VAIL NOISE MEASUREMENTS 2004 - 2008

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PROJECT:	Town of Vail Noise Measurements
DATE:	December 1, 2008

Noise levels were measured at six locations along Interstate 70 in Vail. Measurements were conducted in April 2004 to provide a baseline for future measurements. Measurements were repeated in August 2004 during the speed reduction campaign, again in April-May 2007 to provide additional data, and finally in September 2008 after I-70 was paved with Stone Mastic Asphalt (SMA). This report describes the measurement locations, equipment, and procedures used in each survey, as well as the data analysis methods and results. An executive summary is provided first, followed by technical details.

Executive Summary

The following table lists the maximum one-hour average noise level measured at each measurement location during each survey. The measured noise levels range from 61 to 70 dBA. As a reference, the U.S. EPA recommends noise levels be limited to 55 dBA, and the Colorado Department of Transportation considers providing mitigation to areas where levels equal or exceed 66 dBA. Suburban neighborhoods have noise levels in the 50's (dBA).

Measured Maximum One-Hour Average Noise Levels (dBA)

Survey	M1	M2	M3	M4	M5	M6
Apr 2004	69	63	63	66	---	---
Aug 2004	67	62	62	66	---	---
Apr 2007	68	63	63	67	---	---
Sep 2008	66	61	61	65	70	69

Two analyses were conducted using the measured data. First, the noise levels measured in April 2004 (baseline) were compared to those measured in August 2004 (during which time the speed reduction campaign was in effect). The results of this analysis are inconclusive, in that a decrease in noise levels is seen at some locations, while an increase is seen at others. This is not completely surprising, given the fact that a) a speed reduction of 5 mph by every vehicle at all times would yield only 1 dBA of noise reduction, and b) environmental noise levels fluctuate considerably and thus detecting a 1 dBA change is difficult.

The second analysis compared the average of all of the noise levels measured prior to the 2008 SMA pavement overlay to those measured after the overlay. The results clearly show that the pavement reduced noise levels by approximately 2 to 3 dBA. This is in keeping with other studies conducted by Hankard Environmental in other Colorado communities.

Note that for both of these analyses the data were processed to minimize the effect of other variables, such as weather, non-traffic noise, and the presence of different traffic volumes between surveys.

Noise Measurement Locations

Noise measurements were conducted at the six locations shown in Figure 1-1. A description of each measurement site is provided below. Aerial photographs showing each measurement location are shown in Figures 2-1 through 2-6, and pictures of each site are shown in Figures 3-1 through 3-6. Weather conditions were monitored at M3.

- **M1 (West Vail):** Located on the north side of I-70, west of the West Vail Interchange, and along Chamonix Lane near the Chamonix Chalets Condominiums. This site was selected to represent the West Vail area. The measurement location is 200 feet from the centerline of Westbound I-70, and the view to the highway is unobstructed.
- **M2 (Donovan Park):** Located on the south side of I-70, east of the West Vail Interchange, along Matterhorn Circle. This site was chosen to represent the residents in the area, and Donovan Park. The measurement location is 400 feet from the centerline of Eastbound I-70, and the view to the highway is obstructed somewhat by tress, residences, and the shoulder of Eastbound I-70.
- **M3 (Sandstone Park):** Located on the north side of I-70, west of the Main Vail Interchange, in Sandstone Park. This site was chosen to represent the residences in the area, and Sandstone Park. The measurement location is 300 feet from the centerline of Westbound I-70, and the view to the highway is obstructed somewhat by trees.
- **M4 (East Vail):** Located on the north side of I-70, east of East Vail Interchange, along Fall Line Drive. This site was chosen to represent the East Vail area, and to capture noise from trucks coming down off of Vail Pass. The measurement location is 200 feet from the centerline of Westbound I-70, and the view to the highway is obstructed by a berm to the east.
- **M5 (Timber Ridge Apartments):** Located on the north side of I-70, about half way between the West and Main Vail Interchanges, at the Timber Ridge Apartments. The measurement location is 200 feet from the centerline of Westbound I-70, and the view to the highway is unobstructed.
- **M6 (Red Sandstone Elementary School):** Located on the north side of I-70, west of the Main Vail Interchange, at the Red Sandstone Elementary School. The measurement location is 160 feet from the centerline of Westbound I-70, and the view to the highway is unobstructed.

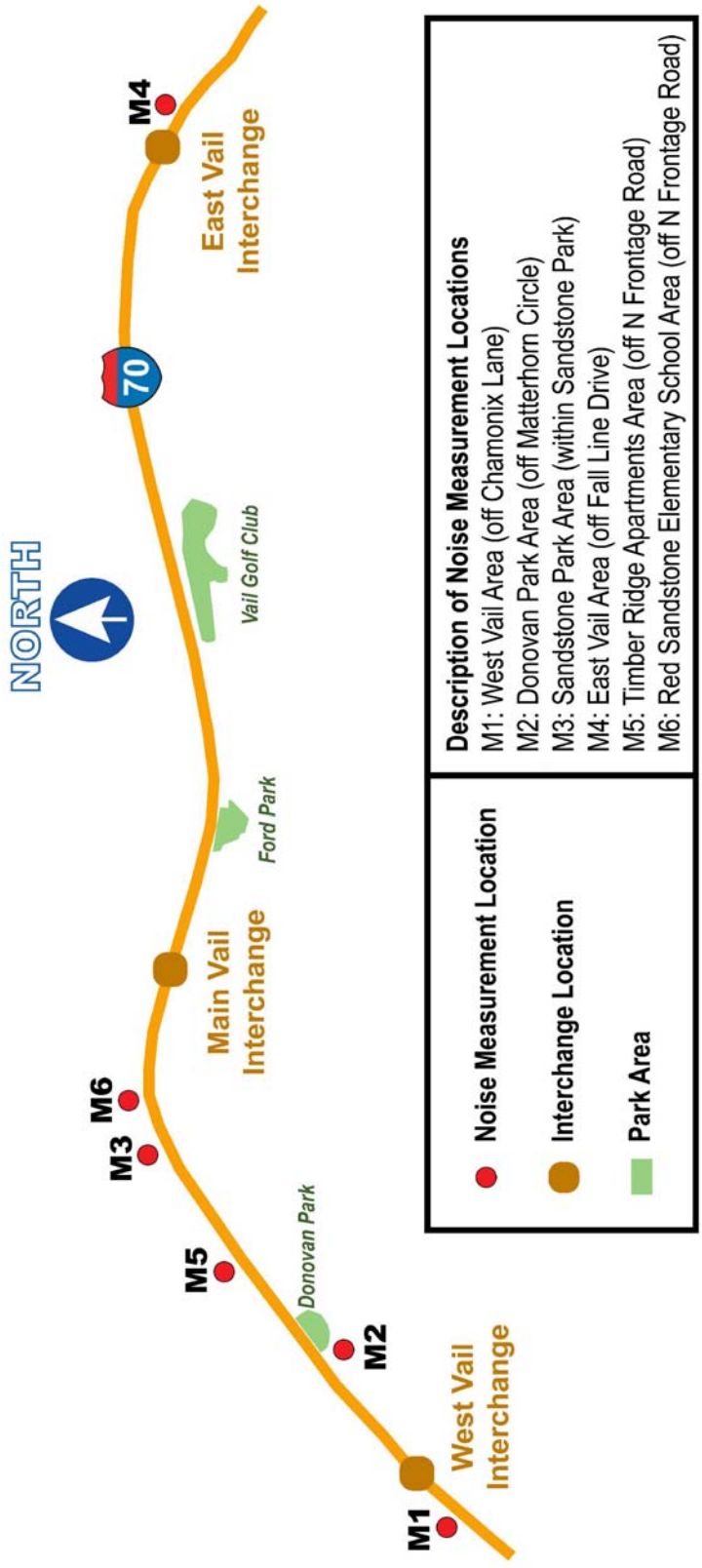

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Figure 1-1: Vail Noise Measurement Sites

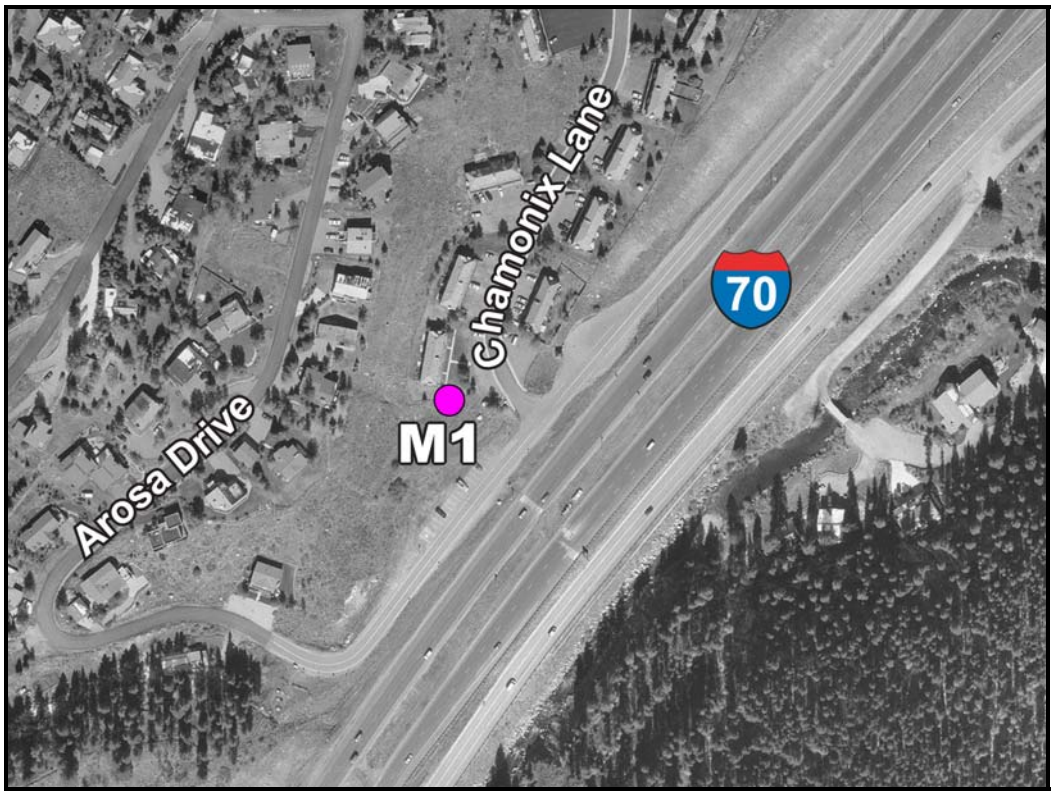


Figure 2-1: Aerial View of M1

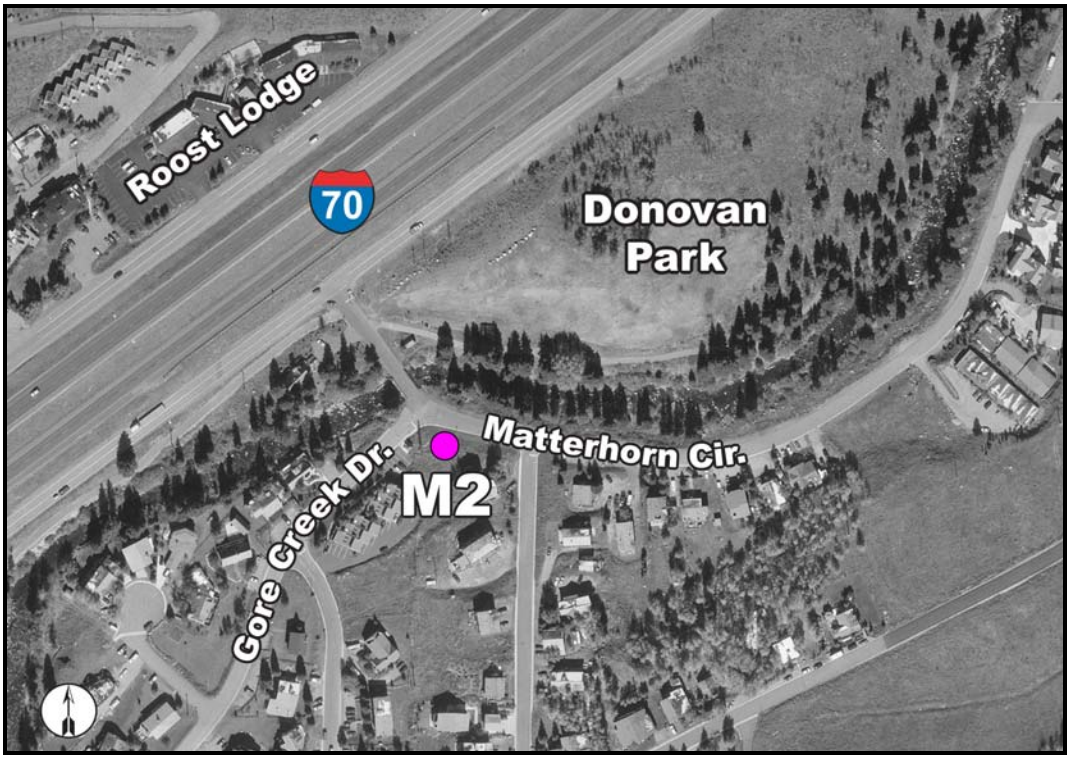


Figure 2-2: Aerial View of M2

Figure 2-3: Aerial View of M3

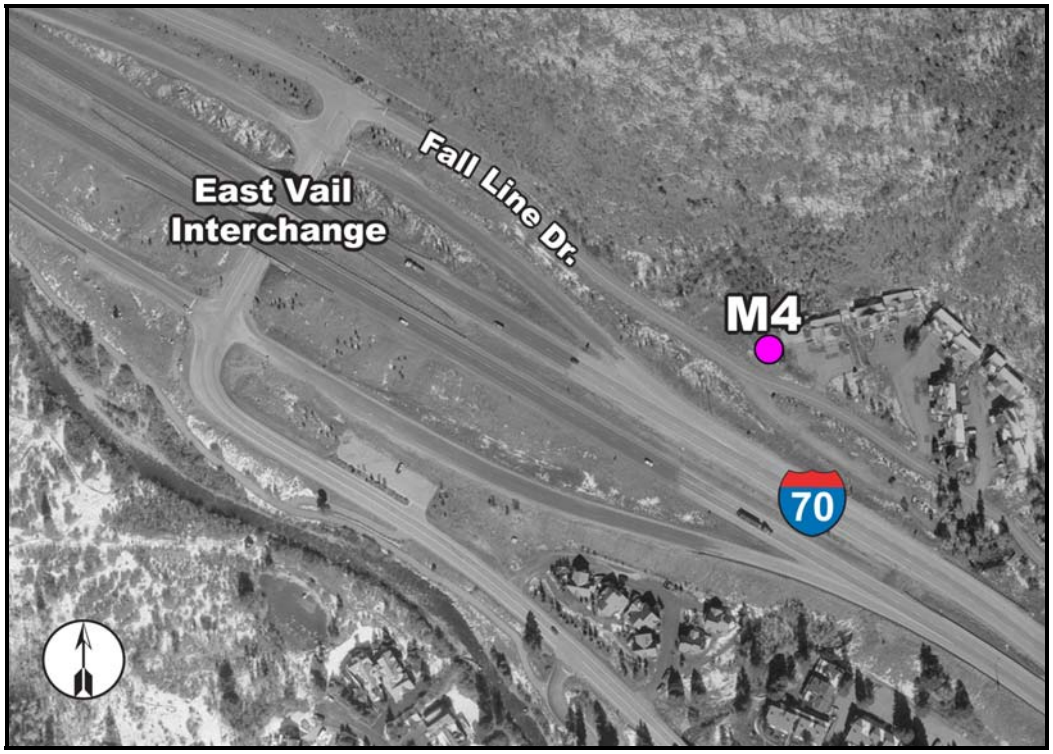


Figure 2-4: Aerial View of M4

Figure 2-5: Aerial View of M5

Figure 2-6: Aerial View of M6

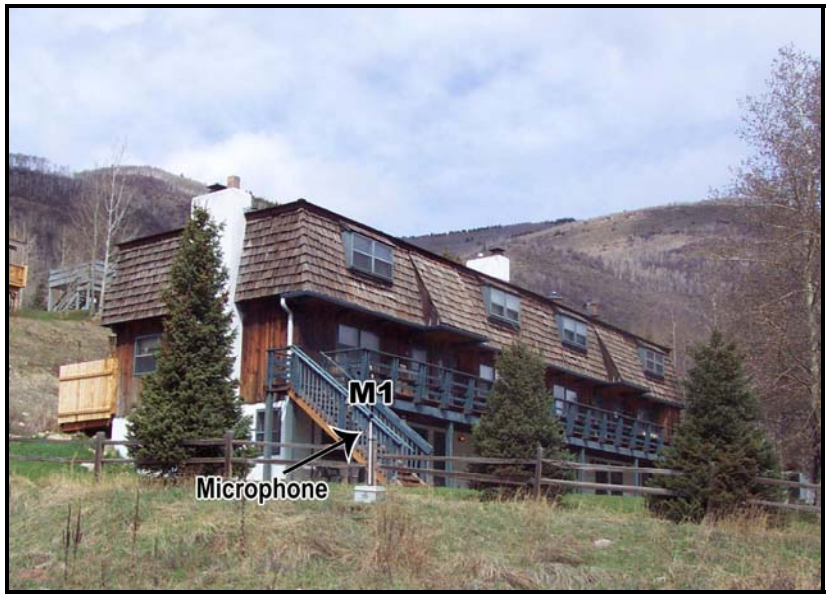
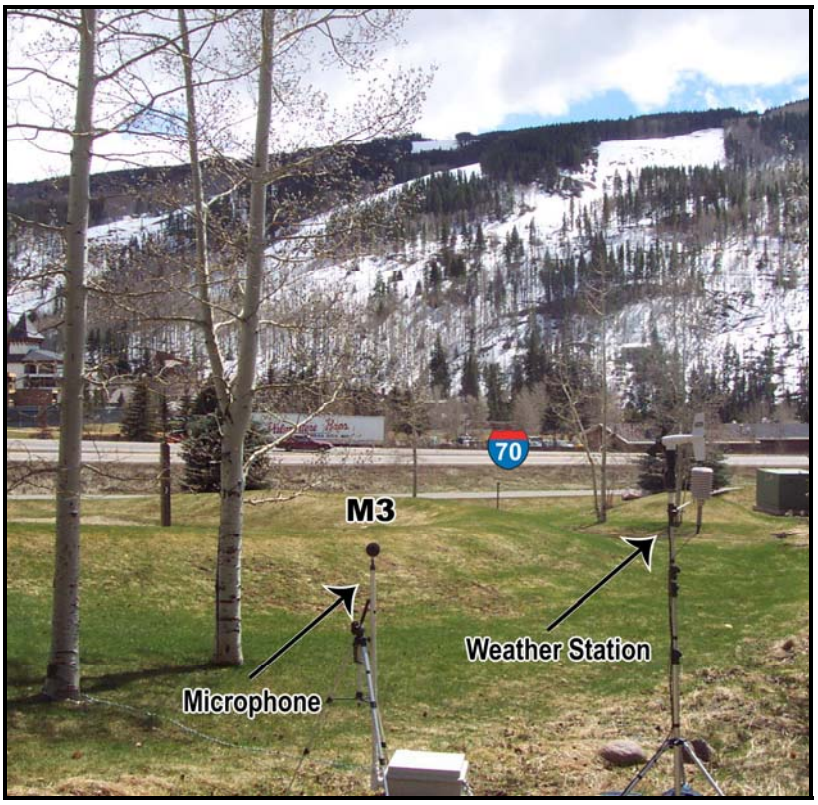


Figure 3-1: Photographs of M1

Figure 3-2: Photographs of M2



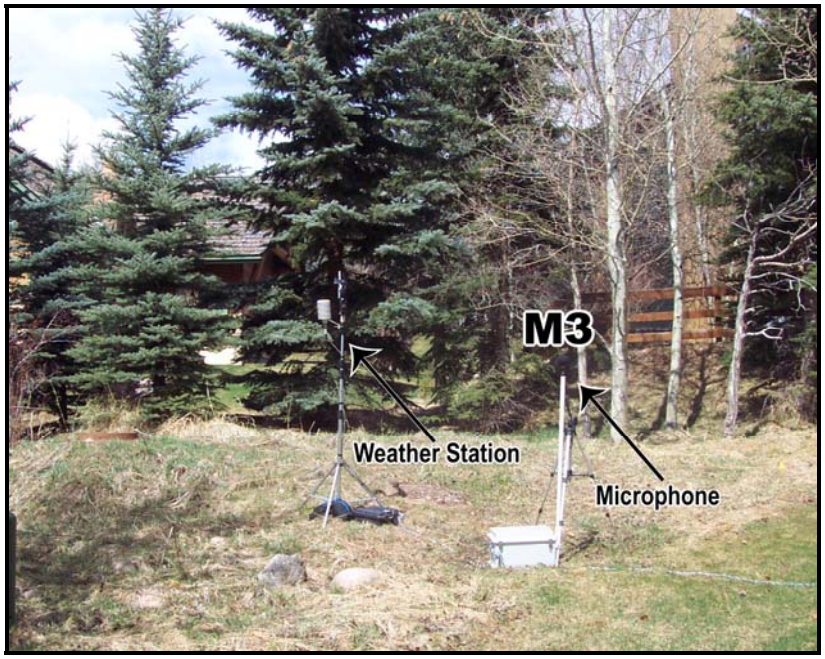


Figure 3-3: Photographs of M3

Figure 3-4: Photographs of M4

Figure 3-5: Photographs of M5

Figure 3-6: Photographs of M6

Measurement Equipment

The following sound level meters were employed on this project:

- Norsonics Type 114
- Larson Davis Model 820
- Larson Davis Model 824

Each of these meters meets American National Standards Institute (ANSI) Type 1 specifications (accuracy ~ ±1 dB). The Larson Davis meters were calibrated by an accredited laboratory within one year of being used, and the Norsonics meter was calibrated within two years of being used.

Traffic counts were obtained from the Colorado Department of Transportation (permanent counter at I-70 mile marker 170.11, near Chamonix Road).

Weather conditions were monitored on-site at M3 using a tripod-mounted system that includes a RM Young wind sensor, a Vaisala relative humidity probe, and a Campbell Scientific CR510 data logger.

Measurement Procedures

All sound level meters were set to monitor the overall, A-weighted, five-minute, equivalent noise level (L_{eq}, dBA). All microphones were equipped with windscreens and were located five feet above the ground. All sound level meters were time-synchronized with each other. Each sound level meter was field calibrated prior to and re-checked after each measurement. All calibrations were within ±0.2 dBA.

The weather station was set to monitor the wind speed, wind direction, temperature, and relative humidity. The station was time synchronized with the sound level meters and set to monitor five-minute averages. The orientation of the weather station was situated using a compass.

Table 1 lists the start and end dates of each measurement survey.

Table 1: Start and End Dates of Measurement Surveys

Survey	Start Date	End Date
Spring 2004	April 3, 2004	May 2, 2004
Summer 2004	August 11, 2004	September 7, 2004
2007	April 26, 2006	May 4, 2006
2008	September 16, 2008	September 24, 2008

Measured Noise Levels

Figure 4-1 shows the measured noise levels at one representative location during one of the surveys. Plots of the measured noise levels at each location during each survey are provided in Appendix A. The measured noise levels are typical of those found near a highway. The levels are relatively low (quiet) during the early morning hours, stay somewhat constant during the daytime, and recede after the evening hours.

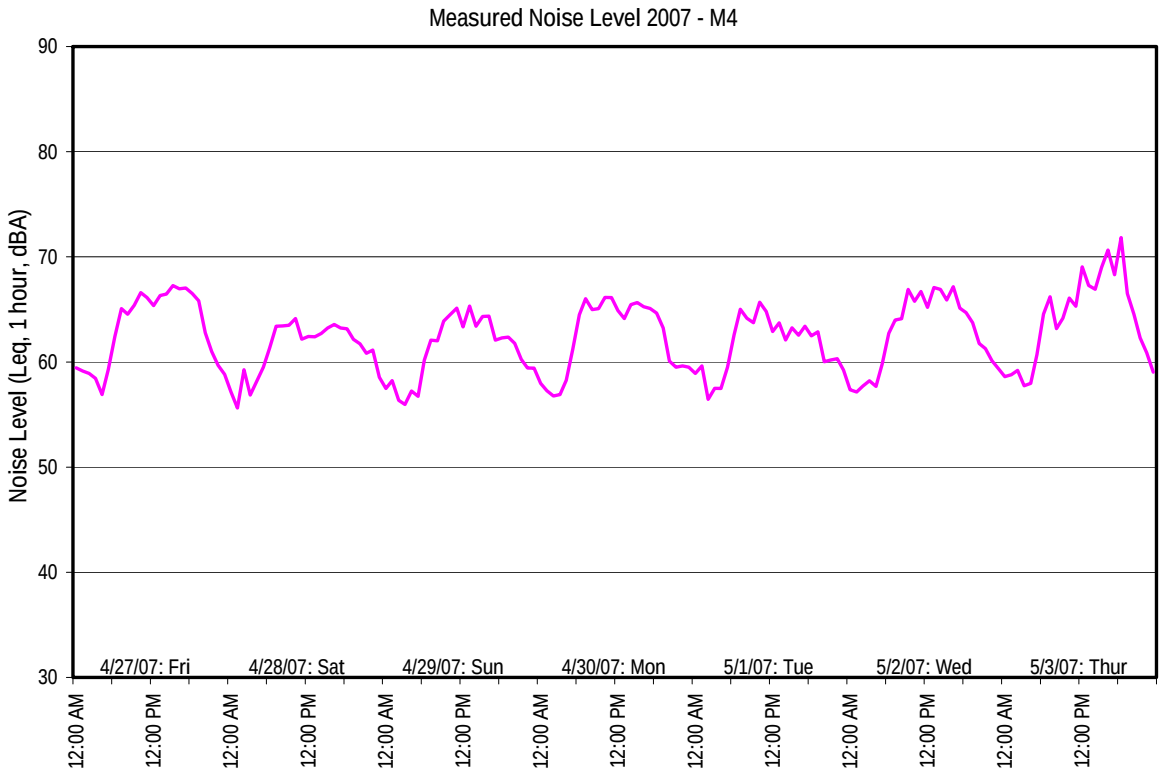


Figure 4-1: Representative Plot of Measured Noise Levels

Table 2 lists the typical maximum one-hour noise level (L_{eq}, dBA) measured at each location during each survey. These levels were obtained by visually inspecting the graphs of measured levels. The levels include all data, and have not been adjusted for differences in traffic or other conditions. The maximum noise levels range from 61 to 70 dBA.

Table 2: Measured Maximum One-Hour Average Noise Levels (dBA)

Survey	M1	M2	M3	M4	M5	M6
Apr 2004	69	63	63	66	---	---
Aug 2004	67	62	62	66	---	---
Apr 2007	68	63	63	67	---	---
Sep 2008	66	61	61	65	70	69

Traffic Volumes

Table 3 lists the average hourly traffic volumes on Interstate 70 during each survey. These volumes are those which were retained after data processing, which is explained in the Analysis of Noise Levels section below. Tables 4 and 5 list the traffic volumes during the daytime and nighttime hours, respectively, and again these are the volumes after data processing. Plots of the unadjusted (pure measured data) CDOT traffic volumes are shown in Appendix B.

Table 3: Average Hourly Traffic Volumes on I-70 – All Times

Survey	M1	M2	M3	M4	M5	M6
Apr 2004	1833	1533	1480	1439	n/a	n/a
Aug 2004	1906	1835	1817	1794	n/a	n/a
Apr 2007	1148	1192	1138	1096	n/a	n/a
Sep 2008	1615	1569	1524	1627	1612	1601

Table 4: Average Hourly Traffic Volumes on I-70 – Daytime Hours (7am to 10pm)

Survey	M1	M2	M3	M4	M5	M6
Apr 2004	1957	1692	1673	1640	n/a	n/a
Aug 2004	2152	2064	2138	2043	n/a	n/a
Apr 2007	1339	1367	1338	1318	n/a	n/a
Sep 2008	1842	1803	1804	1861	2089	2089

Table 5: Nighttime Average Hourly Traffic Volumes on I-70 – Nighttime Hours (10pm to 7am)

Survey	M1	M2	M3	M4	M5	M6
Apr 2004	1244	981	960	929	n/a	n/a
Aug 2004	1263	1196	1145	1170	n/a	n/a
Apr 2007	626	645	629	592	n/a	n/a
Sep 2008	1058	1035	983	1058	474	469

Weather Conditions

The average wind speed, relative humidity, and temperature measured in Vail during each survey are shown in Tables 6, 7, and 8, respectively. Plots of the measured weather conditions are shown in the appendix.

Table 6: Average Wind Speed (mph) During Each Survey

Survey	All	Daytime	Nighttime
Apr 2004	1	2	1
Aug 2004	1	1	1
Apr 2007	4	5	4
Sep 2008	4	4	3

Table 7: Average Relative Humidity (%) During Each Survey

Survey	All	Daytime	Nighttime
Apr 2004	81	73	92
Aug 2004	51	37	76
Apr 2007	53	41	72
Sep 2008	57	46	74

Table 8: Average Temperature (deg F) During Each Survey

Survey	All	Daytime	Nighttime
Apr 2004	40	44	35
Aug 2004	55	62	42
Apr 2007	42	48	33
Sep 2008	51	55	41

Noise Level Analysis Methodology

The following two comparisons were made between the noise levels measured during the different surveys:

- August 2004 and April 2004 noise levels were compared to determine the effect of the speed reduction campaign that was ongoing in August but not in April
- 2008 noise levels were compared to the average of the other surveys to determine the effect of the SMA pavement that was put down just prior to the 2008 noise measurement survey

The effect of speed and pavement changes cannot be determined by a direct comparison of measured noise levels, as there are other noise-affecting variables such as weather, traffic volumes, and non-highway noise sources that changed between surveys. To minimize the effect of weather, all noise level data measured during periods of high wind (greater than 5 mph average) or rain were removed from the analysis.

To minimize the effect of non-highway traffic noise, the measured hourly-average noise levels were compared to corresponding hourly-average traffic volumes. Noise level data that did not correlate with traffic volume to within one standard deviation was removed from the data set. In order to correlate noise and traffic data we first needed to combine eastbound and westbound I-70 traffic volumes into one value. Because the closer lanes of traffic more strongly influence noise levels, we weighted the closer lanes of traffic by a value equal to 10 times the logarithm of the ratio of the distance from the measurement location to the center of the closest and furthest directions of travel. This is shown in the following equation:

$$\text{Combined Traffic Volume} = 10 * \text{Log}\left(\frac{\text{Distance}_{far}}{\text{Distance}_{near}}\right) * \text{Traffic}_{near} + \text{Traffic}_{far}$$

Next the ratio of the measured sound pressure (anti-log of measured level) to the Combined Traffic Volume was calculated for each hour. This calculation was conducted independently for each measurement location and for each survey. The standard deviation for each of these data sets was then determined, and all of the measured noise levels that did not correlate to their corresponding hourly traffic volume within one standard deviation were removed from further analyses.

To minimize the effect of the differences in traffic volumes that existed between the measurement surveys, the remaining noise level data (i.e. noise levels that were taken during acceptable weather conditions and that correlate to I-70 traffic volumes) was "normalized" to the first data set (April 2004 was used as a baseline to which future surveys were normalized to). If traffic volume differences were not accounted for, the effect of speed and pavement changes could be overstated or understated. For example, if traffic volumes were higher during the post-pavement overlay survey (2008) than the pre-pavement overlay surveys, and the difference in traffic volume was not accounted for, the effect of the pavement would be understated.

The Normalized Difference (ND) at a particular site between the noise levels measured during the first measurement survey (April 2004) and any other measurement survey was calculated using the following formula:

$$ND_{site} = M_{site\_first} - M_{site\_current} - TF \ \ dBA$$

M_{site_first} is the average hourly noise level (L_{eq}) measured at a given site during the first survey (April 2004). $M_{site\_current}$ is the average hourly noise level (L_{eq}) measured at a given site during any subsequent survey being analyzed. TF is the Traffic Factor, which accounts for the difference in traffic volume between the two surveys and was calculated using the following formula:

$$TF = 10 * Log \left(\frac{CT_{site\_first}}{CT_{site\_current}} \right) dBA$$

CT is the combined average hourly traffic volume for the indicated site/survey, which was calculated in the same manner as the Combined Traffic Volume described above but this time using the average hourly traffic volume for each direction of travel from the correlated data set.

Noise Level Analysis Results

Table 9 shows a comparison between the noise levels measured in April 2004 (baseline) and the normalized noise levels measured in August 2004 (during which time the speed reduction campaign was in effect). The data show a 0 to 1 dBA reduction in noise levels due to the speed campaign at measurement locations M1 and M2. However, the data show a 0 to -2 reduction (negative reduction being an increase) in noise levels at M3 and M4. Thus, there is no clear pattern of the effect of the speed reduction campaign based on the measured noise levels. This is not completely surprising, given the fact that a) a speed reduction of 5 mph by every vehicle at all times would yield only 1 dBA of noise reduction, and b) environmental noise levels fluctuate considerably and thus detecting a 1 dBA change is difficult.

Table 10 shows the calculation of the reduction in noise levels resulting from the overlay of I-70 with Stone Mastic Asphalt (SMA), which has been shown by other studies to be 2 to 4 dBA quieter than CDOT's standard asphalt pavement. The calculation was conducted by averaging the normalized noise levels from the three surveys made prior to the overlay, and comparing that average to the normalized noise levels measured after the overlay. The calculation was conducted for the entire data set, as well as for daytime and nighttime hours only. From Table 10 it can be clearly seen that noise levels are approximately 2 to 3 dBA lower as a result of the SMA overlay. This is in keeping with studies conducted by Hankard Environmental in other Colorado communities.

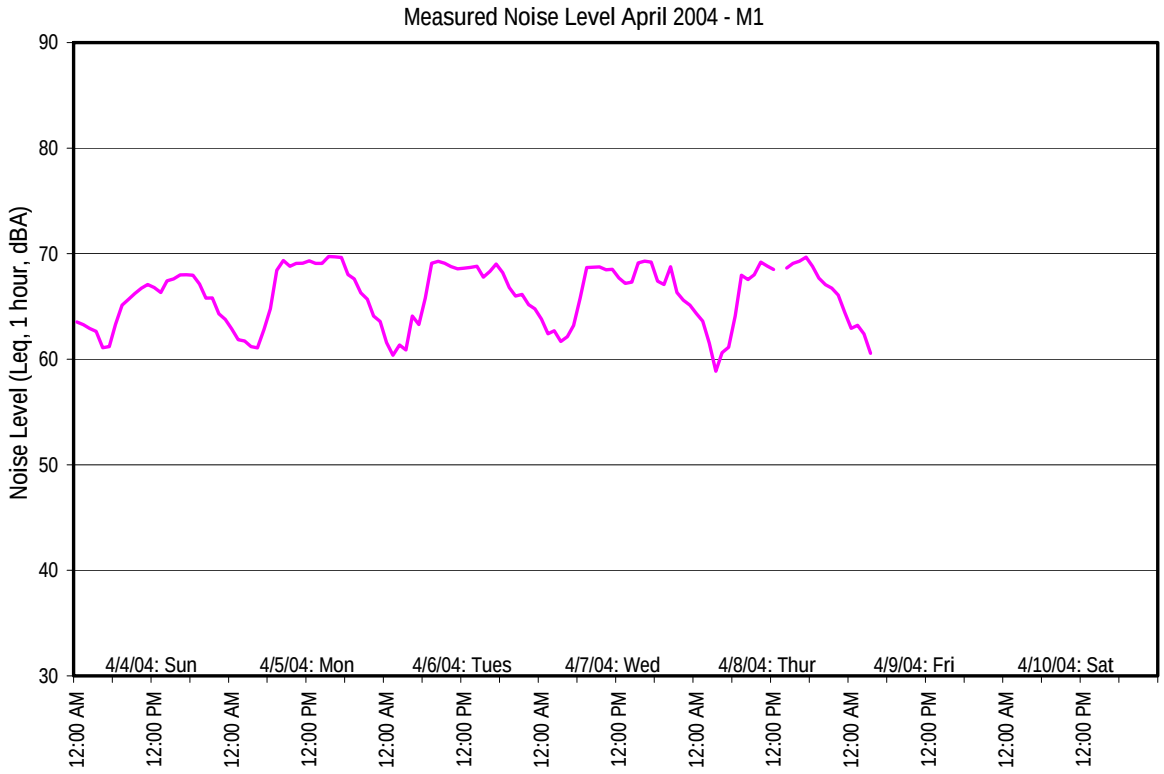
Table 9: Normalized Noise Level Comparison Between April 2004 and August 2004 (speed variable) (dBA)

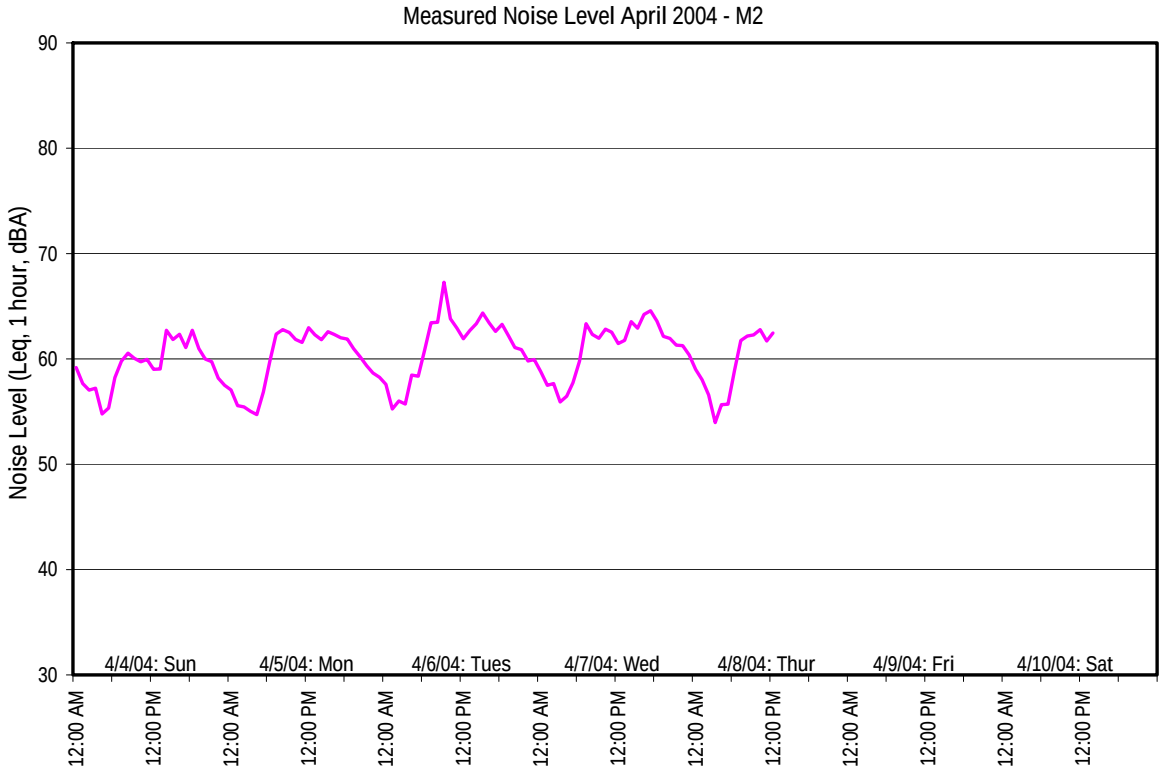
All	M1	M2	M3	M4
Apr 2004	68	61	59	63
Aug 2004	67	60	60	64
Reduction	1	1	-1	-1
Daytime (7am to 10pm)	M1	M2	M3	M4
Apr 2004	68	61	60	64
Aug 2004	67	61	60	65
Reduction	1	0	0	-1
Nighttime (10pm to 7am)	M1	M2	M3	M4
Apr 2004	65	59	56	59
Aug 2004	65	58	58	60
Reduction	0	1	-2	-1

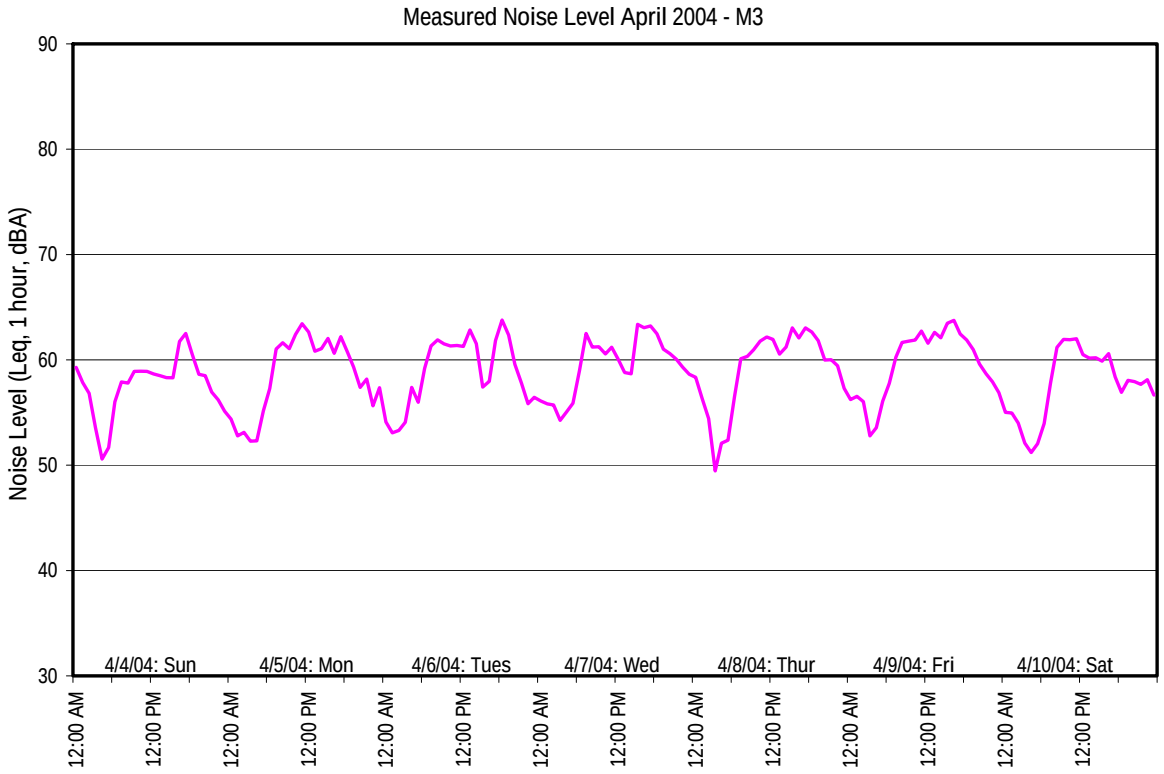
Table 10: Noise Level Comparison Between 2008 and All Others (SMA variable) (dBA)

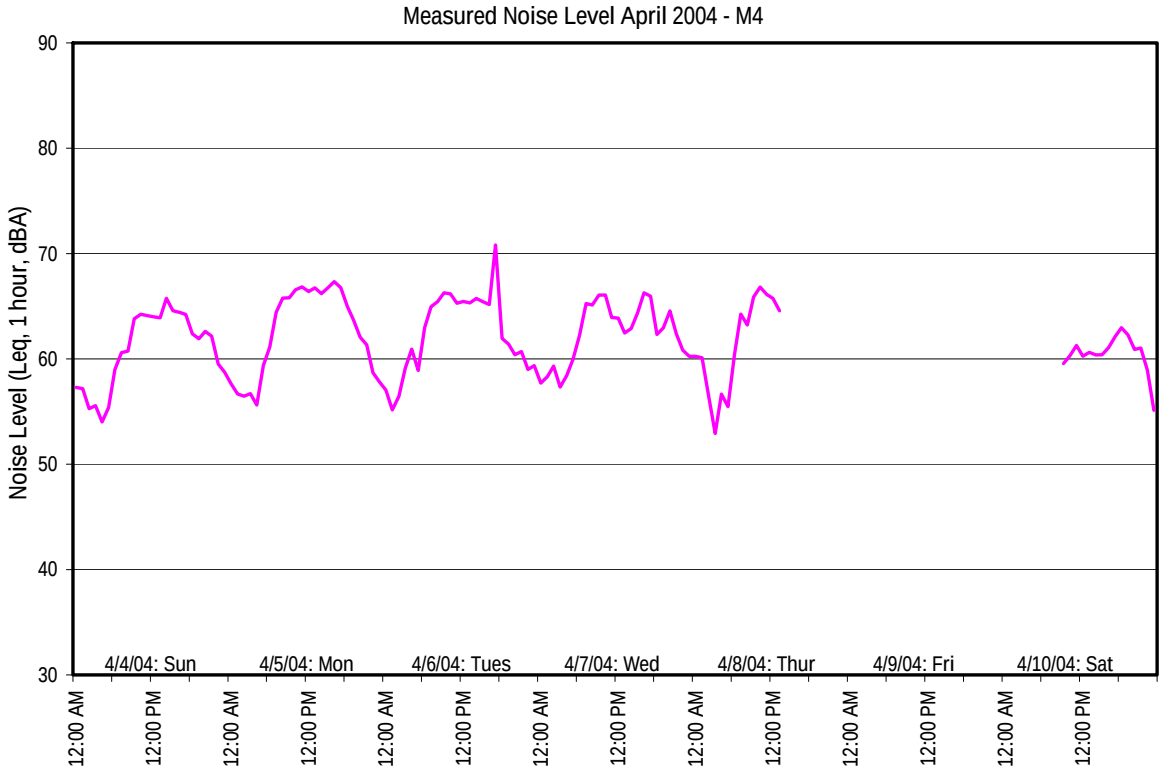
All	M1	M2	M3	M4
Apr 2004	68	61	59	63
Aug 2004	67	60	60	64
Apr 2007	68	62	60	65
Average	68	61	60	64
Sep 2008	65	59	58	62
Reduction	3	2	2	2
Daytime (7am to 10pm)	M1	M2	M3	M4
Apr 2004	68	61	60	64
Aug 2004	67	61	60	65
Apr 2007	68	63	61	66
Average	68	62	60	65
Sep 2008	65	60	59	63
Reduction	3	2	1	2
Nighttime (10pm to 7am)	M1	M2	M3	M4
Apr 2004	65	59	56	59
Aug 2004	65	58	58	60
Apr 2007	65	59	55	60
Average	65	59	56	60
Sep 2008	63	56	55	57
Reduction	2	3	1	3

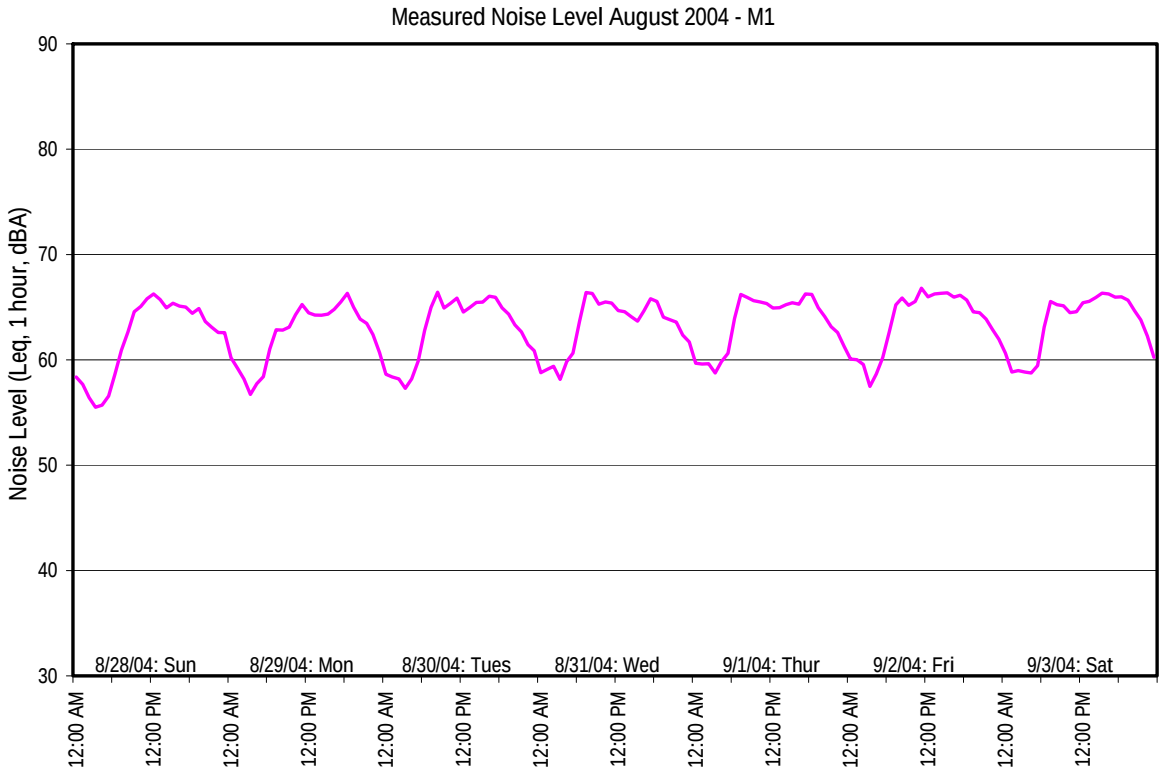
Appendix A
Plots of Measured Noise Levels

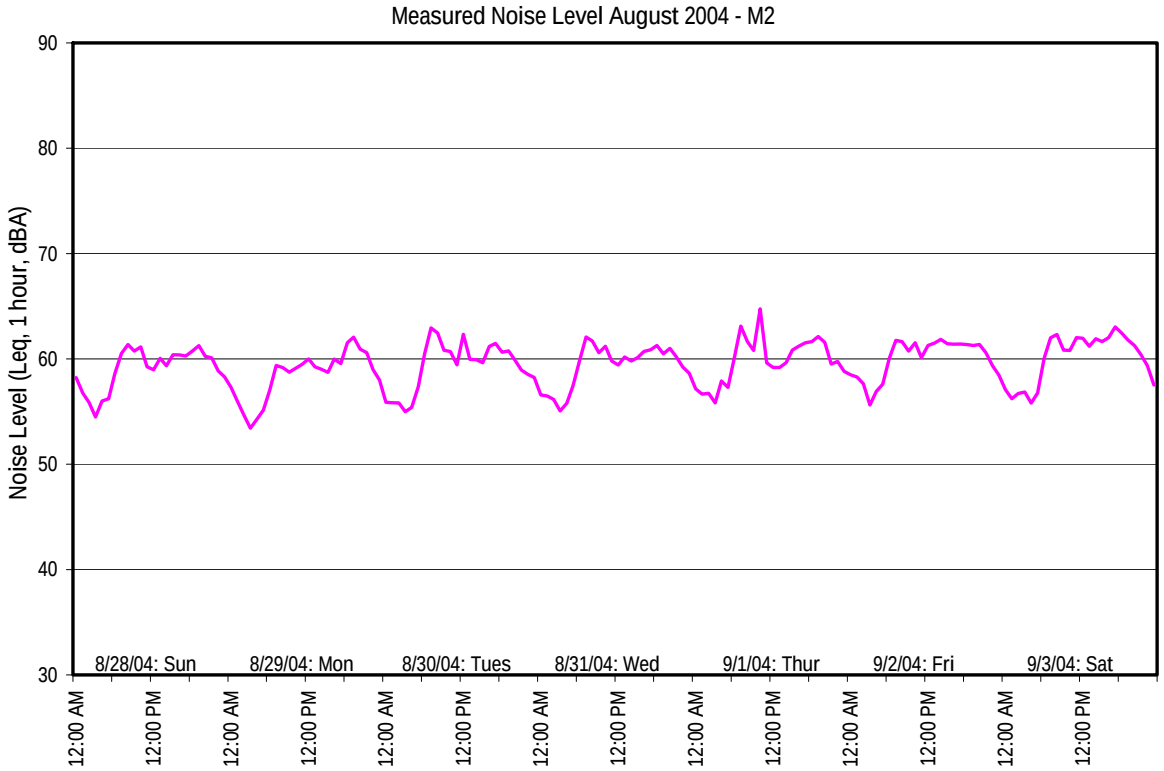

Measured Noise Level April 2004 - M1
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
4/4/04: Sun
4/5/04: Mon
4/6/04: Tues
4/7/04: Wed
4/8/04: Thur
4/9/04: Fri
4/10/04: Sat
12:00 AM
12:00 PM

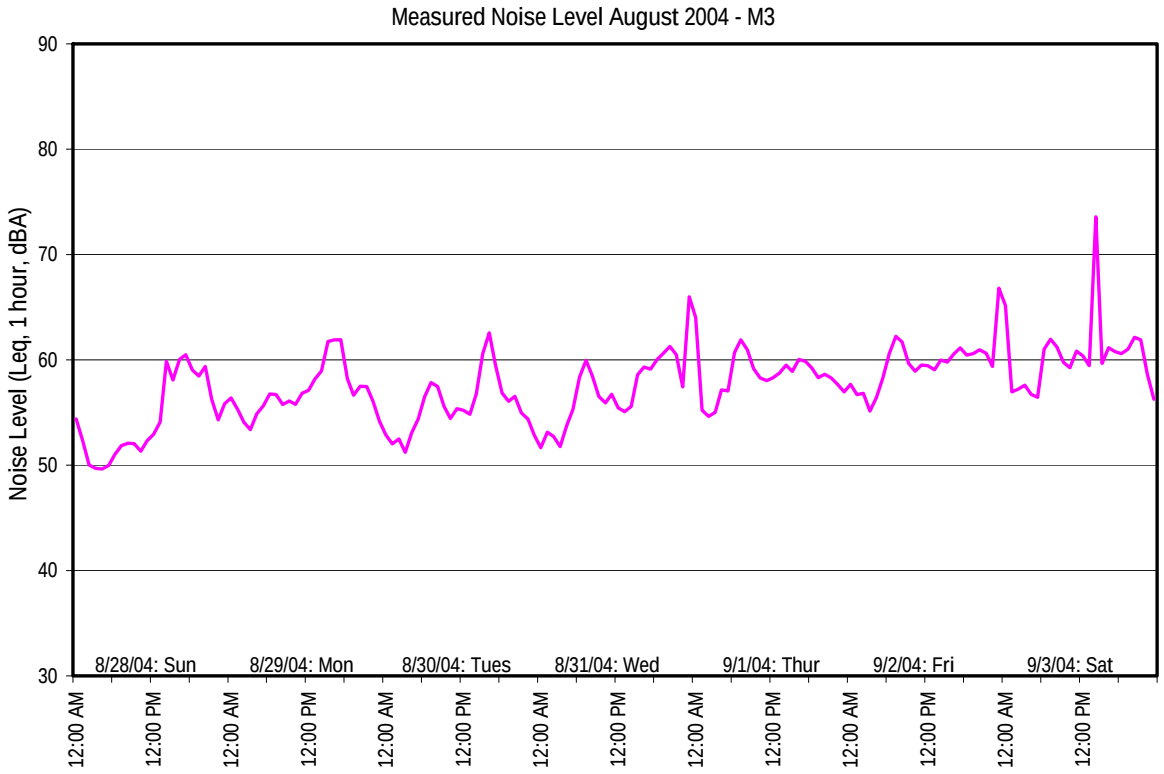

Measured Noise Level April 2004 - M2
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
4/4/04: Sun
4/5/04: Mon
4/6/04: Tues
4/7/04: Wed
4/8/04: Thur
4/9/04: Fri
4/10/04: Sat
12:00 AM
12:00 PM

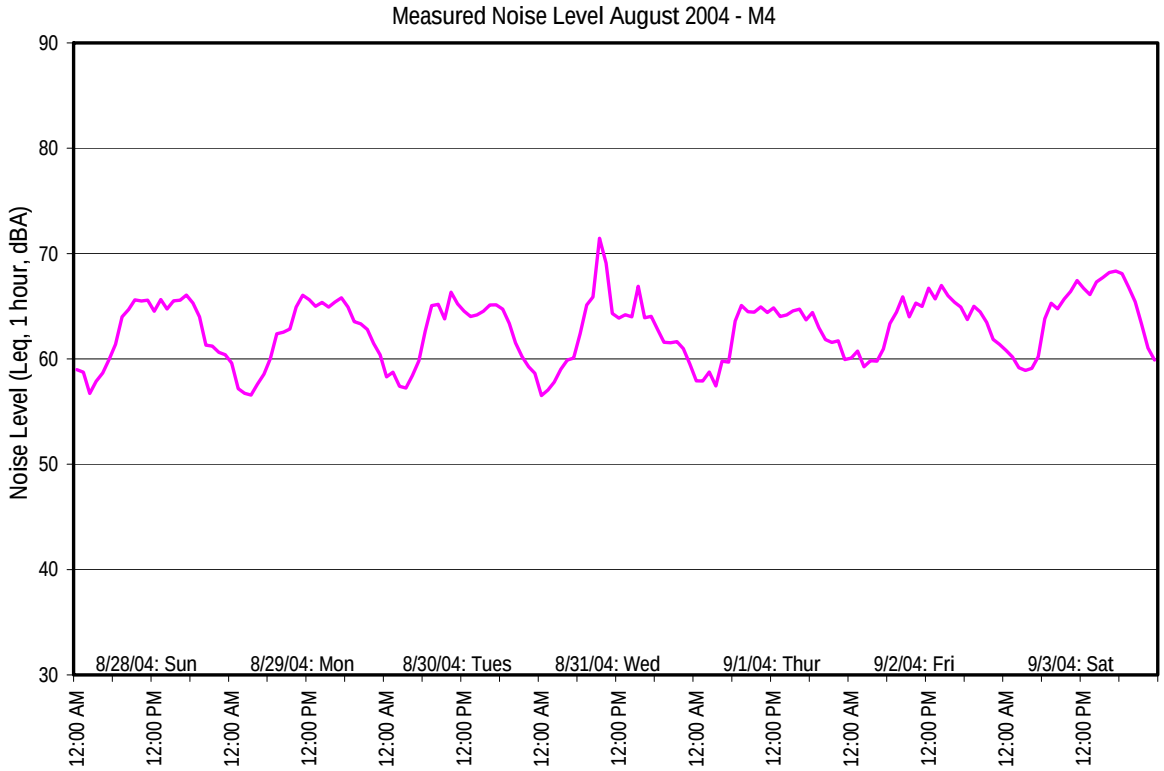

Measured Noise Level April 2004 - M3
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
4/4/04: Sun
4/5/04: Mon
4/6/04: Tues
4/7/04: Wed
4/8/04: Thur
4/9/04: Fri
4/10/04: Sat
12:00 AM
12:00 PM

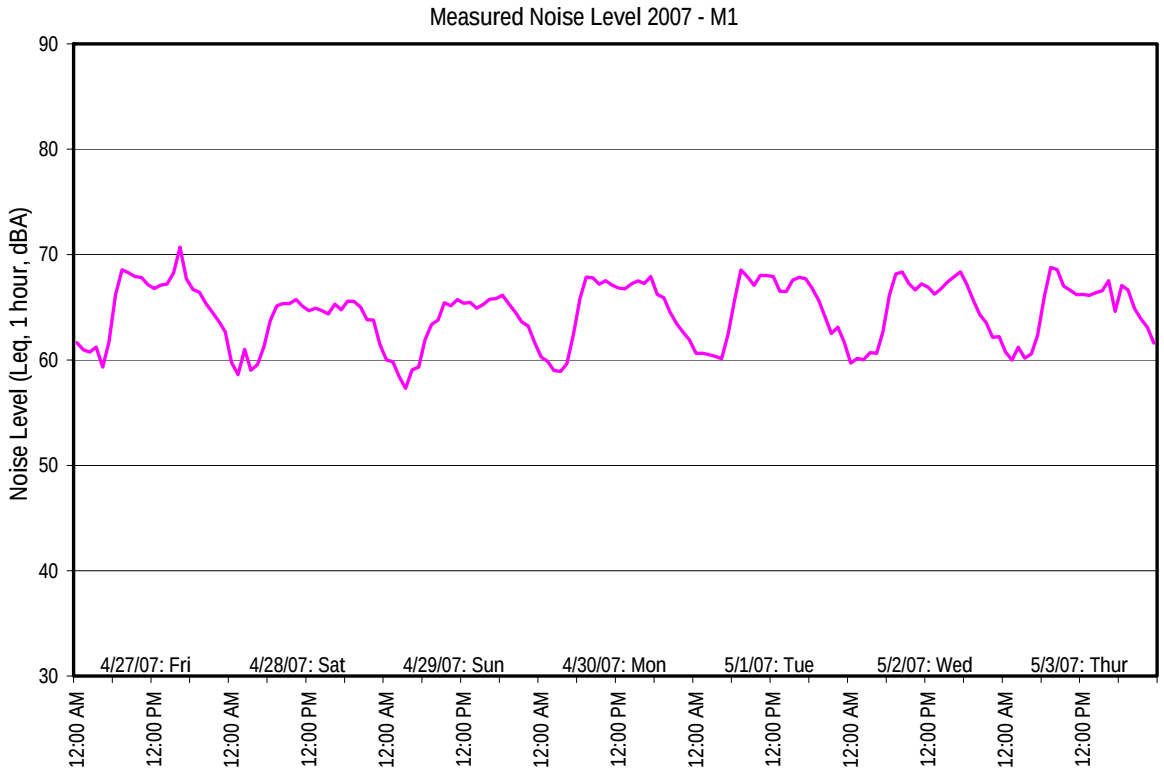

Measured Noise Level April 2004 - M4
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
4/4/04: Sun
4/5/04: Mon
4/6/04: Tues
4/7/04: Wed
4/8/04: Thur
4/9/04: Fri
4/10/04: Sat
12:00 AM
12:00 PM

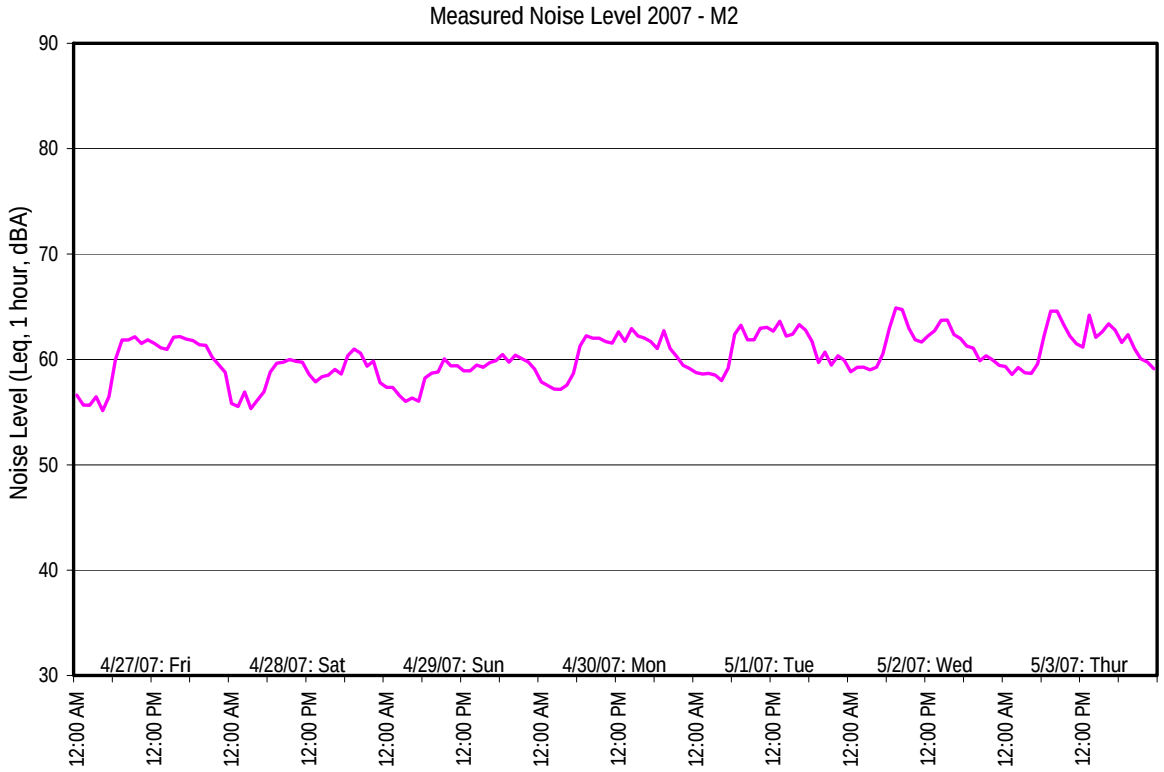

Measured Noise Level August 2004 - M1
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
8/28/04: Sun
8/29/04: Mon
8/30/04: Tues
8/31/04: Wed
9/1/04: Thur
9/2/04: Fri
9/3/04: Sat
12:00 AM
12:00 PM

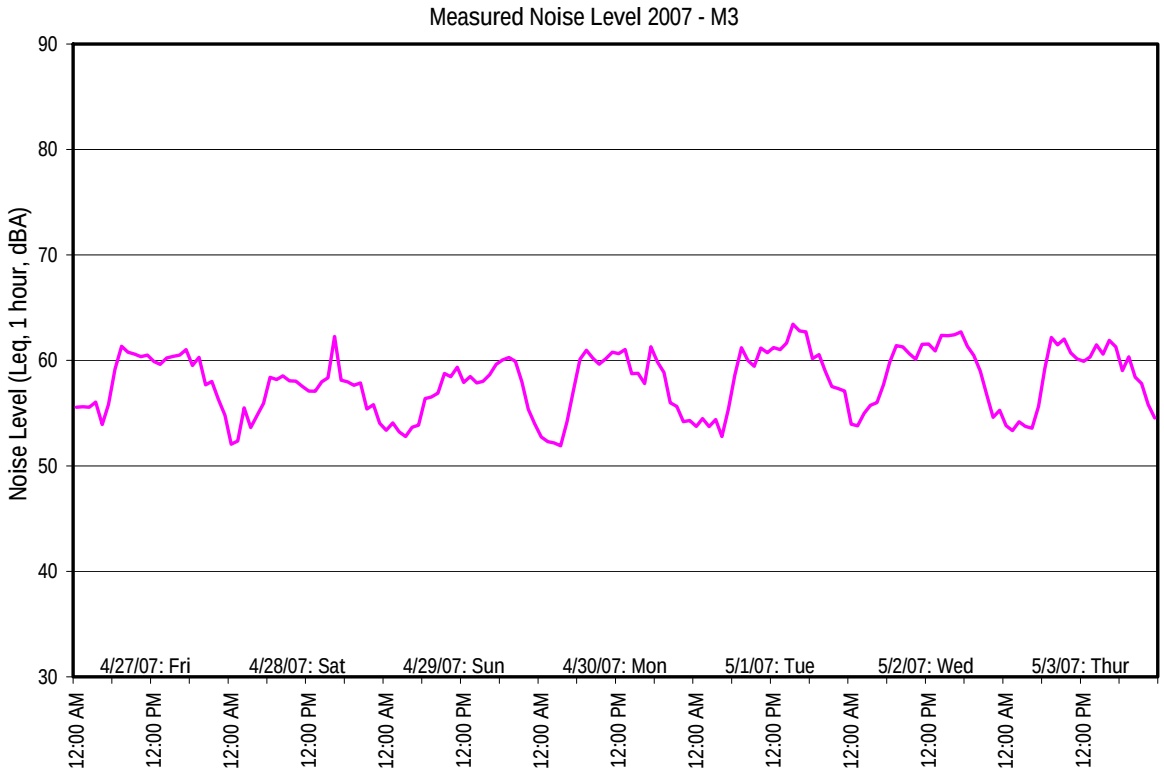

Measured Noise Level August 2004 - M2
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
8/28/04: Sun
8/29/04: Mon
8/30/04: Tues
8/31/04: Wed
9/1/04: Thur
9/2/04: Fri
9/3/04: Sat
12:00 AM
12:00 PM

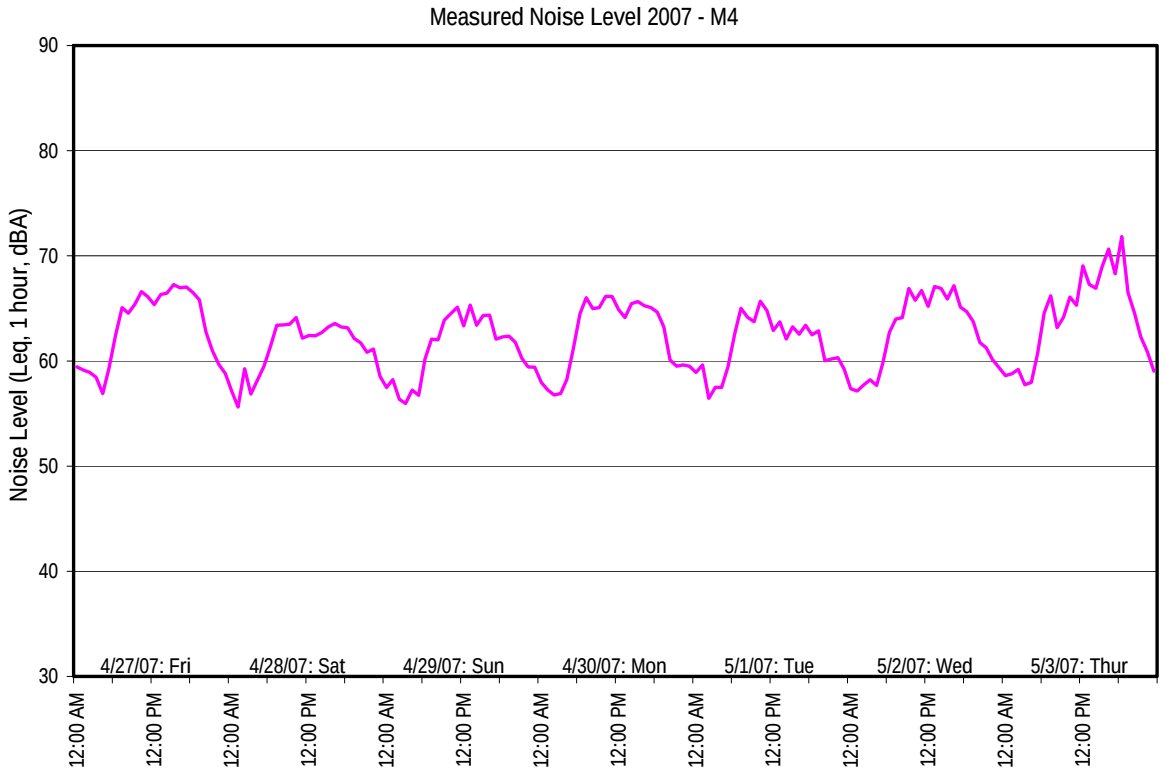

Measured Noise Level August 2004 - M3
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
8/28/04: Sun
8/29/04: Mon
8/30/04: Tues
8/31/04: Wed
9/1/04: Thur
9/2/04: Fri
9/3/04: Sat
12:00 AM
12:00 PM

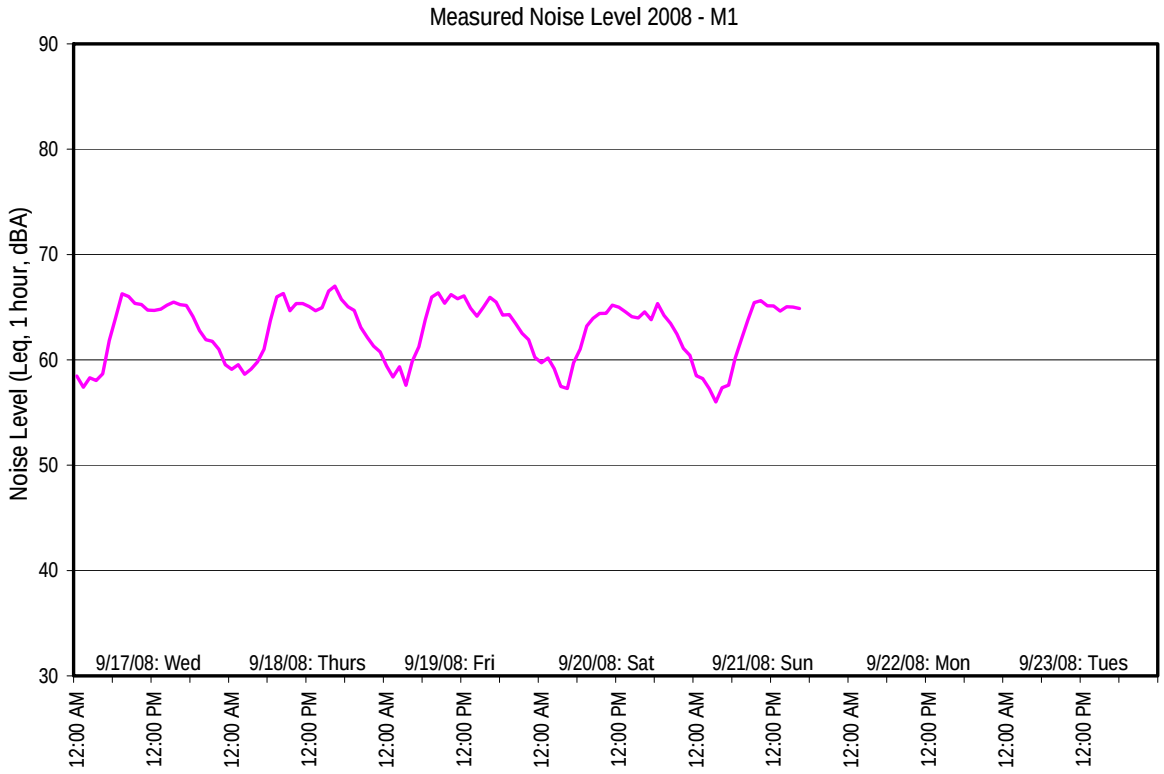

Measured Noise Level August 2004 - M4
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
8/28/04: Sun
8/29/04: Mon
8/30/04: Tues
8/31/04: Wed
9/1/04: Thur
9/2/04: Fri
9/3/04: Sat
12:00 AM
12:00 PM

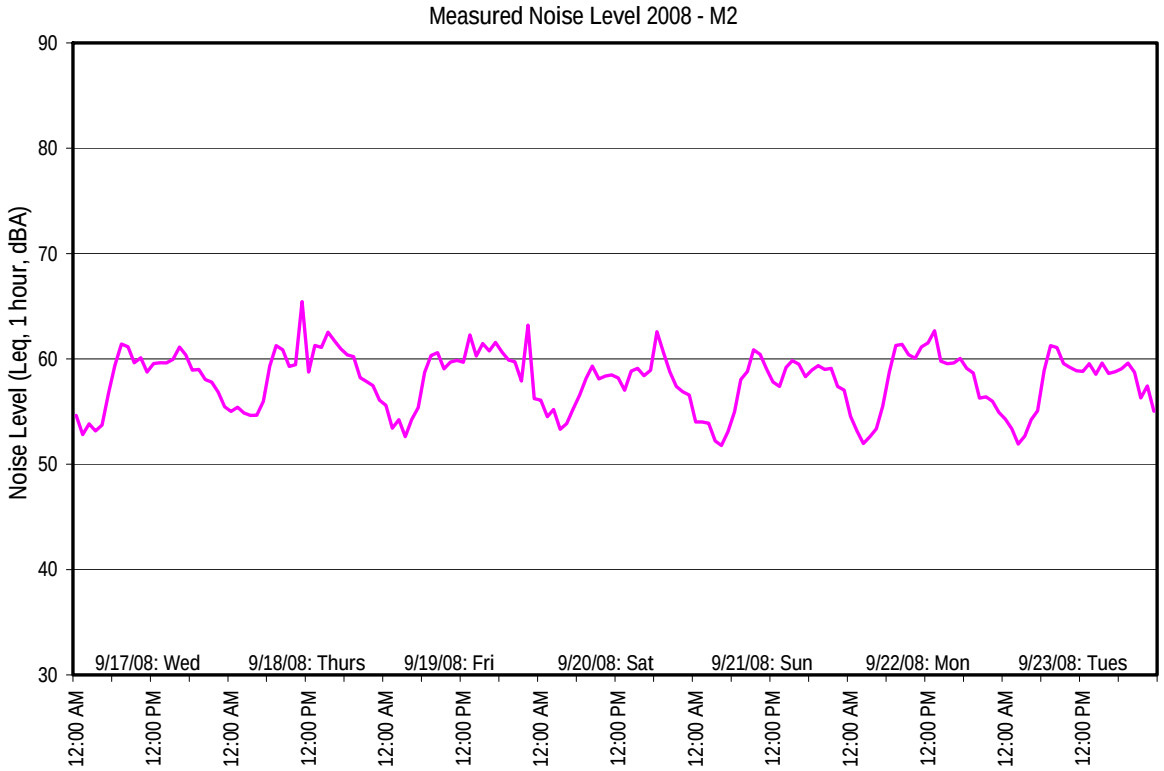

Measured Noise Level 2007 - M1
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
4/27/07: Fri
4/28/07: Sat
4/29/07: Sun
4/30/07: Mon
5/1/07: Tue
5/2/07: Wed
5/3/07: Thur
12:00 AM
12:00 PM

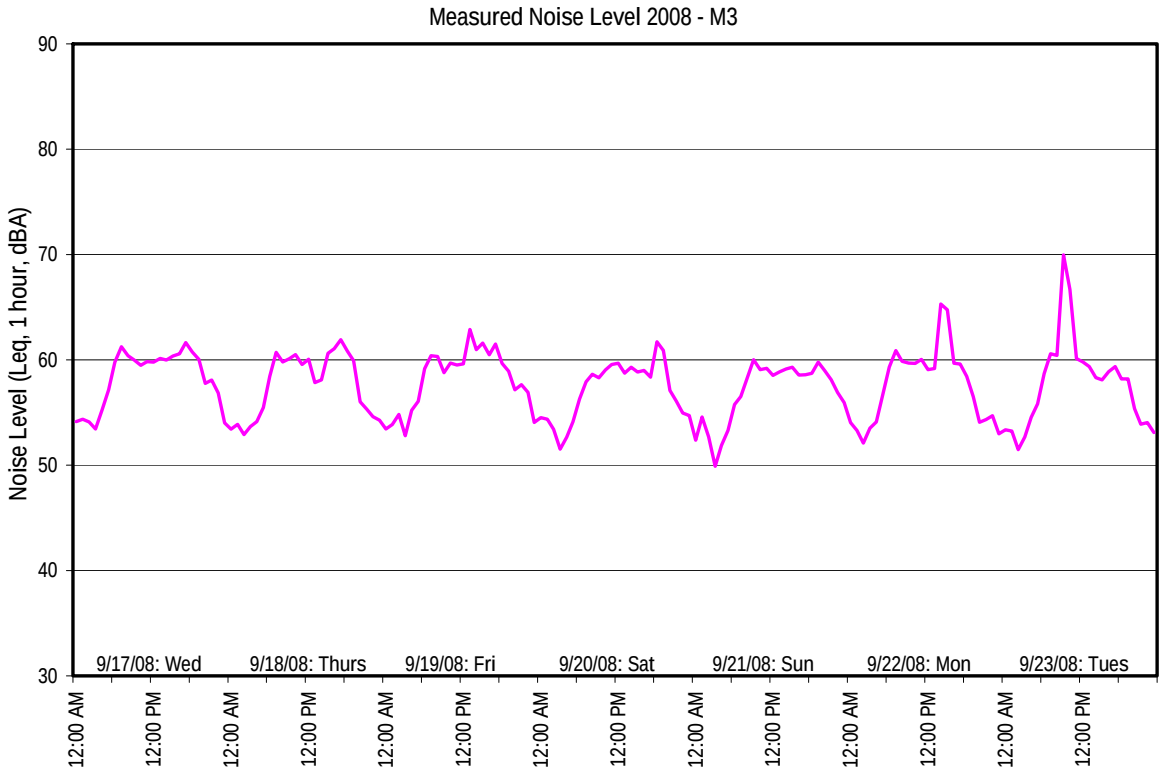

Measured Noise Level 2007 - M2
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
4/27/07: Fri
4/28/07: Sat
4/29/07: Sun
4/30/07: Mon
5/1/07: Tue
5/2/07: Wed
5/3/07: Thur
12:00 AM
12:00 PM

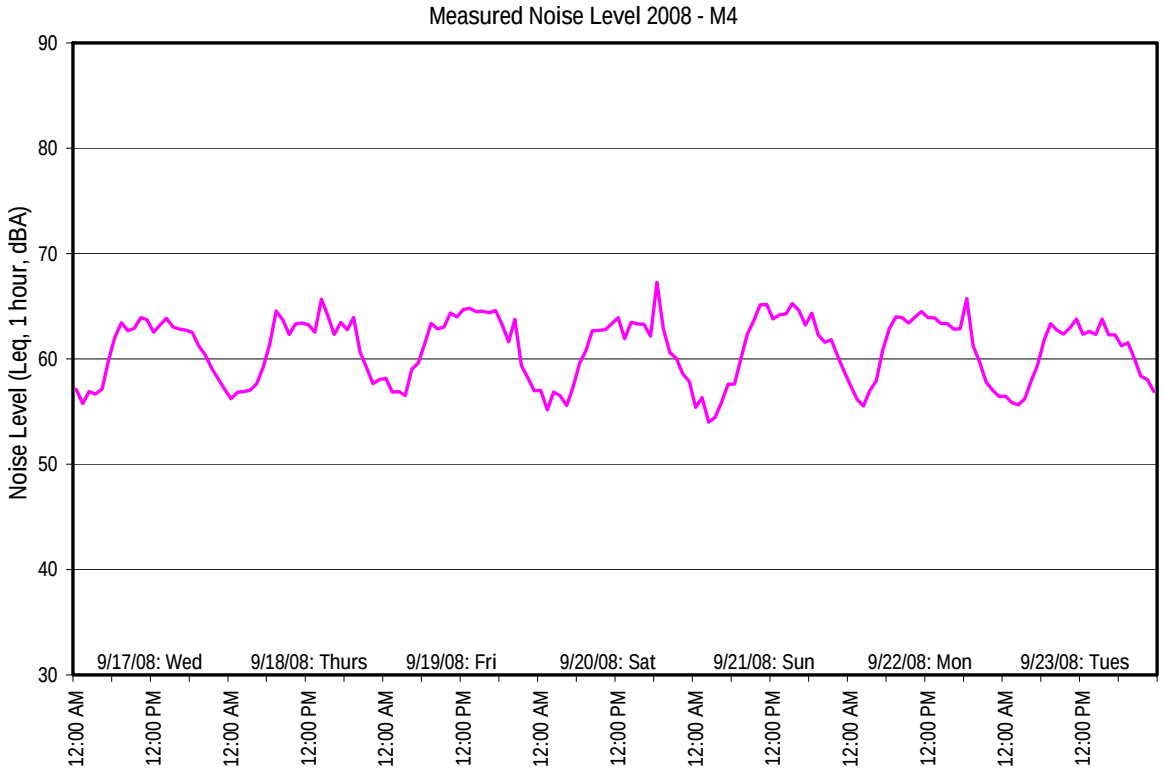

Measured Noise Level 2007 - M3
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
4/27/07: Fri
4/28/07: Sat
4/29/07: Sun
4/30/07: Mon
5/1/07: Tue
5/2/07: Wed
5/3/07: Thur
12:00 AM
12:00 PM

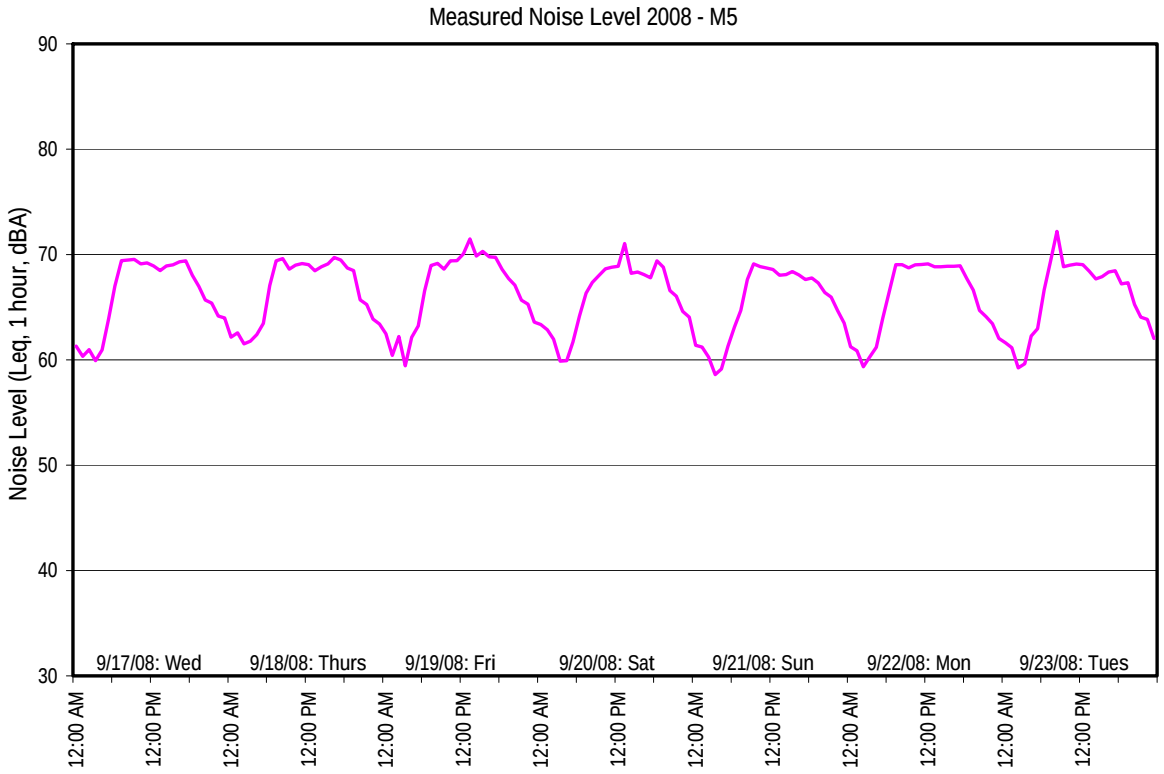

Measured Noise Level 2007 - M4
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
4/27/07: Fri
4/28/07: Sat
4/29/07: Sun
4/30/07: Mon
5/1/07: Tue
5/2/07: Wed
5/3/07: Thur
12:00 AM
12:00 PM

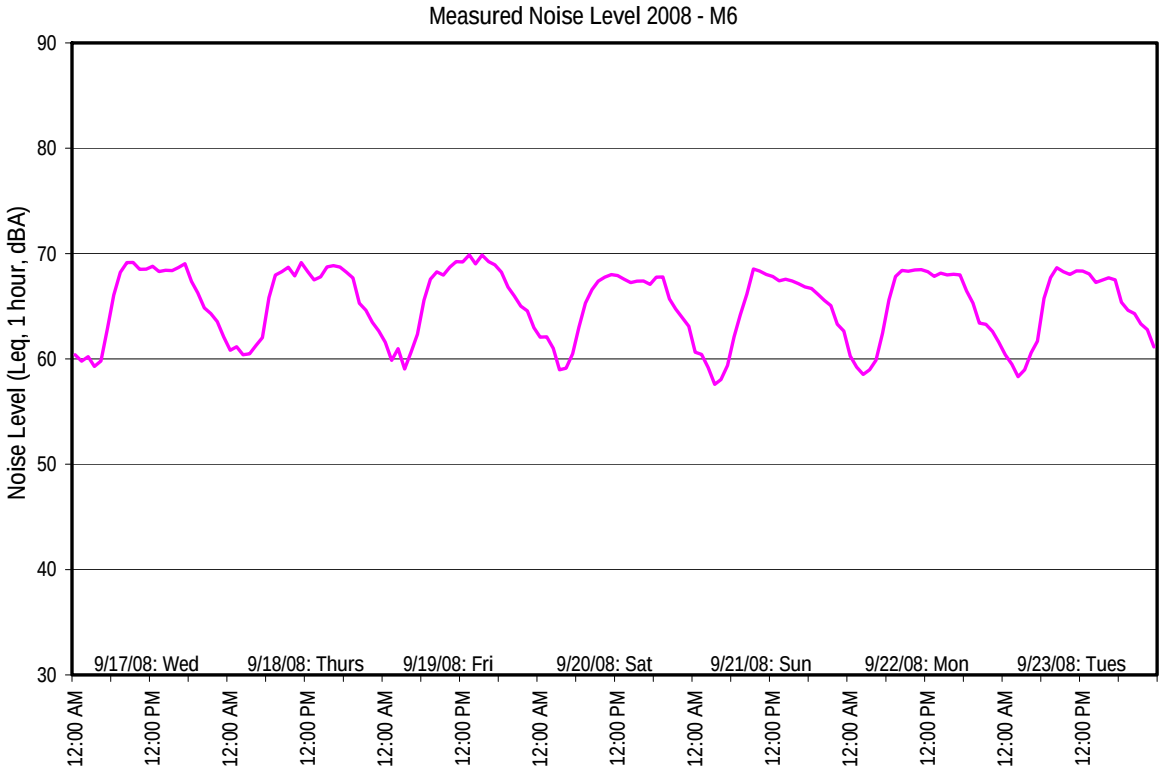

Measured Noise Level 2008 - M1
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM


Measured Noise Level 2008 - M2
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM


Measured Noise Level 2008 - M3
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM

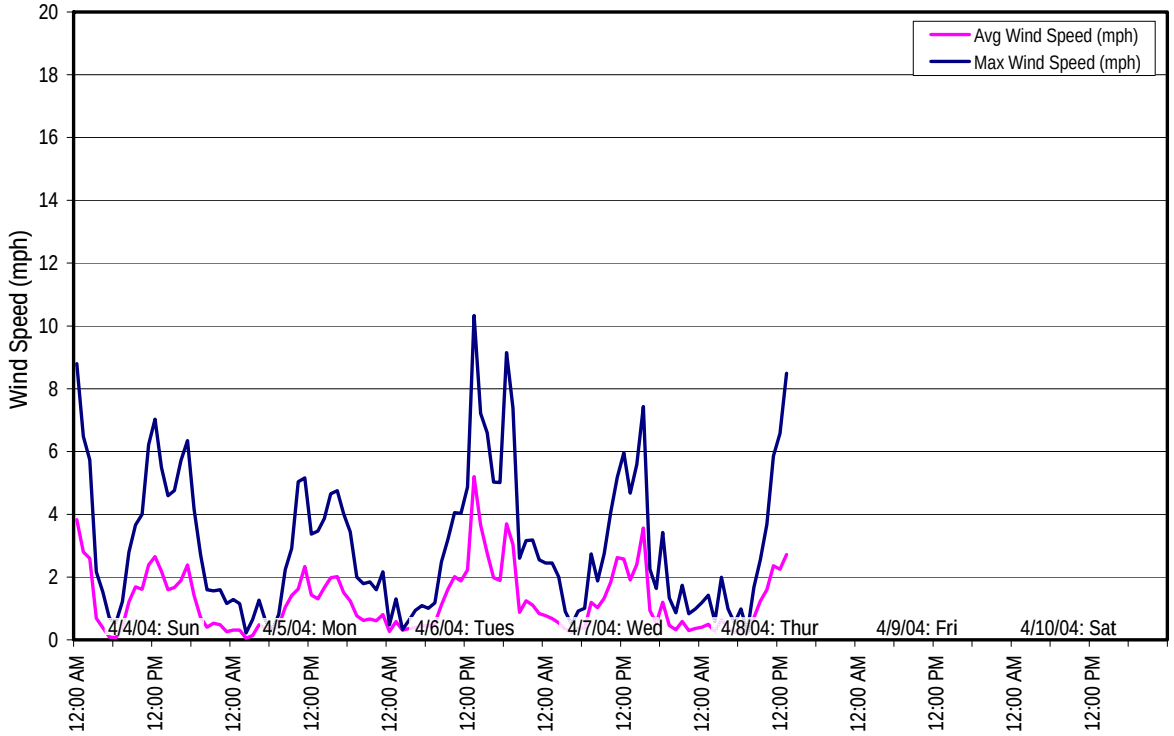

Measured Noise Level 2008 - M4
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM


Measured Noise Level 2008 - M5
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM

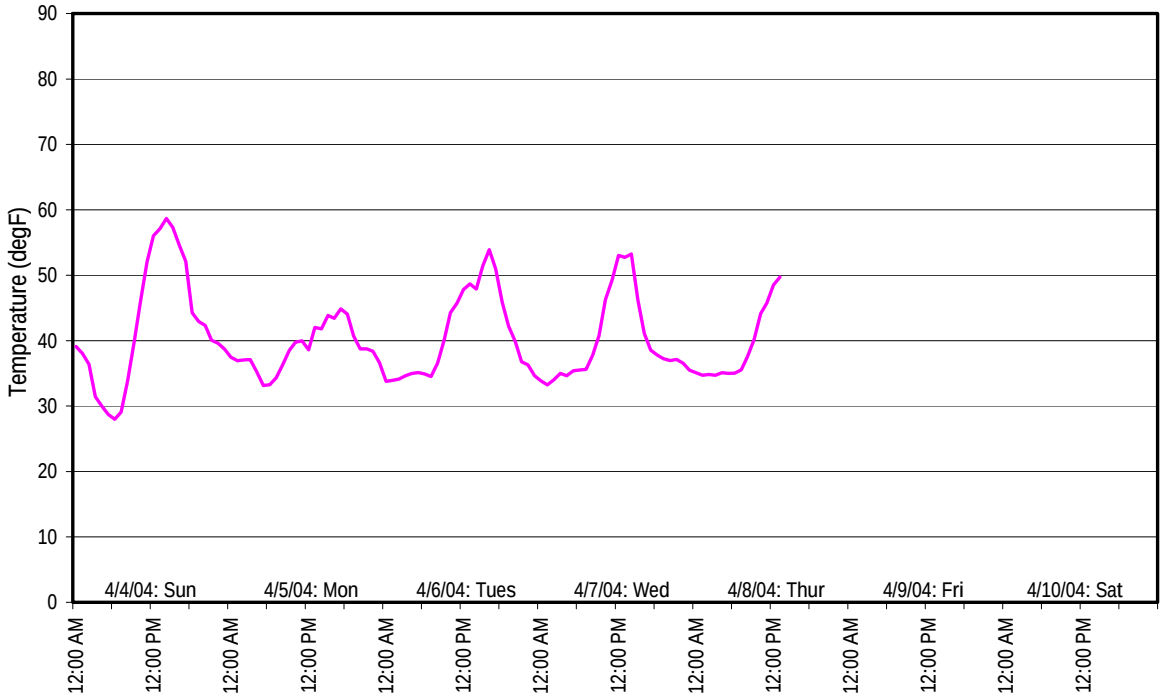

Measured Noise Level 2008 - M6
Noise Level (Leq, 1 hour, dBA)
90
80
70
60
50
40
30
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM

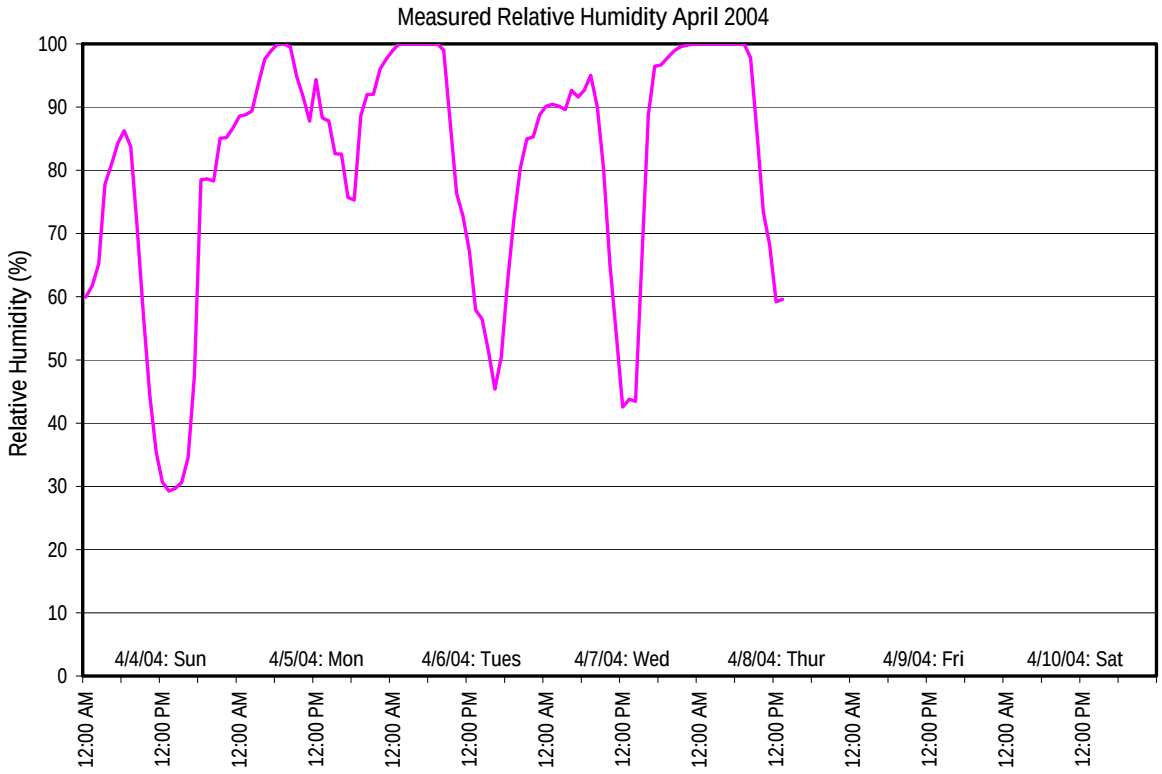
Appendix B
Plots of Measured Weather Data

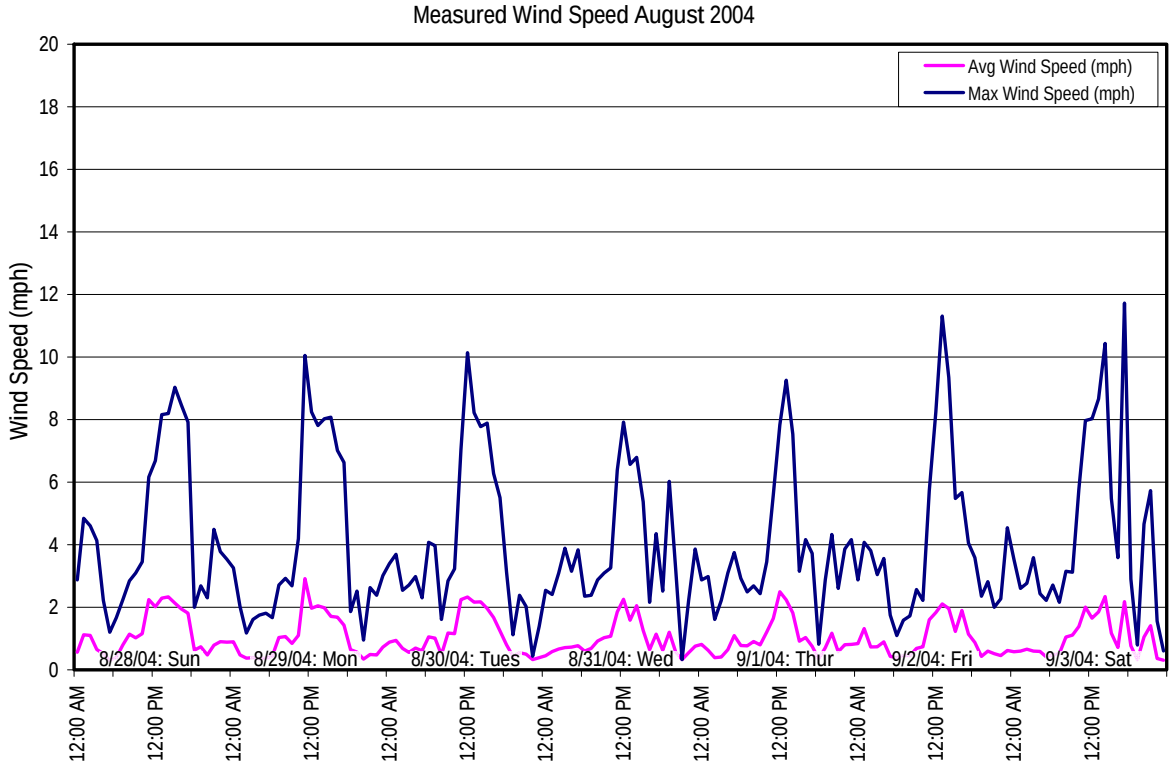
Measured Wind Speed April 2004

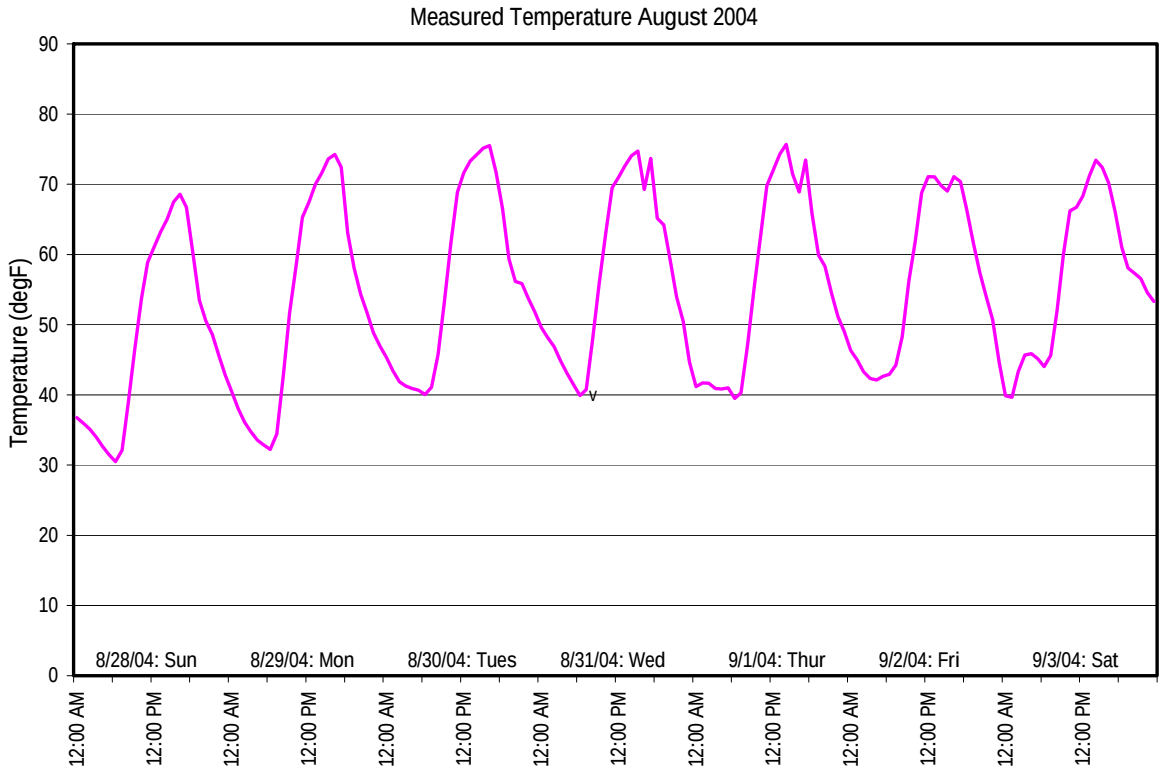


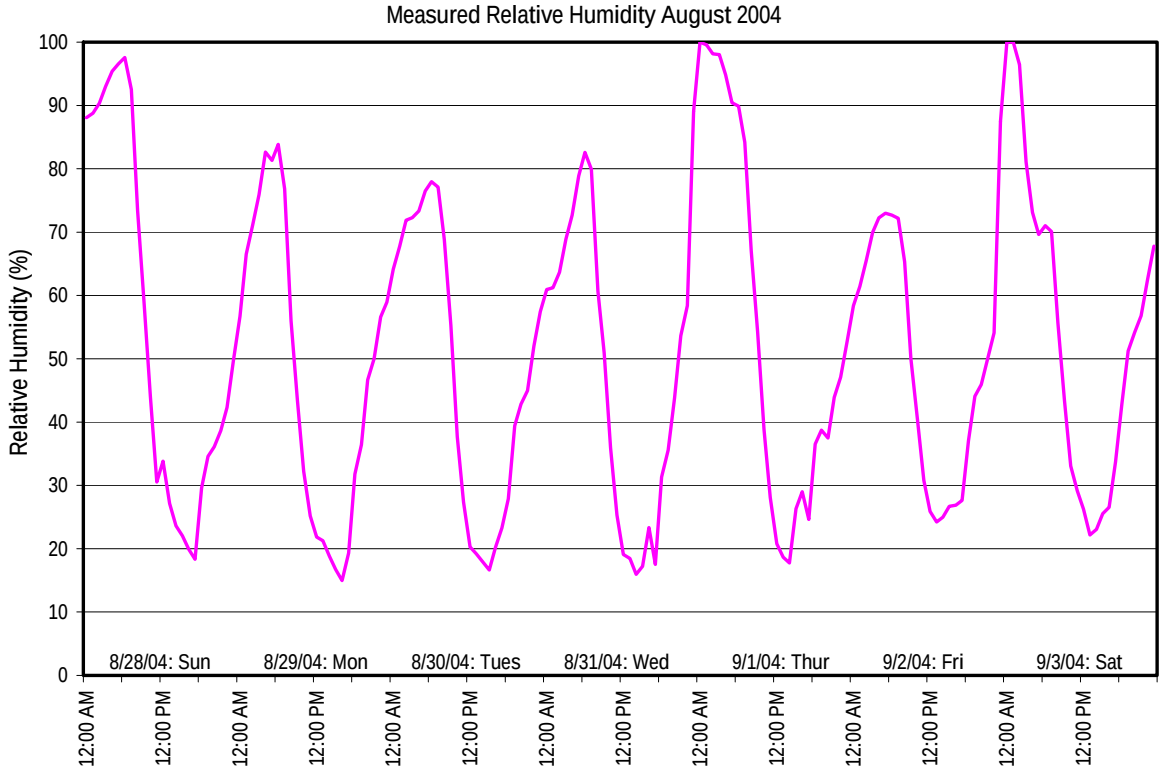
Measured Temperature April 2004

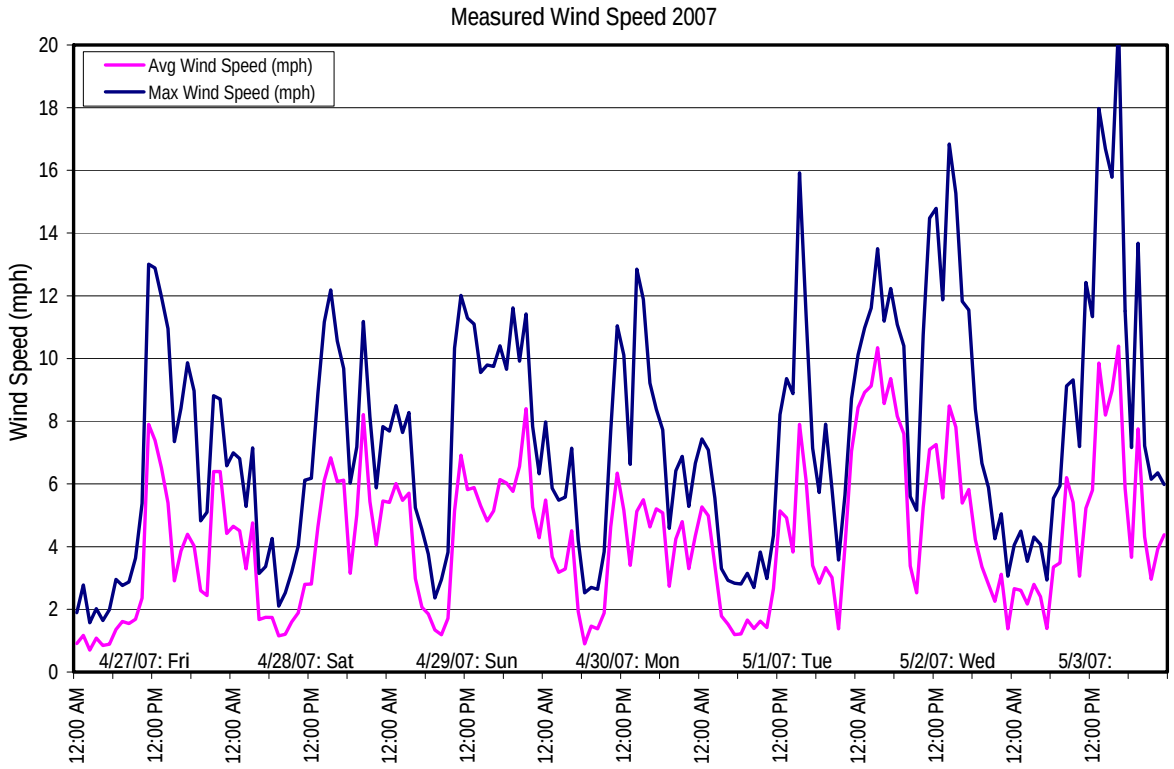


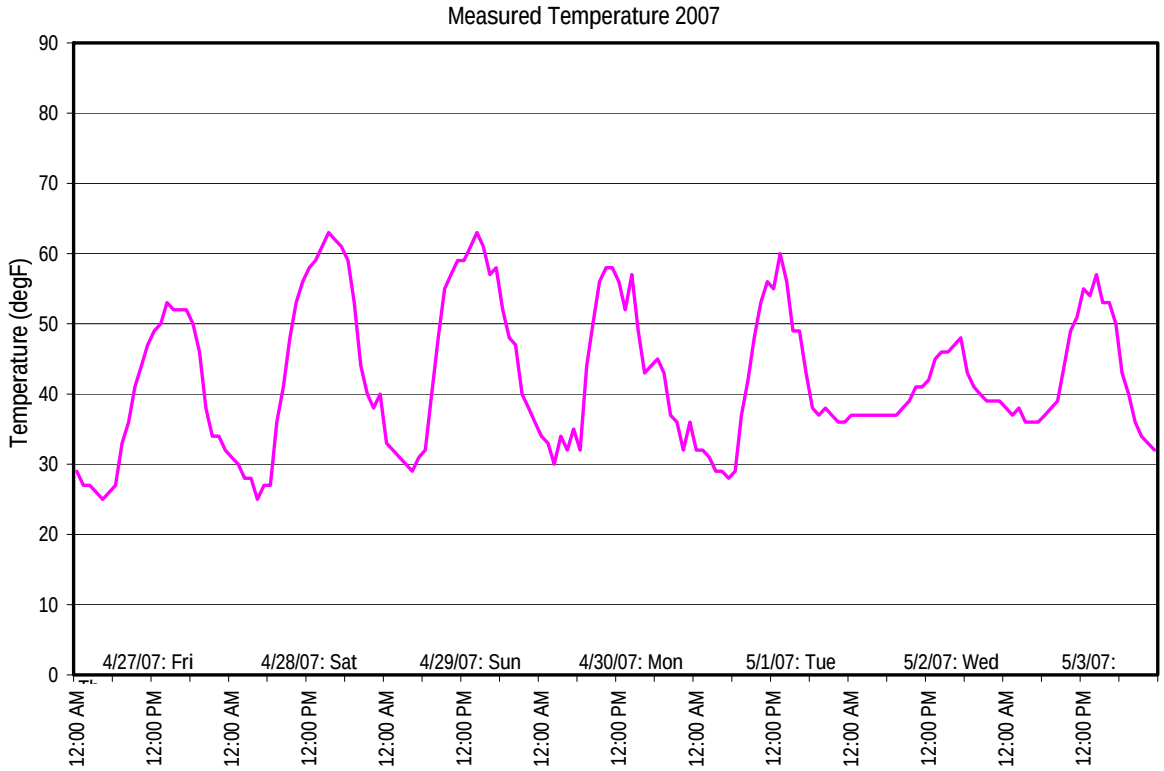

Measured Relative Humidity April 2004
Relative Humidity (%)
100
90
80
70
60
50
40
30
20
10
0
4/4/04: Sun
4/5/04: Mon
4/6/04: Tues
4/7/04: Wed
4/8/04: Thur
4/9/04: Fri
4/10/04: Sat
12:00 AM
12:00 PM

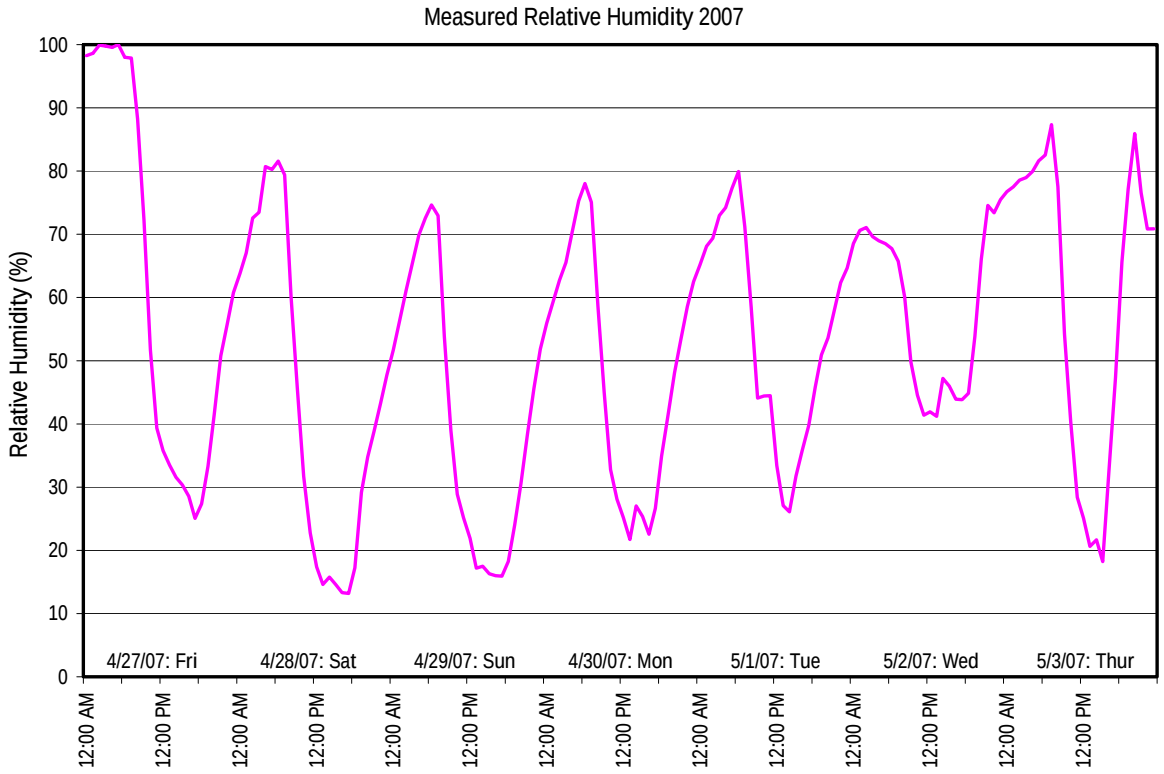

Measured Wind Speed August 2004
Wind Speed (mph)
Avg Wind Speed (mph)
Max Wind Speed (mph)
20
18
16
14
12
10
8
6
4
2
0
8/28/04: Sun
8/29/04: Mon
8/30/04: Tues
8/31/04: Wed
9/1/04: Thur
9/2/04: Fri
9/3/04: Sat
12:00 AM
12:00 PM

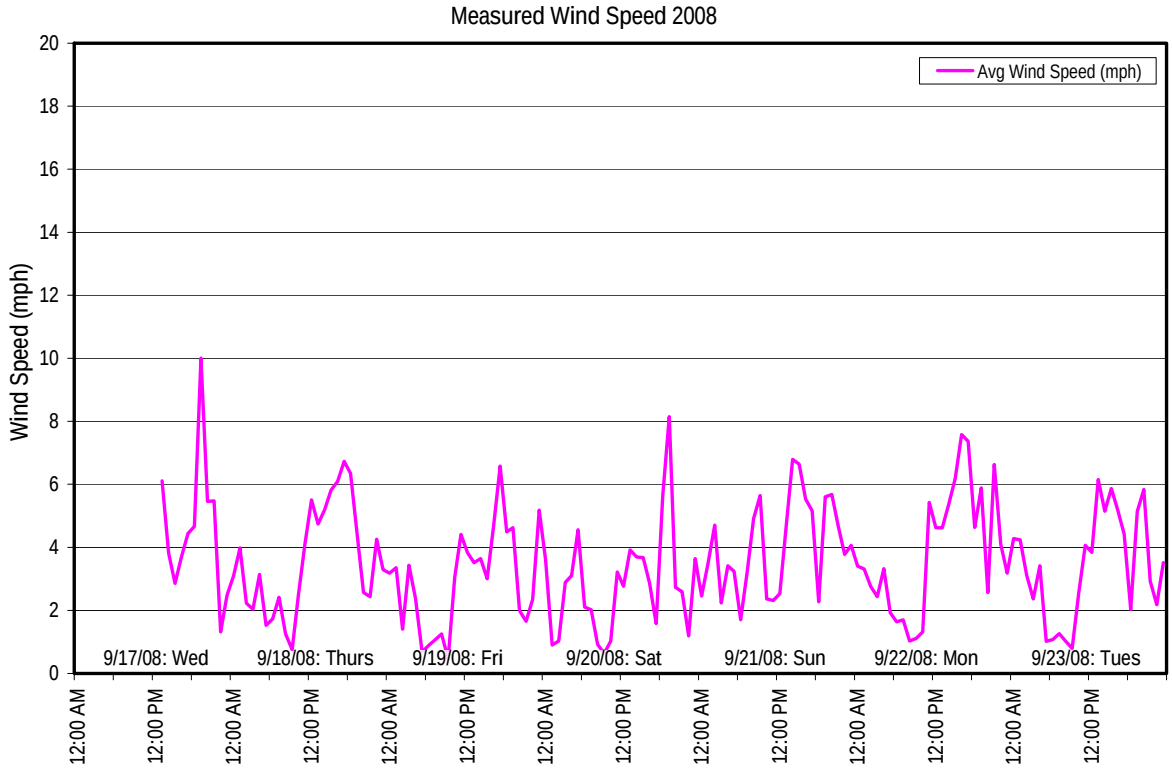

Measured Temperature August 2004
Temperature (degF)
90
80
70
60
50
40
30
20
10
0
8/28/04: Sun
8/29/04: Mon
8/30/04: Tues
8/31/04: Wed
9/1/04: Thur
9/2/04: Fri
9/3/04: Sat
12:00 AM
12:00 PM

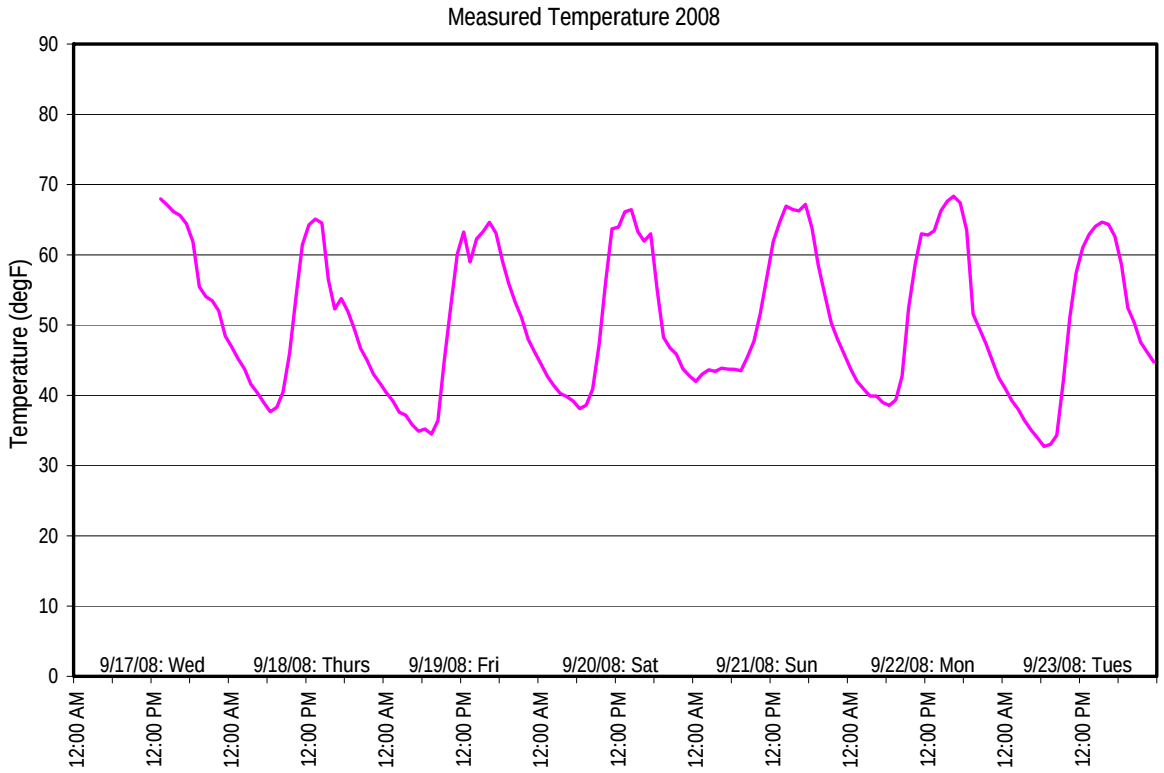

Measured Relative Humidity August 2004
Relative Humidity (%)
100
90
80
70
60
50
40
30
20
10
0
8/28/04: Sun
8/29/04: Mon
8/30/04: Tues
8/31/04: Wed
9/1/04: Thur
9/2/04: Fri
9/3/04: Sat
12:00 AM
12:00 PM

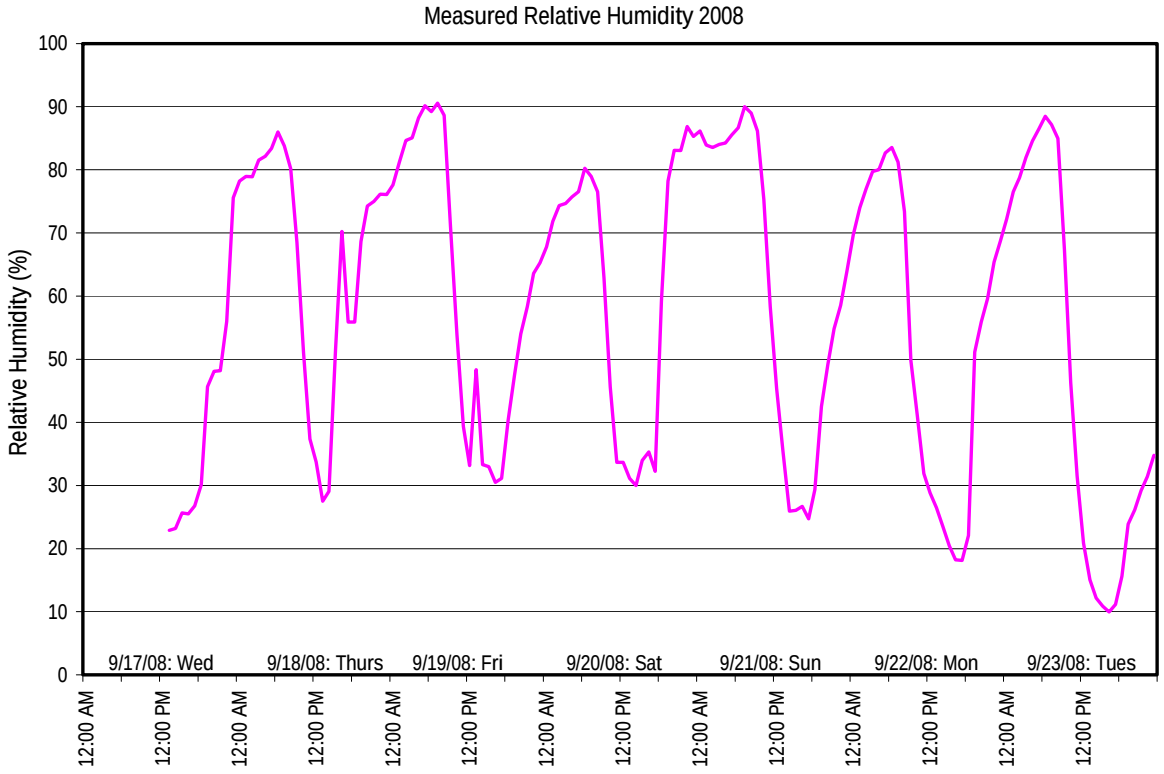

Measured Wind Speed 2007
Avg Wind Speed (mph)
Max Wind Speed (mph)
Wind Speed (mph)
0
2
4
6
8
10
12
14
16
18
20
4/27/07: Fri
4/28/07: Sat
4/29/07: Sun
4/30/07: Mon
5/1/07: Tue
5/2/07: Wed
5/3/07:
12:00 AM
12:00 PM


Measured Temperature 2007
Temperature (degF)
0
10
20
30
40
50
60
70
80
90
4/27/07: Fri
4/28/07: Sat
4/29/07: Sun
4/30/07: Mon
5/1/07: Tue
5/2/07: Wed
5/3/07:
12:00 AM
12:00 PM


Measured Relative Humidity 2007
Relative Humidity (%)
100
90
80
70
60
50
40
30
20
10
0
4/27/07: Fri
4/28/07: Sat
4/29/07: Sun
4/30/07: Mon
5/1/07: Tue
5/2/07: Wed
5/3/07: Thur
12:00 AM
12:00 PM

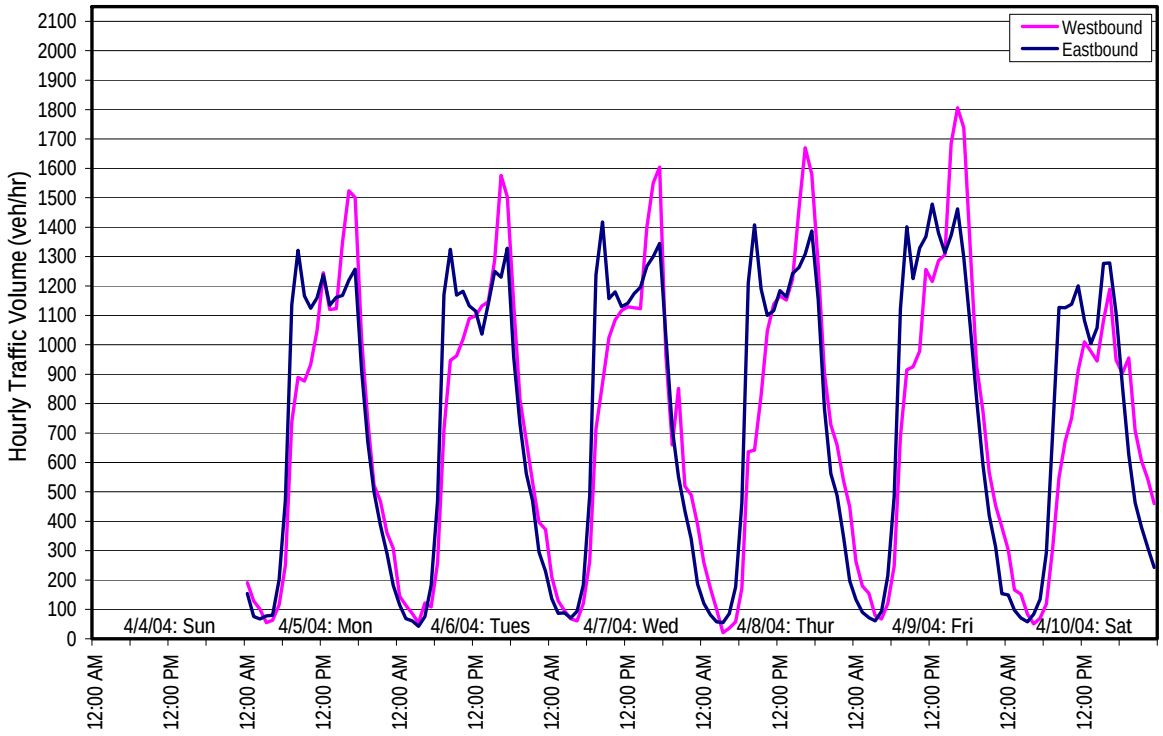

Measured Wind Speed 2008
Wind Speed (mph)
Avg Wind Speed (mph)
20
18
16
14
12
10
8
6
4
2
0
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM


Measured Temperature 2008
Temperature (degF)
90
80
70
60
50
40
30
20
10
0
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM

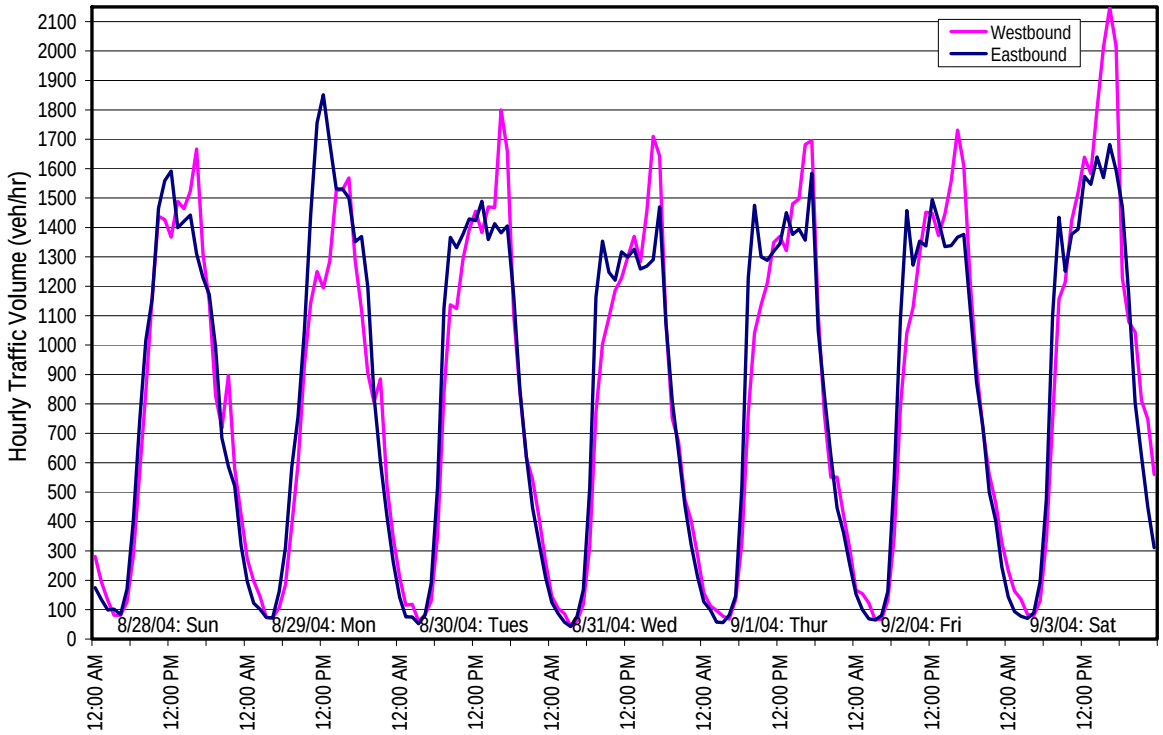

Measured Relative Humidity 2008
Relative Humidity (%)
100
90
80
70
60
50
40
30
20
10
0
9/17/08: Wed
9/18/08: Thurs
9/19/08: Fri
9/20/08: Sat
9/21/08: Sun
9/22/08: Mon
9/23/08: Tues
12:00 AM
12:00 PM

Appendix C
Plots of Measured I-70 Traffic Volumes

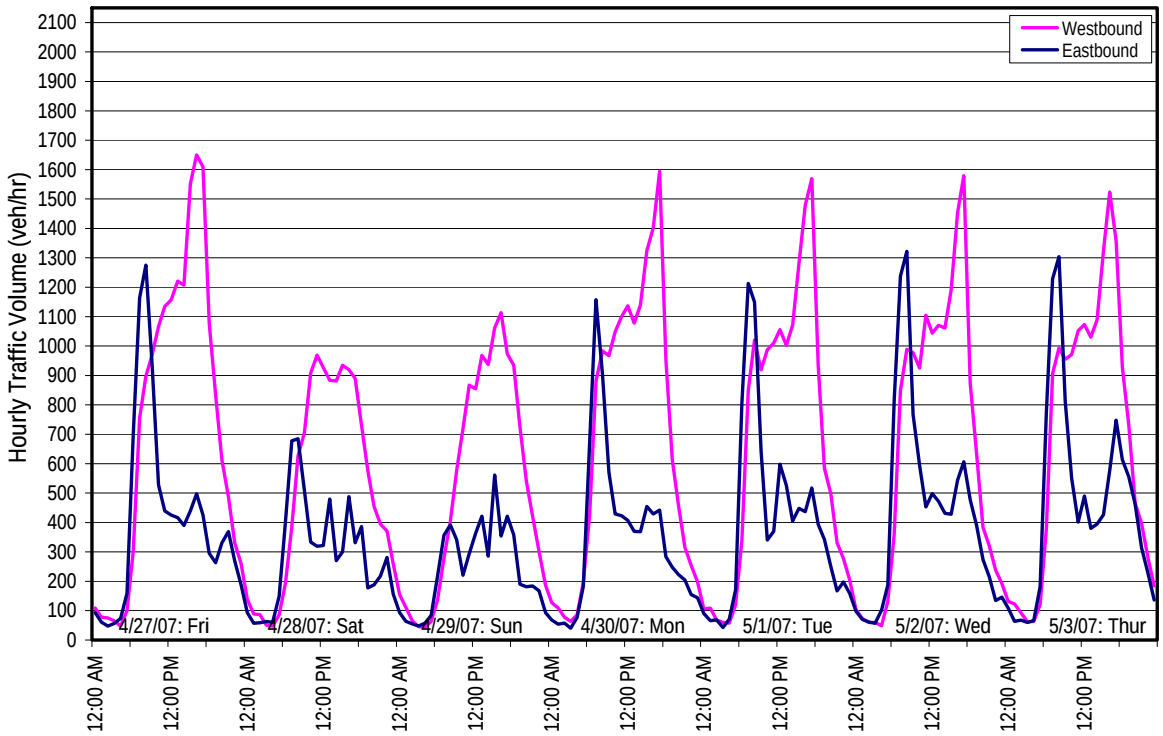
CDOT Traffic Volume April 2004



CDOT Traffic Volume August 2004



CDOT Traffic Volume 2007



CDOT Traffic Volume 2008