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# A47 Thickthorn Junction Improvements Bat Survey Report

December 2017

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# 1. INTRODUCTION

## 1.1 Background and Scope of Works

AECOM undertook bat surveys as part of the Stage 2 Environmental Assessment Report (EAR) for the A47 Thickthorn Junction improvement scheme (AECOM (b), 2016).

Bats were identified as a potential constraint in the Preliminary Ecological Appraisal (PEA) (AECOM (a), 2016) based on a desk study and assessment of potentially suitable habitat present. The surveys were commissioned to identify the value of the site for roosting, commuting and foraging bats and whether bats may constrain or influence the design and implementation of the Proposed Schemes. Recommendations have been made for a European Protected Species Mitigation Licence (EPSML), appropriate mitigation and/or any further survey requirements (where applicable).

The A47 Thickthorn Junction options, which these surveys was based on, are:

- Option 3 Drawing HE551492-ACM-HML-TJ-DR-HE-01064-Layout1.
- Option 4 Drawing HE551492-ACM-HML-TJ-DR-HE-01065-Layout1.

## 2. BAT LEGISLATION, LICENCES AND POLICY

### 2.1 Legislative Framework

The following wildlife legislation is potentially relevant to bats in relation to the Proposed Scheme:

- Wildlife and Countryside Act 1981 (as amended) (the WCA)
- Countryside and Rights of Way (CRoW) Act 2000
- Natural Environment and Rural Communities (NERC) Act 2006
- The Conservation of Habitats & Species Regulations 2017 (as amended) (the Habitats Regulations)

The above legislation has been considered when planning and undertaking the commissioned survey work using the methods described in section 3; when identifying potential constraints to the proposed works; and when making recommendations for further survey, design options and mitigation, as discussed in section 6. Compliance with legislation may require the attainment of relevant protected species licences prior to the implementation of the proposed development.

All bat species and their roosts are legally protected in the UK under the Habitats Regulations, which implements the EC Directive 92/43/EEC (the Habitats Directive). In addition, barbastelle (*Barbastellus barbastellus*), lesser and greater horseshoe bats (*Rhinolophus hipposideros* and *R. ferrumequinum*) and Bechstein's bat (*Myotis bechsteinii*) are listed in Annex II of the Habitats Directive, which requires sites to be designated in member states for their protection. Bats and their roosts are also protected under the WCA.

Taken together, the Habitats Regulations and the WCA make it illegal to:

- Deliberately capture or intentionally take a bat;*
- Deliberately or intentionally kill or injure a bat;*
- To be in possession or control of any live or dead bat or any part of, or anything derived from a bat;*
- Damage or destroy a breeding site or resting place of a bat;*
- Intentionally or recklessly obstruct access to any place that a bat uses for shelter or protection;*
- Intentionally or recklessly disturb a bat while it is occupying a structure or place that it uses for shelter or protection; and*
- Deliberately disturb bats, in particular any disturbance which is likely to (i) impair their ability to survive, breed, reproduce or to rear or nurture their young; or in the case of hibernating or migratory species, to hibernate or migrate; or (ii) affect significantly the local distribution or abundance of the species to which they belong.*

A bat roost is defined as any structure a bat uses for breeding, resting, shelter or protection. It is important to note that since bats tend to re-use the same roost sites, current legal opinion is that a bat roost is protected regardless of whether or not the bats are present at a specific point in time.

## 2.2 European Protected Species Mitigation Licences

Although the law provides strict protection to bats, it also allows this protection to be set aside (derogated) under Regulation 53 of the Habitats Regulations through the issuing of European Protected Species Mitigation Licences (EPSML) for the purpose of preserving public health; public safety; other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment. However, in accordance with the requirements of the Habitats Regulations a licence can only be issued where the following requirements are satisfied:

- a) *there is no satisfactory alternative; and*
- b) *the action authorised will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range.*

In England, EPSML applications are currently determined by Natural England and take up to five working days to acknowledge receipt and then at least 30 working days to determine. Certain types of low value roosts in structures only can be mitigated for under a Low Impact Class Licence, and involve a simpler process with a shorter determination time.

## 2.3 Policy

Refer to the Stage 1 EAR / PEA reports (AECOM (a/b), 2016) and the Stage 2 EAR (AECOM, 2017).



## 3. METHOD

### 3.1 Preliminary Roost Appraisal

A preliminary roost appraisal survey was carried out as part of the PEA (AECOM(a), 2016) on all relevant features on 24 June and 4 July 2016 identified within the PEA Study Area Boundary (i.e. the footprint of the scheme for all Stage 1 options, plus a 50m buffer). Where access permitted, licensed bat ecologists and assistants externally surveyed all relevant structure/buildings and trees for their suitability for roosting bats.

Due to a scheme change, the Study Area Boundary was revised to include additional trees to the west of Thickthorn services (see Figures in Appendix A). These were surveyed on 19 May 2017.

The aim of the survey was to identify (a) the presence of bats or their roost(s), and/or (b) features that are suitable for roosting bats, but for which the presence/absence of bats or their roosts could not be determined. A grade of habitat suitability/risk was assigned to the structure or tree as a whole, based on the suitability of the identified features for bats. Where the presence or potential presence of roosting bats was confirmed in trees further potential roost feature inspections were carried out in April 2017, and additional trees identified to be surveyed later on during 2017.

No buildings are currently proposed to be affected as a result of the scheme. A pedestrian footbridge and an underpass (under the A11) are likely to be affected by the scheme. Both of these structures were assessed as negligible risk and excluded from further assessment. Where trees had roost suitability of moderate to high or had confirmed roosts, dusk emergence and/or dawn re-entry surveys were undertaken between May and September 2017 in accordance with the standard methods in Collins (2016) (see sections 3.2 and 3.3). These surveys aimed to identify species, numbers and access/egress points to characterise the roost and inform any potential mitigation requirements.

### 3.2 Aerial Tree Climbing Survey of Potential Roost Features (PRFs) in Trees

Methods employed during the tree roost assessment followed guidance presented in Bat Surveys: Good Practice Guidelines 3rd Edition (Collins, 2016), Bat Workers Manual (Mitchell-Jones & McLeish, 2004) and Bats and Woodland Management (Forestry Commission, 2005). This comprised a ground inspection and aerial inspection. The surveys were undertaken on 26 and 27 April 2017 by Natural England-licensed bat ecologists, who were also certified to climb trees with ropes.

#### 3.2.1 Ground Inspection

Mature trees identified during the PEA Study Area Boundary (AECOM, 2016) were assessed from ground level using binoculars to identify features that might be suitable for supporting roosting bats. Of particular note were cracks and crevices, woodpecker holes, splits, flaking bark and thick-stemmed ivy. Data were collected from suitable trees on pre-prepared survey forms and included:

- species
- GPS co-ordinates
- a description of the features
- tree categorisation (see below)

In accordance with published guidance (Collins, 2016), suitable trees were assigned a category of Roost Habitat Suitability or 'Risk' corresponding to the likelihood that bats could be present. These categories are described below:

- **Negligible Risk** - No features that could be used by bats (for roosting, foraging or commuting).
- **Low Risk** - Small number of potential roosting features, isolated habitat that could be used by foraging bats, e.g. a lone tree or patch of scrub but not parkland, isolated Site not connected by prominent linear features (but if suitable foraging habitat is adjacent it may be valuable if it is all that is available).

- **Moderate Risk** - Several potential roosting features in the trees, habitat could be used by foraging bats, e.g. trees, shrub, grassland or water. Site is connected with the wider landscape by linear features that could be used by commuting bats, e.g. lines of trees and scrub or linked back gardens.
- **High Risk** – Trees with features of particular significance for roosting bats, habitat of high quality for foraging bats, e.g. broadleaved woodland, tree-lined watercourses and grazed parkland, Site is connected with the wider landscape by strong linear features that would be used by commuting bats e.g. river/stream valleys or hedgerows. Site is close to known roosts.
- **Confirmed Roosting** - Evidence indicates a tree is used by bats, e.g. bats seen roosting or observed flying from a roost or freely in the habitat; droppings, carcasses, feeding remains, etc. found; and/or bats heard 'chattering' inside on a warm day or at dusk, bats recorded/observed using an area for foraging or commuting.

### 3.2.2 Aerial Inspection

Trees within the PEA Study Area Boundary and additional trees identified in 2017 as containing features categorised as Moderate or High Risk were climbed using ropes and ladders. Once accessed, features were examined in detail using a bright torch, endoscope or mirror to inspect (where possible) the full extent of the features and search for bats or evidence of bat activity (e.g. droppings, urine stains, odour, feeding remains, scratch marks, grease stains, wear marks). Where necessary, trees were re-categorised following the aerial inspection.

## 3.3 Bat Emergence / Re-entry Surveys

Dusk emergence and dawn re-entry surveys were undertaken in accordance with guidance given in Collins (2016), based on the assessed habitat suitability/risk category of each tree (see Table 1). No further surveys were required for trees assessed as Negligible or Low Risk, although it will be necessary to take appropriate precautions when felling any of these trees.

**Table 1. Minimum number of visits to determine presence/absence of bat roosts in trees.**

Negligible/Low Habitat Suitability/Risk	Moderate Habitat Suitability/Risk	High Habitat Suitability/Risk
No further surveys.	Two survey visits – one dusk and one dawn at least two weeks apart.	Three survey visits – dusk or dawn (at least one dawn) – at least two weeks apart.

Dusk emergence surveys started approximately 15 mins before sunset and ended 1.5 to 2 hours after sunset. Dawn re-entry surveys started 1.5 to 2 hours before sunrise and ended 15 mins after sunrise. Surveys were only undertaken during suitable weather conditions, i.e. in temperatures above 7°C and in the absence of rain, strong wind and fog.

Surveys were led by a suitably experience bat ecologist. Equipment used comprised full spectrum and frequency division bat detectors connected recording devices. Use was also made of static detectors (e.g. SM2BAT+/Anabat Express) and an infra-red video camera if required. Sound recordings were made to allow subsequent verification of species or species groups, where required.

## 3.4 Bat Activity Surveys

Bat activity surveys were started in April 2017 based on the assessed overall moderate habitat suitability for bats with reference to the revised option schemes provided in March 2017. Two transect routes were surveyed between April and October 2017 covering representative habitats within the Study Area Boundary (i.e. woodland, field margins, hedges, grassland and wetlands).

Each activity survey involved two surveyors walking a transect route which included a series of 'wait points' located at potentially important features with regard to bats. At each 'wait point', surveyors stopped and recorded bat activity for three minutes using bat echolocation detectors. All activity encountered whilst walking between points was also noted. The survey route was designed to include potential flight paths or foraging areas within the

site, and also potential roost sites. The starting point and direction of the transect were varied during each survey visit in order to ensure different areas of the transect were walked close to dusk.

Surveyors carried bat echolocation detectors to help determine which species were present. In accordance with the Bat Conservation Trust survey guidelines, dusk surveys were carried out from 15 minutes before dusk to at least 2 hours after dusk. In line with the guidelines at least one dawn survey was conducted during summer 2017 within the same 24 hour period as a dusk survey (commencing 2 hours before sunrise to sunrise). The time, location, numbers, species (where possible) and direction of flight were recorded for each bat pass (discrete burst of echolocation heard, or bat activity observed) during the survey. Echolocation calls detected with a Batlogger M detector were analysed with specialised software to verify bat calls where required. Survey visits were conducted in this way where weather conditions allowed, with surveys scheduled to avoid nights with cold, wet or windy conditions (>7°C). The transect effort index (number of transect hours per hectare) was calculated as the number of transects per survey multiplied by the number of hours and number of surveys divided by the total site area. This was 38 minutes per hectare (2 x 2.5 x 7 (14 2.5hr dusk surveys) + 4 (2 2hr dawn surveys) = 39 transect hours / 61.2 ha).

**Table 2. Summary of guidelines on bat activity survey effort based on suitability of habitat for bats (Collins, 2016)**

Low suitability habitat for bats	Moderate suitability habitat for bats	High suitability habitat for bats
One transect survey per season (spring, summer and autumn). One static detector per transect on five consecutive nights per season	One transect survey per month (April to Oct (weather permitting)). One survey to comprise dusk and pre-dawn or dusk to dawn. Two static detectors per transect on five consecutive nights per month.	Up to two transect survey per month (April to Oct (weather permitting)). One survey to comprise dusk and pre-dawn or dusk to dawn. Three static detectors per transect on five consecutive nights per month.

*Notes: April, September and October may be weather and location-dependent. If weather conditions are unsuitable, the length of the survey season is reduced.*

In addition to the transect surveys, four automated static bat detectors (Anabat Express) were placed across the site in representative habitats to record bat activity over a longer period of time. All detectors were located at least 1.5m above the ground on trees, and clear of vegetation between the adjacent habitats and the microphone, as follows.

- Static Detector 1 - on the woodland edge close to Thickthorn services.
- Static Detector 2 - on the edge of plantation woodland east of the A11
- Static Detector 3 - in woodland south of the A47.
- Static Detector 4 - on the woodland edge north of the A47.

The locations of the static detectors are shown on Figure 1.

The static detectors were set up to record bats from sunset to sunrise for the recommended minimum of 5 consecutive nights per month from April to October as follows.

- 6 nights 27 April to 2 May
- 5 nights 19 to 23 May
- 6 nights 15 to 20 June
- 6 nights 26 to 31 July
- 6 nights 3 to 8 August
- 6 nights 1 to 6 September
- 7 nights 1 to 7 October

Any nights with rain were subsequently excluded from the analysis (see limitations).

## 3.5 Bat Data Analyses

The static detector data collected were analysed to determine the total number of bat passes for each species or species group (depending on the level of identification possible from the recordings made) and then used to derive a metric - the Bat Activity Index (BAI) (see section 3.5.1) for the bat activity at each survey location. The transect data were described in relation to species, observed behaviour, temporal and spatial trends. These analyses provide an indication of:

- Seasonal variation in species activity and composition at each survey location.
- Relative levels of bat activity across the site.
- Potential roosting sites, important foraging areas and commuting routes.

### 3.5.1 Bat Activity Index (BAI)

BAI values were calculated by averaging the number of bat passes per hour for each static detector unit. The term 'pass' is defined as a single file made up of bat pulses of a single species i.e. this may be one bat in a file or many bats in a single file.

No guidance is available on what constitutes low, moderate or high bat activity based on number of passes. As such a relative scale is used by AECOM in this report where:

- **Very Low Activity** is a mean of less than 2 passes per hour (at each survey location)
- **Low Activity** is a mean of 2 to 25 passes per hour
- **Moderate Activity** is a mean of 26 to 99 passes per hour
- **High Activity** is a mean of over 100 passes per hour

### 3.5.2 Roost types

Where bat roosts were found these were categorised as follows based on guidance in Collins (2016):

- **Day roost** - A place where individual bats, or small groups of males, rest or shelter in the day but are rarely found by night in the summer.
- **Night roost** - A place where bats rest or shelter in the night but are rarely found in the day. May be used by a single individual occasionally or it could be used regularly by the whole colony.
- **Feeding roost** - A place where individual bats or a few individuals rest or feed during the night but are rarely present by day.
- **Transitional/occasional roost** - Used by a few individuals or occasionally small groups for generally short periods of time on waking from hibernation or in the period prior to hibernation.
- **Swarming site** - Where large numbers of males and females gather during late summer to autumn. Appear to be important mating sites.
- **Mating site** - Where mating takes place from late summer and can continue through winter.
- **Maternity roost** - Where female bats give birth and raise their young to independence.
- **Hibernation roost** - Where bats may be found individually or together during winter. They have a constant cool temperature and high humidity.
- **Satellite roost** - An alternative roost found in close proximity to the main nursery colony used by a few individual breeding females to small groups of breeding females throughout the breeding season.

### 3.5.3 Evaluation of nature conservation value

An assessment of the relative ecology and nature conservation value of any bat roosts associated with the site has been determined using the principles described in *Valuing Bats in Ecological Assessment* (Wray *et. al.* 2010) (see Appendix B). Reference has also been made where required to:

- Species Conservation Status Reports - 3rd UK Habitats Directive Reporting 2013 (JNCC, 2013)
- UK Biodiversity Action Plan
- Norfolk Biodiversity Action Plan
- Distribution Atlas of Bats in Britain and Ireland 1980-1999 (Richardson, 2000)
- UK Mammals: Species Status and Population Trends (Battersby, 2005)
- Mammals of the British Isles Handbook (Harris and Yalden, 2008)
- The State of the UK's Bats: National Bat Monitoring Programme Populations Trends 2011 ([www.bats.org.uk](http://www.bats.org.uk))

### 3.6 Survey Limitations

During the PRF inspection, trees covered by ivy were assessed but not climbed because it was not practical to do so (i.e. the action of climbing is likely to be damaging/destructive to the potential roost locations). Where trees were considered unsafe to climb, a conservative roost suitability/risk assessment was ascribed to them. The GPS co-ordinates were taken using a Garmin etrex device, which typically had an accuracy resolution of 4m.

No buildings (private housing) or roadside services were assessed as part of this work as there are no plans to affect these structures. Where these buildings are likely to be affected then internal inspections and presence/absence activity surveys will be required. There is no access along the railway under the A47 road bridge. If this bridge is likely to be affected then a bat inspection survey will be required. The location of any construction compounds/flood compensation areas (where required) are currently unknown and are therefore not covered unless they are to be located within the Study Area Boundary.

Nights with prolonged rain showers and/or strong (wind force 7 and above) were excluded from the static data analysis. This affected 1 night in each of April, July, August and September and 2 nights in October. The minimum of 5 nights was still recorded each month, at each static detector location, as extra time was allowed for static deployment on site. As such this does not affect the results.

The roost surveys undertaken were aimed at determining the presence/likely absence of roosts, therefore there may be a need for further up-to-date surveys on the identified roosts for the purposes of a licence application (i.e. the EPSML). While for the purposes of an EPSML additional survey is appropriate, sufficient robust survey data were collected to allow the Local Planning Authority to evaluate the application and discharge its legal biodiversity duty in accordance with Natural England standing advice. There were no other limitations that affected the survey results.

## 4. RESULTS

### 4.1 Preliminary Roost Appraisal of Additional Trees

In addition to trees assessed in 2016 as part of the PEA (AECOM (a), 2016), in 2017 an additional seven mature trees and a strip of broad-leaved woodland were identified for further survey based on the updated scheme options (see section 1.1). A summary of the results from 2017 are provided in Table 3 below.

**Table 3. Preliminary Roost Appraisal 2017**

Target Note (TN) (2017) <sup>1</sup>	Summary	Roost Suitability/Risk <sup>2</sup>
TN4	Mature oak 1m DBH <sup>3</sup> , located at TG17965 05488. 2 holes but possibly too exposed.	<b>Moderate</b>
TN5	Mature oak 1.2m DBH. TG17835 05478. 2 splits in boughs suitable for roosting but possible water ingress.	<b>Moderate</b>
TN6	Mature oak. 0.5m DBH. Negligible Risk for roosting bats therefore no further consideration.	Negligible
TN7	Mature sycamore 0.9 DBH at TG1791005507. Hole low down with nothing inside, some flaky bark.	Low
TN8	Mature oak 0.9 DBH at TG1794105449. A few splits but upward facing.	Low
TN9	Broad-leaved woodland with mature oak trees. Approximately 12 trees within proposed road alignment. Up to High Risk for roosting bats. Some trees are ivy covered, good foraging habitat.	<b>High</b>
TN64 <sup>4</sup>	Hedge with two ivy covered mature oak trees 1.5m DBH <sup>3</sup> . One hole low down on east tree, no signs of bat. A few splits higher up on both trees.	<b>Moderate</b>

<sup>1</sup>See Figure 10

<sup>2</sup>Those trees in **bold** are Moderate, High or Confirmed Roost Suitability / Risk and highlighted for further survey

<sup>3</sup>DBH - Diameter of tree at Breast Height

<sup>4</sup>TN64 identified in 2016 PEA survey, now within the footprint of the proposed scheme due to scheme changes, therefore included in the survey.

### 4.2 Aerial Inspection

The results of the aerial tree inspection are shown in Table 4. This comprised trees identified with Moderate or High Risk for roosting bats in the PEA (AECOM (a), 2016) (i.e. 20 no.) and additional trees identified in 2017 (i.e. 7 no. See section 4.1 above). In summary, of the 27 trees inspected, there was 1 tree with a Confirmed Roost [REDACTED], nine trees with Moderate Risk, 13 with Low Risk and four with Negligible Risk.

**Table 4. Aerial Tree Inspection Survey Results**

Tree ID <sup>1</sup>	Species	GPS	DBH <sup>2</sup>	Feature(s)	Climbed?	Results of Inspection	Risk
	Oak	TG 19006 05309	0.7	A light covering of ivy and some deadwood but no obvious cavities	No	It is possible that the ivy was obscuring a small number of roosting features	Low
				<b>Cantley Lane (north) hedge additional trees within hedge listed below 7.1 to 7.4. Not previously individually recorded.</b>			
	Oak	TG 18890 05228	1.5	A north-facing hole at 4m A hollowed central stem with south-facing holes between 2m and 10m	No	Many of the holes were too extensive to be fully inspected and could support roosting bats	<b>Moderate</b>
	Oak	TG 18919 05249	2.5	Some deadwood and a light covering of ivy	No	n/a	Low
	Oak	TG 18771 05221	1.1	A large vertical split with several possible cavities	No - unsafe	n/a	<b>Moderate</b>
	Oak	TG 18851 05217	1.5	A woodpecker hole in the southern aspect at 8 m	Yes	The cavity was 10cm deep and clean inside. There is only likely to be room for a single bat.	Low
	Oak	TG 18992 05291	1.0	Two woodpecker holes in a south-west facing branch at 6 m and 7 m	Yes	The woodpecker hole at 6 m contained a 10cm cavity, partly filled with a disused bird's nest. The 7m hole also contained a 10cm cavity but this was clean and dry inside. Although suitable, no evidence of use by bats was recorded.	<b>Moderate</b>
	Oak	TG 18951 05282	2.0	A south-facing callus roll in the central stem at 8m A south-facing branch with a callus roll at 12m A hole in the southern aspect of the central stem at 10m Some deadwood in the crown	Yes	The south facing callus roll did not contain a cavity. Although the branch callus roll did contain a cavity, it was less than 3 cm deep and did not afford protection against the elements The hole in the southern aspect stem did contain a cavity but it was less than 5cm deep and afforded little protection	Low

<sup>1</sup> Target note locations on Figure 10

<sup>2</sup> DBH - Diameter at Breast Height (m)

<sup>3</sup> Additional numbering e.g. 7.1 or letters in lower case refers to individual trees within a target noted feature, such as a woodland / hedge

Tree ID <sup>1</sup>	Species	GPS	DBH <sup>2</sup>	Feature(s)	Climbed?	Results of Inspection	Risk
						against the elements. There were no obvious cavities in the deadwood	
	Oak	TG 18945 05269	2.5	The over-mature tree was hollowed out and contained a large number of possible roosting features.	Yes	Many of the possible roosting locations were open and exposed and would afford little protection against predators such as rats and squirrels. However, due to size of the tree and extensive depth of some cavities, not all could be fully inspected.	<b>Moderate</b>
	Oak	TG 18857 05395	1.2	A west-facing cavity at 6 m	Yes	The cavity was large and open, affording little protection against the elements	Negligible
	Oak	TG 18651 05351	1.0	A south-facing hole in the central stem at 8 m Some deadwood throughout	No	Unable to access the hole.	<b>Moderate</b>
	Oak	TG 18643 05114	1.5	A light covering of ivy but insufficient to create roosting opportunities Deadwood throughout but no obvious cavities	No	n/a	Low
	Oak	TG1820704850 TG1824204847	1.5	2 x Mature oak trees along hedge line. Ivy covered and some deadwood throughout.	No	Both ivy covered and dead wood, unsafe to climb. One south facing hole 2m above ground on eastern tree no signs of a roost. A few shallow splits on dead wood higher up.	<b>Moderate (both trees)</b>
	Oak	TG 17846 04732	1.1	A dense covering of thick-stemmed ivy and flaking bark	No	n/a	<b>Moderate</b>
	Oak	TG 17973 05136	3.0	A veteran tree with lots of flaking bark, a hollowed stem and deadwood throughout	Yes	Although the major cavities were inspected and no evidence of bats found, many areas were too extensive to be fully inspected. A grey squirrel emerged from one of the cavities	<b>Moderate</b>
	Oak		3.0	A veteran tree with lots of flaking bark, a hollowed stem and deadwood throughout	Yes	Two small and old bat droppings were observed within a vertical split in a northwest-facing branch at 4 m. The	<b>Confirmed Roost</b>



Tree ID <sup>1</sup>	Species	GPS	DBH <sup>2</sup>	Feature(s)	Climbed?	Results of Inspection	Risk
						split was approximately 0.5 m in length and 2 cm wide. Although the cavity could support c. 10 bats, the evidence indicated occupancy by a single bat.	
				A series of three holes on the western aspect between 2 – 4 m		The holes did not contain cavities	
				Deadwood throughout		No obvious cavities in the deadwood	
	Oak	TG 18490 05201	2.2	A knot hole in the eastern branch at 8 m	Yes	The feature contained a 5 cm cavity with a disused bird's nest	Low
				A woodpecker hole in the eastern aspect at 12 m		The cavity was small (< 5 cm) and afforded limited protection	
				A hollowed out stem		The hollowed section did not contain any suitable cavities	
	Oak	TG 18427 05260	1.5	An area of damage on the southern aspect of the main stem at 7 m	Yes	The cavity was both open and wet	Low
				A dead north-facing branch at 5 m with a possible cavity	No - unsafe	n/a	<b>Moderate</b>
				The central stem was hollow		There were no suitable cavities within the hollowed stem	
	Oak	TG 18310 05152	2.0	Woodpecker holes in the southern aspect at 3 m and 6 m	Yes	Both woodpecker holes contained disused bird's nests	Low
				Three woodpecker holes in the western aspect at 4, 5 and 6 m in height		The hole at 4 m projected downwards less than 5 cm but could support a single bat The hole at 5 m was wet throughout The hole at 6 m contained a wasps nest	Low
	Ash	TG 19079 04758	0.7		Yes		
				Two holes in the southern aspect of the main stem at 3 m and 4m in height	Yes	Neither hole contained a cavity greater than 5 cm. The hole at 4 m was	Low

Tree ID <sup>1</sup>	Species	GPS	DBH <sup>2</sup>	Feature(s)	Climbed?	Results of Inspection	Risk
				A hazard beam (horizontal split) on an east-facing branch at 6 m Deadwood throughout the crown		covered by dense cobwebs. The hazard beam contained an active honeybee ( <i>Apis mellifera</i> ) hive No cavities were observed in the deadwood	
	Oak	TG 17835 05478	1.1	Some deadwood throughout and some trunk / branch wounds, most notably in the north-west at 7 m and west at 4 m	Yes	None of the features contained cavities that could support roosting bats or were open from above and wet inside.	Negligible
	Oak	TG 17790 05520	1.2	A dense covering of ivy with some overlapping stems. Further features could have been obscured by foliage. A snapped west-facing branch at 8 m	No	Climbing is not appropriate for identifying roosts within ivy.  There was no cavity present	<b>Moderate</b>
	Oak	T 17803 05518	1.1	A trunk wound on the northern aspect at 6 m	No	There was no cavity present	Negligible
	Oak	TG 17816 05536	1.1	A covering of thick-stemmed ivy that could form a small number of cavities between stems. Further features might be obscured by the foliage.	No	Climbing is not appropriate for identifying roosts within ivy.	<b>Moderate</b>
	Oak	TG 17839 05545	0.7	A snapped limb to the north-west at 7 m	Yes	No cavities were present and the feature was open from above	Negligible
	Oak	TG 17827 05504	1.0	Several callus rolls and deadwood on the main stem orientated between the south-east and south-west. There are also some areas of flaking bark.	Yes	All features were inspected and few contained any cavities that would afford protection against the elements. The remaining features were only capable of supporting small numbers of bats	Low

## 4.3 Bat Activity Surveys

Below is a summary of each transect survey completed, with the full results in Appendix C. A transect route map is provided on Figure 1, Appendix A. Mapping of the results is provided on Figures 2 to 9, Appendix A.

### 4.3.1 April 2017 – East Transect

The first bats were two passes of common pipistrelle (*Pipistrellus pipistrellus*) and a soprano pipistrelle (*Pipistrellus pygmaeus*) recorded along Cantley Lane 20 minutes after sunset (first bat at 20:25) indicating that these bats were likely to be roosting close by. A common pipistrelle was recorded at 20:56 close to a woodland plantation south of the A47 followed by another foraging around the tree canopy close to the lake. Later in the night at 22:18 and 22:21 a daubenton's (*Myotis daubentonii*) bat was recorded briefly foraging over the fishing lake (Waitpoint 5).

### 4.3.2 April 2017 – West Transect

A common pipistrelle was recorded 26 minutes after sunset at woodland to the east of the A11, briefly foraging in the woods. Three further records of pipistrelle bats were recorded in the same woodland at 21:21, 21:23 and 22:09.

### 4.3.3 May 2017 – East Transect

Common and soprano pipistrelle bats were recorded foraging up and down Cantley Lane south 23 minutes after sunset (from 21:24), indicating nearby roosts for these species (potentially in adjacent woodland and/or residential houses). A noctule (*Nyctalus noctula*) flew overhead from the south at 21:32. There was regular activity of pipistrelle bats and the occasional noctule along the transect. At the fishing lake an estimated 10 bats comprising Daubenton's and common and soprano pipistrelle bats were recorded foraging over the lake.

### 4.3.4 May 2017 – West Transect

A soprano pipistrelle bat was recorded 16 minutes after sunset (at 21:16) close to woodland just west of the A11 underpass, indicating likely roosting in these or nearby woods. Regular foraging of common and soprano pipistrelle and noctule bats was recorded, particularly along the woodland edge west of Thickthorn services and the track to the east of the A11 underpass.

### 4.3.5 June 2017 – East Transect

The first bat recorded was a noctule flying from south to north high over the site to the north of the A47, 26 minutes after sunset (at 21:46). Common and soprano pipistrelle, Daubenton's and noctule were recorded foraging at the lake. Occasional passes of common pipistrelle were later recorded along the transect, with one serotine recorded north of the A47 pedestrian footbridge towards the end of the survey (at 22:47).

### 4.3.6 June 2017 – West Transect

Regular passes of common and soprano pipistrelle bats were recorded along the track to the east of the A11 underpass at the start of the transect. At least four bats of these species were recorded flying through the A11 underpass from east to west. Along the woodland edge west of Thickthorn services as well as pipistrelle bats, occasional Daubenton's bats were recorded and seen foraging here. Occasional noctule passes were also recorded.

### 4.3.7 July 2017 – East Transect (Dusk and Dawn)

Common pipistrelle bats were regularly recorded commuting and foraging along the hedge to the SW of Cantley Lane. At least three bats were recorded foraging by the hedge in Meadow Farm field just north of the A47 during the dusk survey. Common and soprano pipistrelle bats were regularly recorded passing or foraging along the transect, notably in scrub habitats and along Cantley Lane South. A single Daubenton's bat was recorded passing over the fishing lake. At dawn there was foraging and commuting activity of common and soprano pipistrelle bats at a few locations, notable along a hedge just north of Cantley Lane and along the hedge adjacent to Cantley Lane South. Daubenton's bats were recorded passing over the stream to the close to the road and foraging at the fishing lakes.

#### 4.3.8 July 2017 – West Transect (Dusk and Dawn)

A soprano pipistrelle bat was recorded foraging in the woods just west of the A11 11 minutes after sunset (at 21:10). Common pipistrelles and a few soprano pipistrelles were regularly recorded foraging along the transect route, with relatively higher foraging activity (at least 3 bats) along the track east of the A11 underpass. A brown long-eared bat (*Plecotus auritus*) was recorded in the woodland along this track. At dawn, bat activity was relatively low with a total of nine passes of common and soprano pipistrelle bats spread along the transect. A soprano pipistrelle was recorded possibly returning to a tree roost [REDACTED] at 04:41 (23 minutes before sunrise (see roost surveys in section 4.4).

#### 4.3.9 August 2017 – East Transect

15 minutes after sunset (at 20:48 onwards) eight common pipistrelles and two soprano pipistrelles were recorded flying from the residential area just to the north of the site along Cantley Lane. Further pipistrelle bats were later recorded commuting north to south along Cantley Lane. Soprano pipistrelles were occasionally recorded to the north of the A47 and observations from the footbridge indicated no bats crossing the footbridge. At least five common and soprano pipistrelles were recorded foraging 5 to 10m above the fishing lakes. Common pipistrelle bats and a barbastelle pass were recorded in the woodland east of the A11. Towards the end of the transect there was regular pipistrelle foraging activity north of the A47 along Cantley Lane along with a few social calls.

#### 4.3.10 August 2017 – West Transect

Common and soprano pipistrelle bats were recorded foraging along Cantley Lane South 16 minutes after sunset (from 20:49), with both species foraging and socialising close to the house just west of Cantley Lane South. Both species were then recorded foraging along the track. Activity to the west of the A11 was relatively low with a single noctule pass close to the Thickthorn services woodland and some brief foraging of common pipistrelles close to this woodland and just west of the A11 underpass.

#### 4.3.11 September 2017 – East Transect

The first bats recorded were common pipistrelles, from eight minutes after sunset (at 19:10) heading from the residential area towards Cantley Lane. There was regular foraging of common and soprano pipistrelle bats along the hedges and some socialising activity under a street light just north of the A47. Three or four bats of both these species were recorded foraging over the fishing lake and along Cantley Lane South. A single noctule pass was recorded along Cantley Lane near the end of the survey.

#### 4.3.12 September 2017 – West Transect

A common pipistrelle was recorded foraging around a house along Cantley Lane South five minutes after sunset (at 19:05) and based on the timing was suspected to have emerged from the house. Common and soprano pipistrelle bats were regularly recorded along the transect, including foraging or passing along the stream, foraging along woodland and field edges and a few social calls. Two passes of a brown long-eared bat were recorded in the woodland to the west of Thickthorn services.

#### 4.3.13 October 2017 – East Transect

The first bat was a common pipistrelle recorded passing south to north along Cantley Lane South 16 minutes after sunset (at 18:49). Common and soprano pipistrelles were recorded regularly along the transect, particularly around the fishing lakes (a maximum of two bats), over the horse field and hedges north of the A47, and along Cantley Lane.

#### 4.3.14 October 2017 – West Transect

Activity was relatively low with a single brown long-eared bat recorded 1 hour after sunset (at 19:33). A few passes of common and soprano pipistrelle bats were recorded close to the woods either side of the A11. A single Daubenton's bat was recorded along the edge of the woods just west of Thickthorn services.

### 4.3.15 Static Detector Surveys

The results of these surveys and the Bat Activity Index (BAI) are shown below and in Appendix C.

Species recorded on the static detectors comprised common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), noctule (*Nyctalus noctula*), serotine (*Eptesicus serotinus*), Myotis species (including Daubenton's (*Myotis daubentonii*), brown long-eared (*Plecotus auritus*), and barbastelle (*Barbastella barbastellus*). Leisler's (*Nyctalus leisleri*) was unconfirmed and included within the *Nyctalus* species group (noctule or Leisler's) or 'big bat' group (*Nyctalus* or serotine).

The BAI at all static detector locations ranged from Very Low to Low (see definition in section 3.5) between April and October 2017 (see Chart 1). Relatively higher activity was recorded between May and August with the highest BAI of 9.93 at Static Location 1 in June. The most commonly recorded species across all months (see Appendix C, Chart C1) was common pipistrelle with a total of 1742 passes<sup>4</sup>, followed by soprano pipistrelle with 238 passes, Myotis species (including Daubenton's) (153 passes), noctule (122 passes), *Nyctalus* species (61 passes), 'big bat' (*Nyctalus* or serotine) (47 passes), serotine (33 passes), brown long-eared (25 passes), and barbastelle (14 passes). Even taking into account differences in detectability of individual species on bat detectors,<sup>5</sup> common pipistrelle was the most common species on site. This was reflected in the results of the transect surveys. All the species on the static detector recordings (apart from the possible Leisler's) were recorded during the transect surveys.

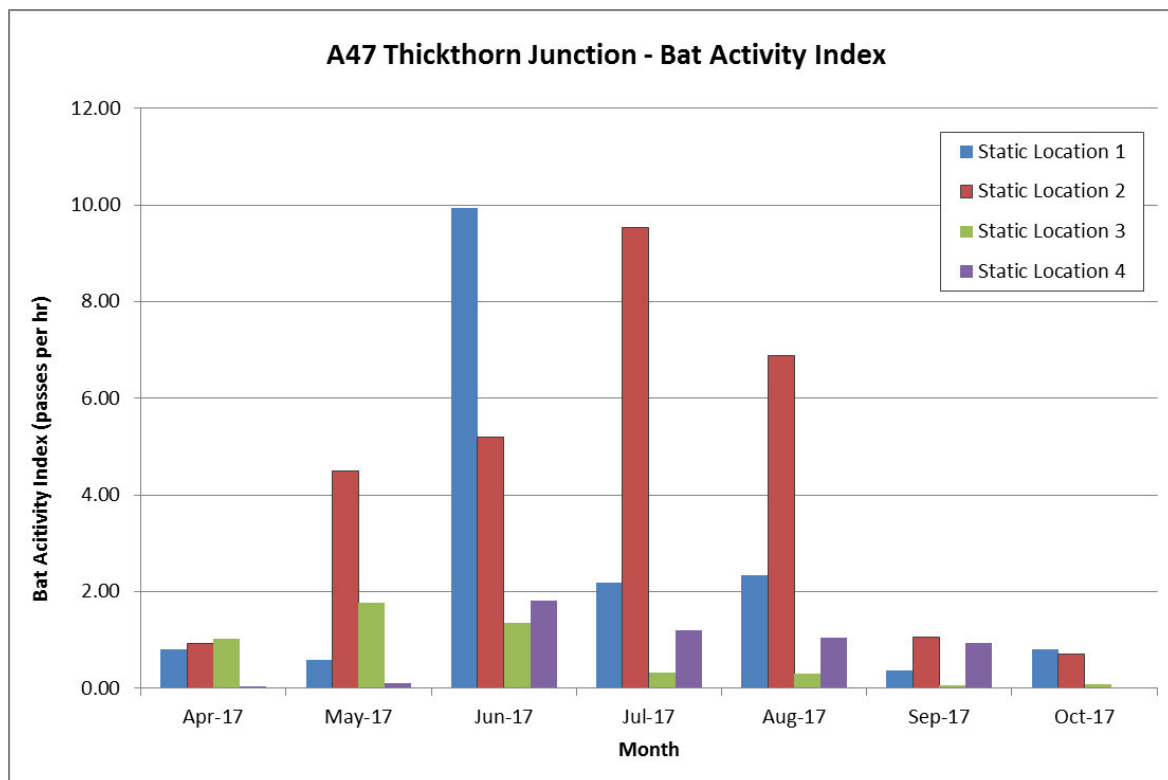


Chart 1 – A47 Thickthorn Junction Bat Activity Index

<sup>4</sup> totals from all static detector sites over all months

<sup>5</sup> Different species of bat are recorded on detectors over different distances. Some species such as a brown long-eared may only be recorded up to 10 metres of the microphone, whereas noctule may be recorded up to 50m away.

## 4.4 Bat Roost Surveys

See Appendix C for results and Appendix A, Figure 10 for confirmed roost locations.

There is a confirmed soprano pipistrelle day roost in an oak tree at [REDACTED]. The roost comprised a vertical split in a northwest-facing branch at 4m. Droppings were present during the aerial tree climbing inspection and a single bat was recorded re-entering the feature at 04:46 during a dawn re-entry survey on 28 July 2017. A soprano pipistrelle was also suspected to be returning to this tree roost the previous morning (27 July) at 04:41 during a dawn transect survey.

There is also a confirmed soprano pipistrelle day roost in an oak tree at [REDACTED]. A single bat was recorded emerging at 21:07 on 26 July 2017, from a woodpecker hole located c.7 m above the ground.

Based on other roost surveys and observations made during the transect surveys, additional roosts are likely to be present in nearby residential buildings along Cantley Lane and in Norwich. For example, during the transect survey on 10 August approximately 8 common pipistrelles and 2 soprano pipistrelles were recorded 15 minutes after sunset flying from the residential area just to the north of Cantley Lane towards the site along Cantley Lane. These houses were not specifically surveyed as they are currently outside the footprint of the Study Area Boundary and not part of the scope of work.

## 5. DISCUSSION & CONCLUSIONS

### 5.1 Roosts

Two day roosts of a common species (soprano pipistrelle) have been confirmed on site during the surveys. Only single bats were recorded as being associated with the roost. The roosts are assessed as of **Local Value** based on the presence of small numbers of relatively common species of bat (see evaluation method in section 3.5.3).

The soprano pipistrelle roost at [REDACTED] is likely to be directly affected by the Proposed Scheme (both Options 3 and 4). The soprano pipistrelle roost at [REDACTED] could be retained although there may be indirect disturbance depending on the exact construction footprint and road lighting requirements.

There are likely to be other roosts (particularly of common and/or soprano pipistrelles) present in adjacent residential areas to the north of the site close to Cantley Lane and associated with properties along Cantley Lane South. Other woodland and hedgerow trees outside the Study Area Boundary also have the potential to contain bat roosts, including rarer species such as barbastelle, noctule and Daubenton's.

Where known at this stage, potential impacts are considered in the Stage 2 EAR report (AECOM, 2017). As precise details of the scheme are currently unavailable (e.g. area of land-take, construction timing, bridge/underpass designs) mitigation will need to be developed at Stage 3 based on the preferred option (either Option 3 or 4). Provisionally mitigation will require an EPSML to allow the disturbance or destruction of the identified tree roosts. The tree roost at [REDACTED] is likely to require removal for both Option 3 and 4 and therefore would be subject to an EPSML. The tree at [REDACTED] could be retained and therefore may not need an EPSML. Suitable mitigation of the loss of Local Value tree roosts is likely to be readily achievable. Following mitigation the loss and/or disturbance to the low value tree roosts identified is unlikely to be significant.

### 5.2 Commuting and Foraging Habitats

Seven species of bats were recorded using the site. These comprised common pipistrelle, soprano pipistrelle, Daubenton's, noctule, brown long-eared, serotine and barbastelle. There were possibly other Myotis bat species and Leisler's present based on static detector records, but these could not be confirmed based on the recordings made (e.g. a few faint recordings and the difficulty of separating Myotis bat species from echolocation alone) and also their absence during the transect surveys. There was a range of activity (including foraging, commuting and socialising) with mainly individual bats recorded throughout the site. Four areas (see locations in Appendix A, Figure 1) consistently had relatively higher activity with multiple bats and a greater range of species. These were:

- Woodland west of the Thickthorn services (west of TN71) (e.g. common and soprano pipistrelle, noctule and brown long-eared)
- Cantley Lane both north and south of the A47 (TN7 and TN51) (e.g. common and soprano pipistrelle, noctule, serotine)
- Woodland edge/track and stream east of A11 (TN64, TN70) (e.g. common and soprano pipistrelle s, brown long-eared, barbastelle)
- Fishing Lakes at TN48 (e.g. common and soprano pipistrelle, Daubenton's)

Large numbers of bats were recorded commuting from housing to the east of Cantley Lane to forage along Cantley Lane. Bats were recorded flying through the A11 underpass and foraging in woodland either side of the A11 and the A47. The track from the A11 underpass to Cantley Lane South adjacent to the mature woodland around TN64 was regularly used by bats including a few records of barbastelle (the rarest species recorded). All these habitats should be retained where possible and kept unlit at night. The scheme should aim to include additional foraging habitats such as wetlands (possibly through flood attenuation lagoons and suitable planting) and additional links from the suburban/urban areas in Norwich beyond the A47 and A11 to the south and west to open countryside.

The commuting/foraging habitat is assessed as of **County Value** based the presence of individual rarer species and large numbers of common species, moderate/unknown numbers of nearby roosts, and habitats ranging from suburban areas or intensive arable land to larger or connected woodland blocks, with mixed agriculture.

In the context of the Proposed Scheme i.e. junction improvement work, new roads, comprising construction work over at least one year and associated temporary and permanent habitat loss, there is likely to be disturbance to foraging and commuting habitats during construction. The new road layout may potentially fragment the habitats, creating barriers for commuting / foraging, particularly for bats moving from roosts north of the A47 to the south and bats east of the A11 moving to the open countryside to the west. No evidence was found that bats regularly used the pedestrian footbridge to cross the A47. It is most likely that as the road is in a cutting, bats cross the carriageway safely at tree canopy height at various places along the A47 or outside the Study Area Boundary along road bridges. The A11 underpass would remain in the same place but potentially be widened or altered potentially affecting bat movement through this feature.

Lighting considerations will be important to ensure continued darkness at night. Where any new road lighting is required the lighting recommendations in Appendix D should be followed. A lighting plan should be provided to the ecologist for review. Mitigation for Proposed Scheme Option 4 in particular will also need consider regularly use of the A11 underpass by bats. The new or altered underpass will need to provide suitable unlit conditions for bats to move freely through this feature.

### 5.3 Consideration of Eaton Chalk Pit SSSI

Eaton Chalk Pit SSSI is located 2.1km to the north-east of the site and is designated for the presence of up to 40 hibernating bats (Daubenton's, Natterer's (*Myotis nattereri*) and brown long-eared bats). There are no direct impact pathways from the Proposed Scheme to this site. Bats hibernating at the SSSI may potentially use the site for foraging, commuting at other times of the year but not for breeding as no maternity roosts were confirmed on site. The fishing lakes are likely to be important for foraging Daubenton's bats, but these habitats will be retained. The scheme will only have minor impacts on the foraging habitats present on site with a loss of habitats mainly restricted to arable fields, semi-improved grassland and young plantation woodland.

There may also be temporary impacts during construction with habitat fragmentation as result of changes in the A11 underpass (see section 5.2 above), potentially affecting bats moving to and from the SSSI at certain times of the year.

During operation, any new road/underpass lighting required particularly under the A11, and along Cantley Lane may make the site less attractive for commuting and foraging bats. Mitigation in the form of lighting restrictions at night, or where unavoidable, the installation of wildlife-sensitive lighting (see Appendix D), the retention of mature hedges along Cantley Lane and other areas, and the creation of suitable new habitats should be provided. After mitigation there are unlikely to be any significant impacts to the SSSI.



## 6. RECOMMENDATIONS

The key recommendations outlined here will need to be reassessed if there is significant change to the type or scale of development proposed, or if there are significant changes in the use or management of the land that would affect the habitats and species. If a planning application is made 2 years or more after this report (i.e. November 2019) it would be advisable to review and update the survey data, particularly with regards to potential bat roosts.

The impacts will need to be re-assessed at Stage 3 based on the preferred option and precise details of the Proposed Scheme.

Table 5 details the recommended work / actions to be done prior to construction.

**Table 5. Summary of Further Work/Actions with Timings**

Survey Type	Summary of Survey Actions	Timing
Bat Emergence / Re-entry Surveys	Update roost characterisation surveys at trees [REDACTED] where affected by the Proposed Scheme to inform EPSML application. Consideration of nearby private residential houses if roosts/potential roosts affected by the Proposed Scheme.	May to September 2018 to characterise the roosts
Tree felling site supervision	Felling of trees with no confirmed roosts under supervision of a licensed bat ecologist (in winter to avoid nesting birds).	October 2017 or 2018 to March 2018 or 2019

## 7. REFERENCES

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Wray S, Wells D, Long E, & Mitchell-Jones T (2010) Valuing Bats in Ecological Impact Assessment, IEEM In-Practice issue 70, p 23-25.

Wray S, Wells D, Long E, & Mitchell-Jones T. (2010) Valuing Bats in Ecological Impact Assessment, IEEM In-Practice issue 70, p 23-25.

## Appendix A Figures

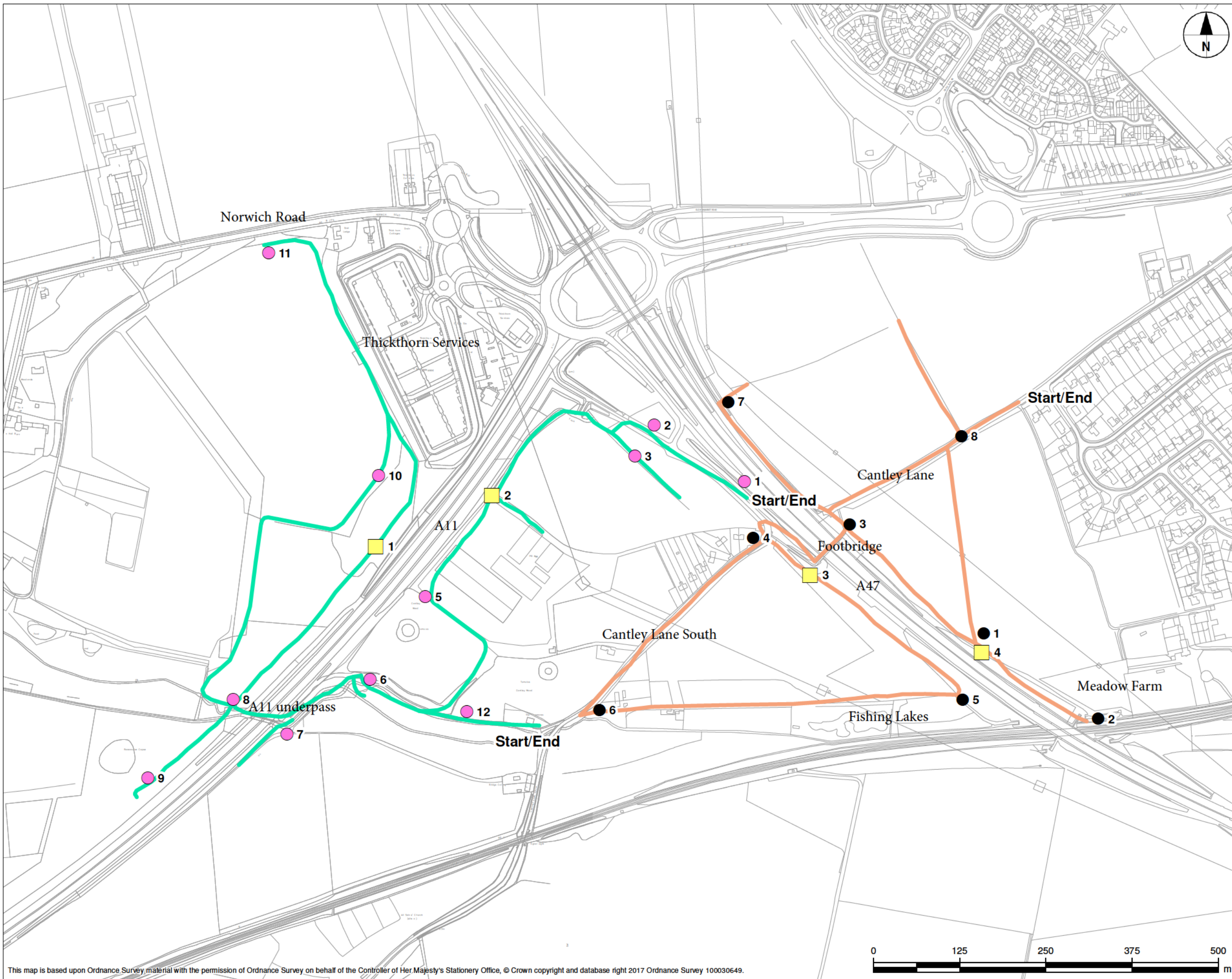
**Figure 1 - Walked Transect and Static Detector Locations**



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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Static Detector Location
- Transect 1
- Transect 2



AMENDED LOCATION OF STATIC DETECTOR 4	GB	MP	24/11/17	F01
MINOR AMENDMENTS TO TRANSECTS AND TRANSECT 1 WAIT POINT 8 & TRANSECT 2 WAIT POINT 10	GB	MP	10/10/17	P02
DRAFT ISSUE FOR COMMENT	FML	MP	24/05/17	P01
Revision Details	By	Check	Date	Suffix

Purpose of Issue: **FINAL**

Client: Highways England  
Woodlands  
Manton Lane  
Bedford  
MK41 7LW

Working on behalf of

Project Title: **A47 CORRIDOR PCF STAGE 2**

Drawing Title: **A47/A11 THICKTHORN JUNCTION BAT TRANSECT AND STATIC DETECTOR LOCATIONS**

Designed FML	Drawn GB	Checked MP	Approved FL	Date 24/11/2017
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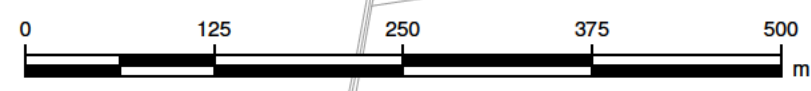
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Page: PAGE 1 of 1



Figure Number: **Figure 1**

Drawing Number HE551492-ACM-EBD-TJ-DR-GI-00006	Rev F01
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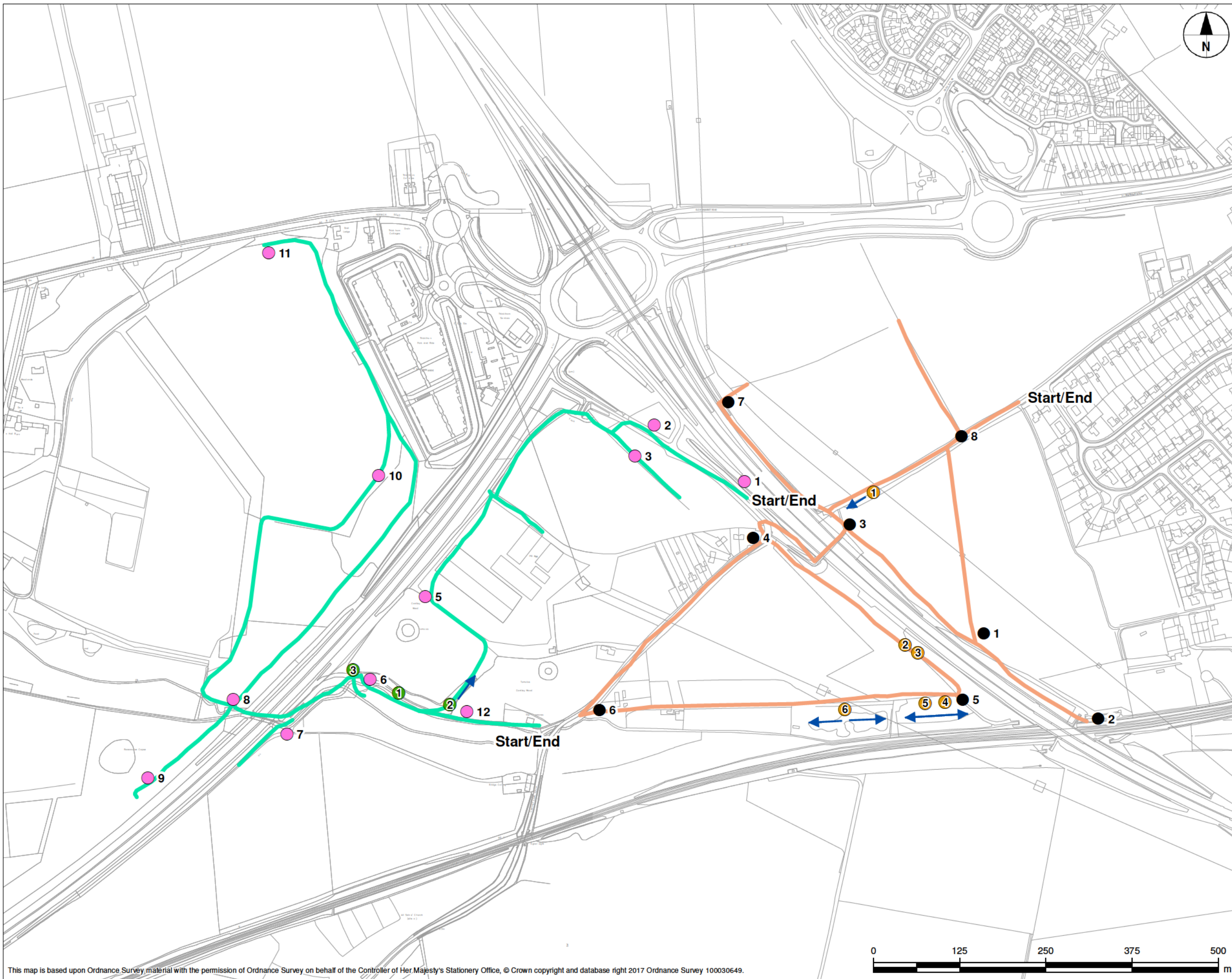
**Figure 2 – April Dusk Transect Results**



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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Transect 1 (East)
- Transect 2 (West)
- Bat Pass (East Transect)
- Bat Pass (West Transect)
- Direction of Movement



DRAFT ISSUE FOR COMMENT	GB	28/11/17	P01
Revision Details	By	Date	Suffix
	Check		

Purpose of Issue **FINAL**

Client  
 Highways England  
 Woodlands  
 Manton Lane  
 Bedford  
 MK41 7LW

Working on behalf of

Project Title  
**A47 CORRIDOR  
 PCF STAGE 2**

Drawing Title  
**A47/A11 THICKTHORN JUNCTION  
 BAT SURVEY RESULTS  
 APRIL DUSK TRANSECTS**

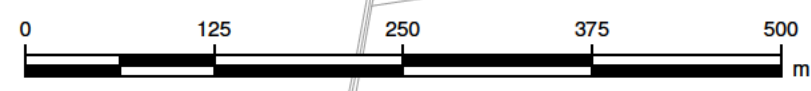
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Figure Number **Figure 2**

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### Figure 3 – May Dusk Transect Results

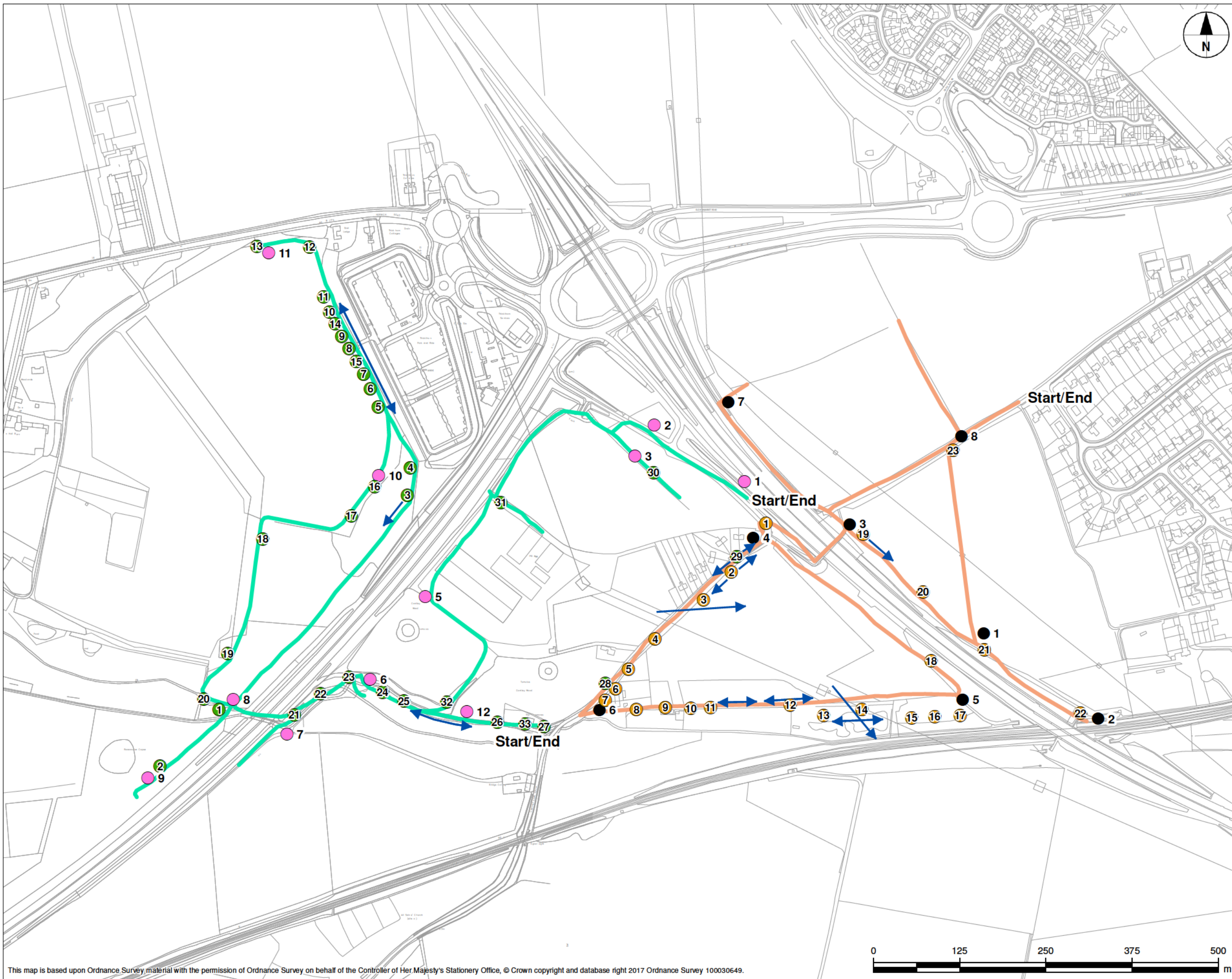




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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Transect 1 (East)
- Transect 2 (West)
- Bat Pass (East Transect)
- Bat Pass (West Transect)
- Direction of Movement



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Revision Details	By	Date	Suffix
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Purpose of Issue: **FINAL**

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MK41 7LW

Working on behalf of  
**highways england**

Project Title: **A47 CORRIDOR PCF STAGE 2**

Drawing Title: **A47/A11 THICKTHORN JUNCTION BAT SURVEY RESULTS MAY DUSK TRANSECTS**

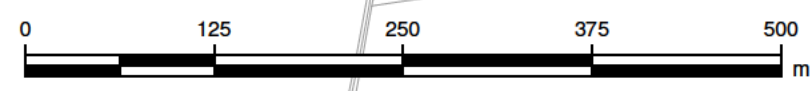
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Scale @ A3 1:5,000	Suitability 50	Page PAGE 1 of 1		

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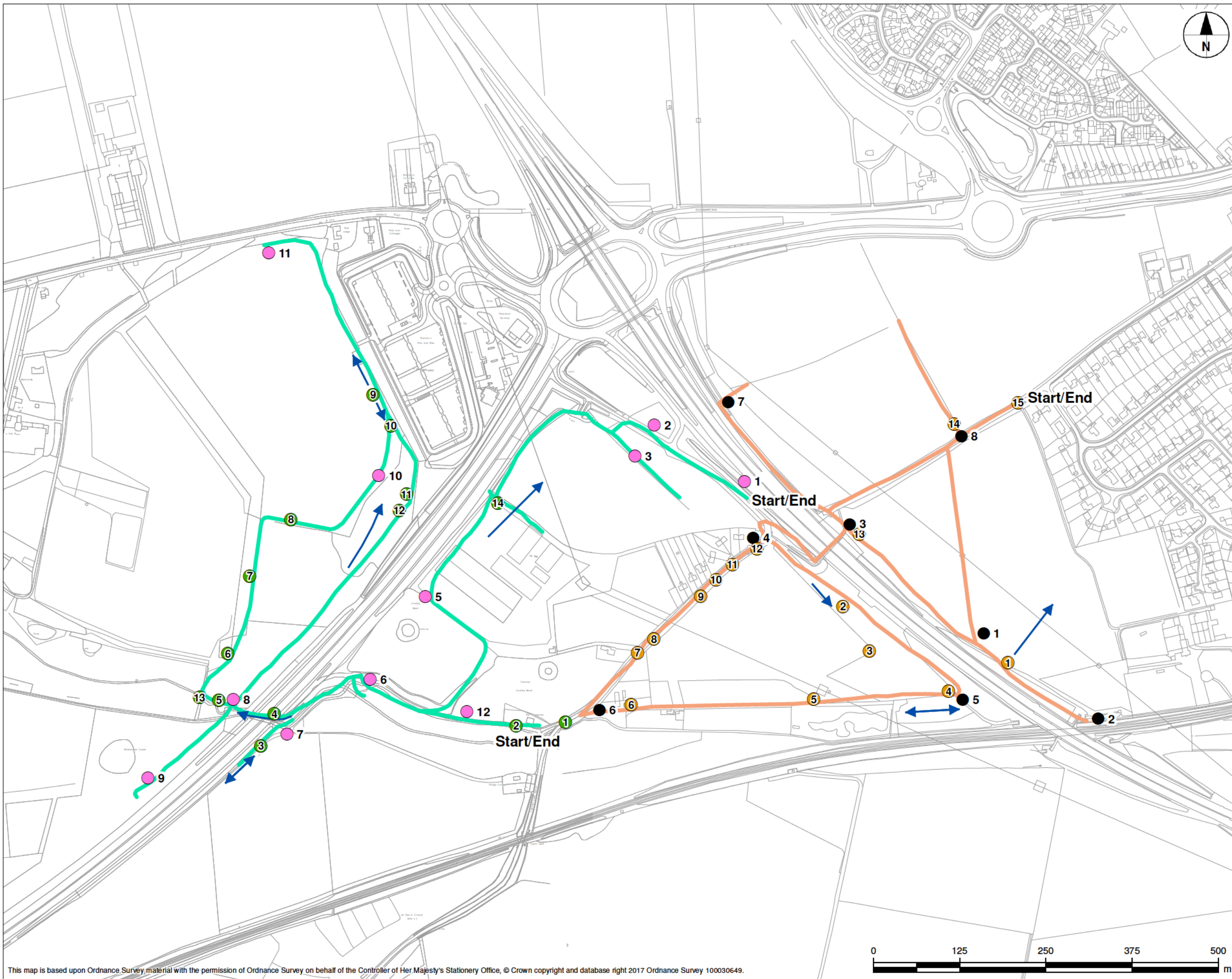
**Figure 4 – June Dusk Transect Results**



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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Transect 1 (East)
- Transect 2 (West)
- Bat Pass (East Transect)
- Bat Pass (West Transect)
- Direction of Movement



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Drawing Title  
**A47/A11 THICKTHORN JUNCTION  
 BAT SURVEY RESULTS  
 JUNE DUSK TRANSECTS**

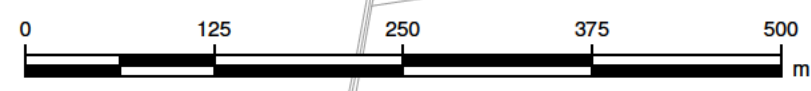
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Scale @ A3 1:5,000	Suitability 50	Page PAGE 1 of 1		

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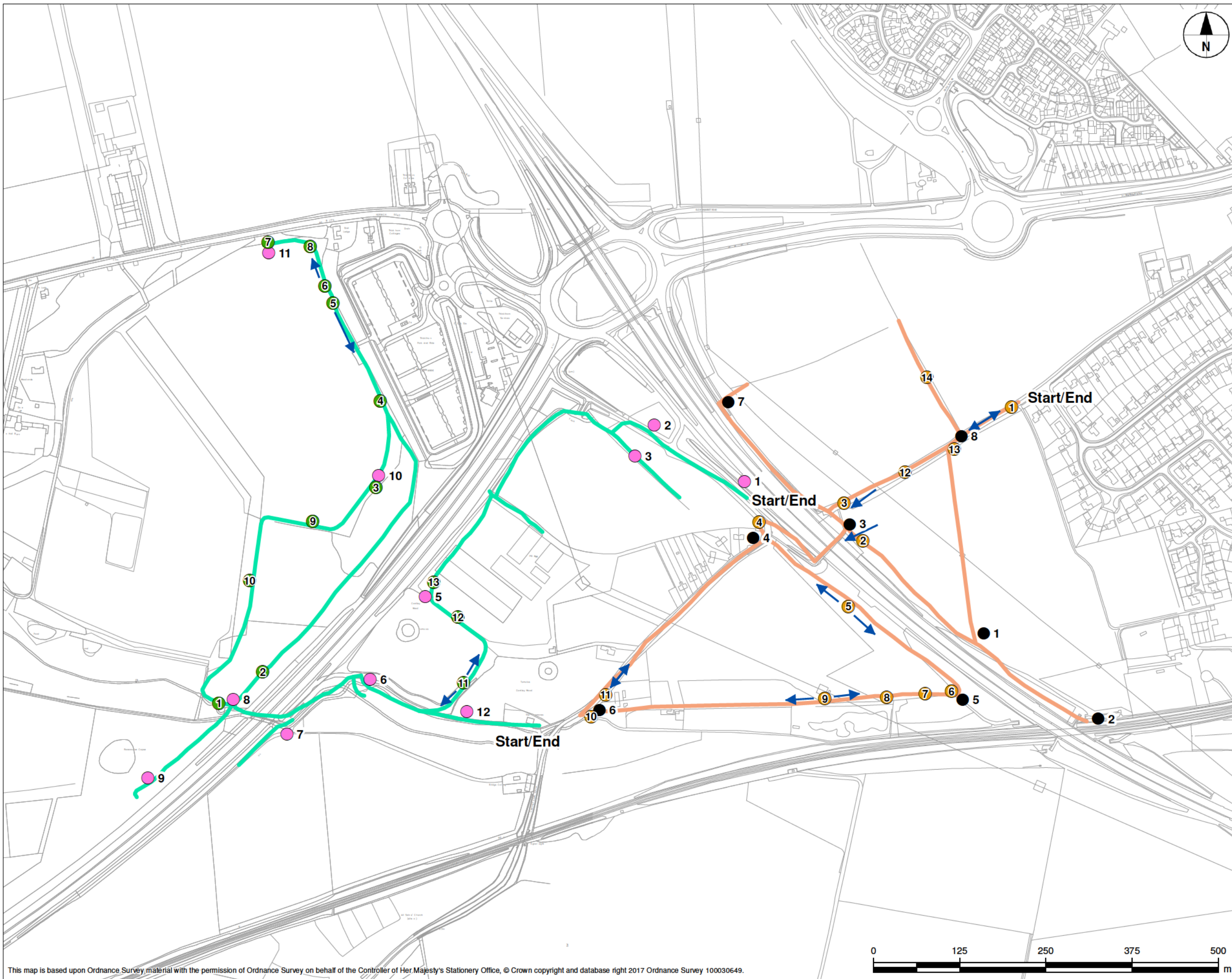
## Figure 5 – July Dusk Transect Results



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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Transect 1 (East)
- Transect 2 (West)
- Bat Pass (East Transect)
- Bat Pass (West Transect)
- Direction of Movement



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 BAT SURVEY RESULTS  
 JULY DUSK TRANSECTS**

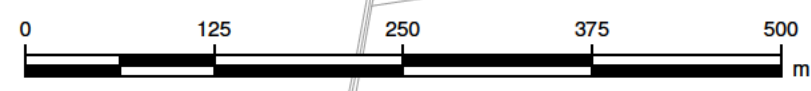
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Scale @ A3 1:5,000	Subsidiary 50	Page PAGE 1 of 1		

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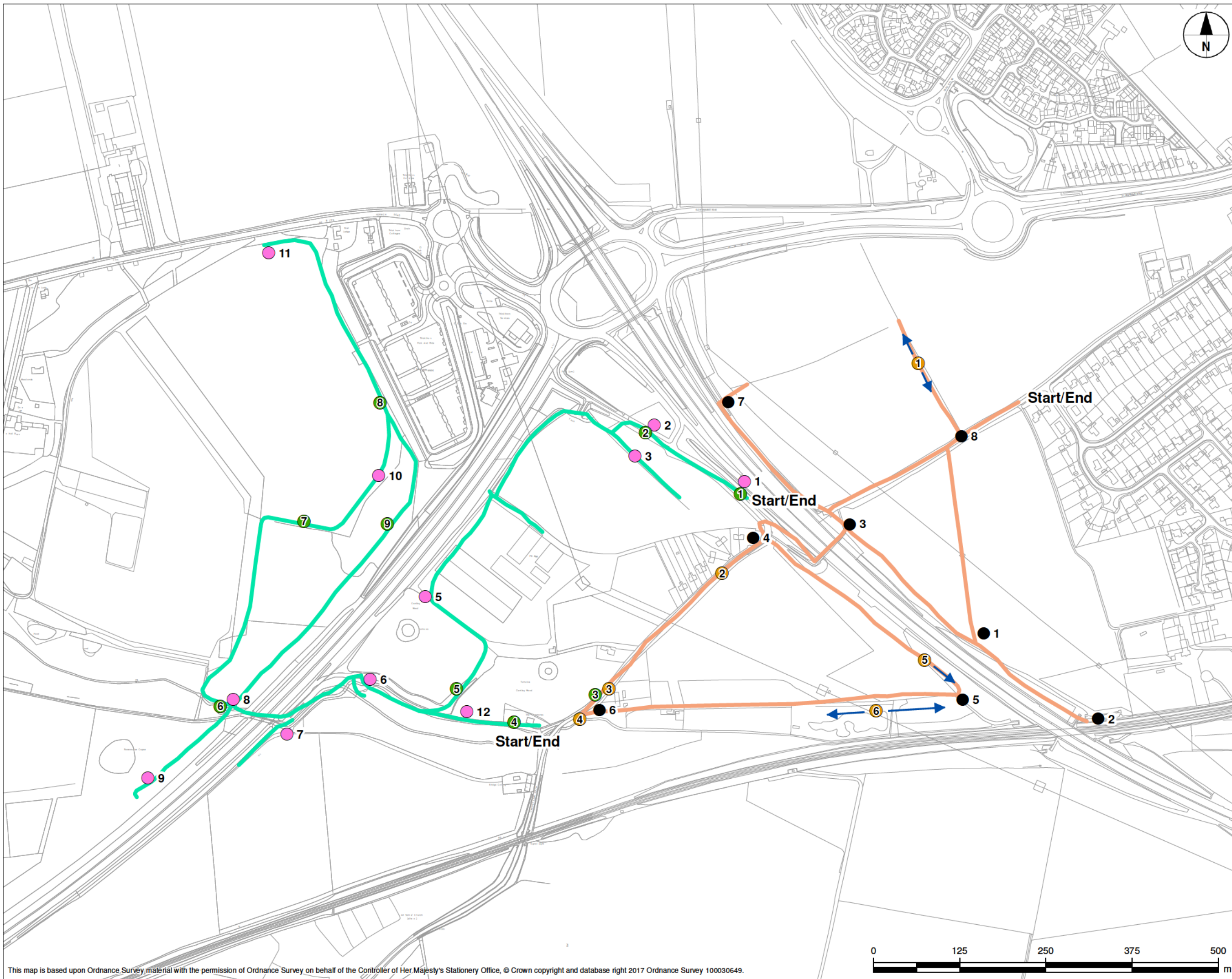
**Figure 6 – July Dawn Transect Results**



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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Transect 1 (East)
- Transect 2 (West)
- Bat Pass (East Transect)
- Bat Pass (West Transect)
- Direction of Movement



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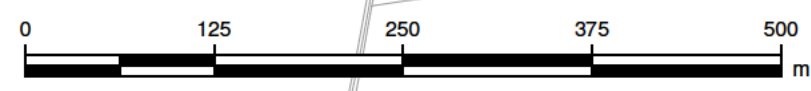
Drawing Title  
**A47/A11 THICKTHORN JUNCTION  
BAT SURVEY RESULTS  
JULY DAWN TRANSECTS**

Designed GB	Drawn GB	Checked MP	Approved FL	Date 28/11/2017
Scale @ A3 1:5,000	Suitability S0	Page PAGE 1 of 1		

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**Figure 7 – August Dusk Transect Results**

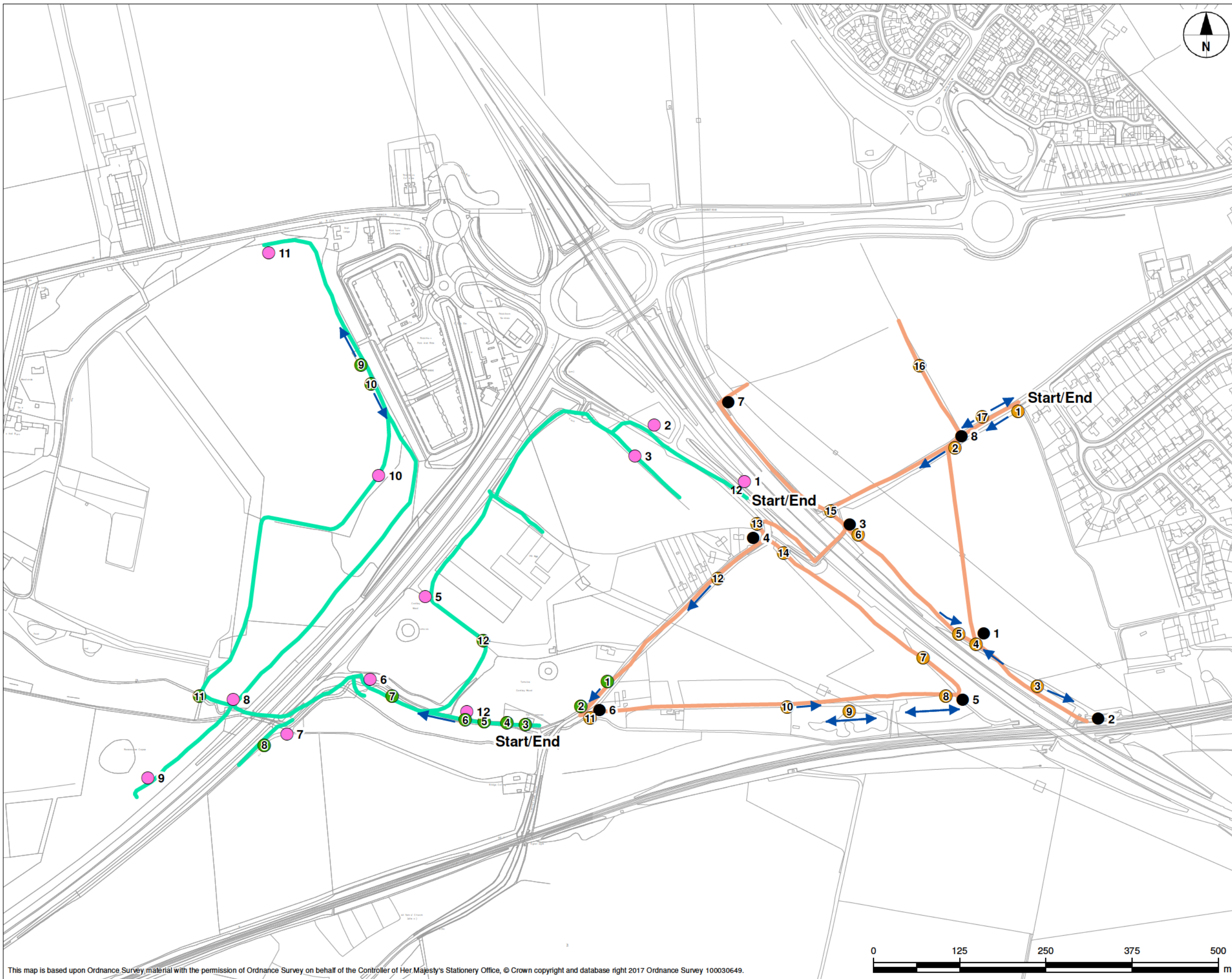




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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Transect 1 (East)
- Transect 2 (West)
- Bat Pass (East Transect)
- Bat Pass (West Transect)
- Direction of Movement



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**A47/A11 THICKTHORN JUNCTION  
 BAT SURVEY RESULTS  
 AUGUST DUSK TRANSECTS**

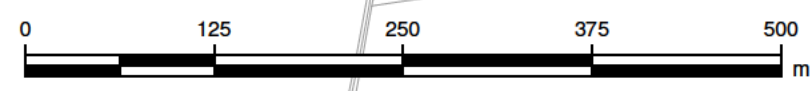
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Scale @ A3 1:5,000	Suitability S0	Page PAGE 1 of 1		

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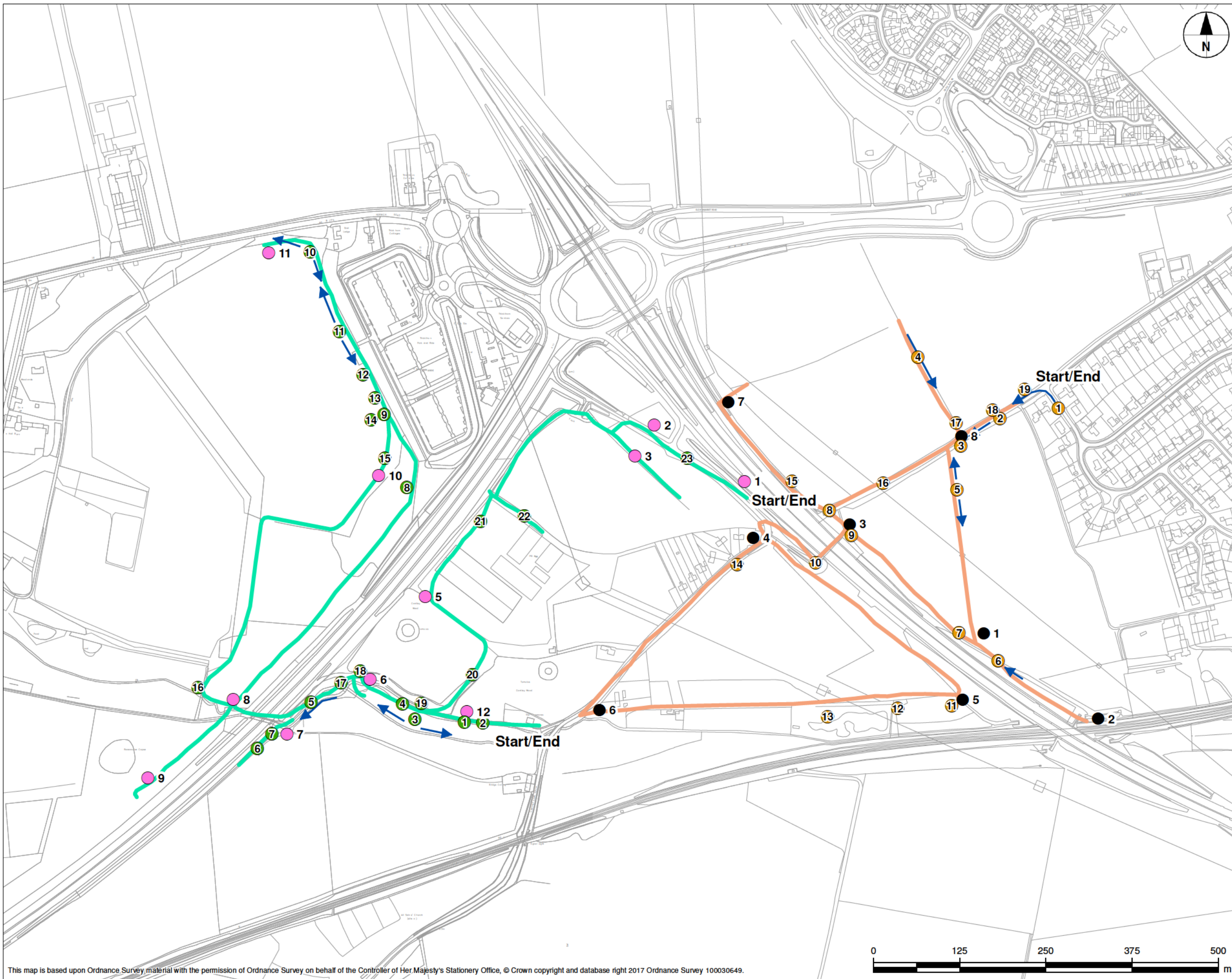
**Figure 8 – September Dusk Transect Results**



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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Transect 1 (East)
- Transect 2 (West)
- Bat Pass (East Transect)
- Bat Pass (West Transect)
- Direction of Movement



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**A47/A11 THICKTHORN JUNCTION  
BAT SURVEY RESULTS  
SEPTEMBER DUSK TRANSECTS**

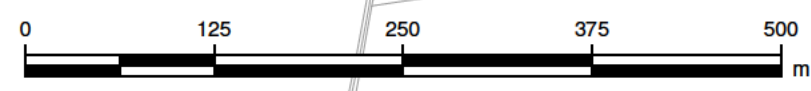
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Scale @ A3 1:5,000	Suitability 50	Page PAGE 1 of 1		

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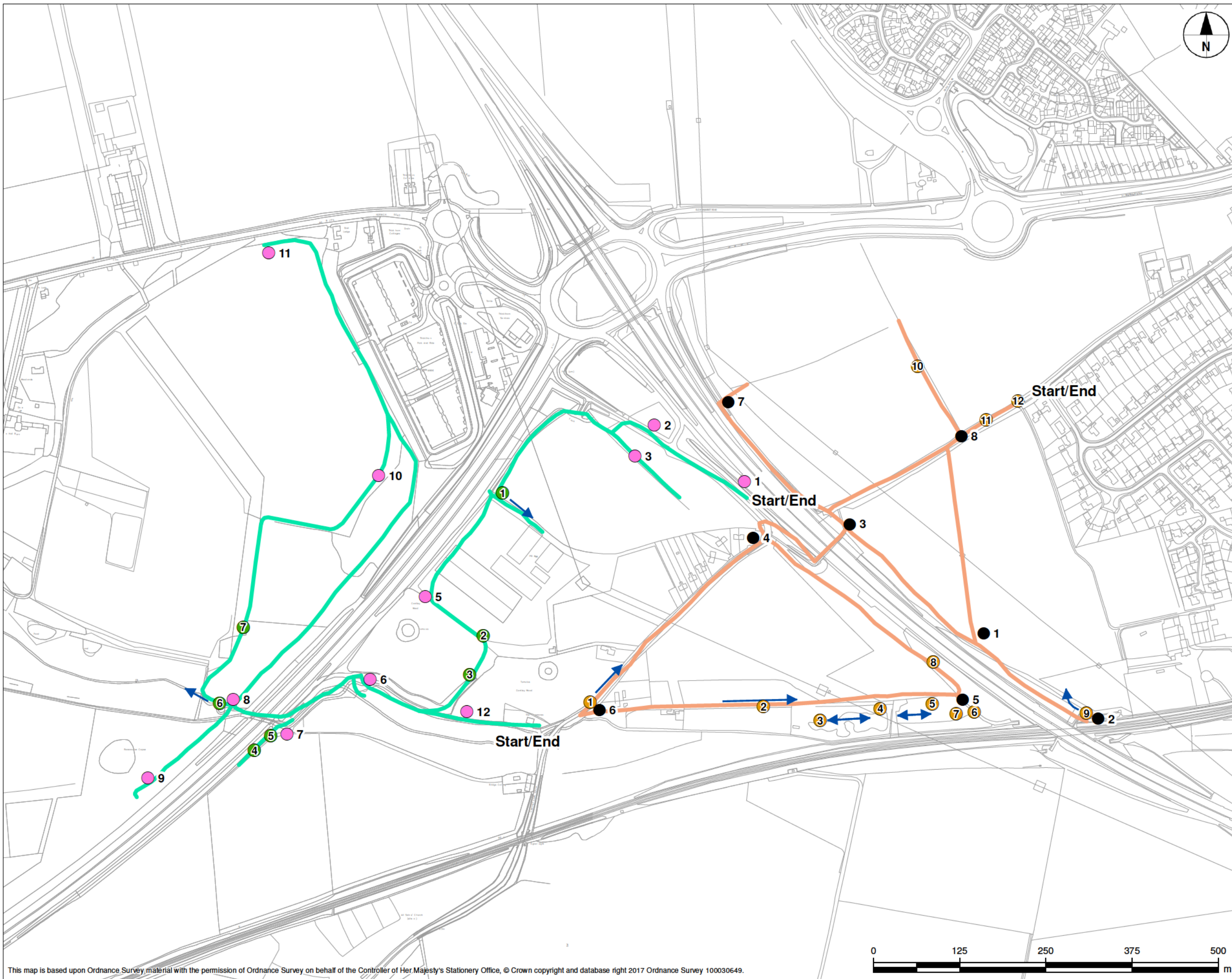
**Figure 9 – October Dusk Transect Results**



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**LEGEND**

- Transect 1 Wait Points
- Transect 2 Wait Points
- Transect 1 (East)
- Transect 2 (West)
- Bat Pass (East Transect)
- Bat Pass (West Transect)
- Direction of Movement



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Drawing Title  
**A47/A11 THICKTHORN JUNCTION  
 BAT SURVEY RESULTS  
 OCTOBER DUSK TRANSECTS**

Designed GB	Drawn GB	Checked MP	Approved FL	Date 28/11/2017
Scale @ A3 1:5,000	Suitability S0	Page PAGE 1 of 1		

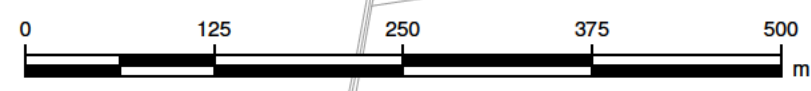
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**Figure 10 – Roost Presence/Absence Survey Results**

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LEGEND

-  Study Area Boundary
-  Confirmed Roost
-  Potential Roost Feature - Moderate/High Risk
-  Potential Roost Feature - Negligible/Low Risk

ADDED EXTRA TARGET NOTES AND CREATED ROOST FEATURE CATEGORIES	GB MP	04/12/17	F02
ADDED TARGET NOTE NUMBERS	GB MP	30/11/17	F01
DRAFT ISSUE FOR COMMENT	GB MP	29/11/17	P01
Revision Details	By Check	Date	Suffix

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PCF STAGE 2**

Drawing Title  
**A47/A11 THICKTHORN JUNCTION  
POTENTIAL ROOST FEATURE &  
BAT ROOST PRESENCE/ABSENCE  
SURVEY LOCATIONS**

Designed GB	Drawn GB	Checked MP	Approved FL	Date 04/12/2017
Scale @ A3 1:5,000	Suitability SO	Page 1 of 1	PAGE 1 of 1	

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Figure Number  
**Figure 10**

Drawing Number HE551492-ACM-EBD-TJ-DR-GI-00006	Rev F02
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## Appendix B Valuing Bat Roosts, Foraging and Commuting Habitats in Ecological Impact Assessment

Tables and valuation method for bat roosts, foraging and commuting habitats are based on Wray *et al* (2010). Species and roost categories relevant to the site are highlighted in grey.

**Table C1. Categorising bats by distribution and rarity**

Rarity within range	England
<b>Rarest</b> (popn. under 10,000)	Greater horseshoe ( <i>Rhinolophus ferrumequinum</i> ) Bechstein's ( <i>Myotis bechsteini</i> ) Alcathoe ( <i>Myotis alcathoe</i> ) Greater mouse-eared ( <i>Myotis myotis</i> ) Barbastelle ( <i>Barbastella barbastellus</i> ) Grey long-eared ( <i>Plecotus austriacus</i> )
<b>Rarer</b> (popn. 10,000 – 100,000)	Lesser horseshoe ( <i>Rhinolophus hipposideros</i> ) Whiskered ( <i>Myotis mystacinus</i> ) Brandt's ( <i>Myotis brandtii</i> ) Daubenton's ( <i>Myotis daubentonii</i> ) Natterer's ( <i>Myotis nattereri</i> ) Leisler's ( <i>Nyctalus leisleri</i> ) Noctule ( <i>Nyctalus noctula</i> ) Nathusius' pipistrelle ( <i>Pipistrellus nathusii</i> ) Serotine ( <i>Eptesicus serotinus</i> )
<b>Common</b> (popn. Over 100,000)	Common pipistrelle ( <i>Pipistrellus pipistrellus</i> ) Soprano pipistrelle ( <i>Pipistrellus pygmaeus</i> ) Brown long-eared ( <i>Plecotus auritus</i> )

**Table C2. Valuing Bat Roosts**

Geographic frame of reference	Roost types
<b>District, Local or Parish</b>	Feeding perches (common species) Individual bats (common species) Small numbers of non-breeding bats (common species) Mating sites (common species)
<b>County</b>	Maternity sites (common species) Small numbers of hibernating bats (common and rarer species) Feeding perches (rarer/rarest species) Individual bats (rarer/rarest species) Small numbers of non-breeding bats (rarer/rarest species)
<b>Regional</b>	Mating sites (rarer/rarest species) including well used swarming sites Maternity sites (rarer species) Hibernation sites (rarest species) Significant hibernation sites for rarer/rarest species or all species assemblages
<b>National/UK</b>	Maternity sites (rarest species) Sites meeting SSSI guidelines
<b>International</b>	SAC sites



**Table C3. Valuing commuting routes**

Species	Number of bats <sup>6</sup>	Roosts/potential roosts nearby	Type and complexity of linear features
Common (2)	Individual bats (5)	None (1)	Absence of (other) linear features (1)
		Small number (3)	Unvegetated fences/walls and large field sizes (2)
Rarer (5)	Small number of bats (10)	Moderate number/Not known (4)	Walls, gappy or flailed hedgerows, isolated well grown hedgerows, and moderate field sizes (3)
		Large number of roosts, or close to a nationally important/protected site for the species (5)	Well-grown and well-connected hedgerows/tree lines, small field sizes (4)
Rarest (20)	Large number of bats (20)	Close to or within an internationally important/protected site for the species(20)	Complex network of mature well-established hedgerows, tree line, small fields and rivers/streams (5)

**Table C4. Valuing foraging areas**

Species	Number of bats	Roosts/potential roosts nearby	Foraging habitat characteristics
Common (2)	Individual bats (5)	None (1)	Industrial or other site without established vegetation (1)
		Small number (3)	Suburban areas or intensive arable land (2)
Rarer (5)	Small number of bats (10)	Moderate number/Not known (4)	Isolated woodland patches, less intensive arable and/or small towns and villages (3)
		Large number of roosts, or close to a nationally important site for the species (5)	Larger or connected woodland blocks, mixed agriculture, and small villages/hamlets (4)
Rarest (20)	Large number of bats (20)	Close to or within a SAC for the species (20)	Mosaic of pasture, woodlands and wetland areas (5)

<sup>6</sup> Individual bats 1 or 2, Small numbers 3 to 10, Large numbers>10 bats

Scores in the four columns of each table above C3 and C4 are added up to provide an overall score to determine the value of commuting routes and foraging areas as per Table C5.

**Table C5. Scoring system for valuing commuting and foraging bats**

<b>Geographic frame of reference</b>	<b>Score</b>
International	>50
National	41 – 50
Regional	31 – 40
County	21 – 30
District/local or parish	11 – 20
Not important	1 - 10

## Appendix C Bat Survey Results

Key to species in tables - PIPI (Common pipistrelle) PIPY (Soprano pipistrelle), NYNO (Noctule), EPSE (serotine) (Eptesicus serotinus), PLAU (Brown long eared), MYDA (Daubenton's), BABA (barbastelle).

**Table C1. April Dusk Transects Survey Results**

TRANSECT EAST			<b>Weather:</b> Wind 1 (Light Air), Rain 0 (None), 80% cloud cover: Start 8 °C to End 7 °C. <b>Sunset:</b> 20:15 <b>Surveyors:</b> MW / RT
Date: 27/4/17			<b>Survey Start:</b> 20:10 <b>Survey End:</b> 22:19
Ref	Time	Species & number of passes (if >1 pass)	<b>Notes:</b> including numbers of bats where multiple bats present
1	20:25	PIPI	Commuting SW along hedge at canopy height
2	20:35	PIPI & PIPY	Foraging
3	20:56	PIPI x 2	Foraging
4	20:59 – 21:02	PIPI x 5	Foraging in tree canopy near lake
5	21:18	MYDA x 2	Foraging
6	22:21	MYDA x 1	Foraging
TRANSECT WEST			
Date: 27/4/17			<b>Weather:</b> As above. <b>Surveyors:</b> MP / KD <b>Survey Start:</b> 20:12 <b>Survey End:</b> 22:15
Ref	Time	Species & number of passes (if >1 pass)	<b>Notes:</b> including numbers of bats where multiple bats present
			Tawny owl flew west across Cantley Lane South
1	20:41	PIPI	Foraging in woods
2	21:21	PIPI x 5	Foraging in woods
3	21:23	PIPI	Faint pass

**Table C2. May Dusk Transect Survey Results**

TRANSECT EAST			<b>Weather:</b> Wind 1 (Light Air), Rain 0 (None), 80% cloud cover: Start 16 °C to End 13 °C. <b>Sunset:</b> 21:01 <b>Surveyors:</b> MP/KD
Date: 25/5/17			<b>Survey Start:</b> 20:50 <b>Survey End:</b> 23:10
Ref	Time	Species & number of passes (if >1 pass)	<b>Notes:</b> including numbers of bats where multiple bats present
1	21:24	PIPI x 6	Foraging
2	21:28	PIPI & PIPY x 6	Foraging up and down road
3	21:32	NYNO	Pass S to N
4	21:33	PIPI x 2	Foraging
5	21:34	PIPI	Foraging
6	21:36	PIPI & PIPY cont.	2 to 3 bats foraging
7	21:38	PIPI x 2	Pass to west
8	21:40	PIPY	Foraging

9	21:41	PIPI & PIPY cont.	2 to 3 bats foraging
10	21:42-45	PIPI & PIPY & NYNO cont.	At least 3 bats foraging
11	21:46	PIPI & PIPY cont.	2 to 3 bats foraging
12	21:48	PIPI cont.	Foraging
13	21:50	PIPY & NYNO x 3	Passes over lake
14	21:54	PIPI & PIPY & NYNO cont.	At least 3 PIPY and noctule over lake
15	21:58	PIPI & PIPY cont.	>3 bats foraging over lake
16	22:05	MYDA & PIPY cont.	>5 bats foraging over lake
17	22:13	MYDA & PIPY cont.	At least 10 bats at the peak of activity
18	22:22	PIPY	Passing edge of plantation
19	22:31	PIPI	Passing W to E
20	22:32	PIPY	Passing
21	22:33	NYNO x 3	Foraging
22	22:43	PIPY	Faint pass
23	22:58	PIPY	Passing
<b>TRANSECT WEST</b>			<b>Weather:</b> Wind 1 (Light Air), Rain 0 (None), 40% cloud cover: Start 18 °C to End 16 °C. <b>Sunset:</b> 21:00 <b>Surveyors:</b> MP/KD
<b>Date: 24/5/17</b>			<b>Survey Start: 20:45 Survey End: 23:10</b>
Ref	Time	Species & number of passes (if >1 pass)	Notes: including numbers of bats where multiple bats present
1	21:16	PIPY x 2	Foraging, probably emerged from nearby woodland
2	21:18	PIPY	Pass in plantation
3	21:33	PIPY	Pass N to S
4	21:35	PIPI cont.	2 bats foraging
5	21:36	PIPI x 2	Foraging edge of woods
6	21:38	NYNO	Pass/foraging over woods S to N
7	21:42	PIPI x 2	Foraging edge of woods
8	21:44	NYNO	Foraging over edge of woods
9	21:46	PIPY x 2	Foraging
10	21:47	PIPY	Foraging edge of woods
11	21:49	PIPI	Foraging edge of woods
12	21:52	PIPI & PIPY cont.	2 bats foraging on corner near house
13	21:54	PIPI & PIPY cont.	Foraging edge of woods
14	21:56	PIPI x 3	Passing
15	21:58	NYNO	Foraging
16	22:04	PIPI x 3	Foraging
17	22:09	PIPI	Passing
18	22:10	PIPI	Passing
19	22:11	PIPI	Passing
20	22:13	PIPI x 2	Foraging along track near underpass
21	22:16	PIPI cont.	2 to 3 bats foraging along stream and track and passing through underpass
22	22:19	PIPI cont.	2 to 3 bats foraging along stream and track and passing through underpass

23	22:20	PIPI cont.	2 to 3 bats foraging along stream and track and passing through underpass
24	22:22	PIPI x 2	Foraging along path
25	22:24	PIPI x 2	Foraging along path
26	22:25	PIPI	2 to 3 bats foraging along path
27	22:30	PIPI x 2	Foraging along road
28	22:31	PIPI x 2	Passing along road
29	22:39	PIPI cont.	2 to 3 bats foraging up to corner by pedestrian bridge, did not cross over
30	22:44	PIPI x 2	Pass along hedge
31	22:52	PIPI	Pass along hedge
32	22:59	PIPI	Pass edge of woods
33	23:04	PIPI	Foraging along track

**Table C3. June Dusk Transect Survey Results**

TRANSECT EAST			<b>Weather:</b> Wind 3 (Light Air), Rain 0 (None), 60% cloud cover: Start 19 °C to End 17 °C. <b>Sunset:</b> 21:20 <b>Surveyors:</b> MP/KD
Date:			<b>Survey Start:</b> 21:15 <b>Survey End:</b> 23:20
Ref	Time	Species & number of passes (if >1 pass)	<b>Notes:</b> including numbers of bats where multiple bats present
1	21:46	NYNO	Pass S to N
2	22:15	PIPI x 3	Pass along edge of woods
3	22:17	PIPI x 2	Foraging
4	22:21	NYNO, PIPY, PIPI, MYDA cont.	Multiple bats foraging at lake
5	22:24	PIPY x 2	
6	22:30	PIPI cont.	Foraging behind houses
7	22:35	PIPI	Faint pass
8	22:36	NYNO & PIPY	Pass along Cantley Road (unlit at night)
9	22:39	PIPI	Passing
10	22:40	PIPI	Passing
11	22:42	PIPI	Passing
12	22:42	PIPI x 3	Passing
13	22:47	EPSE	Pass near bridge
14	22:55	PIPI	Pass along Cantley Road
15	23:07	PIPI	Pass near houses
TRANSECT WEST			<b>Weather:</b> Wind 3 (Gentle Breeze), Rain 0 (None), 80 to 100% cloud cover: Start 20 °C to End 19 °C. <b>Sunset:</b> 21:23 <b>Surveyors:</b> MP / KD
Date:			<b>Survey Start:</b> 21:20 <b>Survey End:</b> 23:25
Ref	Time	Species & number of passes (if >1 pass)	<b>Notes:</b> including numbers of bats where multiple bats present
1	21:47	PIPI	Passing
2	21:50	PIPY	Pass along track to west

3	21:54	PIPY	Pass N to S
4	21:55-57	PIPY & PIPI x 5	3 bats passing through underpass
5	22:03	MYSP	Foraging
6	22:05	PIPI cont.	Foraging
7	22:07	PIPY & PIPI cont.	2 bats foraging
8	22:16	MYDA cont.	Foraging edge of woods, bat seen
9	22:19	PIPY & PIPI cont.	Foraging edge of woods
10	22:32	PIPI	Passing
11	22:34	PIPI x 3	Foraging edge of woods
12	22:36	MYDA & NYNO x 5	Noctule pass S to N. Daubenton's foraging.
13	22:49	PIPI x 2	Foraging
14	22:04	NYNO	Pass overhead

**Table C4. July Dusk Transect Survey Results**

<b>TRANSECT EAST</b>			<b>Weather:</b> Wind 0 (calm) to 2 (Light Breeze), Rain 0 (None), 60 to 80% cloud cover: Start 20.5 °C to End 17.5 °C. <b>Sunset:</b> 20:59 <b>Surveyors:</b> SC / MF
<b>Date: 26/7/17</b>			<b>Survey Start:</b> 20:56 <b>Survey End:</b> 23:06
	<b>Time</b>	<b>Species / number of passes</b>	<b>Notes:</b> including numbers of bats where multiple bats present
1	21:27	PIPI / 3 passes	Commuting bat heading SW along hedge/tree line
2	21:32	PIPI / 2 passes	Feeding buzzes by hedge/tree line on Cantley Lane south
3	21:39	PIPI / continuous passes	3+ bats foraging by hedge/tree line in Meadow Farm field
4	21:53	PIPI / 5 passes	Continuous foraging in scrub and field edge
5	22:00	PIPY / 1 pass	Passing
6	22:02	PIPY / 1 pass	Passing
7	22:05	PIPI / 2 passes	Passing
8	22:07	PIPY / continuous passes	Foraging along hedge/tree line
9	22:10	MYDA / 1 pass	Pass near pond
10	22:27	PIPI / 1 pass	Foraging at entrance to 3 Meadow Farm Cottage
11	22:31	PIPI / 2 passes	Foraging
12	22:50	PIPI / 1 pass	Passing
13	22:52	PIPI	Passing
14	22:57	PIPI / Continuous passes	Foraging along tree line on lane
<b>TRANSECT WEST</b>			<b>Weather:</b> As above <b>Surveyors:</b> MP / HP
<b>Date: 26/7/17</b>			<b>Survey Start:</b> 20:45 <b>Survey End:</b> 23:04
<b>Ref</b>	<b>Time</b>	<b>Species &amp; number of passes (if &gt;1 pass)</b>	<b>Notes:</b> including numbers of bats where multiple bats present
1	21:10	PIPY x 2	Foraging in woods
2	21:19	PIPY x 2	Foraging
3	21:28	PIPI x 2	Foraging
4	21:32	PIPI x 3	Foraging edge of woods
5	21:37	PIPI x 2	Foraging edge of woods
6	21:38	PIPY x 4	Foraging edge of woods

7	21:43 - 50	PIPI & PIPY cont.	Foraging
8	21:58	PIPI x 2	Foraging
9	22:03	PIPI	Passing
10	22:06	PIPI x 4	Foraging
11	22:22	PIPI & PIPY cont.	3 bats foraging in woods
12	22:26	PIPI cont. & PLAU x 2	Foraging plus occasional brown long eared pass
13	22:39	PIPI cont.	Foraging by woods

**Table C5. July Dawn Transect Survey Results**

<b>TRANSECT EAST</b>			<b>Weather:</b> Wind 0 (Calm), Rain 0 (None), 70% to 25% cloud cover: Start 14 °C to End 13 °C. <b>Sunrise:</b> 05:06 <b>Surveyors:</b> SC / MF
<b>Date: 27/7/17</b>			<b>Survey Start:</b> 03:09 <b>Survey End:</b> 05:13.
<b>Ref</b>	<b>Time</b>	<b>Figure ref./ species / number of passes</b>	<b>Notes:</b> including numbers of bats where multiple bats present
1	03:24	PIPI / 3 passes	2 bats feeding buzzes along hedge/tree line near mature oak tree
2	03:55 and 04:00	PIPI / 2 passes	Passing along road hedge
3	04:06	PIP Y / continuous passes	Foraging along road hedge
4	04:09	MYDA / 3 passes	Passes at stream beside road
5	04:30	PIPI / 1 pass	Foraging at scrub
6	04:36	MYDA / continuous passes	4-5 bats foraging at pond
<b>TRANSECT WEST</b>			<b>Weather:</b> As above <b>Surveyors:</b> MP / HP
<b>Date: 27/7/17</b>			<b>Survey Start:</b> 03:05 <b>Survey End:</b> 05:15
<b>Ref</b>	<b>Time</b>	<b>Species &amp; number of passes (if &gt;1 pass)</b>	<b>Notes:</b> including numbers of bats where multiple bats present
1	03:12	PIPI	Passing
2	03:16	PIP Y	Passing
3	03:26	PIPI	Passing
4	03:31	PIPI	Passing
5	03:35	PIPI	Passing in woods
6	04:04	PIPI	Passing
7	04:14	PIPI	Passing
8	04:18	PIPI	Passing
9	04:41	PIP Y	Suspected to be returning to nearby tree roost close to [REDACTED] (confirmed the following morning during roost survey)

**Table C6. August Dusk Transect Survey Results**

<b>TRANSECT EAST</b>			<b>Weather:</b> Wind 1 (Light Air), Rain 0 (None), 80% cloud cover: Start 18 °C to End 16 °C. <b>Sunset: 20:33</b> <b>Surveyors:</b> MP
<b>Date: 10/8/17</b>			<b>Survey Start: 20:33 Survey End: 22:40</b>
<b>Ref</b>	<b>Time</b>	<b>Species &amp; number of passes (if &gt;1 pass)</b>	<b>Notes:</b> including numbers of bats where multiple bats present
1	20:48-55	PIPI x 8 and PIPY x 2	Likely to have emerged from houses in residential area and flew towards Cantley Lane
2	20:56	PIPI & PIPY	Passing N to S as above
3	21:08	PIPI	Pass near horse paddock
4	21:10	PIPY	Passing E to W
5	21:12-13	PIPY x 3	Foraging
6	21:17	PIPY cont.	Foraging E to W
7	21:25	PIPY	Foraging near orange street light
8	21:32	PIPI & PIPY cont. passes	At least 5 bats foraging 5 to 10m above lake
9	21:38	PIPI & PIPY occasional passes	1 to 2 bats foraging
10	21:40	PIPI x 2	Pass towards lake W to E
11	21:45-46	BABA, PIPY & PIPI x 4	Faint passes near house
12	21:49	PIPI x 2	Pass N to S near house
13	21:54	PIPI x 4	Passing
14	22:00	PIPI x 2	Passing in woods
15	22:10	PIPI & PIPY cont.	Foraging and social calls
16	22:18	PIPI x 3	Foraging
17	22:29	PIPI x 2	Foraging along Cantley Lane
<b>TRANSECT WEST</b>			<b>Weather:</b> Wind 2 (Light Breeze), Rain 0 (None), 100% cloud cover: Start 14 °C to End 14 °C. <b>Sunset: 20:33</b> <b>Surveyors:</b> MP/RT
<b>Date: 9/8/17</b>			<b>Survey Start: 20:33 Survey End: 22:33</b>
<b>Ref</b>	<b>Time</b>	<b>Species &amp; number of passes (if &gt;1 pass)</b>	<b>Notes:</b> including numbers of bats where multiple bats present
1	20:49	PIPY	Foraging
2	20:54	PIPY	Foraging
3	20:56	PIPY & PIPI x 3	Foraging near house and social call
4	20:56	PIPY	Foraging near house and social call
5	20:57	PIPY & PIPI x 3	Foraging along track
6	21:00	PIPI	Passing E to W
7	21:05	PIPY x 2	
8	21:36	NYNO	Passing
9	21:37	PIPY x 2	Foraging
10	22:01	PIPI cont. passes	Foraging
11	22:18	PIPI	Passing in wood
12	22:21	PIPI	



**Table C7. September Dusk Transect Survey Results**

<b>TRANSECT EAST</b>			<b>Weather:</b> Wind 0 (None), Rain 0 (None), 0% cloud cover: Start 12°C to End 110 °C. <b>Sunset:</b> 19:02 <b>Surveyors:</b> MP / RT
<b>Date: 19/9/17</b>			<b>Survey Start:</b> 19:00 <b>Survey End:</b> 21:15
<b>Ref</b>	<b>Time</b>	<b>Species &amp; number of passes (if &gt;1 pass)</b>	<b>Notes:</b> including numbers of bats where multiple bats present
1	19:10	PIPI x 2	Passing from houses to the north/east of the site
2	19:12	PIPI x 3	Passing E to W along Cantley Lane
3	19:16	PIPI x cont.	2 bats foraging
4	19:19	PIPI	Pass S to N along hedge
5	19:25	PIPI & PIPY cont.	2 bats foraging along hedge
6	19:29	PIPY	Pass W to E along tree edge
7	19:39	PIPY x 2	Passing by junction of hedges
8	19:47	PIPI	2 bats social calling
9	19:49	PIPI	Foraging near footbridge, didn't cross over road
10	19:53	PIPI	Passing through tree canopy by path
11	20:00 – 05	PIPI & PIPY cont.	3 to 4 bats foraging over lake
12	20:12	PIPI cont.	Foraging over lake
13	20:15	PIPY x 2	Briefly foraging near lake
14	20:27	PIPI	Passing
15	20:34	PIPY	Pass edge of road
16	20:41	PIPI x 2	Foraging along Cantley Lane
17	20:49	PIPI & PIPY x 3	Foraging
18	20:55	NYNO & PIPY x 2	Foraging
19	21:01	PIPI	Foraging near houses
<b>TRANSECT WEST</b>			<b>Weather:</b> Wind 3 (Gentle Breeze), Rain 0 (None), 100% cloud cover: Start 16 °C to End 14 °C. <b>Sunset:</b> 19:00 <b>Surveyors:</b> MP/RT
<b>Date: 20/9/17</b>			<b>Survey Start:</b> 18:50 <b>Survey End:</b> 21:10
<b>Ref</b>	<b>Time</b>	<b>Species &amp; number of passes (if &gt;1 pass)</b>	<b>Notes:</b> including numbers of bats where multiple bats present
1	19:05	PIPI	Foraging around house then went East
2	19:10	PIPI	Passing through woods
3	19:16	PIPI	Foraging W to E along stream
4	19:19	PIPI	Foraging
5	19:26	PIPY	Pass along river E to W
6	19:28	PIPI & PIPY	Foraging along field edge
7	19:32	PIPI	Foraging along field edge
8	19:49	PIPI	Foraging along woodland edge
9	19:52	PIPI	2 bats foraging along woodland edge
10	20:04	PIPI	Foraging
11	20:08	PIPY	Foraging
12	20:14	PLAU	Faint pass in woods

13	20:16	PLAU	Briefly foraging
14	20:19	PIPI & PIPY cont.	Foraging
15	20:21	PIPI	Faint pass
16	20:27	PIPI & PIPY x 3	Foraging
17	20:33	PIPI x 2	Pass along track
18	20:35	PIPI cont.	Foraging
19	20:38	PIPY	Foraging
20	20:41	PIPY x 4	Foraging and social calls
21	20:46	PIPI	Passing
22	20:50	PIPI x 2	Foraging
23	21:02	PIPI	Passing

**Table C8. October Dusk Transect Survey Results**

TRANSECT EAST			Weather: Wind 3 (Gentle breeze), Rain 0 (None), 80% cloud cover: Start 15 °C to End 14 °C. <b>Sunset:</b> 18:33 <b>Surveyors:</b> MP / RT
Date: 2/10/17			Survey Start: 18:25 Survey End: 20:35
Ref	Time	Species & number of passes (if >1 pass)	Notes: including numbers of bats where multiple bats present
1	18:49	PIPI	Pass S to N along Cantley Lane South
2	18:55	PIPI	Pass E to W along track
3	18:57	PIPY	Pass over lake
4	19:00	PIPY x 4	Occasional foraging over lake
5	19:04	PIPI & PIPY	Two bats foraging briefly
6	19:07	PIPI	Pass corner of lake/wood
7	19:07	PIPY	Passing
8	19:13	PIPY	Foraging
9	19:43	PIPY	Pass over horse field north of A47
10	20:08	PIPI x 2	Pass along hedge
11	20:21	PIPI	Pass along Cantley Lane
12	20:30	PIPI	Pass near to houses
TRANSECT WEST			Weather: Wind 4 (Moderate breeze) to 3 (Gentle breeze), Rain 0 (None), 100% cloud cover: Start 13.5 °C to End 12 °C. <b>Sunset:</b> 18:32 <b>Surveyors:</b> MP
Date: 3/10/17			Survey Start: 18:32 Survey End: 21:03
Ref	Time	Species & number of passes (if >1 pass)	Notes: including numbers of bats where multiple bats present
1	19:33	PLAU	Foraging edge of woods
2	19:46	PIPI x 2	Foraging in woods
3	19:48	PIPY x 2	Foraging in woods and social call
4	19:57	PIPY	Pass edge of A11 by woods
5	19:59	MYDA	Edge of woods, social call
6	20:03	PIPY	Pass W of A11 underpass
7	20:10	PIPI	Foraging briefly

**Table C9. Roost Presence Absence Surveys**

Date 2017	Sunset (Ss) Sunrise (Sr) & Survey Start/End Times	Weather
26-Jul	Ss 20:58 start 20:38 end 22:30	14°C, wind 2, cloud 20%
27-Jul	Ss 20:55 start: 20:45 end 22:30	18°C, wind 2, cloud 80%
27-Jul	Sr 05:08 start: 03:40 end 05:28	16°C, wind 2, cloud 40%
28-Jul	Sr 03:35. start 03:35 end: 05:08	16°C, wind 5, cloud 40%
09-Aug	Ss 20:30 start 20:15 end 22:00	16 to 14°C, wind 4, cloud 100%
10-Aug	Sr 05:28, start: 03:42 end: 05:28	14°C, wind 1, 50% cloud
10-Aug	Ss 20:30 start 20:15 end 22:05	14°C, wind 2, cloud 80%
11-Aug	Sr 05:30 start: 03:49 end: 05:30	8°C no wind 20% cloud
16-Aug	Ss 20:18 start 20:00 end 21:50	16°C, wind 1, cloud 40%
17-Aug	Ss 20:15 start 20:00 end 21:45	17°C, wind 2, cloud 80%
18-Aug	Sr 05:42 start: 04:00 end: 06:00	15°C, wind 2, cloud 40%
31-Aug	ss 19:44 start 19:30 end 21:15	16 to 14°C, wind 2 to 1, cloud 100 to 40%

Date 2017	Sunset (Ss) Sunrise (Sr) & Survey Start/ End Times	Weather	
07-Sep	sr 06:15 start 04:35 end 06:30	12°C, wind 1, cloud 80%	
20-Sep	Ss 19:00 Start 18:40 end 20:30	16°C, wind 2, cloud 100%	

**Static Detector Results**

**Table C10 – Static Detector Results**

		<b>Bat Activity Index (BAI) = Number of passes per hour per species (one pass = a 2-second recording (with multiple pulses))</b>													
<b>Night temp. range °C</b>	<b>Date/Location</b>	<b>PIPI</b>	<b>PIPY</b>	<b>NYSP</b>	<b>NYNO</b>	<b>NYEP</b>	<b>MYSP</b>	<b>PLAU</b>	<b>BABA</b>	<b>PIPI/PIPY</b>	<b>EPSE</b>	<b>Total</b>	<b>Nights</b>	<b>hrs/nt<sup>1</sup></b>	<b>BAI per hr</b>
8 to 13	April Location 1	10.0	22.0			1.0					3.0	36.0	5.0	9.00	0.80
8 to 13	April Location 2	24.0	11.0		1.0	2.0			4.0			42.0	5.0	9.00	0.93
8 to 13	April Location 3	9.0	3.0	1.0			33.0					46.0	5.0	9.00	1.02
8 to 13	April Location 4	1.0					1.0					2.0	5.0	9.00	0.04
10 to 20	May Location 1	16.0	4.0		1.0	1.0					1.0	23.0	5.0	8.00	0.58
10 to 20	May Location 2	167.0	7.0		1.0	2.0			1.0		2	180.0	5.0	8.00	4.50
10 to 20	May Location 3						71.0					71.0	5.0	8.00	1.78
10 to 20	May Location 4	1.0			2.0		1.0					4.0	5.0	8.00	0.10
14 to 24	June Location 1	359.0	27.0	3	10.0		17.0	9.0	3.0		4	432.0	6.0	7.25	9.93
14 to 24	June Location 2	178.0	38.0	3	2.0	2.0	1.0		2.0			226.0	6.0	7.25	5.20
14 to 24	June Location 3	42.0	4.0	3.0	8.0	1.0	1.0					59.0	6.0	7.25	1.36
14 to 24	June Location 4	38.0	26.0	2.0	12.0			1.0				79.0	6.0	7.25	1.82
13 to 21	July Location 1	50.0	19.0	9.0	8.0		2.0				2	90.0	5.0	8.25	2.18
13 to 21	July Location 2	358.0	13.0	6.0	7.0	3.0	2.0	1.0			3	393.0	5.0	8.25	9.53
13 to 21	July Location 3				5.0		8.0					13.0	5.0	8.25	0.32
13 to 21	July Location 4	26.0		7.0	16.0	1.0						50.0	5.0	8.25	1.21
15 to 20	August Location 1	57.0	15.0	9.0	6.0	11.0	1.0				4	103.0	5.0	8.75	2.35
15 to 20	August Location 2	262.0	14.0	3.0	5.0	4.0	1.0	1.0	3.0		8	301.0	5.0	8.75	6.88
15 to 20	August Location 3			2.0	9.0	1.0	1.0					13.0	5.0	8.75	0.30
15 to 20	August Location 4	21.0		6.0	18.0	1.0						46.0	5.0	8.75	1.05
10 to 20	September Location 1	14.0	1.0		2.0	1.0	1.0					19.0	5.0	10.50	0.36
10 to 20	September Location 2	24.0	24.0			4.0	1.0	1.0		1.0		55.0	5.0	10.50	1.05

		Bat Activity Index (BAI) = Number of passes per hour per species (one pass = a 2-second recording (with multiple pulses))													
Night temp. range °C	Date/Location	PIPI	PIPY	NYSP	NYNO	NYEP	MYSP	PLAU	BABA	PIPI/PIPY	EPSE	Total	Nights	hrs/nt <sup>1</sup>	BAI per hr
10 to 20	September Location 3				3.0							3.0	5.0	10.50	0.06
10 to 20	September Location 4	47.0		2.0			1.0					50.0	5.0	10.50	0.95
9 to 18	October Location 1	15.0	6.0	2.0	2.0	4.0	5.0	7.0	1.0	2.0	6	50.0	5.0	12.50	0.80
9 to 18	October Location 2	23.0	4.0	2.0	2.0	8.0	1.0	5.0				45.0	5.0	12.50	0.72
9 to 18	October Location 3			1.0	1.0		3.0					5.0	5.0	12.50	0.08
9 to 18	October Location 4				1.0		1.0					2.0	5.0	12.50	0.03

**Notes**

- Note varying numbers of hours per night (sunset to sunrise) at different times of the year, rounded to nearest 0.25hrs.
- Key to species in table - PIPI (Common pipistrelle (*Pipistrellus pipistrellus*)) PIPY (Soprano pipistrelle (*Pipistrellus pygmaeus*)), NYSP (Noctule (*Nyctalus noctula*) or Leisler's (*Nyctalus leisleri*), NYNO (Noctule), NYEP ('big bat', i.e. noctule, leisler's or serotine (*Eptesicus serotinus*), MYSP (*Myotis* species), PLAU (Brown long eared (*Plecotus auritus*), BABA (barbastelle (*Barbastella barbastellus*)) EPSE (Serotine).

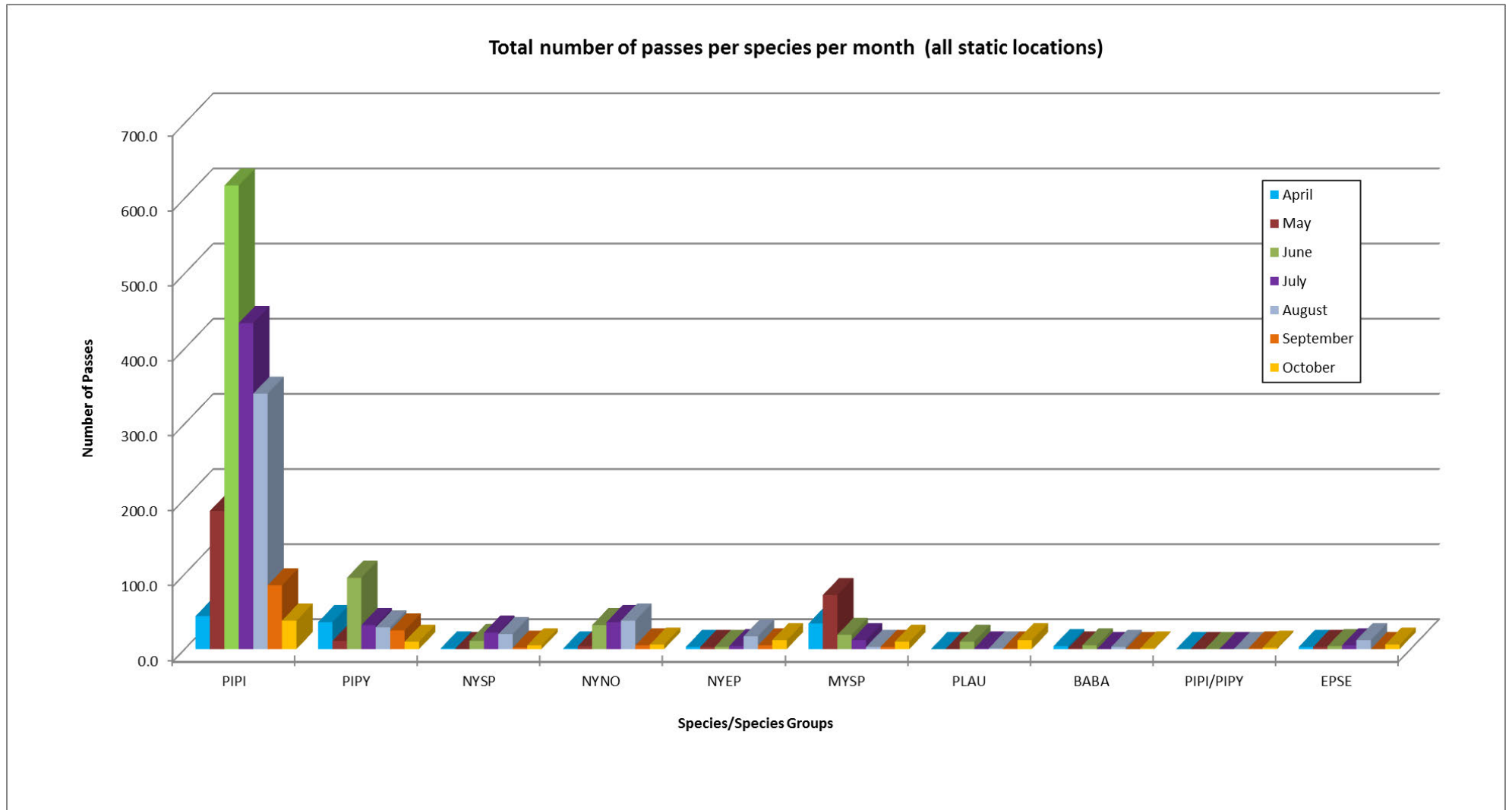


Chart C1 – Total number of passes per species per month (all four static locations combined)





## Appendix D Artificial Lighting Guidance

### Recommendations to Help Minimise the Impact of Artificial Lighting on Bats (Source BCT, 2014)

#### Do not

- provide excessive lighting. Use only the minimum amount of light needed for the task.
- directly illuminate bat roosts or important areas for nesting birds

#### Avoid

- installing lighting in ecologically sensitive areas such as: near ponds, lakes, rivers, areas of high conservation value; sites supporting particularly light-sensitive species of conservation significance (e.g. glow worms, rare moths, slow-flying bats) and habitat used by protected species.
- using reflective surfaces under lights.

#### Do

- consider employing a competent lighting designer who will apply the principals of providing the right light, in the right place, at the right time and controlled by the right system.
- minimise the spread of light to at, or near horizontal and ensure that only the task area is lit. Flat cut-off lanterns or accessories should be used to shield or direct light to where it is required.
- consider the height of lighting columns. It should be noted that a lower mounting height is not always better. A lower mounting height can create more light spill or require more columns. Column height should be carefully considered to balance task and mitigation measures.
- consider no lighting solutions where possible such as white lining, good signage and LED cats eyes. These options can also be effective. For example, light only high-risk stretches of roads, such as crossings and junctions, allowing headlights to provide any necessary illumination at other times.
- use temporary close-boarded fencing until vegetation matures, to shield sensitive areas from lighting.
- limit the times that lights are on to provide some dark periods. The task being lit often varies, for example roads are less used after 23.00hrs and car parks are empty. A lighting designer can vary the lighting levels as the use of the area changes reducing lighting levels or perhaps even switching installations off after certain times. This use of adaptive lighting can tailor the installation to suit human health and safety as well as wildlife needs.

#### Technological specifications

Research from the Netherlands has shown that spectral composition of lighting determines the potential impact on biodiversity. To reduce potential impacts:

- Use narrow spectrum light sources to lower the range of species affected by lighting.
- Use light sources that emit minimal ultra-violet light
- Lights should peak higher than 550nm
- Avoid white and blue wavelengths of the light spectrum to reduce insect attraction and where white light sources are required in order to manage the blue short wave length content they should be of a warm / neutral colour temperature <4,200 kelvin.

Note that recently research from Exeter University suggests that some white LED lighting is actually blue with a white phosphor coating and should be avoided.

