GARFIELD COUNTY
QUARTERLY MONITORING REPORT

FIRST QUARTER
JANUARY 1 THROUGH MARCH 31, 2009

Prepared for:

Garfield County Public Health Department
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1.0 INTRODUCTION

This air quality data summary report has been prepared by Air Resource Specialists, Inc. (ARS) for the Garfield County Public Health Department (GCPHD). This report summarizes data collected from January 1, 2009 through March 31, 2009 at the Garfield County monitoring sites, including metrological characteristics, criteria pollutant levels, and levels of volatile organic compounds (VOCs). Any questions regarding the contents of this report should be addressed to:

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1.1 BACKGROUND

Oil and gas exploration and production within the Piceance Basin in Colorado, and elsewhere in the Rocky Mountain region, has undergone rapid growth over the last decade. In response to this growth, concerns have grown regarding air quality impacts of oil and gas development in Garfield County. The Garfield County Public Health Department (GCPHD) is committed to protecting the health and welfare of its citizens. In 2005, the GCPHD enhanced air quality monitoring efforts to evaluate levels of particulate matter $\leq$ 10 microns (PM_{10}) and VOCs in the area. In 2008, the monitoring network was modified to encompass speciated non-methane organic compounds (SNMOCs) and carbonyl compounds and the regulatory monitoring network expanded from PM_{10} to include particulate matter $\leq$ 2.5 microns ($PM_{2.5}$) and ozone (O_3). These changes were designed to serve a wide range of purposes, including monitoring of criteria pollutant levels, ozone formation potential, toxics assessments, and source attribution.

The current monitoring network in Garfield County consists of four (4) stations, which includes one (1) mobile site that was relocated in January 2009 (total of five (5) locations). Characteristics of the monitoring sites are described below.

- Parachute (PACO): Parachute is a small urban center of approximately 1,300 people within very close proximity to oil and development activities. The town is located along Interstate 70 and is the transportation hub for heavily traveled roads which service the surrounding canyons.
- Rifle (RICO): Rifle is a rapidly growing urban center on the Interstate 70 corridor with estimated population of about 9,200 people. Rifle is in close proximity to oil and gas development activities, and is also central to industrial support for the oil and gas industry.
- Bell-Melton (BRCO): The Bell-Melton site is a rural homestead approximately four (4) miles south of the town of Silt, in close proximity to moderate oil and gas development activities.

- Brock (MOCO): The Brock site is a rural location about four (4) miles south of Rifle, amid oil and development activities. This site was relocated to Rulison location in January 2009.
- Rulison (RUCO): Rulison is a rural community located about 9 miles southeast of Parachute and 5 miles west of Rifle along Interstate 70. This site began operation in late January 2009.

Figure 1-1 is a map of the monitoring sites in Garfield County and Table 1-1 lists the parameters monitored. The Colorado Department of Public Health and Environment (CDPHE) operate PM_{10} monitors in Rifle and Parachute. SNMOC and carbonyl compounds are sampled at all sites and analyzed by the Eastern Research Group, Inc. (ERG). The GCPHD monitors meteorology at all sites with the exception of Rifle, Colorado. Air Resource Specialists, Inc. (ARS) monitors, collects and validates continuous PM_{10} and $PM_{2.5}$, O_3, and meteorology at the Rifle site. ARS also operates a digital Web camera at the Rifle site. Camera images are collected every 15-minutes and displayed on the Garfield County Air Quality Monitoring Web site (http://www.garfieldcountyaq.net), along with associated data.

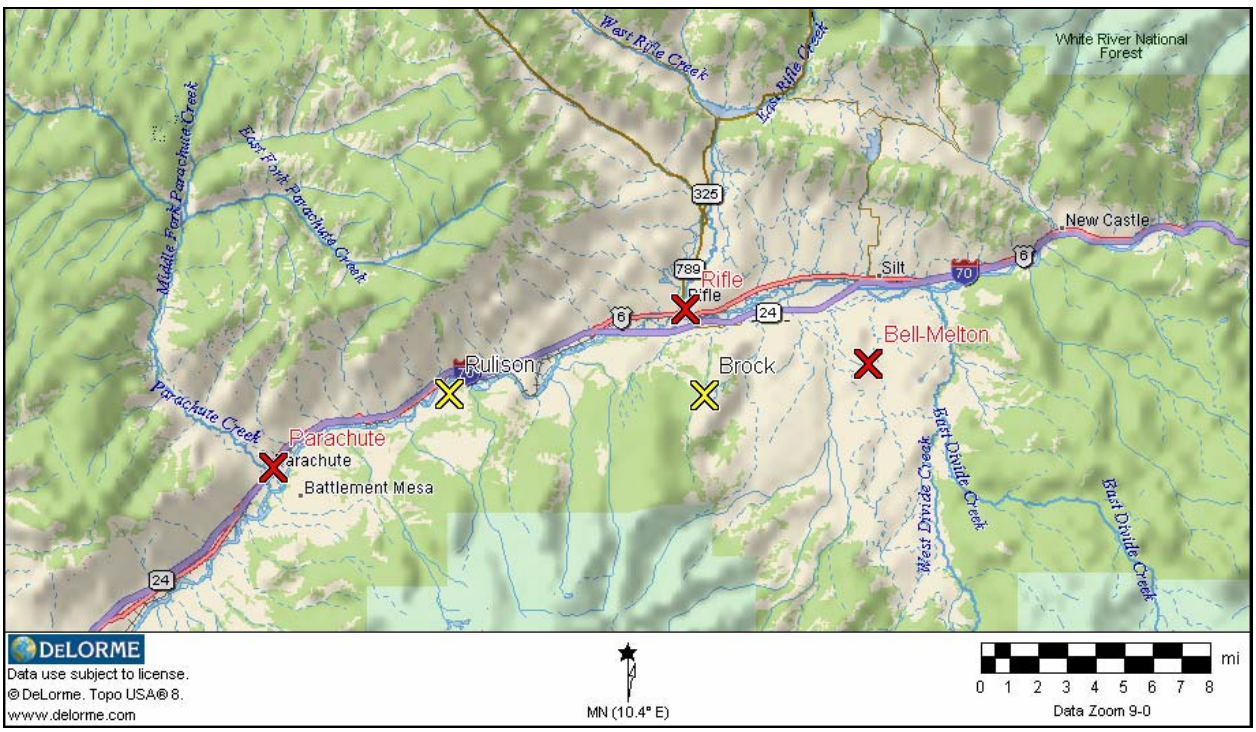


Figure 1-1. Map of Garfield County Monitoring Sites. Yellow sites indicate locations of the mobile station which was relocated from the Brock location to the Rulison location in January, 2009.

Table 1-1

Garfield County
Parameters Monitored by Site

Component	Method	Sampling Frequency	Reporting Agency
Rifle, Colorado			
SNMOC	TO-12	24-hour (1/6 day)	ERG
Carbonyls	TO-11A	24-hour (1/12 day)	ERG
PM_{10}	FRM	24-hour (1/3 day)	CDPHE
PM_{10}	TEOM	Hourly	ARS
$PM_{2.5}$	TEOM	Hourly	ARS
Ozone	42C	Hourly	ARS
Meteorology	Various	Hourly	ARS
Visibility Web Camera	Digital	15-min	ARS
Parachute, Colorado			
SNMOC	TO-12	24-hour (1/6 day)	ERG
Carbonyls	TO-11A	24-hour (1/12 day)	ERG
PM_{10}	FRM	24-hour (1/3 day)	CDPHE
Meteorology	Various	Hourly	GCPHD
Bell-Melton, Colorado			
SNMOC	TO-12	24-hour (1/6 day)	ERG
Carbonyls	TO-11A	24-hour (1/12 day)	ERG
Meteorology	Various	Hourly	GCPHD
Brock, Colorado (1/14/2008-2/18/2009)			
SNMOC	TO-12	24-hour (1/6 day)	ERG
Carbonyls	TO-11A	24-hour (1/12 day)	ERG
Meteorology	Various	Hourly	GCPHD
Rulison, Colorado (1/22/2009-current)			
SNMOC	TO-12	24-hour (1/6 day)	ERG
Carbonyls	TO-11A	24-hour (1/12 day)	ERG
Meteorology	Various	Hourly	GCPHD

2.0 METEOROLOGICAL SUMMARIES

Meteorological data collected along with air quality parameters are used to better understand the local conditions and transport of air pollutants. Meteorological data collected at these sites includes wind speed, wind direction, temperature, relative humidity, and precipitation. Time series plots for all parameters collected between January 1, 2009 and March 31, 2009 are presented in Appendix A.

Figures 2-1 through 2-5 present quarterly wind roses for the monitoring sites. A wind rose shows the frequency of wind direction and uses different shading to represent wind speeds. Generally, wind directions at the Parachute and Rifle sites were scattered with a high percentage of calm winds (27.22 and 22.51%, respectively). Winds from the southeast were most prevalent at the Bell-Melton site, and winds from the northeast and southwest were most prevalent at the Rulison site.

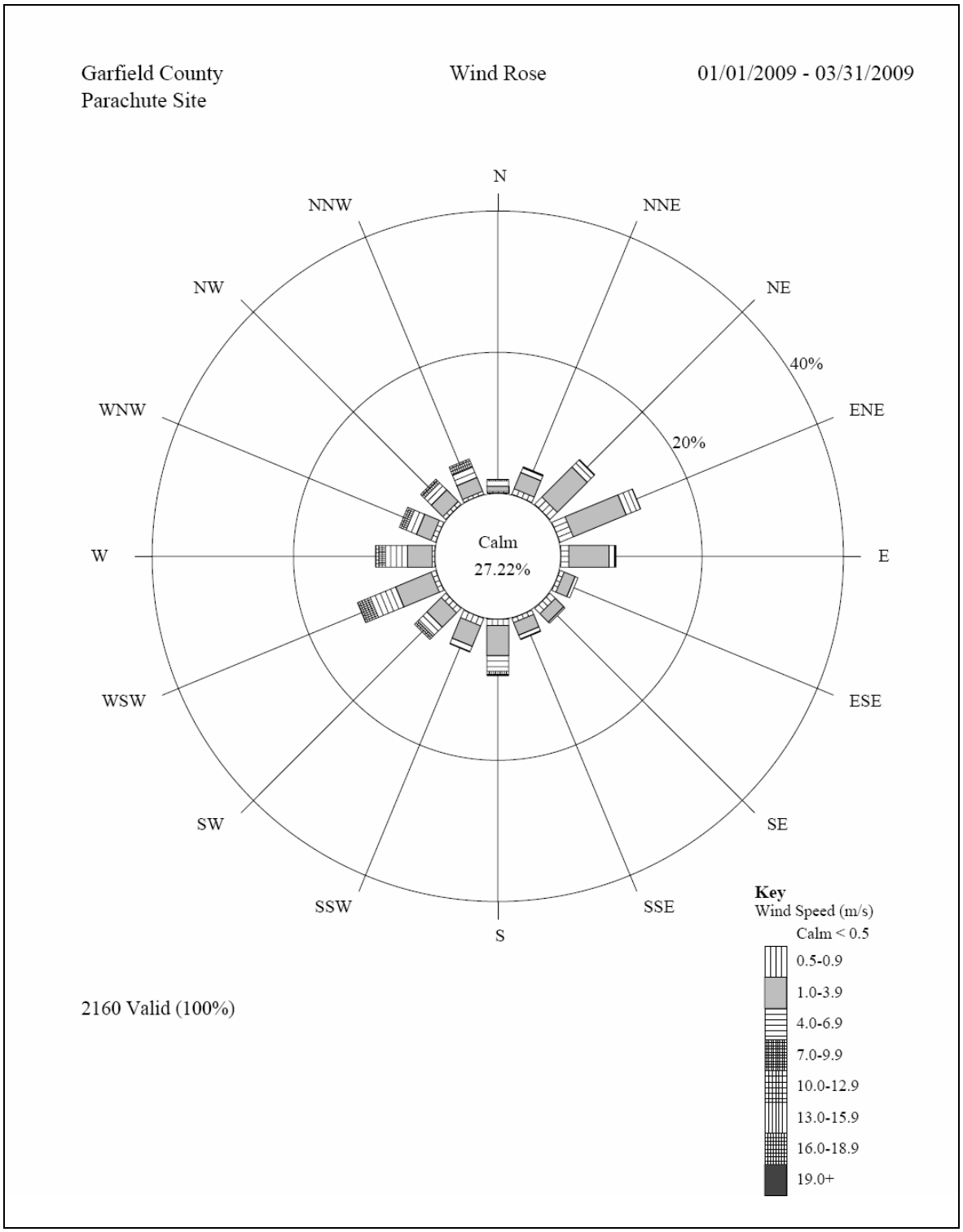


Figure 2-1. Quarterly Wind Rose for the Parachute Monitoring Site.

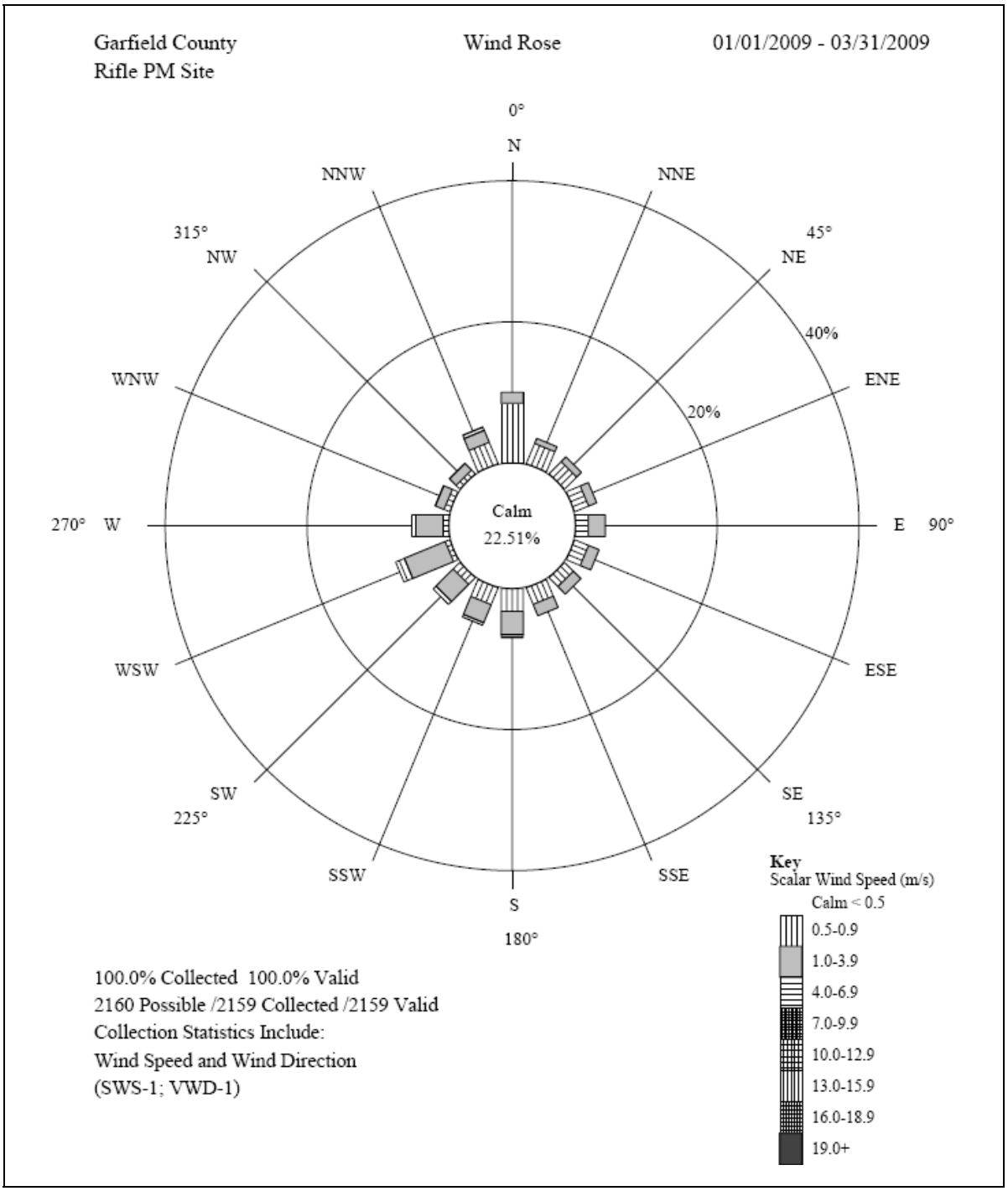


Figure 2-2. Quarterly Wind Rose for the Rifle Monitoring Site.

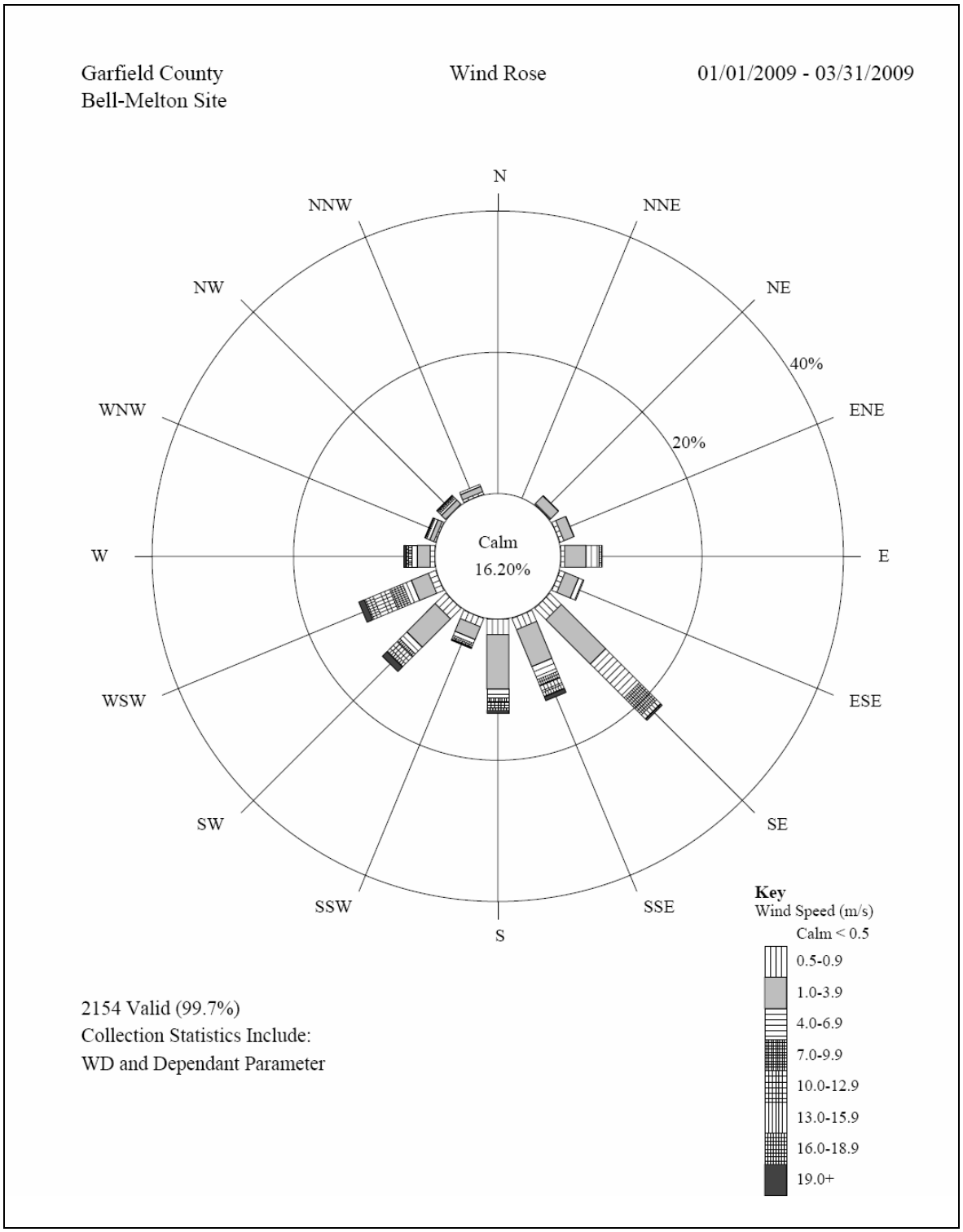


Figure 2-3. Quarterly Wind Rose for the Bell-Melton Monitoring Site.

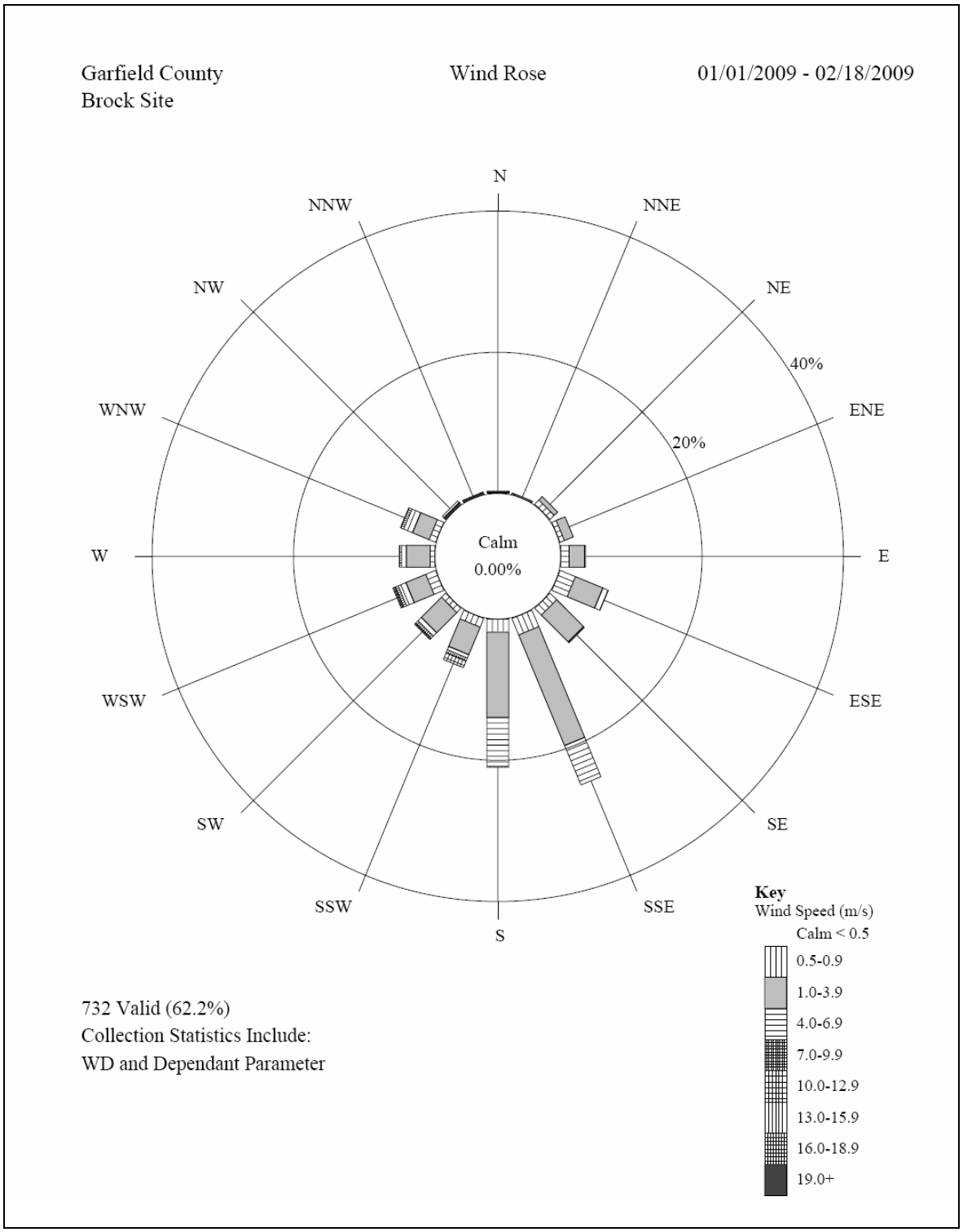


Figure 2-4. Quarterly Wind Rose for the Brock Monitoring Site.

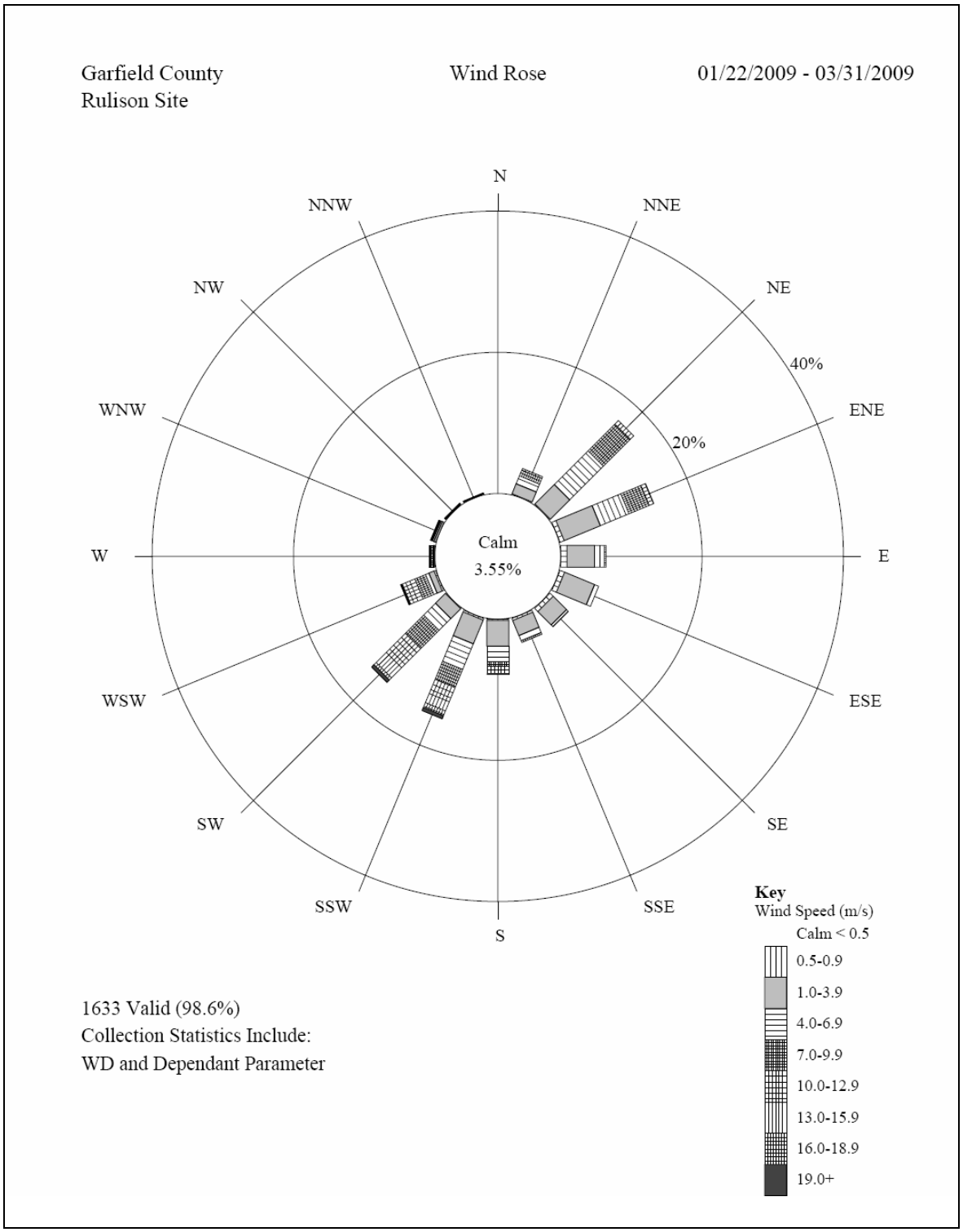


Figure 2-5. Quarterly Wind Rose for the Rulison Monitoring Site.

3.0 CRITERIA POLLUTANT SUMMARIES

The Clean Air Act requires the Environmental Protection Agency (EPA) to set two (2) types of National Ambient Air Quality Standards (NAAQS) for ground-level O_3, particle pollution ($PM_{2.5}$ and PM_{10}), lead, nitrogen dioxide (NO_2), carbon monoxide (CO), and sulfur dioxide (SO_2). The types of standards are as follows:

- Primary Standards: These standards are designed to protect public health with an adequate margin of safety, including the health of sensitive populations such as asthmatics, children, and the elderly.

- Secondary Standards: These standards are designed to protect public welfare from adverse effects, including visibility impairment and effects on the environment (e.g., vegetation, soils, water, and wildlife).

PM_{10} is monitored using filter-based Federal Reference Method (FRM) samplers at the Parachute and Rifle sites. Continuous $PM_{2.5}$ and PM_{10} are also monitored at the Rifle site. The level of the national primary and secondary ambient air quality standards for PM_{10} is a 24-hour average concentration of 150 micrograms per cubic meter ($\mu g/m^3$). A violation of the standard occurs when the number of days with a 24-hour average concentration above 150 $\mu g/m^3$ over a three (3) year period is equal to or less than one. The standards for $PM_{2.5}$ are an annual arithmetic mean of 15 $\mu g/m^3$, and a 24-hour average of 35 $\mu g/m^3$. A violation of the $PM_{2.5}$ standard occurs when the three (3) year average of the weighted annual mean exceeds that annual standard, or the three (3) year average of the 98th percentile 24-hour average value exceeds the 24-hour standard.

Continuous O_3 is monitored at the Rifle site. The NAAQS for O_3 is 0.075 ppm (75 ppb) over an 8-hour period. An exceedance of the standard occurs when an 8-hour average O_3 concentration is greater than or equal to 76 ppb. A violation of the standard occurs when the three (3) year average of the fourth highest daily maximum 8-hour average ozone concentration equals or exceeds 76 ppb.

Values measured for O_3, $PM_{2.5}$, and PM_{10} measured year to date in 2009 at the Rifle site are presented with corresponding NAAQS in Table 3-1. PM_{10} measured at the Parachute site is presented in Table 3-2. At present, air quality measurements in Garfield County do not violate air quality standards for these criteria pollutants.

Table 3-1

Rifle Site
Standards Summary
January 1, 2009 – March 31, 2009

Parameter	NAAQS		Measured	
	Averaging Time	Standard	Measured Value	Date(s)
Ozone (O_3)	Rolling 8-hour	0.075 ppm/ 75 ppb	Highest Daily Max.: 62 ppb	3/29
			4th Highest Daily Max.: 57 ppb	3/8
Particulate Matter ≤2.5µm ($PM_{2.5}$)	Annual	15 µg/m^3	Arithmetic Mean: 13.9 µg/m^3	1/1-3/31
	24-hour	35 µg/m^3	Highest Max: 40.7 µg/m^3	1/2
			98th percentile: 40.3 µg/m^3	1/1
Particulate Matter ≤10µm (PM_{10})	24-hour	150 µg/m^3	Highest Daily Max.: 83 µg/m^3	3/29
			2nd Highest Daily Max.: 59 µg/m^3	2/3

Table 3-2

Parachute Site
Standards Summary
January 1, 2009 – March 31, 2009

Parameter	NAAQS		Measured	
	Averaging Time	Standard	Measured Value	Date(s)
Particulate Matter ≤10µm (PM_{10})	24-hour	150 µg/m^3	Highest Daily Max.: 88 µg/m^3	3/29
			2nd Highest Daily Max.: 71 µg/m^3	2/6

3.1 OZONE

Ozone is measured at the Rifle site. Figure 3-1 presents daily maximum 8-hour averages of ozone measured year to date in 2009 along with the NAAQS. Table 3-3 presents the highest daily maximum 8-hour O_3 measurements to date in 2009.

Figure 3-2 presents a quarterly O_3 pollutant rose for the Rifle site. A pollutant rose shows the frequency of wind direction and uses different shading to represent O_3 values. While the pollutant rose indicates that predominant winds were out of the north, the site measured the highest concentrations of O_3 when winds were out of the west-southwest.

Figure 3-3 presents the quarterly diurnal cycle of measured hourly O_3 at the Rifle station. The cycle shows lowest concentrations in the early morning hours and maximum concentrations in the late afternoon. This pattern results from daytime photochemical production from oxides of nitrogen (NO_X) ($NO + NO_2$) and VOC precursors, and ozone loss by dry deposition and reaction with NO at night.

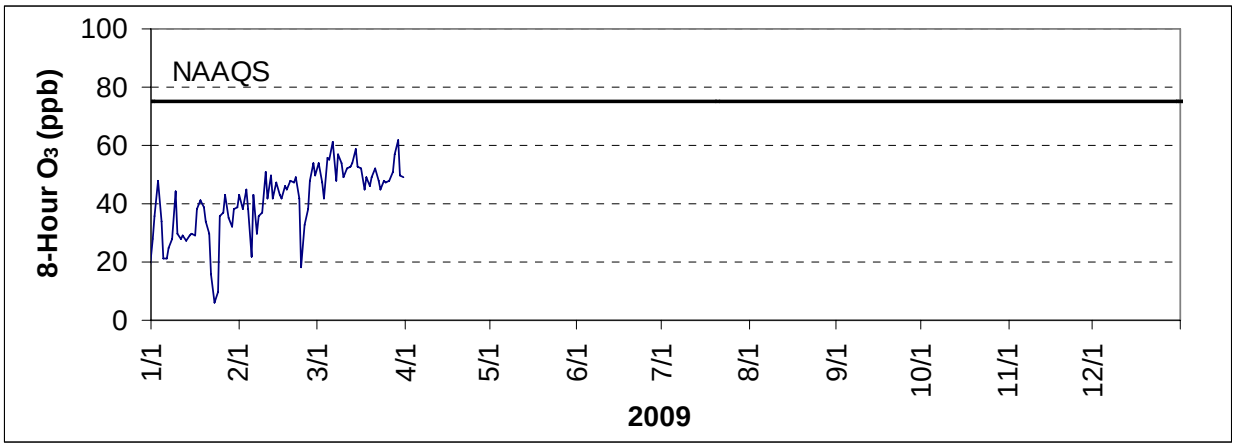


Figure 3-1. Daily Maximum 8-Hour Averages of Ozone Monitored at the Rifle Site.

Table 3-3

Rifle Site
Ten Highest Daily Maximum 8-Hour Ozone Averages
January 1, 2009 – March 31, 2009

Level	Date	Daily Maximum 8-Hour Ozone (ppb)
1	3/29/2009	62
2	3/06/2009	61
3	3/14/2009	59
4*	**3/08/2009**	**57**
5	3/28/2009	57
6	3/04/2009	56
7	3/05/2009	55
8	2/27/2009	54
9	3/01/2009	54
10	3/09/2009	54

* The 3-year average of the 4th highest daily maximum is used to determine attainment status.

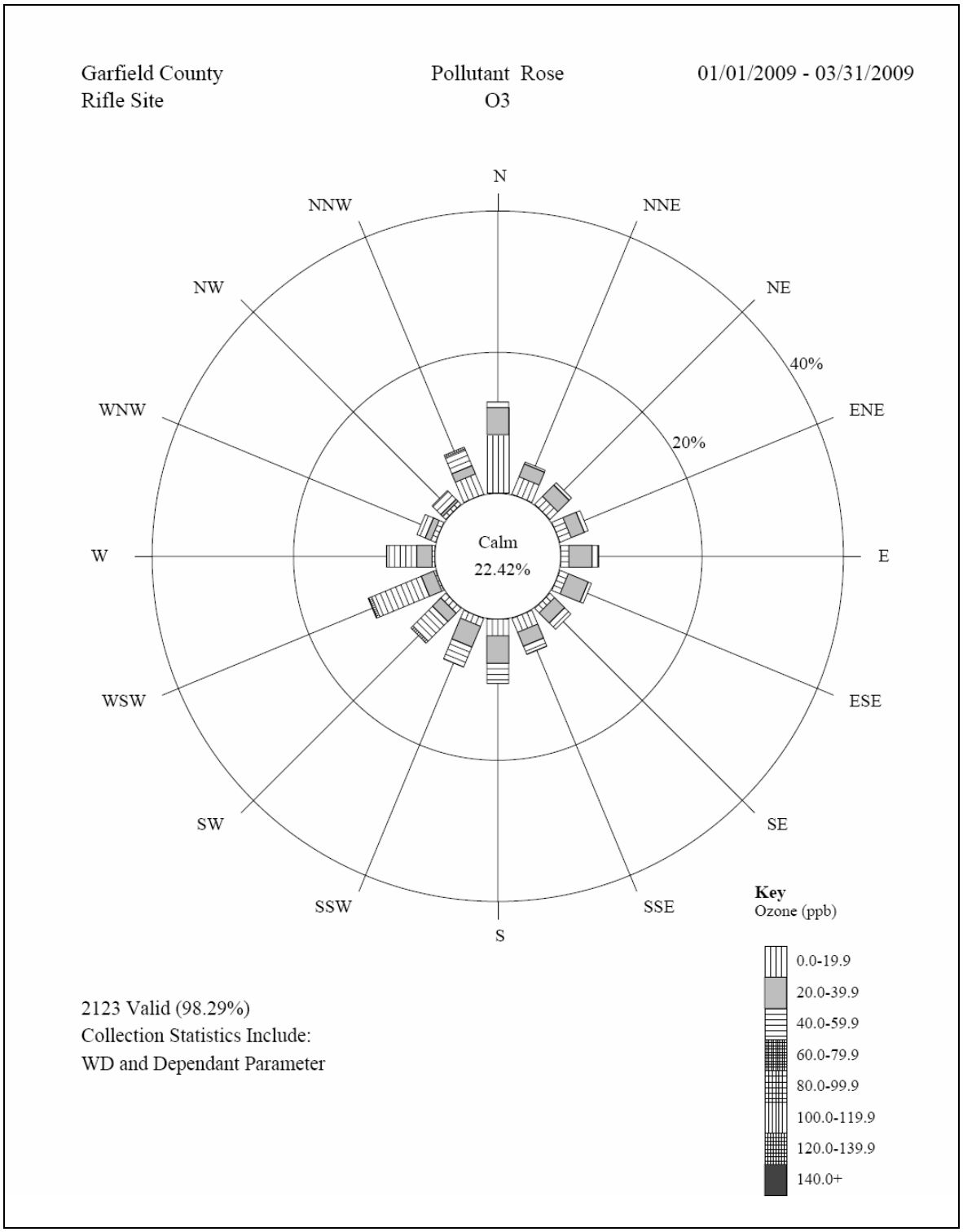


Figure 3-2. Quarterly Ozone Pollutant Rose for the Rifle Monitoring Site.

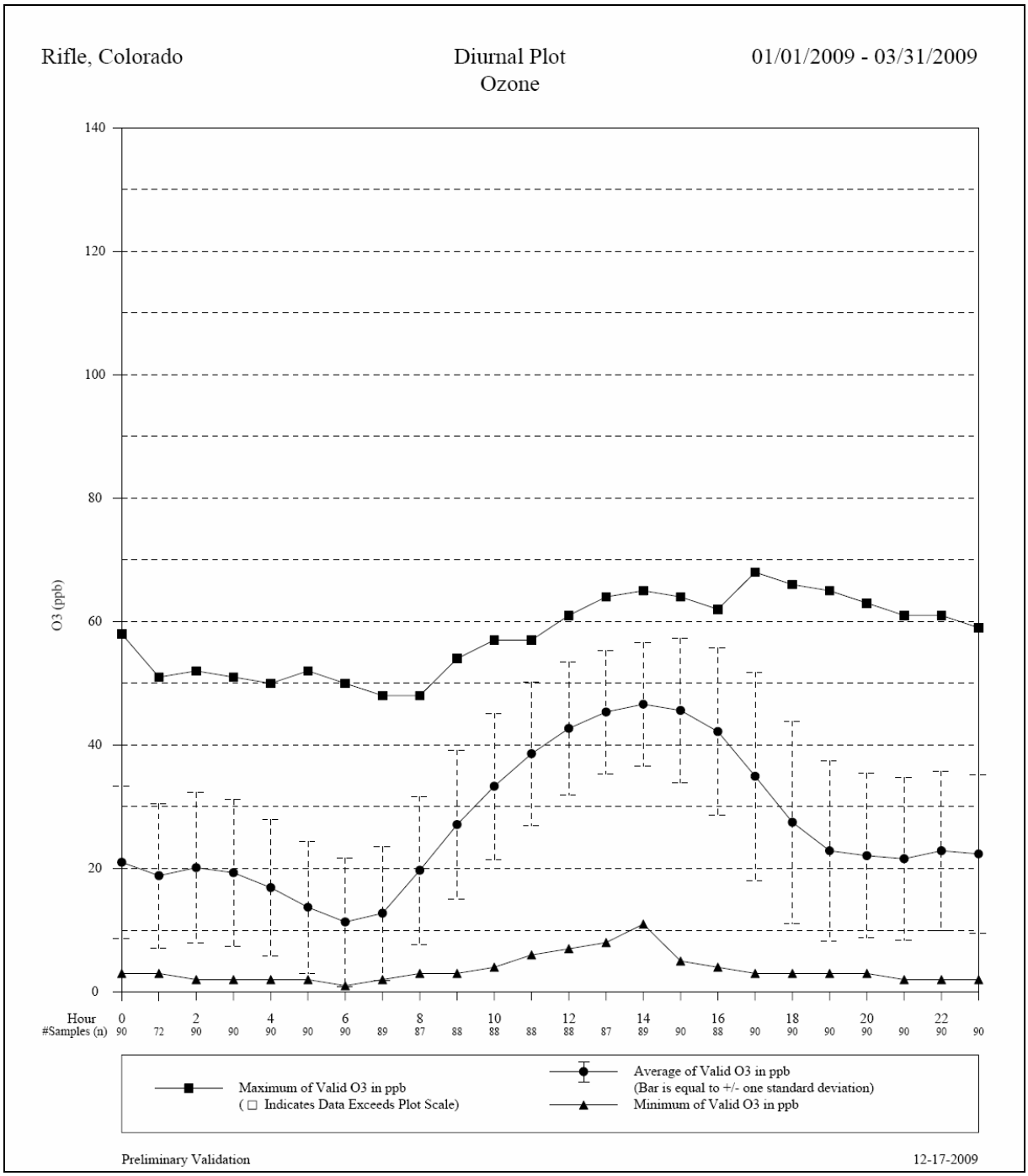


Figure 3-3. Quarterly Ozone Diurnal Plot for Rifle Monitoring Site.

3.2 PARTICULATE MATTER (PM_{10} AND $PM_{2.5}$)

Filter based 24-hour PM_{10} was monitored at the Parachute and Rifle sites, and continuous PM_{10} and $PM_{2.5}$ monitoring began at the Rifle site.

Figures 3-4 and 3-5 present quarterly PM_{10} and $PM_{2.5}$ pollutant roses constructed from the continuous hourly data measured at the Rifle site. The pollutant roses show that the highest PM concentrations were associated with winds out of the north.

Figures 3-6 and 3-7 present quarterly diurnal plots for continuous PM_{10} and $PM_{2.5}$. For PM_{10}, peaks were seen in the early morning and late afternoon, with values averaging the highest in the late afternoon (between about 5:00 and 9:00 pm). For $PM_{2.5}$, peaks were seen in the early morning, but with higher averages in both the morning and late afternoon.

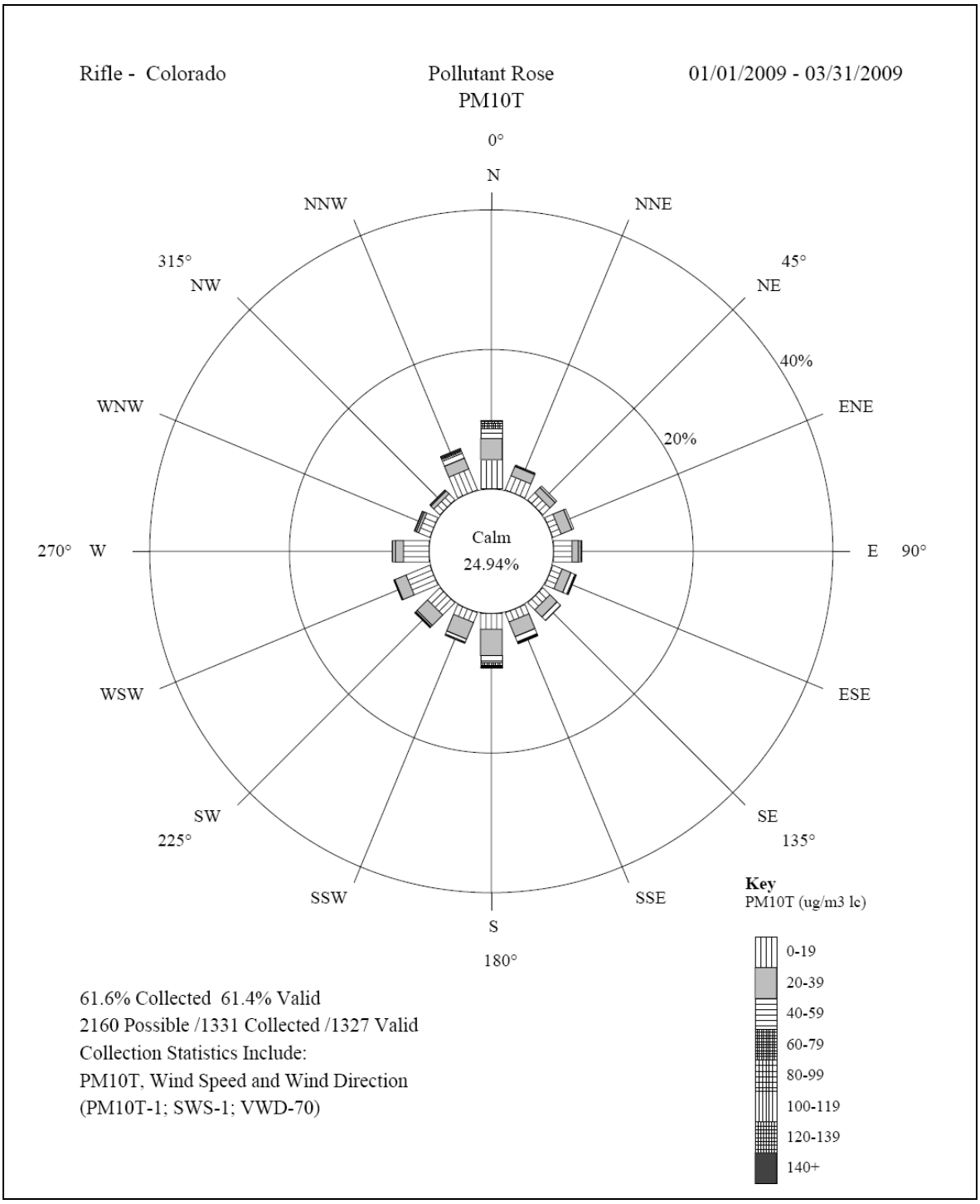


Figure 3-4. Quarterly PM_{10} Pollutant Rose for the Rifle Monitoring Site.

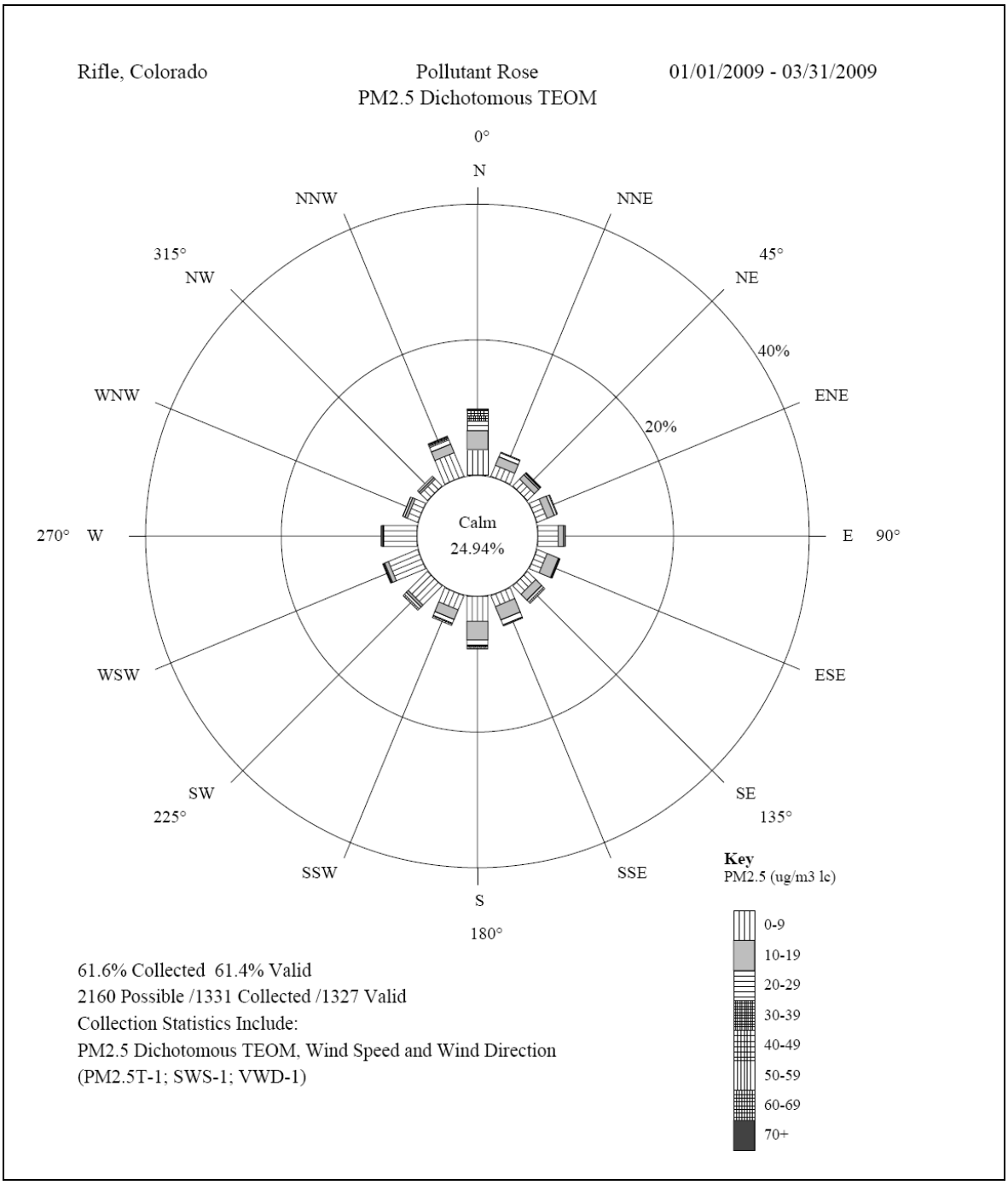


Figure 3-5. Quarterly $PM_{2.5}$ Pollutant Rose for the Rifle Monitoring Site.

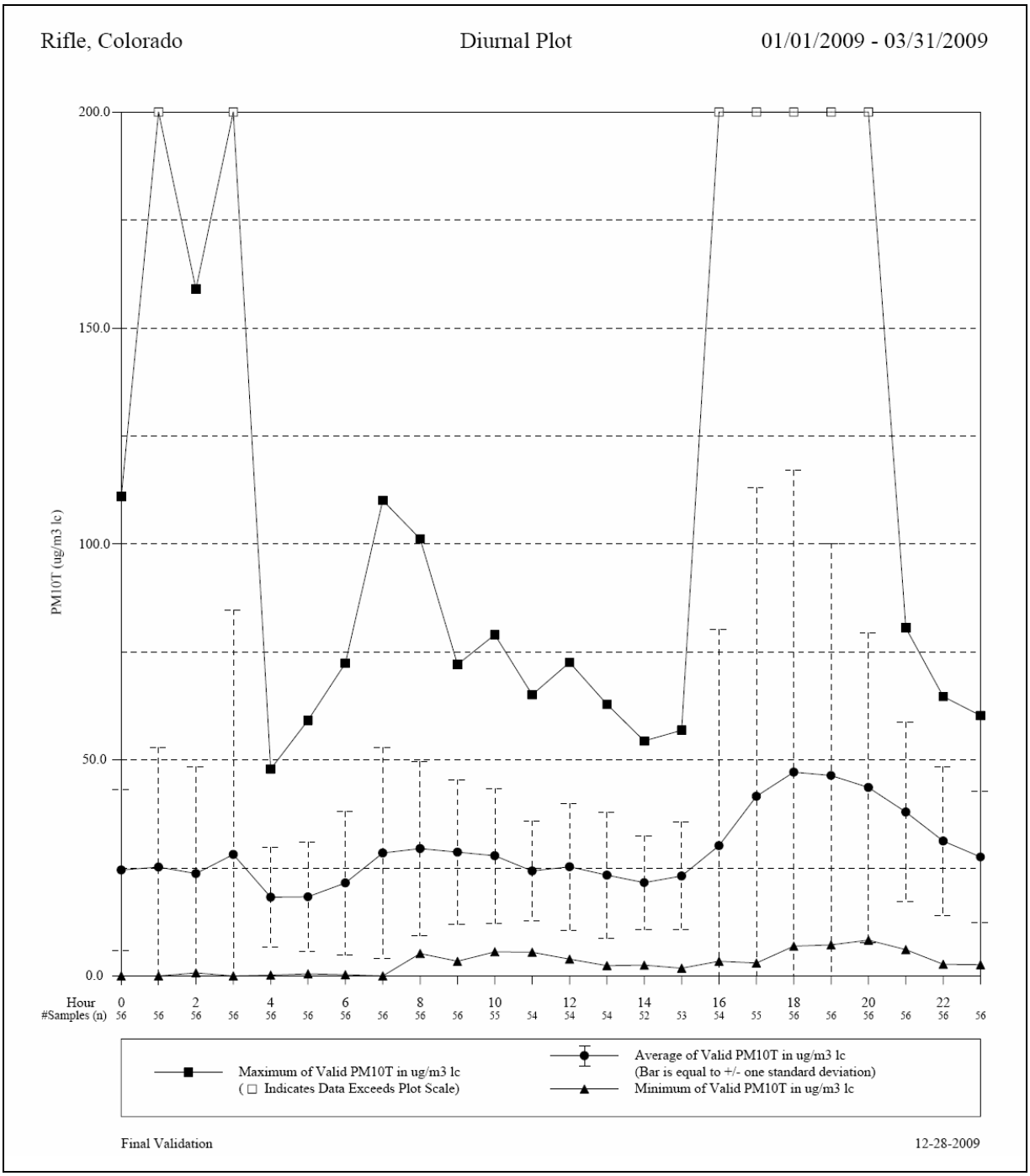


Figure 3-6. Quarterly PM_{10} Diurnal Plot for the Rifle Monitoring Site.

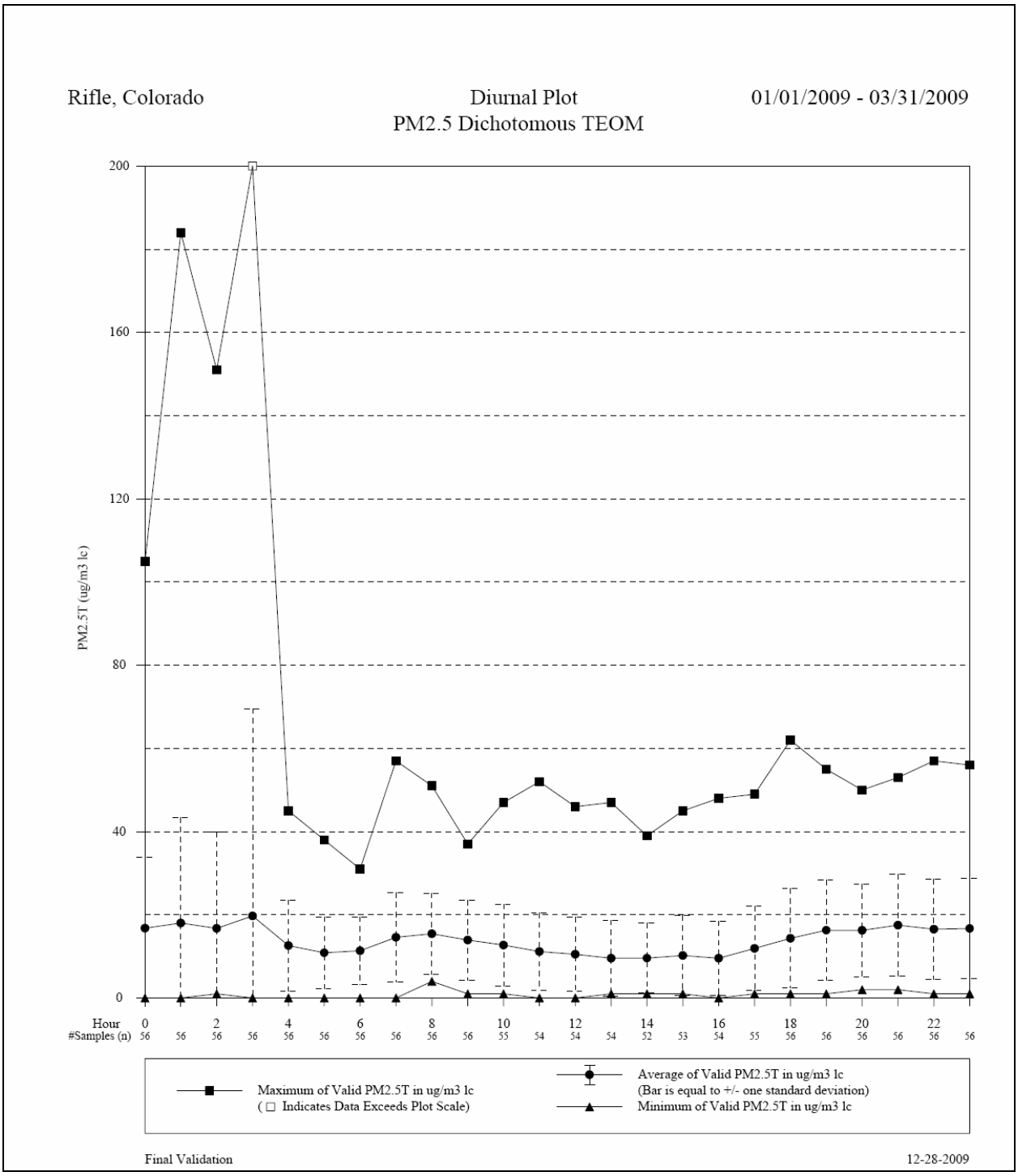


Figure 3-7. Quarterly $PM_{2.5}$ Diurnal Plot for Rifle Monitoring Site.

4.0 SNMOC AND CARBONYL SUMMARIES

In 2009, SNMOCs and carbonyl compounds were monitored at five (5) sites in Garfield County, which includes some overlap at the Brock and Rulison sites in January 2009. SNMOCs and carbonyl compounds are subsets of VOCs. VOCs are generally carbon- and hydrogen-based chemicals that exist in the gas phase or can evaporate from liquids. VOCs can react in the atmosphere to form ozone and fine particulate matter. Hazardous air pollutants (HAPs) are a subset of VOC compounds, and include compounds that are known or believed to cause human health effects at low doses. Levels of HAPs will be analyzed in a separate annual risk assessment report prepared by the CDPHE. Summaries of SNMOC and carbonyl monitoring are presented in this section.

4.1 SNMOC

SNMOC compounds were collected and analyzed according to EPA Compendium Method TO-12, with 24-hour samples collected at all four (4) sites on a 1-in-6 day schedule. This method includes analyses for 81 different compounds. Appendix B lists minimum, maximum, and average concentrations of all detected SNMOC compounds by site.

SNMOC compounds can be grouped into classifications with similar characteristics. For these summaries, measured SNMOC compounds were grouped into the following categories:

- Light Alkanes: Alkanes are the simplest hydrocarbons, consisting of only carbon and hydrogen with single bonds. Light alkanes, which here include alkanes with up to five (5) carbon atoms (ethane, propane, iso/n-butane and iso/n-pentane) are the primary components of natural gas.

- Heavy Alkanes: The hydrocarbons in crude oil are mostly heavy alkanes, which here include alkanes with more than five (5) carbon atoms (C5). Crude oil products include gasoline, a refined mix of predominantly C6 to C10 hydrocarbons, and diesel, which is a refined mix ranging from approximately C10 to C15.

- Alkenes: Alkenes are more complex than alkanes, with at least one (1) carbon to carbon double bond. These compounds are not generally found in crude oil. Alkenes are much more reactive than alkanes, and will deplete quickly in the atmosphere. Alkenes are produced in refineries when larger alkane molecules are dissociated (or cracked) into smaller compounds. Some alkene compounds, including terpenes such as isoprene and a- and b-pinene, are naturally emitted from vegetation.

- Aromatics: Aromatic compounds are the most abundant compounds emitted from gas-fired engines. These compounds include the BTEX parameters (benzene, toluene, ethylbenzene and m/p-xylenes), which are commonly associated with motor vehicles.

Figure 4-1 presents categories of measured SNMOCs in units of ppbV (parts per billion by volume) measured year to date in 2009 at each site. In general, compounds measured were dominated by light alkanes.

Figure 4-2 presents the year to date daily measurements by category in units of ppbC, where ppbC is results in ppbV multiplied by the number of carbons in each compound. Carbon content in a molecule is related to the compound reactivity, which contributes to ozone formation potential (discussed in Section 4.1.1). The unknown category indicates the part of the total carbon measurements were individual species were not identified. Heavier alkanes and aromatics are more significant sources of carbon, especially at the more urban Parachute and Rifle sites.

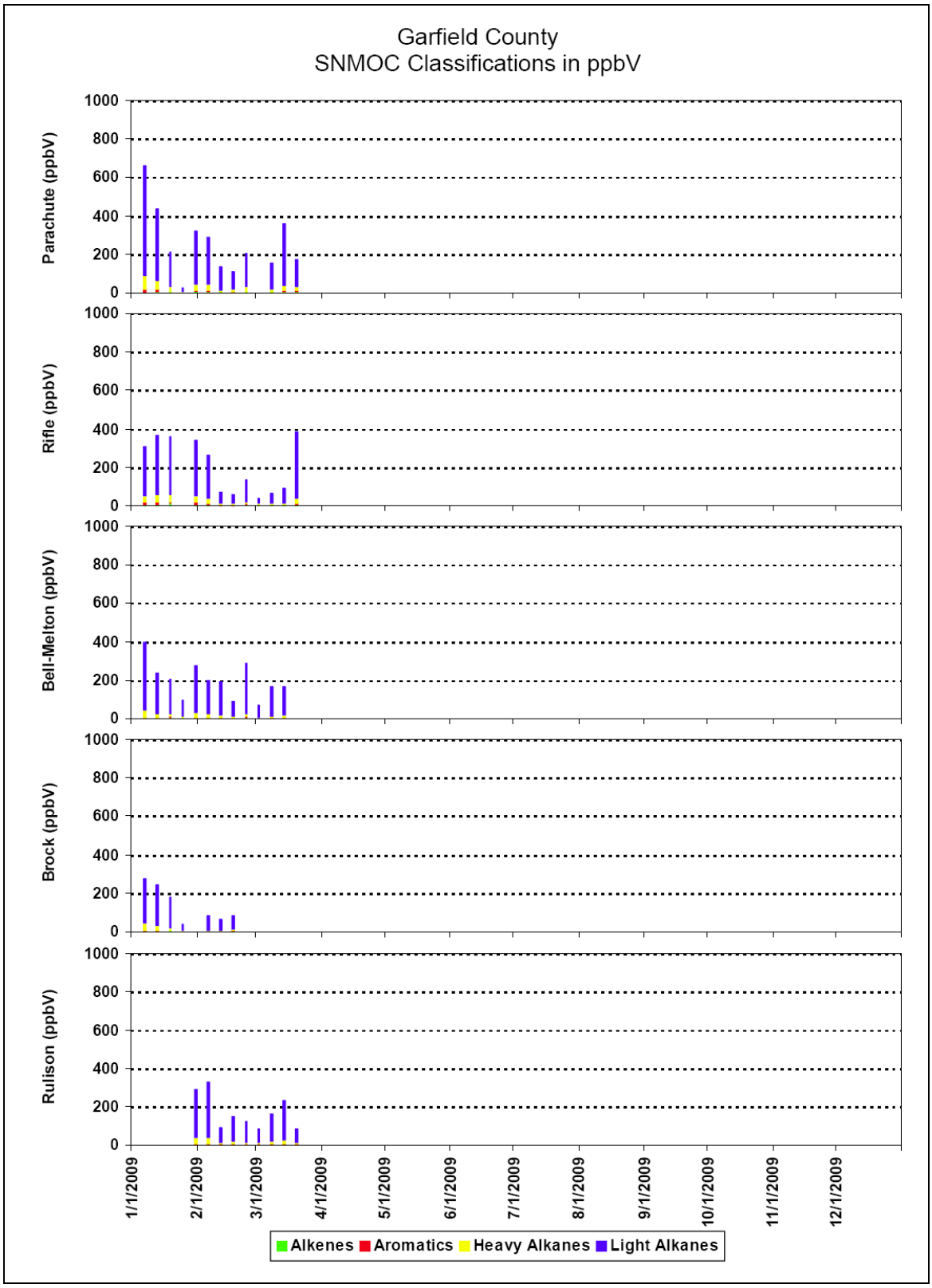


Figure 4-1. 24-Hour SNMOC Measurements by Category in Units of ppbV.

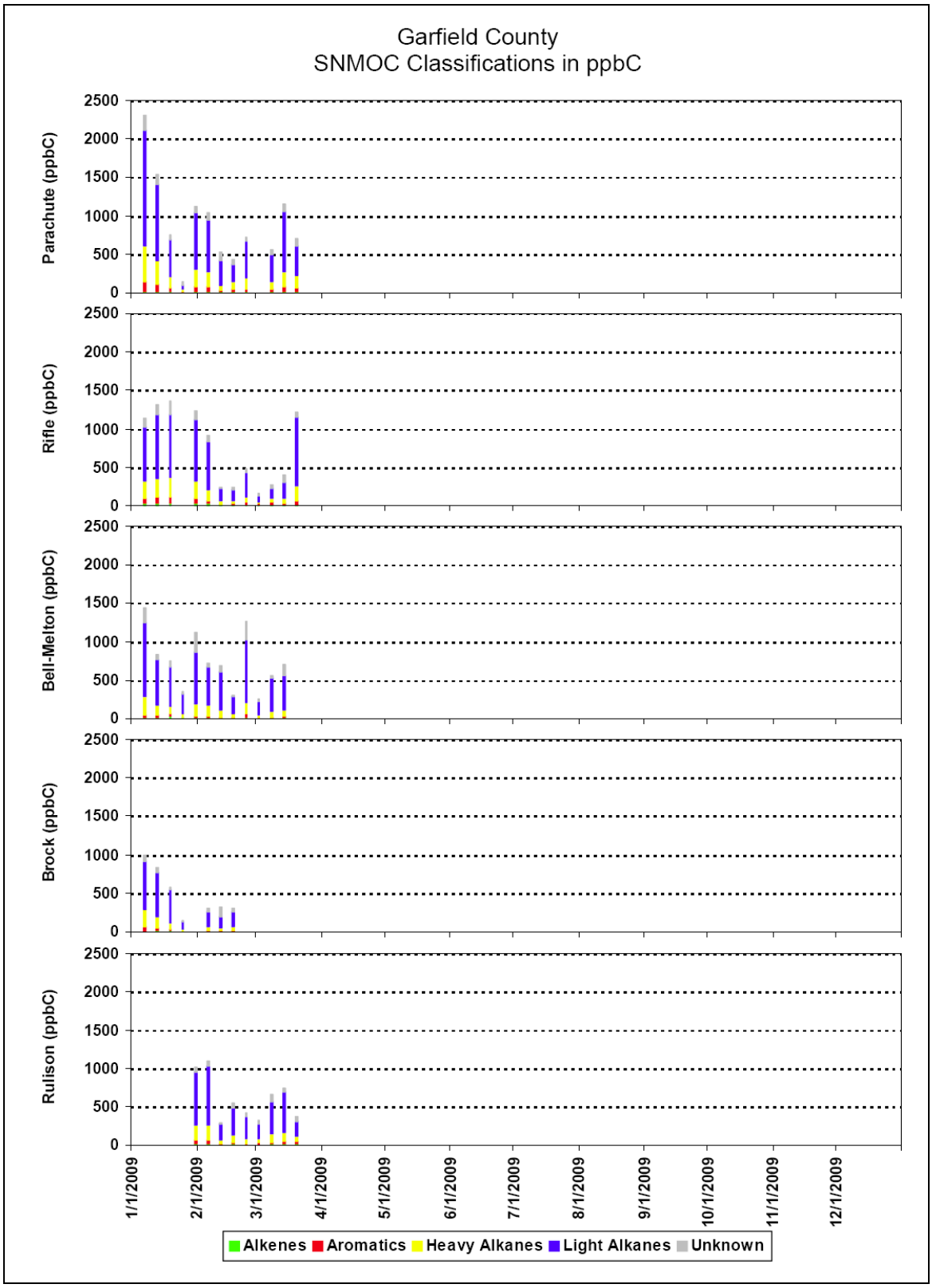


Figure 4-2. 24-Hour SNMOC Measurements by Category in Units of ppbC.

4.1.1 SNMOC Ozone Formation Potential

Ozone is a secondary pollutant, meaning it is not emitted directly from sources, but is formed from photochemical interactions of VOCs and NO_X in the presence of sunlight. The basic formation and depletion equations for O_3 are presented below:

NO_2 + sunlight → NO + O

O + O_2 + M → O_3 + M (where M is a non-reactive molecule required for this process)

NO + O_3 → NO_2 + O_2

Without the presence of VOCs, the diurnal cycle is a balanced reaction, with equal production and depletion of O_3. When VOCs are present, they can react with NO to produce NO_2, as follows:

NO + RO → NO_2 + RO_2 (where R represents a reactive VOC)

This effectively creates competition for NO, allowing O_3 to build up instead of being depleted by NO. Also, when NO reacts with hydrocarbons, additional NO_2 is produced without consuming O_3. The produced NO_2 can further react to produce more O_3.

The potential of individual VOCs to contribute to O_3 formation depends on the reactivity of each compound. Ozone formation potential can be quantified using a Maximum Incremental Reactivity (MIR) scale developed using scenarios where ambient ozone is most sensitive to changes in VOC emissions (Carter, 1994). The California Air Resources Board (CARB) regularly updates and publishes these values. This report uses MIR values published by CARB as updated on March 17, 2009. While MIRs are actually calculated in terms of ozone impact per unit VOC emitted, doing a MIR analysis of measured atmospheric VOCs gives an idea of the relative potential for the measured VOCs to contribute to ozone formation.

Figure 4-3 presents the daily maximum 1-hour ozone average measured at the Rifle site, along with the cumulative reactivity in ppb O_3 for the SNMOCs measured at all sites. Potential O_3 formation is affected by both reactivity and availability. The light alkanes that dominate measurements by volume are the least reactive compounds. Other less abundant compounds are highly reactive and have much more potential to contribute to ozone formation. These include the alkenes (including some biogenic compounds) and aromatics (including the BTEX compounds benzene, toluene, ethylbenzene and x/p-xylenes). Other less abundant compounds, including small quantities of alkenes, are shown to have potential to significantly contribute to O_3 production.

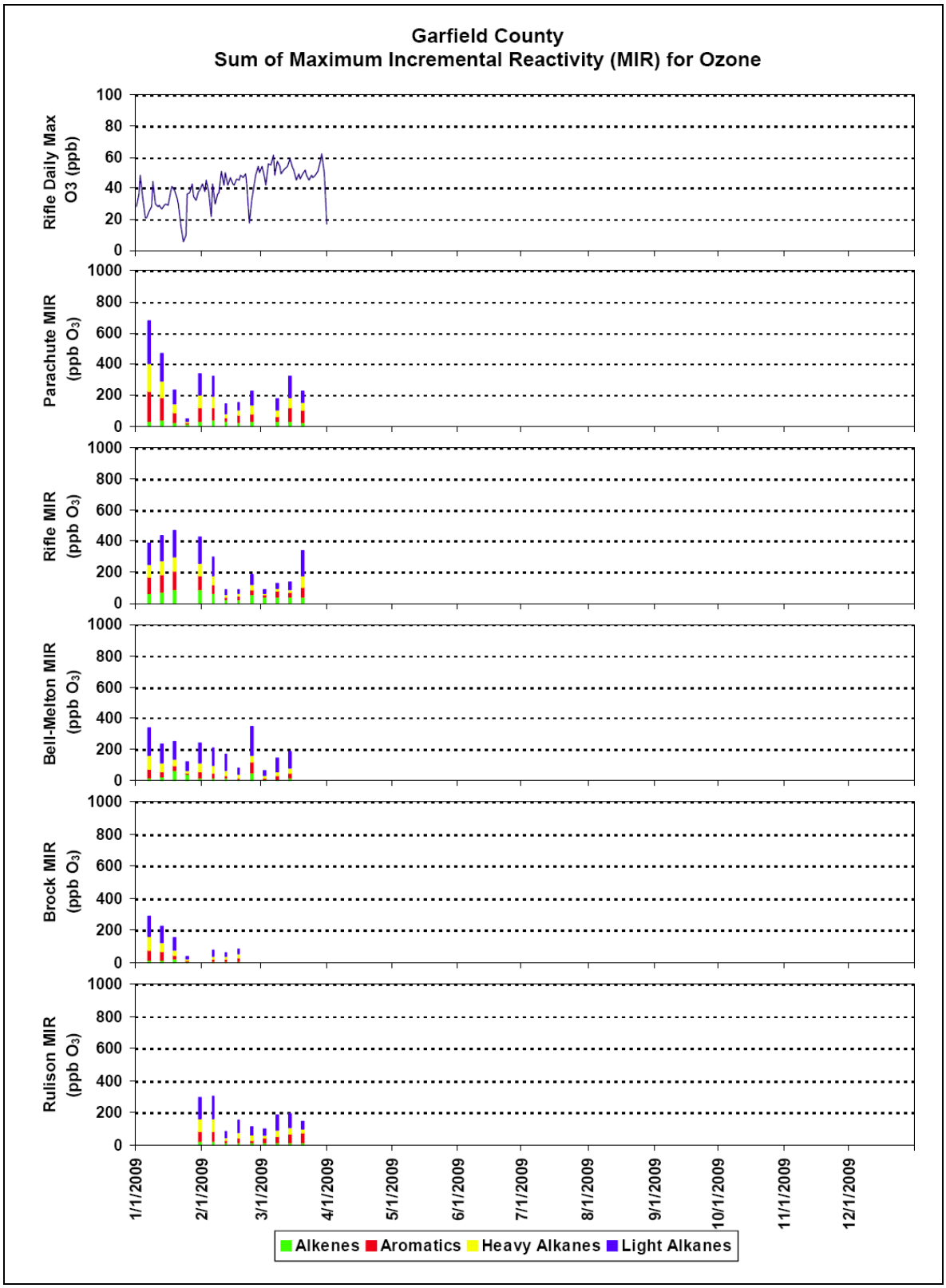


Figure 4-3. Highest Daily 1-Hour Ozone Measurement at the Rifle Site, and Sum of MIR Potential at All SNMOC Sites.

4.2 CARBONYLS

Carbonyl compounds were collected and analyzed according to EPA Compendium Method TO-11A, with 24-hour samples collected at all four sites on a 1-in-12 day schedule. This method includes analysis for twelve (12) different carbonyl compounds.

Carbonyls are highly reactive and play a critical role in the formation of ozone. Some carbonyls, including formaldehyde and acetaldehyde, also have adverse chronic and acute health effects. The major sources of directly emitted carbonyls are fuel combustion, mobile sources, and process emissions from oil refineries (CARB, 2009).

Appendix C lists minimum, maximum, and average concentrations of all detected carbonyl compounds. Major compounds included formaldehyde, acetaldehyde, and acetone. Figure 4-4 presents a time series of the major compounds measured at each site year to date in 2009.

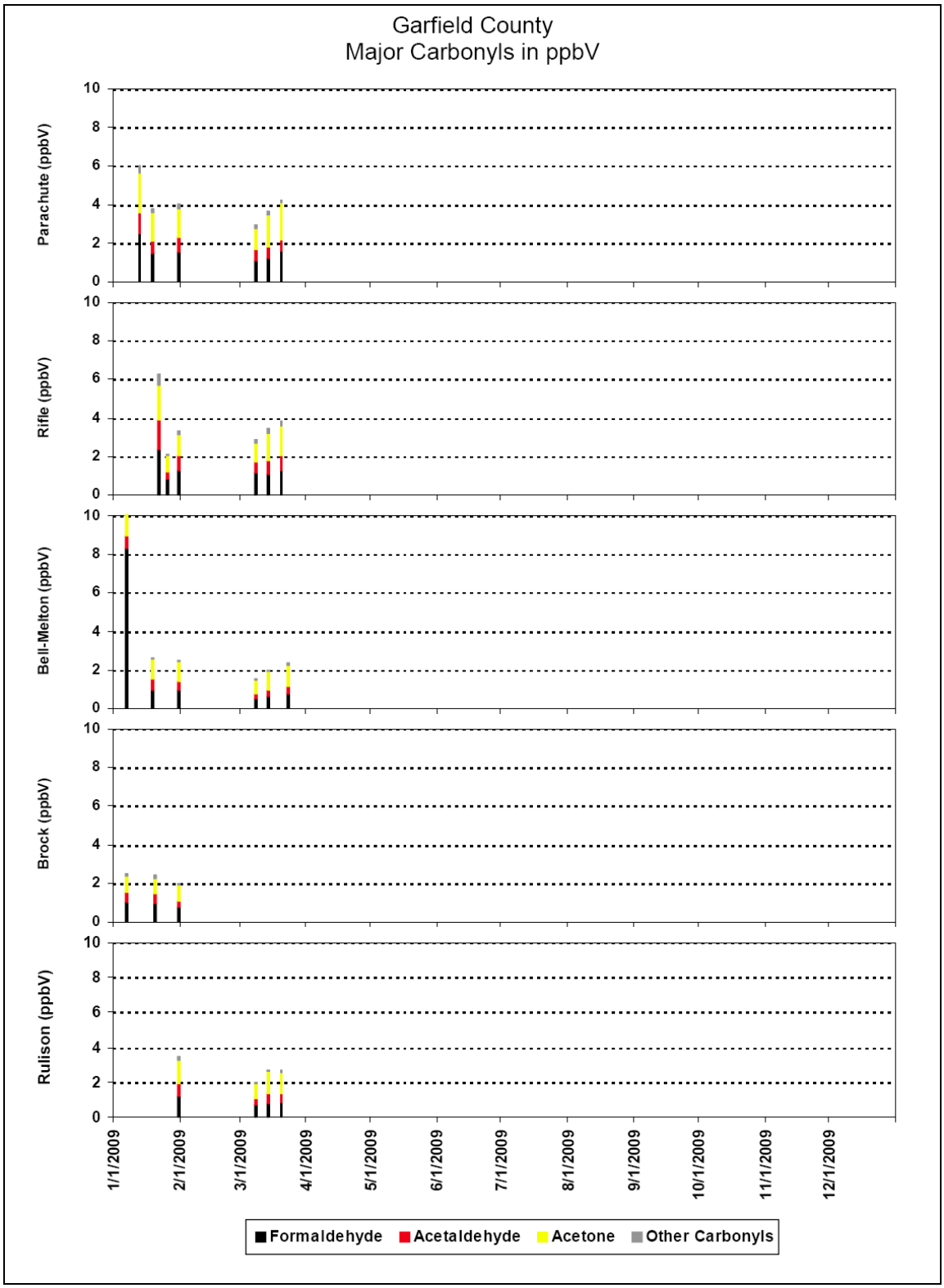


Figure 4-4. 24-Hour Major Carbonyl Compound Concentrations in Units of ppbV.

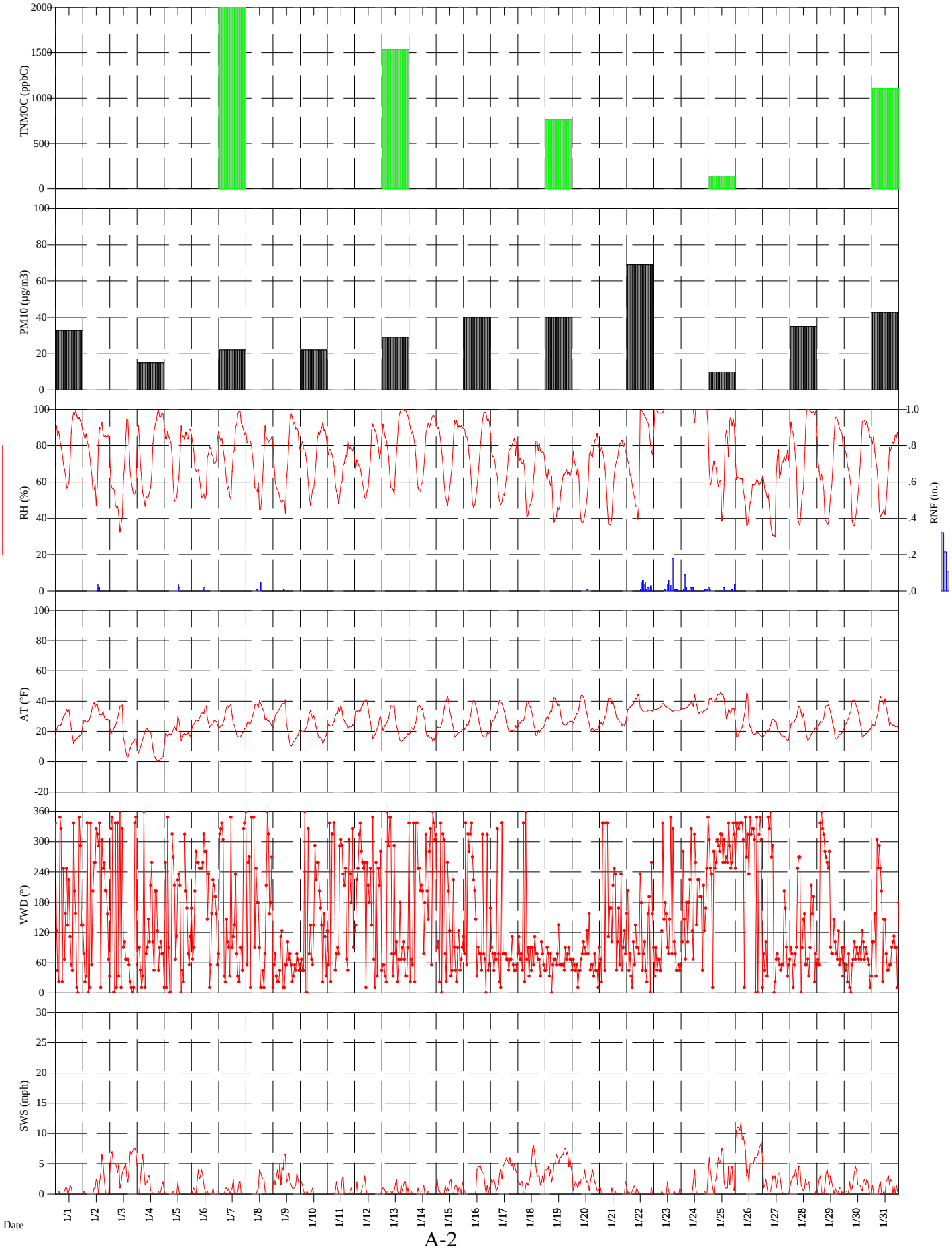
APPENDIX A

Garfield County

Stackplots
January 1, 2009 – March 31, 2009

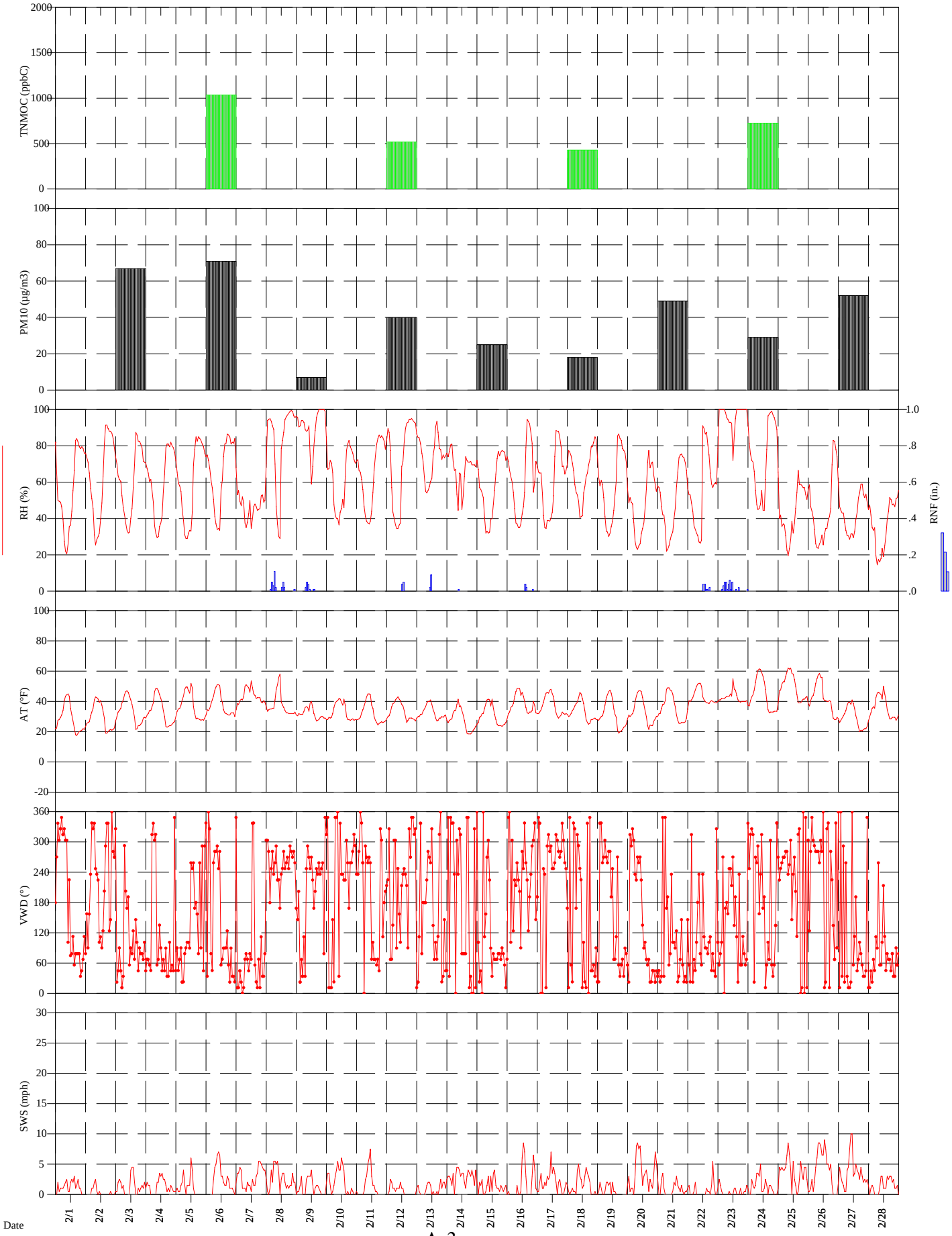
Garfield County, CO

Parachute Site



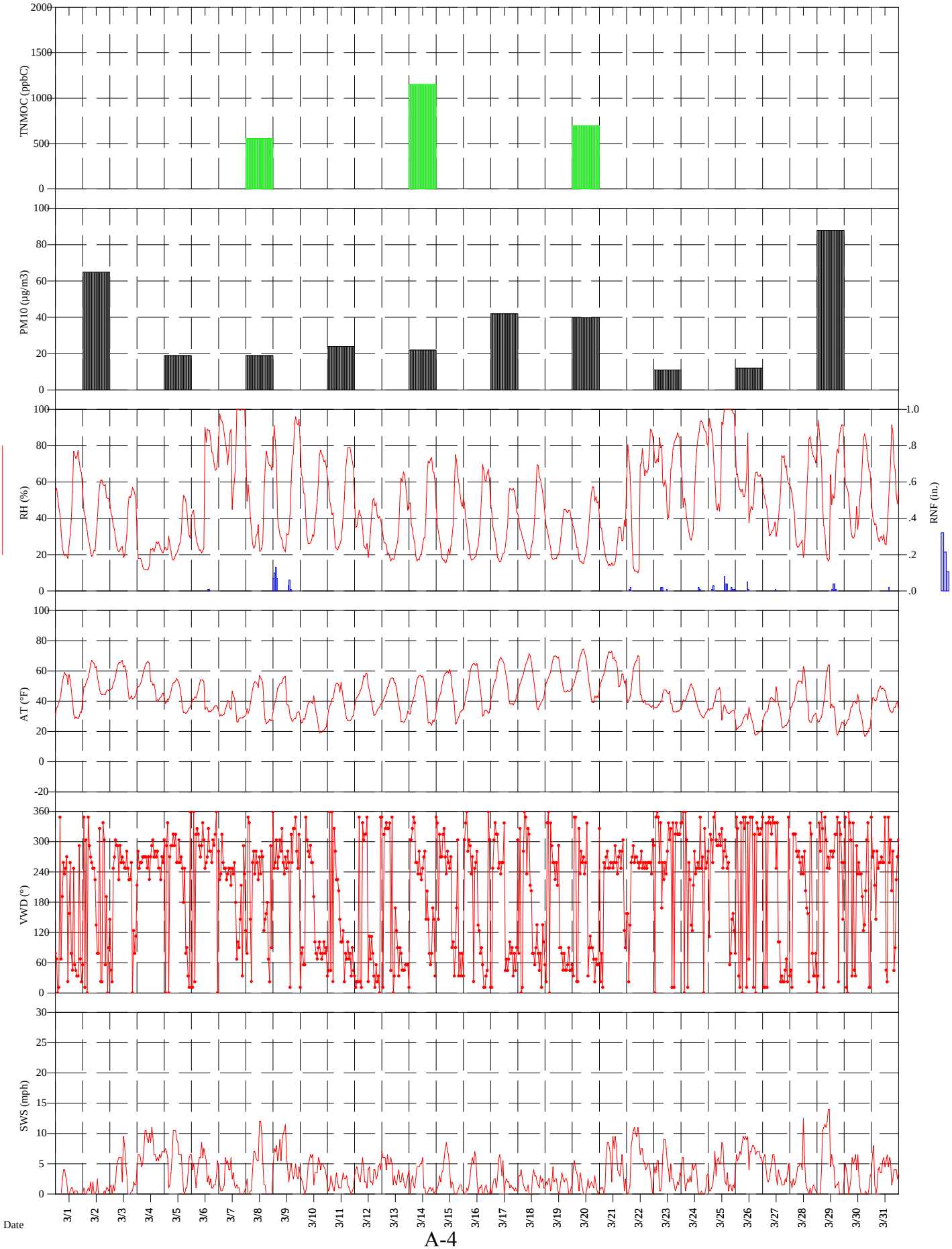
Garfield County, CO

Parachute Site



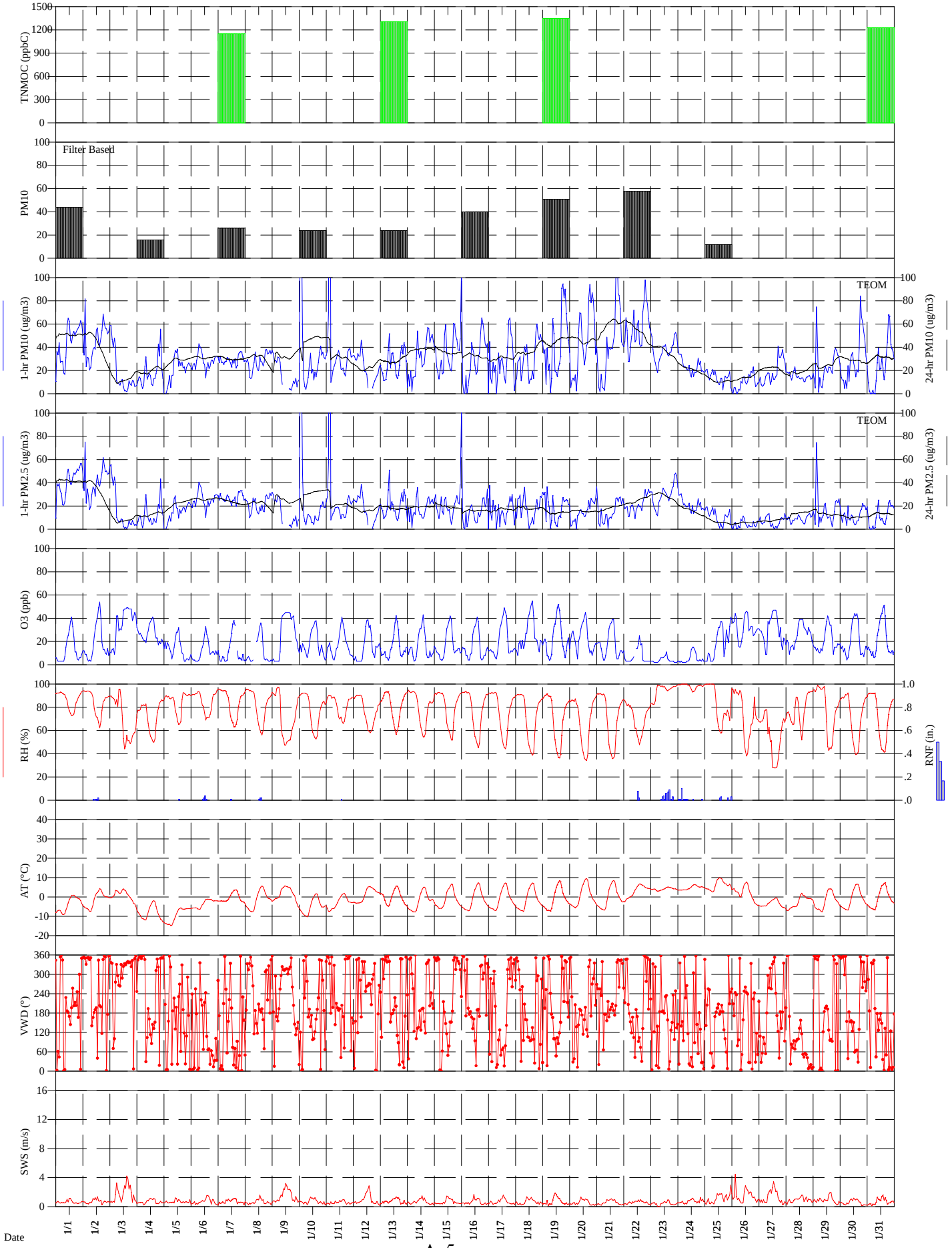
Garfield County, CO

Parachute Site



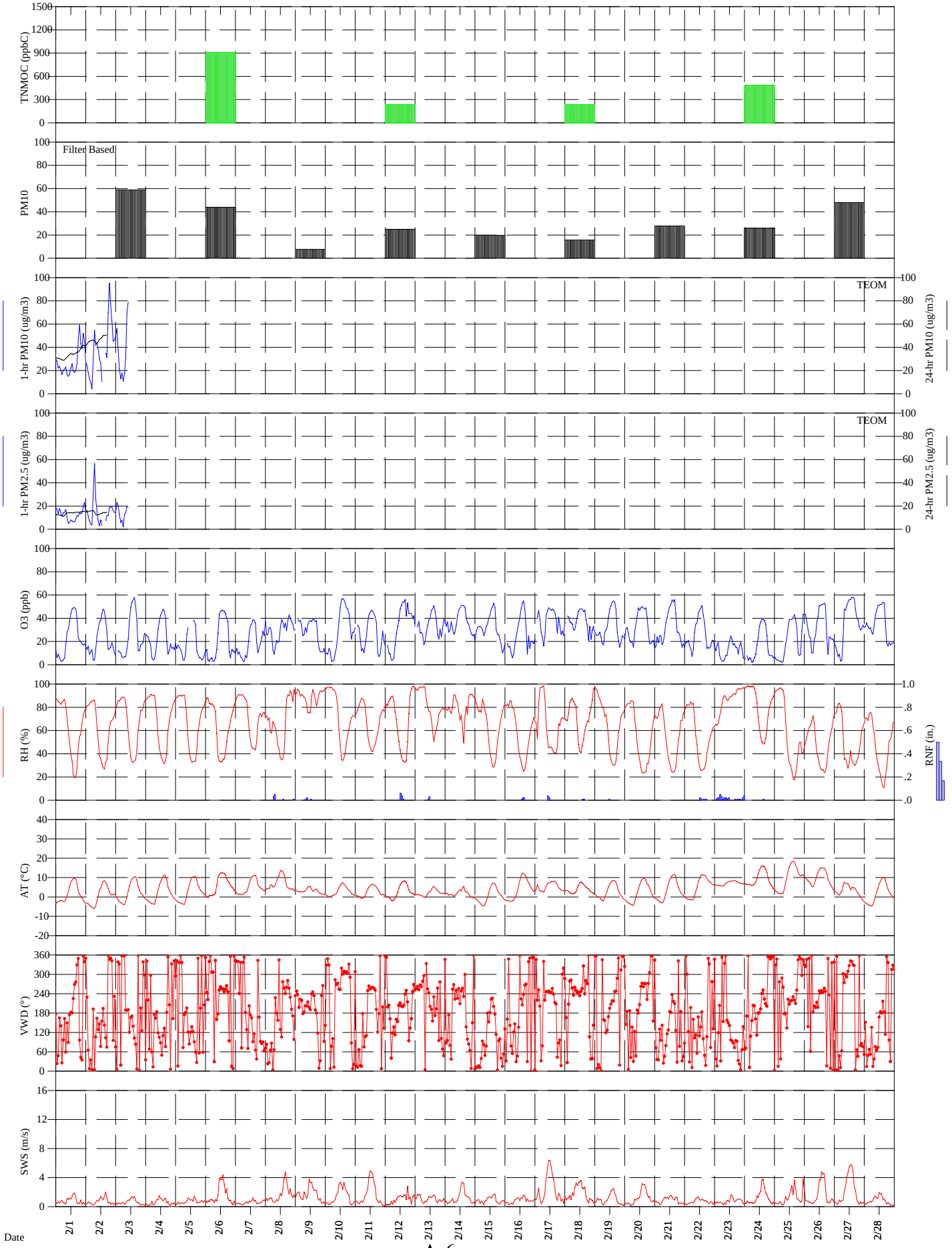
Garfield County, CO

Rifle Site



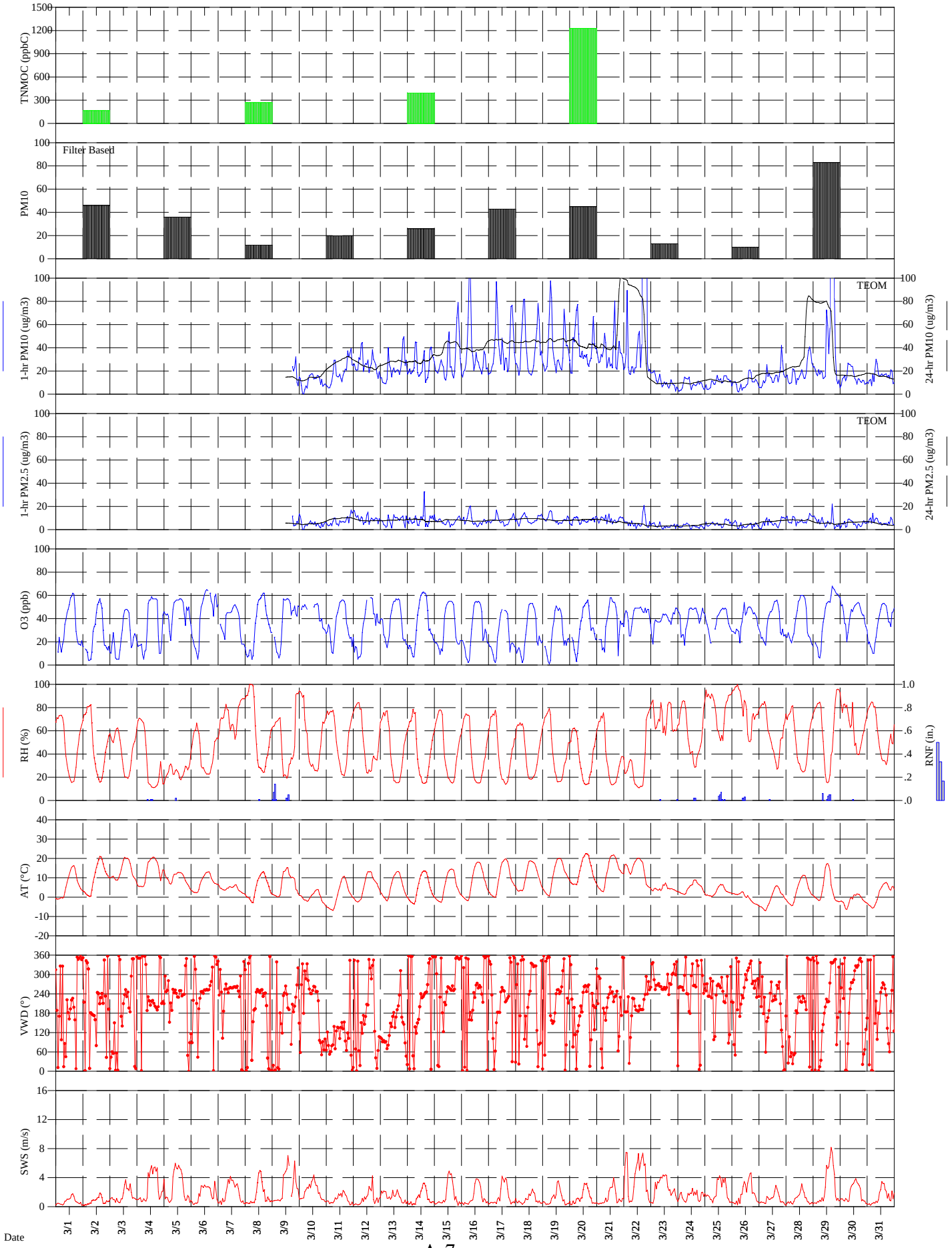
Garfield County, CO

Rifle Site



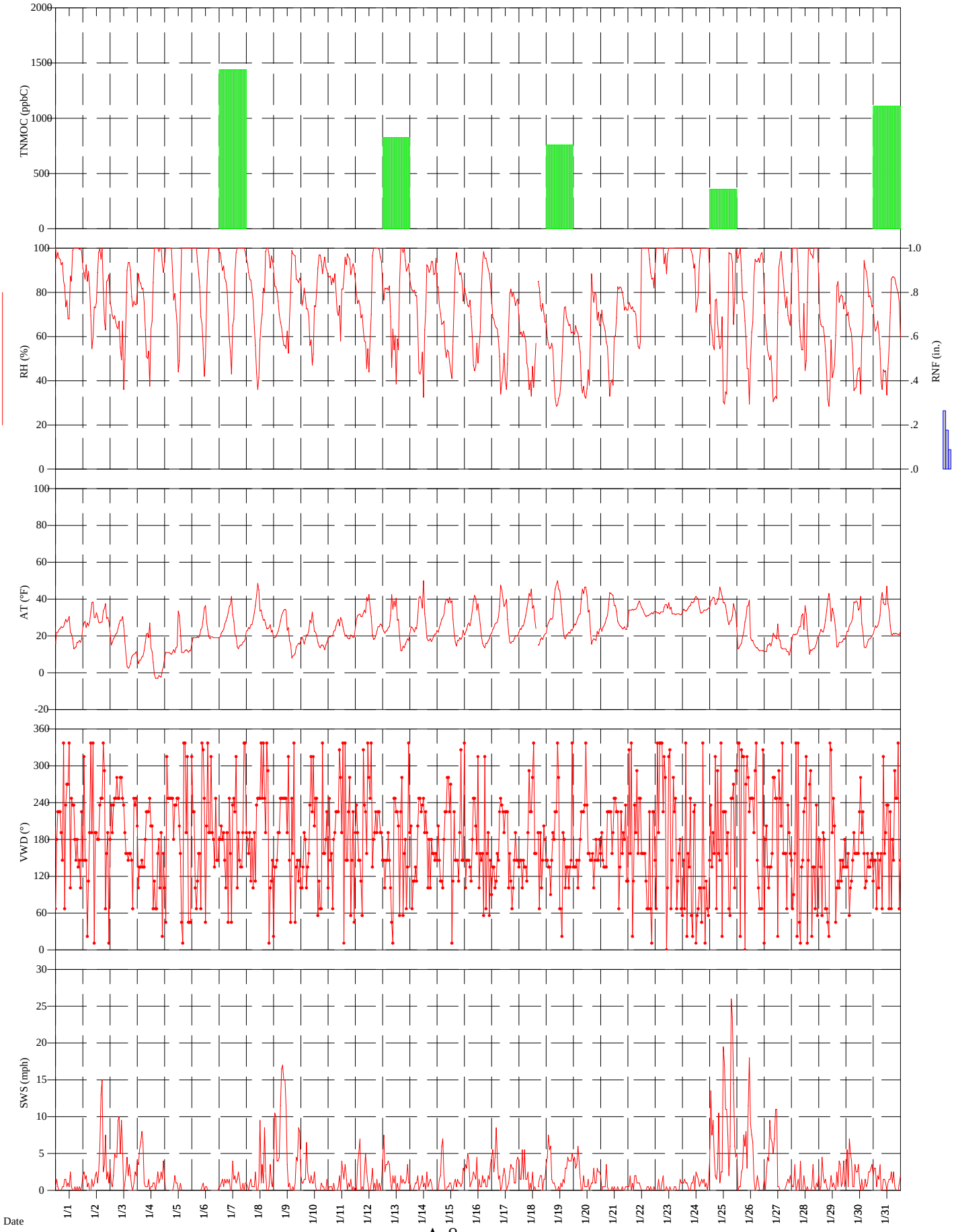
Garfield County, CO

Rifle Site



Garfield County, CO

Bell Melton Site



Garfield County, CO

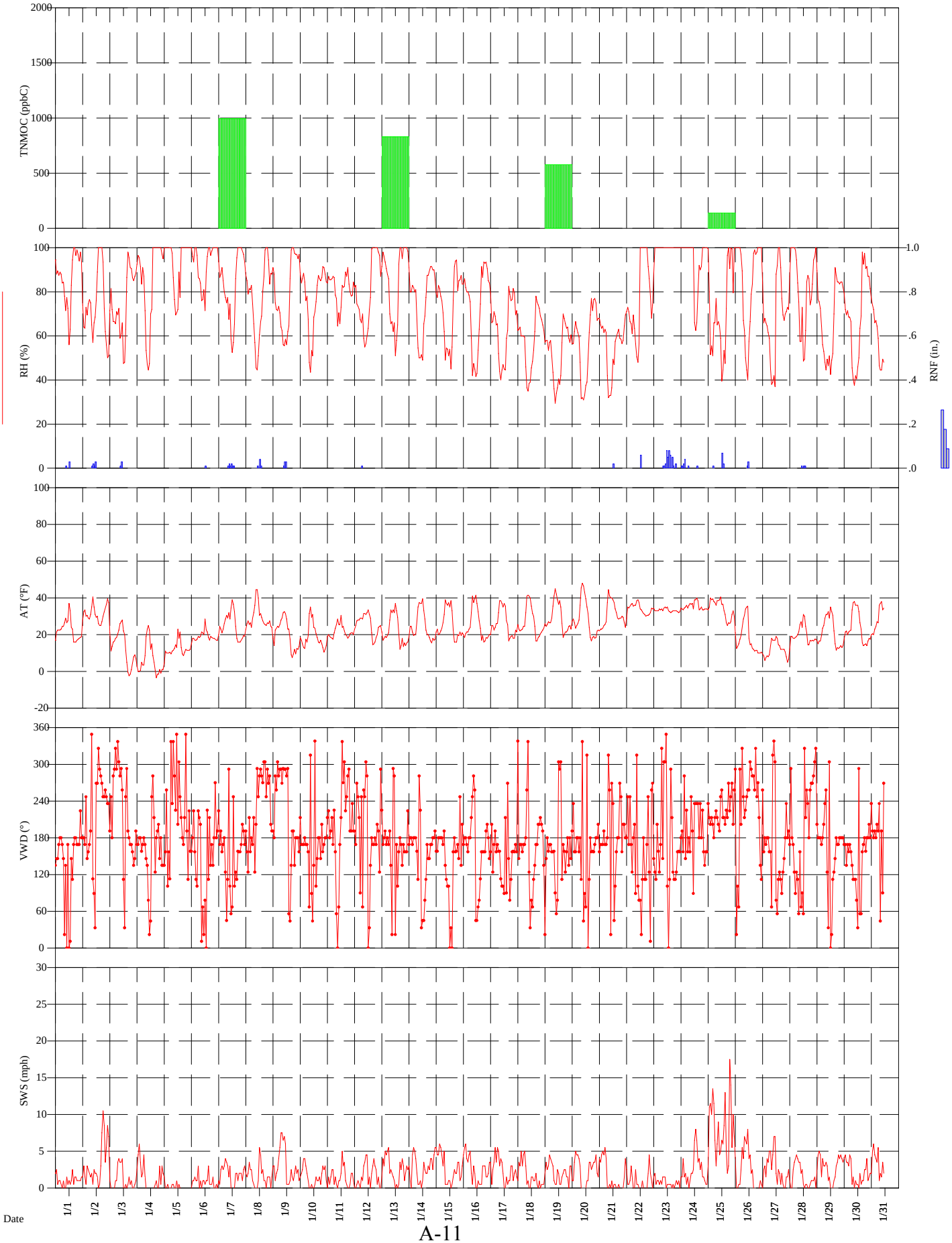
Bell Melton Site

Garfield County, CO

Bell Melton Site

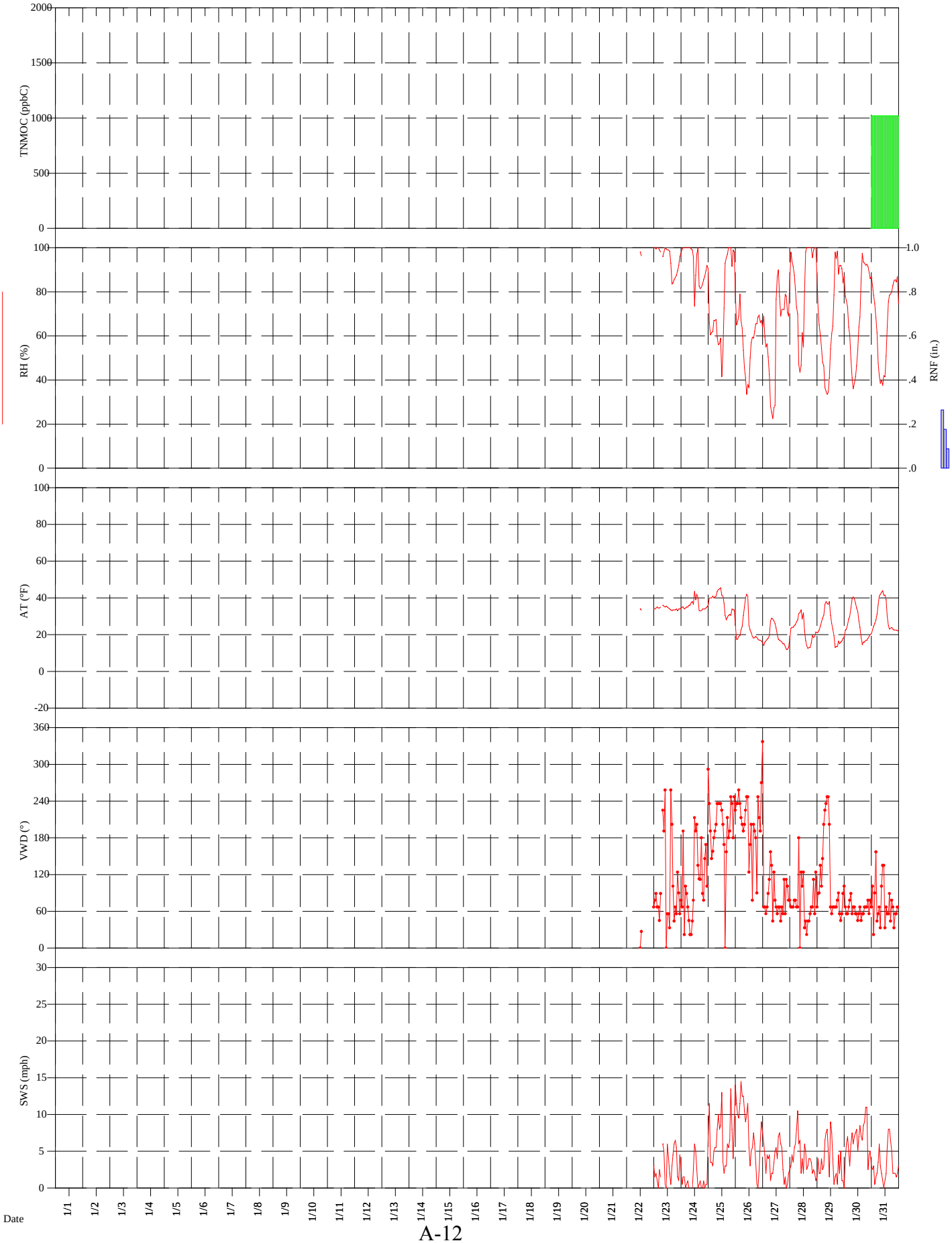
Garfield County, CO

Brock Site



Garfield County, CO

Rulison Site

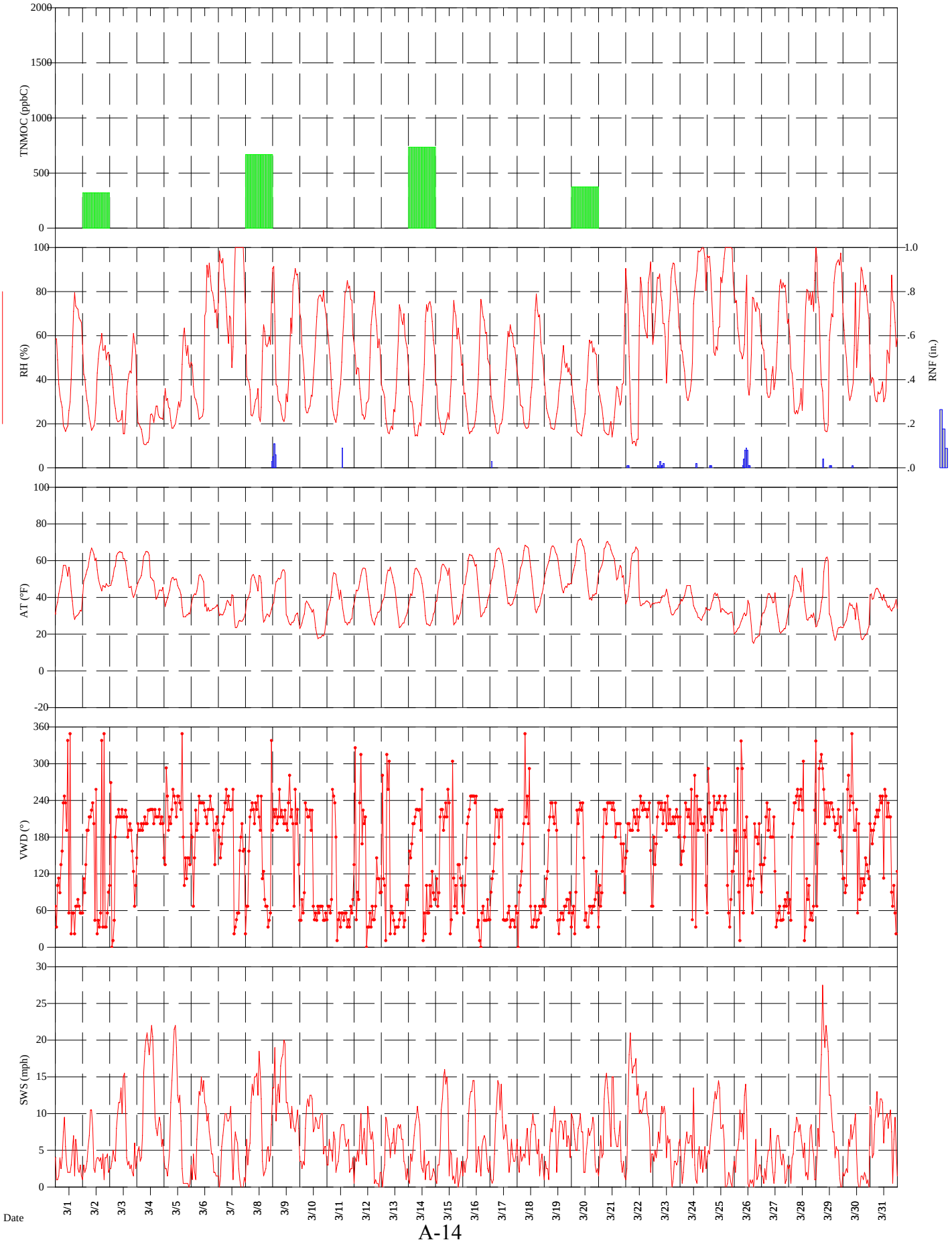


Garfield County, CO

Rulison Site

Garfield County, CO

Rulison Site



APPENDIX B

Garfield County

SNMOC Concentrations
January 1, 2009 – March 31, 2009

Table B-1
Garfield County SNMOC Monitoring
Parachute (PACO)
1/7/2009-3/20/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
1,2,3-Trimethylbenzene (526-73-8)	12	12	0.01	0.13	0.05
1,2,4-Trimethylbenzene (95-63-6)	12	12	0.05	0.66	0.24
1,3,5-Trimethylbenzene (108-67-8)	12	12	0.02	0.58	0.21
1,3-Butadiene (106-99-0)	12	11	0.02	0.08	0.04
1-Dodecene (112-41-4)	12	6	0.01	0.06	0.02
1-Heptene (592-76-7)	12	11	0.03	0.86	0.39
1-Hexene (592-41-6)	12	12	0.02	0.05	0.02
1-Nonene (124-11-8)	12	11	0.03	0.38	0.12
1-Octene (111-66-0)	12	4	0.01	0.03	0.02
1-Pentene (109-67-1)	12	12	0.03	0.08	0.05
1-Tridecene (2437-56-1)	12	3	0.00	0.00	0.01
1-Undecene (821-95-4)	12	5	0.01	0.09	0.02
2,2,3-Trimethylpentane (564-02-3)	12	11	0.04	0.36	0.13
2,2,4-Trimethylpentane (540-84-1)	12	5	0.01	1.13	0.11
2,2-Dimethylbutane (75-83-2)	12	12	0.05	0.85	0.35
2,3,4-Trimethylpentane (565-75-3)	12	12	0.01	0.04	0.02
2,3-Dimethylbutane (79-29-8)	12	12	0.06	1.64	0.66
2,3-Dimethylpentane (565-59-3)	12	12	0.04	0.74	0.31
2,4-Dimethylpentane (108-08-7)	12	12	0.03	0.56	0.22
2-Methyl-1-butene (563-46-2)	12	5	0.05	0.21	0.07
2-Methyl-1-pentene (763-29-1)	12	1	0.01	0.01	0.02
2-Methyl-2-butene (513-35-9)	12	11	0.03	0.08	0.04
2-Methylheptane (592-27-8)	12	12	0.03	1.59	0.56
2-Methylhexane (591-76-4)	12	12	0.12	2.61	1.03
2-Methylpentane (107-83-5)	12	12	0.19	6.48	2.63
3-Methyl-1-butene (563-45-1)	12	3	0.02	0.03	0.02
3-Methylheptane (589-81-1)	12	12	0.02	1.21	0.44
3-Methylhexane (589-34-4)	12	12	0.07	2.44	0.96
3-Methylpentane (96-14-0)	12	12	0.13	3.80	1.52
Acetylene (74-86-2)	12	12	0.55	19.30	2.54
a-Pinene (80-56-8)	12	11	0.01	0.06	0.03
Benzene (71-43-2)	12	12	0.18	3.17	1.41
b-Pinene (127-91-3)	12	2	0.01	0.04	0.01
cis-2-Butene (590-18-1)	12	12	0.05	0.21	0.11
cis-2-Hexene (7688-21-3)	12	6	0.01	0.02	0.02
cis-2-Pentene (627-20-3)	12	12	0.02	0.04	0.03
Cyclohexane (110-82-7)	12	12	0.13	5.45	2.12
Cyclopentane (287-92-3)	12	12	0.05	0.90	0.39
Cyclopentene (142-29-0)	12	9	0.02	0.05	0.03
Ethane (74-84-0)	12	12	9.85	335.00	130.65
Ethylbenzene (100-41-4)	12	12	0.04	0.44	0.18
Ethylene (74-85-1)	12	11	1.23	2.98	1.76

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table B-1 (continued)
Garfield County SNMOC Monitoring
Parachute (PACO)
1/7/2009-3/20/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
Isobutane (75-28-5)	12	12	1.02	32.25	12.64
Isobutene/1-Butene (115-11-7 / 106-98-9)	12	10	0.29	0.76	0.40
Isopentane (78-78-4)	12	12	2.26	20.80	8.87
Isoprene (78-79-5)	12	12	0.02	0.07	0.03
Isopropylbenzene (98-82-8)	12	12	0.01	0.06	0.02
m-Diethylbenzene (141-93-5)	12	11	0.02	0.07	0.03
Methylcyclohexane (108-87-2)	12	12	0.17	12.20	4.60
Methylcyclopentane (96-37-7)	12	12	0.14	4.18	1.67
m-Ethyltoluene (620-14-4)	12	12	0.03	0.41	0.15
m-Xylene/p-Xylene (108-38-3 / 106-42-3)	12	12	0.13	4.54	1.65
n-Butane (106-97-8)	12	12	1.65	32.25	13.54
n-Decane (124-18-5)	12	12	0.22	1.25	0.52
n-Dodecane (112-40-3)	12	12	0.05	0.55	0.14
n-Heptane (142-82-5)	12	12	0.08	5.06	1.92
n-Hexane (110-54-3)	12	12	0.23	8.20	3.10
n-Nonane (111-84-2)	12	12	0.05	2.28	0.78
n-Octane (111-65-9)	12	12	0.06	4.14	1.48
n-Pentane (109-66-0)	12	12	0.96	13.92	5.69
n-Propylbenzene (103-65-1)	12	11	0.02	0.14	0.05
n-Tridecane (629-50-5)	12	12	0.01	0.06	0.02
n-Undecane (1120-21-4)	12	12	0.17	0.76	0.36
o-Ethyltoluene (611-14-3)	12	12	0.02	0.28	0.11
o-Xylene (95-47-6)	12	12	0.05	0.73	0.27
p-Diethylbenzene (105-05-5)	12	10	0.01	0.04	0.02
p-Ethyltoluene (622-96-8)	12	12	0.02	0.31	0.11
Propane (74-98-6)	12	12	3.73	118.67	45.59
Propylene (115-07-1)	12	12	0.28	0.78	0.40
Toluene (108-88-3)	12	12	0.38	6.57	2.75
trans-2-Butene (624-64-6)	12	12	0.06	0.25	0.13
trans-2-Hexene (4050-45-7)	12	4	0.01	0.01	0.02
trans-2-Pentene (646-04-8)	12	12	0.03	0.07	0.05
1,2,3-Trimethylbenzene (526-73-8)	12	12	0.02	0.12	0.06
1,2,4-Trimethylbenzene (95-63-6)	12	12	0.07	0.56	0.26
1,3,5-Trimethylbenzene (108-67-8)	12	12	0.05	0.31	0.14
1,3-Butadiene (106-99-0)	12	12	0.04	0.18	0.10
1-Dodecene (112-41-4)	12	9	0.01	0.05	0.02
1-Heptene (592-76-7)	12	12	0.05	0.67	0.34
1-Hexene (592-41-6)	12	12	0.03	0.06	0.03
1-Nonene (124-11-8)	12	10	0.01	0.16	0.06
1-Octene (111-66-0)	12	3	0.02	0.07	0.02
1-Pentene (109-67-1)	12	12	0.04	0.13	0.08
1-Tridecene (2437-56-1)	12	4	0.00	0.01	0.01

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table B-2
Garfield County SNMOC Monitoring
Rifle (RICO)
1/7/2009-3/20/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
1-Undecene (821-95-4)	12	4	0.01	0.09	0.02
2,2,3-Trimethylpentane (564-02-3)	12	12	0.02	0.19	0.09
2,2,4-Trimethylpentane (540-84-1)	12	12	0.02	0.11	0.05
2,2-Dimethylbutane (75-83-2)	12	12	0.09	0.46	0.27
2,3,4-Trimethylpentane (565-75-3)	12	12	0.02	0.06	0.04
2,3-Dimethylbutane (79-29-8)	12	12	0.14	0.96	0.54
2,3-Dimethylpentane (565-59-3)	12	12	0.09	0.49	0.27
2,4-Dimethylpentane (108-08-7)	12	12	0.06	0.34	0.19
2-Methyl-1-butene (563-46-2)	12	4	0.09	0.19	0.05
2-Methyl-1-pentene (763-29-1)	12	7	0.01	0.02	0.02
2-Methyl-2-butene (513-35-9)	12	12	0.04	0.24	0.12
2-Methylheptane (592-27-8)	12	12	0.06	0.84	0.36
2-Methylhexane (591-76-4)	12	12	0.18	1.46	0.76
2-Methylpentane (107-83-5)	12	12	0.54	4.37	2.34
3-Methyl-1-butene (563-45-1)	12	2	0.02	0.07	0.02
3-Methylheptane (589-81-1)	12	12	0.05	0.60	0.26
3-Methylhexane (589-34-4)	12	12	0.16	1.36	0.71
3-Methylpentane (96-14-0)	12	12	0.34	2.33	1.30
4-Methyl-1-pentene (691-37-2)	12	1	0.01	0.01	0.02
Acetylene (74-86-2)	12	12	1.14	4.00	2.45
a-Pinene (80-56-8)	12	11	0.01	0.07	0.03
Benzene (71-43-2)	12	12	0.29	2.08	1.11
b-Pinene (127-91-3)	12	2	0.02	0.04	0.01
cis-2-Butene (590-18-1)	12	12	0.07	0.79	0.23
cis-2-Hexene (7688-21-3)	12	5	0.01	0.01	0.02
cis-2-Pentene (627-20-3)	12	12	0.03	0.11	0.06
Cyclohexane (110-82-7)	12	12	0.21	2.88	1.56
Cyclopentane (287-92-3)	12	12	0.11	0.58	0.34
Cyclopentene (142-29-0)	12	11	0.02	0.14	0.05
Ethane (74-84-0)	12	12	12.95	215.00	96.91
Ethylbenzene (100-41-4)	12	12	0.06	0.38	0.19
Ethylene (74-85-1)	12	12	1.59	5.40	3.25
Isobutane (75-28-5)	12	12	2.22	24.22	11.57
Isobutene/1-Butene (115-11-7 / 106-98-9)	12	12	0.42	1.14	0.70
Isopentane (78-78-4)	12	12	2.78	14.94	8.36
Isoprene (78-79-5)	12	12	0.03	0.15	0.07
Isopropylbenzene (98-82-8)	12	12	0.01	0.04	0.02
m-Diethylbenzene (141-93-5)	12	12	0.01	0.05	0.03
Methylcyclohexane (108-87-2)	12	12	0.30	6.09	2.95
Methylcyclopentane (96-37-7)	12	12	0.27	2.22	1.25
m-Ethyltoluene (620-14-4)	12	12	0.05	0.34	0.17
m-Xylene/p-Xylene (108-38-3 / 106-42-3)	12	12	0.33	2.48	1.17

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table B-2 (continued)
Garfield County SNMOC Monitoring
Rifle (RICO)
1/7/2009-3/20/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
n-Butane (106-97-8)	12	12	2.72	23.35	12.89
n-Decane (124-18-5)	12	12	0.06	0.78	0.34
n-Dodecane (112-40-3)	12	12	0.03	0.24	0.11
n-Heptane (142-82-5)	12	12	0.15	2.70	1.30
n-Hexane (110-54-3)	12	12	0.42	4.77	2.60
n-Nonane (111-84-2)	12	12	0.04	1.10	0.43
n-Octane (111-65-9)	12	12	0.08	2.04	0.85
n-Pentane (109-66-0)	12	12	1.26	10.14	5.55
n-Propylbenzene (103-65-1)	12	12	0.02	0.11	0.05
n-Tridecane (629-50-5)	12	10	0.01	0.05	0.02
n-Undecane (1120-21-4)	12	12	0.07	0.59	0.29
o-Ethyltoluene (611-14-3)	12	12	0.04	0.19	0.10
o-Xylene (95-47-6)	12	12	0.09	0.57	0.28
p-Diethylbenzene (105-05-5)	12	11	0.01	0.03	0.02
p-Ethyltoluene (622-96-8)	12	12	0.04	0.21	0.10
Propane (74-98-6)	12	12	5.03	68.00	36.94
Propylene (115-07-1)	12	12	0.36	1.42	0.78
Styrene (100-42-5)	12	5	0.01	0.04	0.02
Toluene (108-88-3)	12	12	0.47	4.03	1.95
trans-2-Butene (624-64-6)	12	12	0.08	1.01	0.29
trans-2-Hexene (4050-45-7)	12	9	0.01	0.03	0.02
trans-2-Pentene (646-04-8)	12	12	0.04	0.21	0.12
1,2,3-Trimethylbenzene (526-73-8)	12	9	0.01	0.17	0.03
1,2,4-Trimethylbenzene (95-63-6)	12	12	0.02	0.60	0.12
1,3,5-Trimethylbenzene (108-67-8)	12	12	0.02	0.24	0.07
1,3-Butadiene (106-99-0)	12	5	0.01	0.07	0.03
1-Dodecene (112-41-4)	12	4	0.01	0.08	0.02
1-Heptene (592-76-7)	12	11	0.08	0.42	0.21
1-Hexene (592-41-6)	12	12	0.01	0.08	0.03
1-Nonene (124-11-8)	12	11	0.01	0.08	0.04
1-Octene (111-66-0)	12	4	0.01	0.03	0.02
1-Pentene (109-67-1)	12	12	0.02	0.13	0.05
1-Tridecene (2437-56-1)	12	3	0.01	0.02	0.01
1-Undecene (821-95-4)	12	3	0.01	0.04	0.01
2,2,3-Trimethylpentane (564-02-3)	12	10	0.02	0.11	0.05
2,2,4-Trimethylpentane (540-84-1)	12	9	0.01	0.53	0.07
2,2-Dimethylbutane (75-83-2)	12	12	0.10	0.51	0.24
2,3,4-Trimethylpentane (565-75-3)	12	11	0.01	0.05	0.02
2,3-Dimethylbutane (79-29-8)	12	12	0.19	1.10	0.49
2,3-Dimethylpentane (565-59-3)	12	12	0.09	0.40	0.19
2,4-Dimethylpentane (108-08-7)	12	12	0.05	0.29	0.14
2-Methyl-1-butene (563-46-2)	12	5	0.03	5.02	0.45

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table B-3
Garfield County SNMOC Monitoring
Bell-Melton (BRCO)
1/7/2009-3/14/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
2-Methyl-2-butene (513-35-9)	12	10	0.02	0.06	0.03
2-Methylheptane (592-27-8)	12	12	0.07	0.59	0.22
2-Methylhexane (591-76-4)	12	12	0.17	1.29	0.56
2-Methylpentane (107-83-5)	12	12	0.76	4.87	2.15
3-Methyl-1-butene (563-45-1)	12	4	0.02	0.06	0.02
3-Methylheptane (589-81-1)	12	12	0.04	0.37	0.15
3-Methylhexane (589-34-4)	12	12	0.14	1.18	0.49
3-Methylpentane (96-14-0)	12	12	0.38	2.60	1.15
Acetylene (74-86-2)	12	12	0.45	2.74	0.88
a-Pinene (80-56-8)	12	10	0.01	0.16	0.03
Benzene (71-43-2)	12	12	0.16	1.42	0.66
b-Pinene (127-91-3)	12	1	0.03	0.03	0.01
cis-2-Butene (590-18-1)	12	12	0.01	0.16	0.04
cis-2-Hexene (7688-21-3)	12	5	0.01	0.03	0.02
cis-2-Pentene (627-20-3)	12	12	0.01	0.04	0.02
Cyclohexane (110-82-7)	12	12	0.45	3.03	1.31
Cyclopentane (287-92-3)	12	12	0.15	0.73	0.34
Cyclopentene (142-29-0)	12	4	0.02	0.03	0.02
Ethane (74-84-0)	12	12	30.05	183.50	81.90
Ethylbenzene (100-41-4)	12	12	0.03	0.27	0.09
Ethylene (74-85-1)	12	12	0.66	2.56	1.45
Isobutane (75-28-5)	12	12	4.15	27.75	12.31
Isobutene/1-Butene (115-11-7 / 106-98-9)	12	6	0.20	0.93	0.26
Isopentane (78-78-4)	12	11	3.58	10.84	7.40
Isoprene (78-79-5)	12	12	0.01	0.17	0.04
Isopropylbenzene (98-82-8)	12	11	0.01	0.03	0.02
m-Diethylbenzene (141-93-5)	12	10	0.01	0.06	0.02
Methylcyclohexane (108-87-2)	12	12	0.63	5.24	2.09
Methylcyclopentane (96-37-7)	12	12	0.36	2.47	1.08
m-Ethyltoluene (620-14-4)	12	12	0.02	0.29	0.07
m-Xylene/p-Xylene (108-38-3 / 106-42-3)	12	12	0.15	1.17	0.56
n-Butane (106-97-8)	12	12	5.58	66.25	19.93
n-Decane (124-18-5)	12	12	0.05	1.06	0.26
n-Dodecane (112-40-3)	12	11	0.01	2.74	0.31
n-Heptane (142-82-5)	12	12	0.24	2.60	1.00
n-Hexane (110-54-3)	12	12	0.76	5.88	2.48
n-Nonane (111-84-2)	12	12	0.06	0.59	0.26
n-Octane (111-65-9)	12	12	0.13	1.44	0.54
n-Pentane (109-66-0)	12	12	2.30	13.18	6.81
n-Propylbenzene (103-65-1)	12	12	0.01	0.08	0.03
n-Tridecane (629-50-5)	12	10	0.00	0.75	0.08
n-Undecane (1120-21-4)	12	12	0.03	1.95	0.33

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table B-3 (continued)
Garfield County SNMOC Monitoring
Bell-Melton (BRCO)
1/7/2009-3/14/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
o-Ethyltoluene (611-14-3)	12	11	0.01	0.29	0.06
o-Xylene (95-47-6)	12	12	0.03	0.39	0.13
p-Diethylbenzene (105-05-5)	12	9	0.01	0.03	0.01
p-Ethyltoluene (622-96-8)	12	12	0.02	0.26	0.06
Propane (74-98-6)	12	12	15.90	93.67	46.98
Propylene (115-07-1)	12	12	0.13	1.43	0.35
Styrene (100-42-5)	12	4	0.01	0.05	0.02
Toluene (108-88-3)	12	12	0.20	2.40	1.05
trans-2-Butene (624-64-6)	12	12	0.02	0.20	0.05
trans-2-Hexene (4050-45-7)	12	1	0.01	0.01	0.02
trans-2-Pentene (646-04-8)	12	12	0.01	0.06	0.03
1,2,3-Trimethylbenzene (526-73-8)	7	6	0.01	0.03	0.02
1,2,4-Trimethylbenzene (95-63-6)	7	7	0.02	0.16	0.08
1,3,5-Trimethylbenzene (108-67-8)	7	7	0.01	0.13	0.06
1,3-Butadiene (106-99-0)	7	2	0.01	0.01	0.03
1-Dodecene (112-41-4)	7	1	0.09	0.09	0.03
1-Heptene (592-76-7)	7	6	0.03	0.39	0.14
1-Hexene (592-41-6)	7	7	0.01	0.04	0.02
1-Nonene (124-11-8)	7	6	0.01	0.10	0.04
1-Octene (111-66-0)	7	2	0.01	0.01	0.02
1-Pentene (109-67-1)	7	7	0.02	0.05	0.03
1-Tridecene (2437-56-1)	7	2	0.01	0.01	0.01
2,2,3-Trimethylpentane (564-02-3)	7	6	0.02	0.14	0.05
2,2,4-Trimethylpentane (540-84-1)	7	6	0.01	0.58	0.09
2,2-Dimethylbutane (75-83-2)	7	7	0.06	0.39	0.18
2,3,4-Trimethylpentane (565-75-3)	7	6	0.01	0.02	0.01
2,3-Dimethylbutane (79-29-8)	7	7	0.11	0.83	0.34
2,3-Dimethylpentane (565-59-3)	7	7	0.06	0.42	0.17
2,4-Dimethylpentane (108-08-7)	7	7	0.04	0.29	0.12
2-Methyl-1-butene (563-46-2)	7	5	0.04	0.10	0.05
2-Methyl-2-butene (513-35-9)	7	1	0.01	0.01	0.02
2-Methylheptane (592-27-8)	7	7	0.05	0.68	0.25
2-Methylhexane (591-76-4)	7	7	0.14	1.39	0.52
2-Methylpentane (107-83-5)	7	7	0.43	3.60	1.46
3-Methyl-1-butene (563-45-1)	7	1	0.30	0.30	0.06
3-Methylheptane (589-81-1)	7	7	0.04	0.45	0.17
3-Methylhexane (589-34-4)	7	7	0.10	1.28	0.46
3-Methylpentane (96-14-0)	7	7	0.24	2.07	0.81
Acetylene (74-86-2)	7	7	0.37	0.96	0.68
a-Pinene (80-56-8)	7	4	0.01	0.05	0.02
Benzene (71-43-2)	7	7	0.21	1.47	0.61
cis-2-Butene (590-18-1)	7	7	0.01	0.06	0.03

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table B-4
Garfield County SNMOC Monitoring
Brock (MOCO)
1/7/2009-2/18/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
cis-2-Pentene (627-20-3)	7	6	0.01	0.03	0.02
Cyclohexane (110-82-7)	7	7	0.29	2.98	1.11
Cyclopentane (287-92-3)	7	7	0.08	0.49	0.22
Cyclopentene (142-29-0)	7	1	0.02	0.02	0.02
Ethane (74-84-0)	7	7	18.75	128.50	68.76
Ethylbenzene (100-41-4)	7	7	0.02	0.15	0.07
Ethylene (74-85-1)	7	7	0.63	2.18	1.12
Isobutane (75-28-5)	7	7	1.84	14.42	7.12
Isobutene/1-Butene (115-11-7 / 106-98-9)	7	3	0.22	0.25	0.11
Isopentane (78-78-4)	7	7	2.54	11.36	5.37
Isoprene (78-79-5)	7	6	0.01	0.03	0.02
Isopropylbenzene (98-82-8)	7	6	0.01	0.02	0.02
m-Diethylbenzene (141-93-5)	7	6	0.01	0.02	0.01
Methylcyclohexane (108-87-2)	7	7	0.48	6.00	2.16
Methylcyclopentane (96-37-7)	7	7	0.26	2.38	0.90
m-Ethyltoluene (620-14-4)	7	7	0.02	0.11	0.06
m-Xylene/p-Xylene (108-38-3 / 106-42-3)	7	7	0.09	1.38	0.58
n-Butane (106-97-8)	7	7	2.11	15.65	7.73
n-Decane (124-18-5)	7	7	0.02	0.35	0.17
n-Dodecane (112-40-3)	7	7	0.01	0.11	0.04
n-Heptane (142-82-5)	7	7	0.20	2.96	1.02
n-Hexane (110-54-3)	7	7	0.45	4.87	1.81
n-Nonane (111-84-2)	7	7	0.04	0.71	0.29
n-Octane (111-65-9)	7	7	0.10	1.64	0.64
n-Pentane (109-66-0)	7	7	0.96	7.36	3.28
n-Propylbenzene (103-65-1)	7	6	0.02	0.04	0.02
n-Tridecane (629-50-5)	7	5	0.00	0.02	0.01
n-Undecane (1120-21-4)	7	7	0.02	0.14	0.10
o-Ethyltoluene (611-14-3)	7	6	0.02	0.07	0.04
o-Xylene (95-47-6)	7	7	0.03	0.21	0.10
p-Diethylbenzene (105-05-5)	7	4	0.01	0.02	0.01
p-Ethyltoluene (622-96-8)	7	7	0.01	0.09	0.05
Propane (74-98-6)	7	7	7.07	50.67	26.55
Propylene (115-07-1)	7	7	0.11	0.44	0.20
Styrene (100-42-5)	7	1	0.01	0.01	0.02
Toluene (108-88-3)	7	7	0.22	3.04	1.12
trans-2-Butene (624-64-6)	7	7	0.02	0.04	0.03
trans-2-Pentene (646-04-8)	7	6	0.01	0.03	0.02
1,2,3-Trimethylbenzene (526-73-8)	9	9	0.02	0.05	0.03
1,2,4-Trimethylbenzene (95-63-6)	9	9	0.06	0.21	0.13
1,3,5-Trimethylbenzene (108-67-8)	9	9	0.05	0.19	0.10
1,3-Butadiene (106-99-0)	9	6	0.01	0.03	0.03

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table B-4 (continued)
Garfield County SNMOC Monitoring
Rulison (RUCO)
1/31/2009-3/20/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
1-Dodecene (112-41-4)	9	2	0.03	0.03	0.02
1-Heptene (592-76-7)	9	9	0.12	0.57	0.29
1-Hexene (592-41-6)	9	9	0.02	0.03	0.02
1-Nonene (124-11-8)	9	9	0.01	0.10	0.05
1-Octene (111-66-0)	9	3	0.01	0.02	0.02
1-Pentene (109-67-1)	9	9	0.03	0.05	0.04
1-Undecene (821-95-4)	9	3	0.01	0.15	0.03
2,2,3-Trimethylpentane (564-02-3)	9	9	0.02	0.13	0.06
2,2,4-Trimethylpentane (540-84-1)	9	5	0.01	0.02	0.01
2,2-Dimethylbutane (75-83-2)	9	9	0.12	0.45	0.25
2,3,4-Trimethylpentane (565-75-3)	9	9	0.01	0.02	0.01
2,3-Dimethylbutane (79-29-8)	9	9	0.21	0.87	0.45
2,3-Dimethylpentane (565-59-3)	9	9	0.10	0.36	0.19
2,4-Dimethylpentane (108-08-7)	9	9	0.07	0.27	0.14
2-Methyl-1-butene (563-46-2)	9	1	0.18	0.18	0.04
2-Methyl-2-butene (513-35-9)	9	5	0.01	0.02	0.02
2-Methylheptane (592-27-8)	9	9	0.12	0.56	0.28
2-Methylhexane (591-76-4)	9	9	0.25	1.18	0.59
2-Methylpentane (107-83-5)	9	9	0.80	3.58	1.81
3-Methyl-1-butene (563-45-1)	9	1	0.02	0.02	0.02
3-Methylheptane (589-81-1)	9	9	0.10	0.40	0.20
3-Methylhexane (589-34-4)	9	9	0.22	1.08	0.54
3-Methylpentane (96-14-0)	9	9	0.45	2.03	1.01
Acetylene (74-86-2)	9	9	0.46	3.03	0.88
a-Pinene (80-56-8)	9	8	0.02	0.53	0.08
Benzene (71-43-2)	9	9	0.34	1.42	0.83
b-Pinene (127-91-3)	9	1	0.01	0.01	0.01
cis-2-Butene (590-18-1)	9	9	0.02	0.06	0.03
cis-2-Hexene (7688-21-3)	9	5	0.01	0.02	0.02
cis-2-Pentene (627-20-3)	9	9	0.01	0.03	0.02
Cyclohexane (110-82-7)	9	9	0.62	2.68	1.35
Cyclopentane (287-92-3)	9	9	0.14	0.51	0.28
Cyclopentene (142-29-0)	9	5	0.02	0.05	0.02
Ethane (74-84-0)	9	9	32.90	178.50	86.34
Ethylbenzene (100-41-4)	9	9	0.05	0.46	0.14
Ethylene (74-85-1)	9	9	0.95	1.52	1.22
Isobutane (75-28-5)	9	9	3.70	17.08	9.37
Isobutene/1-Butene (115-11-7 / 106-98-9)	9	5	0.24	0.39	0.17
Isopentane (78-78-4)	9	9	3.40	11.22	6.68
Isoprene (78-79-5)	9	9	0.02	0.05	0.03
Isopropylbenzene (98-82-8)	9	9	0.01	0.03	0.02
m-Diethylbenzene (141-93-5)	9	9	0.01	0.03	0.02

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table B-5
Garfield County SNMOC Monitoring
Rulison (RUCO)
1/31/2009-3/20/2009 (every sixth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
Methylcyclohexane (108-87-2)	9	9	1.10	5.24	2.58
Methylcyclopentane (96-37-7)	9	9	0.49	2.12	1.06
m-Ethyltoluene (620-14-4)	9	9	0.03	0.13	0.08
m-Xylene/p-Xylene (108-38-3 / 106-42-3)	9	9	0.33	1.82	0.96
n-Butane (106-97-8)	9	9	3.75	17.38	10.08
n-Decane (124-18-5)	9	9	0.11	0.46	0.26
n-Dodecane (112-40-3)	9	9	0.03	0.25	0.08
n-Heptane (142-82-5)	9	9	0.36	2.34	1.08
n-Hexane (110-54-3)	9	9	0.80	4.38	2.06
n-Nonane (111-84-2)	9	9	0.15	0.66	0.35
n-Octane (111-65-9)	9	9	0.31	1.45	0.71
n-Pentane (109-66-0)	9	9	1.56	10.58	5.03
n-Propylbenzene (103-65-1)	9	9	0.02	0.04	0.03
n-Tridecane (629-50-5)	9	8	0.01	0.03	0.01
n-Undecane (1120-21-4)	9	9	0.09	0.50	0.22
o-Ethyltoluene (611-14-3)	9	9	0.03	0.09	0.06
o-Xylene (95-47-6)	9	9	0.06	0.46	0.18
p-Diethylbenzene (105-05-5)	9	8	0.01	0.03	0.01
p-Ethyltoluene (622-96-8)	9	9	0.03	0.10	0.06
Propane (74-98-6)	9	9	15.30	59.67	31.97
Propylene (115-07-1)	9	9	0.19	0.28	0.22
Styrene (100-42-5)	9	1	0.03	0.03	0.02
Toluene (108-88-3)	9	9	0.45	2.70	1.36
trans-2-Butene (624-64-6)	9	9	0.02	0.08	0.04
trans-2-Pentene (646-04-8)	9	9	0.02	0.04	0.02

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

APPENDIX C

Garfield County

Carbonyl Concentrations
January 1, 2009 – March 31, 2009

Table C-1
Garfield County Carbonyl Monitoring
Parachute (PACO)
1/13/2009-3/20/2009 (every twelfth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
2,5-Dimethylbenzaldehyde (5779-94-2)	6	0	ND	ND	0.00
Acetaldehyde (75-07-0)	6	6	0.53	1.13	0.71
Acetone (67-64-1)	6	6	1.15	2.03	1.63
Benzaldehyde (100-52-7)	6	6	0.01	0.02	0.01
Butyraldehyde (123-72-8)	6	6	0.03	0.11	0.05
Crotonaldehyde (123-73-9)	6	6	0.02	0.06	0.03
Formaldehyde (50-00-0)	6	6	1.11	2.48	1.56
Hexaldehyde (66-25-1)	6	6	0.01	0.02	0.01
Isovaleraldehyde (590-86-3)	6	0	ND	ND	0.00
Propionaldehyde (123-38-6)	6	6	0.02	0.13	0.06
Tolualdehydes (NA)	6	6	0.02	0.03	0.02
Valeraldehyde (110-62-3)	6	5	ND	0.03	0.01

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table C-2
Garfield County Carbonyl Monitoring
Rifle (RICO)
1/22/2009-3/20/2009 (every twelfth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
2,5-Dimethylbenzaldehyde (5779-94-2)	6	0	ND	ND	0.00
Acetaldehyde (75-07-0)	6	6	0.40	1.53	0.78
Acetone (67-64-1)	6	6	0.82	1.82	1.28
Benzaldehyde (100-52-7)	6	6	0.01	0.04	0.02
Butyraldehyde (123-72-8)	6	6	0.03	0.16	0.06
Crotonaldehyde (123-73-9)	6	6	0.02	0.08	0.04
Formaldehyde (50-00-0)	6	6	0.81	2.38	1.34
Hexaldehyde (66-25-1)	6	5	ND	0.03	0.02
Isovaleraldehyde (590-86-3)	6	0	ND	ND	0.00
Propionaldehyde (123-38-6)	6	6	0.02	0.19	0.07
Tolualdehydes (NA)	6	6	0.02	0.04	0.03
Valeraldehyde (110-62-3)	6	5	ND	0.03	0.02

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table C-3
Garfield County Carbonyl Monitoring
Bell-Melton (BRCO)
1/7/2009-3/23/2009 (every twelfth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
2,5-Dimethylbenzaldehyde (5779-94-2)	6	0	ND	ND	0.00
Acetaldehyde (75-07-0)	6	6	0.25	0.68	0.45
Acetone (67-64-1)	6	6	0.71	1.14	0.99
Benzaldehyde (100-52-7)	6	5	ND	0.02	0.01
Butyraldehyde (123-72-8)	6	6	0.01	0.03	0.02
Crotonaldehyde (123-73-9)	6	6	0.01	0.03	0.02
Formaldehyde (50-00-0)	6	6	0.51	8.31	2.01
Hexaldehyde (66-25-1)	6	2	ND	0.02	0.00
Isovaleraldehyde (590-86-3)	6	0	ND	ND	0.00
Propionaldehyde (123-38-6)	6	6	0.01	0.06	0.03
Tolualdehydes (NA)	6	5	ND	0.02	0.01
Valeraldehyde (110-62-3)	6	1	ND	0.01	0.00

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table C-4
Garfield County Carbonyl Monitoring
Brock (MOCO)
1/7/2009-1/31/2009 (every twelfth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
2,5-Dimethylbenzaldehyde (5779-94-2)	3	0	ND	ND	0.00
Acetaldehyde (75-07-0)	3	3	0.35	0.49	0.44
Acetone (67-64-1)	3	3	0.83	0.84	0.84
Benzaldehyde (100-52-7)	3	3	0.01	0.03	0.02
Butyraldehyde (123-72-8)	3	3	0.01	0.02	0.02
Crotonaldehyde (123-73-9)	3	3	0.02	0.03	0.02
Formaldehyde (50-00-0)	3	3	0.74	1.05	0.92
Hexaldehyde (66-25-1)	3	1	ND	0.02	0.01
Isovaleraldehyde (590-86-3)	3	0	ND	ND	0.00
Propionaldehyde (123-38-6)	3	3	0.01	0.03	0.02
Tolualdehydes (NA)	3	3	0.02	0.02	0.02
Valeraldehyde (110-62-3)	3	1	ND	0.01	0.00

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.

Table C-5
Garfield County Carbonyl Monitoring
Rulison (RUCO)
1/31/2009-3/20/2009 (every twelfth day)

	Sample Count		Concentration (ppbV)		
Detected Compound (CAS Number)	**# Samples**	**# Detects**	**Minimum**	**Maximum**	**Average***
2,5-Dimethylbenzaldehyde (5779-94-2)	4	0	ND	ND	0.00
Acetaldehyde (75-07-0)	4	4	0.35	0.72	0.53
Acetone (67-64-1)	4	4	0.86	1.31	1.15
Benzaldehyde (100-52-7)	4	4	0.01	0.01	0.01
Butyraldehyde (123-72-8)	4	4	0.02	0.06	0.04
Crotonaldehyde (123-73-9)	4	4	0.02	0.04	0.03
Formaldehyde (50-00-0)	4	4	0.70	1.22	0.89
Hexaldehyde (66-25-1)	4	4	0.01	0.01	0.01
Isovaleraldehyde (590-86-3)	4	0	ND	ND	0.00
Propionaldehyde (123-38-6)	4	4	0.02	0.07	0.03
Tolualdehydes (NA)	4	4	0.01	0.02	0.01
Valeraldehyde (110-62-3)	4	2	ND	0.01	0.01

*Samples reported as non-detects (ND) were included in averages as 1/2 minimum detection limits.