OUTDOOR CONCERT NOISE: THE KITCHENER, ONTARIO EXPERIENCE

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1 Introduction

Outdoor music festivals are socially, culturally and economically important to the communities that host them. However, sound generated by these events, have the potential to disturb surrounding noise-sensitive environs, especially area residents. Sensitivities depend on many factors, including but not limited to duration, audibility of the event, type of music, and even non-acoustic associations of the concert and duration. Truly, one person's music can be another person's noise. The challenge facing municipalities and promotors holding these events, is to provide sufficiently high-level sound reinforcement to meet patron audio quality expectations while keeping off-site sound levels sufficiently low, to avoid disturbing surrounding communities.

Since 2015, an Electronic Dance Music (EDM) event, the EverAfter Music Festival has been held in Kitchener, Ontario in early June. Inaugurally, a two-day (Friday – Saturday) event, the festival was extended to three-days (Friday- Sunday) in 2016 and 2017. During, the three-year history of the event, noise complaints to the City of Kitchener Noise-By-law Office have varied significantly, with little or no complaints in 2016, while 57 complaints were received in 2015 and about twice as many in 2017. The complaint history, and key characteristics of the EverAfter event are summarized below:

- Total (complaints) – 2015: (57), 2016: (7), 2017: (130).
- Concert duration (days) - 2015 (2), 2016 & 2017 (3).
- Multi-stage concert - all years.
- Main stage orientation - 2015 (south), other years (east).
- Performances – 1100 h to 2300 h (headliners – 2030 h).
- High SPL / low frequency program – 120 dBA @ 140 ft.
- Some surrounding locales in semi urban areas bordering farm and ravine lands.
- The City granted a Noise-by-law exemption, with festival sound levels limited to 65 dBA at any residences.

Given the complaint record, can the variability be explained and are there approaches available to help provide greater event compatibility with residents' concerns?

2 Design criteria discussion

There are no environmental noise guidelines within Ontario specific to Outdoor Concert / Music noise. However, existing Ontario Ministry of Environment and Climate Change (MOECC) noise guidelines pertaining to industrial / stationary noise sources highlight principles that address key considerations for noise sources which share characteristics with outdoor concert music. MOECC guidelines pertaining to stationary noise (i.e., from noise sources found within a fixed locale) evaluate sound from these sources relative to short duration background ambient noise on a 1-hr LA_{eq}. MOECC guidelines address the potential for greater annoyance and identification of noise due to tonal, rhythmic components by applying penalties to the source being evaluated.

More specific noise guidelines for outdoor concert venues reflect these considerations and assess potential effects of concert music on surrounding noise-sensitive locales as relative criteria, comparing maximum or near maximum sound levels to that of the prevailing ambient noise environment (i.e., in the absence of music). Cavanaugh [1] suggests that the concert level (L_1) and ambient non-concert (L_{90}), difference provides a good indication of the expected community response per Table 1.

Table 1: Outdoor concert site response criteria [1].

L_1-L_{90} Differential	Expected Community Response
Less than 5 dB	Rarely audible, few or no complaints
5 to 15 dB	Sometimes audible, repeated complaints likely
15 dB or greater	Highly audible, widespread complaints

Similar guidelines, have been implemented in other jurisdictions, particularly within the UK and Europe.

3 Rationalizing the complaint record

Figure 1 illustrates the complaint history of the festival. Variability in the data is obvious. In 2017, few complaints occurred during the day Friday through Sunday, with most complaints occurring on Sunday evening, June 4th. Factors thought to contribute to variability in off-site sound levels, audibility and ultimately complaints generated include:

- Stage orientation, sound directivity - changes made after 2015 directed sound from the southwest to the east / north east towards less densely populated lands in 2016, 2017.
- The 65 dBA criteria is too high relative to low prevailing community ambient (L_{90}) levels of 40 dBA to 45 dBA.
- Variation in the music / performers – major annoyance.
- Fatigue with music – rising annoyance.
- Variation in the ambient – decreases into the evening.
- Meteorological effects, particularly inversions.

3.1 Meteorological effects

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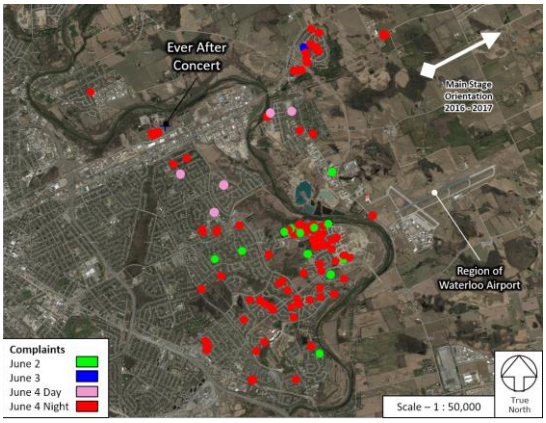

Figure 1: EverAfter festival noise complaints

Meteorological conditions were reviewed for the 2015 - 2017 concert periods (in 10-minute intervals). Some variability with wind speed and direction was found but the major factor relevant to noise propagation was found to be the presence of inversions. Figure 2 illustrates the atmospheric temperature lapse rates classified by Pasquill-Gifford Stability Class. Class A-D denoting no inversions and least propagation, Class E–F typical propagation with mild inversions, Class G very strong inversion – worst-case noise propagation. Notable are the development of inversions in the late evening periods and the very strong inversion (Class G rating) on the Sunday evening of the 2017 event, corresponding to the period with the greatest number of complaints.

Figure 2: Temp. lapse rate during EverAfter Festival, 2015 -2017.

3.2 Noise propagation modelling and inversions

Figure 3 illustrates the effect of inversions on EverAfter Festival sound propagation using event music program levels of 120 dB at 140 ft., topographical effects, acoustical screening, ground absorption and atmospheric attenuation applied to ISO 9613 [2] and CONCAWE [3] algorithms.

Of note is the extent of the 65 dBA isopleth, especially when compared to ambient L_{90} late evening sound levels. Inversion effects result in changes in the 65 dBA contour radius of up to 2 km from Class A to Class G conditions.

4 Conclusions

In 2017, inversions and meteorological conditions drastically increased propagation of the EverAfter concert noise and accordingly, complaints. However, inversions also play a role in concert noise propagation in earlier festivals. Inversions can negate noise control efforts such as barriers and stage orientation. The high number of Sunday evening complaints are likely contributable to multiple factors:

- Meteorology (inversions, wind speed / direction)
- High allowable limits (65 dBA) relative to ambient
- Low ambient (especially during evening period)
- Nature of music (rhythmic, bass heavy EDM) and fatigue

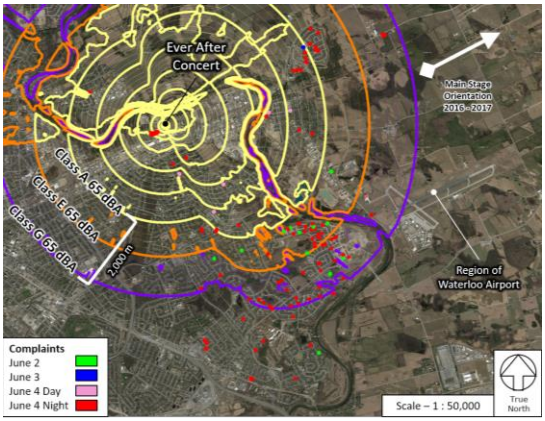

Figure 3: Effect of inversions on modelled festival noise

Efforts should be made for future events (EverAfter or any outdoor concert) to achieve balance and compatibility with surrounding communities. Options include:

- Increased event awareness and enhanced public relations. Events are culturally and socially economically important but must also balance community needs.
- Setting criteria relative to background noise (Table 1).
- Determine and plan for impacts by predictive noise propagation modelling including meteorological effects.
- Monitoring at the sound board to reference limit, in conjunction with ambient measurements, to control impacts at receptors.
- Limit loudest acts to least sensitive time periods
- Strategic speaker and stage orientation away from the residential receptors (where possible), using directional line arrays, distributed speakers to reduce spillage.

Acknowledgements

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References

[1] Cavanaugh, W., (1995) Evaluating the Severity of Community Response at Outdoor Concert Sites: A Model that Seems to Work, Proceedings Inter-Noise 1995.

[2] ISO 9613 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation

[3] Concawe-report No 4/81, The propagation of noise from petrochemical complexes to neighbouring communities, CONCAWE, DenHaag May 1981