ROCK SPORTS COMPLEX SOUND STUDY

May 12, 2023

Prepared for Milwaukee County

Report Title:

Rock Sports Complex Sound Study

Report Prepared by:

RSG

Report Prepared for:

Milwaukee County

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EXECUTIVE SUMMARY

The Rock Sports Complex ("ROC") is located in Franklin, WI on what was formerly the Milwaukee County ("the County") owned Crystal Ridge landfill. The ROC is a privately owned recreational facility, that includes noise-generating events such as:

- Milwaukee Milkmen baseball games and other events held at Franklin Field Baseball Stadium,
- Live amplified music at the Umbrella Bar,
- Fireworks,
- The Hills Have Eyes Halloween event, and
- Snowmaking at the Rock Snowpark.

A Luxe Golf facility opened in August 2022. Based on the data analysis, ROC activities such as drive-in movies at the Milky Way Drive-In Theater, indoor corporate events held at the Lodge, and recreational baseball at the ball fields, do not substantially contribute to the sound environment in the residential areas. A map of the ROC is given in Figure ES-1.

In response to community complaints about sound levels generated by ROC events, Milwaukee County retained the services of RSG to perform a comprehensive sound study for the ROC. This report:

1) Documents the sound levels generated by ROC activities during the sound monitoring survey,
2) Compares the ROC event sound levels with background sound levels (i.e., sound levels occurring without ROC events) and to existing applicable regulatory noise thresholds,
3) Makes recommendations to reduce the noise exposure of facility activities in the surrounding residential areas,
4) Proposes clarifications to the noise thresholds for use in updated municipal code documents.

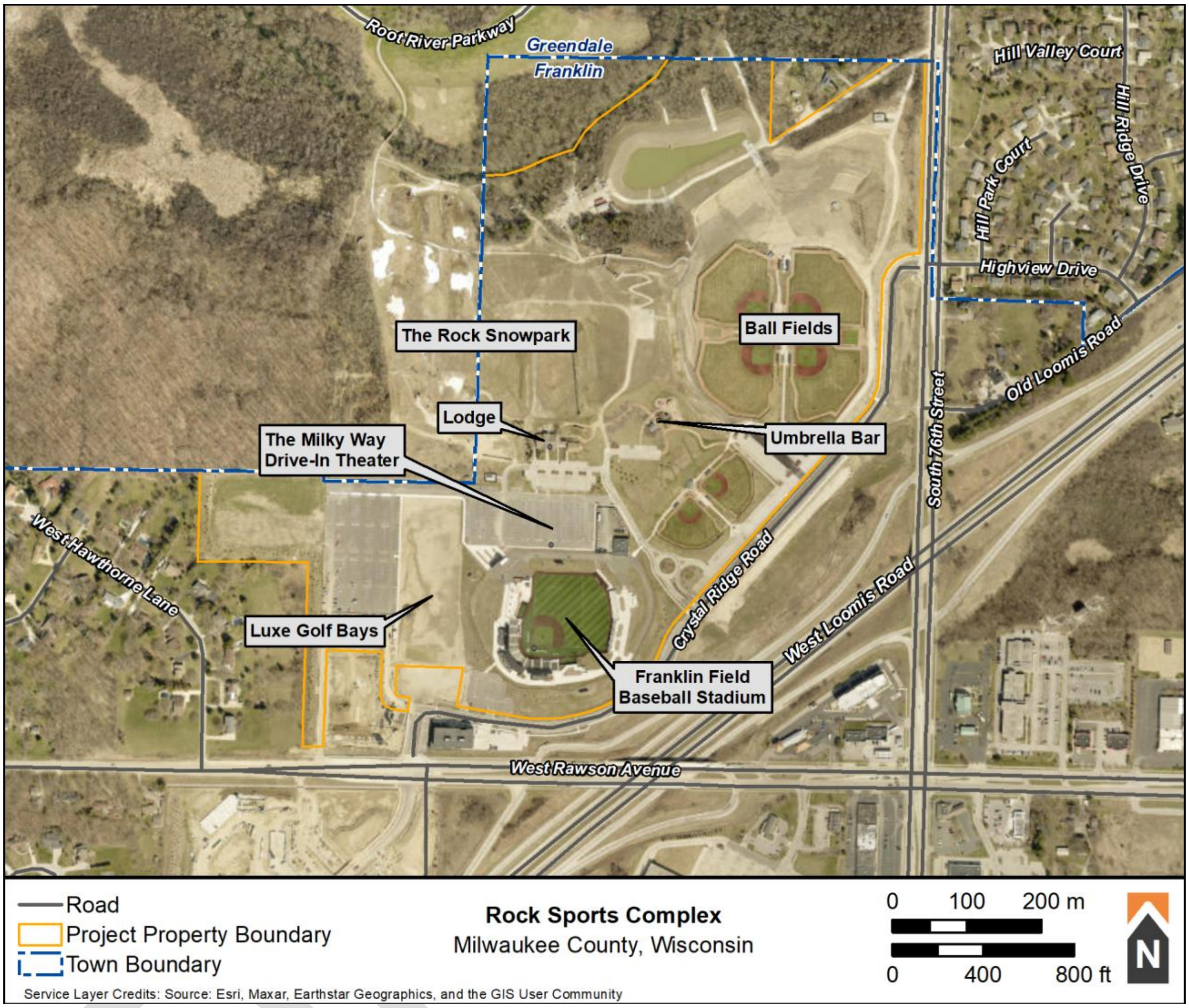


FIGURE ES-1: ROCK SPORTS COMPLEX AREA MAP

Sound levels were documented through a combination of short-term attended and long-term continuous sound monitoring. Short-term attended sound monitoring was conducted for six events to quantify sound levels generated by individual activities. Field staff attended each site for a period of approximately 30 minutes and then moved to the next site, for a total of three to seven sites per monitoring visit. Long-term continuous monitoring was used to assess the overall sound levels occurring during event and non-event times over a six-month period from July 2022 to January 2023. Three long-term monitors were installed; one of the three monitors was a reference location on the ski hill (North Monitor), and the other two monitor locations (East and West Monitors) were representative of the two closest residential neighborhoods. These RSG installed monitors are separate from the three on site ROC monitors (referred to in this document as ROC North, East, and West Monitors), which are located on-site and maintained by the ROC.

Figure ES-2 shows the long-term hourly average sound level results during Milwaukee Milkmen Baseball games occurring over the six-month monitoring period, compared to levels occurring over periods without any ROC events. Notable increases in Event sound levels occurred around 21:00 (9 PM) at all meters on weekends, coinciding with increases in sound levels from live music at the Umbrella Bar. Event Only sound levels for Milkmen Baseball Games ranged from 45 to 53 dBA L_{eq} at the three monitor locations (see Figure ES-3). Sound levels during baseball games were, on average, similar to or below background levels, resulting in increases in the overall sound level of 2 to 4 dB above background at the monitor locations. Although event sound levels did not substantially raise the overall sound level, the sounds were distinctly noticeable in the Hawthorn Neighborhood to the west, either because they rose and fell (for example, cheering at baseball games) or they had a distinct sound (like music or speech from the public announcement system).

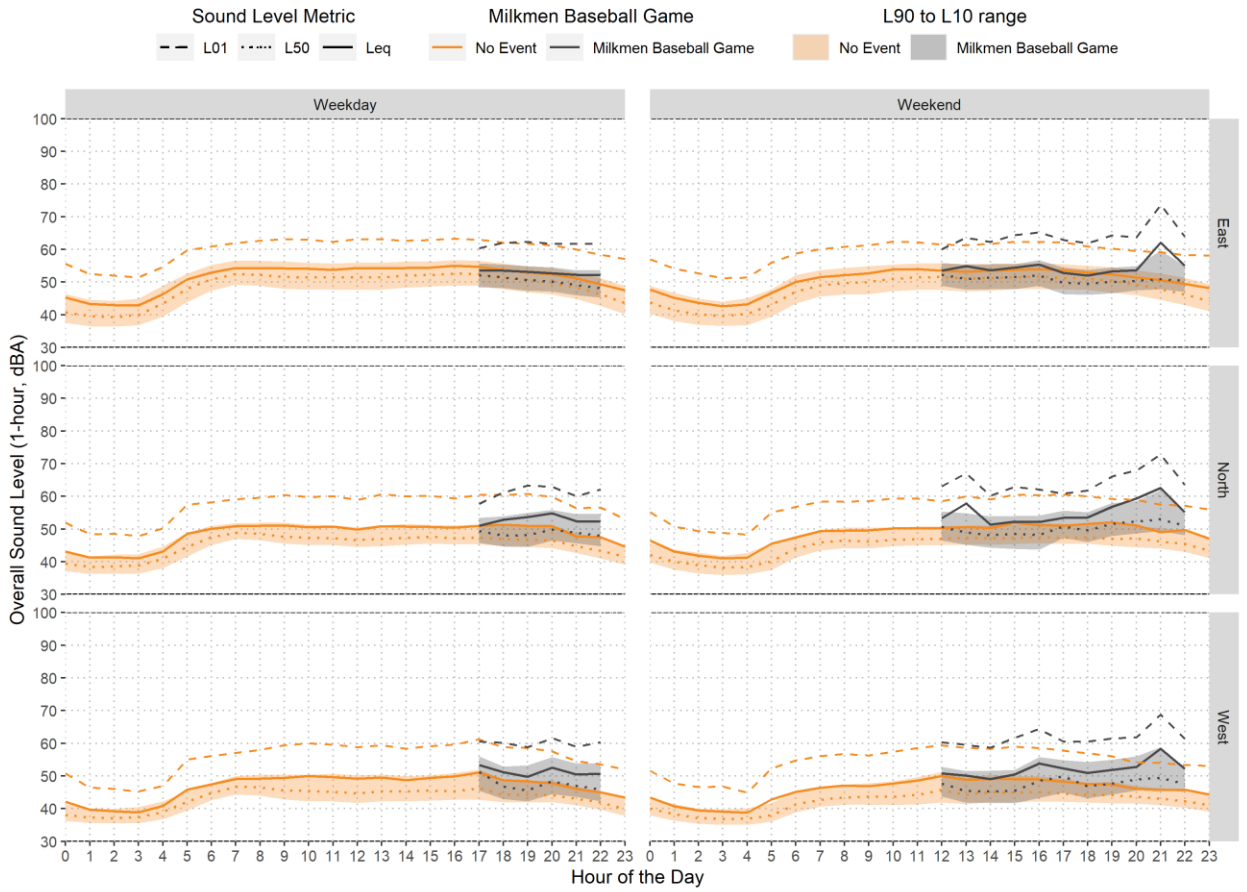


FIGURE ES-2: LONG-TERM SOUND LEVELS FOR MILWAUKEE MILKMEN BASEBALL (ONE-HOUR)

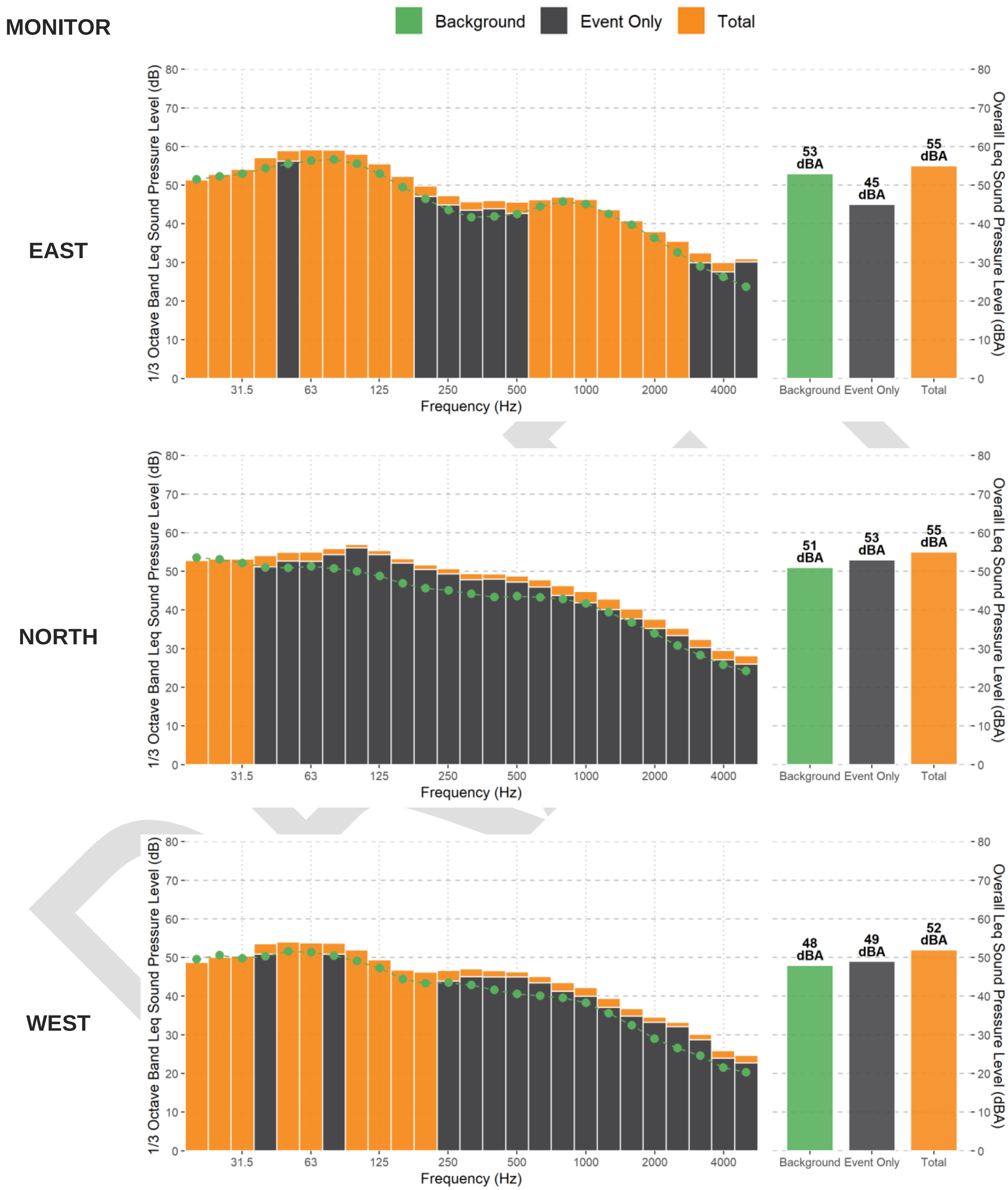


FIGURE ES-3: SPECTRAL RESULTS FOR MILWAUKEE MILKMEN BASEBALL

Low frequency sounds are the primary sound source in the surrounding communities during live music at the Umbrella Bar. During periods when background sound levels were low, music and speech were also audible in some locations. As shown in Figure ES-4 for the Hawthorn Neighborhood, low frequency sounds are clearly identifiable in the spectrogram during the period when the band was playing and drop off when the band goes on break (the spectrogram shown also includes a baseball game).

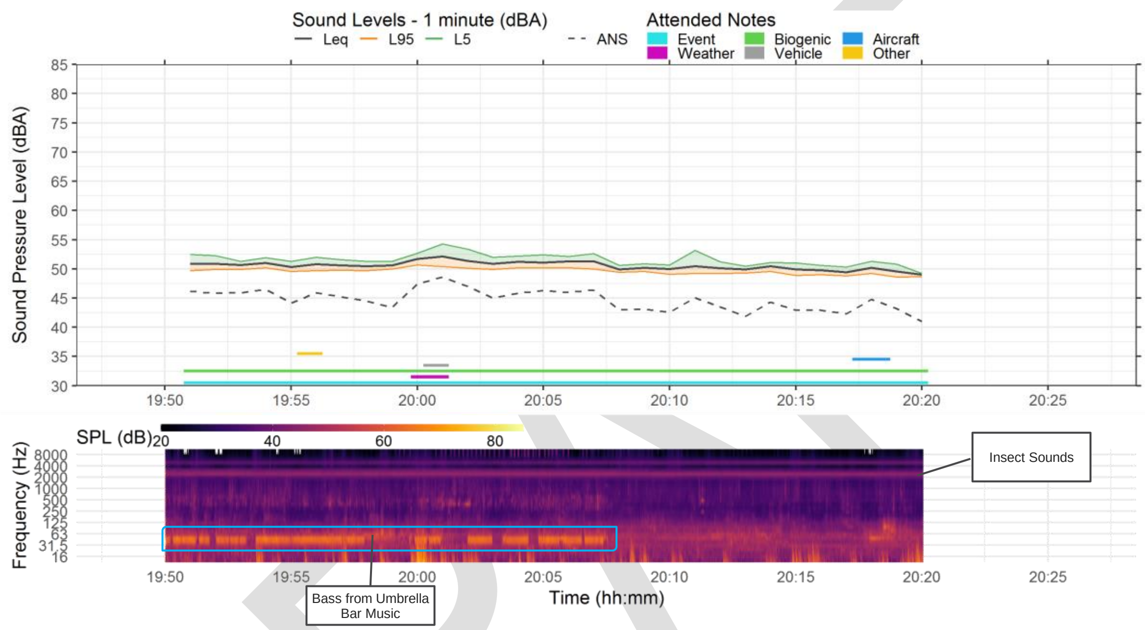


FIGURE ES-4: SPECTROGRAM DURING AND AFTER AN OUTDOOR PERFORMANCE AT UMBRELLA BAR IN HAWTHORN NEIGHBORHOOD

Fireworks generated sound levels of 77 to 84 dBA L_{10m}, which dominated the sound environment at all monitor locations and were 30 to 35 dB above comparable No Event periods. An example spectrogram from the Hawthorn Neighborhood which includes an outdoor performance at the Umbrella Bar and a period with fireworks is given in Figure ES-5. From this example, the elevated sound levels during fireworks are clearly observed.

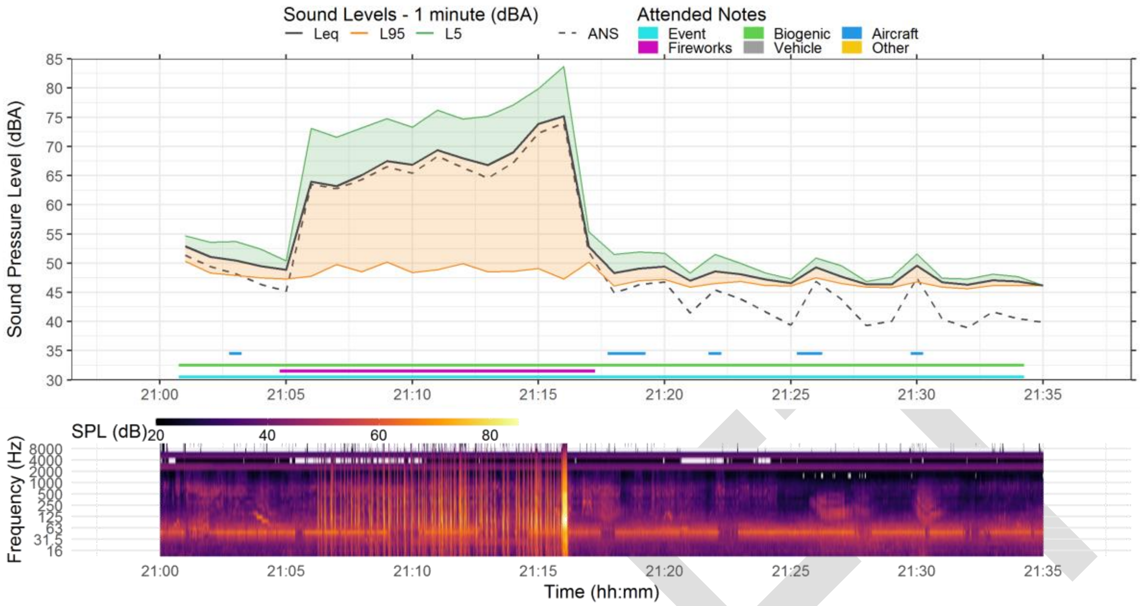


FIGURE ES-5: SPECTROGRAM OF FIREWORKS OCCURRING DURING OUTDOOR PERFORMANCE AT UMBRELLA BAR IN NEIGHBORHOOD E

Sound levels generated by the Hills Have Eyes event were not distinguishable in the sound level data, but the events were audible at locations to the east and more than a mile to the north due to the characteristics of the sounds generated by the event, which included low frequency content and sounds such as speech, music, and a chain saw.

Snowmaking did not have an appreciable effect on sound levels at the East and West Monitors during the daytime but resulted in an increase on the overall sound levels of 2 to 4 dB at the East and West Monitors at night. High sound levels associated with snowmaking occurred at the North Monitor due to the monitor's close proximity to the snow making equipment.

Sound propagation models were developed and then used to adjust the long-term monitoring measured data for use in identifying exceedances of noise limits. Sound exceedances above applicable regulatory thresholds were assessed at the worst-case exposed residence and property boundaries in each of the five nearest neighborhoods. Both ground and second floor receptors were assessed against the City of Franklin and Village of Greendale noise limits, as well as against the ANSI S12.9 Part 4 threshold for low frequency sound. Firework sounds exceeded all three limits (Franklin, Greendale, and ANSI).

Live music at the Umbrella Bar exceeded the City of Franklin limits at the H Section Neighborhood and the Village of Greendale's limits in the H Section and Hawthorn Neighborhoods. No other events exceeded the Franklin or Greendale limits. The low frequency ANSI limits exceeded during fireworks in all surrounding neighborhoods and during live music at the Umbrella Bar in the Hawthorn Neighborhood. However, the World Health ANSI acknowledges that “low-frequency sound sources characterized by rapidly fluctuating amplitude, such as rhythm instruments for popular music, may cause annoyance when these octave-band sound pressure levels are lower” than the given limits.

Note that although average events did not exceed the thresholds in many cases, there is still potential for louder than average events to exceed thresholds. In addition, this report does not include an evaluation of the characteristics of the sound (i.e., use of a penalty to account for speech and / or music sounds) or the impact associated with event generated sound level increases over background sounds.

To help the City of Franklin in applying the noise limits to be used to identify violations, clarifications of the existing City Code are provided, along with recommendations for improved regulation of ROC event sounds.

This study includes recommendations to reduce community sound exposure while allowing for recreational use of the ROC facility. These recommendations include:

- Facility design improvements for Franklin Field,
- A sound system calibration methodology for the Umbrella Bar,
- Notification and limiting of events for fireworks and helicopter usage,
- Sound mitigation strategies for the Hills Have Eyes,
- Changes to the compliance monitoring locations and available sound data that will help ROC and surrounding towns improved ability to respond to exceedances, and
- Recommendations on what information should be requested in the case of proposals for future uses to be constructed at the site.

These recommendations are detailed in Section 11.0 of this report.

1.0 BACKGROUND

The Rock Sports Complex ("ROC") is located in Franklin, WI on what was formerly the Milwaukee County ("the County") owned Crystal Ridge landfill. Crystal Ridge landfill opened in 1955 and was formally closed in the 1990s. In 1983, the County entered into an agreement with a ski hill operator for the portion of the site that is now being operated as a ski hill. In 2012, the County leased additional land to be developed as an outdoor sports recreational facility, the ROC. In 2017, the County approved the sale of the recreational facility portion of the Crystal Ridge landfill to the operator of the facility, BPC County Land, LLC (the "Developer"), in conjunction with a new lease agreement for the ski hill, a development agreement, and a contribution and participation agreement with the Developer. These agreements enabled the Developer to construct the Ballpark Commons, which includes a minor-league baseball stadium, an umbrella bar, a drive-in movie theater, recreational baseball fields, and other amenities. During the course of the sound study, a golf driving range was also constructed on the site. The Rock Snowpark is located in Greendale and continues to be owned by the County. The ROC leases the Rock Snowpark property from the County and then the ROC subleases it to the Rock Snow Park, LLC.

The 2017 agreements are structured so that the Developer was granted an option to purchase certain portions of the ROC contingent upon certain requirements, including noise requirements. As part of the 2017 contracts, three sound monitors ("ROC monitors") were installed on ROC property. The ROC monitors are meant to assess whether the facility conforms with the noise requirements.

Despite the noise requirements, County and City elected officials have received numerous complaints regarding noise emanating from the ROC. In response to community complaints, Milwaukee County has retained the services of RSG to perform a comprehensive sound study for the ROC in order to quantify the noise from certain activities, assess the impact of these activities, and make recommendations to reduce those impacts. RSG performed the sounds study with assistance from Bowlby and Associates, Inc., Beth Foy Associates, and the Law Office of Dennis M Grzezinski.

A glossary of terms and the fundamentals of acoustics are provided in Appendix A. The approved workplan for the study is provided in Appendix B.

2.0 ROCK SPORTS COMPLEX DESCRIPTION

At the start of the sound study in June 2022, the ROC included a 4,000-seat professional minor league baseball stadium (Franklin Field Baseball Stadium), an outdoor performance venue (Umbrella Bar), a drive-in movie theater (Milky Way Drive-In Theater), recreational baseball fields (Ball Fields), and a ski hill (Rock Snowpark). During the study, a golf driving range (Luxe Golf Bays) was also constructed on the site. A map of the ROC is shown in Figure 1.

The facility is adjacent to suburban neighborhoods. A map showing the facility and the surrounding residential neighborhoods, identified by letters A through E, is given in Figure 2.

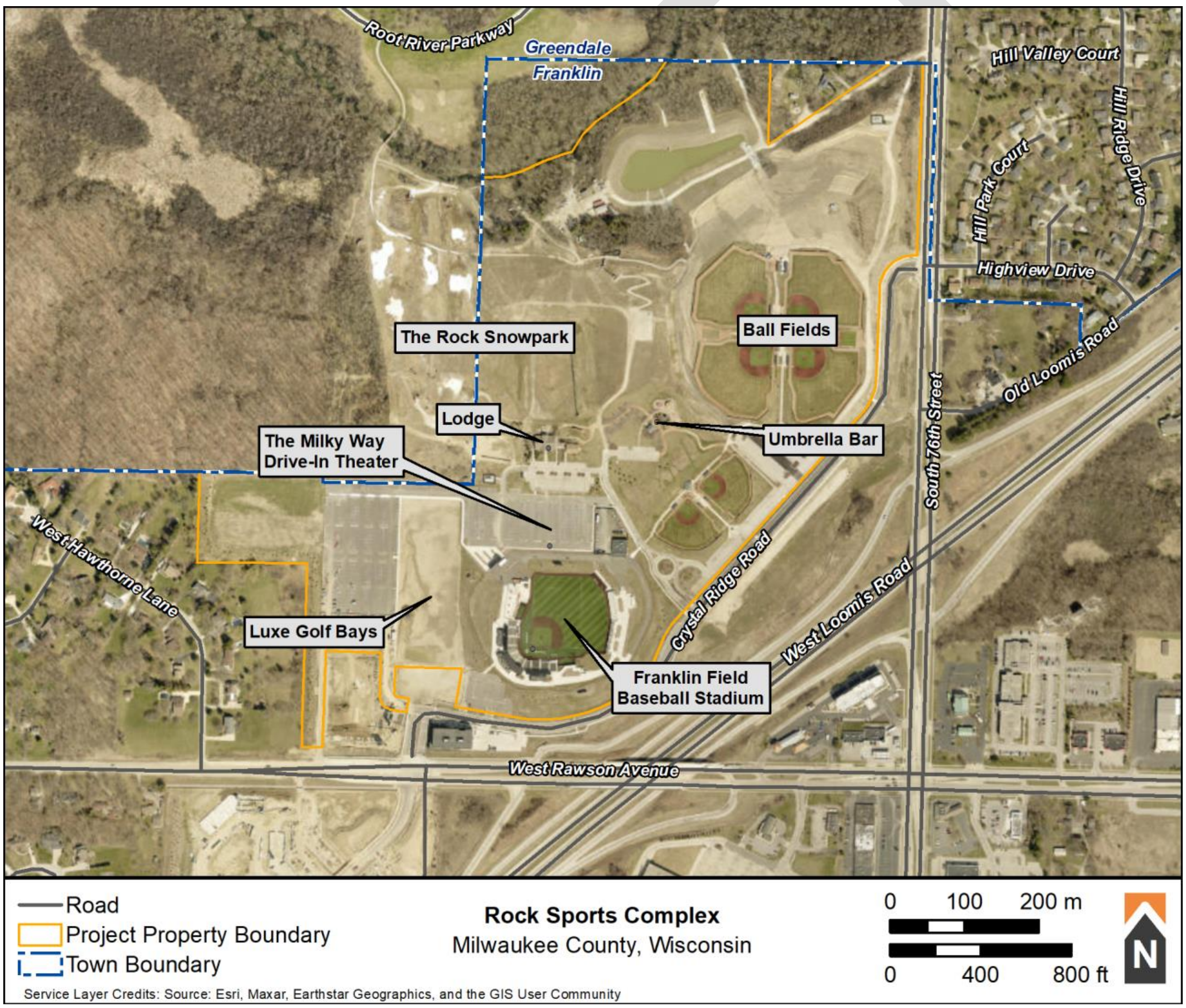


FIGURE 1: ROCK SPORTS COMPLEX AREA MAP

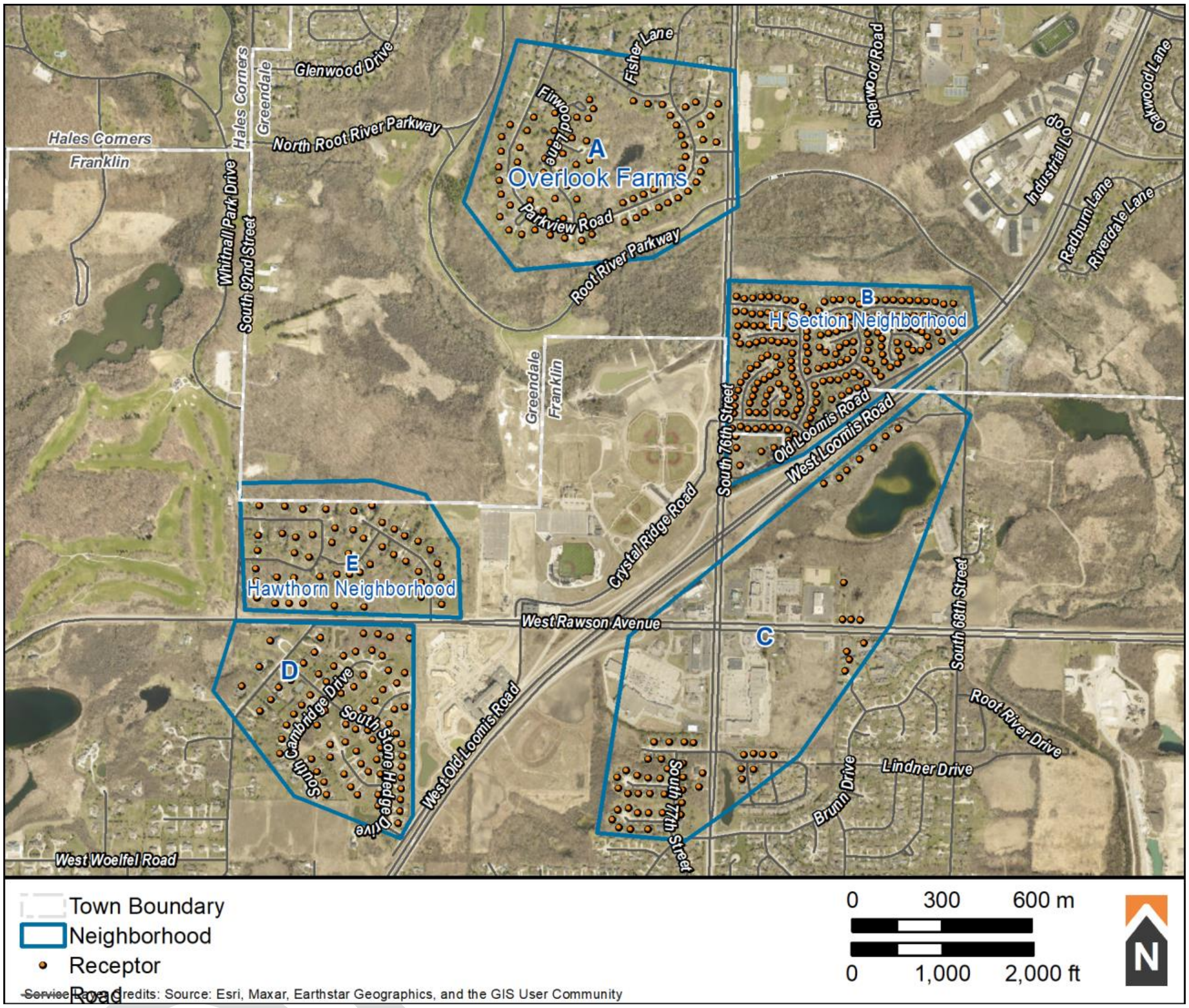


FIGURE 2: MAP OF SITE AND SURROUNDING RESIDENTIAL AREAS

2.1 SOUND GENERATING ACTIVITIES

Sound generating activities at the ROC that were monitored by RSG included 1) Milwaukee Milkmen baseball games and other events held at Franklin Field Baseball Stadium, 2) live amplified music at the Umbrella Bar, 3) fireworks, 4) The Hills Have Eyes Halloween event, and 5) snowmaking at the Rock Snowpark. During the study, a golf driving range (Luxe Golf Bays) was also constructed on the site. The sound data demonstrated that other ROC activities, such as drive-in movies at the Milky Way Drive-In Theater, indoor corporate events held at the Lodge, and recreational baseball at the ball fields, did not substantially contribute to the sound environment in the residential areas during the sound monitoring.

Below is a description of ROC activities and event facility schedules occurring over the 2022 season. Event schedules are provided in Appendix D.

Milwaukee Milkmen Baseball Game

The Milwaukee Milkmen baseball season lasted from May 13th to September 5th, 2022. Home games occurred regularly throughout the season, starting at 6:35 pm on Tuesdays through Thursdays, at 6:00 pm on Saturdays, and at 1:00 pm on Sundays. No games were scheduled for Mondays. Games lasted approximately 3 to 4 hours.

The RSG team did not receive permission to access ROC facilities. Based on aerial mapping, site observations, and available photographs of Franklin Field, the stadium includes approximately eight speaker clusters. Most of the speakers appear to point towards the field or the spectator stands. However, the speakers on the north side of the stadium appear to point north towards the parking lot and west towards residential Neighborhood E. Graphics showing the speaker locations and positioning are included in Appendix D.

Except for the May 14 and 28, 2022 games, which occurred prior to the start of RSG's sound monitoring, all Saturday night baseball games occurred concurrent to live bands playing at the Umbrella Bar.

Summer Concert Series

Outdoor amplified music performances occurred at the Umbrella Bar every Saturday night starting at 6:30 pm, June 4 through September 17, 2022. The concerts ended at approximately 10:00 pm.

It is our understanding that each band brings their own amplification system to use at the Umbrella Bar. A GoogleEarth image showing one example of a speaker setup at the Umbrella Bar is included in Appendix D.

Fireworks

Fireworks occurred on select Saturday nights throughout the baseball season, including June 4, July 9, July 23, August 6, August 20, and August 27, 2022. The firework launch area was located to the north of the Lodge. Fireworks occurred at the completion of baseball games, typically around 10:00 pm, and lasted for about 10 minutes.

The Hills Have Eyes Event

The Hills Have Eyes is an annual Halloween haunted house type of event which was held on Friday, Saturday, and Sunday nights from 6:00 pm to 12:00 am between September 30 and October 30, 2022. The event was located on 45 acres in the northern portion of the site.

Snowmaking

Snowmaking equipment at the Rock Snowpark included ten Techno Alpin T40 snow guns. The snow guns are moved around the ski hill as needed. Over the course of the sound monitoring for the 2022 / 2023 season, snowmaking occurred on the days of November 12, 13, 14, 17, 18, 19, 20, 21, 22, and 30, December 1, 3, 4, 5, 16, 17, 18, 19, 20, 21, 30, and 31, and January 6 and 7.

Helicopter Candy Drop

Helicopter candy drops were scheduled for June 25 and August 28, 2022. The June 25, 2022 event occurred prior to the start of the sound monitoring and the August 28, 2022 event was cancelled due to weather.

Luxe Golf

The Luxe Golf facility opened for business towards the end of August. Based on review of the website, the facility is currently open year-round on weekdays from 11 AM to ‘Close’ and on weekends from 10 AM to “Close”.

3.0 PURPOSE OF THE SOUND STUDY

The purpose of the sound study is to:

1) Document sound levels generated by ROC activities,
2) Compare the ROC event levels with background sound levels (i.e., sound levels occurring without ROC events) and to appropriate sound thresholds,
3) Make recommendations to reduce the exposure of sounds generated by facility activities on the surrounding residential areas, and
4) Develop sound thresholds for use in municipal code documents.

This report describes the methodology and findings from the comprehensive sound study of the ROC conducted by RSG for Milwaukee County. The comprehensive sound study included:

1) Six months of unattended sound monitoring,
2) Attended sound monitoring of events during six site visits,
3) Public outreach,
4) Sound propagation modeling,
5) An evaluation of the existing on-site ROC compliance monitors,
6) Review of the existing applicable noise policies, and
7) Drafting of proposed noise limits to balance community concerns with use of the facility.

A glossary of terms and the fundamentals of acoustics are provided in Appendix A. The approved workplan is provided in Appendix B.

4.0 PUBLIC OUTREACH

The RSG team conducted a virtual public meeting for the ROC sound study on Monday, August 29, 2022. The objective of the meeting was to share information on the purpose of the sound study and receive input from the public.

The meeting was a three-hour long event, with repeating presentations occurring on each hour (4:00, 5:00, and 6:00 pm). Presenters included Regina Flores (Milwaukee County), Beth Foy (Beth Foy Associates), and Dana Lodico (RSG). Following each presentation, the public was given the opportunity to provide comments. Presenters responded to comments, as time allowed.

Notice of the meeting was mailed in a post card format to owners and occupants of properties closest to ROC and to the primary operators of the ROC. The meeting was also posted on the Milwaukee County Events page. The City of Franklin and County Supervisors also shared meeting information.

Attendance at the meeting included four County Supervisors, the Mayor of Franklin, the Franklin Director of Administration, County staff from Procurement, Parks, and Economic Development, developer Mike Zimmerman and managers of sites at the ROC, and approximately 15 to 20 residents, with some representing more than one resident. In addition, two residents that were unable to attend the meeting asked that statements be read by others.

Input was received by residents adjacent to the ROC and those up to a mile and a half from the facility. All reported being disturbed by sound from the ROC, with some discussing the negative impact of these sounds on their quality of life. One resident requested that the ROC inform nearby residents when louder events, such as fireworks and helicopter activities, are to take place. Several residents negatively commented on the placement of the speakers along the outfield edge of the baseball stadium. Some of these speakers point from the stadium and in the direction of neighborhoods (see Appendix D). These residents asked that the speaker be turned toward the stadium and that the volume be turned down.

A summary of the feedback received from the meeting was provided to the County on September 7, 2022. This summary, along with the public outreach meeting materials and feedback are provided in Appendix C.

5.0 NOISE STANDARDS AND GUIDELINES

The sound study included a review of existing applicable standards and guidelines. A glossary of terms and the fundamentals of acoustics are provided in Appendix A.

Noise standards and guidelines that are relevant to the Project are described below, including the Ballpark Commons development agreement, and local standards for the City of Franklin and the Village of Greendale. The Village of Greendale ordinance is relevant, not because it directly regulates noise coming from the ROC, but because it bears on the issue of whether noise from ROC constitutes a nuisance to residents of nearby Greendale neighborhoods. Otherwise, there are no County, State, or Federal noise standards applicable to the ROC.

To supplement the local standards and guidelines, we provide community noise guidelines and a summary of quantitative limits from cities throughout the US to address low frequency sound, and community noise guidelines from the World Health Organization (WHO) and the American National Standards Institute (ANSI).

5.1 BALLPARK COMMONS DEVELOPMENT AGREEMENT

The Ballpark Commons Development Agreement, dated December 20, 2017, includes the following text in its Noise and Light Compliance Plan:

> "Continuous noise monitoring data shall be kept for twelve months. Upon reasonable request by the County, City of Franklin, or the Village of Greendale, noise monitoring data and reports, and a record of complaints, shall be provided to the County, City or Village, evidencing the status of compliance. A violation will be considered material if it represents a complaint filed with the operator or the City of Franklin and is evidenced in the monitoring data logs by an exceedance ("Trigger Event") that is not permitted and is not corrected and remediated within 30 minutes of the Trigger Event. The City shall have the right to enforce payment of the penalties specified in the Noise and Light Standards, which may include payment of a double permit fee for any material violation. If the operator has more than four unpermitted material violations in a calendar year, the operator shall be subject to stepped-up enforcement measures as specified in the Noise and Light Standards. If the City declines to take enforcement action, the County, under the terms of this agreement, shall have the right to impose penalties on the operator, in the County's reasonable judgment given the severity and duration of the violation and the number of violations, which shall not exceed $1,000 for an individual violation and $10,000 in aggregate for a calendar year."

Note that the agreement does not specifically set a noise limit, but rather specifies the amount of time in which a violation is required to be corrected and remediated (30 minutes).

The Noise and Light Addendum, Exhibit C to the Agreement, also states:

> As further mitigation, the operator will install a dedicated sound system to ensure that the sound at the Umbrella Bar is directionally controlled to minimize the spillover effect beyond the property boundary.

5.2 LOCAL STANDARDS

Both the City of Franklin and the Village of Greendale have quantitative noise ordinances. The ROC is located in the City of Franklin. The Village of Greendale directly abuts the ROC property to the east. Therefore, the Village of Greendale's noise ordinance is also relevant to the Project.

City of Franklin

Section 178-1 of the Franklin ordinances prohibits public nuisances, defined as acts or conditions that "substantially annoy, injure or endanger the comfort, health, repose or safety of the public."

Article XII of the City of Franklin Noise and Vibration Code applies to all sound and vibration originating within the City limits. Sections 183-41 states the following:

> "No person shall operate, permit the operation or allow his or her property to be used for such operation of anything which makes or causes a sound at a level between 70 dBA and 79 dBA as measured at the real property boundary of the noise source or beyond 50 feet from the noise source when operated in a public space without a permit."

> "The City Council may issue variances for single events which create noise from 80 dB to 89 dB measured at the real property boundary or 50 feet from the source if the noise originates on public space consisting of special public events."

The Code does not indicate the type of sound level or metric (i.e., maximum sound level, average sound level) or averaging time associated with the sound limits.

Village of Greendale

The purpose of Chapter 9 of the Village of Greendale's Code is to "regulate the creation of noise, which adversely affects adjoining properties in order to prevent the creation of nuisances and to promote the general welfare of the public." The Village sets maximum sound levels depending on the receiving land use and the type of sound generated. The ROC generates several types of sound, including the following (as defined in the Code):

- Perpetual Noise: Any noise whose level varies less than 3 dBA during a period of at least 30 minutes.
- Continuous Noise: Any noise whose level varies less than 3 dBA during a period of at least five minutes.

- Intermittent Noise: Any noise which goes on and off during a course of measurement of at least five minutes, but which exceeds 10 seconds in duration each time it is on.
- Impulsive Noise: Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.

Maximum permissible sound levels for each type of sound are provided in Table 1.

TABLE 1: VILLAGE OF GREENDALE PERMISSIBLE SOUND LEVELS

	PERMISSIBLE SOUND LEVEL BY RECEIVING LAND USE, DBA					
	Residential, agricultural, historic, and park districts		**Businesses and office districts**		**Manufacturing districts**	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
Perpetual (i.e., Snowblowers)	50	45	55	50	60	55
Continuous (i.e., Concerts)	50	45	55	50	60	55
Intermittent (i.e., Baseball)	60	55	65	60	75	70
Impulsive (i.e., Fireworks)	70	60	80	70	90	80

*Daytime is defined as the hours of 7am to 8 pm and nighttime is defined as 8pm to 7am.

An example of perpetual noise would be the snowblowers, live music at the Umbrella Bar would typically be considered continuous, baseball game activity sounds would typically be intermittent, and fireworks would be impulsive.

The Village exempts parades, concerts, festivals, fairs, or similar activities, subject to any sound limits established in the approval by the Village and approved by the appropriate Village departments.

5.3 COUNTY STANDARDS

Milwaukee County does not include regulations for noise that apply to the ROC.

5.4 STATE STANDARDS

The State of Wisconsin does not include regulations for noise that apply to the ROC.

5.5 WHO COMMUNITY NOISE GUIDELINES AND ANSI STANDARDS

To begin our assessment of what other jurisdictions and organizations view as reasonable noise levels in communities, we look at guidelines issued by the World Health Organization (WHO) and the voluntary standards of the American National Standards Institute (ANSI). As these are guidelines and voluntary standards, neither are enforceable but rather provide context in helping to set regulatory standards and design goals.

The WHO guidelines address noise annoyance and potential health impacts. The ANSI standards discuss land use compatibility as it relates to sound originating from different land uses.

World Health Organization

The WHO has studied and adopted noise guidelines to address health and aesthetic issues. In the WHO's Community Noise Guidelines[1], they write, "The scope of WHO's effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments."

The WHO long-term guideline to protect against hearing impairment is 70 dBA L_{24h} over a lifetime exposure, and higher for occupational or recreational exposure. For short-term protection against hearing impairment due to impulsive sound the guideline is 120 dB-peak for children and 140 dB-peak for adults.

The WHO guideline to protect against serious annoyance is 55 dBA averaged over a 16-hour daytime period from 7 AM to 11 PM outside of a residence, and to protect against moderate annoyance the WHO recommends a limit of 50 dBA averaged over a 16-hour daytime period. The WHO guideline for night (11 PM to 7 AM) is 45 dBA averaged over an 8-hour period and an L_{max} of 60 dBA, using fast response, to protect against sleep disturbance. These WHO guidelines are to be measured outdoors.

The WHO recognizes that noise measures based solely on A-weighted values may not adequately characterize some noise environments nor the impacts of certain types of sound sources. For example, if the noise includes a large proportion of low-frequency components, as quantified by the difference between the A-weighted and C-weighted levels being more than 10 dB, it is recommended that a frequency analysis of the noise be performed. The WHO does not offer quantitative guidelines for sources with strong low-frequency components, such as rock music.

American National Standard, ANSI S12.9 Parts 4 and 5

For additional context regarding land use compatibility, we can look to the American National Standard, ANSI S12.9 Part 5, "Quantities and Procedures for Description and Measurement of Environmental Sound – Part 5: Sound Level Descriptors for Determination of Compatible Land Use." ANSI S12.9 Part 5 provides ratings of compatibility for varying sound levels for different land uses in Annex A of the standard. The standard uses an annual average of the day-night

[1] "Guidelines for Community Noise," Edited by Birgitta Berglund, Thomas Lindvall, Dietrich H. Schwela, World Health Organization, Geneva, 2000.

average sound level (DNL)[2]. For urban/suburban residential areas, the standard lists a DNL of up to 55 dBA as being compatible, and a DNL of up to 60 dBA as being marginally compatible. The standard lists a DNL of up to 60 dBA as being compatible with outdoor spectator sports. For music shells and outdoor spectator sports, DNLs of up to 65 and 70 dBA, respectively, are considered marginally compatible.

ANSI S12.9 Part 4, "Quantities and Procedures for Description and Measurement of Environmental Sound — Part 4: Noise Assessment and Prediction of Long-Term Community Response," specifies methods to assess environmental sounds and to predict the potential annoyance response of a community to outdoor long-term noise. Annex D of the standard states that

> "sounds with strong low-frequency content can engender greater annoyance than is predicted from the A-weighted sound level. The additional annoyance may result from a variety of factors including (1) higher indoor exposures that result from the fact that there is less building sound transmission loss at low frequencies than at high frequencies and (2) there is a more rapid growth in subjective loudness per decibel change in lower frequencies compared to higher frequencies. In addition, Z-weighted sound pressure levels in excess of 80 dB outdoors in the 16, 31.5, or 63-Hz octave bands may result in noticeable building rattle sounds. Perceptible rattle can cause a large increase in annoyance. … Generally, annoyance is minimal when Z-weighted octave-band sound pressure levels are less than 65 dB at 16 and 31.5 Hz, and less than 70 dB at 63 Hz. However, low-frequency sound sources characterized by rapidly fluctuating amplitude, such as rhythm instruments for popular music, may cause annoyance when these octave-band sound pressure levels are lower."

5.6 LOW FREQUENCY NOISE REGULATIONS IN OTHER JURISDICTIONS

Some ROC activities include a large proportion of low-frequency components, as recognized in the WHO guidelines. ANSI S12.9 Part 4 suggests a noise limit at a residential receiver of 65 dB at 16 and 31.5 Hz, and 70 dB at 63 Hz to reduce annoyance. In addition, the Noise Pollution Clearinghouse (NPC) has analyzed noise ordinances from the 500 largest communities in the United States with respect to how they regulate low frequency noise. [3] Of the 500 ordinances, 304 include "plainly audible" standards, 23 include octave band limits, 15 use a dBC metric, and six use an "over background" metric, where background is defined as all of the sounds in the environment, excluding the event or equipment being proposed or studied.

[2] A day-night level is the average frequency-weighted sound level with a 10-dB penalty applied to nighttime sound levels between 10 PM and 7 AM.
[3] Blomberg, Leslie D., The state of low frequency noise regulation in the United States, Draft to be submitted.

> "Plainly audible" was generally defined as any sound that can be detected by a person using his or her unaided hearing faculties. If the sound source under investigation is a portable or personal vehicular sound amplification or reproduction device, the enforcement officer need not determine the title of a song, specific words, or the artist performing the song. The detection of the rhythmic bass component of the music is sufficient to constitute a plainly audible sound."

Communities that use the plainly audible standard in a comprehensive manner typically specify larger distances than 50 and 100 feet from the source for observation.

Figure 3 and Figure 4 show the daytime and nighttime criteria levels for the 23 communities that include octave band limits. As shown in the figures, the average limit at 63 Hz is 72 dB during daytime and 67 dB at night. The metrics and averaging times for these criteria varied, but the most common is the L_{eq} metric with averaging times varying from 5 minutes to 1 hour.

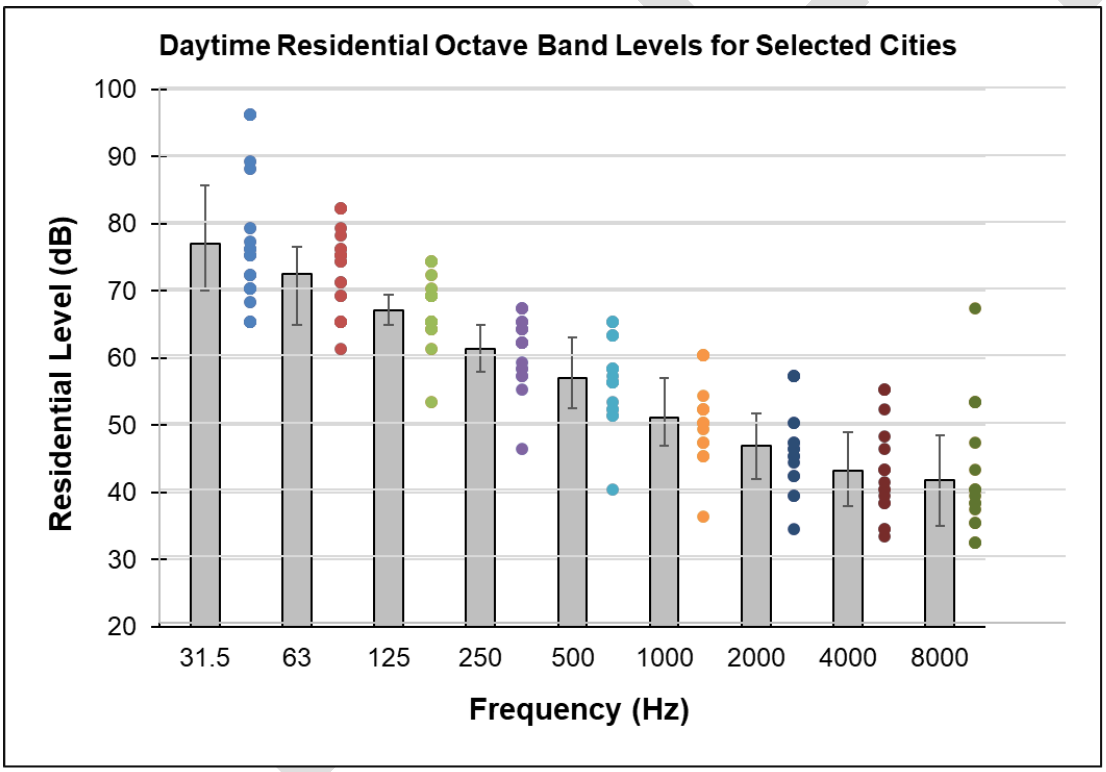


FIGURE 3 : DAYTIME RESIDENTIAL OCTAVE BAND LIMITS FOR US CITIES

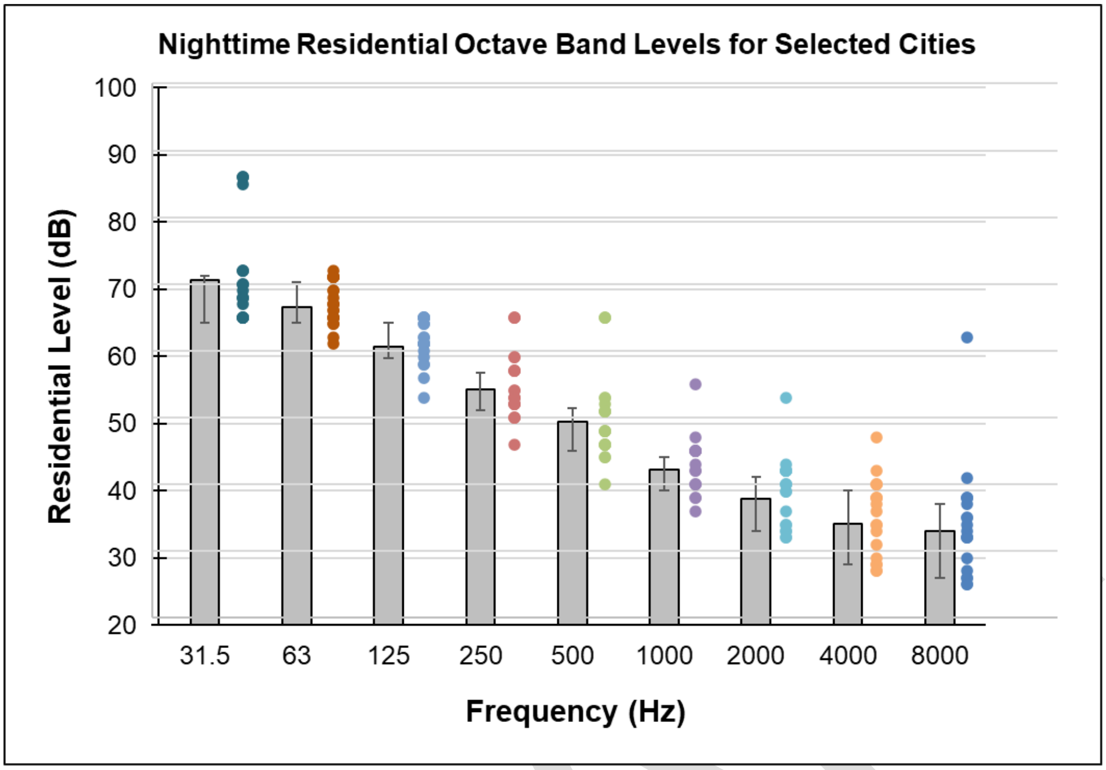


FIGURE 4 : NIGHTTIME RESIDENTIAL OCTAVE BAND LIMITS FOR US CITIES

C-Weighting (denoted by dBC) deemphasizes very high frequencies similarly to A-Weighting but does not deemphasize low frequencies. It is commonly used to describe low frequency sounds. The daytime dBC limits in the 15 ordinances range from 60 dBC to 75 dBC, with a mean of 68 dBC, and a mode of 65 dBC. The nighttime limit range is from 60 dBC to 75 dBC, with a mean of 64 and a mode of 60 dBC. “Above background” dBC criteria range from 5 to 10 dB during daytime and from 3 to 5 dB during nighttime.

Of the six ordinances that use an “over background” metric, four specify a 10 dB increase over the background sound pressure level in any octave band and two ordinances specify a 5 dB increase over background sound levels.

6.0 SOUND MONITORING

Sound monitoring for this study included unattended long-term continuous monitoring in conjunction with attended short-duration monitoring. The purpose of the long-term continuous monitoring was to assess the diurnal sound levels occurring during periods with and without ROC events. The purpose of the attended short-term monitoring was to quantify sound levels generated by individual activities during ROC events. Sound level data from the ROC compliance monitors was reviewed to assess their ability to identify non-compliance with applicable sound limits but was not analyzed to determine event or background sound levels.

RSG installed three long-term monitors on July 6, 2022 and picked up these monitors on January 10, 2023. Attended short-term monitoring was conducted for six events during the long-term measurements, as follows:

- Evening of Saturday, August 6, 2022: Baseball game, parade, fireworks, live band in Umbrella Bar (The Playlist)
- Evening of Saturday, August 20, 2022: Baseball game, live band in stadium, fireworks, live band in Umbrella Bar (The Toys)
- Evening of Saturday, August 27, 2022: Baseball game, parade, movie in stadium, live band in Umbrella Bar (Superfly)
- Afternoon of Sunday, August 28, 2022: Baseball game, planned movie in stadium and planned helicopter drop (cancelled due to weather)
- Evening of Saturday, September 10, 2022: Live band in Umbrella Bar (33 RPM)
- Evening of Saturday, October 29, 2022: Haunted Hills Event, drive-in movie at Milky Way Drive-In

The project team did not receive permission to monitor on ROC property. As a result, monitoring was conducted at the ski hill and in the surrounding communities.

6.1 MONITORING LOCATIONS

All short- and long-term monitoring locations are shown in Figure 5. Note that the North Monitor was relocated slightly in November 2022 to accommodate snow making equipment and recreational users of the facility. Photographs of the three long-term monitor locations are provided in Appendix F. The long-term monitoring locations were selected as follows:

- East Monitor: The East Monitor is representative of the ground floor exposure of residences located in Neighborhood E.

- North Monitor: The North Monitor is a reference location with exposure to Franklin Field and the Umbrella Bar. The data from this site was used to confirm ROC activities and to validate the sound modeling.
- West Monitor: The West Monitor is representative of the ground floor exposure of residences located in Neighborhood B. The location is setback from South 76th Street, which reduces the traffic noise exposure and allows the ROC activity sounds to be more evident in the data (for an example, compare Figure 15 and Figure 16).

Short-term attended monitoring sites included locations on the ski hill and in neighborhoods to the east, west, and north of the ROC. Note that each attended monitoring period only included a few of these locations as staff moved throughout the area. Field staff typically attended each site for a period of approximately 30 minutes and then moved to the next site. Detailed information on the sites used for each short-term monitoring period is provided in Appendix E.

The three ROC monitor locations are also shown in Figure 5. Again, sound level data from the ROC monitors was reviewed to assess their ability to identify non-compliance with applicable sound limits but was not analyzed to determine event or background sound levels.

FIGURE 5 : SOUND MONITORING LOCATIONS

6.2 MONITORING EQUIPMENT

Sound level monitoring was performed with ANSI/IEC Type 1 sound level meters (SLM) with a minimum frequency range of 6.3 Hz to 20 kHz. Cesva SC310 meters were used for long-term sound monitoring. Cesva SC310, Svantek 977, and Larson Davis 831 sound level meters were used for short-term sound monitoring. Sound level meters were set to log 1/3 octave band sound levels once each second.

Attended sound level meters were mounted on tripods at a height of approximately 1.5 meters (5 feet) and covered with windscreens to minimize the impact of wind distortion on the measurements. During short-term monitoring, field staff attended each monitor and documented sound levels attributable to facility and non-facility related activities occurring during the attended events.

Field staff accessed the long-term sound levels meters to download data and change batteries and/or maintain the equipment approximately every 7 to 10 days, as needed. Each Cesva SC310 meter was connected to an Edirol R-09HR or R-05 audio recorder, recording audio data at 128 kbps in *.mp3 format. The microphone of each SLM was mounted on a wooden stake at a height of approximately 1.2 m (4 ft) and protected by a windscreen to minimize the impact of wind distortion on measurements. In addition to sound level data, meteorological data was collected at each long-term location to assist with data exclusions. An Onset HOBO anemometer was located at microphone height at each of the three monitor locations. The average wind speed and maximum wind gust speed were logged once per minute.

The sound level meters were field calibrated during setup, tear down, and all meter checks. All sound level meters and field calibrators were lab-calibrated within one year of the measurement campaign.

6.3 DATA PROCESSING AND PRESENTATION

Short-Term Attended Monitoring

Analysis of the attended event data occurred following each attended event. Logged one-second L_{eq} sound levels were imported into R,[4] an Open-Source computing language, for processing and data analysis. Field notes, meteorological data, and analysis of sound level spectrograms were used to identify exclusion periods and to identify event and non-event periods.

The data from each attended event was provided to the County in the form of six technical memos (one following each attended event), which documented the data acquired during these events including the sound level time history, spectral content of the sound, and sound level

[4] https://www.r-project.org/about.html

statistics, including L_5, L_{95}, and L_{eq}. Definitions of these metrics are provided in Appendix A. The attended monitoring memos are provided in Appendix E.

Long-Term Continuous Monitoring

Logged one-second sound level data for each long-term monitor was downloaded during each field visit. Logged one-second L_{eq} sound levels were then imported into R for processing and data analysis.

Field notes, event schedules, meteorological data, audio recordings, and analysis of sound level spectrograms were used to identify exclusion periods and to identify event and non-event periods. At each monitoring location, the sound level data underwent pre-processing to exclude those periods under the following conditions:

- Wind gust speeds at the monitoring location exceeding 5.4 m/s (12 mph),
- Precipitation and thunder,
- Temperatures below -18° C (0° F), and
- Equipment interactions by field staff and other external activities (e.g., sprinklers).

Approximately 12.6% of the data was removed for data exclusions.

Once the data underwent preprocessing and data exclusions were removed, the one-second sound level data from all monitors were assigned an “Event” or “No Event” designation. Periods corresponding to any event were excluded from the “No Event” category. Hourly sound level metrics (L_{eq}, L_{01}, L_{10}, L_{50}, and L_{90}) were then calculated using the one-second data for each “Event” and “No Event” designation. In the case of Fireworks, data were aggregated into 10-minute sound level metrics to match event duration more appropriately.

Long-Term Overall Daily Sound Levels

Hourly sound level data were then grouped based on time of week (“Weekend” includes both weekends and holidays), hour of day, monitor identification (East, North, and West), and the event category (Event, No Event). From these data, the average metrics for each Event and No Event were calculated. Five average metrics are shown for each hour:

- The highest 1% of sound levels (99^{th} percentile) is represented by the dashed line (L_{01})
- The median sound level (50^{th} percentile) is represented by the dotted line (L_{50})
- The equivalent sound level (L_{eq})
- The shaded region represents the 10^{th} to 90^{th} percentile range of sound levels (L_{90} to L_{10})

For events occurring primarily during the weekend, only weekend hours were considered. These aggregated data were used to compare sound levels occurring during event periods to sound levels occurring under similar conditions without events (same time of day, day of week, etc.). The results are presented in the following section for each event-type.

In the plots, the horizontal axis of each chart shows the hour in local time over the course of a calendar day. The plot's convention is such that the numerical hour of the day includes sounds that occurred during that hour, e.g., hour five (5) represents sound levels from to 5:00:00 AM to 5:59:59 AM. Event periods are colored dark grey and periods without events are in orange.

Spectral Results

Spectral 1/3 Octave Band charts for each monitor are provided for each event type in the following section. "Background" sound levels indicate periods when there were no events at the Facility. "Total" sound levels indicate the measured sound levels during a specified event. "Event Only" sound levels are the background-corrected sound levels attributable to the event (Total minus Background). The "Event-Only" sound levels were calculated by logarithmically subtracting the "No Event" (background) sound levels from the Event (total) sound levels on a 1/3 octave band basis as described in ANSI S12.9 Part 3 Section 7. If sound levels during an event are at or below background during corollary no-event periods, the sound level of the event cannot be quantified at the specific 1/3 octave band. Sounds that are different in character than the background sounds, such as those that include tones, substantial low frequency sounds, or speech or music content, may be audible even if the sound level is below that of the background.

Note that since the background sound levels are calculated based on "No Event" days, which are different days than the "Event" days, in some cases the "Background" levels are calculated to be higher than the "Total" sound levels. This can be seen in the higher frequency data for the Hills Have Eyes and for snowblowing. In both cases, the higher "Background" levels are attributable to insect sounds, which were more prevalent during the summer months than during the late fall and winter when Hills Have Eyes and snowblowing occurred.

6.4 SOUND MONITORING RESULTS

Below is a summary of the sound sources generated by each of the sound generating ROC activities for which RSG performed sound monitoring. An explanation on how to read a spectrogram is given in Appendix A. The neighborhood designations are given in Figure 2.

Milwaukee Milkmen Baseball Game

Prior to the start of a game the primary sound sources included announcements from the Public Address (PA) system, music at the ball field, and the singing of the Star-Spangled Banner. Once the baseball game was underway, the primary sound sources included intermittent speech, music, and "Mooo"ing, amplified over the PA system. Cheering by spectators, which is typically the primary sound source in communities near sporting event facilities, was lower in sound level than these amplified sounds.

Neighborhoods B and E are both shielded from the ROC by intervening berms. Game announcements, music, and “Mooo”ing were clearly audible and distinguishable above background levels in Neighborhood E. Baseball games were not audible in Neighborhood B, which is located further from Franklin Field and has higher background sound levels due to its proximity to South 76th Street.

Figure 6 shows the long-term hourly average sound level results during Milwaukee Milkmen Baseball games. Games occurred on weekdays and on weekends. At the North and West monitors, sound levels during baseball games were typically above background after 17:00 (5 PM). All monitors showed notable increases in Event sound levels around 21:00 (9 PM). This coincides with events at the facility progressing from baseball games to live music at the Umbrella Bar (see Figure 10).

The spectral sound level results for Milwaukee Milkmen Baseball games are shown in Figure 7. “Total” sound levels were up to 4 dB above “Background” at the North and West Monitors, resulting in overall Event-Only sound levels 1 to 2 dB higher than Background sound levels. At the North Monitor, an increase in low to mid frequencies (<500 Hz) was observed during the events. For the West Monitor, the increase was at mid to high frequencies (250 Hz to 4 kHz). Overall event sound levels were below background at the East Monitor.

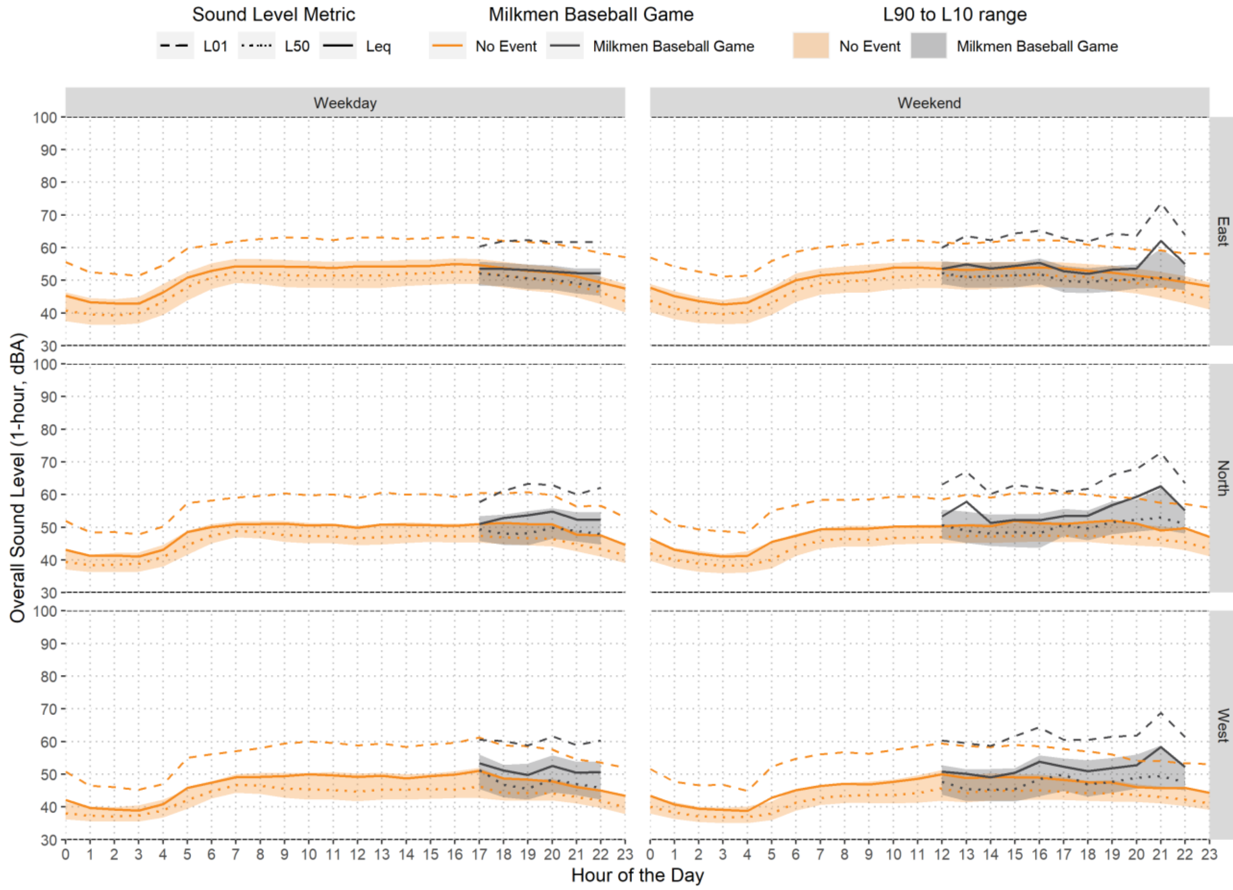


FIGURE 6: LONG-TERM SOUND LEVELS FOR MILWAUKEE MILKMEN BASEBALL (ONE-HOUR)

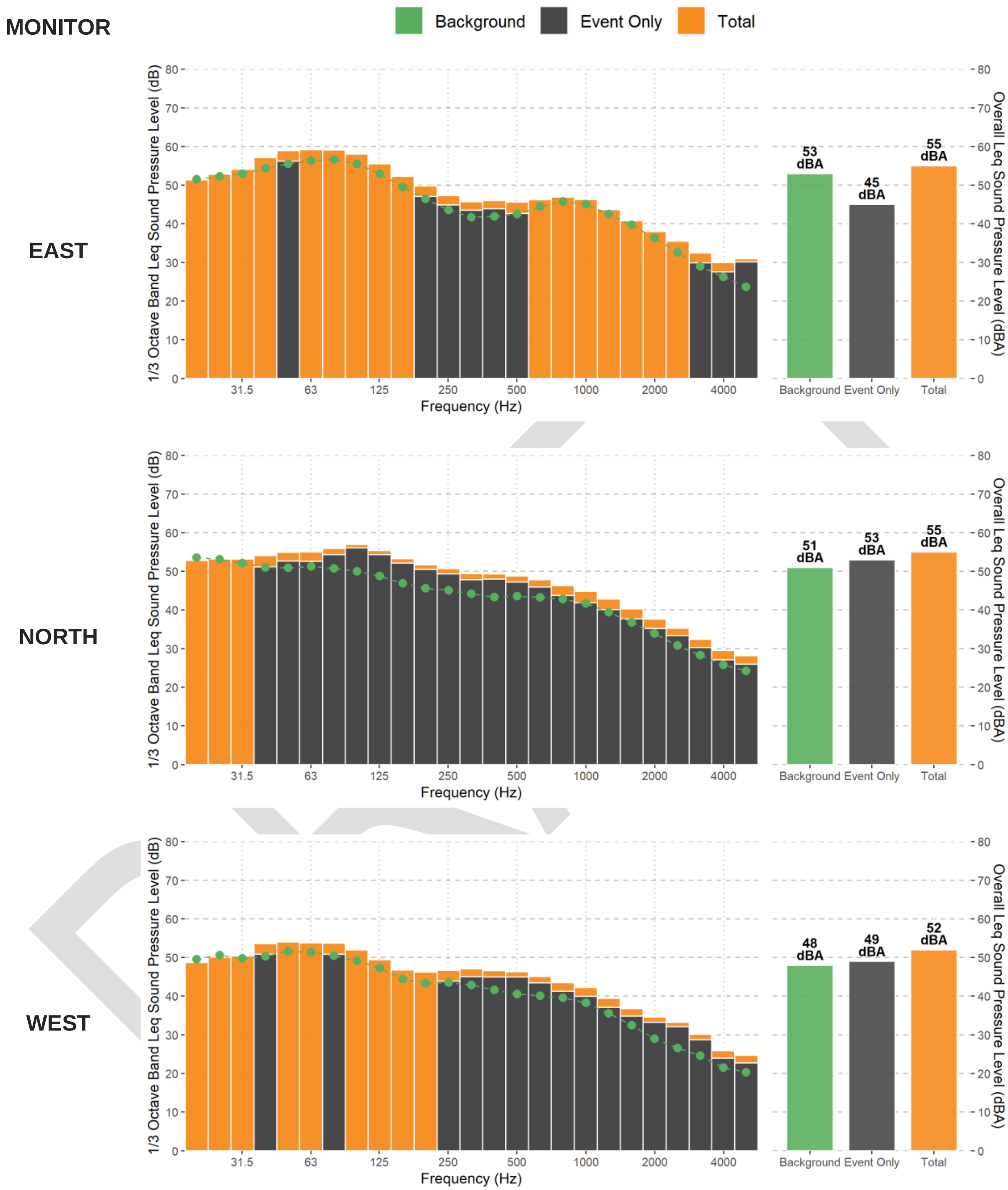


FIGURE 7: SPECTRAL RESULTS FOR MILWAUKEE MILKMEN BASEBALL

Summer Concert Series

Low frequency sounds are the primary concert generated sound source in the surrounding communities during live music at the Umbrella Bar. During periods when background sound levels were low, music and speech were also audible in some locations.

Neighborhoods B and E are shielded from the ROC by intervening berms. Music from the Umbrella Bar was audible at Neighborhood E during attended monitoring, including elevated sounds in the lower frequency bands. Although the overall A-weighted difference between the periods when the band was and was not performing was only 1 dB in Neighborhood E, sound levels in the 40 and 50 Hz bands increased by 12 and 10 dB, respectively, above background levels when the band was playing. As shown in Figure 8, low frequency sounds are clearly identifiable in the spectrogram during the period when the band was playing. In Neighborhood B, bass from live music at the Umbrella Bar band was clearly distinguishable during lulls in traffic. An example spectrogram from Neighborhood E which includes live music at the Umbrella Bar is given in Figure 9.

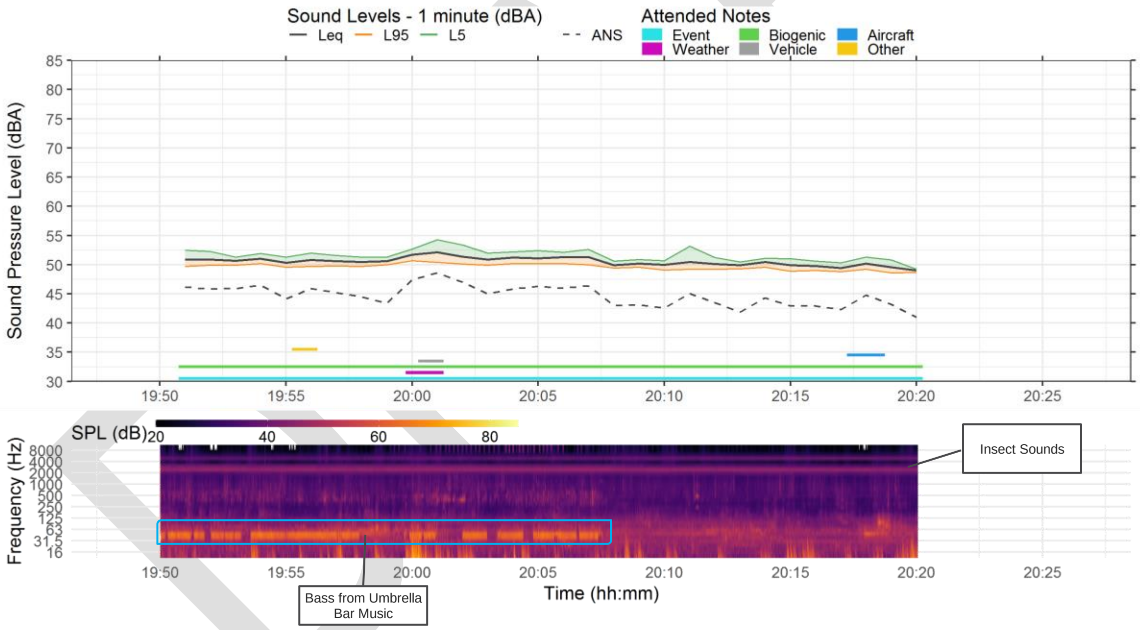


FIGURE 8 : SPECTROGRAM DURING AND AFTER AN OUTDOOR PERFORMANCE AT UMBRELLA BAR IN NEIGHBORHOOD E

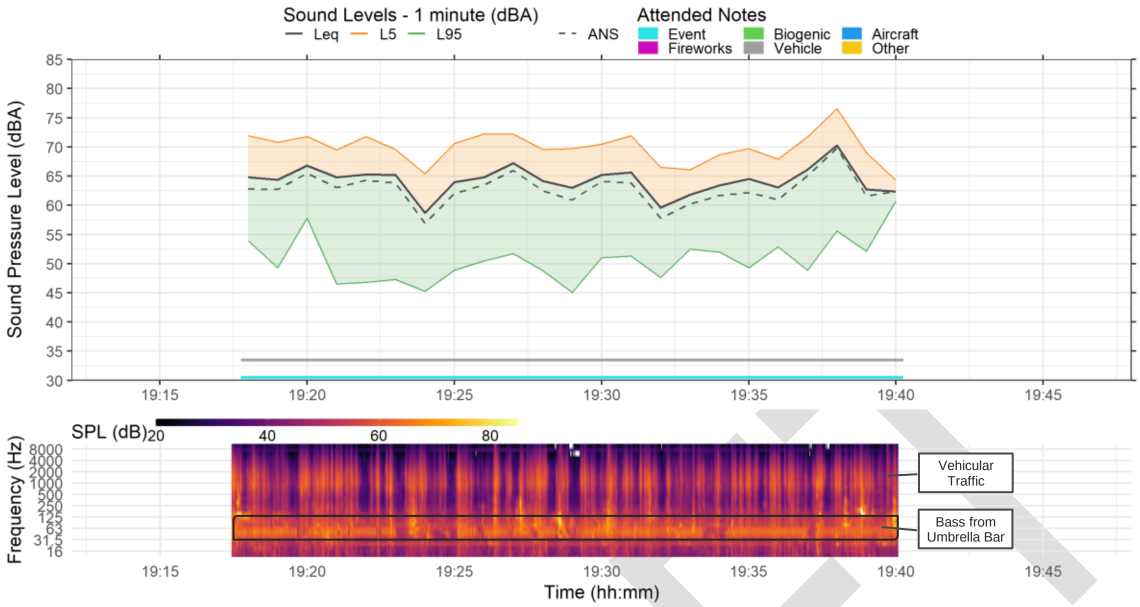


FIGURE 9 : SPECTROGRAM DURING AN OUTDOOR PERFORMANCE AT UMBRELLA BAR IN NEIGHBORHOOD B

Long term daily hourly average sound level results for live music events at the Umbrella Bar are shown in Figure 10. Live music at the bar occurred exclusively on Saturday evenings. Sound levels at the North and West monitors were consistently higher during periods of live music at the Umbrella Bar compared to Background. Event sound levels were highest at all monitors around 21:00 (9 PM). During the highest hourly period, sound levels at the North and West monitors were 10 dB higher than Background levels without events.

Spectral results for Live Music at the Umbrella bar are shown in Figure 11. Although the overall Event-Only sound levels were below the corresponding overall background level at the East Monitor, event sound was prominent at low frequencies (< 125 Hz), with at least a 10 dB increase over background in the 40 Hz 1/3 octave band.

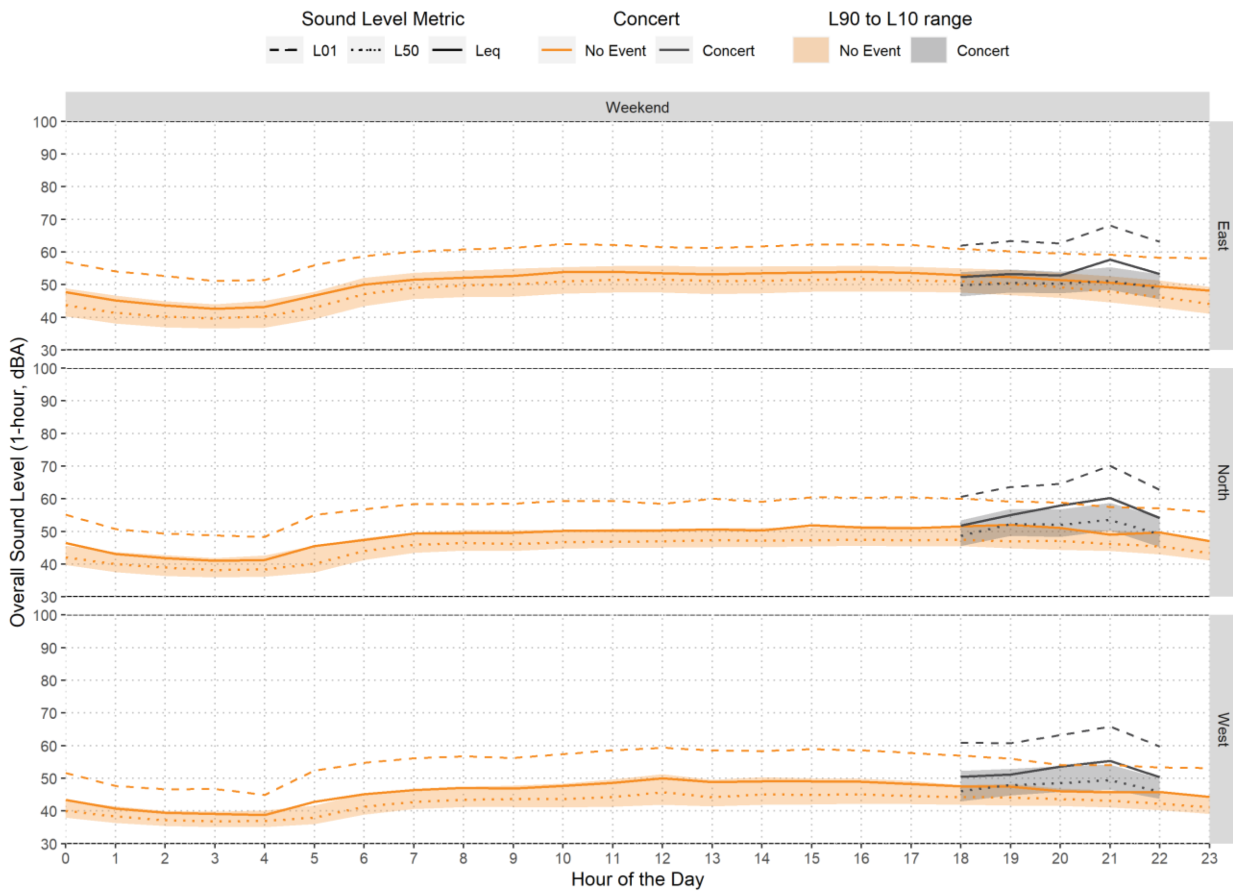


FIGURE 10: LONG-TERM SOUND LEVELS FOR LIVE MUSIC AT THE UMBRELLA BAR (ONE-HOUR)

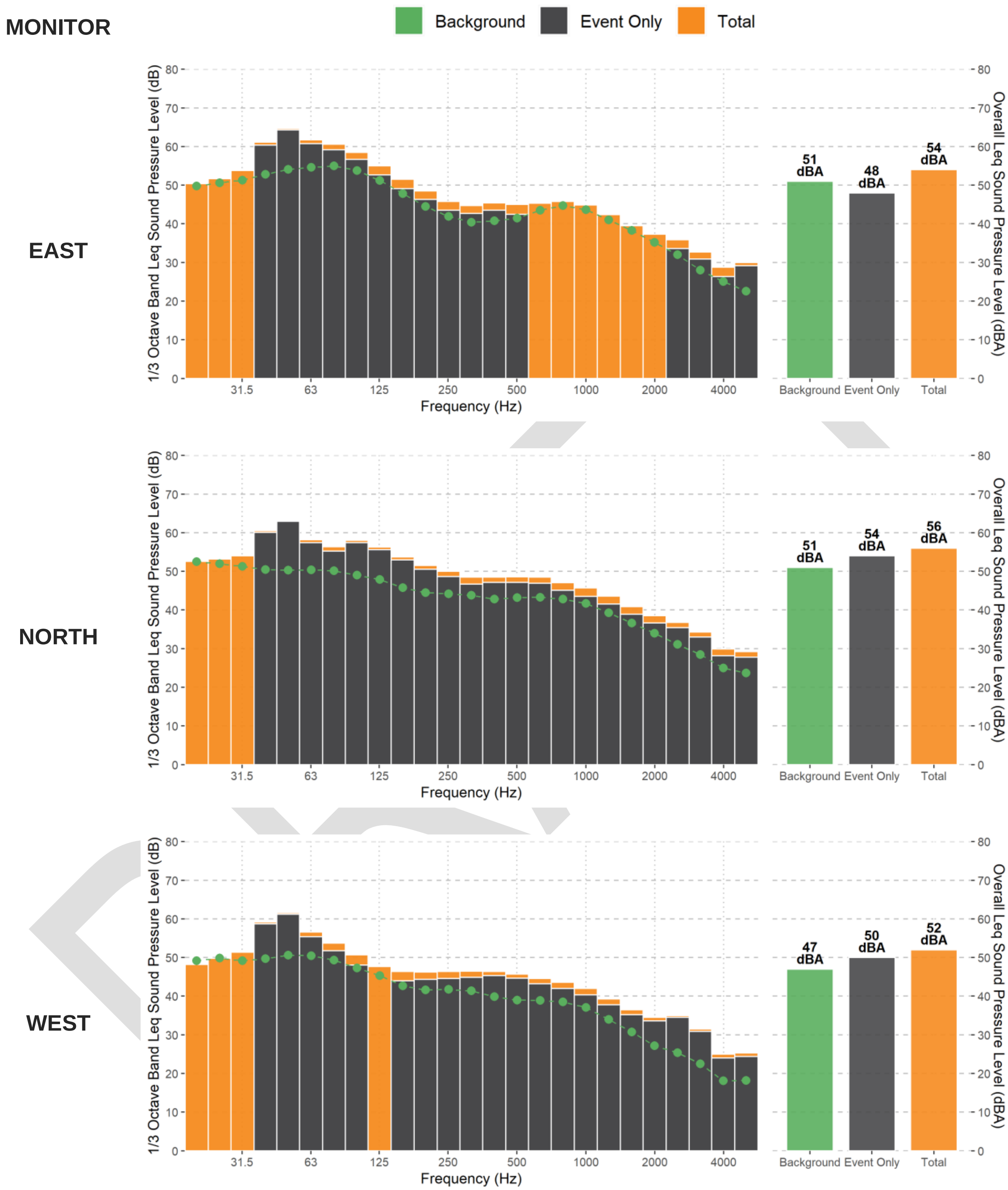


FIGURE 11: SPECTRAL RESULTS FOR LIVE MUSIC AT THE UMBRELLA BAR

Fireworks

One-minute average L_{eq} sound levels during fireworks were 17 to 20 dB louder than sound levels during other ROC events in Neighborhoods A and E. An example spectrogram from Neighborhood E which includes an outdoor performance at the Umbrella Bar and a period with fireworks is given in Figure 12. From this example, the elevated sound levels during fireworks are clearly observed.

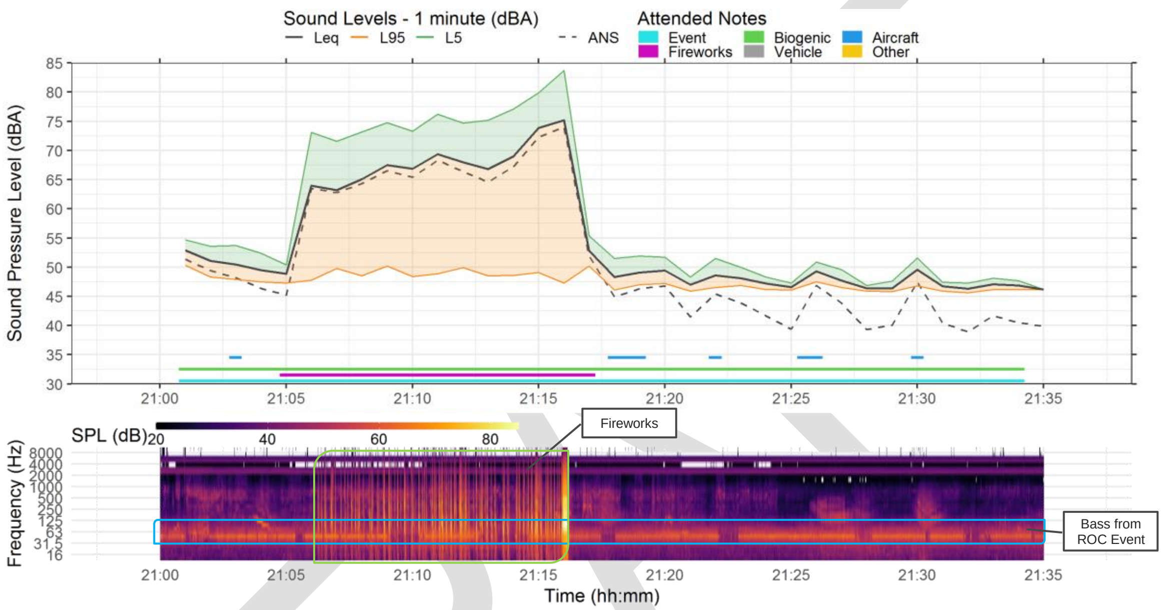


FIGURE 12 : SPECTROGRAM OF FIREWORKS OCCURRING DURING OUTDOOR PERFORMANCE AT UMBRELLA BAR IN NEIGHBORHOOD E

Long-term ten-minute average sound level results during Fireworks events are shown in Figure 13. Fireworks only occurred on weekend nights between 9:00 PM and 10:10 PM local time and are thus represented on the chart for hours 21:00 (9 PM) and 22:00 (10 PM). At all monitors, sound from the fireworks display dominated the soundscape during these times.

Spectral results for fireworks are provided in Figure 14. The broadband dominance of the fireworks is apparent, with the fireworks at least 20 dB above background levels in all 1/3 octave bands and 29 to 35 dB above background L_{eq} levels overall.

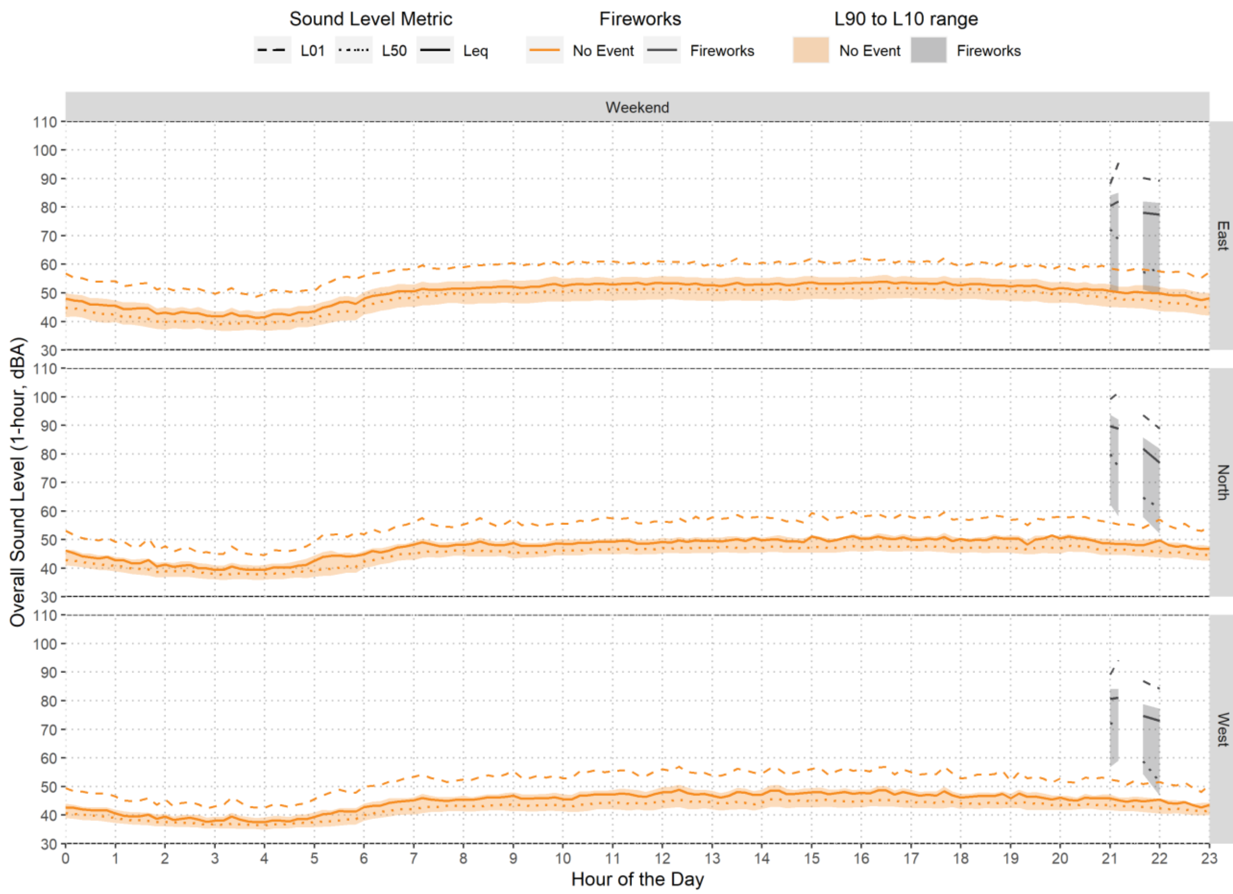


FIGURE 13: LONG-TERM SOUND LEVEL COMPARISON FOR FIREWORKS (10-MINUTE)

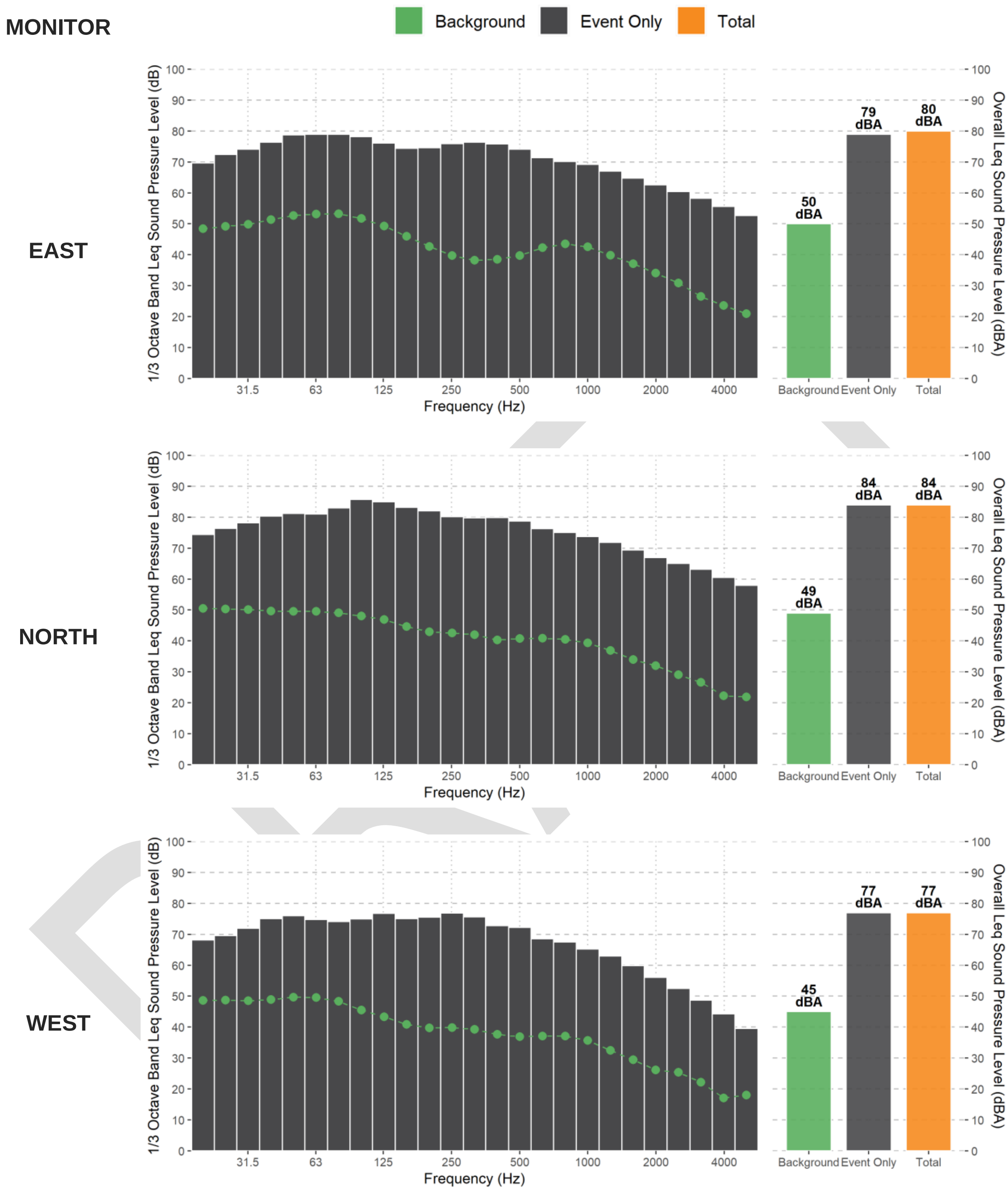


FIGURE 14: SPECTRAL RESULTS FOR FIREWORKS

The Hills Have Eyes Event

The primary sound sources during The Hills Have Eyes event included a chainsaw, the public announcement (PA) system, music, and special effects sounds. During attended monitoring, the event was not audible at homes in Neighborhood E.

In portions of Neighborhood B located near South 76th Street, low frequency sounds from event related music were clearly audible, as identified in the example spectrogram shown in Figure 15, but other event sounds (PA system, chain saw, special events sounds) were not audible. Figure 16 shows the spectrogram at a location in Neighborhood B which is well shielded and setback from South 76th Street by about 1,000 feet. At this location, low frequency sounds are clearly identifiable in the spectrogram and the event was clearly audible including both low frequency sounds and other event sound sources.

In Neighborhood A, the Hills Have Eyes event was clearly audible at sites located more than a mile to the north of the event location. As shown in Figure 17, low frequency sounds are clearly identifiable in the spectrogram, and the event was clearly audible including both low frequency sounds from amplified music and other event sound sources.

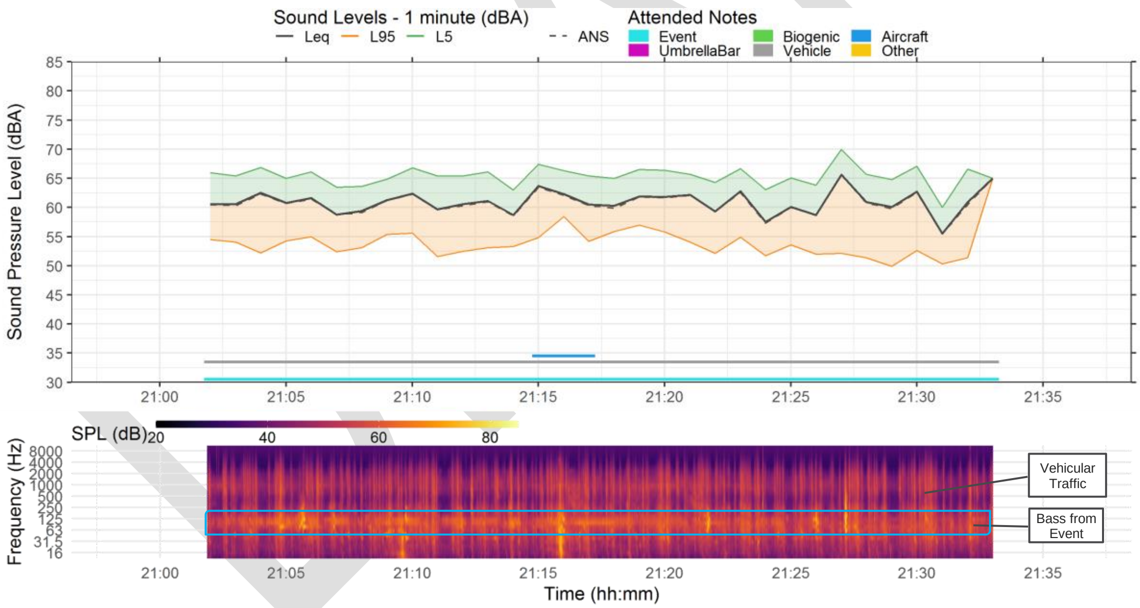


FIGURE 15 : SPECTROGRAM OF HILLS HAVE EYES EVENT IN NEIGHBORHOOD B, ADJACENT TO SOUTH 76TH STREET

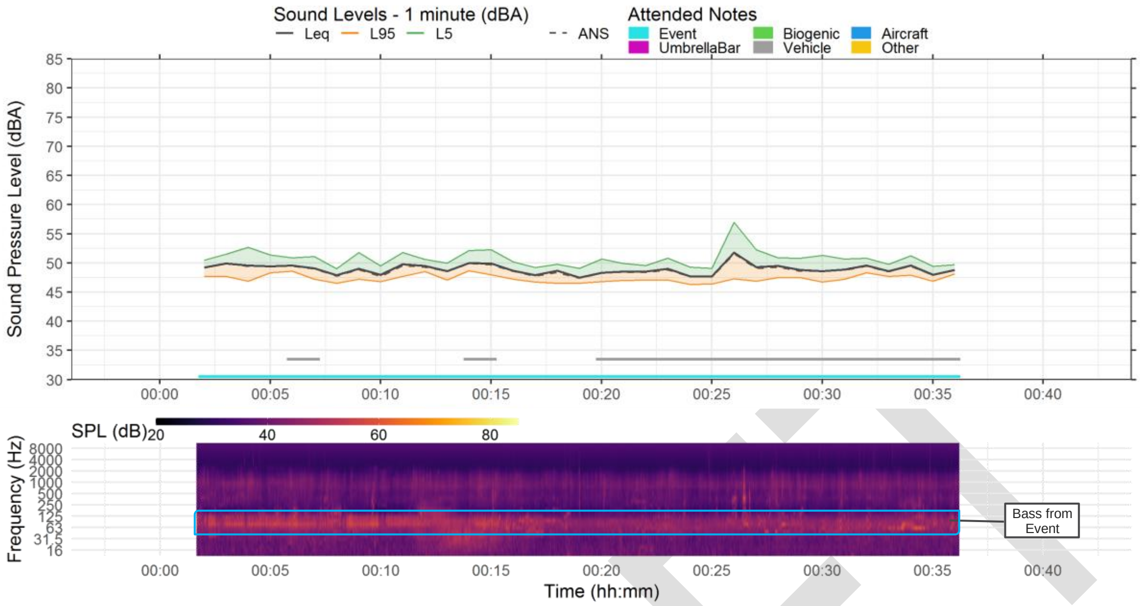


FIGURE 16 : SPECTROGRAM OF HILLS HAVE EYES EVENT IN NEIGHBORHOOD B, SETBACK FROM SOUTH 76TH STREET

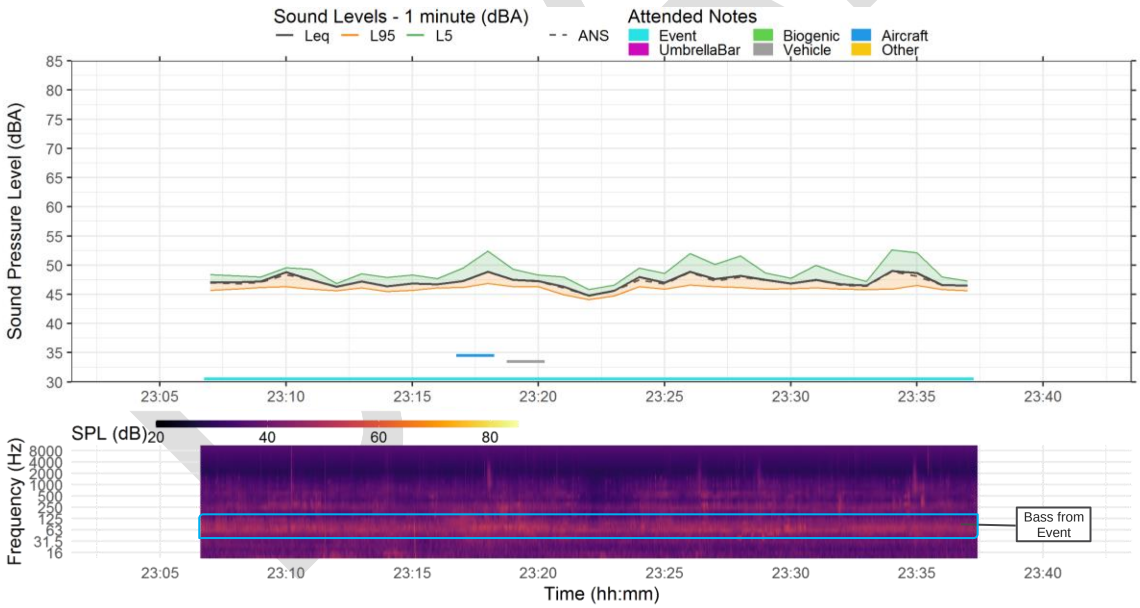


FIGURE 17 : SPECTROGRAM OF HILLS HAVE EYES EVENT IN NEIGHBORHOOD A, MORE THAN ONE MILE FROM THE EVENT LOCATION

Long-term hourly average results for The Hills Have Eyes event in the context of a full day are provided in Figure 18. The Hills Have Eyes event started around 6 PM and ended by midnight each day. Hourly average sound levels at the East and West Monitors were nearly equivalent during the event as they were when no event was present. Conversely, sound levels at the North monitor were typically slightly lower during the event compared to weekend nights when no events were occurring. This is attributable to the Hills Have Eyes event occurring during late fall, when insect sounds are less prevalent.

The spectral results for The Hills Have Eyes event are provided in Figure 19. In all cases, The Hills Have Eyes event was not distinguishable in sound level from background sound levels. However, as described above for the attended monitoring, the sound characteristics of the event made it clearly audible at locations as far as one mile or more to the north of the ROC. As described previously, the higher Background levels in the high frequencies in Figure 19 are attributable to insect sounds, which were more prevalent during the summer months than during the late fall when Hills Have Eyes occurred.

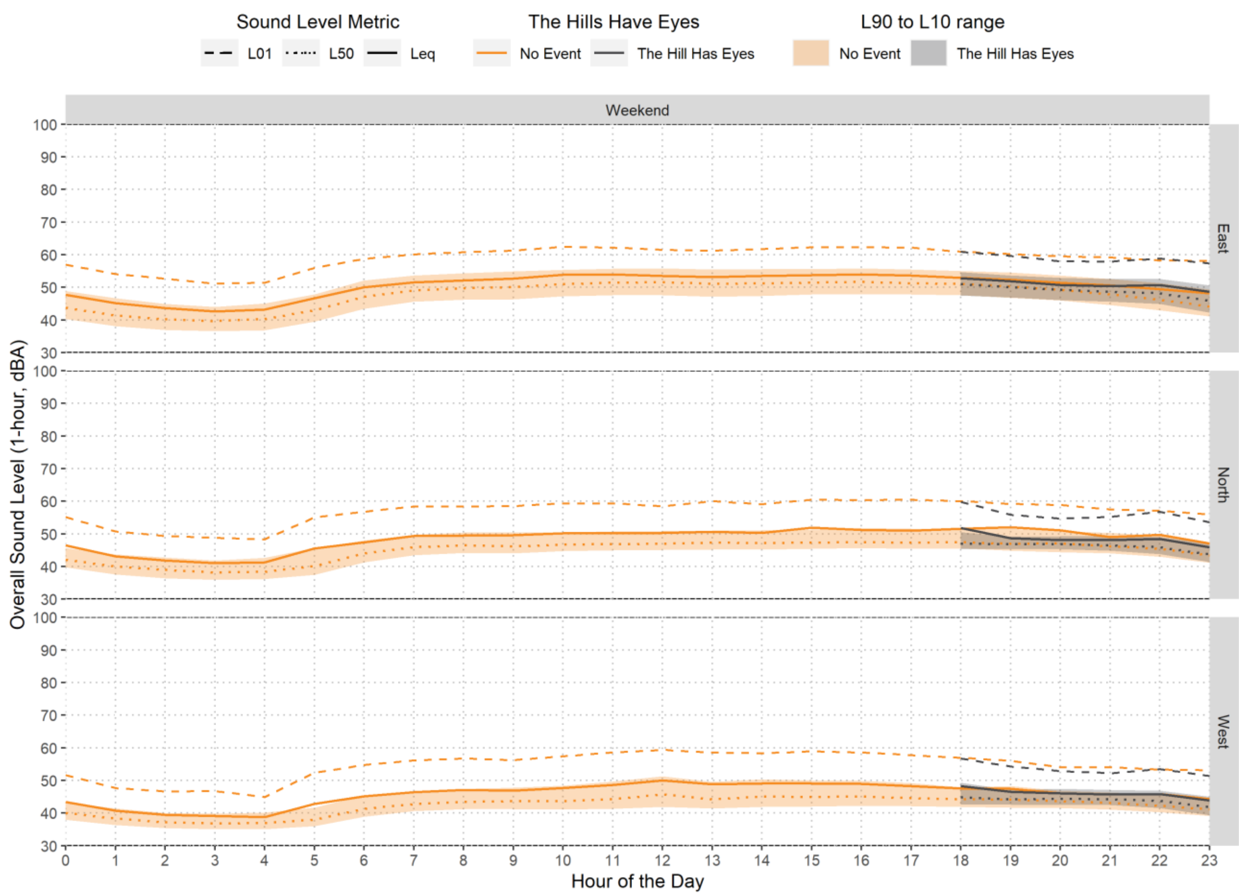


FIGURE 18: LONG-TERM SOUND LEVELS FOR THE HILLS HAVE EYES (ONE-HOUR)

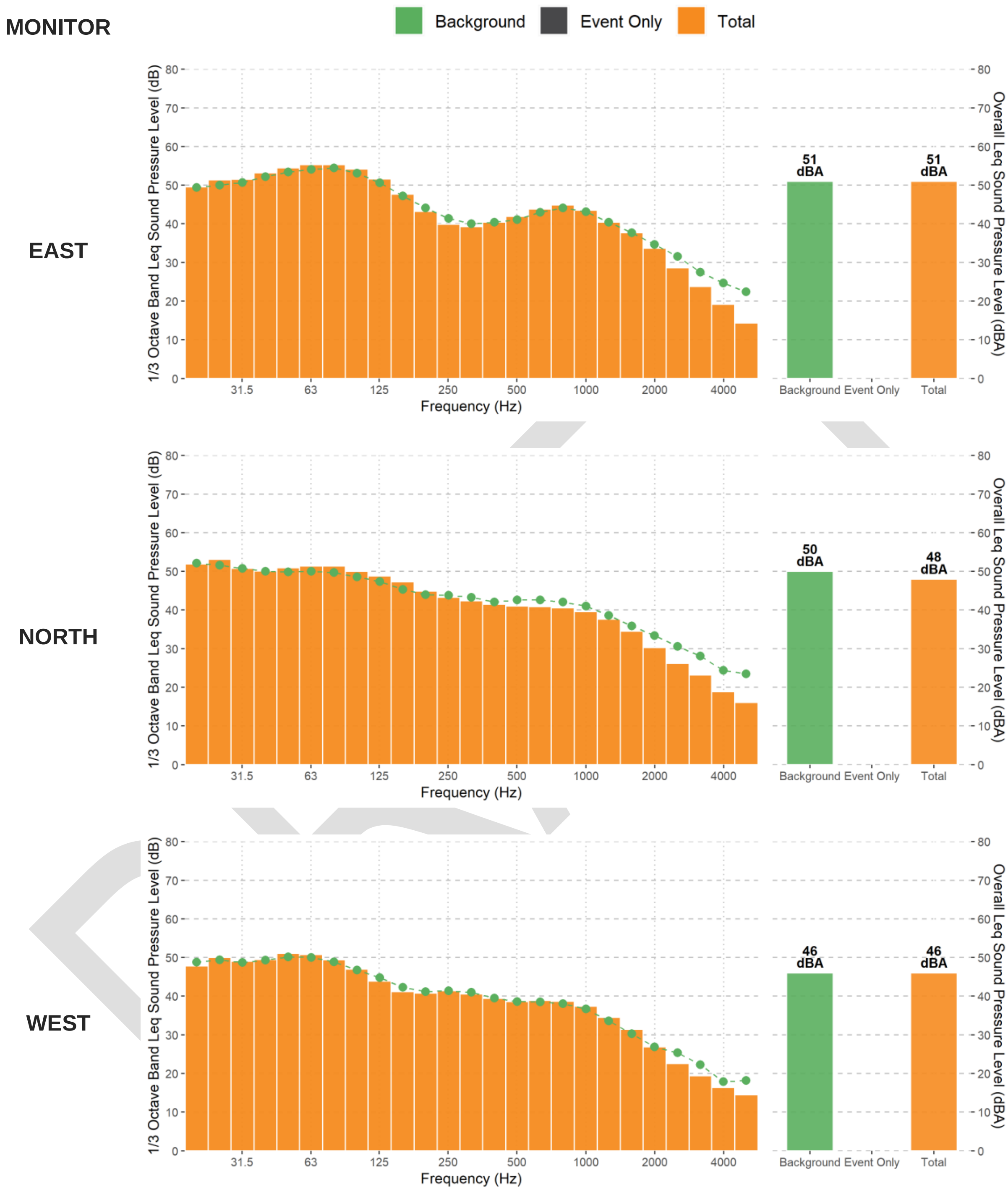


FIGURE 19: SPECTRAL RESULTS FOR THE HILLS HAVE EYES

Snowmaking

Snowmaking occurred at the Facility at all hours of day and night on weekdays and weekends. The primary sound source for snowmaking is the snow guns. The long-term hourly average sound level results for snowmaking at the Facility is presented in Figure 20. The snow guns were located very close to the North Monitor and they dominated sound levels at this location when snowmaking was in progress. Snowmaking was only distinguishable in the sound levels at the West and East Monitors in the nighttime and early morning hours (12 to 5 AM) when background sound levels were low enough for sound from the snow guns to not be masked by background sounds. Hourly average sound levels in the early morning hours were 2 to 4 dB higher with snowmaking compared to background.

Figure 21 shows the spectral sound level results for snowmaking. Snowmaking was a dominant sound source at the North Monitor and the spectral content of snowmaking was well defined at the North Monitor. Sounds in the 31.5 Hz 1/3 octave band were detectable at the East and West Monitors; if the spectral analysis were limited to nighttime hours, sound from snowmaking would be more apparent in the spectra.

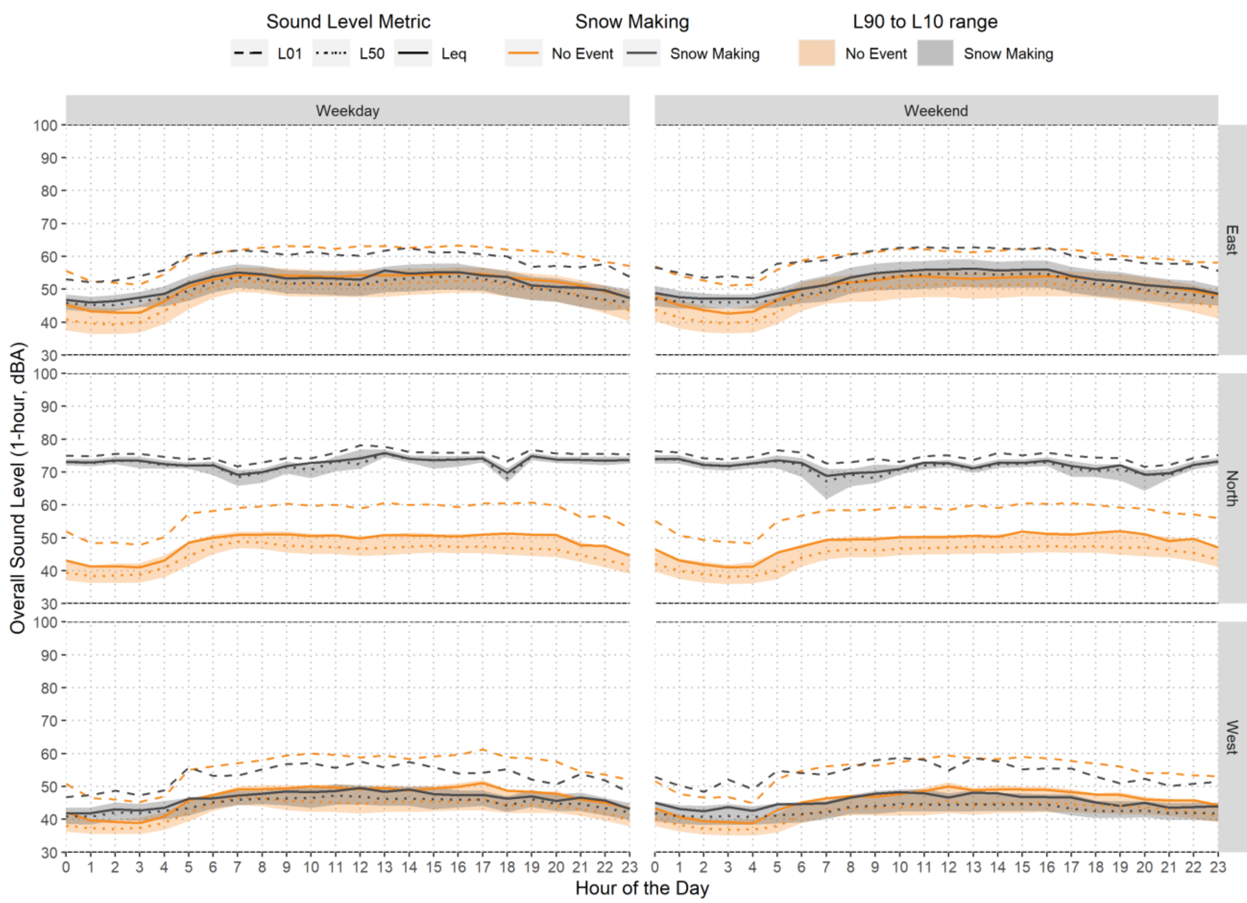


FIGURE 20: LONG-TERM SOUND LEVELS FOR SNOWMAKING (ONE-HOUR)

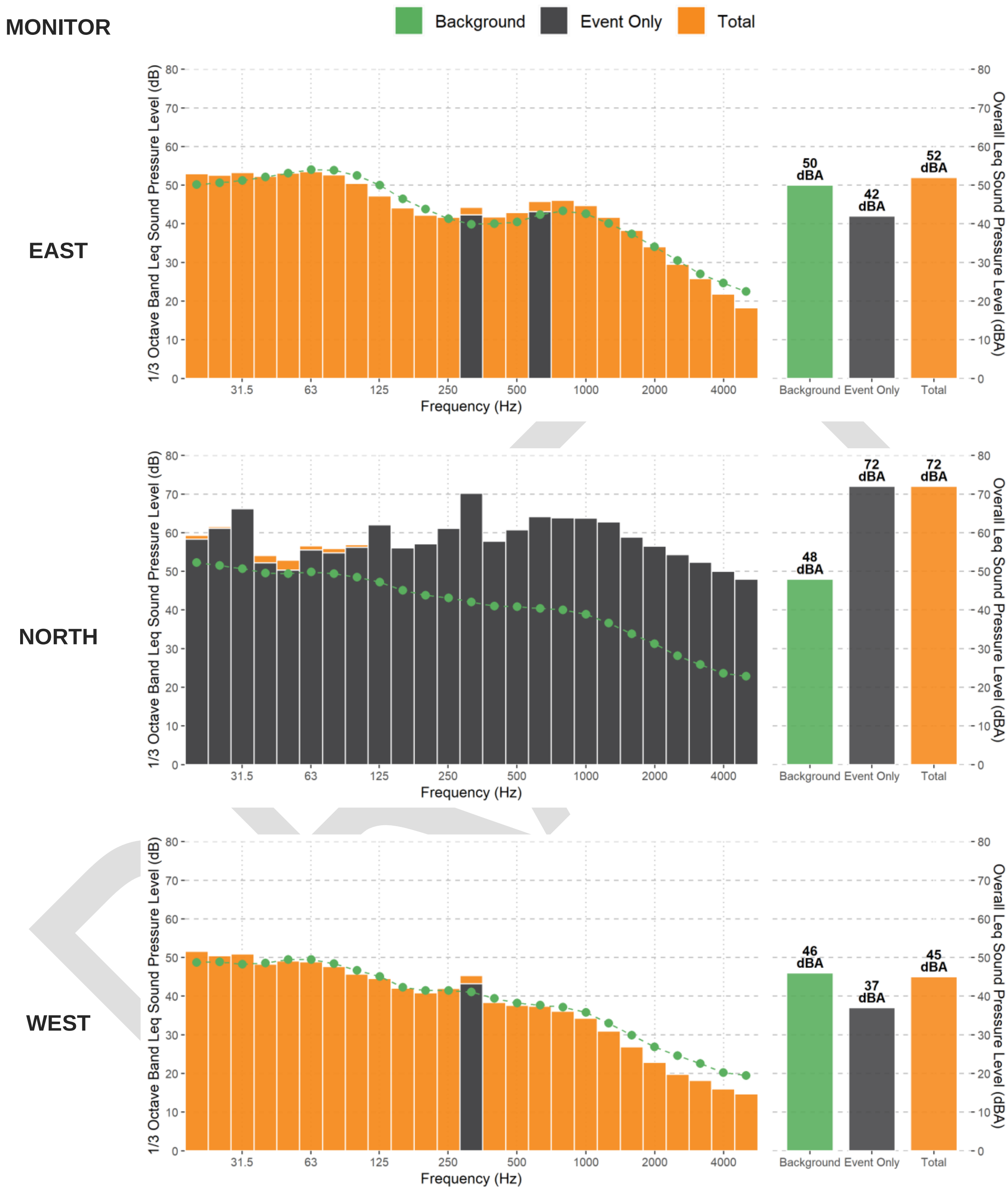


FIGURE 21: SPECTRAL RESULTS FOR SNOWMAKING

Helicopter Candy Drop

The Helicopter candy drop scheduled for August 29, 2022 was cancelled for rain. No indication of a rescheduling of the event was found in the long-term data. As a result, sound monitoring was not conducted during a helicopter candy drop. However, past staff experience of helicopters has indicated that they generate high sound levels.

Luxe Golf

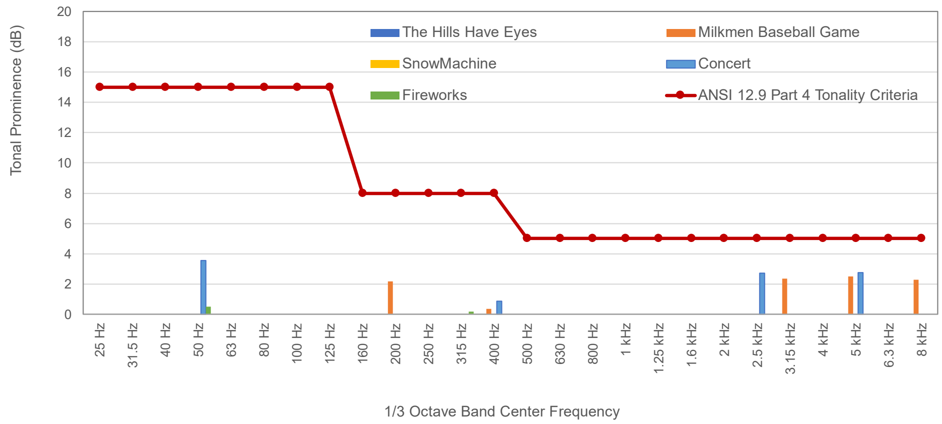
The Luxe Golf facility opened for business over the course of the study and was not a focus of the analysis. However, field staff noted that activities at the golf facility were the primary sound source at adjacent homes in Neighborhood E during the Hills Have Eyes event. Sound sources included golf ball hits, people talking, and the golf ball pickup machine sweeping the range area.

6.5 TONALITY

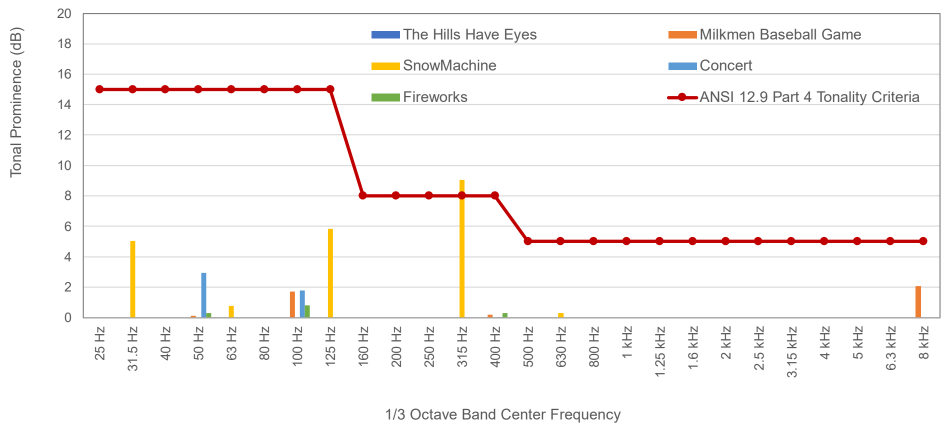
The Event-Only sound level results were assessed for tonal prominence (audible tones) at the long-term monitoring locations. Tonality was assessed using the 1/3 octave band data as defined in ANSI 12.9 Part 4. The results in Figure 22 show that the only tonal prominence associated with an event was found at the North Monitor for snowmaking. Tonality associated with snowmaking at the North Monitor was expected due to the tonal nature of the equipment and the proximity of the North Monitor to the snowmaking equipment. The North Monitor is not representative of any residential areas and the tones did not persist into the residential areas (as shown with the results for the West and East Monitors). No tonal prominence was identified at the East or West Monitors.

MONITOR

EAST



NORTH



WEST

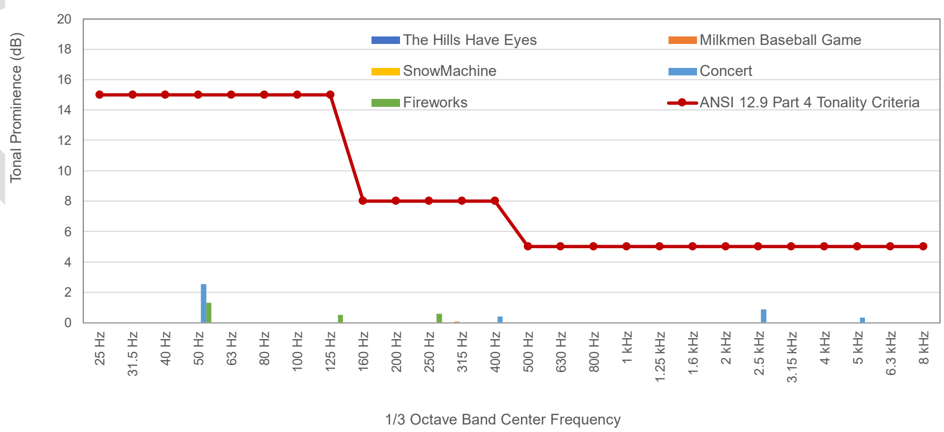


FIGURE 22: TONAL PROMINENCES FOR SPECTRAL EVENT-RESULTS - ALL MONITORS

6.6 LOW-FREQUENCY ANALYSIS

Overall Discussion

Event-only results were logarithmically summed into three respective full octave bands (31.5 Hz, 63 Hz, and 125 Hz) for comparison to the low frequency thresholds (see Chapter 9.0). The results are presented in Figure 23 for each monitor.

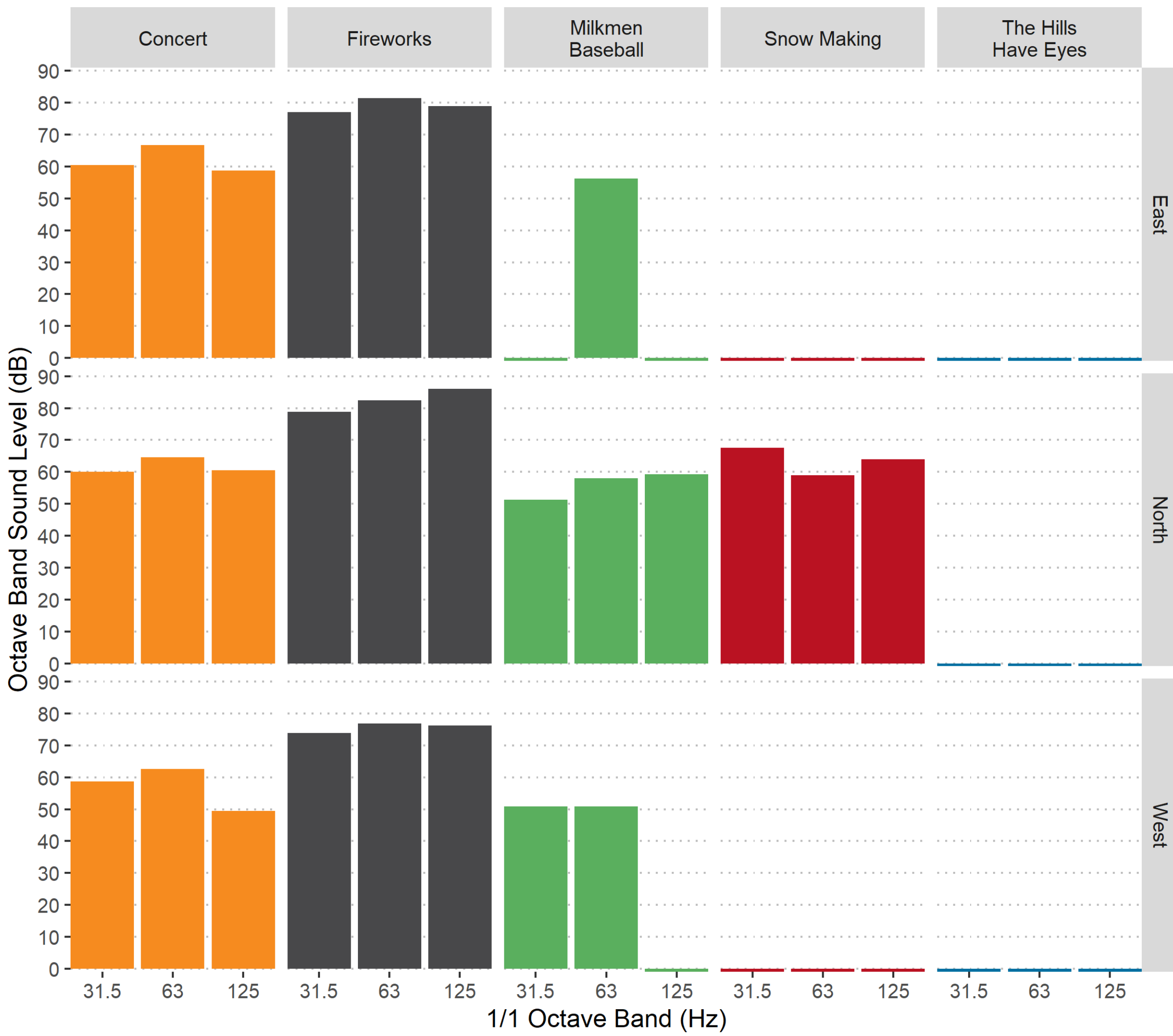


FIGURE 23: LOW FREQUENCY OCTAVE BAND RESULTS

Live Music at Umbrella Bar

Due to the dynamic nature of live music at the Umbrella Bar and complaints regarding the low-frequency portion music, a more detailed analysis was made of the worst-case event-only hour (9 PM, see Figure 11). During this hour, the measured event-only sound level was highest and non-event background sound levels were low because it was a nighttime hour.

The event-only octave band results for the loudest hour of the concert series are presented in Table 2. The event-only levels indicate that the Concert was dominant at the East Monitor. Low frequency octave band sound levels were 2 to 4 dB lower at the West Monitor. At the North Monitor, 31.5 Hz octave band sound levels were nearly equivalent to the East Monitor.

TABLE 2: HIGHEST ONE-HOUR (9PM) L_{EQ} EVENT ONLY SOUND LEVELS FOR LIVE MUSIC

EVENT	MONITOR	TYPE	OCTAVE BAND SOUND LEVEL, dB			OVERALL SOUND LEVEL, dBA
			31.5 Hz	63 Hz	125 Hz	
Concert	East	No Event (Background)	56	58	55	51
		With Event (Total)	65	71	63	58
		Event Only	65	70	62	56
	North	No Event (Background)	56	55	52	49
		With Event (Total)	66	69	66	60
		Event Only	65	69	65	60
	West	No Event (Background)	54	54	49	46
		With Event (Total)	63	67	56	55
		Event Only	63	66	56	54

6.7 SUMMARY OF RESULTS

A summary of results at each monitor for the periods associated with each event type for the East, North, and West Monitors is provided in Table 3. The table provides the sound levels for complementary Event/No Event periods. The Difference column denotes the increase above Background for each event. The Event-Only sound level is the background-corrected sound level attributable to each event.

Table 3 shows that the Event-Only levels for Milkmen Baseball Games and Umbrella Bar Concerts ranged from 45 to 54 dBA L_{1h} at the three monitor locations, similar to or below background levels at all monitors. Baseball games and concerts increased the overall sound level by 2 to 5 dB above background at the monitor locations. Fireworks generated sound levels of 77 to 84 dBA L_{10m}, which dominated the sound environment at all monitor locations and were 29 to 35 dB above comparable non-event periods. The Hills Have Eyes events were not distinguishable in the sound level data but were audible at locations more than a mile to the north due to the characteristics of the sounds generated by the event, which include speech, music, and chainsaw sounds. Snowmaking did not appreciably increase the average sound levels at the East and West Monitors. High sound levels associated with snowmaking at the North Monitor is due to the close proximity (as close as 25 feet) to the snow making equipment.

TABLE 3: AVERAGE L_{EQ} RESULTS FOR EVENTS AT EACH MONITOR

		SOUND LEVEL, dBA			
MONITOR	EVENT TYPE	With Event (Background + Event)	No Event (Background)	Difference	Event Only
East	Milkmen Baseball Game	55	53	2	45
North		55	51	4	53
West		52	48	4	49
East	Concert	54	51	2	48
North		56	51	5	54
West		52	47	6	51
East	Fireworks	80	50	30	79
North		84	49	35	84
West		77	45	32	77
East	The Hills Have Eyes	51	51	0	*
North		48	50	-2	*
West		46	46	0	*
East	Snowmaking	52	50	2	42
North		72	48	24	72
West		45	46	0	37

*Event only sound levels are more than 10 dB below background levels and could therefore not be calculated.

7.0 SOUND PROPAGATION MODELING

Sound propagation models were developed to visually depict how sound from ROC events propagates in the residential areas surrounding the site and to adjust the long-term monitoring data for use in identifying noise limit exceedances.

7.1 PROCEDURES

ISO 9613-2 & CadnaA

Modeling for the ROC was conducted in accordance with the standard ISO 9613-2, "Acoustics – Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation." The ISO standard states,

> This part of ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level … under meteorological conditions favorable to propagation from sources of known sound emissions. These conditions are for downwind propagation … or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

The model takes into account source sound power levels, surface reflection and absorption, atmospheric absorption, geometric divergence, meteorological conditions, walls, barriers, berms, and terrain. The acoustical modeling software used was CadnaA, from Datakustik GmbH. CadnaA is a widely accepted acoustical propagation modeling tool, used by many noise control professionals in the United States and internationally.

ISO 9613-2 assumes downwind sound propagation between every source and every receptor, consequently, all wind directions, including the prevailing wind directions, are taken into account.

Model Assumptions

The study area was modeled with soft ground (G=1.0). A temperature of 10 degrees Celsius with 70 percent relative humidity was used. A 1.5-meter (5 foot) receptor height was used for contour mapping to represent ground level (and ground floor) exposures. Both 1.5-meter (5 foot) and 4-meter (13 foot) receptor heights were used to model discrete receptors (like homes), representing ground level and upper story exposures. On-site structures were modeled in all scenarios. Residential structures were modeled for contour mapping but were not included in the more conservative (worst-case) modeling of discrete receptors. Modeling inputs are provided in Appendix H.

Sound Source Validation

As described in Chapter 6.0, the project team did not receive permission to monitor on ROC property. Sound source levels were validated based on monitoring conducted at the ski hill and in the surrounding communities. For each scenario, a representative time period occurring during attended monitoring was selected. The 1/3 octave sound source spectra were calculated based on the sounds measured at the long-term North Monitor. The overall A-weighted sound level was then validated at each of the three long-term monitors. The 1/3 octave band spectra for all sound sources are provided in Appendix H, based on the data from the North Monitor. Details for each scenario are provided in Section 7.2.

7.2 MODELING RESULTS

Sound propagation models were developed for seven scenarios: 1) Existing daytime background traffic noise, 2) Milwaukee Milkmen baseball game at Franklin Field Baseball Stadium, 3) live music from a band at the Umbrella Bar, 4) a baseball game concurrent with a live band, 5) fireworks, 6) The Hills Have Eyes event, and 7) snowmaking. A summary of modeling results is given in Table 4 for the “worst-case” residence in each residential area surrounding the ROC (see Figure 2 for Neighborhood Identifiers). The modeled sound levels for each receptor are given in Appendix I.

TABLE 4: TYPICAL L_{EQ} AT LONG-TERM MONITORS AND NEARBY RESIDENCES

REPRESENTATIVE RECEPTOR	DAYTIME TRAFFIC NOISE LEVEL	SOUND LEVEL GENERATED BY ROC ACTIVITIES, dBA					
		Baseball	Concert	Baseball + Concert	Fireworks	Hills Have Eyes	Snowmaking
Neighborhood A	36 to 53	40	47	48	78	52	47
Neighborhood B	42 to 57	46	54	54	79	52	45
Neighborhood C	37 to 57	43	39	44	74	45	41
Neighborhood D	29 to 55	43	38	44	74	43	42
Neighborhood E	29 to 51	49	48	52	78	46	47
East Monitor	46	45	45	48	78	50	44
North Monitor	40	55	57	59	88	56	83
West Monitor	26	49	48	51	78	45	47

Existing Traffic Noise

Existing traffic noise levels were predicted using worst-hour traffic volumes available on the Wisconsin Department of Transportation (WisDOT) Traffic Counts Map Application (TCMap). Modeling was conducted using the Federal Highway Administrations Traffic Noise Model (TNM 2.5), as implemented in the CadnaA software. Modeling results do not include sound generated by other background sound sources, such as aircraft, natural, or community sound sources such as lawn equipment or human vocalizations. Modeled sound levels were not validated with sound monitoring. Modeled hourly-average sound levels (L_{1hr}) are shown in Figure 24.

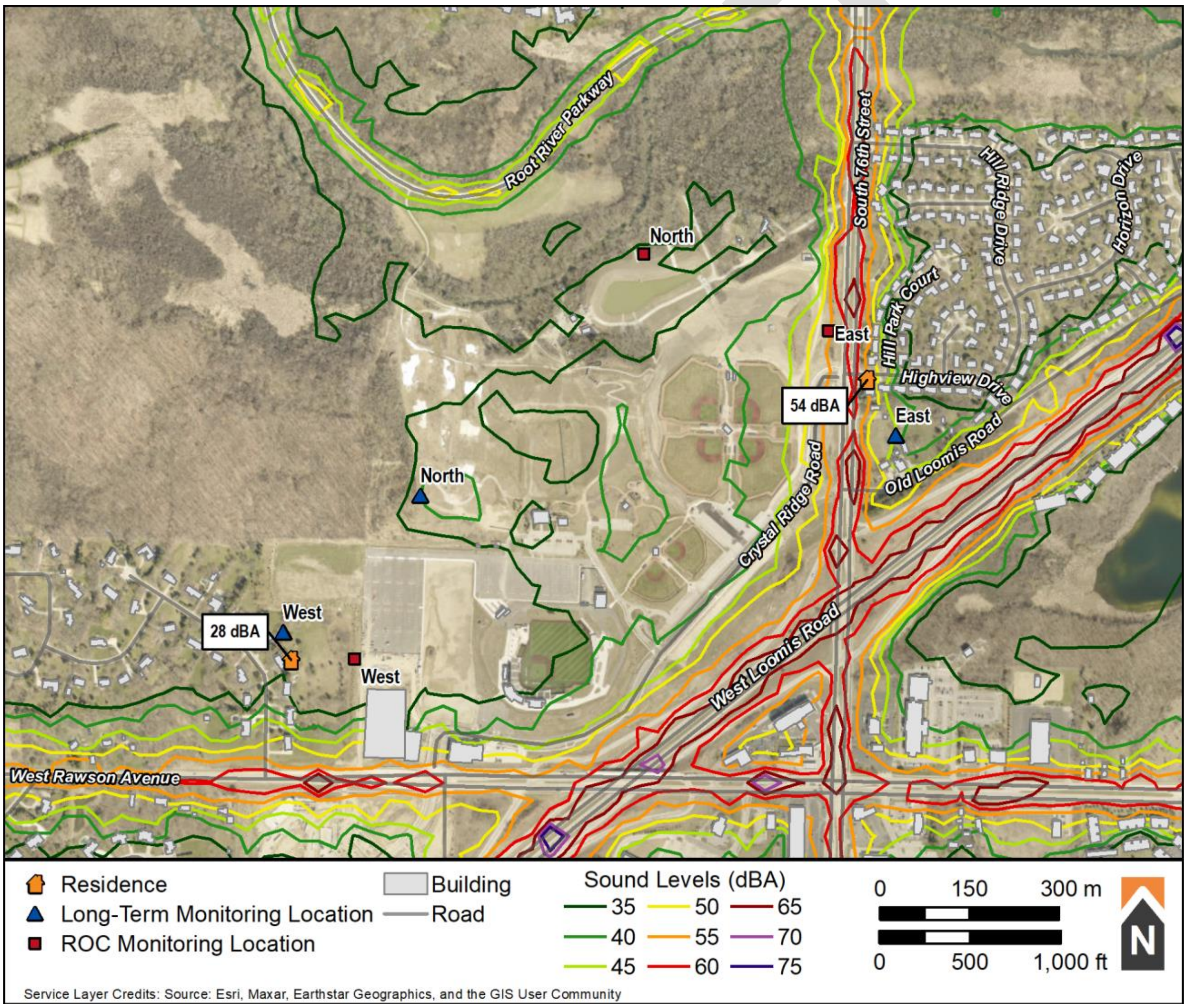


FIGURE 24: MODELED HOURLY AVERAGE L_{EQ} – EXISTING TRAFFIC NOISE

Milwaukee Milkmen Baseball Game

Sound propagation modeling was validated based on the Milwaukee Milkmen baseball game occurring on August 27, 2022, which included both attended and unattended sound monitoring. The speakers from Franklin Field were modeled as individual point sources. Speaker locations, height, and directivity were based on photos taken during field observations (see Appendix D). The spectra and sound level were based on a representative 1-minute L_{eq} that included both the "Moo-ing" and the announcer talking through the PA system. The background sound levels were removed for each 1/3 octave band using a 10-minute L_{eq} prior to the baseball game. Modeled average sound levels (L_{eq}) are shown in Figure 25.

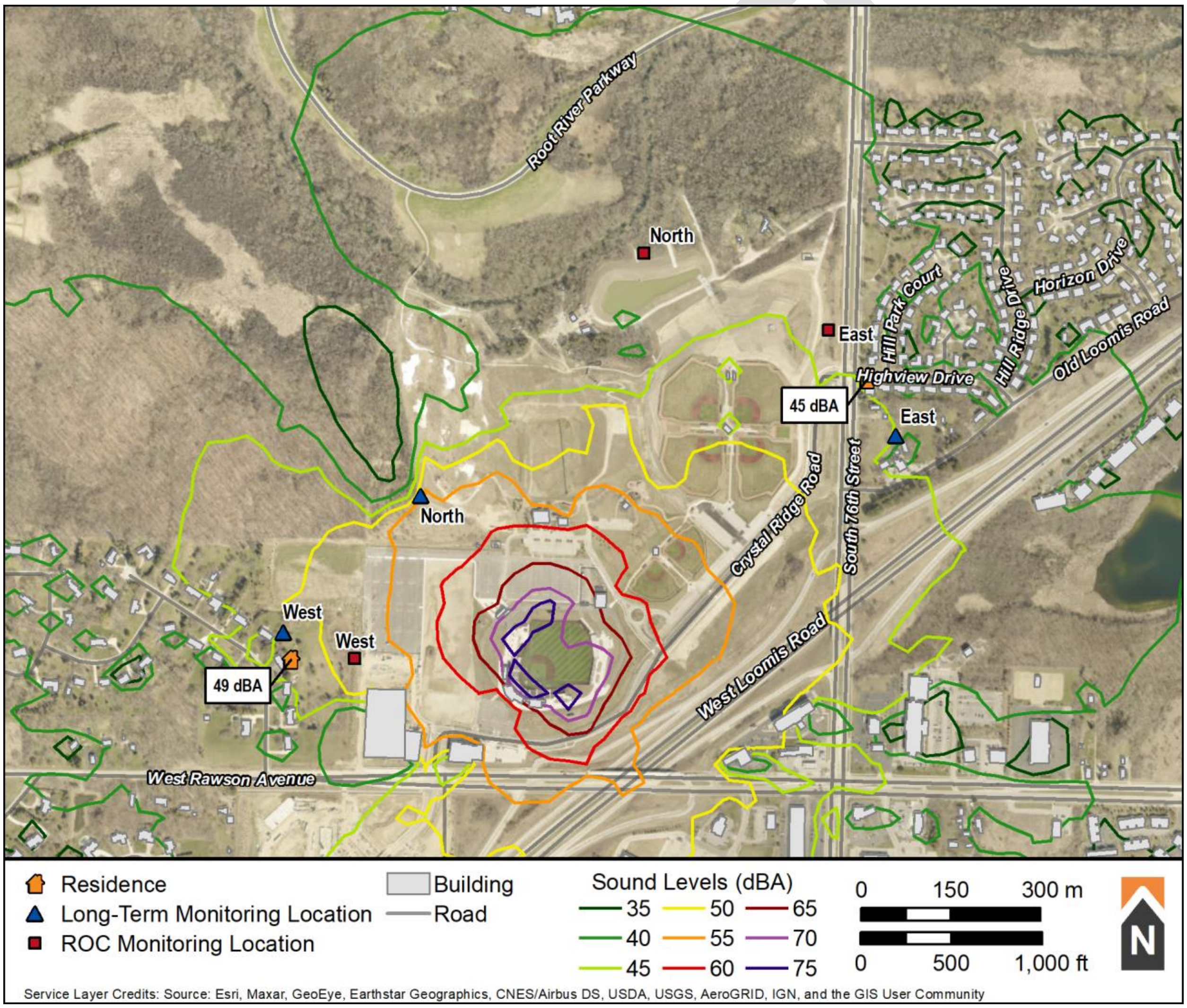


FIGURE 25: MODELED SOUND LEVELS, L_{EQ} - MILWAUKEE MILKMEN BASEBALL GAME

Live Music at the Umbrella Bar

Sound propagation modeling was validated based on the rock band playing at the Umbrella Bar occurring on September 10, 2022, which included both attended and unattended sound monitoring. The band was modeled as an individual point source in front of the stage at a height of 1.5 meters (5 feet) directed towards the patio and umbrella bar area. The spectra and sound level were based on a representative 10-minute L_{eq} during the rock band concert occurring on September 10. The background sound levels were removed for each 1/3 octave band using a 10-minute L_{eq} after the concert was over. Modeled sound levels (L_{eq}) are shown in Figure 26.

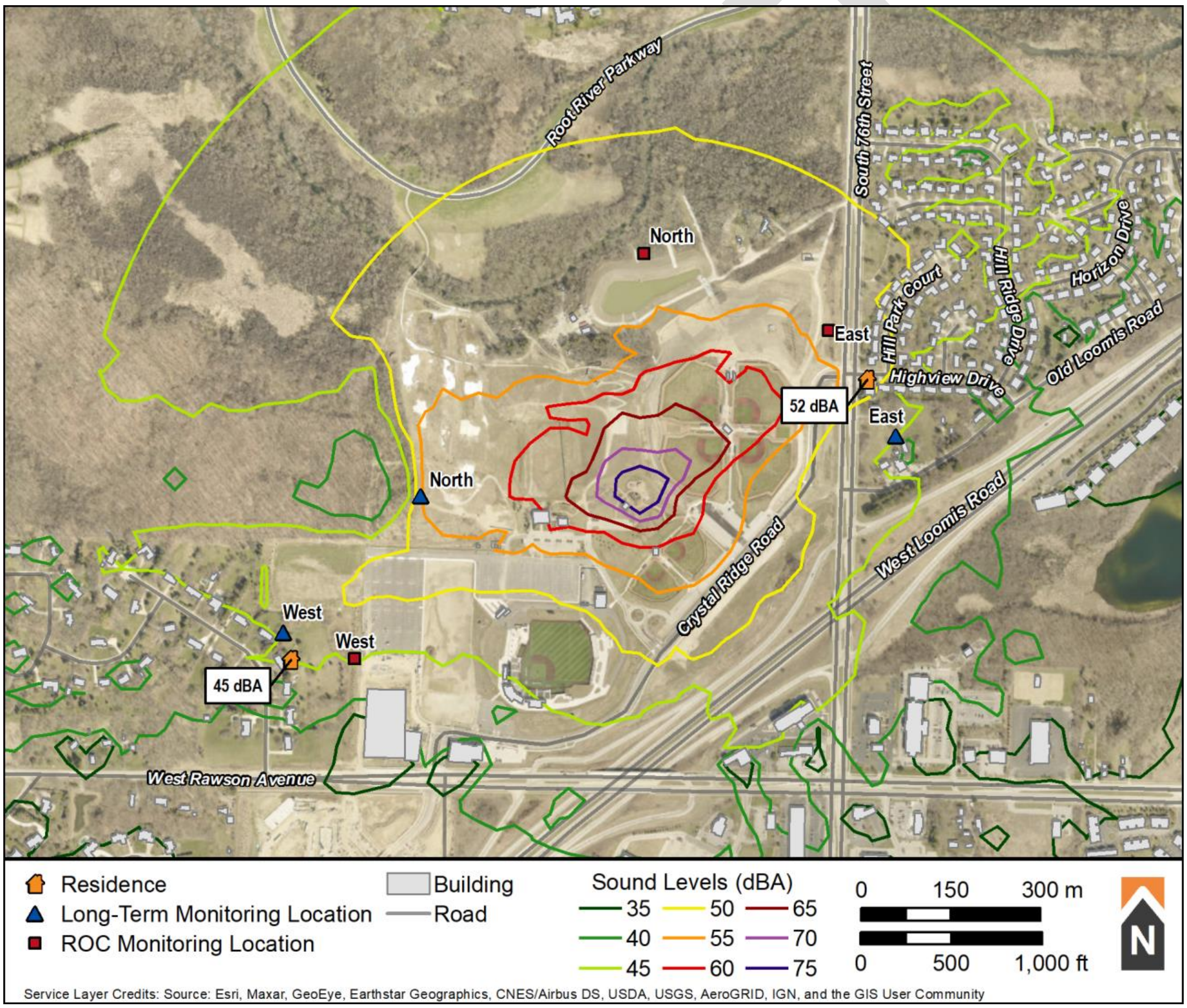


FIGURE 26: MODELED SOUND LEVELS, L_{EQ} – UMBRELLA BAR

Baseball Game Concurrent with Umbrella Bar Band

Sound propagation modeling used the sound pressure levels from “Moo-ing” and announcer during the Milwaukee Milkmen baseball game on August 27, 2022 and the rock band concert at the Umbrella Bar on September 10, 2022. Model inputs are the same as those described in the Milwaukee Milkmen Baseball Game and Umbrella Bar Band sections above. Modeled average sound levels (L_{eq}) are shown in Figure 27.

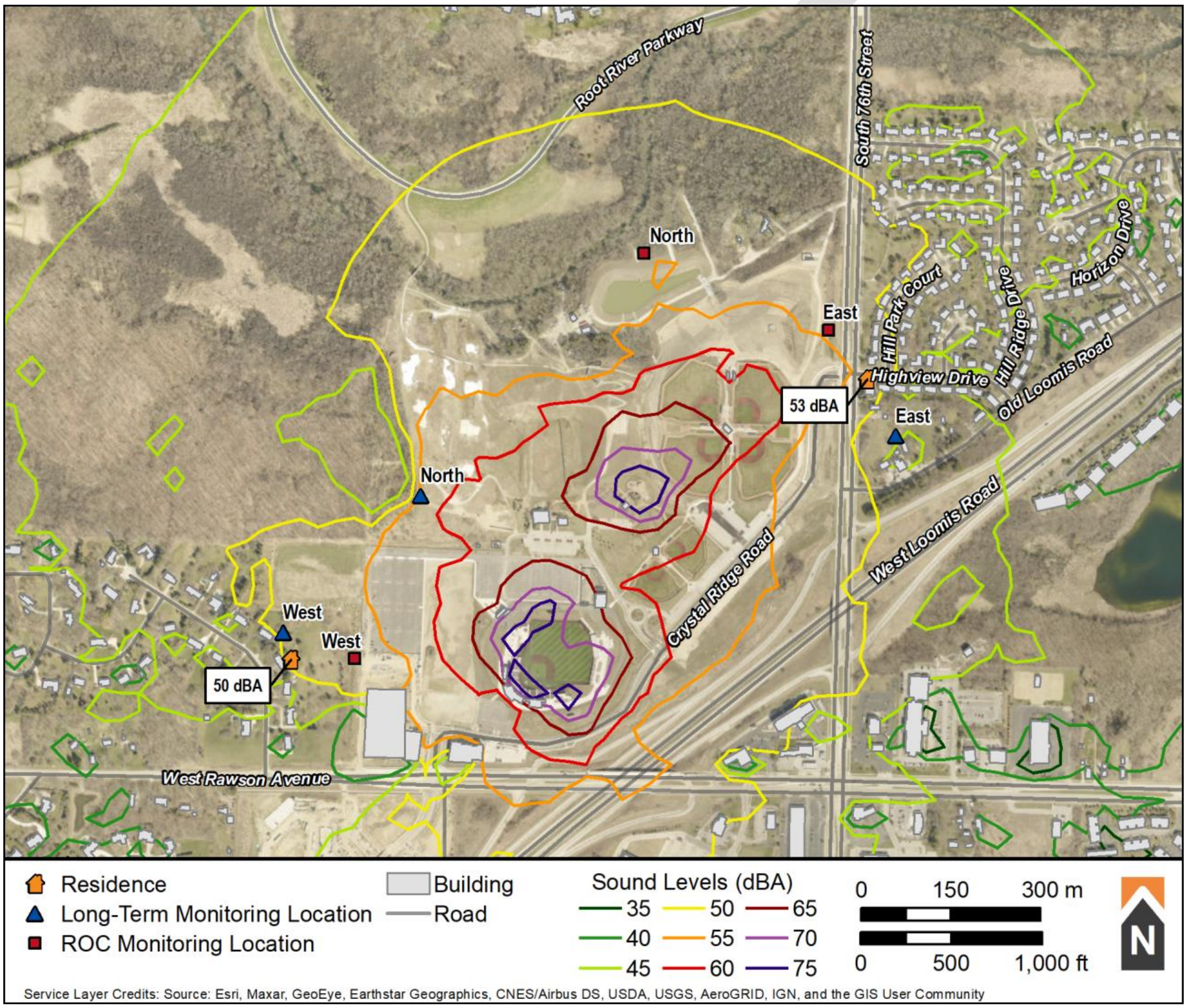


FIGURE 27: MODELED SOUND LEVELS, L_{EQ} – UMBRELLA BAR AND MILKMEN BASEBALL GAME

Fireworks

Sound propagation modeling was validated based on the fireworks occurring on August 6, 2022, which included both attended and unattended sound monitoring. For a conservative worst-case analysis, fireworks were modeled as two individual point-sources, a launch and a burst, occurring simultaneously. The launch was modeled at a height of 0.5 meters (1.6 feet) above the ground elevation and the blast was modeled at a height of 183 meters (600 feet) above the ground. The spectra and sound level were based on the highest 1-second L_{eq} of each sound source. Modeled average sound levels (L_{eq}) are shown in Figure 28.

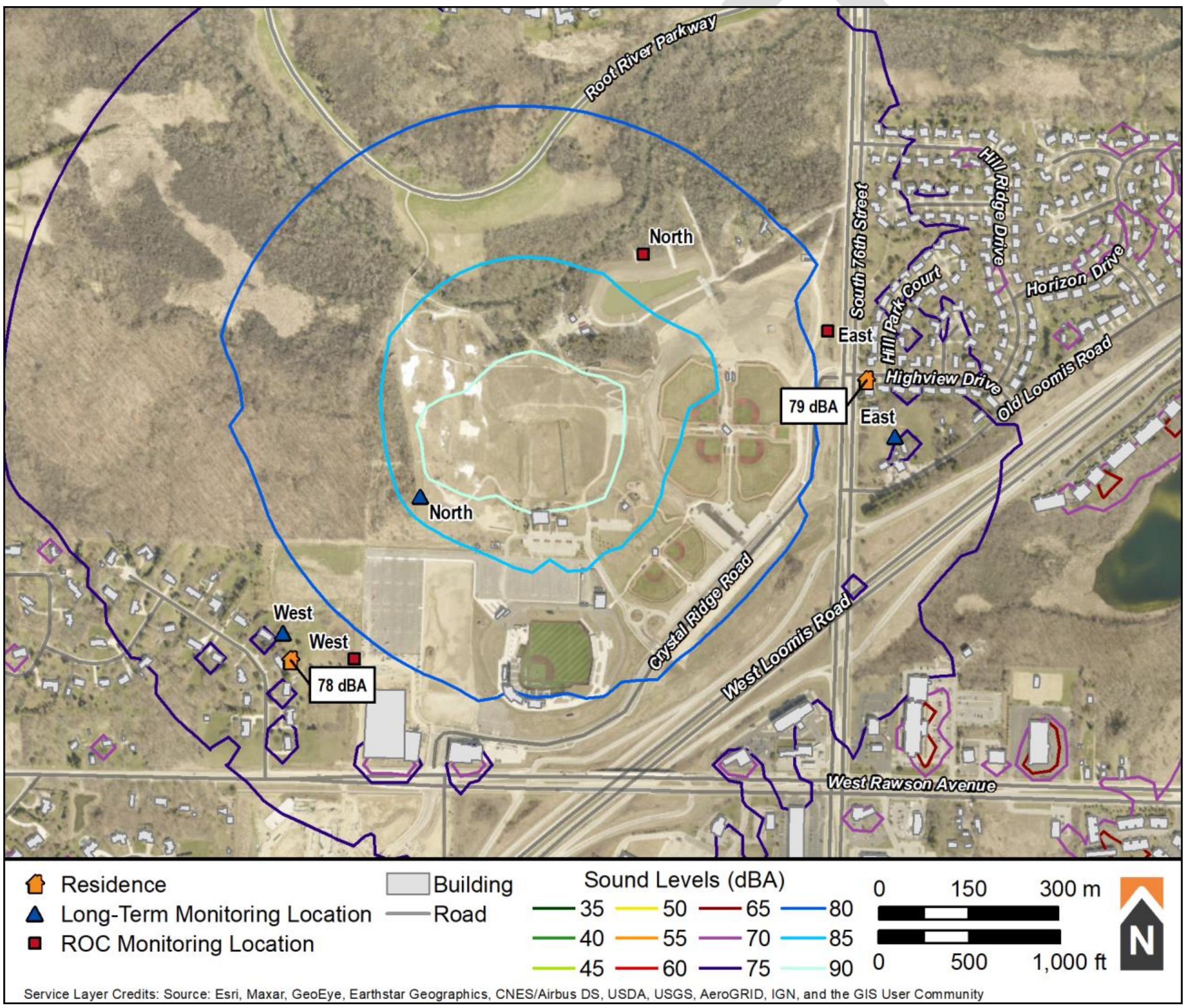


FIGURE 28: MODELED SOUND LEVELS, L_{EQ} – FIREWORKS

The Hills Have Eyes Event

Sound propagation modeling was validated based on measurements made on October 29, 2022, which included both attended and unattended sound monitoring. The event was modeled as an area source located at the base of the tubing hill. The spectra and sound level were based on a representative 10-minute L_{eq} that included all representative sound sources (chain saw, people talking, music, etc.). The background sound levels were removed for each 1/3 octave band using a 10-minute L_{eq} from before the event started. Modeled average sound levels (L_{eq}) are shown in Figure 29.

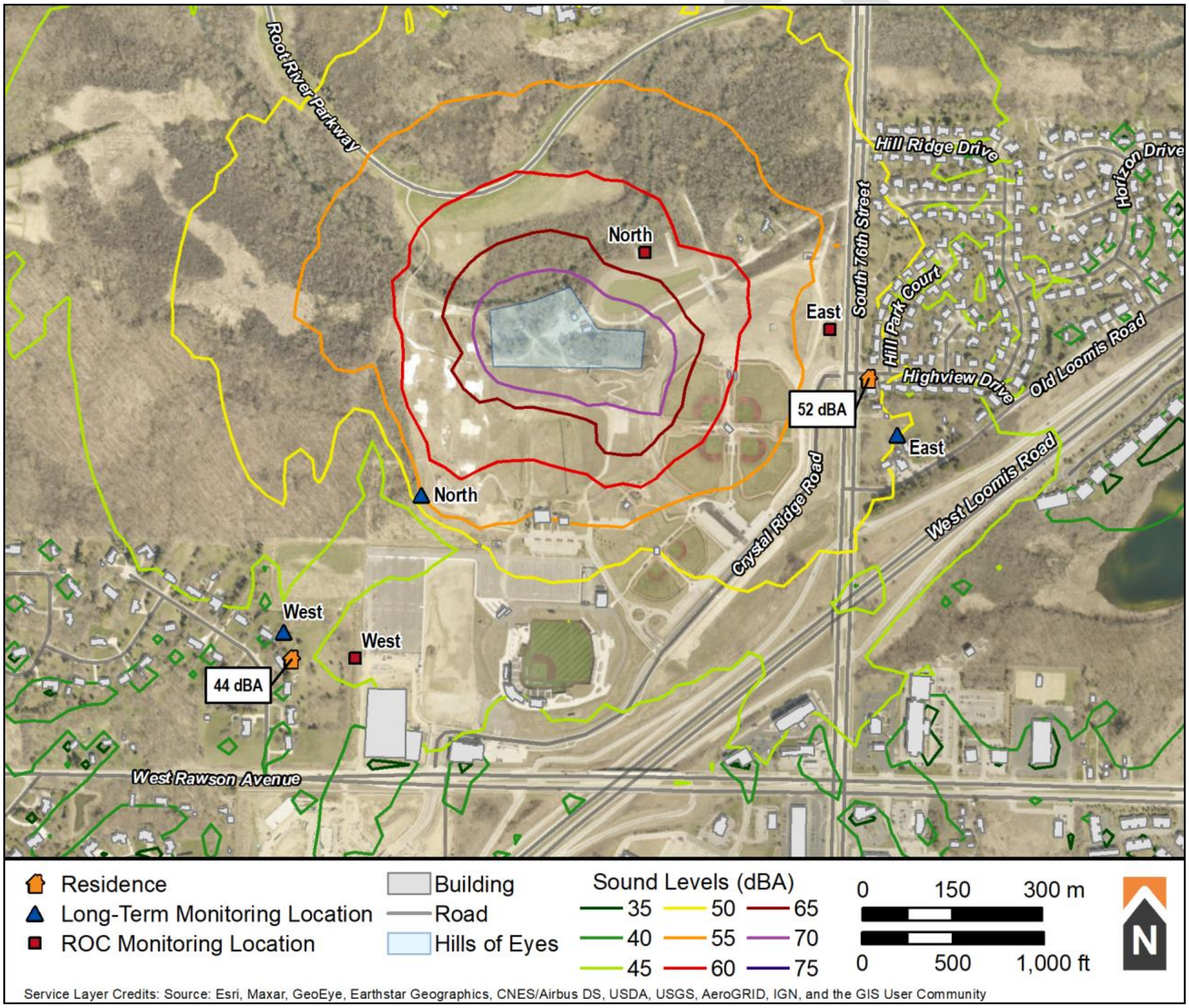


FIGURE 29: MODELED SOUND LEVELS, L_{EQ} – HILLS HAVE EYES EVENT

Snowmaking

Sound propagation modeling was validated based on the snowmaking occurring on December 16, 2022. The snow making equipment was modeled as individual point sources at a height of 1.5 meters (5 feet) or 3 meters (10 feet). The equipment location and height were determined based on photos from the December 12, 2022 field visit and aerial imagery. The spectra and sound level were based on a representative 1-hour L_{eq} while the snowmaking was occurring. Modeled average sound levels (L_{eq}) are shown in Figure 30. Note that these sound levels represent a credible worst-case positioning of the snow guns and are somewhat higher than the average measured levels provided in Section 6.4.

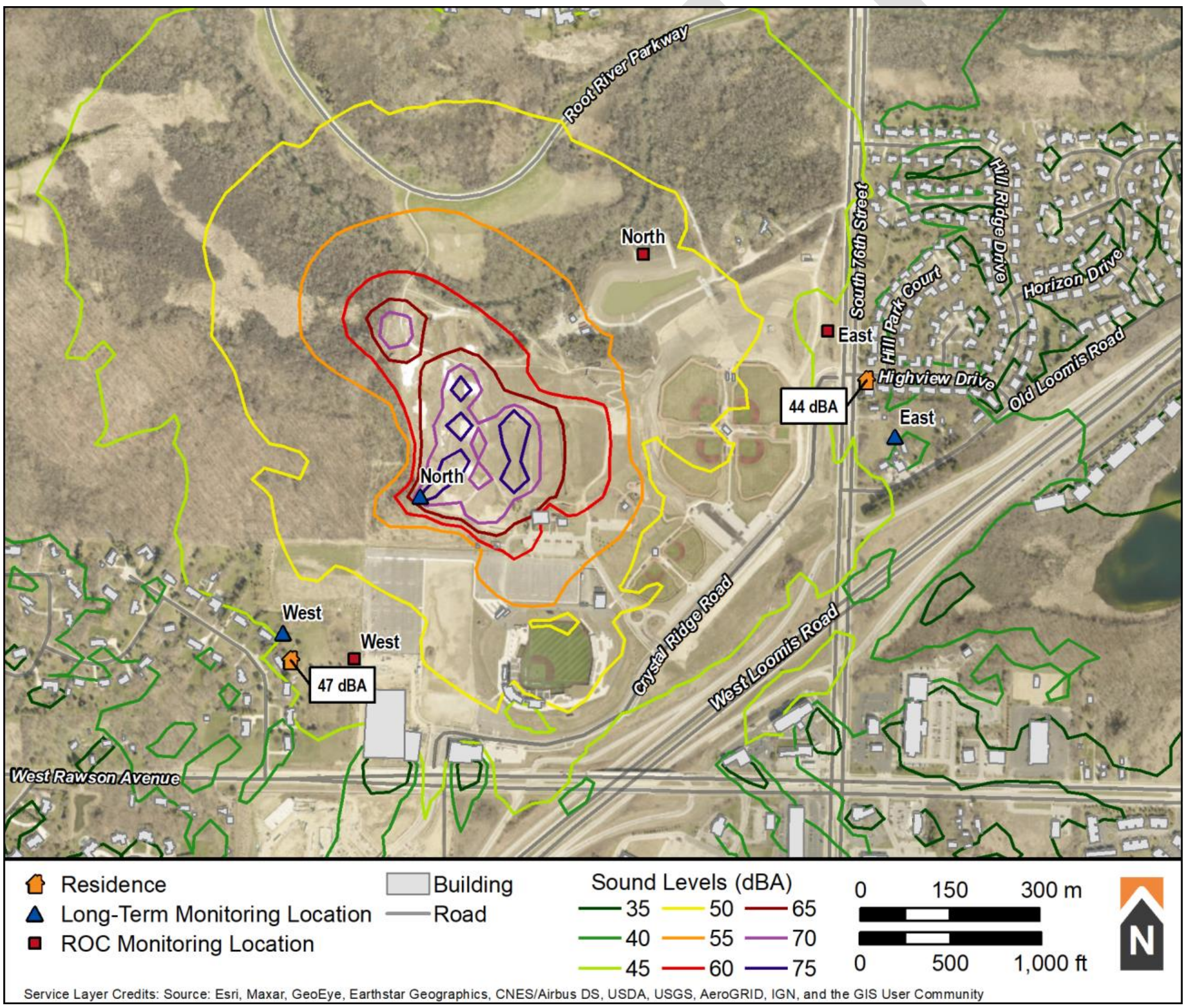


FIGURE 30: MODELED SOUND LEVELS, L_{EQ} – SNOWMAKING

8.0 ROC COMPLIANCE MONITORING

The Chapter described the current state of enforcement of the development agreements through use of compliance monitoring.

8.1 ROC COMPLIANCE MONITOR LOCATIONS

As RSG staff were not given permission to access the ROC facility or monitors, we cannot comment on the appropriateness of the micro-siting of the equipment. Using the general mapped location information provided by the County, the ROC compliance monitor locations were assessed for their ability to represent the sound exposure levels of nearby residences and property boundaries. Based on our review of the monitoring locations, it is assumed that the ROC West Monitor is meant to represent residences in the Hawthorn Neighborhood (Neighborhood E in Figure 31), the ROC East Monitor is meant to represent residences in the H Section Neighborhood (Neighborhood B), and the ROC North Monitor is meant to represent residences in Overlook Farms (Neighborhood A).

The modeled sound levels at each ROC monitor were compared to the modeled sound levels at the neighborhood locations to assess whether each location was appropriate for the associated neighborhood and property boundary locations. A summary of modeling results is given in Table 5 for the three ROC monitors and for the neighborhoods which they are meant to represent. Note that the modeled levels shown in Table 5 are averages and are not necessarily comparable to regulatory limits.

TABLE 5: MODELED AVERAGE SOUND LEVELS AT ROC COMPLIANCE MONITORS COMPARED TO THE WORST-CASE NEIGHBORHOOD RESIDENCE AND PROPERTY BOUNDARY

		SOUND LEVELS GENERATED BY ROC ACTIVITIES, dBA					
		Baseball	Concert	Baseball + Concert	Fireworks	Hills Have Eyes	Snowmaking
ROC West Monitor	Monitor	53	45	54	79	46	48
	Residence	50	48	52	78	46	47
	Property Line (PL)	52	48	53	80	49	49
	Monitor - Res	+3	-3	+2	+1	0	+1
	Monitor - PL Res	+1	-3	+1	-1	-3	-1
ROC North Monitor	Monitor	43	54	55	84	62	51
	Residence	40	47	48	78	52	47
	Res. PL	40	47	48	78	53	47
	Park PL	43	53	54	83	63	60
	Monitor - Res	+3	+7	+7	+6	+10	+4
	Monitor – PL Res	+3	+7	+7	+6	+9	+4
	Monitor - PL Park	0	+1	-1	+1	-1	-9
ROC East Monitor	Monitor	44	54	55	79	51	44
	Residence	46	54	54	79	52	45
	Property Line (PL)	48	54	55	79	53	44
	Monitor - Res	-2	0	+1	0	-1	-1
	Monitor - PL Res	-4	0	0	0	-2	0

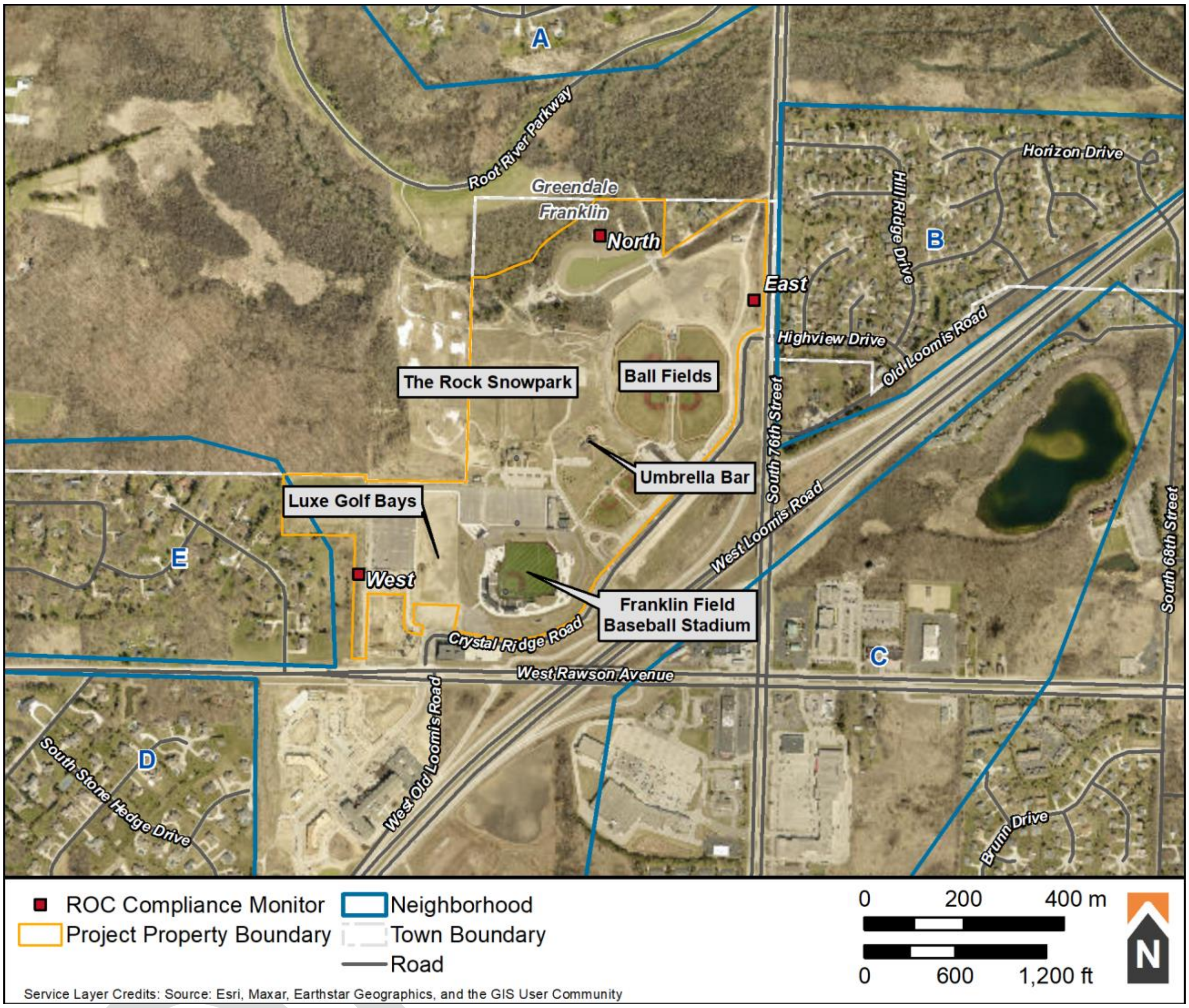


FIGURE 31: ROC COMPLIANCE MONITOR LOCATIONS

Modeled sound levels at the ROC West and East Monitors are within 3 dB of worst-case adjacent residential homes during all events and also within 3 dB of the worst-case property boundary, with the exception of the ROC East Monitor being 4 dB below the level at the property line during baseball games. Baseball games are not generally audible above traffic noise in Neighborhood B. Therefore, we would consider these locations to be appropriate to represent the adjacent residences and residential property boundaries.

The ROC North Monitor is exposed to sound levels 3 to 10 dB higher than the worst-case residences to the north and to the neighborhood property line, but generally within 1 dB of the property boundary of the adjacent park (with the exception of snowmaking, which is located very close to the park boundary). Moving this monitor further to the north, closer to the residences in the Overlook Farms neighborhood, would result in it being better representative of the residences but less representative of the park. Alternatively, since the Overlook Farms neighborhood generally has a lower noise exposure that the Hawthorn or H Section neighborhoods, the ROC North Monitor could be moved to act as a reference location for sounds generated by activities at the Umbrella Bar. In this case, the monitor would be best located at the far (northwest) end of the Umbrella Bar seating area. If the ROC North Monitor is used as a reference location, the sound levels would be anticipated to be substantially higher than those experienced in the neighborhoods. The sound levels measured at this location would, therefore, not be used directly to assess compliance for a residential location. Rather, the monitor would be used to confirm that sound levels occurring at the East or West ROC Monitors are correctly attributable to ROC activities.

8.2 ROC COMPLIANCE MONITORING DATA

Pursuant to the ROC's development agreements with the County, the ROC must make data from the ROC Compliance Monitors available to the City and/or County upon request. It is our understanding that this data is being provided to the City of Franklin, by request, on the days on which a complaint is filed with the City. However, through discussions with the City of Franklin we understand that the ROC East and West Monitors are not currently operational and have been inoperable for a long period, perhaps approaching a year. Therefore, data is currently being provided for the ROC North Monitor only.

As part of the sound study, we reviewed the ROC North Monitor data acquired on the dates of the attended short-term monitoring, August 6, 20, 27, and 28, September 10, and October 29, 2022. Sound level monitoring at the ROC North Monitor is being performed with a Larson Davis 831 sound level meter (SLM). The SLM is currently programed to log overall A-, C-, and Z-weighted equivalent continuous sound levels (L_{eq}) once each minute. Ten-second duration sound recordings are made automatically if the sound level exceeds 65 dBA L_{max} using a slow-response time weighting. An event history is also recorded, with an average (L_{eq}) and maximum (L_{max}) level occurring during each logged period for the entire duration for which the sound levels exceeded 65 dBA L_{max}. Note that this is 5 dB above the City of Franklin's limit of 70 dBA.

Because the amount of time that exceeds 65 dBA L_{max} for each logged event period varies, the duration of the recorded L_{eq} for each of these events varies, resulting in inconsistent data being used to identify violations of the limits. In addition, the selection of 65 dBA L_{max} as a trigger level weights the average sound level (L_{eq}) of these documented events to a sound level closer to 65 dBA L_{eq}. If a higher trigger level were to be used, the resulting L_{eq} level for the recorded event would be higher because the lower sound levels would not be included in the averaging.

The ROC North Monitor data documents that the SLM was last field calibrated on June 20, 2019, almost four years ago. The date of the last lab calibration is unknown.

The Larson Davis 831 SLM is an ANSI/IEC Type 1 SLM with a frequency range of 6.3 Hz to 20 kHz and should be sufficient for use as a compliance monitor. However, compliance monitoring can only be effective if all three required monitors are operating, properly maintained and calibrated, and data is provided to the City and/or County upon request. As a result, we have numerous concerns:

- The compliance monitors are only effective to identify violations if they are operating. Currently the ROC North Montor, which does not clearly represent any of the nearby residences, is the only operational monitor.
- The data file from the ROC North Monitor indicates that it has not been field calibrated in nearly four years. This is insufficient to ensure that the SLM is acquiring accurate data. To ensure that the SLM is acquiring valid data, each meter should be field calibrated at least monthly (ANSI S12.18 specifies that a calibration check shall be performed at least at the beginning and end of each measurement session), and lab-calibrated every two years (see ANSI S1.13:9.2 .1 and ISO 1996-2). Lab-calibrations should take place during the off-season when event exceedances are not anticipated.
- We recommend that a more consistent method of identifying exceedances be programmed into the SLMs. This is described in more detail in Chapter 11.0.

8.3 CITY OF FRANKLIN'S ENFORCEMENT PROCESS

From discussions with the City of Franklin, we understand that the City is currently enforcing compliance of the ROC with the Ballpark Commons Development Agreement through the following process:

1. If the City receives a complaint, they request data from the ROC compliance monitors for the day of the complaint.
2. The data from the ROC compliance monitors is provided to the City for review. The provided data includes sound level and 10-seconds of audio data for periods when sound levels exceeded 65 dBA L_{max}. Currently only data from the ROC North Monitor is being provided.
3. The City listens to all provided recordings for the day of the complaint to determine if the sounds are generated by the ROC or by background sound sources.
4. For ROC generated sounds, the City reviews the monitor data to determine if the sound levels exceed the ordinance limits. Due to the lack of clarity of the Development Agreement and the Franklin Noise Ordinance, the identification of a violation has been interpreted differently over time.
    a. Until recently, the practice of the City had been to identify a violation of the ordinance limits only if the sound level at a monitor continuously exceeded 79 dBA for a duration of 30 minutes or more. Thus, a musical concert could consist

    of a series of songs that are consistently louder than the limits and the concert could go on for several hours and not be treated as a violation if there was even a short break between one song and the next or a relatively quiet period within a song. Only a continuous exceedance of the 79 dBA limit for 30 minutes or more was treated as a violation. There is and was no basis in the language in the Development Agreement or in the ordinance for this practice. The Franklin ordinance prohibits activities resulting in sound levels of 70 to 79 dBA and does not exempt exceedances that last less than 30 continuous minutes.

    b. Currently, the practice of the City is to identify a violation of the ordinance limits if the sound level at a monitor exceeds 74 dBA during nighttime (10 PM to 7 AM) or 79 dBA during daytime (7 AM to 10 PM) hours. The sound level from the provided monitor data that is compared to these limits is the average (L_{eq}) sound level occurring over the period of the exceedance of the 65 dBA L_{max} threshold.

5. If there is an exceedance, the City will provide enforcement of the agreement. So far, no exceedances have been identified through this process. The City's practice is currently to exempt fireworks from the sound limits.

The current interpretation of the noise limits by the City is an improvement from the previous interpretation of the limits. However, the City fails to apply the 70 dBA limit from the ordinance, instead selecting 74 dBA and 79 dBA as the daytime and nighttime limits, respectively. The sound level from the provided monitor data that is currently compared to these limits is the average sound level occurring over the period of the exceedance of the 65 dBA L_{max} threshold. As described above, the use of an L_{eq} that includes sounds down to 9 dB below the violation limit will, by its very nature, tend to weight the sound level to most likely be below the limit. No metric or averaging time is specified. The Franklin limit does not distinguish between daytime and nighttime hours, but the City's enforcement implies that there is a distinction.

Another item of note is that because the City only looks at the data if there is a complaint, the burden is on citizens to enforce the noise standard rather than the ROC reporting back to the City about its activities. Additionally, the City is overlooking the most impactful noise events - fireworks - with apparently no variance in place under the regulations.

As a result, it is no surprise that no violations have been identified, despite regular complaints from residents. Clarity of the Development Agreement and the Franklin Noise Ordinance limits is needed to make this process effective in identifying periods of activity that "substantially annoy, injure or endanger the comfort, health, repose or safety of the public." This is provided in Chapter 11.0.

9.0 SOUND EXCEEDANCE EVALUATION

In this section we identify where sound levels may exceed appropriate noise limits at the receiving use, in this case the residential homes and property boundaries surrounding the ROC. Chapter 6.0 described the results of the sound monitoring, which was made at representative locations and not necessarily at the worst-case residential locations. The modeling results described in Chapter 7.0 can be used to adjust the Chapter 6.0 measured levels to sound levels at residences.

An evaluation of the sound levels in each neighborhood, relative to the applicable standards and guidelines, is provided below. Franklin and Greendale have regulations that include direct sound limits that address the overall A-weighted sound levels only. Due to community concerns over the low frequency content of some of the ROC events, an additional analysis of low frequency sound was also included.

Note that the assessment in this report evaluates sound levels generated by average events. Although typical events did not exceed the thresholds in many cases, there is still potential for louder than typical events to exceed thresholds. In addition, this assessment does not include an evaluation of the characteristics of the sound (i.e., use of a penalty to account for speech and / or music sounds) or the impact associated with event generated sound level increases over background sounds.

9.1 LOCAL JURISDICTIONS

City of Franklin

The City of Franklin noise regulation does not specify the intended metric for their 70 dBA sound limit and does not differentiate between daytime and nighttime limits. The limit applies at the real property boundary of the noise source.

Based on our prior experience and a comparison to the comparable levels in the Greendale code, we are interpreting the 70 dBA limit from the City of Franklin as an L_{max}, which is the highest level measured during a given monitoring period. The L_{max} will vary depending on the time response speed of the sound level meter. The ROC monitors and the RSG monitors are set to a slow time response (1-second time constant), which is a common setting for environmental sound monitoring.

The L_{max} is necessarily an outlier, occurring for less than or equal to a second of any hour. It may make sense to use the L_{max} for identification of individual exceedances when audio is reviewed to attribute the exceedance to the sound source. However, for purposes of identifying typical exceedances for average events, we have used the L_{01} of the long-term monitoring data for this exceedance evaluation. The L_{01} is the highest 1% of sound levels in a given period and is commonly thought of as a ‘typical’ maximum, or the maximum level that is typically reached.

The assessment period for all events was one-hour, except for fireworks, which were assessed on a 10-minute basis.

Table 6 shows the measured L_{01} levels for each monitor location. Table 7 compares the calculated L_{01} levels to the Franklin sound limit. As shown in Table 7, fireworks exceeded the limit in all surrounding neighborhoods and at the property boundaries. Live music at the Umbrella Bar also exceeds the limit at the worst-case location in Neighborhood B and at the Neighborhood B property boundary.

TABLE 6: MEASURED L_{01} SOUND PRESSURE LEVELS (dBA)

MONITOR	FIREWORKS	BASEBALL	CONCERT	SNOWMAKING	HILLS HAVE EYES
East	90	64	64	59	59
North	92	64	64	75	56
West	86	62	62	54	54

TABLE 7: COMPARISON OF MONITORING RESULTS TO CITY OF FRANKLIN LIMIT, L_{01} (dBA)

WORST-CASE MODELED EXPOSURE LEVELS BY NEIGHBORHOOD, dBA										
	Fireworks		Baseball		Concert		Snowmaking		Hills have Eyes	
	Ground Floor	Upper Floor	Ground Floor	Upper Floor	Ground Floor	Upper Floor	Ground Floor	Upper Floor	Ground Floor	Upper Floor
Neighborhood A	82	85	49	50	55	57	39	41	52	52
Neighborhood B	91	94	65	67	72	74	60	62	60	61
Neighborhood C	82	85	56	58	54	57	47	49	54	55
Neighborhood D	82	86	56	57	52	54	49	50	52	53
Neighborhood E	86	89	62	64	62	65	53	54	55	56
Boundary A	82		49		55		39		53	
Boundary Park (A)	87		52		61		52		63	
Boundary B	91		67		73		59		62	
Boundary C	85		65		60		53		55	
Boundary D	83		56		52		48		51	
Boundary E	88		65		62		56		58	
NOISE IMPACTS BY NEIGHBORHOOD (Franklin Limit = 70 dBA)										
Neighborhood	All	All	None	None	B	B	None	None	None	None
Boundaries	All		None		B		None		None	

Village of Greendale

The Village of Greendale regulations include noise limits at residential receiving uses. The limits vary based on the type of sound generated, e.g. perpetual, impulsive, intermittent, and continuous. Similar to the City of Franklin's Code, the averaging time and metric are ambiguous. Although not explicit in the code, it is implied that the limit is an L_{eq} for the duration of the event.

Table 8 shows the calculated Event-Only L_{eq} for each RSG monitor location. Table 9 compares the Village of Greendale nighttime sound limits for residential, agricultural, historic, and park districts to the worst-case sound levels in each neighborhood. Although not specified in the Greendale code, it is assumed that the limits apply to the Event-Only levels and not the overall (event plus background) levels. As shown in Table 9, fireworks exceeded the limit in all surrounding neighborhoods. Live music at the Umbrella Bar during a typical concert exceeded the limit at the worst-case location in Neighborhoods B and E. All other typical events were within the Greendale limits.

TABLE 8: MEASURED SOUND PRESSURE LEVELS, L_{eq} (dBA)

MONITOR	FIREWORKS	BASEBALL	CONCERT	SNOWMAKING	HILLS HAVE EYES
East	79	44	45	41	*
North	84	51	52	70	*
West	77	48	49	35	*

*Not discernable from background sound levels.

TABLE 9: COMPARISON OF GREENDALE LIMITS TO EACH EVENT, L_{eq} (dBA)

WORST-CASE MODELED EXPOSURE LEVELS BY NEIGHBORHOOD, dBA										
	Fireworks		Baseball		Concert		Snowmaking		Hills have Eyes	
	Ground Floor	Upper Floor	Ground Floor	Upper Floor	Ground Floor	Upper Floor	Ground Floor	Upper Floor	Ground Floor	Upper Floor
Neighborhood A	74	77	36	37	43	45	34	36	-	-
Neighborhood B	80	83	45	47	53	55	42	44	-	-
Neighborhood C	73	76	42	44	41	44	28	30	-	-
Neighborhood D	73	77	42	43	39	41	30	31	-	-
Neighborhood E	77	80	48	50	49	52	34	35	-	-
NOISE IMPACTS BY NEIGHBORHOOD										
Greendale Limit Daytime / Nighttime	Impulsive 70/60		Intermittent 60/55		Continuous 50/45		Perpetual 50/45		Intermittent 60/55	
Neighborhood - Daytime	All	All	None	None	B	B, E	None	None	None	None
Neighborhood - Nighttime	All	All	None	None	B, E	B, E	None	None	None	None

Low-Frequency Sound

Fireworks exceed the ANSI S12.9 Part 4 thresholds of 65 dB in the 31.5 Hz octave band and 70 dB in the 63 Hz octave band[5] in all surrounding neighborhoods and live music at the Umbrella Bar exceeded the low frequency thresholds in Neighborhood E. All other events remain below the notated thresholds.

[5] See Section 5.5 for a description of ANSI S12.9 Part 4.

10.0 STANDARDS ANALYSIS

The sound study included the development of sound thresholds for use in the County's and/or other municipality's municipal code(s). Through discussions with the County, RSG was directed to clarify the existing Franklin Code language to help the City to enforce the Development Agreement with the ROC.

The Development Agreement does not specifically set out a noise limit and the City of Franklin's Code is not specific in that it does not indicate the type of sound level or metric (i.e., maximum sound level, average sound level) or averaging time associated with the sound limits. Due to the lack of clarity of the Development Agreement and the Franklin Noise Ordinance, the identification of a violation is left to interpretation by the City's enforcement officer and the interpretation has changed over time.

Identification of the sound metric is essential for the City's Code so it may be used more effectively to identify violations. In defining a sound metric for regulation, the following should be considered:

1) Relevance – The sound metric should be relevant to impacts on humans or wildlife and not be set arbitrarily.
2) Sound source characteristics – The sound metric should be based on the characteristic of the source in terms of the sound sensitivity of humans to the type of sound, the variability of the sound over time, and the spectral characteristics of the sound.
3) Ease of enforcement – The metric should be able to be measured and violations identified using the existing ROC compliance monitor equipment. Some metrics can only be measured or calculated by an experienced noise control engineer using specialized sound monitoring equipment.

10.1 RELEVANCE

Since the results of this study would potentially be used in a regulatory setting, a sound metric used in regulation should be related to the City of Franklin's Code, which prohibits public nuisances, defined as acts or conditions that "substantially annoy, injure or endanger the comfort, health, repose or safety of the public".

The A-weighted sound level is the most commonly used metric for human response to sounds at sound levels typical of ROC events. It is used by the U.S. Environmental Protection Agency, Federal Highway Administration, Department of Housing and Urban Development, and Federal Aviation Administration, for example, as well as the City of Franklin and the Village of Greendale. Studies of human annoyance tend to focus on A-weighted sound levels. Due to community concerns over the low frequency content of some of the ROC events, low frequency sound limits were also considered.

10.2 SOUND SOURCE CHARACTERISTICS

Different types of sound sources may require different sound limits to reduce annoyance. This is acknowledged in the Village of Greendale Code through the setting of different limits for distinct types of sound sources and in the WHO Guidelines, which recognize that noise measures based solely on A-weighted values may not adequately characterize some noise environments nor the impacts of certain types of sound sources.

Appendix A describes how difference sound metrics account for changes in sound over time (see Figure 34). For a steady state sound source, such as a continuous air conditioning system, all sound metrics would give essentially the same value. For more intermittent sounds, like aircraft flyovers, the results would be very different depending on the descriptor and averaging time used.

The spectral content of a sound also influences annoyance. People tend to be more annoyed by sounds with speech or music content, tonal prominence, and/or strong low frequency content.

ROC events did not generate distinct tones at the residences. Concerts were determined to have strong low frequency content and, of course, concerts, baseball games, and the Hills Have Eyes all include speech and music content (and, in the case of the Hills Have Eyes, a chainsaw). While protection from low-frequency sound is desirable, no additional exceedances were identified from the long-term monitoring data using the ANSI low frequency limits than those using the A-Weighted Greendale Code limits. Therefore, the addition of a low-frequency limit may add complexity without adding value for reducing annoyance. The ordinance does not currently include any penalties for speech or music content of the sounds; the inclusion of this type of penalty may further reduce complaints from the community.

10.3 EASE OF ENFORCEMENT

Different sound metrics will require different levels of sophistication with respect to measurement equipment and analysis difficulty. At one end, there may be metrics, such as L_{max}, L_{01}, and L_{eq}, that can be read directly from many sound level meters. A-, C-, and Z-weighted metrics, along with fast and slow response, are standard on most Type 1 and Type 2 sound level meters, including the ones currently used for ROC compliance monitoring. Sound level meters used for enforcement should also have logging capability, to record relevant metrics. Again, the ROC compliance meters have this capability.

Among the metrics evaluated in this study, those that are already being logged with the ROC monitors and do not require significant post-processing include the simple L_{max} and L_{eq}, over one-minute or other averaging times. The L_{01} metric can also be measured using the existing ROC monitoring equipment. Use of these metrics in conjunction with audio recordings to allow for event identification should be sufficient for violation identification. The ROC compliance monitors are set to one minute logging and include audio recordings during triggered events.

11.0 NOISE ORDINANCE RECOMMENDATIONS

This chapter provides clarification of the existing City of Franklin noise ordinance and suggestions on how it may be further refined to reduce annoyance and complaints from residences near the ROC. A review of relevant ordinances and recommendations regarding the City of Franklin's ordinance and enforcement is provided in Appendix J.

11.1 CLARIFICATIONS OF EXISTING REGULATIONS

The current Franklin noise ordinance, at Section 183-41, prohibits noises between 70 to 79 dBA as measured at the real property boundary (or 50 feet from the noise source). As described in Chapter 9.0, we recommend that the Franklin noise limit be enforced when sound levels exceed 70 dBA L_{Smax}. These violations can be easily identified by the City's enforcement officer using the existing data that is provided by the ROC compliance monitors. The ROC compliance monitors provide L_{Smax} for each one-minute duration and also for trigger events. Identification from either of these logged data would be sufficient to detect a violation if audio files are available to ensure that the sound source generating the exceedance is related to ROC activities. If sound source attribution cannot be used, we would recommend the use of the "typical maximum" L_{01} metric (so, 70 dBA L_{01}), similar to the analysis conducted in Section 9.1.

Section 178-1 of the Franklin ordinances also prohibits public nuisances, defined as acts or conditions that "substantially annoy, injure or endanger the comfort, health, repose or safety of the public." Given the widespread negative community reaction under the City's approach to regulating its noise limits, and our knowledge of other noise limits cited in this report that address the comfort, health, repose, and safety of the public, which are below 74 dBA, we believe that other noise standards can be implemented under the regulation that protect the comfort, health, repose, and safety of the public.

70 dBA is used in the Greendale Code as the sound limit for daytime impulsive sounds. We agree that 70 dBA L_{Smax} or L_{01} limit may be appropriate for daytime impulsive sound sources, like fireworks (assuming they occur during daytime hours) but is not appropriate to avoid sleep disturbance or to reduce more steady state sound sources to be compatible with the adjacent residential soundscape. Given that the Village of Greendale has already provided noise limits for other types of sound characteristics and that the 70 dBA L_{Smax} or L_{01} threshold is in line with the City of Franklin's noise limit, the Greendale Code limits can be applied directly to use metrics that are already being provided by the ROC compliance monitors, as shown in Table 10.[6]

[6] RSG can train the City of Franklin's Code Enforcement Officer on how to identify violations of noise limits in this table using the ROC compliance monitor data.

TABLE 10: RECOMMENDED PERMISSIBLE SOUND LEVELS

	PERMISSIBLE SOUND LEVEL, dBA	
	Residential, agricultural, historic, and park districts	
	Daytime (7 am to 8 pm)	Nighttime (8 pm to 7 am)
Perpetual / Continuous, 5-minute L_{eq}	50	45
Intermittent, 1-minute L_{eq}	60	55
Impulsive, L_{Smax} or L_{01}	70	60

Again, these violations can be identified by the City's enforcement officer using the existing data that is provided by the ROC compliance monitors. The ROC compliance monitors provide L_{eq} for each one-minute duration. For example, identification of a single L_{eq} that exceed the 1-minute limits or five consecutive one-minute L_{eq}'s that exceed the 5-minute limit would be a violation.

11.2 RECOMMENDATIONS FOR IMPROVED REGULATION

As described in Chapter 10.0, people tend to be more annoyed by sounds with speech or music content. Many of the ROC events, including concerts, baseball games, and the Hills Have Eyes all include speech and music (and, in the case of the Hills Have Eyes, a chainsaw). If enforcement of the limits specified in Table 10 are not sufficient to reduce complaints from the community, it is recommended that a penalty be added to account for the speech and music content of the sounds. A common penalty that is applied for noise consisting primarily of speech or music is 5 dB.[7] Table 11 shows what the limits would look like with a 5 dB penalty applied to activities that consist primarily of speech or music.

TABLE 11: RECOMMENDED PERMISSIBLE SOUND LEVELS FOR IMPROVED REGULATION, dBA

	Events without speech or music (Fireworks, snowmaking, golf)		Events with speech and/or music (Baseball games, concerts, Hills Have Eyes)	
	Daytime (7 am to 8 pm)	Nighttime (8 pm to 7 am)	Daytime (7 am to 8 pm)	Nighttime (8 pm to 7 am)
5-minute L_{eq}	50	45	45	40
1-minute L_{eq}	60	55	55	50
L_{Smax} or L_{01}	70	60	65	55

11.3 ATTRIBUTION OF SOUND SOURCES

As described in Section 8.3, the City's current enforcement process includes listening to recordings for the day of the complaint to determine if the sounds are generated by the ROC or by background sound sources. The current practice of recording for a period of 10-seconds with a trigger level of 65 dBA L_{max} is not adequate to attribute sound source origins for exceedances

[7] See Oakland, California or Sonoma County, California for examples of the use of the 5 dB speech and music penalty.

that extend beyond 10-seconds. Audio of the entire duration of all exceedances is needed for sound source attribution. If the ROC North Monitor is relocated to be used as a reference location (see Chapter 12.0), it would typically have the highest exposure to ROC sounds and would therefore be the most useful in attributing exceedances to ROC activities. The ROC East and West Monitors are more distant and may therefore be more contaminated by background sounds.

12.0 RECOMMENDATIONS

This chapter includes recommendations to reduce community sound exposure while allowing for recreational use of the ROC facility. The recommendations are based on the results of the comprehensive sound study (Chapters 2.0, 4.0, 6.0, 7.0, 8.0, and 9.0) with respect to the existing relevant noise standards and guidelines (Chapter 5.0) and the suggested improvements to the noise ordinance (Chapter 11.0).

12.1 FACILITY DESIGN IMPROVEMENTS

The project team did not receive permission to access ROC property (see Appendix B). Therefore, a detailed review of the existing sound sources, systems, and facilities could not be conducted. Based on field observations of this facility and knowledge of other similar facilities, we make the following general recommendations for facility design improvements:

- Franklin Field Stadium: The PA system (not crowd cheering) is the primary sound source from the stadium during baseball games. Two methods of reducing community sound exposure from the existing stadium sound system would be to turn the amplification volume down and / or focus the existing speakers away from sound sensitive areas in the surrounding community. Alternatively, a directional speaker system with multiple speakers could be installed.

  Speaker systems should be assessed for their ability to provide optimal coverage of the patron area while minimizing spillover into the surrounding communities. Based on aerial mapping, site observations, and available photographs of Franklin Field, the stadium includes approximately eight speaker clusters (see Appendix D). Most of the speakers appear to point towards the field or the spectator stands. However, the speakers on the north side of the stadium appear to point north towards the parking lot and west towards residential Neighborhood E. Repositioning these speakers to focus towards the patron areas would allow for the volume of the sound system to be turned down which would result in further sound reduction in the communities and could also potentially result in reduced energy costs for the ROC.

  It is recommended that an evaluation be conducted of the staging, engineering, and all sound systems currently in place at the stadium. The evaluation should be conducted by a qualified acoustical consulting company, who is granted full access to the facility, and include a review of the location, orientation, type, and broadcast range of the existing sound system design and design recommendations with respect to sound thresholds, monitoring devices, engineering, and design.

  Umbrella Bar: It is our understanding that each band brings their own amplification system to use at the Umbrella Bar. This is out of compliance with the Development

Agreement, which states "the operator will install a dedicated sound system to ensure that the sound at the Umbrella Bar is directionally controlled to minimize the spillover effect beyond the property boundary."

Installation of a dedicated sound system, as required under the Development Agreement would allow for more control by the ROC over the volume and directivity of the concert event sounds. If a dedicated sound system is not installed, the most effective method of ensuring compliance of this type of sound system with the community sound limits would be to include sound system calibration prior to the start of each event. The relocation of the ROC North Monitor to a location at the far (northwest) end of the seating area would allow for this calibration process. During the sound system check, each band could adjust the volume of their sound system to comply with the limit specified for the ROC Monitor location. This limit would be determined based on the modeled level at the ROC monitor location relative to the limit at the receiving use areas.

- Fireworks and Helicopter Events: Sound levels from fireworks and helicopter events are likely to exceed any reasonable community sound limit. Many communities, including Greendale, exempt some types of special events from their noise ordinance. The City of Franklin currently overlooks fireworks from its noise requirements. We recommend that if the City of Franklin would like to except fireworks from the requirements, that this be explicitly stated in the Development Agreement and that they limit the number of these louder events with the understanding that the noise limits will be exceeded. In an effort to reduce community annoyance during these special events, it is recommended that the City of Franklin commit to a maximum number of allowable special events per year (for example, six). Time limits, such as ending any special events by 10 PM, would reduce the chances of sleep disturbance in the community. It is also highly recommended that the ROC be required to notify residents of the surrounding community of the dates and times in which these events will take place. The notification should happen well in advance of the events, to allow residents to make accommodations in scheduling sound sensitive types of activities at their homes.
- The Hills Have Eyes: Sound levels from the Hills Have Eyes event were not generally above background levels. However, the sounds continue late into the night and the content of the sound, which included the sounds of a chain saw, speech amplified over a PA system, music and special effects sounds, were identified as particularly annoying by community residents. Again, the project team did not receive permission to access ROC property; therefore, a detailed assessment of the sound sources associated with the event was not able to be conducted. In general, sound sources such as chain saws or other disturbing sound events could be eliminated, located indoors, or shielding behind temporary sound barriers or sound blankets. Temporary sound blankets can be easily installed by draping these blankets over a chain link fence or similar fencing or through

the use of movable sound barrier partitions. The speakers used for the PA system should be focused away from community areas.

- Luxe Golf: Although the Luxe Golf facility was not a focus of the study, sounds generated by activities at the facility were measured at the West Monitor and during attended monitoring. Based on preliminary observations of the facility, it is recommended that further review of this facility be made to ensure that sound levels comply with recommended limits and to identify potential construction methods to minimize sound intrusion on residences in Neighborhood E.

12.2 COMPLIANCE MONITORING

The project team did not receive permission to access the ROC monitoring locations or equipment, so we cannot comment on the quality of the micro-siting. Based on an analysis of the sound level exposure at the ROC Monitor locations which were provided from the County, the ROC East and ROC West Monitors are generally in locations appropriate to assess compliance for the two closest neighborhoods, Neighborhoods B and E. However, neither of these monitors are currently acquiring data.

Based on the data received from the ROC North Monitor, we understand that the sound level monitoring equipment that is currently used at the ROC Monitor locations includes ANSI/IEC Type 1 sound level meters. These should be sufficient to enable compliance monitoring. However, only one of the three monitors (the ROC North Monitor) is currently operating, and this monitor has not been properly field calibrated in almost four years.

The City of Franklin currently enforces compliance of the ROC with noise limits through review of the ROC Monitor data on days when complaints occur. The methods and process used by the City seem generally sufficient. However, the data provided is unreliable due to the lack of calibration and also the inconsistency of the time averaging duration of events. Clarity on the limits that would cause an exceedance would help the City to better enforce compliance. Also, as described in Section 8.3, because the City only looks at the data if there is a complaint, the burden is on citizens to enforce the noise standard rather than the ROC reporting back to the City about its activities.

We make the following recommendations to enable the City to check for compliance and respond appropriately:

- Ensure that all ROC Monitors are operational, maintained, field calibrated at least monthly, and lab-calibrated at a minimum f every two years. Lab-calibrations should take place during the off-season when event exceedances are not anticipated.
- A qualified acoustical consultant should review the micro-siting of the ROC Monitors.
- Consider relocating the ROC North Monitor to a reference location at the Umbrella Bar to enable ROC staff to calibrate their sound system to comply with noise limits.

- Update the thresholds used to identify violations to those identified in Chapter 11.0 of this report.
- Require monthly reporting from the ROC on all sound exceedances occurring at each of the ROC compliance monitors, regardless of whether a complaint is filed or not.

12.3 FUTURE USES

A comprehensive sound study, conducted by a qualified acoustical consulting firm, should be conducted prior to the construction of any future uses at the ROC. The sound study should include a review of the proposed facility design, usage, and proposed equipment and activities, a calculation of sound levels anticipated in the surrounding neighborhoods, an evaluation of the calculated community sound exposure with respect to the applicable sound limits, and any noise reduction or mitigation needed to ensure compliance of the new facility with the sound limits. General acoustical design strategies should be used in the siting of future uses on the site, including positioning sound generating uses as far from sound sensitive areas as possible, providing shielding between sound generating and sound sensitive uses (such as building structures or topography), limiting sound generating uses to daytime hours when possible, and selecting quieter equipment. The City should ensure that enforcement of the noise limits are extended to any newly constructed use at the facility.

APPENDIX A. ACOUSTIC PRIMER

GLOSSARY OF TERMS

A-Weighting The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.

Ambient The all-encompassing sound associated with a given environment without contributions from the noise source or sources of interest. Note that the Zoning Ordinance uses “ambient” as meaning “background” (see below)

ANSI American National Standards Institute

ANSI/IEC Type – A classification of sound level meters from ANSI S1.4 and IEC 61672.

Attended Monitoring – Sound monitoring where a person is present to record their qualitative observations of the sound along with the sound level. A sound monitor may automatically record sound levels while the attendant is making observations, or the attendant can record both sound levels and observations at the same time.

Background Sound Level – The sound level measured without the presence of the sound of interest. In this case, it is the ambient sound level when ROC events are not occurring.

C-Weighting The C-weighting filter de-emphasizes the very high frequency components of the sound and is sometimes used to describe louder sounds or sounds with more low frequency content.

County Milwaukee County

dBA A-Weighted decibels (see A-Weighting, Decibel)

Decibel, dB A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.

Frequency In acoustics, the number of times in a second one cycle of a waveform passes a fixed space. The perceived pitch of a sound is proportional to its frequency. The relationship between wavelength and frequency is dependent on the speed of sound.

$$f = \frac{c}{\lambda}$$

where λ is wavelength, c is the speed of sound, and f is frequency. The typical hearing range for young healthy individuals is roughly between frequencies of 20 Hz (1 Hertz is one cycle per second) and 20,000 Hz (also designated as 20 kHz, where 1 kHz is one thousand cycles per second).

L_{1h}, L_{10m}, L_{24h} The average A-weighted sound pressure level, in decibels, during a period of one hour (1h), ten minutes (10m), 24 hours (24h), etc.

L_{50} The median, or 50th percentile sound level measured over a period.

L_{eq} Equivalent continuous sound level. The average of the mean square sound *pressure* over an entire monitoring period and expressed as a decibel:

$$Leq_T = 10 * log_{10}\left(\frac{1}{T}\int_{\theta}^{T} p_A^2(t)dt \Big/ p_{ref}^2\right)$$

where p_A^2 is the squared instantaneous weighted sound pressure signal, as a function of elapsed time t, p_{ref} is the reference pressure of 20 µPa, and T is the stated time interval. The reference pressure of 20 µPa is used for all measurements in this document.

The monitoring period, T, can be for any defined length of time. It could be one second ($L_{eq\ 1\text{-}sec}$), one hour (L_{1h}), eight hours (L_{8h}), or 24 hours (L_{24h}). Because L_{eq} is a logarithmic function of the average pressure, loud and infrequent sounds have a greater effect on the resulting L_{eq} than quieter and more frequent sounds.

Low Frequency Sound – Sound with frequency content between 20 Hz and 200 Hz.

Measured An observed quantity. In this report, we differentiate between measured values, for example, those that are logged by a sound level meter, and modeled values, such as those that are predicted by a sound propagation model.

Measurement Period - The time interval during which acoustical data are obtained.

m/s Velocity in meters per second

mph Velocity in miles per hour

Octave Bands - A band of frequencies whose lower frequency limit is one half of its upper frequency limit. An octave-band is identified by its center frequency. As an example, the 500 Hz octave band is the range which includes frequencies between 360 Hz and 720 Hz. An octave higher would be twice this. That is, it would be centered at 1,000 Hz with a range between 720 and 1,440 Hz. The range of human hearing is divided into 10 standardized octave-bands: 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz. For analyses that require even further frequency detail, each octave-band divided into equal parts, such as 1/3-octave-bands.

Octave Band Sound Pressure Level - The sound pressure level for the sound being measured contained within the specified octave band. The reference pressure is 20 micronewtons per square meter.

ROC Rock Sports Complex

Receptor A location with modeled or otherwise estimated sound levels.

Site The location of a sound measurement.

SLM Sound Level Meter

Sound [Pressure] Level – the sound pressure level as measured in decibels:

$$\text{Lp (in dB)} = 10log_{10}\left(\frac{p}{p_{ref}}\right)^2$$

where p is the sound pressure in Pascals and p_{ref} is the reference sound pressure of 20 µPa. All sound pressure levels shown in this document use this p_{ref}.

Spectrogram - A graph that illustrates the sound spectrum over time, with the horizontal axis as time, the vertical axis as the frequency, and the intensity of the color proportional to the sound level. The spectrogram is useful for identifying the sources of sound. For example, birds show short bursts of high frequency sound, while airplanes are mostly low frequency sound and show slow rise and fall times. In Figure 33 below, we can see several of these events.

Spectrum The components of a sound broken down into individual frequencies.

Tonal Sound Sound where narrow frequency band(s) are pronounced, such as in alarms, sirens, squeals, and horns.

Unattended monitoring – Sound monitoring where a sound level meter and associated equipment is left unattended for some length of time. Data are post-processed to filter out events not associated with the target source. Sound recordings may be taken along with the logged sound levels to aid in identification of different sources of sound.

WHO World Health Organization

Z-Weighting The unweighted sound pressure level.

EXPRESSING SOUND IN DECIBEL LEVELS

The varying air pressure that constitutes sound can be characterized in many different ways. The human ear is the basis for the metrics that are used in acoustics. Normal human hearing is sensitive to sound fluctuations over an enormous range of pressures, from about 20 micropascals (the “threshold of audibility”) to about 20 pascals (the “threshold of pain”).[8] This factor of one million in sound pressure difference is challenging to convey in engineering units. Instead, sound pressure is converted to sound “levels” in units of “decibels” (dB, named after Alexander Graham Bell). Once a measured sound is converted to dB, it is denoted as a level with the letter “L”.

[8] The pascal is a measure of pressure in the metric system. In Imperial units, they are themselves very small: one pascal is only 145 millionths of a pound per square inch (psi). The sound pressure at the threshold of audibility is only 3 one-billionths of one psi: at the threshold of pain, it is about 3 one-thousandths of one psi.

The conversion from sound pressure in pascals to sound level in dB is a four-step process. First, the sound wave's measured amplitude is squared and the mean is taken. Second, a ratio is taken between the mean square sound pressure and the square of the threshold of audibility (20 micropascals). Third, using the logarithm function, the ratio is converted to factors of 10. The final result is multiplied by 10 to give the decibel level. By this decibel scale, sound levels range from 0 dB at the threshold of audibility to 120 dB at the threshold of pain.

Typical sound sources, and their sound pressure levels, are listed on the scale in Figure 32.

HUMAN RESPONSE TO SOUND LEVELS: APPARENT LOUDNESS

For every 20 dB increase in sound level, the sound pressure increases by a *factor* of 10; the sound *level* range from 0 dB to 120 dB covers 6 factors of 10, or one million, in sound *pressure*. However, for an increase of 10 dB in sound *level* as measured by a meter, humans perceive an approximate doubling of apparent loudness: to the human ear, a sound level of 70 dB sounds about "twice as loud" as a sound level of 60 dB. Smaller changes in sound level, less than 3 dB up or down, are generally not perceptible.

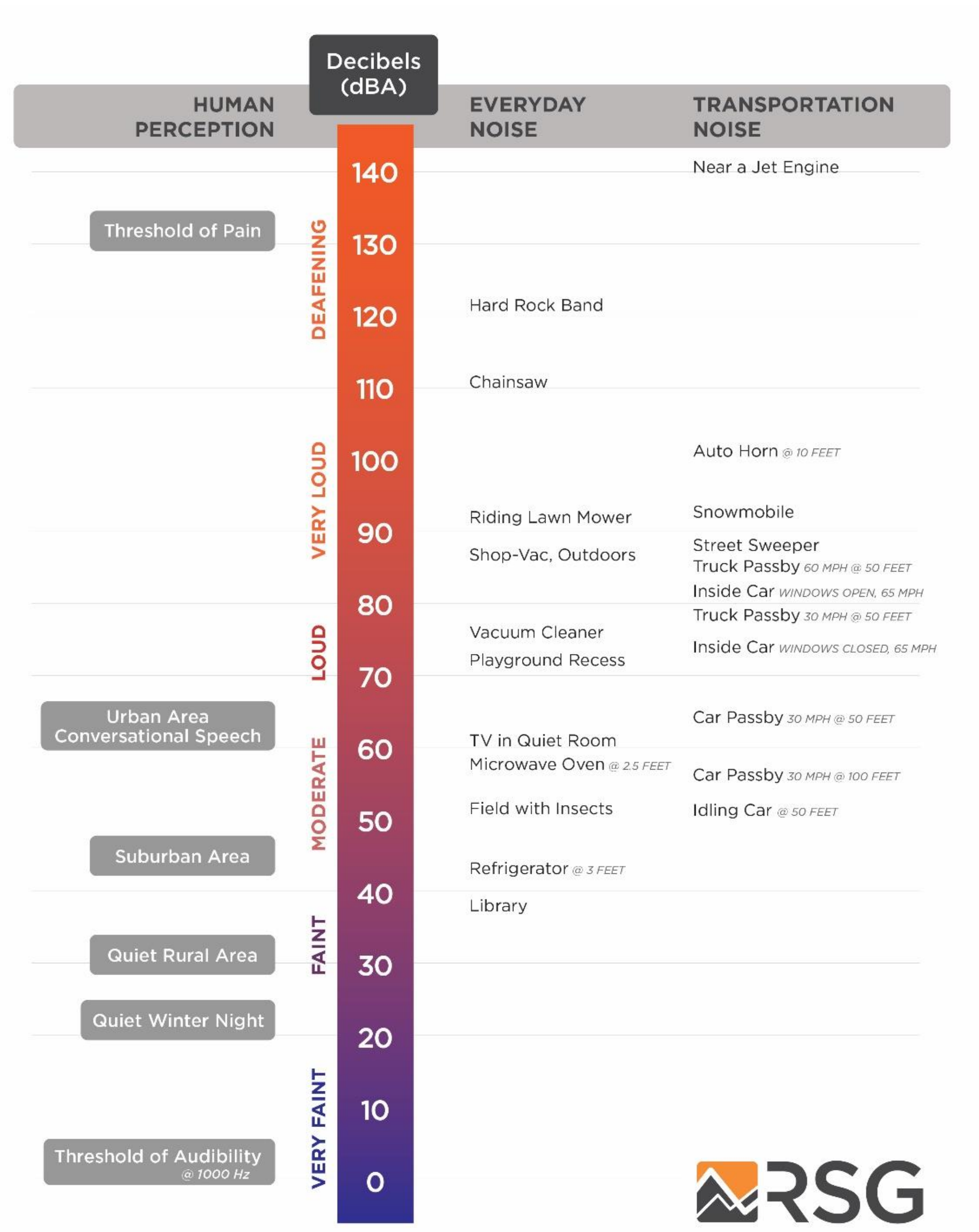


FIGURE 32: A SCALE OF SOUND PRESSURE LEVELS FOR TYPICAL SOUND SOURCES

FREQUENCY SPECTRUM OF SOUND

The “frequency” of a sound is the rate at which it fluctuates in time, expressed in Hertz (Hz), or cycles per second. Very few sounds occur at only one frequency: most sound contains energy at many different frequencies, and it can be broken down into different frequency divisions, or bands. These bands are similar to musical pitches, from low tones to high tones. The most common division is the standard octave band. An octave is the range of frequencies whose upper frequency limit is twice its lower frequency limit, exactly like an octave in music. An octave band is identified by its center frequency: each successive band’s center frequency is twice as high (one octave) as the previous band. For example, the 500 Hz octave band includes all sound whose frequencies range between 354 Hz (Hertz, or cycles per second) and 707 Hz. The next band is centered at 1,000 Hz with a range between 707 Hz and 1,414 Hz. The range of human hearing is divided into 10 standard octave bands: 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1,000 Hz, 2,000 Hz, 4,000 Hz, 8,000 Hz, and 16,000 Hz. For analyses that require finer frequency detail, each octave-band can be subdivided. A commonly used subdivision creates three smaller bands within each octave band, or so-called 1/3-octave bands.

THE SPECTROGRAM

One method of viewing the spectral sound level is to look at a spectrogram of the sound. As shown in Figure 33, the spectrogram shows the level, frequency spectra, and time in one graph. That is, the horizontal axis represents time, the vertical axis is frequency, and the intensity of the color is proportional to the intensity of the sound.

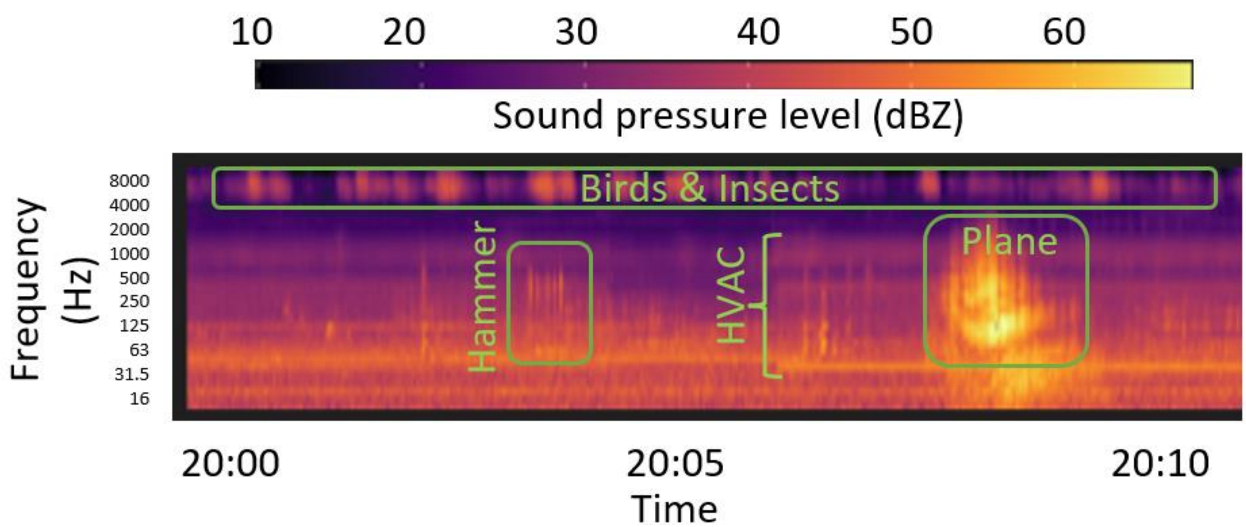


FIGURE 33: AN EXAMPLE OF A SOUND SPECTROGRAM WITH ANNOTATIONS

The spectrogram is useful for identify the sources of sound. For example, birds show short bursts of high frequency sound, while airplanes are mostly low frequency sound and show slow rise and fall times. In the example above, we can see several of these events.

HUMAN RESPONSE TO FREQUENCY: WEIGHTING OF SOUND LEVELS

The human ear is not equally sensitive to sounds of all frequencies. Sounds at some frequencies seem louder than others, despite having the same decibel level as measured by a sound level meter. In particular, human hearing is much more sensitive to medium pitches (from about 500 Hz to about 4,000 Hz) than to very low or very high pitches. For example, a tone measuring 80 dB at 500 Hz (a medium pitch) sounds quite a bit louder than a tone measuring 80 dB at 60 Hz (a very low pitch). The frequency response of normal human hearing ranges from 20 Hz to 20,000 Hz. Below 20 Hz, sound pressure fluctuations are not “heard”, but sometimes can be “felt”. This is known as “infrasound”. Likewise, above 20,000 Hz, sound can no longer be heard by humans; this is known as “ultrasound”. As humans age, they tend to lose the ability to hear higher frequencies first; many adults do not hear very well above about 16,000 Hz. Most natural and man-made sound occurs in the range from about 40 Hz to about 4,000 Hz. Some insects and birdsongs reach to about 8,000 Hz.

To adjust measured sound pressure levels so that they mimic human hearing response, sound level meters apply filters, known as “frequency weightings”, to the signals. There are several defined weighting scales, including “A”, “B”, “C”, “D”, “G”, and “Z”. The most common weighting scale used in environmental noise analysis and regulation is A-weighting. This weighting represents the sensitivity of the human ear to sounds of low to moderate level. It attenuates sounds with frequencies below 1000 Hz and above 4000 Hz; it amplifies very slightly sounds between 1000 Hz and 4000 Hz, where the human ear is particularly sensitive. The C-weighting scale is sometimes used to describe louder sounds. The B- and D- scales are seldom used. All of these frequency weighting scales are normalized to the average human hearing response at 1000 Hz: at this frequency, the filters neither attenuate nor amplify. When a reported sound level has been filtered using a frequency weighting, the letter is appended to “dB”. For example, sound with A-weighting is usually denoted “dBA”. When no filtering is applied, the level is denoted “dB” or “dBZ”. The letter is also appended as a subscript to the level indicator “L”, for example “L_A” for A-weighted levels.

A relatively new standard weighting is the ANS weight. ANS stands for A-weighted, natural sounds. The ANS weight is the same as the A-weighting, but it filters out all sound above the 1,000 Hz octave band. Thus, it removes the impact of many high frequency biogenic sound such as insects, birds, and amphibians. The ANS weighting is often used to eliminate the effects of seasonality of sound, as there are fewer insects and birds during the winter than the summer.

TIME RESPONSE OF SOUND LEVEL METERS

Because sound levels can vary greatly from one moment to the next, the time over which sound is measured can influence the value of the levels reported. Often, sound is measured in real time, as it fluctuates. In this case, acousticians apply a so-called "time response" to the sound level meter, and this time response is often part of regulations for measuring sound. If the sound level is varying slowly, over a few seconds, "Slow" time response is applied, with a time constant of one second. If the sound level is varying quickly (for example, if brief events are mixed into the overall sound), "Fast" time response can be applied, with a time constant of one-eighth of a second.[9] The time response setting for a sound level measurement is indicated with the subscript "S" for Slow and "F" for Fast: L_S or L_F. A sound level meter set to Fast time response will indicate higher sound levels than one set to Slow time response when brief events are mixed into the overall sound, because it can respond more quickly.

In some cases, the maximum sound level that can be generated by a source is of concern. Likewise, the minimum sound level occurring during a monitoring period may be required. To measure these, the sound level meter can be set to capture and hold the highest and lowest levels measured during a given monitoring period. This is represented by the subscript "max", denoted as "L_{max}". One can define a "max" level with Fast response L_{Fmax} (1/8-second time constant), Slow time response L_{Smax} (1-second time constant), or Continuous Equivalent level over a specified time period $L_{eq,max,1s}$.

ACCOUNTING FOR CHANGES IN SOUND OVER TIME

A sound level meter's time response settings are useful for continuous monitoring. However, they are less useful in summarizing sound levels over longer periods. To do so, acousticians apply simple statistics to the measured sound levels, resulting in a set of defined types of sound level related to averages over time. An example is shown in Figure 34. The sound level at each instant of time is the grey trace going from left to right. Over the total time it was measured (1 hour in the figure), the sound energy spends certain fractions of time near various levels, ranging from the minimum (about 27 dB in the figure) to the maximum (about 65 dB in the figure). The simplest descriptor is the average sound level, known as the Equivalent Continuous Sound Level. Statistical levels are used to determine for what percentage of time the sound is louder than any given level. These levels are described in the following sections.

Equivalent Continuous Sound Level - L_{eq}

One straightforward, common way of describing sound levels is in terms of the Continuous Equivalent Sound Level, or L_{eq}. The L_{eq} is the average sound pressure level over a defined period of time, such as one hour or one day. L_{eq} is the most commonly used descriptor in noise

[9] There is a third-time response defined by standards, the "Impulse" response. This response was defined to enable use of older, analog meters when measuring very brief sounds; it is no longer in common use.

standards and regulations. L_{eq} is representative of the overall sound to which a person is exposed. Because of the logarithmic calculation of decibels, L_{eq} tends to favor higher sound levels: loud and infrequent sources have a larger impact on the resulting average sound level than quieter but more frequent sounds. For example, in Figure 34, even though the sound levels spends most of the time near about 34 dBA, the L_{EQ} is 41 dBA, having been "inflated" by the maximum level of 65 dBA and other occasional spikes over the course of the hour.

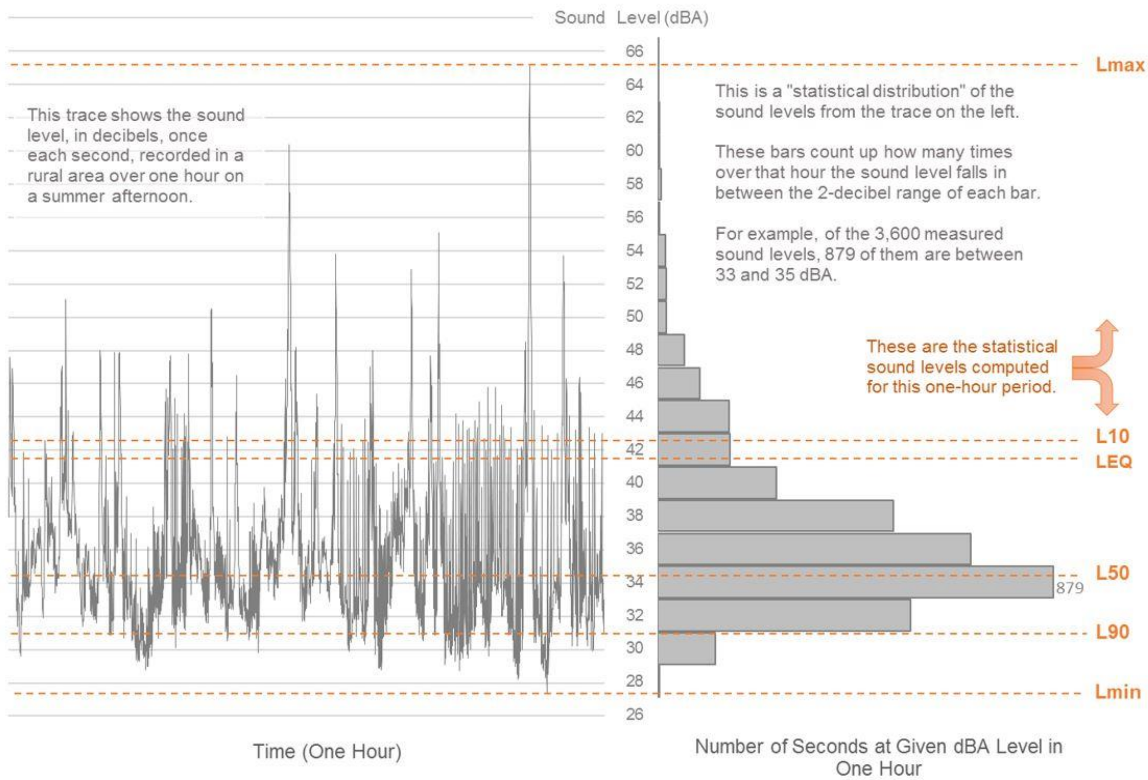


FIGURE 34: EXAMPLE OF DESCRIPTIVE TERMS OF SOUND MEASUREMENT OVER TIME

Percentile Sound Levels – L_N

Percentile sound levels describe the statistical distribution of sound levels over time. "L_N" is the level above which the sound spends "N" percent of the time. For example, L_{90} (sometimes called the "residual base level") is the sound level exceeded 90% of the time: the sound is louder than L_{90} most of the time. L_{10} is the sound level that is exceeded only 10% of the time. L_{50} (the "median level") is exceeded 50% of the time: half of the time the sound is louder than L_{50}, and half the time it is quieter than L_{50}. Note that L_{50} (median) and L_{eq} (mean) are not always the same, for reasons described in the previous section.

The L_{90} is the sound that persists for longer periods, and below which the overall sound level seldom falls. It tends to filter out other short-term environmental sounds that aren't part of the source being investigated. L_{10} represents the higher, but less frequent, sound levels. These could include such events as barking dogs, vehicles driving by and aircraft flying overhead, gusts of wind, and work operations.

Note that if one sound source is very constant and dominates the soundscape in an area, all of the descriptive sound levels mentioned here tend toward the same value. It is when the sound is varying widely from one moment to the next that the statistical descriptors are useful.

Sound Levels from Multiple Sources: Adding Decibels

Because of the way that sound levels in decibels are calculated, the sounds from more than one source do not add arithmetically. Instead, two sound sources that are the same decibel level increase the total sound level by 3 dB. For example, suppose the sound from an industrial blower registers 80 dB at a distance of 2 meters (6.6 feet). If a second industrial blower is operated next to the first one, the sound level from both machines will be 83 dB, not 160 dB. Adding two more blowers (a total of four) raises the sound level another 3 dB to 86 dB. Finally, adding four more blowers (a total of eight) raises the sound level to 89 dB. It would take eight total blowers, running together, for a person to judge the sound as having “doubled in loudness”.

Recall from the explanation of sound levels that a difference of 10 decibels is a factor of 20 in sound pressure and a factor of 10 in sound power. (The difference between sound pressure and sound power is described in the next Section.) If two sources of sound differ individually by 10 decibels, the louder of the two is generating *ten times* more sound. This means that the loudest source(s) in any situation always dominates the total sound level. Looking again at the industrial blower running at 80 decibels, if a small ventilator fan whose level alone is 70 decibels were operated next to the industrial blower, the total sound level increases by only 0.4 decibels, to 80.4 decibels. The small fan is only 10% as loud as the industrial blower, so the larger blower completely dominates the total sound level.

The Difference between Sound Pressure and Sound Power

The human ear and microphones respond to variations in sound *pressure*. However, in characterizing the sound emitted by a specific source, it is proper to refer to sound *power*. While sound pressure induced by a source can vary with distance and conditions, the power is the same for the source under all conditions, regardless of the surroundings or the distance to the nearest listener. In this way, sound power levels are used to characterize noise sources because they act like a “fingerprint” of the source. An analogy can be made to light bulbs. The bulb emits a constant amount of light under all conditions, but its perceived brightness diminishes as one moves away from it.

Both sound power and sound pressure levels are described in terms of decibels, but they are not the same thing. Decibels of sound pressure are related to 20 micropascals, as explained at the beginning of this primer. Sound power is a measure of the acoustic power emitted or radiated by a source; its decibels are relative to one picowatt.

Sound Propagation Outdoors

As a listener moves away from a source of sound, the sound level decreases due to "geometrical divergence": the sound waves spread outward like ripples in a pond and lose energy. For a sound source that is compact in size, the received sound level diminishes or attenuates by 6 dB for every doubling of distance: a sound whose level is measured as 70 dBA at 100 feet from a source will have a measured level of 64 dBA at 200 feet from the source and 58 dBA at 400 feet. Other factors, such as walls, berms, buildings, terrain, atmospheric absorption, and intervening vegetation will also further reduce the sound level reaching the listener.

The type of ground over which sound is propagating can have a strong influence on sound levels. Harder ground, pavement, and open water are very reflective, while soft ground, snow cover, or grass is more absorptive. In general, sounds of higher frequency will attenuate more over a given distance than sounds of lower frequency: the "boom" of thunder can be heard much further away than the initial "crack".

Atmospheric and meteorological conditions can enhance or attenuate sound from a source in the direction of the listener. Wind blowing from the source toward the listener tends to enhance sound levels; wind blowing away from the listener toward the source tends to attenuate sound levels. Normal temperature profiles (typical of a sunny day, where the air is warmer near the ground and gets colder with increasing altitude) tend to attenuate sound levels; inverted profiles (typical of nighttime and some overcast conditions) tend to enhance sound levels.

APPENDIX B. APPROVED WORKPLAN

APPENDIX C. PUBLIC MEETING MATERIALS

APPENDIX D. ROC FACILITY SCHEDULES AND INFORMATION

APPENDIX E. ATTENDED SOUND MONITORING RESULTS

APPENDIX F. PHOTOGRAPHS OF LONG-TERM MONITORING SITES

FIGURE 35: PHOTOGRAPHS OF EAST LONG-TERM MONITOR

FIGURE 36: PHOTOGRAPHS OF NORTH LONG-TERM MONITOR

FIGURE 37: PHOTOGRAPHS OF WEST LONG-TERM MONITOR

APPENDIX G. LONG-TERM MONITORING DATA

Long-term monitoring data, including sound level and meteorological data, is available by request from Milwaukee County. Sound level data includes compiled spectragrams and 1/3 octave band sound levels in one-second and 10-minute intervals at all three long-term monitor locations over the full six-month monitoring period. Meteorological data includes the average wind speed and maximum wind gust speed in one-minute intervals over the full six-month monitoring period. To ensure the privacy of any recorded information, audio files can only be made available if funding is provided for RSG staff to listen to the files and remove any private conversations or other identifying information.

APPENDIX H. SOUND MODELING INPUTS

TABLE 12: MODEL PARAMETER SETTINGS

MODEL PARAMETER	SETTING
Atmospheric Absorption	Based on 10ºC and 70% RH
Foliage	No foliage attenuation
Ground Absorption	ISO 9613-2 spectral, G=1.0
Search Radius	5,000 meters from each source
Receiver Height	1.5 meters for sound level isolines, and 1.5 and 4 meters for discrete receptors

TABLE 13: MODELED SOUND POWER SPECTRA, IN dBA

NAME	SOUND POWER LEVEL	OCTAVE BAND CENTER FREQUENCY (Hz)								
		31.5	63	125	250	500	1000	2000	4000	8000
Snow Machine	112	63	70	88	105	105	108	103	98	89
Field Speaker	112	65	83	106	106	101	107	104	94	--
Umbrella Bar Stage	126	100	109	118	118	122	119	110	107	90
Fireworks Ground Launch	150	99	121	136	142	143	146	143	131	121
Fireworks Burst	150	91	114	131	142	147	143	138	134	117
Hills have Eyes	80	-	69	77	-	-	-	-	72	75

TABLE 14: SOURCE INPUT DATA

NAME	SOUND POWER LEVEL (dBA)	HEIGHT (m)	COORDINATES (NAD83 UTM16N)		
			X (m)	Y (m)	Z (m)
Fireworks Ground Launch	150	0.5	417112	4752629	239
Fireworks Burst	150	183	417111	4752630	421
Baseball Field Speaker 1	112	6	417228	4752187	253
Baseball Field Speaker 2	112	6	417089	4752244	252
Baseball Field Speaker 3	112	6	417131	4752277	251
Baseball Field Speaker 4	112	6	417186	4752139	253
Baseball Field Speaker 5	112	3	417152	4752281	250
Baseball Field Speaker 6	112	6	417132	4752277	252
Baseball Field Speaker 7	112	6	417090	4752244	253
Baseball Field Speaker 8	112	4	417082	4752188	251
Baseball Field Speaker 9	112	5	417096	4752152	250
Baseball Field Speaker 10	112	4	417127	4752141	250
Baseball Field Speaker 11	112	6	417186	4752139	253
Baseball Field Speaker 12	112	6	417228	4752186	253
Umbrella Bar Stage Speaker	126	1.5	417311	4752477	253
Snow Machine 1	112	1.5	417042	4752463	257
Snow Machine 2	112	1.5	416979	4752502	271
Snow Machine 3	112	3	417089	4752558	244
Snow Machine 4	112	3	417090	4752599	239
Snow Machine 5	112	1.5	416989	4752542	260
Snow Machine 6	112	1.5	416994	4752602	245
Snow Machine 7	112	3	417093	4752514	252
Snow Machine 8	112	1.5	416929	4752474	284
Snow Machine 9	112	1.5	417002	4752669	229
Snow Machine 10	112	1.5	416891	4752761	218
Hills Have Eyes Area	80	1.5	417219	4752757	220

APPENDIX I. SOUND MODELING RESULTS

TABLE 15: MODELED SOUND LEVELS AT DISCRETE RECEPTOR LOCATIONS

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R001	A	8211 Fairmont Ln	Greendale	72	75	36	38	43	45	44	46	41	42	45	46
R002	A	8201 Fairmont Ln	Greendale	72	75	36	38	43	46	44	46	41	42	44	46
R003	A	6285 Parkview Rd	Greendale	75	78	38	40	44	46	45	47	44	46	47	48
R004	A	6266 Parkview Rd	Greendale	73	76	36	38	43	45	44	46	42	44	44	46
R005	A	8251 Firwood Ln	Greendale	75	78	38	39	44	47	45	47	44	46	47	48
R006	A	6275 Parkview Rd	Greendale	73	76	37	38	43	45	44	46	42	44	43	46
R007	A	6269 Parkview Rd	Greendale	73	76	37	38	43	45	44	46	42	44	44	46
R008	A	6283 Parkview Rd	Greendale	74	77	38	39	44	46	45	47	44	45	46	48
R009	A	6289 Parkview Rd	Greendale	76	79	39	40	45	47	46	48	46	47	49	49
R010	A	6280 Parkview Rd	Greendale	74	77	38	39	44	46	45	47	44	45	47	48
R011	A	6290 Parkview Rd	Greendale	76	79	39	40	45	47	46	48	45	47	49	49
R012	A	6279 Parkview Rd	Greendale	74	77	37	39	43	46	44	46	43	45	46	47
R013	A	6287 Parkview Rd	Greendale	75	79	39	40	44	47	45	48	45	47	47	49
R014	A	6293 Fleetwood Ct	Greendale	77	80	40	41	45	48	46	49	47	48	50	51
R015	A	6297 Fleetwood Ct	Greendale	77	80	40	41	46	48	47	49	47	48	51	51
R016	A	6270 Parkview Rd	Greendale	73	76	37	38	43	46	44	46	43	44	46	46
R017	B	6605 Hill Ridge Dr	Greendale	75	78	40	41	47	50	48	50	42	43	47	47
R018	B	7390 Hill Valley Ct	Greendale	75	79	40	42	48	50	48	51	42	44	47	48
R019	B	6978 Heathmeadow Ct	Greendale	71	74	37	39	41	43	43	44	38	39	41	42
R020	B	6687 Hill Ridge Dr	Greendale	75	79	41	42	49	51	49	51	42	44	48	48
R021	B	7351 Highview Dr	Greendale	76	79	43	44	42	45	45	48	43	44	47	48
R022	B	6720 Hill Ridge Dr	Greendale	75	78	41	43	42	46	45	48	42	43	46	47

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R023	A	6291 Fleetwood Ct	Greendale	76	79	39	41	45	47	46	48	46	48	49	50
R024	A	6295 Fleetwood Ct	Greendale	77	80	40	41	46	48	47	49	47	49	51	51
R025	A	8280 Flagstone Ct	Greendale	72	75	36	37	43	45	44	46	41	43	44	46
R026	A	8276 Flagstone Ct	Greendale	72	76	36	38	44	46	44	46	42	43	44	46
R027	A	6276 Parkview Rd	Greendale	74	77	37	39	44	46	45	47	43	45	47	47
R028	A	6286 Parkview Rd	Greendale	75	78	39	40	44	47	45	48	45	46	48	49
R029	B	6570 Hill Ridge Dr	Greendale	76	79	40	41	47	50	48	50	43	44	48	48
R030	E	8815 W Meadow Ln	Franklin	74	78	42	43	44	47	46	48	41	42	43	44
R031	D	7217 S Woelfel Rd	Franklin	69	73	37	38	34	37	39	40	35	37	39	40
R032	D	7145 S Woelfel Rd	Franklin	71	74	38	39	35	40	40	42	36	38	39	40
R033	D	7165 S Woelfel Rd	Franklin	70	74	37	39	34	38	39	41	36	37	39	40
R034	A	8267 Firwood Ln	Greendale	73	76	36	37	43	45	44	46	42	43	44	46
R035	A	8254 Firwood Ln	Greendale	74	77	37	38	44	46	45	47	43	45	47	48
R036	A	8242 Firwood Ln	Greendale	75	78	38	39	45	47	45	48	45	46	48	49
R037	A	8264 Firwood Ln	Greendale	73	77	36	38	44	46	44	47	43	44	46	47
R038	A	8243 Firwood Ln	Greendale	76	79	38	40	45	47	46	48	45	47	49	50
R039	A	8247 Firwood Ln	Greendale	75	78	38	39	44	47	45	48	45	46	48	49
R040	A	8263 Firwood Ln	Greendale	73	76	36	38	43	46	44	46	43	44	46	47
R041	A	6313 Parkview Rd	Greendale	77	80	40	41	47	49	48	50	47	48	52	52
R042	A	6309 Parkview Rd	Greendale	78	81	40	41	47	49	48	50	47	48	52	52
R043	A	6312 Parkview Rd	Greendale	77	80	39	40	46	48	47	49	46	47	50	51
R044	A	6319 Parkview Rd	Greendale	76	80	40	41	47	49	48	50	46	47	50	51
R045	A	6323 Parkview Rd	Greendale	76	79	39	40	47	49	48	50	45	46	48	50
R046	A	6267 Overlook Ct	Greendale	72	75	36	37	44	46	44	46	40	42	44	45
R047	A	6210 Overlook Ct	Greendale	71	74	36	37	43	45	44	46	40	41	44	45
R048	A	6280 Overlook Ct	Greendale	72	75	36	38	44	46	45	47	41	42	44	46
R049	A	7718 Overlook Dr	Greendale	73	76	37	38	44	46	45	47	41	43	45	46
R050	A	6320 Parkview Rd	Greendale	76	79	39	40	46	48	47	49	45	46	48	50

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R052	B	6620 Hill Ridge Dr	Greendale	74	78	39	41	46	49	47	49	41	43	46	46
R053	B	6630 Hill Ridge Dr	Greendale	74	78	39	41	46	49	47	49	41	43	46	46
R054	B	7220 Horizon Dr	Greendale	73	77	40	41	44	47	46	48	40	42	45	45
R055	B	7283 Huckleberry Ct	Greendale	74	77	40	41	47	49	48	50	41	42	45	46
R056	B	7291 Huckleberry Ct	Greendale	74	77	40	41	47	49	48	50	41	42	46	46
R057	B	7274 Huckleberry Ct	Greendale	74	77	39	41	46	49	47	49	41	42	45	46
R058	B	7242 Huckleberry Ct	Greendale	73	77	39	41	46	48	47	49	40	41	45	45
R059	B	7210 Huckleberry Ct	Greendale	73	76	39	40	46	48	46	49	40	41	44	45
R060	B	7080 Horizon Dr	Greendale	72	75	38	39	44	48	45	48	39	40	42	43
R061	B	6900 Horizon Dr	Greendale	70	73	36	38	41	43	42	44	37	38	40	41
R062	B	6840 Horizon Dr	Greendale	70	73	36	38	40	42	41	43	37	39	40	41
R063	B	6571 Hill Ridge Dr	Greendale	75	79	39	42	48	50	49	51	42	44	49	49
R064	B	6591 Hill Ridge Dr	Greendale	75	79	40	41	47	50	48	50	42	44	47	48
R065	B	6645 Hill Ridge Dr	Greendale	75	78	40	41	47	50	48	50	42	43	47	47
R066	B	7476 Hill Valley Ct	Greendale	77	80	41	42	49	51	50	52	44	46	50	51
R067	B	7501 Hill Valley Ct	Greendale	77	81	42	43	50	52	51	53	44	46	51	51
R068	B	6681 Hill Ridge Dr	Greendale	75	78	41	42	48	51	49	51	42	43	47	48
R069	B	6715 Hill Ridge Dr	Greendale	75	79	42	43	45	48	46	49	42	44	47	48
R070	B	6725 Hill Ridge Dr	Greendale	76	79	42	43	44	47	46	49	42	44	47	48
R071	B	7376 Highview Dr	Greendale	76	80	43	44	44	48	47	49	43	44	48	49
R072	B	6714 Hilldale Ct	Greendale	76	79	42	43	46	50	48	51	43	44	48	48
R073	B	6701 Hilldale Ct	Greendale	76	79	42	43	49	51	50	52	43	44	48	49
R074	B	6709 Hilldale Ct	Greendale	76	79	42	43	50	52	50	53	43	44	49	49
R075	B	6744 Hill Park Ct	Greendale	78	81	44	45	52	54	53	55	44	46	51	51
R076	B	6706 Hill Park Ct	Greendale	76	80	42	44	50	53	51	53	43	45	50	50
R077	B	6696 Hill Park Ct	Greendale	76	80	42	43	50	52	51	53	43	45	49	50
R078	B	7571 Highview Dr	Greendale	79	82	45	46	50	52	51	53	45	47	51	52
R079	B	7511 Highview Dr	Greendale	78	81	44	46	47	49	49	51	44	46	51	51

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R080	B	7361 Highview Dr	Greendale	76	79	43	44	43	46	46	48	43	44	48	48
R081	B	6740 Hill Ridge Dr	Greendale	75	79	42	43	42	45	45	47	42	43	47	47
R082	B	6710 Hill Ridge Dr	Greendale	74	78	41	42	43	47	45	48	42	43	46	47
R083	B	7231 Horizon Dr	Greendale	74	77	40	41	42	46	44	47	40	42	45	45
R084	B	7086 Hollow Ln	Greendale	72	76	39	40	42	44	43	45	39	41	43	44
R085	B	7151 Horizon Dr	Greendale	72	76	39	40	44	48	45	48	39	41	43	44
R086	B	7053 Heathmeadow Ct	Greendale	72	75	38	40	45	48	46	49	39	40	43	44
R087	B	6962 Heathmeadow Ct	Greendale	71	74	37	38	40	42	42	44	38	39	41	42
R088	B	7032 Heathmeadow Ct	Greendale	71	75	38	39	44	46	45	47	38	40	42	43
R089	B	7050 Heathmeadow Ct	Greendale	71	75	38	39	46	48	46	48	38	40	42	43
R090	B	7027 Horizon Dr	Greendale	71	75	37	39	45	47	46	48	38	39	42	43
R091	A	8272 Flagstone Ct	Greendale	73	76	36	38	44	46	44	47	42	43	46	46
R092	A	6329 Parkview Rd	Greendale	75	78	38	40	47	49	47	49	44	45	48	49
R093	A	6333 Parkview Rd	Greendale	74	77	38	39	46	48	46	48	43	44	47	48
R094	A	6215 Overlook Ct	Greendale	71	75	36	37	44	46	44	46	40	42	44	45
R095	A	7716 Overlook Dr	Greendale	72	76	36	38	44	46	45	47	41	43	46	46
R096	A	6332 Parkview Rd	Greendale	74	77	37	39	45	47	46	48	42	44	47	47
R097	A	6330 Parkview Rd	Greendale	74	77	38	39	46	48	46	48	43	44	47	48
R098	A	6324 Parkview Rd	Greendale	75	78	39	40	47	49	47	49	44	45	48	49
R099	A	6322 Parkview Rd	Greendale	75	79	39	40	46	48	47	49	44	46	49	49
R101	B	6560 Hill Ridge Dr	Greendale	76	79	40	42	48	50	48	51	43	45	48	50
R102	B	6580 Hill Ridge Dr	Greendale	76	79	40	41	47	49	48	50	42	44	47	48
R103	B	6650 Hill Ridge Dr	Greendale	74	78	40	41	47	50	48	51	41	43	46	47
R104	B	6660 Hill Ridge Dr	Greendale	74	78	40	41	47	50	48	50	41	43	46	47
R105	B	6670 Hill Ridge Dr	Greendale	74	78	40	42	47	50	48	50	41	43	46	47
R106	B	6690 Hill Ridge Dr	Greendale	75	78	41	42	48	50	49	51	42	43	47	47
R107	B	6694 Hill Ridge Dr	Greendale	75	78	41	42	48	50	49	51	42	43	47	47
R108	B	7260 Horizon Dr	Greendale	74	77	40	41	46	49	47	50	41	42	46	46

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R109	B	7200 Horizon Dr	Greendale	73	77	39	41	44	47	45	48	40	41	44	45
R110	B	7275 Huckleberry Ct	Greendale	73	77	40	41	46	49	47	50	40	42	45	46
R111	B	7181 Hyacinth Ct	Greendale	73	76	39	40	45	48	46	48	40	41	44	45
R112	B	7217 Hyacinth Ct	Greendale	73	77	39	40	45	48	46	49	40	42	44	45
R113	B	7271 Hyacinth Ct	Greendale	74	77	39	41	46	50	47	50	41	42	45	46
R114	B	7292 Hyacinth Ct	Greendale	74	77	39	40	46	49	47	50	41	42	45	46
R115	B	7182 Hyacinth Ct	Greendale	73	76	38	40	47	48	47	49	40	41	43	44
R116	B	7498 Hill Valley Ct	Greendale	77	80	41	43	49	51	50	52	45	47	51	52
R117	B	7521 Hill Valley Ct	Greendale	77	81	42	43	50	52	50	53	44	46	51	51
R118	B	7441 Hill Valley Ct	Greendale	76	80	41	42	49	51	50	52	43	45	49	49
R119	B	7425 Hill Valley Ct	Greendale	76	79	41	42	49	51	49	51	43	44	49	49
R120	B	7365 Hill Valley Ct	Greendale	75	78	41	42	48	50	49	51	42	43	47	48
R121	B	6695 Hill Ridge Dr	Greendale	75	79	41	43	49	51	50	52	42	43	48	48
R122	B	6741 Hill Ridge Dr	Greendale	76	79	42	43	43	47	46	49	43	44	47	48
R123	B	6723 Hilldale Ct	Greendale	77	80	43	44	51	53	51	54	43	45	50	50
R124	B	6735 Hilldale Ct	Greendale	77	80	43	44	49	51	50	52	43	45	50	50
R125	B	6734 Hill Park Ct	Greendale	77	81	43	44	52	54	52	54	44	46	51	51
R126	B	6716 Hill Park Ct	Greendale	77	80	43	44	51	53	52	54	44	45	50	51
R127	B	6688 Hill Park Ct	Greendale	76	79	41	43	49	51	50	52	43	44	49	49
R128	B	6693 Hill Park Ct	Greendale	76	80	42	43	50	53	50	53	43	45	50	50
R129	B	6697 Hill Park Ct	Greendale	77	80	42	43	50	53	51	54	43	45	50	50
R130	B	6737 Hill Park Ct	Greendale	78	82	44	45	53	55	53	55	44	46	52	52
R131	B	7541 Highview Dr	Greendale	78	82	45	46	49	51	50	52	45	46	51	52
R132	B	7255 Horizon Dr	Greendale	74	77	40	42	43	47	45	48	41	42	45	46
R133	B	7221 Horizon Dr	Greendale	73	77	40	41	42	46	44	47	40	42	44	45
R134	B	7111 Hollow Ln	Greendale	73	76	39	41	41	44	43	46	40	41	44	44
R135	B	7062 Hollow Ln	Greendale	72	76	39	40	41	43	43	45	39	41	43	44
R136	B	7112 Hollow Ln	Greendale	72	76	39	40	41	45	43	46	40	41	43	44

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R137	B	7185 Horizon Dr	Greendale	72	76	39	40	42	46	44	47	40	41	44	44
R138	B	7125 Horizon Dr	Greendale	72	76	38	40	45	47	45	48	39	40	43	44
R139	B	7077 Heathmeadow Ct	Greendale	72	75	38	39	44	48	45	49	39	40	43	44
R140	B	6611 Hollyhock Ct	Greendale	72	75	38	40	43	45	45	47	39	40	43	44
R141	B	6965 Heathmeadow Ct	Greendale	71	74	37	39	40	42	42	44	38	39	41	42
R142	B	6996 Heathmeadow Ct	Greendale	71	74	37	39	42	44	43	45	38	39	41	42
R143	A	6301 Parkview Rd	Greendale	77	81	40	41	46	49	47	49	47	49	51	52
R144	A	8258 Fremont Ct	Greendale	74	77	37	39	44	47	45	47	43	45	47	48
R145	A	6325 Parkview Rd	Greendale	75	79	39	40	47	49	48	50	44	46	49	49
R146	B	6967 Horizon Dr	Greendale	70	74	37	38	43	45	44	46	38	39	41	42
R147	A	6327 Parkview Rd	Greendale	75	78	39	40	47	49	47	49	44	45	49	49
R148	A	6331 Parkview Rd	Greendale	74	78	38	39	46	48	47	49	43	44	46	48
R149	A	6337 Parkview Rd	Greendale	73	76	37	38	45	47	46	48	42	43	44	47
R150	A	6252 Overlook Ct	Greendale	72	75	36	37	44	46	45	46	40	42	45	45
R151	A	7719 Overlook Dr	Greendale	72	76	37	38	44	46	45	47	41	43	43	46
R152	A	6334 Parkview Rd	Greendale	73	76	37	39	45	47	46	48	42	43	46	47
R153	B	6540 Hill Ridge Dr	Greendale	77	80	40	42	48	50	49	51	45	46	49	51
R154	B	6550 Hill Ridge Dr	Greendale	76	79	40	42	48	50	49	51	44	46	49	50
R155	B	6600 Hill Ridge Dr	Greendale	75	78	40	41	47	49	47	50	41	43	46	47
R156	B	6640 Hill Ridge Dr	Greendale	74	78	40	41	47	49	47	50	41	43	46	46
R157	B	6680 Hill Ridge Dr	Greendale	74	78	40	42	48	50	48	51	42	43	46	47
R158	B	7240 Horizon Dr	Greendale	74	77	40	41	45	48	46	49	41	42	45	46
R159	B	7150 Horizon Dr	Greendale	73	76	39	40	46	48	46	49	40	41	44	45
R160	B	7288 Huckleberry Ct	Greendale	74	77	40	41	47	49	47	50	41	42	45	46
R161	B	7251 Hyacinth Ct	Greendale	73	77	39	40	46	48	47	49	40	42	45	45
R162	B	7206 Hyacinth Ct	Greendale	73	76	38	40	46	47	47	48	40	41	44	45
R163	B	7130 Horizon Dr	Greendale	73	76	38	39	45	47	45	48	39	41	43	44
R164	B	7110 Horizon Dr	Greendale	72	75	38	39	44	48	45	49	39	40	43	44

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R165	B	7060 Horizon Dr	Greendale	72	75	37	39	44	47	45	48	38	40	42	43
R166	B	7040 Horizon Dr	Greendale	71	75	37	39	45	47	46	48	38	40	42	43
R167	B	7000 Horizon Dr	Greendale	71	74	37	38	45	47	45	47	38	39	41	42
R168	B	6960 Horizon Dr	Greendale	70	74	37	38	44	46	45	47	37	39	41	42
R169	B	6551 Hill Ridge Dr	Greendale	76	80	41	42	48	51	49	51	43	45	50	50
R170	B	7410 Hill Valley Ct	Greendale	75	79	40	42	48	50	49	51	42	44	48	48
R171	B	7460 Hill Valley Ct	Greendale	76	80	41	42	49	51	49	52	43	45	49	50
R172	B	7485 Hill Valley Ct	Greendale	77	80	42	43	50	52	50	52	44	45	50	50
R173	B	6691 Hill Ridge Dr	Greendale	75	79	41	42	49	51	49	52	42	43	48	48
R174	B	6699 Hill Ridge Dr	Greendale	75	79	41	43	48	50	49	51	42	44	47	48
R175	B	6703 Hill Ridge Dr	Greendale	75	79	42	43	46	48	47	49	42	44	47	48
R176	B	7364 Highview Dr	Greendale	76	79	42	44	43	47	46	48	43	44	48	48
R177	B	6746 Hilldale Ct	Greendale	77	80	43	44	45	49	47	50	43	45	49	49
R178	B	6753 Hilldale Ct	Greendale	77	81	43	45	47	50	49	51	43	45	50	50
R179	B	6728 Hill Park Ct	Greendale	77	81	43	44	51	53	52	54	44	45	51	51
R180	B	6692 Hill Park Ct	Greendale	76	79	42	43	50	52	50	52	43	44	49	49
R181	B	6685 Hillpark Ct	Greendale	76	79	41	43	49	52	50	53	42	44	49	49
R182	B	6689 Hill Park Ct	Greendale	76	80	42	43	49	52	50	52	43	44	49	50
R183	B	6727 Hill Park Ct	Greendale	78	81	43	44	52	55	52	55	44	46	52	52
R184	B	6747 Hill Park Ct	Greendale	79	82	44	46	54	56	54	56	44	46	52	52
R185	B	7481 Highview Dr	Greendale	77	81	44	45	46	48	48	50	44	45	50	50
R186	B	7421 Highview Dr	Greendale	77	80	43	45	44	47	47	49	43	45	49	49
R187	B	7360 Old Loomis Rd	Greendale	76	79	43	45	42	46	46	48	43	44	48	48
R188	B	6700 Hill Ridge Dr	Greendale	75	78	41	42	44	48	46	49	42	43	46	47
R189	B	7279 Horizon Dr	Greendale	74	78	41	42	44	46	45	48	41	43	46	46
R190	B	7071 Hollow Ln	Greendale	72	76	39	41	40	43	43	45	40	41	43	44
R191	B	7163 Horizon Dr	Greendale	72	76	39	40	43	46	44	47	39	41	43	44
R192	B	7133 Horizon Dr	Greendale	72	76	38	40	45	47	46	48	39	40	43	44

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R193	B	6601 Hollyhock Ct	Greendale	72	75	38	40	45	47	45	47	39	40	43	44
R194	B	6641 Hollyhock Ct	Greendale	72	75	38	40	41	43	43	45	39	41	42	43
R195	B	6634 Hollyhock Ct	Greendale	72	75	38	40	40	42	42	44	39	40	42	43
R196	B	6628 Hollyhock Ct	Greendale	71	75	38	39	41	43	43	44	39	40	42	43
R197	B	7005 Heathmeadow Ct	Greendale	71	75	38	39	41	43	43	45	38	39	42	43
R198	B	7009 Horizon Dr	Greendale	71	74	37	39	45	47	46	48	38	39	42	43
R199	B	6939 Horizon Dr	Greendale	70	74	37	38	42	44	43	45	37	39	41	42
R200	B	6827 Horizon Dr	Greendale	70	74	37	38	39	41	41	43	37	38	41	42
R201	B	7412 W Old Loomis Rd	Franklin	77	80	44	46	45	46	47	49	44	45	49	49
R202	B	7432 W Old Loomis Rd	Franklin	77	80	45	47	44	47	47	50	44	46	50	50
R203	B	6776 S 76th St	Franklin	78	82	45	46	48	50	50	52	45	47	51	52
R205	A	6296 Parkview Rd	Greendale	76	80	39	40	45	48	46	48	46	47	50	50
R206	A	6300 Parkview Rd	Greendale	77	80	39	40	46	48	46	49	46	48	50	51
R207	A	8255 Firwood Ln	Greendale	74	77	37	39	44	46	45	47	43	45	47	48
R208	A	8259 Firwood Ln	Greendale	74	77	37	38	44	46	44	47	43	45	46	47
R209	A	8246 Firwood Ln	Greendale	75	78	38	39	44	47	45	48	44	46	48	48
R210	A	8268 Flagstone Ct	Greendale	73	76	36	37	44	46	44	46	42	43	46	46
R211	A	8191 Fairmont Ln	Greendale	72	75	36	37	44	46	44	46	41	42	45	45
R212	A	6305 Parkview Rd	Greendale	78	81	40	41	46	49	47	49	47	49	52	52
R213	A	8256 Fremont Ct	Greendale	74	78	37	39	44	47	45	47	44	45	47	48
R214	A	8238 Firwood Ln	Greendale	76	79	38	40	45	48	46	48	45	47	49	50
R215	A	6321 Parkview Rd	Greendale	76	79	39	41	47	49	48	50	45	46	50	50
R216	A	6335 Parkview Rd	Greendale	73	77	37	39	45	47	46	48	42	44	46	47
R217	A	7616 Parkview Rd	Greendale	72	76	36	38	44	46	45	47	41	42	46	46
R218	A	7714 Overlook Dr	Greendale	72	75	36	38	44	46	45	47	41	42	45	46
R219	A	7720 Overlook Dr	Greendale	73	76	37	38	45	47	45	47	42	43	46	47
R220	A	6328 Parkview Rd	Greendale	74	78	38	39	46	48	47	49	43	45	48	48
R221	A	6326 Parkview Rd	Greendale	75	78	38	40	46	48	47	49	43	45	48	49

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R222	B	6590 Hill Ridge Dr	Greendale	75	78	40	41	47	49	48	50	42	44	47	47
R223	B	6610 Hill Ridge Dr	Greendale	74	78	39	41	46	49	47	49	42	43	46	47
R224	B	7280 Horizon Dr	Greendale	74	78	40	42	47	50	48	50	41	43	46	47
R225	B	7180 Horizon Dr	Greendale	73	76	39	41	45	47	46	48	40	41	44	45
R226	B	7209 Huckleberry Ct	Greendale	73	76	39	41	46	48	47	49	40	41	44	45
R227	B	7243 Huckleberry Ct	Greendale	73	77	39	41	46	49	47	49	40	42	45	45
R228	B	7146 Horizon Dr	Greendale	73	76	39	40	45	48	46	49	40	41	44	45
R229	B	7264 Hyacinth Ct	Greendale	74	77	39	40	46	49	46	50	41	42	45	45
R230	B	7236 Hyacinth Ct	Greendale	73	76	39	40	45	48	46	48	40	41	44	45
R231	B	7020 Horizon Dr	Greendale	71	74	37	39	45	47	46	48	38	39	42	43
R232	B	6980 Horizon Dr	Greendale	71	74	37	38	44	47	45	47	38	39	41	42
R233	B	6940 Horizon Dr	Greendale	70	74	37	38	44	46	45	46	37	39	41	42
R234	B	6920 Horizon Dr	Greendale	70	73	37	38	42	44	43	45	37	39	40	42
R235	B	6820 Horizon Dr	Greendale	70	73	36	38	39	41	41	43	37	38	40	41
R236	B	6541 Hill Ridge Dr	Greendale	77	80	41	42	49	51	49	51	43	46	50	51
R237	B	6561 Hill Ridge Dr	Greendale	76	80	39	42	48	51	49	51	43	45	49	49
R238	B	6581 Hill Ridge Dr	Greendale	75	79	40	42	48	50	48	51	42	44	48	48
R239	B	6625 Hill Ridge Dr	Greendale	75	78	40	41	47	49	48	50	42	43	47	47
R240	B	7430 Hill Valley Ct	Greendale	76	79	41	42	48	51	49	51	43	44	48	49
R241	B	7448 Hill Valley Ct	Greendale	76	79	41	42	48	51	49	51	43	44	49	49
R242	B	7461 Hill Valley Ct	Greendale	77	80	41	43	49	52	50	52	44	45	50	50
R243	B	7401 Hill Valley Ct	Greendale	76	79	41	42	48	51	49	51	42	44	48	49
R244	B	7381 Hill Valley Ct	Greendale	75	79	41	42	48	50	49	51	42	43	48	48
R245	B	6726 Hilldale Ct	Greendale	77	80	42	44	46	50	48	51	43	44	48	49
R246	B	6713 Hilldale Ct	Greendale	76	80	42	44	50	53	51	53	43	45	49	50
R247	B	7480 Highview Dr	Greendale	78	81	44	45	49	51	50	52	44	45	50	50
R248	B	6748 Hill Park Ct	Greendale	78	81	44	45	51	53	51	53	44	46	51	51
R249	B	6711 Hill Park Ct	Greendale	77	80	42	44	51	54	51	54	44	45	51	51

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R250	B	6731 Hill Park Ct	Greendale	78	81	44	45	52	56	53	56	44	46	52	52
R251	B	6743 Hill Park Ct	Greendale	78	82	44	45	53	55	54	56	44	46	52	52
R252	B	7451 Highview Dr	Greendale	77	80	44	45	45	48	48	49	44	45	50	50
R253	B	7391 Highview Dr	Greendale	76	80	43	44	44	46	46	48	43	44	49	49
R254	B	6750 Hill Ridge Dr	Greendale	75	79	42	44	41	45	45	47	42	44	47	47
R255	B	6730 Hill Ridge Dr	Greendale	75	78	42	43	42	46	45	47	42	43	46	47
R256	B	7213 Horizon Dr	Greendale	73	76	40	41	42	45	44	47	40	41	44	45
R257	B	7143 Horizon Dr	Greendale	72	76	38	40	45	49	46	49	39	41	43	44
R258	B	7061 Heathmeadow Ct	Greendale	72	75	38	39	45	48	45	49	39	40	43	44
R259	B	6621 Hollyhock Ct	Greendale	72	75	38	40	42	44	44	46	39	40	43	44
R260	B	6631 Hollyhock Ct	Greendale	72	75	39	40	42	44	43	45	39	40	43	44
R261	B	6616 Hollyhock Ct	Greendale	71	75	38	39	41	43	43	45	39	40	42	43
R262	B	6602 Hollyhock Ct	Greendale	71	75	38	39	42	44	44	45	38	40	42	43
R263	B	6985 Heathmeadow Ct	Greendale	71	75	38	39	40	42	42	44	38	39	42	43
R264	B	6944 Heathmeadow Ct	Greendale	71	74	37	39	39	42	41	43	38	39	41	42
R265	B	7014 Heathmeadow Ct	Greendale	71	74	37	39	43	45	44	46	38	40	42	43
R266	B	7051 Horizon Dr	Greendale	71	75	38	39	44	48	45	48	38	40	42	43
R267	B	6991 Horizon Dr	Greendale	71	74	37	39	44	46	45	47	38	39	41	42
R268	B	6897 Horizon Dr	Greendale	70	74	37	38	41	43	42	44	37	39	41	42
R269	B	6853 Horizon Dr	Greendale	70	74	37	38	40	42	41	43	37	39	41	42
R270	C	S 68th St	Franklin	73	77	41	42	37	41	42	44	40	42	43	44
R271	C	7140 W Rawson Ave	Franklin	71	75	39	41	36	38	41	43	34	36	40	41
R272	E	9059 W Hawthorne Ln	Franklin	73	77	40	42	43	45	45	47	39	40	42	43
R273	C	7106 W Rawson Ave	Franklin	71	75	39	41	36	38	41	43	36	37	41	42
R274	C	7142 W Rawson Ave	Franklin	72	76	38	42	37	39	41	44	35	38	40	41
R275	E	9011 W Meadow Ln	Franklin	72	76	40	41	43	45	44	47	39	40	41	42
R276	E	9059 W Meadow Ln	Franklin	72	76	39	40	42	45	44	46	38	40	41	42
R277	E	8735 W Hawthorne Ct	Franklin	75	79	43	45	44	47	47	49	43	44	44	45

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R278	E	8710 W Hawthorne Ln	Franklin	77	80	45	46	45	47	48	50	44	46	46	46
R279	E	8925 W Meadow Ln	Franklin	73	77	41	42	43	46	45	47	40	41	42	43
R280	E	8735 W Meadow Ln	Franklin	75	79	44	45	45	48	47	49	43	44	44	45
R281	E	8610 W Hawthorne Ln	Franklin	78	82	49	51	48	51	52	54	47	48	45	45
R282	E	8645 W Hawthorne Ln	Franklin	76	80	45	47	46	48	49	51	44	45	44	45
R283	E	8605 W Hawthorne Ln	Franklin	77	80	46	48	44	46	49	50	45	46	44	45
R284	E	8545 W Hawthorne Ln	Franklin	77	80	46	48	43	45	48	50	45	46	44	44
R285	E	8940 W Hawthorne Ln	Franklin	75	78	43	44	45	47	47	49	42	43	43	44
R286	E	9100 W Hawthorne Ln	Franklin	73	76	40	41	42	45	44	46	39	40	41	42
R287	E	9101 W Hawthorne Ln	Franklin	72	76	39	41	42	45	44	46	38	40	41	42
R288	E	8842 W Rawson Ave	Franklin	73	77	41	43	40	42	44	46	40	41	41	42
R289	E	8510 W Hawthorne Ln	Franklin	76	80	43	44	40	42	45	46	44	46	44	44
R290	B	7188 Old Loomis Rd	Greendale	74	77	40	42	42	44	44	46	41	42	45	45
R291	B	7100 Old Loomis Rd	Greendale	73	76	40	41	41	44	44	46	40	41	44	45
R292	E	9011 W Hawthorne Ln	Franklin	74	77	42	43	43	45	46	47	40	42	43	44
R293	E	9029 W Hawthorne Ln	Franklin	73	77	41	42	43	45	45	47	40	41	42	43
R294	E	9030 W Meadow Ln	Franklin	73	77	42	42	43	45	45	47	39	41	42	43
R295	E	8810 W Meadow Ln	Franklin	75	78	43	44	44	47	47	49	42	43	43	44
R296	E	8716 W Meadow Ln	Franklin	76	79	44	45	45	47	47	49	43	44	44	45
R297	E	8730 W Hawthorne Ct	Franklin	77	80	44	46	46	48	48	50	44	45	46	46
R298	E	8845 W Meadow Ln	Franklin	74	78	41	43	44	46	46	48	41	42	43	44
R299	E	8715 W Meadow Ln	Franklin	76	80	45	46	46	48	48	50	44	45	45	46
R300	E	8570 W Hawthorne Ln	Franklin	78	81	48	50	45	47	50	52	46	47	44	44
R301	E	8550 W Hawthorne Ln	Franklin	77	81	47	50	44	46	49	51	46	47	44	45
R302	E	8625 W Hawthorne Ln	Franklin	77	80	46	48	46	49	49	51	45	46	44	45
R303	E	8525 W Hawthorne Ln	Franklin	76	80	45	47	40	43	47	49	44	45	44	44
R304	E	8980 W Hawthorne Ln	Franklin	75	78	42	44	44	47	46	49	42	43	43	44
R305	E	8732 W Rawson Ave	Franklin	74	78	42	44	41	43	45	46	41	42	42	43

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R306	E	9010 W Meadow Ln	Franklin	73	77	42	43	43	46	46	47	40	41	42	43
R307	E	6928 S 90th St	Franklin	74	78	42	44	44	46	46	48	41	42	43	44
R308	E	8750 W Hawthorne Ct	Franklin	76	79	43	45	45	48	47	50	43	44	45	45
R309	E	8650 W Hawthorne Ln	Franklin	77	81	46	47	46	48	49	50	45	46	46	47
R310	E	8755 W Meadow Ln	Franklin	75	78	42	44	45	47	47	49	42	43	43	44
R311	E	8640 W Hawthorne Ln	Franklin	77	81	47	48	46	48	49	51	46	47	46	47
R312	E	8530 W Hawthorne Ln	Franklin	77	80	46	49	41	43	48	50	45	46	44	45
R313	E	7028 S 92nd St	Franklin	71	75	38	40	42	44	43	46	37	39	40	41
R314	E	7050 S 92nd St	Franklin	71	75	38	39	41	44	43	45	37	39	40	41
R317	D	8731 W Rawson Ave	Franklin	73	77	42	43	37	40	43	45	40	42	42	43
R318	D	7222 S Woelfel Rd	Franklin	69	73	37	38	33	35	38	40	35	37	39	40
R319	D	7210 S Woelfel Rd	Franklin	69	73	37	39	33	36	39	40	36	37	39	40
R320	C	7308 S 77th St	Franklin	71	75	41	43	36	38	42	44	35	37	38	39
R321	C	7308 S 77th St	Franklin	71	74	41	42	34	37	42	43	35	37	38	39
R322	C	7308 S 77th St	Franklin	70	74	40	42	34	36	41	43	35	37	38	39
R323	C	7308 S 77th St	Franklin	70	74	40	41	33	36	41	42	35	37	38	39
R324	C	7308 S 77th St	Franklin	70	73	39	40	33	36	40	42	35	37	38	39
R325	C	7713 W Terrace Dr	Franklin	71	75	41	43	35	37	42	44	36	37	38	39
R326	C	7713 W Terrace Dr	Franklin	71	75	42	43	35	38	43	44	36	37	38	39
R327	C	7713 W Terrace Dr	Franklin	70	74	40	41	34	36	41	42	36	38	39	39
R328	C	7713 W Terrace Dr	Franklin	71	74	41	42	34	36	42	43	37	38	39	39
R329	C	7713 W Terrace Dr	Franklin	71	74	41	42	34	37	42	43	36	38	39	39
R330	C	7713 W Terrace Dr	Franklin	71	74	41	42	34	36	42	43	39	40	39	39
R331	C	7713 W Terrace Dr	Franklin	71	75	41	42	35	37	42	43	37	39	39	39
R332	C	7713 W Terrace Dr	Franklin	71	75	42	43	35	37	43	44	39	40	39	39
R333	C	7713 W Terrace Dr	Franklin	71	74	42	44	34	36	43	44	38	40	39	40
R334	C	7713 W Terrace Dr	Franklin	72	75	43	45	35	37	44	45	39	40	39	40
R335	C	7713 W Terrace Dr	Franklin	71	75	43	45	35	38	44	45	39	40	39	40

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R336	C	7713 W Terrace Dr	Franklin	71	75	43	44	34	37	43	45	39	40	39	40
R337	C	7713 W Terrace Dr	Franklin	70	74	40	41	33	36	41	42	36	38	38	39
R338	C	7713 W Terrace Dr	Franklin	70	73	40	41	33	35	41	42	38	39	38	39
R339	C	7713 W Terrace Dr	Franklin	70	74	40	41	33	36	41	42	38	39	38	39
R340	C	7713 W Terrace Dr	Franklin	70	74	41	43	33	36	42	43	38	39	38	39
R341	C	7713 W Terrace Dr	Franklin	70	73	41	42	33	35	42	43	38	39	38	39
R342	C	7713 W Terrace Dr	Franklin	70	74	41	43	33	36	42	44	38	39	39	39
R343	C	7713 W Terrace Dr	Franklin	70	73	41	43	33	35	42	43	38	39	38	39
R344	C	7713 W Terrace Dr	Franklin	70	74	42	43	33	36	42	44	38	40	38	39
R345	C	7713 W Terrace Dr	Franklin	70	74	42	43	33	36	42	44	38	39	38	40
R346	C	7341 S 76th St	Franklin	71	75	41	42	34	37	42	43	36	37	39	41
R347	C	7365 S 76th St	Franklin	70	74	40	41	34	37	41	43	34	37	36	40
R348	C	7388 Carter Cir	Franklin	70	74	40	42	34	36	41	43	35	37	38	39
R349	C	7468 Carter Cir	Franklin	70	74	39	41	34	36	41	42	34	38	37	39
R350	C	7618 W Terrace Dr	Franklin	71	75	42	44	36	38	43	45	36	39	37	38
R351	C	7618 W Terrace Dr	Franklin	71	75	42	43	37	39	43	44	36	37	39	40
R352	C	7714 W Terrace Dr	Franklin	72	75	42	43	36	38	43	45	36	37	38	38
R353	C	7714 W Terrace Dr	Franklin	72	76	43	44	36	38	43	45	36	38	38	39
R354	C	7101 S Beachwood Ct	Franklin	70	74	39	41	35	37	41	42	36	38	40	40
R355	D	7102 S Woelfel Rd	Franklin	72	76	40	42	37	40	42	44	38	40	41	42
R356	D	7170 S Woelfel Rd	Franklin	70	74	38	39	34	36	39	41	36	38	39	40
R357	C	7389 Carter Cir	Franklin	71	74	41	43	34	37	42	44	37	38	39	39
R358	B	7200 Old Loomis Rd	Greendale	75	78	41	42	43	45	45	47	41	43	45	46
R359	B	7144 Old Loomis Rd	Greendale	73	77	40	41	41	44	43	46	41	42	44	45
R360	E	7008 S 92nd St	Franklin	71	75	38	40	42	44	43	46	38	39	40	41
R361	E	8630 W Hawthorne Ln	Franklin	78	81	48	50	47	49	51	53	46	47	45	46
R362	E	9010 W Hawthorne Ln	Franklin	74	78	41	43	44	46	46	48	41	42	43	44
R363	E	9020 W Hawthorne Ln	Franklin	74	77	41	42	43	46	45	47	40	41	42	43

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R364	E	6974 S 92nd St	Franklin	72	76	39	41	42	44	44	46	38	39	41	42
R366	D	8601 W Rawson Ave	Franklin	74	78	43	44	38	40	44	46	42	43	43	43
R367	D	8631 W Rawson Ave	Franklin	74	77	43	44	37	40	44	45	41	42	42	43
R368	D	8701 W Rawson Ave	Franklin	74	77	42	44	37	40	44	45	41	42	42	43
R369	D	7160 S Woelfel Rd	Franklin	70	74	38	40	34	37	40	41	37	38	40	41
R371	C	7516 Carter Cir	Franklin	70	74	40	41	34	37	41	42	35	38	37	38
R372	C	S 68th St	Franklin	73	76	40	41	38	40	42	43	40	41	43	43
R373	A	8260 Fremont Ct	Greendale	74	77	37	39	44	47	45	47	43	44	47	47
R374	A	8262 Fremont Ct	Greendale	74	77	37	38	44	46	45	47	42	44	46	47
R375	B	6721 Hill Park Ct	Greendale	77	81	43	44	51	54	52	55	44	45	52	52
R376	C	7128 W Rawson Ave	Franklin	71	75	39	41	36	38	41	43	35	38	40	41
R377	B	7520 W Old Loomis Rd	Franklin	78	82	46	48	45	48	49	51	45	47	51	51
R378	D	8998 W Stone Hedge Dr	Franklin	71	75	39	41	35	37	41	42	38	39	40	41
R379	D	7125 S Cambridge Dr	Franklin	73	76	41	42	36	39	42	44	40	41	41	42
R380	D	7106 S Cambridge Dr	Franklin	73	77	42	43	36	39	43	44	40	41	42	43
R381	D	7118 S Cambridge Dr	Franklin	73	77	42	43	37	39	43	45	40	42	42	43
R382	D	7176 S Cambridge Dr	Franklin	72	75	41	42	34	37	41	43	38	40	40	42
R383	D	7273 S Cambridge Dr	Franklin	69	73	38	39	32	35	39	40	36	37	39	40
R384	D	7231 S Cambridge Dr	Franklin	70	74	38	39	33	36	39	41	37	38	39	40
R385	D	7251 S Stone Hedge Dr	Franklin	71	75	40	41	33	35	41	42	38	39	40	41
R386	D	7269 S Stone Hedge Dr	Franklin	71	74	40	41	32	35	41	42	38	39	40	41
R387	D	7337 S Stone Hedge Dr	Franklin	70	74	40	42	32	35	40	42	37	39	39	40
R388	D	8760 W Callaway Ct	Franklin	70	74	40	42	32	34	41	43	37	38	38	39
R389	D	8879 W Callaway Ct	Franklin	70	74	38	40	31	34	39	41	37	38	39	40
R390	D	7444 S Stone Hedge Dr	Franklin	69	73	38	39	31	34	38	40	35	37	37	38
R391	D	7358 S Stone Hedge Dr	Franklin	70	74	39	40	32	35	40	41	37	38	38	39
R392	D	7120 S Woelfel Rd	Franklin	72	75	40	41	36	39	41	43	38	39	40	41
R393	D	7140 S Woelfel Rd	Franklin	71	75	39	40	35	38	41	42	37	39	40	41

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R394	C	7713 W Terrace Dr	Franklin	71	75	42	43	35	38	43	44	37	38	38	39
R395	C	7552 Carter Cir	Franklin	70	74	41	42	34	37	42	43	35	37	38	39
R396	C	7141 W Rawson Ave	Franklin	70	74	39	40	35	37	41	42	36	37	40	41
R397	C	7161 W Rawson Ave	Franklin	71	74	39	41	35	37	41	42	36	37	40	41
R398	C	7161 W Rawson Ave	Franklin	71	74	40	41	35	38	41	43	36	37	40	41
R399	D	7141 S Cambridge Dr	Franklin	72	76	41	42	36	38	42	43	39	40	41	42
R400	D	7234 S Cambridge Dr	Franklin	70	74	39	40	33	35	40	41	37	39	40	41
R401	D	7268 S Cambridge Dr	Franklin	70	74	38	40	32	35	39	41	37	38	39	40
R402	D	7380 S Cambridge Dr	Franklin	69	72	37	39	30	33	38	40	36	37	38	39
R403	D	7217 S Stone Hedge Dr	Franklin	71	74	39	40	32	35	40	42	37	39	40	41
R404	D	8826 W Callaway Ct	Franklin	70	74	39	40	32	34	40	41	37	39	39	40
R405	D	8854 W Callaway Ct	Franklin	70	74	39	40	32	34	40	41	37	38	39	40
R406	D	8785 W Callaway Ct	Franklin	69	73	38	40	31	34	39	41	36	37	38	40
R407	D	7401 S Stone Hedge Dr	Franklin	69	73	39	40	31	34	40	41	36	38	38	39
R408	D	7380 S Stone Hedge Dr	Franklin	70	74	39	40	32	34	39	41	36	38	38	39
R409	D	7340 S Stone Hedge Dr	Franklin	70	74	40	41	32	35	40	42	37	39	38	39
R410	D	7178 S Karrington Dr	Franklin	72	76	41	43	34	36	42	44	39	41	40	41
R411	D	7145 S Karrington Dr	Franklin	73	77	43	44	35	38	43	45	40	42	41	42
R412	D	7189 S Karrington Dr	Franklin	72	76	42	43	34	37	42	44	39	41	41	42
R413	C	7532 Carter Cir	Franklin	70	74	40	41	34	37	41	43	35	36	37	38
R414	D	8982 W Stone Hedge Dr	Franklin	71	75	40	41	34	37	41	42	38	39	40	41
R415	D	7158 S Cambridge Dr	Franklin	72	76	41	42	35	37	42	43	39	41	41	42
R416	D	7342 S Cambridge Dr	Franklin	69	73	38	39	31	33	38	40	36	37	39	40
R417	D	7374 S Cambridge Dr	Franklin	69	73	37	39	31	33	38	40	36	37	38	39
R418	D	7315 S Stone Hedge Dr	Franklin	71	74	40	42	32	35	41	42	37	39	39	40
R419	D	8708 W Calloway Ct	Franklin	70	74	39	41	32	34	40	42	37	38	38	39
R420	D	7419 S Stone Hedge Dr	Franklin	69	73	38	39	31	34	39	40	36	37	38	39
R421	D	7412 S Stone Hedge Dr	Franklin	70	73	38	40	31	34	39	41	36	38	38	39

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
R422	D	7282 S Stone Hedge Dr	Franklin	71	75	41	42	33	36	41	43	38	40	39	40
R423	D	7200 S Karrington Dr	Franklin	72	76	41	42	34	36	42	43	39	40	40	41
R424	D	7167 S Karrington Dr	Franklin	73	76	42	43	34	37	43	44	40	41	41	42
R425	D	7228 S Stone Hedge Dr	Franklin	71	75	40	42	33	36	41	43	38	40	40	41
R426	C	7401 Carter Cir	Franklin	71	74	41	43	34	36	42	44	37	39	39	40
R427	C	S 68th St	Franklin	74	78	42	44	39	43	44	46	40	43	45	46
R428	C	S 68th St	Franklin	73	76	40	41	38	39	42	43	40	41	43	44
R429	C	S 68th St	Franklin	72	75	39	41	38	40	41	43	39	41	42	43
R430	C	S 68th St	Franklin	74	77	42	43	38	42	43	45	41	42	44	45
R431	C	S 68th St	Franklin	74	77	41	43	39	41	44	45	41	42	44	45
R432	D	7163 S Cambridge Dr	Franklin	72	75	37	41	35	38	39	43	35	40	40	42
R433	D	7130 S Cambridge Dr	Franklin	73	77	42	43	35	38	43	44	40	41	41	43
R434	D	7194 S Cambridge Dr	Franklin	71	75	40	41	34	36	41	42	38	39	40	41
R435	D	7360 S Cambridge Dr	Franklin	69	73	37	39	31	33	38	40	36	37	38	40
R436	D	7311 S Cambridge Dr	Franklin	69	72	37	38	31	34	38	39	35	37	38	39
R437	D	7295 S Cambridge Dr	Franklin	69	73	37	38	32	34	38	40	36	37	38	40
R438	D	7259 S Cambridge Dr	Franklin	70	74	38	39	33	35	39	41	36	38	39	40
R439	D	7219 S Cambridge Dr	Franklin	70	74	39	40	34	36	40	41	37	38	40	41
R440	D	7233 S Stone Hedge Dr	Franklin	71	74	40	41	32	35	40	42	38	39	40	41
R441	D	8796 W Callaway Ct	Franklin	70	74	39	40	32	34	40	41	37	38	39	40
R442	D	8843 W Callaway Ct	Franklin	70	73	38	39	31	34	39	40	36	38	39	40
R443	D	8811 W Callaway Ct	Franklin	69	73	38	39	31	34	39	40	36	38	39	40
R444	D	8747 W Callaway Ct	Franklin	69	73	39	40	31	33	39	41	36	37	38	39
R445	D	7426 S Stone Hedge Dr	Franklin	69	73	38	39	31	34	39	40	36	37	37	38
R446	D	7324 S Stone Hedge Dr	Franklin	71	74	41	42	33	35	41	43	37	39	39	40
R447	D	7306 S Stone Hedge Dr	Franklin	71	75	42	43	33	35	42	44	38	39	39	40
R448	D	7260 S Stone Hedge Dr	Franklin	71	75	41	42	33	36	42	43	38	40	40	41
R449	D	7211 S Karrington Dr	Franklin	72	75	41	42	34	36	42	43	39	40	40	42

NAME	NEIGHBOR-HOOD	ADDRESS	MUNICIP-ALITY	FIREWORKS		BASEBALL		CONCERT		CONCERT+ BASEBALL		SNOWMAKING		HILLS HAVE EYES	
				1.5 m	4 m	1.5 m	4 m	1.5 m	4 m	1.5 m	4m	1.5 m	4 m	1.5 m	4 m
Neighborhood (See Report Figure 2)				**Worst-Case Modeled Exposure Levels by Neighborhood**											
Neighborhood A			Greendale	78	81	40	41	47	49	48	50	47	49	52	52
Neighborhood B			Greendale	79	82	46	48	54	56	54	56	45	47	52	52
Neighborhood C			Franklin	74	78	43	45	39	43	44	46	41	43	45	46
Neighborhood D			Franklin	74	78	43	44	38	40	44	46	42	43	43	43
Neighborhood E			Franklin	78	82	49	51	48	51	52	54	47	48	46	47

APPENDIX J. REVIEW OF RELEVANT ORDINANCES AND RECOMMENDATIONS