



NDR Ecological Post- Construction Monitoring: Year Two

Bat Mitigation Monitoring

20 April 2020

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
0	April 2020	Mott MacDonald	Mott MacDonald	Mott MacDonald	First Issue

Document reference: 366431 | 1 | 0

Information class: Standard

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Executive summary

The Norwich Northern Distributer Road (NDR) is a 22km dual carriageway which runs between Fakenham Road (A1067), west of the city (near Attlebridge) to the A47 east of the city (near Postwick). Construction was completed over winter 2017/2018 and the design included a number of different mitigation measures for commuting bats. The post-construction monitoring of these measures is a requirement of the Development Consent Order.

Bats are protected under the Conservation of Habitats and Species Regulations 2017 (as amended) and the Wildlife and Countryside Act 1981 (as amended). This report provides information on the year two (2019) post-construction monitoring of the bat crossing locations, including seven gantries, two green bridges, two dark corridors and one underpass.

Manned monitoring has demonstrated that the number of bats crossing the NDR at the various crossing locations in year two remains similar to those in year one; some crossing locations have seen slight increases in numbers of recorded crossings, whereas other have seen slight drops.

The number of safe crossings made by bats – those above the height at which there is a risk of vehicle collision mortality – show similar patterns, with some crossing locations showing an increase, and some a decrease.

Unmanned monitoring of the crossing locations shows that at least nine species of bat are using the habitat either side of the gantries. This replicates the year one survey findings, again with local variations in activity levels.

It will be necessary to continue to monitor the crossing locations for several more years until their conclusions can be drawn as to their success. Future surveys may also identify changes in bat activity as the landscape planting either side of the crossing locations establishes.

1 Introduction

1.1 Project description

Mott MacDonald Ltd has been appointed by Norfolk County Council to undertake the monitoring of bat populations as part of the Norwich Northern Distributor Road (NDR), now known as Broadland Way. This monitoring consists of post-construction surveys as detailed in the Development Consent Order (DCO) mitigation table. The NDR runs from the Fakenham Road (A1067) to the west of the city (near Attlebridge) and passes eastwards around the north of the city to join with the A47 at Postwick. The route is approximately 22km in length. A map of the route is provided in Appendix A, Figure A1.

1.2 Baseline data

As part of the environmental impact assessment, extensive bat surveys were undertaken between 2008 and 2013, by a team of experienced ecologists from Mott MacDonald and various sub-consultancies; 2008 (EcoGraphics, Mott MacDonald and Kepwick Ecological Surveys), 2009 and 2010 (Mott MacDonald and BSG, with Greena Ecological Consultancy, Geckoella and Corylus Ecology) and 2012 (Mott MacDonald and Greena Ecological Consultancy). These surveys were to support the assessment of the potential impacts of the NDR scheme on local bat populations and to determine required mitigation and licencing requirements. Detailed information can be found in the Norwich Northern Distributor Road – Technical Appendix for Bats from the Environmental Statement (available on the Planning Inspectorate website).

1.3 Study area

The study area is comprised of 12 different bat crossing mitigation locations along the NDR, including green bridges, bat gantries, dark corridors and an underpass. The survey type for each location are listed in Table 1 below. The individual survey locations are listed in Section 1.4 and can be found on maps in Appendix A.

Table 1: Survey type and location for 2019 monitoring surveys.

Survey type	Locations	Notes
Manned static monitoring of bat crossings	12 bat crossing mitigation locations	Surveys were carried out on both sides of the NDR concurrently
Un-manned static monitoring of bat crossings	12 bat crossing mitigation locations	Static detectors were positioned on both sides of the NDR concurrently

1.4 Crossing survey locations

The 12 bat crossing mitigation locations are as follows:

- G1 – Gantry 1 (Shooting school access, near Attlebridge)
- G2 – Gantry 2 (Glebe Farm access, near Horsford)
- G3 – Gantry 3 (St Faith's Road, near Spixworth)
- G4 – Gantry 4 (near Beeston Hall cottages)
- G5 – Gantry 5 (near Beeston Hall)
- G6 – Gantry 6 (access off Middle Road, near Great Plumstead)
- G7 – Gantry 7 (Smee Lane, near Great Plumstead)
- GB1 – Green Bridge 1 (Marriot's Way, near Taverham)
- GB2 – Green Bridge 2 (Middle road, near Great Plumstead)
- DC1 – Dark Corridor 1 (Buxton Road, near Spixworth)
- DC2 – Dark Corridor 2 (Newman Road, near Rackheath)

- UP1 – Underpass, (near Rackheath)

Maps showing the specific locations can be found in Appendix A.

1.5 Scope of the report

The scope of this report is to:

- Present the results of the 2019 (year two post-construction) surveys of all bat crossing mitigation locations;
- Provide a comparison to the 2018 (year one post-construction) survey results;
- Inform the levels of usage of the mitigation measures over time;
- Provide recommendations for further mitigation and enhancement; and
- Provide recommendations for additional future surveys, alongside those already required under the terms of the DCO post-construction monitoring regime and the EPS licence.

1.6 Legislation

All bats and their roosts are fully protected under the Conservation of Habitats and Species Regulations, 2017 (as amended) and the Wildlife and Countryside Act 1981 (as amended). In summary, it is an offence to:

- Take, transport, kill, injure, or disturb any bats when they are at a roost; or
- Damage, destroy or obstruct access to any structure used for breeding or resting by bats.

All species of bats are designated as a European Protected Species (EPS), with seven species listed as species “of principal importance for the purpose of conserving biodiversity”.

2 Methodology

All surveys were undertaken in accordance with the Mitigation Tables for post-construction ecological monitoring surveys as presented in both the Norwich Northern Distributor Road Environmental Statement Volume 1 (Mott MacDonald, 2013) and the Construction Environmental Management Plan (Mott MacDonald, 2013). These dictate the number, type and outline methodologies of surveys required. Specific methodologies were based on a combination of Berthinussen & Altringham (2012) and the Bat Conservation Trust Bat Surveys for Professional Ecologists: Good Practice Guidelines 3rd Edition (2016), hereafter referred to as the 'BCT guidelines', as appropriate.

2.1 Manned static monitoring of bat crossings

Dusk and dawn crossing surveys were undertaken on all 12 crossing points (Figures A2, A3 and A4, Appendix A; Figures). For each of the crossings, it was ensured that both dusk and dawn surveys were included. Dusk surveys began 15 minutes before sunset and ended 90 minutes after and dawn surveys began 90 minutes before sunrise, ending 15 minutes after.

Surveys were completed with a space of at least two weeks between each survey and were conducted in suitable weather conditions. Those being:

- Temperature above 10°C
- No or sporadic light rain
- Low wind speeds

Dates and weather conditions for each survey can be found in Table 12, in Appendix B.

At each crossing point two surveyors conducted the survey, one either side of the NDR. They positioned themselves at locations where bats crossing the mitigation features could be seen and the flight path identified. For the gantries, this was generally at the top of the carriageway embankment. For the green bridges and dark corridors, this was towards the top of the approach ramp, around 5m back from the end of the bridge deck, to allow bats flying along and either side of the crossing feature to be identified. For the underpass, this was around 5m from (and slightly offset from) the entrance to the underpass. Each surveyor was equipped with time synchronised Batlogger Ms (handheld bat detectors) with built-in temperature recording capability.

For each bat call and/or sighting, a number of variables were recorded, including the species, date and time of record, direction of travel, vertical distance from the crossing structure (gantry, green bridge, etc) and horizontal distance from the crossing structure. When it could be confirmed that the same bat was recorded by the surveyors either side of the NDR (either end of the crossing mitigation feature), then duplicate records in the survey results were removed to prevent double counting. Vertical and horizontal distance estimations were recorded to the nearest half metre.

For all bat gantries, the flight height from the road was then calculated from taking the vertical distance from the gantry away from the overall height of the gantry (defined as the bottom wire over the road and therefore the gantry's lowest point).

In addition to the above, the direction of the crossing movement was also recorded. The NDR loosely forms an arc around Norwich therefore "inside" refers to the side closest to Norwich and "outside" refers to that furthest away, so movements were recorded as either inside to outside (i.e. away from Norwich) or outside to inside (i.e. towards Norwich).

The activity of bats not crossing the road was also recorded.

2.2 Manned static data analysis

Based on the methodology used in Berthinussen & Altringham (2012), 'safe' and 'unsafe' crossing heights were defined as being greater or less than 5m from the road surface respectively. This is due to the maximum height of heavy goods vehicles being 4.9m in the UK (Department of Transport, 2011). Bats crossing at unsafe heights (less than 5m) are therefore at risk of collision.

For bats which were crossing at a safe height, two definitions of using the gantries were employed. Bats flying within either 2m or 5m of the gantry (Berthinussen & Altringham, 2012). These classifications are based on species observations within the literature. Holderied *et al.* (2006) observed whiskered bats *Myotis mystacinus* flying within 1.7m of a hedgerow and Schaub & Schnitzler (2007) found that Daubenton's bat *Myotis daubentonii* flew within 2.1 - 4.5m from a linear feature.

For the green bridges and dark corridors, the height of each bat crossing was recorded in relation to the deck of the bridge. The horizontal distance was taken from the bridge parapet (the safety barrier at the edge of the bridge); the route of each bat crossing was also recorded. The nature of the specific green bridge/dark corridor was then considered, to assess whether or not the bat crossing was either safe or unsafe, depending on whether or not the feature carries vehicle traffic. For example the Marriott's Way green bridge does not carry traffic, so even bats using it at a height of 1 metre would not be at risk of vehicle collision, whereas the Middle Road green bridge and the two dark corridors do carry traffic, so judgement in terms of height and horizontal position were used.

Bats crossing at the underpass were considered to be safe when the underpass was used, allowing the bat to cross beneath the road. Any bats flying over the road at a height of less than 5m were considered to be crossing at an unsafe height; those crossing above 5m were considered to be safe, although they were not using the underpass.

2.3 Unmanned static monitoring of bat crossings

Static acoustic detectors were deployed at the 12 bat crossing locations along the Scheme. At each location, detectors were deployed on both sides of the NDR. Where possible, detector microphones were attached at the bat crossing facing away from the road. In areas where there is public access, or if works (i.e. landscaping) were ongoing in the immediate area, then detectors were placed close to the crossing. The 12 locations can be found in Figures A2 to A4, Appendix A. At each location, detectors were deployed for at least four consecutive nights on three separate occasions between May and September.

2.4 Call analysis

One bat pass was defined as one track on the Batloggers. The Batlogger detectors are set up so that if there is at least a one second gap between a call a new track is started and therefore can be deemed to be a new pass.

All call analysis was undertaken by experienced ecologists using Kaleidoscope Pro to identify calls to species level where possible. Where needed, British Bat Calls: A Guide to Species Identification (Ross, 2012) was used to aid analysis. All calls excluding those from pipistrelles were then checked using Bat Explorer Pro to verify the identification. Within the genus *Myotis*, call parameters overlap markedly, making their identification to species level very difficult. Where it has been possible to identify these species, this has been done. In all other cases, the calls have simply been grouped under '*Myotis* sp'.

2.5 Static detector data analysis

Once call analysis was completed, the total number of passes were calculated for each location for each species. To account for variations in the total number of days of recording (caused by failure of the equipment for example), an average daily level of bat activity was calculated by dividing the total number of passes recorded by the number of full nights they were deployed. This allowed for the

number of survey nights to be accounted for across the locations, and the average number of calls per night calculated. The data are displayed in Table 12, Appendix B.

2.6 Survey limitations

2.6.1 Manned static monitoring

Collecting data on distances from the crossing features relies on the estimation and judgement of several ecologists; consequently there is unknown variance that cannot fully be controlled for. Furthermore, the positioning of the surveyor can alter the perceived perspective of a crossing bat's position relative to a gantry. These limitations were accounted for as far as possible by consistent positioning of the surveyors, and by providing surveyors with information on the dimension of various parts of the gantries, to use as reference. For example, the height and width of the mesh of the gantry, the width between gantry tower supports, the height of bridge parapets etc.

It was not possible to survey Gantry 2 from both sides of the NDR, due to land access restrictions. On these surveys a pair of surveyors positioned themselves on either side of the gantry (on the same side of the NDR) to provide best possible coverage.

When light levels became low, bats became harder to see, especially when bats were flying in front of a dark landscape (e.g. woodland). It is therefore possible that some bats were missed during the surveys.

During the survey on 5 September 2019, it was not possible to position surveyors on either side of the underpass. Instead, the second surveyor positioned themselves a short distance from the underpass, where the original track and tree line (along which bats previously flew) was located.

2.6.2 Unmanned static monitoring

Due to the proximity to the road, static detectors would often record the noise from traffic, resulting in memory cards becoming full before completion of the full survey period. Repeating the survey did not guarantee that the same issue would not occur.

On a number of occasions, some detectors failed while out in the field; or were subject to vandalism reducing the total number of nights of recording. It is intended that more regular visits to the static detectors will be undertaken in subsequent rounds of monitoring to account for this risk.

Table 2: The total number of survey nights for each static detector deployment.

Location	Total nights of deployment
Gantry 1	12
Gantry 2	12
Gantry 3	10
Gantry 4	9
Gantry 5	11
Gantry 6	9
Gantry 7	12
Buxton road dark corridor	8
Newman road dark corridor	12
Marriot's way green bridge	12
Middle road green bridge	7.5
Underpass	10

3 Results

Across all 2019 bats surveys, nine species were recorded using the study area:

Common pipistrelle <i>Pipistrellus pipistrellus</i>	Widespread and common throughout Britain. Common pipistrelles forage across a range of habitats including deciduous woodland, parkland, gardens and fresh water.
Soprano pipistrelle <i>Pipistrellus pygmaeus</i>	Widespread and common throughout Britain. Soprano pipistrelles are generally more specific in their habitat choice when compared to common pipistrelles, often choosing to forage over freshwater habitats.
Nathusius' pipistrelle <i>Pipistrellus nathusii</i>	An uncommon species although relatively widespread throughout England. Forages along woodland edges and over fresh water.
Daubenton's bat <i>Myotis daubentonii</i>	Common and widespread throughout Britain. Daubenton's bats will regularly forage over fresh water where they trawl insects from the water's surface. They can also be found in other habitats such as open woodland and tree lines.
Natterer's bat <i>Myotis nattereri</i>	Widespread throughout England. Natterer's bats can be found foraging close to vegetation gleaning insects from surfaces. Will often forage in deciduous woodland, along treelines and above water
Barbastelle <i>Barbastella barbastellus</i>	A rare species generally confined to the southern half of Britain. Forages both beneath and over the tree canopy, often flying lower earlier in the night and moving higher later. Main foraging habitat is deciduous woodland but does forage in other areas.
Brown-long eared bat <i>Plecotus auritus</i>	Common and widespread throughout Britain. Brown long-eared bats will forage by gleaning insects off surfaces of vegetation. They are found in habitats that include deciduous and coniferous woodland, parkland and gardens.
Serotine <i>Eptesicus serotinus</i>	An uncommon species generally restricted to the south and south-east of England. Serotines generally forage between 4 and 12m from the ground. They will often feed along linear features including woodland edges and large hedgerows.
Noctule <i>Nyctalus noctula</i>	Widespread throughout England. The UK's largest bat, noctules will generally feed between 10 and 50m from the ground. They feed over a range of habitats including deciduous woodland, parkland and freshwater.

Due to the considerable overlap in call parameters of some *Myotis* species, some calls were only identified to genus, and are recorded in the tables below as *Myotis* spp.

3.1 Manned static monitoring of bat crossings

Below is a summary of the total numbers of bats recorded crossing the NDR, during the three manned surveys at each location. More details can be found in the tables in Section 3.2, as described below.

3.1.1 Bat gantries

- Gantry 1 - a total of four bats were recorded crossing. All bats crossed safely at heights above five meters;
- Gantry 2 – a total of five bats were recorded crossing. Four of these crossed at a safe height, and one crossed at an unsafe height;
- Gantry 3 – a total of two bats were recorded crossing. Both of these crossings were at a safe height;
- Gantry 4 – this location had the most observed activity, with 27 bats crossing; 23 of these crossings were at a safe height, with four at an unsafe height;
- Gantry 5 – a total of three bats were recorded crossing. All of these crossing were at a safe height.
- Gantry 6 - only one crossing was recorded, a brown long-eared bat crossing at an unsafe height;
- Gantry 7 – a total of eight bats were recorded crossing. Six bats crossed safely, and two bats crossed unsafely.

Full details of all crossings at the bat gantries observed during the manned surveys can be found in Table 3, in Section 3.2.

3.1.2 Green bridges

The Marriott's Way green bridge had four bat crossings during the 2019 surveys season. Five crossings were recorded at the Middle Road green bridge.

Full details of all crossings at the green bridges observed during the manned surveys can be found in Table 4, in Section 3.2.

3.1.3 Dark corridors

The Buxton Road dark corridor had one bat crossing during the 2019 survey season, which was considered to be at a safe height. The Newman Road dark corridor saw two recorded crossings in 2019, both of which were also at safe heights.

Full details of all crossings at the dark corridors observed during the manned surveys can be found in Table 5, in Section 3.2.

3.1.4 Underpass

There were four recorded bats crossing at the underpass, however, just one of these, a soprano pipistrelle crossed under the road using the underpass. The remaining three (one brown long-eared and two soprano pipistrelles) did not use the underpass; instead they flew across the road, at unsafe heights of 4m, 3m and 3.5m, respectively.

Full details of all crossings at the underpass observed during the manned surveys can be found in Table 6, in Section 3.2.

3.2 Observed crossings during manned crossing surveys

3.2.1 Bat gantry crossings

Table 3: Observed crossings for the seven gantry crossing points

Location	Date	Time	Species	Direction of crossing	Approx distance above carriageway (m)	Height of gantry (m)	Safe / unsafe	Approx horizontal distance from centre (m)	Crossing within 2m (horizontal distance)	Crossing within 5m (horizontal distance)	Notes
Gantry 1	26.06.19		Soprano pipistrelle	Inside to outside	9.9	7.923	Safe	0.5	Yes	Yes	
Gantry 1	26.06.19		Soprano pipistrelle	Outside to inside	11.9	7.923	Safe	0.5	No	Yes	
Gantry 1	26.06.19	03:46	Common pipistrelle	Outside to inside	5.9	7.923	Safe	0	Yes	Yes	
Gantry 1	04.09.19	21:00	Soprano pipistrelle	Outside to inside	13.9	7.923	Safe	1	No	No	
Gantry 2	25.06.19	03:32	Soprano pipistrelle	Inside to outside	13	8.42	Safe	1	No	Yes	
Gantry 2	25.06.19	03:41	Soprano pipistrelle	Inside to outside	8.4	8.42	Safe	1	No	Yes	
Gantry 2	25.06.19	03:56	Soprano pipistrelle	Inside to outside	8.4	8.42	Safe	2	Yes	Yes	
Gantry 2	09.07.19	21:58	Soprano pipistrelle	Inside to outside	1.4	8.42	Unsafe	2	No	No	
Gantry 2	03.09.19	20:14	Soprano pipistrelle	Inside to outside	6	8.42	Safe	<1	Yes	Yes	Seen on thermal camera
Gantry 3	25.06.19	22:06	Noctule	Outside to inside and back	9.5	8.519	Safe	2-4**	Yes	Yes	
Gantry 3	25.05.19	22:18	Common pipistrelle	Inside to outside	9.5	8.519	Safe	1-7**	Partially	Partially	

Location	Date	Time	Species	Direction of crossing	Approx distance above carriageway (m)	Height of gantry (m)	Safe / unsafe	Approx horizontal distance from centre (m)	Crossing within 2m (horizontal distance)	Crossing within 5m (horizontal distance)	Notes
Gantry 4	15.05.19	21:00	<i>Pipistrellus spp.</i> ***	Inside to outside	6	8.95	Safe	1.5	No	Yes	Unidentified bat – presumed pipistrelle. ***
Gantry 4	15.05.19	21:11	<i>Pipistrellus spp.</i> ***	Inside to outside	4.5	8.95	Unsafe	3	No	No	Unidentified bat – presumed pipistrelle. ***
Gantry 4	15.05.19	21:12	<i>Pipistrellus spp.</i> ***	Inside to outside	6	8.95	Safe	2	No	Yes	Unidentified bat – presumed pipistrelle. ***
Gantry 4	15.05.19	21:15	<i>Pipistrellus spp.</i> ***	Inside to outside	4.5	8.95	Unsafe	3	No	No	Unidentified bat – presumed pipistrelle. ***
Gantry 4	15.05.19	21:17	Soprano pipistrelle	Inside to outside	4	8.95	Unsafe	8	No	No	
Gantry 4	15.05.19	21:18	<i>Pipistrellus spp.</i> ***	Inside to outside	5*	8.95	*Safe	0	No	No	Unidentified bat – presumed pipistrelle. ***
Gantry 4	15.05.19	21:18	Soprano pipistrelle	Inside to outside	4	8.95	Unsafe	0	No	No	
Gantry 4	15.05.19	21:45	Soprano pipistrelle	Outside to inside	12	8.95	Safe	0	No	Yes	
Gantry 4	15.05.19	21:05	<i>Pipistrellus spp.</i> ***	Inside to outside	12	8.95	Safe	1.5	No	Yes	Unidentified bat – presumed pipistrelle. ***
Gantry 4	15.05.19	21:10	<i>Pipistrellus spp.</i> ***	Inside to outside	13	8.95	Safe	2	No	Yes	Unidentified bat – presumed pipistrelle. **
Gantry 4	15.05.19	21:11	<i>Pipistrellus spp.</i> ***	Inside to outside	13.5	8.95	Safe	3	No	Yes	Unidentified bat – presumed pipistrelle. ***

Location	Date	Time	Species	Direction of crossing	Approx distance above carriageway (m)	Height of gantry (m)	Safe / unsafe	Approx horizontal distance from centre (m)	Crossing within 2m (horizontal distance)	Crossing within 5m (horizontal distance)	Notes
Gantry 4	15.05.19	21:12	<i>Pipistrellus spp.</i> ***	Inside to outside	12	8.95	Safe	2	No	Yes	Unidentified bat – presumed pipistrelle. ***.
Gantry 4	15.05.19	21:15	<i>Pipistrellus spp.</i> ***	Inside to outside	13.5	8.95	Safe	3	No	Yes	Unidentified bat – presumed pipistrelle. ***.
Gantry 4	15.05.19	21:17	Common pipistrelle	Inside to outside	14	8.95	Safe	8	No	Yes	
Gantry 4	15.05.19	21:17	Common pipistrelle	Inside to outside	13	8.95	Safe	5	No	Yes	
Gantry 4	15.05.19	21:18	Soprano pipistrelle	Inside to outside	14	8.95	Safe	3	No	Yes	
Gantry 4	15.05.19	21:37	Common pipistrelle	Outside to inside	12	8.95	Safe	4	No	Yes	
Gantry 4	15.05.19	21:03	Soprano pipistrelle	Inside to outside	8 – 8.5 **	8.95	Safe	2-3 **	No	Yes	
Gantry 4	15.05.19	21:11	Soprano pipistrelle	Inside to outside	7	8.95	Safe	5	No	Yes	
Gantry 4	15.05.19	21:30	Common pipistrelle	Inside to outside	6	8.95	Safe	3	No	Yes	
Gantry 4	15.05.19	21:52	Soprano pipistrelle	Inside to outside	12	8.95	Safe	4	No	Yes	
Gantry 4	27.06.19	21:58	Soprano pipistrelle	Inside to outside	9-10 **	8.95	Safe	4	No	Yes	
Gantry 4	27.06.19	22:10	Soprano pipistrelle	Inside to outside	9-11 **	8.95	Safe	2-3 **	No	Yes	
Gantry 4	27.06.19	22:19	Soprano pipistrelle	Inside to outside	16-17 **	8.95	Safe	0.5	No	No	Crossed but not using the gantry. Excluded from figure 3.2.

Location	Date	Time	Species	Direction of crossing	Approx distance above carriageway (m)	Height of gantry (m)	Safe / unsafe	Approx horizontal distance from centre (m)	Crossing within 2m (horizontal distance)	Crossing within 5m (horizontal distance)	Notes
Gantry 4	27.06.19	06:00	Soprano pipistrelle	Inside to outside	7	8.95	Safe	6	No	No	
Gantry 4	13.09.19	06:00	Soprano pipistrelle	Inside to outside	11	8.95	Safe	6	No	No	
Gantry 4	13.09.19	21:00	<i>Pipistrellus spp.</i>	Inside to outside	5*	8.95	*Safe	2	No	Yes	Unidentified bat – presumed pipistrelle. ***.
Gantry 5	14.05.19	21:00	Noctule	Inside to outside	15+	8.95	Safe	3-30 **	No	No	Crossed but not using the gantry. Excluded from figure 3.2.
Gantry 5	27.06.19	22:18	Soprano pipistrelle	Inside to outside	4	8.95	Safe	4.5	No	Yes	
Gantry 5	27.06.19	22:01	Noctule	Inside to outside	15+	8.95	Safe		No	No	Crossed but not using the gantry. Excluded from figure 3.2.
Gantry 6	02.09.19	20:46	Brown long-eared	Inside to outside	1	8.35	Unsafe	3	No	Yes	
Gantry 7	24.06.19	21:41	Noctule	Inside to outside	30	7.087	Safe	15	No	No	
Gantry 7	24.06.19	21:56	Soprano pipistrelle		5*	7.087	*Safe	1	Yes	Yes	
Gantry 7	24.06.19	22:10	Common pipistrelle	Outside to inside	7	7.087	Safe	15	No	No	
Gantry 7	24.06.19	22:16	Common pipistrelle	Outside to inside	5*	7.087	*Safe	10	No	No	
Gantry 7	24.06.19	22:22	Common pipistrelle	Outside to inside	2	7.087	Unsafe	10	No	No	
Gantry 7	09.07.19	08:52	<i>Pipistrellus spp.</i>	Outside to inside	4	7.087	Unsafe	20	No	No	

Location	Date	Time	Species	Direction of crossing	Approx distance above carriageway (m)	Height of gantry (m)	Safe / unsafe	Approx horizontal distance from centre (m)	Crossing within 2m (horizontal distance)	Crossing within 5m (horizontal distance)	Notes
Gantry 7	03.09.19	05:42	Soprano pipistrelle	Outside to inside	9	7.087	Safe	15	No	No	
Gantry 7	03.09.19	05:09	Common pipistrelle	Outside to inside	5*	7.087	Safe	2	Yes	Yes	

* - These individual bat crossings are between 5 and 6 metres in height above the carriageway level, and so according to the methodology are considered to be safe. However, it is likely that bats crossing between these heights may be adversely affected by the air turbulence due to fast-moving HGVs.

** - Where bat crossing movements have included a variation on distance from the feature (horizontal or vertical), the range has been shown.

*** - In some instances, the detectors did not record bat calls, despite a bat being observed as crossing the NDR. In these cases, an attempt at identification was made based on flight characteristics.

3.2.2 Green bridge, dark corridors and the underpass crossings

Table 4: Observed crossings at each of the green bridges

Location	Date	Time	Species	Direction	Approximate height above bridge (m)	Safe/ unsafe	Approximate horizontal distance from parapet (m)	Crossing within 2m	Crossing within 5m	Notes
Marriot's Way green bridge	26.06.19	03:46	<i>Pipistrellus spp p.</i>	Outside to inside	2	Safe	2	Yes	Yes	
	04.09.19	20:17	Common pipistrelle	Inside to outside	6	Safe	1	No	No	Crossed in line with hedge
	04.09.19	20:17	Common pipistrelle	Inside to outside	6	Safe	1	No	No	Crossed in line with hedge
	14.09.19	Unknown	<i>Pipistrellus spp.</i>	Inside to outside	1	Safe	0	Yes	Yes	
Middle Road green bridge	08.07.19	21:39	Noctule	Inside to outside	9	Safe	0	Yes	Yes	

Location	Date	Time	Species	Direction	Approximate height above bridge (m)	Safe/ unsafe	Approximate horizontal distance from parapet (m)	Crossing within 2m	Crossing within 5m	Notes
	08.07.19	21:51	Noctule	Inside to outside	12	Safe	5-20	No	No	Diagonal route above the bridge
	02.09.19	20:11	Brown long-eared	Outside to inside	2	Safe	2	Yes	Yes	
	04.09.19	20:17	Common pipistrelle	Inside to outside	6	Safe	2	Yes	Yes	
	04.09.19	20:17	Common pipistrelle	Inside to outside	6	Safe	2	Yes	Yes	Immediately after the previous bat, crossing along hedge line.

Table 5: Observed crossings at each of the dark corridors

Location	Date	Time	Species	Direction	Approximate height above bridge (m)	Safe/ unsafe	Approximate horizontal distance from parapet (m)	Crossing with 2m	Crossing within 5m	Notes
Buxton Road dark corridor	03.09.19	0:33	Common pipistrelle	Inside to outside	8	Safe	0	No	No	
Newman Road dark corridor	11.07.10	3:23	Soprano pipistrelle	Outside to inside		Safe	0	No	Yes	
	11.07.10	4:08	Noctule	Outside to inside		Safe	1	No	Yes	

Table 6: Observed crossings at the underpass

Location	Date	Time	Species	Direction	Approximate height	Safe/ unsafe	Approximate horizontal distance	Crossed within 2m	Crossed within 5m	Notes
Underpass	26.06.19	21:29	Soprano pipistrelle	Outside to inside	0	Safe	0	Yes	Yes	Bat used the underpass

Location	Date	Time	Species	Direction	Approximate height	Safe/unsafe	Approximate horizontal distance	Crossed within 2m	Crossed within 5m	Notes
	26.06.19	21:40	Brown long-eared	Inside to outside	4	Unsafe	3	No	Yes	Bat crossed low over the road unsafely
	05.09.19	05:26	Soprano pipistrelle	Inside to outside	3.5	Unsafe	50	No	No	Noted when surveyor moved to route of original bat commuting route
	05.09.19	05:26	Soprano pipistrelle	Inside to outside	3	Unsafe	50	No	No	As above

3.3 Un-manned monitoring of bat crossings

The total numbers of calls (for all species) recorded inside and outside of the NDR during the unmanned monitoring are shown in Table 7 below. This information is included to give some understanding of the bat species using the habitat either side of the crossing locations, and to provide some additional context to the number of bat crossings and species recorded in the above tables. The number of species recorded at each location is also included.

Table 7: Comparison of total number of calls inside and outside of the NDR at all crossing locations

Location	No of calls on inside of NDR	Number of species recorded	No of calls on outside of NDR	Number of species recorded
Gantry 1	517	8	600	9
Gantry 2	302	9	466	9
Gantry 3	4697	9	5374	9
Gantry 4	2061	9	273	8
Gantry 5	305	8	396	8
Gantry 6	312	7	124	8
Gantry 7	12303	9	2454	7
Marriott's Way Green Bridge	652	9	569	9
Middle Road Green Bridge	244	6	524	9
Buxton Road Dark Corridor	1940	9	980	9
Newman's Road Dark Corridor	3500	9	4024	9
Underpass	2012	9	1929	8

Table 8 below gives further detail, including a breakdown of the total number of calls, and the average number of calls per night, by species at each crossing location.

Table 8: Mean calls per night inside and outside of the NDR, from each species detected at the 12 crossing locations during unmanned surveys

Location	Species	Inside total call count	Mean no of calls per night inside the NDR	Outside total call count	Mean no of calls per night outside the NDR
Gantry 1	Barbastelle	1	0.10	16	1.78
	Brown long-eared bat	93	9.30	98	10.89
	Common pipistrelle	219	21.90	223	24.78
	Daubenton's bat	3	0.30	2	0.22
	<i>Myotis</i> spp.	8	0.80	4	0.44
	Nathusius's pipistrelle	3	0.30	3	0.33
	Natterer's bat	4	0.40	3	0.33
	Noctule	71	7.10	54	6.00
	Serotine	0	0.00	1	0.11
	Soprano pipistrelle	115	11.50	196	21.78
Gantry 2	Barbastelle	53	5.30	122	11.09
	Brown long-eared bat	6	0.60	16	1.45
	Common pipistrelle	150	15.00	196	17.82
	Daubenton's bat	1	0.10	2	0.18
	<i>Myotis</i> spp.	6	0.60	11	1.00

Location	Species	Inside total call count	Mean no of calls per night inside the NDR	Outside total call count	Mean no of calls per night outside the NDR
Gantry 3	Nathusius's pipistrelle	5	0.50	31	2.82
	Natterer's bat	3	0.30	3	0.27
	Noctule	24	2.40	24	2.18
	Serotine	1	0.10	2	0.18
	Soprano pipistrelle	53	5.30	59	5.36
	Barbastelle	39	3.55	5	0.24
	Brown long-eared bat	27	2.45	18	0.86
	Common pipistrelle	3486	316.91	3943	187.76
	Daubenton's bat	6	0.55	1	0.05
	<i>Myotis</i> spp.	4	0.36	1	0.05
	Nathusius's pipistrelle	12	1.09	19	0.90
	Natterer's bat	6	0.55	1	0.05
	Noctule	135	12.27	90	4.29
	Serotine	11	1.00	2	0.10
	Soprano pipistrelle	971	88.27	1294	61.62
Gantry 4	Barbastelle	45	2.65	4	0.67
	Brown long-eared bat	56	3.29	21	3.50
	Common pipistrelle	1394	82.00	75	12.50
	Daubenton's bat	14	0.82	6	1.00
	<i>Myotis</i> spp.	3	0.18	0	0.00
	Nathusius's pipistrelle	92	5.41	0	0.00
	Natterer's bat	1	0.06	2	0.33
	Noctule	94	5.53	26	4.33
	Serotine	4	0.24	2	0.33
	Soprano pipistrelle	358	21.06	137	22.83
	Gantry 5	Barbastelle	4	0.24	9
Brown long-eared bat		9	0.53	7	0.44
Common pipistrelle		66	3.88	125	7.81
Daubenton's bat		2	0.12	1	0.06
<i>Myotis</i> spp.		0	0.00	1	0.06
Nathusius's pipistrelle		11	0.65	7	0.44
Natterer's bat		0	0.00	0	0.00
Noctule		99	5.82	90	5.63
Serotine		3	0.18	5	0.31
Soprano pipistrelle		111	6.53	151	9.44
Gantry 6	Barbastelle	3	0.27	2	0.22
	Brown long-eared bat	3	0.27	1	0.11
	Common pipistrelle	108	9.82	37	4.11
	Daubenton's bat	0	0.00	1	0.11
	<i>Myotis</i> spp.	2	0.18	0	0.00
	Nathusius's pipistrelle	0	0.00	0	0.00
	Natterer's bat	2	0.18	1	0.11
	Noctule	119	10.82	50	5.56
	Serotine	3	0.27	2	0.22
	Soprano pipistrelle	72	6.55	30	3.33

Location	Species	Inside total call count	Mean no of calls per night inside the NDR	Outside total call count	Mean no of calls per night outside the NDR
Gantry 7	Barbastelle	21	2.10	0	0.00
	Brown long-eared bat	7	0.70	1	0.08
	Common pipistrelle	8297	829.70	1955	150.38
	Daubenton's bat	3	0.30	8	0.62
	<i>Myotis</i> spp.	0	0.00	1	0.08
	Nathusius's pipistrelle	1966	196.60	15	1.15
	Natterer's bat	1	0.10	0	0.00
	Noctule	197	19.70	94	7.23
	Serotine	6	0.60	3	0.23
	Soprano pipistrelle	1805	180.50	377	29.00
Marriot's Way Green Bridge	Barbastelle	2	0.15	12	0.80
	Brown long-eared bat	13	1.00	24	1.60
	Common pipistrelle	483	37.15	336	22.40
	Daubenton's bat	1	0.08	24	1.60
	<i>Myotis</i> spp.	1	0.08	7	0.47
	Nathusius's pipistrelle	18	1.38	17	1.13
	Natterer's bat	1	0.08	19	1.27
	Noctule	66	5.08	60	4.00
	Serotine	1	0.08	10	0.67
Soprano pipistrelle	66	5.08	87	5.80	
Middle Road Green Bridge	Barbastelle	0	0.00	1	0.10
	Brown long-eared bat	1	0.11	4	0.40
	Common pipistrelle	119	13.22	104	10.40
	Daubenton's bat	0	0.00	4	0.40
	<i>Myotis</i> spp.	0	0.00	0	0.00
	Nathusius's pipistrelle	2	0.22	4	0.40
	Natterer's bat	1	0.11	2	0.20
	Noctule	109	12.11	367	36.70
	Serotine	0	0.00	5	0.50
Soprano pipistrelle	12	1.33	33	3.30	
Buxton Road Fark Corridor	Barbastelle	5	0.33	7	0.50
	Brown long-eared bat	36	2.40	18	1.29
	Common pipistrelle	1106	73.73	587	41.93
	Daubenton's bat	8	0.53	4	0.29
	<i>Myotis</i> spp.	2	0.13	0	0.00
	Nathusius's pipistrelle	32	2.13	33	2.36
	Natterer's bat	2	0.13	1	0.07
	Noctule	389	25.93	204	14.57
	Serotine	11	0.73	3	0.21
Soprano pipistrelle	349	23.27	123	8.79	
Newman Road Dark Corridor	Barbastelle	12	0.57	17	0.71
	Brown long-eared bat	178	8.48	337	14.04

Location	Species	Inside total call count	Mean no of calls per night inside the NDR	Outside total call count	Mean no of calls per night outside the NDR
	Common pipistrelle	1078	51.33	1661	69.21
	Daubenton's bat	6	0.29	13	0.54
	<i>Myotis</i> spp.	2	0.10	4	0.17
	Nathusius's pipistrelle	6	0.29	9	0.38
	Natterer's bat	2	0.10	6	0.25
	Noctule	1844	87.81	1018	42.42
	Serotine	22	1.05	17	0.71
	Soprano pipistrelle	350	16.67	942	39.25
Underpass	Barbastelle	11	0.48	3	0.14
	Brown long-eared bat	37	1.61	7	0.32
	Common pipistrelle	972	42.26	581	26.41
	Daubenton's bat	9	0.39	11	0.50
	<i>Myotis</i> spp.	9	0.39	6	0.27
	Nathusius's pipistrelle	7	0.30	3	0.14
	Natterer's bat	4	0.17	0	0.00
	Noctule	262	11.39	312	14.18
	Serotine	6	0.26	11	0.50
	Soprano pipistrelle	785	34.13	995	45.23

By the nature of being unmanned, these static detector surveys cannot be used to determine or inform anything about the use (or not) of the gantries or other crossing features. Instead they can be used to indicate the relative activity levels per species inside and outside of the NDR, and between each of the crossing locations.

3.4 Comparison between 2018 and 2019

3.4.1 Bat gantries

During the surveys of the seven gantries, three species were observed to cross using the gantries; common pipistrelle, soprano pipistrelle and brown long-eared bats. Noctules were also recorded crossing at the gantries, although at a height that could not be considered as using the crossings. (See Table 3 for further information).

Bat crossings were observed at all gantries during 2019, compared to the 2018 season where six out of the seven gantries had a crossing. As with the 2018 survey season, the 2019 season showed gantry 4 to be the most active, with 26 observed crossings, up from 19 the previous year. Table 9 below shows the total number of crossings, and the number of safe crossings, at each of the gantry locations, in both 2018 and 2019.

Table 9: Total observed crossings (safe and unsafe) at each of the seven gantries in 2018 and 2019.

Location	Total number of observed crossings in 2018	Number of observed safe crossings in 2018	Total number of observed crossings in 2019	Number of observed safe crossings in 2019	Difference and direction of change in number of safe crossing
Gantry 1	3	1	4	4	+3
Gantry 2	9	5	5	4	-1
Gantry 3	11	5	2	2	-3

Gantry 4	19	14	27	23	+9
Gantry 5	0	0	3	3	+3
Gantry 6	7	6	1	0	-6
Gantry 7	11	4	8	6	+2

3.4.2 Flight path density comparison

Figure 3.2 below displays the distribution of crossing heights and distances from the seven gantries located across the NDR, relative to the range in gantry heights above the road. When comparing the data from the 2019 survey season to the data from the 2018 survey season (Figure 3.3) it is immediately clear that in general bats are crossing at a greater height. Other observations that are initially clear, is that the range of crossing heights is greater in 2019 than in 2018 and more bats cross above the safe flight height than below.

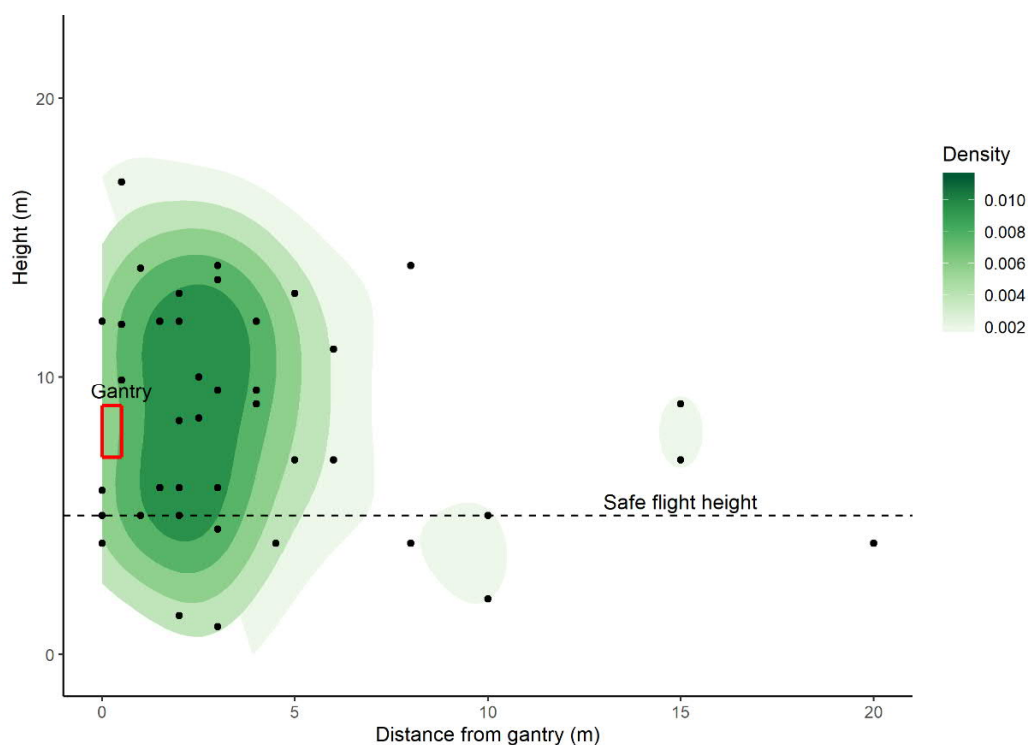


Figure 3.2 Height from the road and the horizontal distance from gantries for all crossing bats in 2019, excluding big bats (gantries one to seven) The range in gantry height above the road surface is shown in red and the minimum safe flight height is highlighted. Kernel density estimations have been applied.

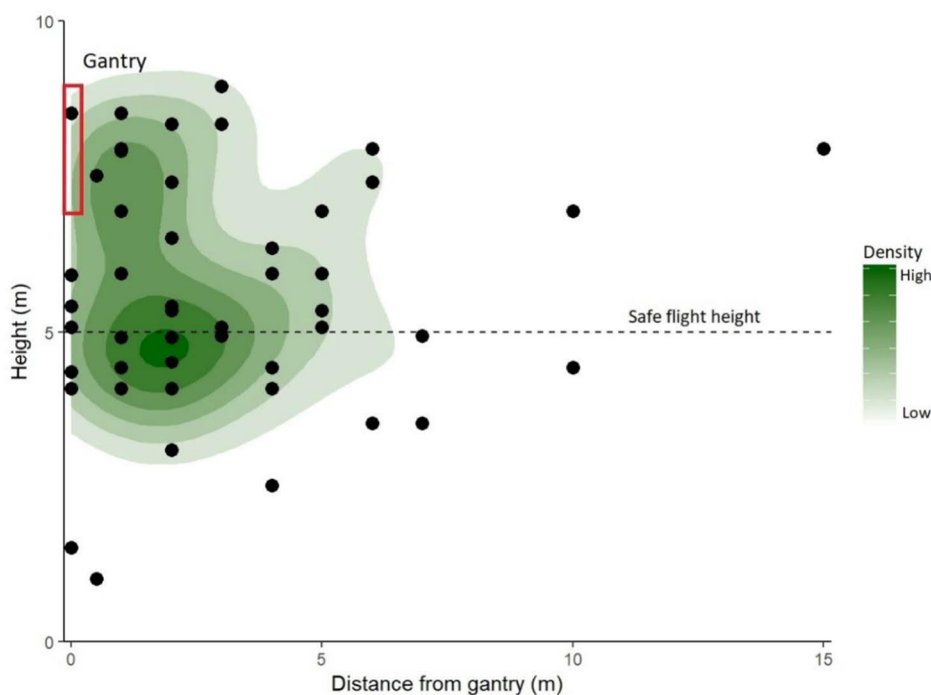


Figure 3.3 Height from the road and the horizontal distance from gantries for all crossing bats in 2018, excluding big bats (gantries one to seven). The range in gantry height above the road surface is shown in red and the minimum safe flight height is highlighted. Kernel density estimations have been applied.

3.4.3 Green bridges

Up to three species were observed to cross over the green bridges during manned static surveys (Table 4); these were common pipistrelle, brown long eared bat, and either common or soprano pipistrelle with varying degrees of ‘use’. All bats were considered to cross safely due to the height of the crossings above the carriage way. The landscape naturally guides bats high over the NDR. In two of the five observed cases bats were considered to not be using the green bridge following the guidelines set out in Section 2.2.

The Marriott’s Way green bridge had four bat crossings during 2019 surveys season, compared to 13 crossing in 2018. Five crossings were recorded at the Middle Road green bridge in 2019, compared to six crossings in 2018.

Table 10: Total observed crossings at each of the green bridges in 2018 and 2019

Location	Number of observed crossings in 2018	Number of observed crossings in 2019	Difference
Marriot’s way green bridge	13	4	-9
Middle Road green bridge	6	5	-1

3.4.4 Dark corridors

Dark corridors had less observed crossings compared to green bridges. At these two crossing locations (Buxton Road and Newman Road) three bats were observed to cross safely and of the three, only one was considered to not use the dark corridor.

The Buxton Road dark corridor had one bat crossing during the 2019 survey season, compared to no observed crossings during the 2018 season. The Newman Road dark corridor saw two recorded crossings in 2019, compared to five during 2018.

Table 11: Total observed crossings at each of the dark corridors in 2018 and 2019.

Location	Number of observed crossings in 2018	Number of observed crossings in 2019	Difference
Buxton Road	0	1	+1
Newman Road	5	2	-3

3.4.5 Underpass

The underpass had only one observed use during manned surveys during the 2019 survey season. Three other crossings were observed during surveys but at distances up to 50m north, flying over the road (Table 6). In this case it is likely that the bats were following the previous commuting route, along the now-removed track and tree line.

No bats were recorded using the underpass in 2018, although three unsafe crossings above the road were recorded.

The first years' post-construction monitoring, in 2018, was undertaken when the vegetation on one side of the road had not yet been planted. By the second year of post-construction monitoring, in 2019, the landscaping at this location was in place.

3.5 Notable species

In 2018 three barbastelles were observed crossing the NDR during manned crossing surveys. These were observed at Gantry 2, 3 and 6. In each instance they crossed at a safe height. The barbastelles crossing at Gantry 3 and Gantry 6 were within 2m of the gantry. The barbastelle crossing at gantry 2 crossed approximately 6m from the gantry.

In 2019 no barbastelles were observed to cross at any of the 12 crossing locations. Barbastelles were recorded both inside and outside of the NDR at each of the 12 crossing points either by the static detectors or on manned surveys, with the exception of Buxton Road dark corridor (inside only) and the underpass (inside only) during manned surveys and Middle Road green bridge during unmanned surveys (inside only).

4 Conclusions

Across the NDR, more bats are crossing at a safe height than an unsafe height, although there are still bats crossing the road unsafely. This means those bats are at risk of collisions with traffic such as haulage lorries. To maintain a favourable conservation status of the bat species a significant proportion (>95%) should be crossing the road at a safe height.

There is variation across the study area; at some crossing locations there has been an increase in the number of observed crossings, whereas at other there has been a decrease. As only two years of data has been collected, it is too early to infer any trends at this stage of monitoring.

The planted landscaping/vegetation across the NDR is not yet established, so it is not yet effectively functioning as a natural guide for bats to the crossing locations. Also, the long dry summer of 2018 was particularly detrimental to the landscaping. These two factors – the young age of the landscape planting and the drought, affecting its health and therefore functionality – are likely to have compounded one another, resulting in the landscaping leading up to and surrounding the crossing point being less attractive to bats, ultimately reducing the effectiveness of the crossing gantries, bridges and dark corridors.

As vegetation becomes increasingly established in the future, the 'guiding' effect should be increased. Creating a corridor for bats to adhere to through vegetation growth is key to ensuring the crossing locations operate as effectively as they can. Replanting failed vegetation and ensuring the landscape is created and maintained as intended is a crucial element in ensuring the success of the mitigation.

As it becomes established, the landscaping vegetation should aid in increasing the effect of the landform – the relative heights of the road and the embankments either side – which is important for aiding to guide the bats over the road at a safe height. Along the majority of its length, the embankments either side of the NDR carriageway form a natural guide that raises up the flight path of bats, but this must be further assisted by the vegetation. Landform topography and well-established vegetation should work together to facilitate the safe use of the crossings over the NDR carriageway.

The impact on local bat populations depends (in part) on the mortality of bats crossing at an unsafe height. Maintaining the favourable conservation status of bat populations affected by the NDR is dependent on the crossing points being effective. At the design and assessment stage of the project it was acknowledged that the habitat loss, habitat change and degradation as a result of the NDR, which is slowly being mitigated for as landscaping establishes, are factors which also impact local bat populations, further highlighting the importance of maintaining the existing habitats and replacing the landscaping in areas with unacceptable failure rates.

The NDR has bisected a large area of countryside to the north of Norwich and has severed many linear features. This is highly likely to have reduced the permeability of the landscape, degrading the suitability for low flying species such as bats. Both Abbott et al. (2012) and Bennet & Zurcher (2013) have found that the absence of substantial vegetation can be a determining factor in whether bats cross the road. It is therefore possible that as current vegetation becomes more established, the numbers of bats using the crossing locations may increase. Increasing vegetation height should raise the flight path of bats leading up to the crossing locations but will take many years to become fully established; therefore, it must be cared for correctly, adhering to the Handover Environmental Management Plan (HEMP).

Replanting, monitoring and caring for the vegetation that has been planted as part of the landscaping design is therefore paramount to ensuring that the mitigation functions as intended to. Without all aspects of the design, the mitigative effects will be diminished.

Until several more survey seasons have been completed it is not appropriate to draw any conclusions about the effectiveness of the gantries and crossing features. Continued monitoring will be essential

for understanding the levels of crossing use in future seasons, as required in the DCO Mitigation and Monitoring Tables. As the landscaping establishes, it will be important to determine how this changes the way bats use the crossing points, if at all. Assessing the extent of the failed vegetation will be essential for designing a strategy to replace the lost assets in order to maintain the intended function of the mitigation and increase the effectiveness as time passes.

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Appendices

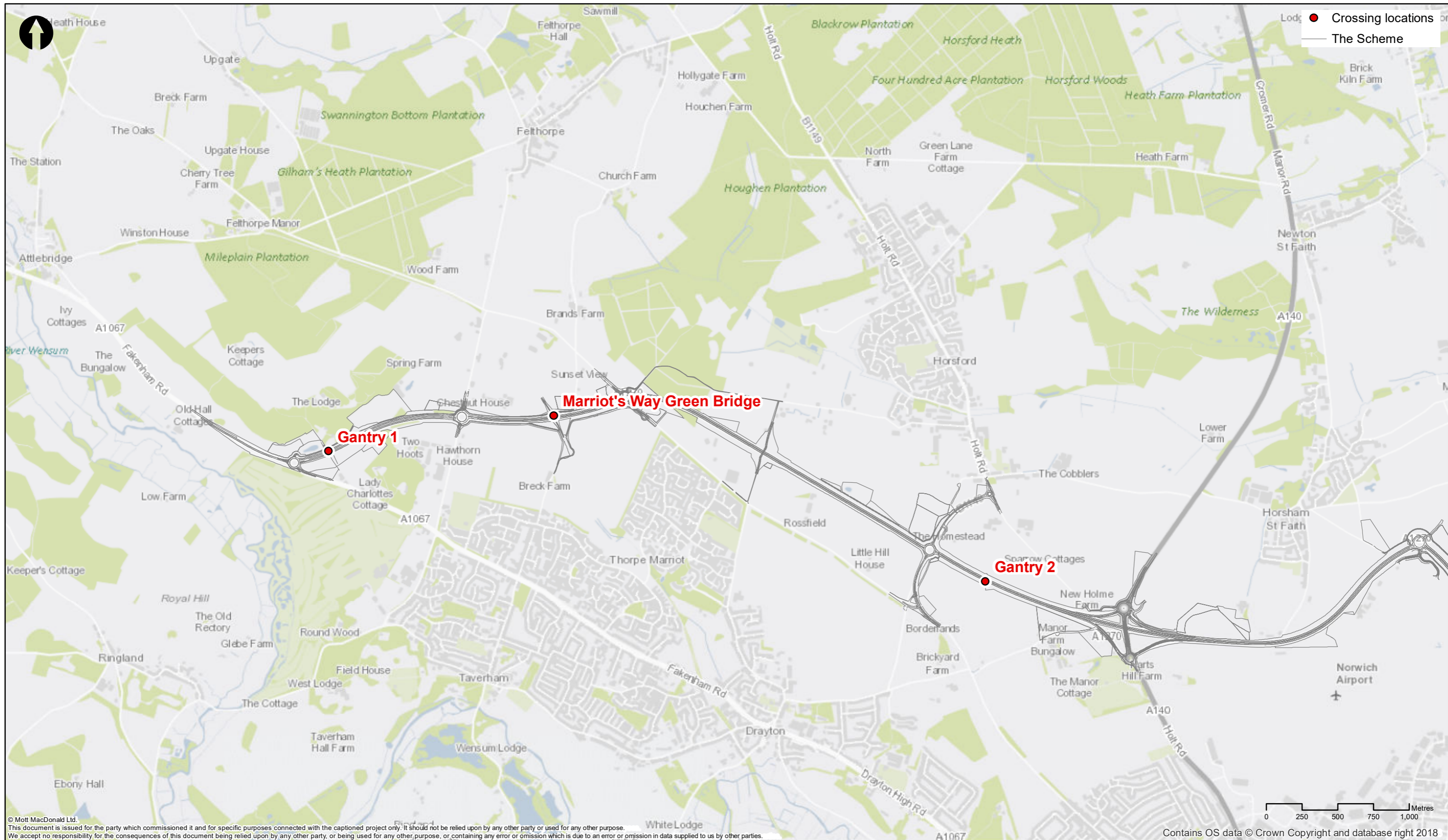
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A. Figures

A.1 NDR route



A.2 Crossing locations at the western end of the NDR



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Client

Rev	Date	Drawn	Description	Ch'kd	App'd
P01	16/01/19	BOH	First Draft	AG	SA

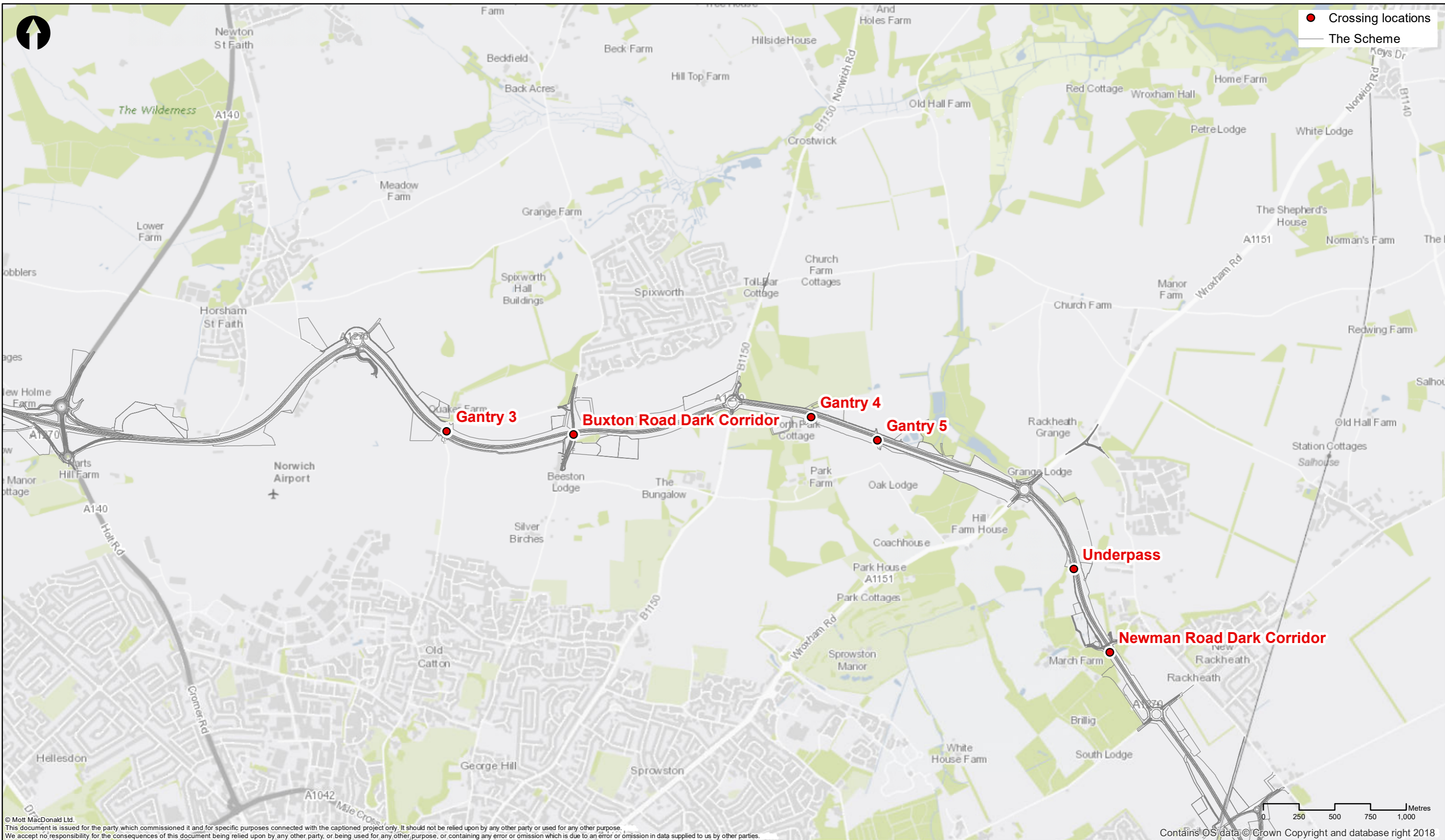
Title

Figure 7.4
Bat Crossings - Western Extent

Drawing Number
366431-MMD-00-GIS-Y-0004

Drawn	B O'Hickey	
Checked	A Gagen	
Approved	S Allen	
Scale at A3 1:25,000		
Security	Status	Rev
STD	PRE	P1

A.3 Crossing locations in the middle section of the NDR



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Rev	Date	Drawn	Description	Ch'k'd	App'd
P01	16/01/19	BOH	First Draft	AG	SA

Title

Figure 7.5

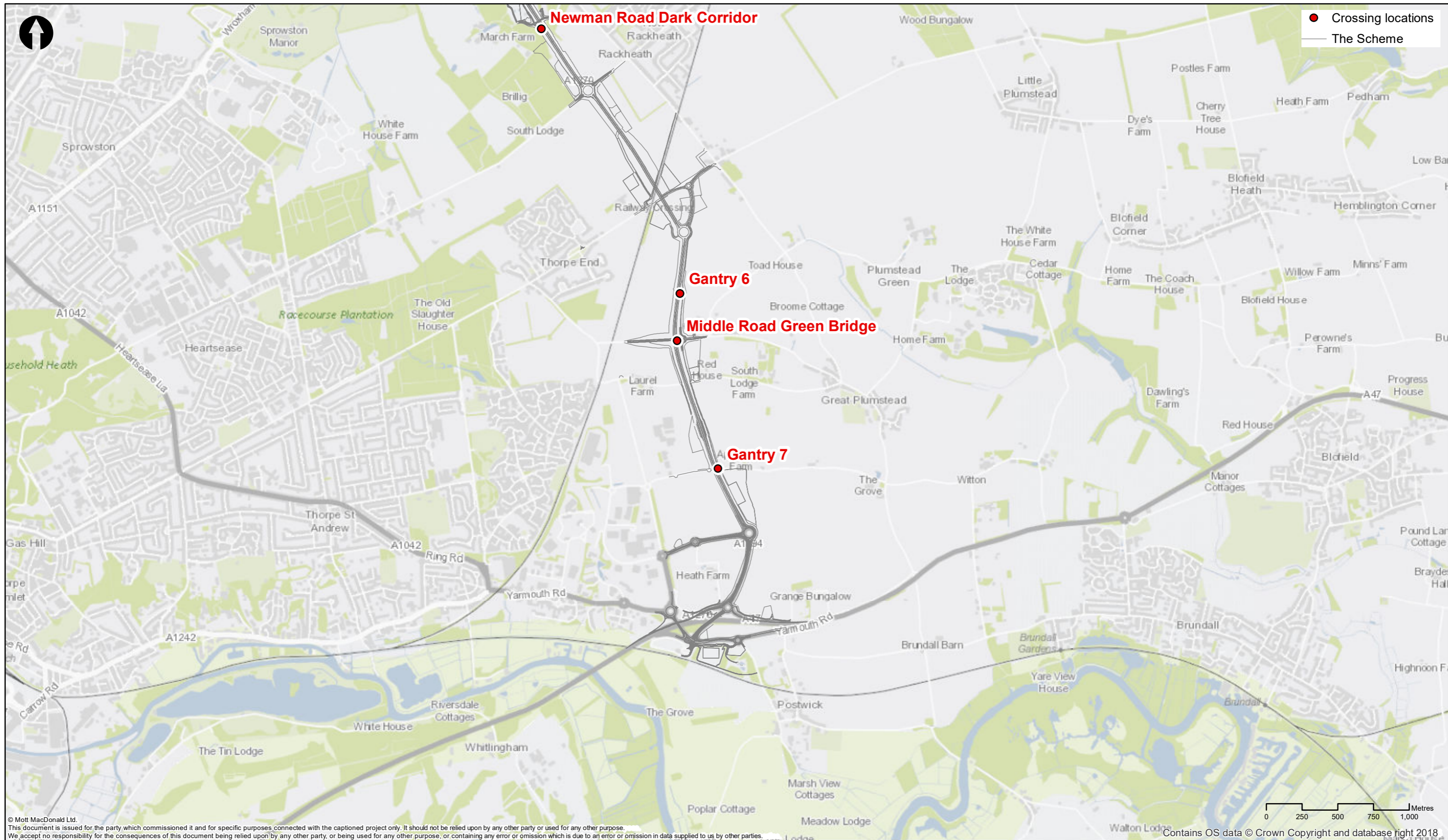
Bat Crossings - Central Extent

Drawing Number

366431-MMD-00-GIS-Y-0005



Drawn	B O'Hickey	
Checked	A Gagen	
Approved	S Allen	
Scale at A3		
1:25,000		
Security	Status	Rev
STD	PRE	P1

A.4 Crossing locations at the western end of the NDR



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		P01	16/01/19	BOH	First Draft	AG	SA		Checked	A Gagen		
										Approved	S Allen	
		<p>Drawing Number</p> <p>366431-MMD-00-GIS-Y-0006</p>									Security	Status
									STD	PRE	P1	

B. Survey Data Tables

Table 12: Weather Conditions for all surveys.

Location	Date	Time of day	Starting temperature (°C)	Weather conditions	Cloud cover
Gantry 1	01.05.19	PM	19	Overcast, calm and mild	8/8
	26.07.19	AM	16	Misty	8/8
	04.09.19	PM	16	Dry, windy.	8/8
Gantry 2	25.06.19	AM	21	Dry, warm	8/8
	09.07.19	PM	18	Dry, warm	8/8
	03.09.19	PM	21	Dry, mild	7/8
Gantry 3	25.06.19	PM	18	Cool, fog	8/8
	10.07.19	PM	21	Dry, cloudy	7/8
	03.09.19	AM	14	Gentle breeze	8/8
Gantry 4	15.05.19	PM	14	Cold breeze, clear, mild.	2/8
	27.06.19	PM	15	Dry, breezy	8/8
	13.09.19	AM	18	Humid, mild	5/8
Gantry 5	14.05.19	PM	15	Clear, mild	0/8
	27.06.19	PM	13	Mild	6/8
	03.09.19	AM	13	Mild, humid	3/8
Gantry 6	02.06.19	AM	15	Mild	8/8
	08.07.19	PM	16	Dry and warm	7/8
	02.09.19	PM	20	Overcast, humid	8/8
Gantry 7	24.06.19	PM	22	Humid	3/8
	09.07.19	AM	16	Light rain	8/8
	03.09.19	AM	14	Dry	3/8
Buxton Road dark corridor	25.06.19	PM	15	Breezy, fog	8/8
	10.07.19	AM	15	Dry, mild	8/8
	03.09.19	PM	20	Mid	4/8
Newman Road dark corridor	26.07.19	PM	14	Mild	8/8
	11.07.19	AM	19	Dry, warm	8/8
	05.09.19	AM	12	Windy, light showers	8/8
Marriot's Way green bridge	26.06.19	AM	14	Thick cloud	8/8
	11.07.19	PM	25	Stormy showers, very warm	8/8
	04.09.19	PM	17	Wind, rain	7/8
Middle Road green bridge	27.06.19	AM	12	Light cloud, breeze	6/8
	08.07.19	PM	17	Cold steady breeze	7/8

Location	Date	Time of day	Starting temperature (°C)	Weather conditions	Cloud cover
	02.09.19	PM	17	Dry, overcast	7/8
Underpass	26.06.19	PM	13	Thick cloud and breezy	8/8
	11.07.19	PM	21	Shower, very warm.	7/8
	05.09.19	AM	12	Sporadic rain and wind	8/8

