A HISTORY OF MISSOULA'S AIR QUALITY PROGRAM
Updated-1999

INTRODUCTION

Missoula is a city located in the Rocky Mountains of western Montana. The Missoula urban area, located in a mountain valley, contains over 69,000 people and is the largest urban area in the United States surrounded by the Rocky Mountains. Because of the mountain valley topography, winter temperature inversions that trap pollution are common. To maintain and improve air quality in Missoula, the growing population of the valley will have to treat the airshed with extra care and continue to find methods of lowering sources of pollution.

The 1967 Montana Clean Air Act authorized local air pollution control programs. By 1969, the Missoula City-County Health Department had developed a local air pollution control program and assumed responsibility for most sources of air pollution in Missoula County.

The Missoula urban area has a history of exceeding the Montana and National Ambient Air Quality particulate standards and the 8-hour carbon monoxide standard. The first recorded exceedances were 1969 for particulate and 1977 for carbon monoxide. Because the National Ambient Air Quality Standards were exceeded, Missoula had to write State Implementation Plans detailing how Missoula would attain and then maintain pollution levels below the federal standards.

HISTORY

Particulate Air Pollution History

Prior to 1970, industrial sources were largely responsible for the high levels of particulate measured in the Missoula valley. By 1974, strict enforcement of emission standards had reduced industrial emissions in the valley by over 90%. As a result, Missoula was able to meet the Federal annual average ambient air quality standard for total suspended particulate (TSP) in 1973 and again in 1975. However, violations of the daily TSP standard continued during the winter months and the respite from generally poor air quality was short.

After the Arab oil embargo of the 1970's, more people began to heat their homes with wood. In 1974 and 1975, local air quality officials found that

wintertime particulate levels were increasing and that TSP collection filters were darker in color than those collected earlier in the decade. They suspected residential wood burning as the source of the increased particulate levels and the cause of the darker filters. Table 1, a compilation of several residential wood burning surveys, shows that the percentage of people burning wood increased through 1980 before beginning to decline.

Table 1: Missoula Residential Wood Burning Trends

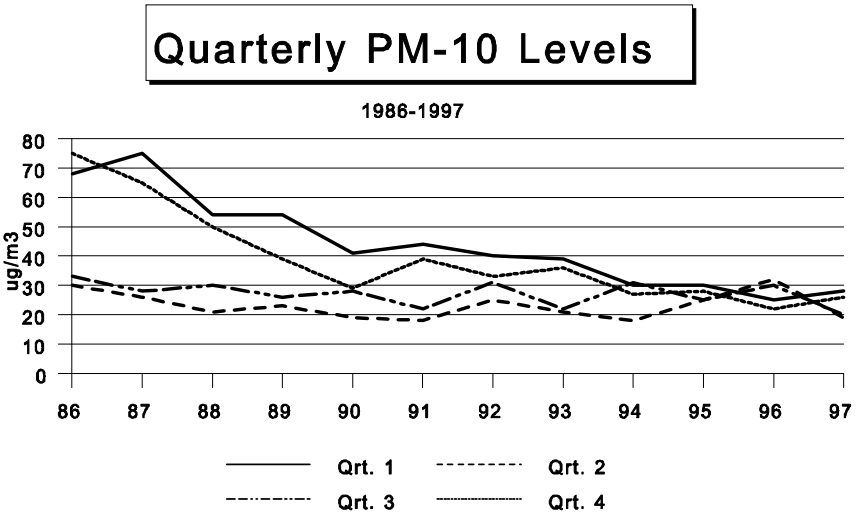
Survey Year	1977	1980	1983	1986	1992	1996
Number of Households	21,305	21,970	22,875	23,325	26,930	27,205
Number of Burners	8,032	11,666	11,483	10,193	6,732	5,332
% RWB	37.7	53.1	50.2	43.7	25.0	19.6
Tons Burned	25,912	54,120	40,296	33,174	22,297	15,151
Tons CO Emitted	2,462	5,141	6,362	6,316	3,595	1,569
Tons PM10 Emitted	648	1,218	1,316	1,079	608	206

In July of 1987, the Environmental Protection Agency passed a PM_{10} (particulate matter with an aerodynamic diameter less than or equal to 10 microns) standard that replaced the total suspended particulate (TSP) standard. The PM_{10} standard was adopted because the 10 micron and smaller particles can reach into the small airways of the lungs while the larger particles are trapped and expelled by the bodies defense mechanisms. So the PM_{10} standard measured particulate that was more relevant to people's health.

During the winter of 1986/1987, the Health Department conducted a chemical mass balance study (CMB) at Rose Park to apportion the sources of PM_{10} in the valley. Residential wood smoke was 47% of the PM_{10} during the study followed by road dust at 22.6%, motor vehicle exhaust at 10.2% and industry at 7.6%. This study confirmed that residential wood burning had replaced industry as the primary source of particulate pollution in the valley.

Missoula exceeded the annual average PM_{10} standard in 1986 and exceeded the 24-hour PM_{10} standard several times between 1987 and 1989. Because of these exceedances, Missoula was designated a non-attainment area for PM_{10} and Montana was required to submit a State Implementation Plan (SIP) to the Federal Environmental Protection Agency by 1990 that included monitoring, emission inventories, chemical analysis of particulate to identify sources, and regulations adequate to meet the PM_{10} standard in Missoula within three years. This plan was written by the Missoula City-County Health Department. To reduce PM_{10} emissions in the valley, both the city and the county adopted regulations on residential wood stoves, outdoor burning, industry, fugitive

emissions, street sanding and street maintenance. As a result of all the community work and effort that has gone into reducing particulate emissions, Missoula has not violated a federal particulate standard since 1989.



The graph above shows how Missoula's winter quarter PM_{10} levels have decreased over the last several years. These decreases have come about because of a community wide effort to control and reduce emissions from vehicles, residential wood burning and industry. Because winter inversions are typical of a mountain valley topography, the highest concentrations of particulate were in the winter and consequently most control measures have been aimed at reducing winter PM_{10} emissions.

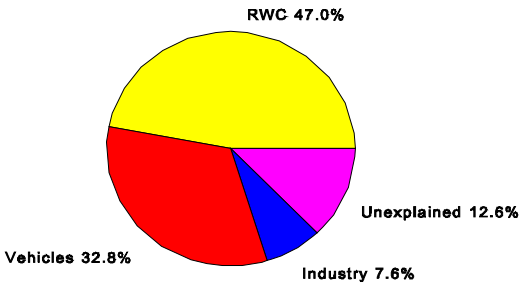
The mix of particulate sources is also different between the summer quarters (quarters 2 and 3) and the winter quarters (quarters 1 and 4). While there is very little residential wood burning in the summer, outdoor burning, forest fires, road dust, and construction fugitive emissions often impact the Missoula airshed during the summer quarters. Since 1994, many of the worst air pollution days have been caused by controlled burns and forest fires outside Missoula's usual winter air pollution season.

In the winter of 1995/1996, Missoula performed another chemical mass balance (CMB) study to see if the apportionment of particulate had changed since the last CMB study. The most striking differences between the two studies were that the average study PM_{10} levels decreased from 107 ug/m^3 to 58.8 ug/m^3, the contribution from residential wood combustion decreased from 50.3 ug/m^3 to 6.2 ug/m^3, and the contribution from road dust increased from 24.2 ug/m^3 to 30.1 ug/m^3. The proportional pie graph on the next page

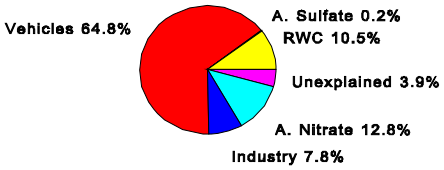
illustrates that wood burning emissions have decreased while vehicle related emissions, mostly road dust, have increased. Road dust emissions have increased even though deicer was used in place of street sand on most city streets during the 1995/1996 study.

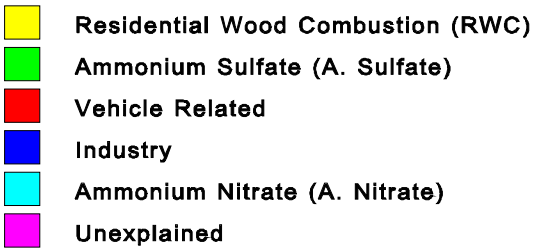
1986/1987 ROSE PARK PM_{10} CMB STUDY AVERAGES
COMPARED WITH THE
1995/1996 BOYD PARK PM_{10} CMB STUDY AVERAGES

1986/1987 ROSE PARK



1995/1996 BOYD PARK



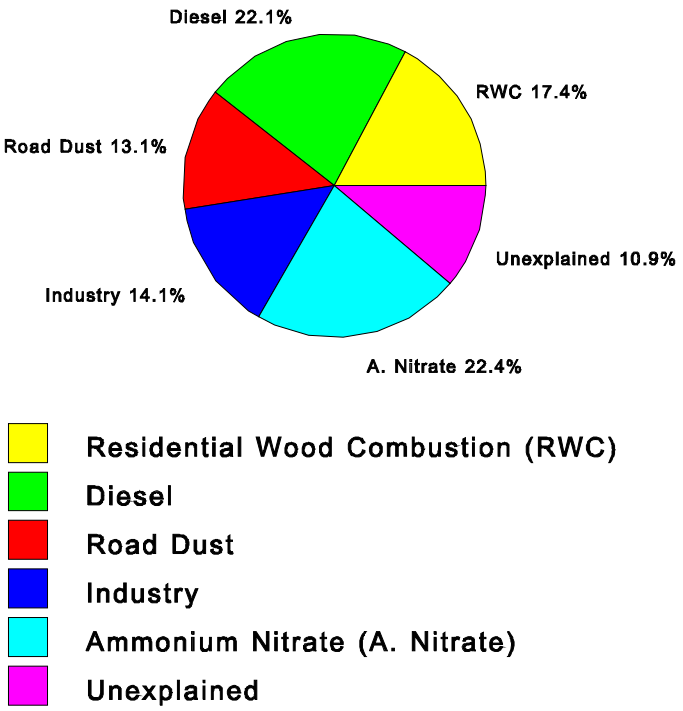


107 *u*g/m^3 58.8 *u*g/m^3

In January of 1999, Missoula began monitoring for $PM_{2.5}$, particulate matter with an aerodynamic diameter less than or equal to 2.5 microns. National ambient air quality $PM_{2.5}$ standards were promulgated by the EPA on July 18, 1997 to address concerns that the PM_{10} standards did not adequately protect human health. The 24-hour standard for $PM_{2.5}$ is 65 *u*g/m^3, not to be exceeded more than 2% of the year, and the three year annual average is 15 *u*g/m^3. Because of $PM_{2.5}$'s smaller size, it can penetrate further into the small lung airways than $PM_{2.5-10}$ and consequently may have more impact on the respiratory system. By 2003, Missoula will know if it violates the $PM_{2.5}$ standards. *(Because of a recent federal court decision, the status of the $PM_{2.5}$ standard is in doubt.)*

$PM_{2.5}$ comes primarily from combustion sources such as woodstoves, vehicle exhaust and industrial boilers. It also includes secondary particulate, like ammonium nitrate, which forms in the atmosphere from ammonia (NH_4^+) and nitrate (NO_3^-) which comes primarily from combustion sources. If Missoula does violate a $PM_{2.5}$ standard, control strategies will have to be applied to these sources. The chart on page 5 shows the sources and relative concentrations of $PM_{2.5}$ for the Missoula 1995/1996 CMB study.

1995/1996 BOYD PARK $PM_{2.5}$ CMB STUDY AVERAGE PERCENTAGES
AVERAGE PARTICULATE LEVELS WERE 32.2 *u*g/m^3



Carbon Monoxide Air Pollution History

Missoula was designated nonattainment for carbon monoxide (CO) on March 3, 1979 (43 FR 9009-9010) because Missoula exceeded the federal 8-hour average CO standard of 9 parts per million. The designation was based on the results of one year of monitoring at the corner of Brooks Street, South Avenue, and Russell Street (Malfunction Junction). On August 14, 1981, Montana submitted a revised carbon monoxide SIP which was based on reconstruction of Brooks Street and anticipated emission reductions from federal emission requirements on new motor vehicles. An analysis of these control strategies

indicated that attainment would be achieved by 1987.

The reconstruction of Brooks Street with minor changes at the intersection was completed in 1985. However, violations of the carbon monoxide standard continued at the Malfunction Junction air monitoring site. Consequently, the EPA notified Montana on May 26, 1988 and again on September 7, 1988 (53 FR 34505) that the Missoula carbon monoxide SIP was substantially inadequate. As a result, Montana was required to complete SIP development activities including a 1988 base year carbon monoxide emission inventory (submitted November 30, 1989). The inventory showed that transportation sources were the primary source of winter carbon monoxide emissions.

The 1990 Federal Clean Air Act (FCAA) designated CO nonattainment areas as moderate or serious. Based on monitoring at the Brooks/South/Russell intersection from 1986 through 1988, Missoula was classified as a moderate nonattainment area for CO. As a result, the EPA required Missoula to implement an oxygenated fuels program and to submit a 1990 base year carbon monoxide emission inventory by November 15, 1992. The inventory indicated that motor vehicles were responsible for 63.8% of the winter carbon monoxide emissions, residential wood combustion contributed 26.1% and industrial sources contributed 9.6% of the carbon monoxide emissions. The graph below shows that Missoula has not violated the 9 parts per million 8-hour average CO standard since the oxygenated fuels program began on November 1, 1992.

A 1992 CO saturation study confirmed that the Brooks/South/Russell intersection had the highest concentrations of carbon monoxide in Missoula. As a result, Missoula only has to monitor at the Brooks/South/Russell intersection and efforts to reduce CO concentrations can be orientated at that intersection.

Also in 1992, as one of 41 cities across the nation that did not meet federal CO standards, Missoula received almost $30 million in federal transportation funding, called Congestion Mitigation Air Quality (CMAQ) funding, to spend over the next five years. In 1993 the Brooks/South/Russell intersection was identified as one of the projects to receive CMAQ funding. The City undertook a long and involved process to find a solution the community would accept and that would solve the congestion and air quality problems at Brooks/South/Russell. Many alternatives were explored including an overpass, an underpass, various roundabouts, system improvements to surrounding arterials, traffic demand management, an urban interchange, and a combination of an overpass or underpass with system improvements. Most of these alternatives were rejected because they would not solve the air quality

problem at the intersection. The overpass alternative, which would significantly reduce the CO at the intersection, was overwhelming rejected by the public. Finally the city settled on an at-grade realignment of South Avenue. The City Council held a public hearing in September of 1997 and approved the project in October 1997. In April 1999, the City Council and the community reaffirmed its commitment to the project with the hiring of a contractor for the final design. The project is expected to be completed by the end of 2001.

Air quality modeling showed that, given worst case meteorological conditions, Missoula would exceed the national ambient air quality standards for CO if nothing was done at the intersection. However, with the project, Missoula would continue to attain the standard with current controls at least through 2015.

Alternative	1993	1998	2015
Existing/No Action	21.1	15.6	10.8
South Ave. Realignment	NA	8.3	6.6

The improvements in the no action alternative come from predicted improvements in the fleet, as older cars are removed from service. However, at some point, the improvements from fleet turn over would be overwhelmed by ever-increasing vehicle miles traveled.

Since Missoula has had more than three years of monitoring with no exceedances of the national standards, Missoula is eligible for applying for redesignation as an Attainment Area for CO. To do this, the Health Department must write a maintenance plan that shows Missoula will not violate the standards. The project at Brooks/South/Russell is essential to this effort.

HEALTH STUDIES

In 1977, the Montana State Legislature funded the Montana Air Pollution Study (MAPS) to evaluate the impacts of air pollution on a state-wide basis. A major portion of the funding went into health effects studies to determine whether air pollution affects school children and those adults with chronic obstructive pulmonary diseases, such as asthma, emphysema and chronic bronchitis.

In 1978 and 1979, third and fourth graders in Great Falls, urban Missoula and outlying rural and low-density suburban areas near Missoula were given pulmonary function tests (PFT). The annual average total suspended particulate (TSP) in Great Falls was 42 ug/m3 compared to Missoula's 81 ug/m3. The TSP levels in the outlying areas near Missoula were one third to one half the levels found in urban Missoula. In all PFT comparisons, with one exception, the children from the lower TSP communities exhibited better pulmonary function than those from urban Missoula. Children exhibited the greatest differences when medium and small airway resistance was measured, which confirmed that small air passages are the most sensitive to air pollution effects.

MAPS also funded a study which compared school children's lung functions to different air pollution levels within one community. In 1978-79 and again in 1979-80, Missoula third and fourth graders were given a series of pre-scheduled PFTs, which were then correlated with pollution levels. During both years, the children exhibited decreased pulmonary function as particulate levels increased.

During 1979-80, 84 adults with chronic obstructive pulmonary diseases underwent monthly pulmonary function testing. These subjects kept diaries of their daily symptoms and activity levels. The researchers compared the PFT and diary data to TSP levels by regression analysis. As particulate levels increased, all PFT parameters and activity levels decreased. In addition, with increased pollution levels, four of five morbidity symptoms increased.

The results of the MAPS studies suggest that TSP similar to that found in Missoula during the winter causes measurable health effects upon the human pulmonary system and upon small airways in particular. Dr. Kit Johnson, Director of the MAPS Health Effects Study, concluded, "Possibly these changes are reversible and short-term and may not lead to significant permanent lung damage in the majority of individuals. However, the long-term effects are not known, and the effects upon the growing lungs of children less than five or six years old are unexplored." Even with these uncertainties, there is no doubt that high pollutant levels make breathing and other normal activities more difficult for those who have asthma, chronic bronchitis, emphysema and other disorders of the pulmonary system.

MAPS also evaluated the relative carcinogenicity (cancer causing potential) of particulate in ten Montana cities. Monthly samples were taken in each town for a year and analyzed for organic mutagen content. The ten cities ranked as follows in decreasing order of the number of mutagen equivalents present: Missoula, Billings, Kalispell, Butte, Libby, Bozeman, Anaconda, Great Falls,

Decker, and Scobey.

At first glance, it was surprising that Missoula, which doesn't have any industries that are considered traditional sources of organic carcinogens, would rank highest on the list. It wasn't like Billings, a town with three oil refineries, which researchers expected to rank high. Further inspection of the test results showed that, with the exception of Billings, the other top five ranking towns exhibited high levels of mutagens during the winter and relatively low concentrations during the summer. These towns are all located in western Montana where wood is readily available and commonly used by industry and residents for heating. An analysis of the combustion products of woodsmoke indicated that sufficient carcinogens are present to explain the results of the Montana mutagen study.

Local Strategies to Improve Air Quality

Residential Wood Combustion

In less than a decade, Missoula's major source of air pollution shifted from six industrial sources to approximately 20,000 residential wood stoves and fireplaces. The shift occurred because Missoulians wanted to save on rising fuel bills while reducing dependence on fossil fuels. The Health Department responded to the increase in residential wood burning by identifying its impacts on air quality and by stressing potential threats to public health.

In 1981 and 1982 the Department used several strategies to encourage individuals to assume responsibility for the community's health. Extensive public education efforts included production of public service announcements, informational pamphlets, and a 20 minute slide show concerning air quality and health effects; creation of air pollution curriculum materials for schools; and establishment of a Speakers' Bureau which made presentations to 2600 people in one year.

In 1983 and 1985, the Air Pollution Control Board and the County Commissioners adopted regulations on wood stoves. Only clean burning wood stoves could be installed inside the Air Stagnation Zone and burning during Stage I Air Alerts was limited to Class I stoves, sole source of heat stoves, people with special needs and dealer demonstrations. A Class I stove is defined as a stove that emits $\leq$ 4.1 grams/hour by the EPA testing method. Other rules adopted included limiting the opacity (density of smoke) emitted from a fire and allowing only newspaper and untreated wood to be burned in a woodstove or fireplace. In 1987, a $20.00 fine for first time residential

burning violations during a Stage I Alert was adopted; in 1994 the fine for the first burning violation was increased to $50.00.

Woodsmoke continued to be, and still is, a major source of air pollution in the Missoula valley. As a result, the Air Pollution Control Board adopted even more stringent rules in 1994 to help maintain and improve air quality in the Missoula Valley. In 1994 it became illegal to install woodstoves in the Air Stagnation Zone. Now, only pellet stoves and gas appliances may be installed inside the Air Stagnation Zone. In addition, all solid fuel burning devices inside the Air Stagnation Zone that emit more than 5.5 grams particulate per hour must be removed upon the sale of a property.

Street Maintenance Regulations

The 1986-1987 Chemical Mass Balance source apportionment study identified street sanding material as a major contributor to violations of the ambient particulate standard. When the snow and ice melts off the urban streets, vehicles stir the sanding material into the air. In 1987, the Air Pollution Control Board passed regulations mandating that cleaner and more durable material be used for street sanding. To control road dust emissions from streets, street sweeping on major arterials must be done in the winter/spring months as soon as the paved road surface is above 32^0F for longer than 4 hours.

In 1994, the Board adopted deicer and paving regulations. In a large part of the urban area, except for sloped roads, the use of deicer in place of street sanding material is required when the ambient temperature is above 0^0F.

Paving Regulations

In 1994, the Air Pollution Control Board, County Commissioners and City Council adopted paving regulations inside the Air Stagnation Zone. These regulations require all new roads, commercial driveways, parking lots and other commercial vehicle use areas be paved before occupancy. They do make an exception for long term storage of heavy equipment and other vehicles and RV parking sites in RV parks. However, these areas must meet gravel specifications to reduce the amount of dust generated on site and dragged onto paved surfaces.

These regulations also require that new driveways accessing a paved road be paved at least 20' back from the pavement or to the edge of the right-of-way, whichever is longer. If the new driveway is accessing an unpaved road, the owner must sign a waiver of the right to protest an RSID for the paving of the

access road in the future.

Outdoor Burning Regulations

In Missoula County, all fires require a permit, with the exception of small recreational and cooking fires. An Interlocal Agreement between the City, the County, the Air Pollution Control Board and the local fire protection agencies has made permitting easier by making permits available at all fire departments and land management agencies at no charge. Requiring permits has significantly reduced the number of illegal burns and escaped fires in the County.

Missoula County has specific seasons for different types of burning to reduce the amount and impacts of smoke.

General	March 1 - August 31
Essential Agriculture	March 1 - October 31
Wildland	March 1 - November 30

These seasons are often suspended in July, August and September due to high fire danger. In addition, burning can be restricted anytime due to air quality or fire danger concerns. Burners must call one of Missoula County's Outdoor Burning Hotlines (728-2667 or north of Clearwater junction 677-2899) after 9 AM on the day they want to burn to see if any restrictions are in effect.

Within Missoula City limits, there are additional limits on outdoor burning. Only those homeowners with one acre or more can obtain a permit for burning. Recreational fires are not permitted in the city, only small cooking fires using just enough fuel to cook the food are allowed.