

City of Vancouver Noise Bylaw Review: Input on Health Impact

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By Jan L. Mayes, MSc, Audiologist (Retired), member of The Quiet Coalition, adviser to Hearing Health Foundation's [Keep Listening](#) hearing loss prevention campaign, and past member of the Board of Directors of the Right to Quiet Society.

<https://www.janlmayes.com/articles/>

Noise Exposure Limits

Even in Quiet Zones, dB limits specified by the City of Vancouver current Noise Bylaws are not likely protective enough, especially for noise-sensitive or high risk members of the general public. More protective noise exposure limits are outlined in various internationally recommended guidelines to prevent adverse communication and/or health effects from public exposure to noise pollution. This might include World Health Organization Guidelines for Community Noise (1999), Night Noise Guidelines (2009), and Environmental Noise Guidelines (2018).

The World Health Organization Guidelines for Community Noise (1999, p. xv) states, *“An adverse effect of noise refers to any temporary or long-term impairment of physical, psychological or social functioning that is associated with noise exposure.”* *Adverse auditory and non-auditory effects include speech interference, sleep disturbance, annoyance, anxiety, depression, high blood pressure, cardiovascular disease, strokes, cognitive impairment in children, Type 2 diabetes, obesity, hearing impairment, tinnitus, dementia, early mortality, and adverse perinatal and birth effects (WHO, 1999, 2009, 2011, 2018, Fink, 2017; Eriksson, Pershagen, and Nilsson, 2018).*

Exposures of 70 dB ($L_{A_{EQ}24\text{-hour}}$) and higher are linked to direct hearing system damage, including noise-induced hearing loss and tinnitus. (WHO, 1999, 2018; Mayes, 2019; Fink & Mayes, 2021). Even noise exposures of 50 to 70 dB SPL (sound pressure level) are linked to adverse health effects, including impaired central auditory processing needed for cognition and speech understanding, with highest risk for children and teens exposed while their auditory systems are still developing (Eggermont, 2013; Pienkowski, 2017). Noise has been shown to elevate blood pressure in children, disrupt learning, and contribute to behavioral problems. (APHA, 2021). Daytime and evening limits of at least 50 dB ($L_{A_{EQ}24\text{-hour}}$) are generally recommended outdoors to protect health and speech communication access (WHO, 1999, 2018), with even lower outside limits recommended to prevent sleep disturbances, e.g. <40 dB L_{night} (WHO, 2009).

The combined public health risk of more than one pollutant is greater than either pollutant alone. The World Health Organization (2018, p. 8) states,

The guidelines do not include recommendations about any kind of multiple exposures. In everyday life people are often exposed to noise from several sources at the same time. In Germany, for example, 44% of the population are annoyed by at least two and up to five sources of noise (Umweltbundesamt, 2015). For some health outcomes, such as obesity, new evidence indicates that combined exposure to noise from several means of transportation is particularly harmful (Pyko et al., 2015; 2017). Research indicates that, alongside exposure to more than one source of noise, combined exposure to different factors – for example, noise and vibration or noise and air pollution – has gained increasing relevance in recent years (Sørensen et al., 2017).

Noise-Sensitive Groups

Noise-sensitive groups are at higher than average risk from noise pollution:

- Pregnant persons.
- Children (newborns to teens).
- Elders (age 65 and older).
- People with pre-existing hearing loss or impairments.
- People with pre-existing cognitive, mental, and/or physical health conditions or illnesses.
- People needing rest and recovery (e.g. illness, after hospital discharge).
- Shift workers.

For groups susceptible to impaired communication access:

“Noise interference with speech comprehension results in a large number of personal disabilities, handicaps, and behavioural changes. Problems with concentration, fatigue, uncertainty and lack of self-confidence, irritation, misunderstandings, decreased working capacity, problems in human relations, and a number of stress reactions have all been identified (Lazarus, 1998). Particularly vulnerable to these types of effects are the hearing impaired, the elderly, children in the process of language and reading acquisition, and individuals who are not familiar with the spoken language (e.g., Lazarus, 1998). Thus, vulnerable persons constitute a substantial proportion of a country’s population (WHO, 1999, p. 24-25).

Sleep Disturbance

The World Health Organization (2009, p. 108)¹⁶ states, “Sleep is an essential part of healthy life and is recognized as a fundamental right under the European Convention on Human Rights (European Court of Human Rights, 2003.” Munzel et al. (2018, p. 836)¹⁷ state, “noise-induced sleep disturbance constitutes an important mechanism on the pathway from chronic noise exposure to the development of adverse health effects.”

Certain groups are also higher risk for sleep disturbance:

As children also spend more time in bed they are exposed more to night noise levels. For these reasons children are considered a risk group. Since with age the sleep structure becomes more fragmented, elderly people are more vulnerable to disturbance. This also happens in pregnant women and people with ill health, so they too are a group at risk. Finally, shift workers are at risk because their sleep structure is under stress due to the adaptations of their circadian rhythm (WHO, 2009, p. xii).

Night noise carries the highest health risk:

Sleep disturbance is a major effect of environmental noise. It may cause primary effects during noise, and secondary effects that can be assessed the day after nighttime noise exposure. Uninterrupted sleep is a physiological prerequisite for good physiological and mental functioning, and the primary effects of sleep disturbance are: difficulty in falling asleep; awakenings and alterations of sleep stages or depth; increased blood pressure; heart rate and finger pulse amplitude; vasoconstriction; changes in respiration; cardiac arrhythmia; and increased body movements...The probability of being awakened depends on the number of noise events per night. The secondary, or after-effects, the following morning or day(s) are: reduced perceived sleep quality; increased fatigue; depressed mood or well-being; and decreased performance (WHO, 1999, p. ix-x).

Noise Reduction Prevents Future Costs

Noise levels exceeding public health guidelines can contribute to a health burden with significant medical and economic costs. Gan et al. (2012) used a noise prediction model that reflected actual noise exposure in Vancouver. The annual population exposure to noise pollution was higher than recommended limits for disability access, speech communication access, and public health.

The European Commission estimates that the social cost of noise and air pollution is up to €1 trillion every year (European Commission, 2016). Munzel et al. (2018, p. 833) state that in the UK, noise pollution has “been estimated to cause an additional 542 cases of hypertension-related myocardial infarction, 788 cases of stroke, and 1169 cases of dementia, with a cost valued at around £1.09 billion annually.”

When considering cost-benefit of noise reduction options, Peters and van Blokland (2018, p. 32) state, “some benefits are directly related to a monetary value, such as reduced hospital costs due to lower occurrence of diseases”. Completely preventable adverse noise-health effects with high healthcare costs include anxiety, depression, high blood pressure, heart attacks, stroke, Type 2 diabetes, obesity, and dementia. For hearing loss alone, Tordrup et al. (2022) estimated noise prevention programs could result in economic and healthcare benefits or savings of up to \$15 for every \$1 invested.

Improving Noise Prevention Actions

A 2017 public health noise monitoring study on *How Loud is too Loud? Health Impacts of Environmental Noise in Toronto* recommended government decision makers adopt a proactive approach aimed at bettering public health by setting a goal to decrease noise by a certain percentage over a specific number of years.

In addition to noise emission targets, City of Vancouver should consider lowering Noise Bylaws specified dB limits to better protect public health, including noise vulnerable groups, from damaging noise exposures. Effective noise pollution action plans could also include mandatory real time noise mapping systems and mandatory noise control, including enforcement of violations. For example, cities with noise mapping systems include Calgary, New York City, and Shanghai. Data has been used to identify violations like construction outside of permitted hours or noisy HVAC systems as well as targeting specific locations for prevention efforts, e.g. noisy traffic intersections, quiet parks, public spaces.

World Health Organization Environmental Noise Guidelines (2018, p. 105-124) identify guiding principles for policy makers including promoting interventions to reduce exposure to noise to minimize environmental health risk. “The guideline recommendations can also be used by civil society, patients and other advocacy groups to raise awareness and encourage actions to protect the population, including vulnerable groups, from exposure to noise” (WHO, 2018, p. 108).

Any City of Vancouver Noise Bylaw revisions should use public-health based noise risk criteria, including appropriate noise measurement procedures. The bylaws are using decibels measured as dBA or dBC LEQ. But, current bylaws specify SLOW response time for sound level meter measurements. Community noise risk recommendations are based on decibels measured using FAST response time to better capture fast peaks or impact noise, e.g. World Health Organization Guidelines for Community Noise (1999) to Environmental Noise Guidelines (2018). FAST measures noise levels at 125 msec. Intervals. SLOW measures at 1 second intervals.

It is unclear if City of Vancouver is also missing other public health criteria or settings when measuring noise risk to public health (e.g. recommended 3 dB exchange rate). This should be addressed during any bylaw review and for training of staff responsible for measuring public noise levels.

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