PRELIMINARY SITE CHARACTERIZATION AIR QUALITY TECHNICAL MEMORANDUM

MOLYCORP MINE RI/FS

REVISION 0

Prepared for
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SECTIONFOURTEEN Air Quality

This chapter presents and summarizes analytical results for air quality monitoring conducted at the Molycorp tailings facility in Questa, New Mexico. These data were collected outside of the RI/FS, but were nonetheless considered important data for consideration in the RI/FS and are therefore summarized here. The air quality data in this chapter covers the period from February 2003 through February 2004.

Two monitoring programs were conducted in 2003 for the purpose of evaluating the air quality at the tailings facility. The first was a continuous PM_{10} monitor network with three stations placed across the length of the site. Its purpose was to collect data continuously for PM_{10} during normal operations over all seasons. The second program was a short-term sampling campaign in May 2003 to collect aerosol samples for metals analysis. This campaign was conducted at the same sites as the continuous PM_{10} monitors.

The air monitoring network was installed in February-March 2003, and its operation is ongoing. Figure 14-1 shows the location of the three monitoring locations overlayed on the tailings facility boundaries. The three monitoring locations were chosen based on downgradient conditions for the typical wind direction, which is out of the southwest.

The instrument used for the PM_{10} monitoring is the Environmental Beta Attenuation Monitor (EBAM). Aerosol is collected continuously onto the quartz fiber tape, which is analyzed on an hourly basis to provide an average for that period. Once every 24-hours the tape is advanced. Tables 14-1 to 14-3 summarize the PM_{10} data. Appendix A-14 is the air quality assessment report for the tailings facility that is the basis for the PM_{10} data characterization presented in this chapter. The hourly PM_{10} data is not included in this report as this data is not as meaningful as daily or yearly averages and is quite voluminous.

A short-term sampling event for airborne metals was conducted between May 6, 2003 and May 29, 2003. PM_{10} particles were collected on Teflon filters and metals analyzed using X-ray fluorescence or inductively coupled plasma emission spectroscopy. Tables 14-4, 14-5, and 14-6 summarize the metals data. Appendix B-14 contains all of the metals data from the airborne metals sampling.

This section describes how and what data were collected during the February 2003 through February 2004 air monitoring program conducted at the tailings facility.

14.1 TAILINGS FACILITY PM_{10} MONITORING

Hourly averages for PM_{10} concentration wind speed, wind direction, and temperature) were collected starting on February 26, 2003 for Site 3, and March 17, 2003 for Sites 1 and 2. The data collected from those starting dates to February 16, 2004 were collated, validated, and analyzed, and are reported here.

14.1.1 Environmental Beta Attenuation Monitor

The instrument used for the PM_{10} monitoring is the EBAM. The EBAM is based on the same beta attenuation technology that is used in the BAM 1020 monitor, EPA federal reference equivalent method (FEM) EQPM-0798-122 under 40 CFR 53. The beta attenuation technique uses a small amount of Carbon-14 radioisotope as a source of beta particles that are absorbed by aerosol material collected on a continuous quartz fiber tape. A photomultiplier detector measures the attenuated (decreased) signal from the aerosol that is proportional to the mass collected. From the volume of air collected and that mass, the concentration is determined. The size fraction measured is determined by the type of separation inlet used, which was the standard PM_{10} virtual impactor used in all federal reference methods. Aerosol is collected continuously onto the quartz fiber tape, which is analyzed on an hourly basis to provide an average for that period. Once every 24-hours the tape is advanced.

The EBAM is also set up to collect wind speed and wind direction data. Temperature is also logged as part of the volumetric flow control. All the meteorological parameters are logged concurrently with the PM_{10} concentrations so that correlations can be made between them. The three monitors are powered by solar power systems consisting of two solar panels and a bank of deep charge batteries.

Figure 14-2 shows a close-up of the EBAM instrument and its parts.

14.1.2 PM_{10} Monitor Site Locations

Site 1 is located approximately 125 feet below the main plateau of the tailings facility. In addition, this site is on the edge of the southern boundary of the main tailings dam, which is located in an arroyo (canyon). This relatively isolated location is on the southern boundary of the tailings operations along the prevailing southwesterly wind direction. With this orientation and the relative distance from the major sources of fugitive dust, this site therefore was considered as representative of dust contributions from the operation to the south. Sites 2 and 3 are located to the north and northeast of the property, near the eastern fence line in the prevailing wind directions. The three monitoring locations on the main plateau of the tailings facility were chosen based on downgradient conditions for the typical wind direction, which is out of the southwest.

Figure 14-1 shows the location of the three monitoring locations overlayed on the tailings facility boundaries.

Figure 14-3 shows the annual wind rose for the tailings facility. The wind is primarily out of the southwest and flows across the tailings facility towards the northeast.

Figure 14-4 shows the diurnal pattern for wind speed.

Table 14-7 contains information describing the exact coordinates of each location.

14.1.3 PM_{10} Time Series Data

Hourly data was collected for all three sites. Because the PM_{10} air quality is evaluated on 24-hour and annual basis for comparison with the National Ambient Air Quality Standards (NAAQS), emphasis is placed on the 24-hour average data. The procedures for data validation along with detailed information on data quality assessment are presented in Appendix A-14. This assessment also includes an EBAM data intercomparison test.

Table 14-1 contains the 24-hour averages for the entire monitoring period.

Figure 14-5 shows a plot of the time series of the 24-hour average PM_{10} concentrations for the three tailing facilities monitoring sites.

Figure 14-6 shows a histogram plot of the 24-hour average PM_{10} concentrations for the three tailing facilities monitoring sites.

Table 14-2 contains data on the frequency of the various PM_{10} concentration levels.

Figure 14-7 shows the diurnal plot of the hourly data.

14.1.4 PM_{10} Averages

Table 14-3 contains summary statistics for the tailings facility PM_{10} monitoring. The column noted “All Sites” contains the average of the three monitoring locations. Maximum concentrations are shown on the four highest days for all three monitoring locations

14.2 TAILINGS FACILITY AIRBORNE METALS SAMPLING

A short-term sampling event for airborne metals was conducted between May 6, 2003 and May 29, 2003. Table 14-4 presents the concentrations of the 40 metals based on the volume of air pulled through the Teflon collection filters. Silicon to iron ratios, fugitive soil concentrations, and measured PM_{10} are also presented in this table.

14.2.1 Metals Sampling Equipment

The purpose of this study was to evaluate concentrations of metal constituents in fugitive dust. The sampling design incorporated 15 samples collected over approximately one month. This number of samples provides a reasonable population sample for statistical purposes while allowing for potential lost samples.

Samples were collected for 24-hours starting at mid-day. In this manner, sequential days were collected since the sample change-out required only a few minutes at the end of the sampling period. Samples were collected only from Monday to Friday. Samples were collected using Rupprecht and Patashnick, Inc. Partisol 2000 PM_{10} samplers. These samplers are EPA FEM samplers for PM_{10}, which means that the data are equivalent to data collected using a Federal Reference Method. The Partisol 2000 samplers are automated flow controlled samplers that collect the PM_{10} particulate at the standard 16.7 liters per minute on a volumetric basis. The size selection is accomplished with the standard low-volume impactor inlet. Although the samplers are automated, they were operated manually to adjust the start time for sample change-out as needed. The sampling time for valid samples ranged from 23.6 to 24 hours.

No utility power was available at the remote tailings facility sites, so power to run the Partisol samplers was supplied by diesel generators. The diesel generators were located approximately

75 feet to the southeast of the samplers. Based on the prevailing wind pattern of southwesterly or northeasterly winds, this siting was selected to least potentially impact the samplers.

Based on field observations and a review of the data, it did not appear that emissions from the generators impacted the field data to any extent.

Samples were collected on pre-weighed 47 mm Teflon filters. The sample cassettes were loaded and unloaded using standard procedures. Care was taken to avoid any contact other than the filter holder. This sampling apparatus was set up at the three sites previously described.

Figure 14-8 shows the metals sampling apparatus set up adjacent to an EBAM station. Three sets of analyses were performed on the collected filters: gravimetry for PM_{10} concentration, X-ray fluorescence for 38 metals from sodium to lead, and inductively coupled plasma emission spectrometry for boron and beryllium. The procedures for data validation along with detailed information on data quality assessment are presented in Appendix A-14.

14.2.2 Aerosol Composition Analysis

Three separate techniques were used to examine the aerosol metals in order to confirm the internal consistency of the data and to understand possible sources. These procedures are (1) reconstruction of the mass, (2) examination of specific source ratios, and (3) examination of potential elemental enrichment factors.

Reconstruction of the mass takes the individual elemental concentrations and makes assumptions about their contribution to common chemical species present in most atmospheric aerosols, particularly those derived from fugitive dust originating in soil.

The key equations (IMPROVE 2002) for this calculation are:

$$\text{Soil} = 1.89*\text{Al} + 2.14*\text{Si} + 1.4*\text{Ca} + 1.43*\text{Fe}$$

$$\text{Ammonium Sulfate} = 4.125*\text{S}$$

$$\text{Ammonium Nitrate} = 1.29\ *\text{NO}_3^-$$

$$\text{Organics} = 1.4*\text{OC}$$

$$\text{Elemental Carbon} = 1*\ \text{EC}$$

$$\text{Fugitive Dust} = 2.2*\text{Al} + 2.49*\text{Si} + 1.63*\text{Ca} + 2.42*\text{Fe} +1.94*\text{Ti}$$

Values that were not measured, such as organic carbon (OC) and elemental carbon (soot, or EC) were estimated by multiplying by two the average PM2.5 concentration obtained from the IMPROVE monitoring site at the Bandolier National Monument, located northwest of Albuquerque. This factor of 2 is conservative, based on the AP-42 ratio of 4 to 6.6 (Countess 2002). The results of this procedure are contained in Table 14-4. Table 14-4 also contains information relating to the Si/Fe ratio, which is an indicator of fugitive soil.

Enrichment Factors (EF) can also be used to examine the elemental composition of the aerosol versus its probable main sources and can provide insight into what was seen in the data. The approach uses the ratio as defined by:

$$EF\ (X) = (X)/(Ref)_{aerosol} / (X)/(Ref)_{source}$$

where X is the element under consideration and Ref is an appropriate reference element. If EF approaches unity, the reference element in the source—e.g., tailings or soil—is probably the dominant origin of the element.

Enrichment factors were calculated for both the tailings and soil as possible sources using recently collected surface soil analysis data of tailings as the tailings reference. An average soil elemental abundance composition was used as the soil reference. Aluminum was the reference element in both cases. Table 14-5 contains the results of this analysis.

14.3 SUMMARY

This section summarizes the tailings facility PM_{10} air quality data collected from February 2003 through February 2004 and the metals data collected in May 2003. PM_{10} averages are compared to NAAQS. Ambient air metal concentrations are compared to human health screening levels and regional background concentrations.

14.3.1 PM_{10} Concentration Summary Statistics

Table 14-3 shows the summary statistics for PM_{10} monitoring from February 2003 to February 2004. The 24-hour averages for the location Sites 1, 2, and 3 were 13.1, 10.6, and 16.7 ug/m^3 respectively. The average for all three sites was 13.5 ug/m^3.

The average data completeness for the three sites was 68.2% with the lowest data completeness (62.3%) for Site 2 and the highest (77.5%) for Site 3.

The maximum PM_{10} concentration was 138.8 ug/m^3 and was detected at Site 3 on May 19, 2003.

14.3.2 Data Gaps

For the period of February 2003 through 2004 there are a number of data gaps in the EBAM data (see Table 14-8). The majority of the data gaps were due to two reasons—instruments being out of service due to either equipment failure or factory upgrade servicing, and losses of the data due to downloading and data handling mistakes. An overall completeness of greater than 68% was achieved.

14.3.3 Tailings Facility Highest PM_{10} Day

Data from the day with the highest PM_{10}, May 19, 2003, can be used to understand the possible sources for the detected particulate at Site 3.

Figure 14-9 shows the hourly PM_{10} concentrations from Site 3 for May 19, 2003, which had the highest 24-hour daily average PM_{10} concentration of 139 ug/m^3.

Figure 14-10 shows the wind speed and wind direction data for May 19, 2003 on an hourly basis.

Figure 14-11 shows the wind rose for May 19, 2003. The wind was predominately out of the east.

These three figures show that the PM_{10} concentrations increase simultaneously with the wind speed and that the wind direction did not change substantially over the day, with the predominant direction from the east, an area of farming activity. These data indicate that Site 3 is subjected to fugitive dust from adjacent tilled farmland.

14.3.4 Comparison of Tailings Facility PM_{10} Concentrations to National Ambient Air Quality Standards

The tailings facility PM_{10} monitoring network was in operation for one year when this data was collected. The standard method of determining compliance with the annual NAAQS of 50 ug/m^3 requires 3 years of data. However, the 24 hr NAAQS of 150 ug/m^3 can be examined since that requires only a count of the number of days that exceed 150 ug/m^3. Even though there was only a years worth of PM_{10} data, comparison to the annual NAAQS was still carried out as it provides useful information.

The various maximum values and the 99th percentile concentration are shown in Table 14-3. It should be noted that the majority of these high values occurred during the period of high vehicular activity during the May 2003 metals sampling events or during the spring farming season.

As the data in Table 14-3 shows there were no 24-hour periods that exceeded 150 ug/m^3. The annual average PM_{10} concentration at the tailings facility is 13.5 ug/m3, which is below the annual NAAQS of 50 ug/m^3.

14.3.5 Comparison of Tailings Facility PM_{10} Concentrations to Regional Data

Table 14-9 shows historical data from routine monitoring conducted at the Questa Middle and High Schools from 1993 to 2002 by the New Mexico Air Quality Bureau (NMAQB 2002). The Middle School is located approximately ¼ mile east of Site 2, and the High School is located approximately ½ mile east of the tailings facility.

The historical data from the Questa Middle and High Schools (Table 14-9) shows a consistently low concentration over several years, indicative of a remote location that is unaffected by many high sources. The measurement data from both the tailings facility and historical data suggests a fairly stable tailings impoundment surface that should continue to exhibit good stability to wind erosion. The Questa historical monitoring data suggests that there is currently little to no contribution from the tailings facility and that the regional levels are consistently in the 12-15 ug/m^3 range. The data suggests that that the primary contribution to the air quality at the tailings facility is nearby farming and vehicular activity.

The average PM_{10} concentration of 13.5 ug/m^3 is also similar to the background concentration of PM_{10} as measured in a remote area of New Mexico, the Bandolier National Monument, a site selected by New Mexico for its remoteness and clean atmosphere. The average PM_{10} concentration measured from 1988 to the present in the National Monument is 8 ug/m^3. The tailings facility PM_{10} average of 13.5 ug/m^3 is only slightly higher than Bandolier and similar to, or lower than, typical air quality experienced in most areas of New Mexico. The EPA AIRS database shows an average of 27.5 ug/m^3 from 22 locations across the state. The majority of these are urban areas with the expectation of higher PM_{10} concentrations. The air quality at Questa and the tailings facility is consistent with a rural, minimally industrialized, and sparsely populated area.

14.4 TAILINGS FACILITY AIRBORNE METALS CONCENTRATIONS

Table 14-4 presents the air concentration for the 40 metals detected. The completeness for metal sample collection was 97.4%; only one sample was lost because of incomplete sampling time.

The metal detected at the lowest concentration was beryllium at 0.00004 ug/m^3. Molybdenum was detected at an average of 0.0009 ug/m^3 for the three sites with little variability between sites. The element detected at the highest concentration was silicon at an average of 2.4 ug/m^3 for the three sites. Silicon was followed by aluminum at an average of 0.86 ug/m^3, iron at 0.51 ug/m^3, and calcium at 0.49 ug/m^3.

Three separate techniques were used to examine the aerosol metals in order to confirm the internal consistency of the data and to understand possible sources. These procedures are (1) reconstruction of the mass, (2) examination of specific source ratios, and (3) examination of potential elemental enrichment factors.

14.4.1 Reconstruction of the Mass

Table 14-4 shows that the average percent reconstructed mass compared to the measured mass was approximately 70%. Considering the large approximations and assumptions for this approximate calculation, it is nonetheless comparable to the typical IMPROVE (IMPROVE 2002) agreement of 86%. This estimate is adequate to suggest that the measured values are internally consistent and that the aerosol metal composition is similar to the aerosol metal compositions in remote areas.

14.4.2 Fugitive Soil – Iron to Silica Ratio

Table 14-4 also contains information relating to the Si/Fe ratio, which is an indicator of fugitive soil (Countess 2001; Countess 2003). It shows that the ratio is similar for all three sites. The ratio for the averaged values from the tailings facility was 4.7, which was indicative of fugitive soil. Literature values for this ratio range from 2 for abraded road dust to 5 for earth's crust, and up to 6.7 for crustal sediment. Abrasion is a key factor in the eventual particle size that relates to its dispersion from the site of generation. The ratio appears to decrease as the geological material becomes more abraded with increasing anthropogenic activity. For comparison, studies have shown that fugitive dust from the California San Joaquin Valley had a ratio of 4.5 for PM_{10}.

14.4.3 Enrichment Factors

An average soil elemental abundance composition was used as the soil reference (Seinfeld 1998). Table 14-5 contains the results of this analysis. Only chromium, cobalt, iron, manganese, and vanadium were common between the three data sets (soil, tailings, and aerosols). This analysis shows that the enrichment factors for the aerosol are similar to soil and are substantially different from those in relation to the tailings composition (See Appendix A-14). This indicates a source in the measured aerosol different from what would be expected if the tailings were to enrich the background aerosol present. The enrichment factors of approximately 1.0 for iron, manganese, and vanadium all suggest a soil source, similar to what was seen in the Si/Fe ratio. The finding that no enrichment is occurring confirms the previous finding that the aerosol is not comprised of material solely from the tailings and that soil is the major source.

14.4.4 Comparison of Tailings Facility Ambient Air Metals Concentrations to Risk Based Concentrations and Background Concentrations

Table 14-6 presents a list of 18 metals that were analyzed for in the air monitoring samples and evaluated relative to health impacts. This table also includes various other criteria and data for comparison with the field data:

- Background levels from the Agency for Toxic Substances and Disease Registry Toxicology Profiles (ATSDR 2004)
- EPA Region 6 Human Health Medium-specific Screening Levels (EPA 2004a)
- EPA Region 3 Risk Based Concentrations (EPA 2004b)
- Air quality monitoring data conducted in 1979-1981 by the New Mexico Air Quality Bureau as reported in EPA Air Data database (EPA 2004c)
- Summary Report, Ambient Air Quality and Associated Data Collected in the Questa, New Mexico Area (1979-1980) (NMAQB 1980)
- Current airborne metals concentrations as reported in Air Data database (EPA 2004c)

The data in this table includes the average concentrations as determined in the monitoring, as well as the upper 95th percentile concentration, as recommended for comparison with health levels. The upper 95th percentile increases the conservatism of the average value to take into account the uncertainty in values based on the variability in measurement.

Background levels were taken from the ATSDR Toxicology Profiles or other literature sources. When a range of concentrations was indicated in the literature, the mid-point of the cited range was selected for comparison. Although some of the background data cited in the ATSDR literature citations was from arid locations that might be similar to the New Mexico area, most were scattered at disparate locations around the country. Very little PM_{10} data with metals concentration data is available for remote areas as most monitoring is performed around population centers. The largest body of remote location data is based on visibility monitoring for PM2.5 species that are mostly not applicable to conversion to PM_{10} data. Therefore, although the background data may not be directly applicable, it is the best available and is likely to be close to local values given the probably crustal source for the soil. Crustal material is more constant in composition than localized soil that is subjected to weathering and other degradation processes. The data cited from other monitoring performed by the state of New Mexico showed higher levels than currently measured. In part, this may be due to the technique used. The other testing was conducted on a total suspended particulate basis, which generally shows higher concentration levels due to the inclusion of all size fractions. The data are included here for a general comparison.

In Table 14-6 three metals were found at concentrations higher than ambient air risk screening levels (EPA Region 6 and EPA Region 3), namely arsenic, cadmium, and chromium. All three metals were present at concentrations similar to or below background ambient air concentrations found in the literature.

SECTION 14

AIR QUALITY

TABLES

Table 14-1
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
2/26/03			
2/27/03			
2/28/03			
3/1/03			
3/2/03			
3/3/03			
3/4/03			
3/5/03			
3/6/03			
3/7/03			6.2
3/8/03			
3/9/03			3.9
3/10/03			
3/11/03			5.6
3/12/03			6.1
3/13/03			9.0
3/14/03			7.6
3/15/03			6.0
3/16/03			
3/17/03			
3/18/03			
3/19/03			
3/20/03	5.5	9.0	4.8
3/21/03	4.2	1.0	
3/22/03	5.0	5.0	
3/23/03	5.1	12.0	
3/24/03	7.6	9.0	6.9
3/25/03	5.5	9.0	5.2
3/26/03	6.7	10.0	5.3
3/27/03	17.9	8.0	22.1
3/28/03	5.3	4.0	14.1
3/29/03	5.6	4.0	4.8
3/30/03	6.7	3.0	5.4
3/31/03	4.1		4.6
4/1/03	9.0	5.0	10.9
4/2/03	8.8	10.0	9.5
4/3/03	18.9	7.0	20.0
4/4/03	10.6	18.0	14.2
4/5/03	18.0	21.0	23.2

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
4/6/03	12.4	20.0	10.3
4/7/03	8.8	1.0	12.3
4/8/03	4.8		
4/9/03	6.3	2.0	7.7
4/10/03	6.5		8.0
4/11/03	11.9		11.2
4/12/03	11.5	10.0	12.8
4/13/03	10.5	7.0	11.0
4/14/03	7.6	11.0	8.3
4/15/03	11.8	13.0	12.4
4/16/03	4.3	9.0	
4/17/03	19.6		38.2
4/18/03	11.0	25.0	11.3
4/19/03		1.0	
4/20/03	5.3	7.0	
4/21/03		4.0	
4/22/03			
4/23/03			
4/24/03			
4/25/03			
4/26/03			
4/27/03			
4/28/03			
4/29/03			
4/30/03			
5/1/03			
5/2/03			9.9
5/3/03			37.7
5/4/03			22.7
5/5/03			7.1
5/6/03	6.9		14.3
5/7/03	13.3	15.0	40.9
5/8/03	14.4	18.0	26.1
5/9/03	40.9	1.0	70.5
5/10/03	12.8	48.0	23.2
5/11/03	7.0	3.0	8.2
5/12/03	10.7	8.0	28.7
5/13/03	8.6	10.0	11.1
5/14/03	13.0	14.0	10.0

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
5/15/03	44.3	15.0	76.5
5/16/03	12.8	3.0	11.1
5/17/03	11.8	3.0	11.1
5/18/03	14.5	11.0	14.6
5/19/03	16.3	13.0	138.8
5/20/03	9.3	5.0	10.4
5/21/03	30.9	23.0	11.8
5/22/03	13.2	12.0	30.1
5/23/03	19.5	13.0	40.5
5/24/03	17.6	18.0	21.4
5/25/03	12.3	14.0	10.9
5/26/03	8.4	10.0	8.1
5/27/03	12.0	10.0	15.3
5/28/03	11.5	12.0	16.0
5/29/03	16.3	1.0	15.6
5/30/03	12.3		10.4
5/31/03	12.1		12.3
6/1/03	14.3		21.1
6/2/03	10.2		20.2
6/3/03	16.8		15.3
6/4/03	14.7		35.8
6/5/03	27.1		74.3
6/6/03	11.9		20.4
6/7/03	17.0		24.8
6/8/03	11.9		16.0
6/9/03	24.7		32.1
6/10/03	28.5		31.8
6/11/03	15.2		14.0
6/12/03	16.0		19.7
6/13/03	28.6		31.0
6/14/03	18.5		18.2
6/15/03	19.1		14.8
6/16/03	16.4		12.6
6/17/03	16.1		53.7
6/18/03	10.1		17.7
6/19/03	11.7		9.1
6/20/03	16.2		
6/21/03	17.6		17.4
6/22/03	15.1		16.3

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
6/23/03	15.3		24.3
6/24/03	23.3		37.6
6/25/03	17.0		22.5
6/26/03	12.4		11.8
6/27/03	10.1		20.8
6/28/03	20.5		18.5
6/29/03	22.6		65.7
6/30/03	11.9	11.0	13.5
7/1/03	14.6	16.0	16.8
7/2/03	16.5	7.0	11.8
7/3/03	16.6	13.0	29.3
7/4/03	19.3	25.0	23.0
7/5/03	19.2	6.0	21.9
7/6/03	25.5	18.0	38.4
7/7/03	32.2	33.0	32.1
7/8/03	13.8	15.0	14.0
7/9/03	18.5	17.0	29.2
7/10/03	22.2	15.0	20.3
7/11/03	17.2	17.0	17.2
7/12/03	20.9	10.0	27.9
7/13/03	19.5	8.0	22.0
7/14/03	28.4	28.0	42.6
7/15/03	20.5	10.0	22.2
7/16/03	19.9	10.0	35.3
7/17/03	16.3	17.0	17.1
7/18/03	18.9	8.0	25.3
7/19/03	27.0	1.0	104.4
7/20/03	15.8	6.0	31.5
7/21/03	13.4	1.0	13.5
7/22/03	16.5	9.0	19.4
7/23/03	15.0		53.1
7/24/03	16.0	12.0	11.3
7/25/03	12.4	9.0	17.1
7/26/03	14.1	5.0	18.6
7/27/03	10.8	10.0	11.1
7/28/03	8.0		9.7
7/29/03	13.2		12.4

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
7/30/03	9.3		9.5
7/31/03	10.8	8.0	10.9
8/1/03	8.3	2.0	8.1
8/2/03	8.4	9.0	13.6
8/3/03	8.8	8.0	16.9
8/4/03	9.5	11.0	7.0
8/5/03	8.9	11.0	14.7
8/6/03	8.5	12.0	9.0
8/7/03	7.7	5.0	8.0
8/8/03	8.5	1.0	9.0
8/9/03	7.0	7.0	9.9
8/10/03	9.9	2.0	10.6
8/11/03	10.9	5.0	7.8
8/12/03	8.2	10.0	13.4
8/13/03	13.1	12.0	14.2
8/14/03	14.2	10.0	13.1
8/15/03	12.0	14.0	10.9
8/16/03	9.2	11.0	8.3
8/17/03	8.0	5.0	
8/18/03	8.1	6.0	6.4
8/19/03	8.8	16.0	9.7
8/20/03	11.0	2.0	9.3
8/21/03	10.6	8.0	14.1
8/22/03	7.1	14.0	7.6
8/23/03	6.4	10.0	6.9
8/24/03	9.2	2.0	9.7
8/25/03	6.0		7.1
8/26/03	9.0		10.1
8/27/03		12.0	9.0
8/28/03			
8/29/03			5.9
8/30/03			
8/31/03			
9/1/03			7.3
9/2/03	9.6	4.0	6.9
9/3/03	7.3		9.6

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
9/4/03	8.2	14.0	7.5
9/5/03	7.0	3.0	9.5
9/6/03	7.3		
9/7/03	9.1	13.0	
9/8/03	5.5		7.9
9/9/03	8.1		8.9
9/10/03			
9/11/03	6.1	5.0	
9/12/03	8.3	7.0	
9/13/03	10.2		9.8
9/14/03	9.5	6.0	8.8
9/15/03	8.3	7.0	9.9
9/16/03	15.0	19.0	8.9
9/17/03	17.7	12.0	16.3
9/18/03	12.0	8.0	18.3
9/19/03	11.4		11.1
9/20/03	9.0	5.0	10.8
9/21/03	9.1	7.0	9.0
9/22/03	9.8	12.0	6.5
9/23/03	11.0	6.0	10.0
9/24/03	12.2	18.0	12.1
9/25/03	12.8	7.0	15.5
9/26/03	13.9	7.0	12.2
9/27/03	11.5	7.0	15.0
9/28/03	12.3	13.0	12.3
9/29/03	15.7	8.0	11.9
9/30/03	14.3	14.0	16.1
10/1/03		4.0	
10/2/03			
10/3/03			
10/4/03			
10/5/03			
10/6/03			
10/7/03			
10/8/03			
10/9/03			
10/10/03			
10/11/03			

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
10/12/03			
10/13/03			
10/14/03			
10/15/03			
10/16/03			
10/17/03			
10/18/03			
10/19/03			
10/20/03		1.0	
10/21/03	12.7	8.0	
10/22/03	10.6	7.0	
10/23/03	7.2	6.0	
10/24/03	10.4	6.0	
10/25/03	20.4	13.0	
10/26/03	7.5		
10/27/03	5.8	2.0	
10/28/03	7.4	8.0	
10/29/03	11.0	10.0	
10/30/03	34.9	20.0	
10/31/03	28.5		
11/1/03	14.6	19.0	
11/2/03	10.3	7.0	
11/3/03	9.6	5.0	
11/4/03	5.5		
11/5/03	7.3	5.0	
11/6/03	6.9	19.0	
11/7/03	7.5	3.0	
11/8/03	5.5	2.0	
11/9/03	5.3	3.0	
11/10/03	6.9	8.0	
11/11/03	5.5	6.0	
11/12/03	8.1	10.0	
11/13/03			
11/14/03	9.9	45.0	
11/15/03	13.1	21.0	
11/16/03	7.9	16.0	
11/17/03	12.6	3.0	
11/18/03	12.0	16.0	

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
11/19/03			
11/20/03		15.0	
11/21/03	6.8	2.0	
11/22/03	16.7		28.3
11/23/03	24.2	4.0	7.2
11/24/03	11.1	17.0	5.3
11/25/03	9.4	19.0	
11/26/03	6.6	7.0	6.8
11/27/03	70.7	9.0	
11/28/03	6.3	5.0	5.4
11/29/03	7.1	2.0	7.4
11/30/03	5.6	7.0	6.4
12/1/03	9.4		7.0
12/2/03	21.2	9.0	10.5
12/3/03	10.5	16.0	7.4
12/4/03	7.5	10.0	7.0
12/5/03	12.3		11.3
12/6/03	13.7	14.0	12.0
12/7/03	8.7	10.0	8.4
12/8/03	8.5	8.0	
12/9/03	50.3		18.1
12/10/03			7.9
12/11/03	8.9	8.0	
12/12/03	20.3	12.0	30.0
12/13/03	14.3	21.0	
12/14/03		1.0	
12/15/03	33.6		32.6
12/16/03	6.8		
12/17/03	6.2	9.0	6.3
12/18/03	10.0	14.0	10.5
12/19/03	9.0	13.0	9.5
12/20/03	10.4	6.0	9.6
12/21/03	8.0	11.0	
12/22/03		21.0	
12/23/03	10.7	9.0	
12/24/03	10.4	1.0	11.9
12/25/03	9.3	1.0	
12/26/03	9.7	7.0	13.6

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
12/27/03	13.2	12.0	13.0
12/28/03	33.1	11.0	
12/29/03			
12/30/03	6.3	2.0	
12/31/03	4.0	6.0	6.1
1/1/04	6.3	16.0	9.0
1/2/04	3.5	1.0	7.6
1/3/04	8.1		
1/4/04		9.0	
1/5/04		5.0	
1/6/04		12.0	7.6
1/7/04	8.5		4.9
1/8/04			
1/9/04			
1/10/04	6.5		
1/11/04	6.0		8.8
1/12/04	6.1		6.5
1/13/04	6.6		6.0
1/14/04	30.5		6.9
1/15/04	9.4		7.2
1/16/04	26.7		
1/17/04	24.6		
1/18/04	5.2		
1/19/04	7.8		8.2
1/20/04	18.6		22.6
1/21/04	7.2		10.8
1/22/04			
1/23/04			8.8
1/24/04	18.0		
1/25/04			12.6
1/26/04	13.2		13.8
1/27/04			6.3
1/28/04		15.0	10.5
1/29/04		13.0	
1/30/04		21.0	
1/31/04	9.9	6.0	7.9

Table 14-1 (continued)
24-hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m^3)	Site 2 24 hr Avg. (ug/m^3)	Site 3 24 hr Avg. (ug/m^3)
2/1/04	41.9	2.0	38.7
2/2/04		16.0	7.2
2/3/04	15.6	5.0	13.4
2/4/04	18.0		22.5
2/5/04			8.5
2/6/04		16.0	
2/7/04			
2/8/04		9.0	
2/9/04		5.0	9.4
2/10/04			10.3
2/11/04		3.0	62.3
2/12/04		73.0	24.8
2/13/04		34.0	11.2
2/14/04		28.0	12.9
2/15/04		11.0	14.9
2/16/04		29.0	15.6

Table 14-2
Frequency Data for PM10 Concentrations

(Percentages refer to portion of all values)

Concentration Range (ug/m3)	Site 1	Site 2	Site 3
0-5	2.3%	26.0%	2.2%
5-10	40.2%	34.1%	35.5%
10-15	29.3%	21.2%	28.1%
15-20	16.2%	11.1%	10.8%
20-25	4.6%	3.8%	8.7%
25-30	3.1%	1.4%	3.5%
30-35	2.3%	1.0%	3.0%
35-40	0.0%	0.0%	3.0%
40-45	1.2%	0.5%	1.3%
45-50	0.0%	0.5%	0.0%
50-55	0.4%	0.0%	0.9%
55-60	0.0%	0.0%	0.0%
60-65	0.0%	0.0%	0.4%
65-70	0.0%	0.0%	0.4%
70-75	0.4%	0.5%	0.9%
75-80	0.0%	0.0%	0.4%
80-85	0.0%	0.0%	0.0%
85-90	0.0%	0.0%	0.0%
90-95	0.0%	0.0%	0.0%
95-100	0.0%	0.0%	0.0%
>100	0.0%	0.0%	0.9%

Table 14-3
Data Summary for Tailings Facility PM10

Parameter	**Site 1**	**Site 2**	**Site 3**	**Totals**
Count--in service days	334	334	356	1024
Count--possible monitoring days	319	320	271	910
Count--valid data days	259	208	231	698
Completeness	77.5%	62.3%	64.9%	68.2%
Exceedances (>150 ug/m3, 24-hr standard)	0	0	0	0
Parameter	**Site 1**	**Site 2**	**Site 3**	**All Sites**
Average--24 hour Avg.	13.1	10.6	16.7	13.5
Average—24 hr Avg., 95th Percentile	13.1 ±1	10.6 ±1.2	16.7 ±2	13.5 ±0.9
Standard Deviation	8.1	8.5	15.7	11.5
95% Confidence Interval	1.0	1.2	2.0	0.9
Lower Confidence Limit	12.1	9.4	14.7	12.6
Upper Confidence Limit	14.1	11.7	18.7	14.3
Median	11.0	9.0	11.8	10.8
1st Max	70.7	73.0	138.8	56.1
2nd Max	50.3	48.0	104.4	50.7
3rd Max	44.3	45.0	76.5	48.9
4th Max	41.9	34.0	74.3	45.3
99th Percentile	32.0	30.2	53.1	56.1

- Units: ug/m3
- Exceedances refers to the number of valid monitoring days in which the average concentration exceeded 150 ug/m3.
- Completeness is the ratio of valid monitoring days divided the possible number of monitoring days
- Lower and upper confidence limits refer to the 95th percentile confidence interval.
- All Sites refers to a spatial average across all three sites. 1st-4th Max days refers to the top four concentrations over the monitoring period. The 99th percentile refers to the 99th percentile concentration over the monitoring period.

Table 14-4
Reconstruction of Aerosol Mass for Metals

Element (ug/m^3)	**Average-1**	**Average-2**	**Average-3**	**Average-All**
Aluminum	0.69	0.75	1.1	0.86
Antimony	0.0028	0.0025	0.0020	0.0024
Arsenic	0.0005	0.0004	0.0006	0.0005
Barium	0.0061	0.011	0.016	0.011
Beryllium	0.00004	0.00004	0.00004	0.00004
Boron	0.025	0.025	0.025	0.025
Bromine	0.0029	0.0031	0.0033	0.0031
Cadmium	0.0018	0.0017	0.0023	0.0019
Calcium	0.45	0.46	0.55	0.49
Chlorine	0.018	0.015	0.016	0.016
Chromium	0.0004	0.0005	0.0007	0.0006
Cobalt	0.0003	0.0005	0.0009	0.0005
Copper	0.0010	0.0010	0.0016	0.0012
Gallium	0.0005	0.0005	0.0006	0.0006
Germanium	0.0005	0.0004	0.0005	0.0005
Indium	0.0044	0.0046	0.0042	0.0044
Iron	0.38	0.44	0.69	0.51
Lanthanum	0.014	0.0099	0.010	0.011
Lead	0.0009	0.0010	0.0011	0.0010
Magnesium	0.11	0.11	0.14	0.12
Manganese	0.0083	0.010	0.016	0.012
Mercury	0.0034	0.0008	0.0009	0.0017
Molybdenum	0.0008	0.0010	0.0009	0.0009
Nickel	0.0002	0.0002	0.0002	0.0002
Palladium	0.0016	0.0015	0.0020	0.0017
Phosphorus	0.0014	0.0014	0.0014	0.0014
Potassium	0.24	0.27	0.39	0.30
Rubidium	0.0011	0.0013	0.0020	0.0015
Selenium	0.0004	0.0003	0.0003	0.0003
Silicon	1.8	2.0	3.2	2.4
Silver	0.0018	0.0018	0.0021	0.0019
Sodium	0.057	0.056	0.081	0.065
Strontium	0.0036	0.0043	0.0058	0.0046
Sulfur	0.31	0.30	0.30	0.30
Tin	0.0029	0.0031	0.0023	0.0028
Titanium	0.044	0.050	0.078	0.057

Table 14-4 (continued)
Reconstruction of Aerosol Mass for Metals

Element (ug/m3)	**Average-1**	**Average-2**	**Average-3**	**Average-All**
Vanadium	0.0006	0.0009	0.0017	0.0011
Yttrium	0.0005	0.0007	0.0007	0.0006
Zinc	0.0037	0.0040	0.0045	0.0041
Zirconium	0.0015	0.0017	0.0028	0.0020
Si/Fe ratio	4.8	4.6	4.6	4.7
Soil concentration	6.50	7.16	10.91	8.19
Fugitive soil	6.7	7.3	11.2	8.4
Fugitive dust/soil	102%	103%	103%	103%
Fugitive dust/PM10	42%	41%	45%	43%
Nitrate	0.467	0.467	0.467	0.467
Organics	3.57	3.57	3.57	3.57
Elemental carbon	0.17	0.17	0.17	0.17
Reconstructed Mass	12.00	12.62	16.35	13.66
Measured PM10	15.8	17.8	24.6	19.4
Percent Mass Agreement	76%	71%	66%	70%

Table 14-5
Enrichment Factors for Metals

Element	EF (aer/soil)	EF (aer/tail)
Chromium	0.23	1.1
Cobalt	5.7	11
Iron	1.1	3.7
Manganese	1.1	5.6
Vanadium	0.88	2.6

Table 14-6
Toxic Metals Summary
(All concentrations in ug/m3)

Element	Average-1	Average-2	Average-3	Average-All		95th Percentile	Background[1]	EPA Screening Level[2]	EPA Region[2a]	1979-1981 Data[3]	NM Data[4]
Aluminum	0.69	0.75	1.1	0.86		1.1	1.7	5.2	6	NA	NA
Arsenic	0.00052	0.00040	0.00060	0.00050		0.00060	0.003	0.00045	6	0.0023	0.005
Barium	0.0061	0.011	0.016	0.011		0.014	0.012	0.026	6	NA	NA
Beryllium	0.000042	0.000042	0.000042	0.000042		0.000042	0.0005	0.0008	6	0.0005	0.002
Boron	0.025	0.025	0.025	0.025		0.025	NA	21	6	NA	NA
Cadmium	0.0018	0.0017	0.0023	0.0019		0.0022	0.001	0.0011	6	0.0014	NA
Chromium (total)	0.00044	0.00050	0.00071	0.00055		0.00067	0.0026	0.00016	6	0.005	0.016
Cobalt	0.00032	0.00046	0.00086	0.00055		0.00077	0.0015	0.00069	6	0.144	NA
Copper	0.0010	0.0010	0.0016	0.0012		0.0014	0.140	150	6	NA	NA
Iron	0.38	0.44	0.69	0.51		0.66	NA	1095	3	1.44	NA
Manganese	0.0083	0.010	0.016	0.012		0.015	0.030	0.052	6	NA	NA
Mercury (inorganic)	0.0034	0.00080	0.00086	0.0017		0.0022	0.015	0.31	6	0.0002	NA
Molybdenum	0.00080	0.0010	0.00092	0.00091		0.0010	NA	18	3	0.002	NA
Nickel	0.00025	0.00025	0.00025	0.00025		0.00025	0.035	73	3	NA	0.050
Selenium	0.00040	0.00026	0.00032	0.00033		0.00039	0.010	18	3	0.001	NA
Silver	0.0018	0.0018	0.0021	0.0019		0.0022	0.001	18	3	NA	NA
Vanadium	0.00061	0.00088	0.0017	0.0011		0.0015	0.020	3.7	3	NA	NA
Zinc	0.0037	0.0040	0.0045	0.0041		0.0047	0.040	1100	3	0.10	NA

1. Background values obtained from ATSDR Toxicology Profiles1

2. EPA Screening Levels for Air obtained from US EPA Regions 32and 63
2a. EPA Region—source of the risk screening levels used in adjacent column.

3. 1979-1981 Monitoring data obtained from report "Summary Report,
Ambient Air Quality Data and Associated Data Collected in the Questa, NM Area," New Mexico Air Quality Bureau

4. Current airborne metals concentrations in EPA AIRS data base. 4The AIRS data base is the repository for most criteria pollutant data currently collected.

Table 14-7
Monitoring Site Information

PM10-1
36 41.755 N
105 37.787 W
13443792E
4061119N
7524 feet elevation
PM10-2
36 43.270 N
105 36.283 W
13446048E
4063904N
7650 feet elevation
PM10-3
36 43.803 N
105 36.510 W
13445717E
4064892N
7660 feet elevation
All lat/long use WGS84
UTM: NAD27

Table 14-8
Explanation of Missing Data

Site 1			Site 2			Site 3		
Start	End	Reason	Start	End	Reason	Start	End	Reason
2/25/03 14:00	3/17/03 11:00	Not in stalled	2/25/03 14:00	3/17/03 12:00	Not installed	4/20/03 16:00	5/1/03 16:00	Equipment upgrade
4/21/03 12:00	5/6/03 4:00	Equipment upgrade	4/21/03 16:00	5/6/03 11:00	Equipment upgrade	9/30/03 13:00	9/30/03 18:00	Temperature sensor failure
8/27/03 18:00	9/1/03 5:00	Unexplained failure	5/29/03 12:00	6/29/03 8:00	Data lost	10/1/03 11:00	10/1/03 19:00	Temperature sensor failure
10/1/03 14:00	10/20/03 9:00	Temperature sensor replacement	7/13/03 17:00	7/13/03 17:00	Logger glitch	10/2/03 15:00	10/31/03 14:00	Temperature sensor repair
11/19/03 4:00	11/20/03 8:00	Field calibration	8/27/03 18:00	9/1/03 5:00	Data lost	11/19/03 13:00	11/20/03 9:00	Field calibration
12/29/03 1:00	12/29/03 10:00	Unexplained failure	9/13/03 20:00	9/13/03 20:00	Logger glitch			
1/27/04 1:00	1/30/04 10:00	Tape failure	9/14/03 1:00	9/14/03 1:00	Logger glitch			
2/2/04 1:00	2/2/04 10:00	Unexplained failure	9/14/03 19:00	9/14/03 21:00	Unexplained			
2/6/04 1:00	2/16/04 23:00	Tape failure	9/15/03 1:00	9/15/03 1:00	Unexplained			
			9/15/03 14:00	9/15/03 20:00	Unexplained			
			9/16/03 1:00	9/16/03 3:00	Unexplained			
			9/16/03 15:00	9/16/03 15:00	Unexplained			
			10/1/03 14:00	10/19/03 9:00	Factory check and repair			
			11/18/03 16:00	11/19/03 11:00	Field calibration			
			1/6/04 14:00	1/27/04 20:00	Tape failure			
			2/4/04 23:00	2/5/04 12:00	Logger glitch			
			2/6/04 5:00	2/6/04 10:00	Logger glitch			
			2/13/04 1:00	2/13/04 1:00	Logger glitch			

Table 14-9
Questa Historical PM10 Data

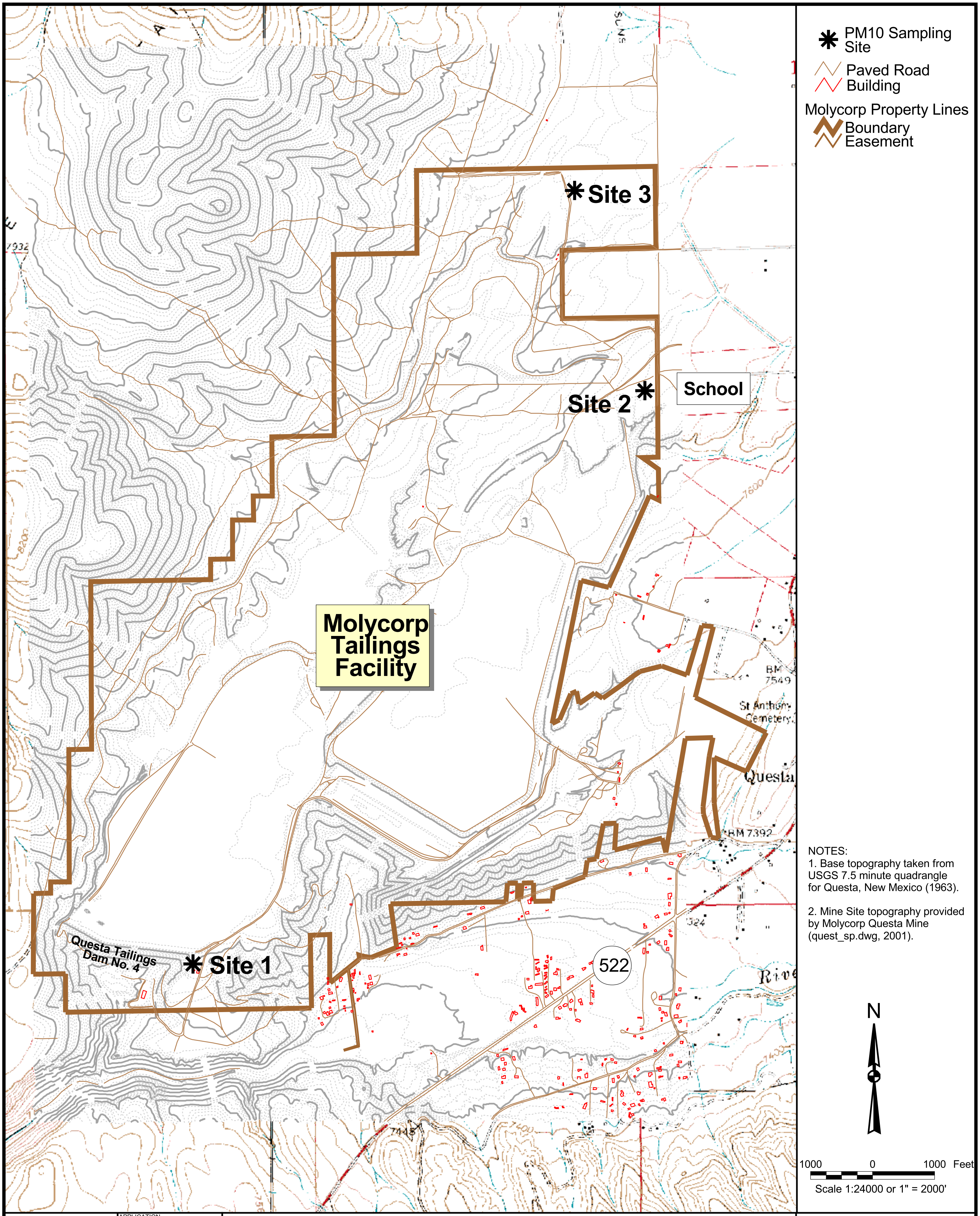
Year	Middle School	High School
1993	18	15
1994	18	9
1995	16	8
1996	24	9
1997	20	9
1998	19	9
1999	14	11
2000	NA	11
2001	NA	10
2002	NA	12
Avg.	18.4	10.3

Units are µg/m3

SECTION 14

AIR QUALITY

FIGURES



NOTES:

1. Base topography taken from USGS 7.5 minute quadrangle for Questa, New Mexico (1963).

2. Mine Site topography provided by Molycorp Questa Mine (quest_sp.dwg, 2001).

URS

URS Center
8181 East Tufts Avenue
Denver, CO 80237-2637
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APPLICATION
ArcView GIS

FILE NAME
secs1_14techmemo.apr

DRAWN BY
GCK - Denver

DATE
3/14/2005

MOLYCORP - QUESTA MINE

TAILINGS FACILITY AND LOCATION
OF PM10 SAMPLING SITES

PROJECT
22236244

Figure 14-1

Preliminary Site Characterization Report

Figure 14-2
Photo of EBAM PM10 Instrument

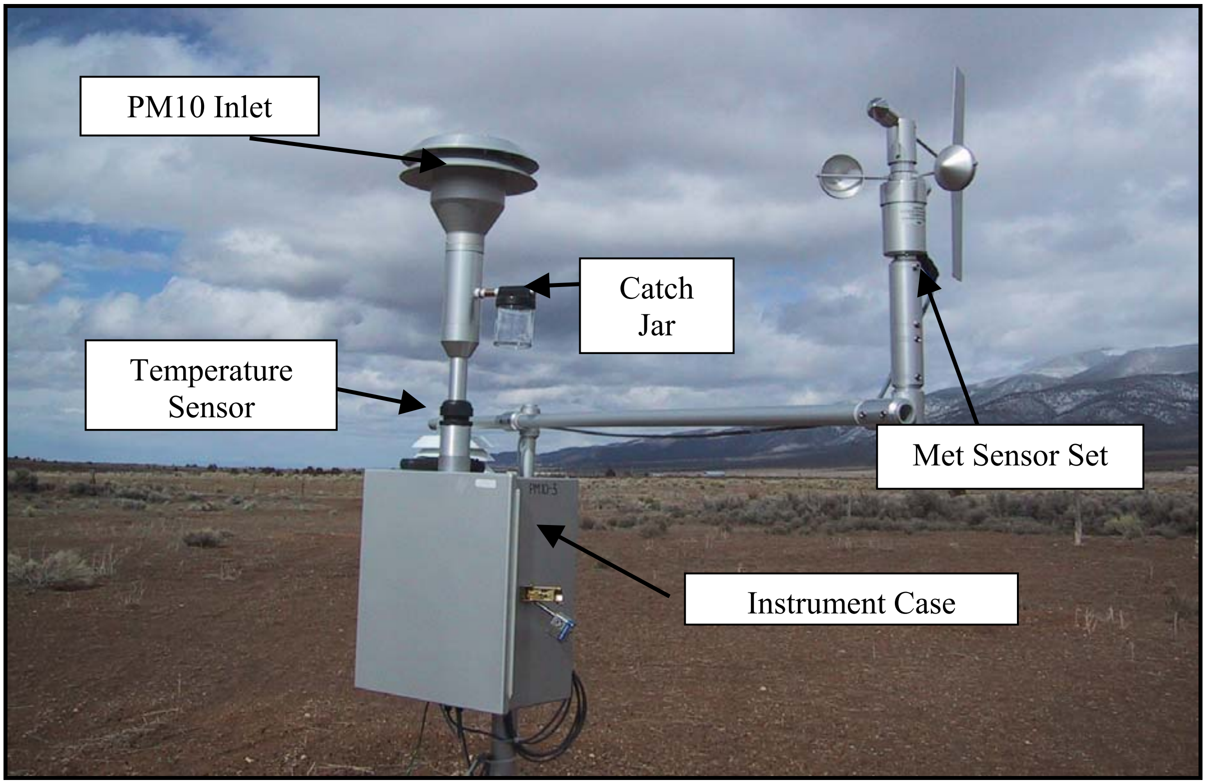


Figure 14-3
Tailings Facility Annual Wind Rose

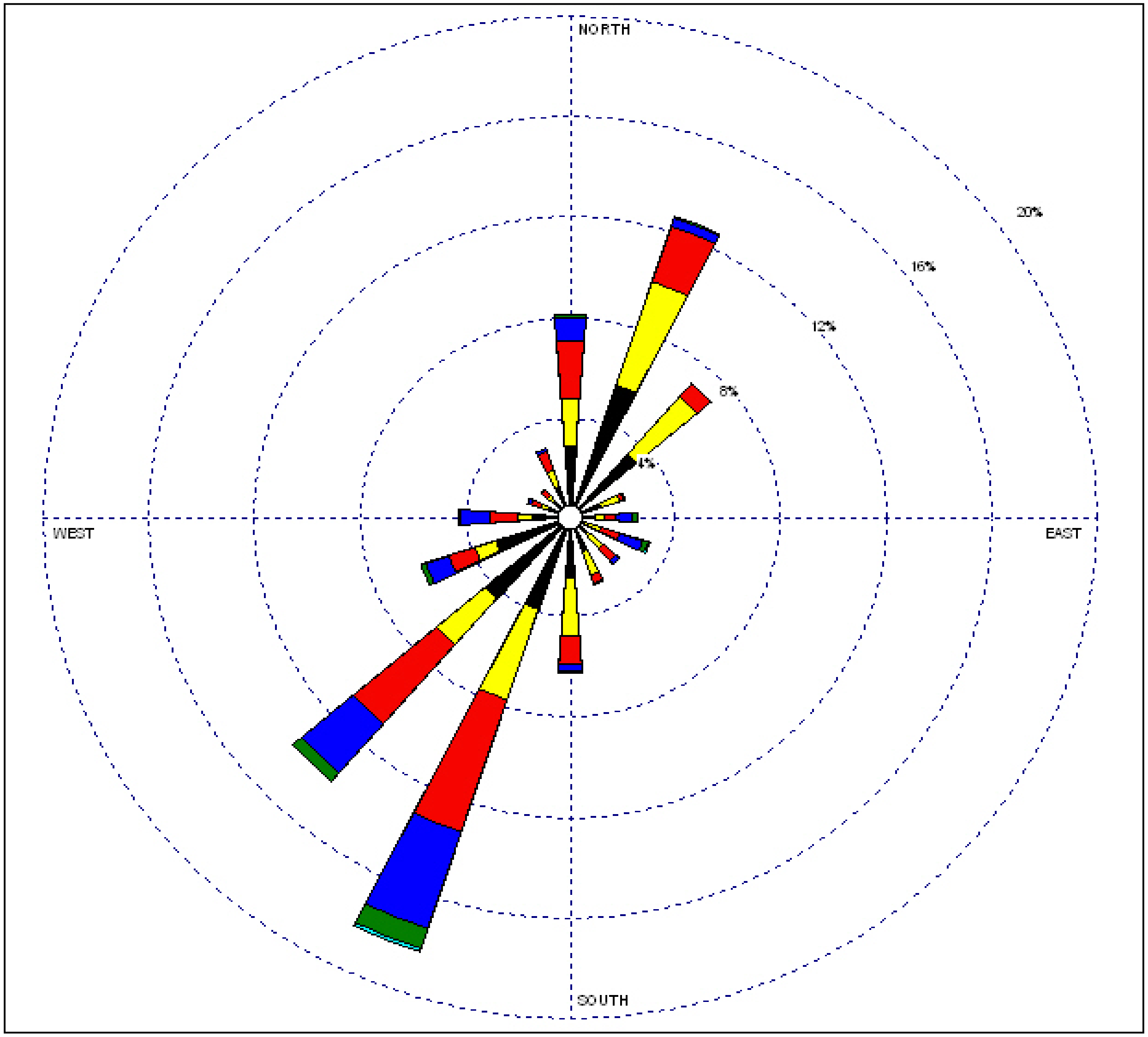


Figure 14-4
Tailings Facility Wind Speed Diurnal Pattern

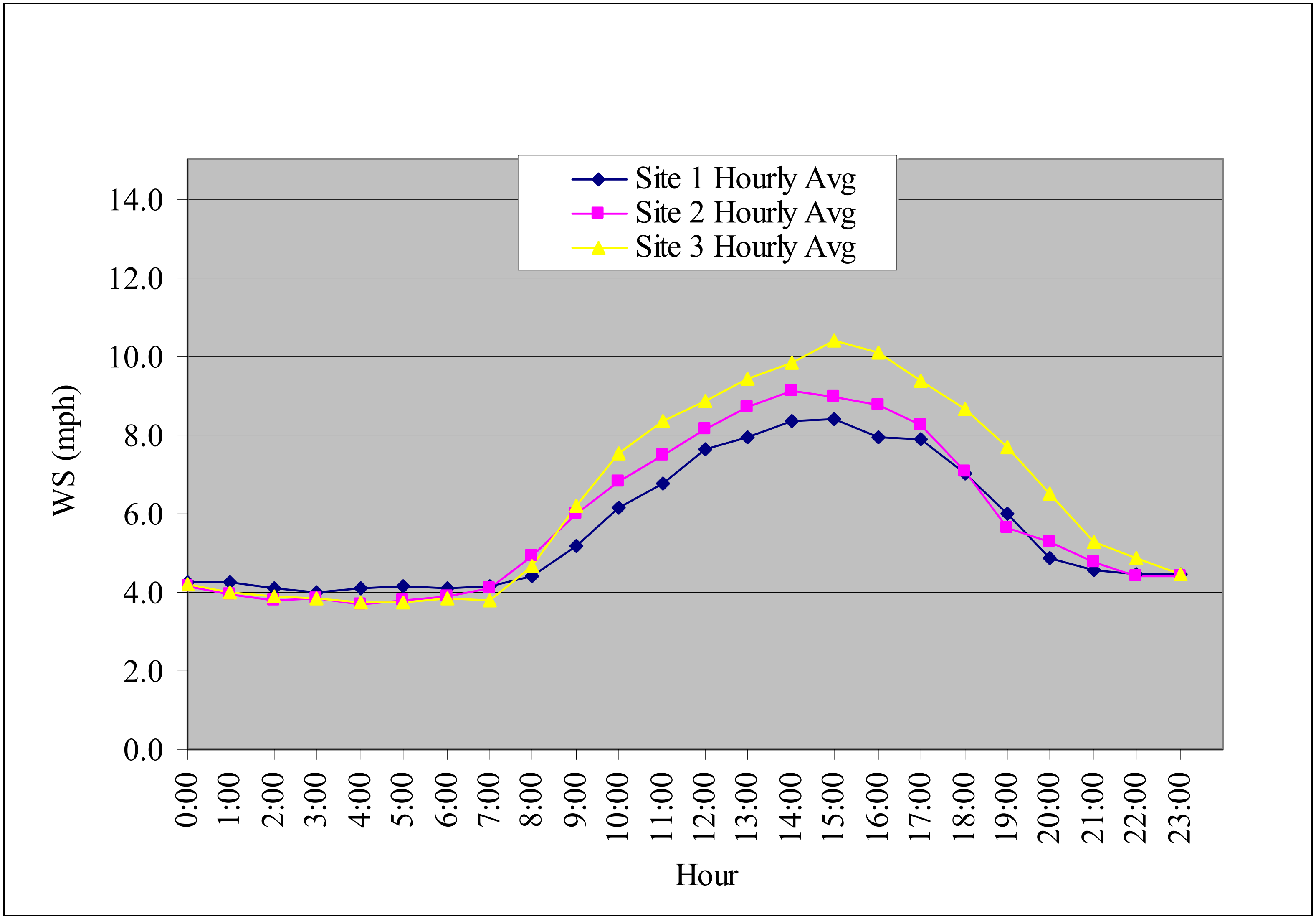


Figure 14-5
Tailings Facility 24-Hr PM10 Concentrations

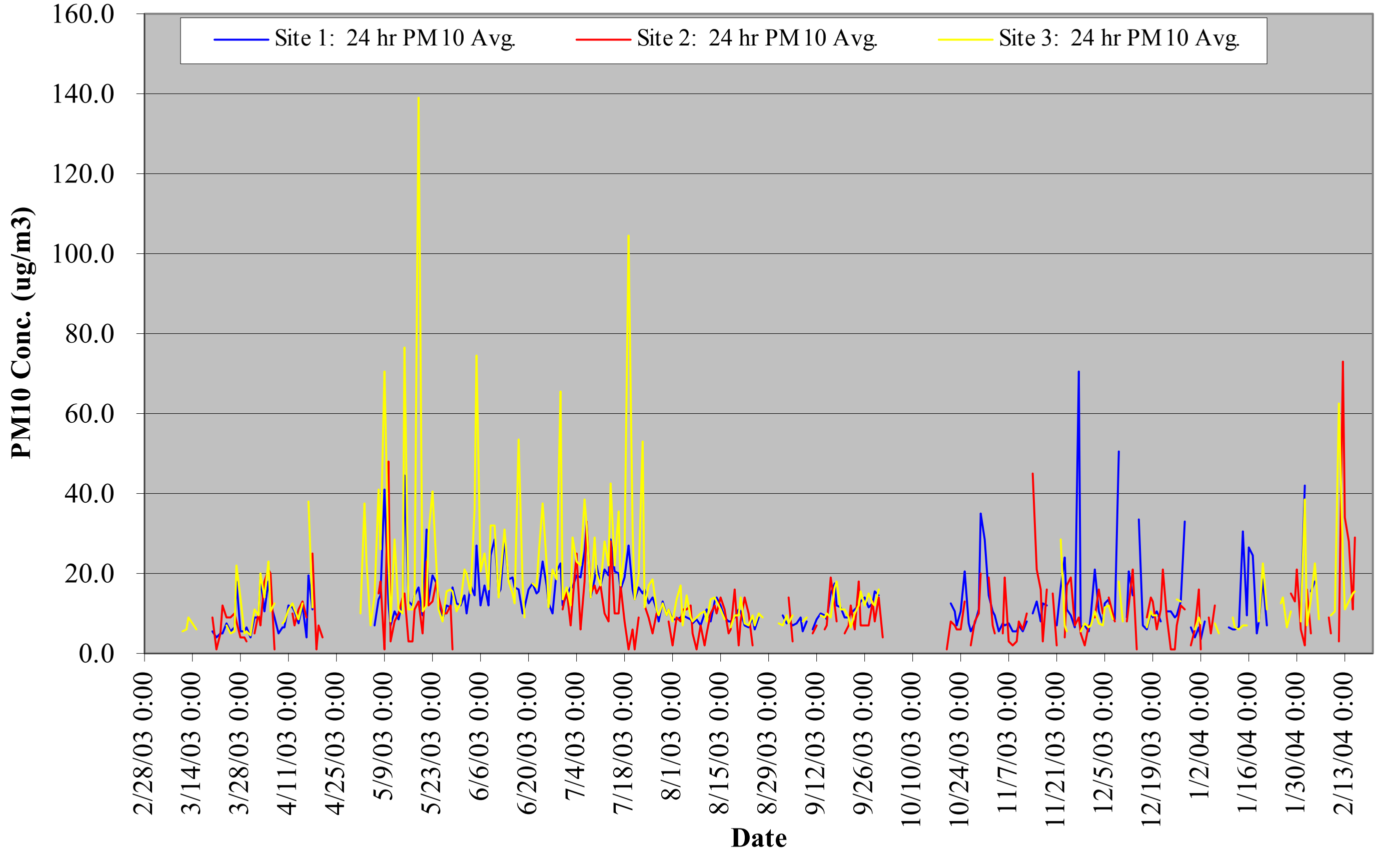


Figure 14-6
Tailings Facility 24-Hour PM10 Data Distribution

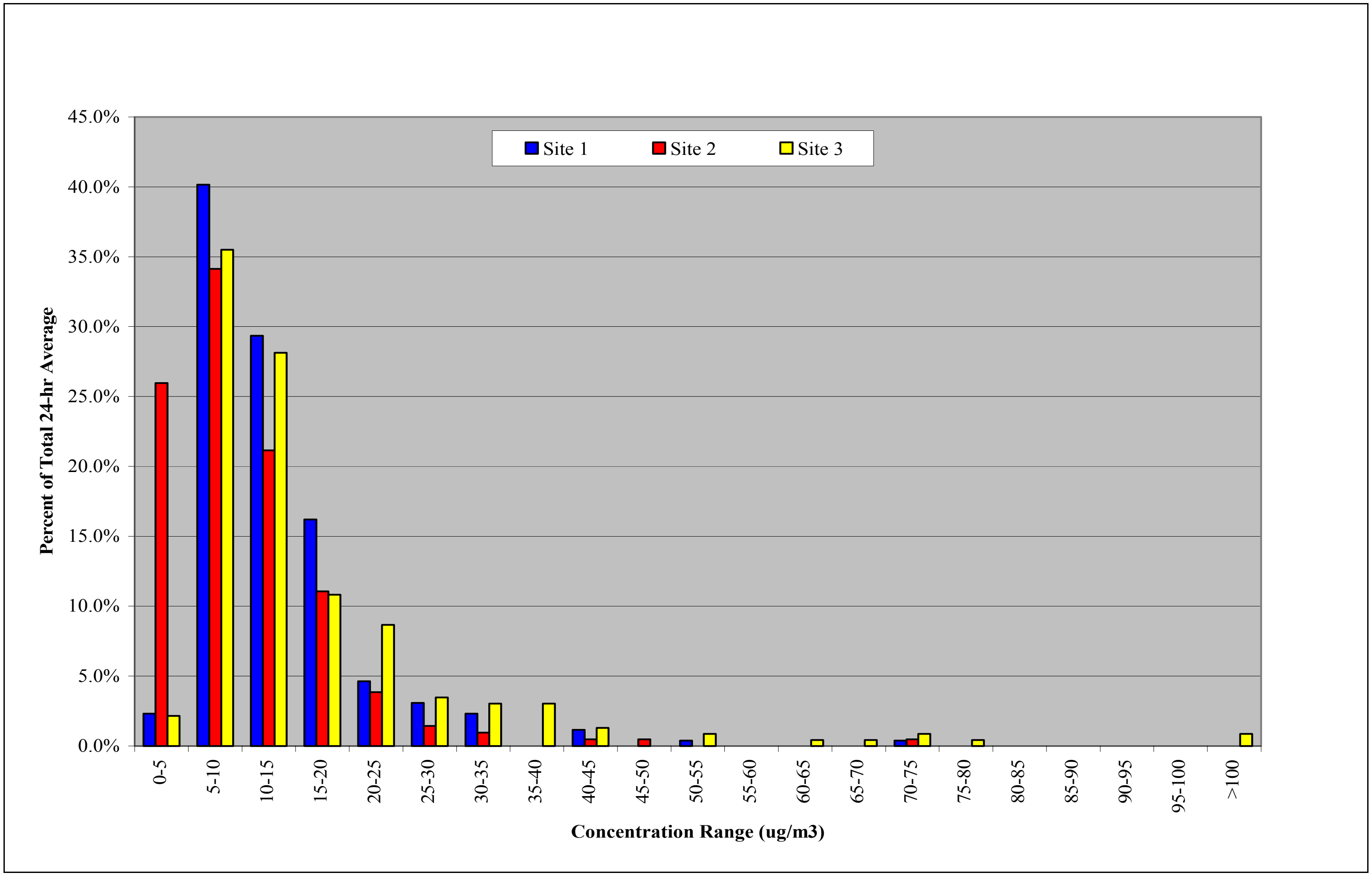


Figure 14-7
Tailings Facility PM10 Diurnal Pattern

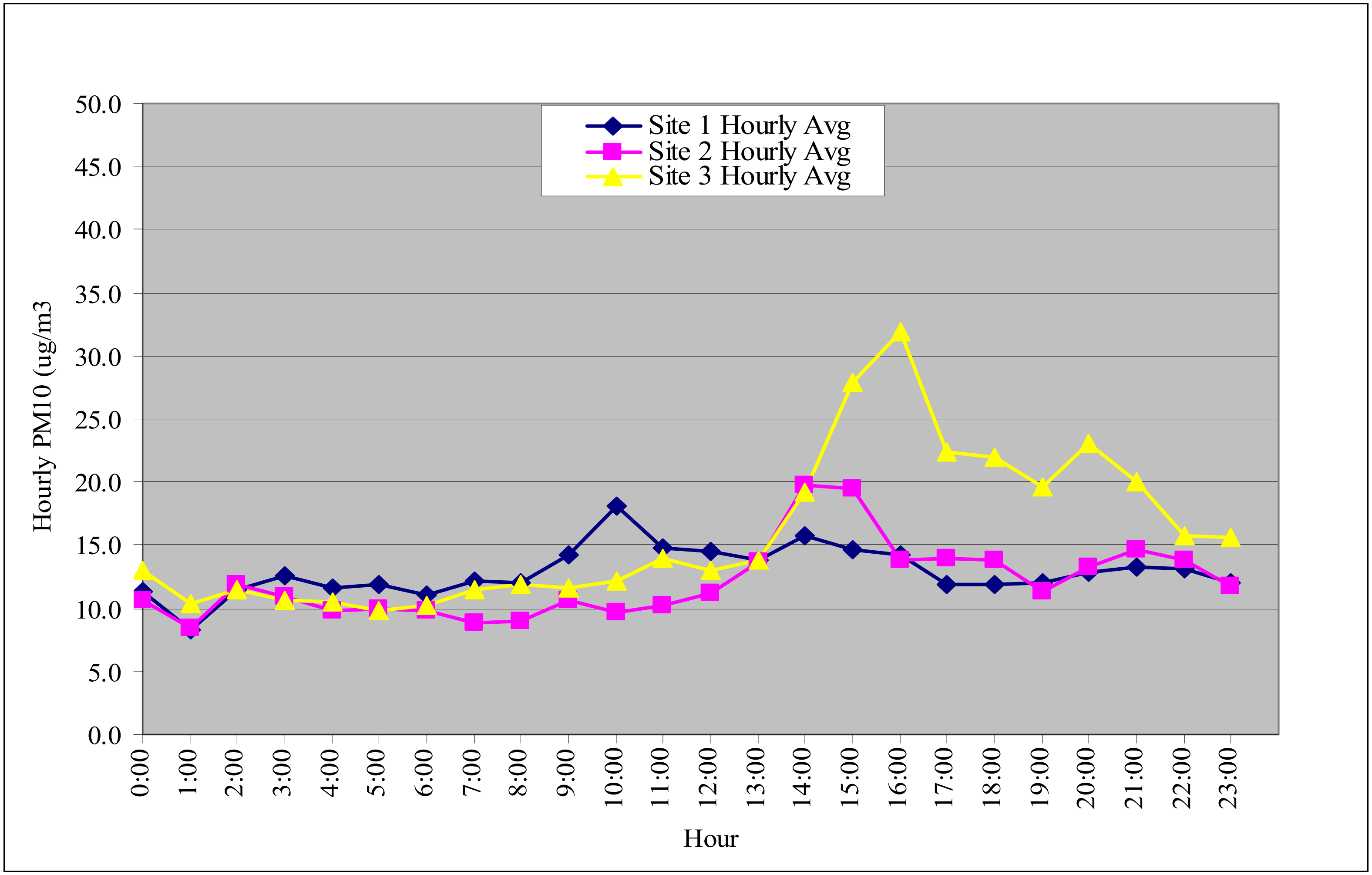


Figure 14-8
Photo of Metals Alongside EBAM PM10 Moitor

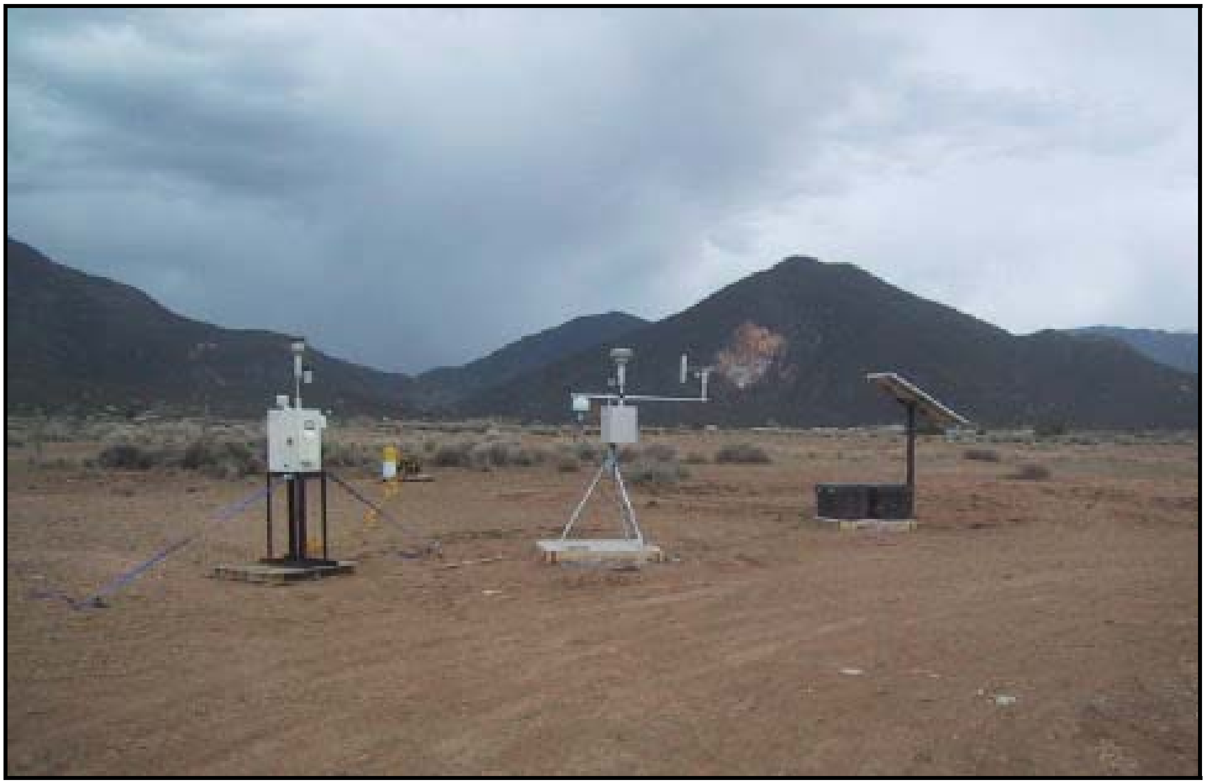


Figure 14-9
Comparison of PM10 and Wind Speed for Highest PM10 Day

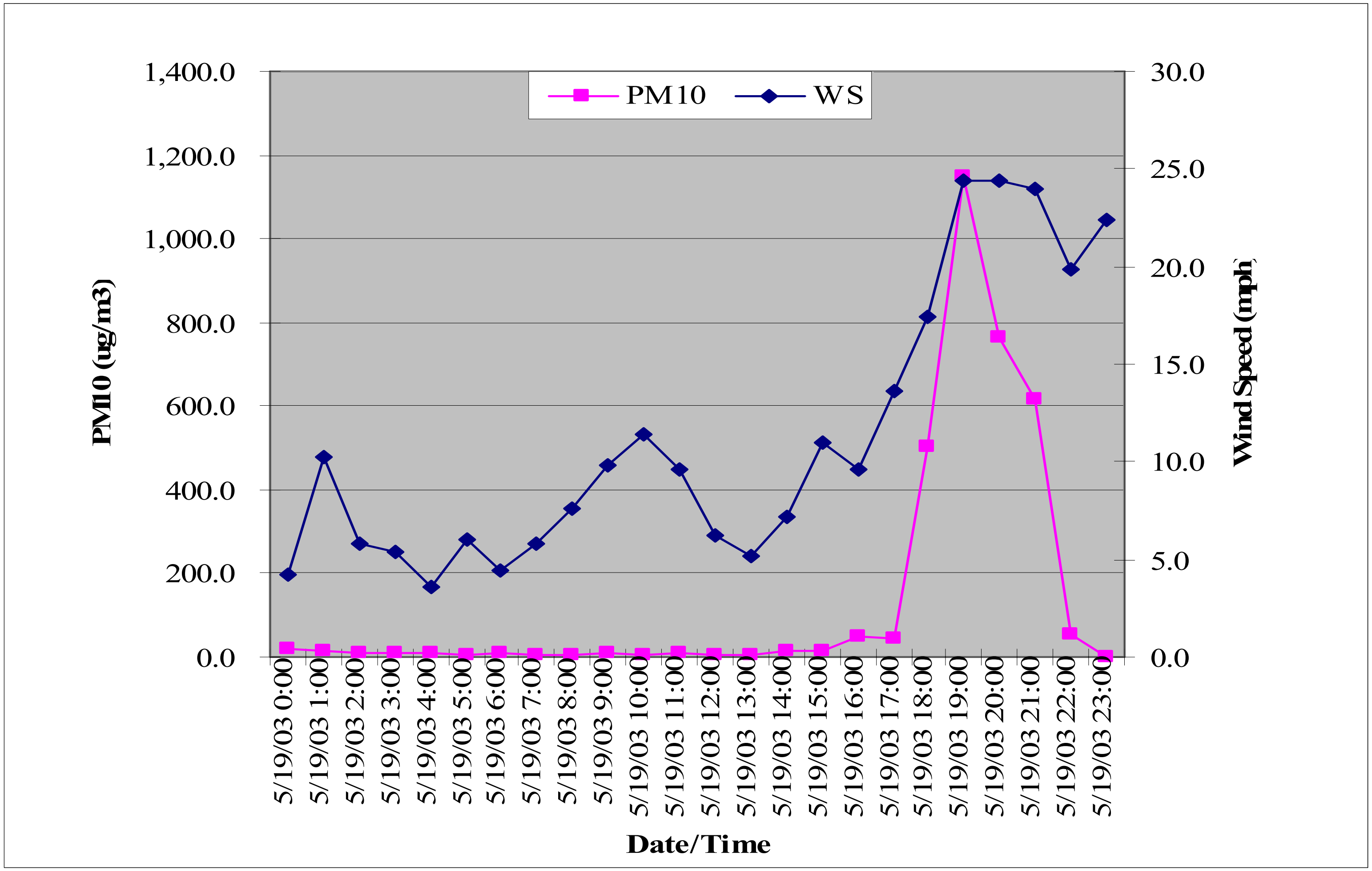


Figure 14-10
Comparison of Wind Speed and Wind Direction for Highest PM10 Day

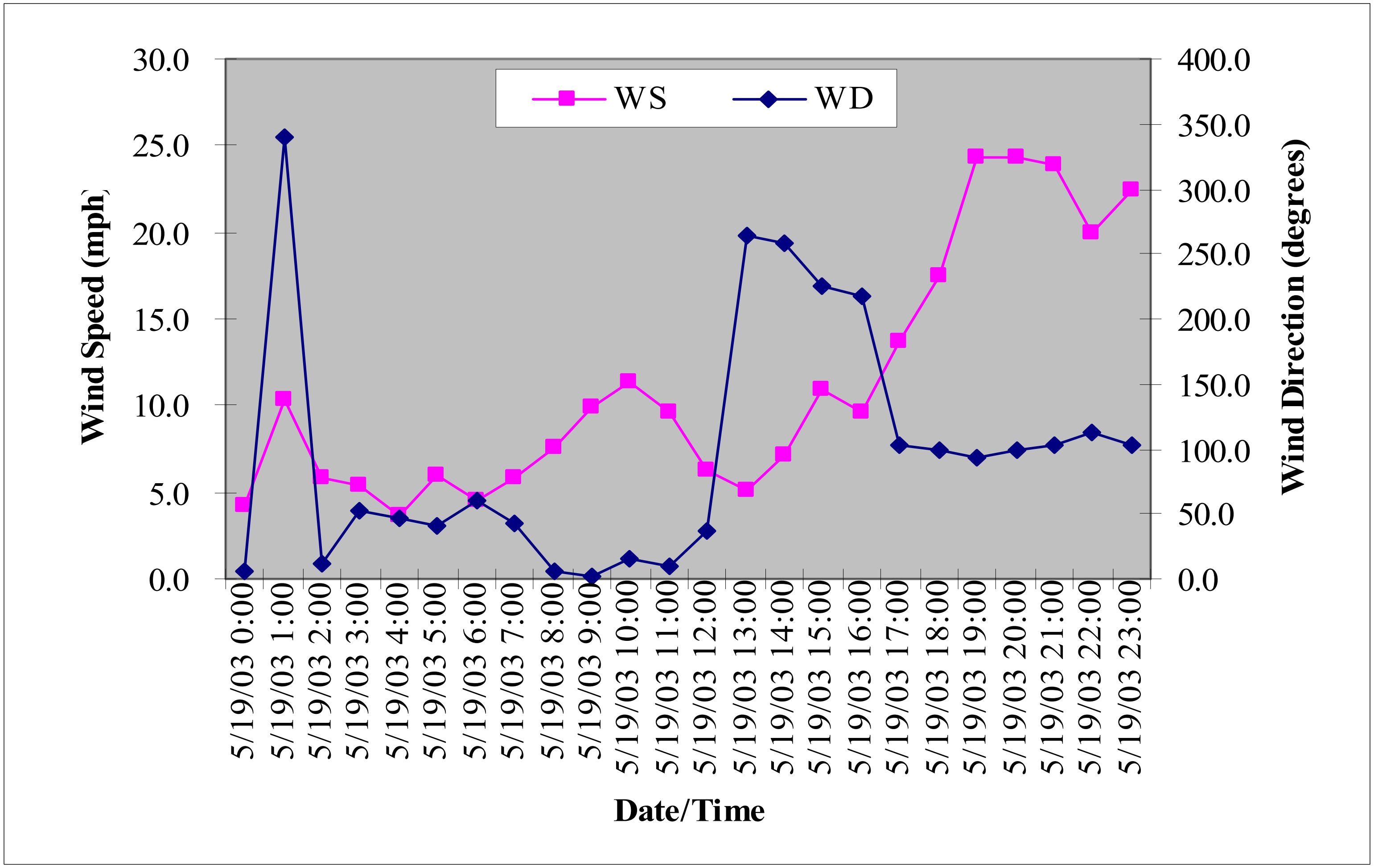
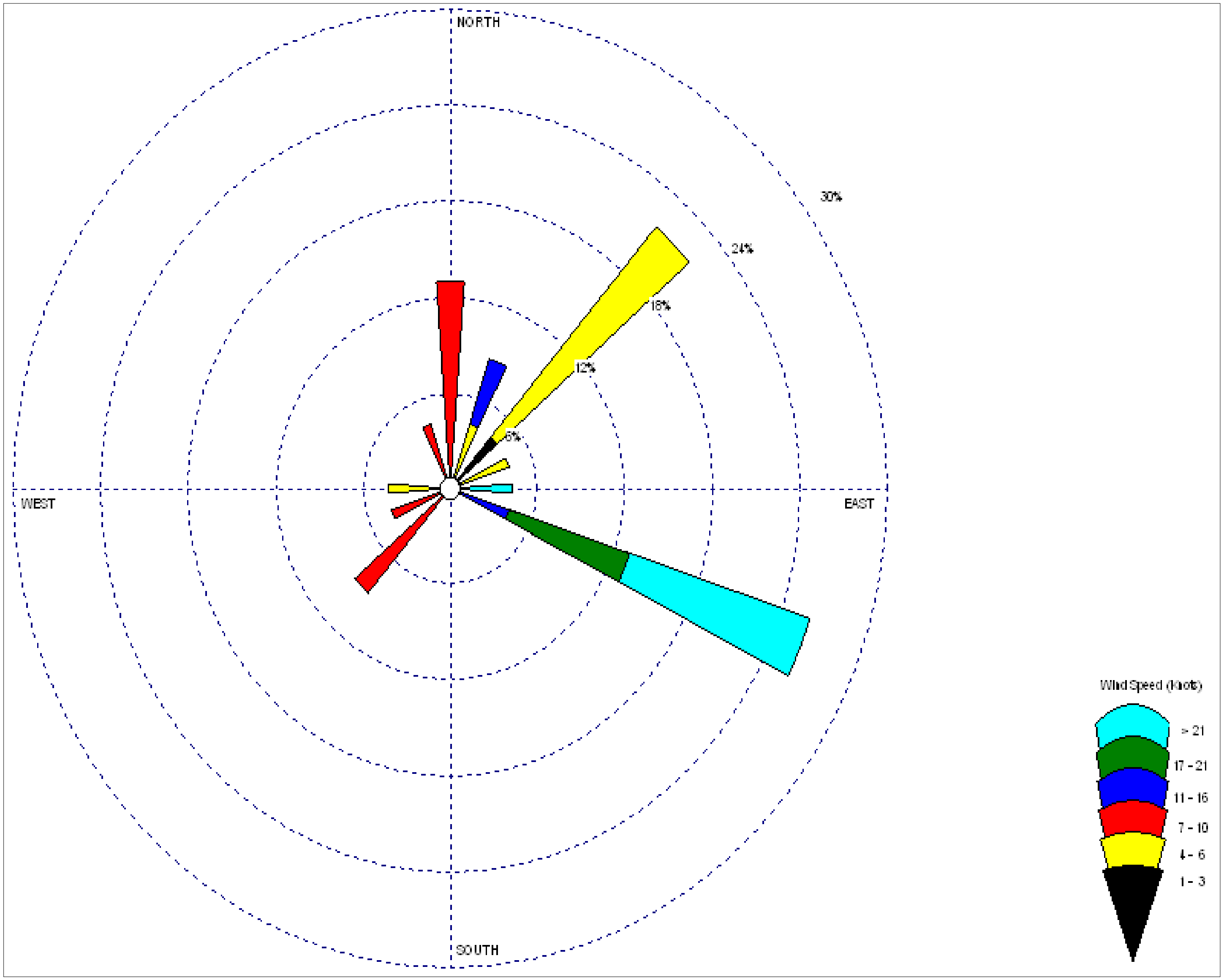


Figure 14-11
Wind Rose for Highest PM10 Day



APPENDIX A-14

AIR QUALITY

VALIDATED ANALYTICAL RESULTS

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-1	PM10-1	PM10-1	PM10-1	PM10-1	PM10-1
		Sample Date	5/6/2003	5/7/2003	5/8/2003	5/9/2003	5/12/2003	5/13/2003
		Sample ID	M1050603	M1050703	M1050803	M1050903	M1051203	M1051303
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Metals								
Aluminum	ug/m3	T	NC	0.1784 :	0.026 :	0.0523 :	0.0566 :	0.0152 :
Antimony	ug/m3	T	-	0.0926 :	0.1318 :	0.2555 :	0.1037 :	0.0166 :
Arsenic	ug/m3	T	-	0.653 :	0.8617 :	1.8832 :	0.4529 :	0.2005 :
Barium	ug/m3	T	-	1.7611 :	2.2685 :	4.9382 :	1.179 :	0.558 :
Beryllium	ug/m3	T	-	<0.001 :	<0.0011 :	<0.0013 :	<0.0008 :	<0.0007 :
Boron	ug/m3	T	-	0.3303 :	0.3547 :	0.297 :	0.2178 :	0.1709 :
Cadmium	ug/m3	T	-	0.2093 :	0.2896 :	0.5906 :	0.1771 :	0.0914 :
Calcium	ug/m3	T	-	0.3955 :	0.5157 :	1.1356 :	0.3792 :	0.1612 :
Chromium	ug/m3	T	-	0.0011 :	<0.0007 :	0.0015 :	<0.0004 :	<0.0003 :
Cobalt	ug/m3	T	-	<0.0003 :	0.0004 :	0.0009 :	<0.0002 :	<0.0002 :
Copper	ug/m3	T	-	0.0082 :	0.0121 :	0.0224 :	0.0067 :	0.0028 :
Gallium	ug/m3	T	-	0.3703 :	0.5089 :	0.9232 :	0.2897 :	0.1239 :
Germanium	ug/m3	T	-	<0.0015 :	<0.002 :	<0.0039 :	<0.0012 :	<0.0006 :
Indium	ug/m3	T	-	<0.0003 :	<0.0003 :	<0.0003 :	<0.0002 :	<0.0002 :
Iron	ug/m3	T	-	0.0013 :	0.0016 :	0.0016 :	0.0013 :	0.0003 :
Lanthanum	ug/m3	T	-	0.0028 :	0.0051 :	0.0057 :	0.0033 :	0.0021 :
Lead	ug/m3	T	-	<0.0007 :	<0.0008 :	<0.0008 :	<0.0007 :	<0.0007 :
Magnesium	ug/m3	T	-	<0.0003 :	<0.0003 :	<0.0003 :	0.0004 :	<0.0003 :
Manganese	ug/m3	T	-	0.0007 :	0.0005 :	0.0009 :	0.0008 :	<0.0002 :
Mercury	ug/m3	T	-	0.0005 :	<0.0003 :	<0.0002 :	<0.0002 :	<0.0002 :
Molybdenum	ug/m3	T	-	0.0052 :	0.0028 :	0.0027 :	0.0019 :	0.002 :
Nickel	ug/m3	T	-	0.0009 :	0.0015 :	0.0034 :	<0.0003 :	0.0009 :
Palladium	ug/m3	T	-	0.0039 :	0.003 :	0.008 :	0.0029 :	0.0011 :
Phosphorus	ug/m3	T	-	<0.0004 :	<0.0004 :	0.0012 :	<0.0004 :	<0.0003 :
Potassium	ug/m3	T	-	0.0016 :	0.0018 :	0.0044 :	<0.0004 :	<0.0004 :
Rubidium	ug/m3	T	-	<0.0007 :	<0.0007 :	<0.0006 :	0.0015 :	<0.0006 :
Selenium	ug/m3	T	-	<0.0018 :	<0.0018 :	<0.0017 :	<0.0016 :	<0.0014 :
Silicon	ug/m3	T	-	<0.0016 :	<0.0017 :	<0.0017 :	<0.0015 :	<0.0014 :
Silver	ug/m3	T	-	<0.0017 :	<0.0017 :	<0.0017 :	<0.0015 :	<0.0014 :
Sodium	ug/m3	T	-	<0.0018 :	0.0025 :	<0.0018 :	<0.0016 :	<0.0015 :
Strontium	ug/m3	T	-	<0.002 :	<0.0021 :	<0.002 :	<0.0018 :	<0.0017 :
Tin	ug/m3	T	-	<0.0072 :	<0.0075 :	0.0157 :	<0.0063 :	<0.0059 :
Titanium	ug/m3	T	-	<0.0091 :	<0.0095 :	0.0158 :	<0.008 :	<0.0075 :

J = Qualified as estimated during data validation

R = Qualified as rejected value from data validation and results are considered unusable for any purpose

T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-1	PM10-1	PM10-1	PM10-1	PM10-1	PM10-1
		Sample Date	5/6/2003	5/7/2003	5/8/2003	5/9/2003	5/12/2003	5/13/2003
		Sample ID	M1050603	M1050703	M1050803	M1050903	M1051203	M1051303
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Vanadium	ug/m3	T	-	<0.0005 :	<0.0005 :	0.0011 :	0.0011 :	<0.0004 :
Yttrium	ug/m3	T	-	<0.0007 :	0.0012 :	0.0011 :	<0.0006 :	<0.0005 :
Zinc	ug/m3	T	-	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :
Zirconium	ug/m3	T	-	<0.0513 :	<0.0511 :	<0.0512 :	<0.0504 :	<0.0504 :
General Chemistry								
Bromine	ug/m3	T	-	0.0867 :	0.0284 :	0.0289 :	0.0147 :	0.0015 :
Chlorine	ug/m3	T	-	0.0409 :	0.0554 :	0.1249 :	0.0273 :	0.0118 :
Sulfur	ug/m3	T	-	<0.0022 :	<0.0024 :	<0.0023 :	<0.0019 :	<0.0019 :

J = Qualified as estimated during data validation

R = Qualified as rejected value from data validation and results are considered unusable for any purpose

T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-1	PM10-1	PM10-1	PM10-1	PM10-1	PM10-1
		Sample Date	5/14/2003	5/15/2003	5/16/2003	5/19/2003	5/20/2003	5/21/2003
		Sample ID	M1051403	M1051503	M1051603	M1051903	M1052003	M1052103
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Metals								
Aluminum	ug/m3	T	0.0329 :	0.0976 :	0.0285 :	R	0.0544 :	0.0233 :
Antimony	ug/m3	T	0.0416 :	0.2142 :	0.0752 :	R	0.0734 :	0.0829 :
Arsenic	ug/m3	T	0.222 :	1.6571 :	0.2878 :	R	0.3571 :	0.3599 :
Barium	ug/m3	T	0.6307 :	4.3025 :	0.7966 :	R	0.9899 :	0.9563 :
Beryllium	ug/m3	T	<0.0009 :	<0.0013 :	<0.0009 :	R	<0.0009 :	<0.0008 :
Boron	ug/m3	T	0.4529 :	0.3494 :	0.3211 :	R	0.3606 :	0.2521 :
Cadmium	ug/m3	T	0.1122 :	0.4466 :	0.1237 :	R	0.1519 :	0.1657 :
Calcium	ug/m3	T	0.1761 :	0.7193 :	0.2576 :	R	0.4021 :	0.3717 :
Chromium	ug/m3	T	<0.0003 :	0.0013 :	0.0005 :	R	<0.0004 :	<0.0004 :
Cobalt	ug/m3	T	<0.0002 :	0.001 :	0.0004 :	R	0.0006 :	<0.0002 :
Copper	ug/m3	T	0.0035 :	0.0134 :	0.0053 :	R	0.0038 :	0.0052 :
Gallium	ug/m3	T	0.1497 :	0.7609 :	0.1891 :	R	0.2458 :	0.2401 :
Germanium	ug/m3	T	<0.0007 :	<0.003 :	<0.0009 :	R	<0.001 :	<0.0011 :
Indium	ug/m3	T	<0.0002 :	<0.0003 :	<0.0002 :	R	<0.0002 :	<0.0002 :
Iron	ug/m3	T	0.0007 :	0.0013 :	0.001 :	R	0.0004 :	0.001 :
Lanthanum	ug/m3	T	0.0027 :	0.004 :	0.0025 :	R	0.0051 :	0.0035 :
Lead	ug/m3	T	<0.0007 :	<0.0009 :	<0.0007 :	R	<0.0008 :	<0.0009 :
Magnesium	ug/m3	T	<0.0003 :	<0.0003 :	<0.0003 :	R	<0.0003 :	<0.0003 :
Manganese	ug/m3	T	<0.0003 :	0.0005 :	<0.0003 :	R	<0.0003 :	<0.0002 :
Mercury	ug/m3	T	<0.0002 :	<0.0003 :	<0.0003 :	R	<0.0002 :	0.0007 :
Molybdenum	ug/m3	T	0.0046 :	0.0028 :	0.003 :	R	0.0019 :	0.0024 :
Nickel	ug/m3	T	0.0005 :	0.0022 :	<0.0003 :	R	0.0008 :	0.0005 :
Palladium	ug/m3	T	0.0014 :	0.0057 :	0.0022 :	R	0.0043 :	0.0035 :
Phosphorus	ug/m3	T	<0.0003 :	0.0005 :	<0.0004 :	R	<0.0004 :	<0.0003 :
Potassium	ug/m3	T	0.001 :	0.0034 :	<0.0005 :	R	0.0007 :	0.001 :
Rubidium	ug/m3	T	<0.0006 :	<0.0008 :	<0.0007 :	R	0.0007 :	<0.0006 :
Selenium	ug/m3	T	<0.0015 :	<0.0018 :	<0.0016 :	R	<0.0015 :	<0.0015 :
Silicon	ug/m3	T	<0.0014 :	0.0021 :	<0.0015 :	R	<0.0015 :	<0.0014 :
Silver	ug/m3	T	<0.0014 :	<0.0018 :	<0.0015 :	R	<0.0015 :	<0.0014 :
Sodium	ug/m3	T	<0.0015 :	<0.0019 :	<0.0016 :	R	<0.0016 :	<0.0015 :
Strontium	ug/m3	T	<0.0017 :	0.0023 :	<0.0018 :	R	<0.0018 :	<0.0017 :
Tin	ug/m3	T	<0.0062 :	0.0168 :	<0.0065 :	R	0.0075 :	<0.0061 :
Titanium	ug/m3	T	<0.0079 :	<0.0093 :	<0.0082 :	R	<0.0081 :	0.0149 :

J = Qualified as estimated during data validation

R = Qualified as rejected value from data validation and results are considered unusable for any purpose

T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-1	PM10-1	PM10-1	PM10-1	PM10-1	PM10-1
		Sample Date	5/14/2003	5/15/2003	5/16/2003	5/19/2003	5/20/2003	5/21/2003
		Sample ID	M1051403	M1051503	M1051603	M1051903	M1052003	M1052103
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Vanadium	ug/m3	T	<0.0004 :	<0.0005 :	<0.0005 :	R	<0.0005 :	<0.0004 :
Yttrium	ug/m3	T	<0.0006 :	0.0009 :	<0.0006 :	R	0.0009 :	<0.0006 :
Zinc	ug/m3	T	<0.0001 :	<0.0001 :	<0.0001 :	R	<0.0001 :	<0.0001 :
Zirconium	ug/m3	T	<0.0504 :	<0.0504 :	<0.0504 :	R	<0.0504 :	<0.0504 :
General Chemistry								
Bromine	ug/m3	T	0.0021 :	0.0084 :	<0.0011 :	R	0.0027 :	0.005 :
Chlorine	ug/m3	T	0.0165 :	0.0914 :	0.0179 :	R	0.0234 :	0.0255 :
Sulfur	ug/m3	T	<0.0019 :	<0.0023 :	<0.002 :	R	<0.002 :	<0.0019 :

J = Qualified as estimated during data validation

R = Qualified as rejected value from data validation and results are considered unusable for any purpose

T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-1	PM10-1	PM10-1	PM10-2	PM10-2	PM10-2
		Sample Date	5/22/2003	5/23/2003	5/27/2003	5/6/2003	5/7/2003	5/8/2003
		Sample ID	M1052203	M1052303	M1052703	M2050603	M2050703	M2050803
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	Units	Fraction						
Metals								
Aluminum	ug/m3	T	0.0319 :	0.0409 :	0.0455 :	<0.0142 :	0.1275 :	0.0563 :
Antimony	ug/m3	T	0.1307 :	0.0968 :	0.0538 :	0.0729 :	0.1225 :	0.129 :
Arsenic	ug/m3	T	0.5828 :	0.505 :	0.2422 :	0.4926 :	0.7307 :	0.9068 :
Barium	ug/m3	T	1.5945 :	1.3462 :	0.6883 :	1.4056 :	2.0357 :	2.4241 :
Beryllium	ug/m3	T	<0.0009 :	<0.001 :	<0.0009 :	<0.001 :	<0.001 :	<0.0011 :
Boron	ug/m3	T	0.2166 :	0.5122 :	0.5433 :	0.3867 :	0.3148 :	0.3462 :
Cadmium	ug/m3	T	0.2612 :	0.2261 :	0.1337 :	0.201 :	0.2828 :	0.3169 :
Calcium	ug/m3	T	0.4861 :	0.4588 :	0.218 :	0.2993 :	0.4655 :	0.4979 :
Chromium	ug/m3	T	<0.0006 :	0.0008 :	0.0006 :	0.001 :	0.0011 :	0.0014 :
Cobalt	ug/m3	T	0.0004 :	0.0005 :	0.0008 :	0.0004 :	0.0006 :	0.0007 :
Copper	ug/m3	T	0.0102 :	0.0079 :	0.0049 :	0.0087 :	0.0129 :	0.0117 :
Gallium	ug/m3	T	0.4055 :	0.3472 :	0.1988 :	0.3429 :	0.4916 :	0.5363 :
Germanium	ug/m3	T	<0.0017 :	<0.0014 :	<0.0008 :	<0.0015 :	<0.002 :	<0.0021 :
Indium	ug/m3	T	<0.0002 :	<0.0003 :	<0.0002 :	<0.0003 :	<0.0003 :	<0.0002 :
Iron	ug/m3	T	0.0008 :	0.0014 :	0.0008 :	0.0008 :	0.0018 :	0.0015 :
Lanthanum	ug/m3	T	0.0031 :	0.0034 :	0.0024 :	0.0042 :	0.0054 :	0.0056 :
Lead	ug/m3	T	<0.0007 :	<0.0008 :	<0.0007 :	<0.0007 :	<0.0006 :	<0.0007 :
Magnesium	ug/m3	T	<0.0003 :	<0.0003 :	<0.0003 :	<0.0003 :	<0.0003 :	<0.0003 :
Manganese	ug/m3	T	<0.0003 :	<0.0005 :	<0.0004 :	0.0008 :	<0.0004 :	<0.0005 :
Mercury	ug/m3	T	<0.0002 :	<0.0003 :	0.0003 :	0.0003 :	0.0003 :	0.0003 :
Molybdenum	ug/m3	T	0.0024 :	0.0035 :	0.0048 :	0.0035 :	0.004 :	0.0041 :
Nickel	ug/m3	T	0.0007 :	0.0005 :	0.0005 :	0.0006 :	0.0011 :	0.0019 :
Palladium	ug/m3	T	0.0039 :	0.0044 :	0.0017 :	0.0025 :	0.0043 :	0.005 :
Phosphorus	ug/m3	T	<0.0003 :	<0.0004 :	<0.0003 :	<0.0004 :	0.0006 :	0.0007 :
Potassium	ug/m3	T	0.0012 :	0.001 :	0.0016 :	<0.0005 :	0.0014 :	0.0012 :
Rubidium	ug/m3	T	<0.0006 :	<0.0007 :	<0.0005 :	<0.0006 :	0.0008 :	<0.0006 :
Selenium	ug/m3	T	<0.0015 :	<0.0016 :	<0.0014 :	<0.0017 :	0.002 :	<0.0015 :
Silicon	ug/m3	T	<0.0015 :	<0.0015 :	<0.0013 :	<0.0016 :	<0.0015 :	<0.0015 :
Silver	ug/m3	T	<0.0014 :	<0.0015 :	<0.0014 :	<0.0016 :	<0.0015 :	<0.0015 :
Sodium	ug/m3	T	<0.0015 :	<0.0016 :	<0.0015 :	<0.0017 :	<0.0016 :	<0.0016 :
Strontium	ug/m3	T	<0.0018 :	<0.0019 :	<0.0017 :	<0.002 :	<0.0019 :	<0.0018 :
Tin	ug/m3	T	<0.0061 :	<0.0066 :	0.007 :	<0.0071 :	<0.0065 :	0.0105 :
Titanium	ug/m3	T	<0.0078 :	<0.0083 :	<0.0075 :	<0.0088 :	<0.0081 :	<0.0079 :

J = Qualified as estimated during data validation

R = Qualified as rejected value from data validation and results are considered unusable for any purpose

T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-1	PM10-1	PM10-1	PM10-2	PM10-2	PM10-2
		Sample Date	5/22/2003	5/23/2003	5/27/2003	5/6/2003	5/7/2003	5/8/2003
		Sample ID	M1052203	M1052303	M1052703	M2050603	M2050703	M2050803
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Vanadium	ug/m3	T	<0.0004 :	<0.0005 :	<0.0004 :	0.0008 :	<0.0004 :	<0.0004 :
Yttrium	ug/m3	T	0.0009 :	0.0017 :	0.0013 :	<0.0006 :	0.0013 :	0.0032 :
Zinc	ug/m3	T	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :
Zirconium	ug/m3	T	<0.0504 :	<0.0504 :	<0.05 :	<0.0558 :	<0.0504 :	<0.0506 :
General Chemistry								
Bromine	ug/m3	T	0.0026 :	<0.0012 :	0.0011 :	0.0052 :	0.0873 :	0.0228 :
Chlorine	ug/m3	T	0.0423 :	0.0355 :	0.0189 :	0.0387 :	0.0567 :	0.0577 :
Sulfur	ug/m3	T	<0.0019 :	<0.002 :	<0.0018 :	<0.0022 :	<0.002 :	<0.002 :

J = Qualified as estimated during data validation

R = Qualified as rejected value from data validation and results are considered unusable for any purpose

T = Total Fraction NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-2		PM10-2		PM10-2		PM10-2		PM10-2		PM10-2	
		Sample Date	5/9/2003		5/12/2003		5/13/2003		5/14/2003		5/15/2003		5/16/2003	
		Sample ID	M2050903		M2051203		M2051303		M2051403		M2051503		M2051603	
		Exposure Area	TAIR		TAIR		TAIR		TAIR		TAIR		TAIR	
Parameter	**Units**	**Fraction**												
Metals														
Aluminum	ug/m3	T	0.0945	:	0.0621	:	0.0326	:	0.0645	:	0.0603	:	0.0464	:
Antimony	ug/m3	T	0.2813	:	0.1217	:	0.0445	:	0.0365	:	0.1615	:	0.0575	:
Arsenic	ug/m3	T	2.3979	:	0.4866	:	0.3055	:	0.2558	:	1.3718	:	0.2802	:
Barium	ug/m3	T	6.4792	:	1.2857	:	0.8761	:	0.716	:	3.6118	:	0.7962	:
Beryllium	ug/m3	T	<0.0016	:	<0.0009	:	<0.0008	:	<0.0009	:	<0.0012	:	<0.0008	:
Boron	ug/m3	T	0.2943	:	0.2171	:	0.1825	:	0.4752	:	0.29	:	0.3068	:
Cadmium	ug/m3	T	0.7317	:	0.18	:	0.1322	:	0.1238	:	0.4239	:	0.1211	:
Calcium	ug/m3	T	1.3171	:	0.3532	:	0.1863	:	0.1764	:	0.6462	:	0.2145	:
Chromium	ug/m3	T	0.0025	:	<0.0005	:	<0.0004	:	<0.0003	:	0.0019	:	<0.0004	:
Cobalt	ug/m3	T	0.0008	:	0.0004	:	<0.0002	:	<0.0002	:	0.0007	:	0.0007	:
Copper	ug/m3	T	0.0279	:	0.0063	:	0.0062	:	0.0038	:	0.0144	:	0.0035	:
Gallium	ug/m3	T	1.2279	:	0.2987	:	0.2094	:	0.1753	:	0.6529	:	0.19	:
Germanium	ug/m3	T	<0.0048	:	<0.0012	:	<0.0009	:	<0.0008	:	<0.0029	:	<0.0009	:
Indium	ug/m3	T	<0.0003	:	<0.0002	:	<0.0003	:	<0.0002	:	<0.0003	:	<0.0003	:
Iron	ug/m3	T	0.0016	:	0.001	:	0.0007	:	0.0008	:	0.0009	:	0.0008	:
Lanthanum	ug/m3	T	0.0059	:	0.0035	:	0.0024	:	0.0028	:	0.0038	:	0.0032	:
Lead	ug/m3	T	<0.0008	:	<0.0007	:	<0.0007	:	<0.0007	:	<0.0007	:	<0.0008	:
Magnesium	ug/m3	T	<0.0003	:	<0.0003	:	<0.0003	:	<0.0003	:	<0.0003	:	<0.0003	:
Manganese	ug/m3	T	0.0004	:	<0.0003	:	<0.0003	:	0.0004	:	<0.0005	:	0.0003	:
Mercury	ug/m3	T	<0.0003	:	<0.0002	:	<0.0003	:	<0.0002	:	<0.0003	:	<0.0002	:
Molybdenum	ug/m3	T	0.0034	:	0.0027	:	0.0032	:	0.0048	:	0.0028	:	0.003	:
Nickel	ug/m3	T	0.005	:	0.0008	:	<0.0003	:	<0.0003	:	0.0013	:	<0.0003	:
Palladium	ug/m3	T	0.0118	:	0.0035	:	0.0018	:	0.0016	:	0.0043	:	0.0023	:
Phosphorus	ug/m3	T	0.0012	:	<0.0004	:	<0.0004	:	<0.0003	:	0.0009	:	0.0007	:
Potassium	ug/m3	T	0.0052	:	0.0008	:	0.0008	:	<0.0004	:	0.0029	:	<0.0005	:
Rubidium	ug/m3	T	<0.0008	:	<0.0006	:	<0.0007	:	<0.0006	:	<0.0007	:	<0.0007	:
Selenium	ug/m3	T	<0.0018	:	<0.0016	:	<0.0016	:	<0.0014	:	<0.0018	:	<0.0016	:
Silicon	ug/m3	T	<0.0018	:	<0.0014	:	<0.0016	:	<0.0014	:	<0.0017	:	<0.0015	:
Silver	ug/m3	T	<0.0018	:	<0.0015	:	<0.0015	:	<0.0014	:	<0.0017	:	<0.0014	:
Sodium	ug/m3	T	<0.002	:	<0.0016	:	<0.0017	:	<0.0015	:	<0.0018	:	<0.0017	:
Strontium	ug/m3	T	<0.0022	:	<0.0018	:	<0.0019	:	<0.0017	:	<0.002	:	<0.0019	:
Tin	ug/m3	T	0.0233	:	0.0066	:	0.012	:	<0.006	:	<0.0071	:	<0.0066	:
Titanium	ug/m3	T	<0.0095	:	<0.0079	:	<0.0085	:	<0.0076	:	<0.0089	:	<0.0084	:

J = Qualified as estimated during data validation

R = Qualified as rejected value from data validation and results are considered unusable for any purpose

T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-2		PM10-2		PM10-2		PM10-2		PM10-2		PM10-2	
		Sample Date	5/9/2003		5/12/2003		5/13/2003		5/14/2003		5/15/2003		5/16/2003	
		Sample ID	M2050903		M2051203		M2051303		M2051403		M2051503		M2051603	
		Exposure Area	TAIR		TAIR		TAIR		TAIR		TAIR		TAIR	
Parameter	**Units**	**Fraction**												
Vanadium	ug/m3	T	<0.0005	:	<0.0005	:	<0.0005	:	<0.0004	:	<0.0005	:	<0.0005	:
Yttrium	ug/m3	T	0.0012	:	0.0011	:	<0.0006	:	<0.0005	:	0.0017	:	<0.0006	:
Zinc	ug/m3	T	<0.0001	:	<0.0001	:	<0.0001	:	<0.0001	:	<0.0001	:	<0.0001	:
Zirconium	ug/m3	T	<0.05	:	<0.0504	:	<0.0504	:	<0.0504	:	<0.0504	:	<0.0504	:
General Chemistry														
Bromine	ug/m3	T	0.027	:	0.0161	:	0.0028	:	0.0014	:	0.002	:	0.0023	:
Chlorine	ug/m3	T	0.1494	:	0.0297	:	0.0203	:	0.0179	:	0.0867	:	0.0201	:
Sulfur	ug/m3	T	<0.0024	:	<0.002	:	<0.0021	:	<0.0019	:	<0.0022	:	<0.002	:

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Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-2	PM10-2	PM10-2	PM10-2	PM10-2	PM10-2
		Sample Date	5/19/2003	5/20/2003	5/21/2003	5/22/2003	5/23/2003	5/27/2003
		Sample ID	M2051903	M2052003	M2052103	M2052203	M2052303	M2052703
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Metals								
Aluminum	ug/m3	T	0.0459 :	0.0301 :	0.0371 :	0.057 :	0.0743 :	0.0524 :
Antimony	ug/m3	T	0.1011 :	0.0763 :	0.1053 :	0.1406 :	0.0905 :	0.0513 :
Arsenic	ug/m3	T	0.907 :	0.3725 :	0.4529 :	0.6979 :	0.5183 :	0.2582 :
Barium	ug/m3	T	2.6455 :	1.0227 :	1.1895 :	1.9143 :	1.4029 :	0.7429 :
Beryllium	ug/m3	T	<0.0011 :	<0.0009 :	<0.0009 :	<0.0009 :	<0.001 :	<0.0009 :
Boron	ug/m3	T	0.2076 :	0.365 :	0.2566 :	0.2236 :	0.5033 :	0.5392 :
Cadmium	ug/m3	T	0.3655 :	0.1572 :	0.1836 :	0.2916 :	0.2483 :	0.1365 :
Calcium	ug/m3	T	0.5399 :	0.4084 :	0.416 :	0.5555 :	0.475 :	0.1815 :
Chromium	ug/m3	T	<0.0009 :	0.0007 :	<0.0005 :	<0.0007 :	0.0015 :	<0.0004 :
Cobalt	ug/m3	T	0.0005 :	0.0004 :	0.0004 :	0.0007 :	<0.0003 :	0.0004 :
Copper	ug/m3	T	0.0133 :	0.0062 :	0.0066 :	0.0132 :	0.0096 :	0.0051 :
Gallium	ug/m3	T	0.6545 :	0.2628 :	0.2939 :	0.4933 :	0.3595 :	0.1991 :
Germanium	ug/m3	T	<0.0026 :	<0.0011 :	<0.0012 :	<0.002 :	<0.0016 :	<0.0008 :
Indium	ug/m3	T	<0.0003 :	<0.0002 :	<0.0003 :	<0.0003 :	<0.0003 :	<0.0002 :
Iron	ug/m3	T	0.0011 :	0.0008 :	0.0009 :	0.0009 :	0.001 :	0.0008 :
Lanthanum	ug/m3	T	0.0058 :	0.0032 :	0.002 :	0.0032 :	0.0039 :	0.0024 :
Lead	ug/m3	T	<0.0008 :	<0.0006 :	<0.0007 :	<0.0008 :	<0.0008 :	<0.0007 :
Magnesium	ug/m3	T	<0.0003 :	<0.0003 :	<0.0003 :	<0.0003 :	<0.0003 :	<0.0003 :
Manganese	ug/m3	T	<0.0003 :	<0.0003 :	<0.0003 :	<0.0003 :	0.0005 :	<0.0003 :
Mercury	ug/m3	T	<0.0003 :	<0.0003 :	<0.0003 :	<0.0002 :	<0.0002 :	0.0007 :
Molybdenum	ug/m3	T	0.0011 :	0.0025 :	0.0023 :	0.0022 :	0.0022 :	0.0042 :
Nickel	ug/m3	T	0.0018 :	0.0009 :	0.0013 :	0.0011 :	0.0008 :	0.0006 :
Palladium	ug/m3	T	0.0058 :	0.0045 :	0.0045 :	0.0047 :	0.0032 :	0.0018 :
Phosphorus	ug/m3	T	<0.0004 :	0.0008 :	<0.0004 :	<0.0003 :	<0.0004 :	<0.0004 :
Potassium	ug/m3	T	0.0032 :	0.0019 :	0.0014 :	0.0014 :	0.0015 :	0.0007 :
Rubidium	ug/m3	T	<0.0007 :	<0.0007 :	<0.0007 :	<0.0006 :	<0.0006 :	<0.0006 :
Selenium	ug/m3	T	<0.0018 :	<0.0016 :	<0.0017 :	<0.0016 :	<0.0016 :	<0.0016 :
Silicon	ug/m3	T	<0.0017 :	<0.0015 :	<0.0016 :	<0.0015 :	<0.0015 :	0.0023 :
Silver	ug/m3	T	<0.0018 :	<0.0015 :	<0.0016 :	<0.0015 :	<0.0015 :	<0.0014 :
Sodium	ug/m3	T	<0.0018 :	<0.0017 :	<0.0017 :	<0.0016 :	<0.0016 :	<0.0016 :
Strontium	ug/m3	T	<0.0021 :	0.0044 :	<0.0019 :	0.003 :	<0.0019 :	<0.0018 :
Tin	ug/m3	T	0.0216 :	0.0128 :	<0.0068 :	0.0141 :	0.0111 :	0.0155 :
Titanium	ug/m3	T	<0.009 :	<0.0086 :	<0.0087 :	<0.0079 :	<0.0082 :	0.0143 :

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Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-2	PM10-2	PM10-2	PM10-2	PM10-2	PM10-2
		Sample Date	5/19/2003	5/20/2003	5/21/2003	5/22/2003	5/23/2003	5/27/2003
		Sample ID	M2051903	M2052003	M2052103	M2052203	M2052303	M2052703
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Vanadium	ug/m3	T	<0.0005 :	<0.0005 :	<0.0005 :	<0.0004 :	<0.0004 :	<0.0004 :
Yttrium	ug/m3	T	<0.0007 :	0.0009 :	<0.0007 :	0.0009 :	<0.0006 :	0.0007 :
Zinc	ug/m3	T	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :
Zirconium	ug/m3	T	<0.0563 :	<0.0504 :	<0.0504 :	<0.0504 :	<0.05 :	<0.05 :
General Chemistry								
Bromine	ug/m3	T	<0.0013 :	0.0052 :	<0.0012 :	<0.0011 :	<0.0012 :	0.0016 :
Chlorine	ug/m3	T	0.0697 :	0.0261 :	0.0284 :	0.0484 :	0.0407 :	0.0184 :
Sulfur	ug/m3	T	<0.0023 :	<0.0021 :	<0.0021 :	<0.0019 :	<0.002 :	<0.002 :

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T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-3		PM10-3		PM10-3		PM10-3		PM10-3		PM10-3	
		Sample Date	5/6/2003		5/7/2003		5/8/2003		5/9/2003		5/12/2003		5/13/2003	
		Sample ID	M3050603		M3050703		M3050803		M3050903		M3051203		M3051303	
		Exposure Area	TAIR		TAIR		TAIR		TAIR		TAIR		TAIR	
Parameter	Units	Fraction												
Metals														
Aluminum	ug/m3	T	0.0389	:	0.1634	:	0.0644	:	0.079	:	0.0434	:	0.0353	:
Antimony	ug/m3	T	0.1002	:	0.0917	:	0.2148	:	0.2166	:	0.1116	:	0.0329	:
Arsenic	ug/m3	T	0.8117	:	0.6803	:	1.7393	:	2.1221	:	0.508	:	0.2608	:
Barium	ug/m3	T	2.3	:	1.8798	:	4.9121	:	5.675	:	1.3748	:	0.7664	:
Beryllium	ug/m3	T	<0.0011	:	<0.0009	:	<0.0013	:	<0.0015	:	<0.0008	:	<0.0007	:
Boron	ug/m3	T	0.3448	:	0.3113	:	0.3348	:	0.3115	:	0.2074	:	0.1803	:
Cadmium	ug/m3	T	0.2953	:	0.2424	:	0.5971	:	0.6275	:	0.1933	:	0.1162	:
Calcium	ug/m3	T	0.3408	:	0.4074	:	0.705	:	1.1433	:	0.3611	:	0.1645	:
Chromium	ug/m3	T	0.0012	:	0.0009	:	0.0025	:	0.0027	:	<0.0005	:	0.0006	:
Cobalt	ug/m3	T	<0.0003	:	0.0008	:	0.0008	:	0.0011	:	0.0005	:	0.0004	:
Copper	ug/m3	T	0.0165	:	0.0103	:	0.0277	:	0.024	:	0.0073	:	0.0053	:
Gallium	ug/m3	T	0.5413	:	0.4196	:	1.1033	:	1.0388	:	0.3227	:	0.1849	:
Germanium	ug/m3	T	<0.0022	:	<0.0017	:	<0.0043	:	<0.0041	:	<0.0013	:	<0.0008	:
Indium	ug/m3	T	<0.0003	:	<0.0003	:	<0.0003	:	<0.0003	:	<0.0002	:	<0.0003	:
Iron	ug/m3	T	0.0008	:	0.0017	:	0.0024	:	0.0016	:	0.0016	:	0.0011	:
Lanthanum	ug/m3	T	0.0039	:	0.0033	:	0.0069	:	0.0056	:	0.0032	:	0.0023	:
Lead	ug/m3	T	<0.0008	:	<0.0007	:	<0.0007	:	<0.0007	:	<0.0008	:	<0.0007	:
Magnesium	ug/m3	T	<0.0004	:	<0.0003	:	<0.0003	:	<0.0003	:	<0.0002	:	<0.0003	:
Manganese	ug/m3	T	0.001	:	<0.0003	:	<0.0005	:	0.0009	:	<0.0004	:	<0.0003	:
Mercury	ug/m3	T	<0.0003	:	0.0009	:	0.0003	:	0.0006	:	<0.0002	:	<0.0002	:
Molybdenum	ug/m3	T	0.0032	:	0.0051	:	0.0032	:	0.0038	:	0.0027	:	0.0034	:
Nickel	ug/m3	T	0.0008	:	0.0009	:	0.0032	:	0.0032	:	0.0009	:	<0.0003	:
Palladium	ug/m3	T	0.0048	:	0.004	:	0.0076	:	0.0091	:	0.0024	:	0.0011	:
Phosphorus	ug/m3	T	0.001	:	0.0006	:	0.001	:	<0.0004	:	<0.0003	:	<0.0004	:
Potassium	ug/m3	T	0.0026	:	0.0021	:	0.0044	:	0.0041	:	0.0015	:	0.0014	:
Rubidium	ug/m3	T	<0.0007	:	<0.0007	:	<0.0006	:	<0.0006	:	<0.0006	:	<0.0007	:
Selenium	ug/m3	T	0.0034	:	<0.0017	:	0.0018	:	<0.0017	:	<0.0014	:	<0.0016	:
Silicon	ug/m3	T	<0.0017	:	<0.0016	:	<0.0016	:	<0.0017	:	<0.0014	:	<0.0015	:
Silver	ug/m3	T	0.0025	:	<0.0016	:	<0.0016	:	<0.0016	:	<0.0013	:	<0.0016	:
Sodium	ug/m3	T	<0.0019	:	<0.0017	:	<0.0017	:	<0.0018	:	<0.0015	:	<0.0016	:
Strontium	ug/m3	T	<0.0022	:	<0.0019	:	<0.002	:	<0.002	:	<0.0017	:	<0.0019	:
Tin	ug/m3	T	<0.0076	:	<0.007	:	0.0113	:	0.019	:	<0.006	:	<0.0066	:
Titanium	ug/m3	T	<0.0096	:	<0.0088	:	<0.0086	:	<0.0085	:	<0.0076	:	<0.0084	:

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Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-3	PM10-3	PM10-3	PM10-3	PM10-3	PM10-3
		Sample Date	5/6/2003	5/7/2003	5/8/2003	5/9/2003	5/12/2003	5/13/2003
		Sample ID	M3050603	M3050703	M3050803	M3050903	M3051203	M3051303
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Vanadium	ug/m3	T	<0.0005 :	<0.0005 :	0.0006 :	<0.0005 :	<0.0004 :	<0.0005 :
Yttrium	ug/m3	T	<0.0007 :	0.0013 :	0.0033 :	0.0013 :	0.0012 :	0.0009 :
Zinc	ug/m3	T	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :
Zirconium	ug/m3	T	<0.0538 :	<0.0504 :	<0.0502 :	<0.05 :	<0.0504 :	<0.0504 :
General Chemistry								
Bromine	ug/m3	T	0.0074 :	0.0872 :	0.0257 :	0.0303 :	0.0127 :	0.0015 :
Chlorine	ug/m3	T	0.0588 :	0.0455 :	0.1244 :	0.1258 :	0.0322 :	0.0188 :
Sulfur	ug/m3	T	<0.0024 :	<0.0022 :	<0.0022 :	<0.0022 :	<0.0019 :	<0.002 :

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Appendix A-14
Air - Tailings Facility
Validated Analytical Results

Parameter	Units	Fraction	PM10-3 5/14/2003 M3051403 TAIR	PM10-3 5/15/2003 M3051503 TAIR	PM10-3 5/16/2003 M3051603 TAIR	PM10-3 5/19/2003 M3051903 TAIR	PM10-3 5/20/2003 M3052003 TAIR	PM10-3 5/21/2003 M3052103 TAIR
Site ID / Sample Date / Sample ID / Exposure Area								
Metals								
Aluminum	ug/m3	T	0.0687 :	0.1091 :	0.0362 :	0.24 :	0.0432 :	0.0554 :
Antimony	ug/m3	T	0.0814 :	0.2577 :	0.0616 :	0.3492 :	0.0592 :	0.0915 :
Arsenic	ug/m3	T	0.6034 :	2.3983 :	0.3284 :	3.5761 :	0.3388 :	0.3741 :
Barium	ug/m3	T	1.7861 :	6.5084 :	0.9521 :	10.1643 :	0.9744 :	0.9895 :
Beryllium	ug/m3	T	<0.001 :	<0.0015 :	<0.0008 :	<0.0021 :	<0.0009 :	<0.0009 :
Boron	ug/m3	T	0.4937 :	0.3003 :	0.2973 :	0.2081 :	0.364 :	0.244 :
Cadmium	ug/m3	T	0.2504 :	0.6546 :	0.1443 :	1.2718 :	0.1605 :	0.1613 :
Calcium	ug/m3	T	0.2821 :	0.9672 :	0.2373 :	1.2732 :	0.4021 :	0.3549 :
Chromium	ug/m3	T	<0.0006 :	0.0035 :	<0.0004 :	0.0069 :	<0.0004 :	0.0007 :
Cobalt	ug/m3	T	0.0007 :	0.0008 :	<0.0002 :	0.002 :	0.0005 :	0.0006 :
Copper	ug/m3	T	0.0111 :	0.0221 :	0.0058 :	0.058 :	0.0047 :	0.0052 :
Gallium	ug/m3	T	0.4166 :	1.1168 :	0.224 :	2.4357 :	0.2458 :	0.2391 :
Germanium	ug/m3	T	<0.0017 :	<0.0044 :	<0.0009 :	<0.0094 :	<0.0011 :	<0.0011 :
Indium	ug/m3	T	<0.0002 :	<0.0003 :	<0.0002 :	<0.0004 :	<0.0002 :	<0.0003 :
Iron	ug/m3	T	0.0015 :	0.0014 :	0.0008 :	0.0038 :	0.0011 :	0.0011 :
Lanthanum	ug/m3	T	0.0033 :	0.0053 :	0.0033 :	0.0121 :	0.0028 :	0.002 :
Lead	ug/m3	T	<0.0007 :	<0.0007 :	<0.0008 :	0.0009 :	<0.0008 :	<0.0007 :
Magnesium	ug/m3	T	<0.0003 :	<0.0003 :	<0.0003 :	<0.0004 :	<0.0002 :	<0.0003 :
Manganese	ug/m3	T	<0.0004 :	0.0015 :	<0.0003 :	0.0007 :	<0.0002 :	<0.0003 :
Mercury	ug/m3	T	<0.0002 :	0.0005 :	<0.0002 :	<0.0003 :	<0.0002 :	0.0003 :
Molybdenum	ug/m3	T	0.0047 :	0.0024 :	0.0033 :	0.0022 :	0.0021 :	0.003 :
Nickel	ug/m3	T	0.0016 :	0.0035 :	0.0006 :	0.008 :	0.0006 :	<0.0003 :
Palladium	ug/m3	T	0.0034 :	0.0086 :	0.0022 :	0.0204 :	0.0035 :	0.0028 :
Phosphorus	ug/m3	T	<0.0003 :	0.0014 :	<0.0004 :	0.0025 :	<0.0003 :	<0.0004 :
Potassium	ug/m3	T	0.0021 :	0.0045 :	<0.0004 :	0.009 :	0.0007 :	<0.0005 :
Rubidium	ug/m3	T	<0.0006 :	<0.0007 :	<0.0006 :	<0.0007 :	<0.0005 :	<0.0007 :
Selenium	ug/m3	T	<0.0015 :	<0.0017 :	<0.0016 :	<0.0021 :	<0.0014 :	<0.0016 :
Silicon	ug/m3	T	<0.0014 :	0.0026 :	<0.0015 :	<0.002 :	<0.0013 :	<0.0015 :
Silver	ug/m3	T	<0.0014 :	<0.0017 :	<0.0014 :	<0.002 :	<0.0014 :	<0.0015 :
Sodium	ug/m3	T	<0.0015 :	<0.0018 :	<0.0016 :	<0.0021 :	<0.0014 :	<0.0016 :
Strontium	ug/m3	T	<0.0017 :	0.0034 :	<0.0018 :	<0.0023 :	<0.0016 :	<0.0019 :
Tin	ug/m3	T	0.008 :	0.017 :	0.0174 :	0.0499 :	<0.0059 :	0.0079 :
Titanium	ug/m3	T	<0.0076 :	<0.0085 :	<0.008 :	<0.0098 :	<0.0074 :	<0.0084 :

J = Qualified as estimated during data validation
R = Qualified as rejected value from data validation and results are considered unusable for any purpose
T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-3	PM10-3	PM10-3	PM10-3	PM10-3	PM10-3
		Sample Date	5/14/2003	5/15/2003	5/16/2003	5/19/2003	5/20/2003	5/21/2003
		Sample ID	M3051403	M3051503	M3051603	M3051903	M3052003	M3052103
		Exposure Area	TAIR	TAIR	TAIR	TAIR	TAIR	TAIR
Parameter	**Units**	**Fraction**						
Vanadium	ug/m3	T	<0.0004 :	<0.0005 :	<0.0004 :	<0.0005 :	<0.0004 :	<0.0005 :
Yttrium	ug/m3	T	0.0015 :	0.0009 :	<0.0006 :	0.0013 :	0.0006 :	0.001 :
Zinc	ug/m3	T	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :	<0.0001 :
Zirconium	ug/m3	T	<0.0504 :	<0.0504 :	<0.0504 :	<0.0563 :	<0.0504 :	<0.0504 :
General Chemistry								
Bromine	ug/m3	T	<0.0011 :	0.0114 :	0.0024 :	<0.0019 :	0.004 :	0.0019 :
Chlorine	ug/m3	T	0.0464 :	0.1351 :	0.0226 :	0.2807 :	0.0265 :	0.0236 :
Sulfur	ug/m3	T	<0.0019 :	<0.0022 :	<0.0019 :	<0.0025 :	<0.0018 :	<0.002 :

J = Qualified as estimated during data validation

R = Qualified as rejected value from data validation and results are considered unusable for any purpose

T = Total Fraction   NC = sample not collected because of equipment or other problems

Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-3	PM10-3	PM10-3			
		Sample Date	5/22/2003	5/23/2003	5/27/2003			
		Sample ID	M3052203	M3052303	M3052703	----	----	----
		Exposure Area	TAIR	TAIR	TAIR			
Parameter	**Units**	**Fraction**						
Metals								
Aluminum	ug/m3	T	0.0671 :	0.0613 :	0.0318 :	-	-	-
Antimony	ug/m3	T	0.1408 :	0.0911 :	0.0364 :	-	-	-
Arsenic	ug/m3	T	0.7118 :	0.5325 :	0.2458 :	-	-	-
Barium	ug/m3	T	1.9769 :	1.4442 :	0.7121 :	-	-	-
Beryllium	ug/m3	T	<0.0009 :	<0.001 :	<0.0009 :	-	-	-
Boron	ug/m3	T	0.216 :	0.5142 :	0.5217 :	-	-	-
Cadmium	ug/m3	T	0.3046 :	0.2393 :	0.1282 :	-	-	-
Calcium	ug/m3	T	0.5197 :	0.4433 :	0.1626 :	-	-	-
Chromium	ug/m3	T	<0.0007 :	0.0006 :	<0.0004 :	-	-	-
Cobalt	ug/m3	T	0.0007 :	0.0005 :	<0.0002 :	-	-	-
Copper	ug/m3	T	0.0133 :	0.009 :	0.0046 :	-	-	-
Gallium	ug/m3	T	0.5113 :	0.3475 :	0.1922 :	-	-	-
Germanium	ug/m3	T	<0.002 :	<0.0015 :	<0.0008 :	-	-	-
Indium	ug/m3	T	<0.0002 :	<0.0002 :	<0.0003 :	-	-	-
Iron	ug/m3	T	0.0012 :	0.001 :	0.0012 :	-	-	-
Lanthanum	ug/m3	T	0.0042 :	0.0032 :	0.0035 :	-	-	-
Lead	ug/m3	T	<0.0007 :	<0.0007 :	<0.0008 :	-	-	-
Magnesium	ug/m3	T	<0.0003 :	<0.0003 :	<0.0003 :	-	-	-
Manganese	ug/m3	T	<0.0003 :	<0.0003 :	0.0007 :	-	-	-
Mercury	ug/m3	T	<0.0002 :	<0.0002 :	0.0003 :	-	-	-
Molybdenum	ug/m3	T	0.0027 :	0.0027 :	0.0043 :	-	-	-
Nickel	ug/m3	T	0.0014 :	0.0012 :	<0.0003 :	-	-	-
Palladium	ug/m3	T	0.0047 :	0.0041 :	0.0017 :	-	-	-
Phosphorus	ug/m3	T	<0.0004 :	0.0005 :	<0.0004 :	-	-	-
Potassium	ug/m3	T	0.0027 :	0.0006 :	<0.0005 :	-	-	-
Rubidium	ug/m3	T	<0.0006 :	<0.0006 :	<0.0007 :	-	-	-
Selenium	ug/m3	T	<0.0016 :	<0.0015 :	<0.0016 :	-	-	-
Silicon	ug/m3	T	<0.0015 :	<0.0014 :	<0.0015 :	-	-	-
Silver	ug/m3	T	<0.0015 :	<0.0014 :	<0.0016 :	-	-	-
Sodium	ug/m3	T	<0.0016 :	<0.0015 :	<0.0017 :	-	-	-
Strontium	ug/m3	T	<0.0019 :	<0.0017 :	<0.0019 :	-	-	-
Tin	ug/m3	T	<0.0062 :	0.0161 :	0.0104 :	-	-	-
Titanium	ug/m3	T	<0.0079 :	<0.0076 :	0.0105 :	-	-	-

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Appendix A-14
Air - Tailings Facility
Validated Analytical Results

		Site ID	PM10-3		PM10-3		PM10-3							
		Sample Date	5/22/2003		5/23/2003		5/27/2003							
		Sample ID	M3052203		M3052303		M3052703		----		----		----	
		Exposure Area	TAIR		TAIR		TAIR							
Parameter	**Units**	**Fraction**												
Vanadium	ug/m3	T	<0.0004	:	<0.0004	:	<0.0005	:	-		-		-	
Yttrium	ug/m3	T	<0.0006	:	0.0009	:	<0.0006	:	-		-		-	
Zinc	ug/m3	T	<0.0001	:	<0.0001	:	<0.0001	:	-		-		-	
Zirconium	ug/m3	T	<0.0504	:	<0.05	:	<0.05	:	-		-		-	
General Chemistry														
Bromine	ug/m3	T	0.0016	:	0.0024	:	<0.0011	:	-		-		-	
Chlorine	ug/m3	T	0.0523	:	0.0367	:	0.0192	:	-		-		-	
Sulfur	ug/m3	T	<0.0019	:	<0.0018	:	<0.0021	:	-		-		-	

J = Qualified as estimated during data validation
R = Qualified as rejected value from data validation and results are considered unusable for any purpose
T = Total Fraction   NC = sample not collected because of equipment or other problems

APPENDIX B-14

AIR QUALITY ASSESSMENT
OF MOLYCORP INC.
QUESTA FACILITY TAILINGS DIVISION

·Applied Measurement Science·

🜁 ▽ 🜃

Consultants in Quantitative Process and Environmental Measurements

Final Report

Air Quality Assessment of Molycorp, Inc. Questa Division Tailings Facility

Prepared for:

Molycorp
Questa Division
Questa, New Mexico

Prepared by:

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Applied Measurement Science
4764 Concord Drive
Fair Oaks, California 95628

May 19, 2004

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1.0 INTRODUCTION

The Questa Division of Molycorp, Inc. operates a tailings facility to the west of the Village of Questa, New Mexico. The purpose of this facility is to collect the tailings slurry from the main processing plant several miles away.

In order to assess the air quality at the tailings facility, two monitoring programs were conducted in 2003, one of which currently continues to operate. The first was initiated in February-March, 2003 and consisted of a network of three solar-powered continuous PM10 monitoring stations. This network is still in operation. The second program was conducted during the month of May, 2003, consisting of a short-term sampling campaign for airborne metals in dust conducted at the same locations as the PM10 monitoring network. The report presenting the results of that program are contained in the appendix. That report simply presented the data, with no interpretation of the data in relation to any air quality standards or health standards.

The purpose of this report is to present and analyze the data from these programs in order to assess the air quality for the period of 2003-4 at the tailings facility in relation to US EPA Region 3 and Region 6 ambient air risk screening levels and National Air Quality Standards. Two aspects of air quality will be considered: the measured concentration of PM10, and the measured concentration of metals in respirable PM10. The basis for assessment for PM10 will be the National Ambient Air Quality Standards, and the basis for assessment of the metals concentrations will be the air risk screening levels from US EPA risk assessment programs. This evaluation is not a risk assessment, but rather a simple comparison of the concentrations obtained in the monitoring efforts to the various screening levels and national background concentration levels.

1.1 Description of Tailings Facility[1]

The Molycorp Tailings Facility is located on the northwestern edge of the Village of Questa, New Mexico. The property consists of 2,132 acres in Sections 25,35, and 36, Township 29 North, Range 12 East. The property is made up of patented and fee simple land owned by Molycorp.

The site boundaries are irregular along a general southwest to northeast orientation. The northern end is situated in farmland. The western boundaries of the property are at the base of Guadalupe Mountain, and the eastern boundaries abut farmland, the Questa Middle School, and a few isolated residences. The southern end terminates in an arroyo.

Approximately 90 acres of the site have exposed tailings. Approximately 534 acres have an interim cover of topsoil at a depth of 9 inches that has been seeded until future use. Another 93 acres are covered with water, with the current tailings discharge area encompassing 717

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[1] All operational information in this section was obtained from Roy Torres, Operations Manager of Questa Division, March, 2004.

acres. All active tailings areas are at the south end of the facility behind Dam 4. Figure 1 contains an aerial photo of the facility and the Village of Questa.

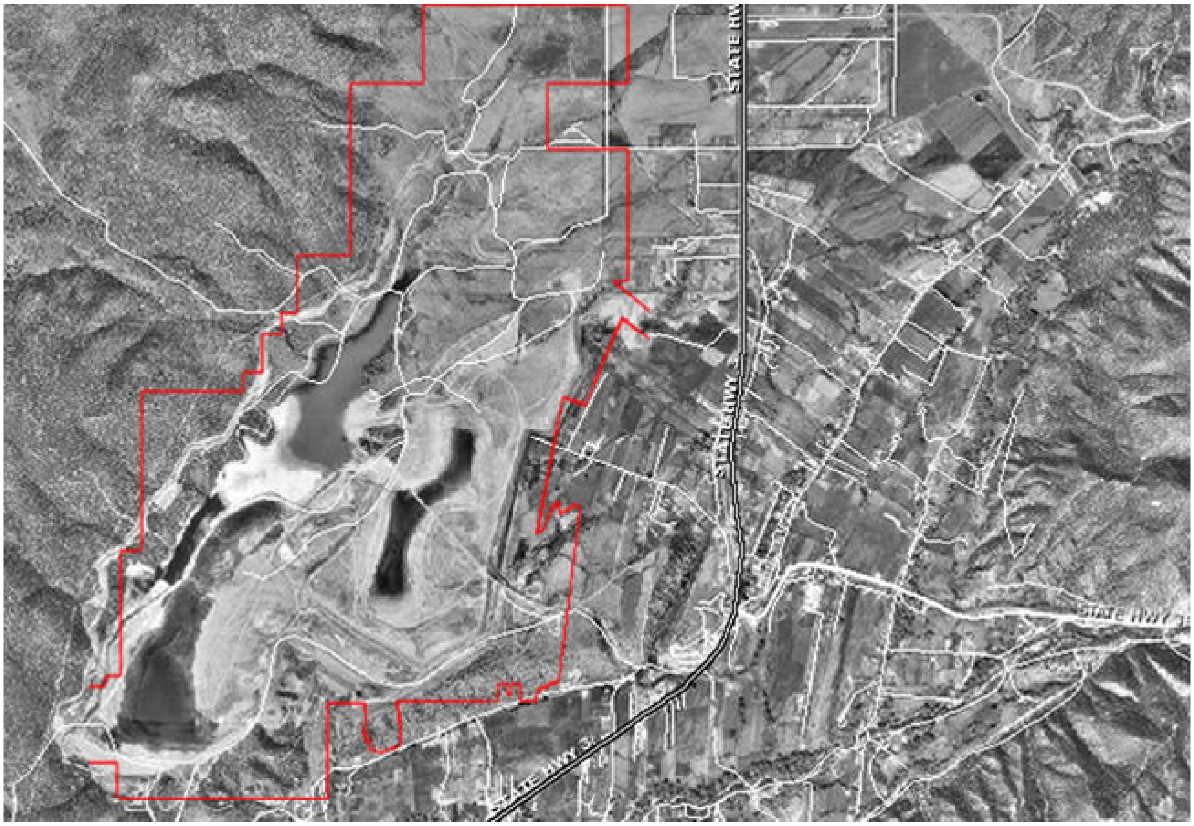

Figure 1. Aerial Photo of Tailings Facility and Village of Questa Area
(Red line is Molycorp property boundaries)

1.2 Description of Tailings Generation Process

During the processing of the raw molybdenite ore, the mined rock is crushed and mechanically processed to separate the molybdenum from other minerals and elements present. The tailings material ends up in a 38% by weight slurry that is pumped in two pipelines for the 9 miles from the mill to the tailings area. The composition of the tailings is approximately equal portions of Aplite and Andesite. The composition of these two rock types is as follows:

Table 1. Tailings Mineral Composition

Mineral	Percent Mineral in Aplite	Percent Mineral in Andesite
Na_2O	3.25	2.56
K_2O	5.54	3.86
CaO	0.24	2.67
MgO	0.24	2.74
Fe_2O_3	3.17	0.61
Al_2O_3	12.80	10.96
TiO_2	0.22	0.85
MnO_2	0.04	0.29
SiO_2	74.42	61.33
SrO	0.01	0.12
BaO	0.04	0.33
L.O.I.	0.23	8.64
Minor materials: Mo, Cu, Pb, Zn, LiO_2, Rb, SO_4		

In addition to the major mineral components, the following chemicals are used in the milling process and may be included in the tailings slurry. However, most of the chemicals used in the process remain in the final product.

Table 2. Potential Chemical Additives in Tailings

Reagent	**lbs/ton**
Lime	0.70
Diesel	0.16
Pineoil	0.05
Oreprep F-501	0.24
D-8	0.33
Nokes (P_2S_5)	0.14

The tailings slurry is discharged from spigot points located around the perimeter of the disposal area. Following disposal, the tails water is retained until the solids settle. The tailings are covered pas soon as possible after each milling campaign. The tailings areas are either wet from current disposal, under water in the clarification process, covered with surfactant stabilizer for short-term dust control, or covered with a 9-12 inches of cover for long-term dust control. The cover consists of local alluvial material, gravel or soil, and these areas are often seeded.

The remaining tailings facility surface area is composed of soil and/or vegetated range land. Access roads cross the entire site, which is enclosed by fencing.

2.0 DATA COLLECTION EVENTS

Two monitoring programs were conducted in 2003 for the purpose of evaluating the air quality at the Tailings Facility. The first was a continuous PM10 monitor network with three stations placed across the length of the site. Its purpose was to collect data continuously for PM10 during normal operations over all seasons. The second program was an short-term sampling campaign in May, 2003 to collect aerosol samples for metals analysis. This campaign was conducted at the same sites as the continuous PM10 monitors. The report for the metals sampling is contained in the appendix, and various data from it will be cited in relation to evaluation of the metals concentrations.

Given that the metals report presented the details of that effort, this report will present the PM10 program in more detail. The metals program will be only generally described. The results of both programs will be examined in relation to the air quality evaluation.

2.1 PM10 Monitoring

2.1.1 Monitoring Sites

The air monitoring network was installed in February-March, 2003, and its operation is on-going. Figure 2 shows the location of the three monitoring locations. The three monitoring locations were chosen based on downgradient conditions for the typical wind direction. Table 3 contains location information and the three locations are indicated on the map in Figure 2.

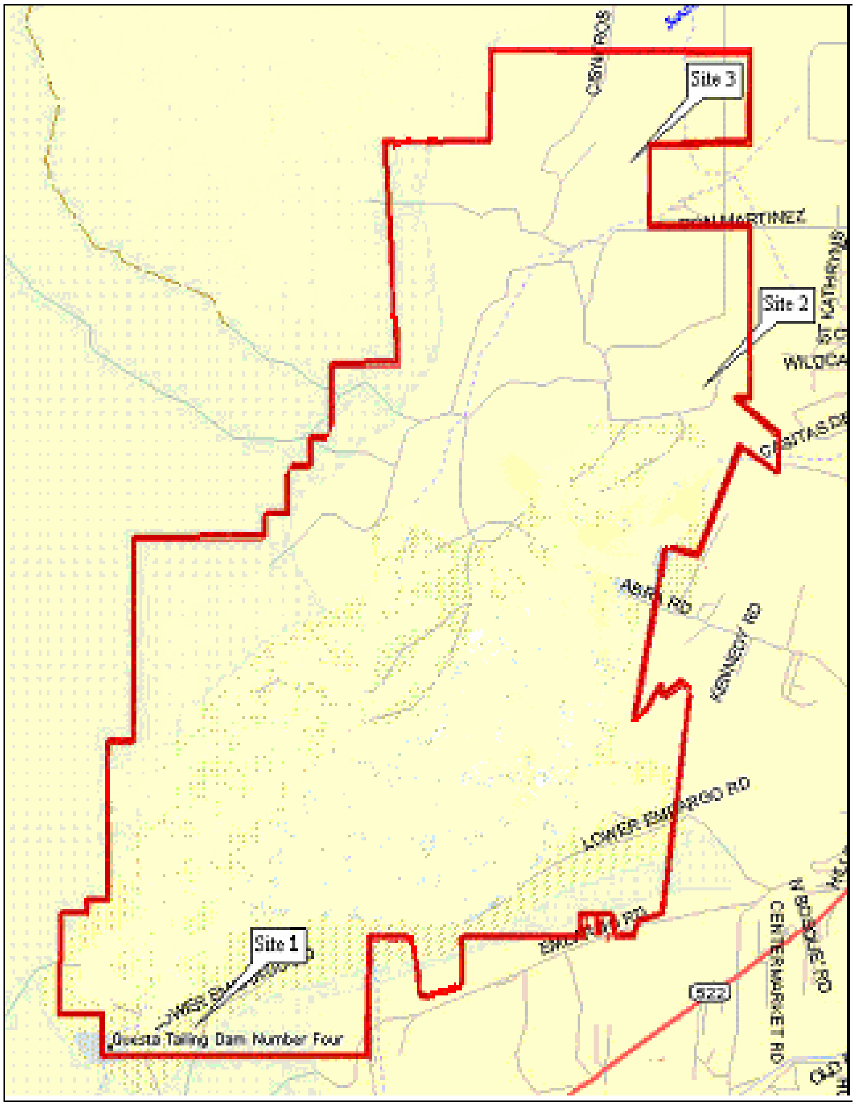

Figure 2. Questa Division Tailings Operation
(Boundaries Approximate)

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Table 3. Monitoring Site Information

PM10-1
36 41.755 N
105 37.787 W
13443792E
4061119N
7524 feet elevation
PM10-2
36 43.270 N
105 36.283 W
13446048E
4063904N
7650 feet elevation
PM10-3
36 43.803 N
105 36.510 W
13445717E
4064892N
7660 feet elevation
All lat/long use WGS84
UTM: NAD27

As can be seen from the elevation data, Site 1 is located approximately 125 feet below the main plateau of the tailings where Sites 2 and 3 are located. In addition, this site is on the edge of the southern boundary of the main tailings dam which is located in an arroyo (canyon). This relatively isolated location is on the southern boundary of the tailings operations along the prevailing southwesterly wind direction. With this orientation and the relative distance from the major sources of fugitive dust, this site therefore was considered as representative of dust contributions from the operation to the south. Sites 2 and 3 are located to the north and northeast of the property, near the eastern fence line in the prevailing wind directions.

2.1.2 PM10 Monitoring Instrumentation

The instruments used for the PM10 monitoring effort are the MetOne Instruments, Inc. EBAM. The EBAM (Environmental Beta Attenuation Monitor) is based on the same beta attenuation technology that is used in the BAM 1020 monitor, EPA federal reference equivalent method (FEM) EQPM-0798-122 under 40 CFR 53, as well as a California Approved Sampler under 17 CCR Section 70100.1 The beta attenuation technique uses a small amount of Carbon-14 radioisotope as a source of beta particles that are absorbed by aerosol material collected on a continuous quartz fiber tape. A photomultiplier detector measures the attenuated (decreased) signal from the aerosol that is proportional to the mass collected. From the volume of air collected and that mass, the concentration is determined. The size fraction measured is determined by the type of separation inlet used, which was the standard PM10 virtual impactor used in all federal reference methods.

Aerosol is collected continuously onto the quartz fiber tape, which is analyzed on an hourly basis to provide an average for that period. Once every 24-hours, the tape is advanced.

In addition to the PM10 sensor, the EBAM collects wind speed and wind direction data. Temperature is also logged as part of the volumetric flow control. All the meteorological parameters are logged concurrently with the PM10 concentrations so that correlations can be made between them.

The three monitors are powered by solar power systems consisting of two solar panels and a bank of deep charge batteries.

Figure 3 shows a photo of the set up at Site 1, with the solar array in the foreground. Figure 4 shows a close-up of the instrument and its parts.

Figure 3. Photo of EBAM monitor and solar power system

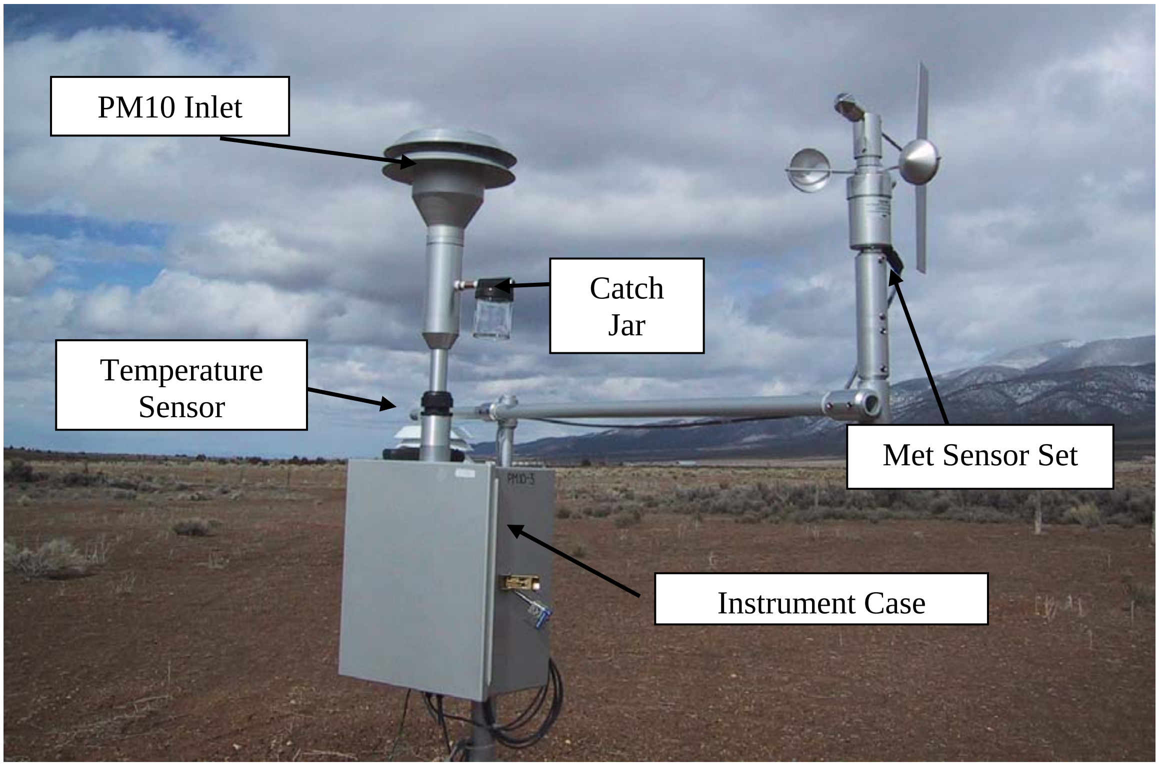

Figure 4. Close-up Photo of EBAM instrument

2.1.3 Instrument Evaluation

Two types of instrument evaluation and validation were performed for the EBAM units. The first was an intercomparison study with the gravimetrically determined PM10 as collected by the Partisol sampler. This was conducted as part of the May, 2003 metals study, described below. The second evaluation was an instrument audit performed in November, 2003.

2.1.3.1 EBAM Intercomparison Test

As an cross-calibration between the Partisol and EBAM, the data from the gravimetric mass determination of PM10 from the Partisol sampler was compared against the EBAM data. The results of that testing is included in a Technical Memorandum that is included in the appendix. The conclusion of that testing was that the EBAM produced PM10 concentration data that was statistically significant, but two of the three EBAM units (Sites 2 and 3) were positively biased by approximately 30 to 50 percent, respectively.

This performance is under further investigation. While the results for these two units are biased high, the overall conclusions from the program are not affected. The positive nature of the bias retains a conservatism that is protective of public health.   None of the data has been adjusted for this bias.

Nothing in the Partisol data was indicative of any bias, either positive or negative, from those samples, so the metals results contained in the report on that testing are accurate. An additional data examination relative to a more in-depth examination of the internal consistency of the data is contained in Section 3.2.1.

2.1.3.2 EBAM Instrument Audit

An audit/evaluation was performed on the EBAM units, including the meteorological sensors, in November, 2003. The report is included in the appendix of this report. The audit included a full calibration of the EBAM unit plus testing of the wind speed and wind direction sensors. The conclusion of the audit was that the units were operating correctly, per the original factory specifications.

2.2 Metals Sampling

As noted above, a short-term sampling event for airborne metals was conducted between May 6, 2003 and May 29, 2003. The report for that effort is included in the appendix.

The Partisol is a Federal Equivalence Method that uses 47 mm filters to collect aerosol for external laboratory analysis. Three sets of analyses were performed on the collected filters: gravimetry for PM10 concentration, X-ray fluorescence for 38 metals from sodium to lead, and inductively coupled plasma emission spectrometry for boron and beryllium.

Figure 5 shows the metals sampling set up adjacent to an EBAM station.

Figure 5. Metals sampler set up alongside EBAM PM10 monitor

3.0 RESULTS AND DISCUSSION

3.1 PM10 Concentrations Summary and Statistics

Hourly averages for PM10 concentration, wind speed, wind direction, and temperature were collected starting on February 26, 2003 for Site 3, and March 17, 2003 for Sites 1 and 2. The data collected from those starting dates to February 16, 2004 were collected, collated, validated, and analyzed, and are reported in this section. The procedures for data validation along with detailed information on data quality assessment are presented in the Appendix. This assessment also includes the EBAM data intercomparison test cited in Section 2.1.3.1.

3.1.1 PM10 Time Series Data Presentation

Although hourly data was collected for all three sites, because the PM10 air quality is evaluated on 24-hour and annual bases for the National Ambient Air Quality Standards, only 24-hour average data will be presented and analyzed except in cases where any of the hourly data can help elucidate any particular 24-hour data point.

Table 4 contains the 24-hour averages for the entire monitoring period. Figure 6 shows a plot of the time series of the 24-hour average concentration. Figure 7 shows a histogram plot of the same data set. Table 5 contains data on the frequency of the various concentration levels that are represented in the histogram plot. Figure 8 shows the diurnal plot of the hourly data.

Several observations can be made from the time series data:

- Site 3 Concentrations. Higher concentrations were noted at Site 3 from mid-April to late July. Many of the higher values in May are likely due to dust generation during site access for the metals testing, as noted in the metals report. Although care had been taken to minimize the generation of excess fugitive dust emissions during that time, a detailed examination of the hourly data suggests this effect not only at Site 3, but also at the other sites, though the impact at Site 3 was the greatest. Several of the highest concentrations were observed during the time period of the metals testing, so it is likely that activity contributed substantially to the measured concentration values.

  Another explanation for high concentrations at Site 3 is its proximity to farming operations. Several periods of high concentration averages were evident during the period after the metals sampling was completed, so other than normal operations, the nearby field tilling and associated activities were the possible cause. Many of the high hourly values that contributed to the 24-hour averages occurred in the later afternoon to early evening hours. Since the Tailing Facility staff ends their work day at 4 PM, the most likely activities that contributed to the noted high concentrations would be the localized farming activities.

  In addition, it is notable that the concentration spikes decrease after July, which likely coincides with the cessation of field preparation activities. Therefore, it is concluded that the farming activity is a major contributor to the observed concentrations.

Table 4. 24-Hour Average PM10 Concentrations

Date	Site 1 24 hr Avg. (ug/m3)	Site 2 24 hr Avg. (ug/m3)	Site 3 24 hr Avg. (ug/m3)
2/26/03			
2/27/03			
2/28/03			
3/1/03			
3/2/03			
3/3/03			
3/4/03			
3/5/03			
3/6/03			
3/7/03			6.2
3/8/03			
3/9/03			3.9
3/10/03			
3/11/03			5.6
3/12/03			6.1
3/13/03			9.0
3/14/03			7.6
3/15/03			6.0
3/16/03			
3/17/03			
3/18/03			
3/19/03			
3/20/03	5.5	9.0	4.8
3/21/03	4.2	1.0	
3/22/03	5.0	5.0	
3/23/03	5.1	12.0	
3/24/03	7.6	9.0	6.9
3/25/03	5.5	9.0	5.2
3/26/03	6.7	10.0	5.3
3/27/03	17.9	8.0	22.1
3/28/03	5.3	4.0	14.1
3/29/03	5.6	4.0	4.8
3/30/03	6.7	3.0	5.4
3/31/03	4.1		4.6
4/1/03	9.0	5.0	10.9
4/2/03	8.8	10.0	9.5
4/3/03	18.9	7.0	20.0
4/4/03	10.6	18.0	14.2
4/5/03	18.0	21.0	23.2

Date	Site 1 24 hr Avg. (ug/m3)	Site 2 24 hr Avg. (ug/m3)	Site 3 24 hr Avg. (ug/m3)
4/6/03	12.4	20.0	10.3
4/7/03	8.8	1.0	12.3
4/8/03	4.8		
4/9/03	6.3	2.0	7.7
4/10/03	6.5		8.0
4/11/03	11.9		11.2
4/12/03	11.5	10.0	12.8
4/13/03	10.5	7.0	11.0
4/14/03	7.6	11.0	8.3
4/15/03	11.8	13.0	12.4
4/16/03	4.3	9.0	
4/17/03	19.6		38.2
4/18/03	11.0	25.0	11.3
4/19/03		1.0	
4/20/03	5.3	7.0	
4/21/03		4.0	
4/22/03			
4/23/03			
4/24/03			
4/25/03			
4/26/03			
4/27/03			
4/28/03			
4/29/03			
4/30/03			
5/1/03			
5/2/03			9.9
5/3/03			37.7
5/4/03			22.7
5/5/03			7.1
5/6/03	6.9		14.3
5/7/03	13.3	15.0	40.9
5/8/03	14.4	18.0	26.1
5/9/03	40.9	1.0	70.5
5/10/03	12.8	48.0	23.2
5/11/03	7.0	3.0	8.2
5/12/03	10.7	8.0	28.7
5/13/03	8.6	10.0	11.1
5/14/03	13.0	14.0	10.0
5/15/03	44.3	15.0	76.5
5/16/03	12.8	3.0	11.1
5/17/03	11.8	3.0	11.1

Date	Site 1 24 hr Avg. (ug/m3)	Site 2 24 hr Avg. (ug/m3)	Site 3 24 hr Avg. (ug/m3)
5/18/03	14.5	11.0	14.6
5/19/03	16.3	13.0	138.8
5/20/03	9.3	5.0	10.4
5/21/03	30.9	23.0	11.8
5/22/03	13.2	12.0	30.1
5/23/03	19.5	13.0	40.5
5/24/03	17.6	18.0	21.4
5/25/03	12.3	14.0	10.9
5/26/03	8.4	10.0	8.1
5/27/03	12.0	10.0	15.3
5/28/03	11.5	12.0	16.0
5/29/03	16.3	1.0	15.6
5/30/03	12.3		10.4
5/31/03	12.1		12.3
6/1/03	14.3		21.1
6/2/03	10.2		20.2
6/3/03	16.8		15.3
6/4/03	14.7		35.8
6/5/03	27.1		74.3
6/6/03	11.9		20.4
6/7/03	17.0		24.8
6/8/03	11.9		16.0
6/9/03	24.7		32.1
6/10/03	28.5		31.8
6/11/03	15.2		14.0
6/12/03	16.0		19.7
6/13/03	28.6		31.0
6/14/03	18.5		18.2
6/15/03	19.1		14.8
6/16/03	16.4		12.6
6/17/03	16.1		53.7
6/18/03	10.1		17.7
6/19/03	11.7		9.1
6/20/03	16.2		
6/21/03	17.6		17.4
6/22/03	15.1		16.3
6/23/03	15.3		24.3
6/24/03	23.3		37.6
6/25/03	17.0		22.5
6/26/03	12.4		11.8
6/27/03	10.1		20.8
6/28/03	20.5		18.5

Date	**Site 1 24 hr Avg. (ug/m3)**	**Site 2 24 hr Avg. (ug/m3)**	**Site 3 24 hr Avg. (ug/m3)**
6/29/03	22.6		65.7
6/30/03	11.9	11.0	13.5
7/1/03	14.6	16.0	16.8
7/2/03	16.5	7.0	11.8
7/3/03	16.6	13.0	29.3
7/4/03	19.3	25.0	23.0
7/5/03	19.2	6.0	21.9
7/6/03	25.5	18.0	38.4
7/7/03	32.2	33.0	32.1
7/8/03	13.8	15.0	14.0
7/9/03	18.5	17.0	29.2
7/10/03	22.2	15.0	20.3
7/11/03	17.2	17.0	17.2
7/12/03	20.9	10.0	27.9
7/13/03	19.5	8.0	22.0
7/14/03	28.4	28.0	42.6
7/15/03	20.5	10.0	22.2
7/16/03	19.9	10.0	35.3
7/17/03	16.3	17.0	17.1
7/18/03	18.9	8.0	25.3
7/19/03	27.0	1.0	104.4
7/20/03	15.8	6.0	31.5
7/21/03	13.4	1.0	13.5
7/22/03	16.5	9.0	19.4
7/23/03	15.0		53.1
7/24/03	16.0	12.0	11.3
7/25/03	12.4	9.0	17.1
7/26/03	14.1	5.0	18.6
7/27/03	10.8	10.0	11.1
7/28/03	8.0		9.7
7/29/03	13.2		12.4
7/30/03	9.3		9.5
7/31/03	10.8	8.0	10.9
8/1/03	8.3	2.0	8.1
8/2/03	8.4	9.0	13.6
8/3/03	8.8	8.0	16.9
8/4/03	9.5	11.0	7.0
8/5/03	8.9	11.0	14.7
8/6/03	8.5	12.0	9.0
8/7/03	7.7	5.0	8.0
8/8/03	8.5	1.0	9.0
8/9/03	7.0	7.0	9.9

Date	Site 1 24 hr Avg. (ug/m3)	Site 2 24 hr Avg. (ug/m3)	Site 3 24 hr Avg. (ug/m3)
8/10/03	9.9	2.0	10.6
8/11/03	10.9	5.0	7.8
8/12/03	8.2	10.0	13.4
8/13/03	13.1	12.0	14.2
8/14/03	14.2	10.0	13.1
8/15/03	12.0	14.0	10.9
8/16/03	9.2	11.0	8.3
8/17/03	8.0	5.0	
8/18/03	8.1	6.0	6.4
8/19/03	8.8	16.0	9.7
8/20/03	11.0	2.0	9.3
8/21/03	10.6	8.0	14.1
8/22/03	7.1	14.0	7.6
8/23/03	6.4	10.0	6.9
8/24/03	9.2	2.0	9.7
8/25/03	6.0		7.1
8/26/03	9.0		10.1
8/27/03		12.0	9.0
8/28/03			
8/29/03			5.9
8/30/03			
8/31/03			
9/1/03			7.3
9/2/03	9.6	4.0	6.9
9/3/03	7.3		9.6
9/4/03	8.2	14.0	7.5
9/5/03	7.0	3.0	9.5
9/6/03	7.3		
9/7/03	9.1	13.0	
9/8/03	5.5		7.9
9/9/03	8.1		8.9
9/10/03			
9/11/03	6.1	5.0	
9/12/03	8.3	7.0	
9/13/03	10.2		9.8
9/14/03	9.5	6.0	8.8
9/15/03	8.3	7.0	9.9
9/16/03	15.0	19.0	8.9
9/17/03	17.7	12.0	16.3
9/18/03	12.0	8.0	18.3
9/19/03	11.4		11.1
9/20/03	9.0	5.0	10.8

Date	Site 1 24 hr Avg. (ug/m3)	Site 2 24 hr Avg. (ug/m3)	Site 3 24 hr Avg. (ug/m3)
9/21/03	9.1	7.0	9.0
9/22/03	9.8	12.0	6.5
9/23/03	11.0	6.0	10.0
9/24/03	12.2	18.0	12.1
9/25/03	12.8	7.0	15.5
9/26/03	13.9	7.0	12.2
9/27/03	11.5	7.0	15.0
9/28/03	12.3	13.0	12.3
9/29/03	15.7	8.0	11.9
9/30/03	14.3	14.0	16.1
10/1/03		4.0	
10/2/03			
10/3/03			
10/4/03			
10/5/03			
10/6/03			
10/7/03			
10/8/03			
10/9/03			
10/10/03			
10/11/03			
10/12/03			
10/13/03			
10/14/03			
10/15/03			
10/16/03			
10/17/03			
10/18/03			
10/19/03			
10/20/03		1.0	
10/21/03	12.7	8.0	
10/22/03	10.6	7.0	
10/23/03	7.2	6.0	
10/24/03	10.4	6.0	
10/25/03	20.4	13.0	
10/26/03	7.5		
10/27/03	5.8	2.0	
10/28/03	7.4	8.0	
10/29/03	11.0	10.0	
10/30/03	34.9	20.0	
10/31/03	28.5		
11/1/03	14.6	19.0	

Date	Site 1 24 hr Avg. (ug/m3)	Site 2 24 hr Avg. (ug/m3)	Site 3 24 hr Avg. (ug/m3)
11/2/03	10.3	7.0	
11/3/03	9.6	5.0	
11/4/03	5.5		
11/5/03	7.3	5.0	
11/6/03	6.9	19.0	
11/7/03	7.5	3.0	
11/8/03	5.5	2.0	
11/9/03	5.3	3.0	
11/10/03	6.9	8.0	
11/11/03	5.5	6.0	
11/12/03	8.1	10.0	
11/13/03			
11/14/03	9.9	45.0	
11/15/03	13.1	21.0	
11/16/03	7.9	16.0	
11/17/03	12.6	3.0	
11/18/03	12.0	16.0	
11/19/03			
11/20/03		15.0	
11/21/03	6.8	2.0	
11/22/03	16.7		28.3
11/23/03	24.2	4.0	7.2
11/24/03	11.1	17.0	5.3
11/25/03	9.4	19.0	
11/26/03	6.6	7.0	6.8
11/27/03	70.7	9.0	
11/28/03	6.3	5.0	5.4
11/29/03	7.1	2.0	7.4
11/30/03	5.6	7.0	6.4
12/1/03	9.4		7.0
12/2/03	21.2	9.0	10.5
12/3/03	10.5	16.0	7.4
12/4/03	7.5	10.0	7.0
12/5/03	12.3		11.3
12/6/03	13.7	14.0	12.0
12/7/03	8.7	10.0	8.4
12/8/03	8.5	8.0	
12/9/03	50.3		18.1
12/10/03			7.9
12/11/03	8.9	8.0	
12/12/03	20.3	12.0	30.0
12/13/03	14.3	21.0	

Date	Site 1 24 hr Avg. (ug/m3)	Site 2 24 hr Avg. (ug/m3)	Site 3 24 hr Avg. (ug/m3)
12/14/03		1.0	
12/15/03	33.6		32.6
12/16/03	6.8		
12/17/03	6.2	9.0	6.3
12/18/03	10.0	14.0	10.5
12/19/03	9.0	13.0	9.5
12/20/03	10.4	6.0	9.6
12/21/03	8.0	11.0	
12/22/03		21.0	
12/23/03	10.7	9.0	
12/24/03	10.4	1.0	11.9
12/25/03	9.3	1.0	
12/26/03	9.7	7.0	13.6
12/27/03	13.2	12.0	13.0
12/28/03	33.1	11.0	
12/29/03			
12/30/03	6.3	2.0	
12/31/03	4.0	6.0	6.1
1/1/04	6.3	16.0	9.0
1/2/04	3.5	1.0	7.6
1/3/04	8.1		
1/4/04		9.0	
1/5/04		5.0	
1/6/04		12.0	7.6
1/7/04	8.5		4.9
1/8/04			
1/9/04			
1/10/04	6.5		
1/11/04	6.0		8.8
1/12/04	6.1		6.5
1/13/04	6.6		6.0
1/14/04	30.5		6.9
1/15/04	9.4		7.2
1/16/04	26.7		
1/17/04	24.6		
1/18/04	5.2		
1/19/04	7.8		8.2
1/20/04	18.6		22.6
1/21/04	7.2		10.8
1/22/04			
1/23/04			8.8
1/24/04	18.0		

Date	**Site 1 24 hr Avg. (ug/m3)**	**Site 2 24 hr Avg. (ug/m3)**	**Site 3 24 hr Avg. (ug/m3)**
1/25/04			12.6
1/26/04	13.2		13.8
1/27/04			6.3
1/28/04		15.0	10.5
1/29/04		13.0	
1/30/04		21.0	
1/31/04	9.9	6.0	7.9
2/1/04	41.9	2.0	38.7
2/2/04		16.0	7.2
2/3/04	15.6	5.0	13.4
2/4/04	18.0		22.5
2/5/04			8.5
2/6/04		16.0	
2/7/04			
2/8/04		9.0	
2/9/04		5.0	9.4
2/10/04			10.3
2/11/04		3.0	62.3
2/12/04		73.0	24.8
2/13/04		34.0	11.2
2/14/04		28.0	12.9
2/15/04		11.0	14.9
2/16/04		29.0	15.6

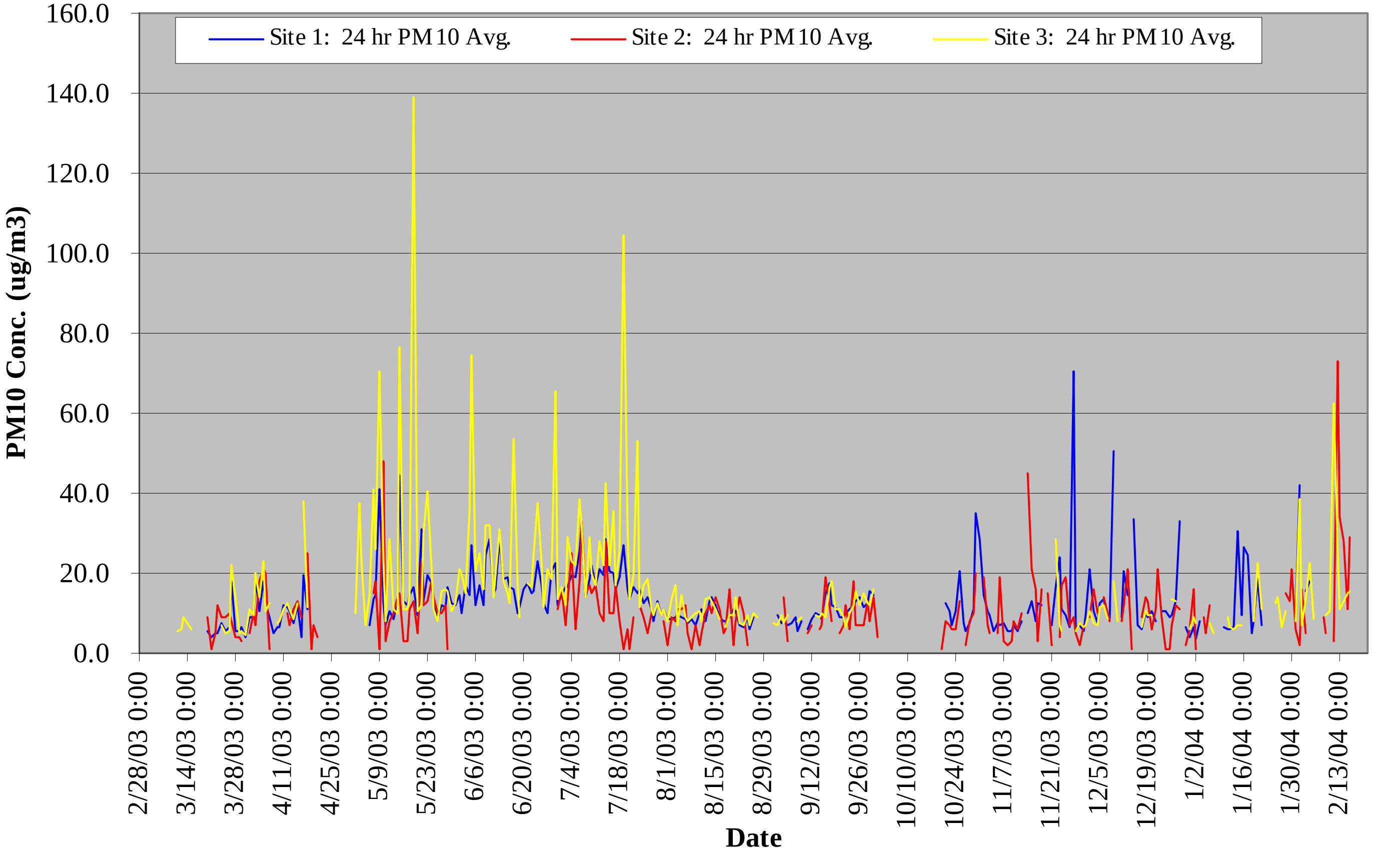

Figure 6. Tailings Facility 24-Hr PM10 Concentrations

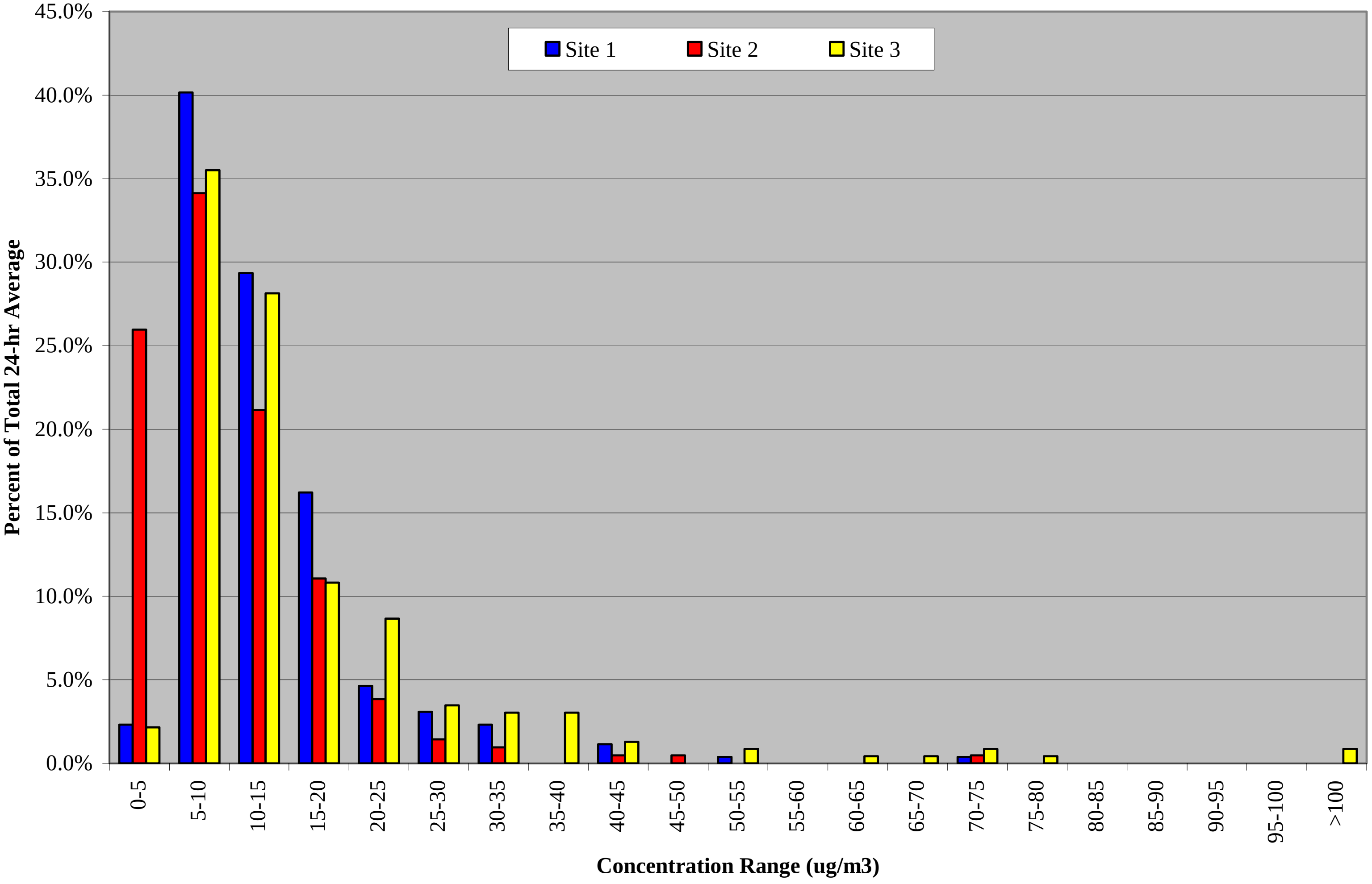

Figure 7. 24-Hour Data Distribution

Table 5. Frequency Data for PM10 Concentrations
(Percentages refer to portion of all values)

Concentration Range (ug/m3)	**Site 1**	**Site 2**	**Site 3**
0-5	2.3%	26.0%	2.2%
5-10	40.2%	34.1%	35.5%
10-15	29.3%	21.2%	28.1%
15-20	16.2%	11.1%	10.8%
20-25	4.6%	3.8%	8.7%
25-30	3.1%	1.4%	3.5%
30-35	2.3%	1.0%	3.0%
35-40	0.0%	0.0%	3.0%
40-45	1.2%	0.5%	1.3%
45-50	0.0%	0.5%	0.0%
50-55	0.4%	0.0%	0.9%
55-60	0.0%	0.0%	0.0%
60-65	0.0%	0.0%	0.4%
65-70	0.0%	0.0%	0.4%
70-75	0.4%	0.5%	0.9%
75-80	0.0%	0.0%	0.4%
80-85	0.0%	0.0%	0.0%
85-90	0.0%	0.0%	0.0%
90-95	0.0%	0.0%	0.0%
95-100	0.0%	0.0%	0.0%
>100	0.0%	0.0%	0.9%

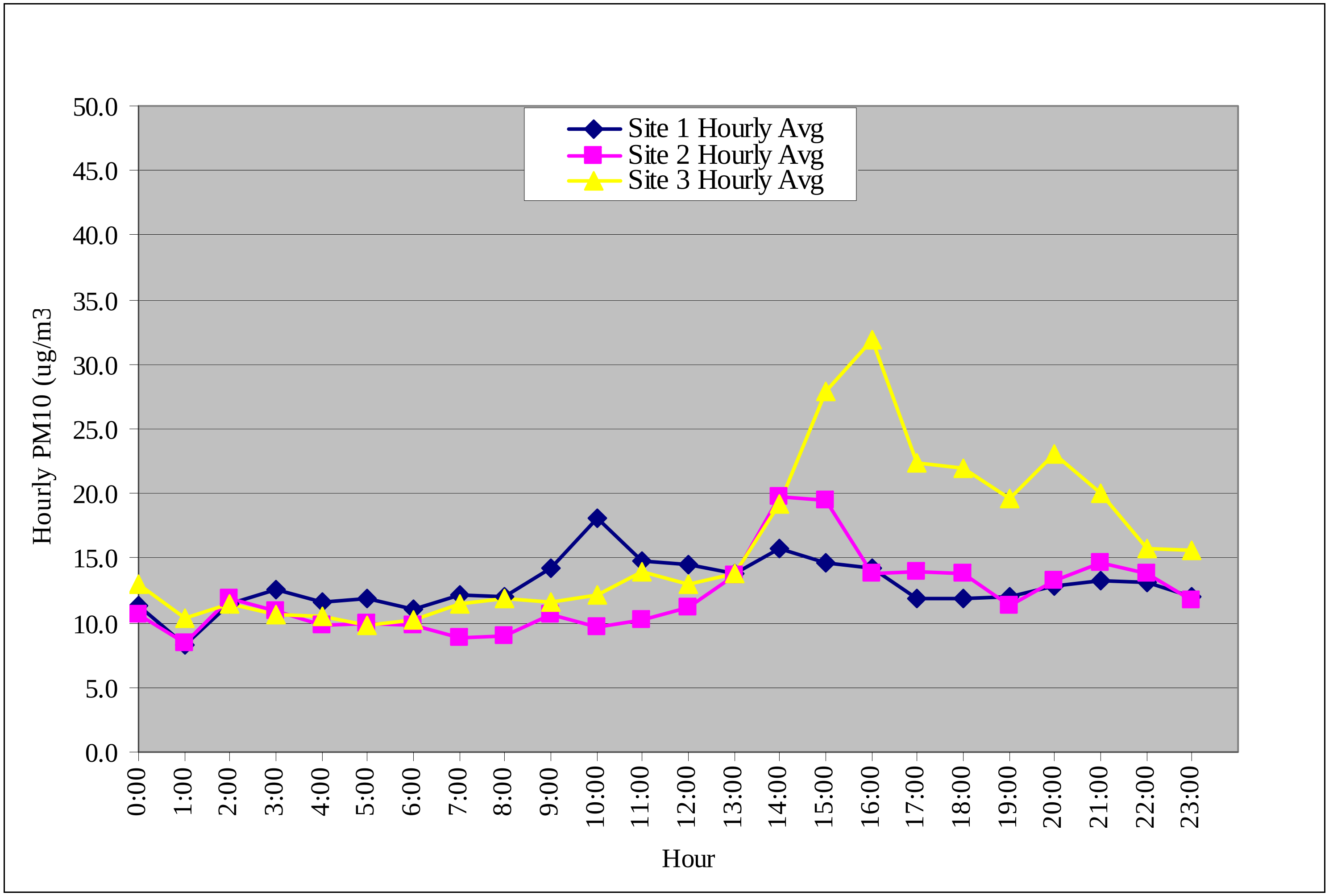

Figure 8. PM10 Diurnal Pattern

- Many periods of similar fluctuations in PM10 concentrations occurred throughout the monitoring period. This is indicative of regional effects other than specific localized activities such as farming or fugitive dust from vehicles.

- Site 1 experienced the fewest major spikes, although several high spikes were noted in the fall time frame. This time period is consistent with several major development activities at the southern area of the facility.

- The histogram plot and table contain information relating to instrument operation and the overall trend in measured concentrations. The histogram shows, for example, that Site 2 had a much higher rate of averages in the 0-5 ug/m3 range than the other two monitors. This level of inhomogeneity is much greater than would be expected based on the siting of the monitors, as well as the other data. This observation prompts a further examination of the monitor at Site 2.

  The histogram also shows the greater incidence of higher concentration averages for Site 3 compared to Sites 1 and 2, particularly at concentrations levels greater than the 20-25 ug/m3 range. The tabulated data in Table 5 shows the specific frequency of the various totals for the noted concentration ranges.

- Diurnal Pattern Plot. The diurnal plot in Figure 8 shows a couple of noteworthy features. First, the higher concentrations measured at Site 3 in the afternoon and evening hours is clear from the plot. Some spiking is evident at Site 2 during part of that period, which may be due to farming operations nearby, but the consistently highest concentration is at Site 3 in the 4 PM to 8 PM time frame. Other than a minor peak at around 10 AM at Site 1 that is likely due to nearby facility operations, most of the daily pattern is fairly similar.

  From these data, two factors support the hypothesis that localized farming contributes to the high concentration values. First, the facility staff is not normally on-site during that time. Second, few operations other than periodic patrols are performed in the central and northern-most sections of the site, thus the primary contributions to dust creation are the short-lived drive-by patrols.

- The apparent bias in the monitors that is described in the intercomparison memo in the appendix would modify Figure 8 by decreasing the higher concentrations in the afternoon hours to be more in line with the other data, particularly Site 2. Therefore, the dramatic differences between the data from Site 3 and Site 2 are likely not a great as the uncorrected data would suggest.

3.1.1.1 Data Validation

The data validation procedure consisted of the following steps:

1. Compile data from instruments. Verify source and time and date stamps.
2. Examine data gaps. Determine and document reasons why gaps exist. Establish complete time line for data.
3. Check flow rates to determine if any deviations (± 10%) occurred.
4. Check temperature data for any extreme deviations that could affect flow rate or indicate malfunction.
5. Remove zeros and negative concentrations. Remove any other obvious errors. Remove duplicate values.
6. Examine meteorological data for extreme values. Exame for correlation with high PM10 concentrations.
7. Plot time series for each parameter. Examine high values and compare against other data and other information for possible causes.
8. Examine point to point variability; remove extreme differences if can not be correlated with wind conditions.
7. Average hourly data into 24-hour periods; remove days with less than 18 hour of valid data.
8. Document time periods when instrument was out of service due to maintenance or other

3.1.1.2 Missing Data

The instrument data was validated according to the procedures listed above, with the result being a "clean" data set with gaps where no data exist. The information in Table 6 presents the reasons for the gaps. The majority of the data gaps were due to two reasons—instruments being out of service due to either equipment failure or factory upgrade servicing, and losses of the data due to downloading and data handling mistakes. The data handling procedures have been improved and gaps due to data losses are expected to disappear.

Other small data gaps were due to intermittent glitches in the data loggers. Most of these were unexplained, but if a number occurred over a relatively short period of time, the unit was returned to the factory for a checkout, as was done with the unit from Site 2 in October after a number of unexplained glitches.

The overall data capture was due to the large data losses and the gaps due to factory upgrades. The other minor problems that occurred would not have affected the overall capture rate to less than the 75% completeness criterion.

Table 6. Explanation of Missing Data

Site 1			Site 2			Site 3		
Start	End	Reason	Start	End	Reason	Start	End	Reason
2/25/03 14:00	3/17/03 11:00	Not in stalled	2/25/03 14:00	3/17/03 12:00	Not installed	4/20/03 16:00	5/1/03 16:00	Equipment upgrade
4/21/03 12:00	5/6/03 4:00	Equipment upgrade	4/21/03 16:00	5/6/03 11:00	Equipment upgrade	9/30/03 13:00	9/30/03 18:00	Temperature sensor failure
8/27/03 18:00	9/1/03 5:00	Unexplained failure	5/29/03 12:00	6/29/03 8:00	Data lost	10/1/03 11:00	10/1/03 19:00	Temperature sensor failure
10/1/03 14:00	10/20/03 9:00	Temperature sensor	7/13/03 17:00	7/13/03 17:00	Logger glitch	10/2/03 15:00	10/31/03 14:00	Temperature sensor repair
11/19/03 4:00	11/20/03 8:00	Field calibration	8/27/03 18:00	9/1/03 5:00	Data lost	11/19/03 13:00	11/20/03 9:00	Field calibration
12/29/03 1:00	12/29/03 10:00	Unexplained failure	9/13/03 20:00	9/13/03 20:00	Logger glitch			
1/27/04 1:00	1/30/04 10:00	Tape failure	9/14/03 1:00	9/14/03 1:00	Logger glitch			
2/2/04 1:00	2/2/04 10:00	Unexplained failure	9/14/03 19:00	9/14/03 21:00	Unexplained			
2/6/04 1:00	2/16/04 23:00	Tape failure	9/15/03 1:00	9/15/03 1:00	Unexplained			
			9/15/03 14:00	9/15/03 20:00	Unexplained			
			9/16/03 1:00	9/16/03 3:00	Unexplained			
			9/16/03 15:00	9/16/03 15:00	Unexplained			
			10/1/03 14:00	10/19/03 9:00	Factory check and repair			
			11/18/03 16:00	11/19/03 11:00	Field calibration			
			1/6/04 14:00	1/27/04 20:00	Tape failure			
			2/4/04 23:00	2/5/04 12:00	Logger glitch			
			2/6/04 5:00	2/6/04 10:00	Logger glitch			
			2/13/04 1:00	2/13/04 1:00	Logger glitch			

3.1.2 *PM10 Averages*

Table 7 contains summary statistics for the PM10 monitoring. Note that the column labeled "Totals" is the sum of data from all three sites, so it represents a spatial average, or an overall site performance. The column noted "Averages" contains the average of the three sites. For the 1st through 4th highest concentrations, each day was averaged across all three sites, and then evaluated for the spatial average. Thus, the 1st maximum for all three sites can be less than the 1st maximum for Site 3.

Table 7. Data Summary for Tailings Facility PM10

Parameter	**Site 1**	**Site 2**	**Site 3**	**Totals**
Count--in service days	334	334	356	1024
Count--possible monitoring days	319	320	271	910
Count--valid data days	259	208	231	698
Completeness	77.5%	62.3%	64.9%	68.2%
Exceedances (>150 ug/m3, 24-hr standard)	0	0	0	0

Parameter	**Site 1**	**Site 2**	**Site 3**	**All Sites**
Average--24 hour Avg.	13.1	10.6	16.7	13.5
Average—24 hr Avg., 95th Percentile	13.1 ±1	10.6 ±1.2	16.7 ±2	13.5 ±0.9
Standard Deviation	8.1	8.5	15.7	11.5
95% Confidence Interval	1.0	1.2	2.0	0.9
Lower Confidence Limit	12.1	9.4	14.7	12.6
Upper Confidence Limit	14.1	11.7	18.7	14.3
Median	11.0	9.0	11.8	10.8
1st Max	70.7	73.0	138.8	56.1
2nd Max	50.3	48.0	104.4	50.7
3rd Max	44.3	45.0	76.5	48.9
4th Max	41.9	34.0	74.3	45.3
99th Percentile	32.0	30.2	53.1	56.1

- Units: ug/m3
- Exceedances refers to the number of valid monitoring days in which the average concentration exceeded 150 ug/m3.
- Completeness is the ratio of valid monitoring days divided the possible number of monitoring days
- Lower and upper confidence limits refer to the 95th percentile confidence interval.
- All Sites refers to a spatial average across all three sites.
- 1st-4th Max days refers to the top four concentrations over the monitoring period. The 99th percentile refers to the 99th percentile concentration over the monitoring period.

The data in Table 7 show that the average across all sites for all monitored days is 13.5

±0.9 ug/m3.   A useful comparison is to look at the data collected at the Questa Middle and High Schools by the New Mexico Environmental Department Air Quality Bureau.

Table 8 shows the data from routine monitoring conducted at the Questa Middle and High Schools from 1993 to 2002. The Middle School is located approximately ¼ mile east of Site 2, and the High School is located approximately ½ mile east of the Tailings Site. The table shows that the average for 2003 of 13.5 ug/m3 is very close to the last recorded average from 1999 of 14 ug/m3 at the Middle School. The High School has shown lower concentrations in general over the years. The trend at the Middle School had been of decreasing concentrations over the last four years of monitoring, from a high of 24 ug/m3 in 1996 to a low of 14 ug/m3 in 1999.   The data in Table 6 also shows the PM10 concentrations at Questa High School to have been increasing slightly over the last three years, with the last recorded year average of 12 ug/m3 being very close to the 2003 average of 13.5 ug/m3. These data suggest that that the overall measured concentration at the Tailings Facility is consistent with other observed values in the area.

The changes in the Tailings Facility operation since 1993 does not seem to be correlated strongly with the measured concentrations at the Middle School, the closest monitoring site. The facility was closed in 1993-94, with a resumption of the application of water on the tailings in 1995. Milling operations started again in 1996 and have operated since. The data in Table 6 are not consistent with this history, suggesting that the Middle School data are not representative of facility operations. This lack of a correlation suggests that the monitoring data has captured general regional effects and does not fully represent the tailings as the main source of its measured PM10 concentrations.

Table 8. Questa PM10 Data

Year	Middle School	High School
1993	18	15
1994	18	9
1995	16	8
1996	24	9
1997	20	9
1998	19	9
1999	14	11
2000	NA	11
2001	NA	10
2002	NA	12
Avg.	18.4	10.3

Units: ug/m3

It has been observed that the Tailings Facility may produce some dust plumes during extreme wind events. This behavior is consistent with typical fugitive dust sources, and the data suggests that these plumes are short-lived and due to circumstances that are difficult to control. An example of this phenomenon was observed during the metals testing in May, 2003. Figure 9 shows the hourly data at Site 3 for May 9, 2003 when the PM10 metals testing was being conducted. The wind data that is also shown for the same time period on the plot indicates high wind speed starting around 8 AM and continuing throughout the day. The PM10 concentrations increase during the early part of the day in concert with the increased wind speed and remain fairly high into the evening. However, in the mid-afternoon, during a likely site visit to service the metals sampler., the concentration increased significantly for two hours. This occurred during a time period prior to the establishment of more controlled vehicle access routines, so the absolute magnitude of the vehicular dust impact due to site access is higher than would have occurred later. These data show that a general background level of PM10 can be exceeded by simple high wind effects, followed by other factors such as site access and the impact caused by vehicles on the soft, dry ground in the area.

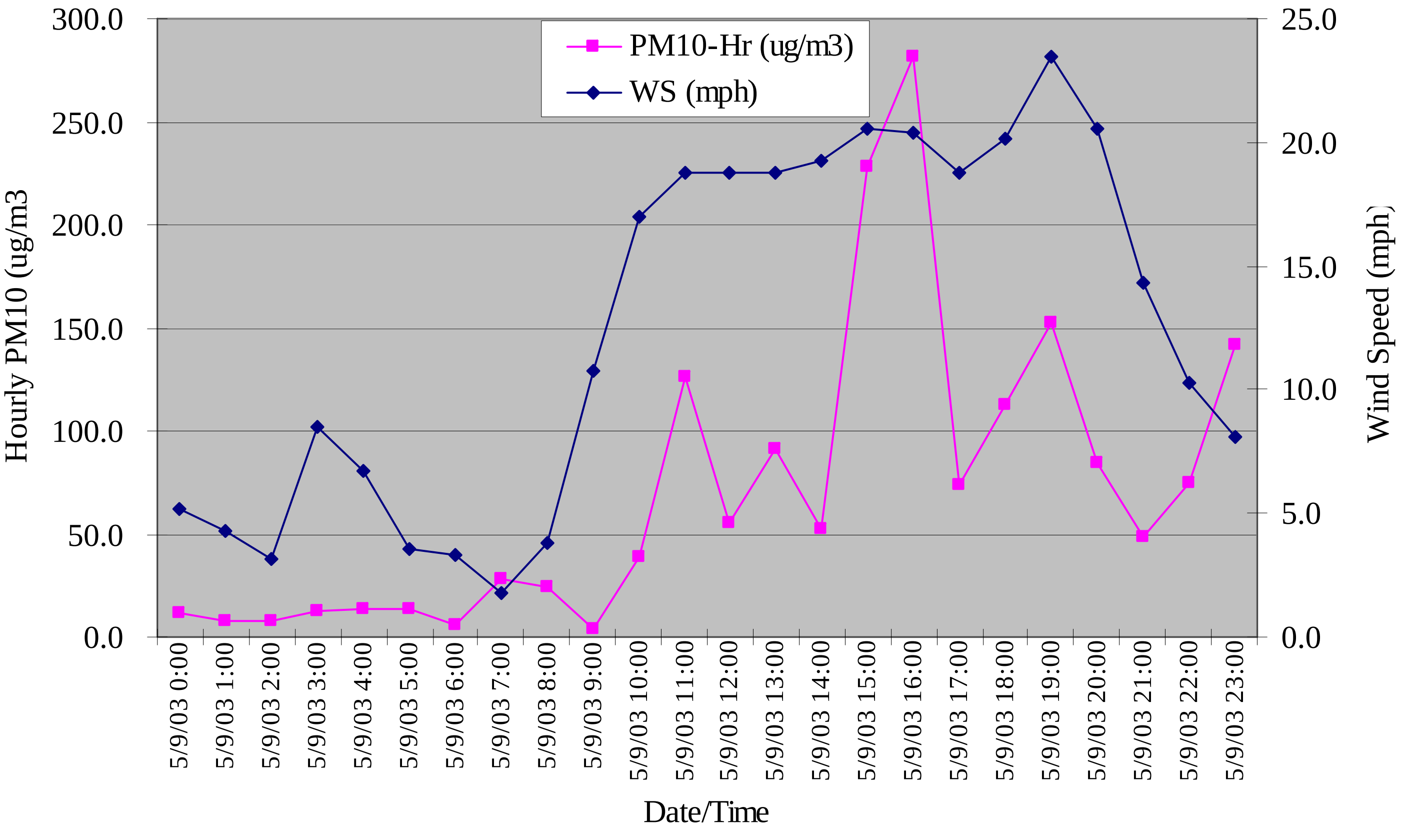

Figure 9. Wind Speed and. Localized Generation Effect

This data also shows that simple wind effects can provide a major increase in concentration, as indicated by the high values recorded for the later hours 19:00 and 23:00 when no vehicle access was occurring but when the wind was continuing at a high to moderate velocity. The hourly averaging does not allow the detection of small, short but high velocity gusts of wind that can kick up large dust plumes. However, the concentrations measured above 200 ug/m3 for a couple of hours may be indicative of many small gusts of very high concentration—the kinds of events that cause the observation of large visible plumes that rise off the ground. The average for that 24-hour value was 70 ug/m3, one of the higher concentrations measured at Site 3, which obviously was affected by the short-term high concentration values.

For reference, the annual wind rose for Site 3 is shown in Figure 10. Figure 11 shows the diurnal pattern for wind speed. It shows how the wind remains fairly constant at around 4 mph for the evening hours and then during the day increases consistently to approximately 8-10 mph. The difference between the sites appears to be due to site characteristics—Site 1 is situated in an arroyo, with Sites 2 and 3 on more level ground.

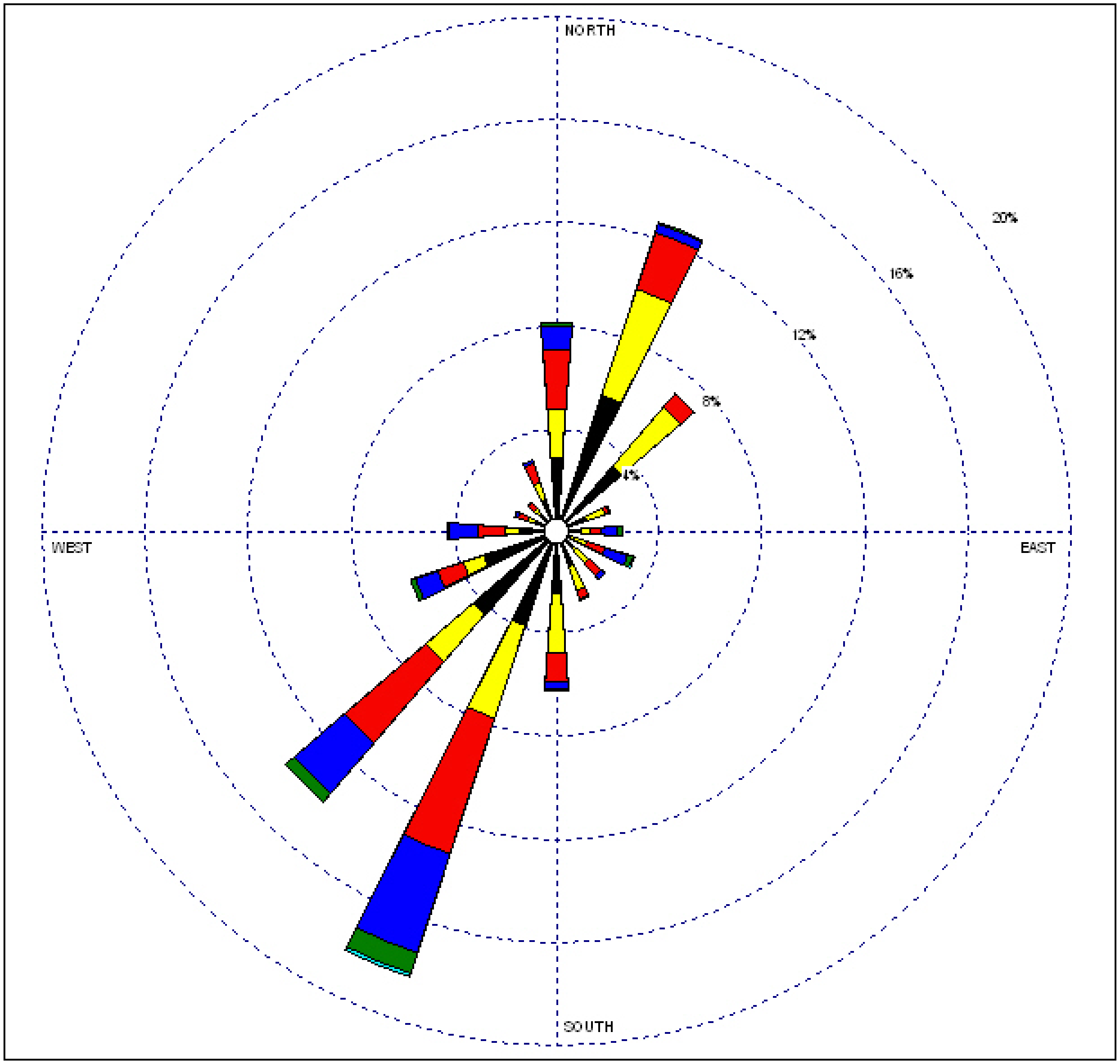

Figure 10. Annual Wind Rose

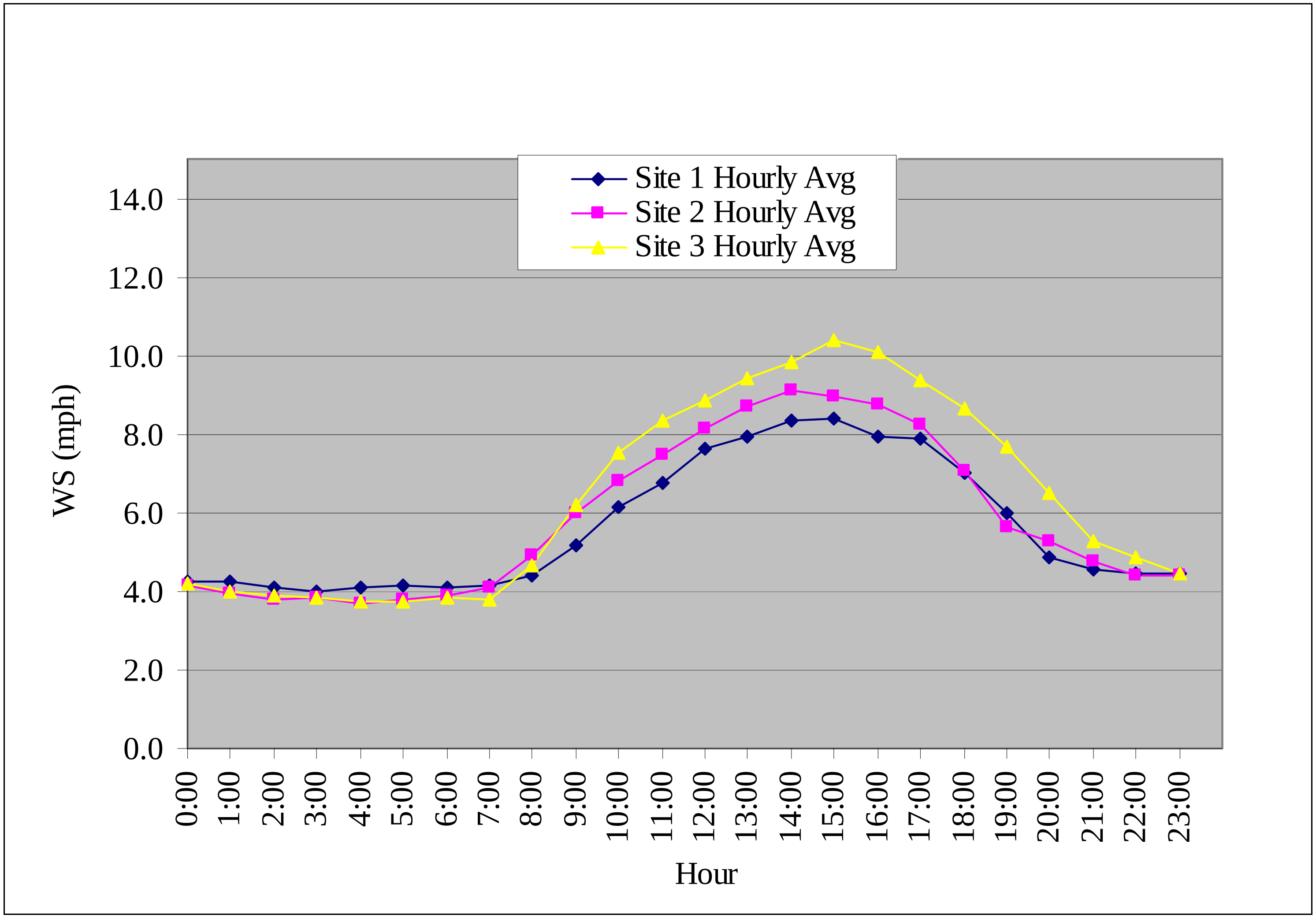

Figure 11. Wind Speed Diurnal Pattern

3.1.2.1 Highest PM10 Day

The day with the highest PM10 is a notable example of the possible sources for the detected particulate at the Tailings sites. As noted above, Site 3 is located adjacent to tilled farmland and is therefore subjected to fugitive dust from that source. Figure 12 shows the hourly PM10 concentrations from Site 3 for May 19, 2004, which averaged to the highest 24-hour daily average concentration of 139 ug/m3. Figure 13 shows the wind speed and wind direction data for the same period of time on an hourly basis, and Figure 14 shows the wind rose for the same period of time.

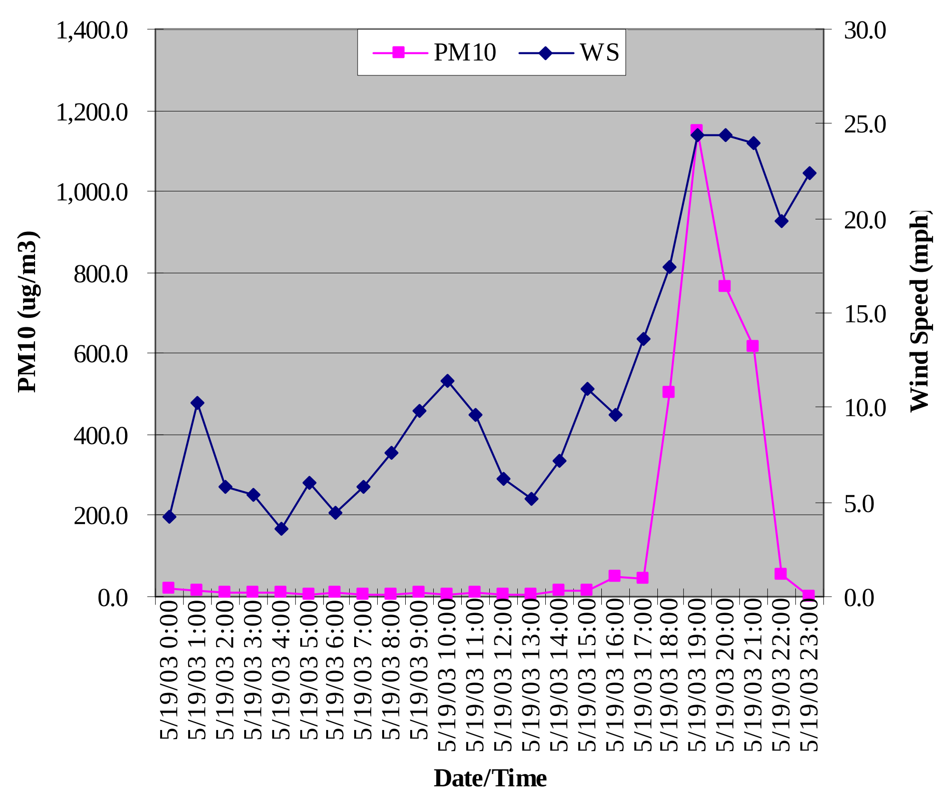

Figure 12. PM10 and Wind Speed for May 19, 2004

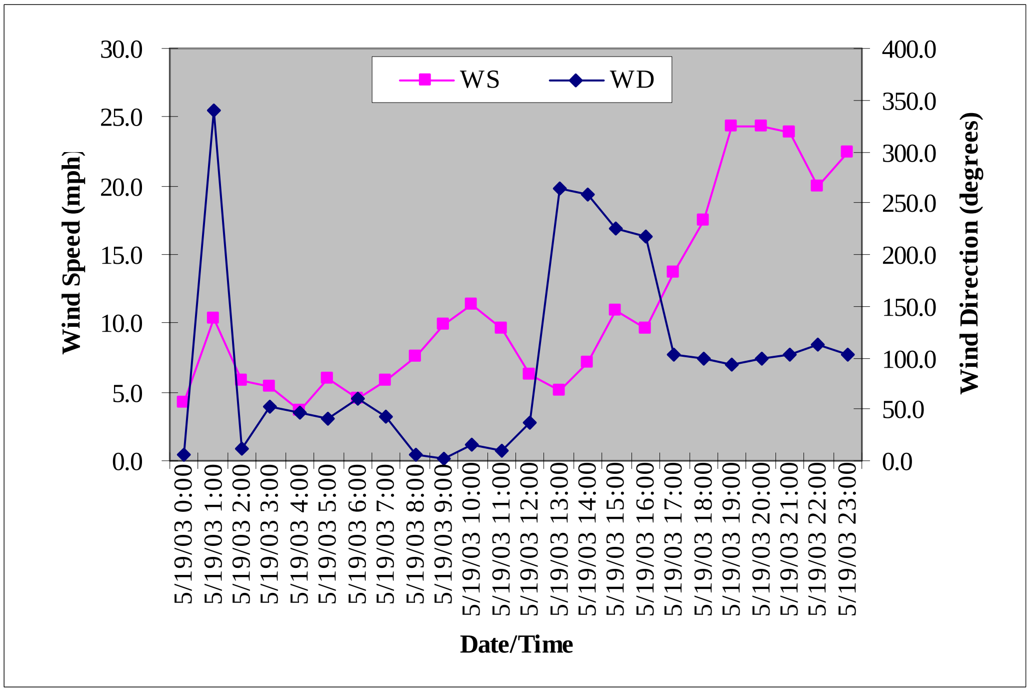

Figure 13. Wind Speed and Wind Direction for May 19, 2004

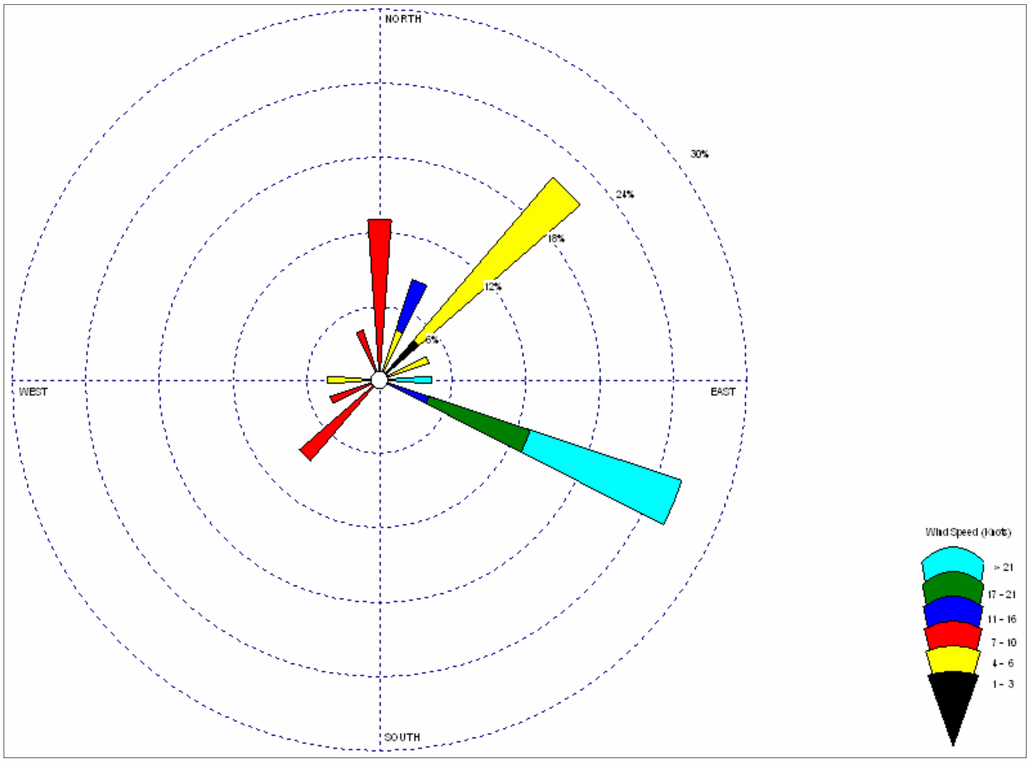

Figure 14. Wind Rose for May 19, 2004

These three plots show that the PM10 concentrations increase simultaneously with the wind speed and that the wind direction did not change substantially over the day, with the direction being predominately from the general easterly directions of the farmland. These data indicate that this highest day was due to localized sources other than the Tailings operations.

3.2 Airborne Metals Concentrations

The purpose of this discussion is to present an additional analysis of the airborne metals sampling data collected in May, 2003 that was presented in the report entitled "Molycorp, Inc. Questa Division, Results of PM10 Metals Monitoring at the Tailings Facility: May, 2003," dated October 27, 2003. This report is included in the Appendix. In addition, a Technical Memorandum detailing additional information and slight corrections to the data is included in the Appendix. This memorandum also shows the range and variability in the metals data.

This additional analysis to examine the internal consistency of the collected data was prompted by review of other data sets being performed for an overall analysis of air quality at the Tailings Facility. The differences between some key concentration values from previous data collection efforts and the current data set suggested a re-examination of the current data set to ensure that the calculated concentrations were consistent with other data and itself.

3.2.1 Data Interpretation Techniques for Aerosol Metals

Three separate techniques were used to examine the aerosol metals in order to confirm the data's internal consistency and to understand possible sources. These procedures are 1) reconstruction of the mass, 2) examination of specific source ratios, and 3) examination of potential elemental enrichment factors.

Reconstruction of the mass takes the individual elemental concentrations and makes assumptions about their contribution to common chemical species present in most atmospheric aerosols, particularly those derived from fugitive dust originating in soil.

The key features of this reconstruction use the following relationships between the noted categories and the typical composition of that category based on their average chemistry:[2]

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[2] IMPROVE, 2002. Interagency Monitoring of Protected Visual Environments-Data Resources. National Park Service, Ft. Collins, CO. http://vista.cira.colostate.edu/IMPROVE.

Solomon, P.A.; Fall, T.; Salmon, L.G.; Cass, G.R.; Gray, H.A.; and Davidson, A., 1989. "Chemical Characteristics of PM10 Aerosols Collected in the Los Angeles Area. *J. Air Pollution Control Assoc.*, 39(2):154-163.

Soil = 1.89*Al + 2.14*Si + 1.4*Ca + 1.43*Fe
Ammonium Sulfate = 4.125*S
Ammonium Nitrate = 1.29 *NO_3^-
Organics = 1.4*OC
Elemental Carbon = 1* EC
Fugitive Dust = 2.2*Al + 2.49*Si + 1.63*Ca + 2.42*Fe +1.94*Ti

Values that were not measured, such as organic carbon (OC) and elemental carbon (soot, or EC) were estimated by multiplying by two the average PM2.5 concentration obtained from the IMPROVE monitoring site at the Bandolier National Monument, located northwest of Albuquerque. This factor of 2 is conservative, based on the AP-42 ratio of 4 to 6.6.[3] The results of this procedure are contained in Table 9.

Table 9. Reconstruction of Aerosol Mass

Element	Average-1	Average-2	Average-3	Average-All
Aluminum	0.69	0.75	1.1	0.86
Antimony	0.0028	0.0025	0.0020	0.0024
Arsenic	0.0005	0.0004	0.0006	0.0005
Barium	0.0061	0.011	0.016	0.011
Beryllium	0.00004	0.00004	0.00004	0.00004
Boron	0.025	0.025	0.025	0.025
Bromine	0.0029	0.0031	0.0033	0.0031
Cadmium	0.0018	0.0017	0.0023	0.0019
Calcium	0.45	0.46	0.55	0.49
Chlorine	0.018	0.015	0.016	0.016
Chromium	0.0004	0.0005	0.0007	0.0006
Cobalt	0.0003	0.0005	0.0009	0.0005
Copper	0.0010	0.0010	0.0016	0.0012
Gallium	0.0005	0.0005	0.0006	0.0006
Germanium	0.0005	0.0004	0.0005	0.0005
Indium	0.0044	0.0046	0.0042	0.0044
Iron	0.38	0.44	0.69	0.51
Lanthanum	0.014	0.0099	0.010	0.011
Lead	0.0009	0.0010	0.0011	0.0010
Magnesium	0.11	0.11	0.14	0.12
Manganese	0.0083	0.010	0.016	0.012
Mercury	0.0034	0.0008	0.0009	0.0017
Molybdenum	0.0008	0.0010	0.0009	0.0009
Nickel	0.0002	0.0002	0.0002	0.0002
Palladium	0.0016	0.0015	0.0020	0.0017

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[3] Countess, R. J., 2002. "Quantifying the Contribution of Fugitive Geological Dust to Ambient PM10 and PM2.5 Concentrations in the San Joaquin Valley," Final Report prepared for the San Joaquin Valley APCD, Countess Environmental, Westlake Village, CA, December.

Phosphorus	0.0014	0.0014	0.0014	0.0014
Potassium	0.24	0.27	0.39	0.30
Rubidium	0.0011	0.0013	0.0020	0.0015
Selenium	0.0004	0.0003	0.0003	0.0003
Silicon	1.8	2.0	3.2	2.4
Silver	0.0018	0.0018	0.0021	0.0019
Sodium	0.057	0.056	0.081	0.065
Strontium	0.0036	0.0043	0.0058	0.0046
Sulfur	0.31	0.30	0.30	0.30
Tin	0.0029	0.0031	0.0023	0.0028
Titanium	0.044	0.050	0.078	0.057
Vanadium	0.0006	0.0009	0.0017	0.0011
Yttrium	0.0005	0.0007	0.0007	0.0006
Zinc	0.0037	0.0040	0.0045	0.0041
Zirconium	0.0015	0.0017	0.0028	0.0020

Units: ug/m3

Si/Fe ratio	4.8	4.6	4.6	4.7
Soil concentration	6.50	7.16	10.91	8.19
Fugitive soil	6.7	7.3	11.2	8.4
Fugitive dust/soil	102%	103%	103%	103%
Fugitive dust/PM10	42%	41%	45%	43%
Nitrate	0.467	0.467	0.467	0.467
Organics	3.57	3.57	3.57	3.57
Elemental carbon	0.17	0.17	0.17	0.17
Reconstructed Mass	12.00	12.62	16.35	13.66
Measured PM10	15.8	17.8	24.6	19.4
Percent Mass Agreement	76%	71%	66%	70%

Units: ug/m3

The table shows that the average percent reconstructed mass compared to the measured mass was 70%. Considering the large approximations and assumptions for this approximate calculation, it compares favorably to the typical IMPROVE agreement of 86%. Some more detailed examination of the estimated values would likely yield a better agreement, but this estimate is adequate to suggest that the measured values are internally consistent and that the aerosol composition is similar to the aerosol compositions in remote areas.

Table 9 also contains information relating to the Si/Fe ratio, which is an indicator of fugitive soil.[4] It shows that the ratio is similar for all three sites. Literature values for this ratio range from 2 for abraded road dust to 5 for earth's crust, and up to 6.7 for crustal sediment.

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[4] Countess, Richard, "Methodology for Estimating Fugitive Windblown and Mechanically Resuspended Road Dust Emissions Applicable for Regional Air Quality Modeling," Report for WGA, April, 2001.

Countess, Richard, "Reconciling Fugitive Dust Emission Inventories with Ambient Measurements," 12th International Emission Inventory Conference, San Diego, CA April 29-May 1, 2003.

Abrasion is a key factor in the eventual particle size that relates to its dispersion from the site of generation. The ratio appears to decrease as the geological material becomes more abraded with increasing anthropogenic activity. For comparison, studies have shown that fugitive dust from the California San Joaquin valley had a ratio of 4.5 for PM10. The ratio for the averaged values from the Tailings Facility was 4.7, which was indicative of fugitive soil.

It should be emphasized that the values obtained by this procedures are inexact conservative estimates because of the type of data collected and the limited number of data points. However, they are useful in establishing a reference point for validity of the data set.

Another examination of the elemental composition of the aerosol versus its probable main sources can provide some insight into the what was seen in the data. The approach uses the ratio as defined by

$$\mathrm{EF}\ (X) = (X)/(\mathrm{Ref})_{\mathrm{aerosol}} \big/ (X)/(\mathrm{Ref})_{\mathrm{source}}$$

where X is the element under consideration and Ref is an appropriate reference element.[5] If EF approaches unity, the reference element in the source—e.g., tailings or soil—is probably the dominant origin of the element.

Enrichment factors were calculated for both the tailings and soil as possible sources using recently collected surface soil analysis data of tailings as the tailings reference.[6] An average soil elemental abundance composition was used as the soil reference.[7] Aluminum was the reference element in both cases.

Table 10. Enrichment Factors

Element	**EF (aer/soil)**	**EF (aer/tail)**
Chromium	0.23	1.1
Cobalt	5.7	11
Iron	1.1	3.7
Manganese	1.1	5.6
Vanadium	0.88	2.6

Table 10 contains the results of this analysis. Only these five elements were common between three data sets. This analysis shows that the enrichment factors for the aerosol in relation to soil are substantially different from those in relation to the tailings composition. This indicates a source in the measured aerosol different from what would be expected if the tailings were to enrich the background aerosol present.

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[5] Warneck, Peter. "Chemistry of the Natural Atmosphere, 2nd Ed.", Academic Press, San Diego, 2000, page 419.

[6] Five surface soil samples collected in the 0-1 foot depth during the Fall 2003. Provided by Anne Wagner, Molycorp, April 26, 2004.

[7] Seinfeld, J.H., Spyros Pandis, "Atmospheric Chemistry and Physics," Wiley, NY, 1998, page 440.

The enrichment factors of approximately 1.0 for iron, manganese, and vanadium all suggest a soil source, similar to what was seen in the Si/Fe ratio. Based on the other data, the finding that no enrichment is occurring is not unexpected, but does confirm the previous finding that the aerosol is not comprised of material solely from the tailings and that soil is the major source.

3.2.2 Conclusions from Aerosol Composition Analyses

The examination presented here suggests the following conclusions:

1. The airborne metals concentrations are both internally consistent and consistent with aerosols in remote areas.
2. The majority of the measured aerosol is derived from fugitive soil dust.
3. The concentration of metals in the aerosols does not appear to be greatly influenced by the tailings.

4.0 DATA INTERPRETATION

4.1 Comparison of PM10 Concentrations with Air Quality Standards

Table 11 shows the summary statistics for nearly a year of PM10 monitoring at the Questa Tailings Facility.

Table 11. PM10 Summary Statistics

Units: ug/m3	**Site 1**	**Site 2**	**Site 3**	**All 3 Sites**
Average--24 hr Avg., 95th % Confidence Interval	13.1 ±1	10.6 ±1.2	16.7 ±2	13.5 ±0.9
1st Max Conc.	70.7	73.0	138.8	56.1
2nd Max Conc.	50.3	48.0	104.4	50.7
3rd Max Conc.	44.3	45.0	76.5	48.9
4th Max Conc.	41.9	34.0	74.3	45.3
99th Percentile Conc.	32.0	30.2	53.1	33.8

Units: ug/m3

Since the Tailings PM10 monitoring network has been in operation for only one year, the standard method of determining any compliance with the annual standard of 50 ug/m3 cannot be done, as that procedure requires 3 years of data. However, the daily standard of 150 ug/m3 can be examined since that requires only a count of the number of days that exceed 150 ug/m3. As the data in Table 11 shows (and was introduced earlier in Table 7), there were no valid 24-hour periods that exceeded 150 ug/m3.

The various maximum values and the 99^{th} percentile concentration are exhibited to show the typical high levels that were encountered. It should be noted that the majority of these high values occurred during the period of high vehicular activity during the May metals sampling events or during the spring farming season.

The annual average is 13.5 ±0.9 ug/m3, which is well below the annual standard of 50 ug/m3. Even with the existence of several high wind events and only one year of monitoring completed, it is unlikely for the area to experience non-compliance with the annual standard. The data from the Questa Middle and High Schools shows a consistently low concentration over several years, indicative of a remote location that is unaffected by many high sources. Indeed, notwithstanding the amount of bare ground and the dry climate, the measurement data from both the Tailings Facility suggests a fairly stable surface that should continue to exhibit good stability to wind erosion. The Questa monitoring data suggests that there is little to no contribution from the Tailings Facility and that the regional levels are consistently in the 12-15 ug/m3 range. The data suggests that that the primary contribution to the air quality on the site is farming and vehicular activity in the tailings area, both of which are not likely to change over time and both of which do not contribute to substantially high concentrations in the local area.

Besides a favorable comparison to local data, the average PM10 concentration of 13.5 ug/m3 compares favorably to the background concentration of PM10 as measured in a remote area of New Mexico, the Bandolier National Monument, a site chosen for its remoteness and clean atmosphere.[8] The average PM10 concentration measured from 1988 to the present is 8 ug/m3. The average of 13.5 ug/m3 at the Tailings Facility is favorable compared to that value. Other activities in the Questa area such as the highway, homes and light industrial activity contribute to the air quality impact, so this comparison with a "clean background" area suggests that the Tailings Facility does not contribute significantly to the air quality impact to the area. At a minimum, assuming all the measured value was from the Tailings Facility, even then the impact is minimal, with concentrations averaging much lower than most areas in New Mexico. The average of 13.5 ug/m3 compares favorably to typical air quality experienced in most areas of New Mexico. The EPA AIRS data base shows an average of 27.5 ug/m3 from 22 locations across the state. While the majority of these are urban areas with the expectation of higher PM10 concentrations, when put into context, the air quality at Questa is consistent with a rural, minimally industrialized and sparsely populated area. The fact that the air quality monitors are located at the edge of a soil intensive industrial operation with nearby farming, the measured concentrations are quite favorable.

4.2 Comparison of Airborne Metals Concentrations with Risk Levels

4.2.1. Data Examination

Besides the issue of PM10 fugitive dust, the question arises regarding the elemental composition of the dust. With the prevailing perception that the majority of the dust originates at the Tailings Operation, the air monitoring conducted in May, 2003 was useful to elucidate the actual composition of the Tailings Facility aerosol.

Table 9 showed the concentrations of all elements monitored at the site. Table 12 presents a smaller list of toxic metals that were analyzed for in the air monitoring samples and that should be considered for evaluation relative to health impacts. This table also includes various other information and data for comparison with the field data:

- Agency for Toxic Substances and Disease Registry Toxicology Profiles[9]
- US EPA Region 6 Human Health Medium-specific Screening Levels[10]
- US EPA Region 3 Risk Based Concentrations[11]
- Air quality monitoring data conducted in 1979-1981 by the New Mexico Air Quality Bureau as reported in EPS AIRS data base[12]
- Summary Report, Ambient Air Quality and Associated Data Collected in the Questa, New Mexico Area (1979-1980)[13]

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[8] IMPROVE data site: http://vista.cira.colostate.edu/improve/Data/data.htm

[9] http://www.atsdr.cdc.gov/toxfaq.html

[10] http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm

[11] http://www.epa.gov/reg3hwmd/risk/human/index.htm

[12] http://www.epa.gov/air/data/index.html

[13] Cecelia Williams, Environmental Specialist, State of New Mexico Environmental Improvement Division, Air Quality Bureau. Report obtained from Molycorp Environmental Department personnel.

- Current airborne metals concentrations as reported in AIRS[14]

The data in this table includes the raw averages as determined in the monitoring, but determines the 95th percentile concentration, as recommended for comparison with health levels.[15] The 95th percentile increases the conservatism of the average value to take into account other variabilities possibly not included in the average of field data.

Background levels were taken from the ATSDR Toxicology Profiles or other literature sources. When a range of concentrations were indicated in the literature, the mid-point of the cited range was selected for comparison. Although some of the background data cited in the ATSDR literature citations was from arid locations that might be similar to the New Mexico area, most were scattered at disparate locations around the country. Very little PM10 data with metals concentration data is available for remote areas as most monitoring is performed around population centers. The largest body of remote location data is based on visibility monitoring for PM2.5 species that are mostly not applicable to conversion to PM10 data. Therefore, although the background data may not be directly applicable, it is the best available and is likely to be close to local values given the probably crustal source for the soil. Crustal material is more constant in composition than localized soil that is subjected to weathering and other degradation processes.

The data cited from other monitoring performed by the State of New Mexico showed higher levels than currently measured. In part, this may be due to the technique used. The other testing was conducted on a total suspended particulate basis, which generally shows higher concentration levels due to the inclusion of all size fractions. In addition, the data collected over 20 years prior undoubtedly was analyzed using different techniques, so the comparability of the two data sets is uncertain. The data are included here for a general comparison.

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[14] http://www.epa.gov/air/data/index.html

[15] http://www.epa.gov/superfund/programs/risk/datause/parta.htm

Table 12. Toxic Metals Summary
(all concentrations in ug/m3)

Element	**Average-1**	**Average-2**	**Average-3**	**Average-All**	**Detection Ratio**	**95th Percentile[1]**	**Background[2]**	**EPA Screening Level[3]**	**EPA Region[3a]**	**1979-1981 Data[4]**	**NM Data[5]**
Aluminum	0.69	0.75	1.1	0.86	37/1	1.1	1.7	5.2	6	NA	NA
Arsenic	0.00052	0.00040	0.00060	0.00050	22/16	0.00060	0.003	0.00045	6	0.0023	0.005
Barium	0.0061	0.011	0.016	0.011	33/5	0.014	0.012	0.026	6	NA	NA
Beryllium	0.000042	0.000042	0.000042	0.000042	0/38	0.000042	0.0005	0.0008	6	0.0005	0.002
Boron	0.025	0.025	0.025	0.025	0/38	0.025	NA	21	6	NA	NA
Cadmium	0.0018	0.0017	0.0023	0.0019	6/32	0.0022	0.001	0.0011	6	0.0014	NA
Chromium (total)	0.00044	0.00050	0.00071	0.00055	36/2	0.00067	0.0026	0.00016	6	0.005	0.016
Cobalt	0.00032	0.00046	0.00086	0.00055	9/29	0.00077	0.0015	0.00069	6	0.144	NA
Copper	0.0010	0.0010	0.0016	0.0012	37/1	0.0014	0.140	150	6	NA	NA
Iron	0.38	0.44	0.69	0.51	37/1	0.66	NA	1095	3	1.44	NA
Manganese	0.0083	0.010	0.016	0.012	37/1	0.015	0.030	0.052	6	NA	NA
Mercury (inorganic)	0.0034	0.00080	0.00086	0.0017	6/32	0.0022	0.015	0.31	6	0.0002	NA
Molybdenum	0.00080	0.0010	0.00092	0.00091	9/29	0.0010	NA	18	3	0.002	NA
Nickel	0.00025	0.00025	0.00025	0.00025	0/38	0.00025	0.035	73	3	NA	0.050
Selenium	0.00040	0.00026	0.00032	0.00033	20/18	0.00039	0.010	18	3	0.001	NA
Silver	0.0018	0.0018	0.0021	0.0019	11/27	0.0022	0.001	18	3	NA	NA
Vanadium	0.00061	0.00088	0.0017	0.0011	33/5	0.0015	0.020	3.7	3	NA	NA
Zinc	0.0037	0.0040	0.0045	0.0041	37/1	0.0047	0.040	1100	3	0.10	NA

1. 95th Percentile concentration, per RAGS Guidance[16] This concentration is the value to be compared against any screening levels.

2. Background values obtained from ATSDR Toxicology Profiles[17]

3. EPA Screening Levels for Air obtained from US EPA Regions 3[18] and 6[19]
3a. EPA Region—source of the risk screening levels used in adjacent column.

4. 1979-1981 Monitoring data obtained from report "Summary Report,
Ambient Air Quality Data and Associated Data Collected in the Questa, NM Area," New Mexico Air Quality Bureau

5. Current airborne metals concentrations in EPA AIRS data base.[20] The AIRS data base is the repository for most criteria pollutant data currently collected.

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[16] Supplemental Guidance to RAGS: Calculating the Concentration Term, USEPA OSWER, May, 1992.

[17] http://www.atsdr.cdc.gov/toxfaq.html

[18] http://www.epa.gov/reg3hwmd/risk/human/index.htm

[19] http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm

[20] http://www.epa.gov/air/data/index.html

4.2.2 *Decision Logic for Site Effect from Detected Concentrations*

The data contained in Table 12 were evaluated by comparing the various monitoring data, background concentrations, and other monitoring data to determine if the detected concentrations exceeded EPA risk screening levels. The decision logic was as follows:

1. Detection ratio of at least 1/3 detects
2. 95th Percentile concentrations greater than background
3. 95th Percentile concentrations greater than Risk Screening Level

When the data was examined in this manner, it was found that three elements exceeded the risk screening levels but the background concentrations were greater than the risk screening levels. Arsenic, cadmium and chromium were all found at concentrations greater than the risk screening levels. However, the background concentrations for these three elements were greater than the risk screening level. In fact, the concentrations detected for these three elements were very close to the cited background levels, suggesting a general background concentration that is not indicative of any contribution from the tailings facility. Last, but of some significance to the analysis is that both arsenic and cadmium had detection ratios of 22/16 and 6/32, respectively. The low rate of detection suggests in itself that the presence of these elements is rare and at very low levels altogether. Therefore, they would not be a likely source for any toxicity as seen.

Another way to examine the possibility of the tailings material as contributing to the ambient aerosol is to examine the composition of the tailings to determine if the presence of unique materials in the tailings is detectable. As noted in Table 9, the composition of the aerosol is consistent with soil and crustal material. There was no evidence of any elemental enrichment as noted in Table 10. In particular, the Silicon/Iron ratio, which was noted above is indicative of a soil source, was not consistent with a tailings enrichment, but was reflective of crustal material--soil. Furthermore, taking the chemistry as indicated in Table 1, the ratio of Silicon to Iron would be on the order of 16.5 if the tailings were the major source of the aerosol detected. Even if mixed with a soil source, the ratio would be between 5 as a component of a soil source and 16.5 as a component of a tailings source. As the data in Table 9 shows, the measured ratio was 4.7, which is indicative of a slightly abraded soil source, and not at all enriched in Silicon as would occur if the minerals in the tailings were a major source.

Other materials in the tailings would be either present at such low concentrations as to be below risk levels and undetectable by current monitoring technologies. The additives listed in Table 2 are primarily hydrocarbon materials. The amount of the hydrocarbon-based additives is only 0.7 lbs/ton, which amounts to 0.04 percent of the total mass deposited in the tailings. Assuming that even all of the tailings were the source for the aerosol present, the resulting mass of organics present would be on the order of 5 ng/m3, a concentration that is below health standards for hydrocarbons, and too low for everything other than the most advanced and sophisticated monitoring techniques. Another additive, Nokes, consists of phosphorus and sulfur. There was no phosphorus detected down to 1.4 ng/m3.

Therefore, this examination leads to two conclusions:

1. The detected concentrations are below the EPA risk screening levels.
2. The data indicate that the source of the detected aerosol is fugitive soil, not tailings material.

5.0 CONCLUSIONS

The data from the PM10 air monitoring program and the airborne metals sampling program were examined in detail in order to assess the air quality at the Tailings Facility in Questa, New Mexico. The data examined in this report lead to the following conclusions:

1. The PM10 concentrations do not exceed the Federal Ambient Air Quality Standards. Based on nearly one full year of monitoring data, with several episodes of high particulate detected, the potential for exceeding the standards in the future is low.

2. The comparison of the field monitoring data with EPA screening levels and regional and national background concentrations indicates that none of the 17 metals analyzed are present at elevated concentrations. A simple comparison with the EPA screening concentrations as well as other sampling and background data shows that the aerosol detected is composed of primarily soil particles. In addition, there is no evidence of enrichment of the aerosol from the minerals that comprise the tailings materials.

Appendix

TECHNICAL MEMORANDUM

May 15, 2004

Corrections to Metals Calculations in the Report:

Molycorp, Inc. Questa Division
Results of PM10 Metals Monitoring at the Tailings Facility: May, 2003

A recent review of the data in the report :" Molycorp, Inc. Questa Division Results of PM10 Metals Monitoring at the Tailings Facility: May, 2003" dated October 27, 2004 revealed a slight error in the calculation of the 95th percentile concentrations. Instead of using the average for the concentrations, the data from Site 1 had been used. The subsequent re-calculation changed the reported 95th percentile concentrations by an average of 6 percent, with the maximum increase of 29.7% for Vanadium, and a maximum decrease of 77% for Mercury.

Table 1 contains the corrected 95th percentile concentrations as well as other calculations of the standard deviation and the range. All data in the table are reported in ug/m3.

Element	Average-1	Average-2	Average-3	Average-All	Std Dev	MAX	MIN	CI	95th Percentile
Aluminum	0.6935	0.7467	1.1451	0.8618	0.80	3.6	0.20	0.27	1.1
Antimony	0.0028	0.0025	0.0020	0.0024	0.0011	0.0032	0.00019	0.00037	0.0028
Arsenic	0.0005	0.0004	0.0006	0.0005	0.00029	0.0015	0.000097	0.000097	0.00060
Barium	0.0061	0.0110	0.0157	0.0109	0.010	0.050	0.00066	0.0035	0.014
Beryllium	0.00004	0.00004	0.00004	0.00004	1.10E-12	4.20E-05	4.20E-05	3.69E-13	0.000042
Boron	0.0255	0.0252	0.0252	0.0253	0.00043	0.028	0.025	0.00015	0.025
Bromine	0.0029	0.0031	0.0033	0.0031	0.00098	0.0052	0.0011	0.00033	0.0034
Cadmium	0.0018	0.0017	0.0023	0.0019	0.00075	0.0025	0.000097	0.00025	0.0022
Calcium	0.4514	0.4601	0.5532	0.4882	0.32	1.3	0.16	0.11	0.60
Chlorine	0.0179	0.0145	0.0156	0.0160	0.024	0.087	0.00076	0.0082	0.024
Chromium	0.0004	0.0005	0.0007	0.0006	0.00036	0.0020	0.000097	0.00012	0.00067
Cobalt	0.0003	0.0005	0.0009	0.0005	0.00067	0.0027	0.000097	0.00022	0.00077
Copper	0.0010	0.0010	0.0016	0.0012	0.00062	0.0038	0.00029	0.00021	0.0014
Gallium	0.0005	0.0005	0.0006	0.0006	0.00018	0.00090	0.000046	0.000061	0.00061
Germanium	0.0005	0.0004	0.0005	0.0005	0.00019	0.00058	0.000046	0.000065	0.00053
Indium	0.0044	0.0046	0.0042	0.0044	0.0022	0.0058	0.000046	0.00075	0.0051
Iron	0.3802	0.4447	0.6907	0.5052	0.46	2.4	0.12	0.15	0.66
Lanthanum	0.0137	0.0099	0.0100	0.0112	0.0060	0.016	0.0011	0.0020	0.013
Lead	0.0009	0.0010	0.0011	0.0010	0.00071	0.0033	0.000046	0.00024	0.0013
Magnesium	0.1088	0.1092	0.1390	0.1190	0.079	0.35	0.017	0.027	0.15
Manganese	0.0083	0.0101	0.0165	0.0117	0.011	0.058	0.0028	0.0036	0.015
Mercury	0.0034	0.0008	0.0009	0.0017	0.0015	0.0045	0.000046	0.00052	0.0022
Molybdenum	0.0008	0.0010	0.0009	0.0009	0.00031	0.0015	0.000046	0.00010	0.0010
Nickel	0.00025	0.00025	0.00025	0.00025	0.0000043	0.00027	0.00025	0.0000014	0.00025
Palladium	0.0016	0.0015	0.0020	0.0017	0.00074	0.0034	0.00016	0.00025	0.0020
Phosphorus	0.0016	0.0014	0.0014	0.0016	0.000024	0.0015	0.0014	0.0000081	0.0016
Potassium	0.2358	0.2683	0.3929	0.2990	0.25	1.3	0.091	0.083	0.38
Rubidium	0.0011	0.0013	0.0020	0.0015	0.0016	0.0080	0.00024	0.00054	0.0020
Selenium	0.0004	0.0003	0.0003	0.0003	0.00019	0.00085	0.000046	0.000063	0.00039
Silicon	1.8381	2.0407	3.1902	2.3563	2.2	10	0.56	0.74	3.1

Element	Average-1	Average-2	Average-3	Average-All	Std Dev	MAX	MIN	CI	95th Percentile
Silver	0.0018	0.0018	0.0021	0.0019	0.00071	0.0026	0.00014	0.00024	0.0022
Sodium	0.0565	0.0558	0.0814	0.0646	0.049	0.24	0.012	0.017	0.081
Strontium	0.0036	0.0043	0.0058	0.0046	0.0037	0.020	0.0011	0.0012	0.0058
Sulfur	0.3107	0.3036	0.2998	0.3047	0.081	0.49	0.17	0.027	0.33
Tin	0.0029	0.0031	0.0023	0.0028	0.0015	0.0044	0.000046	0.00050	0.0033
Titanium	0.0435	0.0501	0.0784	0.0573	0.056	0.28	0.012	0.019	0.076
Vanadium	0.0006	0.0009	0.0017	0.0011	0.0013	0.0069	0.000046	0.00045	0.0015
Yttritrium	0.0005	0.0007	0.0007	0.0006	0.00046	0.0025	0.000096	0.00016	0.00079
Zinc	0.0037	0.0040	0.0045	0.0041	0.0019	0.012	0.0020	0.00065	0.0047
Zirconium	0.0015	0.0017	0.0028	0.0020	0.0019	0.0090	0.00019	0.00062	0.0026

Units: ug/m3

·Applied Measurement Science·

Consultants in Quantitative Process and Environmental Measurements

Final Report

Molycorp, Inc. Questa Division

Results of PM10 Metals Monitoring at the Tailings Facility: May, 2003

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October 27, 2003

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1.0 OBJECTIVES AND TECHNICAL APPROACH

The Questa Division of Molycorp, Inc. operates a tailings facility in the town of Questa, New Mexico. To evaluate fugitive dust emissions and its metal element concentrations in the dust, monitoring was conducted for PM10 particulate matter at three sites during the month of May, 2003. The objective of the testing was to obtain a snapshot of the fugitive dust composition at the tailings facility during a nominally representative time of year. The samples were collected to represent the respirable fraction (PM10).

Applied Measurement Science was contracted to conduct the program, with assistance from Class One Technical Services of Albuquerque, NM. Dr. Eric Winegar conducted the overall program, with assistance from Mr. Arnold Graham of Class One Technical Services for the field operations. Chester LabNet, Inc. of Portland, OR conducted the laboratory analysis. Mr. Scott Honan of Molycorp, Inc. provided oversight for the Molycorp Environmental Department.

1.1 Site Description

The Questa Tailings operation is located on the northwest corner of the town of Questa, New Mexico. Figure 1 shows its location.

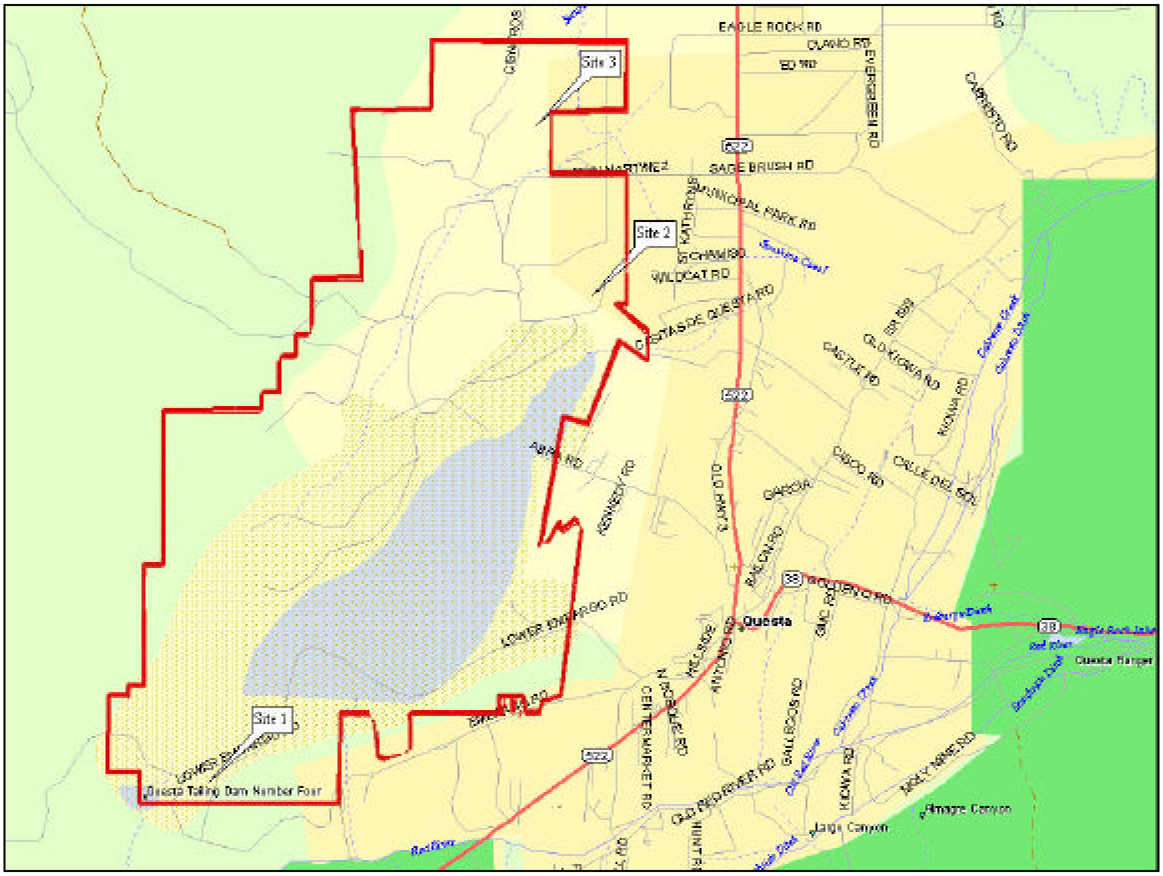

Figure 1. Questa Division Tailings Operation
(Boundaries Approximate)

1.2 Sampling Locations

The sampling locations were co-located with the continuous PM10 monitors (MetOne, Inc. Environmental Beta Gauge Monitors—EBAM). The three monitoring locations were chosen based up and downgradient conditions for the typical wind direction and to evaluate the potential magnitude and concentrations of metals at the property boundary. Table 1 contains location information and the three locations are indicated on the map in Figure 1.

Table 1. Sampling Site Information

PM10-1
36 41.755 N
105 37.787 W
13443792E
4061119N
7524 feet elevation
PM10-2
36 43.270 N
105 36.283 W
13446048E
4063904N
7650 feet elevation
PM10-3
36 43.803 N
105 36.510 W
13445717E
4064892N
7660 feet elevation
All lat/long use WGS84
UTM: NAD27

As can be seen from the elevation data, Site 1 is located approximately 125 feet below the main plateau of the tailings where Sites 2 and 3 are located. In addition, this site is on the edge of the southern boundary of the main tailings dam which is located in an arroyo (canyon). This relatively isolated location on the southern boundary of the tailings operations along the prevailing southwesterly wind direction (discussed below), and the relative distance from the major sources of fugitive dust, this site therefore was considered as representative of dust contributions from the operation to the south. Sites 2 and 3 are located to the north and northeast of the property, near the fence line in the prevailing wind directions.

1.3 Sampling Study Design

The purpose of this study was to evaluate fugitive dust concentrations of metal constituents. The sampling design incorporated 15 samples collected over approximately one month. This number of samples provides a reasonable population sample for statistical purposes while allowing for potential lost samples.

Samples were collected for 24-hours starting at mid-day. In this manner, sequential days were collected since the sample changeout required only a few minutes at the end of the sampling period.

Samples were collected only from Monday to Friday. Besides the beneficial logistical aspects of this strategy, this schedule would be conservative in terms of the possible impact from site operations (primarily truck traffic on the dirt roads that raise dust during normal activities) because of reduced operational activities on weekends.

1.4 Sampling Equipment

Samples were collected using Rupprecht and Patashnick, Inc. Partisol 2000 PM10 samplers. These samplers are USEPA Federal Equivalent Method (FEM) samplers for PM10, which means that the data are equivalent to data collected using a Federal Reference Method (FRM).

The Partisol 2000 samplers are automated flow controlled samplers that collect the PM10 particulate at the standard 16.7 liters per minute on a volumetric basis. The size selection is accomplished with the standard low-volume impactor inlet.

Although the samplers are automated, they were operated manually to adjust the start time for sample changeout as needed. The sampling time for valid samples ranged from 23. 6 to 24 hours. One sampler did not function normally upon initial startup, resulting in a loss of one of the field sampling days. Therefore, sample collection at Site 1 commenced on May 7 instead of May 6 as with the other sites. No other malfunction occurred.

Samples were collected on pre-weighed 47 mm Teflon filters. The sample cassettes were loaded and unloaded using standard procedures. Care was taken to avoid any contact other than the filter holder.

When not in the filter holders, the filters were stored in plastic Petri dishes for handling and shipment.

In addition to the filter sample collection, meteorological data was collected at each site using the existing EBAM samplers. Wind speed, wind direction and ambient temperature were collected on a hourly average basis using the on-board EBAM sensors.

Figure 2 shows the configuration of the Partisol sampler adjacent to the EBAM sampler.

Figure 2. Metals Sampler Set Up
(Partisol on left, EBAM in middle, solar array on right, generator in back)

1.5 Sampler Logistics

No utility power was available at the remote Tailings Facility sites, so power to run the Partisol samplers was supplied by diesel generators. The diesel generators were located approximately 75 feet to the southeast of the samplers. Based on to the prevailing wind pattern of southwesterly or northeasterly winds, this siting was selected to potentially impact the samplers the least. Based on field observations and a review of the data, it did not appear that emissions from the generators impacted the field data to any extent.

1.6 Sample Analysis

Sample analyses were conducted by Chester LabNet, Inc. of Portland, OR. Gravimetry was conducted according to standard protocol: equilibration in a 50% RH atmosphere for 24 hours followed by deionization and weighing using calibrated balances accurate to four decimal places.

Metals analyses were conducted using two methods. The majority of the metals were analyzed using x-ray fluorescence (XRF) under Chester LabNet's Protocol 6 using EPA Inorganic Compendium Method 3.3. This method provided concentrations of 38 metals from sodium to lead (in order of atomic number). In addition, boron and beryllium could not be analyzed using XRF, so ICP-AES following EPA Method 6010 was used. The nominal sensitivity of these methods was 0.012 ug/filter to 2 ug/filter. Assuming a nominal sample volume of 24 m^3, the method sensitivity would be approximately 0.09 ng/m^3 to 250 ng/m^3. To provide an idea of the sensitivity of the method, Table 2 contains the average detection limits of the field samples.

Table 2. Approximate Sample Detection Limits

Element	**Average Sample Detection Limit (ug/m^3)**
Aluminum	0.0930
Antimony	0.0022
Arsenic	0.0003
Barium	0.0071
Beryllium	0.0539
Boron	0.0001
Bromine	0.0004
Cadmium	0.0016
Calcium	0.0535
Chlorine	0.0023
Chromium	0.0003
Cobalt	0.0020
Copper	0.0003
Gallium	0.0008
Germanium	0.0003
Indium	0.0018
Iron	0.0262
Lanthanum	0.0089
Lead	0.0007
Magnesium	0.0162
Manganese	0.0009
Mercury	0.0005
Molybdenum	0.0007
Nickel	0.0003
Palladium	0.0017
Phosphorus	0.0011
Potassium	0.0325
Rubidium	0.0003
Selenium	0.0003
Silicon	0.2570
Silver	0.0016
Sodium	0.0175
Strontium	0.0005
Sulfur	0.0385
Tin	0.0020
Titanium	0.0029
Vanadium	0.0007
Yttrium	0.0004
Zinc	0.0004
Zirconium	0.0005

1.7 Quality Assurance and Data Validation

The flow rate for the samplers was audited twice, at the beginning of the sampling period, and at the end of the sampling period. In addition, the flow rate was checked on a daily basis for the first week of sample collection. A BGI DeltaCal field calibrator was used to check flow, with all flows being within 0.5 liters per minute of the stated flow rate. Leak checks were conducted at the beginning and end of the sampling period, with all meeting the leak test criteria acceptably.

Field blanks were collected by placing a new filter in a filter holder, inserting it in the sampler for a short period, and returning it to its Petri holding dish. A total of six field blanks were collected. The results were examined for both gravimetric and metal contaminations.

For the gravimetric blanks, there was no substantial effect seen. The results showed that for an equivalent PM10 concentration, the maximum effect of any blank contamination on field sample concentration would be less than 0.1 percent of the lowest average PM10 concentration, and significantly less than the highest average PM10 concentration. Therefore, none of the gravimetric data were qualified.

For metal elements, the field blank data showed low level contamination from handling or filter background contamination in many of the filters. In particular, one filter blank had a high frequency of detections for the target analytes. However, only chromium and zinc showed a frequency of detection in at least three of the six blanks. Twelve other metals were detected once or more in the six blank filters, and all were at insignificant concentrations. For chromium, the average of the three detections was equivalent to 35.5% of the average regular field sample concentration, and for zinc the average of the five detections was 11% of the average field sample concentration.

Of these two instances, only chromium has the potential to affect field data, and the primary effect would be to effectively raise the level that is detectable to the level of the blank concentration. However, in this data set, based on the low frequency of detection and the magnitude of the blank concentration, it is concluded that the chromium did not significantly impact the quantitation of the chromium data. Therefore, no metals element data was qualified.

Overall, the quality assurance for the field samples showed good control and therefore no data was qualified. One sample (May 19 at Site 1) was invalidated due to incompleteness as the total sample volume was only 6.8 m^3, which indicated less than 18 hours of operation.

All laboratory quality assurance was satisfactory; spikes were within the stated limits and replicate analyses were within expected variations. The overall laboratory quality assurance also showed good control, thus none of the laboratory data was qualified.

The completeness for this sample collection was 97.4%; only one sample was lost because of incomplete sampling time.

2.0 RESULTS AND DISCUSSION

2.1 Meteorological Data

Hourly wind speed and direction data were used to calculate an overall wind rose for each of the three sites. Figures 3- 5 contain the wind rose for the entire sampling period from May 6 to May 28.

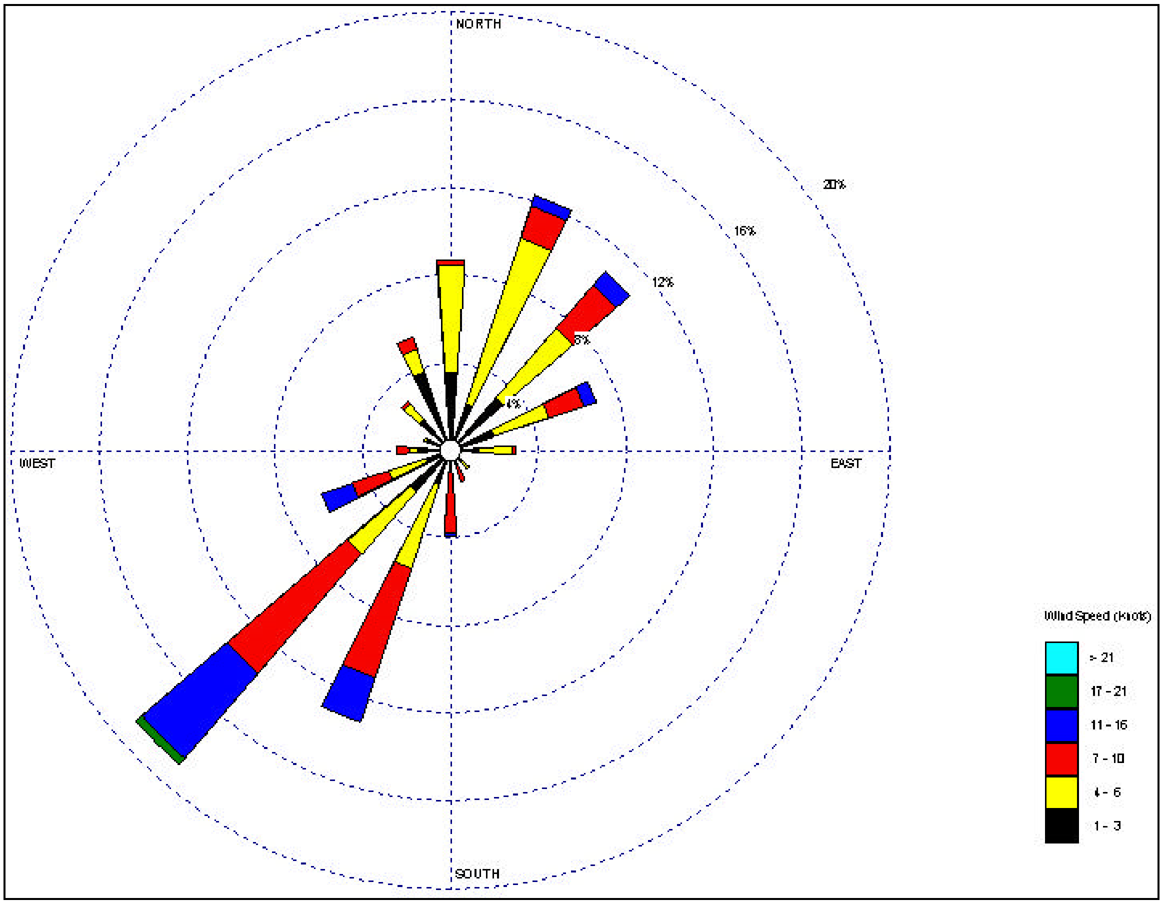

Figure 3. Site 1 Wind Rose

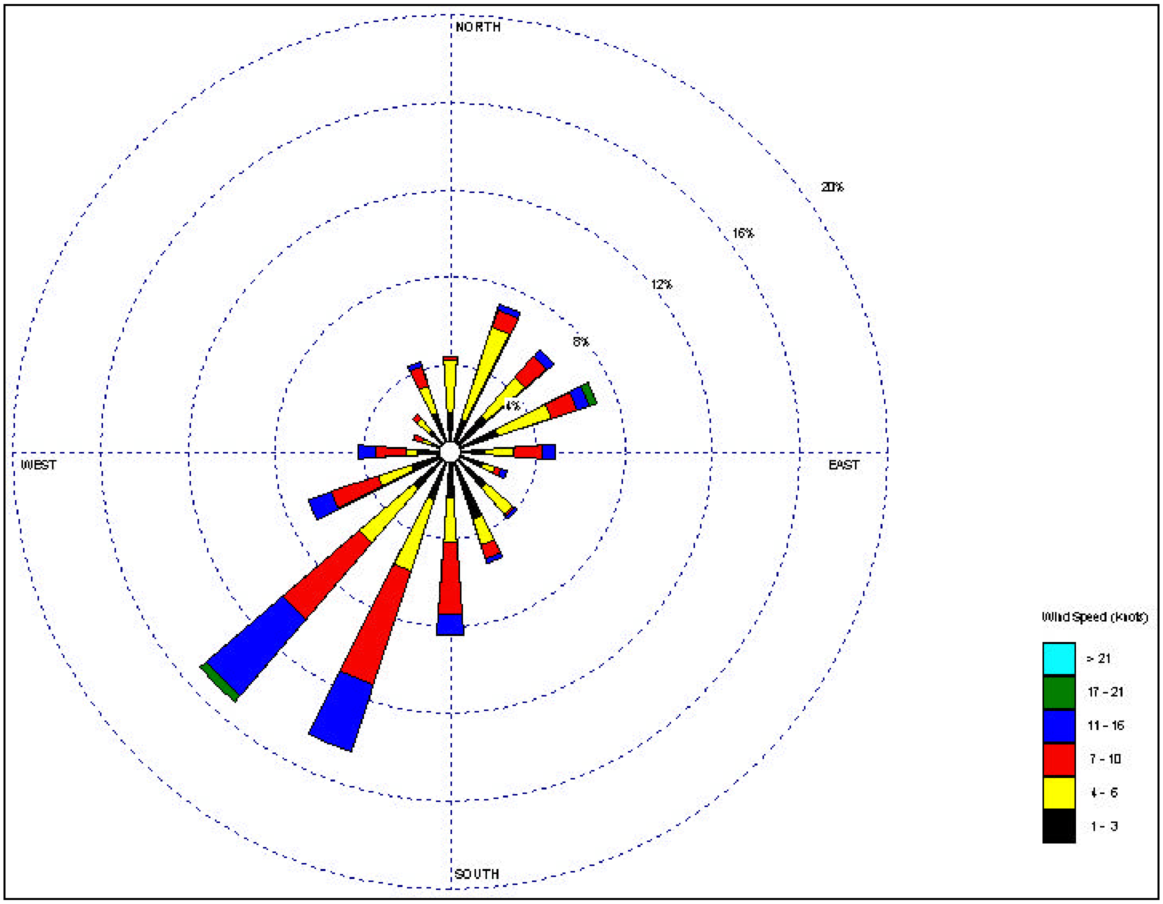

Figure 4. Site 2 Wind Rose

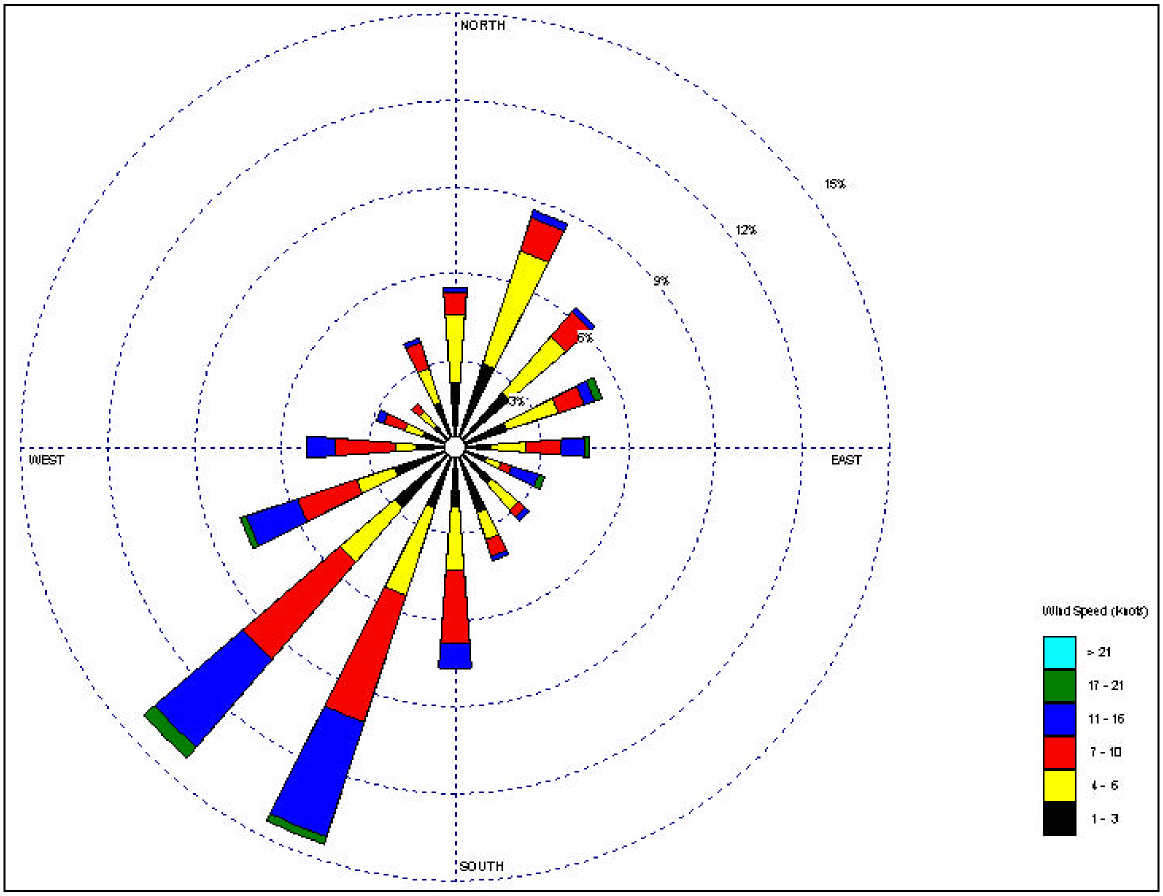

Figure 5. Site 3 Wind Rose

The key features in these data are the dominant wind direction and the magnitude of the wind speed. The southwesterly direction is shown to be the dominant direction, followed by the northeasterly direction. The characteristics at Site 1 are slightly different than at Sites 2 and 3, which is not unexpected since the surrounding terrain for that site is somewhat different than the others. As described above, the site is below the grade of the other locations and is located on a plateau along a fairly steep incline between two hills. Therefore, the wind data from this site should be used with caution and may only reflect localized conditions. Site 3 is closest to standard wind sensor siting guidelines, although it should be noted that the height is only approximately 7 feet above the ground surface, which is below most specifications for regulatory meteorological data collection. These systems were placed to provide trends related to the localized wind pattern that might affect the PM10 data collected at the EBAM systems.

2.2 Metals Data

The metals element composition data are contained in Table 3. For non-detects, one-half of the sample detection limit was used in the calculation of the average. The last column on the right shows the ratio of detected to non-detected elements, which is indicative of the effect of the one-half detection limit factor in the average.

Table 3. Average Metal Element Concentration in PM10 Samples

Element	**Average Site 1 (ug/ m^3)**	**Average Site 2 (ug/ m^3)**	**Average Site 3 (ug/ m^3)**	**Overall Average (ug/ m^3)**	**Detects/ Nondetects**
Aluminum	0.69	0.75	1.1	0.86	37/1
Antimony	0.0028	0.0025	0.0020	0.0024	27/11
Arsenic	0.0005	0.0004	0.0006	0.0005	31/7
Barium	0.0061	0.011	0.016	0.011	36/2
Beryllium	0.00004	0.00004	0.00004	0.00004	24/14
Boron	0.025	0.025	0.025	0.025	24/14
Bromine	0.0029	0.0031	0.0033	0.0031	37/1
Cadmium	0.0018	0.0017	0.0023	0.0019	26/12
Calcium	0.45	0.46	0.55	0.49	37/1
Chlorine	0.018	0.015	0.016	0.016	37/1
Chromium	0.0004	0.0005	0.0007	0.0006	36/2
Cobalt	0.0003	0.0005	0.0009	0.0005	27/11
Copper	0.0010	0.0010	0.0016	0.0012	37/1
Gallium	0.0005	0.0005	0.0006	0.0006	26/12
Germanium	0.0005	0.0004	0.0005	0.0005	27/11
Indium	0.0044	0.0046	0.0042	0.0044	27/11
Iron	0.38	0.44	0.69	0.51	37/1
Lanthanum	0.014	0.0099	0.010	0.011	28/10
Lead	0.0009	0.0010	0.0011	0.0010	34/4
Magnesium	0.11	0.11	0.14	0.12	37/1
Manganese	0.0083	0.010	0.016	0.012	37/1
Mercury	0.0034	0.0008	0.0009	0.0017	27/11
Molybdenum	0.0008	0.0010	0.0009	0.0009	32/6
Nickel	0.0002	0.0002	0.0002	0.0002	24/14
Palladium	0.0016	0.0015	0.0020	0.0017	28/10
Phosphorus	0.0014	0.0014	0.0014	0.0014	24/14
Potassium	0.24	0.27	0.39	0.30	37/1
Rubidium	0.0011	0.0013	0.0020	0.0015	36/2
Selenium	0.0004	0.0003	0.0003	0.0003	30/8
Silicon	1.8	2.0	3.2	2.4	37/1
Silver	0.0018	0.0018	0.0021	0.0019	29/9
Sodium	0.057	0.056	0.081	0.065	37/1
Strontium	0.0036	0.0043	0.0058	0.0046	37/1
Sulfur	0.31	0.30	0.30	0.30	37/1
Tin	0.0029	0.0031	0.0023	0.0028	28/10
Titanium	0.044	0.050	0.078	0.057	37/1
Vanadium	0.0006	0.0009	0.0017	0.0011	35/3
Yttrium	0.0005	0.0007	0.0007	0.0006	30/8
Zinc	0.0037	0.0040	0.0045	0.0041	37/1
Zirconium	0.0015	0.0017	0.0028	0.0020	36/2

An examination of these values suggests that most are due to regional contributions rather than site specific conditions. One approach to detect localized vs. regional contributions is to assess the similarity between the sites using a measure of statistical agreement, the relative standard deviation (RSD). The RSD for 32 of the 40 elements was less than 30%, a level indicative of a fair agreement between disparate sample sites, particularly with the approach used for nondetects.

The full data sets are included in the appendix. These tables include the sample concentration along with the sample-specific detection limits.

2.3 PM10 Concentrations

The PM10 concentrations are contained in Table 4.

Table 4. PM10 Concentrations

Date	**PM10 Site 1 (ug/m^3)**	**PM10 Site 2 (ug/m^3**	**PM10 Site 3 (ug/m^3)**
6-May-03	--	13.3	21.4
7-May-03	14.0	18.7	17.1
8-May-03	16.1	18.4	33.1
9-May-03	35.3	40.4	33.8
12-May-03	11.1	13.9	14.6
13-May-03	8.4	9.5	9.1
14-May-03	9.3	8.9	19.8
15-May-03	30.3	32.9	37.2
16-May-03	10.2	10.3	11.2
19-May-03	--	26.1	89.7
20-May-03	12.9	13.2	14.4
21-May-03	12.6	13.0	17.2
22-May-03	15.5	16.6	19.7
23-May-03	16.8	19.5	18.5
27-May-03	12.5	12.2	12.5
Average	17.0	17.8	24.6

The PM10 sample data for Site 3 is higher than the other two sites. This may be due to localized effects from nearby farming (observed on several sampling days generate windborne dust) and from the absence of ground cover in the vicinity of the sampler.

None of the PM10 24-hour concentration exceeded the Federal Ambient Air Quality Standard of 150 ug/m^3. Based on the data collected for this period, it is likely the annual standard would not exceeded.

The data from Site 2 can be compared to a several year data set collected by the State of

New Mexico at the Questa Middle School, which is within 300 yards of the Site 2 sampler. Data obtained from USEPA Airs web site (http://www.epa.gov/air/data/monvals.html?st~NM~New%20Mexico) showed a data set with annual averages of PM10 from 1993 to 1999. Table 5 contains the data from this series of sample collection.

Table 5. PM10 Collected by the State of New Mexico

Year	**Questa Middle School Annual Average (ug/m^3)**
1993	18
1994	18
1995	16
1996	24
1997	20
1998	19
1999	14
Avg.	18.4

The average PM10 concentration of 17.8 ug/m^3; for Site 2 obtained in May, 2003 agrees quite well with the several year PM10 average of 18.4 ug/m^3; obtained from the EPA data base. Assuming standard methodology and quality assurance was used in the EPA data set, this suggests both valid current measurements as well as a good representativeness of the single month sampling period for an entire annual period.

These data can be compared with other data from around the state. Table 6 contains a compilation of the average concentrations at the three Tailings Facility monitoring sites, the Questa Middle School and the average of 22 sites throughout New Mexico. These values are all below the 24-hour National Ambient Air Quality Standard for PM10 as shown. The values obtained from the Tailings Facility were all below the average value from around the state.

Table 6. Compilation of Comparison Data

Site 1	17.0
Site 2	17.8
Site 3	24.6
Questa Middle School*	18.4
2003 NM Avg.**	27.5
24-hr PM10 NAAQS	150
*7 year average	
*22 sites around NM	Units: ug/m^3

3.0 CONCLUSIONS

Samples collected over a one month period using standard USEPA methodology and analyzed using sensitive laboratory analysis showed that the average concentrations of PM10 metal elements are primarily in the nanograms per cubic meter range. No differences were observed between sampling sites. The wind direction was representative of annual conditions, with the dominant directions being from the southwest and from the northwest. None of the PM10 concentrations exceeded Federal Ambient Air Quality Standard of 150 ug/m^3 and were similar to what has been measured in the area by the State of New Mexico.

Appendix

Detailed Field Results

Element	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1
	6-May-03		7-May-03		8-May-03		9-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	NA	NA	0.1784	0.0277	0.0260	0.0166	0.0523	0.0209
Antimony	NA	NA	0.0926	0.0134	0.1318	0.0178	0.2555	0.0342
Arsenic	NA	NA	0.6530	0.0753	0.8617	0.0999	1.8832	0.2256
Barium	NA	NA	1.7611	0.2033	2.2685	0.2638	4.9382	0.5970
Beryllium	NA	NA	<0.001	0.0010	<0.0011	0.0011	<0.0013	0.0013
Boron	NA	NA	0.3303	0.0376	0.3547	0.0405	0.2970	0.0345
Bromine	NA	NA	0.0867	0.0100	0.0284	0.0036	0.0289	0.0037
Cadmium	NA	NA	0.2093	0.0236	0.2896	0.0327	0.5906	0.0672
Calcium	NA	NA	0.3955	0.0446	0.5157	0.0582	1.1356	0.1288
Chlorine	NA	NA	0.0409	0.0022	0.0554	0.0030	0.1249	0.0064
Chromium	NA	NA	0.0011	0.0006	<0.0007	0.0007	0.0015	0.0014
Cobalt	NA	NA	<0.0003	0.0003	0.0004	0.0003	0.0009	0.0003
Copper	NA	NA	0.0082	0.0007	0.0121	0.0009	0.0224	0.0014
Gallium	NA	NA	0.3703	0.0188	0.5089	0.0257	0.9232	0.0660
Germanium	NA	NA	<0.0015	0.0015	<0.002	0.0020	<0.0039	0.0039
Indium	NA	NA	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Iron	NA	NA	0.0013	0.0003	0.0016	0.0003	0.0016	0.0003
Lanthanum	NA	NA	0.0028	0.0003	0.0051	0.0004	0.0057	0.0004
Lead	NA	NA	<0.0007	0.0007	<0.0008	0.0008	<0.0008	0.0008
Magnesium	NA	NA	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	NA	NA	0.0007	0.0003	0.0005	0.0003	0.0009	0.0003
Mercury	NA	NA	0.0005	0.0002	<0.0003	0.0003	<0.0002	0.0002
Molybdenum	NA	NA	0.0052	0.0004	0.0028	0.0004	0.0027	0.0003
Nickel	NA	NA	0.0009	0.0003	0.0015	0.0003	0.0034	0.0004
Palladium	NA	NA	0.0039	0.0004	0.0030	0.0004	0.0080	0.0006
Phosphorus	NA	NA	<0.0004	0.0004	<0.0004	0.0004	0.0012	0.0004
Potassium	NA	NA	0.0016	0.0005	0.0018	0.0005	0.0044	0.0005
Rubidium	NA	NA	<0.0007	0.0007	<0.0007	0.0007	<0.0006	0.0006
Selenium	NA	NA	<0.0018	0.0018	<0.0018	0.0018	<0.0017	0.0017
Silicon	NA	NA	<0.0016	0.0016	<0.0017	0.0017	<0.0017	0.0017
Silver	NA	NA	<0.0017	0.0017	<0.0017	0.0017	<0.0017	0.0017
Sodium	NA	NA	<0.0018	0.0018	0.0025	0.0019	<0.0018	0.0018
Strontium	NA	NA	<0.002	0.0020	<0.0021	0.0021	<0.002	0.0020
Sulfur	NA	NA	<0.0022	0.0022	<0.0024	0.0024	<0.0023	0.0023
Tin	NA	NA	<0.0072	0.0072	<0.0075	0.0075	0.0157	0.0073
Titanium	NA	NA	<0.0091	0.0091	<0.0095	0.0095	0.0158	0.0090
Vanadium	NA	NA	<0.0005	0.0005	<0.0005	0.0005	0.0011	0.0005
Yttrium	NA	NA	<0.0007	0.0007	0.0012	0.0007	0.0011	0.0006
Zinc	NA	NA	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	NA	NA	<0.0513	0.0513	<0.0511	0.0511	<0.0512	0.0512

Element	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1
	12-May-03		13-May-03		14-May-03		15-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0566	0.0141	0.0152	0.0107	0.0329	0.0122	0.0976	0.0219
Antimony	0.1037	0.0137	0.0166	0.0050	0.0416	0.0070	0.2142	0.0283
Arsenic	0.4529	0.0518	0.2005	0.0229	0.2220	0.0254	1.6571	0.1969
Barium	1.1790	0.1350	0.5580	0.0635	0.6307	0.0719	4.3025	0.5143
Beryllium	<0.0008	0.0008	<0.0007	0.0007	<0.0009	0.0009	<0.0013	0.0013
Boron	0.2178	0.0248	0.1709	0.0194	0.4529	0.0511	0.3494	0.0403
Bromine	0.0147	0.0021	0.0015	0.0010	0.0021	0.0010	0.0084	0.0018
Cadmium	0.1771	0.0200	0.0914	0.0103	0.1122	0.0127	0.4466	0.0507
Calcium	0.3792	0.0427	0.1612	0.0182	0.1761	0.0199	0.7193	0.0815
Chlorine	0.0273	0.0016	0.0118	0.0008	0.0165	0.0010	0.0914	0.0047
Chromium	<0.0004	0.0004	<0.0003	0.0003	<0.0003	0.0003	0.0013	0.0011
Cobalt	<0.0002	0.0002	<0.0002	0.0002	<0.0002	0.0002	0.0010	0.0003
Copper	0.0067	0.0006	0.0028	0.0005	0.0035	0.0005	0.0134	0.0009
Gallium	0.2897	0.0148	0.1239	0.0093	0.1497	0.0078	0.7609	0.0383
Germanium	<0.0012	0.0012	<0.0006	0.0006	<0.0007	0.0007	<0.003	0.0030
Indium	<0.0002	0.0002	<0.0002	0.0002	<0.0002	0.0002	<0.0003	0.0003
Iron	0.0013	0.0003	0.0003	0.0002	0.0007	0.0002	0.0013	0.0003
Lanthanum	0.0033	0.0003	0.0021	0.0003	0.0027	0.0003	0.0040	0.0004
Lead	<0.0007	0.0007	<0.0007	0.0007	<0.0007	0.0007	<0.0009	0.0009
Magnesium	0.0004	0.0003	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	0.0008	0.0003	<0.0002	0.0002	<0.0003	0.0003	0.0005	0.0003
Mercury	<0.0002	0.0002	<0.0002	0.0002	<0.0002	0.0002	<0.0003	0.0003
Molybdenum	0.0019	0.0003	0.0020	0.0003	0.0046	0.0004	0.0028	0.0004
Nickel	<0.0003	0.0003	0.0009	0.0002	0.0005	0.0003	0.0022	0.0004
Palladium	0.0029	0.0004	0.0011	0.0003	0.0014	0.0003	0.0057	0.0005
Phosphorus	<0.0004	0.0004	<0.0003	0.0003	<0.0003	0.0003	0.0005	0.0004
Potassium	<0.0004	0.0004	<0.0004	0.0004	0.0010	0.0004	0.0034	0.0006
Rubidium	0.0015	0.0006	<0.0006	0.0006	<0.0006	0.0006	<0.0008	0.0008
Selenium	<0.0016	0.0016	<0.0014	0.0014	<0.0015	0.0015	<0.0018	0.0018
Silicon	<0.0015	0.0015	<0.0014	0.0014	<0.0014	0.0014	0.0021	0.0018
Silver	<0.0015	0.0015	<0.0014	0.0014	<0.0014	0.0014	<0.0018	0.0018
Sodium	<0.0016	0.0016	<0.0015	0.0015	<0.0015	0.0015	<0.0019	0.0019
Strontium	<0.0018	0.0018	<0.0017	0.0017	<0.0017	0.0017	0.0023	0.0021
Sulfur	<0.0019	0.0019	<0.0019	0.0019	<0.0019	0.0019	<0.0023	0.0023
Tin	<0.0063	0.0063	<0.0059	0.0059	<0.0062	0.0062	0.0168	0.0076
Titanium	<0.008	0.0080	<0.0075	0.0075	<0.0079	0.0079	<0.0093	0.0093
Vanadium	0.0011	0.0004	<0.0004	0.0004	<0.0004	0.0004	<0.0005	0.0005
Yttrium	<0.0006	0.0006	<0.0005	0.0005	<0.0006	0.0006	0.0009	0.0007
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	<0.0504	0.0504	<0.0504	0.0504	<0.0504	0.0504

Element	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1
	16-May-03		19-May-03		20-May-03		21-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0285	0.0122	NV	0.0376	0.0544	0.0139	0.0233	0.0121
Antimony	0.0752	0.0102	NV	0.0246	0.0734	0.0104	0.0829	0.0115
Arsenic	0.2878	0.0329	NV	0.0937	0.3571	0.0409	0.3599	0.0412
Barium	0.7966	0.0910	NV	0.2613	0.9899	0.1135	0.9563	0.1096
Beryllium	<0.0009	0.0009	NV	0.0027	<0.0009	0.0009	<0.0008	0.0008
Boron	0.3211	0.0364	NV	0.0776	0.3606	0.0409	0.2521	0.0286
Bromine	<0.0011	0.0011	NV	0.0035	0.0027	0.0012	0.0050	0.0012
Cadmium	0.1237	0.0140	NV	0.0452	0.1519	0.0171	0.1657	0.0187
Calcium	0.2576	0.0290	NV	0.0753	0.4021	0.0453	0.3717	0.0418
Chlorine	0.0179	0.0011	NV	0.0035	0.0234	0.0014	0.0255	0.0015
Chromium	0.0005	0.0004	NV	0.0012	<0.0004	0.0004	<0.0004	0.0004
Cobalt	0.0004	0.0002	NV	0.0008	0.0006	0.0002	<0.0002	0.0002
Copper	0.0053	0.0006	NV	0.0018	0.0038	0.0006	0.0052	0.0006
Gallium	0.1891	0.0097	NV	0.0329	0.2458	0.0126	0.2401	0.0175
Germanium	<0.0009	0.0009	NV	0.0028	<0.001	0.0010	<0.0011	0.0011
Indium	<0.0002	0.0002	NV	0.0008	<0.0002	0.0002	<0.0002	0.0002
Iron	0.0010	0.0003	NV	0.0008	0.0004	0.0002	0.0010	0.0003
Lanthanum	0.0025	0.0003	NV	0.0012	0.0051	0.0004	0.0035	0.0003
Lead	<0.0007	0.0007	NV	0.0027	<0.0008	0.0008	<0.0009	0.0009
Magnesium	<0.0003	0.0003	NV	0.0012	<0.0003	0.0003	<0.0003	0.0003
Manganese	<0.0003	0.0003	NV	0.0010	<0.0003	0.0003	<0.0002	0.0002
Mercury	<0.0003	0.0003	NV	0.0010	<0.0002	0.0002	0.0007	0.0002
Molybdenum	0.0030	0.0003	NV	0.0010	0.0019	0.0003	0.0024	0.0003
Nickel	<0.0003	0.0003	NV	0.0010	0.0008	0.0003	0.0005	0.0003
Palladium	0.0022	0.0004	NV	0.0013	0.0043	0.0004	0.0035	0.0004
Phosphorus	<0.0004	0.0004	NV	0.0013	<0.0004	0.0004	<0.0003	0.0003
Potassium	<0.0005	0.0005	NV	0.0017	0.0007	0.0004	0.0010	0.0004
Rubidium	<0.0007	0.0007	NV	0.0023	0.0007	0.0006	<0.0006	0.0006
Selenium	<0.0016	0.0016	NV	0.0056	<0.0015	0.0015	<0.0015	0.0015
Silicon	<0.0015	0.0015	NV	0.0055	<0.0015	0.0015	<0.0014	0.0014
Silver	<0.0015	0.0015	NV	0.0055	<0.0015	0.0015	<0.0014	0.0014
Sodium	<0.0016	0.0016	NV	0.0058	<0.0016	0.0016	<0.0015	0.0015
Strontium	<0.0018	0.0018	NV	0.0065	<0.0018	0.0018	<0.0017	0.0017
Sulfur	<0.002	0.0020	NV	0.0073	<0.002	0.0020	<0.0019	0.0019
Tin	<0.0065	0.0065	NV	0.0234	0.0075	0.0064	<0.0061	0.0061
Titanium	<0.0082	0.0082	NV	0.0296	<0.0081	0.0081	0.0149	0.0079
Vanadium	<0.0005	0.0005	NV	0.0017	<0.0005	0.0005	<0.0004	0.0004
Yttrium	<0.0006	0.0006	NV	0.0023	0.0009	0.0006	<0.0006	0.0006
Zinc	<0.0001	0.0001	NV	0.0003	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	NV	0.1765	<0.0504	0.0504	<0.0504	0.0504

Element	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1
	22-May-03		23-May-03		27-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0319	0.0136	0.0409	0.0148	0.0455	0.0132
Antimony	0.1307	0.0170	0.0968	0.0134	0.0538	0.0083
Arsenic	0.5828	0.0670	0.5050	0.0580	0.2422	0.0277
Barium	1.5945	0.1840	1.3462	0.1555	0.6883	0.0789
Beryllium	<0.0009	0.0009	<0.001	0.0010	<0.0009	0.0009
Boron	0.2166	0.0247	0.5122	0.0582	0.5433	0.0614
Bromine	0.0026	0.0011	<0.0012	0.0012	0.0011	0.0010
Cadmium	0.2612	0.0295	0.2261	0.0255	0.1337	0.0151
Calcium	0.4861	0.0548	0.4588	0.0517	0.2180	0.0246
Chlorine	0.0423	0.0023	0.0355	0.0019	0.0189	0.0011
Chromium	<0.0006	0.0006	0.0008	0.0005	0.0006	0.0004
Cobalt	0.0004	0.0002	0.0005	0.0003	0.0008	0.0002
Copper	0.0102	0.0008	0.0079	0.0007	0.0049	0.0006
Gallium	0.4055	0.0292	0.3472	0.0177	0.1988	0.0102
Germanium	<0.0017	0.0017	<0.0014	0.0014	<0.0008	0.0008
Indium	<0.0002	0.0002	<0.0003	0.0003	<0.0002	0.0002
Iron	0.0008	0.0003	0.0014	0.0003	0.0008	0.0002
Lanthanum	0.0031	0.0003	0.0034	0.0003	0.0024	0.0003
Lead	<0.0007	0.0007	<0.0008	0.0008	<0.0007	0.0007
Magnesium	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	<0.0003	0.0003	<0.0005	0.0005	<0.0004	0.0004
Mercury	<0.0002	0.0002	<0.0003	0.0003	0.0003	0.0002
Molybdenum	0.0024	0.0003	0.0035	0.0004	0.0048	0.0004
Nickel	0.0007	0.0003	0.0005	0.0003	0.0005	0.0003
Palladium	0.0039	0.0004	0.0044	0.0004	0.0017	0.0003
Phosphorus	<0.0003	0.0003	<0.0004	0.0004	<0.0003	0.0003
Potassium	0.0012	0.0004	0.0010	0.0005	0.0016	0.0004
Rubidium	<0.0006	0.0006	<0.0007	0.0007	<0.0005	0.0005
Selenium	<0.0015	0.0015	<0.0016	0.0016	<0.0014	0.0014
Silicon	<0.0015	0.0015	<0.0015	0.0015	<0.0013	0.0013
Silver	<0.0014	0.0014	<0.0015	0.0015	<0.0014	0.0014
Sodium	<0.0015	0.0015	<0.0016	0.0016	<0.0015	0.0015
Strontium	<0.0018	0.0018	<0.0019	0.0019	<0.0017	0.0017
Sulfur	<0.0019	0.0019	<0.002	0.0020	<0.0018	0.0018
Tin	<0.0061	0.0061	<0.0066	0.0066	0.0070	0.0058
Titanium	<0.0078	0.0078	<0.0083	0.0083	<0.0075	0.0075
Vanadium	<0.0004	0.0004	<0.0005	0.0005	<0.0004	0.0004
Yttrium	0.0009	0.0006	0.0017	0.0006	0.0013	0.0005
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	<0.0504	0.0504	<0.05	0.0500

Element	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2
	6-May-03		7-May-03		8-May-03		9-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	<0.0142	0.0142	0.1275	0.0232	0.0563	0.0171	0.0945	0.0264
Antimony	0.0729	0.0109	0.1225	0.0165	0.1290	0.0175	0.2813	0.0388
Arsenic	0.4926	0.0565	0.7307	0.0846	0.9068	0.1054	2.3979	0.2928
Barium	1.4056	0.1614	2.0357	0.2367	2.4241	0.2834	6.4792	0.7996
Beryllium	<0.001	0.0010	<0.001	0.0010	<0.0011	0.0011	<0.0016	0.0016
Boron	0.3867	0.0439	0.3148	0.0359	0.3462	0.0396	0.2943	0.0345
Bromine	0.0052	0.0013	0.0873	0.0101	0.0228	0.0030	0.0270	0.0037
Cadmium	0.2010	0.0227	0.2828	0.0320	0.3169	0.0358	0.7317	0.0835
Calcium	0.2993	0.0337	0.4655	0.0525	0.4979	0.0562	1.3171	0.1498
Chlorine	0.0387	0.0022	0.0567	0.0030	0.0577	0.0031	0.1494	0.0077
Chromium	0.0010	0.0006	0.0011	0.0007	0.0014	0.0008	0.0025	0.0017
Cobalt	0.0004	0.0003	0.0006	0.0003	0.0007	0.0002	0.0008	0.0004
Copper	0.0087	0.0007	0.0129	0.0009	0.0117	0.0009	0.0279	0.0017
Gallium	0.3429	0.0249	0.4916	0.0248	0.5363	0.0271	1.2279	0.0616
Germanium	<0.0015	0.0015	<0.002	0.0020	<0.0021	0.0021	<0.0048	0.0048
Indium	<0.0003	0.0003	<0.0003	0.0003	<0.0002	0.0002	<0.0003	0.0003
Iron	0.0008	0.0003	0.0018	0.0003	0.0015	0.0003	0.0016	0.0003
Lanthanum	0.0042	0.0004	0.0054	0.0004	0.0056	0.0004	0.0059	0.0005
Lead	<0.0007	0.0007	<0.0006	0.0006	<0.0007	0.0007	<0.0008	0.0008
Magnesium	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	0.0008	0.0003	<0.0004	0.0004	<0.0005	0.0005	0.0004	0.0004
Mercury	0.0003	0.0003	0.0003	0.0002	0.0003	0.0002	<0.0003	0.0003
Molybdenum	0.0035	0.0004	0.0040	0.0004	0.0041	0.0003	0.0034	0.0004
Nickel	0.0006	0.0003	0.0011	0.0003	0.0019	0.0003	0.0050	0.0004
Palladium	0.0025	0.0004	0.0043	0.0004	0.0050	0.0004	0.0118	0.0007
Phosphorus	<0.0004	0.0004	0.0006	0.0003	0.0007	0.0003	0.0012	0.0005
Potassium	<0.0005	0.0005	0.0014	0.0004	0.0012	0.0004	0.0052	0.0006
Rubidium	<0.0006	0.0006	0.0008	0.0006	<0.0006	0.0006	<0.0008	0.0008
Selenium	<0.0017	0.0017	0.0020	0.0016	<0.0015	0.0015	<0.0018	0.0018
Silicon	<0.0016	0.0016	<0.0015	0.0015	<0.0015	0.0015	<0.0018	0.0018
Silver	<0.0016	0.0016	<0.0015	0.0015	<0.0015	0.0015	<0.0018	0.0018
Sodium	<0.0017	0.0017	<0.0016	0.0016	<0.0016	0.0016	<0.002	0.0020
Strontium	<0.002	0.0020	<0.0019	0.0019	<0.0018	0.0018	<0.0022	0.0022
Sulfur	<0.0022	0.0022	<0.002	0.0020	<0.002	0.0020	<0.0024	0.0024
Tin	<0.0071	0.0071	<0.0065	0.0065	0.0105	0.0064	0.0233	0.0078
Titanium	<0.0088	0.0088	<0.0081	0.0081	<0.0079	0.0079	<0.0095	0.0095
Vanadium	0.0008	0.0005	<0.0004	0.0004	<0.0004	0.0004	<0.0005	0.0005
Yttrium	<0.0006	0.0006	0.0013	0.0006	0.0032	0.0006	0.0012	0.0007
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0558	0.0558	<0.0504	0.0504	<0.0506	0.0506	<0.05	0.0500

Element	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2
	12-May-03		13-May-03		14-May-03		15-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0621	0.0149	0.0326	0.0125	0.0645	0.0136	0.0603	0.0185
Antimony	0.1217	0.0158	0.0445	0.0074	0.0365	0.0067	0.1615	0.0220
Arsenic	0.4866	0.0558	0.3055	0.0349	0.2558	0.0293	1.3718	0.1618
Barium	1.2857	0.1478	0.8761	0.0999	0.7160	0.0816	3.6118	0.4307
Beryllium	<0.0009	0.0009	<0.0008	0.0008	<0.0009	0.0009	<0.0012	0.0012
Boron	0.2171	0.0247	0.1825	0.0207	0.4752	0.0537	0.2900	0.0335
Bromine	0.0161	0.0022	0.0028	0.0011	0.0014	0.0010	0.0020	0.0014
Cadmium	0.1800	0.0203	0.1322	0.0149	0.1238	0.0140	0.4239	0.0481
Calcium	0.3532	0.0398	0.1863	0.0210	0.1764	0.0199	0.6462	0.0732
Chlorine	0.0297	0.0017	0.0203	0.0012	0.0179	0.0019	0.0867	0.0045
Chromium	<0.0005	0.0005	<0.0004	0.0004	<0.0003	0.0003	0.0019	0.0010
Cobalt	0.0004	0.0002	<0.0002	0.0002	<0.0002	0.0002	0.0007	0.0003
Copper	0.0063	0.0006	0.0062	0.0006	0.0038	0.0005	0.0144	0.0010
Gallium	0.2987	0.0152	0.2094	0.0107	0.1753	0.0130	0.6529	0.0470
Germanium	<0.0012	0.0012	<0.0009	0.0009	<0.0008	0.0008	<0.0029	0.0029
Indium	<0.0002	0.0002	<0.0003	0.0003	<0.0002	0.0002	<0.0003	0.0003
Iron	0.0010	0.0003	0.0007	0.0003	0.0008	0.0002	0.0009	0.0003
Lanthanum	0.0035	0.0003	0.0024	0.0003	0.0028	0.0003	0.0038	0.0004
Lead	<0.0007	0.0007	<0.0007	0.0007	<0.0007	0.0007	<0.0007	0.0007
Magnesium	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	<0.0003	0.0003	<0.0003	0.0003	0.0004	0.0002	<0.0005	0.0005
Mercury	<0.0002	0.0002	<0.0003	0.0003	<0.0002	0.0002	<0.0003	0.0003
Molybdenum	0.0027	0.0003	0.0032	0.0004	0.0048	0.0004	0.0028	0.0003
Nickel	0.0008	0.0003	<0.0003	0.0003	<0.0003	0.0003	0.0013	0.0003
Palladium	0.0035	0.0004	0.0018	0.0004	0.0016	0.0003	0.0043	0.0005
Phosphorus	<0.0004	0.0004	<0.0004	0.0004	<0.0003	0.0003	0.0009	0.0004
Potassium	0.0008	0.0004	0.0008	0.0005	<0.0004	0.0004	0.0029	0.0005
Rubidium	<0.0006	0.0006	<0.0007	0.0007	<0.0006	0.0006	<0.0007	0.0007
Selenium	<0.0016	0.0016	<0.0016	0.0016	<0.0014	0.0014	<0.0018	0.0018
Silicon	<0.0014	0.0014	<0.0016	0.0016	<0.0014	0.0014	<0.0017	0.0017
Silver	<0.0015	0.0015	<0.0015	0.0015	<0.0014	0.0014	<0.0017	0.0017
Sodium	<0.0016	0.0016	<0.0017	0.0017	<0.0015	0.0015	<0.0018	0.0018
Strontium	<0.0018	0.0018	<0.0019	0.0019	<0.0017	0.0017	<0.002	0.0020
Sulfur	<0.002	0.0020	<0.0021	0.0021	<0.0019	0.0019	<0.0022	0.0022
Tin	0.0066	0.0064	0.0120	0.0068	<0.006	0.0060	<0.0071	0.0071
Titanium	<0.0079	0.0079	<0.0085	0.0085	<0.0076	0.0076	<0.0089	0.0089
Vanadium	<0.0005	0.0005	<0.0005	0.0005	<0.0004	0.0004	<0.0005	0.0005
Yttrium	0.0011	0.0006	<0.0006	0.0006	<0.0005	0.0005	0.0017	0.0007
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	<0.0504	0.0504	<0.0504	0.0504	<0.0504	0.0504

Element	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2
	16-May-03		19-May-03		20-May-03		21-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0464	0.0132	0.0459	0.0166	0.0301	0.0131	0.0371	0.0141
Antimony	0.0575	0.0087	0.1011	0.0148	0.0763	0.0108	0.1053	0.0140
Arsenic	0.2802	0.0321	0.9070	0.1053	0.3725	0.0426	0.4529	0.0519
Barium	0.7962	0.0909	2.6455	0.3094	1.0227	0.1174	1.1895	0.1365
Beryllium	<0.0008	0.0008	<0.0011	0.0011	<0.0009	0.0009	<0.0009	0.0009
Boron	0.3068	0.0348	0.2076	0.0239	0.3650	0.0414	0.2566	0.0292
Bromine	0.0023	0.0011	<0.0013	0.0013	0.0052	0.0013	<0.0012	0.0012
Cadmium	0.1211	0.0137	0.3655	0.0413	0.1572	0.0178	0.1836	0.0207
Calcium	0.2145	0.0242	0.5399	0.0610	0.4084	0.0460	0.4160	0.0468
Chlorine	0.0201	0.0012	0.0697	0.0037	0.0261	0.0015	0.0284	0.0016
Chromium	<0.0004	0.0004	<0.0009	0.0009	0.0007	0.0004	<0.0005	0.0005
Cobalt	0.0007	0.0002	0.0005	0.0003	0.0004	0.0002	0.0004	0.0002
Copper	0.0035	0.0005	0.0133	0.0010	0.0062	0.0006	0.0066	0.0007
Gallium	0.1900	0.0098	0.6545	0.0331	0.2628	0.0134	0.2939	0.0150
Germanium	<0.0009	0.0009	<0.0026	0.0026	<0.0011	0.0011	<0.0012	0.0012
Indium	<0.0003	0.0003	<0.0003	0.0003	<0.0002	0.0002	<0.0003	0.0003
Iron	0.0008	0.0003	0.0011	0.0003	0.0008	0.0003	0.0009	0.0003
Lanthanum	0.0032	0.0003	0.0058	0.0005	0.0032	0.0003	0.0020	0.0003
Lead	<0.0008	0.0008	<0.0008	0.0008	<0.0006	0.0006	<0.0007	0.0007
Magnesium	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Mercury	<0.0002	0.0002	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Molybdenum	0.0030	0.0003	0.0011	0.0003	0.0025	0.0003	0.0023	0.0003
Nickel	<0.0003	0.0003	0.0018	0.0004	0.0009	0.0003	0.0013	0.0003
Palladium	0.0023	0.0004	0.0058	0.0005	0.0045	0.0004	0.0045	0.0005
Phosphorus	0.0007	0.0004	<0.0004	0.0004	0.0008	0.0004	<0.0004	0.0004
Potassium	<0.0005	0.0005	0.0032	0.0005	0.0019	0.0005	0.0014	0.0005
Rubidium	<0.0007	0.0007	<0.0007	0.0007	<0.0007	0.0007	<0.0007	0.0007
Selenium	<0.0016	0.0016	<0.0018	0.0018	<0.0016	0.0016	<0.0017	0.0017
Silicon	<0.0015	0.0015	<0.0017	0.0017	<0.0015	0.0015	<0.0016	0.0016
Silver	<0.0014	0.0014	<0.0018	0.0018	<0.0015	0.0015	<0.0016	0.0016
Sodium	<0.0017	0.0017	<0.0018	0.0018	<0.0017	0.0017	<0.0017	0.0017
Strontium	<0.0019	0.0019	<0.0021	0.0021	0.0044	0.0019	<0.0019	0.0019
Sulfur	<0.002	0.0020	<0.0023	0.0023	<0.0021	0.0021	<0.0021	0.0021
Tin	<0.0066	0.0066	0.0216	0.0075	0.0128	0.0067	<0.0068	0.0068
Titanium	<0.0084	0.0084	<0.009	0.0090	<0.0086	0.0086	<0.0087	0.0087
Vanadium	<0.0005	0.0005	<0.0005	0.0005	<0.0005	0.0005	<0.0005	0.0005
Yttrium	<0.0006	0.0006	<0.0007	0.0007	0.0009	0.0006	<0.0007	0.0007
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	<0.0563	0.0563	<0.0504	0.0504	<0.0504	0.0504

Element	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2
	22-May-03		23-May-03		27-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0570	0.0154	0.0743	0.0165	0.0524	0.0140
Antimony	0.1406	0.0183	0.0905	0.0128	0.0513	0.0081
Arsenic	0.6979	0.0806	0.5183	0.0597	0.2582	0.0296
Barium	1.9143	0.2217	1.4029	0.1628	0.7429	0.0851
Beryllium	<0.0009	0.0009	<0.001	0.0010	<0.0009	0.0009
Boron	0.2236	0.0255	0.5033	0.0572	0.5392	0.0609
Bromine	<0.0011	0.0011	<0.0012	0.0012	0.0016	0.0011
Cadmium	0.2916	0.0329	0.2483	0.0280	0.1365	0.0154
Calcium	0.5555	0.0626	0.4750	0.0535	0.1815	0.0205
Chlorine	0.0484	0.0026	0.0407	0.0022	0.0184	0.0012
Chromium	<0.0007	0.0007	0.0015	0.0006	<0.0004	0.0004
Cobalt	0.0007	0.0003	<0.0003	0.0003	0.0004	0.0002
Copper	0.0132	0.0009	0.0096	0.0008	0.0051	0.0006
Gallium	0.4933	0.0250	0.3595	0.0260	0.1991	0.0102
Germanium	<0.002	0.0020	<0.0016	0.0016	<0.0008	0.0008
Indium	<0.0003	0.0003	<0.0003	0.0003	<0.0002	0.0002
Iron	0.0009	0.0003	0.0010	0.0003	0.0008	0.0003
Lanthanum	0.0032	0.0003	0.0039	0.0004	0.0024	0.0003
Lead	<0.0008	0.0008	<0.0008	0.0008	<0.0007	0.0007
Magnesium	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	<0.0003	0.0003	0.0005	0.0003	<0.0003	0.0003
Mercury	<0.0002	0.0002	<0.0002	0.0002	0.0007	0.0003
Molybdenum	0.0022	0.0003	0.0022	0.0003	0.0042	0.0004
Nickel	0.0011	0.0003	0.0008	0.0003	0.0006	0.0003
Palladium	0.0047	0.0004	0.0032	0.0004	0.0018	0.0003
Phosphorus	<0.0003	0.0003	<0.0004	0.0004	<0.0004	0.0004
Potassium	0.0014	0.0005	0.0015	0.0005	0.0007	0.0004
Rubidium	<0.0006	0.0006	<0.0006	0.0006	<0.0006	0.0006
Selenium	<0.0016	0.0016	<0.0016	0.0016	<0.0016	0.0016
Silicon	<0.0015	0.0015	<0.0015	0.0015	0.0023	0.0015
Silver	<0.0015	0.0015	<0.0015	0.0015	<0.0014	0.0014
Sodium	<0.0016	0.0016	<0.0016	0.0016	<0.0016	0.0016
Strontium	0.0030	0.0018	<0.0019	0.0019	<0.0018	0.0018
Sulfur	<0.0019	0.0019	<0.002	0.0020	<0.002	0.0020
Tin	0.0141	0.0064	0.0111	0.0066	0.0155	0.0064
Titanium	<0.0079	0.0079	<0.0082	0.0082	0.0143	0.0080
Vanadium	<0.0004	0.0004	<0.0004	0.0004	<0.0004	0.0004
Yttrium	0.0009	0.0006	<0.0006	0.0006	0.0007	0.0006
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	<0.05	0.0500	<0.05	0.0500

Element	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3
	6-May-03		7-May-03		8-May-03		9-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0389	0.0168	0.1634	0.0264	0.0644	0.0209	0.0790	0.0234
Antimony	0.1002	0.0144	0.0917	0.0135	0.2148	0.0292	0.2166	0.0302
Arsenic	0.8117	0.0940	0.6803	0.0786	1.7393	0.2084	2.1221	0.2567
Barium	2.3000	0.2682	1.8798	0.2189	4.9121	0.5950	5.6750	0.6917
Beryllium	<0.0011	0.0011	<0.0009	0.0009	<0.0013	0.0013	<0.0015	0.0015
Boron	0.3448	0.0394	0.3113	0.0355	0.3348	0.0388	0.3115	0.0363
Bromine	0.0074	0.0016	0.0872	0.0101	0.0257	0.0034	0.0303	0.0039
Cadmium	0.2953	0.0333	0.2424	0.0274	0.5971	0.0679	0.6275	0.0715
Calcium	0.3408	0.0385	0.4074	0.0460	0.7050	0.0800	1.1433	0.1298
Chlorine	0.0588	0.0031	0.0455	0.0025	0.1244	0.0064	0.1258	0.0065
Chromium	0.0012	0.0008	0.0009	0.0006	0.0025	0.0014	0.0027	0.0015
Cobalt	<0.0003	0.0003	0.0008	0.0003	0.0008	0.0003	0.0011	0.0003
Copper	0.0165	0.0011	0.0103	0.0008	0.0277	0.0017	0.0240	0.0015
Gallium	0.5413	0.0273	0.4196	0.0212	1.1033	0.0554	1.0388	0.0522
Germanium	<0.0022	0.0022	<0.0017	0.0017	<0.0043	0.0043	<0.0041	0.0041
Indium	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Iron	0.0008	0.0003	0.0017	0.0003	0.0024	0.0003	0.0016	0.0003
Lanthanum	0.0039	0.0004	0.0033	0.0003	0.0069	0.0005	0.0056	0.0004
Lead	<0.0008	0.0008	<0.0007	0.0007	<0.0007	0.0007	<0.0007	0.0007
Magnesium	<0.0004	0.0004	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	0.0010	0.0003	<0.0003	0.0003	<0.0005	0.0005	0.0009	0.0003
Mercury	<0.0003	0.0003	0.0009	0.0003	0.0003	0.0002	0.0006	0.0002
Molybdenum	0.0032	0.0004	0.0051	0.0004	0.0032	0.0003	0.0038	0.0004
Nickel	0.0008	0.0004	0.0009	0.0003	0.0032	0.0004	0.0032	0.0004
Palladium	0.0048	0.0005	0.0040	0.0004	0.0076	0.0006	0.0091	0.0006
Phosphorus	0.0010	0.0004	0.0006	0.0004	0.0010	0.0004	<0.0004	0.0004
Potassium	0.0026	0.0006	0.0021	0.0005	0.0044	0.0005	0.0041	0.0005
Rubidium	<0.0007	0.0007	<0.0007	0.0007	<0.0006	0.0006	<0.0006	0.0006
Selenium	0.0034	0.0019	<0.0017	0.0017	0.0018	0.0017	<0.0017	0.0017
Silicon	<0.0017	0.0017	<0.0016	0.0016	<0.0016	0.0016	<0.0017	0.0017
Silver	0.0025	0.0017	<0.0016	0.0016	<0.0016	0.0016	<0.0016	0.0016
Sodium	<0.0019	0.0019	<0.0017	0.0017	<0.0017	0.0017	<0.0018	0.0018
Strontium	<0.0022	0.0022	<0.0019	0.0019	<0.002	0.0020	<0.002	0.0020
Sulfur	<0.0024	0.0024	<0.0022	0.0022	<0.0022	0.0022	<0.0022	0.0022
Tin	<0.0076	0.0076	<0.007	0.0070	0.0113	0.0069	0.0190	0.0070
Titanium	<0.0096	0.0096	<0.0088	0.0088	<0.0086	0.0086	<0.0085	0.0085
Vanadium	<0.0005	0.0005	<0.0005	0.0005	0.0006	0.0005	<0.0005	0.0005
Yttrium	<0.0007	0.0007	0.0013	0.0006	0.0033	0.0007	0.0013	0.0006
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0538	0.0538	<0.0504	0.0504	<0.0502	0.0502	<0.05	0.0500

Element	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3
	12-May-03		13-May-03		14-May-03		15-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0434	0.0135	0.0353	0.0123	0.0687	0.0158	0.1091	0.0250
Antimony	0.1116	0.0146	0.0329	0.0065	0.0814	0.0118	0.2577	0.0348
Arsenic	0.5080	0.0583	0.2608	0.0298	0.6034	0.0697	2.3983	0.2921
Barium	1.3748	0.1582	0.7664	0.0873	1.7861	0.2075	6.5084	0.7929
Beryllium	<0.0008	0.0008	<0.0007	0.0007	<0.001	0.0010	<0.0015	0.0015
Boron	0.2074	0.0236	0.1803	0.0205	0.4937	0.0562	0.3003	0.0350
Bromine	0.0127	0.0019	0.0015	0.0011	<0.0011	0.0011	0.0114	0.0020
Cadmium	0.1933	0.0218	0.1162	0.0131	0.2504	0.0283	0.6546	0.0746
Calcium	0.3611	0.0407	0.1645	0.0186	0.2821	0.0319	0.9672	0.1099
Chlorine	0.0322	0.0018	0.0188	0.0011	0.0464	0.0025	0.1351	0.0069
Chromium	<0.0005	0.0005	0.0006	0.0004	<0.0006	0.0006	0.0035	0.0016
Cobalt	0.0005	0.0002	0.0004	0.0002	0.0007	0.0002	0.0008	0.0003
Copper	0.0073	0.0007	0.0053	0.0006	0.0111	0.0008	0.0221	0.0014
Gallium	0.3227	0.0164	0.1849	0.0095	0.4166	0.0211	1.1168	0.0561
Germanium	<0.0013	0.0013	<0.0008	0.0008	<0.0017	0.0017	<0.0044	0.0044
Indium	<0.0002	0.0002	<0.0003	0.0003	<0.0002	0.0002	<0.0003	0.0003
Iron	0.0016	0.0003	0.0011	0.0003	0.0015	0.0003	0.0014	0.0003
Lanthanum	0.0032	0.0003	0.0023	0.0003	0.0033	0.0003	0.0053	0.0004
Lead	<0.0008	0.0008	<0.0007	0.0007	<0.0007	0.0007	<0.0007	0.0007
Magnesium	<0.0002	0.0002	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	<0.0004	0.0004	<0.0003	0.0003	<0.0004	0.0004	0.0015	0.0003
Mercury	<0.0002	0.0002	<0.0002	0.0002	<0.0002	0.0002	0.0005	0.0002
Molybdenum	0.0027	0.0003	0.0034	0.0004	0.0047	0.0004	0.0024	0.0003
Nickel	0.0009	0.0003	<0.0003	0.0003	0.0016	0.0003	0.0035	0.0004
Palladium	0.0024	0.0003	0.0011	0.0003	0.0034	0.0004	0.0086	0.0006
Phosphorus	<0.0003	0.0003	<0.0004	0.0004	<0.0003	0.0003	0.0014	0.0004
Potassium	0.0015	0.0004	0.0014	0.0005	0.0021	0.0004	0.0045	0.0006
Rubidium	<0.0006	0.0006	<0.0007	0.0007	<0.0006	0.0006	<0.0007	0.0007
Selenium	<0.0014	0.0014	<0.0016	0.0016	<0.0015	0.0015	<0.0017	0.0017
Silicon	<0.0014	0.0014	<0.0015	0.0015	<0.0014	0.0014	0.0026	0.0017
Silver	<0.0013	0.0013	<0.0016	0.0016	<0.0014	0.0014	<0.0017	0.0017
Sodium	<0.0015	0.0015	<0.0016	0.0016	<0.0015	0.0015	<0.0018	0.0018
Strontium	<0.0017	0.0017	<0.0019	0.0019	<0.0017	0.0017	0.0034	0.0020
Sulfur	<0.0019	0.0019	<0.002	0.0020	<0.0019	0.0019	<0.0022	0.0022
Tin	<0.006	0.0060	<0.0066	0.0066	0.0080	0.0061	0.0170	0.0071
Titanium	<0.0076	0.0076	<0.0084	0.0084	<0.0076	0.0076	<0.0085	0.0085
Vanadium	<0.0004	0.0004	<0.0005	0.0005	<0.0004	0.0004	<0.0005	0.0005
Yttrium	0.0012	0.0006	0.0009	0.0006	0.0015	0.0006	0.0009	0.0007
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	<0.0504	0.0504	<0.0504	0.0504	<0.0504	0.0504

Element	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3
	16-May-03		19-May-03		20-May-03		21-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0362	0.0127	0.2400	0.0478	0.0432	0.0125	0.0554	0.0145
Antimony	0.0616	0.0091	0.3492	0.0521	0.0592	0.0090	0.0915	0.0125
Arsenic	0.3284	0.0376	3.5761	0.4504	0.3388	0.0388	0.3741	0.0428
Barium	0.9521	0.1089	10.1643	1.3211	0.9744	0.1119	0.9895	0.1140
Beryllium	<0.0008	0.0008	<0.0021	0.0021	<0.0009	0.0009	<0.0009	0.0009
Boron	0.2973	0.0337	0.2081	0.0249	0.3640	0.0413	0.2440	0.0278
Bromine	0.0024	0.0011	<0.0019	0.0019	0.0040	0.0011	0.0019	0.0011
Cadmium	0.1443	0.0163	1.2718	0.1462	0.1605	0.0181	0.1613	0.0182
Calcium	0.2373	0.0268	1.2732	0.1460	0.4021	0.0453	0.3549	0.0400
Chlorine	0.0226	0.0013	0.2807	0.0142	0.0265	0.0015	0.0236	0.0014
Chromium	<0.0004	0.0004	0.0069	0.0031	<0.0004	0.0004	0.0007	0.0004
Cobalt	<0.0002	0.0002	0.0020	0.0005	0.0005	0.0002	0.0006	0.0002
Copper	0.0058	0.0006	0.0580	0.0032	0.0047	0.0006	0.0052	0.0006
Gallium	0.2240	0.0115	2.4357	0.1221	0.2458	0.0179	0.2391	0.0175
Germanium	<0.0009	0.0009	<0.0094	0.0094	<0.0011	0.0011	<0.0011	0.0011
Indium	<0.0002	0.0002	<0.0004	0.0004	<0.0002	0.0002	<0.0003	0.0003
Iron	0.0008	0.0003	0.0038	0.0004	0.0011	0.0002	0.0011	0.0003
Lanthanum	0.0033	0.0003	0.0121	0.0012	0.0028	0.0003	0.0020	0.0003
Lead	<0.0008	0.0008	0.0009	0.0008	<0.0008	0.0008	<0.0007	0.0007
Magnesium	<0.0003	0.0003	<0.0004	0.0004	<0.0002	0.0002	<0.0003	0.0003
Manganese	<0.0003	0.0003	0.0007	0.0004	<0.0002	0.0002	<0.0003	0.0003
Mercury	<0.0002	0.0002	<0.0003	0.0003	<0.0002	0.0002	0.0003	0.0002
Molybdenum	0.0033	0.0003	0.0022	0.0004	0.0021	0.0003	0.0030	0.0003
Nickel	0.0006	0.0003	0.0080	0.0006	0.0006	0.0002	<0.0003	0.0003
Palladium	0.0022	0.0003	0.0204	0.0012	0.0035	0.0003	0.0028	0.0004
Phosphorus	<0.0004	0.0004	0.0025	0.0005	<0.0003	0.0003	<0.0004	0.0004
Potassium	<0.0004	0.0004	0.0090	0.0008	0.0007	0.0004	<0.0005	0.0005
Rubidium	<0.0006	0.0006	<0.0007	0.0007	<0.0005	0.0005	<0.0007	0.0007
Selenium	<0.0016	0.0016	<0.0021	0.0021	<0.0014	0.0014	<0.0016	0.0016
Silicon	<0.0015	0.0015	<0.002	0.0020	<0.0013	0.0013	<0.0015	0.0015
Silver	<0.0014	0.0014	<0.002	0.0020	<0.0014	0.0014	<0.0015	0.0015
Sodium	<0.0016	0.0016	<0.0021	0.0021	<0.0014	0.0014	<0.0016	0.0016
Strontium	<0.0018	0.0018	<0.0023	0.0023	<0.0016	0.0016	<0.0019	0.0019
Sulfur	<0.0019	0.0019	<0.0025	0.0025	<0.0018	0.0018	<0.002	0.0020
Tin	0.0174	0.0065	0.0499	0.0086	<0.0059	0.0059	0.0079	0.0066
Titanium	<0.008	0.0080	<0.0098	0.0098	<0.0074	0.0074	<0.0084	0.0084
Vanadium	<0.0004	0.0004	<0.0005	0.0005	<0.0004	0.0004	<0.0005	0.0005
Yttrium	<0.0006	0.0006	0.0013	0.0007	0.0006	0.0005	0.0010	0.0006
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	<0.0563	0.0563	<0.0504	0.0504	<0.0504	0.0504

Element	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3
	22-May-03		23-May-03		27-May-03	
	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)	Conc. (ug/m^3)	Det. Limit (ug/m^3)
Aluminum	0.0671	0.0163	0.0613	0.0150	0.0318	0.0133
Antimony	0.1408	0.0184	0.0911	0.0128	0.0364	0.0070
Arsenic	0.7118	0.0823	0.5325	0.0613	0.2458	0.0282
Barium	1.9769	0.2298	1.4442	0.1673	0.7121	0.0815
Beryllium	<0.0009	0.0009	<0.001	0.0010	<0.0009	0.0009
Boron	0.2160	0.0247	0.5142	0.0584	0.5217	0.0590
Bromine	0.0016	0.0012	0.0024	0.0011	<0.0011	0.0011
Cadmium	0.3046	0.0344	0.2393	0.0270	0.1282	0.0145
Calcium	0.5197	0.0587	0.4433	0.0500	0.1626	0.0184
Chlorine	0.0523	0.0028	0.0367	0.0021	0.0192	0.0012
Chromium	<0.0007	0.0007	0.0006	0.0005	<0.0004	0.0004
Cobalt	0.0007	0.0003	0.0005	0.0002	<0.0002	0.0002
Copper	0.0133	0.0009	0.0090	0.0008	0.0046	0.0006
Gallium	0.5113	0.0258	0.3475	0.0251	0.1922	0.0099
Germanium	<0.002	0.0020	<0.0015	0.0015	<0.0008	0.0008
Indium	<0.0002	0.0002	<0.0002	0.0002	<0.0003	0.0003
Iron	0.0012	0.0003	0.0010	0.0003	0.0012	0.0003
Lanthanum	0.0042	0.0004	0.0032	0.0003	0.0035	0.0004
Lead	<0.0007	0.0007	<0.0007	0.0007	<0.0008	0.0008
Magnesium	<0.0003	0.0003	<0.0003	0.0003	<0.0003	0.0003
Manganese	<0.0003	0.0003	<0.0003	0.0003	0.0007	0.0003
Mercury	<0.0002	0.0002	<0.0002	0.0002	0.0003	0.0003
Molybdenum	0.0027	0.0003	0.0027	0.0003	0.0043	0.0004
Nickel	0.0014	0.0003	0.0012	0.0003	<0.0003	0.0003
Palladium	0.0047	0.0004	0.0041	0.0004	0.0017	0.0004
Phosphorus	<0.0004	0.0004	0.0005	0.0003	<0.0004	0.0004
Potassium	0.0027	0.0005	0.0006	0.0004	<0.0005	0.0005
Rubidium	<0.0006	0.0006	<0.0006	0.0006	<0.0007	0.0007
Selenium	<0.0016	0.0016	<0.0015	0.0015	<0.0016	0.0016
Silicon	<0.0015	0.0015	<0.0014	0.0014	<0.0015	0.0015
Silver	<0.0015	0.0015	<0.0014	0.0014	<0.0016	0.0016
Sodium	<0.0016	0.0016	<0.0015	0.0015	<0.0017	0.0017
Strontium	<0.0019	0.0019	<0.0017	0.0017	<0.0019	0.0019
Sulfur	<0.0019	0.0019	<0.0018	0.0018	<0.0021	0.0021
Tin	<0.0062	0.0062	0.0161	0.0061	0.0104	0.0067
Titanium	<0.0079	0.0079	<0.0076	0.0076	0.0105	0.0085
Vanadium	<0.0004	0.0004	<0.0004	0.0004	<0.0005	0.0005
Yttrium	<0.0006	0.0006	0.0009	0.0005	<0.0006	0.0006
Zinc	<0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001
Zirconium	<0.0504	0.0504	<0.05	0.0500	<0.05	0.0500

·Applied Measurement Science·
Consultants in Quantitative Process and Environmental Measurements

TECHNICAL MEMORANDUM

EBAM and Partisol Cross-Calibration

Molycorp, Inc. Questa Division
Tailings Facility

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April 9, 2004

1.0 INTRODUCTION

As part of an evaluation of the EBAM PM10 monitoring instrument at the Questa Tailings Facility, a comparison/ and cross-calibration with the Federal Reference Method Partisol sampler was performed during the metals sampling program conducted in May, 2003. The report entitled “Molycorp, Inc., Questa Division, Results of PM10 Metals Monitoring at the Tailings Facility, May, 2003,” dated October 27, 2003 contains the details of the metals sampling program. However, the results of the intercomparison were not included in that report. The purpose of this technical memorandum is to document the results of that test.

2.0 COMPARISON TEST DESIGN

Since the EBAM is a relatively new instrument with little validation or performance data available, an evaluation test was deemed of value to ensure that the PM10 data being collected would meet general standards of scientific and regulatory acceptability. The metals testing program provided an opportunity to conduct a comparison test without major effort.

The test design was straight-forward: run the EBAM monitor as normal throughout the metals sampling program and use the gravimetric determination of PM10 as the standard against which the EBAM would be evaluated. The basis would be the 24-hour average from each sampler, with the Partisol sampler providing the reference concentration.

The average PM10 concentration was obtained as part of the metals sampling. The metals sampling was conducted using Partisol 2000 samplers, a filter-based PM10 sampler that is designated as a Federal Equivalent Method (FEM). A FEM sampler provides equivalent data to a Federal Reference Method.

Each of the three monitoring sites was configured with a Partisol sampler alongside the EBAM monitoring system. Figure 1 shows a photograph of the site set up.

Figure 1. Metals Sampler alongside PM10 Monitor

2.1 Field Events

As detailed in the metals report cited above, the metals testing was conducted between May 7 and 29, excluding Sundays and Mondays, for a total of 15 days of valid 24-hour data. Data was collected on a 24-hour basis, starting and ending approximately mid-day. The hourly data from the EBAMs were averaged over the same period as the integrated Partisol filter samplers to provide an average from each instrument. The samples were analyzed using x-ray fluorescence and ICP, as well as gravimetry, which was the basis for the PM10 concentration.

Both the EBAM and Partisols were calibrated or checked regularly. The EBAMs had just been returned from the factory after an equipment upgrade and calibration, so their operation was optimal, which was confirmed in the field. In addition, an extensive audit conducted in November, 2003—approximately 6 months after the metals testing—showed that the EBAMs were operating correctly at that time, so the May 2003 calibration checks showing good agreement were valid.

The Partisol had been calibrated at the rental facility before arrival at the Questa site, which was verified at the start of sampling. The flow rates were checked daily for at least the first week after commencement, weekly for the last two weeks, and then followed by a final check at the end of the sampling period. All calibration checks showed the samplers were within specifications. Therefore, it was concluded that the data obtained from the samplers was valid.

3.0 RESULTS AND DISCUSSION

The gravimetric 24-hour PM10 concentrations and the associated averaged hourly EBAM concentrations are shown in Table 1. All concentrations are in ug/m3.

Table 1. Partisol and EBAM Concentrations

	Site 1		Site 2		Site 3	
Date	**Partisol**	**EBAM**	**Partisol**	**EBAM**	**Partisol**	**EBAM**
6-May-03	NA	NA	13.3	13.1	21.4	24.4
7-May-03	14.0	15.4	18.7	23.6	17.1	29.1
8-May-03	16.1	20.5	18.4	18.4	33.1	46.7
9-May-03	35.3	35.2	40.4	47.1	33.8	48.7
12-May-03	11.1	11.1	13.9	10.4	14.6	16.3
13-May-03	8.4	10.1	9.5	6.7	9.1	7.8
14-May-03	9.3	11.2	8.9	8.7	19.8	27.3
15-May-03	30.3	39.8	32.9	42.9	37.2	49.2
16-May-03	10.2	14.8	10.3	8.1	11.2	11.7
19-May-03	Outlier	Outlier	26.1	29.3	89.7	136.3
20-May-03	12.9	15.0	13.2	12.8	14.4	12.7
21-May-03	12.6	24.8	13.0	8.6	17.2	12.6
22-May-03	15.5	17.0	16.6	14.6	19.7	53.4
23-May-03	16.8	18.0	19.5	16.8	18.5	22.9
27-May-03	12.5	15.2	12.2	11.2	12.5	14.0
Average	**17.0**	**18.6**	**17.8**	**18.2**	**24.6**	**34.2**

Figures 2-4 show the plots of the Partisol PM10 concentrations versus the EBAM PM10 24-hour averages. This type of comparison plot indicates the agreement between the two samplers. A slope of 1 indicates a perfect 1:1 comparison.

Figure 2. Site 1 Comparison Data

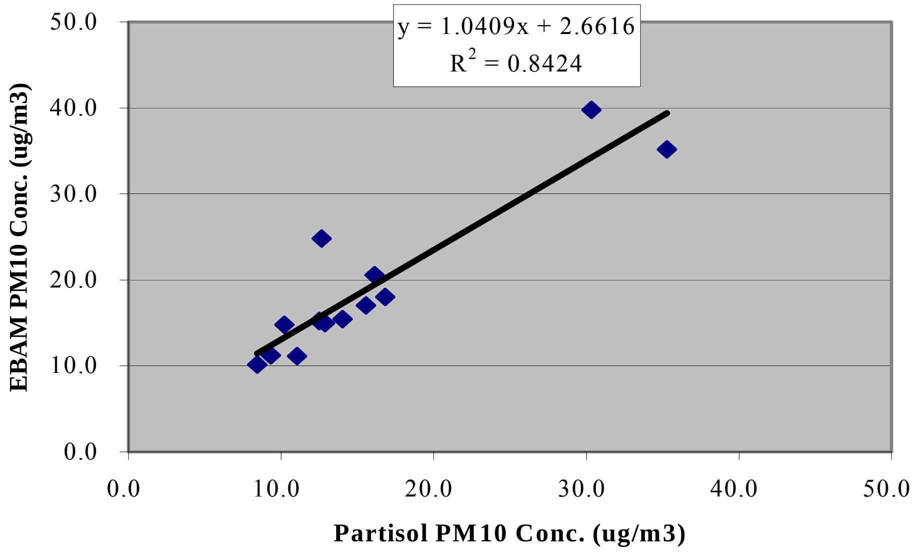

Figure 3. Site 2 Comparison Data

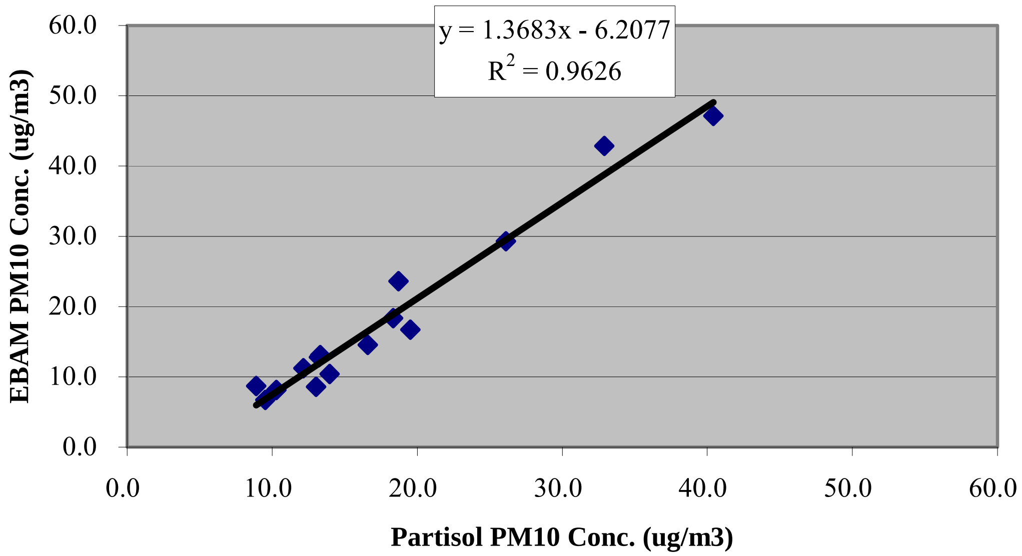

Figure 4. Site 3 Comparison Data

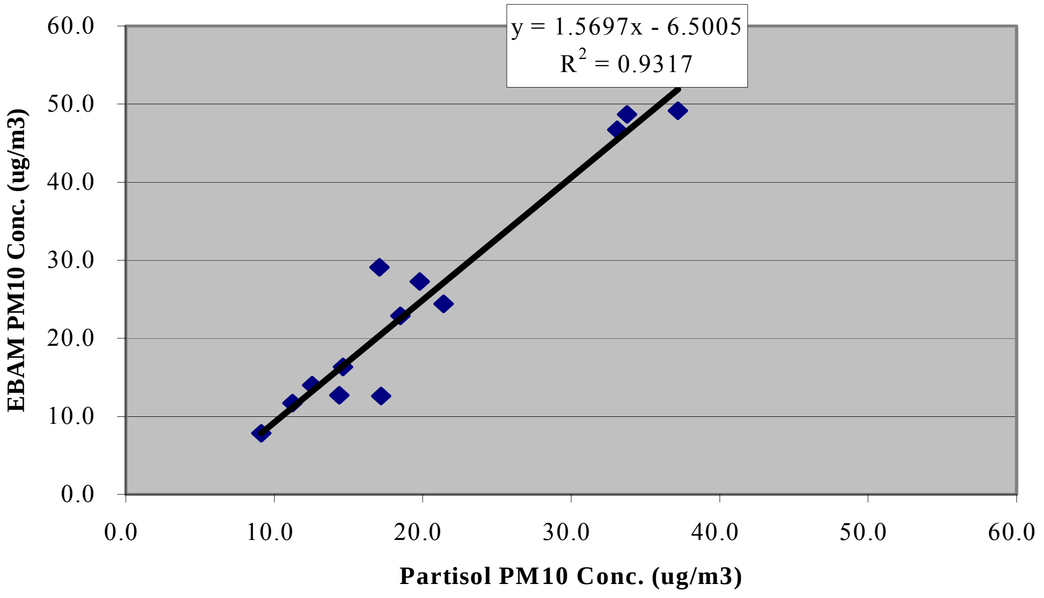

Table 2 contains a summary of the regression data for the three sites.

Table 2. Regression Data

Regression Data	
Site 1	
Slope	1.04
Intercept	2.66
Correlation (r)	0.92
Site 2	
Slope	1.37
Intercept	-6.2
Correlation (r)	0.98
Site 3	
Slope	1.57
Intercept	-4.4
Correlation (r)	0.96

The three factors listed in Table 2 all relate to the agreement between the EBAM instrument and the Partisol instrument that is serving as the standard for comparison.

The slope and intercept are both indications of the accuracy of the EBAM compared to the Partisol. A slope close to 1.0 shows a good accuracy. The intercept is an indication of the offset of the accuracy and should be viewed together with the slope. The correlation coefficient is an indicator of the degree of scatter in the two data sets. This scatter may be due to problems in either instrument, but since the daily values are plotted against each other, it is difficult to directly discern which instrument is causing the any additional variability.

Although there is no standard basis for acceptable agreement between two instruments, general guidance can be found in the standards contained in 40 CFR Part 53, Subpart C, the procedure for determining comparability between a candidate method and federal reference methods.

This standard is fairly strict, as it serves to establish that an instrument is equivalent to a federal reference method, thereby allowing it to provide data for compliance to air quality standards.

The criteria for acceptance for EPA method equivalence are: regression analysis between two sets of comparison data with a slope of 1±0.1, an intercept of 0 ±5 ug/m3, and a correlation coefficient (r) of ≥0.97. Another set of acceptance criteria are slightly different from these standards: 1±0.1, an intercept of 0±1 ug/m3, and a correlation coefficient of ≥0.95 (ref).

The results from the Questa comparison are mixed in relation to these criterion, but a key factor is that the correlation between the two methods is positive—the EBAM provides an equal or higher value for PM10. Therefore, at a minimum, the sensor would provide a greater level of protection from high concentrations that might occur because they would indicate a slightly higher value that

The level of correlation is consistent with the generally acceptable factor of agreement between two instruments of ±30%. This fits with the usual conservative approach for environmental protection. Other work is currently being conducted in relation to the EBAM evaluation that shows various levels of agreement between different instruments.[1] Therefore, until a complete understanding of the instrument response is obtained, the conservative approach obtained in this test will suffice for a conservative estimate of PM10 concentrations.

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[1] Winegar, Eric D, Scott G. Honan, "Field Evaluation of EBAM PM10 Monitor," Proceedings of the AWMA Air Quality Measurement Methods and Technology Symposium, Cary, NC, April 20, 2004.

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Consultants in Quantitative Process and Environmental Measurements

Final Report

Molycorp, Inc. Questa Division

Audit of Tailings Facility PM10 Monitoring Equipment

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March 15, 2004

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1.0 OBJECTIVES AND TECHNICAL APPROACH

The Questa Division of Molycorp, Inc. operates a tailings facility on the outskirts of the Village of Questa, New Mexico. A three-station PM10 monitoring network was installed in February-March 2003 for the purpose of monitoring air quality in the vicinity of the tailings operation. The purpose of this report is to present the results of a performance audit of the monitoring equipment for the operating period of March, 2003 to January, 2004. The goal of the performance audit was to determine the conformity of the meteorological and particular sensors to the original factory specifications.

The performance audit was conducted using the guidance in three EPA documents: "On-Site Meteorological Program Guidance for Regulatory Modeling Applications," EPA-450/4-87-013, and its updated version, "Meteorological Monitoring Guidance for Regulatory Modeling Applications," EPA-454/R-99-005, as well as "Quality Assurance Handbook on Air Pollution Measurement Systems, Volume IV: Meteorological Measurements," EPA-600/4-90-003. In addition, the specifications as listed in the EBAM and wind sensor manuals were consulted for operational specifications.

The performance audit was conducted on both the EBAM instrument PM10 monitoring functions as well as its meteorological monitoring functions. The PM10 functions included flow rate, ambient temperature, ambient pressure, pump operation, and detector zero and span. The meteorological monitoring functions that were audited included wind speed, wind direction linearity, and wind direction alignment. In addition, site records were examined for completeness and accuracy.

The performance audit was performed using both NIST-traceable secondary calibration standards as well as the collocated NIST-traceable transfer standard. The response of the sensors were compared to either equipment specifications or industry standards.

1.1 Location and Monitoring Sites Description

The Questa Tailings operation is located on the northwest side of the Village of Questa, New Mexico. Figure 1 shows the location of the three monitoring locations. The three monitoring locations were chosen based on downgradient conditions for the typical wind direction. Table 1 contains location information and the three locations are indicated on the map in Figure 1.

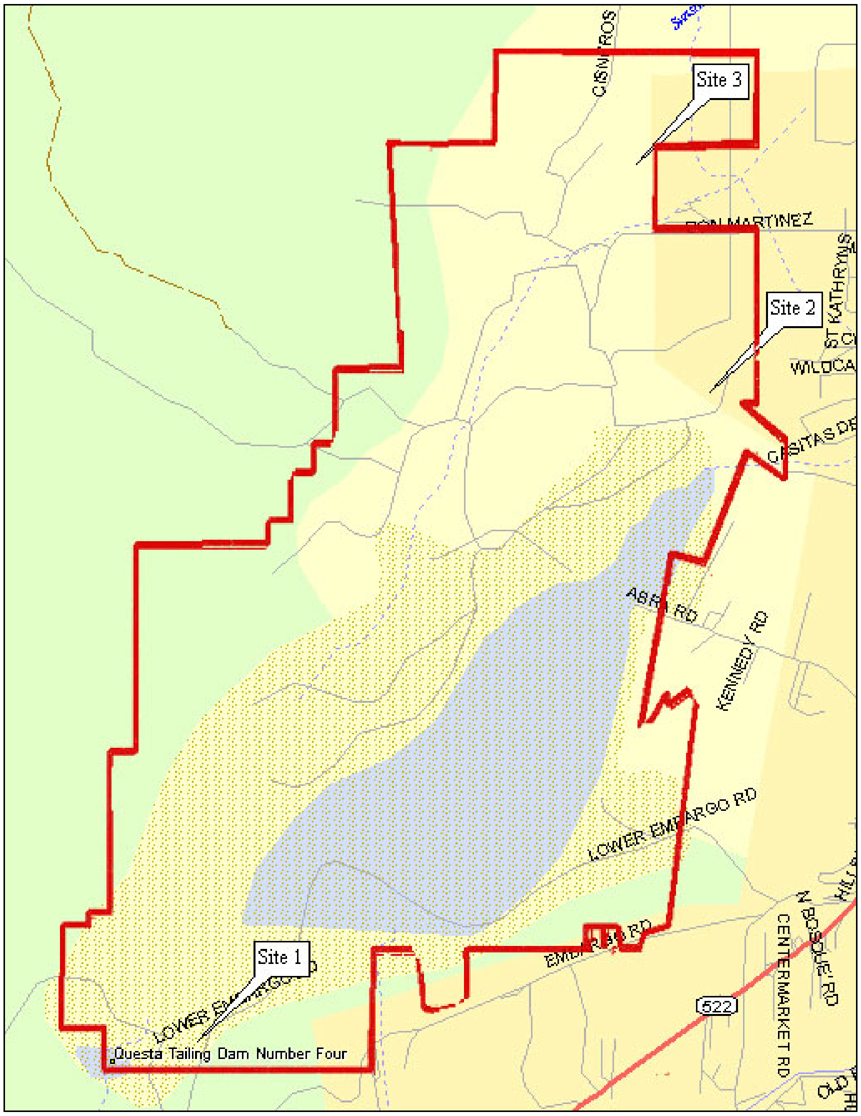

Figure 1. Questa Division Tailings Operation
(Boundaries Approximate)

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Table 1. Monitoring Site Information

PM10-1
36 41.755 N
105 37.787 W
13443792E
4061119N
7524 feet elevation
PM10-2
36 43.270 N
105 36.283 W
13446048E
4063904N
7650 feet elevation
PM10-3
36 43.803 N
105 36.510 W
13445717E
4064892N
7660 feet elevation
All lat/long use WGS84
UTM: NAD27

As can be seen from the elevation data, Site 1 is located approximately 125 feet below the main plateau of the tailings where Sites 2 and 3 are located. In addition, this site is on the edge of the southern boundary of the main tailings dam which is located in an arroyo (canyon). This relatively isolated location is on the southern boundary of the tailings operations along the prevailing southwesterly wind direction. With this orientation and the relative distance from the major sources of fugitive dust, this site therefore was considered as representative of dust contributions from the operation to the south. Sites 2 and 3 are located to the north and northeast of the property, near the fence line in the prevailing wind directions.

1.2 Description of the Monitoring Equipment

The MetOne Instruments, Inc. EBAM (Environmental Beta Attenuation Monitor) is based on the same beta attenuation technology that is used in the BAM 1020 monitor, an EPA federal reference equivalent method. The beta attenuation technique uses a small amount of Carbon-14 radioisotope as a source of beta particles that are absorbed by aerosol material collected on a continuous quartz fiber tape. A photomultiplier detector measures the attenuated (decreased) signal from the aerosol that is proportional to the mass collected. From the volume of air collected and that mass, the concentration is determined. The size fraction measured is determined by the type of separation inlet used.

The EBAM differs from the BAM instrument primarily in the absence of an automated zero and span calibration function. Therefore, this function must be performed manually at a prescribed interval. This interval is recommended by MetOne to be six months.

As an adjunct to the PM10 concentration, wind speed and wind direction data can be collected. This allows the direct comparison of the measured particulate concentration with the wind data.

The wind speed and direction sensor used are the MetOne 034B sensor set. This sensor set is configured with the wind speed hub collocated with the spindle of the anemometer. While this allows for a compact physical arrangement, this configuration prevents a full audit to be performed in the field, per standard practice. Therefore, as discussed below in detail, instead of the torque wrench technique for assessing wind speed threshold, the collocated transfer standard method was used to assess the performance of the wind speed sensors.

1.3 Description of the Performance Audit Procedures

1.3.1 Wind Speed Collocated Transfer Standard

As cited above, the configuration of the EBAM wind sensors does not allow an easy in-field calibration check using the usual torque wrench equipment. In lieu of this approach, as allowed in the EPA guidance noted in the Introduction, the collocated transfer standard (CTS) approach was used. The CTS approach uses a second carefully calibrated anemometer located in the vicinity of the subject anemometer being audited. The comparison of the identically-timed output of the two sensors is used to provide the assessment of the function of the subject anemometer. The audit anemometer was an identical model 034B that had not previously been deployed in the field, coming directly from the factory with its original factory calibration. This anemometer was placed on the same sensor arm as the subject anemometer and connected to a Campbell Scientific CR10X data logger. Both the EBAM data logger and the CR10X data loggers were synchronized and averaging period set to one minute to allow for a larger number of data points for comparison. The two sensors were left for periods ranging from 6 to 14 hours to collect data.

The subsequent data analysis consisted of a graphical and statistical comparisons. Both the time series of the two anemometers as well as the one-to-one comparison were performed. The statistical comparison consisted of calculating linear regression of the two data sets as well as a calculation of the standard deviation of the difference between the two sensor data.

The evaluation of performance was made based on the visual graphic comparison, the line fitting parameters (slope and correlation coefficient), and the standard deviation of the differences between the two sensor readings.

1.3.2. Wind Direction Linearity and Alignment

The wind direction sensor performance was assessed using two types of directional sensors: a portable transit and a global positioning sensor (GPS). The transit was used with a portable non-magnetic tripod to align the compass with true north, which had been determined from the site location and tabulations of magnetic declination. Furthermore, the GPS provided confirmation of that determination. In addition, the GPS tracing method was used as a secondary method to the transit compass. In this method, the GPS is used to trace a transit out to a distant object along a north-south path that corresponds with the sensor axis.

The linearity of the sensor was assessed by using a linearity calibration fixture.

1.3.3 EBAM Measurement System

The EBAM instrument embedded software contains two main internal check procedures. The first is an automatic system check that occurs whenever the system is initiated. The second consists of a series of interactive tests that examine the various operation parameters: flow system leak test, temperature sensor, pressure sensor, flow rate, and detector zero/span.

2.0 RESULTS AND DISCUSSION

The introductory portion of this section presents the data and discussion, followed by the tables and figures.

Tables 2-4 contain the results from the audit procedures at Sites 1 to 3, respectively. Figures 2-10 show the collocated transfer standard data, the time series collocated data, and the wind rose for each of the three stations, respectively. Discussion related to these data tables and figures are contained in the following sections.

2.1 PM10 Sensor Functions

For all three stations, the basic audit functions were all satisfactory, indicating correct operation within factory specifications:

- Leak check: all PASS, less than 0.5 LPM
- Pressure check: all PASS, within 2 mm Hg
- Flow Rate: all PASS, within 2% of set point
- Span Membrane: all PASS, within internal automatic specifications

For the particularly critical flow rate parameter, the calibrations all showed satisfactory agreement with the audit instrument.

2.2 Meteorological Sensors

2.2.1 Wind Speed

The usual procedure for a wind speed is two-fold--to assess the accuracy of the wind speed transfer function, and to assess the starting threshold of the sensor. As noted above, the wind speed sensor was audited using the collocated transfer standard (CTS) method due to difficulties in conducting the standard audit procedure in the field for this type of wind sensor. The collocated transfer function procedure is intended to provide an implicit check on both functions. For the starting threshold, the overall satisfactory comparison between the audit and subject sensors implies an adequate performance.

The expectation was that the sensors would easily pass any audit test due to their status as relatively new instruments, having been in operation only approximately six months in a relatively gentle environment. The execution of the field test was satisfactory, but the wind speed audit data collected were difficult to interpret. However, the data were inconclusive, suggesting that the CTS procedure used was not adequate to do a rigorous assessment.

The major reason the CTS approach appears to be inadequate was the lack of precise agreement of the hourly values from the two sensors. Although the two anemometers were placed close to one another and the wind speed data were collected with synchronized clocks (as best as could done) and identical averaging periods as specified in the CTS guidance, the agreement between the two sensors was not as good as expected. The linear regression showed slopes of 1.004, 0.949, and 1.02 for Sites 1 through 3, respectively, suggesting accuracies of 100%, 95%, and 102%. These values are in themselves satisfactory. However, the correlation coefficients (r^2) were only 0.877, 0.893, and 0.823 for Sites 1 through 3 respectively, suggesting a relatively large amount of scatter. The somewhat small correlation coefficients are due to the relatively large degree of scatter between the two data sets.

Though the cause is not known, a possible reason for the lack high agreement is the interference of the EBAM sensor body that was located physically between the two sensors on the same boom. The standard configuration for the wind sensors on the EBAM stand does not conform completely to standard siting guidance such as isolation from other structures, and a sufficient height above the ground, etc. Because of the overall equipment purpose and configuration, it appears that the lack of agreement between the two sensors may be related to that configuration. Another possible reason is an inaccuracy in the timing between the two loggers. However, because the met sensor logger channels are embedded in the entire EBAM set up, they are not as directly accessible as a stand-alone logger. Therefore, the relatively inaccurate synchronization of setting the system clocks manually was performed.

In addition to the slope of the line and the correlation coefficient, another suggested criterion of agreement for two sensors is the standard deviation of the difference between two data sets. If the value is less than or equal to 0.2 m/s, the two sensors are deemed to be operating equivalently. In this case, the standard deviation ranged between 0.4 to 0.7 m/s—above the criterion of 0.2 m/s.

The time series wind speed plots show a visually satisfactory representation of agreement, with some deviations at low and high speeds. However, the low speed deviations are due to the differences in data logger voltage input thresholds. These low-level deviations were removed from the linear regression analysis, and are represented as the data set containing only data greater than 1 mph.

The overall conclusion from the regression data as described above is that the agreement between the two sensors was adequate, suggesting the subject sensor is still operating within the permissible operating limits. The scatter between the two data sets is concluded to be due to the orientation of the two sensors as well as the probable timing differences between the two data loggers.

While the starting threshold is not directly examined as part of the CTS procedure, if the audit sensor that meets the original threshold specification is in agreement with the subject sensor, then it is implied that the subject sensor meets those same specifications. As with the wind speed determination, the adequate starting threshold level is implicit with overall good agreement between the audit and subject anemometers.

Therefore, while the CTS procedure suggested that the wind speed sensor did not meet strictly meet some of the specific recommended acceptance criteria, the mitigating factors described above suggests the overall evaluation was satisfactory. The overall conclusion from the evaluation of the wind data collection system is that it satisfactorily meets the intended objectives of the program.

2.2.2 Wind Direction

While the wind direction sensor itself showed adequate response for linearity, deviations in wind direction were noted during the re-alignment of the direction sensors. This was due to a deviation in the mounting bracket, not any issue with the sensor itself. While Stations 1 and 3 showed small deviations, Station 2 was the furthest out of alignment, approximately 18 degrees. This is likely due be to handling of the wind and temperature sensor boom that occurred during a maintenance operation during the fall of 2003.

The wind roses show some slight differences between the sites. In particular, the Site 2 data set suggests some rotation of the data, which confirms the directional offset that was noted. The other differences were small and probably due to the site characteristics.

The key features in these data are the dominant wind direction and the magnitude of the wind speed. The southwesterly direction is shown to be the dominant direction, followed by the northeasterly direction. The characteristics at Site 1 are slightly different than at Sites 2 and 3, which is not unexpected since the surrounding terrain for that site is somewhat different than the others. The Station 1 topography is such that the site is below the grade of the other locations and is located on a plateau along a fairly steep incline between two hills. Therefore, the wind data from this site should be used with caution and may only reflect localized conditions. Site 3 is closest to standard wind sensor siting guidelines, although it should be noted that the height is only approximately 6.5 feet above the ground surface, which is below most specifications for regulatory meteorological data collection. These systems were placed to provide trends related to the localized wind pattern that might affect the PM10 data collected at the EBAM systems.

2.3 Site 1 Data

Table 2. Audit Results for Site 1

EBAM Audit Report				
Station Location	Questa			
Instrument Serial Number	B6581			
Location	Site 1			
Date	11/20/2003			
PM10 Sensor Tests				
1. Leak Test	Flow	Pressure	Criterion	Status
Units: LPM	0.2	30000	<1.5	PASS
Units: Pascal				
2a. Temperature-Low	EBAM	REF	Calibration	Status
Units: Degrees C	7.1	-30	7.1	PASS
2b. Temperature-High	Did not perform—too cold.			N/A
3. Pressure	EBAM	REF	Calibration	Status
Units: pascals	77727	120000	57700	Pass
4. Flow	Setting	Indicated	Reference	Calibration
Units: LPM	17.5	17.5	17.2	17
	14	14	14	13.72
	16.7	16.7	16.7	16.7
	Status	PASS		
5. Membrane Calibration	S/N B6581	B6581	Status	PASS

Table 2 continued.

Meteorological Sensors				
Wind Speed Sensor	Model	034B	S/N	C01063
1. Wind Direction				
Alignment	Declination	10 degrees	Aligned to true north.	
	Alignment methods			
	Magellan Meridian GPS, using transit method			
	Brunton Pocket Transit, model E5008, S/N 5080903000			
Linearity	Setting	Reading		
	0	0		
	90	91		
	180	179		
	270	270		
2. Wind Speed	Reference Sensor:		MetOne 034B, S/N A5477	

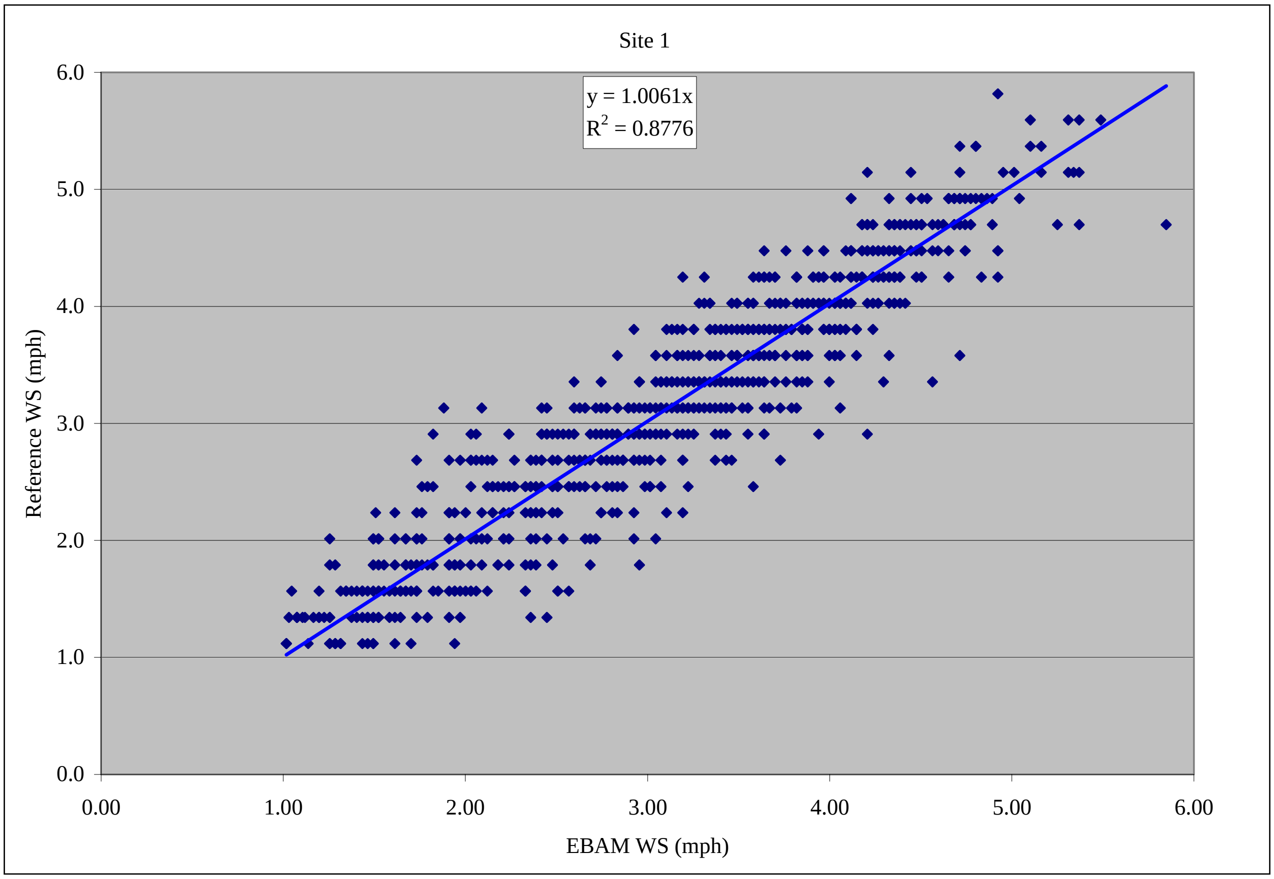


Figure 2. Site 1 Wind Speed Collocated Transfer Standard Data

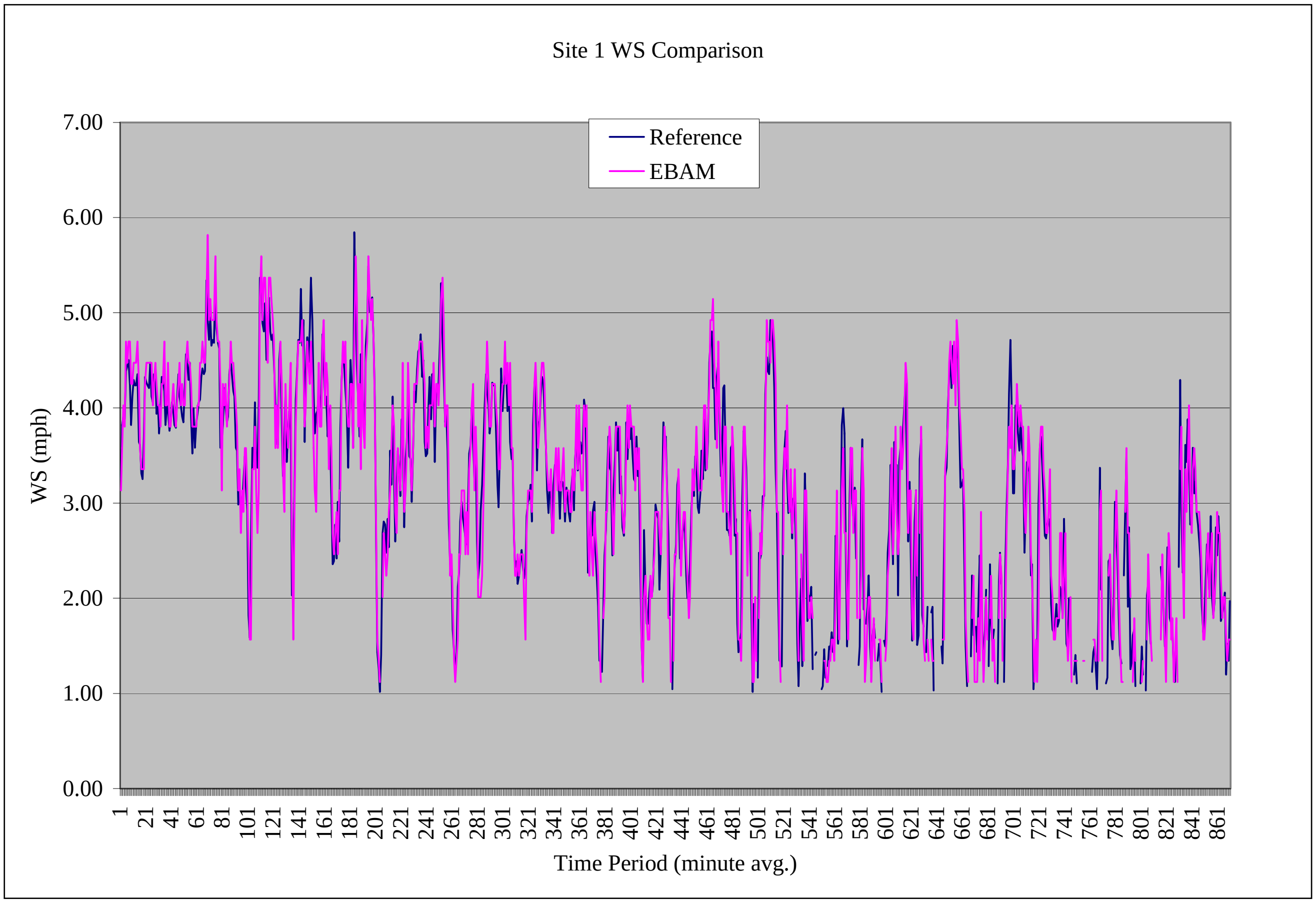


Figure 3. Site 1 Time Series Wind Speed Collocated Transfer Standard Data

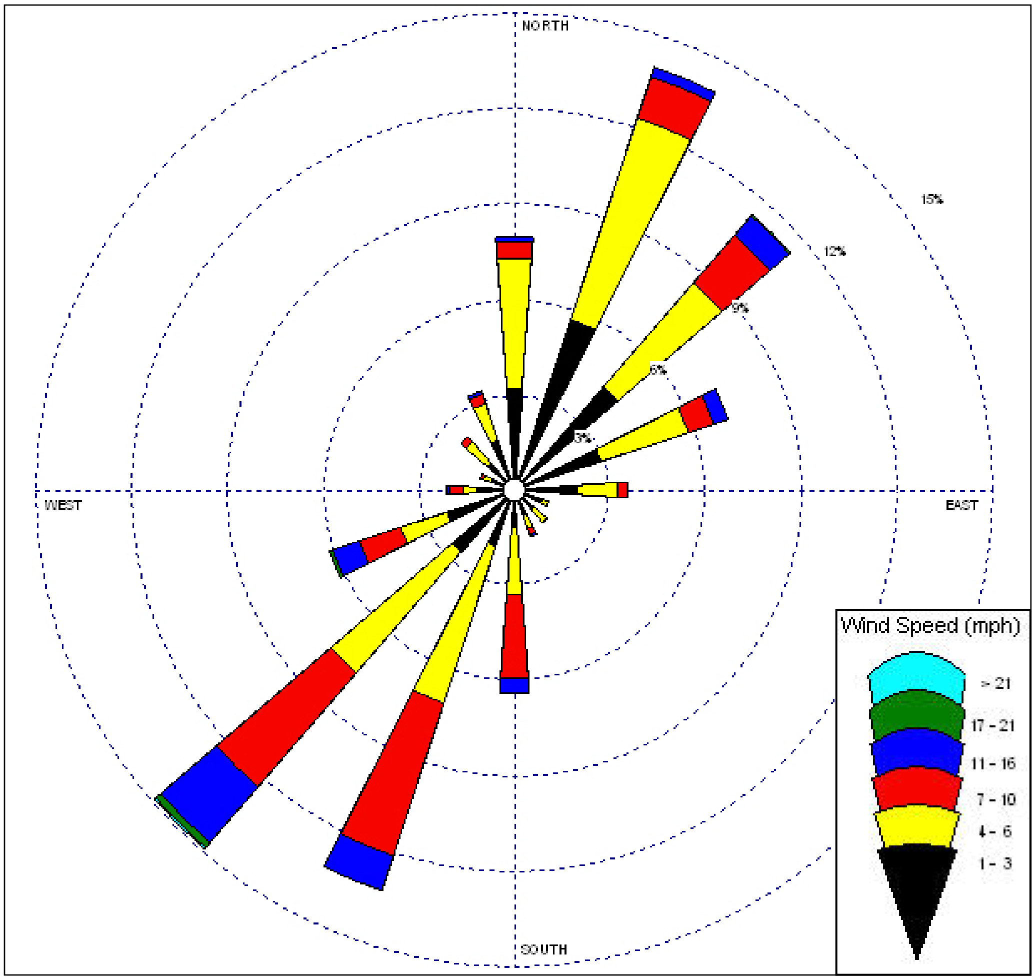


Figure 4. Site 1 Wind Rose

2.4 Site 2 Data

Table 3. Audit Results for Site 2

EBAM Audit Report				
Station Location	Questa			
Instrument Serial Number	B6583			
Location	Site 2			
Date	11/19/2003			
PM10 Sensor Tests				
1. Leak Test	Flow	Pressure	Criterion	Status
Units: LPM	0.2	30000	<1.5	PASS
Units: Pascal				
2a. Temperature-Low	EBAM	REF	Calibration	Status
Units: Degrees C	5.6	-30	5.6	PASS
2b. Temperature-High	Did not perform--too cold.			N/A
3. Pressure	EBAM	REF	Calibration	Status
Units: pascals	76926	80000	57700	Pass
4. Flow	Setting	Indicated	Reference	Calibration
Units: LPM	17.5	17.5	17.5	16.75
	14	14	14	13.54
	16.7	16.6	16.6	16.7
	Status	PASS		
5. Membrane Calibration	S/N	B6581	Status	FAIL
	S/N	B6581	Status	PASS

Table 3 continued.

Meteorological Sensors				
Wind Speed Sensor	Model	034B	S/N	C1064
1. Wind Direction				
Alignment	Declination	10 degrees	Aligned to true north.	
	Alignment methods			
	Magellan Meridian GPS, using transit method			
	Brunton Pocket Transit, model E5008, S/N 5080903000			
Linearity	Setting	Reading		
	0	0		
	90	91		
	180	180		
	270	270		
2. Wind Speed	Reference Sensor:		MetOne 034B, S/N A5477	

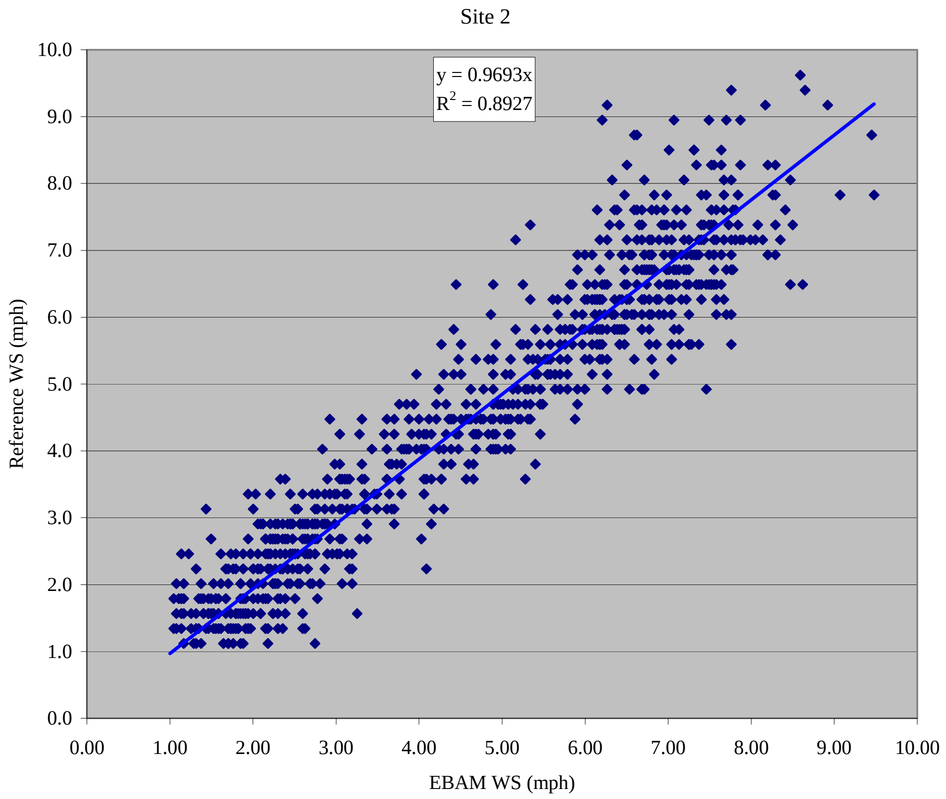


Figure 5. Site 2 Wind Speed Collocated Transfer Standard Data

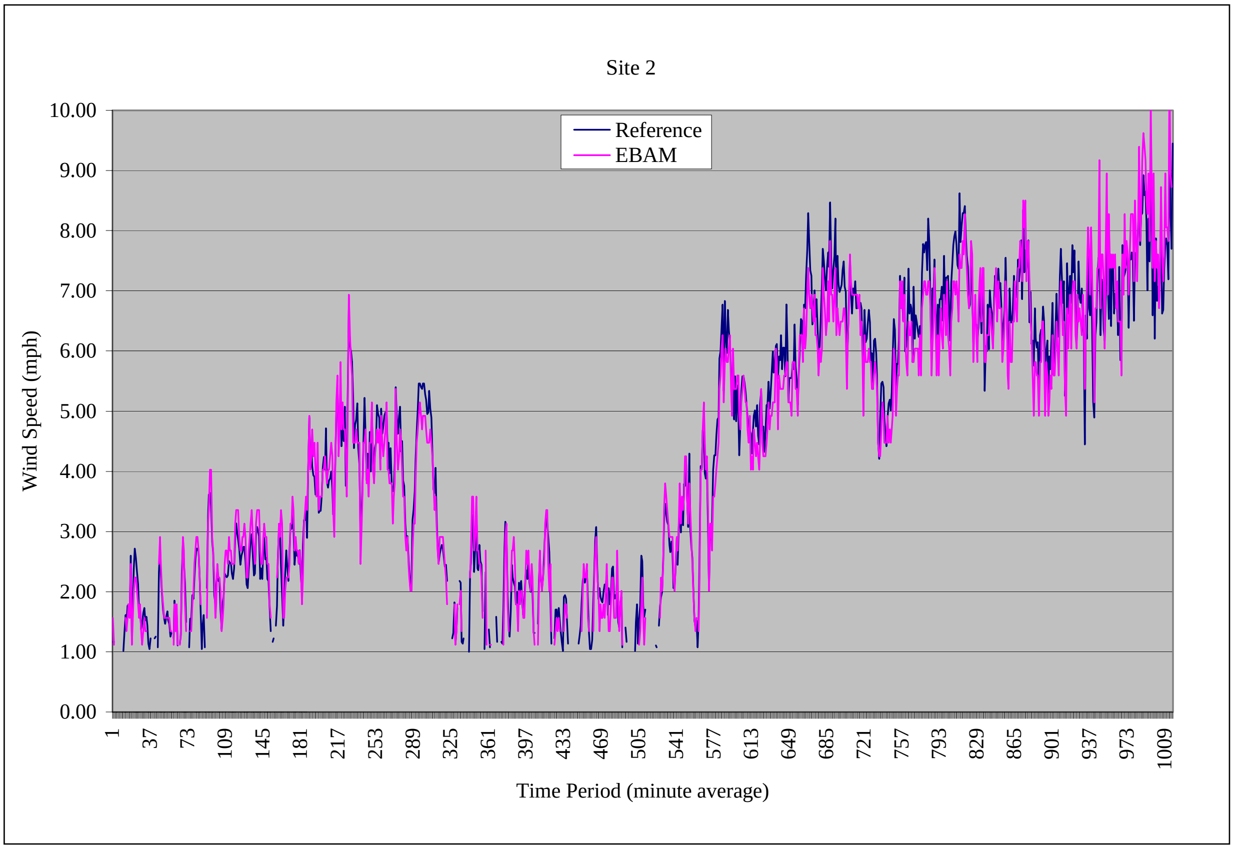


Figure 6. Site 2 Time Series Wind Speed Collocated Transfer Standard Data

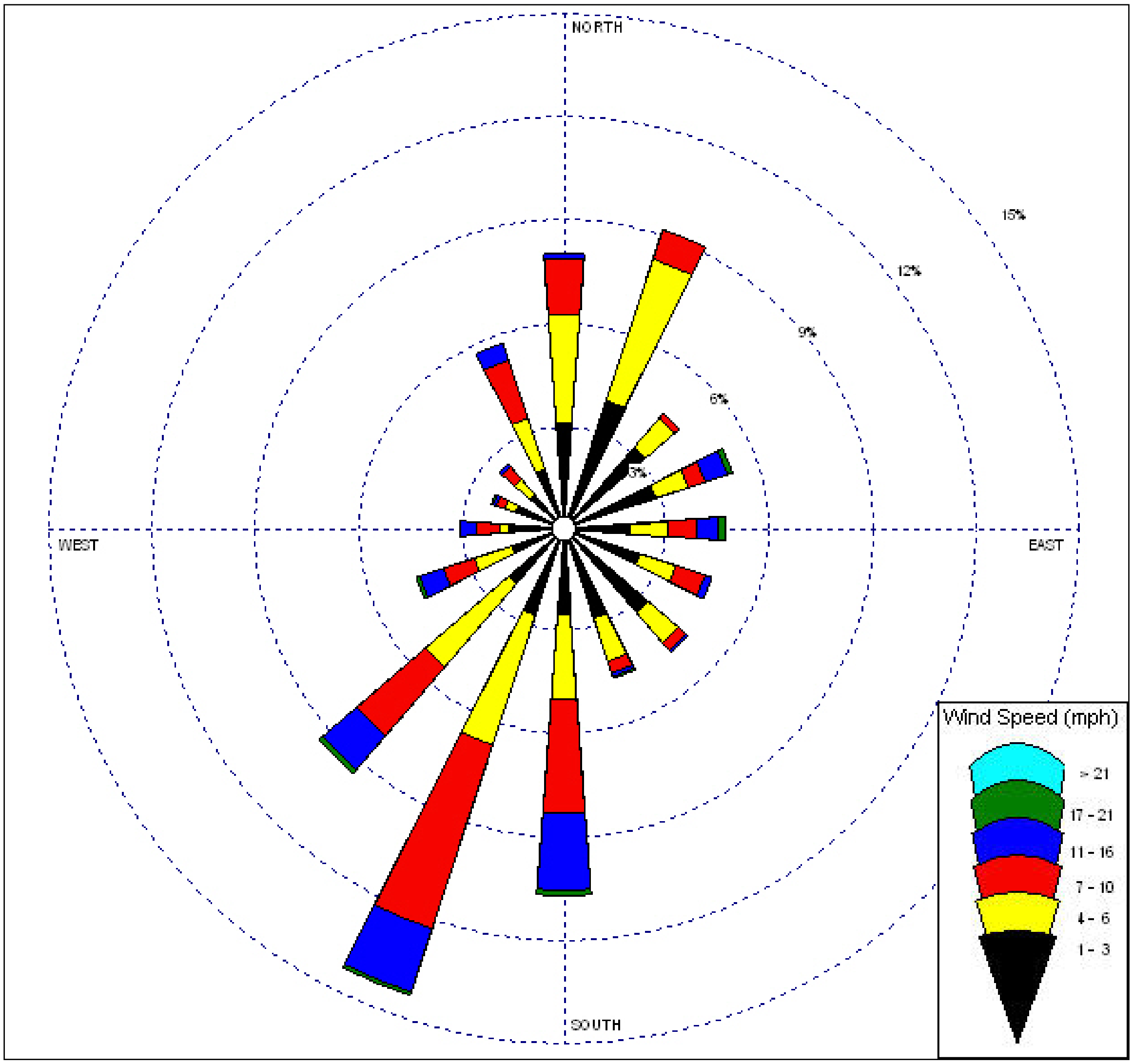


Figure 7. Site 2 Wind Rose

2.5 Site 3 Data

Table 4. Audit Results for Site 3

EBAM Audit Report				
Station Location	Questa			
Instrument Serial Number	B4336			
Location	Site 3			
Date	11/19/2003			
PM10 Sensor Tests				
1. Leak Test	Flow	Pressure	Criterion	Status
Units: LPM	0.4	30000	<1.5	PASS
Units: Pascal				
2a. Temperature-Low	EBAM	REF	Calibration	Status
Units: Degrees C	2.4	-30	2.8	PASS
2b. Temperature-High	Did not perform--too cold.			N/A
3. Pressure	EBAM	REF	Calibration	Status
Units: pascals	77727	120000	58300	Pass
4. Flow	Setting	Indicated	Reference	Calibration
Units: LPM	17.5	17.5	17.8	17.15
	14	14	13.9	13.8
	16.7	16.6	16.7	16.6
	Status	PASS		
5. Membrane Calibration	S/N	B6581	Status	PASS

Table 4 continued.

Meteorological Sensors				
Wind Speed Sensor	Model	034B	S/N	C1160
1. Wind Direction				
Alignment	Declination	10 degrees	Aligned to true north.	
	Alignment methods			
	Magellan Meridian GPS, using transit method			
	Brunton Pocket Transit, model E5008, S/N 5080903000			
Linearity	Setting	Reading		
	0	0		
	90	90		
	180	180		
	270	270		
2. Wind Speed	Reference Sensor:		MetOne 034B, S/N A5477	

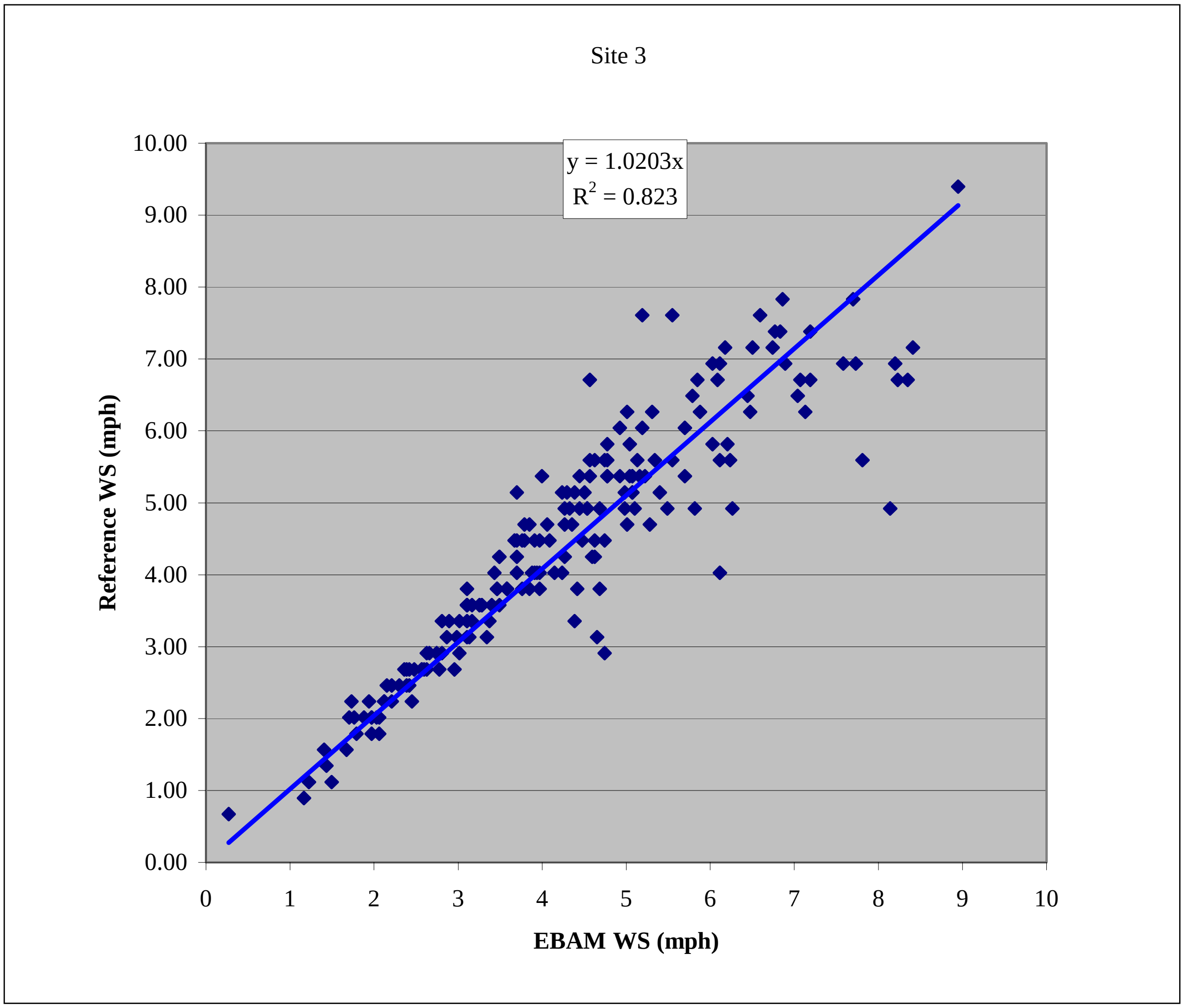


Figure 8. Site 3 Wind Speed Collocated Transfer Standard Data

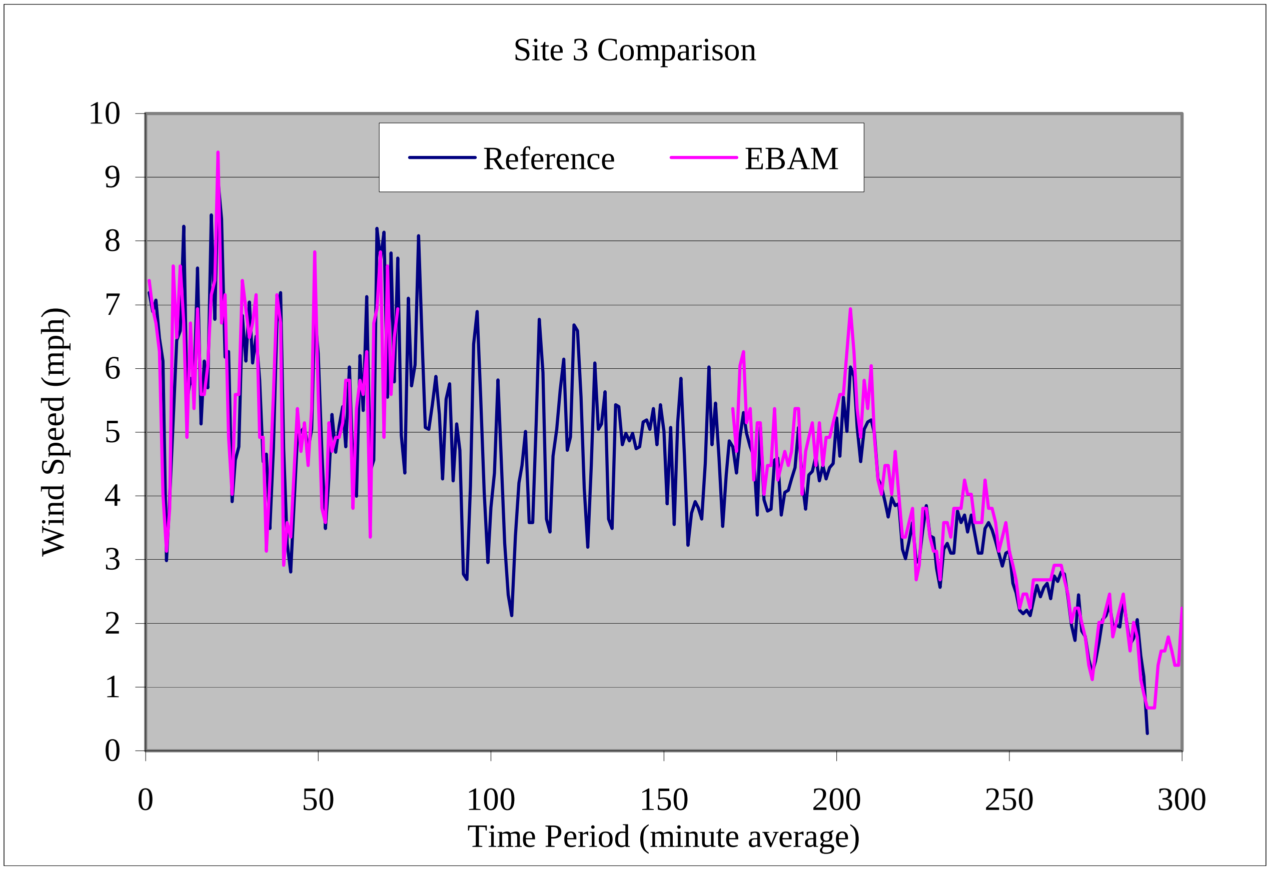


Figure 9. Site 3 Time Series Wind Speed Collocated Transfer Standard Data

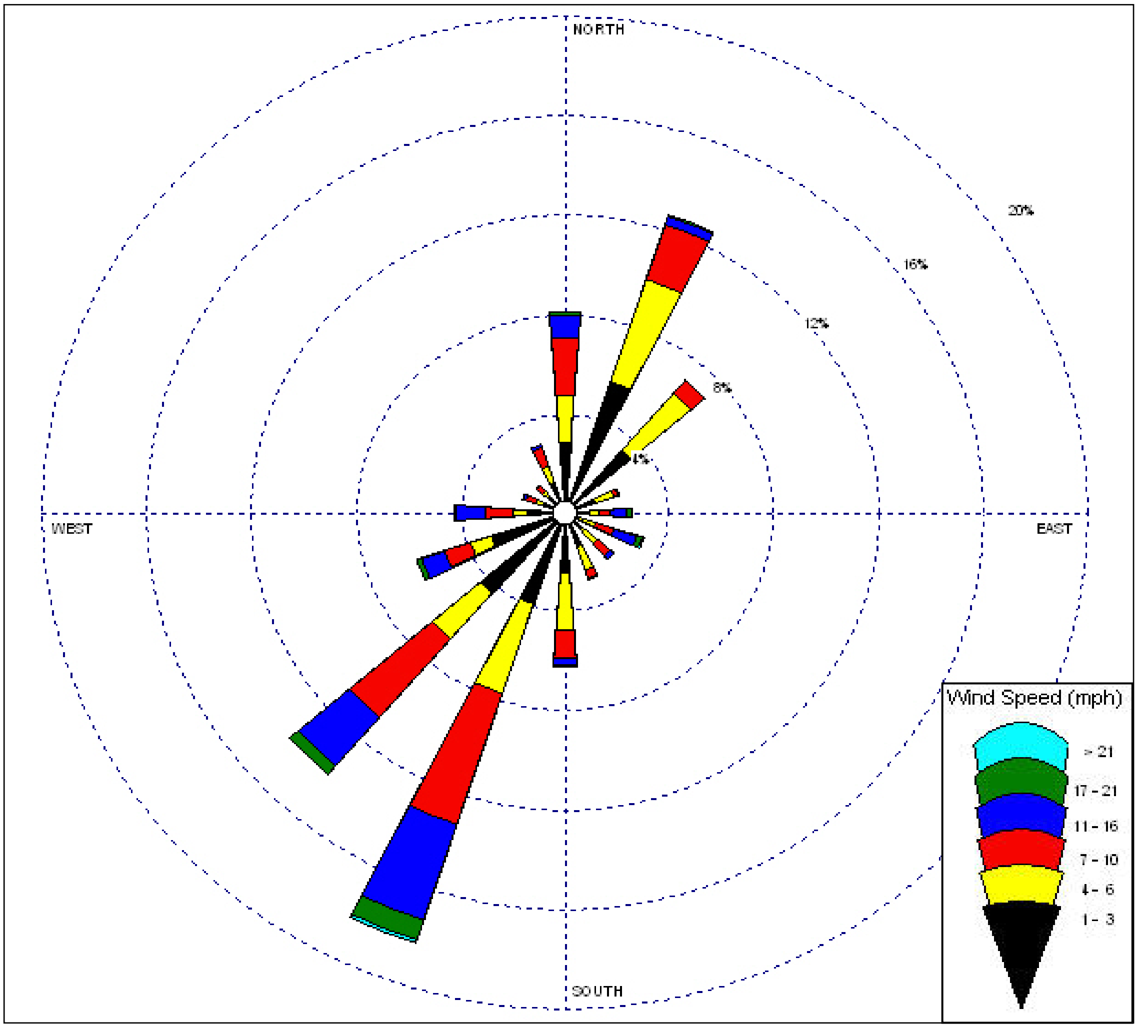


Figure 10. Site 3 Wind Rose

2.3 Site Log Books

Each site has a log book for recording events that occur at the site. It appears that most events are noted appropriately, but it is evident that some download visits and activities were not noted, as some downloaded data were missing due to the location of that downloaded data having not been noted. It is recommended that the log books be used for notations related to any site activities.

2.4 Audit Recommendations

Two recommendations arose out of the audit procedures:

1. Wind Speed and Direction Sensor Calibration. Due to the observed issues with the CTS approach, it is recommended that future audits of the wind speed and direction sensor be conducted by returning the unit to the factory for recalibration. Since the wind speed and direction data for the three locations are quite similar, the data from one of the other sites could easily be substituted for the missing sensor during that downtime.

2. Log Book. Additional effort should be directed towards ensuring that all site activities are documented in the EBAM logbooks.

3.0 CONCLUSIONS

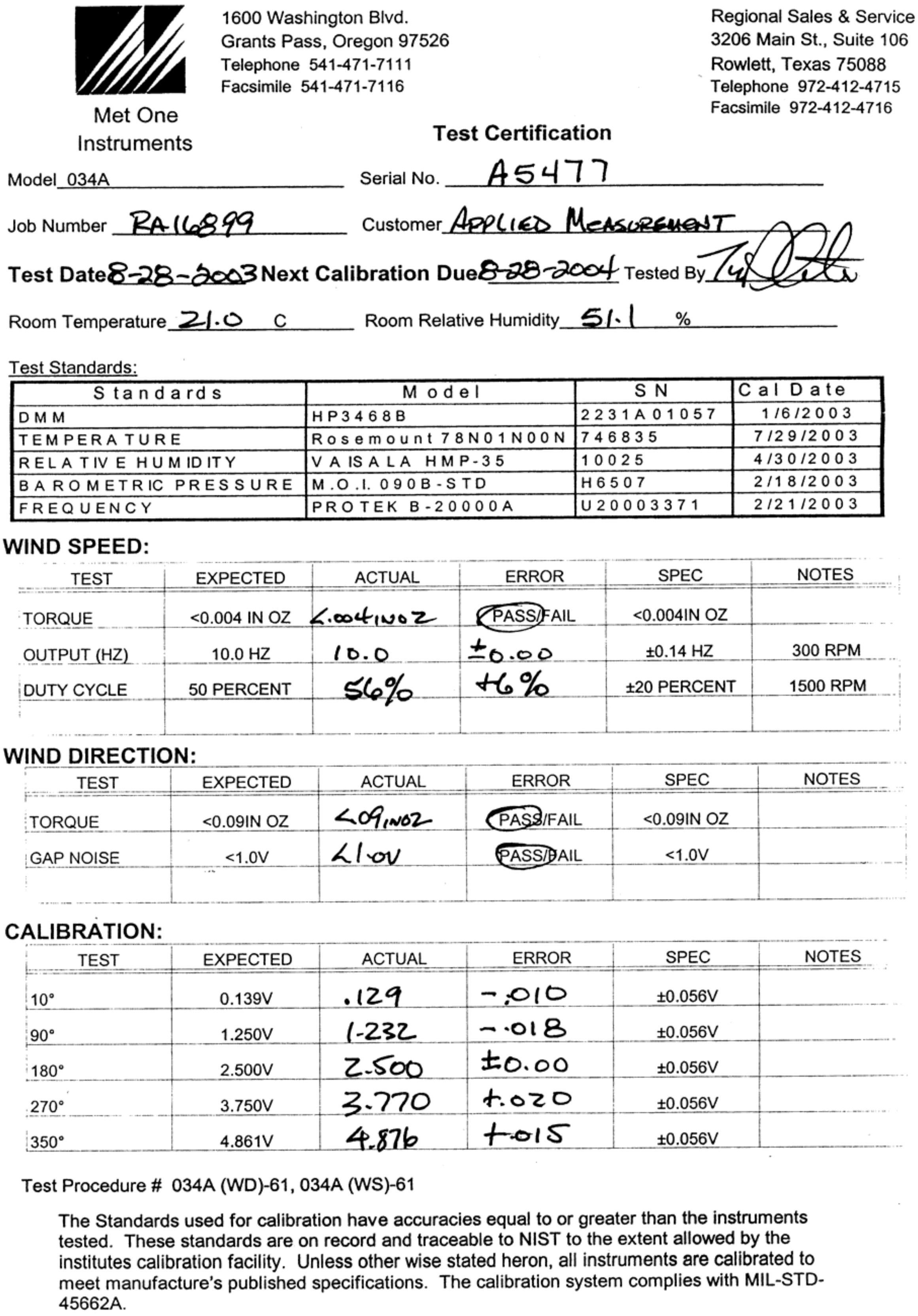
The findings of the EBAM PM10 sensor and meteorological sensors showed the following:

1. The EBAM PM10 monitoring equipment is operating within factory and/or EPA specifications.
2. The meteorological sensors are operating within specifications. One recommendation was made concerning future calibration events.

The overall conclusion is that the EBAM monitoring system meets operating specifications and is operating as expected.

Appendix

Calibration Certificates



Met One Instruments

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Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 972-412-4715
Facsimile 972-412-4716

Test Certification

Model 034A

Serial No. A5477

Job Number RA16899

Customer APPLIED MEASUREMENT

Test Date 8-28-2003 **Next Calibration Due** 8-28-2004 Tested By

Room Temperature 21.0 C

Room Relative Humidity 51.1 %

Test Standards:

Standards	Model	SN	Cal Date
DMM	HP3468B	2231A01057	1/6/2003
TEMPERATURE	Rosemount 78N01N00N	746835	7/29/2003
RELATIVE HUMIDITY	VAISALA HMP-35	10025	4/30/2003
BAROMETRIC PRESSURE	M.O.I. 090B-STD	H6507	2/18/2003
FREQUENCY	PROTEK B-20000A	U20003371	2/21/2003

WIND SPEED:

TEST	EXPECTED	ACTUAL	ERROR	SPEC	NOTES
TORQUE	<0.004 IN OZ	<.004 IN OZ	[✓ PASS]/FAIL	<0.004IN OZ	
OUTPUT (HZ)	10.0 HZ	10.0	±0.00	±0.14 HZ	300 RPM
DUTY CYCLE	50 PERCENT	56%	+6%	±20 PERCENT	1500 RPM

WIND DIRECTION:

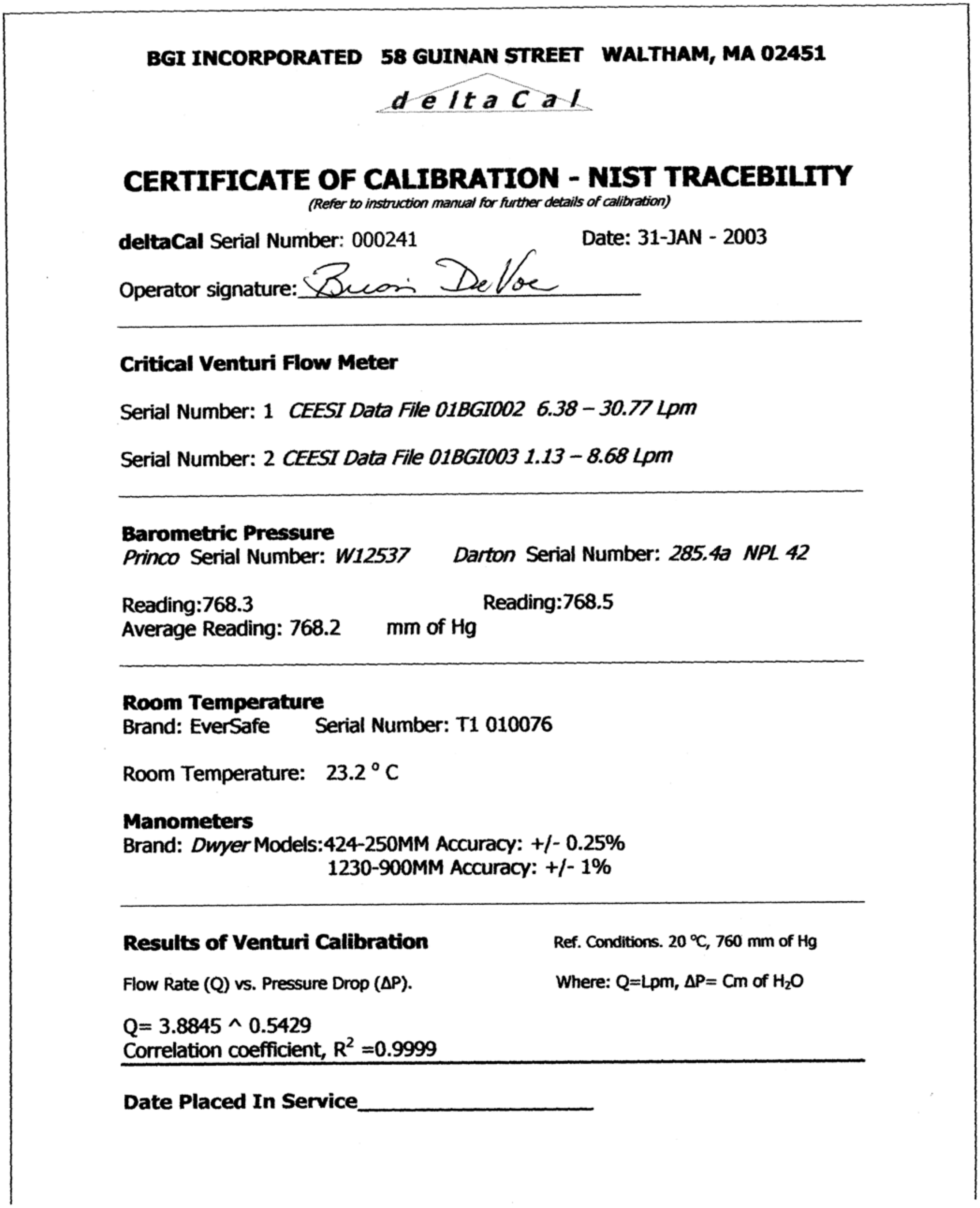
TEST	EXPECTED	ACTUAL	ERROR	SPEC	NOTES
TORQUE	<0.09IN OZ	<.09 IN OZ	[✓ PASS]/FAIL	<0.09IN OZ	
GAP NOISE	<1.0V	<1.0V	[✓ PASS]/FAIL	<1.0V	

CALIBRATION:

TEST	EXPECTED	ACTUAL	ERROR	SPEC	NOTES
10°	0.139V	.129	-.010	±0.056V	
90°	1.250V	1.232	-.018	±0.056V	
180°	2.500V	2.500	±0.00	±0.056V	
270°	3.750V	3.770	+.020	±0.056V	
350°	4.861V	4.876	+.015	±0.056V	

Test Procedure # 034A (WD)-61, 034A (WS)-61

The Standards used for calibration have accuracies equal to or greater than the instruments tested. These standards are on record and traceable to NIST to the extent allowed by the institutes calibration facility. Unless other wise stated heron, all instruments are calibrated to meet manufacture's published specifications. The calibration system complies with MIL-STD-45662A.



BGI INCORPORATED 58 GUINAN STREET WALTHAM, MA 02451

deltaCal

CERTIFICATE OF CALIBRATION - NIST TRACEBILITY

(Refer to instruction manual for further details of calibration)

deltaCal Serial Number: 000241 Date: 31-JAN - 2003

Operator signature: Brian DeVoe

Critical Venturi Flow Meter

Serial Number: 1 *CEESI Data File 01BGI002 6.38 – 30.77 Lpm*

Serial Number: 2 *CEESI Data File 01BGI003 1.13 – 8.68 Lpm*

Barometric Pressure

Princo Serial Number: *W12537* *Darton* Serial Number: *285.4a NPL 42*

Reading:768.3 Reading:768.5

Average Reading: 768.2 mm of Hg

Room Temperature

Brand: EverSafe Serial Number: T1 010076

Room Temperature: 23.2 ° C

Manometers

Brand: *Dwyer* Models:424-250MM Accuracy: +/- 0.25%

1230-900MM Accuracy: +/- 1%

Results of Venturi Calibration Ref. Conditions. 20 °C, 760 mm of Hg

Flow Rate (Q) vs. Pressure Drop (ΔP). Where: Q=Lpm, ΔP= Cm of H_2O

Q= 3.8845 ^ 0.5429

Correlation coefficient, R^2 =0.9999

Date Placed In Service____________________