

**ARBORFIELD CROSS RELIEF ROAD
WOKINGHAM
WOKINGHAM BOROUGH COUNCIL**

BIG Biodiversity Challenge Award Category: *Innovation Award*

Project Overview

Wokingham Borough Council (WBC) provided the Arborfield Cross Relief Road (ACRR), a 2.3km single carriageway by-passing Arborfield Cross. The scheme includes a 'Green Bridge' as experimental mitigation for the loss of bat commuting habitat which is being tested through bespoke 3D bat monitoring surveys.

What were the biodiversity conditions on site, prior to the enhancement?

The ACRR is sited in greenfield land dominated by arable fields and pasture, with numerous hedgerows and woodland parcels. Baseline survey and assessment work was completed for a range of habitats and species, whereby woodlands, bats and badger were identified as important ecological features influential to the scheme's design. Mitigation to facilitate the continued movement of commuting bats in the landscape was conditioned, in addition to requirements to deliver biodiversity gains, badger tunnels and appropriate planting. The planning consent 'strongly encouraged' testing of the green bridge's efficacy as ecological mitigation for bats to provide an evidence legacy for future schemes.

What were the reasons behind this project ?

The 'Green Bridge' was designed to maintain a bridleway over the new road, the ecological elements were largely experimental given the lack of case studies. The planning consent encouraged the project to be used as an evidence legacy to inform future infrastructure schemes. Specific planning conditions were discharged using the 'Green Bridge' ecological mitigations. An innovative 3D bat monitoring survey methodology was devised to determine whether bats alter their flight path to follow the 'Green Bridge', away from their preferred, pre-construction route. The aim of the monitoring work is to publish the results in Conservation Evidence (www.conservationevidence.com) for industry reference.



IACRR pre-development (looking north from approximately the location of the Green Bridge). The hedgerow in the picture is the one which was identified as a key commuting route for bats, and which links two woodland parcels (one of which is ancient woodland and Local Wildlife Site).



Planting installed at the Green Bridge; new woodland, hedgerows, and scrub link the two existing woodland parcels

What were the biodiversity measures taken?

Planning stage surveys determined that a hedgerow required for removal which linked two woodland parcels was an important bat commuting route. The 'Green Bridge' was designed to combine the bridgeway and provide valuable new habitat, 60m to the south of the hedgerow. The Green Bridge sought to contribute to net gains to biodiversity and provide a mitigation solution for bats.

The 'Green Bridge' designs were subject to extensive cross disciplinary collaboration; new woodland and hedgerow planting link the existing woodland parcels, and new hedgerow and shrub planting span the bridge on the northern and southern edges. The northern line of hedgerow and shrubs on the bridge doubles as maintenance track and a badger crossing, and the tall equestrian fencing provides a physical guide for bats crossing the bridge to follow whilst the hedgerow matures.

The replicable survey methodology seeks to test the null hypothesis: "There will be no change in the number of bats crossing ACRR at either the 'hedgerow' or 'Bridgeway/Green Bridge' post-construction, in comparison to either the pre-construction or during construction stages".

Pre- and during-construction phase surveys are complete, and years 1, 3 and 5 post-construction will commence in 2021. Each survey comprises four dusk and pre-dawn visits. The survey team note the species, height above ground, direction, trajectory, and distance of the flight from either the hedgerow (the pre-construction commuting feature) or the Green Bridge. The digitised flight paths are then elevated using temporally relevant 3D topographical data.

Once duplicate observations (from multiple surveyors) are filtered from analysis, the 'association' of bat flight paths to either the hedgerow or the Green Bridge/PRoW is determined to enable comparison. Pre-construction, 97% of flight paths (excluding noctules, which fly very high) fell within 5m of the hedgerow, and during construction, 89% within 10m of the line of the removed hedgerow.



Plane imagery of the new ACRR, looking south along the alignment. The Green Bridge is visible, linking Spring Copse, (immediately west/right of the alignment) the Arborfield Court Woodland (immediately east/left of the alignment). The Green Bridge maintains the line of the PRoW (visible in image), with the ACRR dug into cutting at this point of the alignment.



Green Bridge at ACRR with newly installed planting – southern span, looking west

Further information

To enable analysis and avoid bias the survey methodology was meticulously prepared prior to commencement and considered each of the pre, during and post-construction stages. Exact surveyor locations were chosen for their replicability throughout the years; surveys are to be completed over a range of moon phases to avoid background light levels affecting bat behaviour; consistent lead surveyors are used each year, and data analysis parameters are rigorously applied. Data collection parameters in the field were defined prior to commencement to facilitate digitisation, record identification and future statistical analysis; this element was a collaborative undertaking to facilitate meaningful data presentation, interrogation and importantly, survey replication. The survey teams were fully briefed on the survey methodology prior to commencement.

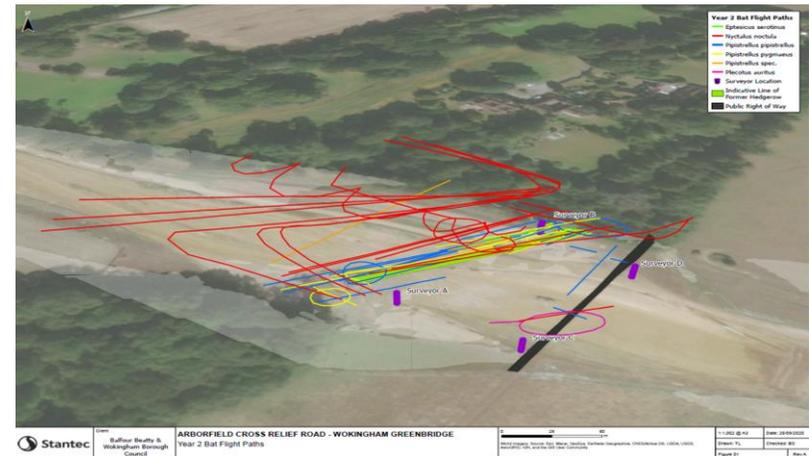
Three-dimensional (3D) ground form data was gathered by drone or topological survey close to the survey events to ensure that flight heights could be modelled in 3D against an accurate landform. This element of bat flight could then be factored into consideration of mitigation efficacy – an important element of this scheme given ACRR was built into 7m deep cutting.

The 3D animated gifs prepared in ArcGIS Pro were used to visualise and compare the bat flight paths for analysis as well as presentation to stakeholders. This innovative approach to data interrogation and presentation resulted in more engagement and helps secure funding for future years survey. Post-construction surveys are essential for determining the green bridge’s efficacy and publishing the conclusions for industry reference, the ultimate intended legacy of the surveys.



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Source: Esri, DigitalGlobe, GeoEye, Earthstar (United States), USDA, AeroGRID, IGN, and the GIS User Community

Snapshot from an animated GIF of the Year 1 (pre-development) 3D bat survey work. Purple lines indicate the flight paths of noctule (flying high above the scheme, not following hedgerows), with the interest species tightly following the line of the hedgerow. The PRoW (seen as a faint green line) had no bat flight paths associated with it in the pre-development year.



Year 2 (during construction) data shown in another format. PRoW is marked by the black line, with the line of the former hedgerow (removed at this point), still visibly a strong commuting route for bats such as pipistrelles and serotine. A few bats were observed foraging over the bare earth near to the PRoW, however in comparison, very few bats used the line of the PRoW as a commuting route. The aerial image in this figure has been overlaid onto the updated topographical survey, meaning the changes in ground form associated with the construction stage are visible.



Project Team

WBC were the ultimate client, Balfour Beatty the construction contractor, and Stantec the detailed designer. Specialist ecologists and WBC's ecology officer were heavily involved throughout and the bat survey methodology was reviewed by Conservation Evidence to allow the results to be the subject of a research paper.

All parties are keen to ensure this project informs future schemes within the borough, country or internationally to enable future biodiversity mitigation to be designed referencing proven success or failures. This is important to ultimately ensure that biodiversity mitigation and enhancements provided on highways infrastructure are effectively delivering maximum biodiversity benefit.