

Missoula Montana

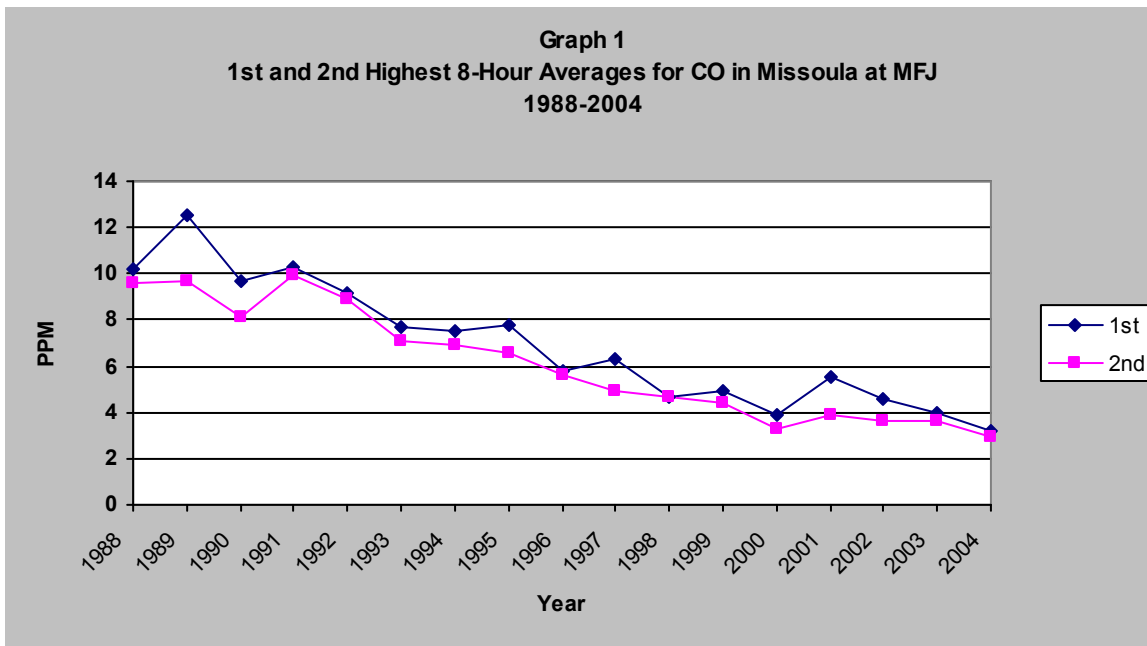
Reserve Street Carbon Monoxide Study

Winter 2005-2006

Benjamin Schmidt, Missoula City-County Health Department, 301 W. Alder, Missoula, MT 59802

Introduction

Missoula has a history of violating the 8-hour average National Ambient Air Quality Standard for carbon monoxide (CO). The 8-hour standard is 9 parts per million not to be exceeded more than once per calendar year. With the advent of oxygenated fuel and cleaner burning vehicle fleets that emit less CO per vehicle mile traveled, violations of the CO standard have ceased in Missoula. As shown by Graph 1 below, the last violation of the 8-hour average CO standard was in 1991, and the CO concentrations have steadily declined when compared to the early 1990s concentrations.



The December 1992 CO saturation study¹ proved that the intersection of Brooks-South-Russell, also known as Malfunction Junction (MFJ), had the highest concentrations of CO in the Missoula urban area. Therefore, monitoring at MFJ caught the worst-case CO levels. Because the Missoula CO concentrations are well below the standard, the Missoula City-County Health Department (Department) applied in 2005 to the Environmental Protection Agency for CO redesignation. When redesignation is complete, Missoula will be considered a maintenance area, rather than a non-attainment area, for CO.

During the redesignation process, various individuals and groups in the Missoula community pointed out that Missoula had grown and changed since the 1992 CO saturation study and that CO concentrations on the Reserve Street corridor may be higher than those at MFJ. Since 1992, Reserve Street has grown from a two-lane road into a busy four-lane highway with major commercial development along most of the corridor.

Traffic count data (see Appendix A) show that Reserve Street has become the busiest road in Missoula. In response to these concerns, the Missoula Air Pollution Control Board requested that the Missoula Health Department conduct a winter 2005-2006 CO study along the Reserve Street corridor.

The primary purpose of the study was to verify that Missoula is in compliance with the CO National Ambient Air Quality Standards by measuring for CO by Reserve Street, where concentrations are expected to be highest. The other purpose of the study was to compare CO levels between MFJ, which was restructured in 2005 prior to the study, and the Reserve Street corridor. Missoula's permanent CO analyzer is also located at MFJ.

The main focus of the study was near the major Reserve Street intersections because vehicles are the primary source of CO in Missoula and CO concentrations are higher at intersections where large numbers of vehicles idle, accelerate and stop. Vehicles produce more CO when they stop, start and idle than they do when cruising at a steady speed. CO concentrations are higher in the winter time because temperature inversions trap cold air and pollution on the valley floor and cold vehicles produce more CO.

Equipment

A CO analyzer designated by the EPA as equivalent to the Federal Reference Method monitored CO concentrations at the MFJ site from October 1, 2005 through March 31, 2006. Seven minivol portable samplers built by AirMetrics collected 8-hour CO bag samples from various locations. The portable samplers were supplied by the Montana Department of Environmental Quality. The CO analyzer already in operation at MFJ was used to analyze the Reserve Street CO samples collected by the portable samplers.

Each minivol sampler consists of a battery pack, a flow control and pumping module, and one or two Tedlar bag modules. Samples were collected over an 8-hour period so that the 8-hour average CO concentrations could be determined. Air was pumped into the Tedlar bags at a constant rate for the 8-hour sample period. The bag module was then taken to the EPA certified CO analyzer at MFJ for analysis. A collocated sample was collected when two Tedlar bag modules are connected to one flow control/pumping module.

Minivol samplers and collection bags were checked over and flows were adjusted before the study began. Sample volume collected was noted during the study and adjustments were made as necessary.

Sampling Sites

All seven samplers ran at the same time to form a "sample set." With seven samplers, it was possible to sample two or more intersections at a time with each "sample set." Comparisons were made between the intersections with samplers and the Brook-South-Russell intersection.

Collocated samples were collected at one site each sample day to measure the precision of the CO analyzer and sampling technique. One sampler from each sample set was placed in a residential neighborhood near Reserve Street to measure background CO concentrations. So each sample set included six sample locations at two or more intersections and one sample from a Missoula residential area. Generally, samplers at the same intersection were placed on different legs of the intersection.

Sampling Schedule

Samples were collected during periods when poor dispersion was predicted between November 9 and February 11. The goal of the study was to collect samples when CO levels were at their highest. To determine what time of day would have the highest CO concentrations, we looked at past CO violations and considered current sources of CO pollution. Table 1 below summarizes the most recent 8-hour CO violations.

Table 1
CARBON MONOXIDE VIOLATIONS
 1985-1991
 MISSOULA, MT

<u>SITE</u>	<u>DATE</u>	<u>HOURS</u>	<u>PPM</u>
Boyd Park	12-4/5-85	1700-2400	10.6
Boyd Park	12-23/24-85	1900-0200	9.9 *
MFJ	2-10/11-87	1800-0100	10.4
MFJ	2-11/12-87	1800-0100	10.6 *
MFJ	2-12/13-87	1900-0200	9.6 *
MFJ	2-13/14-87	1800-0100	9.2 *
MFJ	1-12/13-88	1700-2400	9.8
MFJ	12-6/7-88	1800-0100	9.6 *
MFJ	1-9-89	1200-1900	12.3
MFJ	12-4-89	1500-2200	9.7 *
MFJ	12-31-90	1400-2100	9.7
MFJ	1-8-91	0800-1500	9.7
MFJ	1-14-91	0800-1500	9.8 *
MFJ	2-1-91	1600-2300	9.8 *
MFJ	11-3-91	1500-2200	10.2 *
MFJ	11-4-91	1000-1700	9.9 *

STANDARD = 9.0 PPM AVERAGED OVER 8 HOURS
 NOT TO BE EXCEEDED MORE THAN ONCE PER YEAR

*Counts as violation of the Federal Standard

Most of the 8-hour exceedances between 1985 and 1989 started after 5:00 PM and ran into the night. For these dates, woodstoves were a significant contributor to CO pollution in the valley. It seems likely that many people started their woodstoves when they got home in the evening and then dampened the stove down when they went to bed. This behavior would cause woodstoves to produce large amounts of CO during the evening and into the night. By the 1990s, woodstove use had declined significantly². This decline in woodstove use has continued because of regulations that prohibit the installation of solid fuel burning devices and because inefficient woodstoves must be removed when a property changes ownership³.

With increased traffic and drastically reduced woodstove use, the primary source of CO is the vehicle fleet. This, combined with the results from the 1992 CO Saturation Study and the Year 2000 CO Emission Inventory⁴, indicate that intersections have the highest concentrations of CO. Because residential wood

combustion is not the large CO contributor that it was, the highest CO concentrations occur when traffic is heavy and dispersion is poor. The table above shows that by 1991, the high CO concentrations had shifted to earlier in the day when traffic was heavier.

Therefore, 8-hour samples for this study were collected between 10:00 AM and midnight, with most samples collected in the late afternoon through evening hours after CO concentrations had a chance to build up.

Quality Assurance

The EPA-approved equivalence method CO analyzer used for the study was calibrated and operated according to the Montana State Quality Assurance Manual. The Airmetrics Minivol samplers were operated in accordance with the manufacturers specifications.

Accuracy of the study was verified by the weekly zero/span/precision checks and quarterly audits performed on the CO analyzer. To check the precision of the study, one collocated sample was collected with each sample set. Table 2 below summarizes the collocated sample results. Two days of collocated data were missed because of equipment malfunctions. All collocated samples collected were within one-tenth of a part per million of each other. The pump module with SN# 3737 was used to collect the collocated samples. When facing the front of the pump module the left side of 3737 was labeled “a” and the right side was labeled “b”. All quality assurance criteria were passed.

Table 2
Collocated Precision Results in Parts Per Million CO



Date	3737 a	3737 b
11-9-2005	1.6	1.6
11-18-2005	1.9	1.9
11-22-2005	1.7	1.6
11-25-2005	1.2	1.3
12-9-2005	No Data - Malfunction	1.8
12-15-2005	1.7	1.7
12-23-2005	2.2	2.2
1-5-2006	No Data - Malfunction	2.7
1-23-2006	1.4	1.4
1-24-2006	2.2	2.1
2-7-2006	2.0	2.0
2-11-2006	1.3	1.4

Study Results

Table 3
Reserve Street 2005-2006 Carbon Monoxide Study Results in Parts Per Million
8-Hour Bag Samples

Site	11/9/2005	11/18/2005	11/22/2005	11/25/2005	12/9/2005	12/15/2005	12/23/2005	1/5/2006	1/23/2006	1/24/2006	2/7/2006	2/11/2006
MFJ	1.4	1.8	1.5	1.2	2.2	1.8	2.0	2.1	1.2	1.6	1.5	1.0
MR-NE	1.6	1.9	1.7	1.6	1.8	1.7	2.2	2.7	1.4	2.2	2.0	1.3
MR-NW	1.3	1.3	1.3	1.2	1.5	1.2						
MR-SW		1.0	0.7	0.8								
MR-NW2					1.5	1.0						
4R-E	1.4	1.4	1.3	1.0	1.6	1.5						
3R-NW	1.2	1.2	0.7	0.7	1.4	0.8						
3R-SE							1.8	2.7	1.3			
NR-SE		1.4	1.1	1.1	1.5	1.4						
Grove St.		0.6	0.4	0.5	0.8	0.6						
Schilling							1.3	2.7	0.6	1.7	1.9	1.1
S-NW							1.4	2.8	0.6	1.8	1.8	1.1
S-SE							1.7	2.9	0.9	1.9	2.0	1.3
B-NE							1.8	2.7	0.8	1.9	2.0	1.3
B-NW							1.6	2.6	0.6	1.5	1.6	1.0
B-SE											1.6	1.2

Key: MFJ = Brooks-South-Russell
 MR = Mullan & Reserve
 4R = 4th & Reserve
 3R = 3rd & Reserve
 NR = Northern Pacific & Reserve, aka Krispy Kreme
 S = South & Reserve
 B = Brooks & Reserve

NE = northeast
 NW = northwest
 SW = southwest
 SE = southeast
 E = east side of Reserve Street
 = highest value on a single sample day
 = sites that had highest value at least once during study

Sample Dates, Times and Weather Data

Table 4
Sample Dates, Times and Weather Summary

Date	Day of Week	Sample Duration		Temperature °F		Wind in MPH	
		Start	Stop	Maximum	Minimum	Peak	Average
11/9/05	Wed.	2 pm	10 pm	35	22	8	1.1
11/18/05	Fri.	12 noon	8 pm	34	22	7	0.8
11/22/05	Tues.	11 am	7 pm	30	27	5	0.6
11/25/05	Fri.	10 am	6 pm	29	22	5	0.0
12/9/05	Fri.	3 pm	11 pm	18	-1	7	0.8
12/15/05	Thurs	2 pm	10 pm	15	-1	9	1.5
12/23/05	Fri.	4 pm	Midnight	45	34	18	5.1
1/5/06	Thurs	4 pm	Midnight	39	25	7	1.2
1/23/06	Monday	3 pm	11 pm	44	30	13	4.3
1/24/06	Tues.	4 pm	Midnight	44	24	2.3	8
2/7/06	Tues.	4 pm	Midnight	40	19	6	0.6
2/11/06	Sat.	2 pm	10 pm	36	12	6	1.5

Weather data was collected at the Missoula National Weather Station located near the Missoula Airport. Friday, November 25, was the day after Thanksgiving.

Discussion and Conclusions

Four important items jump out from the study results.

- No values came near the 8-hour average national air quality standard of 9 parts per million (ppm) for CO.
- MFJ still has relatively high CO concentrations.
- The daily high values at each intersection were on the east side of Reserve Street.
- The residential site west of Reserve had lower values than the east side residential site.

The highest 8-hour sample collected was 2.9 ppm on January 5, 2006, at the southeast corner of Reserve Street and South Avenue. Since samples were collected where and when CO levels were expected to be at their highest, we conclude CO concentrations throughout the Missoula Valley are well below the 9 ppm 8-hour standard.

For 11 of the 12 sample days, the northeast corner of Mullan and Reserve had the highest values on Reserve Street. MFJ had higher values than the Reserve Street results on 2 sample days and was never more than 0.8 ppm below the high Reserve Street values. While MFJ may not have the highest CO levels in Missoula on most days, it still has elevated CO concentrations and is comparable to Reserve Street CO concentrations. Because of the closeness in CO levels between MFJ and Reserve Street and

because CO levels are so far below the national standard, MFJ remains a good location to monitor CO trends in the Missoula Valley.

One unexpected result of the study was that the CO concentrations were always highest on the east side of Reserve Street. This fact is most striking when you compare the Grove Street residential site about one block west of Reserve with the Schilling residential site which was four blocks east of Reserve. The west residential site results were significantly below the intersection concentrations while the east residential site results were equivalent to the intersection concentrations. Under stagnant conditions, there appears to be a drift to the east along these sections of Reserve Street. It has been noted that under stagnant conditions a circular air movement may set up in the Missoula Valley which would cause air to drift to the west on the most northerly part of Reserve Street and east on the southern part of Reserve Street. One of the drivers of the circular pattern could be the air that drains out of Hellgate Canyon into the northeast corner of the valley. While this eastward CO drift presents many interesting questions, we conclude that from a public health perspective further study is unnecessary because of the low CO concentrations found.

Bibliography

1. Schmidt, Benjamin, "Missoula, Montana Carbon Monoxide Saturation Study, December 5, 1992 to December 20, 1992," Missoula City-County Health Department, April 1993.
2. Missoula City-County Health Department, "A History of Missoula's Air Quality Program," Updated 1999.
3. Missoula City-County Air Pollution Control Program, Rule 9.118, November 17, 2000.
4. Montana DEQ, "2000 Missoula, Montana, Carbon Monoxide Emission Inventory," July 2004.

Appendix A

Major Missoula Intersection Traffic Count Data 2005 Update

Revised: 8-Dec-2005

A	B	C	D	E	F
Map Ref. No.	Location Description	2003	2004		
RESERVE AND MULLAN					
135	Reserve St. (FAU 8103) 0.3 mi. north of Mullan Rd. (FAU 8124/FAS 263); Loop	32,050	32,570		
132	Reserve St. (FAU 8103) just north of River Rd.; Loop	42,730	40,560	36,565	
134	Mullan Rd. (FAS 263) 300 ft. west of Reserve St. (FAU 8103)		17,320		
133	Mullan Rd. (FAU 8124) 300 ft. east of Reserve St. (FAU 8103)	13,610		15,465	52,030
RESERVE AND SOUTH THIRD WEST					
121	Reserve St. (FAU 8103) between Olafson Dr. & S. 3rd St. W. (FAU 8102)	34,960	37,190		
125	Reserve St. (FAU 8103) just south of Larkenwood Dr.; Loop		37,190	37,190	
120	S. 3rd St. W. (FAU 8102) just east of Reserve St. (FAU 8103)	12,860	14,040		
122	S. 3rd St. W. (FAU 8102) just west of Reserve St. (FAU 8103)	7,950	7,790	10,915	48,105
RESERVE AND SOUTH AVENUE					
89	Reserve St. (FAU 8103) between South Ave. (FAU 8120) & Central Ave.	32,720	33,170		
268	Reserve St. between South & Dearborn		29,990	31,580	
88	South Ave. (FAU 8120) between Clark St. & Reserve St. (FAU 8103)	15,030	17,080		
90	South Ave. (FAU 8120) between Reserve St. (FAU 8103) & 26th St.	15,220	14,750	15,915	47,495
RESERVE AND US 93					
79	Reserve St. (FAU 8103) between McDonald & Dixon Sts.		29,260		
78	Reserve St. (FAU 8103) between Brooks St. (FAP 7) & 39th St. (FAU 8122)		9,100	19,180	
21	Brooks St. (FAP 7) between 39th St. (FAU 8122) & Reserve St. (FAU 8103)		31,470		
22	Brooks St. (FAP 7) just northeast of Reserve St. (FAU 8103)		22,720	27,095	46,275
RUSSELL AND BROADWAY					
149	Russell St. between Cooper & Sherwood Sts.	6,570	6,840		
153	Russell St. (FAU 8105) just south of Broadway (FAP 71)	22,090	21,600	14,220	
12	Broadway (FAP 71) between Burns & Cowper Sts.		26,420		
11	Broadway (FAP 71) just south of Mullan Rd. (FAU 8124)		27,470	26,945	41,165
RUSSELL AND SOUTH THIRD WEST					
157	Russell St. (FAU 8105) between S. 2nd St. & S. 3rd St. (FAU 8102)		19,340		
163	Russell St. (FAU 8105) between S. 7th & S. 8th Sts.		16,490	17,915	
158	S. 3rd St. (FAU 8102) just east of Russell St. (FAU 8105)	7,810	8,930		
156	S. 3rd St. W. (FAU 8102) just west of Russell St. (FAU 8105)	15,250	15,180	12,055	29,970

RUSSELL AND MOUNT

164	Russell St. (FAU 8105) at R.R. Crossing (just north of Lawrence St.)		15,860	
170	Russell St. (FAU 8105) between Kent & Central Aves.		12,160	14,010
166	Mount Ave. (FAU 8116) between Rollins & Stephens Sts.	11,090	11,720	
165	S. 14th St. W. between Catlin & Garfield Sts.	11,770	13,230	12,475 26,485

BROOKS/SOUTH/RUSSELL

24	Brooks St. (FAP 7) just northeast of South Ave. (FAU 8120)		22,290	
23	Brooks St. (FAP 7) just southwest of Russell St. (FAU 8105)		23,880	23,085
174	South Ave. (FAU 8120) between Oxford & Regent Sts.		12,240	
173	South Ave. (FAU 8120) between Catlin & Washburn Sts.		14,000	13,120
170	Russell St. (FAU 8105) between Kent & Central Aves.		12,160	
176	Russell St. (FAU 8105) between Fairview & Benton Aves.		15,020	13,590 49,795

HIGGINS AND BROADWAY

223	Higgins St. (FAU 8113) between Broadway (FAP 71) & Pine Sts.	7,600		
214	Higgins St. (FAU 8113) between Main (FAU 8108) & Front (FAU 8110)		14,770	11,185
16	Broadway (FAP 71) between Washington & Adams Sts.		12,860	
15	Broadway (FAP 71) between Ryman (FAU 8111) & Higgins (FAU 8113)		14,140	13,500 24,685

Source: MISSOULA TRANSPORTATION STUDY AREA TRAFFIC COUNTING PROGRAM

Notes: Column E = (Sum of 2 most recent counts for intersection legs) ÷ 2

Column F = Sum of Column E for each intersection

Appendix B
Daily Data Sheets

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Wednesday, 11-9-05

Site	Pump SN# Inlet Height	Start Time	End Time	Total Hours	CO ppm
4R-E Mid-block 4 th & 5 th , E of Reserve 19'6" to Reserve	3738 9'6"	2:00 PM	10:00 PM	8	1.4
3R-NW 3 rd & Reserve 11' to 3rd 15' to Reserve	3739 12'	2:00 PM	10:00 PM	8	1.2
405 Grove Street Residential site 10' to Grove St.	3742 11'6"	2:00 PM	10:15 AM on 11-10-05 Program error	20.25	0.7 Invalid sample
MR-NEa 14'6" to Mullan 72' to Reserve	3737 10'	2:00 PM	10:00 PM	8	1.6
MR-Neb 14'6" to Mullan 72' to Reserve	3737 10'	2:00 PM	10:00 PM	8	1.6
MR-NW 16' to Mullan 53' to Reserve	3741 11'6"	2:00 PM	10:00 PM	8	1.3
MR-SW 197' to Mullan 74' to Reserve	3740 11'	2:00 PM	10:00 PM	8	Insufficient sample collected.
MFJ 16' to Russell 90' to Brooks	9'6"	2:00 PM	10:00 PM	8	1.4

Visual Weather Observations (wind, clouds, murky air): slightly smoky/murky outside, high pressure, moderate to poor dispersion.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-NW = 3rd & Reserve, northwest corner. M = Mullan. R = Reserve. NE = northeast corner, NW = northwest corner, SW = southwest corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Friday, 11-18-05

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
4R-E Mid-block 4 th & 5 th , E of Reserve 19'6" to Reserve	3743 9'6"	12:00 PM	8:00 PM	8	1.4
3R-NW 3 rd & Reserve 11' to 3rd 15' to Reserve	3740 12'	12:00 PM	8:00 PM	8	1.2
405 Grove Street Residential site 10' to Grove St.	3742 11'6"	12:00 PM	8:00 PM	8	0.6
MR-NEa 14'6" to Mullan 72' to Reserve	3737 10'	12:00 PM	8:00 PM	8	1.9
MR-Neb 14'6" to Mullan 72' to Reserve	3737 10'	12:00 PM	8:00 PM	8	1.9
MR-NW 16' to Mullan 53' to Reserve	3741 11'6"	12:00 PM	8:00 PM	8	1.3
MR-SW 197' to Mullan 74' to Reserve	3739 11'	12:00 PM	8:00 PM	8	1.0
NR-SE 10' to NorthPac. 75' to Reserve	3738 10'	12:00 PM	8:00 PM	8	1.4
MFJ 16' to Russell 90' to Brooks	9'6"	12:00 PM	8:00 PM	8	1.8

Visual Weather Observations (wind, clouds, murky air): calm winds, poor dispersion, marginal PM₁₀ air quality.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-NW = 3rd & Reserve, northwest corner. M = Mullan. R = Reserve. N = Northern Pacific by Krispy Kreme. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Tuesday, 11-22-05

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
4R-E Mid-block 4 th & 5 th , E of Reserve 19'6" to Reserve	3741 9'6"	11:00 AM	7:00 PM	8	1.3
3R-NW 3 rd & Reserve 11' to 3rd 15' to Reserve	3742 12'	11:00 AM	7:00 PM	8	0.7
405 Grove Street Residential site 10' to Grove St.	3739 11'6"	11:00 AM	7:00 PM	8	0.4
MR-NEa 14'6" to Mullan 72' to Reserve	3737 10'	11:00 AM	7:00 PM	8	1.7
MR-NEb 14'6" to Mullan 72' to Reserve	3737 10'	11:00 AM	7:00 PM	8	1.6
MR-NW 16' to Mullan 53' to Reserve	3738 11'6"	11:00 AM	7:00 PM	8	1.3
MR-SW 197' to Mullan 74' to Reserve	3743 11'	11:00 AM	7:00 PM	8	0.7
NR-SE 10' to NorthPac. 75' to Reserve	3740 10'	11:00 AM	7:00 PM	8	1.1
MFJ 16' to Russell 90' to Brooks	9'6"	11:00 AM	7:00 PM	8	1.5

Visual Weather Observations (wind, clouds, murky air): calm winds, poor dispersion, heavy fog.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-NW = 3rd & Reserve, northwest corner. M = Mullan. R = Reserve. N = Northern Pacific by Krispy Kreme. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Accident on Reserve stacked up traffic near the NR-SE site in the afternoon (Krispy Kreme).

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Friday after Thanksgiving, 11-25-05

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
4R-E Mid-block 4 th & 5 th , E of Reserve 19'6" to Reserve	3738 9'6"	10:00 AM	6:00 PM	8	1.0
3R-NW 3 rd & Reserve 11' to 3rd 15' to Reserve	3743 12'	10:00 AM	6:00 PM	8	0.7
405 Grove Street Residential site 10' to Grove St.	3741 11'6"	10:00 AM	6:00 PM	8	0.5
MR-NE 14'6" to Mullan 72' to Reserve	3742 10'	10:00 AM	6:00 PM	8	1.6
MR-NWa 16' to Mullan 53 ' to Reserve	3737a 10'	10:00 AM	6:00 PM	8	1.2
MR-NWb 16' to Mullan 53 ' to Reserve	3737b 11'6"	10:00 AM	6:00 PM	8	1.3
MR-SW 197' to Mullan 74' to Reserve	3739 11'	10:00 AM	6:00 PM	8	0.8
NR-SE 10' to NorthPac. 75' to Reserve	3740 10'	10:00 AM	6:00 PM	8	1.1
MFJ 16' to Russell 90' to Brooks	9'6"	10:00 AM	6:00 PM	8	1.2

Visual Weather Observations (wind, clouds, murky air): Fog changed to overcast. Poor changing to marginal dispersion. Light breezes apparent. Staked traffic at Krispy Kreme, site NR-SE, drive through noticed at 10:00 am.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-NW = 3rd & Reserve, northwest corner. M = Mullan. R = Reserve. N = Northern Pacific by Krispy Kreme. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Friday, 12-9-05

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
4R-E Mid-block 4 th & 5 th , E of Reserve 19'6" to Reserve	3743 9'6"	3:00 PM	11:00 PM	8	1.6
3R-NW 3 rd & Reserve 11' to 3rd 15' to Reserve	3740 12'	3:00 PM	11:00 PM	8	1.4
405 Grove Street Residential site 10' to Grove St.	3739 11'6"	3:00 PM	11:00 PM	8	0.8
MR-NEa 14'6" to Mullan 72' to Reserve	3737 10'	3:00 PM	11:00 PM	8	Malfunction
MR-NEb 14'6" to Mullan 72' to Reserve	3737 10'	3:00 PM	11:00 PM	8	1.8
MR-NW 16' to Mullan 53' to Reserve	3742 11'6"	3:00 PM	11:00 PM	8	1.5
MR-NW#2 32'6" to Reserve 7'6" to turn lane	3738 Sportsman 10'	3:00 PM	11:00 PM	8	1.5
NR-SE 10' to NorthPac. 75' to Reserve	3741 10'	3:00 PM	11:00 PM	8	1.5
MFJ 16' to Russell 90' to Brooks	9'6"	3:00 PM	11:00 PM	8	2.2

Visual Weather Observations (wind, clouds, murky air): Inversion visible, poor dispersion.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-NW = 3rd & Reserve, northwest corner. M = Mullan. R = Reserve. N = Northern Pacific by Krispy Kreme. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Thursday, 12-15-05

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
4R-E Mid-block 4 th & 5 th , E of Reserve 19'6" to Reserve	3743 9'6"	2:00 PM	10:00 PM	8	1.5
3R-NW 3 rd & Reserve 11' to 3rd 15' to Reserve	3741 12'	2:00 PM	10:00 PM	8	0.8
405 Grove Street Residential site 10' to Grove St.	3740 11'6"	2:00 PM	10:00 PM	8	0.6
MR-NEa 14'6" to Mullan 72' to Reserve	3737a 10'	2:00 PM	10:00 PM	8	1.7
MR-Neb 14'6" to Mullan 72' to Reserve	3737b 10'	2:00 PM	10:00 PM	8	1.7
MR-NW 16' to Mullan 53' to Reserve	3739 11'6"	2:00 PM	10:00 PM	8	1.2
MR-NW#2 32'6" to Reserve 7'6" to turn lane	3738 Sportsman 10'	2:00 PM	10:00 PM	8	1.0
NR-SE 10' to North ac. 75' to Reserve	3742 10'	2:00 PM	10:00 PM	8	1.4
MFJ 16' to Russell 90' to Brooks	9'6"	2:00 PM	10:00 PM	8	1.8

Visual Weather Observations (wind, clouds, murky air): poor dispersion.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-NW = 3rd & Reserve, northwest corner. M = Mullan. R = Reserve. N = Northern Pacific by Krispy Kreme. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Friday, 12-23-05

Site	Pump SN# Inlet Height	Start Time	End Time	Total Hours	CO ppm
3R-SE 134' to 3 rd 9'6" to Reserve	3743 10'8"	4:00 PM	12:00 AM	8	1.8
S-NW 263' to South 21'6" to Reserve	3738 11' 9"	4:00 PM	12:00 AM	8	1.4
S-SE 219' to South 7' to Reserve	3739 11'2"	4:00 PM	12:00 AM	8	1.7
MR-NEa 14'6" to Mullan 72' to Reserve	3737a 10'	4:00 PM	12:00 AM	8	2.2
MR-NEb 14'6" to Mullan 72' to Reserve	3737b 10'	4:00 PM	12:00 AM	8	2.2
1812 Schilling Residential site 17' to Schilling	3741 10'	4:00 PM	12:00 AM	8	1.3
B-NE 11' to Brooks 96' to Reserve	3742 10'4"	4:00 PM	12:00 AM	8	1.8
B-NW 275' to Brooks 23' to Reserve	3740 11'2"	4:00 PM	12:00 AM	8	1.6
MFJ 16' to Russell 90' to Brooks	9'6"	4:00 PM	12:00 AM	8	2.2

Visual Weather Observations (wind, clouds, murky air): High pressure building. Moderate to poor dispersion. Thick traffic in afternoon and evening.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-SE = 3rd & Reserve, southeast corner. M = Mullan. R = Reserve. B = Brooks. S = South. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Thursday, 1-5-06

Site	Pump SN# Inlet Height	Start Time	End Time	Total Hours	CO ppm
3R-SE 134' to 3 rd 9'6" to Reserve	3738 10'8"	4:00 PM	12:00 AM	8	2.7
S-NW 263' to South 21'6" to Reserve	3743 11' 9"	4:00 PM	12:00 AM	8	2.8
S-SE 219' to South 7' to Reserve	3740 11'2"	4:00 PM	12:00 AM	8	2.9
MR-NEa 14'6" to Mullan 72' to Reserve	3737a 10'	4:00 PM	12:00 AM	8	Insufficient Sample
MR-NEb 14'6" to Mullan 72' to Reserve	3737b 10'	4:00 PM	12:00 AM	8	2.7
1812 Schilling Residential site 17' to Schilling	3741 10'	4:00 PM	12:00 AM	8	2.7
B-NE 11' to Brooks 96' to Reserve	3742 10'4"	4:00 PM	12:00 AM	8	2.7
B-NW 275' to Brooks 23' to Reserve	3739 11'2"	4:00 PM	12:00 AM	8	2.6
MFJ 16' to Russell 90' to Brooks	9'6"	4:00 PM	12:00 AM	8	2.1

Visual Weather Observations (wind, clouds, murky air): High pressure building. Poor dispersion. Murky air. Forecast for winds at 3mph from the east.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-SE = 3rd & Reserve, southeast corner. M = Mullan. R = Reserve. B = Brooks. S = South. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Monday, 1-23-06

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
3R-SE 134' to 3 rd 9'6" to Reserve	10'8"	3:00 PM	11:00 PM	8	1.3
S-NW 263' to South 21'6" to Reserve	11' 9"	3:00 PM	11:00 PM	8	0.6
S-SE 219' to South 7' to Reserve	11'2"	3:00 PM	11:00 PM	8	0.9
MR-NEa 14'6" to Mullan 72' to Reserve	3737a 10'	3:00 PM	11:00 PM	8	1.4
MR-NEb 14'6" to Mullan 72' to Reserve	3737b 10'	3:00 PM	11:00 PM	8	1.4
1812 Schilling Residential site 17' to Schilling	10'	3:00 PM	11:00 PM	8	0.6
B-NE 11' to Brooks 96' to Reserve	10'4"	3:00 PM	11:00 PM	8	0.8
B-NW 275' to Brooks 23' to Reserve	11'2"	3:00 PM	11:00 PM	8	0.6
MFJ 16' to Russell 90' to Brooks	9'6"	3:00 PM	11:00 PM	8	1.2

Visual Weather Observations (wind, clouds, murky air): High pressure. Marginal dispersion.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-SE = 3rd & Reserve, southeast corner. M = Mullan. R = Reserve. B = Brooks. S = South. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Tuesday, 1-24-06

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
S-NW 263' to South 21'6" to Reserve	3742 11' 9"	4:00 PM	12:00 AM	8	1.8
S-SE 219' to South 7' to Reserve	3738 11'2"	4:00 PM	12:00 AM	8	1.9
MR-NEa 14'6" to Mullan 72' to Reserve	3737a 10'	4:00 PM	12:00 AM	8	2.2
MR-NEb 14'6" to Mullan 72' to Reserve	3737b 10'	4:00 PM	12:00 AM	8	2.1
1812 Schilling Residential site 17' to Schilling	3743 10'	4:00 PM	12:00 AM	8	1.7
B-NE 11' to Brooks 96' to Reserve	3740 10'4"	4:00 PM	12:00 AM	8	1.9
B-NW 275' to Brooks 23' to Reserve	3739 11'2"	4:00 PM	12:00 AM	8	1.5
MFJ 16' to Russell 90' to Brooks	9'6"	4:00 PM	12:00 AM	8	1.6

Visual Weather Observations (wind, clouds, murky air): High pressure. Poor dispersion. Murky air.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-SE = 3rd & Reserve, southeast corner. M = Mullan. R = Reserve. B = Brooks. S = South. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Tuesday, 2-7-06

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
S-NW 263' to South 21'6" to Reserve	3741 11' 9"	4:00 PM	12:00 AM	8	1.8
S-SE 219' to South 7' to Reserve	3742 11'2"	4:00 PM	12:00 AM	8	2.0
MR-NEa 14'6" to Mullan 72' to Reserve	3737a 10'	4:00 PM	12:00 AM	8	2.0
MR-NEb 14'6" to Mullan 72' to Reserve	3737b 10'	4:00 PM	12:00 AM	8	2.0
1812 Schilling Residential site 17' to Schilling	3740 10'	4:00 PM	12:00 AM	8	1.9
B-SE 29' to Brooks 466' to Reserve	3743 10'6"	4:00 PM	12:00 AM	8	1.6
B-NE 11' to Brooks 96' to Reserve	3739 10'4"	4:00 PM	12:00 AM	8	2.0
B-NW 275' to Brooks 23' to Reserve	3738 11'2"	4:00 PM	12:00 AM	8	1.6
MFJ 16' to Russell 90' to Brooks	9'6"	4:00 PM	12:00 AM	8	1.5

Visual Weather Observations (wind, clouds, murky air): High pressure. Poor dispersion. Murky air.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-SE = 3rd & Reserve, southeast corner. M = Mullan. R = Reserve. B = Brooks. S = South. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner

Missoula Reserve Street Carbon Monoxide Study Winter 2005-2006

Daily Field Data Sheet

DATE SAMPLES COLLECTED: Saturday, 2-11-06

Site	Pump SN# Inlet Hieght	Start Time	End Time	Total Hours	CO ppm
S-NW 263' to South 21'6" to Reserve	3740 11' 9"	2:00 PM	10:00 PM	8	1.1
S-SE 219' to South 7' to Reserve	3738 11'2"	2:00 PM	10:00 PM	8	1.3
MR-NEa 14'6" to Mullan 72' to Reserve	3737a 10'	2:00 PM	10:00 PM	8	1.3
MR-NEb 14'6" to Mullan 72' to Reserve	3737b 10'	2:00 PM	10:00 PM	8	1.4
1812 Schilling Residential site 17' to Schilling	3739 10'	2:00 PM	10:00 PM	8	1.1
B-SE 29' to Brooks 466' to Reserve	3741 10'6"	2:00 PM	10:00 PM	8	1.2
B-NE 11' to Brooks 96' to Reserve	3742 10'4"	2:00 PM	10:00 PM	8	1.3
B-NW 275' to Brooks 23' to Reserve	3743 11'2"	2:00 PM	10:00 PM	8	1.0
MFJ 16' to Russell 90' to Brooks	9'6"	2:00 PM	10:00 PM	8	1.0

Visual Weather Observations (wind, clouds, murky air): High pressure. Moderate to Poor dispersion.

Comments: 4R-E = 4th Street and Reserve, east side of Reserve. 3R-SE = 3rd & Reserve, southeast corner. M = Mullan. R = Reserve. B = Brooks. S = South. NE = northeast corner, NW = northwest corner, SW = southwest corner, SE = southeast corner