

**FINAL**



**RANGE 7-1 NOISE MONITORING  
STUDY**

**FOR THE  
VERMONT ARMY NATIONAL GUARD  
AT  
ETHAN ALLEN FIRING RANGE, JERICHO, VERMONT**

**JULY 2009**

## ACRONYMS AND ABBREVIATIONS

AR	Army Regulation
ADNL	A-weighted Day/Night Average Sound Level
CDNL	C-weighted Day/Night Average Sound Level
cps	cycles per second
dB	decibel
DA	Department of the Army
EAFR	Ethan Allen Firing Range
FICON	Federal Interagency Committee on Noise
Hz	hertz
mm	millimeter
MRFR	Modified Record Fire Range
NOAA	National Oceanic and Atmospheric Administration
NLR	Noise Level Reduction
NZ I	Noise Zone I
NZ II	Noise Zone II
NZ III	Noise Zone III
PA	Public Address
USEPA	U.S. Environmental Protection Agency
dBp	unweighted peak sound levels
VTARNG	Vermont Army National Guard

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## SECTION 1 INTRODUCTION

The Vermont Army National Guard (VTARNG) retained AMEC Earth and Environmental, Inc., to complete a noise monitoring associated with noise events stemming from Range 7-1 operations at the Ethan Allen Firing Range (EAFR) in Jericho, Vermont. This study was initiated by the VTARNG in response to community concerns associated with operations from Range 7-1.

Range 7-1 is EAFR's newly developed Modified Record Fire Range (MRFR) located in the northern section of the EAFR boundary near the community of Underhill. The MRFR is designed to handle M-4 and M-16 rifles utilizing 5.56 millimeter (mm) ammunition. The residents of Underhill have contacted VTARNG personnel and voiced their concerns regarding noise levels from firing activities on Range 7-1, specifically weekend training firing activities.

Over a period of one-year, noise levels from weekend firing activities on Range 7-1 were monitored within the community of Underhill, including noise levels at specific residences at the homeowners request. Monitoring results are included within this study. Additionally, these monitoring events were used to field verify noise exposure associated with previous noise modeling efforts of Range 7-1.

Current efforts to mitigate noise levels from Range 7-1 operations include a reduction in firing rates (frequency of fire) and modifications to the Public Address (PA) system used by instructors at the range. In some areas and under certain meteorological conditions, the noise from the PA was more pervasive than that of rifle fire. The PA system used at the range must be loud enough so that instructions are audible to personnel wearing hearing protection and who are in firing positions several hundred feet from the observation tower. In response to complaints specific to the use of this PA system, the loudspeaker was lowered on its mounting pole and the volume reduced to a lower but adequate audible level. This simple mitigation measure has reduced noise from the PA system at Range 7-1.



## SECTION 2

### NOISE

Noise is often defined as unwanted sound. Noise from local roadway traffic, commercial service activities and neighborhood sources may intrude on the everyday quality of life. Community annoyance with noise is often influenced by the source of noise (i.e. objectionable music) and the time of day. Noise that is generally well tolerated during daytime hours (e.g., yard maintenance equipment) may be highly annoying if it occurs during what are otherwise quiet hours. When gauging levels of community annoyance with a specific source of noise these factors play an important role. It is often true that one person's music is another person's noise.

Sound is a physical phenomenon consisting of minute vibrations, which travel through a medium (such as air) and are sensed by the human ear. Whether that sound is interpreted as pleasant (e.g., music) or unpleasant (e.g., jack hammer) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound.

The measurement and human perception of sound involves two basic physical characteristics – intensity and frequency. Intensity is a measure of the acoustic energy of sound vibrations and is expressed in terms of sound pressure. The higher the sound's pressure, the more energy the sound carries and the louder the sound is perceived. The second important physical characteristic is frequency, which is the number of times per second the air vibrates or oscillates. Rumbles or roars characterize low-frequency sounds, while sirens or screeches typify high-frequency sounds.

The loudest sounds that the human ear can comfortably detect have intensities that are 1 trillion times higher than those of sound that cannot be detected by humans. Because of this vast range, any attempt to represent the intensity of sound using a linear scale becomes very unwieldy. As a result, a logarithmic unit known as the decibel (dB) is used to represent the intensity of a sound. Such a representation is called a sound level.

A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60-70 dB, depending on the environment. Sound levels above about 120 dB begin to be felt inside the human ear as discomfort and eventually pain at still higher levels.

Because of the logarithmic nature of the dB unit, sound levels cannot be added or subtracted directly and are somewhat cumbersome to handle mathematically. However, some simple rules of thumb are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. Thus, for example:

$$60 \text{ dB} + 60 \text{ dB} = 63 \text{ dB, and}$$

$$80 \text{ dB} + 80 \text{ dB} = 83 \text{ dB.}$$



The total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

$$60.0 \text{ dB} + 70.0 \text{ dB} = 70.4 \text{ dB}.$$

Because the addition of sound levels behaves differently than that of ordinary numbers, such an addition is often referred to as “dB addition” or “energy addition.” The latter term arises from the fact that when dB values are added, each is actually first converted to its corresponding acoustic energy. Then, the energies are added using the normal rules of addition and the total energy is finally converted back to its dB equivalent.

Sound frequency is measured in terms of cycles per second (cps), or hertz (Hz), which is the preferred scientific unit for cps. The normal human ear can detect sounds over a wide range of frequencies. However, not all frequencies in this range are heard equally well by the human ear, which is most sensitive to frequencies in the 1,000 to 4,000 Hz range.

Sound levels do not represent instantaneous measurements, but averages over short periods of time. Two measurement time periods are most common – 1 second and 1/8 of a second. A measured sound level averaged over 1 second is called a “slow response sound level;” one averaged over 1/8 of a second is called a “fast response sound level.” Field measurements recorded for this study are based on the fast response average to measure maximum, or unweighted peak sound levels (dBP) associated with noise generated by individual shots fired at Range 7-1.

## **2.1 DEPARTMENT OF THE ARMY SMALL ARMS NOISE METRIC**

To assess noise levels of small arms through noise modeling, the Department of the Army (DOA) utilizes the peak sound level, factoring in the statistical variations caused by weather, that is likely to be exceeded only 15% (PK15[met]) of the time (i.e., 85% certainty that sound will be within this range). This metric exists only in modeling—one cannot take a PK15 (met) measurement on the ground—and it is used for land use planning with small arms and as additional information for large arms and other impulsive sounds. It has gained popularity for military applications in recent years because it is a metric that works very well at showing just how loud things are likely to get at a particular location. Unfortunately, PK15 (met) does not take duration or incidence into consideration, so it cannot tell how often things will be that loud.

One of the simplest ways to measure sound is through the use of dBP. This is the peak, single event sound level on the ground, without any particular certainty—such as with the 85% certainty built into the PK15 (met) above. This is a real-time measurement that is affected by everything from the weather to the length of the grass. As such, it is highly variable.

## **2.2 DEPARTMENT OF THE ARMY NOISE ZONES**

The DOA uses a system whereby noise is partitioned into three noise zones, each labeled by Roman numerals and each representing an area of increasing noise. As particular uses such as schools, residences, and churches are more sensitive to noise than other more industrial uses, the zones help to create a picture of where things should be located.



### **2.2.1 Noise Zone I (NZ I)**

NZ I includes all areas in which the PK15 (met) dB is less than 87 dB (for small arms), the A-weighted Day/Night Average Sound Level (ADNL) is less than 65 (for aircraft), or the C-weighted Day/Night Average Sound Level (CDNL) is less than 62 (for large arms and explosions)—it's usually the furthest zone from the noise source, and it is basically all areas not in either of the next two zones. As a rule, this area is suitable for all types of land use.

### **2.2.2 Noise Zone II (NZ II)**

This is the next furthest area away from the noise source where the PK15 (met) dB is between 87 and 104, the ADNL is between 65 and 75, or the CDNL is between 62 and 70. The noise exposure here is considered significant and the use of land in this zone should generally be limited to activities such as manufacturing, warehousing, transportation, and resource protection. Residential use is strongly discouraged; however, if the community determines that this land must be used for houses, then the integration of Noise Level Reduction (NLR) features into the design and construction should be required.

### **2.2.3 Noise Zone III (NZ III)**

NZ III is the area closest to the source of the noise where the PK15 (met) dB is greater than 104, the ADNL is greater than 75, or the CDNL is greater than 70. The noise level in this area is so severe that no noise-sensitive uses should be considered therein.

## **2.3 NOISE EFFECTS**

### **2.3.1 Hearing Loss**

Noise-induced hearing loss is among the best defined of any potential effects of human exposure to excessive noise. Federal workplace standards for protection from hearing loss allow a time-averaged level of 90 dB over an 8-hour period, or 85 dB averaged over a 16-hour period. Even the most protective criterion suggests a time-averaged sound level of 70 dB over a 24-hour period. Since the possibility of hearing loss below a time-averaged sound level of 75 dB is low, this protection level is extremely conservative.

### **2.3.2 Non-Auditory Health Effects**

Non-auditory health effects of long-term noise exposure, in which noise may act as a risk factor, have never been found to occur at levels below those protecting against noise-induced hearing loss. Most studies attempting to clarify such health effects have found that noise exposure levels established for hearing protection will also protect against any potential non-auditory health effects, at least in workplace conditions. The best scientific summary of these findings is contained in the lead paper at the National Institute of Health Conference on Noise and



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Hearing Loss, held on 22-24 January 1990 in Washington, D.C.

*The non-auditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease, and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dB for complete protection against hearing loss for an 8-hour day). At the recent (1988) International Congress on Noise as a Public Health Problem, most studies attempting to clarify such health effects did not find them at levels below the criteria protective of noise-induced hearing loss, and even above these criteria, results regarding such health effects were ambiguous. Consequently, one comes to the conclusion that establishing and enforcing exposure levels protecting against noise-induced hearing loss would not only solve the noise-induced hearing loss problem but also any potential non-auditory health effects in the workplace. (Von Gierke 1990; parenthetical wording added for clarification.)*

Although these findings were directed specifically at noise effects in the workplace, they are equally applicable to noise effects in the community environment. Research studies regarding the non-auditory health effects of noise are ambiguous at best, and are often contradictory. In addition, even those studies which purport to find such health effects use time-averaged noise levels of 75 dB and higher for their research. In summary, no scientific basis exists for a claim that potential health effects exist for time-average sound levels below 75 dB.

### **2.3.3 Annoyance**

The primary effect of pervasive noise on exposed communities is one of annoyance. Noise annoyance is defined by the U.S. Environmental Protection Agency (USEPA) as any negative subjective reaction on the part of an individual or group (USEPA 1972). Relative levels of community annoyance with noise are highly subjective and influenced by a variety of circumstances.

It is often suggested that a lower time averaged sound level, such as 60 or 55 dB, be adopted as the threshold of community noise annoyance for environmental analysis documents. While there is no technical reason why a lower level cannot be measured or calculated for comparison purposes, a time-averaged sound level of 65 dB provides a valid basis for comparing and assessing community noise effects. As stated above, normal speech is approximately 60-70 dB, depending upon the surroundings or activity.

The U.S. Department of Housing and Urban Development also established a time-averaged sound level standard of 65 dB for eligibility for federally guaranteed home loans.

### **2.3.4 Speech Interference**

Speech interference associated with noise is a primary cause of annoyance to individuals in residential areas. The disruption of routine activities, such as radio or television listening, telephone use, or family conversation, gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings and can cause fatigue and vocal strain in those who attempt to communicate over the noise. Research has



shown that “whenever intrusive noise exceeds approximately 60 dB indoors, there will be interference with speech communication” (Federal Interagency Committee on Noise [FICON] 1992). A steady time averaged background sound level of 60 dB will produce 93 percent intelligibility, that of 70 dB will produce 66 percent intelligibility, and that of 75 dB will produce 2 percent intelligibility (USEPA 1972).

### **2.3.5 Sleep Interference**

Sleep interference may be measured in either of two ways. “Arousal” represents actual awakening from sleep, while a change in “sleep stage” represents a shift from one of four sleep stages to another stage of lighter sleep without actual awakening. In general, arousal requires a somewhat louder noise level than does a change in sleep stage.

The USEPA identified an indoor time averaged sound level of 45 dB as necessary to protect against sleep interference (USEPA 1972). Since typical dwelling units provide a sound level reduction of 20 dB, an outdoor noise level of 65 dB would cause minimal interference with sleep.

### **2.3.6 Noise Effects on Domestic Animals and Wildlife**

Animal species differ greatly in their responses to noise. Each species has adapted both physically and behaviorally to fill its ecological role in nature, and its hearing ability usually reflects that role. Animals rely on their hearing to avoid predators, obtain food, and communicate with and attract other members of their species. Noise may mask or interfere with these functions. Secondary effects may include non-auditory effects similar to those exhibited by humans – stress, hypertension, and other nervous disorders. Tertiary effects may include interference with mating and resultant population declines.

Many scientific studies are available regarding the effects of noise on wildlife and some anecdotal reports of wildlife “flight due to noise”. Few of these studies or reports include any reliable measures of the actual noise levels involved.

In the absence of definitive data on the effect of noise on animals, the Committee on Hearing, Bioacoustics, and Biomechanics of the National Research Council has proposed that protective noise criteria for animals be taken to be the same as for humans (National Academy of Sciences 1977).

### **2.3.7 Effects of Noise-Induced Vibration on Structures and Humans**

Sound travels from the exterior to the interior of the house in one of two ways: through solid structural elements and directly through the air. The sound transmission starts with noise impinging on the wall exterior. Some of this sound energy will be reflected away and some will make the wall vibrate. The vibrating wall radiates sound into the airspace, which, in turn, sets the interior finish surface vibrating with some of the energy lost in the airspace. This surface then radiates sound into the dwelling interior. Vibrational energy also bypasses the air cavity by traveling through the studs and edge connections.



Normally, the most sensitive components of a structure to noise are the windows and, infrequently, the plastered walls and ceilings. An evaluation of peak sound pressure impinging on the structure is normally sufficient to determine the possibility of damage. In general, sound levels above 130 dB (peak sound pressure for window breakage) may be of more concern than other frequencies. Conservatively, only sounds lasting more than 1 second above a sound level of 130 dB are potentially damaging to structural components (Von Gierke *et al.* 1991).

Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations, or “rattle”, of objects within the dwelling – hanging pictures, dishes, plaques, and bric-a-brac. Loose windowpanes may also vibrate noticeably when exposed to high levels of noise, causing homeowners to fear breakage.

In general, such noise-induced vibrations occur at sound levels above those considered normally compatible with residential land use. Thus, noise levels compatible with residential land use (i.e., below a time averaged level of 65 dB) would not cause significant secondary noise-induced vibrations.



## **SECTION 3**

### **NOISE MONITORING**

Prior to the development and operation of Range 7-1, the VTARNG retained AMEC to perform computer noise modeling and develop noise exposure footprint from all training activities at EAFR. Further, a long-term scenario which included Range 7-1 was also modeled.

Concerns from residents within the community of Underhill prompted further noise investigation efforts on behalf of EAFR, including this study. The monitoring effort was conducted in the areas where the majority of residential concerns were initiated, residents volunteered for noise monitoring at their residence, and sites that had been identified by VTARNG and AMEC personnel. These areas include Krug Road, Beartown Road and Stevensville Road. Residences along these roads are located near Range 7-1. Residents who attended a public meeting regarding operations at EAFR were invited to participate in the monitoring effort by permitting AMEC to monitor noise levels within their properties. Additionally, residents have been notified of planned training schedules prior to range operations.

#### **3.1 NOISE MONITORING METHODOLOGY**

Field measurements of noise associate with firing operations from Range 7-1 were collected outdoors using a hand held sound level meter (Quest Technologies 2200 Integrating Sound Level Meter). The sound level meter was field calibrated to 114 dB prior to each monitoring event and fit with a wind screen.

For the purposes of the monitoring event, the meter was set to record dBP, which is the DA's criteria (Army Regulation [AR] 200-1) for assessing noise from small caliber weapons (less than 40 mm). Measurements were collected at a series of fixed locations within a pre-determined and defined study area over time in various ambient conditions. Sound levels recorded for this study were collected during daylight hours when Range 7-1 was active.

Prior to each noise measurement, environmental influences including temperature, wind direction, wind speed and relative humidity were recorded. Noise events from Range 7-1 that coincided with passing vehicles, gusting wind, or other neighborhood sources were not recorded. Although other noise data was recorded for use as comparison, field measurements were specifically focused on noise originating from Range 7-1.

The noise from Range 7-1 is generated by the firing of M-4 or M-16 rifles. The noise from these small caliber weapons is distinctive and can be easily discerned from other forms of weapons. For example, 50 caliber weapons systems (i.e., M-2) and 7.62 mm weapons (i.e., M-60) are distinctively louder than the M-4 and M-16.

After each field measurement was recorded, the sound level meter was reset, or cleared of the previous peak measurement. As soon as firing was audible, the dBP displayed on the sound level meter was recorded. This process was repeated at least three times in each of the monitoring



locations.

Fixed monitoring locations used in this noise study were determined through discussions between VTARNG and AMEC personnel during a site visit of the vicinity thought to be most influenced by activities at Range 7-1. Further, monitoring locations were based on comparative field data and on the number complaints filed in a given area. These locations were used to record noise levels associated with Range 7-1 operations. Monitoring events were scheduled to coincide with active use of the range and sample a variety of seasonal atmospheric conditions.

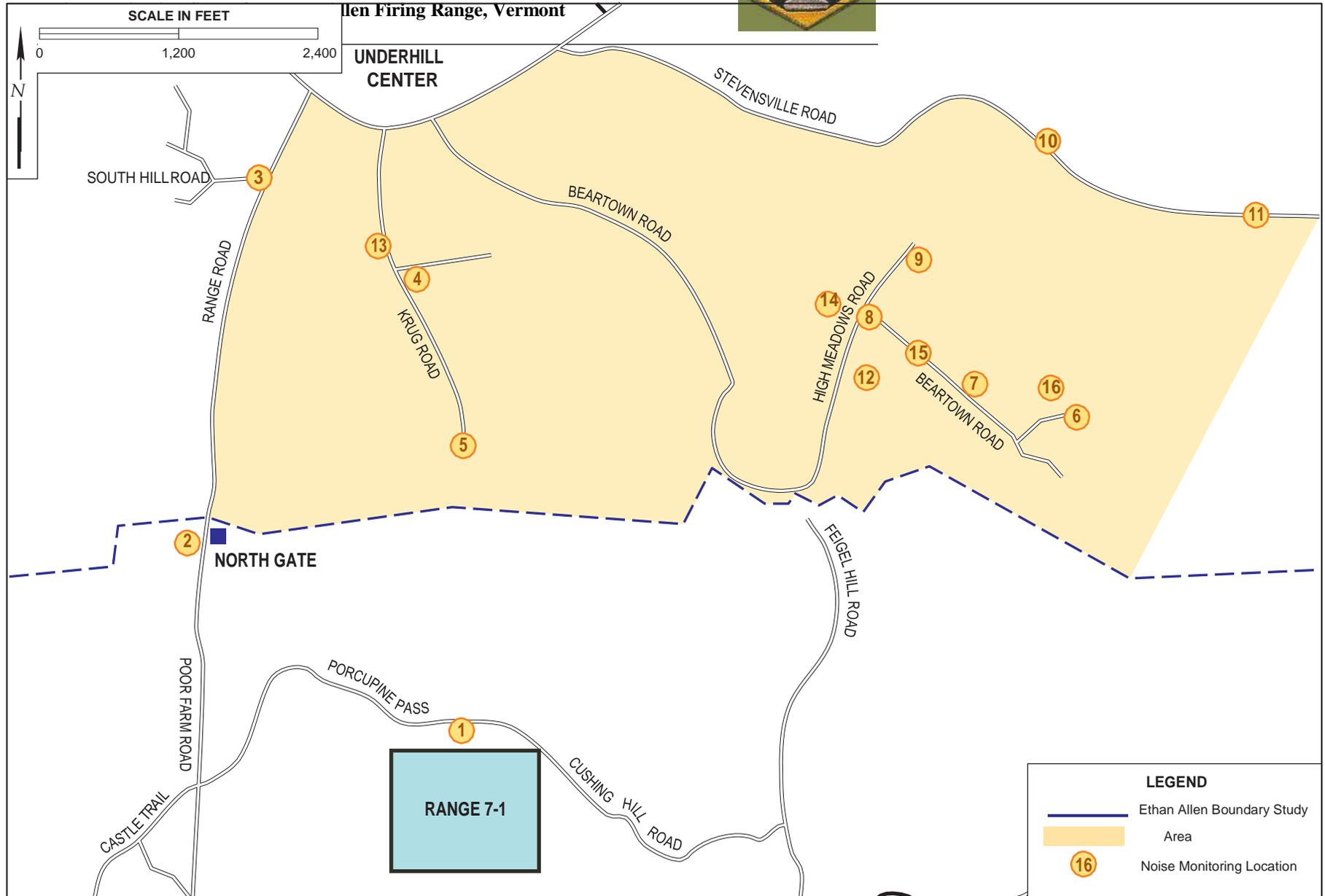
Monitoring occurred in the vicinity of EAFR's northern boundary and included residential areas within the Town of Underhill, which is located adjacent to the EAFR boundary. The VTARNG sponsored a public meeting and residents were invited to participate in the monitoring which resulted in three additional residences to be included in the monitoring. Some locations that were identified and monitoring during the initial phase of the study were later dropped as sound traveling from Range 7-1 was indistinguishable from ambient noise levels at these locations. Monitoring locations used in this study are presented in **Figure 1**.

### 3.2 FINDINGS

Noise monitoring was performed in a variety of local weather conditions over the course of the study. Precipitation in the form of rain or snow can scatter, or deflect measurable noise. Low cloud cover also tends to reflect sound over local topography. However, it was noted that wind direction and speed had a direct and measurable influence on noise traveling from Range 7-1 regardless of other conditions. Range 7-1 is oriented in a north-south direction with targets located directly to the south of the firing positions.

Winds in the vicinity of Range 7-1 and the Town of Underhill are either from the north or south and are determined by either a Northern Cold Front or Southern warm front, respectively (National Oceanic and Atmospheric Administration [NOAA] 2008, 2009). Simply, the wind is either carrying noise north from Range 7-1 towards the Town of Underhill or to the south, downrange and away from Underhill.

In conditions when prevailing winds were from the north, or down range, noise from Range 7-1 was indistinguishable from ambient noise within the study area. During monitoring events that coincided with winds from the south, noise from Range 7-1 was easily distinguishable from ambient noise and the source could also be identified. Analysis of field data indicate that noise levels in the study area associated with training activities at Range 7-1 are strongly affected by weather conditions. Wind direction and speed has a profound influence on peak noise levels measured throughout the study area (**Graph 1**).



**LEGEND**

- Ethan Allen Boundary Study
- Area
- Noise Monitoring Location

NS

Noise Monitoring Locations and Study Area  
Ethan Allen Firing Range, Vermont

FIGURE  
1

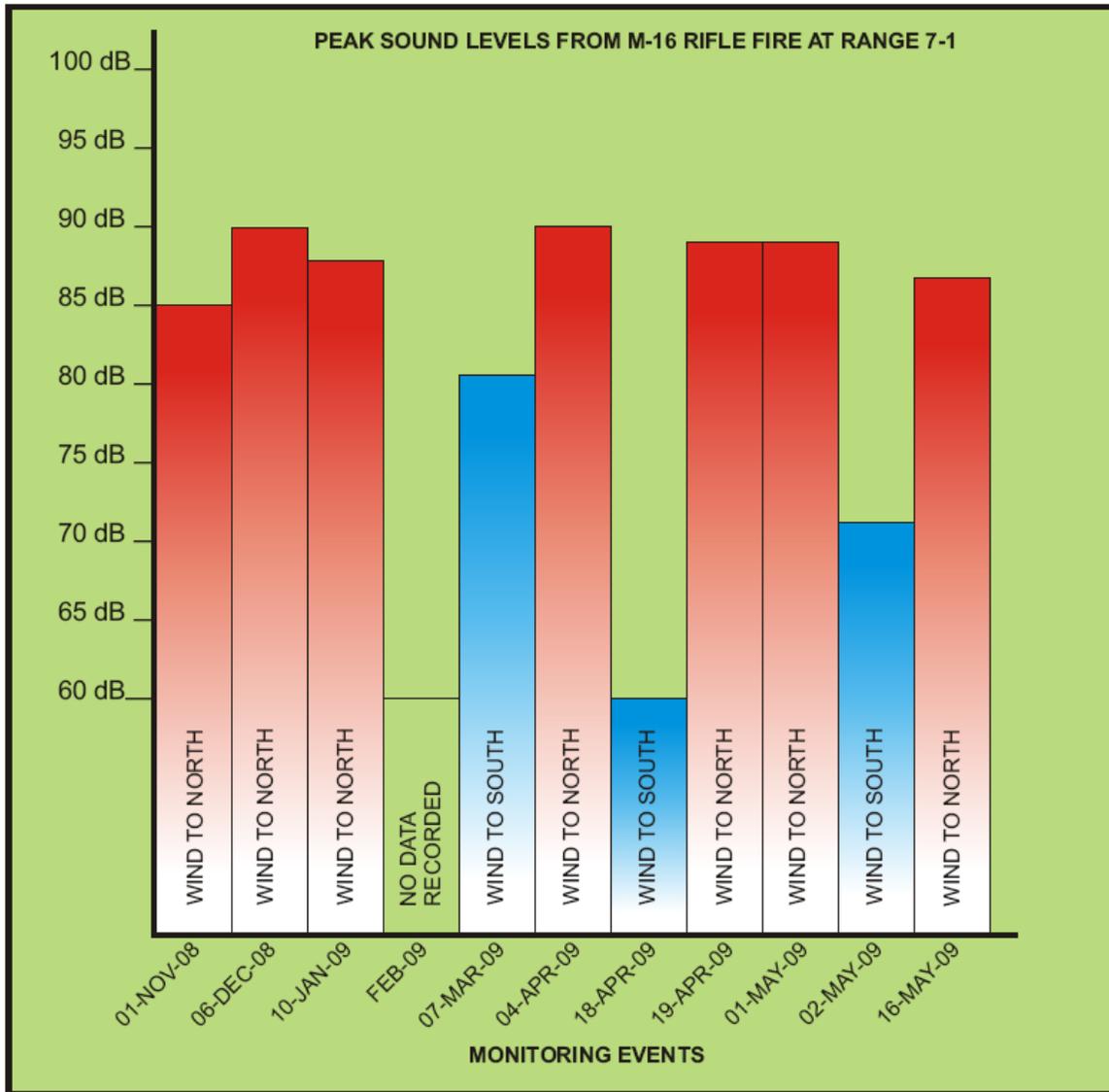


Weather conditions in the study area can be highly variable and seasonal descriptions of prevailing wind directions are presented in general terms. On the weekend of April 19<sup>th</sup>, 2009, wind conditions (north wind) were such that noise from Range 7-1 was being carried downrange and away from the Beartown Road area. Skies were rainy and overcast with seasonal temperatures at 48 degrees. Although firing was in progress and efforts were made by field personnel over a period of hours, no accurate data could be collected at the monitoring locations in the study area.

Firing exercises at Range 7-1 and other ranges within EAFR continued into the evening as weather conditions quickly changed. The rain and low clouds gave way to clear skies and winds died down to calm air. This change in conditions influenced noise levels within the Town Underhill and Range Control logged a noise complaint at 7:00 PM from a resident living in the study area. However, it is unclear if the noise complaint was specifically related to Range 7-1 as there were other ranges active at the time. This is one example how a change in conditions can influence sound level exposure from Range 7-1.



**Graph 1. Peak Sound Levels From M-16 Rifle Fire at Range 7-1**

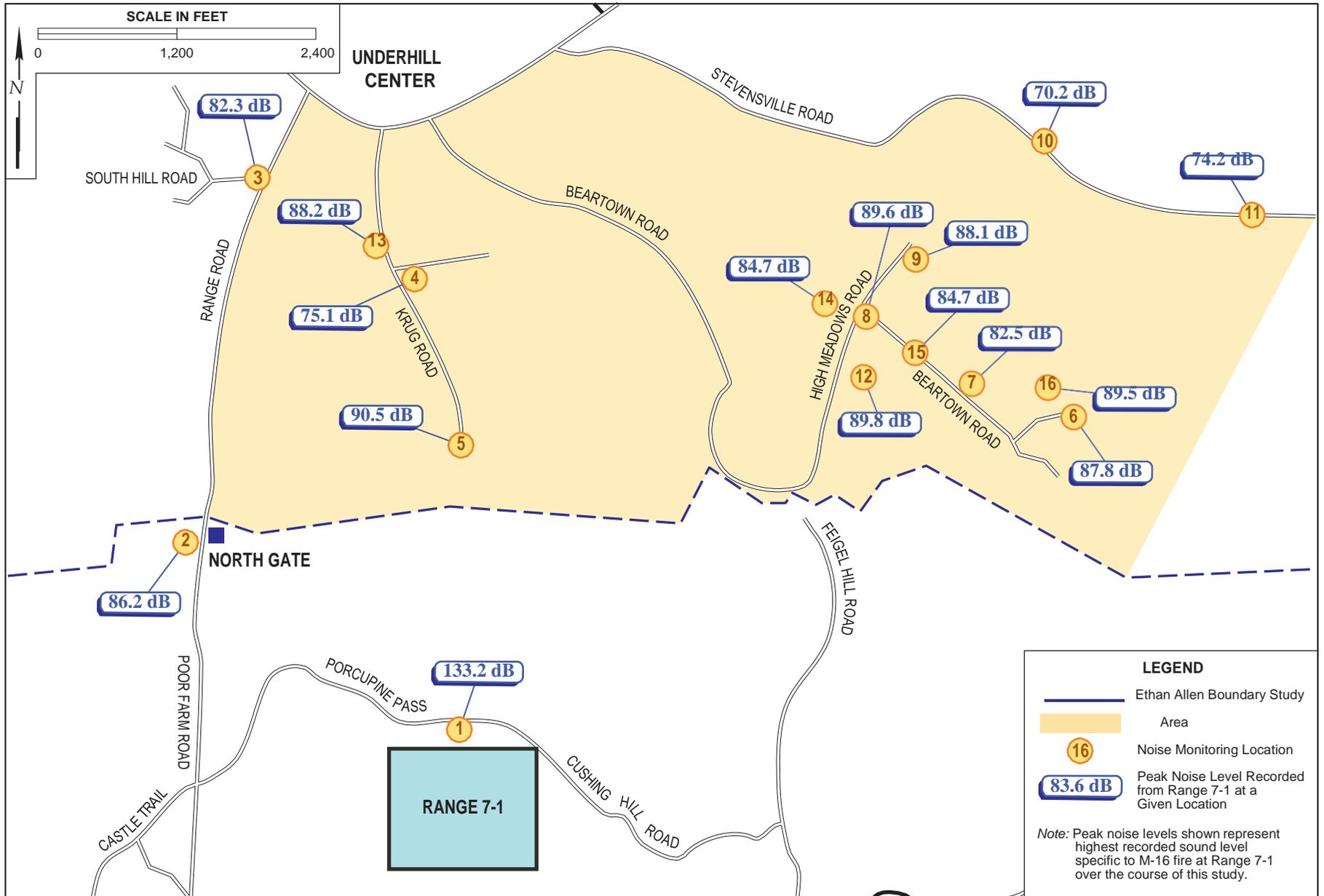




**Table 1. Peak Sound Levels (dB) from Range 7-1 and Monitoring Dates and Locations**

Location	Date							
	11/01/08	12/06/08	01/10/09	03/07/09	04/04/09	04/18/09	05/01/09	05/16/09
Location 1 Range 7-1	123.0 dB	133.2 dB	128.5 dB	108.3 dB	123.1 dB	125.0 dB	127.1 dB	127.6 dB
Location 2 Guard shack	74.5 dB	86.0 dB	70.0 dB	86.2 dB	NM	NM	NM	NM
Location 3 South Hill and Range Road	73.9 dB	82.3 dB	NM	NM	NM	NM	NM	NM
Location 4 Krug Road	75.1 dB	NM						
Location 5 Top of Krug Road	63.9 dB	90.5 dB	NM	80.4 dB	NM	87.9 dB	88.8 dB	87.7 dB
Location 6 177 Beartown Road	85.0 dB	87.8 dB	NM	NM	NM	NM	NM	NM
Location 7 153 Beartown Road	81.3 dB	82.5 dB	NM	NM	NM	NM	NM	NM
Location 8 135 Beartown Road	70.0 dB	89.6 dB	85.8 dB	76.2 dB	89.0 dB	88.7 dB	83.6 dB	84.0 dB
Location 9 High Meadows Road	75.5 dB	NM	82.0 dB	80.1 dB	88.1 dB	86.0 dB	83.1 dB	NM
Location 10 151 Stevensville Road	70.0 dB	NM	NM	NM	NM	NM	NM	70.2 dB
Location 11 Stevensville Road	74.2 dB	NM						
Location 12 130 Beartown Road	NM	NM	89.8 dB	76.7 dB	NM	87.2 dB	87.2 dB	85.8 dB
Location 13 22 Krug Road	NM	87.8 dB	88.2 dB	77.0 dB	NM	86.0 dB	82.3 dB	84.1 dB
Location 14 135 Beartown Road	NM	84.6 dB	84.7 dB	NM	NM	NM	NM	NM
Location 15 144 Beartown Road	NM	NM	84.7 dB	82.4 dB	NM	NM	83.8 dB	80.4 dB
Location 16 177 Beartown Road	NM	NM	87.5 dB	74.4 dB	82.3 dB	87.5 dB	89.5 dB	80.0 dB

Notes: dB - Decibel  
 NM - Not Measured



NS

**Peak Sound Levels Associated with Range 7-1  
Ethan Allen Firing Range, Vermont**

**FIGURE  
2**



### 3.3 ADDITIONAL NOISE SOURCES

The stated focus of this study is on noise originating from Range 7-1. As such, noise levels from other firing ranges were recorded for comparison as they occurred. There are other active ranges within EAFR which contribute to noise exposure beyond the camp boundary. Specifically, ranges 6-3 and 6-5 are adjacent to Range 7-1 and are both used for M-2 and M-60 training. These weapons systems produce a higher sound level than M-4 or M-16 rifle fire and have easily distinguishable, percussive quality which carries well into the study area. During training exercises which include M-2 and M-60 training coinciding with firing activities on Range 7-1, overall noise levels in the study area are noticeably higher (**Graph 2**).

Noise levels in the study area from M-16 fire at Range 7-1 are less than 91 dBP even in non-favorable firing conditions (i.e., southerly winds). During monitoring events when Range 7-1 was the only active range, residents that had requested monitoring at their location commented that it was “quieter than usual” and a few were unaware Range 7-1 was active at the time. However, when monitoring events coincided with the firing activities of M-2 or M-60 weapons, residents were well aware of it and the sound was perceptibly louder.

Training areas near the northern border are utilized for combat simulation exercises involve the use of blank rounds. However, blank rounds do not produce the same noise level as live rounds and depending on the azimuth (direction) to the receiver, peak sound levels of blank rounds can be within the range of 20 and 40 dBs less than live rounds (**Table 2**). These training exercises occur in areas closer to the community of Underhill than Range 7-1 and the noise of blanks being fired during southerly winds could be audible to residents living nearby.

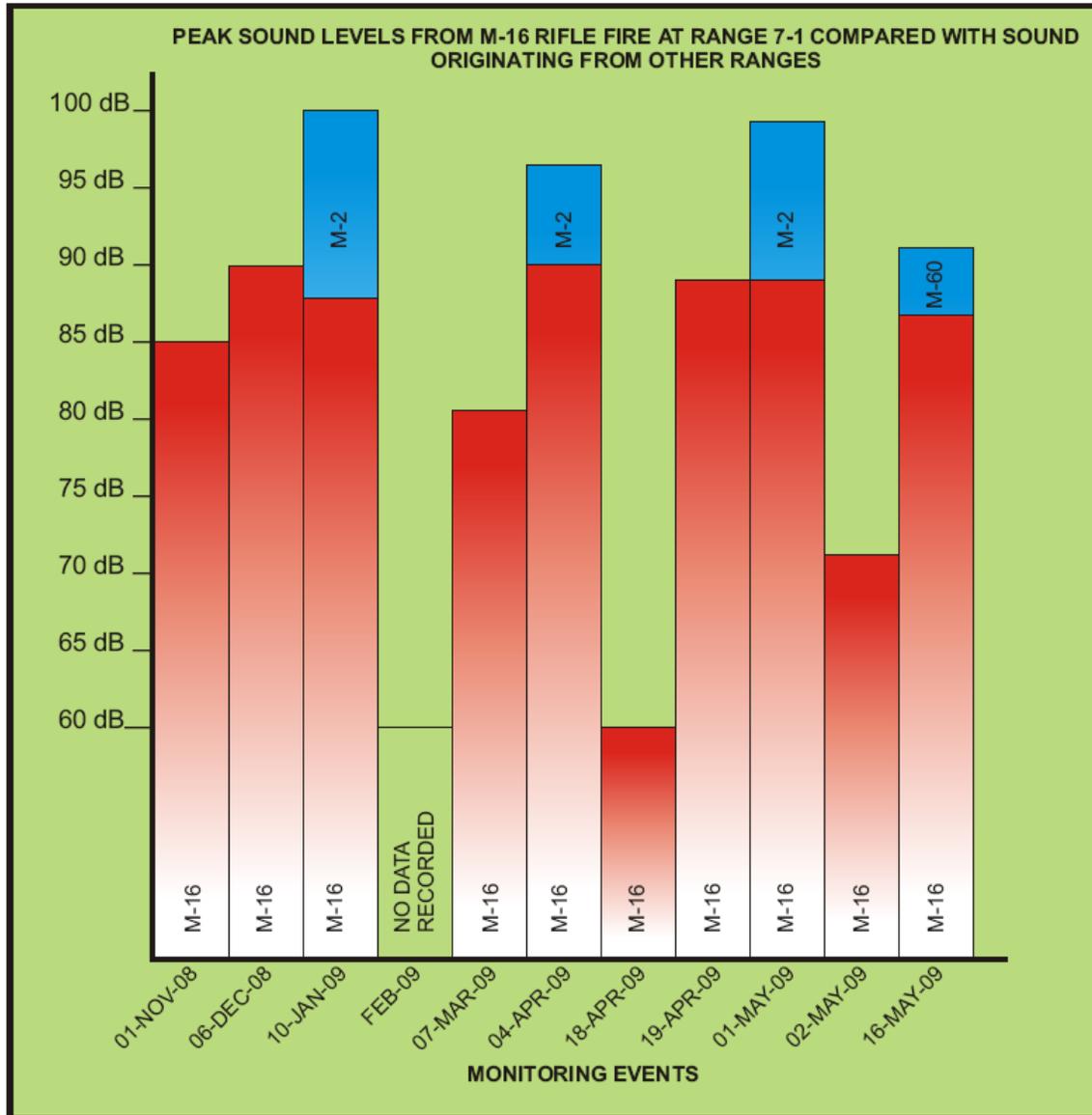
**Table 2. Peak Noise Levels (dB) Associated with M-16 Blank Rifle Fire**

Distance (feet)	Azimuth		
	0	90	180
50	94-104	92-102	92-102
100	87-97	86-96	87-97
200	80-90	79-89	80-90
400	69-79	68-78	69-79
800	60-70	59-69	60-70

Source: Fort McCoy 2008.



**Graph 2. Peak Sound Levels From M-16 Rifle Fire at Range 7-1 Compared with Sound Originating From Other Ranges**





## SECTION 4 CONCLUSIONS

Analysis of the collected noise monitoring data and field observations for this study indicate that even under conditions ideal for sound travel (i.e., southerly winds to the north at 5 to 10 miles per hour) unweighted peak sound levels specifically associated with the MRFR activities at Range 7-1 beyond the EAFR boundary are less than 87 dBP at seven locations and less than 90.5 dBP at the remaining seven locations. These sound levels are fairly consistent with noise exposure identified for Range 7-1 prior to development.

The DA's NZ I (< 87 dB) and NZ II (87 to 104 dB) metric of PK15(met) indicates that 85 percent of noise events would be within that sound level range and 15 percent of noise events beyond the sound level range (i.e., 15 percent of noise events would result in NZ II sound levels within NZ I). Noise monitoring and recording unweighted peak sound levels over a seven-month period and within varying weather conditions of Range 7-1 resulted in locations beyond the EAFR boundary to be within PK15(met) NZ I and NZ II and consistent with noise exposure identified for Range 7-1 prior to development and compliant with AR 200-1. Further, noise concerns are more likely to be associated with the increased frequency of large caliber firing activities (specifically, M-2 and M-60 weapons) that take place on the ranges 6-3, 6-5, 6-6.

According to EAFR, the numbers of noise complaints tend to increase during summer months. In addition to the winds, residents are also more likely to be outdoors, or to have household windows open after dark than during colder months. These factors affect how residents in the study area perceive and react to noise from the range.

Based on comments from homeowners within the area, community annoyance with noise from EAFR was at its highest during the summer of 2008. The quality of noise described by residents as occurring during this time period is not consistent with M-16 or M-4 rifle fire as used on Range 7-1. The sound of an M-16 at Range 7-1 can be described as a distant "crackling" noise in the areas monitored for this study. Residents complained of a "louder" noise with more "rumble" quality, and confirmed when M-2 and M-60 weapons were being fired during the study.

Noise levels associated with the firing of heavier weapons, such as an M-2 or M-60 at ranges adjacent to Range 7-1 have been shown to generate measurably higher noise levels than an M-16 within the study area. Of the residents who elected to have their location monitored, the majority residents feel they can determine the difference between the noise from a weapon such as an M-16 and the sound of an M-2. However, a misconception exists that these sounds all originate from Range 7-1 operations which is based in part to the timing of the new Range 7-1 coming on line coinciding with an increase in M-2 utilization at EAFR. Additionally, training areas in the wooded hillsides near the northern border were utilized for exercises involving the use of blank rounds. However, these activities are required to be at a distance of 500 feet from the EAFR boundary.

Based on the monitoring data and conversations with EAFR personnel, Range 7-1 is not the source of the increased noise levels and resulting community concerns. Further, all activities at EAFR meet AR 200-1 criteria for on- and off-post noise exposure. While noise and resulting

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annoyance is subjective and EAFR has received noise complaints from the adjacent community, the VTARNG and EAFR has been proactive in addressing these concerns, both through development of an Installation Operational Noise Management Plan and this Monitoring Study.



## SECTION 5

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**APPENDIX A**  
**NOISE MONITORING EVENTS FIELD NOTES**



**Appendix A**  
**Noise Monitoring Events Field Notes**

<b>First Monitoring Event</b>					
<b>11/01/08</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 11/01/08</b>
Location 1 Range 7-1	10:05	88.2	S 0-2	45	Distant shots to SW of range 7-1 measured from baseline.
Location 1 Range 7-1	10:36	102.4	S 0-2	45	PA Loudspeaker measured from baseline.
Location 1 Range 7-1	10:40	123.0	S 5	45	M-16 rifle fire measured from baseline.
Location 1 Range 7-1	10:55	100.7	S 3	45	Trucks moving past on access road measured from baseline.
Location 2 Guard shack	11:10	74.5	S 10	45	M-16 rifle fire measured from street.
Location 3 South Hill and Range Rd.	11:20	73.9	S 5	45	M-16 rifle fire measured from street.
Location 3 South Hill and Range Rd.	11:30	73.9	S 5	45	M-16 rifle fire measured from street.
Location 4 Krug Rd.	11:35	NM	S 5	45	M-16 rifle fire not audible. Measured from street. This location dropped from study after this monitoring event.
Location 5 top of Krug Rd.	11:45	63.9	S 5-10	45	M-16 rifle fire measured from street.
Location 6 177 Beartown Rd.	12:00	85.2	S 5-10	45	M-16 rifle fire. Shots clearer and sharper than on Krug Rd. Measured from street near residence.
Location 6 177 Beartown Rd.	12:10	85.0	S 5-10	45	M-16 rifle fire measured from street near residence.
Location 7 153 Beartown Rd.	12:15	81.3	S 0-5	45	M-16 rifle fire measured from street near residence.
Location 7 153 Beartown Rd.	12:15	84.4	S 0-5	45	Off-base rifle shot to south east, possibly deer hunter.
Location 8 High Meadows and Beartown Rd.	12:40	70.0	S 05	45	M-16 rifle fire measured from street.
Location 9 High Meadows Rd.	12:40	75.5	S 0-5	45	M-16 rifle fire measured from street.
Location 10 Stevensville Rd.	12:30	70.0	S 0-5	45	M-16 rifle fire measured from street.
Location 11 Stevensville Rd.	12:50	74.2	S 0-5	45	M-16 rifle fire measured from street.



<b>Second Monitoring Event 12/06/08</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 12/06/08</b>
Location 1 Range 7-1	11:09	130.2	S 4-9	35	M-16 fire measured from baseline.
Location 1 Range 7-1	11:15	133.2	S 7.1	35	M-16 fire measured from baseline.
Location 2 Guard shack	12:10	86.0	S 2.1	35	M-16 rifle fire diffuse due to topography. PA system audible.
Location 3 South Hill and Range Rd.	12:20	82.3	S 0.9	34	M-16 rifle fire distant and diffuse, measured from street. Tall trees behind nearby houses.
Location 3 South Hill and Range Rd.	12:25	63.9	S 1.2	34	M-16 rifle fire very distant, mostly echoes. This location dropped from study after this monitoring event.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.	12:35	90.5	S 1.8	34	M-16 rifle fire measured from street. PA barely audible. Mostly ambient noise.
Location 6 177 Beartown Rd.	14:15	82.3	S 3.5	35	M-16 rifle fire measured from street. Cloud cover increasing.
Location 6 177 Beartown Rd.	14:20	87.8	S 2.0	31	M-16 rifle fire measured from street near residence. Temp dropping. Clouds increasing. Rifle fire echoes from ridge to west of Range 7-1. This location dropped from study after this monitoring event.
Location 7 153 Beartown Rd.	14:45	82.5	S 7.2	28.5	M-16 rifle fire mostly echoes. Temps dropping quickly. This location dropped from study after this monitoring event.
Location 8 135 Beartown Rd.	11:50	89.6	S 4.0	36	M-16 rifle fire rifle fire measured from street near residence. Variable wind direction.
Location 8 135 Beartown Rd.	14:50	85.2	S 2.5	29	M-16 rifle fire barely audible. Measured from street near residence.
Location 9 High Meadows Rd.	14:50	NM	S 3.4	29	M-16 rifle fire barely audible. Echoes and cold wind. No data.
Location 10 151 Stevensville Rd.	15:10	NM	S 2.5	30	M-16 rifle fire not audible. No Data.
Location 11 Stevensville Rd.	15:10	NM	S 2.5	30	Not measured. Road impassable due to ice.
Location 12 130 Beartown Rd.		NM			New location. (residence) Not measured. Access to property not yet granted for this monitoring event.



<b>Second Monitoring Event 12/06/08</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 12/06/08</b>
Location 13 22 Krug Rd.	11:30	87.8	S 2-5	31	New location. (residence) M-16 rifle fire measured from street in front of house. VANG supporter.
Location 13 22 Krug Rd.	11:40	75.1	SW 3.8	31	M-16 rifle fire measured from street in front of house.
Location 14 135 Beartown Rd.	11:48	84.6	SW 1.0	35	New location. (residence) M-16 rifle fire measured from behind house facing range. Hostile petitioner against VANG.

<b>Third Monitoring Event 01/10/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 01/10/09</b>
Location 1 Range 7-1	11:45	128.1	S 0-5	20	M-16 fire measured from baseline.
Location 1 Range 7-1	11:45	128.5	S 0-5	20	M-16 fire measured from baseline.
Location 1 Range 7-1	11:50	98.7	S 0-5	20	PA system measured from baseline.
Location 1 Range 7-1	11:50	108	S 0-5	20	Mortar round impact in target area measured from baseline.
Location 2 Guard shack.	12:15	70.0	S 0-5	20	M-16 rifle fire barely audible due to topography. Measured from street.
Location 3 South Hill and Range Rd.		NM			Not measured. This location dropped from study.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.		NM			Not measured. Road impassable due to ice.
Location 6 177 Beartown Rd.		NM			Not measured. This location dropped from study.
Location 7 153 Beartown Rd.		NM			Not Measured. This location dropped from study.
Location 8 135 Beartown Rd.	13:45	85.8	S 0-3	20	M-16 rifle fire. Measured from street near residence.
Location 9 High Meadows Rd.	14:15	82.0	S 0-2	20	Echoes and wind. M-16 rifle fire measured from street.
Location 10 151 Stevensville Rd.	14:30	NM	S 2.5	30	Not measured. M-16 rifle fire not audible.
Location 11 Stevensville Rd.	14:30	NM	S 2.5	30	Not measured. Road impassable due to ice.
Location 12 130 Beartown Rd.	13:10	76.5	S 0-2	20	New location. (residence) M-16 rifle fire very distant, mostly echoes, measured from behind



<b>Third Monitoring Event</b>					
<b>01/10/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 01/10/09</b>
					house facing range.
Location 12 130 Beartown Rd.	13:10	89.8	S 0-5	20	M-16 rifle fire measured from behind house facing range.
Location 12 130 Beartown Rd.	13:10	83.6	S 0-2	20	M-16 rifle fire measured from behind house facing range.
Location 13 22 Krug Rd.	12:30	88.2	S 0-3	20	M-16 rifle fire measured from street.
Location 13 22 Krug Rd.	12:35	96.4	S 0	20	Mortar round impact measured from street in front of house.
Location 14 135 Beartown Rd.	13:35	84.7	S 0-2	20	M-16 rifle fire measured from behind house facing range. Not measured from property after this monitoring event due to hostility of occupants.
Location 15 144 Beartown Rd.	13:40	84.7	S 0-2	20	New location. (residence) M-16 rifle fire measured from in back of house facing range. Hostile resident.
Location 16 177 Beartown Rd.	14:00	87.5	S 0-2	20	New location. (residence) M-16 rifle fire measured from in front of house facing range. Hostile resident.

<b>Fourth Monitoring Event</b>					
<b>03/07/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 03/17/09</b>
Location1 Range 7-1	10:35	104	NW 0-5	41	M-16 fire measured from baseline.
Location1 Range 7-1	10:40	100	NW 1.5	41	PA loudspeaker at range measured from baseline.
Location1 Range 7-1	10:50	82.1	NW 5.1	41	PA loudspeaker at range measured from baseline.
Location1 Range 7-1	10:50	108.3	NW 2.7	41	M-16 rifle fire measured from baseline.
Location 2 Guard shack.	11:00	86.2	N 0	41	M-16 fire distant echoes. This location dropped from study after this monitoring event.
Location 3 South Hill and Range Rd.		NM			Not measured. This location dropped from study.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.	11:30	80.4	N 0	41	M-16 rifle fire distant echoes. Measured from street.
Location 6 177 Beartown Rd.		NM			Not measured. This location dropped from study.



<b>Fourth Monitoring Event</b>					
<b>03/07/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 03/17/09</b>
Location 7 153 Beartown Rd.		NM			Not Measured. This location dropped from study.
Location 8 135 Beartown Rd.	12:15	76.2	NW 5	42	M-16 rifle fire distant echoes. Measured from street near residence.
Location 9 High Meadows Rd.	12:55	80.1	N 0-5	41	M-16 rifle fire barely audible. Measured from street.
Location 10 151 Stevensville Rd.	13:10	NM	N 0	41	Not measured. M-16 rifle fire not audible.
Location 11 Stevensville Rd.	13:15	NM	N 0	41	Not measured. M-16 rifle fire not audible.
Location 12 130 Beartown Rd.	11:50	76.7	NW 2.4	42	M-16 rifle fire distant echoes. Measured from behind house facing range.
Location 12 130 Beartown Rd.	11:50	76.2	N 0	42	M-16 rifle fire barely audible. Measured from behind house facing range.
Location 13 22 Krug Rd.	11:10	77.0	N 0-2	41	M-16 rifle fire distant echoes. Measured from front of house on street.
Location 14 135 Beartown Rd		NM			Not Measured. This location dropped from study
Location 15 144 Beartown Rd.	12:15	82.4	NW 0-2	42	M-16 rifle fire distant echoes. Measured from behind house facing range.
Location 16 177 Beartown Rd.	12:40	74.4	N 0	42	M-16 rifle fire distant echoes. Measured from front of house facing range.

<b>Fifth Monitoring Event</b>					
<b>04/04/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 04/04/09</b>
Location1 Range 7-1	10:00	96.8	S 5.5	41	Single 50 cal (M-2) rifle shots at Range 6-5 adjacent to Range 7-1, measured from baseline at Range 7-1.
Location1 Range 7-1	10:05	89	S 6	41	PA loudspeaker measured from baseline.
Location1 Range 7-1	10:20	109.8	S 7.9	41	M-2 machine gun fire at adjacent Range 6-5 measured from baseline at Range 7-1.
Location1 Range 7-1	11:00	123.1	0-5	41	M-16 rifle fire measured from baseline.
Location 2 Guard shack.		NM			Not Measured. This location dropped from study



<b>Fifth Monitoring Event</b>					
<b>04/04/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 04/04/09</b>
Location 3 South Hill and Range Rd.		NM			Not measured. This location dropped from study.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.	13:10	94.5	S 7.0	40	M-2 machine gun fire measured from street in front of house.
Location 6 177 Beartown Rd.		NM			Not measured. This location dropped from study.
Location 7 153 Beartown Rd.		NM			Not Measured. This location dropped from study.
Location 8 135 Beartown Rd.	13:45	89.0	S 5	40	M-16 rifle fire distant echoes. Measured from street near residence.
Location 9 High Meadows Rd.	13:50	88.1	S 5-7	40	M-16 rifle fire barely audible, overlaid by noise of 50 cal. automatic rifle fire. Measured from street.
Location 10 151 Stevensville Rd.	14:00	NM	S 5	40	Not measured. M-16 rifle fire not audible.
Location 11 Stevensville Rd.	14:05	NM	S 5	40	Not measured. M-16 rifle fire not audible.
Location 12 130 Beartown Rd.	13:25	94.2	S 5-7	40	M-2 machine gun fire measured from behind house facing range.
Location 12 130 Beartown Rd.	13:25	99.5	S 5-7	40	Mortar impact measured from behind house facing range.
Location 13 22 Krug Rd.	13:00	94.2	S 0	40	M-2 machine gun fire measured from street in front of house. Could not measure M-16 rifle fire accurately.
Location 14 135 Beartown Rd		NM			Not Measured. This location dropped from study
Location 15 144 Beartown Rd.	11:20	94.8	S 0-5	40	M-2 machine gun fire measured from behind house facing range.
Location 16 177 Beartown Rd.	12:35	95.2	S 2.5	40	M-2 machine gun fire measured from front of house facing range.
Location 16 177 Beartown Rd.	12:35	82.3	S 2-5	40	M-16 rifle fire measured from front of house facing range.

<b>Sixth Monitoring Event</b>					
<b>04/18/09-04/19/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 04/18/09</b>
Location 1 Range 7-1	09:15	93.4	N 0-5	45	PA at Range 7-1 measured from baseline.



<b>Sixth Monitoring Event 04/18/09-04/19/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 04/18/09</b>
Location 1 Range 7-1	09:15	119.8	N 0-5	45	M-4 rifle fire measured from baseline (carbine version of M-16, same caliber).
Location 1 Range 7-1	09:15	123.5	N 2.5	45	M-4 rifle fire measured from baseline.
Location 2 Guard shack.		NM			Not Measured. This location dropped from study
Location 3 South Hill and Range Rd.		NM			Not measured. This location dropped from study.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.	11:30	NM	N 0-5	44	Not Measured. M-4 rifle fire distant and diffuse. <60 dB Measured from street.
Location 6 177 Beartown Rd.		NM			Not measured. This location dropped from study.
Location 7 153 Beartown Rd.		NM			Not Measured. This location dropped from study.
Location 8 135 Beartown Rd.	12:10	NM	N 5.2	44	Not Measured. M-4 rifle fire distant and diffuse. <60 dB Measured from street.
Location 9 High Meadows Rd.	12:55	NM	N 0-2	44	Not Measured. M-4 rifle fire <60 dB, barely audible over ambient noise
Location 10 151 Stevensville Rd.	13:10	NM	N 0-2	44	Not Measured. M-4 rifle fire <60 dB, not audible over ambient noise.
Location 11 Stevensville Rd.	13:15	NM	N 0-2	44	Not Measured. M-4 rifle fire <60 dB, not audible over ambient noise.
Location 12 130 Beartown Rd.	11:55	NM	N 0-5	44	Not Measured. M-4 rifle fire distant and diffuse. <60 dB Measured from behind house facing range.
Location 13 22 Krug Rd.	11:40	NM	N 6.6	44	Not Measured. M-4 rifle fire distant and diffuse. <60 dB Measured from street in front of house.
Location 14 135 Beartown Rd		NM			Not Measured. This location dropped from study
Location 15 144 Beartown Rd.	12:50	NM	N 0-5	44	Not Measured. M-4 rifle fire barely audible over ambient noise. <60 dB Measured from behind house facing range
Location 16 177 Beartown Rd.	12:30	NM	N 0-2	44	Not Measured. M-4 rifle fire barely audible over ambient noise. <60 dB Measured from in front of house facing range.



<b>Sixth Monitoring Event</b>					
<b>04/19/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 04/19/09</b>
Location1 Range 7-1	10:15	113.0	SE 0-5	46	M-4 rifle fire measured from baseline.
Location1 Range 7-1	10:15	91.0	SE 3.5	46	PA system measured from baseline.
Location1 Range 7-1	10:20	125.0	SE 0	46	M-4 rifle fire measured from baseline.
Location 2 Guard shack.		NM			Not Measured. This location dropped from study
Location 3 South Hill and Range Rd.		NM			Not measured. This location dropped from study.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.	12:40	87.9	SE 0-2	46	M-4 rifle fire measured from street. Wind variable directions.
Location 6 177 Beartown Rd.		NM			Not measured. This location dropped from study.
Location 7 153 Beartown Rd.		NM			Not Measured. This location dropped from study.
Location 8 135 Beartown Rd.	11:15	88.7	SE 0	47	M-4 rifle fire measured from street near residence.
Location 9 High Meadows Rd.	13:00	86.0	SE 0-5	46	M-4 rifle fire measured from street.
Location 10 151 Stevensville Rd.	13:10	NM	SE 0-5	46	Not Measured. M-4 rifle fire not audible.
Location 11 Stevensville Rd.	13:15	NM	SE 0-5	46	Not Measured. M-4 rifle fire not audible.
Location 12 130 Beartown Rd.	12:00	87.2	SE 5.7	46	M-4 rifle fire measured from back of house facing range.
Location 13 22 Krug Rd.	12:45	86.0	SE 0-5	46	M-4 rifle fire measured from street in front of house.
Location 14 135 Beartown Rd		NM			Not Measured. This location dropped from study
Location 15 144 Beartown Rd.	11:00	88.5	SE 0-5	46	M-2 machine gun fire measured from back of house facing range.
Location 16 177 Beartown Rd.	12:10	87.5	SE 4.3	46	M-4 rifle fire measured from front of house facing range.

<b>Seventh Monitoring Event</b>					
<b>05/01/09-05/02/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 05/01/09</b>
Location1 Range 7-1	12:15	114.9	S 7.2	65	M-16 rifle fire measured from baseline.



<b>Seventh Monitoring Event 05/01/09-05/02/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 05/01/09</b>
Location1 Range 7-1	12:15	101.0	S 10.2	65	PA system measured from baseline.
Location1 Range 7-1	12:20	126.0	S 8.7	65	M-16 rifle fire measured from baseline.
Location1 Range 7-1	12:20	125.6	S 10.7	65	M-16 rifle fire measured from baseline.
Location 2 Guard shack.		NM			Not Measured. This location dropped from study
Location 3 South Hill and Range Rd.		NM			Not measured. This location dropped from study.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.	14:40	88.8	S 5	63	M-16 rifle fire at measured from street.
Location 6 177 Beartown Rd.		NM			Not measured. This location dropped from study.
Location 7 153 Beartown Rd.		NM			Not Measured. This location dropped from study.
Location 8 135 Beartown Rd.	13:50	83.6	S 0	64	M-16 rifle fire measured from street near residence.
Location 9 High Meadows Rd.	14:00	83.1	S 6.0	64	M-16 rifle fire measured from street.
Location 10 151 Stevensville Rd.	15:20	NM	S 0-2	64	Not Measured. M-16 rifle fire not audible.
Location 11 Stevensville Rd.	15:20	NM	S 0-2	64	Not Measured. M-16 rifle fire not audible.
Location 12 130 Beartown Rd.	14:40	99.7	S 3.5	64	M2 machine gun fire measured from behind house facing range.
Location 12 130 Beartown Rd.	14:10	87.2	S 7.2	64	M-16 rifle fire measured from behind house facing range.
Location 13 22 Krug Rd.	15:00	82.3	S 6.3	63	M-16 rifle fire measured from street in front of house.
Location 14 135 Beartown Rd		NM			Not Measured. This location dropped from study
Location 15 144 Beartown Rd.	13:15	83.3	S 7.3	63	M-16 rifle fire measured from behind house facing range.
Location 15 144 Beartown Rd.	13:15	89.5	S 6.9	63	M2 machine gun fire measured from behind house facing range.
Location 16 177 Beartown Rd.	13:35	80.6	S 0-2	63	M-16 rifle fire measured from front of house facing range.
Location 16 177 Beartown Rd.	13:40	89.5	S 6.9	63	M2 machine gun fire measured from front of house facing range.

<b>Seventh Monitoring Event 05/02/09</b>
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<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 05/02/09</b>
Location1 Range 7-1	09:05	126.2	N 3.8	50	M-16 rifle fire measured from baseline.
Location1 Range 7-1	09:10	100.6	N 3.2	50	PA system measured from baseline.
Location1 Range 7-1	09:10	127.1	N 5.7	50	M-16 rifle fire measured from baseline.
Location 2 Guard shack.		NM			Not Measured. This location dropped from study
Location 3 South Hill and Range Rd.		NM			Not measured. This location dropped from study.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.	11:20	NM	N 4.2	54	M-4 rifle fire distant and diffuse. <60 dB
Location 6 177 Beartown Rd.		NM			Not measured. This location dropped from study.
Location 7 153 Beartown Rd.		NM			Not Measured. This location dropped from study.
Location 8 135 Beartown Rd.	10:40	72.2	C	54	M-16 rifle fire measured from street near residence.
Location 9 High Meadows Rd.	10:25	NM	N 0-2	53	Not Measured. M-16 rifle fire not audible.
Location 10 151 Stevensville Rd.	11:30	NM	N 0-2	53	Not Measured. M-4 rifle fire not audible.
Location 11 Stevensville Rd.	11:30	NM	N 0	53	Not Measured. M-4 rifle fire not audible.
Location 12 130 Beartown Rd.	10:50	NM	N 0-2	54	Not Measured. M-16 rifle fire not audible. Dog barking incessantly, resident not home.
Location 13 22 Krug Rd.	11:15	NM	N 5.7	54	Not Measured. M-4 rifle fire measured from street in front of house distant and diffuse. <60 dB
Location 14 135 Beartown Rd		NM			Not Measured. This location dropped from study
Location 15 144 Beartown Rd.	10:35	74.7	N 3.9	53	M-16 rifle fire measured from behind house facing range.
Location 15 144 Beartown Rd.	10:35	80.2	N 3.9	53	M-2 machine gun fire measured from behind house facing range.
Location 16 177 Beartown Rd.	10:20	77.8	N 4.3	53	M-16 rifle fire measured from front of house facing range.
Location 16 177 Beartown Rd.	10:20	78.0	N 2.5	53	M-16 rifle fire measured from front of house facing range.



<b>Eighth Monitoring Event</b>					
<b>05/16/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 15/16/09</b>
Location 1 Range 7-1	11:20	98.6	S 7.8	64	M-60 machine gun fire at adjacent range 6-5 measured from baseline at Range 7-1.
Location 1 Range 7-1	11:40	127.6	S 8.7	64	M-16 rifle fire measured from baseline.
Location 1 Range 7-1	11:45	127.0	S 5.2	64	M-16 rifle fire measured from baseline.
Location 2 Guard shack.		NM			Not Measured. This location dropped from study
Location 3 South Hill and Range Rd.		NM			Not measured. This location dropped from study.
Location 4 Krug Rd.		NM			Not Measured. This location dropped from study.
Location 5 Top of Krug Rd.	12:00	87.7	S 3.5	64	M-16 rifle fire measured from street distant and diffuse.
Location 5 Top of Krug Rd.	12:05	96.7	S 2.3	64	Mortar impact measured from street.
Location 5 Top of Krug Rd.	12:20	87.5	S 3.0	64	M-16 rifle fire measured from street.
Location 6 177 Beartown Rd.		NM			Not measured. This location dropped from study.
Location 7 153 Beartown Rd.		NM			Not Measured. This location dropped from study.
Location 8 135 Beartown Rd.	14:10	76.0	S 3.5	64	M-16 rifle fire measured from street near residence.
Location 8 135 Beartown	14:10	90.8	S 2.1	64	M-60 machine gun fire measured from street near residence.
Location 8 135 Beartown Rd.	14:15	84.0	S 2.5	64	M-16 rifle fire measured from street near residence.
Location 9 High Meadows Rd.	14:25	109.7	S 4.2	64	Mortar impact measured from street.
Location 10 151 Stevensville Rd.	14:25	70.2	S 3.0	64	M-16 rifle fire measured from street.
Location 11 Stevensville Rd.	14:35	98.2	S 4.8	64	Mortar impact measured from street. M-16 rifle fire not audible.
Location 12 130 Beartown Rd.	13:45	85.8	S 2.9	64	M-16 rifle fire measured from behind house facing range.
Location 12 130 Beartown Rd.	13:45	97.6	S 2.0	64	Mortar impact measured from behind house facing range.
Location 12 130 Beartown Rd.	13:55	113.0	S 3.5	64	Mortar impact measured from behind house facing range.
Location 13 22 Krug Rd.	12:30	81.9	S 3.2	64	M-16 rifle fire measured from street in front of house.
Location 13 22 Krug Rd.	12:35	84.1	2.0	64	M-16 rifle fire measured from street in front of house.



<b>Eighth Monitoring Event</b>					
<b>05/16/09</b>					
<b>Location</b>	<b>Time</b>	<b>Max dB</b>	<b>Wind Mph</b>	<b>Temp F°</b>	<b>Comments 15/16/09</b>
Location 14 135 Beartown Rd		NM			Not Measured. This location dropped from study
Location 15 144 Beartown Rd.	13:25	87.0	S 3.5	64	M-60 machine gun fire measured from behind house facing range. Light rain.
Location 15 144 Beartown Rd.	13:30	76.9	S 3.0	64	M-16 rifle fire measured from behind house facing range.
Location 15 144 Beartown Rd.	13:30	80.4	S 2.9	64	M-16 fire measured from behind house facing range.
Location 15 144 Beartown Rd.	13:35	104.8	S 3.2	64	Mortar impact measured from behind house facing range.
Location 16 177 Beartown Rd.	12:50	92.2	S 4.0	64	M-60 machine gun fire measured from front of house facing range.
Location 16 177 Beartown Rd.	12:55	108.4	S 5.8	64	Mortar impact measured from front of house facing range.
Location 16 177 Beartown Rd.	13:20	80.0	S 4.8	64	M-16 rifle fire measured from front of house facing range.