Noise Analysis PPM Clayton Wind Farm

TO: Clayton Wind Farm Project Team

FROM: Mark Bastasch/CH2M HILL

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Summary

This memorandum provides a baseline noise assessment for the proposed Clayton Wind Power Facility (the Facility). Atlantic Wind, LLC proposes to construct a wind-generation facility in Clayton, New York, with generating capacity of up to approximately 130 megawatts (MW). The facilities noise levels were compared to the local noise requirements and New York State noise guidelines.

The facilities steady state noise levels are predicted to comply with the Town of Clayton's Wind Energy Facilities Ordinance limit of 50 dBA at offsite residences. The facility is predicted to comply with the 50 dBA limit at all residences, both participating and non-participating. The New York State Department of Environmental Conservation (NY DEC) published guidance "Assessing and Mitigating Noise Impacts" suggest that "Sound pressure increases of more than 6 dB may require a closer analysis of impact potential depending on existing sound levels and the character of surrounding land use and receptors." Given the variability in existing noise levels, the facilities noise level may exceed the existing levels by 6 dBA at lower wind speeds but maintains compliance with the Town of Clayton's Wind Energy Facilities Ordinance limit of 50 dBA even at the highest wind speeds.

Fundamentals of Acoustics

It is useful to understand how noise is defined and measured. Noise is defined as unwanted sound. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. There are several ways to measure noise, depending on the source of the noise, the receiver, and the reason for the noise measurement. Table 1 summarizes the technical noise terms used in this memorandum.

TABLE 1
Definitions of Acoustical Terms

Term	Definitions
Ambient noise level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the measured pressure to the reference pressure, which is 20 micropascals.

TABLE 1
Definitions of Acoustical Terms

Term	Definitions
A-weighted sound pressure level (dBA)	The sound pressure level in decibels as measured on a sound level meter using the A-weighted filter network. The A-weighted filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this report are A-weighted.
Equivalent Sound Level (L_{eq})	The L_{eq} integrates fluctuating sound levels over a period of time to express them as a steady-state sound level. As an example, if two sounds are measured and one sound has twice the energy but lasts half as long, the two sounds would be characterized as having the same equivalent sound level. Equivalent Sound Level is considered to be related directly to the effects of sound on people since it expresses the equivalent magnitude of the sound as a function of frequency of occurrence and time.
Day–Night Level (L_{dn} or DNL)	The Day-Night level (L_{dn} or DNL) is a 24-hour average L_{eq} where 10 dBA is added to nighttime levels between 10 p.m. and 7 a.m. For a continuous source that emits the same noise level over a 24-hour period, the L_{dn} will be 6.4 dB greater than the L_{eq}.
Statistical noise level (L_n)	The noise level exceeded during n percent of the measurement period, where n is a number between 0 and 100 (for example, L_{50} is the level exceeded 50 percent of the time)

Table 2 shows the relative A-weighted noise levels of common sounds measured in the environment and in industry for various sound levels.

TABLE 2
Typical Sound Levels Measured in the Environment and Industry

Noise Source At a Given Distance	A-Weighted Sound Level in Decibels	Qualitative Description
Carrier Deck Jet Operation	140	
	130	Pain threshold
Jet takeoff (200 feet)	120	
Auto Horn (3 feet)	110	Maximum Vocal Effort
Jet takeoff (2000 feet) Shout (0.5 feet)	100	
N.Y. Subway Station Heavy Truck (50 feet)	90	Very Annoying Hearing Damage (8-hr, continuous exposure)
Pneumatic drill (50 feet)	80	Annoying
Freight Train (50 feet) Freeway Traffic (50 feet)		
	70	Intrusive Telephone Use Difficult
Air Conditioning Unit (20 feet)	60	
Light auto traffic (50 feet)	50	Quiet
Living Room Bedroom	40	
Library Soft whisper (5 feet)	30	Very Quiet

TABLE 2
Typical Sound Levels Measured in the Environment and Industry

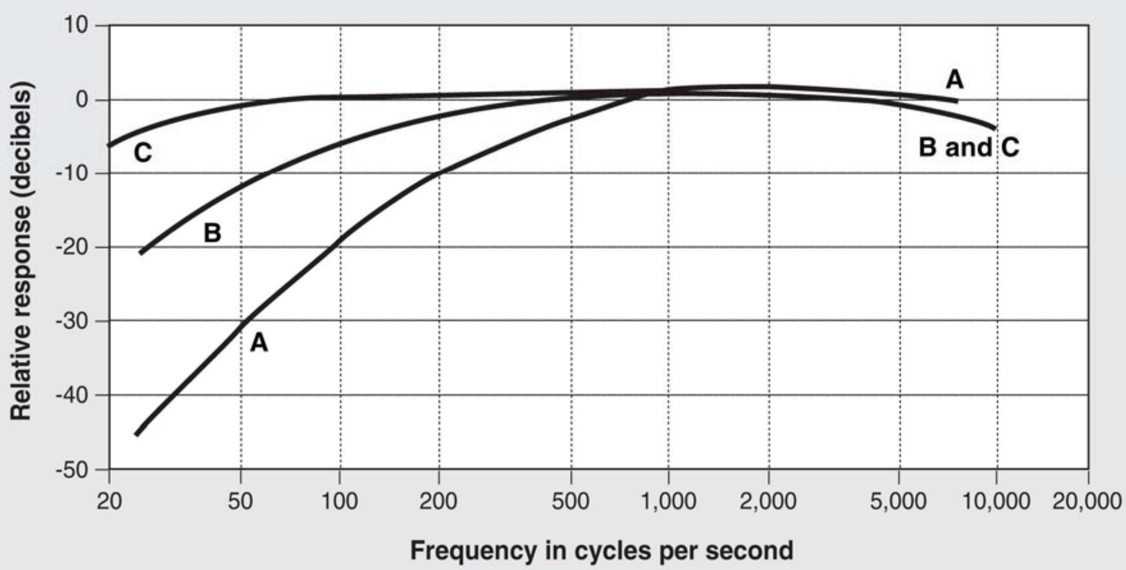
Noise Source At a Given Distance	A-Weighted Sound Level in Decibels	Qualitative Description
Broadcasting Studio	20	Recording studio
	10	Just Audible

Adapted from Table E, "Assessing and Mitigating Noise Impacts", NY DEC, February 2001.

The most common metric is the overall A-weighted sound level measurement that has been adopted by regulatory bodies worldwide. The A-weighting network measures sound in a similar fashion to how a person perceives or hears sound, thus achieving very good correlation in terms of how to evaluate acceptable and unacceptable sound levels.

Figure 1

NOISE METRICS—FREQUENCY RESPONSE

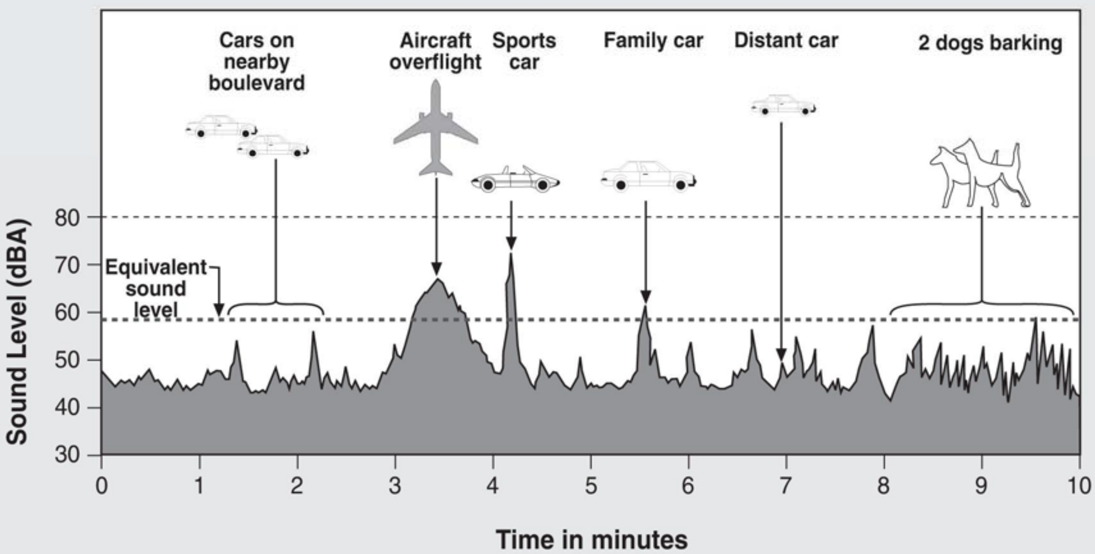


Source: A. Peterson and E. Gross, *Handbook of Noise Control*, West Concord: General Radio Company, 1967.

The measurement of sound is not a simple task. Consider typical sounds in a suburban neighborhood on a normal or "quiet" afternoon. If a short time in history of those sounds is plotted on a graph, it would look very much like Figure 2. In Figure 2, the background, or residential sound level in the absence of any identifiable noise sources, is approximately 45 dB. During roughly three-quarters of the time, the sound level is 50 dB or less. The highest sound level, caused by a nearby sports car, is approximately 70 dB, while an aircraft generates a maximum sound level of about 68 dB. The following provides a discussion of how variable community noise is measured.

Figure 2

NOISE METRICS—COMPARATIVE NOISE LEVELS



Source: *Protective Noise Levels, Condensed Version of EPA Levels Document,* United States Environmental Protection Agency, November 1978.

One obvious way of describing noise is to measure the maximum sound level (L_{max})—in the case of Figure 2, the nearby sports car at 70 dBA. The maximum sound level measurement does not account for the duration of the sound. Studies have shown that human response to noise involves both the maximum level and its duration. For example, the aircraft in this case is not as loud as the sports car, but the aircraft sound lasts longer. For most people, the aircraft overflight would be more annoying than the sports car event. Thus, the maximum sound level alone is not sufficient to predict reaction to environmental noise.

A-weighted sound levels typically are measured or presented as equivalent sound pressure level (L_{eq}), which is defined as the average noise level, on an equal energy basis for a stated period of time, and is commonly used to measure steady-state sound or noise that is usually dominant. Statistical methods are used to capture the dynamics of a changing acoustical environment. Statistical measurements are typically denoted by $L_{xx,}$ where xx represents the percentile of time the sound level is exceeded. The L_{90} is a measurement that represents the noise level that is exceeded during 90 percent of the measurement period. Similarly, the L_{10} represents the noise level exceeded for 10 percent of the measurement period.

The effects of noise on people can be listed in three general categories:

- Subjective effects of annoyance, nuisance, dissatisfaction
- Interference with activities such as speech, sleep, learning
- Physiological effects such as startling and hearing loss

In most cases, environmental noise may produces effects in the first two categories only. However, workers in industrial plants may experience noise effects in the last category. No completely satisfactory way exists to measure the subjective effects of noise, or to measure the corresponding reactions of annoyance and dissatisfaction. This lack of a common standard is primarily due to the wide variation in individual thresholds of annoyance and habituation to noise. Thus, an important way of determining a person's subjective reaction to a new noise is by comparing it to the existing or "ambient" environment to which that person has adapted. In general, the more the level or the tonal (frequency) variations of a noise exceeds the previously existing ambient noise level or tonal quality, the less acceptable the new noise will be, as judged by the exposed individual.

The general human response to changes in noise levels that are similar in frequency content (for example, comparing increases in continuous (L_{eq}) traffic noise levels) are summarized below:

- A 3-dB change in sound level is considered a barely noticeable difference
- A 5-dB change in sound level will typically be noticeable
- A 10-dB change is considered to be a doubling in loudness.

It also is useful to understand the difference between a sound pressure level (or noise level) and a sound power level. A sound power level (commonly abbreviated as PWL or Lw) is analogous to the wattage of a light bulb; it is a measure of the acoustical energy emitted by the source and is, therefore, independent of distance. A sound pressure level (commonly abbreviated as SPL or Lp) is analogous to the brightness or intensity of light experienced at a specific distance from a source and is measured directly with a sound level meter. Sound pressure levels always should be specified with a location or distance from the noise source.

Sound power level data is used in acoustic models to predict sound pressure levels. This is because sound power levels take into account the size of the acoustical source and account for the total acoustical energy emitted by the source. For example, the sound pressure level 15 feet from a small radio and a large orchestra may be the same, but the sound power level of the orchestra will be much larger because it emits sound over a much larger area. Similarly, 2-horsepower (hp) and 2,000-hp pumps can both achieve 85 dBA at 3 feet (a common specification) but the 2,000-hp pump will have significantly larger sound power level. Consequently the noise from the 2,000-hp pump will travel farther. A sound power level can be determined from a sound pressure level if the distance from and dimensions of the source are known. Sound power levels will always be greater than sound pressure levels and sound power levels should never be compared to sound pressure levels such as those in Table 2. The sound power level of a wind turbine typically will vary between 100 and 110 dBA. This will result in a sound pressure level of about 55 to 65 dBA at 130 feet (similar in level to a normal conversation).

Existing Land Use

All Facility components will be located on private land on which the Applicants have negotiated long-term wind energy leases with the landowners. The majority of the area consists of fields and pastures, with forested areas generally confined to small woodlots and slopes that descend into adjacent valleys. In the area where the Facility will be located, scattered residences exist.

Significance Thresholds

The New York State Department of Environmental Conservation (NY DEC) published guidance "Assessing and Mitigating Noise Impacts" (NY DEC, 2001) is the basis used to assess the Facility's potential for noise impacts. This guidance does not provide quantitative noise limits but its key recommendations briefly are summarized below:

- New noise sources should not increase noise level above 65 dBA in non-industrial areas.
- The U.S. Environmental Protection Agency (EPA) found that 55 L_{dn} was sufficient to protect public health and welfare, and in most cases did not create an annoyance. (55 L_{dn} is equal to a continuous level of 49 dBA)
- Sound level increases of more than 6 dB may require a closer analysis of impact potential depending on existing sound levels and the character of surrounding land use and receptors.
- In determining the potential for an adverse noise impact, consider not only ambient noise levels, but also the existing land use, and whether or not an increased noise level or the introduction of a discernable sound that is out of character with existing sounds will be considered annoying or obtrusive.
- Any unavoidable adverse effects must be weighed along with other social and economic considerations in deciding whether to approve or deny a permit.

In addition to the NY DEC guidelines, the Town of Clayton's Wind Energy Facilities Ordinance (Local Law No. 1 of 2007) states the following :

"The Sound Level statistical sound pressure level (L_{10}) due to any WECs operation shall not exceed 50 dBA when measured at any off-site residence, school, hospital, church or public library existing on the date of the WECs application." In the event that this level or the minimum distance setbacks cannot be met, the law allows for the owners of the affected property to enter into a permanent noise or setback easement.

Table 3 summarizes the significance thresholds established for this analysis. Two types of thresholds are established, absolute and relative. Absolute limits are limits on project generated noise that should not be exceeded. The Town of Clayton has established an absolute limit of 50 dBA which can only be exceeded if a noise easement is obtained.

TABLE 3
Summary of Significance Thresholds

	Participating Landowner	**Non-Participating Landowner**
Absolute Threshold (L_{10})	50 dBA	50 dBA
Relative Threshold (L_{eq})	None	6 dBA[1]

Notes:
1. Resulting noise level must exceed 35 dBA to be considered potentially significant increase.

Relative limits are limits on the increase in noise resulting from the project. Neither the NY DEC guidance nor the Town of Clayton's ordinance provides clarity on the metric or magnitude for evaluating increases in noise levels. The NY DEC guidance states that the L_{eq}

"provides an indication of the effects of sound on people (and is) useful in establishing the ambient sound levels" and the L_{90} is "often used to designate the background noise level". However, the Town of Clayton's noise ordinance defines "ambient sound level" as the L_{90} statistic. Because the evaluation of project-related increases is only discussed in the NY DEC guidance, their L_{eq} metric is used as the basis of the 6 dBA relative threshold established at a non-participating landowners. As a project participant becomes one willingly and derives benefit from the project, therefore a relative significance threshold for participants is not established.

For a conventional power plant or industrial facility, the increase in noise resulting from the projects would be evaluated under calm wind conditions when ambient noise levels are low. Because a wind turbine needs wind to operate, evaluating increases in noise under calm conditions, when noise levels are lowest, is inappropriate. The speed at which the wind turbine starts to operate and generate power is called the cut-in wind speed. The speed at which the wind turbine generates the maximum noise level can be referred to as the full power wind speed. For the turbine under consideration here, the cut-in hub height wind speed is approximately 4 m/s (9 mph) and the maximum noise level (full output) occurs at 12.5 m/s (28 mph).

Existing Noise Levels

Existing noise levels were measured at five locations shown in Figure 3. Figure 3 also depicts the general area for which each monitoring location is representative. The measurement period started on Monday, December 4 and ended on Sunday, December 17, 2006. Measurement equipment consisted of Larson Davis 820 Type 1 (precision) sound level meters. All equipment had been factory calibrated within the previous 12 months and field calibrated both before and after the measurement period. Noise measurements were collected in 10-minute intervals to correspond to wind measurement collection efforts. Noise measurement parameters consisted of the energy average (L_{eq}) and statistical levels (L_{10}, L_{50} and L_{90}). Regression charts of wind speed and noise levels are presented in Appendix A.

Table 4 presents the estimated existing nighttime average noise level (L_{eq}) under cut-in and full output hub height wind conditions (approximately 6 m/s and 13 m/s respectively) at each of the five monitoring locations.

TABLE 4
Summary of Existing Nighttime L_{eq} Noise Levels (dBA)

Monitoring Location	L_{eq} Noise Level at Cut-in Wind speeds (6 m/s)	L_{eq} Noise Level at Full Output Wind speeds (13 m/s)
M1	28	50
M2	33	45
M3	36	45
M4	46[1]	50
M5	32	50

1. Location M4 is adjacent to State Highway 12; as such the nighttime L_{eq} is elevated by sporadic vehicle pass-by levels.

The existing nighttime noise levels summarized in Table 4 were used to develop the threshold of potential significance consistent with NY DEC guidance on limiting increases to 6 dBA. As shown in Table 5, the resulting relative thresholds under the lower cut-in wind speeds are more restrictive than the 50 dBA limit established in the Town of Clayton's Wind Energy Ordinance at all locations except M4 (because of its proximity to State Highway 12).

TABLE 5
Thresholds of Potential Significance

	Participating Landowner	Non-Participating Landowner				
Absolute Threshold (L_{10})	50 dBA	50 dBA				
Relative Threshold (L_{eq})[1]						
		M1	M2	M3	M4	M5
Low Wind speeds (above cut-in)	50 dBA	35 dBA	39 dBA	42 dBA	50 dBA	38 dBA
High Wind speeds (full output)	50 dBA	50 dBA				

1. Resulting level must exceed 35 dBA to be considered potentially significant.

Facility Sound Levels

Standard acoustical engineering methods were used in the noise analysis. The noise model, CADNA/A by DataKustik GmbH of Munich, Germany, is a sophisticated software program that facilitates noise modeling of complex projects. The sound propagation factors used in the model have been adopted from ISO 9613 (ISO, 1993) and VDI 2714 (VDI, 1988). Atmospheric absorption for conditions of 10°C and 70 percent relative humidity (conditions that favor propagation) was computed in accordance with ISO 9613-1, *Calculation of the Absorption of Sound by the Atmosphere*.

Each wind turbine was considered to be a point source of noise at the hub height with an overall sound power level of 104 dBA under cut-in conditions or 109 dBA under full power conditions. The full power conditions corresponds to the anticipated maximum noise level generated by the turbines as measured in accordance with IEC61400-11 (the turbine noise level would be less at lower wind speeds). The transmission line is 115-kilovolt (kV), therefore audible corona noise is anticipated to be negligible (corona noise generally is associated with voltages exceeding 345 kV).

Figure 4 and Table 6 present the predicted project levels under full power conditions. No residences are predicted to exceed the Town of Clayton's limit of 50 dBA. In addition, under these high wind speeds no locations are anticipated to exceed the existing nighttime levels by more than 6 dBA.

TABLE 6
Summary of Predicted Project Full Power Noise Levels (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R147	M4	50	50	0.2

TABLE 6
Summary of Predicted Project Full Power Noise Levels (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R162	M2	45	50	5.1
R191	M2	45	50	5.1
R85	M4	50	50	0.1
R92	M2	45	50	4.9
R83	M4	50	50	-0.1
R84	M4	50	50	-0.1
R91	M2	45	50	4.8
R93	M2	45	50	4.7
R86	M4	50	50	-0.3
R165	M2	45	50	4.6
R76	M2	45	50	4.6
R90	M2	45	50	4.5
R94	M2	45	50	4.5
R166	M2	45	49	4.4
R167	M2	45	49	4.4
R95	M2	45	49	4.4
R161	M4	50	49	-0.6
R108	M4	50	49	-0.7
R146	M4	50	49	-0.7
R163	M2	45	49	4.2
R168	M2	45	49	4.2
R193	M2	45	49	4.2
R150	M4	50	49	-0.8
R96	M2	45	49	4.1
R87	M4	50	49	-0.9
R164	M2	45	49	4
R192	M2	45	49	3.9
R151	M4	50	49	-1.1
R22	M2	45	49	3.8
R109	M5	50	49	-1.3
R73	M2	45	49	3.7
R89	M2	45	49	3.7
R105	M4	50	49	-1.3
R149	M4	50	49	-1.3
R114	M5	50	49	-1.4
R115	M5	50	49	-1.4
R116	M5	50	49	-1.4
R124	M5	50	49	-1.4
R75	M2	45	49	3.6
R97	M2	45	49	3.6

TABLE 6
Summary of Predicted Project Full Power Noise Levels (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R78	M4	50	49	-1.4
R112	M5	50	49	-1.5
R117	M5	50	49	-1.5
R74	M2	45	49	3.5
R111	M5	50	48	-1.6
R102	M2	45	48	3.4
R103	M2	45	48	3.4
R104	M2	45	48	3.4
R72	M2	45	48	3.4
R88	M2	45	48	3.4
R101	M2	45	48	3.3
R169	M2	45	48	3.3
R107	M4	50	48	-1.7
R19	M1	50	48	-1.8
R113	M5	50	48	-1.8
R100	M2	45	48	3.2
R64	M2	45	48	3.2
R71	M2	45	48	3.2
R77	M2	45	48	3.2
R98	M2	45	48	3.2
R148	M4	50	48	-1.8
R79	M4	50	48	-1.8
R40	M1	50	48	-1.9
R110	M5	50	48	-1.9
R34	M2	45	48	3.1
R65	M2	45	48	3.1
R99	M2	45	48	3.1
R123	M3	45	48	3.1
R106	M4	50	48	-1.9
R43	M1	50	48	-2
R82	M4	50	48	-2
R145	M5	50	48	-2.1
R66	M2	45	48	2.9
R44	M1	50	48	-2.2
R6	M1	50	48	-2.3
R59	M2	45	48	2.7
R157	M4	50	48	-2.3
R38	M1	50	48	-2.4
R10	M1	50	48	-2.5
R37	M1	50	48	-2.5

TABLE 6
Summary of Predicted Project Full Power Noise Levels (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R45	M1	50	48	-2.5
R130	M3	45	48	2.5
R18	M1	50	47	-2.6
R67	M2	45	47	2.4
R152	M1	50	47	-2.7
R35	M1	50	47	-2.7
R36	M1	50	47	-2.7
R39	M1	50	47	-2.7
R42	M1	50	47	-2.7
R41	M1	50	47	-2.8
R181	M2	45	47	2.2
R119	M3	45	47	2.2
R5	M1	50	47	-2.9
R9	M1	50	47	-2.9
R68	M2	45	47	2.1
R17	M1	50	47	-3
R50	M1	50	47	-3
R190	M5	50	47	-3
R23	M2	45	47	2
R118	M3	45	47	2
R128	M3	45	47	2
R46	M1	50	47	-3.1
R7	M1	50	47	-3.1
R141	M5	50	47	-3.1
R131	M3	45	47	1.8
R80	M4	50	47	-3.2
R20	M1	50	47	-3.3
R48	M1	50	47	-3.3
R140	M5	50	47	-3.3
R143	M5	50	47	-3.3
R16	M1	50	47	-3.4
R21	M1	50	47	-3.4
R182	M2	45	47	1.6
R30	M2	45	47	1.6
R69	M2	45	47	1.6
R184	M3	45	47	1.6
R15	M1	50	47	-3.5
R47	M1	50	47	-3.5
R144	M5	50	47	-3.5
R180	M2	45	47	1.5

TABLE 6
Summary of Predicted Project Full Power Noise Levels (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R127	M3	45	47	1.5
R4	M1	50	46	-3.6
R60	M2	45	46	1.4
R129	M3	45	46	1.4
R3	M1	50	46	-3.7
R158	M4	50	46	-3.7
R159	M4	50	46	-3.7
R49	M1	50	46	-3.8
R51	M1	50	46	-3.8
R183	M3	45	46	1.2
R2	M1	50	46	-3.9
R139	M5	50	46	-4
R142	M5	50	46	-4
R186	M3	45	46	1
R33	M2	45	46	0.9
R122	M3	45	46	0.9
R14	M1	50	46	-4.2
R8	M1	50	46	-4.2
R120	M3	45	46	0.8
R121	M3	45	46	0.8
R156	M4	50	46	-4.2
R52	M1	50	46	-4.3
R58	M2	45	46	0.7
R53	M1	50	46	-4.4
R54	M1	50	46	-4.4
R28	M2	45	46	0.6
R185	M3	45	46	0.6
R81	M4	50	46	-4.4
R1	M1	50	46	-4.5
R179	M2	45	46	0.5
R31	M2	45	46	0.5
R63	M2	45	46	0.5
R70	M1	50	45	-4.6
R24	M2	45	45	0.4
R32	M2	45	45	0.4
R57	M2	45	45	0.4
R126	M3	45	45	0.2
R125	M3	45	45	0.1
R132	M5	50	45	-5
R178	M2	45	45	-0.1

TABLE 6
Summary of Predicted Project Full Power Noise Levels (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R55	M1	50	45	-5.2
R56	M1	50	45	-5.2
R138	M5	50	45	-5.2
R25	M2	45	45	-0.2
R160	M4	50	45	-5.2
R154	M5	50	45	-5.3
R29	M2	45	45	-0.3
R27	M2	45	45	-0.5
R177	M2	45	44	-0.7
R62	M2	45	44	-0.8
R13	M1	50	44	-5.9
R153	M5	50	44	-5.9
R135	M5	50	44	-6
R26	M2	45	44	-1
R176	M2	45	44	-1.3
R175	M2	45	44	-1.5
R61	M2	45	44	-1.5
R134	M5	50	43	-6.6
R137	M5	50	43	-6.8
R11	M1	50	43	-6.9
R133	M5	50	43	-6.9
R172	M2	45	43	-2.2
R136	M5	50	43	-7.5
R155	M5	50	42	-7.7
R187	M1	50	42	-7.8
R173	M2	45	42	-2.8
R12	M1	50	42	-7.9
R188	M2	45	42	-2.9
R174	M2	45	42	-3.2
R189	M2	45	41	-4.4
R171	M2	45	40	-5.2
R170	M2	45	40	-5.4

Figure 5 presents the predicted project levels at lower wind speeds. Table 7 evaluates the difference between the existing level when the hub height wind speed is approximately 8 m/s (19 mph). This is above the cut-in wind speed but is the lowest wind speed for which noise data is available. Therefore, this analysis is believed to be somewhat conservative.

Numerous locations are predicted to exceed existing nighttime levels by 6 dBA or more. This indicates the project would be clearly audible. When evaluating these levels, it is helpful to keep the following factors in mind:

- The comparison is based on nighttime levels. Daytime levels are louder as shown in Appendix A.
- The existing levels were collected during the winter and were not strongly influenced by wind blowing through fields or foliage.
- As shown in Appendix A the noise level varies, even under similar wind speeds.
- The predicted noise level would be considered "Quiet" according to Table E of the NY DEC guidance.

TABLE 7
Evaluation of Difference from Existing Noise Levels – Low Wind Speeds (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R19	M1	28	43	15.3
R40	M1	28	43	15.2
R43	M1	28	43	15.1
R44	M1	28	43	14.9
R6	M1	28	43	14.8
R38	M1	28	43	14.7
R10	M1	28	43	14.6
R37	M1	28	43	14.6
R45	M1	28	43	14.6
R18	M1	28	43	14.5
R152	M1	28	42	14.4
R35	M1	28	42	14.4
R36	M1	28	42	14.4
R39	M1	28	42	14.4
R42	M1	28	42	14.4
R41	M1	28	42	14.3
R5	M1	28	42	14.2
R9	M1	28	42	14.2
R17	M1	28	42	14.1
R50	M1	28	42	14.1
R46	M1	28	42	14
R7	M1	28	42	14
R20	M1	28	42	13.8
R48	M1	28	42	13.8
R16	M1	28	42	13.7
R21	M1	28	42	13.7
R15	M1	28	42	13.6

TABLE 7
Evaluation of Difference from Existing Noise Levels – Low Wind Speeds (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R47	M1	28	42	13.6
R4	M1	28	42	13.5
R3	M1	28	41	13.4
R49	M1	28	41	13.3
R51	M1	28	41	13.3
R2	M1	28	41	13.2
R14	M1	28	41	12.9
R8	M1	28	41	12.9
R52	M1	28	41	12.8
R53	M1	28	41	12.7
R54	M1	28	41	12.7
R1	M1	28	41	12.6
R70	M1	28	41	12.5
R162	M2	33	45	12.2
R191	M2	33	45	12.2
R92	M2	33	45	12
R55	M1	28	40	11.9
R56	M1	28	40	11.9
R91	M2	33	45	11.9
R109	M5	32	44	11.8
R93	M2	33	45	11.8
R114	M5	32	44	11.7
R115	M5	32	44	11.7
R116	M5	32	44	11.7
R124	M5	32	44	11.7
R165	M2	33	45	11.7
R76	M2	33	45	11.7
R112	M5	32	44	11.6
R117	M5	32	44	11.6
R90	M2	33	45	11.6
R94	M2	33	45	11.6
R111	M5	32	44	11.5
R166	M2	33	45	11.5
R167	M2	33	45	11.5
R95	M2	33	45	11.5
R113	M5	32	43	11.3
R163	M2	33	44	11.3
R168	M2	33	44	11.3
R193	M2	33	44	11.3
R110	M5	32	43	11.2

TABLE 7
Evaluation of Difference from Existing Noise Levels – Low Wind Speeds (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R13	M1	28	39	11.2
R96	M2	33	44	11.2
R164	M2	33	44	11.1
R145	M5	32	43	11
R192	M2	33	44	11
R22	M2	33	44	10.9
R73	M2	33	44	10.8
R89	M2	33	44	10.8
R75	M2	33	44	10.7
R97	M2	33	44	10.7
R74	M2	33	44	10.6
R102	M2	33	44	10.5
R103	M2	33	44	10.5
R104	M2	33	44	10.5
R72	M2	33	44	10.5
R88	M2	33	44	10.5
R101	M2	33	43	10.4
R169	M2	33	43	10.4
R100	M2	33	43	10.3
R64	M2	33	43	10.3
R71	M2	33	43	10.3
R77	M2	33	43	10.3
R98	M2	33	43	10.3
R11	M1	28	38	10.2
R34	M2	33	43	10.2
R65	M2	33	43	10.2
R99	M2	33	43	10.2
R190	M5	32	42	10.1
R141	M5	32	42	10
R66	M2	33	43	10
R140	M5	32	42	9.8
R143	M5	32	42	9.8
R59	M2	33	43	9.8
R144	M5	32	42	9.6
R67	M2	33	43	9.5
R181	M2	33	42	9.3
R187	M1	28	37	9.3
R12	M1	28	37	9.2
R68	M2	33	42	9.2
R139	M5	32	41	9.1

TABLE 7
Evaluation of Difference from Existing Noise Levels – Low Wind Speeds (dBA)

Map ID	Representative Monitoring Location	Representative Existing Nighttime Noise Level	Predicted Turbine Noise Level	Difference
R142	M5	32	41	9.1
R23	M2	33	42	9.1
R182	M2	33	42	8.7
R30	M2	33	42	8.7
R69	M2	33	42	8.7
R180	M2	33	42	8.6
R60	M2	33	42	8.5
R132	M5	32	40	8.1
R33	M2	33	41	8
R138	M5	32	40	7.9
R154	M5	32	40	7.8
R58	M2	33	41	7.8
R28	M2	33	41	7.7
R179	M2	33	41	7.6
R31	M2	33	41	7.6
R63	M2	33	41	7.6
R24	M2	33	41	7.5
R32	M2	33	41	7.5
R57	M2	33	41	7.5
R123	M3	36	43	7.2
R153	M5	32	39	7.2
R135	M5	32	39	7.1
R178	M2	33	40	7
R25	M2	33	40	6.9
R29	M2	33	40	6.8
R130	M3	36	43	6.6
R27	M2	33	40	6.6
R134	M5	32	39	6.5
R177	M2	33	39	6.4
R119	M3	36	42	6.3
R137	M5	32	38	6.3
R62	M2	33	39	6.3
R133	M5	32	38	6.2
R118	M3	36	42	6.1
R128	M3	36	42	6.1
R26	M2	33	39	6.1

Construction Noise Impact Assessment

The U.S. Environmental Protection Agency (EPA) Office of Noise Abatement and Control studied noise from individual pieces of construction equipment, as well as from construction sites for power plants and other types of facilities (see Table 8). Because specific information, about types, quantities, and operating schedules of construction equipment, is not known at this stage, data from the EPA document for industrial projects of similar size have been used. These data are conservative, because the evolution of construction equipment generally has gravitated toward quieter design. Use of these data is reasonable for estimating noise levels, given that they still are used widely by acoustical professionals.

TABLE 8
Average Noise Levels from Common Construction at a Reference Distance of 50 feet (dBA)

Construction Equipment	Typical Average Noise Level at 50 ft, dBA
Air compressor	81
Backhoe	85
Concrete mixer	85
Concrete pump	82
Crane, mobile	83
Dozer	80
Generator	78
Grader	85
Loader	79
Paver	89
Pile driver	101
Pneumatic tool	85
Pump	76
Rock drill	98
Saw	78
Scraper	88
Shovel	82
Truck	91

Source: U.S. EPA, 1971.

Table 9 shows the total composite noise level at a reference distance of 50 feet, based on the pieces of equipment operating for each construction phase and the typical usage factor for each piece. The noise level at 1,500 feet also is shown. The calculated level at 1,500 feet is probably conservative, because the only attenuating mechanism considered was geometric spreading, which results in an attenuation rate of 6 dBA per doubling of distance; attenuation related to the presence of structures, trees or vegetation, ground effects, and terrain was not considered.

TABLE 9
Composite Construction Site Noise Levels

Construction Phase	Composite Equipment Noise Level at 50 feet, dBA	Composite Equipment Noise Level at 1,500 feet, dBA
Clearing	88	58

TABLE 9
Composite Construction Site Noise Levels

Excavation	90	60
Foundation	89	59
Erection	84	54
Finishing	89	59

Construction activities are anticipated to occur over an 8- month duration. The following Best Management Practices will be followed to reduce the potential for annoyance from construction-related activities:

- Establish a project telephone number that the public can use to report complaints.
- Ensure equipment is maintained adequately and equipped with manufacturers recommended muffler.
- Limit construction to between the hours of 7 a.m. to 7 p.m., Monday through Friday.
- Conduct noisiest activities during weekdays between the hours of 8 a.m. and 5 p.m. For unusually loud activities, such as blasting or pile driving, notify residence by mail or phone at least 1 week in advance.
- Locate stationary construction equipment (air compressors/generators) as far away from residences uses as feasible. When feasible, utilize equipment in acoustically designed enclosures and/or erect temporary barriers.

With the above mitigation measures, project construction activities will be minimized to the greatest extent reasonable. While they still may result in short-term annoyance, they do not represent a significant adverse impact.

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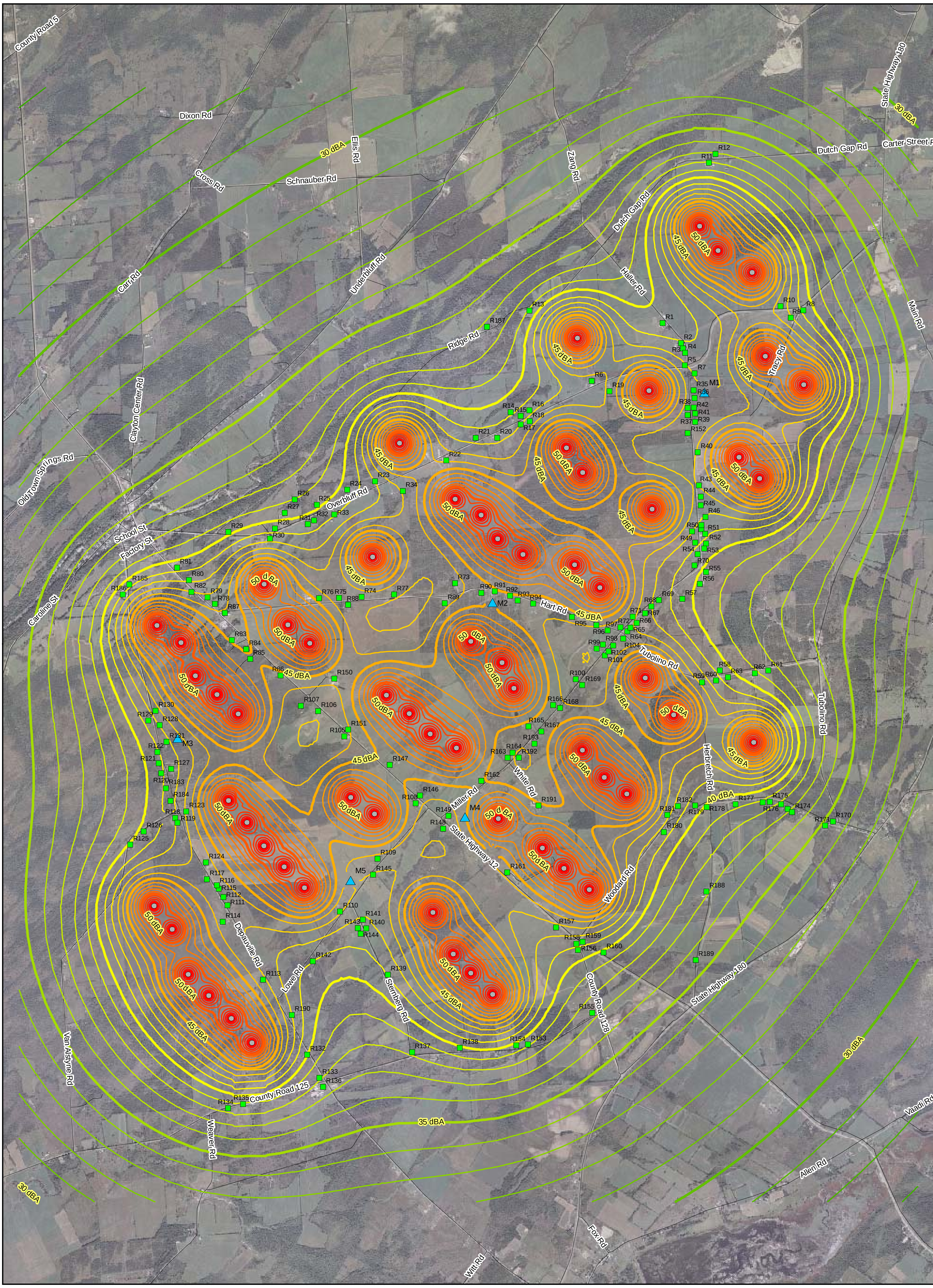
Appendix A



LEGEND

- Monitoring Locations
- Residences
- Proposed Wind Turbines
- Cut-In Conditions (dBA)
- Roads

N

0 3,000 6,000
Feet

Figure 5

Cut-In Noise Contours (dBA)

Clayton, New York

CH2MHILL

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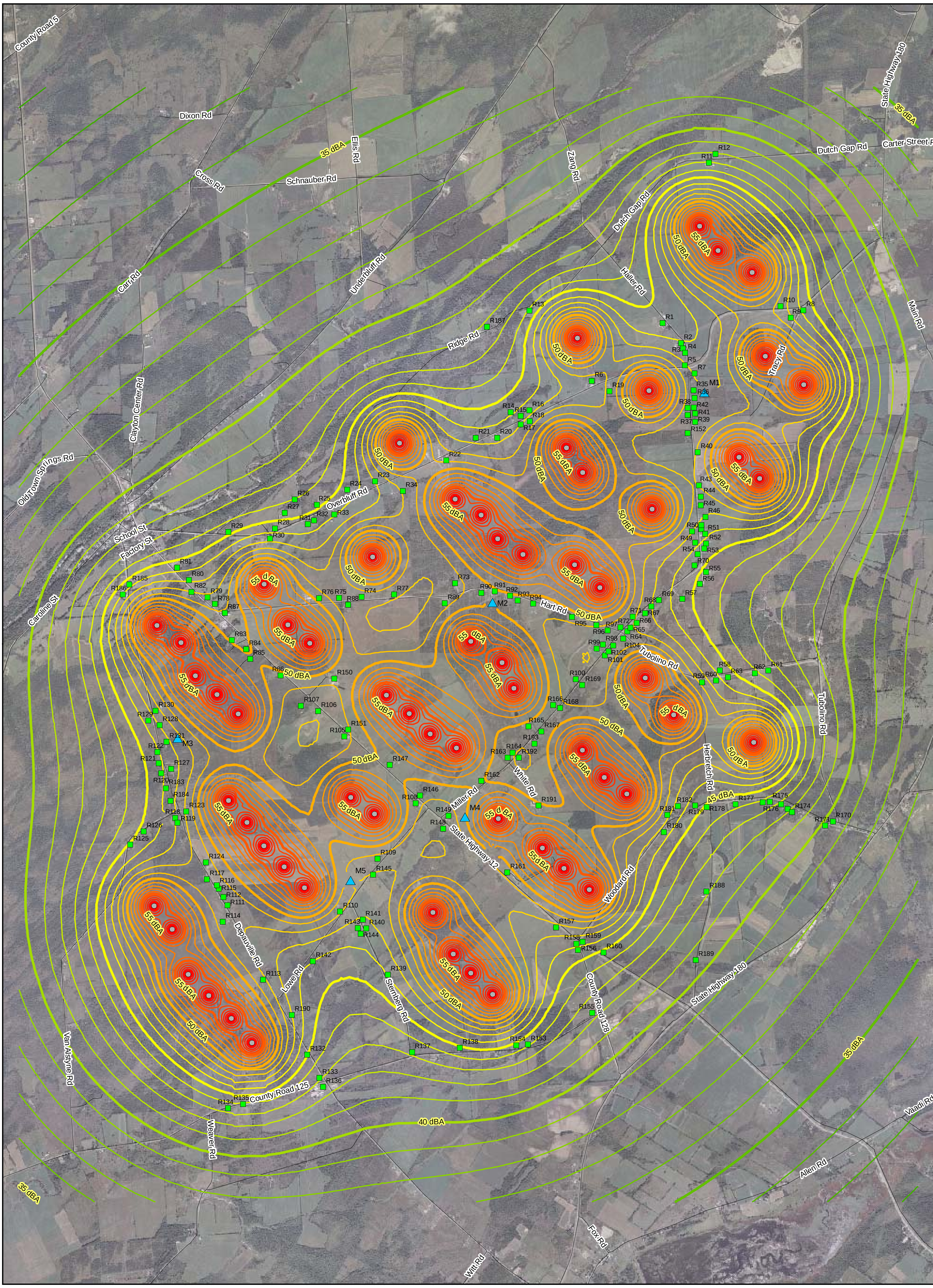

LEGEND

- Monitoring Locations
- Residences
- Proposed Wind Turbines
- Full Power Conditions (dBA)
- Roads

N

0 3,000 6,000
Feet

Figure 4

Full Power Noise Contours (dBA)

Clayton, New York

CH2MHILL

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Figure 1-Monitoring Location M1 Daytime Leq Regression

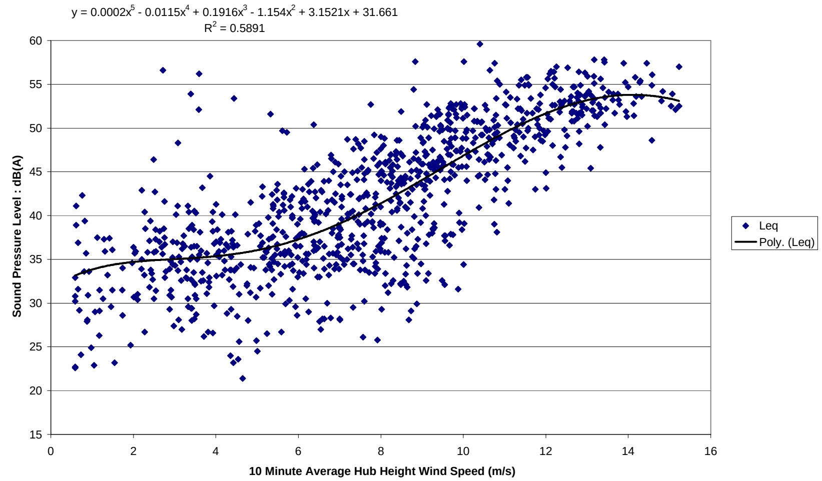

Figure 2- Monitoring Location M1 Nighttime Leq Regression

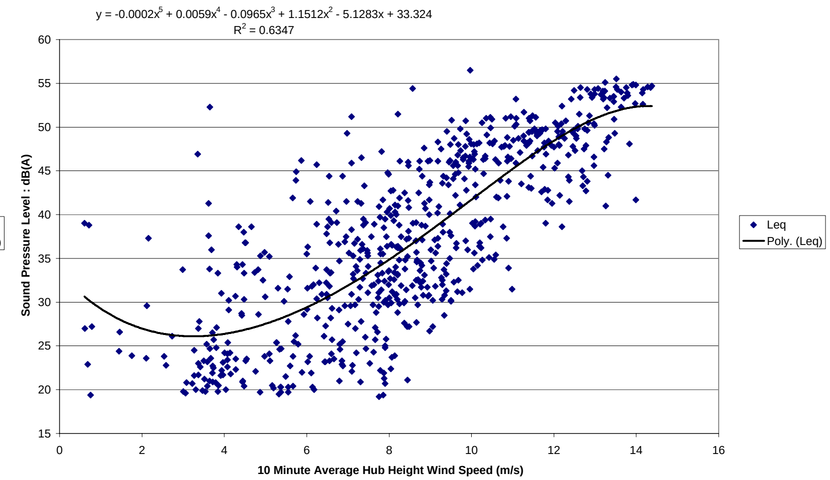

Figure 3-Monitoring Location M1 Daytime L90 Regression

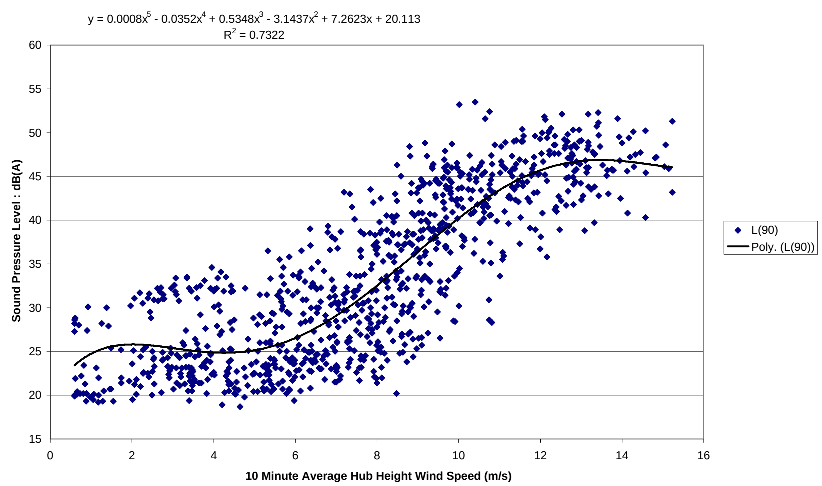

Figure 4-Monitoring Location M1 Nighttime L90 Regression

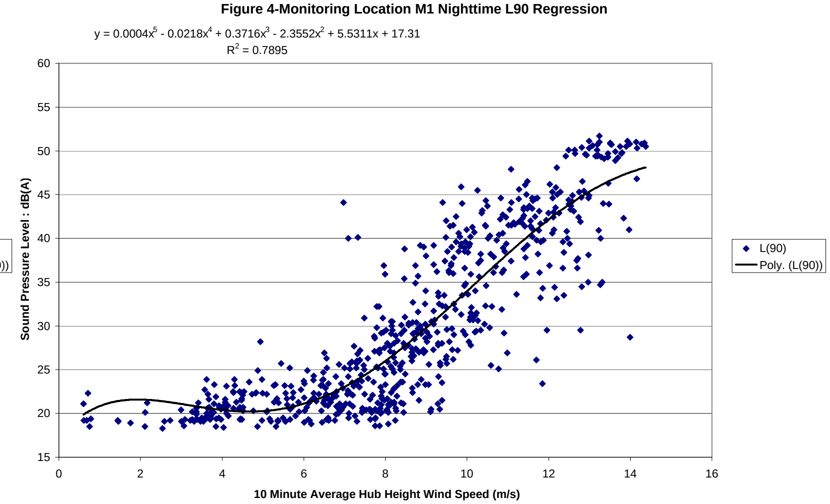

Figure 5-Monitoring Location M2 Daytime Leq Regression

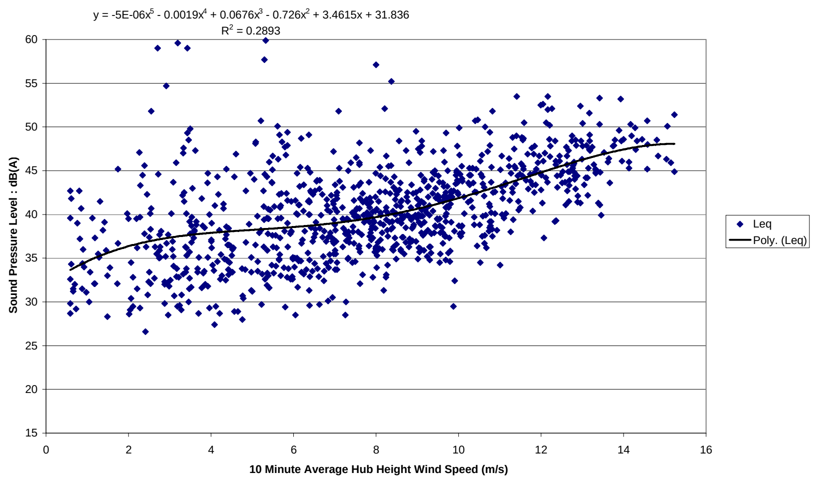

Figure 6-Monitoring Location M2 Nighttine Leq Regression

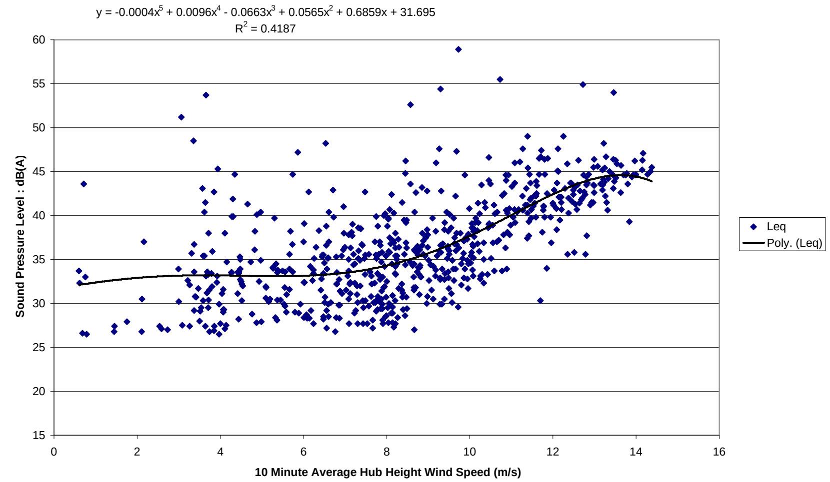

Figure 7-Monitoring Location M2 Daytime L90 Regression

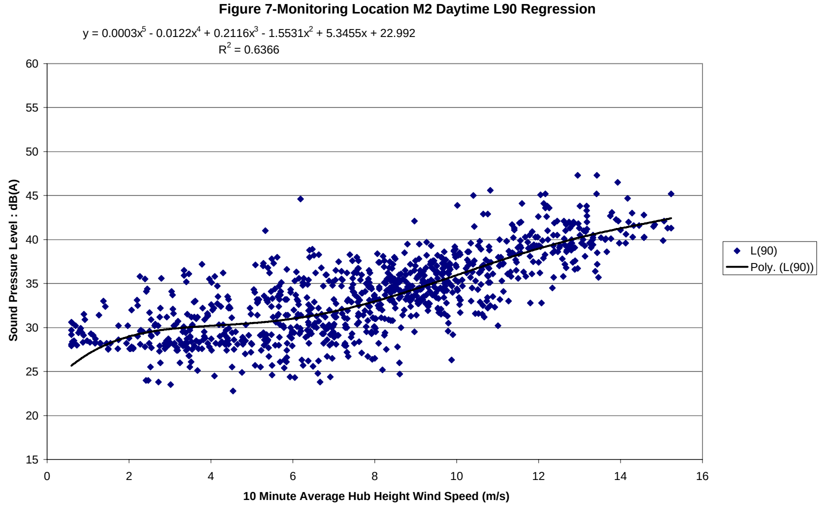

Figure 8-Monitoring Location M2 Nighttime L90 Regression

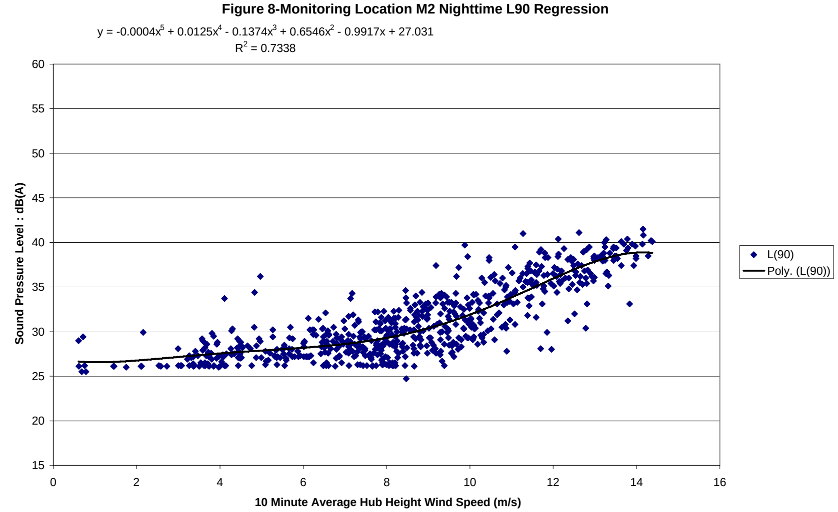

Figure 9- Monitoring Location M3 Daytime Leq Regression

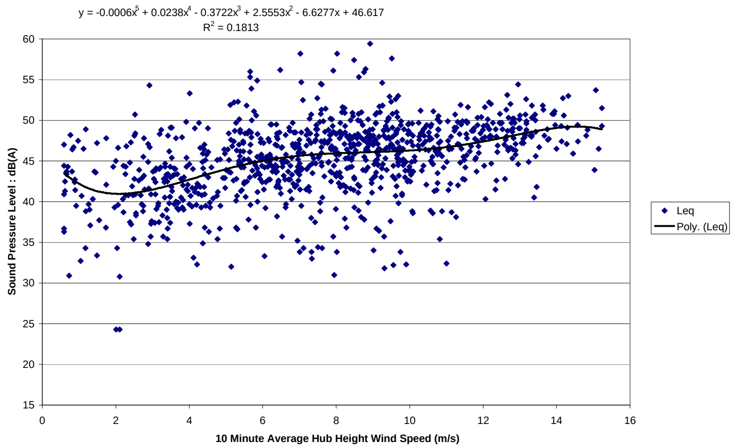

Figure 10-Monitoring Location M3 Nighttime Leq Regression

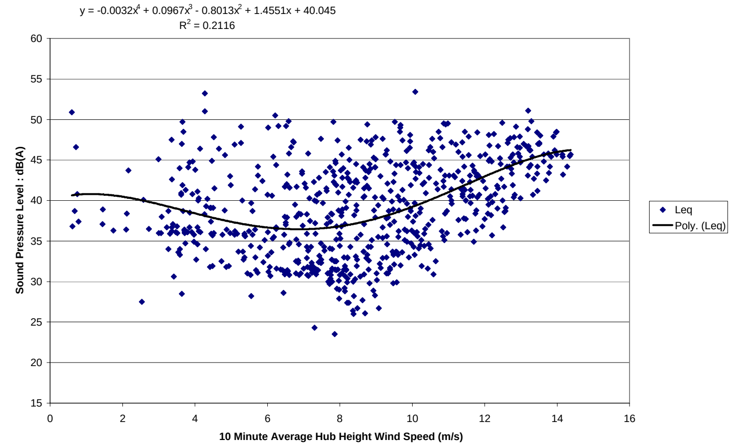

Figure 11-Monitoring Location M3 Daytime L90 Regression

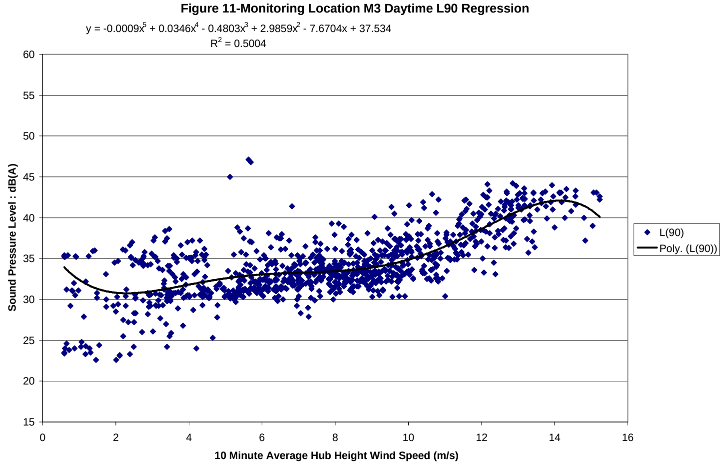

Figure 12-Monitoring Location M3 Nighttime L90 Regression

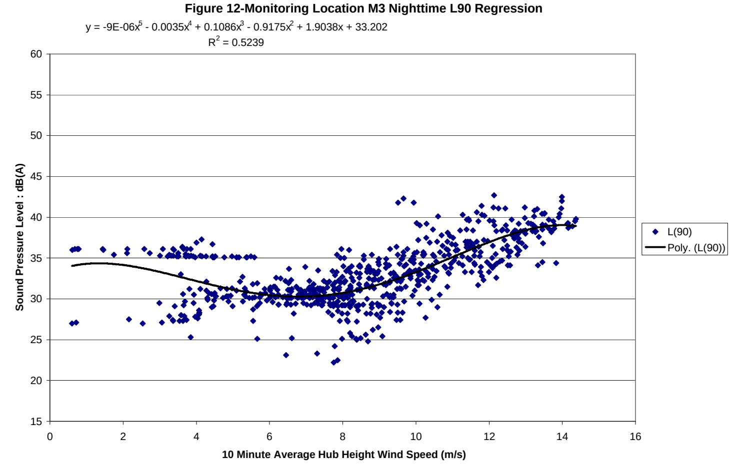

Figure 13-Monitoring Location M4 Daytime Leq Regression

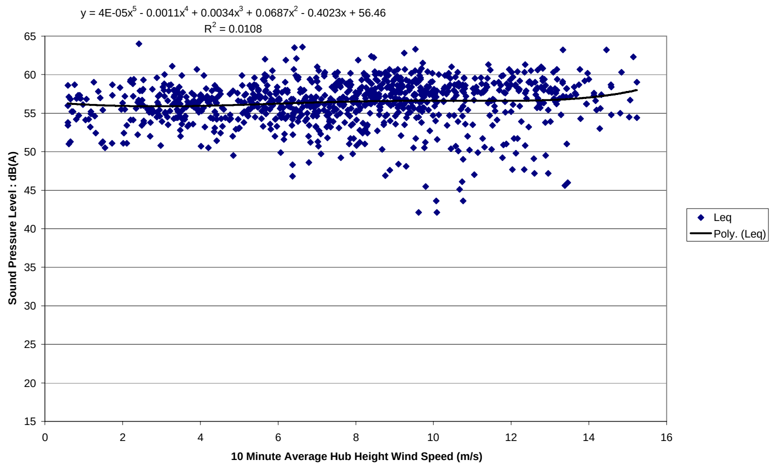

Figure 14-Monitoring Location M4 Nighttime Leq Regression

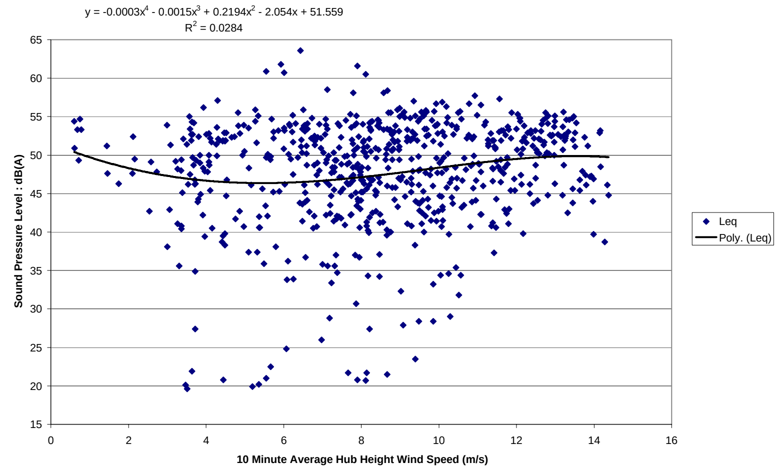

Figure 15-Monitoring Location M4 Daytime L90 Regression

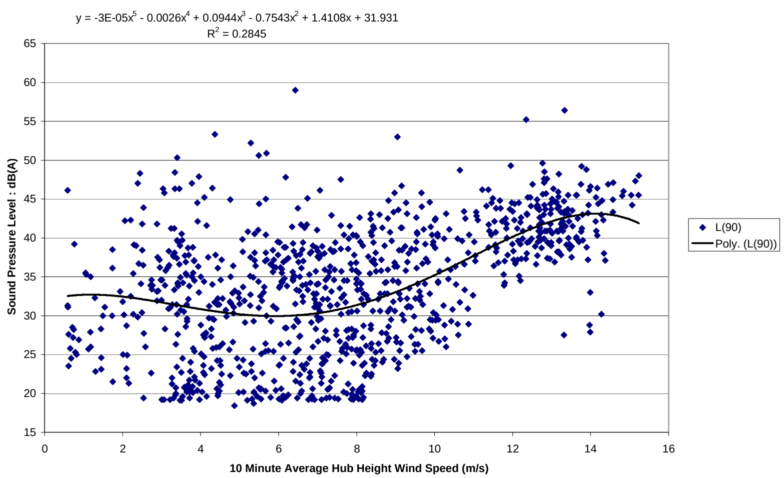

Figure 16-Monitoring Location M4 Nighttime L90 Regression

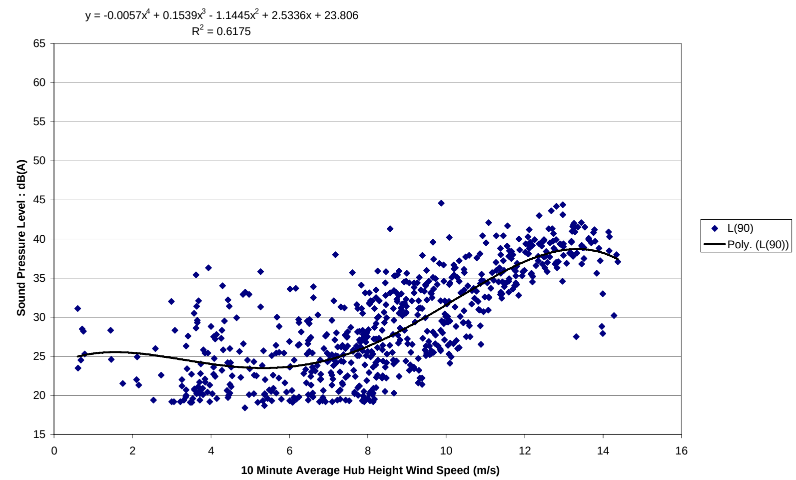

Figure 17-Monitoring Location M5 Daytime Leq Regression

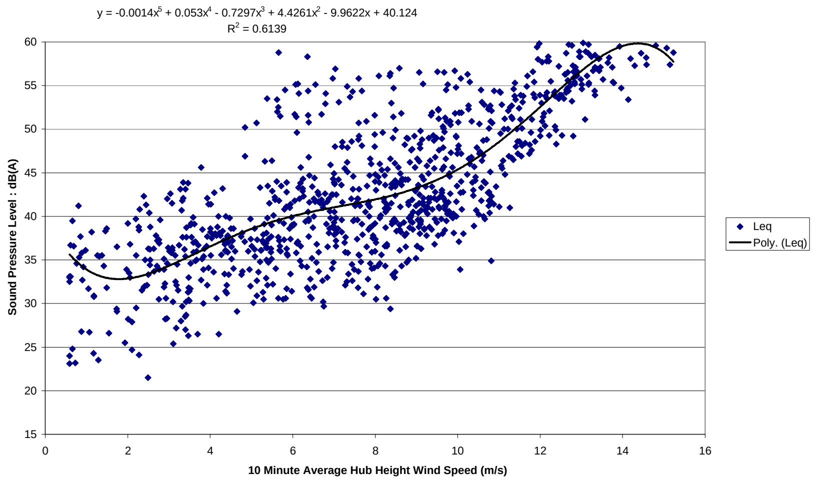

Figure 18-Monitoring Location M5 Nighttime Leq Regression

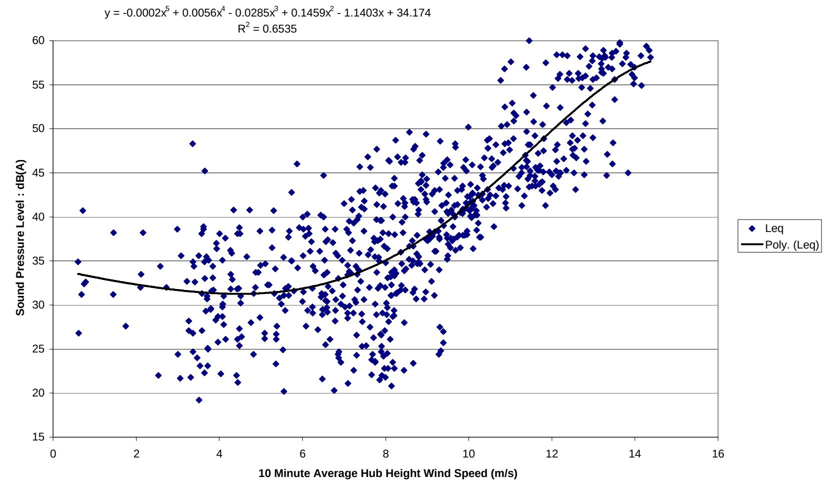

Figure 19-Monitoring Location M5 Daytime L90 Regression

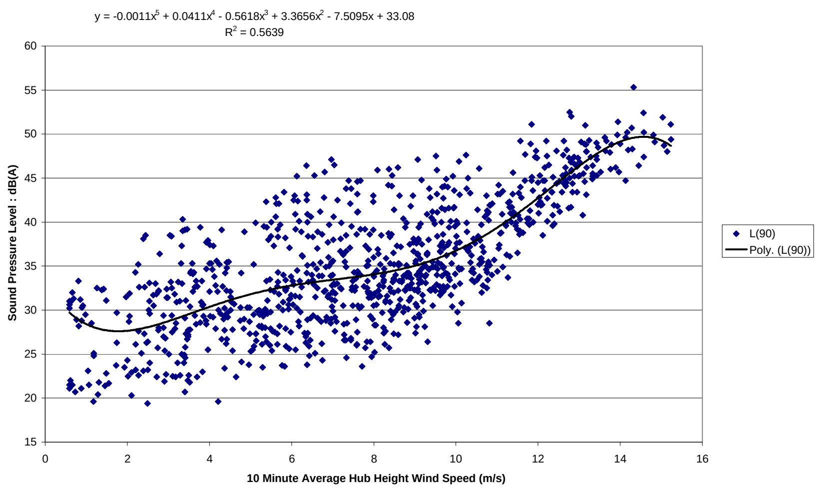

Figure 20-Monitoring Location M5 Nighttime L90 Regression