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Dear Sir,

FURTHER EVIDENCE RELATING TO THE WIDTH OF GREEN CORRIDORS

1.0 As requested at the Birchall Garden Suburb hearing of the 16th December 2019, I am writing to provide further evidence relating to the width of green corridors. As you rightly pointed out, we must provide rigorous evidence in order to confirm our view that the Green Corridor should be at least 250 metres wide for the benefit of the largest animal which transits through the corridor, the fallow deer. This is not to say that this width alone would be sufficient for the creation of a corridor, as smaller species have further distinct needs which could be accommodated within a corridor of sufficient width (see **Bright, 1998**).

1.1 You asked if I could provide examples of research or corridors in practice. To that end, I thought it would be helpful to provide references to a variety of academic articles and research projects which provide further information. I have briefly summarised their findings, but would be glad to provide you with the full papers if they would be useful to you. I have highlighted in bold specific references.

1.2 The crux of the academic argument is in the existence of 'edge effects'. Every habitat is affected by what occurs along its edge, and negative effects are greatest at the point of convergence.

1.3 Some edge effects, for example those between grassland and woodland, may be less harmful than others – between the urban edge and woodland. Edge effects are grouped into categories, of which the most important for this letter are: *Dispersal barriers*, which stop wildlife moving for fear of harm; *Influence on mortality,* whereby species experience greater levels of predation and harm by being located at an edge, or the creation of a new edge, and; *Species shift,* a phenomenon where species which require a habitat further from the edge (in the core) disappear due to an increase in the edge effect **(Fonseca, 2007: 1209).**

1.4 There is a fairly simple relationship between proximity to a habitat's edge and density and variety of species. With the exception of some adapted species, most species prefer to stay away from the edge of a habitat. The ratio between perimeter and area is key to understanding edge effects: the greater the ratio of edge to area, the less habitable a specific habitat is for the majority of species. Therefore habitats are functionally at their best when they are large and shaped to allow for large internal areas **(Helzer & Jelinski, 1999: 1448).**

1.5 The depth of these edge effects varies from 50 metres to 500 metres dependent on the types of habitat which adjoin. In essence, 'to ensure that the link maintains some portion relatively free of disturbance, the width must be *more than twice* that over which edge disturbances influence ecological processes'. **(Bennett, 2003: 139, original emphasis).**

1.6 The effect of edges on wildlife corridors is well researched, though often highly species specific. For this reason, it is not possible to find an exact precedent for the species types and conditions found in the Green Corridor. We must instead draw key lessons from other environments, and stitch them together in a logical way. What is consistent across all research is that if a corridor is too narrow, it becomes 'all edge' and inappropriate for wildlife. This should not be based on arbitrary issues such as size of a particular species, but by documented encounters with and behaviours of those species.

Width and edge effects for comparable species – applying the theory

2.1 There is a local precedent for accommodating the behaviour of wildlife. When the Baldock bypass was completed in 2006 in North Hertfordshire, it included the Weston Hills Tunnel. The tunnel is 230 metres long, producing a 200+ metre wide wildlife bridge connecting the Weston Hills Nature Reserve to the wider countryside. Trevor James, Director of Hertfordshire Ecology at the time of construction, recalls the reasoning for the width:

'It was deliberately planned at the time to be not only a visual disguise for the road, but also as a breadth of open ground between Weston Hills and the landscape further south through which the most mobile mammals would be likely to move without undue stress.'

This has been seen to be somewhat effective in encouraging the transit of deer through the area, reducing the impact of the road. Its width has reduced edge effects on deer to a low enough level to encourage its use, though anecdotal evidence from the manager of the LNR (in post since 2001) is that the presence of deer has reduced since the construction of the road. This indicates that while 200 metres is better than no link at all, it is not sufficient to accommodate historic levels of species dispersal.

2.2 **Bock, Bock and Bennett (1999**) conducted a study on grassland birds in Colorado, and the effect of the suburban edge. This environment reflects the conditions south of Welwyn Garden City to an extent, with low density housing adjacent to natural and semi-natural grassland and brush habitats. They found that grassland species were over twice as abundant in plots over 200 metres from the suburban edge than in plots less than 200 metres or directly abutting the edge. This implies an edge effect of at least 200 metres, so applying the Bennett principle explained above would result in a corridor of at least 400 metres from the suburban edge.

2.3 **Newmark (1993),** despite his focus being on Tanzania, applies the same logic to corridor design as Bennett. While of course Tanzania is home to much larger species than the UK, his work discusses species of comparable scale. The northern olive thrush is similar in size to a blackbird, and the lesser kudu is comparable in mass and behaviour to the fallow deer. For the olive thrush, the width of the corridor was calculated based on the average distance from the habitat edge of encounters with the bird. This could be easily established with reference to the Green Corridor deer population, for which sightings have been recorded. While the pressures on land use are lower in Tanzania, Newmark writes:

It was recommended that most corridors be at least one km in width in order to provide a buffer around the 600m core, i.e. the estimated minimum corridor width for the understory bird community. This minimum width was estimated by doubling the median distance of encounter for the understory species (northern olive thrush (Turdus abyssinica)'.

It is therefore clear that Newmark's view on wildlife corridors is that a simple calculation based on key species is an appropriate way to arrive at a corridor width. If tempered with the constraints of applying such logic to Hertfordshire (and existing conditions on the ground), a similar method can be used to find the right balance between development and ecology. Deer movements have been recorded across the top of the arable ridge on the BGS site, following it down into Commons Wood. At its nearest, this is 200 metres from the urban edge. Applying

Newmark's logic to this area would require the corridor to be at least 400 metres wide in order to facilitate existing deer behaviour.

2.3 **Harris and Scheck (1993)** offer their parameters for a green corridor based on its permanence and intended function. They write:

'for the movement of a species, when much is known of its biology and when the corridor is expected to function over years, the width should be measured in 100's of metres'.

We know that the Green Corridor serves as a transit route for many species of farmland birds, as well as fallow deer, badgers and raptors. This much has been recorded thoroughly. We also know that roe deer, relatively rare in Hertfordshire, have recently recolonised the Green Corridor. The WHBC Green Corridor strategy talks about net gains to biodiversity and a defensible edge to Welwyn Garden City. The Green Corridor is, therefore, clearly intended to function over years and is almost uniquely mapped in terms of its biology. Harris and Scheck would therefore argue that a Green Corridor across the BGS site would need to measured in the hundreds of metres.

2.5 **Harrison (1992: 294)** asserts that calculations about corridor width should be calculated from the home range of the female of a target species. In the case of the fallow deer, the female home range is judged to be between 0.66 and 2.1 square kilometres **(Nugent, 1994:159 & Borkowski & Pudelko, 2007: 107).** In order for it to be considered a functioning corridor, Harrison would suggest an ideal corridor would be made up of rectangular sections, twice as long as they are wide. This results in a minimum width of around 575 metres, and a maximum width of just over 1,000 metres.

2.6 Applying Harrison's calculation to other species present in the corridor results in the following:

Species	Female home range (km^2)	Required corridor width (m)
Roe deer	0.088[a]	210
Badger	0.21[b]	324
Barn owl	0.53[c]	518
Polecat	0.79[d]	631

[a] Tufto, Andersen & Linnell, 1996: 721
[b] Cresswell & Harris, 1988: 41
[c] Baghli, Walzberg & Verhagen, 2005: 334
[d] Thomson, Kroeger, Bloom and Harvey: 339

2.7 While it is clear that the academic literature would expect a width greater than the 250 metres proposed by the Green Corridor Group, we believe that a reasonable compromise can be achieved, 250 metres is the absolute minimum width of a functioning corridor.

Human and domesticated animal interaction

3.1 Another significant edge effect which arises when habitats are directly adjoining urban and suburban areas comes from human interaction. The presence of domesticated animal predation has been proven to force wildlife deeper into habitats by multiplying mortality edge effects. As **Theobald, Miller and Hobbs (1997)** write:

These 'subsidized predators' feed on small mammals, amphibians, reptiles, and songbirds, and can have a substantial impact on native species'

3.2 Furthermore, **Woods, McDonald and Harris (1997)** estimate that 92 million prey items – small mammals, invertebrates and birds – are killed by domestic cats in the UK each year. Large populations of significant species of farmland birds, water voles and great crested newts are present in the Commons and Commons Wood, which would be at risk from disturbance and predation from household cats, necessitating extended buffers around these habitats. The impact of walkers and dogs on Commons Wood is likely to reduce its value for deer, while increasing compaction and damaging the quality of the woodland itself. This is where significant buffers, as detailed in previous Green Corridor Group literature, are vital in protecting these habitats.

Wildlife crossings, bridges and culverts

4.1 There is a well established effect of roads on wildlife populations. The BGS masterplan indicates significant road building would take place on the site, severing it north to south. Tarmac's representatives at the hearing loosely outlined options for wildlife crossings as amelioration techniques.

4.2 A number of papers from the University of Birmingham's School of Geography and Environmental Sciences concisely indicate the effect of roads on wildlife in the UK. The presence of a road 'greatly inhibits access to habitats which lie on the opposite side' for small mammals **(Underhill, 2002: 94).** She also remarks that: '*Unfortunately, the difference wildlife tunnels will make to the overall death rate of animals on roads will be negligible. There are too few of these structures to have a significant impact on the number of road-kills and the benefits to be derived from them are likely to accrue almost exclusively…to a limited number of species.'* **(196).** By creating barriers isolating species to islands within a network of roads, the risk of localised extinction rises dramatically **(Underhill & Angold, 2000: 6)**.

4.3 It must also be noted that the effect of roads on small mammals will translate into negative effects on the species which predate on them. Localised extinction of rodents and other small animals will have a damaging effect on the ten species of raptor present at the site.

4.4 In his 2005 paper, **Dr. Clevenger** of Montana State University queries the robustness of the evidence base relating to wildlife bridges, which seek to reduce wildlife deaths from the construction of roads. He writes: *'Until now, the general idea of how well a crossing performs has not gone far beyond the simplest level of scrutiny – if animals use it, then it must be functional.'.* This is clearly an insufficient measure of success, as any mitigation measures would require species to continue to behave and travel in the way they did before development.

He goes on to say that:

'Our research has shown that species respond differently to wildlife crossing structure designs and adjacent landscape features, therefore mitigation planning in a multiple-species ecosystem will not be a simple task (Clevenger and Waltho 2000, Clevenger and Waltho 2005). No individual crossing structure design fits all. Further, the crossings will only be as effective as the land and resource management strategies around them'

This highlights the need for detailed consideration to be given to the design of interventions, with extensive consultation required with local wildlife stakeholders. In order to accommodate the different species proximal to BGS, and those transiting through, it is likely that a significant variety of interventions would be required to achieve the standard laid out in Bennett's paper.

Concluding thoughts

5.1 There is a clear need for housing in Welwyn Hatfield. Indeed, the constraints map provided by the Green Corridor Group indicates that certain areas of the proposed BGS site would be suitable for development when looked at ecologically. I am not against development, but to develop the full extent of BGS would be opposed to the NPPF's requirement for net gains to biodiversity. This site is already a functioning wildlife corridor, and steps must be taken to ensure it remains as such. This is not limited to width, and further consultation is required to establish specific features vital for species dispersal.

5.2 The academic literature relating to specific widths for specific corridors is understandably and recognisably lacking. The variety of possible species, locations, constraints and habitats make it impossible to create a set of rigid criteria for the design of wildlife corridors. However, when an effort is made to assess the literature more widely, key points do emerge.

5.3 Edge effects are substantial, and should be measured by observed behaviour of species in existing conditions. The literature cited above would support the idea of doubling the median point of encounter for a specific target species as the method for arriving at a corridor width. To do so for the largest animal at the BGS site, the fallow deer, would result in a corridor width of at least 400 metres based on observed behaviour. The literature cited above would suggest a minimum of 575 metres for fallow deer.

5.4 Perimeter to area ratio is also a critical factor in the success of habitats. The present layout of the proposed development at BGS means the Green Corridor is at risk of becoming 'all edge' and therefore inappropriate for wildlife due to dispersal barriers and mortality effects. Its direct abuttal against existing habitats threatens to harm them through human and domestic animal incursions, further adding to the ecological harm and encouraging species shift.

5.5 While it is clear there is no consensus on precise width for species, there is undeniably consensus of two facts: bigger is better, and 250 metres is at the lowest end of what is acceptable for the species in question on the BGS site and across central Hertfordshire. Anything less than 250 metres would create an 'all edge' environment, and cease to function as a wildlife corridor.

I trust that this is helpful in your deliberations. I am at your disposal should you wish to discuss anything further.

Yours sincerely,

Peter Oakenfull

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