Institute of Acoustics
Sound • Noise • Vibration

Briefing Note

Reducing Noise with Green Space

Reasons for increasing green space

The Institute of Acoustics has been looking into the increasing evidence that 'greening' and 'rewilding' open spaces can offer lower noise levels, and how careful planting can be used to reduce noise. Tree planting and 'rewilding' are being widely advocated to help to combat climate change and preserve and increase biodiversity. Increasing the total area of grass verges, hedges, parks and gardens in a city can help to reduce the local urban heat island effect and provides shading against increasing global temperatures. 'Green' roofs also increase thermal insulation. Furthermore, planted areas hold water and result in less run off than paved and built-up areas, so reducing flood risk.

Green space and noise levels

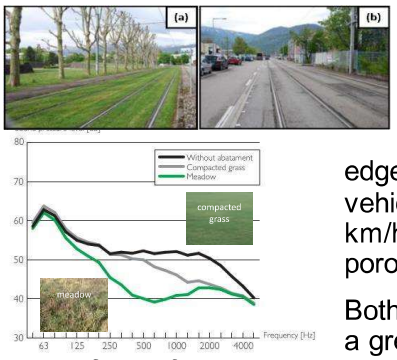
A comparative study of noise levels in six EU cities and eight UK cities and towns[1] has shown that, overall, the resulting noise levels depend on the proportion and distribution of green areas. A greater proportion of 'green' means a lower density of roads, housing and industry, which, in turn, implies a lower density of noise sources.

How do green spaces reduce noise?

We hear noise when sound waves reach our ears from a noise source, for example, a car, an aircraft or a generator. The level of sound that reaches us depends on the environment as well as the source. 'Green' areas and urban treescapes reduce sound levels as the sound travels through them.

The 'Soft' ground effect - Have you ever wondered why it's quieter when there's snow on the ground? In part this is because newly fallen snow means less and slower traffic, but an important reason for lower sound levels is that snow is porous. When sound reaches snow, some of the sound energy enters the pores, where it's absorbed and delayed before being reflected. When both sound source and listener are close to porous ground, the sound reflected from its surface cancels part of the sound that travels between the source and the listener, reducing the overall sound level. In the same way, the 'soft' ground in meadows, parks, fields, gardens and lawns helps to reduce sound levels. In contrast surfaces that are not porous such as pavements, roads, car parks and buildings reflect most of the sound arriving at them and tend to increase sound levels.

This 'soft' ground effect is useful near noise sources. For example, having (a) grass rather than (b) asphalt around tram tracks leads to lower noise levels near the tracks with at least a halving of the sound energy[2].



The type of grass matters. The graph compares the sound level at each frequency that would be experienced at a height of 1.5 m (the average height of a person's ears) 50 m from the edge of a typical urban road (with the traffic comprising 5% heavy vehicles, 95 % light vehicles, travelling at an average speed of 50 km/h) when the ground between the road and the listener is not porous or occupied by a compacted lawn or a meadow.

Both types of grassland will reduce noise levels but the meadow gives a greater reduction. This is because sound is less able to penetrate the surface of a lawn compacted by frequent mowing and rolling than the surface of a 'natural' meadow. So, there is an acoustic case for rewilding, as well as for biodiversity conservation.

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Noise reduction by vegetation - Crops, hedges, bushes and forests influence noise levels. The presence of vegetation assists the 'soft' ground effect not only because root growth loosens the soil near the surface but also because the cover provided by dead and decaying leaves makes it easier for sound to penetrate and be absorbed. Trunks, branches, leaves and stems also deflect sound and absorb sound through friction.

Even more noise reduction occurs if trees are planted in a suitable pattern. A tree belt can be designed to give a useful reduction in traffic noise[3]. Also, vegetated façades, vertical forests[4] and 'green' roofs can reduce urban noise levels as well as altering the perception of the sound[5]. Although they occupy more land, vegetated berms provide better traffic noise reduction for people downwind of roads than solid noise barriers of comparable height[6].

How can green space be used to control noise?

- **Where there is enough land, instead of building solid noise barriers, use tree belts** with optimum planting patterns and dense evergreen understory to exploit the sound reduction of leaves.
- **Replace lawns, grass-covered parkland and mowed verges with wilder areas** as these can increase sound reduction due to the 'soft' ground effect.
- **Increase green spaces, urban forests, roof top gardens and vegetated façades** in new housing developments and use vegetated berms instead of solid noise barriers.
- **Grow crops in urban areas** since, even though the effect would be seasonal, corn and wheat offer good sound attenuation through their foliage when it is most dense; and

With the potential for increasing the use of green space to manage noise, there is also a need to improve the noise prediction techniques currently used by planners and noise consultants to determine the noise from roads and railways, so that better account can be taken of the noise reduction that occurs with soft ground, foliage, tree belts, green roofs, and vegetated façades.

With thanks to (Prof.) Keith Attenborough, HonFIOA and Jo Webb, Hon FIOA, acoustic engineer, for drafting this briefing note.

[1] Efstathios MARGARITIS and Jian KANG, Relationship between green space-related variables and traffic noise distribution in the urban scale, an overall approach, Proc. InterNoise 2016, Hamburg, 2882-2888 and Relationship between urban green spaces and other features of urban morphology with traffic noise distribution, Urban Forestry & Urban Greening, 15 174 - 185 (2016)
[2] *Environmental Methods for Transport Noise Reduction*, ed. Nilsson *et al*, CRC Press, (2015)
[3] K. Attenborough and T. Van Renterghem, *Predicting Outdoor Sound*, Taylor and Francis, (2021)
[4] X. Wang, W. Gard, et al Vertical greenery systems: from plants to trees with self-growing inter-connections, European Journal of Wood and Wood Products, https://doi.org/10.1007/s00107-020-01583-0 (2020)
[5] T. Van Renterghem, and D. Botteldooren, View on outdoor vegetation reduces noise annoyance for dwellers near busy roads. Landscape Urban Plan. **148**, 203 – 215 (2016)
[6] T. Van Renterghem and D. Botteldooren, On the choice between walls and berms for road traffic noise shielding including wind effects, Landscape Urban Plan. **105**, 199 – 210 (2012)