MUNICIPALITY OF ANCHORAGE

Department of Health and Human Services

January 8, 2009

Barbara Trost
ADEC - Air Monitoring Section
619 E. Ship Creek Ave.
Suite 249
Anchorage, AK 99501

RE: Exceptional Event Flagged PM_{10} Data

Dear Barbara:

On Sunday, December 2, 2007; the 24-hour PM_{10} concentration at the Parkgate station in Eagle River (AQS Site ID = 02-020-1004) was measured at 223 $\mu g/m^3$ exceeding the National Ambient Air Quality Standard (NAAQS). We are requesting that this exceedance be classified as an exceptional event associated with high winds and that you forward this request to EPA for consideration.

We understand that once this data point is flagged it will not be considered in determining whether the Parkgate is in compliance with the NAAQS. You may be aware that we are in the process of preparing a new Limited Maintenance Plan for Eagle River. The plan can not move forward before this request has been approved.

The EPA published the final rule on the treatment of monitoring data influenced by exceptional events on March 22, 2007. This rule describes the circumstances under which a high wind episode that results in an exceedance of the PM_{10} NAAQS can be considered an "exceptional event." We have provided documentation in accordance with this rule that demonstrates that (1) "there is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area…, (2) "the event is associated with an unusual measured concentration beyond typical fluctuations including background…," and (3) "there would have been no exceedance or violation but for the event."

Anchorage's natural events action plan (NEAP) was not implemented during the exceedance. The reason for not implementing the NEAP is explained later in this correspondence.

Below, we demonstrate that a predominant fraction of the PM_{10} in the ambient air measured at Parkgate site on Dec 2, 2007 was generated in Palmer-Matanuska Valley area and conveyed downwind to Eagle River area. Therefore, the event was not controllable. We also demonstrate the unusual nature of this event and discuss frequency of future exceedance at Parkgate using the empirical frequency model, which is a recommended by the EPA for estimating the PM_{10} design value from data collected from a particular monitoring site.

1. Causal relationship between high winds and high PM_{10} concentration at Parkgate, Eagle River

Matanuska and Knik winds as the cause of airborne dust

Palmer and vicinity experience strong seasonal winds due to the rugged terrain surrounding the Matanuska Valley and the proximity to the Gulf of Alaska to the south (Figure 1). In winter months, N-NE winds, known as Matanuska Winds, blow down the Matanuska River Valley canyon, whereas Knik Winds typically blow down the Knik River floodplain in spring and summer months[*] (Figure 1). These are both active glacial rivers that continue to produce and convey large amounts of glacial silt, which is subsequently deposited on the floodplain and into Knik Arm. Most upland soils around Palmer and lower Matanuska and Knik Valleys are covered with a thick layer (up to 60 cm) of silty loess deposits that are the result of wind-blown dust, transported over time, that originated from glacial floodplains and from volcanic ash[†]. Strong Matanuska and Knik winds are known to blow these deposits up to 3000 ft or higher in the air causing extremely dusty conditions (Figure 2).[†]

Figure 1. Topographic characteristics of Matanuska Valley and surrounding areas. Strong seasonal winds are shown in yellow arrows.

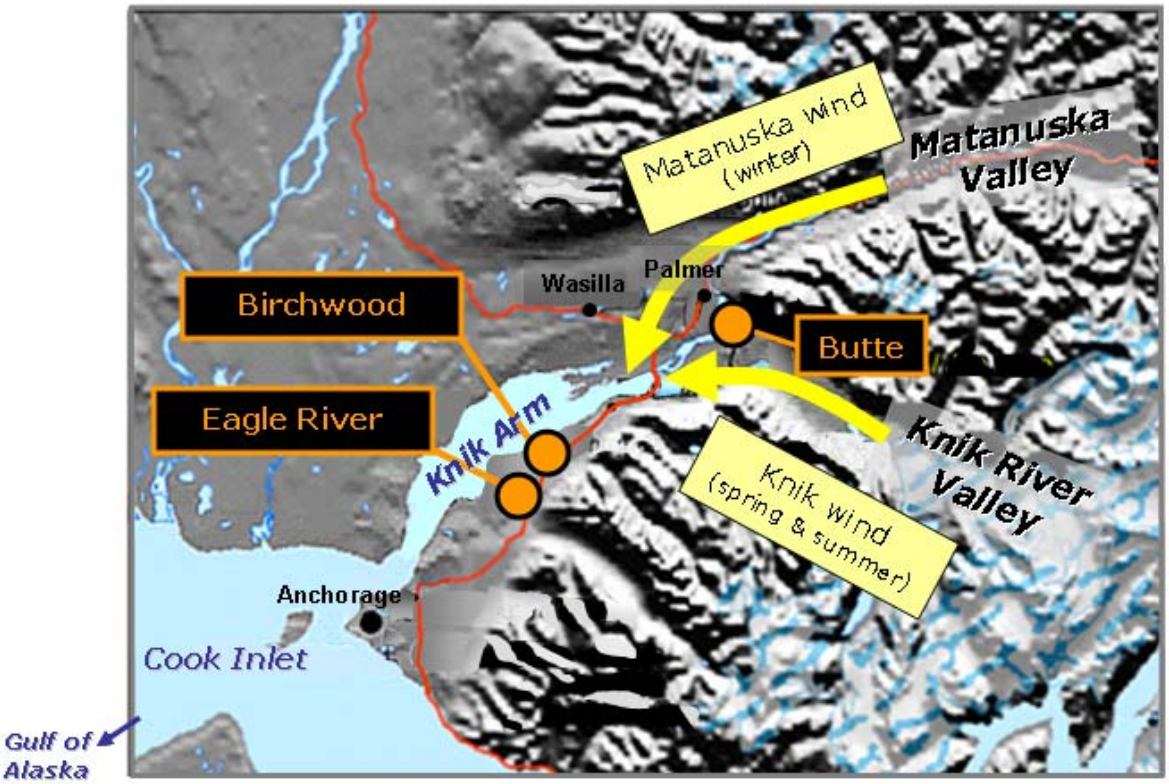

Figure 2. Windblown silt forming a cloud of dust above the floodplains of the Knik and Matanuska Rivers south of Palmer. Upper left peak is Pioneer Peak (Picture adopted from USDA 1989[†]).

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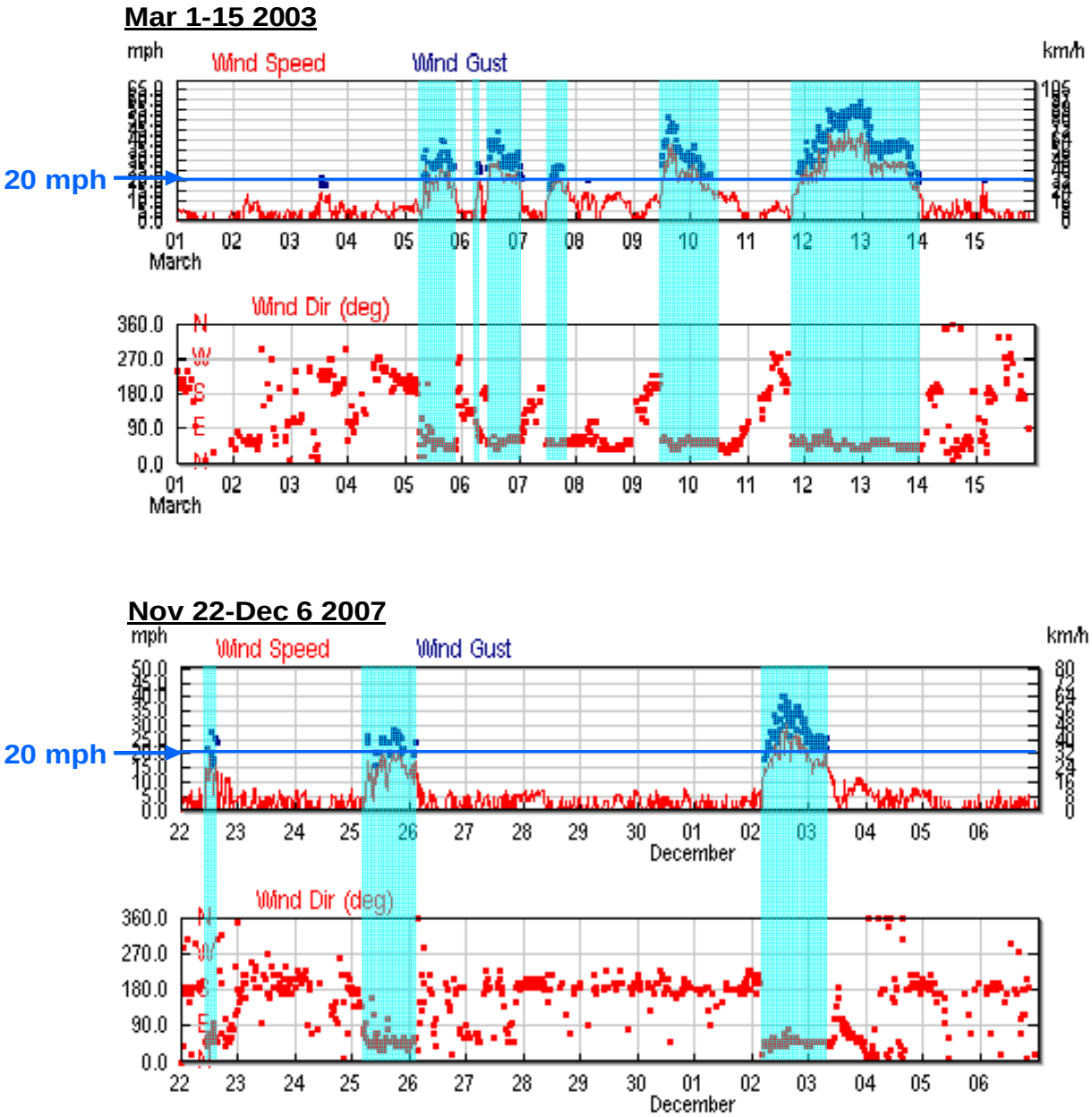
[*] Soil Survey of Matanuska-Susitna Valley Area, Alaska. United States Department of Agriculture Natural Resources Conservation Service (Aug 1998).

North and NE winds that blow down the glacial-river valleys and floodplains continue down the Knik Arm corridor into the Eagle River area. As a result, the ambient air quality in the Eagle River area is strongly affected by conditions upwind in the Palmer area. Examples of relationships between wind direction and speed at Birchwood station, about six miles NE of Eagle River, are shown in Figure 3 for two 15-day periods in 2003 and 2007 when high winds caused exceedances of the PM_{10} NAAQS.[†] The figure demonstrates that high winds (winds above 20 mph) were almost exclusively associated with a N or NE wind direction. This suggests that ambient air quality in Eagle River area is significantly influenced by conditions upwind in the Matanuska - Palmer area during high-wind events.

[†] These exceptional events occurred on March 12, 2003 and December 2, 2007.

Figure 3. A relationship between wind direction and high wind at Birchwood, ~6 miles NE of Eagle River. Wind gusts higher than 20 mph are shown with the blue bands. The figure was adopted from the Weather Underground website[‡]

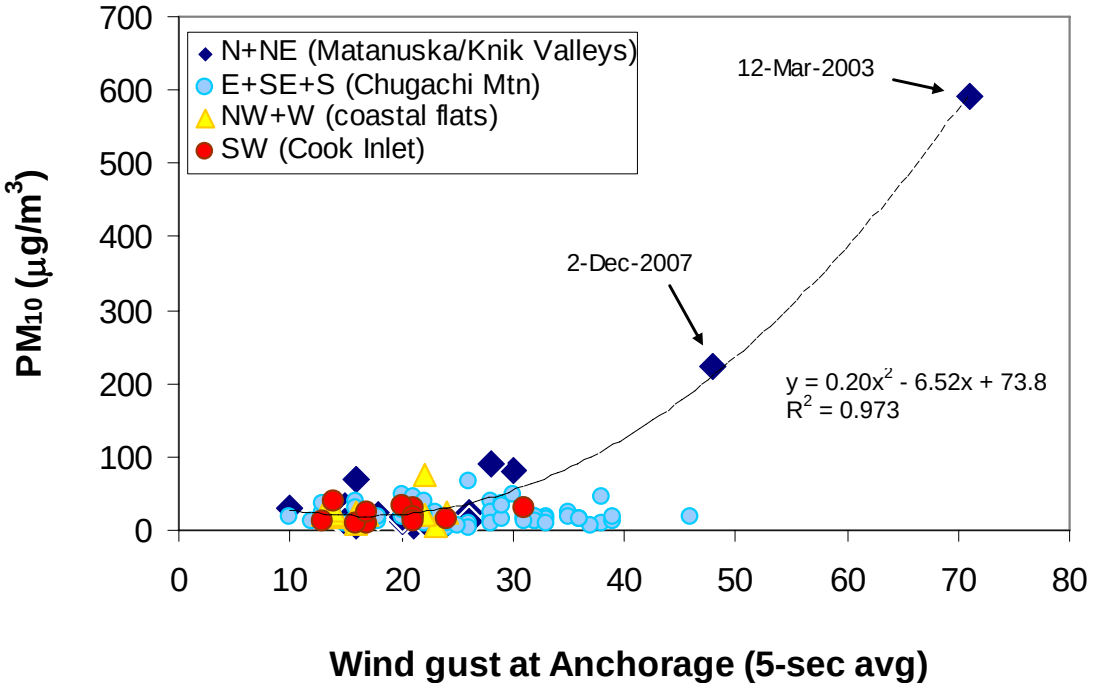


[‡] For 2003:
http://www.wunderground.com/history/airport/PABV/2003/3/1/CustomHistory.html?dayend=15&monthend=3&yearend=2003&req_city=NA&req_state=NA&req_statename=NA
For 2007:
http://www.wunderground.com/history/airport/PABV/2007/11/22/CustomHistory.html?dayend=6&monthend=12&yearend=2007&req_city=NA&req_state=NA&req_statename=NA

The analysis of historical data indicates that PM_{10} concentrations at Parkgate are strongly influenced by N and NE winds (Matanuska winds and also potentially Knik winds that blow down the Knik Arm corridor toward Eagle River) when the ground surface is dry and not covered with snow or ice. In Figure 4, relationships between the wind speed and PM_{10} concentrations are plotted by wind direction for the 2003-2007 period. Because generation of airborne dust is minimal when snow/ice cover exists on the ground and during precipitation events, we eliminated data points that were collected under those circumstances[§]. We used weather data measured at Ted Steven's International Airport in Anchorage (PANC), because there are no official observation sites in Eagle River that provide snow/ice depth. For the purpose of this analysis, we assumed that the ground surface in Eagle River was covered with snow/ice when there was 1.0 inch or deeper cover at PANC.

Figure 4 shows the relationship between PM_{10} and wind speed for four wind directions. For three of the four wind directions analyzed there is little or no correlation between wind speed and PM_{10} concentration. There is, however, a strong correlation when winds are from the N or NE. As noted earlier, the Matanuska/Knik/Palmer region that lies roughly 30 miles to the N and NE of Eagle River contains an immense stockpile of fine, silty loess that can become airborne during strong winds (i.e., Palmer area, Matanuska and Knik valleys). In contrast, when winds blow from other directions they are generally weaker and they blow down wet coastal flats (NW,W), over the waters of Cook Inlet (SW), or over land that has no major glacial rivers (E, SE, S) with little potential for generating dust.

Figure 4. Relationship between wind speed and PM_{10} concentration by wind direction at Parkgate site in Eagle River.



[§] PM_{10} data were excluded when there was 1.0 inch or more snow/ice cover on the ground or 0.01 inch or more water-equivalent precipitation at PANC station.

The 2 December 2007 case

Unusually strong NE winds were recorded in the Matanuska Valley, Eagle River and in the Anchorage bowl on December 2, 2007. They generated great amounts of dust. Figure 5 shows dusty conditions in the Palmer area, approximately 30 miles NE of Eagle River.[**]

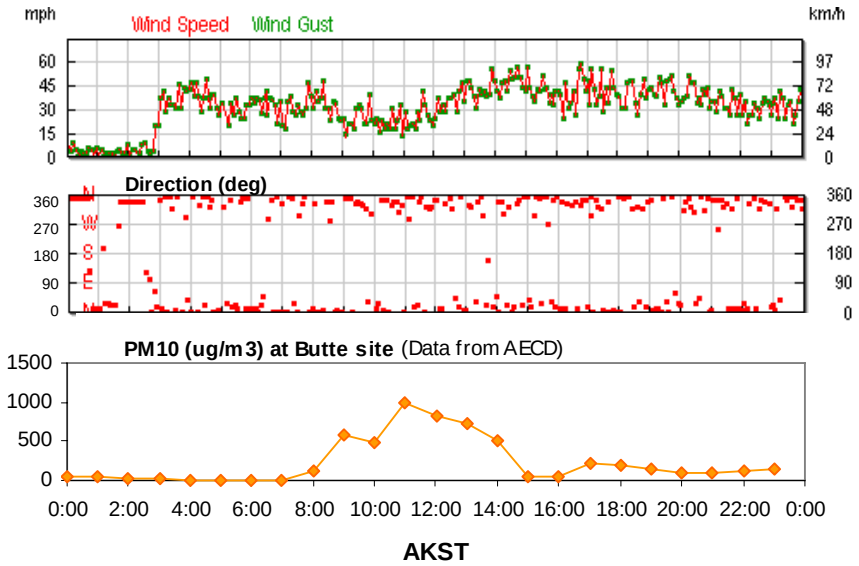
Figure 5. Windblown dust on 2 December 2007, near Palmer. Background is Pioneer Peak. (Adopted from the Weatherunderground.com[‡])

The N to NE winds blew down the entire Knik Arm corridor. Maximum gusts observed were 59 mph at Palmer, 40 mph at Birchwood, and 48 mph at the PANC station in Anchorage (Figure 6). High winds were experienced first at Palmer, then at Birchwood and finally at PANC in Anchorage suggesting the N/NE wind progressed southward over time. These Matanuska winds created area-wide dusty conditions and caused an unusual spike in PM_{10} concentrations at all monitoring stations in the Matanuska Valley and Anchorage/Eagle River area. Exceptionally high PM_{10} concentrations were first observed at the ADEC Butte monitoring station near Palmer about 30 miles northeast of Eagle River. The PM_{10} "front" was first observed at approximately 8:00 am at Butte site and reached the Tudor site in Anchorage about 2 hours later (Figure 6). The spread of PM_{10} front southwestward from Butte site to Tudor site in Anchorage is consistent with our assertion that the PM_{10} source was the Matanuska region and the dust was dispersed downwind to Eagle River and Anchorage. Note that hourly concentrations at the Butte site neared 1000 $\mu g/m^3$ (pre-QC data), three to five times greater than those at the Tudor monitoring site in Anchorage.

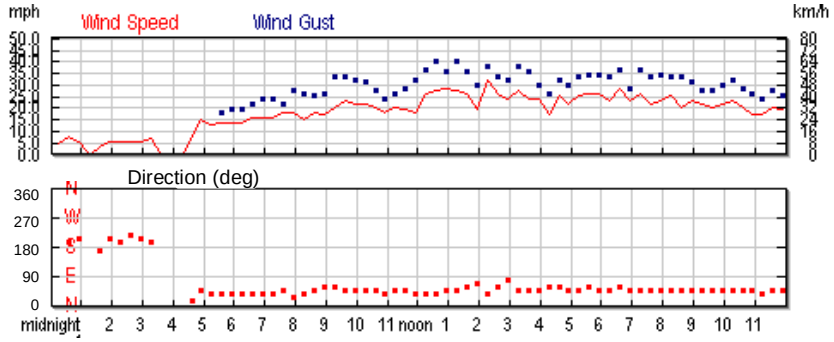
[**] Picture obtained from Weather Underground website (http://www.wunderground.com/wximage/viewsingleimage.html?mode=singleimage&handle=habataku&number=970)

Figure 6. Progression of Wind and PM_{10} Front Southwestward from Palmer to Anchorage on 2 December 2007.

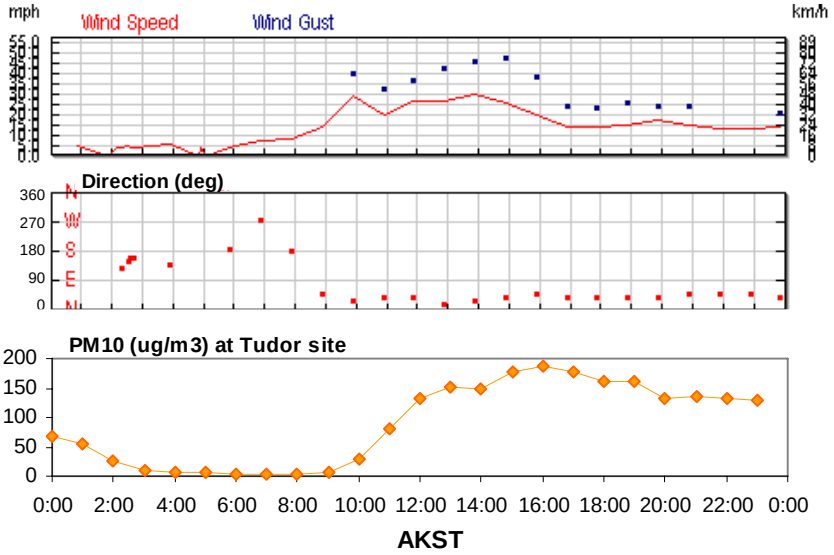
Palmer area: max gust =59mph (PM_{10} data from Butte station)



Birchwood : max gust =40mph



Anchorage: max gust =48mph



2. Unusual nature of the PM_{10} exceedance on Dec 2, 2007

Historical PM_{10} data

A PM_{10} concentration of 223 $\mu g/m^3$ observed on Dec 2, 2007 is highly unusual for any site within the Municipality. Except for events related to the eruption of Mt. Spurr in 1992 and high winds in 2003, the Parkgate site in Eagle River has not exceeded the NAAQS since 1987.[††] Data for this site from the past years are summarized in Table 1 below.

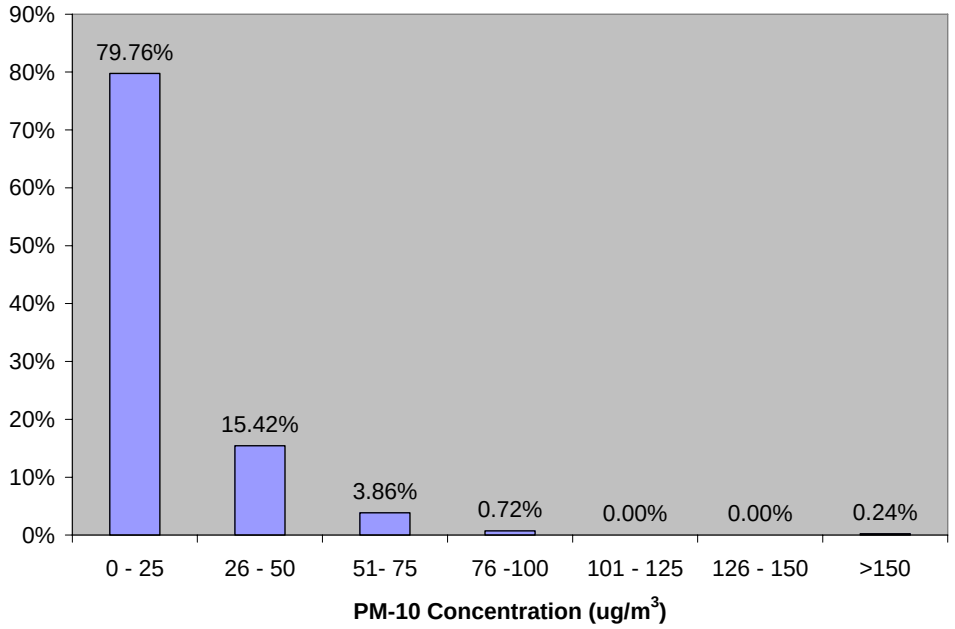
Table 1. Maximum and 2nd Maximum PM_10 Concentrations at Parkgate Station, Eagle River

Year	Sampling Frequency	Max 24-Hour Avg ($\mu g/m^3$)	2nd Max 24-Hour Avg ($\mu g/m^3$)	Year	Sampling Frequency	Max 24-Hour Avg ($\mu g/m^3$)	2nd Max 24-Hour Avg ($\mu g/m^3$)
1985	daily	**219**	**194**	1997	1 in 6	61	59
1986	daily	**336**	**326**	1998	1 in 6	59	55
1987	daily	**219**	147	1999	1 in 6	90	66
1988	daily	83	83	2000	1 in 6	64	53
1989	daily	69	56	2001	1 in 6	69	66
1990	1 in 6	143	106	2002	1 in 6	46	40
1991	1 in 6	78	72	2003	1 in 6	**590**	92
1992	1 in 6	**165**	128	2004	1 in 6	70	43
1993	1 in 6	79	77	2005	1 in 6	90	65
1994	1 in 6	94	60	2006	1 in 6	65	60
1995	1 in 6	60	51	2007	1 in 6	**223**	48
1996	1 in 6	91	49				

Figure 7 shows a frequency distribution of PM_{10} measurements at Parkgate between 2000 and 2006. Clearly, concentrations above 100 $\mu g/m^3$ are rare, and as stated earlier, since the late 1980's, all exceedances have been associated with either a volcanic eruption or wind/dust storm.

[††] In the late 1980's PM-10 concentrations dropped as a result of an ambitious road paving and road surfacing program that substantially reduced road dust emission from unpaved roads in Eagle River.

Figure 7. Frequency Distribution of Park Gate PM_{10} Concentrations 2000-2006 (n =415)



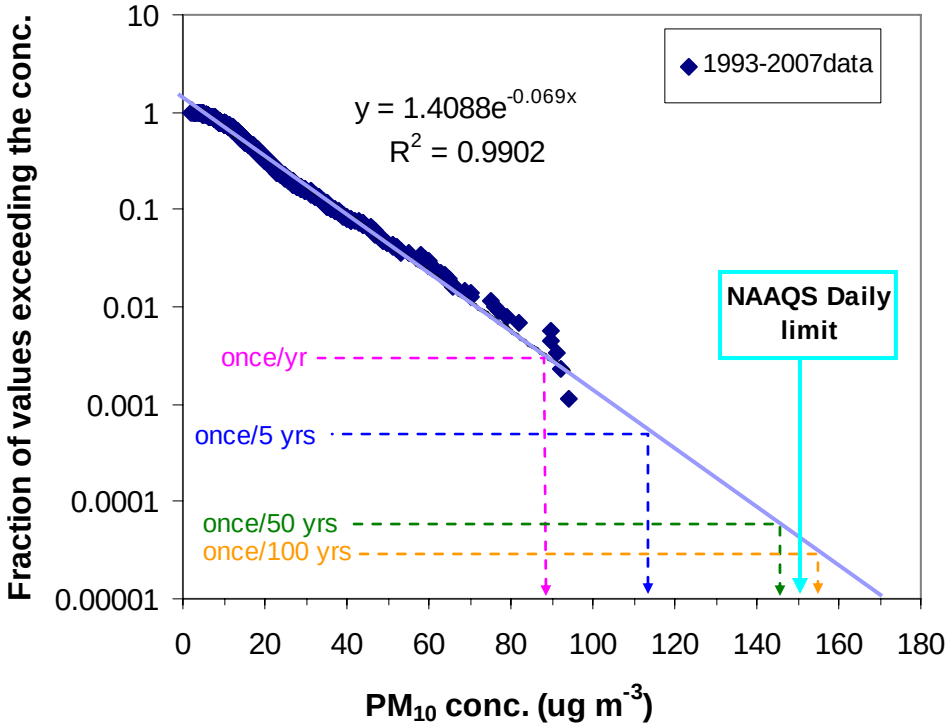
Probability of future exceedance

To determine the likelihood of the Parkgate site exceeding the NAAQS in the future we applied the empirical frequency distribution approach to data collected during the period 1993-2007. This approach is recommended by the EPA for the determination of the PM_{10} design concentration.[‡‡]. The year 1993 was chosen because the paving program called for in the Eagle River PM_{10} Plan (included in the Alaska SIP in 1993) had been completed and the effect of re-suspended ash from the Mt. Spurr volcanic eruption (August 1992) had largely abated.

When the events on March 12, 2003 (previously approved as an exceptional event) and this December 2, 2007 (under review) are excluded, a model fitted to empirical frequency distribution suggests that the frequency of Parkgate site exceeding the daily PM_{10} NAAQS (150 µg/m^3) would be once every 61 years (Figure 8). This indicates that the high PM_{10} observed on December 2, 2007 (223 µg/m^3) was an exceptional case and that there is little likelihood of reoccurrence in the future, assuming no change in the local weather pattern.

[‡‡] PM_{10} SIP Development Guidance. EPA 450, 2-86-001. July 1987.

Figure 8. Estimating probability of a violation of the PM_{10} NAAQS at the Parkgate Site. (Empirical Frequency Distribution method)



3. Conclusion

There would have been No Exceedance or Violation but for the Event

The evidence presented in this document demonstrates clearly that there would not have been an exceedance if not for the wind storm. We have documented winds exceeding 40 mph for the entire Knik Arm corridor on December 2, 2007. It is well documented that strong N and NE winds down Matanuska and Knik Valleys generate dust clouds in the Palmer area and that the source of the airborne dust is glacial deposits in the area.[†] Our analysis of historical data from the Parkgate site shows that concentrations above 100 $\mu g/m^3$ are rare and that the probability of a future exceedance is extremely low. Therefore, the exceedance on Dec 2, 2007 should be considered an "exceptional natural event."

Implementation of the NEAP

Anchorage prepared a NEAP for wind blown dust events in 2002. Two required elements of the NEAP are to:

1. Establish public notification and education programs.
2. Minimize public exposure to high concentrations of PM_{10} due to future natural events.

Although Anchorage has developed a system of notifying the public when PM_{10} concentrations are predicted to approach or exceed the NAAQS so that their exposure can be minimized, the public was not notified during the event on December 2, 2007. Monitoring in Eagle River is done with the filter-based federal reference method. Because filters cannot be weighed until they have been collected and equilibrated, data are not available for 36 to 72 hours after the sample day. Although continuous or "real time" data were available from the Tudor Road site in Anchorage, the data there suggested that PM_{10} concentrations were likely to remain below 150 $\mu g/m^3$ for a 24 hour average, the action level for public notification. The maximum *hourly* concentrations measured on December 2 at Tudor were below 200 $\mu g/m^3$. Indeed, the 24-hour concentration at Tudor was only 96 $\mu g/m^3$ that day.

Based on our experience it seemed very unlikely that an exceedance would occur at that site. Moreover, the Tudor site typically records significantly higher PM_{10} levels than any other site in the Municipality, including Parkgate. For this reason, there was no reason to believe that PM_{10} concentrations in Eagle River would be above the NAAQS.

This shortcoming should soon be remedied with the new Cook Inlet Regional Integrated Air Monitoring System (CIRIAMS). Continuous air quality data, including PM_{10}, will be available from a regional network that will include Anchorage, Eagle River, Matanuska-Susitna and Kenai. CIRIAMS should improve our ability to inform the public of PM_{10} episodes in the future.

We have attached supplemental information regarding wind and weather on December 2, 2007. Please contact me if you have questions. Thanks for considering our request for an exceptional event determination.

Sincerely,

Stephen S. Morris
Manager, Air Quality Program

Attachment - Supplemental Information

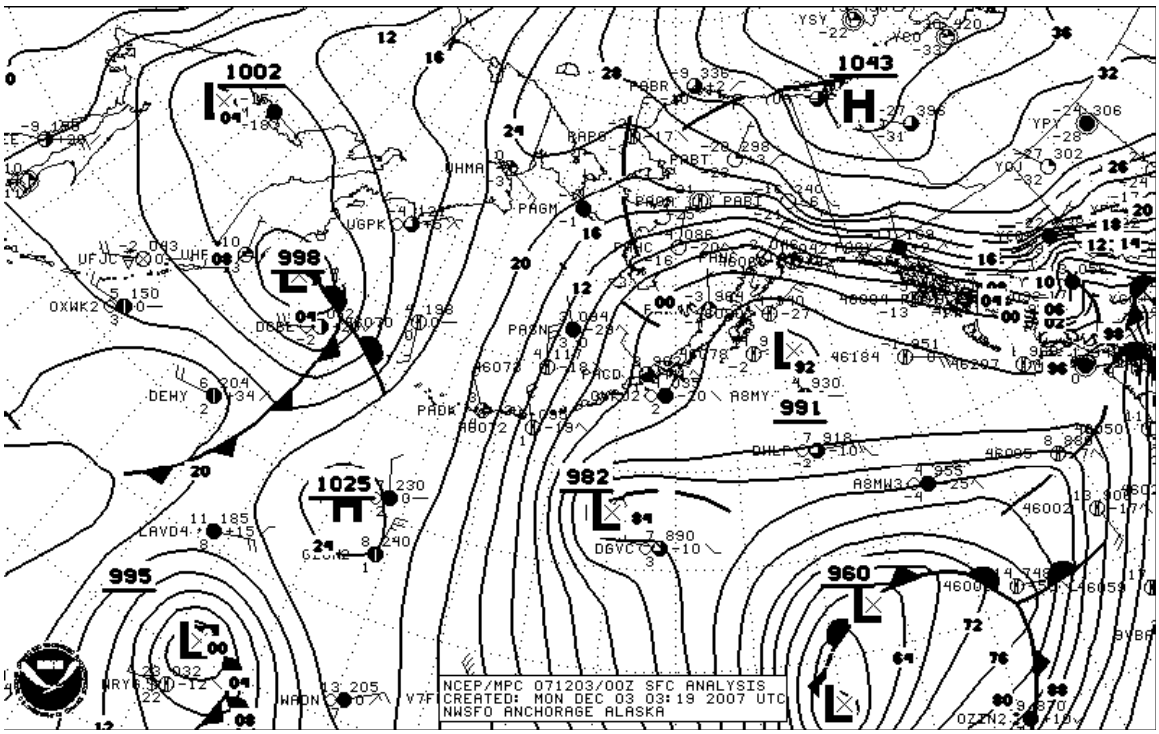
Description of December 2, 2007 wind Event by Andy Brown, Meteorologist NWS Anchorage

"Strong high pressure was building over western Canada the days leading up to the event. Extreme arctic air was evident under the dome of high pressure from the Copper River Basin eastward into the Yukon Territory. It is very typical for a strong temperature inversion to form just above the surface under the influence of high pressure. This was the case for most of south central Alaska including Palmer, Eagle River, and Anchorage.With strong high pressure to the north and east and low pressure building in the Gulf of Alaska, the cold air began to filter initially through the Matanuska Valley south toward Eagle River and Anchorage the morning of December 2nd. Palmer Airport (PAAQ) andthe Mesonet Station "South Palmer" (PLMA2) first reported the strong northeast winds between 2 and 3am on December 2nd. The initial winds brought the warm air aloft to the surface, raising the temperature on average 15 to 20 degrees within an hour at most reporting stations. At 11am, Palmer Airport reported blowing dust and continued carrying the dust in their observation until the afternoon of the 3rd. During that time, winds were from the northeast at 25 to 50 mph. South Palmer Mesonet station reported winds 45 to 65 mph during this time frame.

At 8am on December 2nd, the warm air aloft began to mix down to the surface in Eagle River. Temperatures rose 20 degrees within 10 minutes and winds increased to 10 to 20 mph at two Mesonet stations in Eagle River: Eagle River Heights (ERHA2) and Upper Kantishna (ERTA2). At Eagle River South Fork (ESFA2) which is at a much higher elevation (1600 ft), winds gusted 20 to 40 mph between the hours of 8 am and 2 pm on December 2nd. In Anchorage, winds began to pick up and temperatures rose 15 to 20 degrees at 9am.Elmendorf AFB reported winds 30 to 50 mph from 9am until 7pm, peaking between 1pm and 3pm. At the Mesonet station Northeast Anchorage, winds increase at 8:15am and gusted between 10 and 20 mph through 3 pm. At Dimond and Minnesota (ABDA2), winds increased between 9 and 10am to 15 to 30 mph and sustained through 4 pm. Winds were not as high at the stations located along the hillside but stations such as Upper O'Malley and Glen Alps reported winds 10 to 25 mph between 10am and 4 pm.

During the evening, winds subsided slightly as the cold air began to filter in to the area. Overnight, northerly winds at most stations gusted between 10 and 20 mph in Anchorage. Eagle River winds subsided to 10 mph or less. Northeasterly winds in Palmer sustained very strong gusts 30 to 55 mph through Tuesday evening (December 4th). This is out of my realm of expertise but this northeasterly fetch may have contributed to elevated levels of dust in Eagle River and Anchorage through Monday."

"(Below) is a surface analysis showing the strong high pressure in western Canada and low pressure in the gulf. The strong N-S pressure gradient across south central Alaska was the main factor in why the winds increased the morning of December 2nd."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