

Air Quality in Butte-Silver Bow

During the summer of 2013, the Butte-Silver Bow Health Department commissioned two studies of the airshed. The studies were performed by private contractors who specialize in ambient air quality, Tony J. Ward, Ph.D., the University of Montana, and Kumar Ganesan, Ph.D., Energy and Environmental Research & Technology, LLC.



The Ward Executive Summary

During the summer of 2013, ambient samples of PM-2.5 (particulate matter less than or equal to 2.5 microns in diameter) were collected in Butte, Montana. These samples were then used to identify the major sources of PM-2.5 to the Butte airshed during the summer of 2013. As part of the program, air samples were collected every six days from June 3 through Sept. 7, 2013. After the samples were collected, they were analyzed for chemical compounds of interest (elements, carbon and ions). These data were then used in a Chemical Mass Balance (CMB) computer model to

apportion the sources of the fine fraction. For the samples collected during the summer of 2013 and used for CMB modeling, PM-2.5 mass concentrations were very low. The average PM-2.5 24-hour concentration was 5.8 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) on the scheduled sample days ($n=10$), with the highest concentration ($11.5 \mu\text{g}/\text{m}^3$) measured July 3, 2013. The results of the CMB modeling revealed that wood smoke was the major source of ambient PM_{2.5} throughout the summer

months in Butte, contributing nearly 72 percent of the measured PM-2.5. This wood smoke component is likely from residential outdoor biomass burning, as well as local and regional controlled/wild forest fire events. The other sources of PM-2.5 identified by CMB were street sand/road dust (11.1 percent), secondary sulfate (7.8 percent), ammonium nitrate (5.5 percent), and automobile exhaust (1.3 percent). About 2.4 percent of the PM-2.5 was unexplained by the CMB model.

The Ganesan Executive Summary

Particulate concentration data in Butte were evaluated to understand the trend of particulate matter less than or equal to 10 micrometer diameter size (PM-10) and 2.5 micrometer in diameter size (PM-2.5) with respect to wind direction at the Greeley School monitoring site in Butte. In addition, PM-2.5 data from several satellite temporary monitoring sites were analyzed to understand the distribution of PM-2.5 across the Butte Valley. Also, five specific metal contents in the PM-2.5 were evaluated from samples collected from Greeley School site.

The PM-10 data from 1993 through 2012 was analyzed to understand the particulate trend in Butte over the years. The annual average PM-10 levels since 1993 were steady at 20ug/m³ until 2000. A small decline occurred in the concentration from 2001 through 2004, reaching a lowest concentration of 14ug/m³ in 2002. The PM-10 levels showed increasing trends from 2005, peaking at 32ug/m³ in 2007 and becoming steady from 2008 through 2012 at about 29ug/m³. The maximum hourly concentration of 163ug/m³ of the PM-10 occurred Sept. 15, 2012. The PM-10 trend indicated an increase of about 10ug/m³, or 30 percent, during the last five years compared to the PM-10 levels

during 2000.

The PM-2.5 data for the Greeley School was analyzed using daily, quarterly and annual averaging times. In general, the PM-2.5 concentrations at the Greeley School site were lower during the second quarter compared to the first quarter (January-March) and fourth quarter (October-December). However, a 24-hour (daily) maximum of 100.6ug/m³ was observed Sept. 15, 2012.

The metal content in the PM-2.5 samples from the Greeley School site for 2010-2012 was compared to results from a background site in Sieben Flats near Helena, Mont. The results showed no major differences between the two sites.

This event being in the summer could be attributed to contributions from sources other than residential wood-burning, such as forest fires, long-range transport, yard-burning and other sources. The 24-hour PM-2.5 Design Value for 2010, 2011 and 2012 for Butte were 38ug/m³, 39ug/m³ and 34ug/m³. These Design Values can be directly compared to the NAAQS of 35ug/m³. Thus, the 24-hour PM-2.5 levels exceeded the federal PM-2.5 standards in 2010 and 2011 in Butte. However, the annual average Design Values for these three years, 9.8, 9.6 and 8.9ug/m³, respectively, were below the annual NAAQS

standard of 12ug/m³.

Up to eight additional monitoring sites were established on a temporary basis to measure PM-2.5 across the Butte Valley to compare with the Greeley School site PM-2.5 concentrations.

In summary, it appears that during winter months the Greeley School PM-2.5 levels can be twice as high as the Butte Valley PM-2.5 averaged over all sites. The PM-2.5 pollution rose also indicates that the wind direction influencing the PM-2.5 was different in each site based on the available data. During winter months the Greeley School site has predominant wind and associated PM-2.5 from South East to East directions.

The metal content in the PM-2.5 samples from the Greeley School site for 2010-2012 was less than 0.2ug/m³ for all five metals: arsenic, cadmium, copper, lead and nickel. The metal content was also compared to results from a background site in Sieben Flats near Helena, Mont. The results showed no major differences between the two sites. However, the Butte site had slightly higher levels than the Helena site, except nickel. Nickel values in Butte PM-2.5 were either less than or almost equal to the background nickel levels.