Status of Garfield County's Air Quality Monitoring Program

September 28, 2005

Garfield County Fairgrounds

Garfield County

Agenda

- **Doug Dennison – Garfield County**
  - **Background**
  - **Sampling Locations and Analytical Parameters**
  - **Future Plans**
- **Chris Reed – Colorado Mtn. College**
  - **Sampling Methods and Frequencies**
  - **QA/QC**
  - **Data Reduction & Evaluation**
- **Jim Rada – Garfield County**
  - **PM10 Results**
  - **VOC Results**
  - **Risk Screening**
- **Questions**

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Meeting Objectives

- Inform public on the scope and limitations of GarCo's program
- Discuss future plans for the program
- Discuss the methodology being used to collect and analyze samples and evaluate the analytical results
- Provide a preliminary discussion of the analytical results for samples collected to date

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DISCLAIMER

The sample results presented tonight should be viewed as preliminary. In most cases, results from additional sampling events are needed to identify clear trends in the data. Further evaluation of these data in regard to health risk will be performed as part of the health risk assessment being undertaken by Garfield County.

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Program Background

- $10K grant received from CDPHE for planning and scoping
- Applied for energy impact grant funding – request was denied
- Garfield County Board of County Commissioners authorized funding for this program as part of the 2005 budget

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Program Background (cont.)

- **Funding to continue the program is included in 2006 budget request**
- **Installation of sampling equipment began in late March 2005 and sampling was initiated in late April – early May 2005**
- **Considerable support is being provided by CDPHE in the form of equipment and technical support**

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Sampling Locations

- **Seven (7) fixed monitoring locations have been established between Parachute & Glenwood Springs – An 8th location is planned near the Garfield/Mesa County line as soon as a suitable location is found**
  - **Particulates (PM10) and volatile organic compound (VOC) samples are collected at the fixed locations**

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Sampling Locations (cont.)

- Approximately 6 locations are also being sampled for VOCs only
  - These locations were selected based on either frequent complaints about odors or potential health concerns expressed by residents
- Grab samples are also being collected by GarCo staff in response to complaints
- Have trained several residents to collect grab samples for VOCs when strong odors are present

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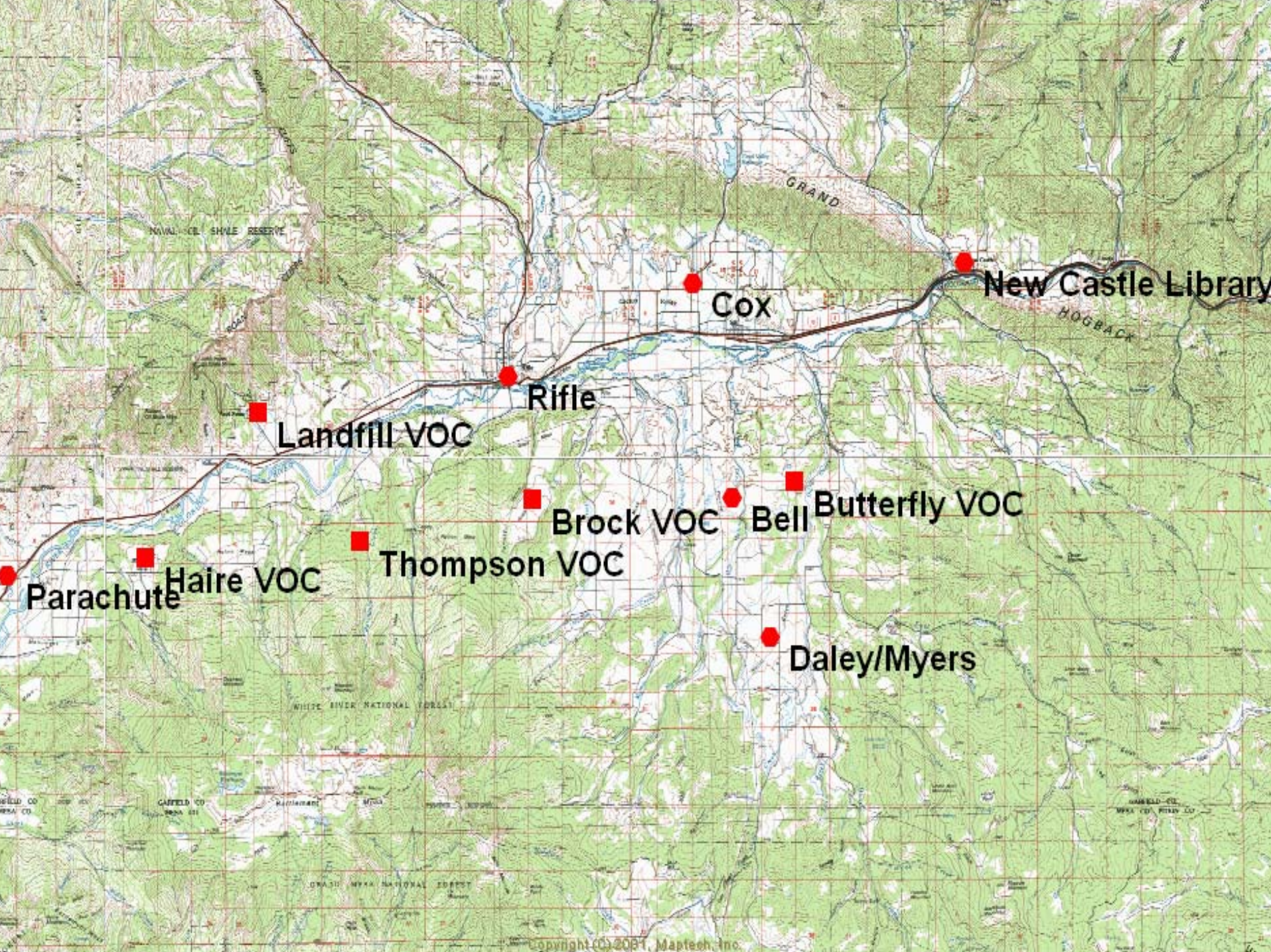
GRAND
NAVAL OIL SHALE RESERVE
New Castle Library
Cox
HOGBACK
Rifle
Landfill VOC
Butterfly VOC
Brock VOC
Bell
Thompson VOC
Haire VOC
Parachute
Daley/Myers
WHITE RIVER NATIONAL FOREST
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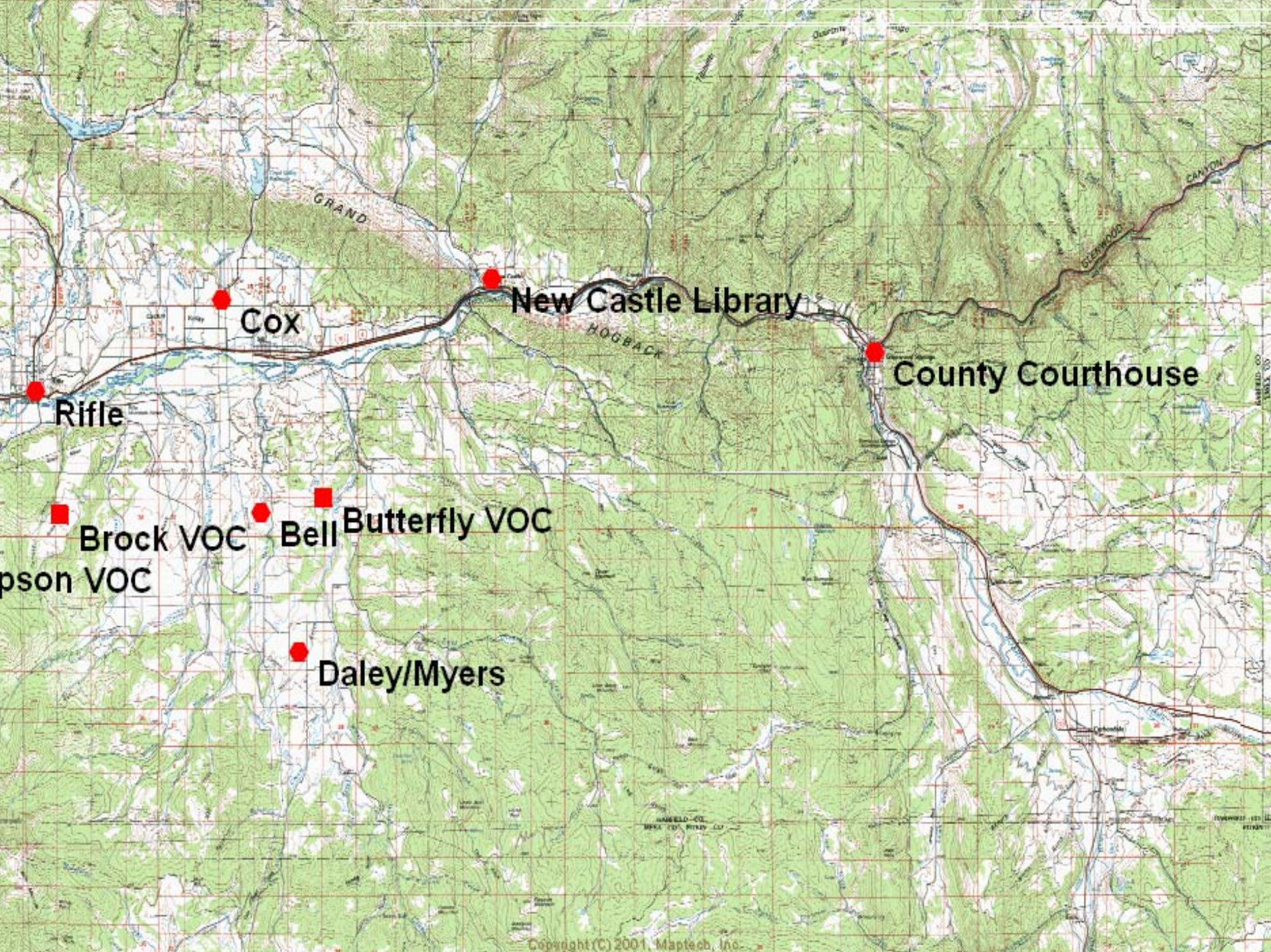
GRAND
HOGBACK
GLENWOOD
CANYON
New Castle Library
Cox
County Courthouse
Rifle
Brock VOC
Bell
Butterfly VOC
pson VOC
Daley/Myers
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Future Plans

- **Meteorological stations will be installed at 6-8 locations before the end of 2005**
  - **Stations will continuously record**
    - **Windspeed & direction**
    - **Temperature**
    - **Relative humidity**
    - **Barometric pressure**
- **Ozone monitoring with passive monitors will be initiated during the 2006 ozone season (app. May to Oct.)**

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Future Plans (cont.)

- **Quarterly update meetings will be initiated in early 2006**
- **Analytical results will be available on the County's website (www.garfield-county.com) by the end of the first quarter of 2006**

Garfield County

Who We Are

- **Natural Resource Management Institute (NRMI) CMC/Leadville**
- **Student Focused Environmental Science**
- **4 full time staff plus 5-10 students depending on field season**
- **Current clients include: EPA,BLM,USFS, CDOW, Cities of Aurora, Pueblo, Gar. CO.**
- **Air Quality Tech/Assistant Project Manager: Chris Reed *AAS Natural Resource Management, BS Molecular Biology***

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Air Quality Monitoring Methods

Particulate Monitoring

- Criteria is based on particles10 microns in diameter or smaller
- EPA current PM_{10} standards are 50 µg/m3 (monthly annual average) and 150 µg/m3 (24 hour maximum)

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Particulate Sampling Methods

1. Particulates are drawn into sampling unit
2. Particulates are deposited onto a pre weighed filter
3. Filters are sent to lab (IML/Air Science) for analysis
4. Data is sent to CPHE for statistical validation and analysis
5. Sampling is for a 24 hour period
6. Sampling is conducted every 3 days in conjunction with EPA schedule
7. Garfield County locations have 2 PM_{10} units per site
8. 7 PM_{10} sites are in operation within Garfield County
9. Annually, several filters will also be analyzed for chemical content in an attempt to identify the nature and source of the particulates

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Particulate Sampling Methods

Glenwood
Court House

Intake/impact area

Barometer

Motor

Flow Controller

Elapsed Time Meter

Volatile Organic Compounds (VOC's)

Definition From the Code of Federal Regulations :*Volatile organic compounds (VOC)* any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions

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Volatile Organic Compounds (VOC'S) Sampling Method

- Use EPA method T-015
- Samples are collected with Summa canisters
- Canisters are cleaned and certified by EPA authorized lab (Columbia Analytical)
- Samples are collected either once per month (24 hour period) or "grabbed" when odor complaint is made
- 8 monthly sites and 4 quarterly sites
- Samples are shipped back to lab and undergo analysis for 43 different VOC's

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VOC Collection

West Landfill

Garfield County

QA/QC

- Chains of custodies for VOC samples
- 10 % duplicate sample frequency
- Detailed field notes
- VOC Sample plan designed with CDPHE input
- Particulate data reduction/analysis performed by CDPHE
- PM_{10} units calibrated and maintained by CDPHE

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DISCLAIMER

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What is particulate matter?

- Mixture of solid particles and liquid droplets found in the air.

- Many sizes and shapes and can be made up of hundreds of different chemicals.

- PM10, which refers to particles less than or equal to 10 µm in diameter.

- Particles ranging in size from 2.5 to 10 µm can penetrate the upper regions of the body's respiratory defense mechanisms.

Source: http://www.epa.gov/airtrends/pmreport03/pmunderstand_2405.pdf#page=1

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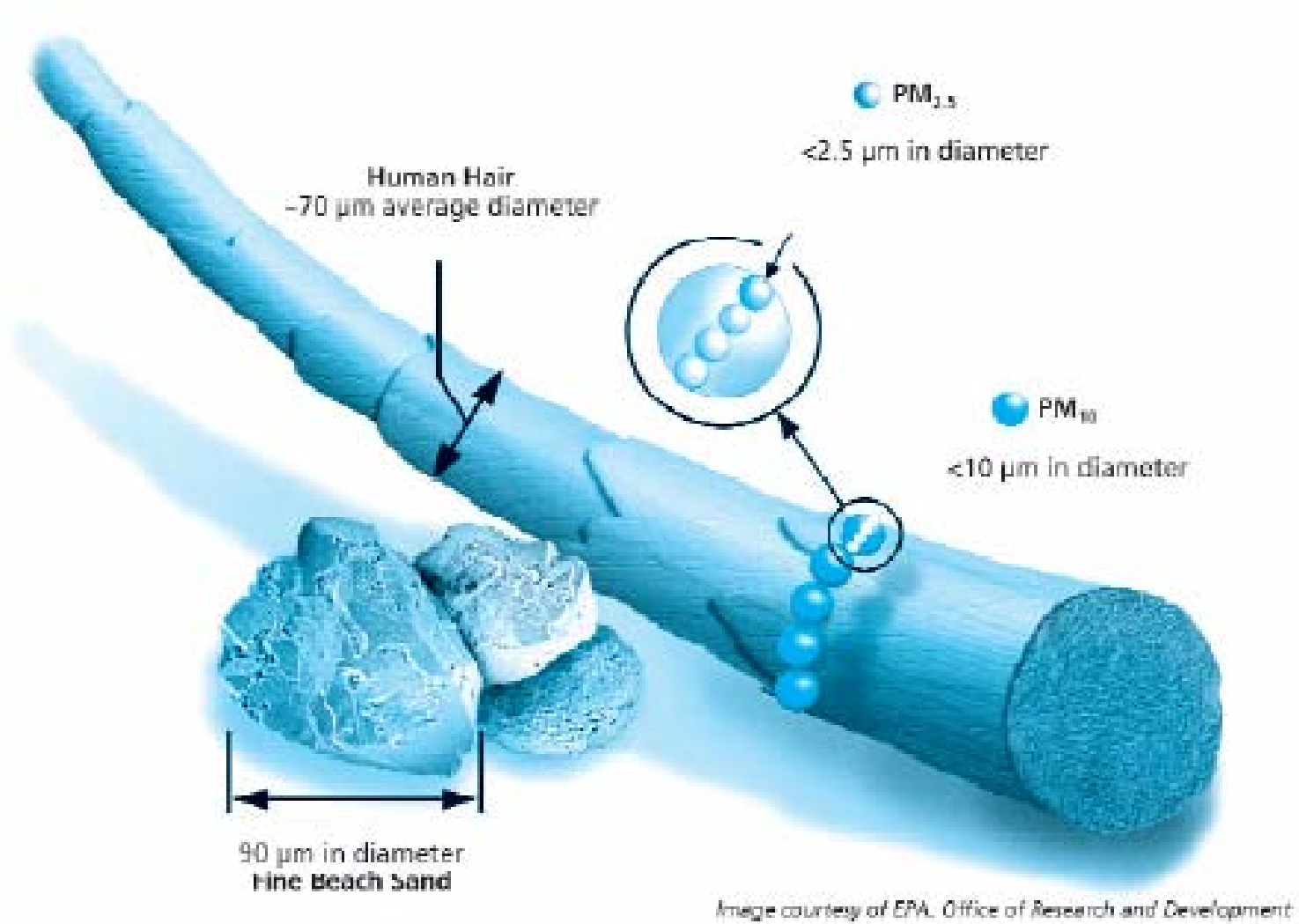
How Small?


PM2.5
<2.5 µm in diameter
Human Hair
~70 µm average diameter
PM10
<10 µm in diameter
90 µm in diameter
Fine Beach Sand
Image courtesy of EPA, Office of Research and Development

Health Effects

Long-term exposures to high particle levels –

- Decreased lung function
- Development of chronic bronchitis
- Premature death

Short-term exposures to particle pollution (hours or days) –

- Decreased lung function
- Increased respiratory symptoms
- Cardiac arrythmias (heartbeat irregularities)
- Heart attacks
- Hospital admissions or emergency room visits for heart or lung disease
- Premature death

Sensitive groups at greatest risk include people with heart or lung disease, older adults, and children.

Source: http://www.epa.gov/airtrends/pmreport03/pmunderstand_2405.pdf#page=1

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Environmental Effects

Major source of haze

Affects vegetation and ecosystems by settling on soil and water, upsetting delicate nutrient and chemical balances.

Causes soiling and erosion damage to structures, including culturally important objects such as monuments and statues.

Source: http://www.epa.gov/airtrends/pmreport03/pmunderstand_2405.pdf#page=1

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Garfield County --- 24-Hour PM10 (ug/m3)

May 2005 - August 2005

		Glenwood-Courthouse 109 8th St.		New Castle 402 W. Main St.		Silt-Bell 512 Owens Dr.		Silt-Daley 884 CR 327		Silt-Cox 5933 CR 233		Rifle-Henry 144 E. 3rd Ave.		Parachute 102 E. 2nd St.	
Year	Month	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
2005	5	14.1	26	18.6	29	10.1	13	9.0	16	19.0	19	23.1	33	17.9	33
	6	15.4	24	19.7	39	11.8	26	9.8	22	17.7	33	23.4	34	18.9	33
	7	19.0	25	25.0	34	17.3	20	16.9	26	26.3	62	29.3	39	29.0	40
	8	13.2	18	18.6	29	12.2	16	10.1	13	16.4	23	19.8	32	20.9	32
	9														
	10														
	11														
	12														

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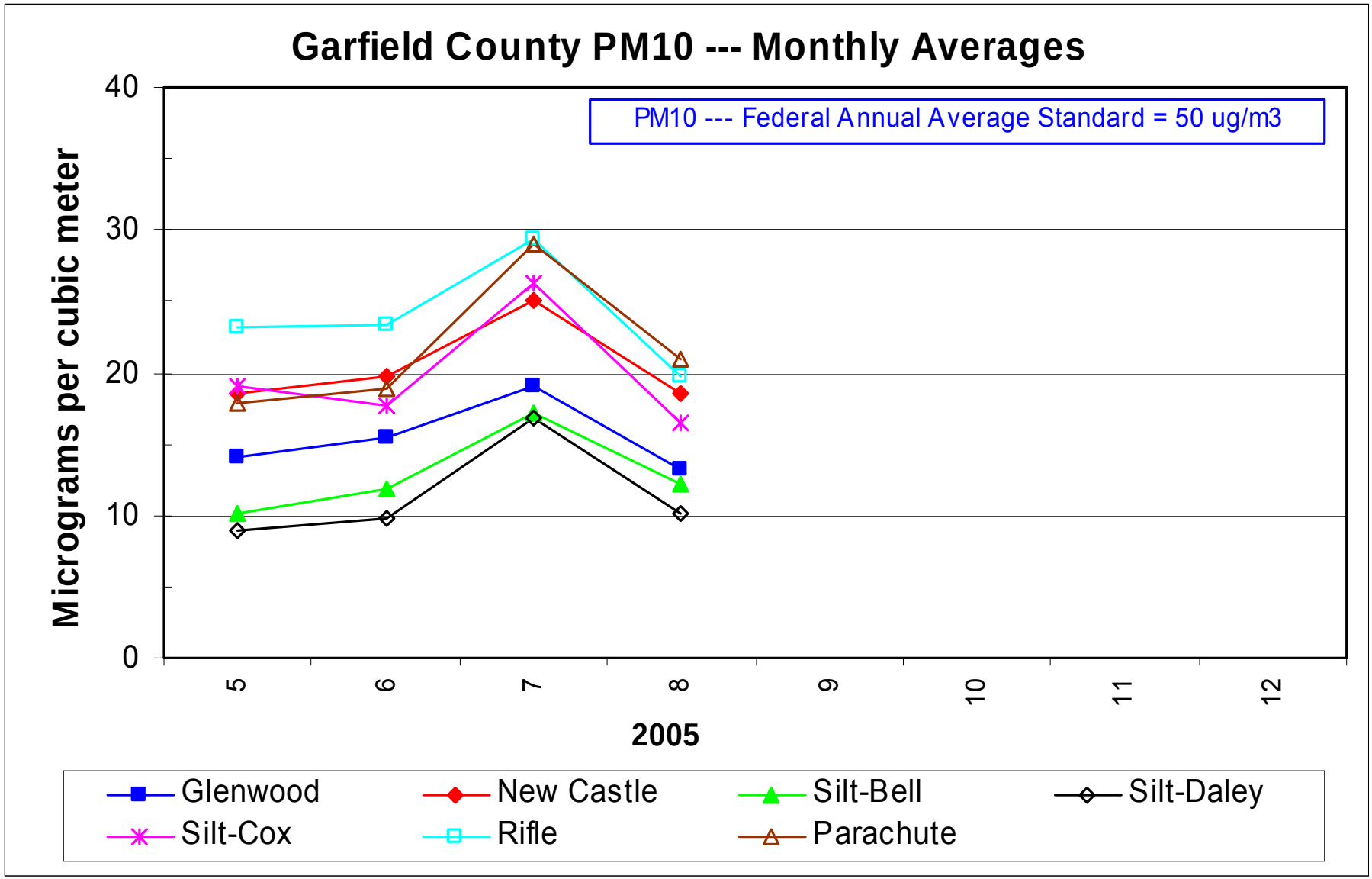

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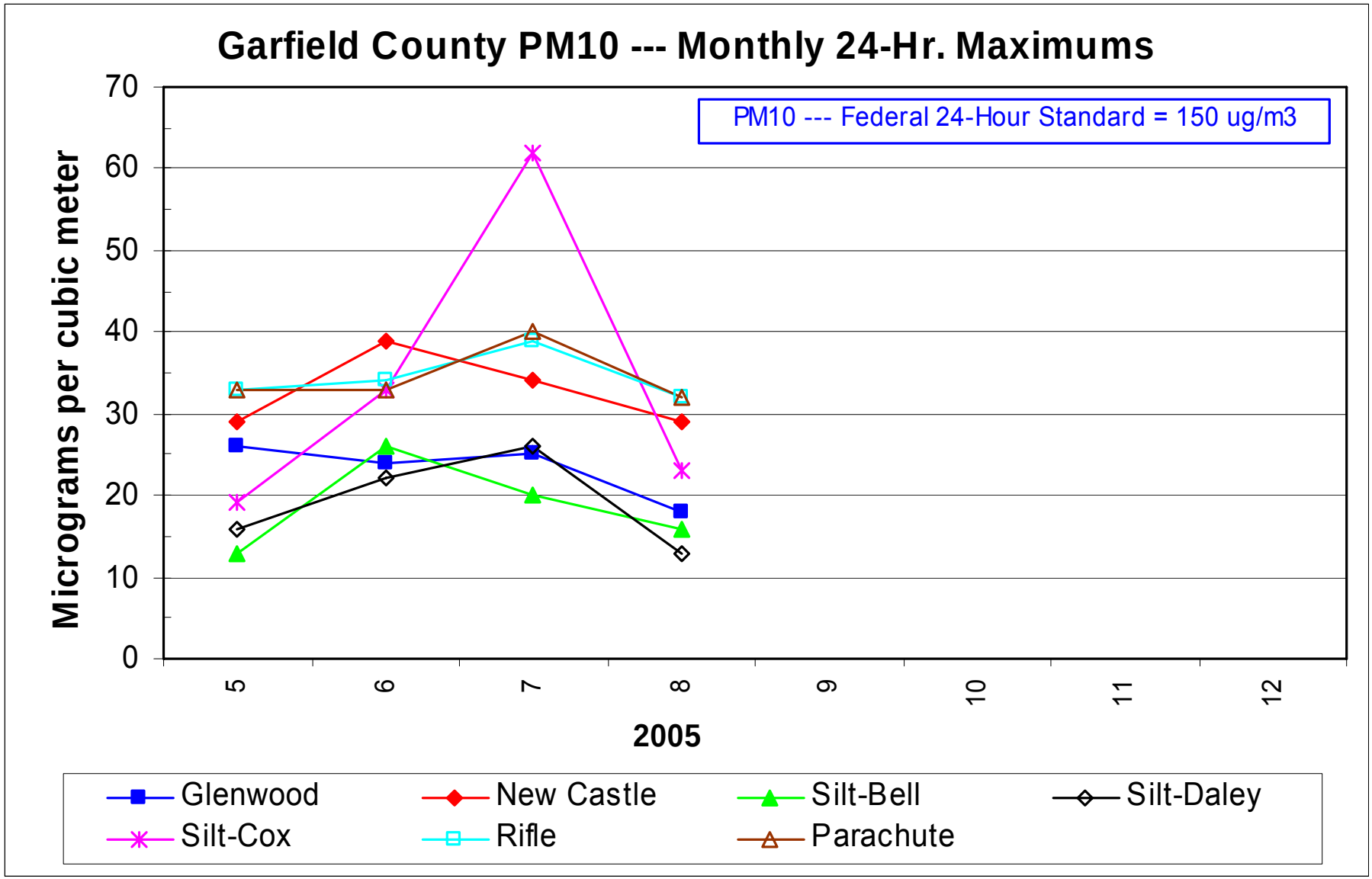

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What are Volatile Organic Compounds?

- Toxic air pollutants, aka hazardous air pollutants (HAPs)
- Volatile organic compounds (VOCs) include a large group of chemicals containing carbon and hydrogen atoms that can react quickly to form other chemicals in atmosphere.
- Can react with oxides of nitrogen in the presence of sunlight to form ozone and photochemical smog
- Can be toxic to humans, animals or vegetation.

http://www.casadata.org/pollutants/vol_compounds.asp

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Outdoor Sources of VOC's

vegetation,

automobile emissions,

gasoline marketing and storage tanks,

petroleum and chemical industries,

dry cleaning,

fireplaces,

natural gas combustion

aircraft.

http://www.casadata.org/pollutants/vol_compounds.asp

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Indoor VOC Sources

furniture deodorizers

copy machine toners

felt-tip markers and pens correction fluids

paint adhesives solvents

upholstery draperies

carpeting spray cans clothing

construction materials cleaning compounds,

http://www.casadata.org/pollutants/vol_compounds.asp

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Garfield County --- Volatile Organic Compounds

June 2005 - August 2005

List of 43 VOC's analyzed

CAS #	Compound
74-87-3	Chloromethane
75-01-4	Vinyl Chloride
74-83-9	Bromomethane
75-00-3	Chloroethane
67-64-1	Acetone
75-69-4	Trichlorofluoromethane
75-35-4	1,1-Dichloroethene
75-09-2	Methylene chloride
76-13-1	Trichlorotrifluoroethane
75-15-0	Carbon Disulfide
156-60-5	trans-1,2-Dichloroethene
75-34-3	1,1-Dichloroethane
1634-04-4	Methyl tert-Butyl Ether
108-05-4	Vinyl Acetate
78-93-3	2-Butanone (MEK)
156-59-2	cis-1,2-Dichloroethene
67-66-3	Chloroform
107-06-2	1,2-Dichloroethane
71-55-6	1,1,1-Trichloroethane
71-43-2	Benzene
56-23-5	Carbon Tetrachloride
78-87-5	1,2-Dichloropropane

CAS #	Compound
75-27-4	Bromodichloromethane
79-01-6	Trichloroethene
10061-01-5	cis-1,3-Dichloropropene
108-10-1	4-Methyl-2-pentanone
10061-02-6	trans-1,3-Dichloropropene
79-00-5	1,1,2-Trichloroethane
108-88-3	Toluene
591-78-6	2-Hexanone
124-48-1	Dibromochloromethane
106-93-4	1,2-Dibromoethane
127-18-4	Tetrachloroethene
108-90-7	Chlorobenzene
100-41-4	Ethylbenzene
136777-61-2	*m,p* -Xylenes
75-25-2	Bromoform
100-42-5	Styrene
95-47-6	o-Xylene
79-34-5	1,1,2,2-Tetrachloroethane
541-73-1	1,3-Dichlorobenzene
106-46-7	1,4-Dichlorobenzene
95-50-1	1,2-Dichlorobenzene

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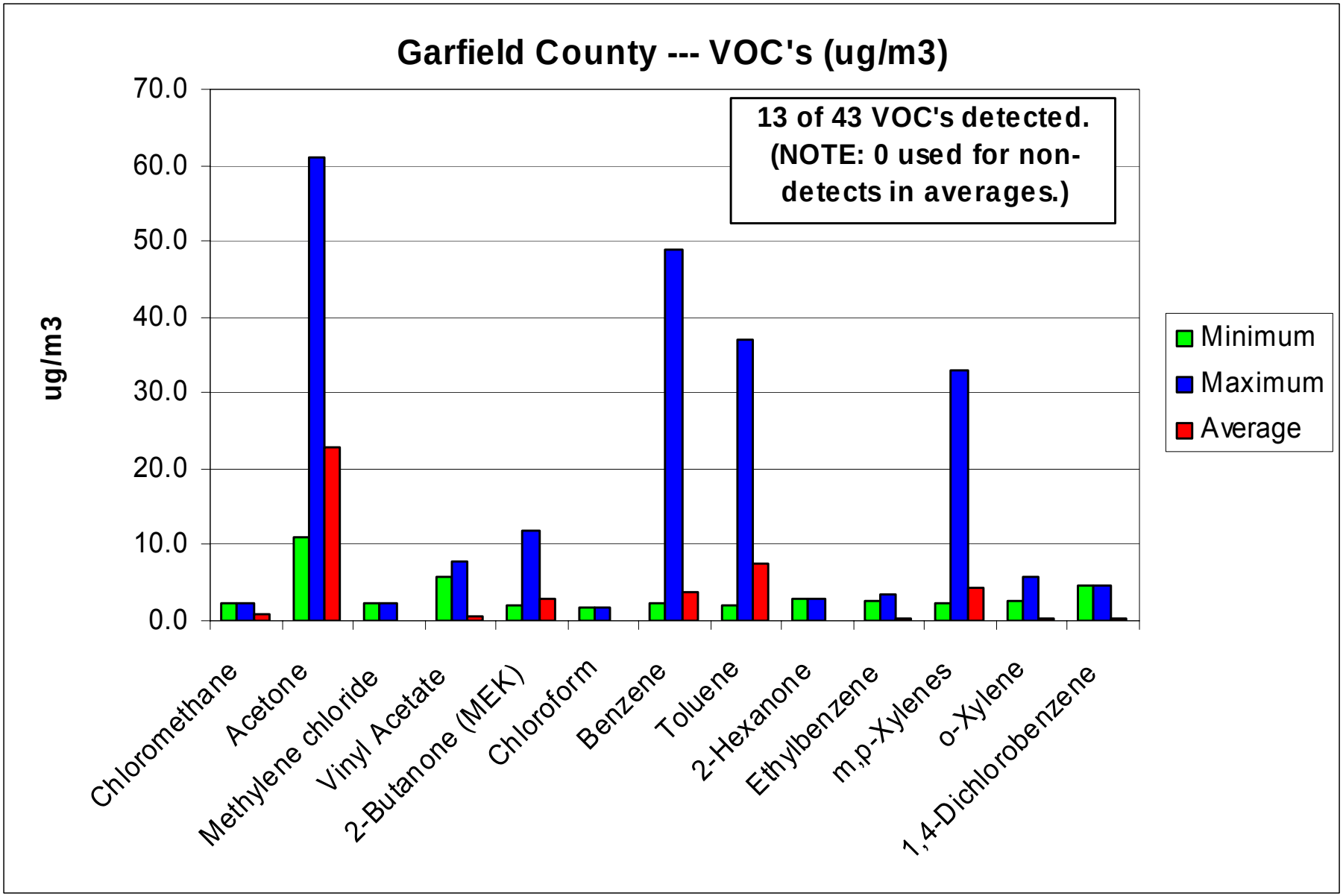
Garfield County --- Volatile Organic Compounds

June 2005 - August 2005

13 different VOC's detected in 23 samples (21 = 24-hour, 2 = grab)

CAS #	Compound	Min	Max	Avg	Min	Max	Avg	#	%
			µg/m³			ppb		detected	detected
74-87-3	Chloromethane	2.2	2.2	1.0	1.10	1.10	0.05	1	4.3%
67-64-1	Acetone	11.0	61.0	22.9	4.50	26.00	9.63	20	87.0%
75-09-2	Methylene chloride	2.3	2.3	0.1	0.65	0.65	0.03	1	4.3%
108-05-4	Vinyl Acetate	5.9	7.9	0.6	1.70	2.30	0.17	2	8.7%
78-93-3	2-Butanone (MEK)	1.9	12.0	2.9	0.65	4.20	0.99	19	82.6%
67-66-3	Chloroform	1.6	1.6	0.1	0.32	0.32	0.01	1	4.3%
71-43-2	Benzene	2.2	49.0	3.7	0.70	15.00	1.14	8	34.8%
108-88-3	Toluene	2.1	37.0	7.4	0.56	9.80	1.96	18	78.3%
591-78-6	2-Hexanone	3.0	3.0	0.1	0.73	0.73	0.03	1	4.3%
100-41-4	Ethylbenzene	2.7	3.4	0.3	0.62	0.79	0.06	2	8.7%
136777-61-2	*m,p* -Xylenes	2.4	33.0	4.3	0.55	7.70	0.99	12	52.2%
95-47-6	o-Xylene	2.7	5.9	0.4	0.63	1.40	0.09	2	8.7%
106-46-7	1,4-Dichlorobenzene	4.6	4.6	0.2	0.76	0.76	0.03	1	4.3%

NOTE: 0 used for non-detects on averages.



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WHAT IS RISK?

- Risk is the chance or probability that an event will occur
- Risk = Hazard x Exposure
- Hazard is “How toxic is it?”
- Exposure is “How likely is it to happen?”

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4-Step Process

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Step 1 - Data Collection & Evaluation

- Determine which chemicals are being released
- Determine how much of a chemical is present
- Determine where a chemical is present

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Step 2 - Exposure Assessment

Exposure assessment answers three key questions:

- How are people exposed?
- Who could be exposed?
- How much of the chemicals are people exposed to?

People must come in contact with chemicals to be at risk

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Step 3 - Toxicity Assessment

Toxicology is the study of adverse effects of chemicals in living organisms

This step of the risk assessment process considers:

1) the types of adverse health effects associated with particular chemical exposures;
2) the relationship between magnitude of exposure and adverse effects

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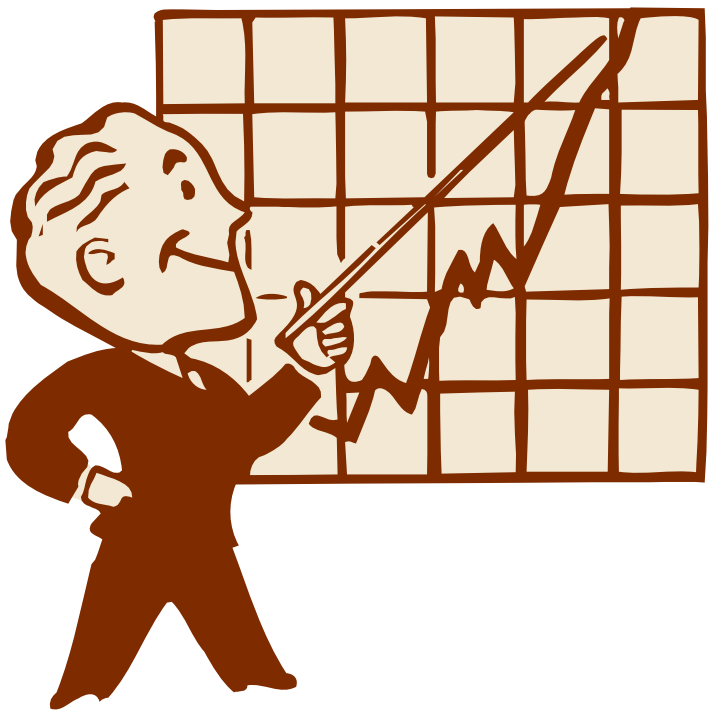
Step 4 - Risk Characterization



The risk characterization summarizes and combines outputs of the exposure and toxicity assessments to characterize risk.

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How are Risks Quantified for Carcinogens?

for carcinogens, the increased probability of individuals' getting cancer from a particular exposure

For a single contaminant:

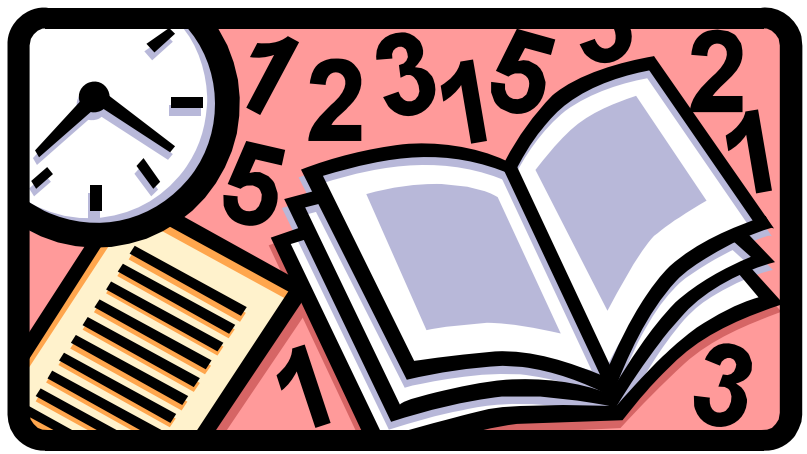
$$\text{Risk} = \text{Conc}_{\text{Air}} \times \text{UR}_{\text{Air}}$$

Where:

Risk = Risk from chemical

Conc_{Air} = Concentration in Air

UR_{Air} = Air Unit Risk Factor



How do we express cancer risk?

1/10	0.1	10^{-1}	1E-01
1/100	0.01	10^{-2}	1E-02
1/1,000	0.001	10^{-3}	1E-03
1/10,000	0.0001	10^{-4}	1E-04
1/100,000	0.00001	10^{-5}	1E-05
1/1,000,000	0.000001	10^{-6}	1E-06

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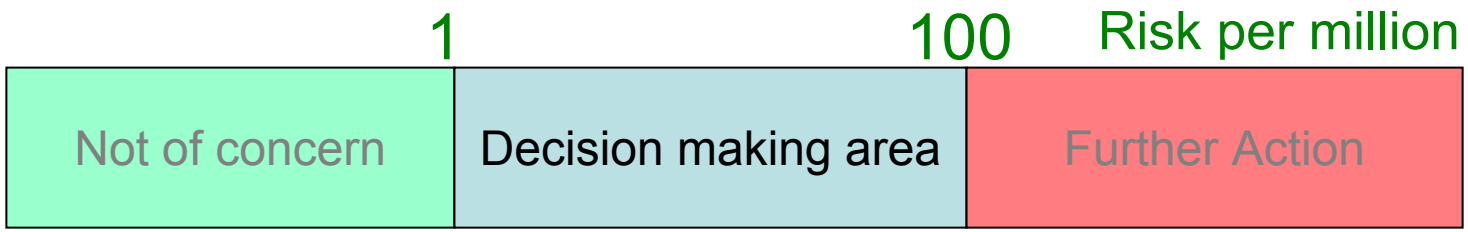
The level of cancer risk that is of concern is a matter of individual, community and regulatory judgment. However,……..

Risks below 1 in a million (1E-06) are typically considered to be well below a level of concern

Risks above 100 per million (1E-04) are typically deemed large enough that some sort of action or intervention is evaluated.



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How are Risks Quantified for Noncarcinogens?

a comparison of an exposure concentration to a concentration that is assumed to be insignificant

Calculate HQ as:

$$HQ = \frac{Conc_{Air}}{RfC}$$

Where:

HQ = Hazard quotient from chemical

$Conc_{Air}$ = Concentration of chemical in air

RfC = Reference Concentration for chemical

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If the HQ is equal to or less than a value of 1, it is believed that there is no appreciable risk that noncancer effects will occur.

If an HQ exceeds 1, there is some possibility that noncancer effects may occur, although an HQ above 1 does not indicate that an effect will definitely occur.

Values are expressed to one significant figure

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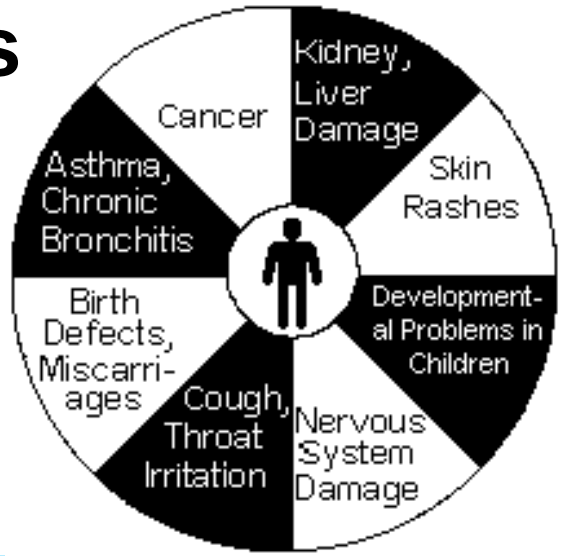
Hazard Indices

- **Hazard Index (HI) = The sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways.**
- **Segregation of Hazard Indices**



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Garfield County --- Volatile Organic Compounds

June 2005 - August 2005

13 different VOC's detected in 23 samples (21 = 24-hour, 2 = grab)

CAS #	Compound	Min	Max	Avg	Min	Max	Avg	#	%
			µg/m³			ppb		detected	detected
74-87-3	Chloromethane	2.2	2.2	1.0	1.10	1.10	0.05	1	4.3%
67-64-1	Acetone	11.0	61.0	22.9	4.50	26.00	9.63	20	87.0%
75-09-2	Methylene chloride	2.3	2.3	0.1	0.65	0.65	0.03	1	4.3%
108-05-4	Vinyl Acetate	5.9	7.9	0.6	1.70	2.30	0.17	2	8.7%
78-93-3	2-Butanone (MEK)	1.9	12.0	2.9	0.65	4.20	0.99	19	82.6%
67-66-3	Chloroform	1.6	1.6	0.1	0.32	0.32	0.01	1	4.3%
71-43-2	Benzene	2.2	49.0	3.7	0.70	15.00	1.14	8	34.8%
108-88-3	Toluene	2.1	37.0	7.4	0.56	9.80	1.96	18	78.3%
591-78-6	2-Hexanone	3.0	3.0	0.1	0.73	0.73	0.03	1	4.3%
100-41-4	Ethylbenzene	2.7	3.4	0.3	0.62	0.79	0.06	2	8.7%
136777-61-2	*m,p* -Xylenes	2.4	33.0	4.3	0.55	7.70	0.99	12	52.2%
95-47-6	o-Xylene	2.7	5.9	0.4	0.63	1.40	0.09	2	8.7%
106-46-7	1,4-Dichlorobenzene	4.6	4.6	0.2	0.76	0.76	0.03	1	4.3%

NOTE: 0 used for non-detects on averages.

Garfield County --- Volatile Organic Compounds

June 2005 - August 2005

Chronic Risk Screening (using average values)

CAS #	Compound	Chronic Inhalation Risk Factor		Average µg/m³	Non-cancer Hazard Index	Cancer Risk (per million)
		Non-cancer µg/m³	Cancer 1/(µg/m³)			
74-87-3	Chloromethane	90	---	1.0	0.01	---
67-64-1	Acetone	---	---	22.9	---	---
75-09-2	Methylene chloride	1000	4.7E-07	0.1	0.00	0.05
108-05-4	Vinyl Acetate	200	---	0.6	0.00	---
78-93-3	2-Butanone (MEK)	5000	---	2.9	0.00	---
67-66-3	Chloroform	98	---	0.1	0.00	---
71-43-2	Benzene	30	7.8E-06	3.7	0.12	29.00
108-88-3	Toluene	400	---	7.4	0.02	---
591-78-6	2-Hexanone	---	---	0.1	---	---
100-41-4	Ethylbenzene	1000	---	0.3	0.00	---
136777-61-2	*m,p* -Xylenes	100	---	4.3	0.04	---
95-47-6	o-Xylene	---	---	0.4	---	---
106-46-7	1,4-Dichlorobenzene	800	1.1E-05	0.2	0.00	2.20
				TOTAL:	0.20	31.24

Garfield County --- Volatile Organic Compounds

June 2005 - August 2005

13 different VOC's detected in 23 samples (21 = 24-hour, 2 = grab)

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75-09-2	Methylene chloride	2.3	2.3	0.1	0.65	0.65	0.03	1	4.3%
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NOTE: 0 used for non-detects on averages.

Garfield County --- Volatile Organic Compounds

June 2005 - August 2005

Acute Risk Screening (using maximum values)

CAS #	Compound	Acute Risk Factor mg/m³	Maximum µg/m³	Acute Hazard Index
74-87-3	Chloromethane	410	2.2	0.0000
67-64-1	Acetone	---	61.0	---
75-09-2	Methylene chloride	800	2.3	0.0000
108-05-4	Vinyl Acetate	---	7.9	---
78-93-3	2-Butanone (MEK)	---	12.0	---
67-66-3	Chloroform	240	1.6	0.0000
71-43-2	Benzene	160	49.0	0.0003
108-88-3	Toluene	190	37.0	0.0002
591-78-6	2-Hexanone	---	3.0	---
100-41-4	Ethylbenzene	350	3.4	0.0000
136777-61-2	*m,p* -Xylenes	390	33.0	0.0001
95-47-6	o-Xylene	390	5.9	0.0000
106-46-7	1,4-Dichlorobenzene	90	4.6	0.0001
			TOTAL:	0.0007

Garfield County

Questions???

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