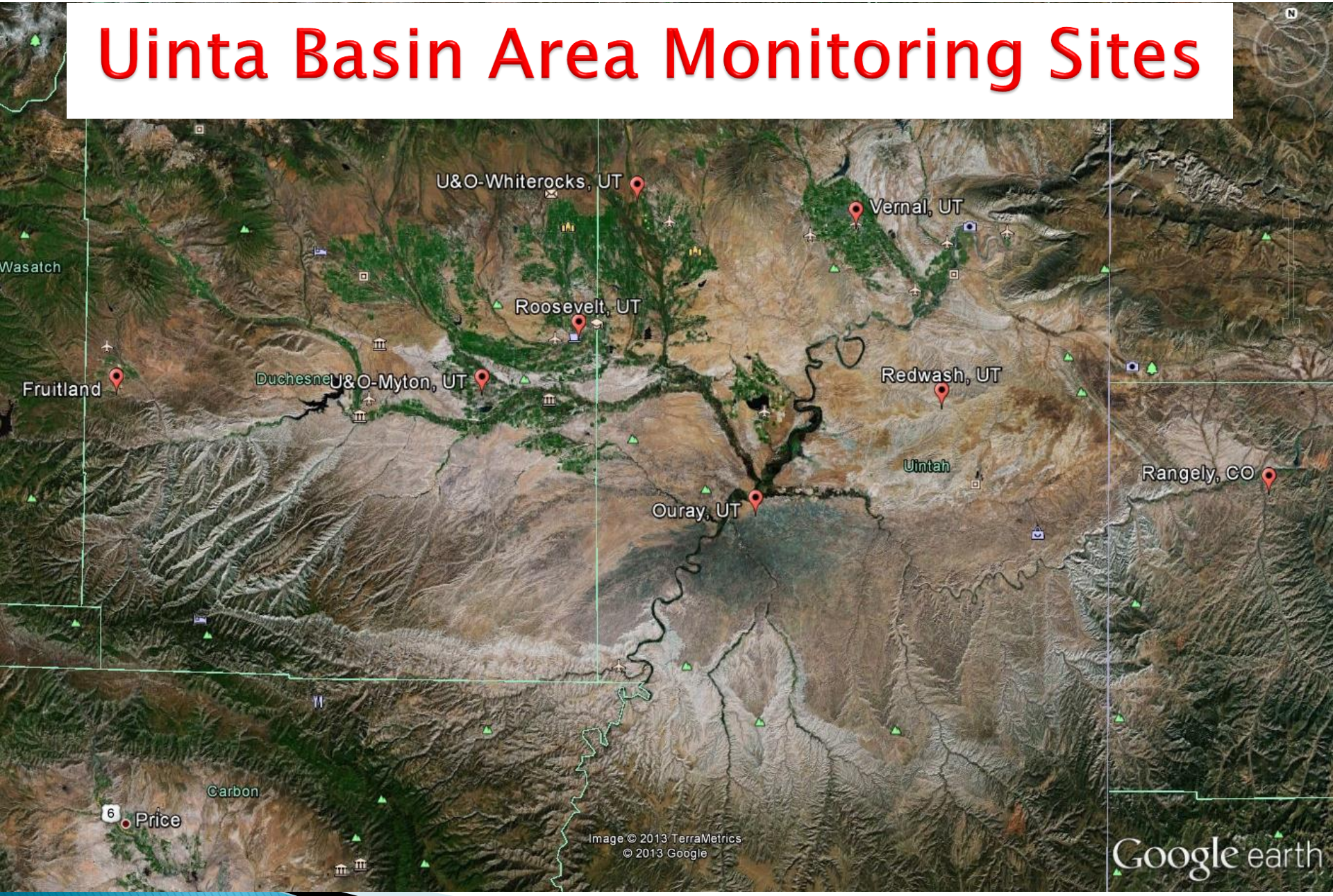
June 15, 2009

Focus on the Uinta Basin

- Issue: High wintertime ozone values
- Discovered in late 2009/early 2010
- Similar to Upper Green River Basin in WY
- Primarily in UT, but some in CO



Uinta Basin Area Monitoring Sites



Ozone data – Uinta Basin

4th Maximum 8-hr. (ppm)

	2006	2007	2008	2009	2010	2011	2012	2013	2014*
Lay Peak, CO							0.066	0.065	0.062
BLM-Meeker, CO					0.066	0.063	0.064	0.064	0.062
BLM-Rangely, CO						0.073	0.069	**0.091**	0.062
Roosevelt, UT							0.067	**0.104**	0.062
Fruitland, UT						0.065	0.070	0.069	
U&O Myton, UT						**0.111**		**0.108**	0.067
NPS-Dinosaur NM, UT	0.068	0.063	0.066	0.063	0.068	**0.090**	0.075	**0.114**	0.064
Vernal, UT							0.064	**0.102**	0.061
Redwash, UT				0.067	**0.098**	**0.100**	0.067	**0.112**	0.061
Ouray, UT				0.067	**0.117**	**0.116**	0.070	**0.133**	0.079
U&O Whiterocks, UT						0.068		**0.095**	

3-yr. Average of the 4th Max. 8-hr. (ppm)

	2006-2008	2007-2009	2008-2010	2009-2011	2010-2012	2011-2013	2012-2014*
Lay Peak, CO							0.064
BLM-Meeker, CO					0.064	0.063	0.063
BLM-Rangely, CO						**0.077**	0.074
Roosevelt, UT							**0.077**
Fruitland, UT						0.068	
U&O Myton, UT							
NPS-Dinosaur NM, UT	0.065	0.064	0.065	0.073	**0.077**	**0.093**	**0.084**
Vernal, UT							0.075
Redwash, UT				**0.088**	**0.088**	**0.093**	**0.080**
Ouray, UT				**0.100**	**0.101**	**0.106**	**0.094**
U&O Whiterocks, UT							

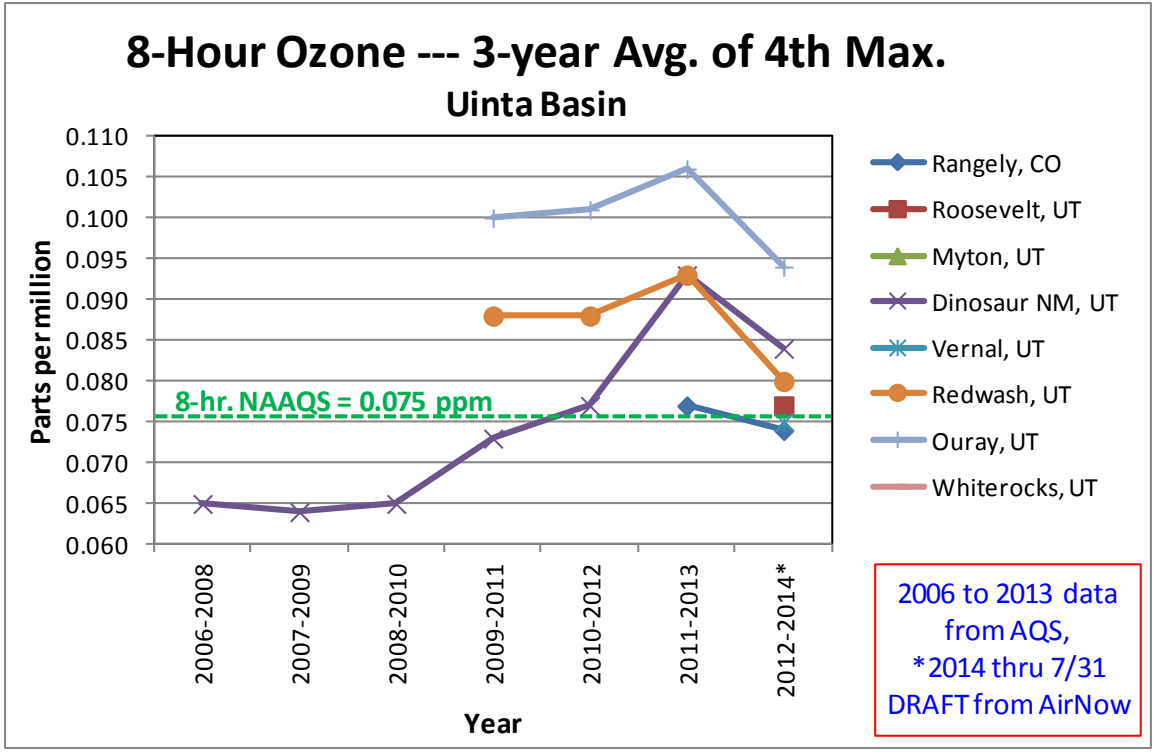
= Regulatory

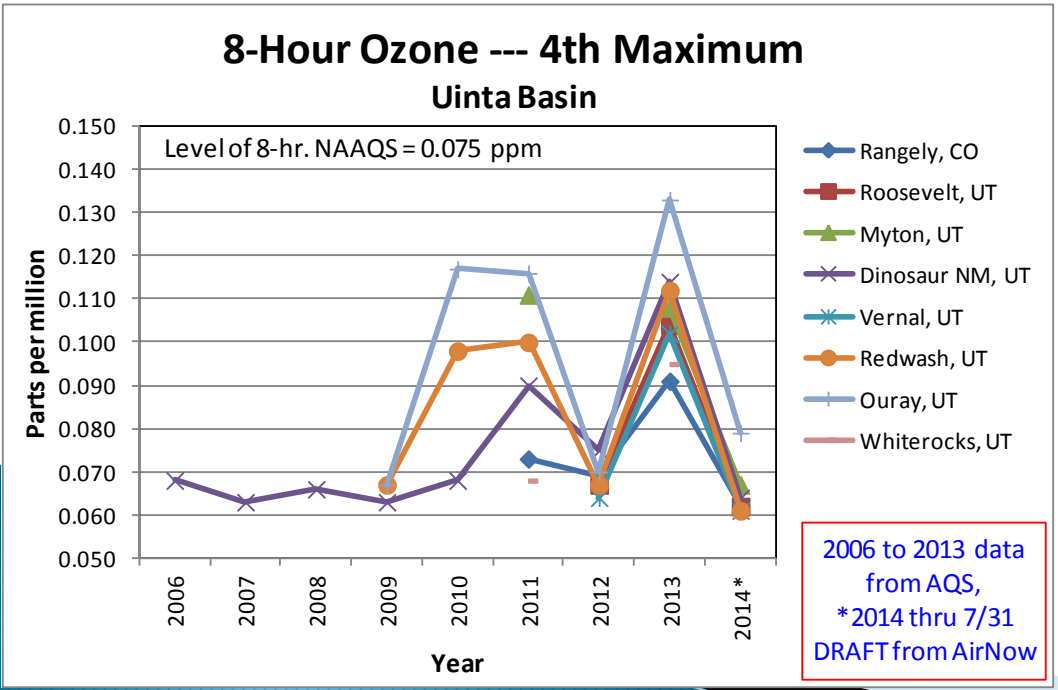
#.### = Exceeded level of NAAQS

#.### = Violates NAAQS

* Thru 7/31/2014

Ozone data – Uinta Basin





2011 – 2014
Uinta Basin Ozone Studies

- Involve State, Federal, Tribal, universities and industry
- Ground, mobile vans and aircraft
- Designed to:
  - Establish baseline ozone conditions
  - Help develop more accurate emissions inventories
  - capture atmospheric chemistry data under high ozone formation conditions
  - determine ozone sensitivity to VOC, NOx, and the Basin's unique winter photochemistry conditions
  - develop a model to evaluate effectiveness of VOC and NOx mitigation

Uinta Basin Study Results

- VOC readings were highest in gas producing areas and lower in oil producing and population centers
- NOx readings were highest in population centers, lower in gas producing areas, and lowest in oil producing areas
- Oil and gas operations are responsible for 98-99 percent of VOC emissions and 57-61 percent of NOx emissions
- VOC controls may be more effective than NOx controls in reducing ozone levels
- Nitrous acid and formaldehyde appear to be the biggest contributors to the creation of the chemically reactive radicals that drive ozone formation

Uinta Basin Ozone – Why?

- High ozone formed when:
  - High pressure system to west
  - Snow cover for increased albedo
  - Strong inversion, low winds
  - Mixing heights 300-400m
  - Topographic isolation/recirculation of air mass
  - Sunny days
  - VOC and NOx sources/radicals
- Build-up over a number of days
- Flushes out with storm front

Uinta Basin Next Steps

- Rangely will has 3-years of "regulatory"
- Violating UT sites will not have 3-years of "regulatory" data until end of 2014
- Much of the land in UT is Tribal, so EPA has jurisdiction
- UT has jurisdiction over non-tribal lands
- UT is considering and implementing additional control measures
- Number of potential policy options available
- Preference is to coordinate as a whole basin, not piecemeal

Future Western Colorado Studies and Monitoring Plans

- Continue collaboration with Garfield County, including assistance on their emissions and dispersion study
- Ensure that appropriate risk assessment analyses are performed for both North Front Range and Garfield emissions and dispersion studies are performed
- Continue 3-State Study
  - 2011 and 2014 emissions inventories
  - Modeling for ozone
  - Monitoring – move Lay Peak site
- Work with Utah and EPA as needed on Uinta Basin

Questions?

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