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Knowledge Exchange Seminar Series (KESS)

...is a forum that encourages debate on a wide range of research findings, with the overall aim of promoting evidence-based policy and law-making within Northern Ireland

Environmental Methods for Reducing Surface Transport Noise

Keith Attenborough
Shahram Taherzadeh
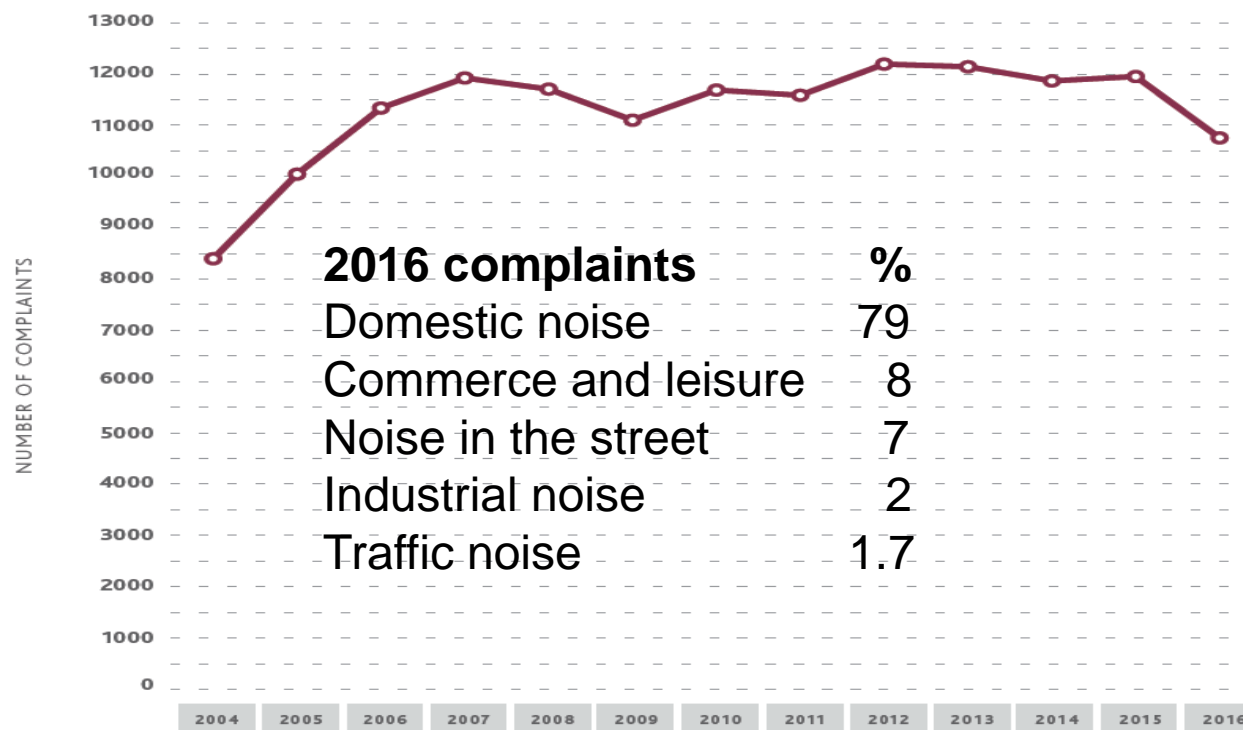Engineering and Innovation
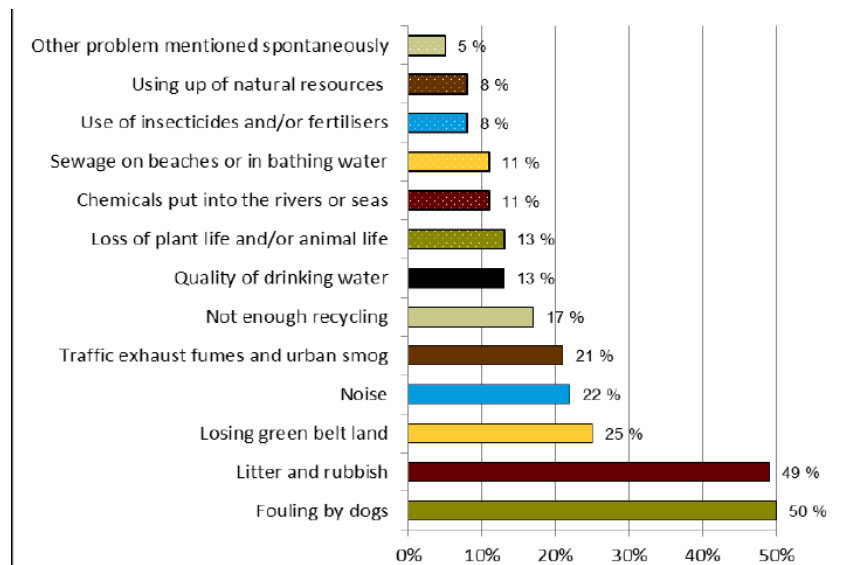Faculty of STEM
The Open University
Milton Keynes
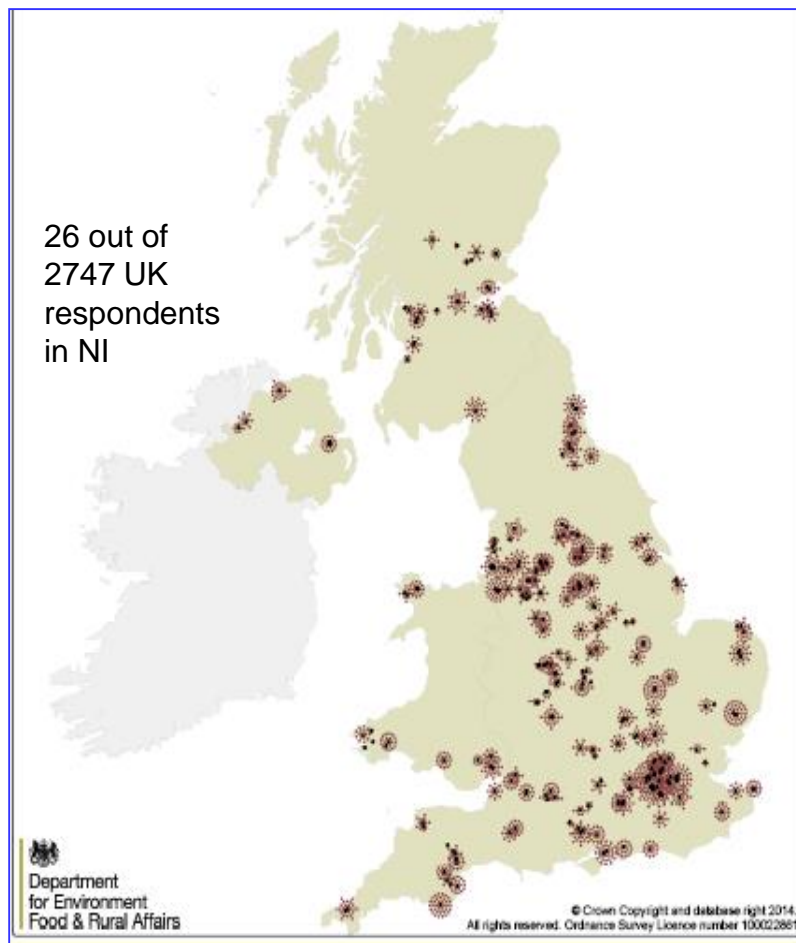MK7 AA
UK

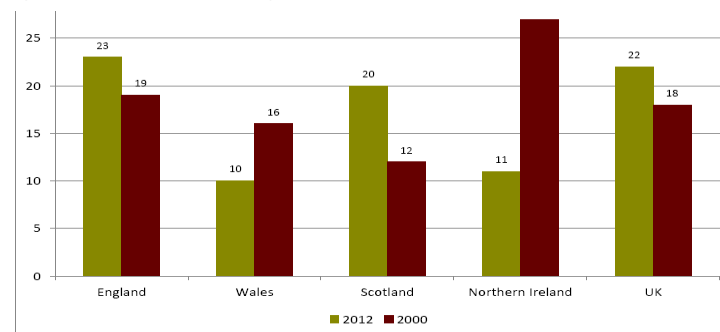**figure 3**

Total number of complaints
2004-2016

2016 complaints **%**
Domestic noise 79
Commerce and leisure 8
Noise in the street 7
Industrial noise 2
Traffic noise 1.7

NUMBER OF COMPLAINTS

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
TOTAL NO. COMPLIANTS	8397	10047	11337	11923	11705	11099	11687	11585	12193	12142	11865	11951	10754

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National Noise Attitude Survey 2012

26 out of 2747 UK respondents in NI

Percentage ranking 'noise' in top 5 problems in 2012

Problem	Percentage
Other problem mentioned spontaneously	5 %
Using up of natural resources	8 %
Use of insecticides and/or fertilisers	8 %
Sewage on beaches or in bathing water	11 %
Chemicals put into the rivers or seas	11 %
Loss of plant life and/or animal life	13 %
Quality of drinking water	13 %
Not enough recycling	17 %
Traffic exhaust fumes and urban smog	21 %
Noise	22 %
Losing green belt land	25 %
Litter and rubbish	49 %
Fouling by dogs	50 %

Change in top 5 ranking for noise between 2000 and 2012

	England	Wales	Scotland	Northern Ireland	UK
2012	23	10	20	11	22
2000	19	16	12	27	18

Green spaces and settlement density v noise levels

Porosity index = non-porous/porous
Green space coverage = total area/green area

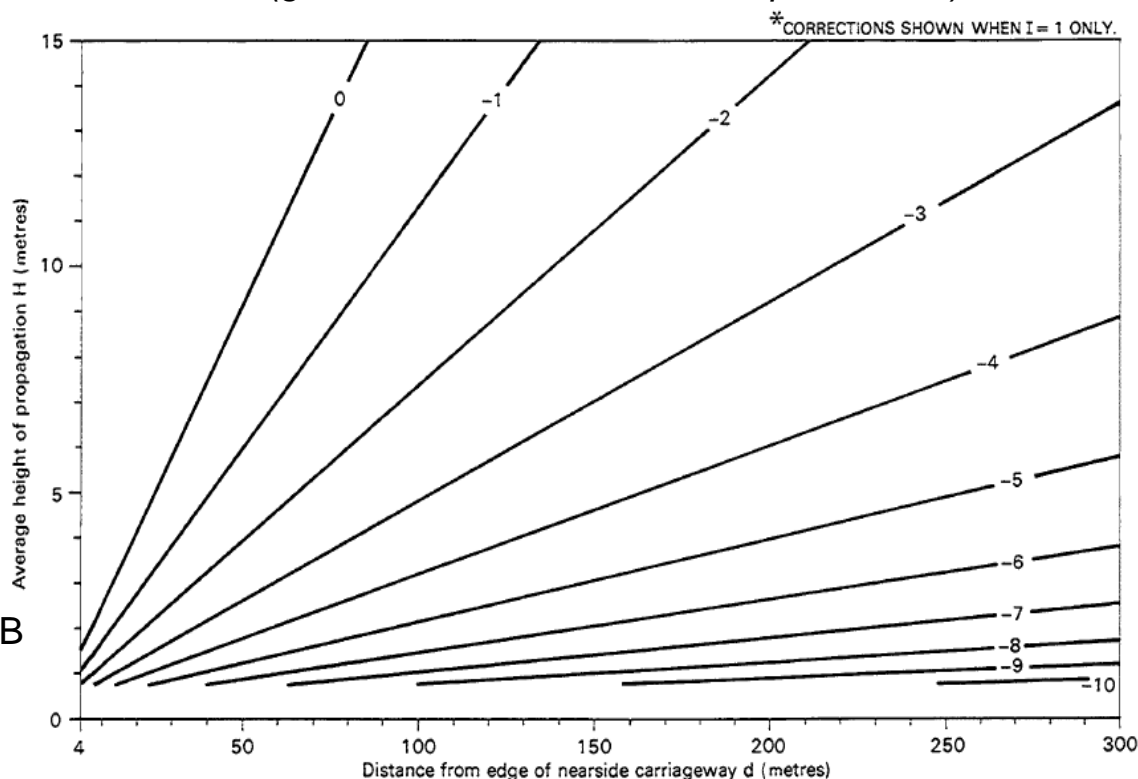| R^2	Sheffield	Brighton
Local road intersections	0.66	0.67
Primary roads length	0.82	0.70
Natural urban green ratio	−0.54	−0.61

Traffic noise barriers – the traditional solution

Part of the prediction procedure in CRTN
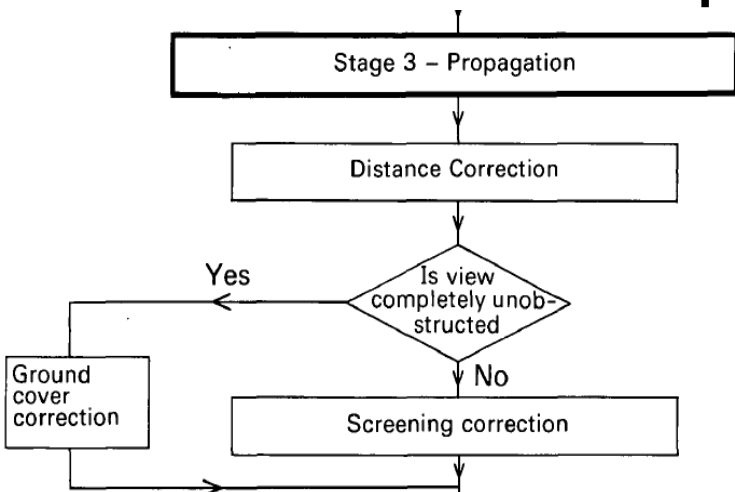
'ground cover' correction if ground surface is 'absorbent…(grassland, cultivated fields or plantations)'

• distance correction is 3 dB per doubling of distance (beyond 4 m from edge)

• at a 1.5 m high receiver 50 m from road, predicted ground cover correction is about 4 dB

"To avoid the difficulty of defining adequately the many other more absorbent types of ground cover, the correction ... is to be used for all predominantly absorbent surfaces …calculations will slightly underestimate attenuation effects, particularly where the intervening ground is intensively cultivated or planted."
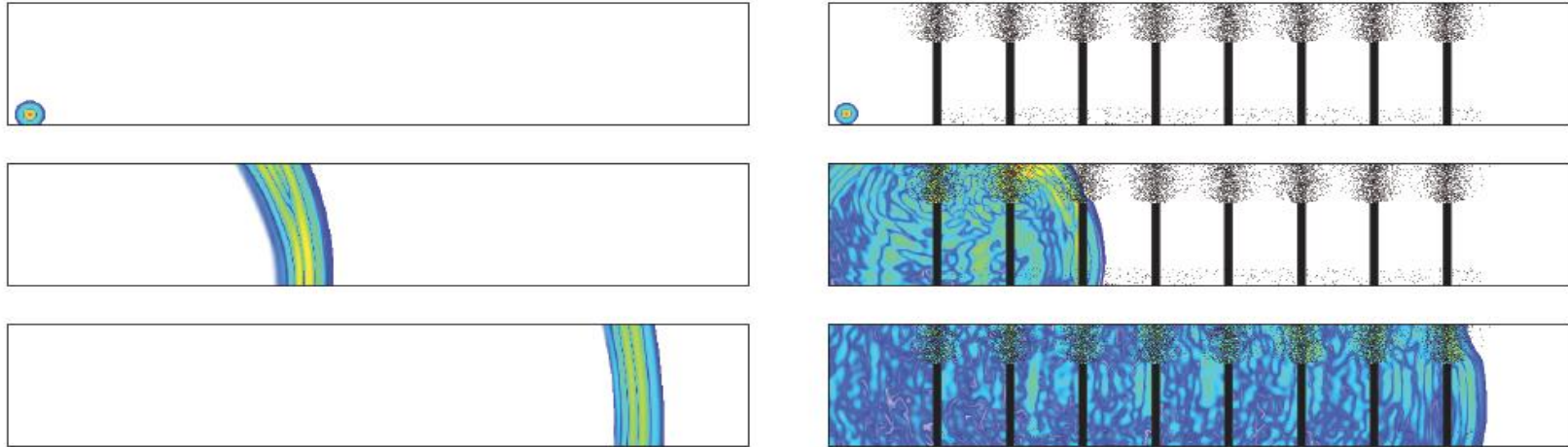
Exploiting 'soft' ground effect

compacted grass

meadow

Ground type	Distance from road	
	50 m	100 m
	dB reduction	
Compacted grass	5.5	7.5
meadow	7.5	12.0
25 m of gravel	9.0	9.5

Predicted levels at 1.5 m high receiver 50 m from 2-lane urban road (5% HGV, 50 km/h)
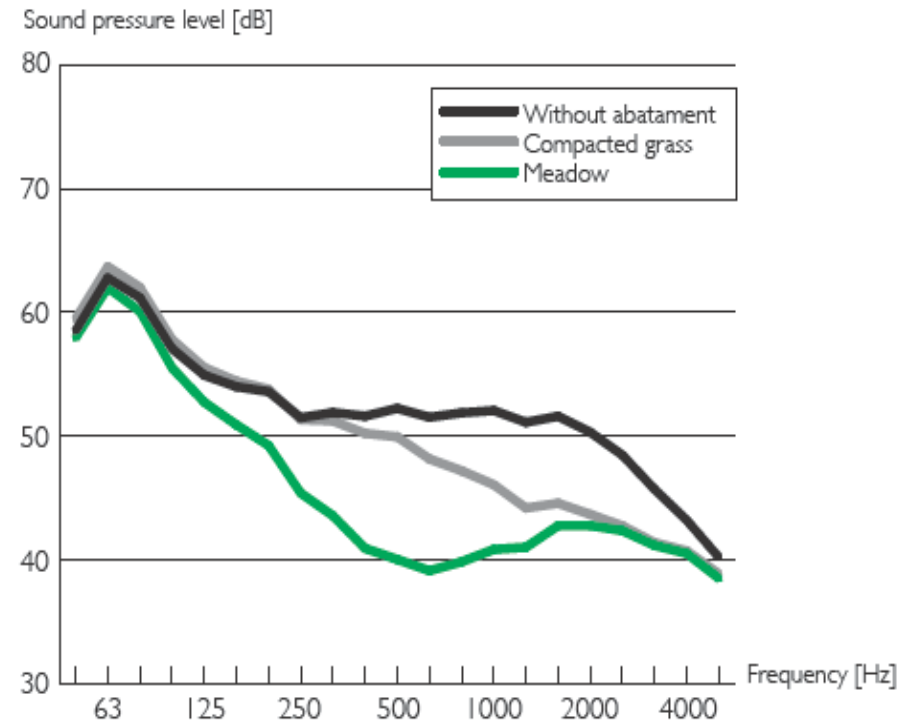
Noise reduction by trees and hedges

Numerical simulations of sound travelling over grass and through trees
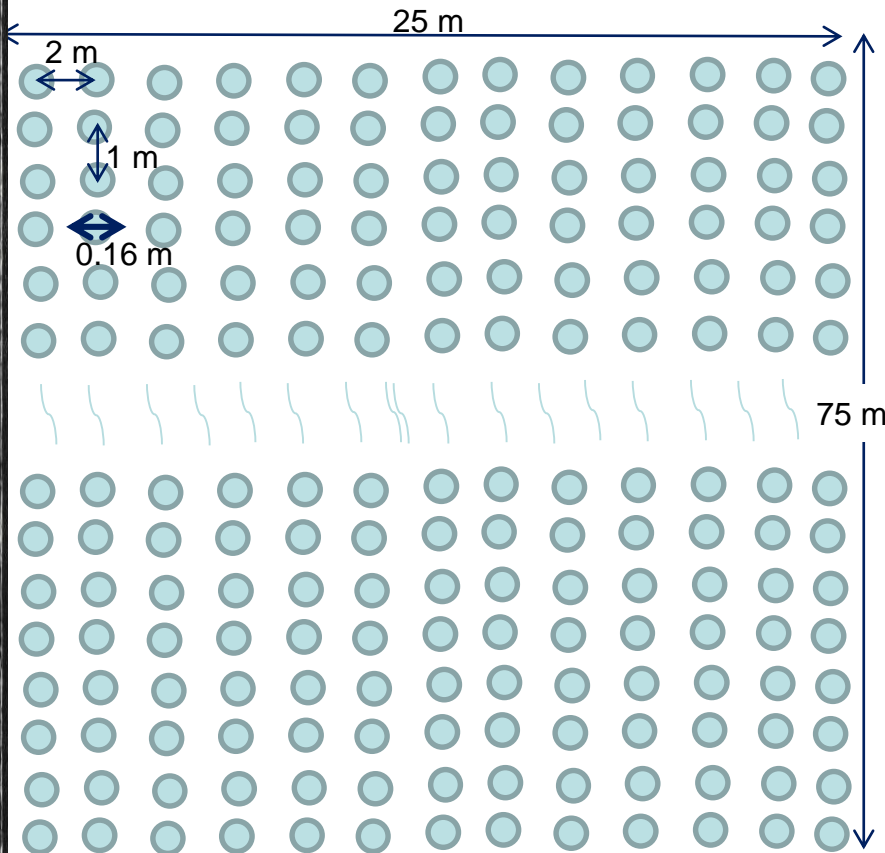
Noise reducing mechanisms in a tree belt:
- ❑ scattering (redirection) by trunks and branches (potential 'sonic crystal' effects)
- ❑ friction, heat exchange and vibration in foliage
- ❑ 'soft' ground effect

Predicted noise reduction due to a 25 m wide tree belt

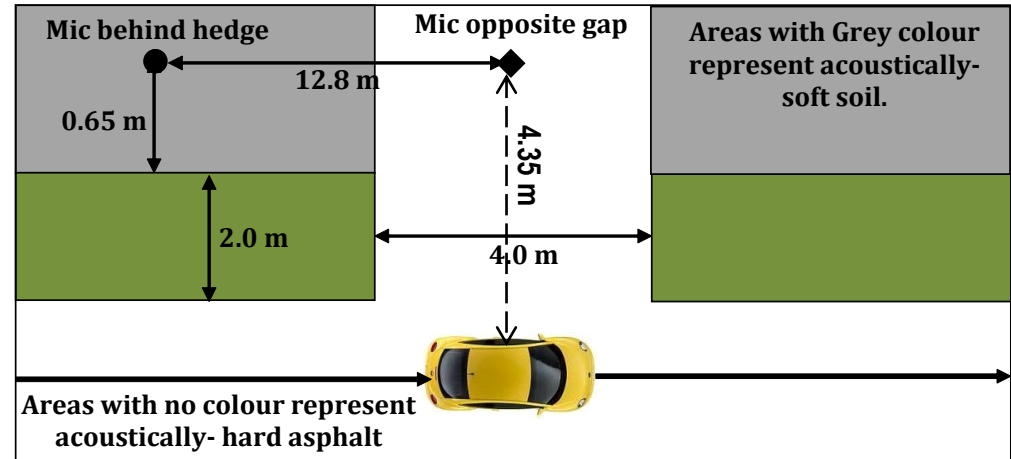Plan of tree belt (*not to scale*)

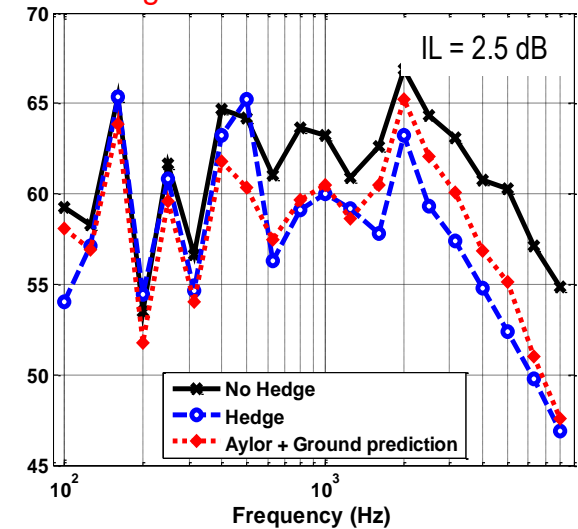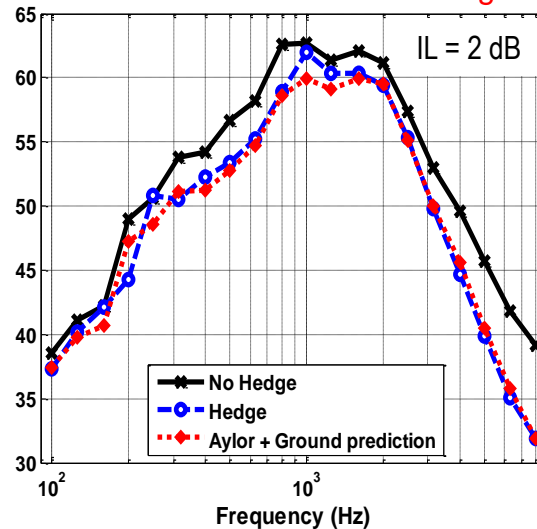Predicted levels at 1.5 m high receiver 40 m (15 + 25) from 2-lane urban road (5% HGV, 50 km/h)

25 m

2 m

1 m

0.16 m

75 m
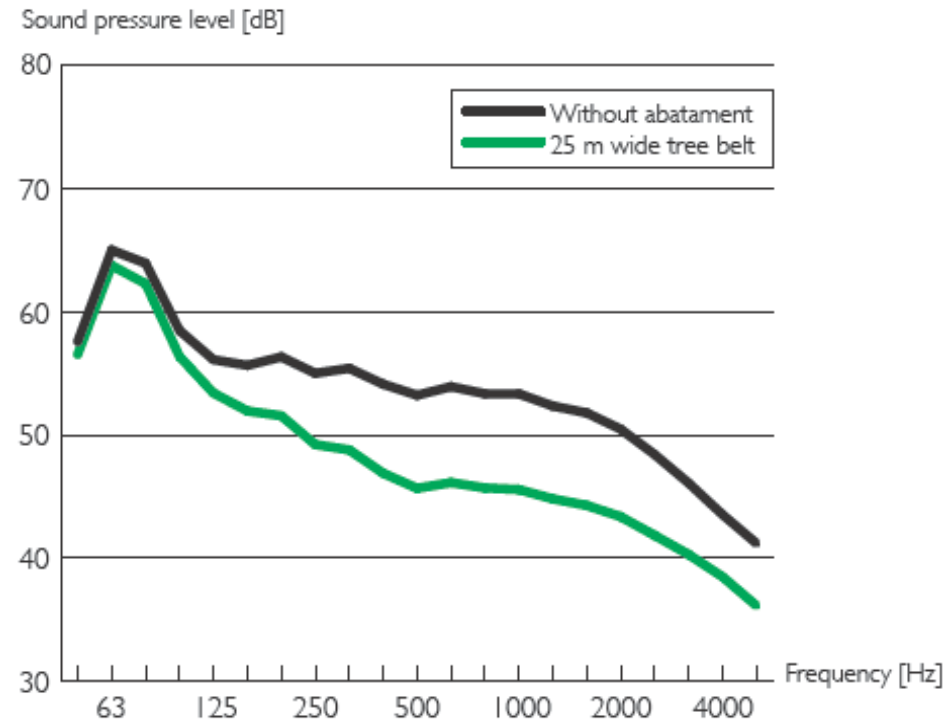
IL = 7 dB (including 'soft' ground effect)

Pass by measurements near a 1.9 m tall 2.0 m wide hornbeam' hedge

Mic behind hedge — Mic opposite gap — Areas with Grey colour represent acoustically-soft soil.

12.8 m

0.65 m

4.35 m

2.0 m

4.0 m

Areas with no colour represent acoustically- hard asphalt

Predictions sum soft ground and foliage effects

IL = 2 dB

No Hedge
Hedge
Aylor + Ground prediction

Frequency (Hz)

IL = 2.5 dB

No Hedge
Hedge
Aylor + Ground prediction

Frequency (Hz)

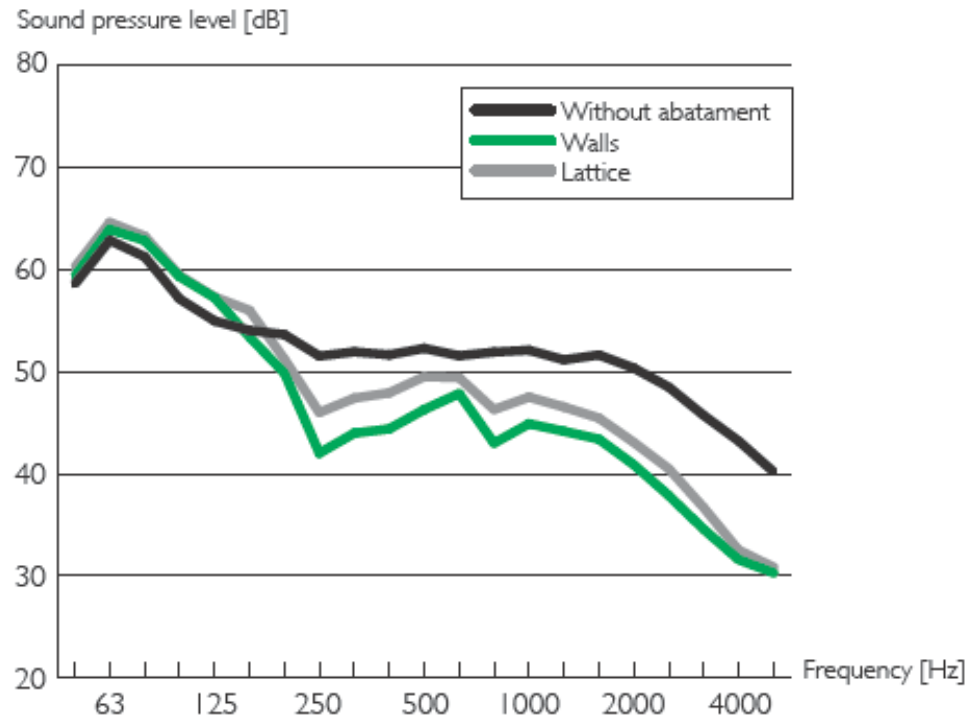# Noise reduction by parallel low walls and lattices

Brick structures used in trials

Predicted levels at 1.5 m high receiver 50 m from 2-lane urban road (5% HGV, 50 km/h)

Array of Walls: 0.3 m high, 3.05 m wide
Lattice: 0.3 m high, 1.53 m wide

width m of 0.3 m high lattice	dB IL re hard
1.53	5.9
3.05	7.2
12.05	10.5

Concluding remarks

❑ 'Green' alternatives to noise barriers for reducing surface transport noise include replacing 'hard' by 'soft' ground, introducing vegetation including tree belts and hedges and installing areas of low walls or lattices on hard surfaces.

❑ Although each method on its own offers less than 10 dB reduction, they can be combined.

❑ Other methods investigated in the HOSANNA project include vegetated façades, green roofs, 'gabion' barriers made from piles of stones, vegetated low barriers, special designs of barrier tops, sonic crystal barriers (regular arrays of vertical cylinders), sonic-crystal-assisted barriers and artificial 'refraction' of sound using horizontal cylinder arrays, corrugating the surfaces of berms and porous road surfaces enhanced by buried resonators.

❑ The methods are not widely known or accepted at present but it is hoped that this presentation will encourage their consideration and use .