



Noise Impact Assessment

for the proposed

Motocross at The Range

1190 South State Street

North Adams, Massachusetts

This report is the noise impact assessment of the proposed off-road motorcycle (Motocross) facility at The Range (Site) located at 1190 South State Street in North Adams, Massachusetts.

The noise impact assessment methodology includes the following elements:

1. Review of the existing Site and the proposed motocross track layout and operations;
2. Measuring ambient sound levels at the Site, the closest residential locations and other residential areas in North Adams;
3. Measuring Motocross sound levels at an existing facility to represent future conditions;
4. Correlating source levels and predicting future levels within North Adams;
5. Comparing predicted sound levels with commonly used impact criteria, and
6. Assessing the noise impact of the proposed Motocross operations.

The sound level measurements and prediction methodology were made according to standard engineering practices and guidelines. The impact assessment is based on the most commonly used sound level metrics and impact thresholds for community noise impact assessment, using the same guidance and criteria that are typically used for noise impact assessment of roadway, railway and airport facilities.

Measurement Methodology

Sound level measurements were made with a precision Casella CEL 633B octave band sound level analyzer meeting ANSI Type 1 and IEC 179 standards. The instrument has a certified calibration and a field calibration check was made prior to measurements. Measurements were made according to good engineering practices and consistent with common guidelines. A windscreen was utilized to minimize wind effects and measurements were made from a tripod at a 5 foot height. A fast meter response was utilized to determine the average amplitude of the measured sound levels. The weather was favorable for noise monitoring, with light winds and dry roadway conditions.

The human ear does not perceive sound levels from every frequency as equally loud. As part of the hearing process, the human ear will attenuate low and high-frequency sounds. To compensate for these phenomena in perception, the A-weighted decibel scale, referred to as dBA, is used to measure and evaluate environmental noise levels. The A-weighted scale adjusts sound pressure levels by frequency, reducing low and high-frequency sound, similar to the way people hear sound. Unless specifically noted, the sound levels presented in this report are “A-weighted”.

The measured data included the following statistical levels that help describe the variations in intensity and temporal pattern of the sound levels:

- Leq is the energy averaged sound level. It represents the average sound (level) energy that was recorded during the time period and accounts for both loud events and quiet background sound levels. Very loud events (even of short duration) dramatically increase the Leq due to the nature of energy-averaging.
- Lmax is the maximum A-weighted sound level measured during the time period, based on a one second sample interval. The Lmax is typically an infrequent occurrence of very short duration.
- Lmin is the minimum A-weighted sound level measured during the time period.
- L₁₀ is the A-weighted sound level which is exceeded for 10 percent of the time during the time period. The L₁₀ will often represent the average traffic noise component when measurements are made in areas with moderate or heavy traffic.
- L₅₀ is the A-weighted sound level which is exceeded for 50 percent of the time during the time period. It is the median level based on occurrence (time based).
- L₉₀ is the A-weighted sound level which is exceeded for 90 percent of the time during the time period. The L₉₀ is considered to be the background level that occurs when local transient sounds are not audible (when the area is very quiet).

Land-Use Compatibility and Community Noise Impact

Individual human response to noise is subject to considerable variability. There are many factors, both emotional and physical, which contribute to the variation in human reaction to noise. The existence of numerous emotional and physical variables prohibits defining an exact individual or community response for any given noise level. Community noise criteria are therefore based on statistical averages of human response to noise and applicable health criterion.

Most federal agencies have created guidelines for determining noise impacts and land-use compatibility. Two commonly used guidelines are those established by the Department of Housing and Urban Development (HUD) and the Environmental Protection Agency (EPA). HUD has established land use compatibility criteria for federally-funded housing projects to help protect public health and welfare from excessive noise. These criteria establish an Ldn range that defines normally acceptable and unacceptable land use for new construction and rehabilitation projects. The HUD land use compatibility criteria are

presented in Appendix A. The HUD criteria are used to determine the land use compatibility of HUD funded residential developments. The EPA has published information which describes noise “cause and effect” relationships for sensitive land uses. These relationships are not standards because they do not account for the cost or feasibility of achieving these levels. These relationships are therefore often considered conservative and are provided for comparative purposes. The EPA cause and effect relationships are presented in Appendix A.

The Ldn is a 24 hour, weighted average sound level that the Department of Housing and Urban Development (HUD), Federal Aviation Administration, Federal Transit Administration, and Department of Defense commonly use for noise impact assessment. The Ldn is derived from hourly Leq values. Studies have shown that additional annoyance occurs during the nighttime since background sound levels are typically at their minimum and many people are noise sensitive while trying to sleep. A 10 dBA nighttime (10:00 PM to 7:00 AM) penalty is therefore added to nighttime Leq values to account for increased noise annoyance during these hours.

Because the human ear does not hear sound energy linearly (on a one-to-one basis), humans do not perceive changes in sound level as equally loud. Research indicates the following general relationships between sound level and human perception:

- A 3 dB increase is a doubling of acoustic energy and is the threshold of perceptibility. The average person will not be able to distinguish a 3 dB difference in sound level in a laboratory condition.
- A 10 dB increase is a tenfold increase in acoustic energy but is perceived as a doubling in loudness to the average person. The average person will judge a 10 dB change in sound level to be twice or half as loud.

Nighttime penalties of 5 to 10 dBA are commonly applied in environmental noise assessments. The nighttime 10 dBA penalty used in the Ldn calculations implies that nighttime sound levels that are half as loud as daytime levels induce a similar level of annoyance. A 10 dBA increase in sound level is often considered to be a possible noise impact. The majority of the Federal agencies responsible for building projects use the 65 dBA (Ldn) as the threshold for noise impacts.

The Commonwealth of Massachusetts has established noise regulations that are often used to regulated community noise. The MA Department of Environmental Protection (DEP) has established a noise level policy for implementing these regulations. The policy specifies that the ambient background sound level, measured at the property line of the facility or at the nearest inhabited buildings, shall not be increased by more than 10 decibels (dBA) due to the sound from the facility or create pure tones. The ambient background sound level is considered to be the level (L_{90}) that is exceeded 90% of the time. Ambient background sound levels are typically lowest during the early morning periods when anthropogenic activity is at a minimum.

The DEP criteria are routinely used to regulate noise from mechanical equipment that operate with regularity from fixed positions, typically being used to reduce late-night mechanical noise emissions in residential neighborhoods. These criteria do not work for vehicular noise sources (trains, planes and automobiles) that are all regulated using energy averaging (Leq noise metrics) in recognition of the mobile and variable nature of their noise emissions. The DEP criteria would not accurately assess the noise impact since a transient noise source would not change the ambient background noise. Although motorcycle noise may be considered a unique sound, one very similar to other two and four stroke engine powered devices, they typically do not create pure tones.

Existing Sound Levels

Sound levels were measured in the project area to determine existing noise exposure at various noise sensitive locations. The most noise sensitive locations in the project area are the residential homes. Four measurement locations were selected to assess the existing noise exposure at the various nearby residential locations. Sound level measurements were made at five representative locations:

1. The project Site area (Location 1);
2. The nearest residences southeast of the Site on Church Street and South Church Street (Location 2);
3. The nearest residences northeast of the Site on Church Street and off West Shaft Road (Location 3);
4. The residences in the center of North Adams, specifically those adjacent to the main traffic routes (Location 4), and
5. The nearest residences northwest of the Site on Curren Highway (Location 5).

The project area and four of the five measurement locations are illustrated in Figure 1. Locations 2, 3 and 5 are representative of the closest residences to the project Site. All of the closest residences are located adjacent to busy roadways that handle significant local and transient traffic. Location 4 represents the numerous homes located in the downtown area that are in close proximity to the busiest roadways. Residences located in areas removed from active roadways are likely to experience lower sound levels.

The existing ambient sound levels in the North Adams project area were measured on 3 October 2014. Overall, the predominant noise source in the project area is motor vehicle traffic. The busiest and loudest roadways are Route 8 and Route 8A. Church Street heading south of the Route 8A portion also experiences significant traffic. Railway traffic also occurs intermittently throughout the project area and train horns were heard during the measurement program. Numerous small and large aircraft over-flights also occur intermittently over the project area and were heard during the measurement program. Other transient noise sources heard during the measurement program include chain saws and brush grinders, landscaping equipment and construction equipment. Typical noise from insects was not present given the time of year when the measurements were taken.



Location	Description	Leq	Lmax	Lmin
1	Project Site	59	75	44
2	Residential locations adjacent to Route 8A	61	73	46
3	Residential locations near Route 8A	57	69	45
4	Residential locations in North Adams	70	84	53
5	Residential locations adjacent to Route 8	71	78	46

Location 1: This location was on the proposed project site about 150-200 feet from Curren Highway (Route 8). The dominant noise at this location is motor vehicle traffic. The Lmax sound level was from heavy truck traffic. The Lmin sound level was measured in the absence of traffic on Route 8.

Location 2: This location is approximately 100 feet from Church Street adjacent to the ice rink and the cemetery. The sound levels measured here reflect the close proximity to a major roadway (Route 8A) that has frequent use. The Lmax sound level resulted from traffic noise on Church Street. At this location, passing traffic typically produced sound levels (L_{10}) ranging from 62 dBA to 69 dBA. During quiet periods, the sound levels (L_{90}) varied (over a one-minute interval) from 47 dBA to 57 dBA, these sound levels were measured in the absence of nearby traffic.

Location 3: This location is approximately 250 feet from Church Street at the edge of the front parking lot of the high school with an overlook view of the Site. The sound levels measured here reflect the close proximity (although more distant than Location 1) to a major roadway (Route 8A) that has frequent use. The Lmax sound level resulted from traffic noise on Church Street. At this location, passing traffic typically produced sound levels (L_{10}) ranging from 55 dBA to 63 dBA. During quiet periods, the sound levels (L_{90}) varied (over a one-minute interval) from 47 dBA to 55 dBA, these sound levels were measured in the absence of nearby traffic.

Location 4: This location is approximately 25 feet from State Street adjacent to the Christopher Columbus Drive. The sound levels measured here reflect the very close proximity to a major roadway (Route 8) that has frequent use. The Lmax sound level resulted from traffic noise on State Street. At this location, passing traffic typically produced sound levels (L_{10}) ranging from 71 dBA to 75 dBA. During quiet periods, the sound levels (L_{90}) varied (over a one-minute interval) from 58 dBA to 67 dBA.

Location 5: This location is approximately 75 feet from Curren Highway at the closest residential area northwest of the Site. The sound levels measured here reflect the very close proximity to a major roadway (Route 8) that has frequent use. The Lmax sound level resulted from traffic noise on Curren Highway. At this location, passing traffic typically produced sound levels (L_{10}) ranging from 71 dBA to 75 dBA. During quiet periods, the sound levels (L_{90}) varied (over a one-minute interval) from 48 dBA to 70 dBA.

Source Sound Levels

Sound levels were measured at an existing motocross facility to determine the future noise exposure at the proposed Site. Source sound level measurements were made at four locations that were representative of the source location and sound propagation over distance:

- A. Within the motocross track area, approximately 50 feet from adjacent track elements;
- B1. An elevated location approximately 1500 feet from the track with an over looking and unshielded view of the motocross track;
- B2. An elevated location approximately 1700 feet from the track with an over looking and unshielded view of the motocross track;
- C. A quiet location approximately one mile from the track with a vegetated but unshielded view of the motocross track;

The source sound levels were measured during a regional race event at an existing facility on 5 October 2014. Overall, the predominant sound source at locations A, B1 and B2 was the active motocross facility since these three locations were very removed from nearby roadways. At location C, the dominant noise source was traffic from a distant roadway

The measured source sound level data are presented in Table 2 and Appendix C. The Leq presented in Table 2 represents the energy average sound level measured over the entire time period, which varied from 15 to 35 minutes (using contiguous 5 minute intervals). The Lmax was created by the motorcycle race and the Lmin was measured in the absence of motocross activity. The motocross activity was clearly audible at Locations B1 and B2. At Location C, the motocross activity was sporadically audible during Lmax events or faintly audible during typical conditions.

TABLE 2
Measured Source Sound Levels in dBA

Location	Description	Leq	Lmax	Lmin
A	Motocross Race Track	85	96	44
A	Motocross Race Track	85	97	61
B1	A 1500 feet distance with unobstructed view	67	81	46
B2	A 1700 feet distance with unobstructed view	63	75	52
C	One mile distance with unshielded view	53	66	45

The sound level data, including the Leq and statistical interval data, are presented in Appendix C. The interval Leq levels varied during each individual race and between the different categories of races. The levels are greatest when more than two dozen riders are on the course at once and at the beginning of a race when acceleration of all vehicles is in unison and the riders are not fatigued. The size and type of vehicles on the course also

affect sound emissions. The average at the race track over two 30 minute intervals during the largest races was 85 dBA (Leq). The sound levels measured at the three other locations reflect sound energy dissipating with distance.

Noise Impact Determination

The potential for project related noise impact was determined through the following steps:

1. Measure and evaluate the existing ambient sound levels in the project area;
2. Measure source sound levels at representative locations for use in future condition predictions;
3. Predict future motocross noise exposure at representative locations using the measured sound data and conservatively using standard engineering procedures, and
4. Compare these levels with commonly used noise guidelines and criteria.

The measured sound level data clearly shows how the motocross sound energy reduces with distance from the source. The reduction in sound level due to increase in distance (the spreading of energy spherically) is called divergence in acoustical terms. Several other factors also account for a measurable reduction in sound level as distance from the source increases. These common factors include molecular absorption by the air, anomalous excess attenuation by small changes in the atmosphere and atmospheric effects such as wind, temperature and precipitation. None of these factors were included in the predictions. Also not included is any attenuation that would result from terrain barriers and attenuation that would result from blockage by the dense woods. Many of these factors can combine and result in substantial attenuation.

To provide a conservative estimate of motocross impact, the 85 (dBA) level was used in the impact assessment assuming only reduction due to divergence. The measured data was used to corroborate the divergence predictions by adjusting the reference distance of the source levels from 50 feet to 150 feet. This is an additional conservative prediction that accommodates the fact the point measurements were used for an area source, physically representing the 50 feet measurement as the level at 150 feet in future predictions. A source level of 85 dBA (Leq) was used for predicting noise exposure during race day events. The race events will represent the loudest use of the proposed facility and will occur infrequently.

The loudness of the motocross facility will be directly related to the number of vehicles on the course, the size and type of the vehicle and the intensity of the riding. The motocross noise exposure expected during typical and low usage days at the future facility is significantly less than that expected from race events. The lower sound levels are expected because the track usage is expected to be significantly less. The measured “race day” source data was adjusted according to standard acoustical principals and

mathematics to represent a typical “busy day” condition of a dozen motorcycles using the facility and a low use “slow day” condition of 1-3 motorcycles.

Table 3 presents the predicted sound levels at various distances from the proposed motocross activity. The distance column represents the distance from the center of the motocross course to a point of interest. The source level represents the average sound level (Leq) coming from the entire group of motorcycles coming from the course. The table clearly shows how quickly the sound level drops as distance increases.

The closest group of residences, such as those on Church Street, are well over 1500 feet away, a point where the predicted motocross sound levels would be less than 65 dBA (Leq) on race day events. At the same locations, the sound levels are expected to be less than 50-60 dBA (Leq) during typical non-event days. The residences on Route 8A routinely experience traffic noise greater than would be expected from the motocross operations.

TABLE 3
Source Sound Levels and Attenuation from Distance

Distance From Source (feet)	Attenuation (Divergence) ² (dBA)	Motocross Source Levels ¹		
		Race Day (dBA)	Busy Day (dBA)	Slow Day (dBA)
150	0	85	80	70
250	4	81	76	66
300	6	79	74	64
500	10	75	70	60
1000	16	69	64	54
1500	20	65	60	50
1700	21	64	59	49
2000	22	63	58	48
2500	24	61	56	46
3000	26	59	54	44
4500	30	55	50	40
5280	31	54	49	39
10,560	37	48	43	33
15,840	40	45	40	30
26,400	45	40	35	25

¹ Source sound levels were adjusted to a 150 foot reference distance. The Race Day source levels represent 2-3 dozen motorcycles on the course at the same time, the Busy Day represents one dozen motorcycles using the facility at the same time, and the Slow Day represents 1-3 motorcycles.

² The distance attenuation resulting only from divergence (spherical spreading of energy) and these values do not include several other factors that commonly reduce sound such as molecular absorption, anomalous excess attenuation, atmospheric effects such as wind, temperature and precipitation and ground effects (vegetation and barriers). These other factors typically result in significant additional noise reduction over distances.

Conclusions

The conclusion of this report is that the proposed motocross activity at The Range in North Adams will not create an adverse noise impact in the community from their daytime operation. The surrounding community experiences substantial traffic on Routes 8 and 8A. This creates sound levels greater than would be heard from the motocross activity. Similar sounds as the off-road motorcycles that would commonly be expected in the community include; road motorcycles, ATV's, snowmobiles, chain saws, brush grinders and construction equipment. Our analysis concludes the motocross facility is not expected to create an adverse noise impact in the surrounding residential community.

APPENDIX A
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Sound Level Primer

Sound Level Primer

This Sound Level Primer provides information to foster a better understanding of the physical aspects of sound, the subjective nature of noise, some of the issues involved in community noise management and the basic principles of noise mitigation.

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, work or recreation. Under extreme conditions sound can cause physical harm such as hearing loss or adverse mental health effects. How people perceive any given sound depends on several measurable physical characteristics of the sound. These factors are:

- **Intensity:** Sound intensity is often equated to loudness. The sound level magnitude (typically measured in decibels) is a measure of sound intensity. A 10 decibel increase in intensity is generally perceived as a doubling in loudness.
- **Frequency Content:** Most common sounds are comprised of acoustic energy distributed over a variety of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz (Hz). Pure tones (such as those generated by a tuning fork) have all their energy concentrated in a narrow frequency range. High-frequency (above 2,000 Hz) sound is typically considered more annoying than low-frequency (below 500 Hz) sound and may also be perceived as louder.
- **Temporal Pattern:** The temporal nature of sound includes factors such as continuity, fluctuation, impulsiveness, and intermittence. Sound with increasing intensity is often perceived as louder than sound with decreasing intensity. Impulsive and intermittent sounds are usually perceived as louder than the actual sound level.

Individual human response to noise is subject to considerable variability. There are many factors, both emotional and physical, which contribute to the variation in human reaction to noise. These factors are summarized in Table 1. The existence of numerous emotional and physical variables prohibits defining an exact individual or community response for any given noise level. Community noise criteria are therefore based on statistical averages of human response to noise and applicable health criterion. Table 2 summarizes some generalized effects of noise on people in a residential environment.

Sound levels are most often measured on a logarithmic scale of decibels (dB). The decibel scale compresses the audible acoustic pressure levels which can vary from 20 micropascals (μPa), the threshold of hearing and reference pressure (0 dB), to 20 million μPa , the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. To add sound levels in dB, the levels (dB) must be converted into “energy” terms, which

are added and then converted back to dB. Adding two equal sound levels creates a 3 dB increase in overall level. An example is 50 dB (100,000 in “energy”) added to 50 dB (100,000 in “energy”) equals 53 dB (200,000 in “energy”). If more than a 10 dB difference exists between two sound levels, there is no significant additive effect. An example is 50 dB (100,000 in “energy”) added to 60 dB (1,000,000 in “energy”) equals 60.4 dB (1,100,000 in “energy”). Figure 1 further illustrates the range of acoustic pressures (μPa) and their relationship to the acoustic decibel scale.

Because the human ear does not hear sound energy linearly (on a one-to-one basis), humans do not perceive changes in sound level as equally loud. Research indicates the following general relationships between sound level and human perception:

- A 3 dB increase is a doubling of acoustic energy and is the threshold of perceptibility. The average person will not be able to distinguish a 3 dB difference in sound level in a laboratory condition.
- A 10 dB increase is a tenfold increase in acoustic energy but is perceived as a doubling in loudness to the average person. The average person will judge a 10 dB change in sound level to be twice or half as loud.

The human ear does not perceive sound levels from every frequency as equally loud. As part of the hearing process, the human ear will attenuate low and high-frequency sounds. To compensate for these phenomena in perception, the A-weighted decibel scale, referred to as dBA, is used to measure and evaluate environmental noise levels. The A-weighted scale adjusts sound pressure levels by frequency, reducing low and high-frequency sound, similar to the way people hear sound.

Community Noise Management

The Noise Control Act of 1972 (NCA) established by mandate a national policy "to promote an environment for all Americans free from noise that jeopardizes their public health and welfare". The NCA provides for a division of powers between the Federal government and State and local governments. The primary Federal responsibility is for noise source emission control. The States and other political subdivisions have the responsibility to control the use of noise sources and the levels of noise to be permitted in their environment. The exceptions are transportation noise sources including aircraft and railroad operations and motor vehicle traffic involved in interstate transport.

The concept of making individual states and communities responsible for noise management is a fair one. It relies on three basic premises. First, noise is a temporary impact; the impact ceases when the noise source does. Second, noise is a local impact; the impacts rarely extend great distances from the noise source. Third, there is an inherent cost associated with reducing noise, including the financial costs involved in noise reduction and the costs associated with legislative restrictions. Managing community noise is a balancing act and often one that involves higher

costs and greater restrictions for increased noise control. Therefore, a common belief is that the local communities should decide what the appropriate level of noise management (including regulation) should be within their community.

Noting these three premises, one can realize why transportation sources are exempt from local control. Transportation sources are often frequent enough to be considered continuous and their mobile nature results in distributing noise impacts across the nation. The Federal control over transportation sources maintains a uniform control over the sources as they travel from state to state. Federal control also does not impede transportation between states and communities through changing noise control regulations that might restrict vehicle uses.

Unfortunately, transportation noise sources are typically a community's most prevalent and predominant noise sources. The States and their political subdivisions subsequently only have the responsibility to control the stationary noise sources within their communities and those mobile sources that are not directly involved with interstate transport. Nevertheless, this level of control also involves the balancing act between higher costs and greater restrictions for increased noise management.

Since community-based environmental noise regulations do not exist on the federal level; State and municipal regulations are the primary means for communities to manage noise. What is notable is that very few states have addressed noise issues with legislation or have established a framework that can provide effective community noise management. If State regulations for community noise management do not exist, the municipalities have the choice and responsibility to manage noise issues.

Community based environmental noise management follows two general approaches:

- (1) Decibel-based noise criteria that restrict sound emission; and
- (2) Subjective "public nuisance/disturbance" noise standards which do not require the use of sound level meters for enforcement.

Decibel-based noise criteria offer two substantial benefits; they can apply to both proposed and existing facilities, and they provide a definitive scale to enforce noise violations. Communities have the ability to prevent excessive noise exposures from occurring during permitting by providing a fixed limit that developers can use as a design standard. Communities also have a definitive means to address noise complaints and enforce compliance at existing facilities.

Decibel based standards offer fixed impact thresholds, but can be the most difficult to enforce from a practical standpoint. The enforcement difficulty is the focus on decibel readings. In order to enforce the fixed impact thresholds, measurements have to be made with sophisticated instrumentation following an established measurement protocol. Municipal enforcement can be an issue since complex instrumentation and trained personnel are necessary. The decibel based standards offer the benefit of being much less subjective than nuisance criteria and are therefore well suited for design standards and are less likely to experience legal challenges of interpretation.

Nuisance noise ordinances provide some general protection to the community from environmental noise impacts. One inherent problem with nuisance ordinances is that they are vague and may be difficult to apply consistently and enforce when they are challenged. Public nuisance noise ordinances are typically based on subjective standards. A common definition is a noise condition that is objectionable to one or more reasonable persons. Nuisance criteria are easier for non-acoustically trained personnel to enforce; however, subjective criteria may be challenged in court. Enforcement can often be made through citizen witnesses without the need for rigorous measurements. Communities without specific nuisance noise policies may not be able to adequately establish a nuisance condition and thereby regulate community noise.

The greatest benefit of nuisance ordinances is they offer flexibility in noise management. The subjective nature of nuisance criteria includes the inherent flexibility in annoyance perception. Noise can therefore be tolerated in areas that are not sensitive and regulated in areas that are. Noise management can also evolve more easily with the community's needs and desires.

Some states and communities that do not have specific noise management policies have promulgated legislation that requires noise issues to be addressed during an environmental permitting process, particularly for large site developments. In these cases, environmental review typically occurs on the state or regional level and may incorporate land use planning and community zoning. When noise issues are identified during the permitting process, noise abatement can be incorporated in the environmental permits and later enforced through permit compliance conditions. However, through this process, existing facilities and projects that do not exceed the large site development thresholds do not receive any environmental review with respect to noise.

Noise Impact Thresholds & Land-Use Compatibility

Many federal agencies have created guidelines for use in determining noise impacts and land-use compatibility. Two commonly used guidelines are those established by the Department of Housing and Urban Development (HUD) and the Environmental Protection Agency (EPA).

HUD has established land use compatibility criteria for federally-funded housing projects to help protect public health and welfare from excessive noise. These criteria establish an L_{dn} range that defines normally acceptable and unacceptable land use for new construction and rehabilitation projects. Table 3 describes the HUD land use compatibility criteria. The HUD criteria are used to determine the land use compatibility of HUD funded residential developments and when noise abatement measures are required and can be funded through HUD.

The day-night average sound level (L_{dn}) is a 24 hour, weighted average sound level that HUD, EPA, Federal Aviation Administration, Federal Transit Administration, and Department of Defense commonly use for noise impact assessment. The L_{dn} is derived from hourly L_{eq} values. Studies have shown that additional annoyance occurs during the nighttime since background

sound levels are typically at their minimum and many people are noise sensitive while trying to sleep. A 10 dBA nighttime (10:00 PM to 7:00 AM) penalty is therefore added to nighttime L_{eq} values to account for increased noise annoyance during these hours.

The EPA has published information which describes noise “cause and effect” relationships for sensitive land uses. These relationships are not standards because they do not account for the cost or feasibility of achieving these levels. These relationships are therefore often considered conservative and are provided for comparative purposes. The EPA cause and effect relationships are presented in Table 4.

Audibility and Annoyance

It is very important to note that it is not reasonable to use the “threshold of audibility” as an impact determinate at residential locations with low or moderate noise exposures. The human ear is a very good hearing device and can distinguish and locate sounds with 10 to 100 (10-20 dB) times less energy than the average ambient sound during quiet times. Noise, by definition, is considered unwanted sound, which is a subjective interpretation of a sound. The “threshold of audibility” is important because it reflects when a person becomes aware of the sound and its cause which triggers annoyance. The sound level is not high enough to create an adverse impact or annoyance in a reasonable person but the association with the noise producing activity is the trigger for annoyance. A good analogy would be the noise generated by a mosquito; the sound level could hardly be considered a noise impact but the sound represents the presence of a potential parasite and therefore triggers a high level of annoyance.

Noise Mitigation Principles

There are three distinct types of noise mitigation:

1. Reduce the sound level at the source;
2. Interrupt the path of the noise; or
3. Shield the receptor from the noise.

Source Control

Reducing the source sound emissions results in the most desirable effect; lowering sound levels for everyone without those who are impacted having to provide mitigation. Source control can sometimes be the cheapest form of noise reduction since lower source emissions may preempt the need for alternative mitigation efforts at many other locations. Noise control engineering can typically reduce source sound emissions, particularly, when it is included into the equipment design or prior to installation. It is typically more difficult to retrofit noise reductions on existing equipment. In some cases equipment or operations can not accommodate any or more noise reduction technology and other methods of noise control must be considered.

Path Control

Interrupting the path of sound can reduce sound exposure. The most common type of path control is a noise barrier. Noise barriers that block the direct path of the sound reduce the sound exposure to that resulting from refraction by the barrier and the sound that travels over the top of the barrier. Properly designed noise barriers can offer reductions in sound level of up to 20-25 dB, although a 10 dB reduction may be more likely. The amount of sound reduction is typically proportional to the size of the barrier, both height and length. Noise barriers offer the greatest reduction when they are placed close to either the source or the receiver (the receiver is the person, residence, etc.). The closer the barrier is to the source, the greater the effective height of the barrier. Barriers that are closer to the receiver provide abatement by creating a “shadow zone”, which typically is only effective for a limited area. Barriers are least effective when placed in the middle of the source and receiver. Barriers also lose effectiveness with increasing distance between the source and receiver, particularly when the barrier is neither close to the source or the receiver. Over large distances (such as those greater than 300 meters) sound can be bent over the barrier by wind or reflected back towards ground by temperature inversions thereby reducing the attenuating effects. A drawback with noise barriers is they can reflect sound back in other directions. Often this is not a problem and is commonly mitigated by including sound absorption on the face of the barrier.

Receptor Shielding

Shielding the receptor is typically utilized as a last resort because the high sound levels are ever present and an impact exists when the shielding is removed. The most common types of receptor shielding are ear plugs and headphones; which are very effective and inexpensive when utilized. Home sound proofing is also a type of receptor shielding and is typically the only available solution to noise impacts from airborne aircraft. Ear plugs and headphones are viable and common solutions to high noise in the work place but are poor solutions to community noise issues. Home sound proofing can be very effective for reducing sound exposure within the home; however, it does not address the outdoor environment and is typically only considered when other options are not available. Because the (closed) windows in our homes are typically the part of the structure that allow the greatest amount of noise to enter, the addition of storm windows to the exterior can often substantially reduce the interior noise exposure, particularly with a gap of 2-4 inches between storm and window panes.

Sound Masking

Although not a form of noise reduction, sound masking can often be utilized to reduce noise annoyance. Sound masking works by “masking” the annoying sound, “the noise”, with a new sound thereby making the noise less or not noticeable. Sound masking is commonly used to reduce noise annoyance. Common sound masking devices are air-conditioners, fans, and electronic equipment that produce continuous “white” or “pink” noise to cover up intrusive sounds. Sound masking is less effective when its levels have to be loud in order to “mask” the noise.

TABLE 1
Factors Involved In the Human Reaction to Noise

EMOTIONAL VARIABLES

- *Feelings about the Necessity or Possibility of Prevention of the Noise:* If people feel that their needs and concerns are being ignored, they are more likely to feel hostile towards the noise.
- *Judgment of the Importance and Value of the Activity which is Producing the Noise:* If the noise is produced by an activity which people feel is vital, they are not as bothered by it as they would be if the noise-producing activity was considered superfluous.
- *Activity at the Time an Individual Hears the Noise:* A person's sleep, rest and relaxation have been found to be more easily disrupted by noise than by communication and entertainment activities.
- *Attitudes about Environment:* The existence of undesirable features in a person's environment will influence the way in which the person reacts to a particular intrusion.
- *General Sensitivity to Noise:* People vary in their ability to hear sound, their physiological predisposition to noise and their emotional experience of annoyance to a given noise.
- *Belief about the Effect of Noise on Health:* The extent to which people believe that the noise exposure will damage their health, affects their response to the noise.
- *Feeling of Fear Associated with the Noise:* The extent to which people fear physical harm from the sources of the noise, affects their attitude towards the noise.

PHYSICAL VARIABLES

- *Type of Neighborhood:* The type of neighborhood sometimes associated with one's expectations regarding noise there. Instances of annoyance, disturbance and complaints associated with a particular noise exposure will be greater in areas which are typically noted for their quiet and less active nature.
- *Time of Day:* Noise intrusions are typically considered more annoying in the early evening and at night than during the day.
- *Season:* Noise is considered more disturbing during the summer than in winter, especially in climates where, during the summer, windows are likely to be open and recreational activities occur outside more frequently.
- *Predictability of the Noise:* Research has revealed that individuals exposed to unpredictable noise have a lower noise tolerance than those exposed to predictable noise.
- *Control over the Noise Source:* Someone who has no control over the noise source will be more annoyed than one who is able to exercise some control.
- *Length of Time an Individual is Exposed to a Noise:* There is little evidence supporting the argument that annoyance resulting from noise will decrease with continued exposures, and, under some circumstances, annoyance increase with longer exposures.

Source: Aviation Noise Effects, USDOT-FAA, March 1985.

TABLE 2
Effects of Noise on People (Residential Land Uses Only)

Day-Night Average Sound in Decibels		Effects ¹				
	Hearing Loss	Speech Interference		Annoyance ²	Average Community Reaction ⁴	General Community Attitude Towards Area
	Qualitative Description	Indoor Percentage Sentence Intelligibility	Outdoor Distance in Meters for 95% Sentence Intelligibility	Percentage of Population Highly Annoyed ³		
75 & above	may begin to occur	98%	0.5	37%	very severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	will not likely occur	99%	0.9	25%	severe	Noise is one of the most important adverse aspects of the community environment.
65	will not occur	100%	1.5	15%	significant	Noise is one of the important adverse aspects of the community environment.
60	will not occur	100%	2.0	9%	moderate	Noise may be considered an adverse aspect of the community environment.
55 & below	will not occur	100%	3.5	4%	slight	Noise considered no more important than various other environment factors.

¹ "Speech Interference" data are drawn from the following tables in the United States Environmental Protection Agency's (USEPA) "Levels Document"; Table 3, Figure D-1, Figure D-2, Figure D-3. All other data from the National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."

² Depends on attitudes and other factors.

³ The percentages of people reporting annoyance to lesser extent are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.

⁴ Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.

SOURCE: Federal Interagency Committee on Urban Noise. 1980. Guidelines for Considering Noise for Land Use Planning and Control.

FIGURE 1
Indoor and Outdoor Sound Levels

	Sound Pressure		Sound Level	
<u>Outdoor Sound Levels</u>	<u>(μPa)</u>		<u>(dBA)</u>	<u>Indoor Sound Levels</u>
	6,324,555	-	110	Rock Band at 5 m
Jet Over-Flight at 300 m		-	105	
	2,000,000	-	100	Inside New York Subway Train
Gas Lawn Mower at 1 m		-	95	
	632,456	-	90	Food Blender at 1 m
Diesel Truck at 15 m		-	85	
Noisy Urban Area--Daytime	200,000	-	80	Garbage Disposal at 1 m
		-	75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	-	70	Vacuum Cleaner at 3 m
Suburban Commercial Area		-	65	Normal Speech at 1 m
	20,000	-	60	
Quiet Urban Area -- Daytime		-	55	Quiet Conversation at 1m
	6,325	-	50	Dishwasher Next Room
Quiet Urban Area--Nighttime		-	45	
	2,000	-	40	Empty Theater or Library
Quiet Suburb--Nighttime		-	35	
	632	-	30	Quiet Bedroom at Night
Quiet Rural Area--Nighttime		-	25	Empty Concert Hall
Rustling Leaves	200	-	20	
		-	15	Broadcast and Recording Studios
	63	-	10	
		-	5	
Reference Pressure Level	20	-	0	Threshold of Hearing

Notes:

μ Pa - MicroPascals describe pressure levels (force/area).

dBA - A-weighted decibels describe pressure logarithmically with respect to 20 μ Pa (reference pressure level).

TABLE 3
HUD Land Use Compatibility

Land Use Category	Ldn Value			
	Clearly Acceptable	Normally Acceptable	Normally Unacceptable	Clearly Unacceptable
Residential: single family, duplex, mobile home	Ldn < 60	60 < Ldn < 65	65 < Ldn < 75	Ldn > 75
Residential: multi-family, dormitories	Ldn < 60	60 < Ldn < 65	65 < Ldn < 75	Ldn > 75
Transient Lodging	Ldn < 65	65 < Ldn < 70	70 < Ldn < 80	Ldn > 80
School Classrooms, Libraries, Churches	Ldn < 60	60 < Ldn < 65	65 < Ldn < 75	Ldn > 75
Hospitals, Nursing Homes	Ldn < 60	60 < Ldn < 65	65 < Ldn < 75	Ldn > 75
Auditoriums, Concert Halls, Music Shells	Ldn < 50	50 < Ldn < 60	60 < Ldn < 70	Ldn > 70
Sports Arena, Outdoor Spectator Sports	Ldn < 60	60 < Ldn < 65	65 < Ldn < 75	Ldn > 75
Playgrounds, Neighborhood Parks	Ldn < 55	55 < Ldn < 65	65 < Ldn < 75	Ldn > 75
Golf Courses, Riding Stables, Cemeteries, Water Recreation	Ldn < 60	60 < Ldn < 70	70 < Ldn < 80	Ldn > 80
Office Buildings: professional	Ldn < 65	65 < Ldn < 75	75 < Ldn < 80	Ldn > 80
Commercial: retail, movie theaters, restaurants	Ldn < 65	65 < Ldn < 75	75 < Ldn < 80	Ldn > 80
Commercial: wholesale, light manufacturing, utilities	Ldn < 70	70 < Ldn < 80	80 < Ldn < 85	Ldn > 85
Manufacturing: noise sensitive	Ldn < 55	55 < Ldn < 70	70 < Ldn < 80	Ldn > 80
Livestock Farming, Animal Breeding	Ldn < 60	60 < Ldn < 75	75 < Ldn < 80	Ldn > 80
Agriculture (not livestock), Mining, Fishing	Ldn < 75	75 < Ldn < 95		
Public right-of-way	Ldn < 75	75 < Ldn < 85	85 < Ldn < 95	
Extensive Natural Recreation Areas	Ldn < 60	60 < Ldn < 75	75 < Ldn < 85	Ldn > 85

Source: The Noise Guidebook, U.S. Department of Housing and Urban Development, 1980.

TABLE 4
EPA Cause-And-Effect Relationships

Type of Comparison	Land Use	“Cause”	“Effect” ¹
Absolute comparison (Based on overall magnitude of the sound level)	Residences Hospitals	55 dBA L _{dn} (OUTDOORS)	IMPACT THRESHOLD ² 1. 95% sentence intelligibility (average) at 3.5m (11 ft.), normal voice 2. Indoors, 100% sentence intelligibility with a 5 dB margin of safety, normal voice ³ 3. Consistent with available sleep criteria
		65 dBA L _{dn} (OUTDOORS)	1. 95% sentence intelligibility (average) at 1m (3 ft.), normal voice 2. Indoors, greater than 99% sentence intelligibility, normal voice ³ 3. Above available sleep criteria
		75 dBA L _{dn} (OUTDOORS)	1. 95% sentence intelligibility (average) at 0.7m (2ft), raised voice: or at 1.5m (5ft), loud voice 2. Indoors, greater than 95% sentence intelligibility, normal voice ³ 3. Further above available sleep criteria
	Educational Uses	55 dBA L _{eq} (24) (OUTDOORS)	IMPACT THRESHOLD outdoors IMPACT THRESHOLD, with 5 dB margin of safety, indoors ³
Relative comparison ⁴ (Based on the difference between existing and project induced sound levels)	Residences	Intruding noise 5 dBA less than background noise, in the absence of the intruding noise	IMPACT THRESHOLD 1. 15% complaints 2. 15-20% highly annoyed 3. Noise essentially least important of various community factors 4. No expected community reaction
		Intruding noise exceeds background by 5 dBA	1. 5% complaints 2. 30-35% highly annoyed 3. Threats of legal action
		Intruding noise exceeds background by 15 dBA	1. 15% complaints 2. 50-55% highly annoyed 3. Vigorous community action expected

¹ All percentages shown are average percentages; specific percentage values depend upon community attitudes towards the noise source, prior experience with similar noise sources, plus other factors not related to the actual noise level.

² “Requisite to protect the public health and welfare with an adequate margin of safety.”

³ Windows assumed open, resulting in outdoor-to-indoor noise insulation of 15 dBA.

⁴ This presentation of EPA conclusions condenses the EPA’s “normalized L_{dn},” to a single IMPACT THRESHOLD tabulation. This condensation is consistent with the following average background noise levels:

- Quiet suburban or rural community (remote from large cities and from industrial activity and trucking) 50 dBA L_{dn}
- Normal suburban community (not located near industrial activity) 55 dBA L_{dn}
- Urban residential community (not immediately adjacent to heavily traveled roads and industrial areas) 60 dBA L_{dn}
- Noisy urban residential community (near relatively busy roads or industrial areas) 65 dBA L_{dn}
- Very noisy urban residential community 70 dBA L_{dn}

Source: U.S. Environmental Protection Agency, “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,” Report 550/9-74-004, Washington, D.C., March 1974.

APPENDIX B
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Existing Ambient Sound Level Data

Location 1 - Project Site

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/3/2014 11:04	0:57:05	58.5 dB	43.9 dB	75.1 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/3/2014 11:04	65.6 dB	60.3 dB	52.4 dB	55.5 dB	59.0 dB	63.5 dB
10/3/2014 11:05	66.9 dB	60.5 dB	52.8 dB	55.0 dB	59.0 dB	63.5 dB
10/3/2014 11:06	66.6 dB	59.1 dB	51.4 dB	53.0 dB	56.5 dB	63.0 dB
10/3/2014 11:07	67.3 dB	57.8 dB	48.2 dB	50.5 dB	55.5 dB	61.5 dB
10/3/2014 11:08	66.1 dB	58.6 dB	53.4 dB	55.0 dB	57.5 dB	61.5 dB
10/3/2014 11:09	62.2 dB	58.0 dB	52.8 dB	54.5 dB	57.5 dB	60.5 dB
10/3/2014 11:10	62.1 dB	57.1 dB	49.5 dB	51.0 dB	56.0 dB	60.5 dB
10/3/2014 11:11	68.4 dB	60.1 dB	51.0 dB	53.0 dB	58.0 dB	63.5 dB
10/3/2014 11:12	63.8 dB	58.6 dB	50.0 dB	53.0 dB	58.0 dB	61.5 dB
10/3/2014 11:13	75.1 dB	64.2 dB	51.5 dB	55.0 dB	59.5 dB	66.5 dB
10/3/2014 11:14	71.8 dB	59.8 dB	50.9 dB	52.0 dB	56.5 dB	61.5 dB
10/3/2014 11:15	66.7 dB	58.1 dB	48.4 dB	50.0 dB	56.5 dB	62.0 dB
10/3/2014 11:16	59.1 dB	54.3 dB	50.0 dB	51.5 dB	53.5 dB	56.5 dB
10/3/2014 11:17	64.5 dB	57.2 dB	49.8 dB	52.0 dB	55.5 dB	60.0 dB
10/3/2014 11:18	67.4 dB	61.2 dB	55.2 dB	58.0 dB	60.0 dB	64.0 dB
10/3/2014 11:19	63.2 dB	57.0 dB	51.3 dB	52.5 dB	56.0 dB	60.5 dB
10/3/2014 11:20	63.0 dB	58.0 dB	51.7 dB	54.0 dB	58.0 dB	60.0 dB
10/3/2014 11:21	64.1 dB	56.1 dB	47.4 dB	49.5 dB	55.5 dB	59.5 dB
10/3/2014 11:22	63.4 dB	57.8 dB	52.2 dB	54.5 dB	57.0 dB	60.5 dB
10/3/2014 11:23	62.4 dB	57.3 dB	50.4 dB	53.0 dB	56.5 dB	60.0 dB
10/3/2014 11:24	63.3 dB	55.5 dB	47.1 dB	49.0 dB	53.0 dB	60.0 dB
10/3/2014 11:25	67.4 dB	60.3 dB	51.4 dB	54.5 dB	58.5 dB	64.0 dB
10/3/2014 11:26	63.9 dB	56.5 dB	45.9 dB	47.5 dB	56.0 dB	59.5 dB
10/3/2014 11:27	65.2 dB	57.7 dB	50.4 dB	51.5 dB	56.0 dB	61.0 dB
10/3/2014 11:28	63.2 dB	54.8 dB	46.7 dB	48.5 dB	53.0 dB	58.0 dB
10/3/2014 11:29	64.8 dB	57.3 dB	45.7 dB	47.0 dB	54.5 dB	62.0 dB
10/3/2014 11:30	60.1 dB	52.7 dB	43.9 dB	45.0 dB	51.5 dB	57.0 dB
10/3/2014 11:31	63.2 dB	58.2 dB	51.2 dB	53.5 dB	58.0 dB	60.5 dB
10/3/2014 11:32	66.1 dB	56.7 dB	48.1 dB	50.0 dB	53.5 dB	60.5 dB
10/3/2014 11:33	62.0 dB	57.0 dB	51.0 dB	53.0 dB	56.5 dB	59.5 dB
10/3/2014 11:34	63.9 dB	58.6 dB	47.6 dB	50.0 dB	58.5 dB	62.0 dB
10/3/2014 11:35	62.0 dB	56.0 dB	48.3 dB	50.0 dB	54.0 dB	59.5 dB
10/3/2014 11:36	62.4 dB	57.7 dB	52.4 dB	54.0 dB	57.0 dB	60.0 dB
10/3/2014 11:37	68.8 dB	58.6 dB	49.9 dB	51.5 dB	55.0 dB	61.5 dB
10/3/2014 11:38	67.3 dB	59.1 dB	50.1 dB	52.0 dB	58.0 dB	61.5 dB
10/3/2014 11:39	61.7 dB	56.5 dB	48.7 dB	50.5 dB	56.0 dB	58.5 dB
10/3/2014 11:40	60.7 dB	57.5 dB	52.3 dB	54.0 dB	57.5 dB	59.5 dB
10/3/2014 11:41	61.1 dB	55.0 dB	47.6 dB	48.5 dB	54.5 dB	58.5 dB
10/3/2014 11:42	64.1 dB	58.1 dB	50.1 dB	52.0 dB	56.0 dB	61.0 dB
10/3/2014 11:43	64.0 dB	58.1 dB	49.4 dB	51.0 dB	57.5 dB	61.0 dB
10/3/2014 11:44	66.5 dB	59.1 dB	48.8 dB	51.0 dB	58.5 dB	62.0 dB
10/3/2014 11:45	65.2 dB	59.2 dB	48.6 dB	51.0 dB	58.5 dB	63.0 dB
10/3/2014 11:46	67.1 dB	58.9 dB	50.5 dB	52.0 dB	56.0 dB	63.5 dB
10/3/2014 11:47	65.2 dB	56.9 dB	47.5 dB	49.0 dB	54.0 dB	61.0 dB
10/3/2014 11:48	64.8 dB	57.3 dB	48.9 dB	50.0 dB	55.5 dB	61.0 dB
10/3/2014 11:49	62.4 dB	57.6 dB	52.1 dB	54.5 dB	57.0 dB	60.0 dB
10/3/2014 11:50	64.6 dB	58.9 dB	50.0 dB	52.0 dB	57.0 dB	63.0 dB
10/3/2014 11:51	65.8 dB	58.7 dB	50.0 dB	51.0 dB	58.0 dB	62.0 dB
10/3/2014 11:52	60.5 dB	55.5 dB	48.7 dB	50.0 dB	55.5 dB	57.5 dB
10/3/2014 11:53	73.9 dB	64.1 dB	55.6 dB	57.5 dB	61.0 dB	68.0 dB
10/3/2014 11:54	67.3 dB	59.0 dB	52.2 dB	54.0 dB	57.5 dB	61.5 dB
10/3/2014 11:55	68.7 dB	62.1 dB	50.5 dB	57.0 dB	60.5 dB	66.5 dB
10/3/2014 11:56	63.1 dB	55.8 dB	46.3 dB	47.5 dB	52.5 dB	59.5 dB
10/3/2014 11:57	67.2 dB	58.8 dB	50.3 dB	51.5 dB	56.0 dB	62.5 dB
10/3/2014 11:58	61.2 dB	55.1 dB	49.4 dB	50.5 dB	53.5 dB	58.5 dB
10/3/2014 11:59	61.4 dB	55.6 dB	49.0 dB	50.5 dB	55.5 dB	58.0 dB

Location 2 - Nearest Residence - On Route 8A

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/3/2014 12:42	0:19:02	61.3 dB	46.2 dB	73.4 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/3/2014 12:42	67.0 dB	60.8 dB	46.2 dB	47.5 dB	60.0 dB	64.0 dB
10/3/2014 12:43	70.2 dB	62.2 dB	46.2 dB	47.0 dB	60.5 dB	66.0 dB
10/3/2014 12:44	67.8 dB	58.8 dB	49.2 dB	50.5 dB	57.0 dB	62.5 dB
10/3/2014 12:45	73.0 dB	64.2 dB	51.3 dB	55.0 dB	62.5 dB	68.5 dB
10/3/2014 12:46	73.4 dB	63.5 dB	49.3 dB	54.0 dB	61.5 dB	66.0 dB
10/3/2014 12:47	67.3 dB	60.9 dB	50.5 dB	53.5 dB	60.0 dB	64.5 dB
10/3/2014 12:48	69.6 dB	61.7 dB	51.5 dB	54.0 dB	61.0 dB	64.5 dB
10/3/2014 12:49	66.4 dB	61.2 dB	50.7 dB	52.5 dB	60.5 dB	64.5 dB
10/3/2014 12:50	65.1 dB	60.4 dB	49.3 dB	52.5 dB	60.5 dB	63.0 dB
10/3/2014 12:51	66.8 dB	61.5 dB	50.5 dB	53.0 dB	61.0 dB	64.0 dB
10/3/2014 12:52	66.4 dB	60.4 dB	51.6 dB	54.0 dB	59.5 dB	64.0 dB
10/3/2014 12:53	68.9 dB	62.2 dB	52.7 dB	54.5 dB	61.0 dB	66.0 dB
10/3/2014 12:54	68.6 dB	59.8 dB	48.7 dB	50.0 dB	58.0 dB	63.5 dB
10/3/2014 12:55	67.1 dB	61.3 dB	52.8 dB	54.5 dB	60.5 dB	64.0 dB
10/3/2014 12:56	67.3 dB	61.5 dB	53.8 dB	56.5 dB	60.5 dB	65.0 dB
10/3/2014 12:57	64.2 dB	58.4 dB	48.7 dB	50.5 dB	58.0 dB	61.5 dB
10/3/2014 12:58	65.4 dB	59.4 dB	47.3 dB	48.5 dB	58.5 dB	63.0 dB
10/3/2014 12:59	68.8 dB	61.3 dB	49.5 dB	51.0 dB	59.5 dB	65.0 dB
10/3/2014 13:00	67.7 dB	61.6 dB	52.1 dB	55.0 dB	61.0 dB	64.5 dB

Location 3 - Trury High School - On Route 8A

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/3/2014 13:06	0:19:55	56.6 dB	45.3 dB	68.7 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/3/2014 13:06	61.7 dB	55.0 dB	46.7 dB	48.0 dB	54.5 dB	58.0 dB
10/3/2014 13:07	63.3 dB	56.2 dB	47.5 dB	50.0 dB	55.0 dB	59.5 dB
10/3/2014 13:08	64.1 dB	58.6 dB	50.3 dB	52.0 dB	57.5 dB	62.0 dB
10/3/2014 13:09	57.7 dB	52.3 dB	45.6 dB	47.0 dB	51.5 dB	55.0 dB
10/3/2014 13:10	68.7 dB	59.5 dB	47.0 dB	51.5 dB	58.0 dB	62.5 dB
10/3/2014 13:11	62.7 dB	56.8 dB	48.4 dB	50.5 dB	56.0 dB	59.5 dB
10/3/2014 13:12	64.1 dB	58.4 dB	46.5 dB	48.5 dB	56.5 dB	62.5 dB
10/3/2014 13:13	60.2 dB	55.7 dB	50.4 dB	53.0 dB	55.5 dB	58.0 dB
10/3/2014 13:14	62.0 dB	53.3 dB	46.3 dB	47.5 dB	52.0 dB	56.0 dB
10/3/2014 13:15	66.9 dB	57.9 dB	45.3 dB	47.0 dB	55.5 dB	62.0 dB
10/3/2014 13:16	62.4 dB	56.8 dB	49.5 dB	51.5 dB	56.0 dB	59.5 dB
10/3/2014 13:17	64.0 dB	58.3 dB	51.4 dB	54.5 dB	57.5 dB	61.0 dB
10/3/2014 13:18	62.7 dB	56.9 dB	47.9 dB	50.5 dB	57.0 dB	59.5 dB
10/3/2014 13:19	59.0 dB	54.4 dB	48.8 dB	51.0 dB	54.0 dB	56.5 dB
10/3/2014 13:20	63.1 dB	56.1 dB	46.2 dB	48.5 dB	55.0 dB	60.0 dB
10/3/2014 13:21	62.8 dB	55.6 dB	45.5 dB	47.0 dB	53.5 dB	59.0 dB
10/3/2014 13:22	61.3 dB	55.7 dB	46.0 dB	48.5 dB	55.5 dB	58.0 dB
10/3/2014 13:23	61.0 dB	54.6 dB	47.9 dB	49.5 dB	53.5 dB	57.5 dB
10/3/2014 13:24	64.7 dB	55.7 dB	46.0 dB	47.5 dB	55.0 dB	58.0 dB
10/3/2014 13:25	62.9 dB	56.3 dB	49.0 dB	51.5 dB	55.5 dB	59.0 dB

Location 4 – Residence in North Adams - On Route 8

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/3/2014 13:43	0:20:59	70.0 dB	53.2 dB	84.2 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/3/2014 13:43	72.3 dB	67.2 dB	55.4 dB	58.0 dB	66.5 dB	70.5 dB
10/3/2014 13:44	75.4 dB	70.2 dB	60.8 dB	66.0 dB	69.0 dB	73.0 dB
10/3/2014 13:45	75.3 dB	69.1 dB	57.4 dB	61.5 dB	68.5 dB	72.0 dB
10/3/2014 13:46	77.9 dB	70.5 dB	63.4 dB	65.0 dB	69.0 dB	73.0 dB
10/3/2014 13:47	79.8 dB	69.7 dB	59.5 dB	63.0 dB	68.5 dB	73.0 dB
10/3/2014 13:48	78.1 dB	70.4 dB	59.5 dB	62.0 dB	69.5 dB	73.5 dB
10/3/2014 13:49	74.4 dB	67.3 dB	56.0 dB	58.5 dB	64.5 dB	71.5 dB
10/3/2014 13:50	78.8 dB	69.8 dB	54.8 dB	60.0 dB	69.5 dB	73.0 dB
10/3/2014 13:51	84.2 dB	72.7 dB	58.7 dB	66.5 dB	69.0 dB	75.0 dB
10/3/2014 13:52	78.8 dB	70.5 dB	59.6 dB	66.0 dB	69.5 dB	73.0 dB
10/3/2014 13:53	75.2 dB	69.7 dB	58.1 dB	63.0 dB	69.0 dB	72.5 dB
10/3/2014 13:54	77.4 dB	68.5 dB	58.9 dB	61.0 dB	66.5 dB	72.5 dB
10/3/2014 13:55	74.2 dB	68.5 dB	57.7 dB	61.0 dB	67.5 dB	72.0 dB
10/3/2014 13:56	79.9 dB	71.3 dB	57.6 dB	63.5 dB	69.5 dB	74.0 dB
10/3/2014 13:57	80.9 dB	70.1 dB	54.9 dB	58.5 dB	68.0 dB	72.5 dB
10/3/2014 13:58	81.1 dB	70.4 dB	55.4 dB	61.0 dB	69.0 dB	73.0 dB
10/3/2014 13:59	83.7 dB	70.2 dB	53.2 dB	58.0 dB	66.0 dB	72.5 dB
10/3/2014 14:00	80.9 dB	71.3 dB	57.7 dB	61.5 dB	69.0 dB	74.0 dB
10/3/2014 14:01	74.3 dB	69.3 dB	56.3 dB	58.5 dB	69.5 dB	72.0 dB
10/3/2014 14:02	77.6 dB	69.2 dB	58.4 dB	61.5 dB	67.5 dB	73.0 dB
10/3/2014 14:03	73.9 dB	69.6 dB	62.5 dB	65.5 dB	69.0 dB	72.0 dB

Location 5 - Nearest Residence on Route 8

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/3/2014 14:10	0:21:00	71.0 dB	46.2 dB	77.9 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/3/2014 14:10	75.7 dB	70.9 dB	63.3 dB	65.5 dB	70.5 dB	73.5 dB
10/3/2014 14:11	76.5 dB	70.0 dB	49.6 dB	52.0 dB	69.0 dB	73.5 dB
10/3/2014 14:12	76.9 dB	72.7 dB	67.8 dB	69.5 dB	72.5 dB	74.5 dB
10/3/2014 14:13	74.3 dB	66.1 dB	46.2 dB	48.0 dB	63.0 dB	71.0 dB
10/3/2014 14:14	76.1 dB	71.2 dB	53.5 dB	57.5 dB	70.5 dB	74.5 dB
10/3/2014 14:15	77.0 dB	72.4 dB	64.1 dB	66.0 dB	72.0 dB	75.0 dB
10/3/2014 14:16	76.8 dB	69.4 dB	47.9 dB	50.5 dB	67.5 dB	73.5 dB
10/3/2014 14:17	77.9 dB	72.3 dB	59.8 dB	65.0 dB	72.0 dB	75.0 dB
10/3/2014 14:18	75.7 dB	70.1 dB	57.2 dB	63.0 dB	69.5 dB	73.5 dB
10/3/2014 14:19	76.8 dB	69.9 dB	59.7 dB	63.5 dB	69.0 dB	73.0 dB
10/3/2014 14:20	75.8 dB	70.2 dB	59.7 dB	61.5 dB	69.0 dB	73.5 dB
10/3/2014 14:21	77.0 dB	72.5 dB	63.7 dB	67.0 dB	72.5 dB	75.0 dB
10/3/2014 14:22	77.4 dB	71.0 dB	55.3 dB	59.0 dB	69.5 dB	75.0 dB
10/3/2014 14:23	75.9 dB	70.0 dB	51.0 dB	53.5 dB	69.0 dB	74.5 dB
10/3/2014 14:24	76.5 dB	71.2 dB	61.0 dB	66.0 dB	70.5 dB	74.0 dB
10/3/2014 14:25	77.0 dB	72.6 dB	61.9 dB	67.0 dB	72.5 dB	75.0 dB
10/3/2014 14:26	77.0 dB	71.1 dB	60.4 dB	65.5 dB	70.5 dB	73.5 dB
10/3/2014 14:27	75.6 dB	70.4 dB	58.2 dB	63.0 dB	70.0 dB	73.5 dB
10/3/2014 14:28	77.0 dB	71.9 dB	61.5 dB	66.0 dB	71.5 dB	74.0 dB
10/3/2014 14:29	76.8 dB	71.0 dB	55.5 dB	62.5 dB	71.0 dB	74.0 dB
10/3/2014 14:30	77.0 dB	70.5 dB	58.6 dB	63.5 dB	69.5 dB	74.0 dB

APPENDIX C
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Source Sound Level Data

Location A - Race Course @ 50 ft

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/5/2014 10:29	0:35:57	84.6 dB	44.4 dB	96.4 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/5/2014 10:29	87.1 dB	70.5 dB	44.4 dB	61.5 dB	67.5 dB	74.0 dB
10/5/2014 10:34	93.6 dB	80.3 dB	62.6 dB	69.0 dB	77.5 dB	84.0 dB
10/5/2014 10:39	92.5 dB	81.8 dB	69.5 dB	76.0 dB	80.0 dB	85.0 dB
10/5/2014 10:44	91.2 dB	80.4 dB	68.3 dB	74.5 dB	79.0 dB	83.5 dB
10/5/2014 10:49	96.4 dB	87.9 dB	66.7 dB	75.0 dB	85.0 dB	92.5 dB
10/5/2014 10:54	96.4 dB	87.4 dB	69.7 dB	77.5 dB	86.0 dB	91.0 dB
10/5/2014 10:59	96.1 dB	86.9 dB	72.3 dB	80.0 dB	85.5 dB	90.0 dB

Location A - Race Course @ 50 ft

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/5/2014 12:40	0:32:39	84.9 dB	61.2 dB	97.3 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/5/2014 12:40	97.0 dB	84.9 dB	64.7 dB	72.0 dB	79.5 dB	89.5 dB
10/5/2014 12:45	95.7 dB	85.5 dB	67.5 dB	73.5 dB	82.5 dB	90.0 dB
10/5/2014 12:50	97.2 dB	86.0 dB	69.3 dB	76.0 dB	83.0 dB	90.0 dB
10/5/2014 12:55	97.3 dB	84.6 dB	71.5 dB	77.5 dB	82.5 dB	88.0 dB
10/5/2014 13:00	97.0 dB	84.0 dB	61.2 dB	68.5 dB	78.0 dB	88.5 dB
10/5/2014 13:05	96.1 dB	85.1 dB	63.8 dB	70.0 dB	81.5 dB	89.5 dB
10/5/2014 13:10	94.1 dB	82.4 dB	65.2 dB	68.5 dB	79.0 dB	87.0 dB

Location B1 - Unobstructed View @ 1500 ft

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/5/2014 11:16	0:35:01	67.4 dB	45.9 dB	81.3 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/5/2014 11:16	74.6 dB	66.0 dB	50.6 dB	61.5 dB	65.0 dB	68.5 dB
10/5/2014 11:21	71.8 dB	63.7 dB	56.2 dB	60.0 dB	63.0 dB	66.0 dB
10/5/2014 11:26	81.3 dB	70.4 dB	54.2 dB	62.5 dB	69.0 dB	74.0 dB
10/5/2014 11:31	76.7 dB	68.4 dB	61.1 dB	65.5 dB	68.0 dB	70.5 dB
10/5/2014 11:36	80.3 dB	68.5 dB	62.0 dB	65.0 dB	67.5 dB	70.5 dB
10/5/2014 11:41	75.7 dB	67.7 dB	59.5 dB	64.5 dB	67.0 dB	70.0 dB
10/5/2014 11:46	71.9 dB	61.1 dB	45.9 dB	49.5 dB	55.5 dB	66.0 dB

Location B2 - Unobstructed View @ 1700 ft

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/5/2014 13:22	0:25:00	63.1 dB	51.8 dB	74.6 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/5/2014 13:22	71.9 dB	63.7 dB	51.9 dB	57.0 dB	63.0 dB	66.5 dB
10/5/2014 13:27	73.1 dB	63.4 dB	56.0 dB	60.0 dB	62.5 dB	66.0 dB
10/5/2014 13:32	74.6 dB	64.2 dB	53.4 dB	59.5 dB	63.5 dB	67.0 dB
10/5/2014 13:37	72.1 dB	62.3 dB	54.3 dB	58.5 dB	62.0 dB	64.5 dB
10/5/2014 13:42	70.1 dB	61.1 dB	51.8 dB	57.0 dB	60.0 dB	64.0 dB

Location C - Vegetated View @ 5280 ft

Start Time	Duration	Leq(A)	Lmin(A)	Lmax(A)		
10/5/2014 12:04	0:15:02	52.8 dB	45.3 dB	65.6 dB		
Start Date & Time	LAFmax	LAeq	LAFmin	LAF 90%	LAF 50%	LAF 10%
10/5/2014 12:04	65.3 dB	53.6 dB	45.6 dB	49.0 dB	51.5 dB	56.5 dB
10/5/2014 12:09	61.1 dB	50.8 dB	45.3 dB	48.0 dB	50.0 dB	53.0 dB
10/5/2014 12:14	65.6 dB	53.4 dB	46.4 dB	49.0 dB	52.0 dB	56.0 dB