$PM_{2.5}$ Survey Results

Winter 2009-2010

Report Completed

May 2010

Introduction

According to the Environmental Protection Agency (EPA), particle pollution (also called particulate matter or PM) is the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small, they can only be detected using an electron microscope.

Particle pollution includes "inhalable coarse particles," with diameters larger than 2.5 micrometers and smaller than 10 micrometers and "fine particles," with diameters that are 2.5 micrometers and smaller.

These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some particles, known as *primary particles* are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Others form in complicated reactions in the atmosphere of chemicals such as sulfur dioxides and nitrogen oxides that are emitted from power plants, industries and automobiles. These particles, known as *secondary particles*, make up most of the fine particle pollution in the country.

EPA regulates inhalable particles (fine and coarse). Particles larger than 10 micrometers (sand and large dust) are not regulated by EPA.

- **Health Effects**: Particle pollution contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. The size of particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream.
- **Visibility Effects**: Fine particles ($PM_{2.5}$) are the major cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas.

The Summit County Health Department in 2007 was tasked with measuring the air quality in the county by the County Commission. The Health Department contacted the Department of Environmental Quality (DEQ), Division of Air Quality to request an air monitoring station for this area. The DEQ denied the request stating that Summit County did not have an air quality problem. However, the DEQ did offer to loan the county monitoring equipment that tested for $PM_{2.5}$. In the spring of 2008, the Summit County Health Department began testing for this specific particulate matter.

The following season, two $PM_{2.5}$ monitors were purchased by the Health Department and County. These machines cost $20,000 each and were capable of testing continuously throughout the season. The monitors that were on loan from DEQ required individual sampling disks and evaluating could only be done at the DEQ offices. The two monitors were placed in the Park City area with one on Old Ranch Road (Image 1) and the other at Quinn's Junction (Image 2).

This report summarizes the data from the past year of the levels of $PM_{2.5}$. The data is represented in units of $\mu g/m^3$ – micrograms per meter cubed, or parts per billion. Because of differing methodologies and equipment, comparisons are not available between years one and two. However, annual trends will be documented in future reports.

Summary

The Summit County Health Department (SCHD) conducted a four-month study of $PM_{2.5}$ particulates in the Quinn's Junction and Snyderville Basin areas of Summit County, Utah. Sampling was continuous over the span of 105 days at both sites running December 23, 2009 through April 12, 2010.

Results indicated generally low levels of $PM_{2.5}$, with the exception of two days. During those two days, levels of $PM_{2.5}$ were elevated due to dust storm events. The 24-hour mean concentrations of $PM_{2.5}$ were lower at the Quinn's Junction site (4.4 $\mu g/m^3$) than at the Old Ranch Road site (5.5 $\mu g/m^3$). The highest measured $PM_{2.5}$ level was 44.9 $\mu g/m^3$ recorded March 30, 2010 at the Old Ranch Road Site.

Demographics

The $PM_{2.5}$ sampling area has approximately 28,000 residents. Park City has 8,000 within its limits with the other 20,000 living in the Snyderville Basin area.

Park City is a resort community with year-round tourism. During the winter, visitors can increase these numbers by 10,000 to 25,000 people depending on the day and event.

Study Objective

The objective of the study was to determine the $PM_{2.5}$ concentrations of the outdoor air in the Quinn's Junction and Snyderville Basin areas during periods of wintertime temperature inversions.

Parameter Tested

The monitoring stations were testing for $PM_{2.5}$ particulates. These airborne "fine particles" found in smoke and haze are 2.5 micrograms in diameter or less. Often referred to as soot, these small particles are comprised of acids (such as nitrates and sulfates), organic chemicals, metals, soil or dust particles, and allergens.

Sampling Periods and Frequency

The study was limited to the winter months (December 2009 through April 2010) when the likelihood of $PM_{2.5}$ concentrations is highest. Following EPA sampling protocol, air samplers were programmed to run 24-hour periods (from midnight to midnight) for each sample run.

Equipment Description

$PM_{2.5}$ Air Samplers: SCHD used the BAM (Beta Attenuation Monitor) -1020 $PM_{2.5}$ (Met One Instruments, Inc, Grants Pass, Oregon). The BAM-1020 automatically measures and records airborne particulate concentration levels using beta ray attenuation. The system determines the concentration in units of milligrams or micrograms of particulate per cubic meter of air. A small 14C (Carbon 14) element emits a constant source of high-energy electrons referred to as beta particles. The beta particles are detected and counted by the system using a sensitive scintillation detector. An external pump pulls a measured amount of dust-laden air through a filter tape. Once the tape is loaded with ambient dust, it is then automatically placed between the source and the detector which causes an attenuation of the beta particle signal. The degree of attenuation of the beta particle signal is used to determine the mass concentration of particulate matter on the filter tape. This recording shows the volumetric concentration of particulate matter in the ambient air.

Results and Discussion

The $PM_{2.5}$ levels at each site were generally in the good range. These levels were exceeded only during two sample periods as a result of significant dust storm events. On one occurrence the sensitive groups (Refer to Table 1) were at risk for a 24-hour period. One sample average concentration $PM_{2.5}$ of this study exceeded the 24-hour National Ambient Air Quality Standard (NAAQS) which is set at 35 $\mu g/m^3$. The maximum concentration was 44.9 $\mu g/m^3$ on March 30, 2010 when a storm created large amounts of dust, which increased the concentration for five to six hours and then dropped back to minimum range (less than 10 $\mu g/m^3$).

For purposes of reporting air quality conditions to the public and providing an assessment of health risk, DAQ has classified $PM_{2.5}$ exposure levels into six risk categories (only the four lowest are shown in Table 1). Pollutant concentrations are expressed in terms of an Air Quality Index (AQI) with its associated health advisories.

The charts at the end of this report illustrate the data collected. Chart 1 shows the daily average reading concentrations of Quinn's Junction and Old Ranch Road. Chart 2 from March 30, 2010 shows the 24-Hour concentration comparison between Old Ranch Road and Quinn's Junction test site. Chart 3 is a comparison of 2009 to 2010 winter months at the Old Ranch Road test site.

Image 1: Old Ranch Road Air Quality Test Site

Image 2: Quinn's Junction
(Where the Summit County Health Department is now located.)

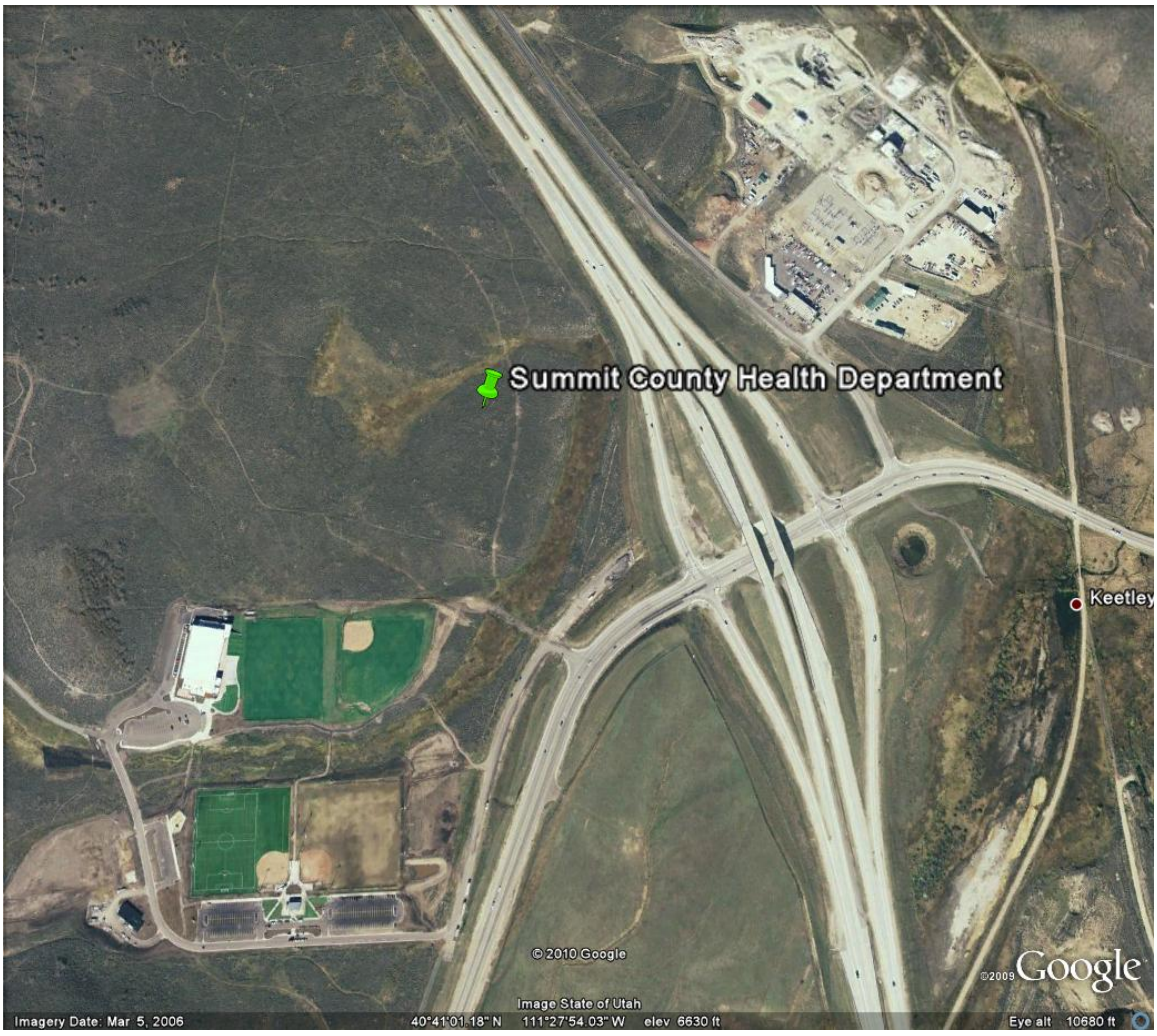


Table 1: Air Quality Index Levels Based on $PM_{2.5}$ Concentrations and Health Advisories.

AQI Notification	$PM_{2.5}$ Concentration ($\mu g/m^3$)	Health Advisory
Good (Green)	0 to 15.4	None
Moderate (Green)	15.5 to 25.4	None
Moderate (Yellow Action)	25.5 to 35.4	None
Unhealthy for Sensitive Groups	35.5 to 55.4	Sensitive people (those with respiratory or heart disease, the elderly, and children) should reduce prolonged or heavy exertion outdoors.

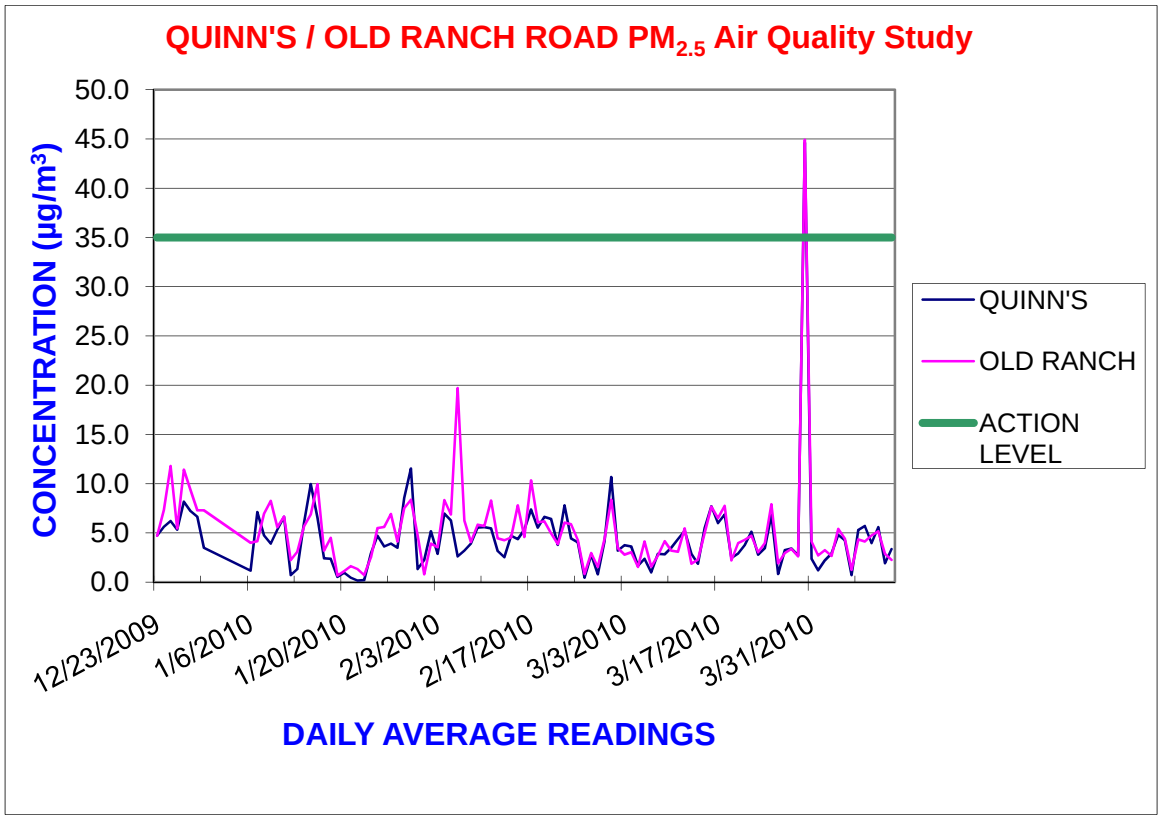
The Environmental Protection Agency characterizes particulate matter by size, not chemical composition. Size is determined by a particle's aerodynamic diameter expressed in micrograms (µg). "Fine particulates" are typically defined as $PM_{2.5}$ or smaller; coarse particulates are greater than 2.5 µg, but smaller than 10 µg. Smaller particles pose a greater hazard to health.

Table 2: $PM_{2.5}$ sample results from Quinn's Junction and Old Ranch Road.

QUINN'S JUNCTION / OLD RANCH ROAD $PM_{2.5}$ WINTERTIME STUDY: DAILY AVERAGE CONCENTRATIONS

SAMPLE DATE	QUINN'S JUNCT.	OLD RANCH ROAD		SAMPLE DATE	QUINN'S JUNCT.	OLD RANCH ROAD		SAMPLE DATE	QUINN'S JUNCT.	OLD RANCH ROAD
12/23/2009	4.8	4.7		2/10/2010	5.6	5.7		3/25/2010	6.8	7.9
12/24/2009	5.6	7.3		2/11/2010	5.5	8.3		3/26/2010	0.8	1.9
12/25/2009	6.2	11.8		2/12/2010	3.2	4.5		3/27/2010	3.3	3.0
12/26/2009	5.3	5.5		2/13/2010	2.5	4.3		3/28/2010	3.4	3.4
12/27/2009	8.2	11.4		2/14/2010	4.7	4.5		3/29/2010	2.7	2.6
12/28/2009	7.2	9.3		2/15/2010	4.4	7.8		3/30/2010	44.6	44.9
12/29/2009	6.7	7.3		2/16/2010	5.3	4.6		3/31/2010	2.4	4.1
12/30/2009	3.5	7.3		2/17/2010	7.4	10.3		4/1/2010	1.2	2.7
1/6/2010	1.2	4.0		2/18/2010	5.5	6.1		4/2/2010	2.2	3.3
1/7/2010	7.1	4.2		2/19/2010	6.6	6.2		4/3/2010	2.9	2.7
1/8/2010	4.8	7.0		2/20/2010	6.4	5.0		4/4/2010	4.8	5.4
1/9/2010	3.9	8.3		2/21/2010	3.8	3.9		4/5/2010	4.3	4.4
1/10/2010	5.3	5.6		2/22/2010	7.8	6.0		4/6/2010	0.7	1.3
1/11/2010	6.6	6.7		2/23/2010	4.4	5.9		4/7/2010	5.3	4.3
1/12/2010	0.7	2.3		2/24/2010	4.0	4.3		4/8/2010	5.7	4.1
1/13/2010	1.3	3.1		2/25/2010	0.5	0.8		4/9/2010	4.0	4.8
1/14/2010	6.0	5.7		2/26/2010	2.8	3.0		4/10/2010	5.6	5.2
1/15/2010	10.0	6.9		2/27/2010	0.8	1.5		4/11/2010	1.9	2.9
1/16/2010	6.5	10.0		2/28/2010	4.2	4.4		4/12/2010	3.4	2.3
1/17/2010	2.4	3.2		3/1/2010	10.7	8.4				
1/18/2010	2.4	4.5		3/2/2010	3.2	3.5				
1/19/2010	0.5	0.7		3/3/2010	3.8	2.8				
1/20/2010	1.0	1.1		3/4/2010	3.6	3.0				
1/21/2010	0.5	1.6		3/5/2010	1.7	1.5				
1/22/2010	0.2	1.3		3/6/2010	2.4	4.1				
1/23/2010	0.2	0.7		3/7/2010	1.0	1.6				
1/24/2010	2.9	2.5		3/8/2010	2.9	2.7				
1/25/2010	4.7	5.5		3/9/2010	2.8	4.2				
1/26/2010	3.6	5.6		3/10/2010	3.5	3.2				
1/27/2010	3.9	6.9		3/11/2010	4.4	3.1				
1/28/2010	3.5	4.1		3/12/2010	5.2	5.5				
1/29/2010	8.5	7.5		3/13/2010	2.9	1.9				
1/30/2010	11.5	8.4		3/14/2010	1.9	2.3				
1/31/2010	1.3	4.8		3/15/2010	5.5	5.0				
2/1/2010	2.3	0.8		3/16/2010	7.7	7.7				
2/2/2010	5.2	3.9		3/17/2010	6.0	6.5				
2/3/2010	2.9	3.5		3/18/2010	6.9	7.8				
2/4/2010	7.0	8.3		3/19/2010	2.5	2.2				
2/5/2010	6.3	6.9		3/20/2010	2.9	4.0				
2/6/2010	2.6	19.7		3/21/2010	3.8	4.3				
2/7/2010	3.2	6.3		3/22/2010	5.1	4.7				
2/8/2010	3.9	4.1		3/23/2010	2.8	3.0				
2/9/2010	5.5	5.8		3/24/2010	3.5	4.0				

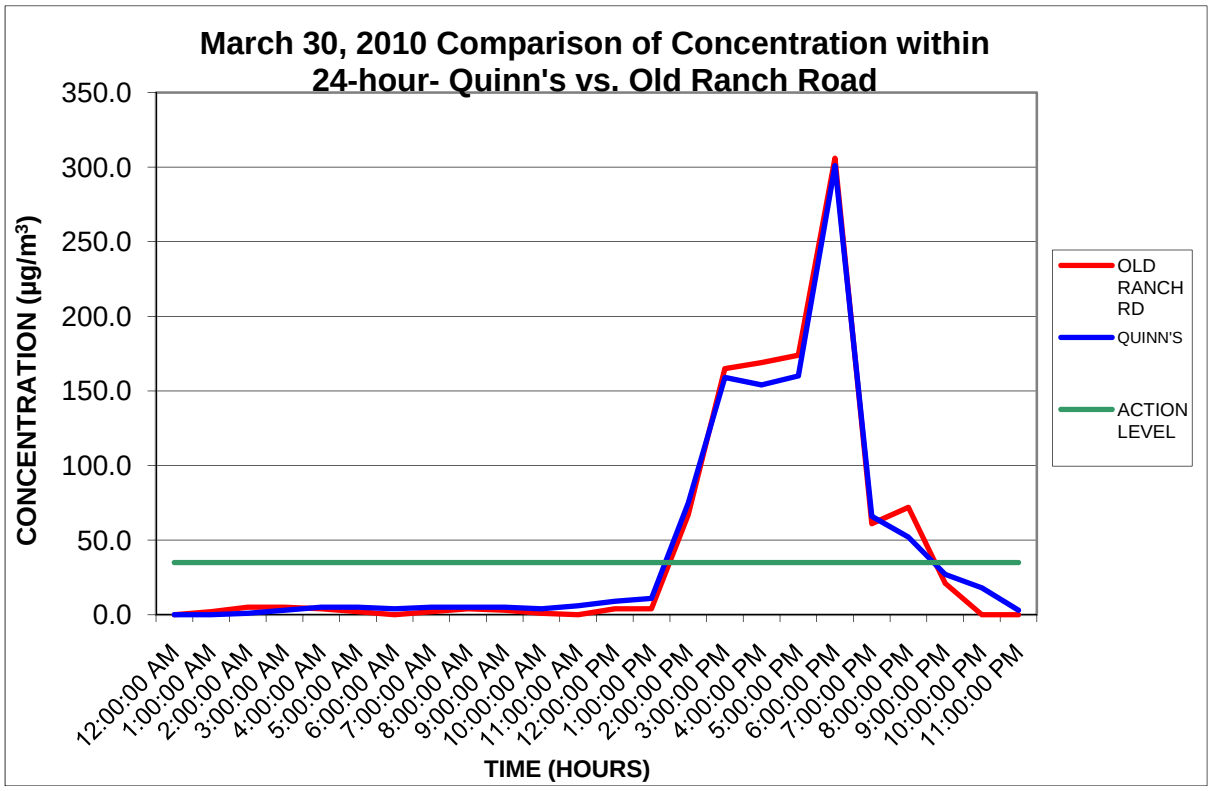
Chart 1: Daily average reading concentrations of Quinn's Junction and Old Ranch Road.



As illustrated in the graph shown above, the Old Ranch Road test site indicated higher $PM_{2.5}$ levels than Quinn's Junction. The daily average $PM_{2.5}$ levels at Old Ranch Road were 5.5 µg/m^3, compared to Quinn's Junction at 4.4 µg/m^3. Eighty percent of the time, Old Ranch Road $PM_{2.5}$ levels were higher. The Quinn's Junction indicated levels that matched or surpassed Old Ranch Road only on those days when the concentrations at both sites were minimal (<10 µg/m^3).

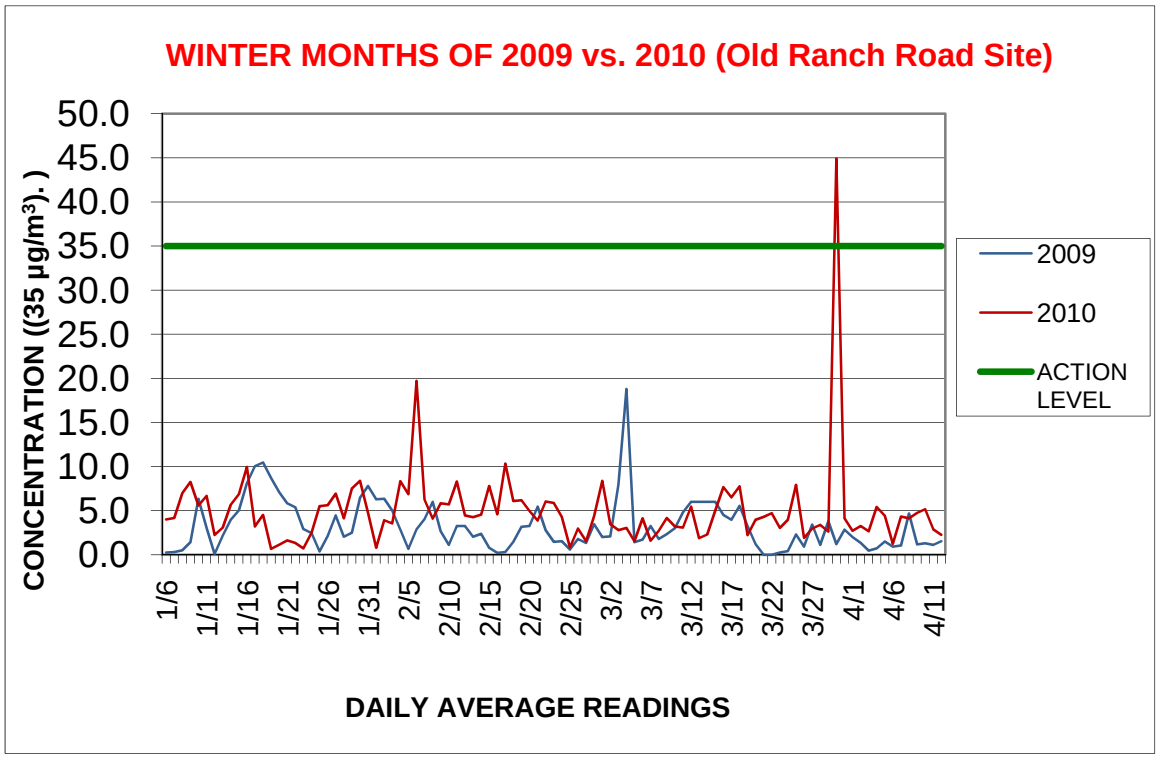
To comply with the 24-hour $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS), the three-year average of the 98th percentile of 24-hour concentrations at each site must not exceed 35 µg/m^3. The standard is based on three continuous years of monitoring data and is statistically-based. For example, if sampling occurs everyday, without fail during a calendar year, the seven highest $PM_{2.5}$ concentrations would be dismissed and the eight highest level (98th percentile) determines compliance or non-compliance with the standard when coupled with two other contiguous years of $PM_{2.5}$ monitoring from the site.

Chart 2: March 30, 2010, 24-Hour concentration comparison between Old Ranch Road and Quinn's Junction test site.



The data in the chart above provides concentration readings taken on March 30, 2010 for a period of 24-hours. On this day a storm moved into the Salt Lake Valley from the west. Winds from the storm increased in strength and brought large amounts of dust particles into the Park City area. For a period of six hours the $PM_{2.5}$ concentration exceeded the action level (35 µg/m^3), but the concentration dropped dramatically back to well below the minimum range.

Chart 3: Comparison of 2009 to 2010 winter months at the Old Ranch Road test site.



The Graph above shows the $PM_{2.5}$ concentration differences between the months of January through April in the years of 2009 and 2010. The same site on Old Ranch Road was utilized in these tests to provide data that is consistent for comparison purposes. In 2009 there was a spike of 18.8 µg/m^3 on March 4, 2009. A disturbance also occurred on February 6, 2010 with a $PM_{2.5}$ concentration 19.7 µg/m^3. The largest recorded spike, as noted previously, occurred on March 30, 2010 when a storm pushed large amounts of dust particulates into the area. The $PM_{2.5}$ concentration that day reached 44.9 µg/m^3, which exceed the action level of 35 µg/m^3 for six hours and then dropped back well below the action level.