

Air Quality Monitoring
at
Homer, AK
2001 –2002
July 31, 2013

Air Quality Division

Air Monitoring
&
Quality Assurance
Program

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Introduction

The Alaska State Legislature has mandated the Alaska Department of Environmental Conservation (DEC) to assess, evaluate, and mediate environmental issues that may affect the health and welfare of residents within the state (Title 46 of the Alaska Statutes). DEC established and maintains a statewide network of regulatory and special purpose monitoring sites that collect ambient air data. DEC uses these data to assess the air quality within the state. The network currently comprises long-term monitoring sites in Juneau, Anchorage, Fairbanks, Soldotna and the Matanuska- Susitna (Mat-Su) Valley as well as additional, special purpose or temporary sites. This document reports on the air quality monitoring survey performed at two special-purpose monitoring sites in Homer in 2001 and 2002. DEC set up monitoring sites in Homer in response to local complaints about smoke from slash burning of trees killed by spruce bark beetles.

Methods

Smoke is a mixture of gases, vapors, and suspended particles. One common way to measure smoke is to measure the concentration of the suspended particles. Two properties that most influence how these particles behave in the ambient air are shape and density. Scientists have developed the term “aerodynamic diameter” that unites both of these properties into a single dimension. The aerodynamic diameter is the diameter of a spherical particle having a density of one gram per cubic centimeter (g/cm^3) and the same terminal settling velocity in the air as the particle of interest. A solid sphere, a hollow sphere, and an irregular shaped particle having different densities and different shapes can have the same aerodynamic diameter. Conversely, visually similar particles can have different aerodynamic diameters. Most smoke particles have an aerodynamic diameter of $2.5 \mu\text{m}^1$ or less. (The average human hair has a diameter of $60 \mu\text{m}$.) This size fraction of particulate matter is referred to as $\text{PM}_{2.5}$.

Until 1997, when EPA established the $\text{PM}_{2.5}$ National Ambient Air Quality Standard, particles in this size range were not evaluated as a separate pollutant. Rather, they were captured as part of the PM_{10} (particle size of $10 \mu\text{m}$ or less; used to measure dust) size fraction of particulate pollutants. $\text{PM}_{2.5}$ monitoring equipment was not readily available in 2001 when DEC began its study in Homer; therefore DEC used PM_{10} monitoring equipment. DEC designed the study as a preliminary survey. While $\text{PM}_{2.5}$ monitoring yields data on this parameter that are more directly related to air quality impacts from smoke, PM_{10} monitoring can also provide useful data on $\text{PM}_{2.5}$ because $\text{PM}_{2.5}$ is a subset of PM_{10} . If no fires occur at the time of sampling, then PM_{10} levels likely indicate dust from gravel roads, road sanding, or other windblown dust. If fires do occur at sampling time and significant amounts of dust are not detected by other means, then the PM_{10} data can be used as an indicator of $\text{PM}_{2.5}$ (smoke levels).

¹ A μm (micrometer) is one millionth of a meter.

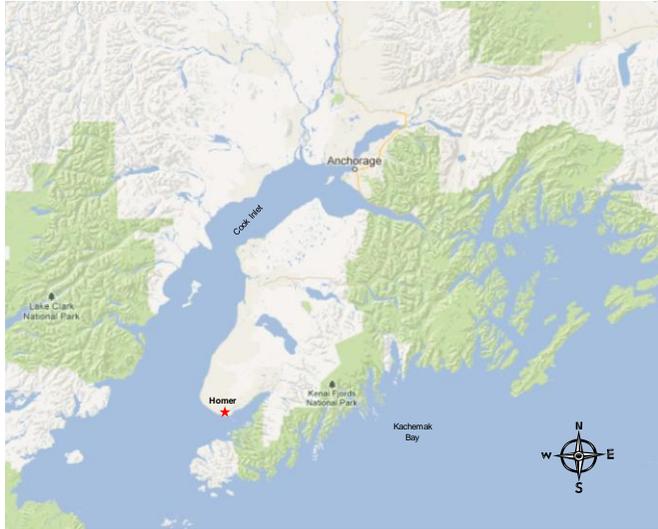


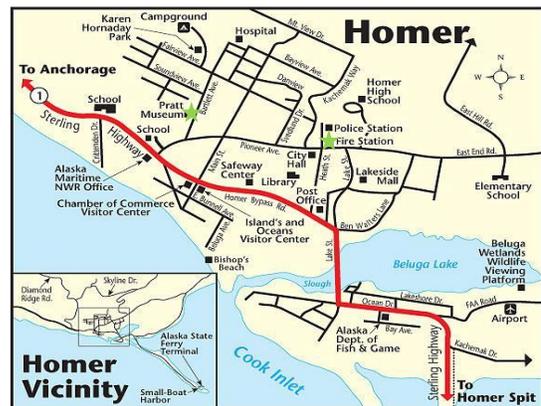
Figure 1. Map of Kenai Peninsula, City of Homer marked by red star.

The City of Homer is located in south-central Alaska at the terminus of the Sterling Highway near the southern tip of the Kenai Peninsula (Figure 1). The City encompasses 15 square miles of land and 10.5 square miles of water. The Pacific Ocean moderates Homer's climate, resulting in warmer winters and cooler summers than in places farther inland in Alaska. The average maximum temperature is 29.2°F in January and 60.9°F in July. The average minimum temperature is 16.7°F in January and 46.3°F in July. Average total annual precipitation is 24.4 inches, with 54.9

inches of snowfall, and 5 inches average snow depth in February (Western Region Climate Center). The city's population in 2000 was 3,946 and increased 27% to 5,003 by 2010 (2010 U.S. Census). Homer's economy relies primarily on tourism, sport and commercial fishing, and government sectors (State of Alaska, Department of Commerce, Alaska Community Database Community Information Summaries).

In designing the survey, DEC had to balance the number of sites needed to be representative of the area, logistical requirements, and budget constraints. DEC, in cooperation with the City of Homer, chose two monitoring sites based on the above factors and, in addition, ease of access, availability of local volunteers to operate the equipment, and availability of power. One of the two monitoring sites was located at the Homer Volunteer Fire Department (VFD) and the other at the Pratt Museum (Pratt) (Figure 2). Because several of the smoke complaints originated close to the Pratt Museum, DEC included that factor in its choice of sites.

Figure 2. Map of Homer, AK. DEC monitoring site locations indicated by ★.



DEC installed an FRM² High Volume sampler (HiVol) and an Andersen Beta Attenuation Monitor (BAM) at the VFD site and another HiVol at the Pratt site (see Appendix A, Figs 5 & 6). A HiVol sampler is one that is manually operated i.e., requires a person to install a new filter

² A Federal Reference Method (FRM) is one that EPA has accepted for comparison to the NAAQS by meeting certain design, precision, and bias (performance) specifications (40 CFR Part 58).

for each sample run, to record clock times, and to verify pre- and post sampling flow readings. The monitor collects a sample from midnight to midnight (24 hours). The HiVol filters have to be sent to a lab for post-weighing and subsequent calculation of concentration of the parameter of interest (in this case, PM₁₀). HiVol results are typically not available for several weeks after the sample date.

The BAM is an automated sampler that uses a roll of filter tape that needs changing only every other month and that measures, records, and stores concentrations and associated metadata such as flow, temperature, relative humidity, etc. BAM data are available hourly (near real-time) because the measurement is conducted by the BAM itself, i.e., filter tapes do not need to be sent to a lab for post-processing. DEC co-located the BAM with the HiVol (VFD site) so that it could compare the data from the two samplers and evaluate whether the BAM measurement data correlated well enough with the FRM HiVol data that DEC could use it in place of the HiVol. The fact that the BAM provides hourly data that are available near real-time is an advantage in notifying the public of air quality issues as well as providing DEC with a near continuous record of particulate levels.

DEC staff trained volunteers at both sites to operate the samplers and conducted regular quality control checks, calibrations, and filter analyses. Staff programmed the VFD HiVol on a one in six day EPA sampling schedule and the Pratt HiVol on a one in three-day EPA schedule. The Andersen BAM operated continuously and DEC staff downloaded sampling results via a telephone line and modem several times daily.

DEC quality-checked the data collected from all three samplers according to EPA criteria. DEC invalidated any HiVol data that did not meet EPA critical criteria. Invalid HiVol samples include those for which HiVol pump run times were outside of the 24-hour \pm 1 hour collection window.

Results and Discussion

The VFD site operated from February 2001 to January 2002 and the Pratt site operated from May 2001 to March 2002. Table 1 summarizes minimum and maximum concentration values obtained during the study. Concentrations were below both the 1997 PM₁₀ NAAQS value of 150 $\mu\text{g}/\text{m}^3$ and the 1997 PM_{2.5} NAAQS value with two exceptions: the VFD BAM measured a 24-hour average concentration of 76 $\mu\text{g}/\text{m}^3$ and the Pratt HiVol measured a 24-hour concentration of 128 $\mu\text{g}/\text{m}^3$.

Site	Minimum	Sample date	Maximum	Sample date	1997 PM _{2.5} NAAQS	1997 PM ₁₀ NAAQS
VFD HiVol	4	2/12/2001	55	7/6/2001		
VFD BAM	2	12/29/2000	76	4/10/2001	65	150
Pratt HiVol	1	2/2/2002	128	9/28/2001		

Table 1. Summary of PM₁₀ concentrations at all sites. All values in units of $\mu\text{g}/\text{m}^3$.

Figures 3, 4, and 5 are graphical representations of the complete data sets generated by the VFD HiVol, the VFD BAM, and the Pratt HiVol respectively. The Pratt HiVol yielded many more data points than the VFD HiVol, in part because the Pratt HiVol sampled every third day while the VFD HiVol sampled every sixth day and, in part, because it operated much longer

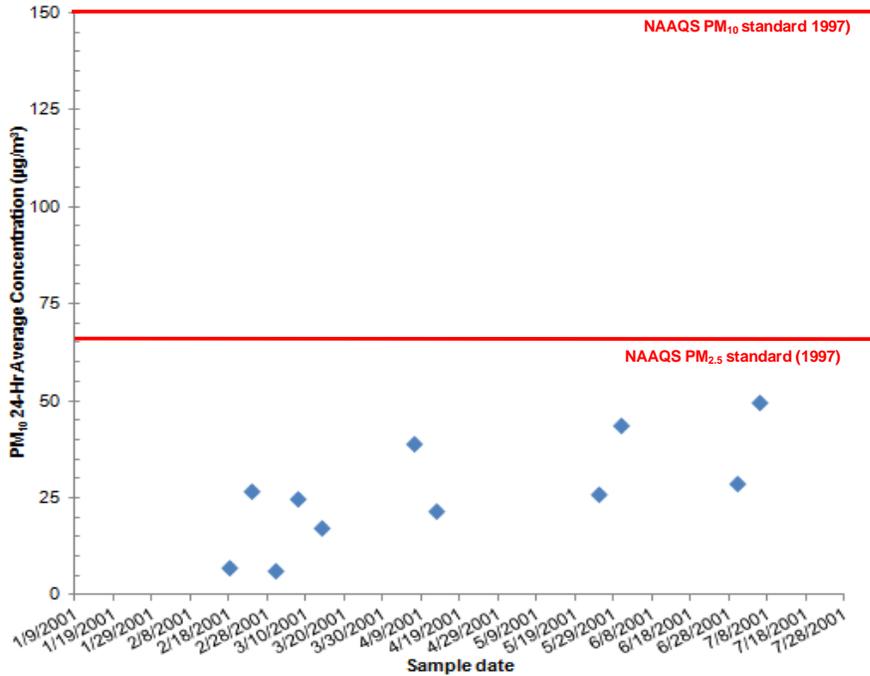


Figure 3. HiVol PM₁₀ concentrations measured at VFD site in 2001.

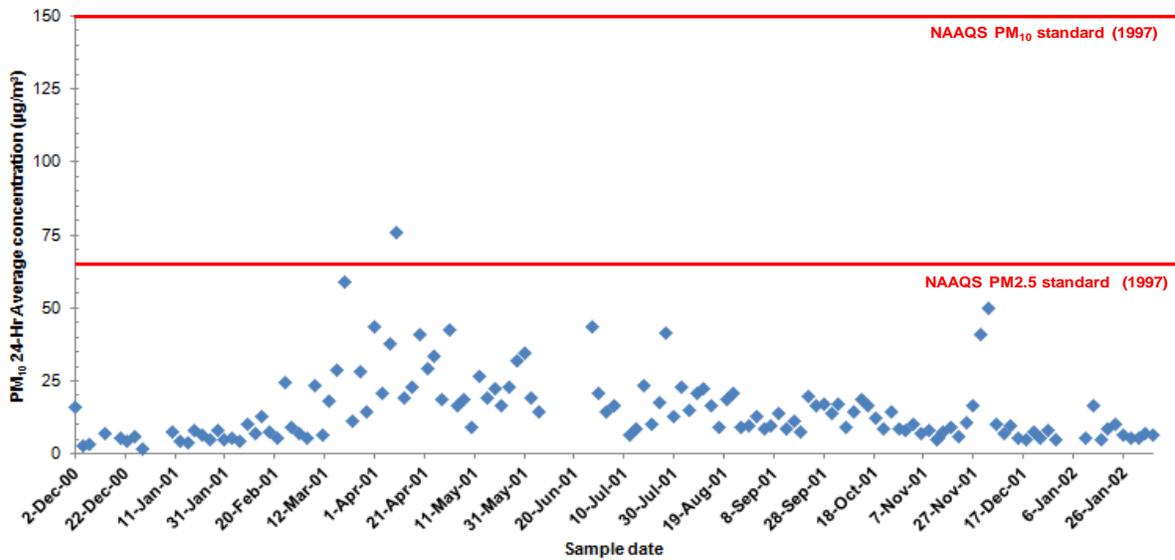


Figure 4. BAM PM₁₀ concentrations measured at VFD site in 2001.

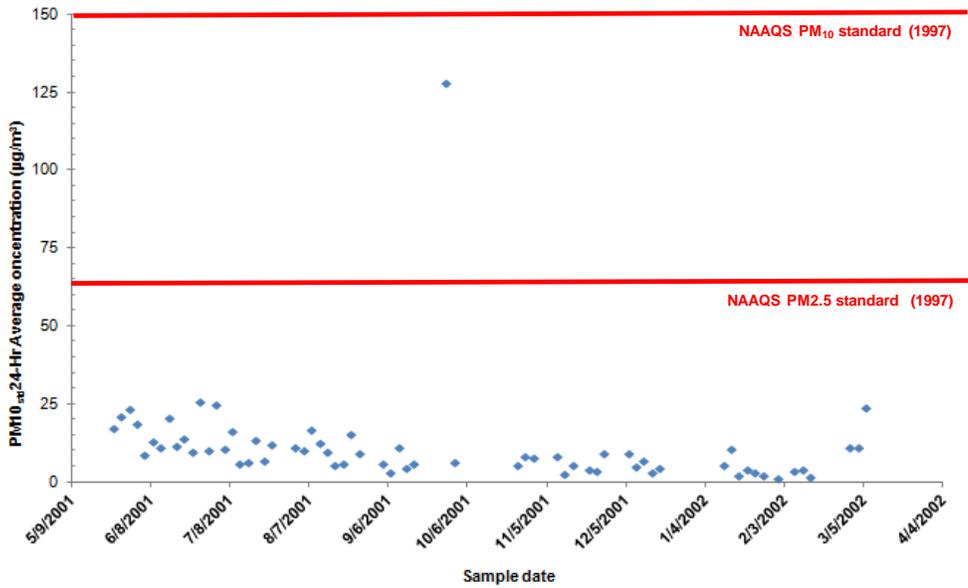


Figure 5. HiVol PM₁₀ concentrations measured at Pratt site in 2001-2002.

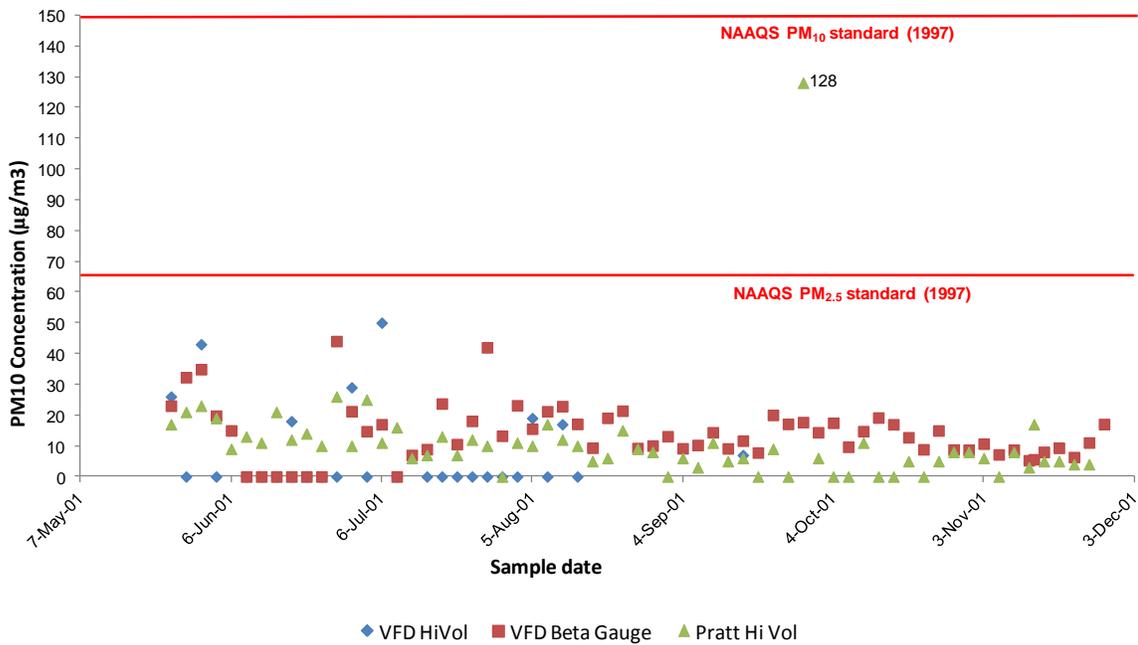


Figure 6. VFD HiVol, VFD Beta Gauge (BAM), and Pratt HiVol concentrations measured from May 25, 2001 through November 27, 2001.

Figure 6 shows concentration data collected by all three samplers for the period May 25, 2001 through November 27, 2001. During this period, all three samplers were functioning and, although data were not necessarily collected on every scheduled collection time and date due to sampler instrument maintenance and/or malfunctions, the data presented in the graph provide a comparison of PM₁₀ air quality between the two sites and among the three instruments. Concentrations during this period were below the 1997 PM₁₀ NAAQS value of 150 µg/m³ and the PM_{2.5} NAAQS of 65 µg/m³ except for values of 76 µg/m³ on April 10, 2001 and 128 µg/m³ on September 28, 2001.

The Anderson BAM sampled continuously and reported 24-hour average values. No fires were recorded in the Homer area the three days before and after the high values of 76 µg/m³ on April 10, 2001 and 128 µg/m³ on September 28, 2001 (Kelsa Shilanski, Alaska Department of Natural Resources, Forestry Regional Office Fairbanks, pers. comm.). Therefore, DEC believes this value was likely due to dust rather than smoke.

Because a HiVol is a Federal Reference Method for measuring PM₁₀, other methods used to collect PM₁₀ data must demonstrate, among other things, that the data collected are closely correlated with data collected using the Federal Reference Method. If the correlation is poor, then the data collected using the alternate method cannot be used for regulatory purposes but can be used for advisories. DEC correlated the data from the two co-located samplers: the VFD HiVol and the VFD Andersen BAM. The correlation coefficient between the two was poor. Therefore, DEC used the Andersen BAM data to provide near real-time data for air quality advisories only. Had the correlation coefficient been good, DEC could have used just the BAM at the VFD site.

This survey relied on PM₁₀ levels to estimate PM_{2.5} levels. As mentioned previously in the report, little equipment designed to specifically measure or sample for PM_{2.5} (smoke) was available at the time of the study. Because PM_{2.5} is a subset of PM₁₀, if PM₁₀ measurements do not exceed the standard, then PM_{2.5} values also will not. DEC, based on evidence cited above, believes that the few values that were higher than the NAAQS were due to airborne dust rather than smoke from fires. Because the sample values from the survey were generally low, i.e., well below the NAAQS PM₁₀ standard and below the NAAQS PM_{2.5} standard (with one exception), DEC discontinued the sampling and did not institute a more rigorous sampling program.

Based on this survey, DEC categorized overall air quality in Homer as good with respect to particulate matter. Occasional impacts of wild land fire smoke or road dust can occur, but this study did not document any such significant events.

References Cited

U.S. Census 2010, U.S. Census Bureau, <http://www.census.gov/2010census>

Western Regional Climate Center; period of record from Sept. 1, 1932 to Sept. 30, 2009; Homer Airport weather station.

State of Alaska, Department of Commerce, Alaska Community Database Community Information Summaries, <http://commerce.alaska.gov/dca/commdb/CIS.cfm>



Appendix A: Site Photos

Figure 7. VFD Monitoring Site: PM₁₀ HiVol on roof of trailer, PM₁₀ Andersen BAM inside trailer

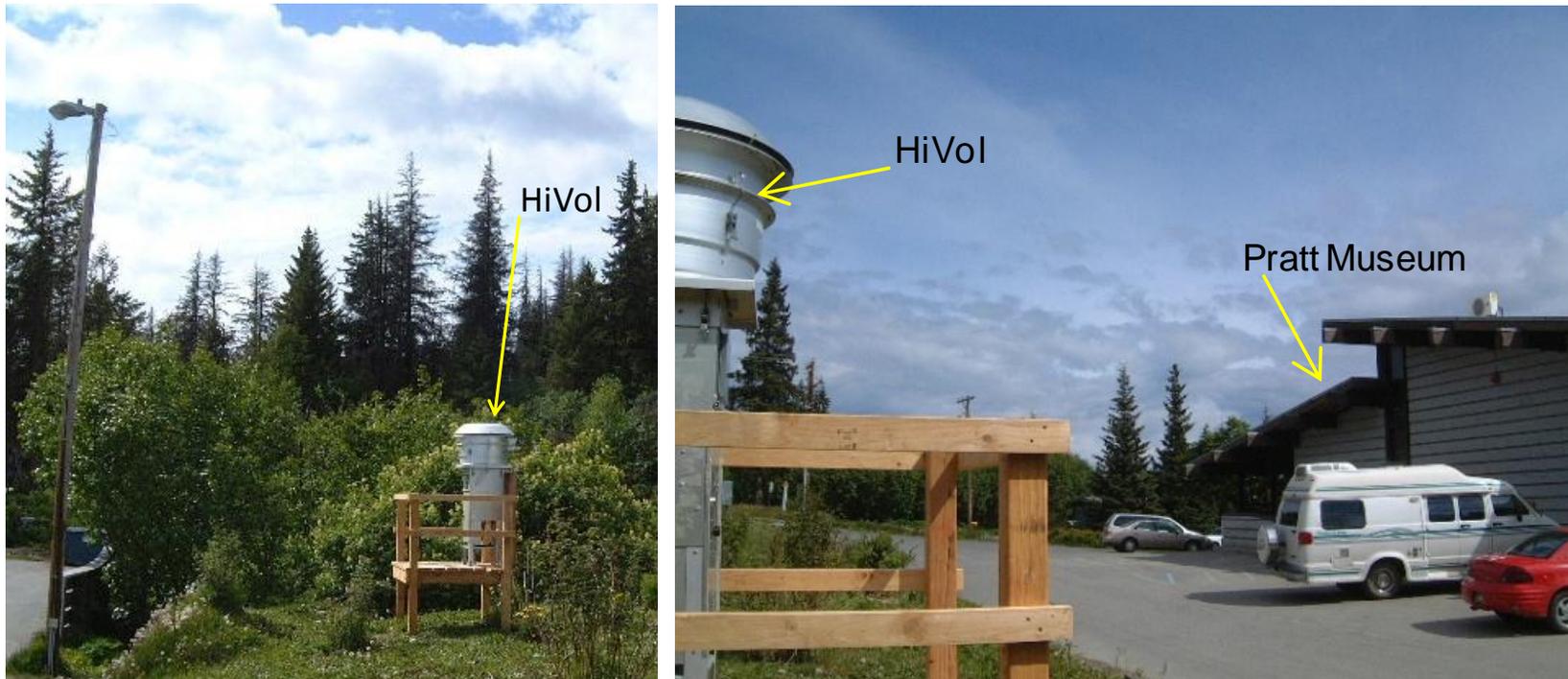


Figure 8. Pratt Museum Monitoring Site: PM₁₀ Hi Volume Sampler on platform

Appendix B:VFD Sample Data

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Sample Date	BAM PM _{10act} (µg/m ³)	HiVol PM _{10act} (µg/m ³)
2-Dec-00	16	
5-Dec-00	2	
8-Dec-00	3	
11-Dec-00		
14-Dec-00	7	
17-Dec-00		
20-Dec-00	5	
23-Dec-00	4	
26-Dec-00	6	
29-Dec-00	2	
1-Jan-01		
4-Jan-01		
7-Jan-01		
10-Jan-01	8	
13-Jan-01	4	
16-Jan-01	4	
19-Jan-01	8	
22-Jan-01	6	
25-Jan-01	5	
28-Jan-01	8	
31-Jan-01	5	
3-Feb-01	5	
6-Feb-01	4	
9-Feb-01	10	
12-Feb-01	7	
15-Feb-01	13	
18-Feb-01	7	7
21-Feb-01	5	
24-Feb-01	25	29
27-Feb-01	9	

Sample Date	BAM PM _{10act} (µg/m ³)	HiVol PM _{10act} (µg/m ³)
2-Mar-01	7	7
5-Mar-01	5	
8-Mar-01	23	27
11-Mar-01	6	
14-Mar-01	18	19
17-Mar-01	28	
20-Mar-01	59	
23-Mar-01	11	
26-Mar-01	28	
29-Mar-01	14	
1-Apr-01	43	
4-Apr-01	21	
7-Apr-01	38	43
10-Apr-01	76	
13-Apr-01	19	24
16-Apr-01	23	
19-Apr-01	41	
22-Apr-01	29	
25-Apr-01	34	
28-Apr-01	18	
1-May-01	42	
4-May-01	16	
7-May-01	18	
10-May-01	9	
13-May-01	26	
16-May-01	19	
19-May-01	22	
22-May-01	16	
25-May-01	23	29
28-May-01	32	
31-May-01	34	48
3-Jun-01	19	

Sample Date	BAM PM _{10act} (µg/m ³)	HiVol PM _{10act} (µg/m ³)
6-Jun-01	14	
9-Jun-01		
12-Jun-01		
15-Jun-01		
18-Jun-01		
21-Jun-01		
24-Jun-01		
27-Jun-01	44	
30-Jun-01	21	31
3-Jul-01	14	
6-Jul-01	17	54
9-Jul-01		
12-Jul-01	7	
15-Jul-01	8	
18-Jul-01	23	
21-Jul-01	10	
24-Jul-01	18	
27-Jul-01	42	
30-Jul-01	13	
2-Aug-01	23	
5-Aug-01	15	
8-Aug-01	21	
11-Aug-01	22	
14-Aug-01	17	
17-Aug-01	9	
20-Aug-01	19	
23-Aug-01	21	
26-Aug-01	9	
29-Aug-01	10	
1-Sep-01	13	
4-Sep-01	9	
7-Sep-01	10	
10-Sep-01	14	
13-Sep-01	9	

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Sample Date	BAM PM _{10act} (µg/m ³)	HiVol PM _{10act} (µg/m ³)
16-Sep-01	11.	
19-Sep-01	7	
22-Sep-01	20	
25-Sep-01	17	
28-Sep-01	17	
1-Oct-01	14	
4-Oct-01	17	
7-Oct-01	9	
10-Oct-01	14	
13-Oct-01	19	
16-Oct-01	16	
19-Oct-01	12	
22-Oct-01	8	
25-Oct-01	14	
28-Oct-01	8	
31-Oct-01	8	
3-Nov-01	10	
6-Nov-01	7	
9-Nov-01	8	
12-Nov-01	5	
13-Nov-01	5	
15-Nov-01	8	
18-Nov-01	9	
21-Nov-01	6	
24-Nov-01	11	
27-Nov-01	17	
30-Nov-01	41	
3-Dec-01	50	
6-Dec-01	10	
9-Dec-01	7	
12-Dec-01	9	
15-Dec-01	5	
18-Dec-01	5	
21-Dec-01	8	

Sample Date	BAM PM _{10act} (µg/m ³)	HiVol PM _{10act} (µg/m ³)
24-Dec-01	5	
27-Dec-01	8	
30-Dec-01	5	
2-Jan-02		
5-Jan-02		
8-Jan-02		
11-Jan-02	5	
14-Jan-02	16	
17-Jan-02	5	
20-Jan-02	8	
23-Jan-02	10	
26-Jan-02	7	
29-Jan-02	5	
1-Feb-02	5	
4-Feb-02	7	
7-Feb-02	7	

Appendix C: Pratt Sample Data

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Date sampled	HiVol PM _{10act} (µg/m ³)
5/25/2001	19
5/28/2001	24
5/31/2001	26
6/3/2001	21
6/6/2001	10
6/9/2001	14
6/12/2001	12
6/15/2001	23
6/18/2001	13
6/21/2001	15
6/24/2001	11
6/27/2001	28
6/30/2001	11
7/3/2001	27
7/6/2001	12
7/9/2001	18
7/12/2001	7
7/15/2001	7
7/18/2001	15
7/21/2001	8
7/24/2001	13
8/2/2001	12
8/5/2001	11
8/8/2001	18
8/11/2001	14
8/14/2001	11
8/17/2001	6
8/20/2001	6
8/23/2001	17
8/26/2001	10
9/4/2001	6
9/7/2001	3
9/10/2001	12

Date sampled	HiVol PM _{10act} (µg/m ³)
9/13/2001	5
9/16/2001	7
9/28/2001	142
10/1/2001	7
10/25/2001	6
10/28/2001	9
10/31/2001	9
11/9/2001	9
11/12/2001	3
11/15/2001	6
11/21/2001	5
11/24/2001	4
11/27/2001	10
12/6/2001	10
12/9/2001	5
12/12/2001	7
12/15/2001	3
12/18/2001	5
1/11/2002	6
1/14/2002	12
1/17/2002	2
1/20/2002	5
1/23/2002	3
1/26/2002	2
2/1/2002	1
2/7/2002	4
2/10/2002	4
2/13/2002	2
2/28/2002	12
3/3/2002	12
3/6/2002	27