



State of Oregon
Department of
Environmental
Quality

SE PORTLAND PM_{2.5}PARTICULATE SITE VALIDATION STUDY

1999 - 2000

Conducted By

The Oregon Department Of Environmental Quality

Laboratories And Applied Research Division

Air Quality Monitoring Section

Report By: Mark Hansen and Jeff Smith

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Date: 6/15/01

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Date: 6/20/01

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Date: 8/20/01

WORK PLAN

1. PURPOSE:

This study is being conducted in conjunction with the establishment of a new Federal Reference Method (FRM) PM_{2.5} particulate sampling site in Portland at the longtime DEQ Air Quality monitoring site at 5824 SE Lafayette St. Data from this fine particulate study will help determine if the FRM PM_{2.5} sampler is optimally placed to characterize neighborhood scale PM_{2.5} levels in southeast Portland. PM_{2.5} measurements from this neighborhood site will be used to determine if the SE Portland air shed meets the new National Ambient Air Quality Standard (NAAQS) for PM_{2.5} particulates.

2. HOW ACCOMPLISHED:

The study will begin in February, 1999 and continue for one year. The survey samplers used have been successfully tested and their sampling precision and accuracy documented. Two types of PM_{2.5} survey samplers are available for use in this study. Both samplers are low volume devices using an inertial greased impactor as the particulate size separation method. Both use the same 47 mm diameter Teflon filter. One is a battery powered sampler, the "Mini-Vol", operating at 5 lpm. The filter attaches to the top of the sampler by means of a special fitting. The other samplers uses a 110 VAC pump to pull 15 lpm of ambient air through the filter. The filter is "Quik" connected to a 2 meter piece of PVC pipe which is attached to the pump with tygon tubing. Both types of samplers have been used in many studies in the past and both have been recently re-tested at selected sites for their precision and accuracy. Test results are on file at the ODEQ laboratory. The battery powered 5 lpm "Mini-Vol" samplers will be used in the southeast Portland survey, primarily due to noise concerns.

The samplers will run on the national EPA every 6th day schedule like other particulate samplers located statewide. Sites will be serviced by the local air monitoring network personnel as required. The filters will be returned to the Oregon DEQ laboratory for analysis and determination of their PM_{2.5} mass loadings.

3. SITE SELECTION:

Survey sites have been located to the northwest, northeast, southeast and southwest of the FRM PM_{2.5} benchmark sampler at the SE Lafayette site with surroundings approximately similar to the FRM site and to each other. Effort was made to select sites with no known major fine particulate point source nearby. The survey sites are all within 1-2 kilometers of the benchmark FRM site.

See the site photos and network map below for more information about the sites.

Southeast Portland PM2.5 Survey Site Photos

Benchmark Site (SEL)

5824 SE Lafayette St.
Lat./Long: 45° 29' 48.0"/122° 36' 8.0"
Site ID# 99-26-014
LASAR #10139



Northeast (NE)

Maciver Residence
2704 SE 65th Ave.
Lat./Long: 45° 30' 11.83"/122° 35' 45.83"
Site ID# 99-26-007
LASAR #20492



Southeast (SE)

Jacobson Residence
5134 SE 67th Ave.
Lat./Long: 45° 29' 8.29"/122° 35' 38.52"
Site ID# 99-26-008
LASAR #20493



Southwest

Wachlin Residence
4319 SE Ramona St.
Lat./Long: 45° 28' 51.31"/122° 37' 3.33"
Site ID# 99-26-005
LASAR #20490



Northwest (NW)

Rose City Builders
4315 SE Division St.
Lat./Long: 45° 30' 20.05"/122° 37' 4.66"
Site ID# 99-26-006
LASAR #20491



4. NETWORK QA/QC:

The Rupprecht & Patashnick (R&P) model 2025 sequential FRM PM_{2.5} sampler is an EPA certified reference method sampler for the measurement of PM_{2.5}. It is a proven and reliable method of measuring fine particulate and will be the benchmark device for this study. It (and a duplicate FRM sampler) is located at the SE Lafayette site. Two PM_{2.5} survey samplers will be co-located at the benchmark site where they will provide data to determine the precision and accuracy of the study results.

All of the survey samplers will be subjected to periodic independent flow audits performed by DEQ Lab staff during regularly scheduled (monthly) network reviews. The performance of the staff operators will also be reviewed during these visits.

The operators will maintain a journal of the project, noting significant events (equipment problems, unusual weather, etc.), and document the required cleaning and regreasing of the PM_{2.5} impactor inlets.

Additional Quality Control will occur at the laboratory during the review of the samples and field data sheets before and after analysis.

5. FUND CODE:

This study is part of the calendar year 1999 work plan for the state wide PM_{2.5} network. It is funded under an EPA 103 grant. The internal DEQ Lab fund code is 9811.

6. SUMMARY AND REPORT:

A report detailing the results of this study will be generated at the end of the one year project. The report will include all of the sampling data from all 5 sites. The data from the co-located survey samplers (primary and duplicate) at the benchmark site will be analyzed to determine the precision of the survey samplers. For comparison, the precision of the co-located FRM's at the benchmark site will also be determined. The accuracy of the survey method will be determined by comparing the results of the co-located survey and FRM samplers. The results of the 4 survey sites will be compared to that of the benchmark site. A conclusion will be made as to the suitability of the current PM_{2.5} siting in Salem.

7. PROJECT SCHEDULE:

Activity	Date
Develop work plan.	October –November, 1998
Site search and procurement.	November-December, 1998
Equipment preparation and testing.	December-January, 1999
Begin sampling.	February, 1999
End sampling.	March, 2000
Final report.	August, 2000

Project Implementation

1. NETWORK QA/QC:

All sampler and flow orifices used in the survey were calibrated at the Lab using a National Institute of Standards and Technology (NIST) traceable roots meter.

Prior to startup of the actual survey, the 5 lpm inlets were tested as a group at a site in Portland. Three 24 hour samples were collected. This was to compare the performance of the standardized inlets used in the survey. Results of the co-located group testing showed that the PM_{2.5} inlets compared favorably to one another, although they all tended to over collect PM_{2.5} as compared to the reference method sampler. The results of this test are on file at the ODEQ laboratory.

Network Quality Control (QC) audits were performed on 10-19-99, and again on 11-18-99. A final audit was performed at the conclusion of the survey on 2-23-00. A review of audit records indicated that all of the samplers operated within 10% of the ideal design flow (assuring a proper particulate size cut by the inlets) and that the operator's flow orifice used for the survey was well within 10% of the audit orifice values. Delays in the audit schedule were due to tardiness in developing an audit orifice for the "Mini-Vol" samplers. According to the operator's records all of the PM_{2.5} impactor inlets were cleaned at their regularly scheduled (monthly) intervals throughout the duration of the survey.

The benchmark PM_{2.5} FRM sampler was subject to regular monthly QC audits. All sensor and flow audits performed during the duration of the survey were within EPA established limits. Additional quarterly Quality Assurance (QA) audits of the PM_{2.5} FRM sampler performed by the DEQ Laboratory QA section were all within EPA limits, confirming these results.

As a result of all of these efforts, we believe that the data quality objectives for this project were met and are confident in the quality of the data generated by this survey.

Explanation of missed samples

NW			NE		
Aug 10	Sampler malfunction			27-Oct	Damaged filter
				2-Nov	Operator error
SE					
22-Aug	Low flow		SEL FRM-Pri		
28-Aug	Sampler malfunction			15-Apr	Sampler malfunction
15-Oct	Sampler malfunction			2-Nov	Sampler lost data
27-Oct	Damaged filter			8-Nov	Sampler lost data
				31-Jan	Power failure
SW					
1-Mar	Battery failure		SEL FRM-Dup		
				16-Aug	Sample ran short
SEL-Pri				27-Oct	Sampler did not run
24-May	Battery failure				

2. RESULTS:

Results of the SE Portland PM_{2.5} survey are shown in the following tables and graphs. Table 1 contains all of the sampling data from the study. Table 2 is a summary of the data.

The precision and accuracy (P&A) of the R&P PM_{2.5} FRM samplers used in this study was developed from the co-located samplers at the benchmark site. These results are shown in Table 5 and its accompanying graph. In addition, P&A data for this sampler is routinely developed at a number of regular PM_{2.5} sampling sites across the state. This information is available from the DEQ Lab and from EPA.

Data on the precision of the survey samplers was generated from the co-located (primary and duplicate) samplers at the benchmark site. This data is displayed in Table 3 and its accompanying graph. The statistical correlation between the two is 0.9286. The corresponding R squared value is 0.8623. The average difference between the primary and duplicate samplers was 0.561 ug/m³ with a maximum difference of 6 ug/m³. The standard deviation (sigma value) between the two is 2.448 ug/m³.

Survey sampler accuracy is represented by the average of the co-located survey samplers vs. the average of the co-located PM_{2.5} FRM samplers. This data is displayed in Table 4 and its accompanying graph. The survey samplers tended to over collect particulate as compared to the benchmark FRM samplers. The correlation between these two is 0.9066 with a corresponding R squared value of 0.822. The average difference between the FRM averages and the survey sampler averages was 2.008 ug/m³ with a maximum difference of 12.7 ug/m³. The standard deviation between the two methods is 2.666 ug/m³.

FRM precision data for this study is derived from the co-located FRM samplers at the benchmark site. This data is displayed in Table 5 and its accompanying graph. The correlation between the two is 0.998 with a corresponding R squared value of 0.996. The average difference between the two is 0.1 ug/m³ with a maximum difference of 1.4 ug/m³. The standard deviation between the two is 0.3789. These statistical results demonstrate the obvious performance differences between the \$12,000 FRM sampler and the \$400 survey sampler.

All of the survey sites generated similar results. The data is displayed as graphs in Table 6. Survey sampler averages from the five sites ranged from 11.3 to 12.1 ug/m³, all well below the annual PM_{2.5} NAAQS of 15 ug/m³. This difference between survey sites is small, less than one sigma of the precision of the method. The highest single value from the entire survey was 47.7 ug/m³ and occurred at the southeast survey site on 2-18-00. This is less than 3/4 of the NAAQS 24 hour standard of 65 ug/m³.

3. CONCLUSIONS:

During the survey period the southeast survey site generated the highest individual concentration as well as the highest survey average. The northeast site produced the lowest individual value and survey average.

For this report the average values from the five survey sites were compared to each other. Using this method, the SEL site PM_{2.5} values were tied for second (with the northwest survey site) when ranking the five sites. It also ranked second (barely ahead of the NW site) when comparing the highest values obtained from each site. The southwest survey site was fourth in

both categories, just below the SEL and NW sites. Only 0.8 ug/m³ separated the highest and lowest survey averages which indicates a very homogenous mixture in the area surveyed.

Overall results indicate that the PM_{2.5} monitoring station at the SE Lafayette (SEL) site is suitably located to characterize neighborhood scale PM_{2.5} levels for southeast Portland.

The “Mini-Vol” 5 lpm survey samplers appear to perform reasonably well for surveys of this nature. Although they compare nicely to one another, more variability was present in the accuracy data as compared to results from the Beaverton survey which utilized Oregon DEQ 15 lpm samplers. The conclusion here is that the increased variability in the accuracy data is attributable to the lower flow (and thus, lower total mass collected) used by the “Mini-Vol” samplers.

Table 1.**Southeast Portland PM2.5 Survey Results (15 lpm samplers)**

(all values in ug/m3)

Date	NW	NE	SW	SE	Avg. at SEL
23-Feb-99	8.8	5	3.6	5.1	5.6
1-Mar	11.5	5.9		7.6	6.3
7-Mar-99	11.4	11	22.9	14	13.7
13-Mar-99	7.4	7.2	12.2	9.5	11
19-Mar-99	13.3	15.3	18.1	13.3	15.9
25-Mar-99	4	4.7	4	4.7	6.5
31-Mar-99	10.1	10.4	10	10.1	11
6-Apr-99	6	8.7	12.5	15.6	11.6
12-Apr-99	10.7	10.1	10.2	11.3	10.6
18-Apr-99	12.1	10.6	9.7	8.9	9.1
24-Apr-99	12.3	12	13.2	15	12.5
30-Apr-99	14.3	10.7	10.8	19.3	13.8
6-May-99	6.6	2.4	3.8	6.2	9
12-May-99	7.8	6	7.5	6.3	6.3
18-May-99	10.4	7.1	3.8	8.8	7.7
24-May-99	15.2	15.2	15.8	12.4	14.3
30-May-99	10.6	8	9.8	9.5	11.1
5-Jun-99	6.7	7	7.3	5.3	5.6
11-Jun-99	10.7	8.9	12.5	9.9	10.3
17-Jun-99	9.3	9.3	11.4	9.8	10.6
23-Jun-99	7.5	6.4	4.5	8.2	7.6
29-Jun-99	9.5	7.9	7.7	8.5	6.8
5-Jul-99	14	12.9	14	16	13.2
11-Jul-99	7.7	9.3	8.3	7.6	8.2
17-Jul-99	9.5	8.1	7.6	6.8	9.2
23-Jul-99	5.9	5	5.6	6	5.4
29-Jul-99	11.7	8.3	10.5	8.7	11.5
4-Aug-99	11.9	10.3	10.3	9.3	8.2
10-Aug-99		23.8	17	12.9	18
16-Aug-99	8.7	10.4	11.6	8.6	9.2
22-Aug-99	12.7	12.1	10.9		10.4
28-Aug-99	15.4	12.8	13.8		15.3

Date	NW	NE	SW	SE	Avg. at SEL
3-Sep-99	12.7	13.6	11.3	12.9	12.8
9-Sep-99	9.6	10.6	13.1	15.8	8.9
15-Sep-99	28.8	21.6	19.3	23.5	25
21-Sep-99	24.5	21.8	24.6	26.4	23.9
27-Sep-99	13.2	12.4	15.2	9.7	12.9
3-Oct-99	16.9	12.1	29.3	22.5	15.3
9-Oct-99	13.2	10.2	10.3	11.8	11.4
15-Oct-99	19.1	29.2	13.6		19.1
21-Oct-99	22.6	19.3	15.6	18.8	19.5
27-Oct-99	6.8		4.2		5.3
2-Nov-99	19.8		18.7	19	19.2
8-Nov-99	16.1	10.3	15.1	18.9	15.3
14-Nov-99	21.9	15.7	18.6	16.8	17.1
20-Nov-99	2.3	4.4	4.8	1.1	5.3
26-Nov-99	7.4	10	11	9.3	10.8
2-Dec-99	3.5	4.5	5	4.4	5
8-Dec-99	5.5	7.4	7.5	6.3	7.5
14-Dec-99	3.4	3.7	4.7	6	5.4
20-Dec-99	12.1	11.9	12.1	12.6	11.6
26-Dec-99	8	8.5	5.9	6.8	8.7
1-Jan-00	7.4	9.4	7.6	10.6	10
7-Jan-00	4	5.6	4.8	4.7	5.2
13-Jan-00	7	9.6	9.6	8.6	10.6
19-Jan-00	13.5	13.7	13.4	12.1	15.4
25-Jan-00	8.4	14.5	15.3	18	10.9
31-Jan-00	7.6	8.3	9.8	10.3	12.1
6-Feb-00	7.9	8.4	7.6	8.1	8.7
12-Feb-00	13.4	11.2	11.1	10.6	9.9
18-Feb-00	45.1	36.5	42.3	47.7	45.4
24-Feb-00	18.9	20.9	12	17.5	15.2
1-Mar-00	22.7	18.8	18.7	27.2	21.4
Survey avg	11.9	11.3	11.8	12.1	11.9

Table 2. Summary

Site	# samples	Survey Avg ug/m3	Highest ug/m3	Days > 15 ug/m3
NW	62	11.9	45.1	13
NE	61	11.3	36.5	11
SW	62	11.8	42.3	15
SE	59	12.1	47.7	16
P&D Avg	62	11.9	45.4	15
FRM Avg	63	9.9	43.5	7

Table 3. PRECISION DATA (from the co-located survey samplers at SEL) all values in ug/m3

Date	Primary	Duplicate	Pri-Dup
23-Feb-99	7	4.1	2.9
1-Mar	6.2	6.4	-0.2
7-Mar-99	14	13.3	0.7
13-Mar-99	9.8	12.1	-2.3
19-Mar-99	14.8	16.9	-2.1
25-Mar-99	8.7	4.3	4.4
31-Mar-99	11.5	10.4	1.1
6-Apr-99	10.1	13.1	-3
12-Apr-99	11.2	9.9	1.3
18-Apr-99	9.7	8.5	1.2
24-Apr-99	11.8	13.2	-1.4
30-Apr-99	13.8	13.8	0
6-May-99	6.9	11	-4.1
12-May-99	6.4	6.2	0.2
18-May-99	9.4	5.9	3.5
30-May-99	12.2	10	2.2
5-Jun-99	5.1	6	-0.9
11-Jun-99	9.1	11.4	-2.3
17-Jun-99	13	8.2	4.8
23-Jun-99	8	7.1	0.9
29-Jun-99	6.9	6.7	0.2
5-Jul-99	13.1	13.2	-0.1
11-Jul-99	7.1	9.2	-2.1
17-Jul-99	8.5	9.8	-1.3
23-Jul-99	5.7	5	0.7
29-Jul-99	10.8	12.1	-1.3
4-Aug-99	6.9	9.4	-2.5
10-Aug-99	17.7	18.2	-0.5
16-Aug-99	8.8	9.6	-0.8
22-Aug-99	10.7	10.1	0.6
28-Aug-99	13.1	17.5	-4.4
3-Sep-99	12.6	12.9	-0.3
9-Sep-99	7.5	10.2	-2.7
15-Sep-99	22.7	27.3	-4.6

Date	Primary	Duplicate	Pri-Dup
21-Sep-99	23.7	24.1	-0.4
27-Sep-99	13	12.8	0.2
3-Oct-99	15.4	15.1	0.3
9-Oct-99	10.2	12.5	-2.3
15-Oct-99	18.2	19.9	-1.7
21-Oct-99	16.7	22.3	-5.6
27-Oct-99	4.6	6	-1.4
2-Nov-99	19.3	19	0.3
8-Nov-99	13.6	16.9	-3.3
14-Nov-99	18	16.1	1.9
20-Nov-99	4.6	5.9	-1.3
26-Nov-99	11.1	10.4	0.7
2-Dec-99	4.7	5.3	-0.6
8-Dec-99	6.8	8.1	-1.3
14-Dec-99	4.9	5.9	-1
20-Dec-99	10.7	12.4	-1.7
26-Dec-99	7	10.3	-3.3
1-Jan-00	11	9	2
7-Jan-00	5	5.4	-0.4
13-Jan-00	7.6	13.6	-6
19-Jan-00	12.5	18.3	-5.8
25-Jan-00	10.3	11.5	-1.2
31-Jan-00	14.8	9.4	5.4
6-Feb-00	8.3	9	-0.7
12-Feb-00	9.1	10.7	-1.6
18-Feb-00	46.9	43.9	3
24-Feb-00	16.9	13.4	3.5
1-Mar-00	21.2	21.5	-0.3

Survey avg	11.6	12.1	-0.5613
Count =	62		
Correlation between P&D =	0.9286		
Avg diff =	0.5613 ug/m3		
Max diff =	6 ug/m3		
Sigma =	2.448		

Primary vs Duplicate Survey Samplers at SEL

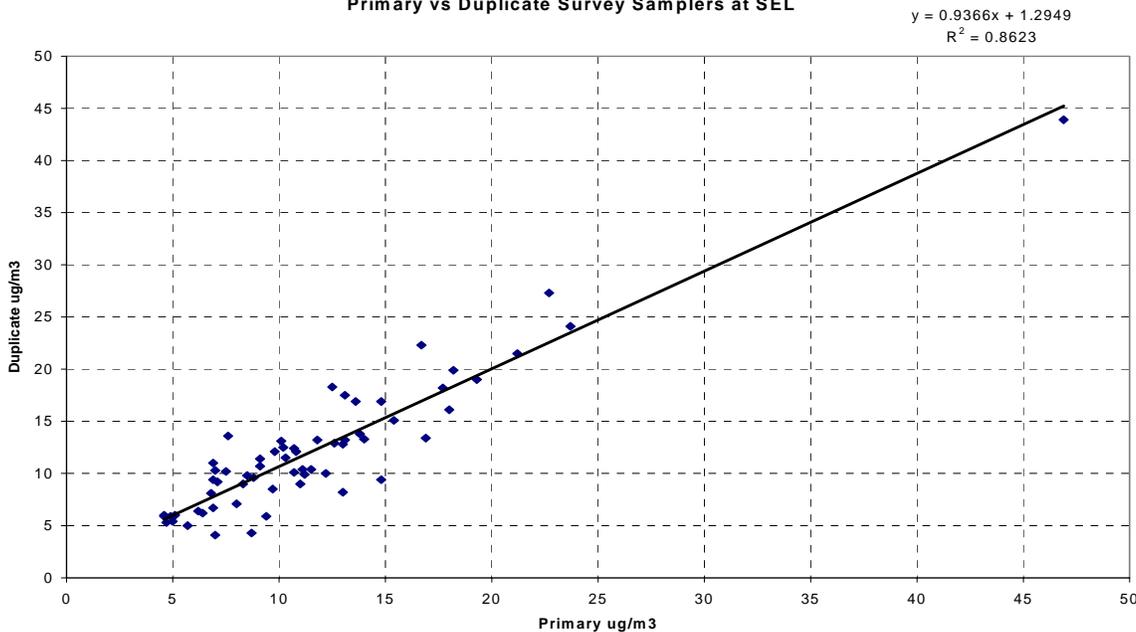


Table 4.

ACCURACY DATA. (PM2.5 from co-located FRM's and survey samplers at SEL) all values in ug/m3

Date	FRM	Survey	FRM-Survey
23-Feb-99	2.9	5.6	-2.7
1-Mar	6.1	6.3	-0.2
7-Mar-99	14.5	13.7	0.8
13-Mar-99	8.2	11	-2.8
19-Mar-99	12	15.9	-3.9
25-Mar-99	6.2	6.5	-0.3
31-Mar-99	9.5	11	-1.5
6-Apr-99	11	11.6	-0.6
12-Apr-99	9.5	10.6	-1.1
18-Apr-99	11	9.1	1.9
24-Apr-99	11.1	12.5	-1.4
30-Apr-99	9.9	13.8	-3.9
6-May-99	5	9	-4
12-May-99	3.7	6.3	-2.6
18-May-99	3.5	7.7	-4.2
24-May-99	10.6	14.3	-3.7
30-May-99	7.1	11.1	-4
5-Jun-99	3.1	5.6	-2.5
11-Jun-99	8	10.3	-2.3
17-Jun-99	7.8	10.6	-2.8
23-Jun-99	5.9	7.6	-1.7
29-Jun-99	5.8	6.8	-1
5-Jul-99	11.2	13.2	-2
11-Jul-99	7.7	8.2	-0.5
17-Jul-99	5.9	9.2	-3.3
23-Jul-99	4.9	5.4	-0.5
29-Jul-99	8.6	11.5	-2.5
4-Aug-99	7	8.2	-1.2
10-Aug-99	11.6	18	-6.4
16-Aug-99	7.4	9.2	-1.8
22-Aug-99	6.8	10.4	-3.6
28-Aug-99	10.6	15.3	-4.7
3-Sep-99	8.8	12.8	-4
9-Sep-99	6.7	8.9	-2.2

Date	FRM	Survey	FRM-Survey
15-Sep-99	12.3	25	-12.7
21-Sep-99	16.8	23.9	-7.1
27-Sep-99	9.4	12.9	-3.5
3-Oct-99	12.6	15.3	-2.7
9-Oct-99	11.4	11.4	0
15-Oct-99	14.1	19.1	-5
21-Oct-99	16.4	19.5	-3.1
27-Oct-99	5.3	5.3	0
2-Nov-99	17.5	19.2	-1.7
8-Nov-99	16.6	15.3	1.3
14-Nov-99	18.6	17.1	1.5
20-Nov-99	6.5	5.3	1.2
26-Nov-99	10.3	10.8	-0.5
2-Dec-99	3.4	5	-1.6
8-Dec-99	6.3	7.5	-1.2
14-Dec-99	3.2	5.4	-2.2
20-Dec-99	11.7	11.6	0.1
26-Dec-99	5.4	8.7	-3.3
1-Jan-00	5.8	10	-4.2
7-Jan-00	12.6	5.2	7.4
13-Jan-00	7.7	10.6	-2.9
19-Jan-00	12	15.4	-3.4
25-Jan-00	11.3	10.9	0.4
31-Jan-00	9	12.1	-3.1
6-Feb-00	7.8	8.7	-0.9
12-Feb-00	13.5	9.9	3.6
18-Feb-00	43.5	45.4	-1.9
24-Feb-00	14.2	15.2	-1
1-Mar-00	18.6	21.4	-2.8

Survey avg 9.9 11.9 -2.008

Count = 63

Correlation between FRM avg & Survey avg = 0.9066

Avg diff = -2.008

Max diff = 12.7

Sigma = 2.666

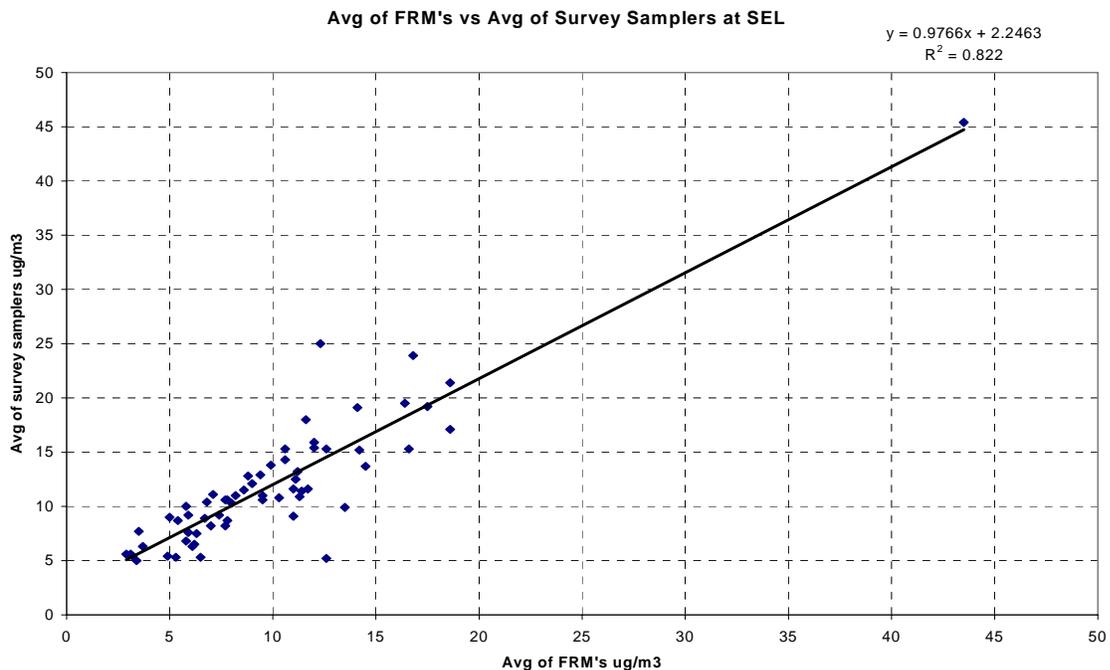


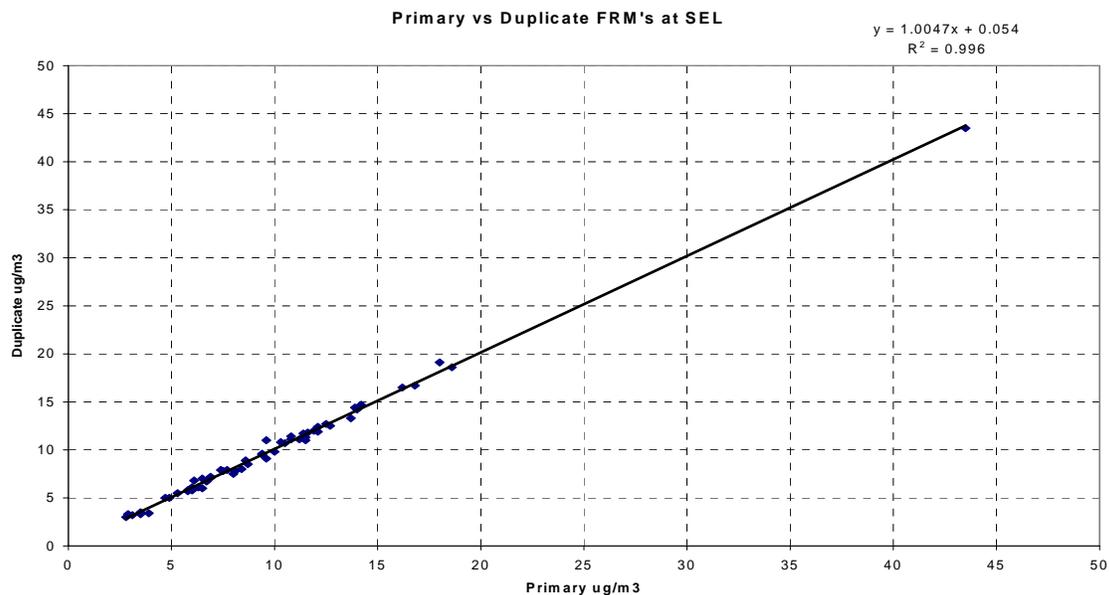
Table 5.

FRM PRECISION DATA PM2.5 data from co-located FRM's at SEL (values in ug/m3)

Date	Primary	Duplicate	Pri-Dup
23-Feb-99	2.8	3	-0.2
1-Mar	6	6.1	-0.1
7-Mar-99	14.2	14.7	-0.5
13-Mar-99	8.4	8	0.4
19-Mar-99	11.9	12	-0.1
25-Mar-99	6.3	6.1	0.2
31-Mar-99	9.4	9.6	-0.2
6-Apr-99	10.8	11.1	-0.3
12-Apr-99	9.4	9.5	-0.1
24-Apr-99	10.8	11.4	-0.6
30-Apr-99	10	9.8	0.2
6-May-99	4.9	5	-0.1
12-May-99	3.9	3.4	0.5
18-May-99	3.5	3.5	0
24-May-99	10.5	10.7	-0.2
30-May-99	6.9	7.2	-0.3
5-Jun-99	2.9	3.3	-0.4
11-Jun-99	8.1	7.8	0.3
17-Jun-99	7.7	7.9	-0.2
23-Jun-99	6	5.8	0.2
29-Jun-99	5.8	5.8	0
5-Jul-99	11.2	11.1	0.1
11-Jul-99	7.5	7.8	-0.3
17-Jul-99	6	5.8	0.2
23-Jul-99	4.7	5	-0.3
29-Jul-99	8.7	8.5	0.2
4-Aug-99	6.9	7.1	-0.2
10-Aug-99	11.4	11.7	-0.3
22-Aug-99	6.5	7	-0.5
28-Aug-99	10.3	10.8	-0.5
3-Sep-99	8.6	8.9	-0.3
9-Sep-99	6.7	6.7	0

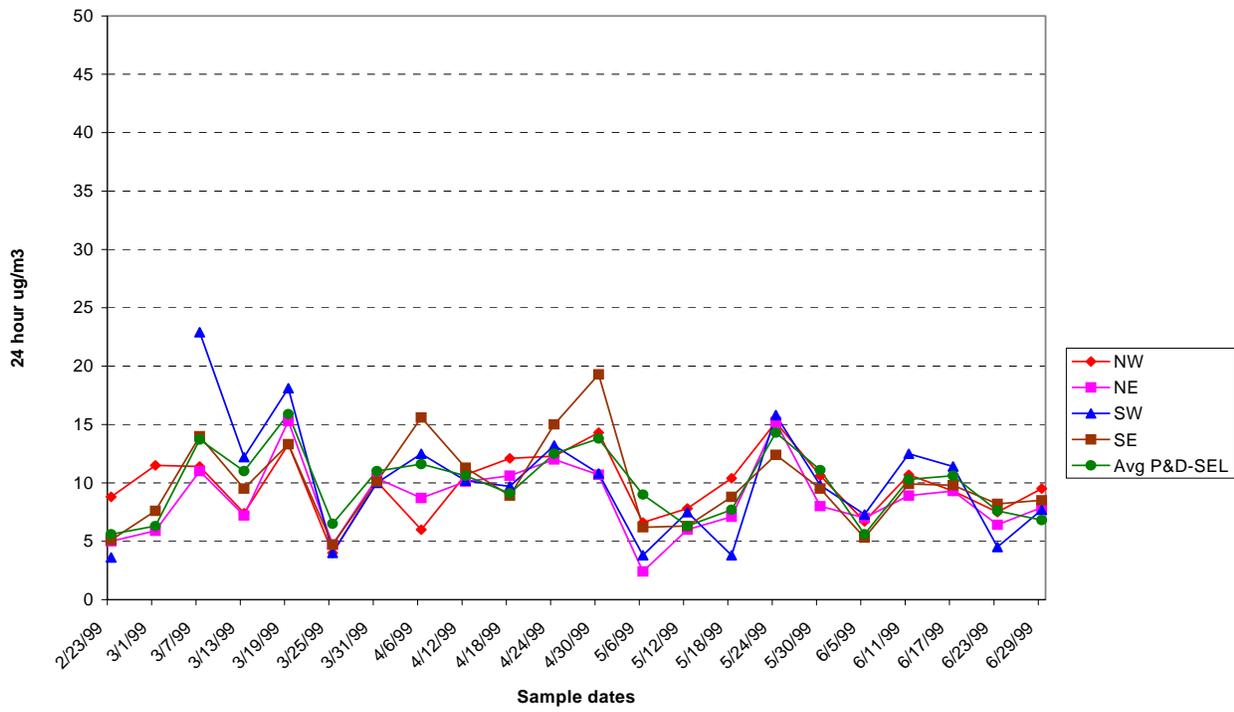
Date	Primary	Duplicate	Pri-Dup
15-Sep-99	12.1	12.4	-0.3
21-Sep-99	16.8	16.7	0.1
27-Sep-99	9.6	9.1	0.5
3-Oct-99	12.5	12.7	-0.2
9-Oct-99	11.5	11.3	0.2
15-Oct-99	14	14.2	-0.2
21-Oct-99	16.2	16.5	-0.3
14-Nov-99	18	19.1	-1.1
20-Nov-99	6.1	6.8	-0.7
26-Nov-99	9.6	11	-1.4
2-Dec-99	3.5	3.3	0.2
8-Dec-99	6.5	6	0.5
14-Dec-99	3.1	3.2	-0.1
20-Dec-99	11.6	11.8	-0.2
26-Dec-99	5.3	5.5	-0.2
1-Jan-00	5.8	5.7	0.1
7-Jan-00	12.7	12.5	0.2
13-Jan-00	7.4	7.9	-0.5
19-Jan-00	12.1	11.9	0.2
25-Jan-00	11.5	11	0.5
6-Feb-00	8	7.5	0.5
12-Feb-00	13.7	13.3	0.4
18-Feb-00	43.5	43.5	0
24-Feb-00	13.9	14.4	-0.5
1-Mar-00	18.6	18.6	0

Survey avg 9.7 9.8 -0.1
 Count = 57
 Correlation between Primary & Dupe = 0.998
 Avg diff = 0.1
 Max diff = 1.4
 Sigma = 0.3789

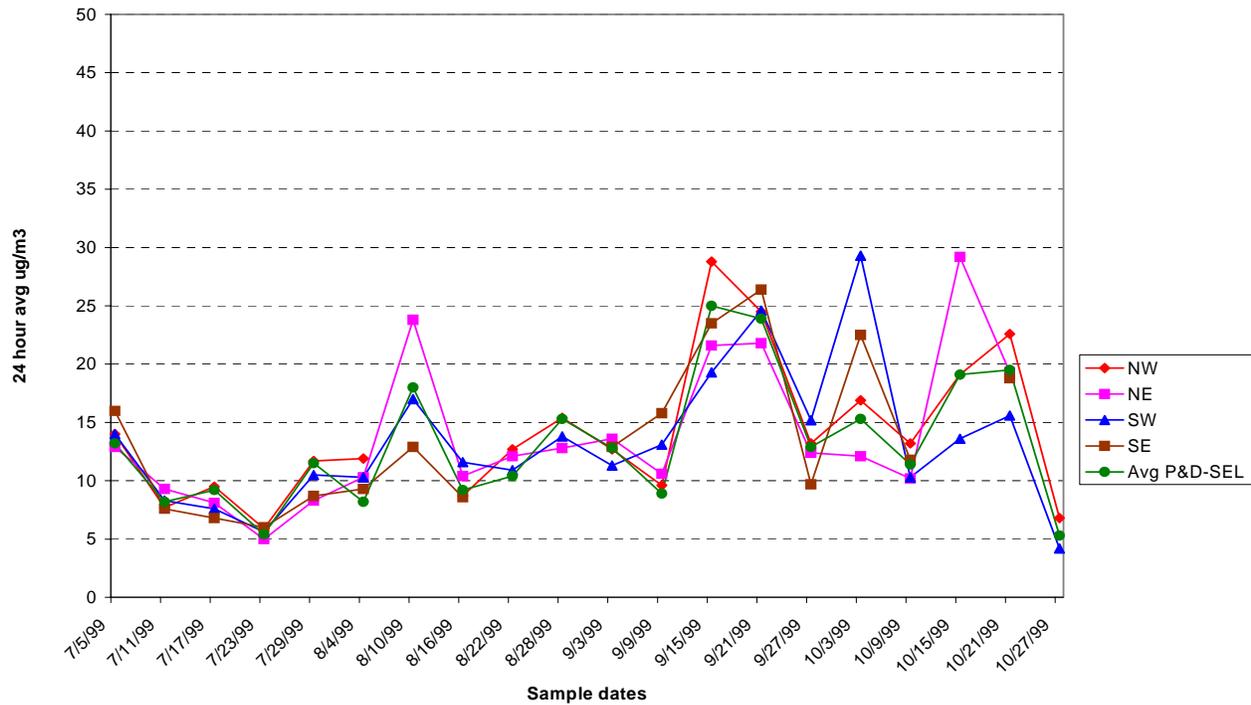


Figures 2 - 4.

SE Portland PM2.5 Survey Comparison



SE Portland PM2.5 Survey Comparison



SE Portland PM2.5 Survey Comparison

