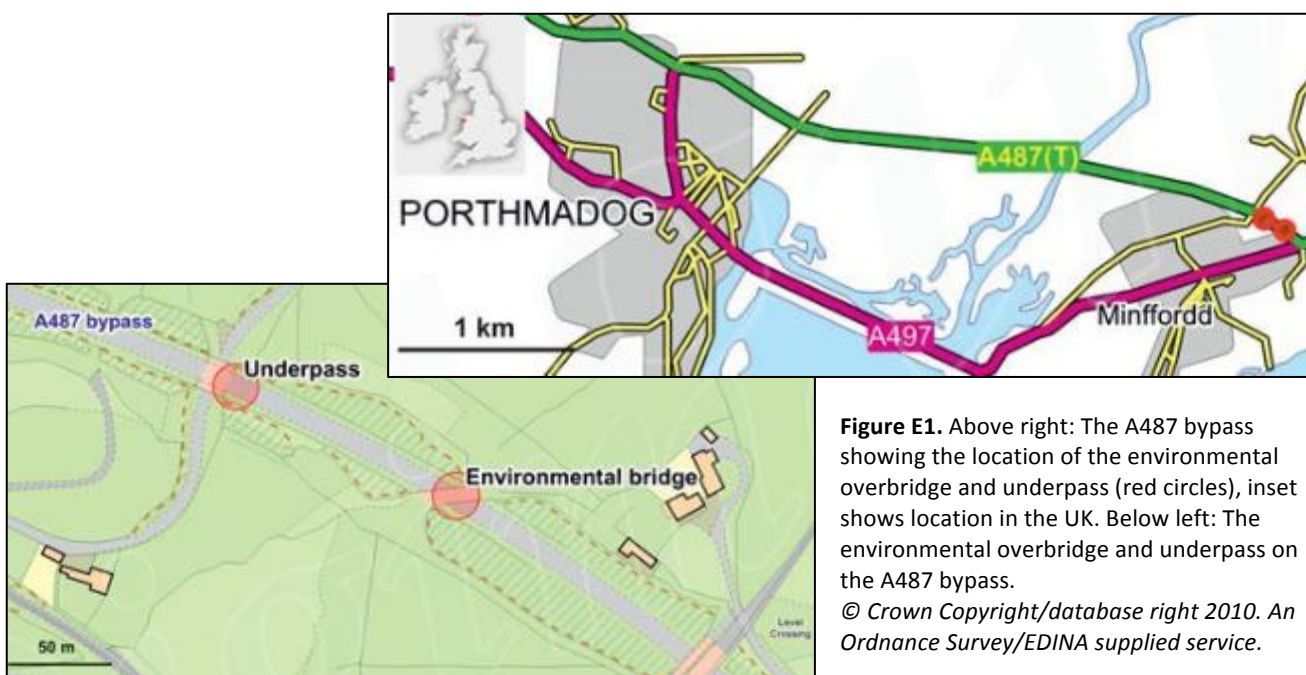


## Appendix F: Details of mitigation sites

### Environmental overbridge and underpass, A487, Gwynedd, Wales

<b>Road</b>	A487 (Figure E1)
<b>Section studied</b>	Porthmadog, Minffordd and Tremadog bypass (2 lane single carriageway)
<b>Length of section</b>	5.2 km
<b>Construction works</b>	New bypass
<b>Works completed</b>	Opened in 2012
<b>Structure(s) surveyed</b>	An environmental overbridge and an underpass (Figure E1, see below for details)
<b>Traffic volume</b>	10,000 vehicles per day (AADT*) recorded at nearby junction (data not yet available for the bypass)
<b>Speed limit</b>	60 mph
<b>Surrounding landscape</b>	The bypass is located in a relatively flat agricultural valley that lies between Glaslyn estuary and Snowdonia National Park. The bypass crosses the valley bottom and climbs the sides of the valley. The surrounding landscape is hilly and consists of small coastal settlements, improved grassland and woodland.

\* AADT (Average Annual Daily Traffic, Department for Transport 2013)



**Figure E1.** Above right: The A487 bypass showing the location of the environmental overbridge and underpass (red circles), inset shows location in the UK. Below left: The environmental overbridge and underpass on the A487 bypass.

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### Environmental overbridge

<b>Dimensions</b>	Approx. 30 m length x 5 m width x 6 m height
<b>Features</b>	Constructed at an angle over the road to connect previous known bat commuting routes. The road lies in a cutting and there are steep banks on either side. Woven wooden fencing has been installed to guide commuting bats to the bridge. The bridge itself has vertical sides (approximately 2 m high) and a line of deadwood and planters containing hawthorn ( <i>Crataegus monogyna</i> ) along its length. See Figure E2.



**Figure E2.** The environmental overbridge on the A487 from the southeast verge.

### A487 underpass

<b>Dimensions</b>	25 m length x 2.5 m width x 2.5 m height
<b>Features</b>	Used as a livestock creep. Has woven wooden fencing approaching it from both sides to guide commuting bats towards the underpass entrance from a nearby hedge line. See Figure E3.



Figure E3. The underpass below the A487. Both taken from the north side.

### Two underpasses, A465, Monmouthshire, Wales

<b>Road</b>	A465 (Figure E4)
<b>Section studied</b>	Section 1 'Heads of the Valley', Gilwern to Abergavenny (Figure 3)
<b>Length of section</b>	6.8 km
<b>Construction works</b>	Widened from existing single (2 lane) carriageway to a dual (4 lane) carriageway
<b>Works completed</b>	2008
<b>Structure(s) surveyed</b>	Two underpasses: Hopyard farm and Evesham nurseries (Figure E4, see below for structure details)
<b>Traffic volume</b>	16,000 – 17,000 vehicles per day (AADT*)
<b>Speed limit</b>	70 mph
<b>Surrounding landscape</b>	Within the Brecon Beacons National Park. Affects two Special Areas of Conservation (SACs) including a site that contains 5% of the UK's lesser horseshoe bat population. The surrounding landscape is mainly agricultural with grazing pasture and improved grassland interspersed with parkland and woodland.

\* AADT (Average Annual Daily Traffic, Department for Transport 2013)



Figure E4. Above: The A465 'Heads of the Valley' dualling scheme, looking east from the western end. Below left: The A465 showing the location of the two underpasses, inset shows location in the UK. © Crown Copyright/database right 2010. An Ordnance Survey/EDINA supplied service.



### Hopyard Farm underpass

<b>Dimensions</b>	70 m length x 2.5 m width x 2.5 m height
<b>Features</b>	Existed under the original road and has been extended/modified during widening. Both ends of the underpass have grilles fitted and open onto minor access roads with plantings at the roadside (see Figure E5), A known <i>Rhinolophus hipposideros</i> roost at Llanwenarth House is located approx. 400 m from the southern entrance to the underpass.



Figure E5. Location map and photograph of Hopyard Farm underpass on the A465. © Crown Copyright/database right 2010. An Ordnance Survey/EDINA supplied service.

### Evesham nurseries underpass

<b>Dimensions</b>	45 m length x 4.5 m width x 4.5 m height
<b>Features</b>	Existing underpass that has been extended/modified during widening. Carries a public footpath and contains motion-activated lighting, although the lights have been permanently deactivated (Len Wyatt, pers. comm. Jan 2014). There are well connected tree lines on either side of the underpass and a fence line at the southern entrance. See Figure E6.



Figure E6. Location map and photograph of Evesham Nurseries underpass on the A465. © Crown Copyright/database right 2010. An Ordnance Survey/EDINA supplied service.

### Scotney Castle landscape bridge, A21, Kent, England

<b>Road</b>	A21
<b>Section studied</b>	Lamberhurst bypass (4 lane dual carriageway)
<b>Length of section</b>	2.5 km
<b>Construction works</b>	New bypass
<b>Works completed</b>	2005
<b>Structure(s) surveyed</b>	Scotney Castle landscape bridge (see below & Figure E7)
<b>Traffic volume</b>	15,000 vehicles per day (AADT*)
<b>Speed limit</b>	70 mph
<b>Surrounding landscape</b>	Located in an AONB (Area of Outstanding Natural Beauty) and designated Special Landscape Area, and surrounded by woodland and parkland including the Scotney Castle estate, which is known to be inhabited by several bat species.

\* AADT (Average Annual Daily Traffic, Department for Transport 2013)

## Landscape bridge

<b>Dimensions</b>	Approx. 50 m length x 30 m width x 6 - 8 m height
<b>Features</b>	The bridge carries a minor road lined on both sides by grass verges, woven wooden fencing, shrubs and mature trees up to 2-3 m in height. Well connected on both sides by mature trees and woodland. The bypass is not visible from the bridge itself as the plantings screen the view as well as much of the traffic noise. There is lighting on the underside of the bridge. See Figures E7-E9.



**Figure E7.** Scotney Castle green bridge from the south east.



**Figure E8.** Scotney Castle green bridge, over the top (left) and below (right).



**Figure E9.** Mature trees and woodland connected with Scotney Castle green bridge, looking towards the bridge from the west (left) and east (right).



### Three wire bat bridges and an overpass, A11, Norfolk, England

<b>Road</b>	A11 (Figure E10)
<b>Section studied</b>	A11 Fiveways to Thetford Improvement
<b>Length of section</b>	15 km
<b>Construction works</b>	Upgrading existing (2 lane) single carriageway to (4 lane) dual carriageway, and re-routing of a 5 km section to bypass Elveden village
<b>Works completed</b>	On-going since Jan 2013, expected completion late 2014
<b>Structure(s) surveyed</b>	Three bat wire bridges (no. 6, 5 & 3) and B1106 overbridge (see Figure E11 and below)
<b>Traffic volumes</b>	20,000 vehicles per day before construction (AADT*)
<b>Speed limit</b>	70 mph (restricted 50 mph during study and only one lane open in each direction)
<b>Surrounding landscape</b>	The road runs through a rich landscape of woodland, forest, heath and farmland with much of the area designated as a Site of Special Scientific Interest (SSSI) for its biodiversity. At least 11 bat species are known to be present in the area.

\* AADT (Average Annual Daily Traffic, Department for Transport 2013)



Figure E10. The A11 looking towards the north from the B1106 overbridge.

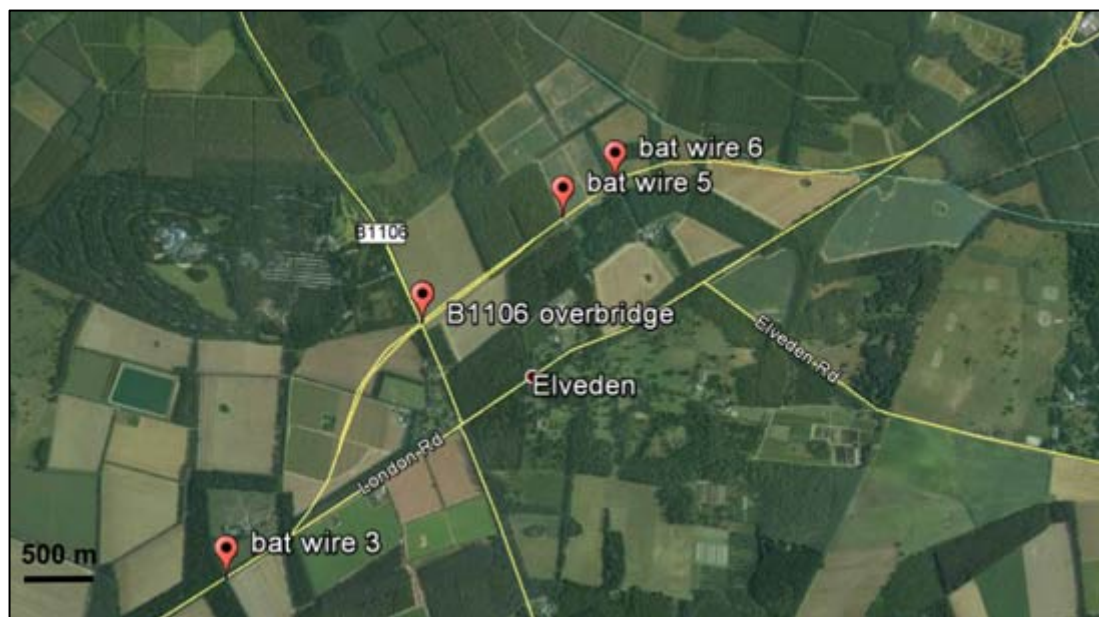


Figure E11. Aerial photograph (pre-construction) of the re-routed section of the A11 and location of mitigation structures.  
© 2013 Google Earth © 2013 Getmapping plc.

### Bat wire bridge 6

<b>Design</b>	Three 7 m high wires and wire mesh forming a V shape suspended between two vertical poles on each side of the road. Wire mesh also in place on each side of the poles from 4 m above ground level to the top of the structure, designed to guide bats up and over the wires.
<b>Features</b>	Located on new bypass (re-routed section of A11). Connected with mature treelines on the north side of road. Treelines approaching on south side but disconnected by open unpaved access track running parallel to the A11. Activity of at least seven bat species were recorded before construction and 'significant' numbers of <i>N. leisleri</i> and <i>Pipistrellus</i> species were observed commuting at low heights at the proposed location of the bat wire. See Figures E12 & E13.



Figure E12. Aerial photograph (pre-construction) showing the locations of bat wires 5 and 6.  
© 2013 Google Earth © 2013 Getmapping plc.



Figure E13. Bat wire 6 on the A11, both taken from the south east.

### Bat wire bridge 5

<b>Design</b>	7 m high with three wires and wire mesh forming a V shape suspended between two vertical poles on each side of the road. Wire mesh also in place on each side of the poles from 4 m above ground level to the top of the structure, designed to guide bats up and over the wires.
<b>Features</b>	Located on new bypass (re-routed section of A11). Connected with mature treelines on the north side of road. Treelines approaching on south side but disconnected by open unpaved access track running parallel to the A11. At least nine bat species were recorded before construction work commenced with a range of crossing points and 'significant' foraging activity adjacent to the road. See Figures E12, E14 & E15.



Figure E14. Bat wire 5 on the A11, taken on the south east side.



Figure E15. Left: Treelines approaching bat wire 5 on the A11 from the east and access track. Right: treelines running parallel to the A11, looking down the south east side of the road.

### Bat wire bridge 3

<b>Design</b>	Design to match bat wires above. At time of survey only the two 7 m high vertical poles had been installed on either side of the road, no wires were in place.
<b>Features</b>	Located on original A11 route. Connected with mature treelines on the north side of road. Treelines approaching on south side but disconnected by paved access road running parallel to the A11. At least 10 species were recorded flying along the woodland edge and crossing the road at a range of crossing points before construction work commenced. This was the only site along the Improvement where <i>Myotis daubentonii</i> were recorded. See Figures E16-E18.





**Figure E16.** Aerial photograph (pre-construction) showing the locations of bat wire 3.  
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**Figure E17.** Left: Location of Bat wire 3 on the A11 looking across the road from the east. Right: Location of Bat wire 3 on the A11 taken from the north east.

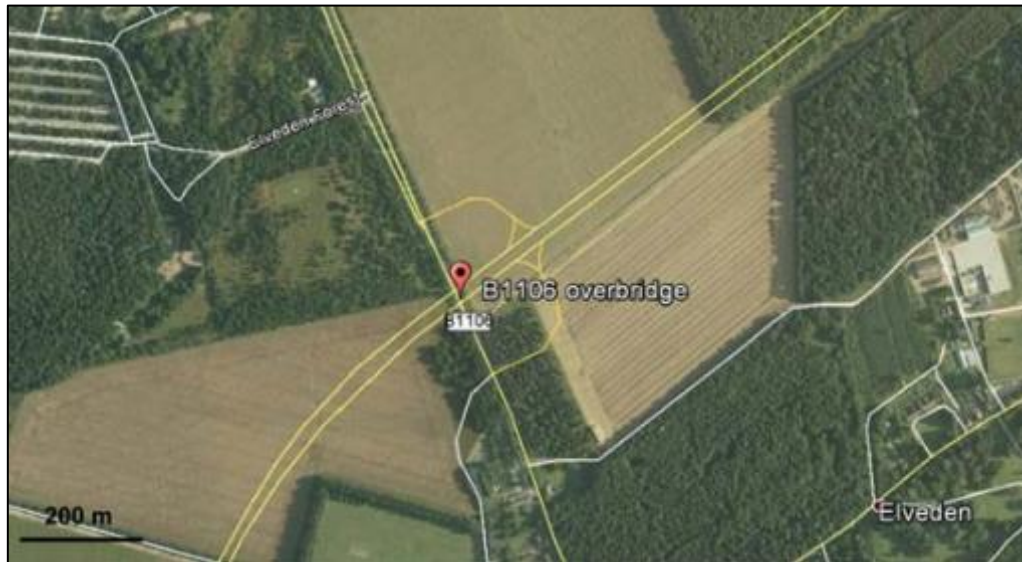


**Figure E18.** Treelines approaching the A11 and bat wire 3 location on the east (left) and west (right).



### B1106 overbridge

<b>Dimensions</b>	Approx. 40 m length x 15 m width x 8 m height
<b>Features</b>	Located on new bypass (re-routed section of A11). Built to carry an existing B road over the A11, and also designed as a mitigation structure for bats. No direct connectivity to surrounding treelines/woodland. It was proposed that there would be planting to guide bats to the bridge as well as a parapet wall and mesh over the bridge, but none of this had been built at the time of our study. Prior to construction, at least nine bat species were recorded at this location crossing at a range of crossing points and heights. See Figures E19-E22.



**Figure E19.** Aerial photograph (pre-construction) showing the location of the overbridge.  
© 2013 Google Earth © 2013 Getmapping plc.



**Figure E20.** Side views of the overbridge taken from the south east (above) and north (below right).



**Figure E21.** Looking across the top of the overbridge from the south east.



**Figure E22.** Right: the south east embankment approaching the overbridge, left: treelines/woodland approaching the road and fencing on the north west side of the overbridge.

### **Bat wire design from previous study**



**Figure E23.** A bat wire bridge on the A590 in Cumbria, England, with the wire and ball design.

For the full study and more information see:

Berthinussen, A. & Altringham, J. (2012) Do bat gantries and underpasses help bats cross roads safely? *PLoS ONE*, **7**, e38775.