

Appendix 13-5 Bat Survey Report

East Reading Mass Rapid Transit Scheme

Bat Survey Report

On behalf of **Reading Borough Council Highways and Transport Department**



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1 Executive Summary

- 1.1.1 This Bat Survey Report has been prepared in respect of a planning application for a new mass rapid transit (MRT) scheme to the east of Reading, Berkshire (referred to as the 'proposed development'). An indicative area of works (referred to as the 'East MRT Site') is included on Figure 1.
- 1.1.2 A Preliminary Ecological Assessment (PEA) was completed by PBA in April 2016 including an ecological desk study and Phase 1 habitat survey of the East MRT Site. The desk study identified the presence of at least six species of bat within a 2 km radius of the East MRT Site with the field survey identifying the railway bridge and a number of mature trees within the East MRT Site as having the potential to provide roosting opportunities to bats. In addition, the woodland, tree-lines and adjacent watercourses (River Thames and River Kennet) were also considered to provide suitable foraging and commuting habitats for bats.
- 1.1.3 As a result of these initial findings PBA were commissioned to undertake a ground-level assessment of trees, a dusk emergence survey of the bridge as well as dusk emergence and dawn return to roost surveys of trees identified as having a high level of roosting potential in order to determine the presence/likely absence of roosting bats. Activity transect surveys supplemented by the use of automated static bat detectors were used to determine the extent that the East MRT Site and its immediate surrounds are used by foraging and commuting bats.
- 1.1.4 No bats were found to be roosting in the railway bridge during the dusk emergence survey conducted in June 2016. Ten trees were found to support features capable of providing roosting opportunities to bats. Of these trees, three were subjected to more detailed ground-level inspection using a fibre-optic scope with one tree group (containing three trees) and two individual trees (all assessed as having high roosting potential) subjected to dusk emergence or dawn return to roost surveys. No bats were found to be roosting in any of the trees present on site.
- 1.1.5 The activity transect surveys and automated static detector surveys revealed that an assemblage of at least eight species of bat use the East MRT Site, and its immediate surrounds, with tree-lines, woodland parcels and the watercourses being the habitat features of most value.
- 1.1.6 It is recommended that trees with a high level of roosting potential (if due to be removed) are subjected to a pre-felling dawn survey. In the unlikely event that roosting bats are found, a licence will need to be applied for from Natural England to allow felling works to proceed lawfully. Trees with potential roosting features at low height should also be re-inspected prior to felling with all trees being felled using "soft-felling" techniques by qualified arborists. Mitigation for the loss of roosting opportunities within the trees can be achieved through the provision of bat boxes on retained mature trees elsewhere within the East MRT Site. In order to mitigate potential impacts upon commuting and foraging bats, artificial lighting should be kept to a minimum and sensitively designed to minimise light spill and the attraction of insects. A buffer of tree/shrub/hedgerow planting between lit areas (e.g. the proposed development) and unlit areas (the adjacent semi-natural habitats and watercourses) could also be incorporated to minimise lighting effects and to provide additional foraging and commuting habitats.
- 1.1.7 The East MRT Site could also be enhanced for roosting, commuting and foraging bats through the inclusion of additional bat boxes or roosting provision within mature and semi-mature trees on site and within the adjacent Local Wildlife Site and the planting of nectar-rich plant species within any new soft-landscaping to be incorporated into the proposed development.

- 1.1.8 This Executive Summary contains an overview of the key findings and conclusions. However, no reliance should be placed on any part of the executive summary until the whole of the report has been read.

2 Introduction

2.1 Overview

- 2.1.1 This Bat Survey Report has been prepared in respect of a planning application for a new mass rapid transit (MRT) scheme to the east of Reading, Berkshire (referred to as the 'proposed development'). An indicative area of works (referred to as the 'East MRT Site') is included on Figure 1: Site Location Plan.

2.2 Project Background

Site Location

- 2.2.1 The East MRT Site is located between Thames Valley Business Park and Napier Road, Reading, to the south of the River Thames and north of the Great Western Main Line Railway, as shown on Figure 1: Site Location Plan.
- 2.2.2 The East MRT Site comprises three main land parcels:
- Land to the east of the River Kennet, which is dominated by a matrix of poor semi-improved grassland and tall ruderal habitat;
 - A central area of broadleaved woodland and riparian vegetation (i.e. vegetation along the river banks) associated with The Coal, Kennetmouth and Kings Meadow East Local Wildlife Site (LWS; see below); and
 - Land within the Tesco supermarket ownership at the western extent of the East MRT Site which is dominated by hardstanding and introduced shrub.
- 2.2.3 Other habitats across the East MRT Site include dense and scattered scrub, ephemeral/short-perennial vegetation and scattered trees.
- 2.2.4 Within a wider landscape context, the East MRT Site is located approximately 1 km north-east of Reading town centre within the county of Berkshire. South of the East MRT Site land use is dominated by residential and commercial development associated with Reading town. North of the East MRT Site lies the settlement of Caversham along with a network of lakes and other waterbodies (including a marina and rowing lakes) adjacent to the River Thames.

Proposed Development

- 2.2.5 The proposed description is described as follows:

'Construction of a segregated fast-track public transport, pedestrian and cycle bridge and viaduct, comprising concrete bridge structure with a river span of 59.5m and a land span of 316m, supported by concrete columns, steel beams and reinforced soil embankment, together with new footpath links and existing footpath alterations, replacement supermarket car parking provision, junction improvements and landscaping.'

- 2.2.6 The proposed development comprises:

- creation of a new route for public transport only, including cycle path and footway between Napier Road and the A3290 at Thames Valley Park proposed Thames Valley Park and Ride (TVP P&R);
- the erection of a new bridge over the River Kennet;

- formation of a new T-junction with Napier Road;
- connection to the proposed TVP P&R;
- development of new and improved footpath links to Tesco and the towpath; and
- associated infrastructure and landscaping.

2.2.7 The proposed development is being promoted by Reading Borough Council (RBC), working with Wokingham Borough Council (WBC), Thames Valley Berkshire Local Enterprise Partnership (TVB LEP) and Peter Brett Associates LLP (PBA). The public-sector led project has been allocated funding by TVB LEP from the Local Growth Fund.

Ecological Background

- 2.2.8 A Preliminary Ecological Assessment (PEA) was completed by PBA in April 2016 including an ecological desk study and Phase 1 habitat survey of the East MRT Site.
- 2.2.9 The desk study element of the assessment returned records of the following bat species from within a 2 km radius of the East MRT Site; Daubenton's bat *Myotis daubentonii*, noctule bat *Nyctalus noctula*, common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *Pipistrellus pygmaeus* and brown long eared bat *Plecotus auritus* with additional records for bat sp. *Chiroptera* and pipistrelle bat species *Pipistrellus* sp. Confirmed roost records were returned for bat sp., located 1.5 km south of the East MRT Site in 2009, and soprano pipistrelle, located 0.8 km south west of the East MRT Site in 2010.
- 2.2.10 Although no buildings or built structures are found on site, the railway bridge over the River Kennet is located immediately adjacent to the south of the East MRT Site at grid reference SU 730 738. The bridge was identified as providing features suitable for use by roosting bats (e.g. gaps in the brickwork, cracks where mortar may be missing, etc.). Further to this, several mature and semi-mature trees identified within the East MRT Site were noted to be of sufficient age and condition to support potential roost features (e.g. split limbs, gaps, rot holes, etc.). Such trees were contained both within on-site woodland and as standalone specimens.
- 2.2.11 Habitats across the East MRT Site were also considered to range in value for use by foraging and commuting bats with linear features such as the woodland edges, lines of trees and the off-site but immediately adjacent River Thames and River Kennet considered to be of greatest value. In light of these initial findings further survey to determine the presence of roosting bats and the extent to which foraging and commuting bats use the East MRT Site was recommended (PBA, 2016).

2.3 Aims of Study

- 2.3.1 In order to determine the current status of bats using the East MRT Site PBA were commissioned to undertake the following:
- i. A ground-level assessment of trees followed by further detailed inspection and dusk emergence/dawn return to roost surveys of trees classified as having a high/medium level of roosting potential;
 - ii. A dusk emergence survey of the railway bridge spanning the River Kennet; and
 - iii. Monthly activity transect surveys between May and September inclusive supplemented through the use of automated static bat detectors between May and October inclusive.
- 2.3.2 The purpose of these surveys was to determine presence/likely absence of roosting bats and the level of bat activity in and around the East MRT Site to inform necessary mitigation and enhancement measures that could be implemented to improve the East MRT Site post-

development for bats. This report sets out the study findings, providing the following information:

- The results of the ground-level tree assessment (GLTA);
- The results of the dusk emergence and dawn return to roost surveys on the railway bridge and trees;
- The results of the activity transect and automated static detector surveys;
- The legislative and/or policy protection afforded to bats that may be impacted by the proposed development;
- An assessment of any potential ecological impacts of the works based on the survey findings; and
- Recommendations for potential mitigation with regard to relevant legislation and planning policy.

3 Methods

3.1 Ground Level Tree Assessment

- 3.1.1 An assessment of the potential for all trees within the East MRT Site to provide opportunities for roosting bats was undertaken on the 11th July 2016 by Stephen Foot and Ed Austin. Weather conditions were partially cloudy (5/8 cloud cover) with a moderate breeze (Beaufort Scale F3-F4) and warm temperatures of 23°C. Trees were inspected from the ground, using binoculars and a high power torch as necessary.
- 3.1.2 The Bat Conservation Trust has developed a survey protocol (Collins, 2016) which categorises the potential for trees to support roosting bats. Using the categories detailed below, an assessment was made of the potential for each tree/group of trees included within the survey to support roosting bats:
- Known or Confirmed Roost: Confirmed bat roost with field evidence of the presence of bats (trees where bat(s), and/or clear evidence of bat use, were found to be present).
 - High Potential: Trees with multiple highly suitable features capable of supporting larger roosts.
 - Medium Potential: Trees with definite bat potential supporting fewer features than high potential trees.
 - Low Potential: Trees with no obvious potential although the tree is of a size and age that elevated surveys may result in cracks or crevices being found; or the tree supports some features which may have limited potential to support bats.
 - Negligible Potential: Trees with no potential to support bat roosts (Trees with no obvious features with potential to support a bat roost).
- 3.1.3 Trees supporting potential roosting features of low enough height to be safely accessed by ladder were also inspected with the aid of a fibre-optic scope to search for evidence of bats (bat droppings) or bats themselves. This included trees T136, T163 and T180.

3.2 Dusk Emergence and Dawn Return to Roost Surveys

- 3.2.1 Survey visits were conducted on the railway bridge and trees T88, T91 and G115 (assessed as having at least a medium level of roosting potential). These visits were undertaken in accordance with the Bat Conservation Trusts Good Practice Guidance (Collins, 2016) in suitable weather conditions as detailed in Table 1. The surveys were undertaken at an optimal time of year, when bats are active and are likely to be using summer/maternity roosts. The dusk emergence surveys began 15 minutes before sunset and continued until 1.75 hours after sunset. The dawn return to roost surveys began 1.75 hours before sunrise and finished at sunrise. Where bat activity was still evident close to sunrise, surveys were extended a further 15 minutes after sunrise.
- 3.2.2 Three surveyors were used during the survey of the bridge, with two surveyors used on tree group G115 (supported by a night vision camera) with one surveyor on each of trees T88 and T91 (also supported by a night vision camera). This allowed the potential roosting features present on the bridge and trees to be fully observed. These surveyor locations are shown in Figure 2. The personnel, timings and weather conditions recorded during these visits are shown in Table 1.

Table 1: Personnel, Timings and Weather Conditions during the Dusk Emergence and Dawn Return to Roost Surveys

Date and Structure/ Tree	Time of Survey	Time of Sunset/ Sunrise	Personnel (see Section 2.6)	Location Number (refer to Figure2)	Weather Conditions
27/06/16 Railway Bridge	21:07 – 23:07	21:22	EA NW SF	L1 L2 L3	Dry with partial cloud cover (5/8-7/8 cloud cover) and calm conditions (Beaufort Scale F1). Air temperatures ranged between 14 and 16°C
04/08/16 Tree Group G115	03:48 – 05:33	05:33	SF EA	L4 L5	Dry with mostly clear skies (2/8 cloud cover) and a light-moderate breeze (Beaufort Scale F2-F3). Air temperatures ranged between 17 and 16°C.
22/08/16 Trees T88 and T91	19:56 – 21:56	20:11	EA SF	L6 L7	Dry and partially cloud cover (cloud cover 5/8-2/8) with a light breeze (Beaufort Scale F2) with air temperatures ranging between 21 and 22°C during the survey.

- 3.2.3 The surveyors used EM3+ and Elekon Batlogger M bat detectors to listen to and record echolocation calls of bats observed. During the survey, surveyors mapped the flight-lines used by any bats observed and noted any features used by the bats to exit/enter the building. The recorded calls were subsequently analysed using Analook computer software following the survey to confirm the identification of the species observed in the field.
- 3.2.4 During the dusk emergence and dawn return to roost surveys, bat activity within the vicinity of the bridge and trees was also recorded as incidental observations, with the species of bat and number of passes also noted.
- 3.2.5 Two-way radios were used by the surveyors during each survey to communicate information about bat activity to one another and gain a greater understanding of the use of the East MRT Site by bats.

3.3 Activity Transect Surveys

- 3.3.1 The East MRT Site extends approximately 1.0 km in length and predominantly consists of riverside/riparian habitats, small pockets of grassland with parcels of woodland and areas of dense scrub. The western third of the East MRT Site comprises hardstanding consisting of the supermarket carpark and roads. When considered in combination these habitats categorise the East MRT Site as being of moderate quality with regard to its suitability to support foraging and commuting bats (Collins, 2016). Therefore, dusk or dawn activity transect surveys were undertaken each month between May and September.
- 3.3.2 One transect route was devised that covered the East MRT Site as a whole. During this activity survey, a pair of surveyors walked the transect of the East MRT Site, stopping at regular intervals for periods of 5 minutes. The dusk transects began 15 minutes before sunset (to account for earlier emerging species) and finished two hours after sunset. The dawn transect survey began two hours before sunrise and finished at sunrise (or later if depending on current levels of bat activity). During the surveys bat detectors were used (EM3+ and Batlogger M detectors); calls registered by the bat detectors were recorded for later analysis using specialist computer software (Analook); see Section 2.5. During the surveys, any visual

observations or bat call registrations (passes) were noted, recording time, location, species and activity.

- 3.3.3 A plan showing the transect route taken during the survey is given in Figure 3. The direction of the transect route was altered on each visit so as to cover all points of the transect route during the times of peak bat activity at some stage during the suite of survey visits.
- 3.3.4 Dates, times and weather conditions of each of the transect survey visits are provided in Table 2 below.

Table 2: Personnel, Timings and Weather Conditions during the Dusk and Dawn Activity Transect Surveys

Date	Time of Survey	Time of Sunrise	Personnel (see Section 2.6)	Weather Conditions
24/05/16	20:47-23:02	21:02	SF EA	Dry with clear skies throughout the duration of the survey (1/8 cloud cover). A moderate breeze was present (Beaufort Scale F3-F4) at the start of the survey which lessened towards the survey finish (Beaufort Scale F2). Air temperatures ranged between 16°C and 12°C.
13/06/16	21:07 – 23:22	21:22	SF EA	Dry for the most part with a heavy shower in the middle of the survey with partially cloudy skies at the start of the survey (cloud cover 4/8) becoming more overcast by the survey finish (cloud cover 8/8). A light breeze was present throughout (Beaufort Scale F1-F2) with air temperatures ranging between 18°C and 16°C.
11/07/16	21:03-23:18	21:18	SF EA	Dry with partially cloudy skies and a moderate breeze throughout the duration of the survey (5/8 cloud cover and Beaufort Scale F2-F3). Air temperatures ranged between 18°C and 16°C.
12/07/16	03:02-05:02	05:02	SF EA	Dry and partially cloudy (cloud cover 5/8) at the survey start with cloud clearing by the survey end (2/8 cloud cover). A light breeze was present throughout (Beaufort Scale F1-F2) and air temperatures ranged between 15°C and 14°C.
15/08/16	20:10 – 22:25	20:25	SF EA	Dry with clear skies and a light breeze throughout the survey (1/8 cloud cover and Beaufort Scale F2). Air temperatures ranged between 22 and 19°C.
12/09/16	19:09 – 21:24	19:24	SF EA	Dry and overcast (5/8 – 7/8 cloud cover) with a light breeze (Beaufort Scale F1-F2) and air temperatures ranging between 21 and 20°C.

3.4 Automated Static Detector Surveys

- 3.4.1 Automated static bat detectors (Anabat Express[®]) were deployed at two locations along the transect route in each of the survey months as well as in October (i.e. May-October inclusive). These static detectors were deployed to passively record bat activity within these two areas of the East MRT Site for a minimum of five consecutive nights during each of the visits (Collins, 2016). The static detectors were set to turn on half an hour before sunset and switch off half an hour after sunrise.

- 3.4.2 Table 3 below details the dates that detectors were installed with the locations of static detectors shown on Figure 3.

Table 3: Dates of Static Detectors Deployment

Month	Dates of Static Monitoring		No. Nights Survey
	From	To	
May	24 th May 2016	29 th May 2016	5
June	14 th June 2016	19 th June 2016	5
July	11 th July 2016	16 th July 2016	5
August	15 th August 2016	20 th August 2016	5
September	12 th September 2016	17 th September 2016	5
October	12 th October 2016	17 th October 2016	5

3.5 Data Analysis

- 3.5.1 Bats generate echolocation calls which were recorded by the detectors during the dusk emergence and dawn return to roost surveys, activity transect surveys and automated static detector surveys. These were analysed using Analook software to give an indication of the species of bat present and their relative levels of activity. The software enables analysis of the relative activity of different species of bats by counting the minimum number of bats recorded within discrete sound files. Once triggered by ultrasound, the EM3+ and Anabat Express detectors record sound files with a duration of 15 seconds, which may contain a number of individual bat calls (or passes), or discrete groups of ultrasound 'pulses'.
- 3.5.2 Where possible, bat calls are identified to species level. However, species of the genus *Myotis* are grouped together in most cases as their calls are similar in structure and have overlapping call parameters, making species identification problematic (Russ, 2012). When determining *Myotis* calls approximately 30% of calls were fully analysed (slope, call duration, peak frequency, etc, to arrive at the most likely species); where calls were closely timed (i.e. within consecutive files) these were assumed to be the same species unless calls looked significantly different.
- 3.5.3 For *Pipistrellus* species the following criteria based on measurements of peak frequency are used to classify calls:
- Common pipistrelle ≥ 42 and $<49\text{KHz}$;
 - Soprano pipistrelle $\geq 51\text{KHz}$;
 - Nathusius pipistrelle $<39\text{KHz}$;
 - Common/soprano pipistrelle ≥ 49 and $<51\text{KHz}$; and
 - Common/Nathusius pipistrelle ≥ 39 and $<42\text{KHz}$.
- 3.5.4 In addition, the following categories are used for calls which cannot be identified with confidence due to the overlap in call characteristics between species or species groups:
- *Myotis/Plecotus* sp.;
 - *Nyctalus* sp. (either Leisler's bat or noctule);
 - Serotine/Leisler's; and
 - Serotine/*Plecotus* sp.

3.6 Survey Personnel

- 3.6.1 The bat surveys were led by Stephen Foot and Ed Austin. Stephen Foot (SF) MCIEEM has worked as a professional ecologist since 2005 and has held a licence to handle and disturb bats (Level 2 Class Licence) since 2010. During his time as a professional ecologist he has undertaken an extensive number of external and internal building assessments, dusk emergence and dawn return to roost surveys and activity transect surveys across the UK and Ireland. He has been involved in numerous projects requiring bespoke mitigation to be designed and implemented where proposed development has an impact on roosting bats. He undertakes voluntary surveys for his local bat group and is a registered bat carer (looking after injured bats found by members of the public).
- 3.6.2 Ed Austin (EA) MCIEEM has worked as a full-time professional ecologist since 2004 and began his career in environmental consultancy in 2002. During this time, he has also undertaken a large number of protected species surveys across the UK and has extensive experience in bat activity, emergence and dawn return to roost surveys throughout the UK and Ireland.
- 3.6.3 Natalie White (NW) MCIEEM assisted during the dusk emergence survey of the bridge. Natalie has worked as a professional ecologist since 2007 and also holds a licence to handle and disturb bats (Level 2 Class Licence). During this time Natalie has undertaken a number of dusk emergence and dawn return to roost surveys and activity transect surveys throughout the UK.

3.7 Limitations to Methods

- 3.7.1 Given that the planning application boundary for the proposed development had not been fixed at the time, the area included within the activity surveys varied slightly from the current East MRT Site – see Figure 3 for extent, with a more extensive survey area considered. This included land within the immediate surrounding of the East MRT Site, to both the east and west of the River Kennet. The results within these locations provide contextual information and as such, are not considered to limit the findings of the surveys.
- 3.7.2 Surveys were undertaken at an optimal time of year in suitable/good weather conditions. As such there are not considered to be any limitations to the bat survey methods or survey results.

4 Results and Interpretation

4.1 Overview

- 4.1.1 This section sets out the results of the bat surveys. The implications of the results are then explored with reference to current legislation and planning policy.

4.2 Ground Level Tree Assessment Results

- 4.2.1 A number of trees were found to be present within the East MRT Site that have the potential to provide roosting opportunities for bats. Table 4 in Appendix C lists these trees/tree groups using the tree numbering system detailed in the tree schedule provided by Tree Work Environmental Practice (Tree Work Environmental Practice, 2016) with the locations of these trees shown on Figure 4. All trees/tree groups listed on the schedule were assessed for their potential to support roosting bats. The survey results are summarised below.
- 4.2.2 Of the trees/tree groups surveyed the following roosting potentials were noted:
- Three trees/tree groups were assessed as having high roosting potential (T88, T91 and G115 (see Photograph 1 in Appendix B));
 - One tree was assessed as having medium roosting potential (T163); and
 - Six trees were assessed as having low roosting potential (T53, T136, T146, T151, T153 and T180).
- 4.2.3 Of these trees, T136, T163 and T180 supported roosting features that were at low-level and could therefore be inspected with the aid of a ladder and a fibre-optic scope. No signs of roosting bats were found within these cavities at the time of the inspection. This inspection enabled current use of these trees by roosting bats to be ruled out. The high potential trees were subjected to additional survey effort (see Section 3.4 below) with recommendations with regard to medium and low potential trees provided in Section 4.

4.3 Dusk Emergence Survey – Railway Bridge

- 4.3.1 No bats were observed emerging from the bridge during the dusk survey. The earliest bats recorded were a noctule bat *Nyctalus noctula* at 21:40 (18 minutes after sunset) and a soprano pipistrelle *Pipistrellus pygmaeus* at 21:44 (22 minutes after sunset) both at location L1. The noctule was observed commuting high over the River Thames to the north with the soprano pipistrelle seen to fly past the bridge from a northerly direction. In addition, to these species, common pipistrelles *Pipistrellus pipistrellus* and *Myotis* bats (classified as Daubenton's bats *Myotis daubentonii* given the call parameters and observed flight patterns) were also recorded. The earliest common pipistrelle bat was recorded at 21:56 (34 minutes after sunset) with the earliest Daubenton's bat recorded at 22:09 (47 minutes after sunset).
- 4.3.2 Both soprano and common pipistrelles commonly roost within buildings and built structures (Dietz *et al.*, 2009) though they also regularly roost within trees. Both common and soprano pipistrelle bats typically emerge between 10 and 30 minutes after sunset (Russ, 2012). Given the timing of these calls it is likely that roosts are relatively close by, possibly within nearby woodland to the north/north-west.
- 4.3.3 Noctule bats primarily roost within cavities in trees and generally emerge from their roosts between 0 and 26 minutes after sunset and return to the roost at or very close to sunrise (Russ, 1999). The timing of the first recorded noctule call during the emergence survey was 18 minutes after sunset which indicates that there could also be a roost close by. It is worth

noting that the noctule bat is a fast flying species reaching speeds of up to 50 kmph (BCT, 2010) suggesting that the roost could still be a considerable distance from the East MRT Site.

- 4.3.4 Daubenton's bats typically roosts in tree holes and bat boxes but also in cracks in bridges and more rarely in buildings. Roosts of small numbers of individual males are also found in underground channels (Dietz *et al.*, 2009). This species typically emerges from its roost between 30 minutes and 50 minutes after sunset (Russ, 2012). The timing of the first call during the survey (47 minutes after sunset) suggests that a roost is close to the bridge but as the bat was initially observed flying from a northerly direction, it is likely to be roosting within trees in the woodland further along the River Thames.
- 4.3.5 Incidental bat activity close to the bridge was generally high, particularly at surveyor location L1 which is shielded from lighting on the eastern side of the Kennet. This is unsurprising as the River Kennet and Thames and associated bankside trees and vegetation provide high quality foraging habitat for this species group. Further details regarding the use of the East MRT Site by bats is provided in subsequent sections of this report.

4.4 Dusk Emergence and Dawn Return to Roost Surveys - G115, T88 and T91

- 4.4.1 No bats were observed returning to roost within any of the poplar trees within G115 during the dawn return to roost survey in early August. Activity was low with only a small number of common and soprano pipistrelles recorded during the survey visit. The latest of these (a common pipistrelle bat) was recorded at 04:59 (34 minutes before sunrise) flying in a southerly direction through the woodland towards the rail corridor. The night vision video camera supporting this survey was focussed on a group of woodpecker holes on the northernmost tree. No bats were observed in association with these holes; however, a wren *Troglodytes troglodytes* was observed using this complex of holes as a night roost (see Photograph 2 in Appendix B). The presence of roosting birds indicates that these woodpecker holes were not in use by bats at the time of survey, which is supported by the survey data.
- 4.4.2 No bats were recorded emerging from trees T88 and T91 during the dusk surveys conducted in late August. The earliest recorded bat calls were a soprano pipistrelle recorded at 20:46 (35 minutes after sunset) and a noctule bat commuting overhead at 20:59 (48 minutes after sunrise). The timing of these calls suggests that these bats are not roosting particularly close to these trees. The night vision camera also did not record evidence of any "quieter" bat species (*Plecotus* sp. etc.) within the tree canopies. Further recommendations with regard to these trees are provided in Section 4.

4.5 Activity Transect Survey Results

- 4.5.1 At least five species of bats were recorded over both of the activity transect surveys. The confirmed species or species groups include:
- *Myotis* sp. (likely Daubenton's bat given recorded call parameters and observed flight behaviour);
 - Noctule;
 - Soprano pipistrelle;
 - Common pipistrelle; and
 - Nathusius' pipistrelle
- 4.5.2 The calls recorded during the transect surveys between May and September are summarised in Appendix D: Bat Activity Survey Results. Locations of bats encountered during the transect surveys are shown on Figure 5, which displays all calls recorded during the manual activity transects across the survey period.

- 4.5.3 The results in Figure 5 show that activity levels were highest along the River Thames and adjacent to woodland/tree-lines which is to be expected as this constitutes high quality foraging and commuting habitats for bats. The table contained within Appendix D (Table 5) shows that activity peaked during May and July which is likely the result of bats intensively foraging prior to the maternity period and to replenish fat reserves in May (following hibernation). This may also be a result of this year's cohort adding to the number of bats using the East MRT Site, as young bats become independent by July-August (Mitchell-Jones, 2004).
- 4.5.4 Soprano pipistrelle and common pipistrelle bat calls made up the majority of the calls recorded (73.83% of total activity), including pipistrelle bats calling at 50kHz which is unsurprising as both species are common and widespread throughout the UK. Both of these species were recorded throughout the transect route, though higher numbers of soprano pipistrelle bats were noted. A likely reason for this is put forward in Section 3.6.
- 4.5.5 The second most frequently recorded species was the noctule bat which was recorded foraging along the River Thames during most survey visits. Higher levels of activity from this species were also noted along the southern boundary of the East MRT Site, particularly in the south-west close to the Network Rail compounds where the bats were foraging on invertebrates attracted to the lighting along the edge of the compound. This species (as well as pipistrelle and Leisler's bats) can tolerate high levels of lighting and are known to use lighting as a foraging resource (feeding upon invertebrates attracted to the lights) (Rich and Longcore, 2005).
- 4.5.6 Of the remaining species encountered only a very small number of calls were recorded. An interpretation of this data in relation to each species/species group is provided in Section 4.6 below where the data obtained from the automated static detectors is fully explored.

4.6 Automated Static Detector Surveys

- 4.6.1 A total of at least eight bat species (a slightly larger assemblage to that recorded during the walked transects) were recorded within the East MRT Site during the periods of static detector monitoring. These species were as follows:
- Common pipistrelle;
 - Soprano pipistrelle;
 - Nathusius pipistrelle;
 - Noctule;
 - Leisler's;
 - *Nyctalus* sp. (either Noctule or Leisler's bat);
 - *Myotis* sp.;
 - Serotine; and
 - Barbastelle
- 4.6.2 The data recorded during the static monitoring periods for all months are summarised in Appendix E: Automated Static Detector Survey Results.

General Levels of Bat Activity

- 4.6.3 Automated bat data results show that activity levels were highest in May with 1,500 calls (46.77% of all calls recorded). This is likely a result of bats undertaking increased foraging activity in preparation for the maternity period. Activity levels were also high in both August and September with 618 and 635 calls (19.27% and 19.80% of all calls recorded respectively). As mentioned in Section 3.5, this is likely to be due to the presence of this year's cohort adding to the number of bats using the East MRT Site as young bats become independent by July-August (Mitchell-Jones, 2004).
- 4.6.4 Activity levels were higher at detector S1 (2186 calls, 68.16% of calls) in comparison to S2 (1,021 calls, 31.84% of calls) despite detector S1 being located slightly further from the River Thames than S2. The woodland in which detector S1 was sited provides good quality foraging and commuting habitat in its own right, which likely accounts for these high levels of activity.

Pipistrelle bats

- 4.6.5 The data in Appendix E shows that the majority of all calls recorded (67.48%) were produced by common pipistrelles and soprano pipistrelles (including calls from undetermined pipistrelle species calling at around 50 kHz (either common or soprano pipistrelles)). This high proportion of calls is to be expected as both species are common and widespread throughout the UK (Dietz *et al.*, 2009). A higher number of calls from common pipistrelle bats was recorded as opposed to soprano pipistrelle bats (1,256 calls in comparison to 787 calls). This data differs from that recorded during the activity transect surveys and a possible reason for this is the locations where detectors were sited (in woodland/scrub habitats as rather than adjacent to the water courses). Soprano pipistrelle bats are more of a specialist in their habitat preferences being more strongly dependent on riparian forests, lowlands and water bodies of any size, in particular still waters (Dietz *et al.*, 2009 and Russ, 2012). This ecological trait likely explains why soprano pipistrelle bat activity was especially recorded at the riverside during the activity transect. Common pipistrelle bats have very general habitat requirements being found in virtually all habitat types in the UK (Dietz *et al.*, 2009) and are more likely to exploit the woodland/scrub habitats where the detectors were sited. Both common and soprano pipistrelles rarely forage over open landscapes as this increases their susceptibility to predation (Dietz *et al.*, 2009, Verboom & Spoelstra, 1999). This accords with the survey results as pipistrelles tended to be recorded close to linear features (hedgerows/treelines) rather than within open landscapes.
- 4.6.6 A number of confirmed and possible Nathusius' pipistrelle bat *Pipistrellus nathusii* echolocation calls (calls ranging between 39 kHz and 41 kHz) were recorded (3.93% of all recorded echolocation calls). The majority of these echolocation calls were recorded at static detector S1 during the September and October survey periods. Smaller numbers of calls were recorded during May with only three calls in total recorded during June, July and August.
- 4.6.7 Like other species of pipistrelle, this bat tends to predominantly forage along linear structures (Dietz *et al.*, 2009) but also forages over woodland rides, paths and meadows, flying at an average height of 4-15 m above the ground (Russ, 1999). Nathusius' pipistrelles are also known to migrate seasonally between maternity and hibernation sites, with migration to hibernation sites occurring in the autumn (September and October) (Dietz *et al.*, 2009). This species is known to migrate across Europe (Dietz *et al.*, 2009). On 23rd September 2013 a Nathusius' pipistrelle was identified in the Netherlands with an identity ring that was fitted in the UK proving that this species does migrate between the UK and mainland Europe (BCT website). It is thought that this species may migrate to the UK to exploit foraging habitats and avoid harsh climatic winter conditions in north-eastern Europe, or it is possible that bats hibernating in south-western Europe come to the UK to breed and migrate back to south-west Europe to hibernate in the autumn (Russ *et al.*, 2001). The data gathered during 2016 suggests that the Nathusius' pipistrelle activity recorded is indicative of low numbers of Nathusius' pipistrelle bats passing through and using the East MRT Site on a very occasional basis. Given the timing of the calls recorded from this species it is considered that the River

Thames and River Kennet are used by this species as a commuting feature and foraging resource during migration.

Noctule

- 4.6.8 The second most recorded species (after pipistrelles) was the noctule bat *Nyctalus noctula*; with noctule bat activity constituting 27.69% of all recorded echolocation calls. This species was recorded at both static detector locations with activity higher at detector S1. Noctule bats are found in a range of habitat types including deciduous woodland, parkland and pasture (Russ, 2012) and often forage over water-bodies (Dietz et al, 2009). This species typically forages between 2.5 km-4 km (up to a maximum of 25 km) from a roost (Dietz et al., 2009). The timing of the data suggests that noctule bats were recorded close to sunset and sunrise as they flew over the detector to reach foraging opportunities within the woodland and along the nearby watercourses. Some calls recorded were from before sunset indicating that a roost of this species is likely to be in close proximity to the East MRT Site.

Myotis bats

- 4.6.9 The third most recorded species/species group (behind pipistrelle bats and noctule bats) were the *Myotis* bats, however, this species group only accounted for 0.47% of all calls recorded during the static detector surveys (15 calls in total). As stated in the methods section of this report, species of the genus *Myotis* were grouped together as many of the species have overlapping call parameters, making specific identification problematic (Collins, 2016). However, the parameters of the calls associated with this suite of surveys are indicative of Daubenton's bats (as observed during the activity transect and dusk emergence survey on the bridge). Daubenton's bats tend to forage close to the surface of water where they prey upon non-biting midges and other small Dipterans (two-winged flies) (Dietz et al., 2009). As such the River Thames and River Kennet adjacent to the East MRT Site provide a suitable foraging resource for bats of this species.

Leisler's

- 4.6.10 A small number of Leisler's bat *Nyctalus leisleri* calls (3 calls, 0.09% of calls) were recorded in September. This species is typically associated with parkland, cattle pastures, meadows, tree crowns and water-bodies. This species is also known to forage around streetlights (Russ, 2012). Foraging activity for this species typically occurs up to a distance of 4 km from a roost site (Dietz et al., 2009).
- 4.6.11 Like the Nathusius' pipistrelle and noctule bat, this species is also known to seasonally cover long distances with flights up to 1,500 km recorded in Europe (Dietz et al., 2009). It is considered that Leisler's bats are sedentary in the UK (Dietz et al, 2009); however, this species is more than capable of migrating across the UK to suitable hibernation roosts and could pass through and forage on the stretch of the Rivers Thames and Kennet adjacent to the East MRT Site during the course of this travel. This is a possible explanation for the calls being recorded during the September survey only.

Nyctalus bats

- 4.6.12 A total of seven calls (0.22%) were made by indeterminate bats from the genus *Nyctalus*. These calls were too short in duration (too brief) or within clutter where the overlapping call parameters between species are too similar to allow reliable analysis to species level.

Serotine

- 4.6.13 Serotine bat *Eptesicus serotinus* activity made up 0.09% (three calls) of all echolocation calls and was recorded at static detector S1 in August and September. This species is known to feed along woodland edge habitat, hedgerows, parkland and pasture. This species also hunts

above streetlights (Russ, 2012) and can forage considerable distances from its roosting site but tends to forage between distances of 4.5 km and 12 km (Dietz *et al.*, 2009). It is evident that this species utilises the East MRT Site as a foraging resource very occasionally, however, the results of the static detector surveys indicate that the East MRT Site is of minimal value to this species as a foraging/commuting resource.

Barbastelle bat

- 4.6.14 A single barbastelle bat *Barbastella barbastellus* call was recorded. The barbastelle is considered to be rare in Britain, and only sparsely distributed through its range in Europe (Altringham, 2003). Its characteristic short and directional echolocation call (Denzinger *et al.*, 2001), and fast and far-travelling flight (Dietz *et al.*, 2009) are likely to reduce detection levels. This species tends to forage in woodland where its summer roost sites are usually associated with splits and cracks in trees or occur beneath raised bark (Dietz *et al.*, 2009).
- 4.6.15 This species tends to emerge from a roost between 25 and 60 minutes after sunset (Russ, 2012). The barbastelle has a strong aversion to well-lit areas; however, it emerges early to enable it to cover the large distances separating their roosting and foraging areas during the relatively short summer nights. The call recorded 4 hours and 55 minutes after sunset suggests that this bat was commuting through the East MRT Site between roosting and foraging areas, with the river corridor of the Thames likely to provide good quality foraging habitat for this species. The data collated during 2016 suggests that it is unlikely that the East MRT Site itself is of value to barbastelle bats.
- 4.6.16 The foraging area for this species covers an area of approximately 8.8 ha around the roost (Dietz, *et al.*, 2009). For male barbastelle bats, the peak foraging period/metabolic demand is likely to be in autumn and early winter, coinciding with mating activity (Greenaway, 2004). The recording of a barbastelle in September is likely the results of a single male bat increasing foraging range to maximise energy levels in preparation for mating/hibernation.
- 4.6.17 Example sonograms from bats recorded during the activity transect and automated static detector surveys are provided within Appendix F.

4.7 Summary of Results and Interpretation

- 4.7.1 As outlined above, no bats were observed roosting within the railway bridge adjacent to the East MRT Site. Furthermore, no bats were observed roosting within on-site trees although the potential for their future use by roosting bats remains.
- 4.7.2 The assemblage of bats recorded during the activity surveys (transect surveys and automated static detector surveys) was dominated by common and widespread species of bats, with activity focussed along the River Thames and adjacent to woodland/tree-lines. This assemblage is likely to be typical of the wider urban and riparian landscape in which the East MRT Site is located.

4.8 Legislative Considerations

- 4.8.1 Both bats and their roosts are afforded protection under the Conservation of Species and Habitats Regulations 2010 (as amended) and the Wildlife and Countryside Act 1981 (as amended). In broad terms these pieces of legislation jointly mean that the animals themselves are protected against killing, injury, taking (capture) and disturbance. In addition, their places of shelter are protected against damage, destruction and obstruction. Several species are also classified as Species of Principal Importance (SPIs), including soprano pipistrelle and noctule which were both recorded on site during this suite of surveys. SPI species are included on a list drawn up in response to the requirements of Section 41 of the Natural Environment and Rural Communities (NERC) Act, 2006 and are considered a priority for the conservation of biodiversity in England (see Appendix A).

5 Recommendations

5.1 Overview

- 5.1.1 The presence of bats using the East MRT Site described in the preceding sections of this report, and the legislation relating to them, make them a necessary consideration in the future proposed development. Therefore, the likely impacts of the proposed development on bats are discussed below along with the appropriate mitigation and compensation that will be required within the context of relevant legislation and planning policy.

5.2 Further Survey

Removal of High Potential Trees

- 5.2.1 Given the time that is likely to elapse between this assessment and the proposed development, the two trees and one tree group assessed as having high roosting potential should be reassessed through conducting a pre-felling dawn return to roost surveys during the bats' active period (i.e. May to October) to confirm the current status in terms of presence/likely absence of roosting bats. If no bats are seen returning at dawn to roost, it can be assumed that these trees do not constitute a roost in current or regular use, and as such an EPS licence would not be required to facilitate their removal. The trees should therefore be felled immediately and using sensitive techniques (see Section 4.2.2-4.2.4 below).

Removal of Low-Medium Potential Trees

- 5.2.2 The current best practice guidance states that *"From what is known about the ecology of tree-roosting bats, it is arguable that all trees with bat roosting potential should be considered part of a resource that will be used at one time or another by tree roosting bats in order to determine the extent of impacts. Survey work on individual trees may confirm presence but is unlikely to conclusively confirm absence. Precautionary measures are likely to still be essential during works even where surveys have not identified occupancy"* (Collins, 2016).
- 5.2.3 Therefore, despite no evidence of roosting bats being recorded from the medium potential trees subjected to a fibre-optic scope inspection, those trees assessed as having Low-Medium potential to support roosting bats and which will require felling to facilitate the proposed development will need to be removed with reference to good practice guidance (Collins, 2016) and in accordance with the following measures:
- Medium potential trees should be first subjected to a re-inspection of potential roost features using a fibre-optic scope;
 - All Low and Medium potential trees should be removed using soft-felling by suitably qualified arborists, i.e. felled in sections which are carefully lowered to the ground in the presence of a licenced ecologist; and
 - Trees should be felled during the period bats are least vulnerable to disturbance (in the unlikely event they are found to be present); i.e. spring or autumn.
- 5.2.4 If in the unlikely event a bat is found during soft felling of the trees, all works must cease and advice must be sought from an appropriately qualified ecologist in order determine the best way to proceed.

5.3 Mitigation Measures - Roosting Bats

- 5.3.1 Roosting bats were found to be absent from the bridge and trees subjected to dusk emergence and/or dawn return to roost surveys. Therefore, specific mitigation is unlikely to be

required over and above the sensitive timing and methods (for tree removal) outlined in the previous section. However, given that high potential trees are to be lost and that these could provide roosting opportunities in the future, it is advised that bat boxes are to be installed within the woodland and upon suitable retained trees along the River Thames to provide a continued roosting resource in the local area. These should be suitable for a range of species including noctule bats, *myotis* and pipistrelle bats.

- 5.3.2 The bat boxes should be installed in positions where they are out of reach of people from the ground (so as to limit interference) and high enough to deter cats and other predators (without being placed too high as this makes maintenance more difficult and can leave the boxes exposed to weather, particularly strong winds). In practice, placing them between 3 and 4.5 metres from the ground is optimal. The direction of the boxes should be selected to avoid facing them into the prevailing weather and where they will receive a good degree of sunlight for at least part of the day (i.e. west through south to south-east).

5.4 Mitigation Measures - Foraging and Commuting Bats

- 5.4.1 The survey results have shown that the East MRT Site and its immediate surrounds provides a good quality foraging and commuting resource for an assemblage of at least eight species of bats. Depending on final design parameters for the proposed development, mitigation measures are likely to be required if adverse effects on this assemblage of bats are to be avoided.
- 5.4.2 Road/transport developments have the potential to adversely impact local populations of bats. Altringham (2008) states that bats are particularly vulnerable to this type of development as a result of their life history strategy of low fecundity (reproductive rate) and their use of large areas of the landscape. In the absence of appropriate mitigation, the construction of the new public transport route could affect local bats/bat populations in the following ways:
- Severance of commuting routes (e.g. through the creation of physical barriers or through the insensitive use of street-lighting);
 - Loss of small areas of foraging habitat through removal of areas of scrub and woodland;
 - The degradation of adjacent roosting, commuting and foraging habitats (e.g. through the insensitive use of street-lighting); and/or
 - Killing or injury as the result of collision with vehicles.
- 5.4.3 Once the design of the proposed development has been finalised and possible impacts on local bats / bat populations are fully understood, avoidance, mitigation and compensation measures should be identified to reduce and eliminate the possible impacts outlined above, as applicable. These could include:
- Installation of new planting (trees, hedgerows and shrubs) to compensate for possible lost commuting and foraging routes and to provide additional commuting foraging and commuting habitat parallel to the scheme. Newly planted hedgerows should be allowed to grow as tall as possible and be a mix of native woody species.
 - Use of sensitive lighting. Where street-lighting is necessary it should be kept to a minimum. If lighting is required it is important to consider the column height of the lighting to balance task and mitigation measures (BCT, 2014). If brighter lighting is required low or high pressure sodium lights should be used instead of mercury and metal halides and luminaires or other directional light accessories (shields, hoods or cowls) should be employed to suitably control light spillage, particularly onto adjacent hedge or tree lines is avoided (BCT and ILE, 2008). When selecting appropriate lighting, it is recommended that:

- o Narrow spectrum light sources are used to lower the range of species affected by lighting;
 - o Lights that peak higher than 550 nanometres are used; and
 - o Lights that emit white and blue wavelengths of the light spectrum are avoided 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 (BCT, 2014).
 - Where possible the lighting levels should also be varied. For example, it may be possible to reduce lighting levels or perhaps even switch installations off after certain times e.g. between 00:00 and sunrise along the public transport route. This use of “adaptive lighting” can tailor the installation to suit human health and safety as well as wildlife needs (BCT, 2014).
- 5.4.4 A buffer of tree/shrub/hedgerow planting close to the proposed development (as identified above) could also minimise the effects of proposed lighting along the route by shielding adjacent areas as well as providing an additional commuting/foraging resource as detailed above.

5.5 Opportunities for Enhancement

- 5.5.1 In-line with the NPPF and local planning policy, enhancements should also be provided (over and above the requirements of mitigation). Additional bat boxes over and above those to be installed to mitigate for the loss of potential roosting opportunities could be installed on mature trees elsewhere within the East MRT Site and wider The Coal, Kennetmouth and Kings Meadow East LWS in order to improve the value of the East MRT Site and immediate surrounding as a roosting resource to bats.
- 5.5.2 Nectar-rich plant species that are attractive to night-flying insects could also be planted as part of the landscaping scheme for the East MRT Site to enhance foraging opportunities for bats.

6 Conclusion

- 6.1.1 The bat surveys undertaken for the East MRT Site in 2016 confirmed that the East MRT Site provides a foraging and commuting resource for an assemblage of at least eight species of bat. Roosting within trees and the bridge was found to be absent.
- 6.1.2 Steps should be taken to minimise impacts upon this species group as a result of the proposed development, via the provision of new roosting opportunities (to replace the loss of roosting features that could be used in future years), a re-survey of medium to high roosting potential trees prior to felling, the provision of new habitat planting and the sensitive use of lighting along the proposed new vehicular and pedestrian routes.
- 6.1.3 The provision of additional bat boxes over and above those required for the purposes of mitigation as well as the provision of nectar-rich planting within associated soft-landscaping would promote compliance with national and local planning policies.

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Figures

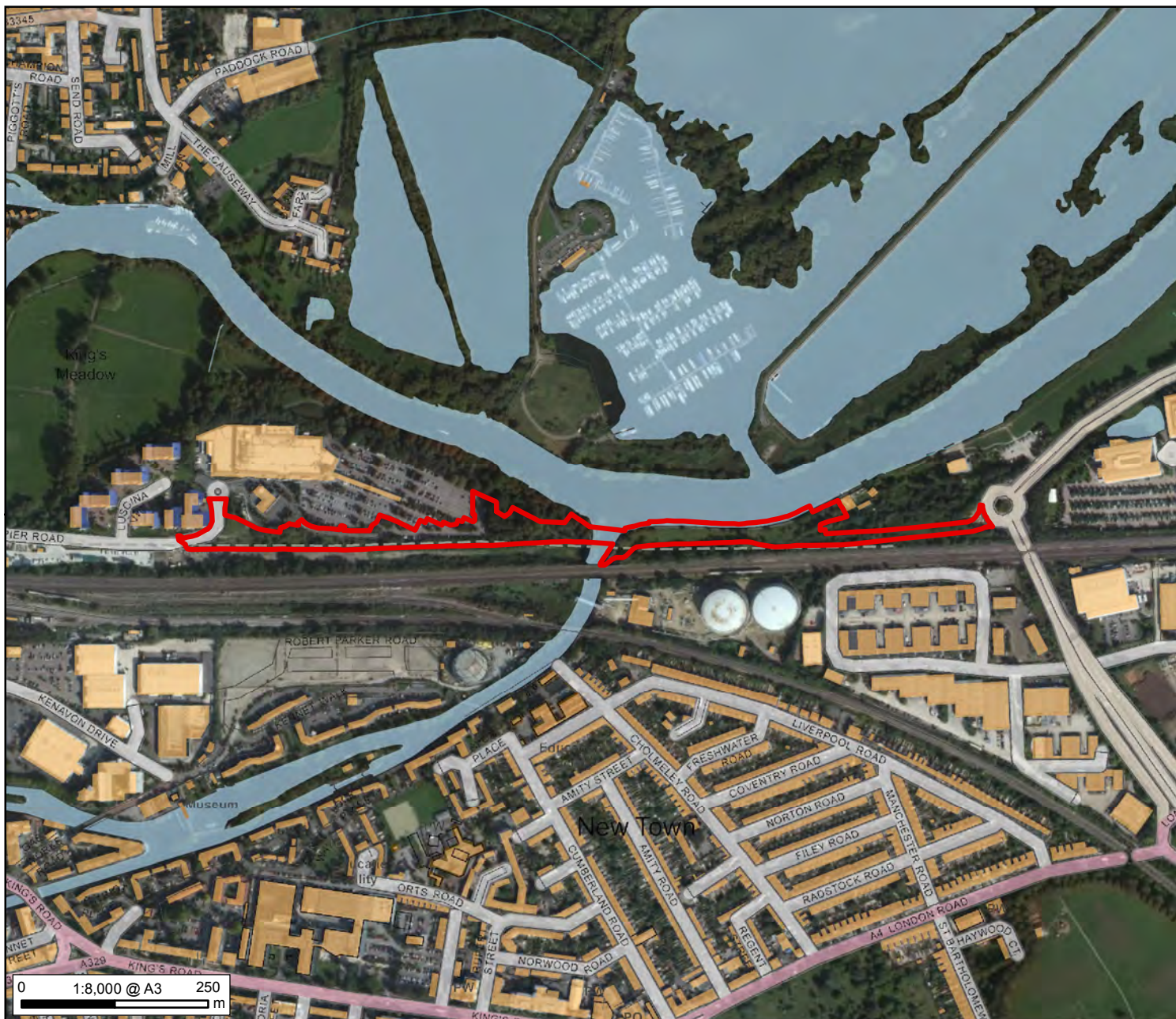
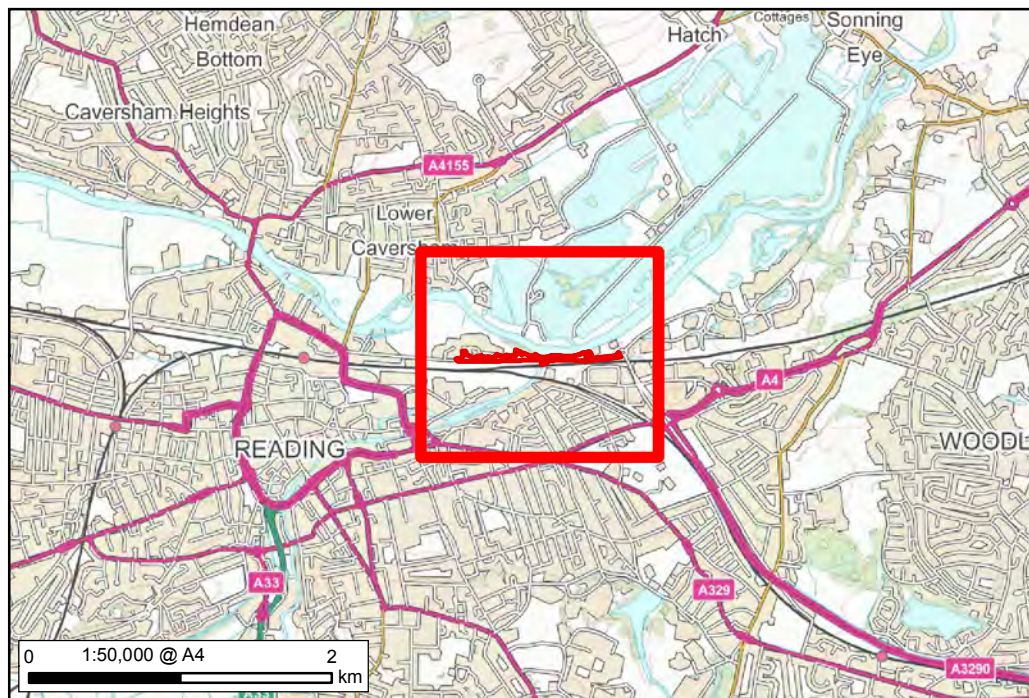
Figure 1. Site Location Plan

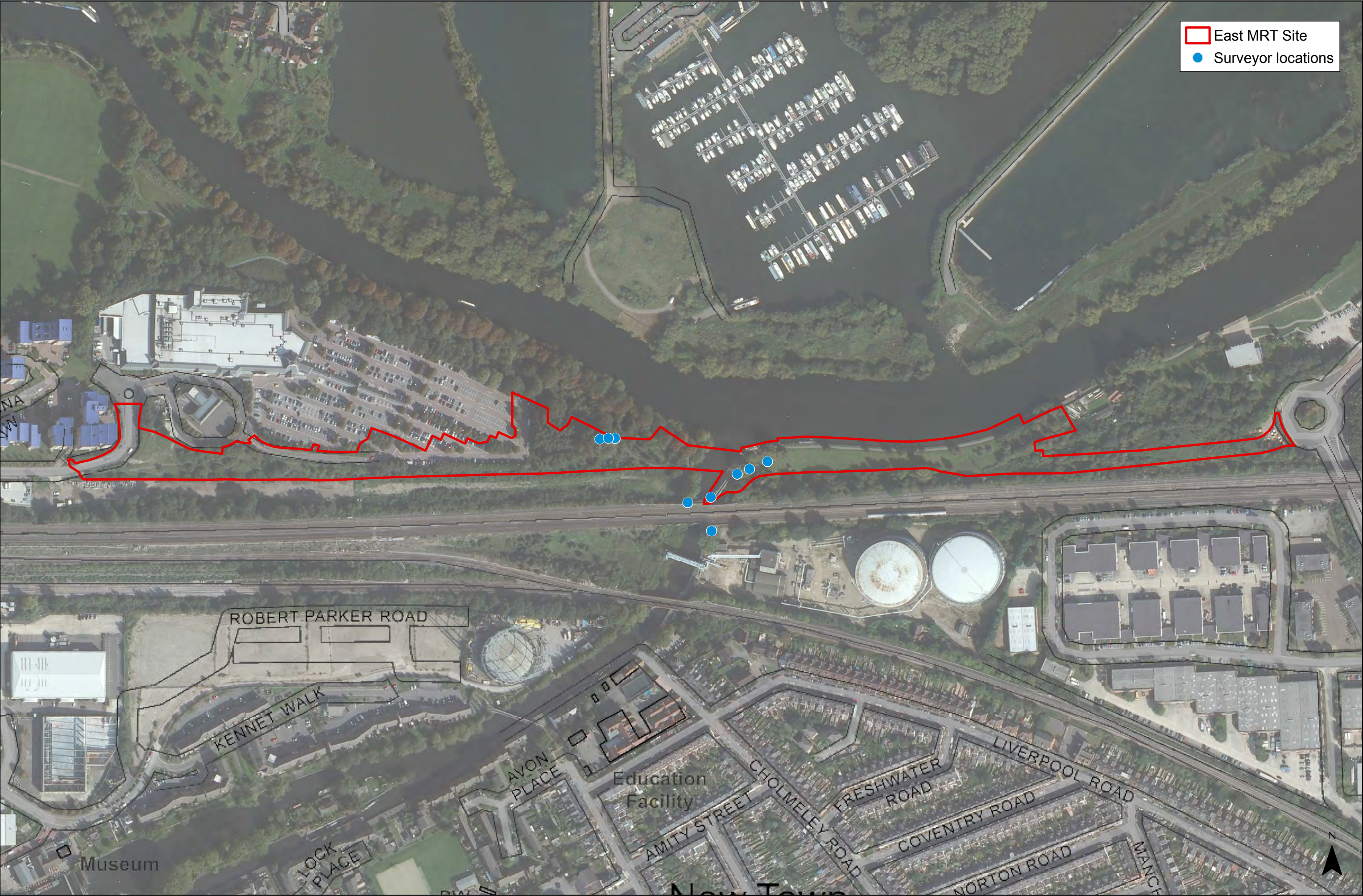
Figure 2: Surveyor Locations

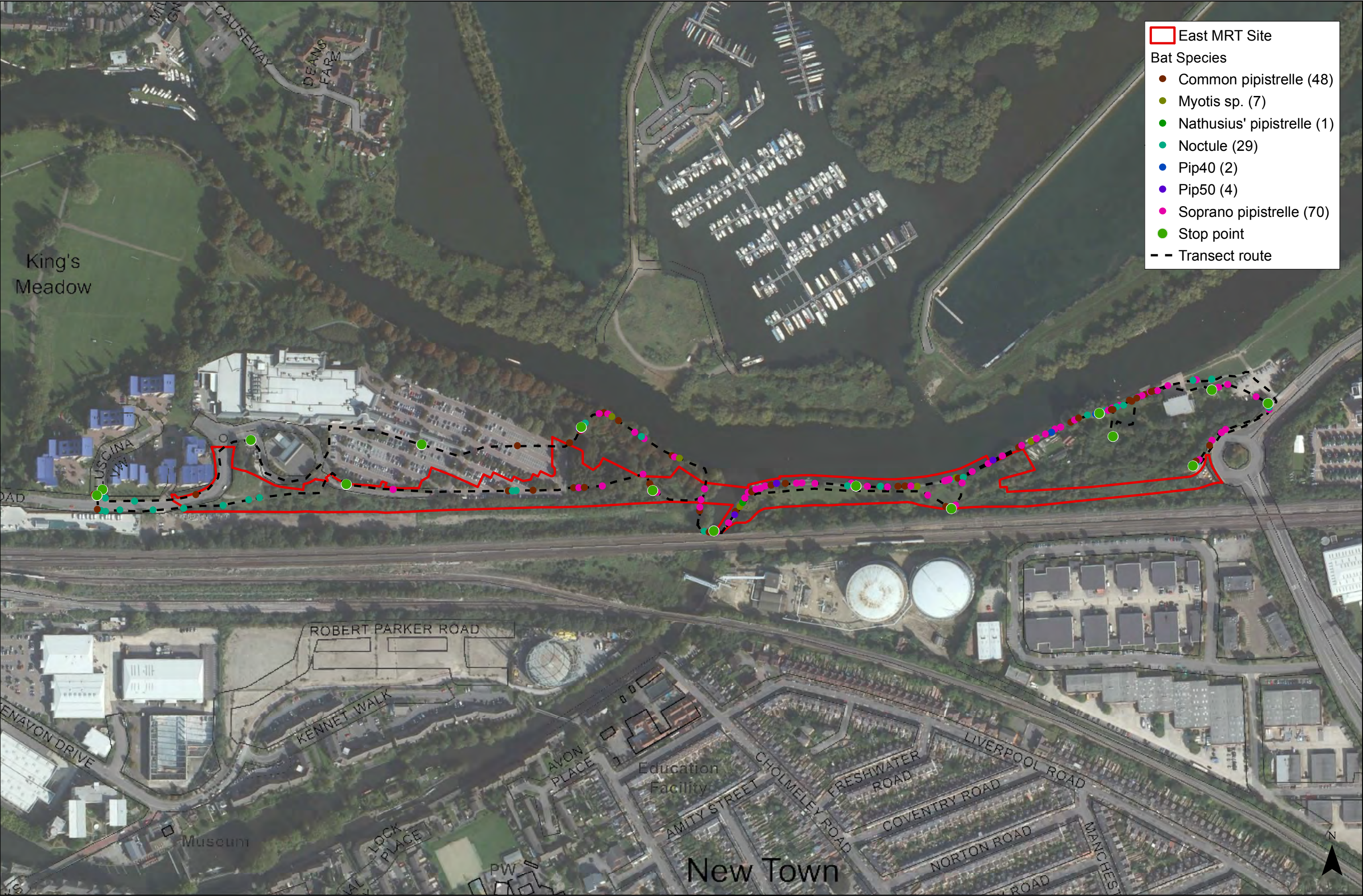
Figure 3: Activity Transect Route and Automated Static Detector Locations

Figure 4: Ground Level Tree Assessment Results

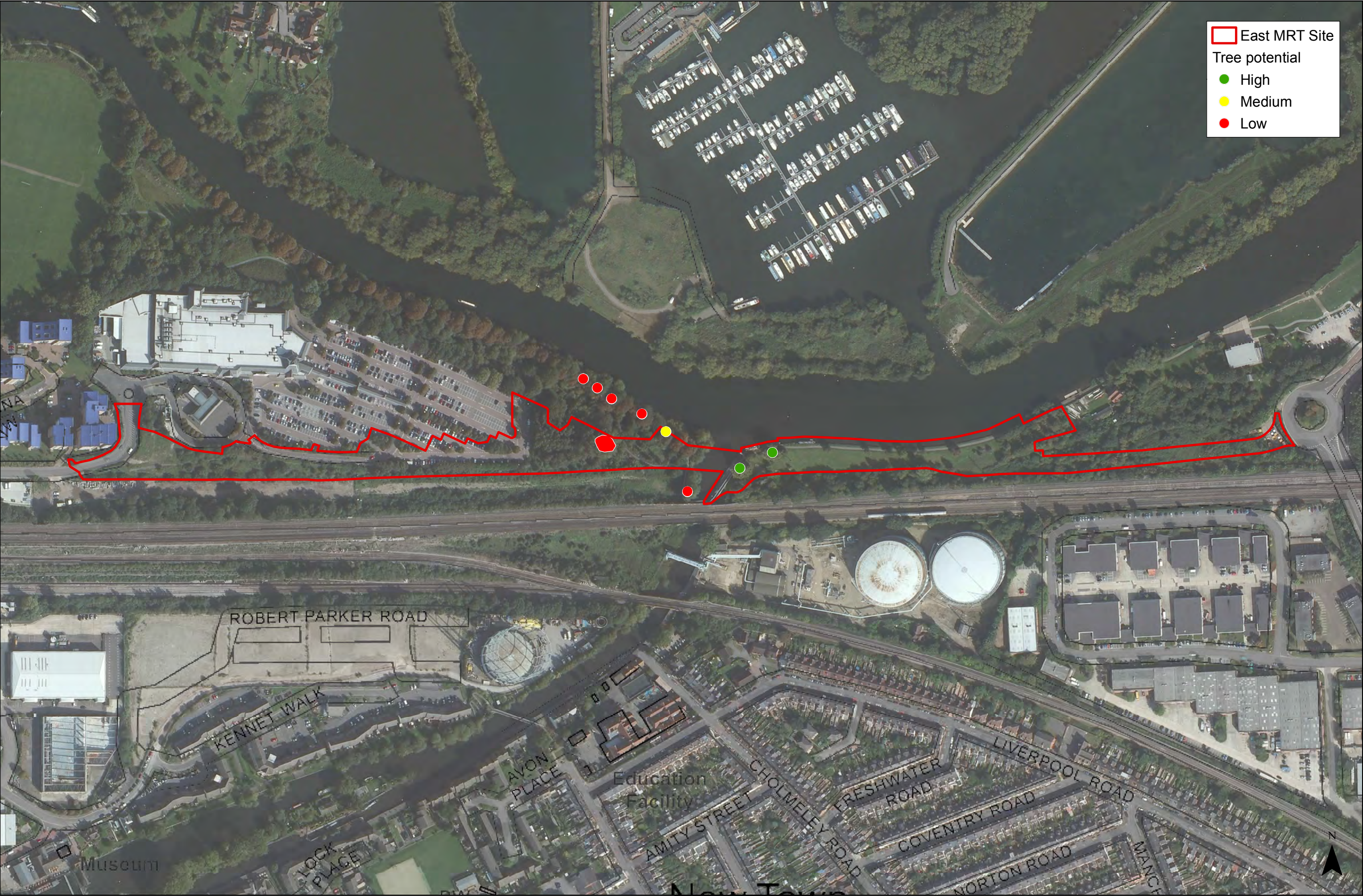
Figure 5: Activity Transect Survey Results

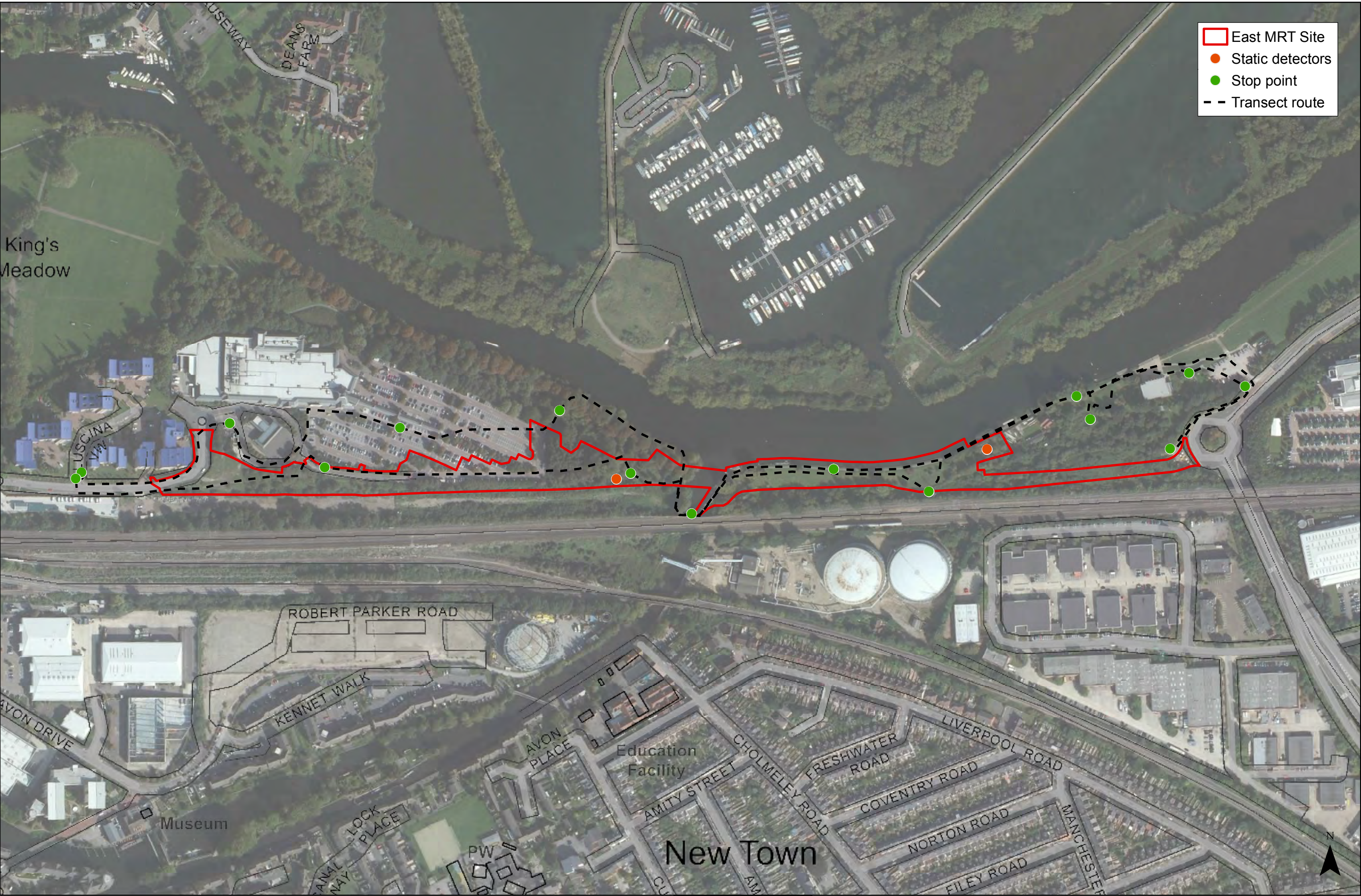






- East MRT Site
- Bat Species
- Common pipistrelle (48)
 - Myotis sp. (7)
 - Nathusius' pipistrelle (1)
 - Noctule (29)
 - Pip40 (2)
 - Pip50 (4)
 - Soprano pipistrelle (70)
 - Stop point
 - - Transect route





- East MRT Site
- Static detectors
- Stop point
- - Transect route

Appendix A Summaries of Relevant Legislation and Planning Policy

A.1 Overview

- A.1.1 This section briefly summarises the relevant planning policies and legislation pertaining to species (bats) mentioned within this report. Please note that the following text does not constitute legal advice.

A.2 National Planning Policy Framework

- A.2.1 The National Planning Policy Framework (NPPF) sets out how the planning system should protect and enhance nature conservation interests. It consolidates previous planning guidance (including Planning Policy Statement 9 (PPS9), the previous guidance on the protection of biodiversity through the planning system) into a single document. A key function of the NPPF is to promote a presumption in favour of sustainable development whilst ensuring that planning decisions should protect, and try to improve, wildlife and the habitats they live in. The framework sets out nationally important issues whilst leaving other planning matters to be decided upon by local authorities and communities through the presumption of sustainable development.

- The NPPF (paragraph 109) states that, *“The planning system should contribute to and enhance the natural and local environment by: Protecting and enhancing valued landscapes, geological conservation interests and soils;*
- *Minimising impacts on biodiversity and providing net gains in biodiversity, where possible contributing to the Government’s commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures; and*
- *Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability”.*

- A.2.2 The National Planning Policy Framework (NPPF) sets out how the planning system should protect and enhance nature conservation interests. It consolidates previous planning guidance (including Planning Policy Statement 9 (PPS9), the previous guidance on the protection of biodiversity through the planning system) into a single document. A key function of the NPPF is to promote a presumption in favour of sustainable development whilst ensuring that planning decisions should protect, and try to improve, wildlife and the habitats they live in. The framework sets out nationally important issues whilst leaving other planning matters to be decided upon by local authorities and communities through the presumption of sustainable development.

- A.2.3 The NPPF (paragraph 109) states that, *“The planning system should contribute to and enhance the natural and local environment by:*

- *Protecting and enhancing valued landscapes, geological conservation interests and soils;*
- *Recognising the wider benefits of ecosystem services;*
- *Minimising impacts on biodiversity and providing net gains in biodiversity, where possible contributing to the Government’s commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;*

- *Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and*
 - *Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."*
- A.2.4 The NPPF also states that *"When determining planning applications, local planning authorities should aim to conserve and enhance biodiversity by applying the following principles:*
- *If significant harm resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;*
 - *Proposed development on land within or outside a Site of Special Scientific Interest (SSSI) likely to have an adverse effect on a SSSI (either individually or in combination with other developments) should not normally be permitted. Where an adverse effect on the site's notified special interest features is likely, an exception should only be made where the benefits of the development, clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of SSSIs;*
 - *Development proposals where the primary objective is to conserve or enhance biodiversity should be permitted;*
 - *Opportunities to incorporate biodiversity in and around developments should be encouraged; and*
 - *Planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss".*
- A.2.5 The Government launched new Planning Practice Guidance to support the NPPF on 6 March 2014. The Guidance on the Natural Environment (ID:8) states that information on biodiversity impacts and opportunities should inform all stages of development. It refers to guidance in Government Circular 06/2005 (ODPM, 2005) with regards to protected species. Paragraph 99 of the Circular states "It is essential that the presence or otherwise of protected species, and the extent that they may be affected by the proposed development, is established before the planning permission is granted, otherwise all relevant material considerations may not have been addressed in making the decision."
- A.2.6 The Planning Practice Guidance reiterates section 40 of the NERC Act 2006, which places a duty on all public authorities in England and Wales to have regard, in the exercise of their functions, to the purpose of conserving biodiversity. Paragraph 117 of the NPPF also states that local authorities should seek to promote the preservation, restoration and re-creation of priority habitats and recovery of priority species populations, linked to national and local targets, through planning policies. Priority habitats and species referred to in the NPPF relate to species and habitats of principle importance listed in accordance with Section 41 of the NERC Act, 2006.

A.3 Local Planning Policy

- A.3.1 The site is located partially within Reading Borough and partially within Wokingham Borough; as such, the relevant planning policy for each borough has been outlined below.

Reading Borough Local Development Framework: Core Strategy

- A.3.2 Reading Borough Local Development Framework: Core Strategy was adopted in January 2008, with alterations adopted on 27th January 2015. This document sets out the overall planning strategy and important principles for development.
- A.3.3 'Living within Environmental Limits' is one of the five 'Guiding Principles' set out within the strategy. This sets out the Environmental Objectives for the borough which include: '*Value, protect and enhance the amount and diversity of habitat and wildlife and other contributors to natural diversity*'.
- A.3.4 Policies contained within the Core Strategy of particular relevance to protected species include the following:
- A.3.5 Policy CS36: Biodiversity and Geology:

- (a) *Development should retain, protect and incorporate features of biodiversity or geological interest (including protected species and their habitats) found within the application site into their schemes.*

On sites with recognised biodiversity or geological value, development will not be permitted where there would be a direct or indirect adverse impact on the site, unless it can be clearly demonstrated that: -

- *The need for development clearly outweighs the need to protect the value of the site; and*
 - *Appropriate compensation, impact minimisation, mitigation and compensation are provided.*
- (b) *Local Nature Reserves and Wildlife Heritage Sites will be safeguarded and where possible, enhanced. Permission will not be granted for any development that would adversely affect a designated nature reserve or Wildlife Heritage Site.*
- (c) *Any development that would sever or threaten the integrity of an established wildlife link, as indicated on an adopted proposals map, will not be permitted. Where applicable, developments should be designed to protect, consolidate, extend and enhance the network of wildlife links and corridors in and adjoining the Borough, working with neighbouring authorities where appropriate.*

Reading Borough Council: Local Plan (Proposed)

- A.3.6 Reading Borough Council Local Plan was released as a draft document for consultation on 1st May 2017.
- A.3.7 EN12: Biodiversity and the Green Network

The identified Green Network, the key elements of which are shown on the Proposals Map, shall be maintained, protected, consolidated, extended and enhanced. Permission will not be granted for development that affects the sites with identified interest or fragments the overall network. The Green Network comprises:

- *Sites with identified biodiversity interest - Local Wildlife Sites, Local Nature Reserves, Biodiversity Opportunity Areas, protected and priority species and their habitats, Priority and Biodiversity Action Plan habitats, and the River Thames and its tributaries (including the River Kennet and the Kennet and Avon Canal); and*
- *Areas with potential for biodiversity value and which stitch the Green Network together – designated Local Green Space and open spaces, and existing and potential Green Links.*

New development shall demonstrate how the location and type of open space, landscaping and water features provided within a scheme have been arranged such that they maintain or link into the existing Green Network and contribute to its consolidation. Such features should be designed to maximise the opportunities for enhancing this network. All new development

should maximise opportunities to create new assets and links into areas where opportunities are as yet unidentified on the Proposals Map.

On all sites, development should not result in a net loss of biodiversity and geodiversity, and should provide a net gain for biodiversity wherever possible. Development should:

- Protect and where possible enhance features of biodiversity interest on and adjacent to the application site, incorporating and integrating them into development proposals where practicable; and*
- Provide new tree planting, wildlife friendly landscaping and ecological enhancements (such as wildlife ponds, bird and bat boxes) where practicable.*

In exceptional circumstances where the need for development clearly outweighs the need to protect the value of the site, and it is demonstrated that the impacts cannot be: 1) avoided; 2) mitigated or; 3) compensated for on-site; then new development will provide off-site compensation to ensure that there is “no net loss” of biodiversity. Provision of off-site compensation shall be calculated in accordance with nationally or locally recognised guidance and metrics.

Wokingham Borough Council: Local Development Framework - Adopted Core Strategy

A.3.8 Wokingham Borough Council Core Strategy policy document determines the future development of the borough until March 2026. Policies contained within the Core Strategy of particular relevance to this scheme include the following:

A.3.9 CP3: General Principles for Development:

Planning permission will be granted for development proposals that comply with the following, (of relevance to this report):

- Have no detrimental impact upon important ecological, heritage, landscape (including river valleys) or geological features or water courses; and*
- Maintain or enhance the ability of the site to support fauna and flora including protected species.*

A.3.10 CP7: Biodiversity:

Sites designated as of importance for nature conservation at an international or national level will be conserved and enhanced and inappropriate development will be resisted. The degree of protection given will be appropriate to the status of the site in terms of its international or national importance.

Development:

- (a) Which may harm county designated sites (Local Wildlife Sites in Berkshire), whether directly or indirectly, or*
- (b) Which may harm habitats or, species of principle importance in England for nature conservation, veteran trees or features of the landscape that are of major importance for wild flora and fauna (including wildlife and river corridors), whether directly or indirectly, or*
- (c) That compromises the implementation of the national, regional, county and local biodiversity action plans*

Will be only permitted if it has been clearly demonstrated that the need for the proposal outweighs the need to safeguard the nature conservation importance, that no alternative site that would result in less or no harm is available which will meet the need, and:

- Mitigation measures can be put in place to prevent damaging impacts; or*
- Appropriate compensation measures to offset the scale and kind of losses are provided.*

A.4 European Legislation

A.4.1 The original (1994) “*Habitat Regulations*” transposed the EC Habitats Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (Council Directive 92/43/EEC) into national law. The Conservation of Habitats and Species Regulations 2010 (as amended) consolidates the various amendments that have been made to the Regulations.

A.4.2 “*European protected species*” (EPS) are those which are present on Schedule 2 of the Conservation of Habitats and Species Regulations 2010 (as amended); this includes all UK bats. These species are subject to the provisions of Regulation 41 of those Regulations. All EPS are also protected under the Wildlife and Countryside Act 1981 (as amended). Taken together, these pieces of legislation make it an offence to:

- Intentionally or deliberately capture, injure or kill any wild animal included amongst these species
- Possess or control any live or dead specimens or any part of, or anything derived from these species
- deliberately disturb wild animals of any such species
- deliberately take or destroy the eggs of such an animal, or
- intentionally, deliberately or recklessly damage or destroy a breeding site or resting place of such an animal, or obstruct access to such a place

A.4.3 For the purposes of paragraph (c), disturbance of animals includes in particular any disturbance which is likely—

- to impair their ability to survive, to breed or reproduce, or to rear or nurture their young,
- or in the case of animals of a hibernating or migratory species, to hibernate or migrate; or
- to affect significantly the local distribution or abundance of the species to which they belong.

A.4.4 Although the law provides strict protection to these species, it also allows this protection to be set aside (derogation) through the issuing of licences. The licences in England are currently determined by Natural England (NE) for development works. In accordance with the requirements of the Regulations (2010), a licence can only be issued where the following requirements are satisfied:

- The proposal is necessary ‘*to preserve public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment*’
- ‘*There is no satisfactory alternative*’
- The proposals ‘*will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range*’.

Appendix B Photographs

Photograph 1: Tree Group G115 showing a selection of the woodpecker holes present



Photograph 2: A wren observed using one of the woodpecker holes as a night roost.



Appendix C Ground Level Tree Assessment Results

Table 4: Ground Level Tree Assessment Results

Tree/Tree Group No.	Species	Height (m)	Stem count	DBH (cm)	Crown clearance height (m)	Life stage	Physical condition	Retention category	Roosting features	Bat Rooting Potential
T53	Smooth leaved elm <i>Ulmus minor</i>	8.0	2	35	3	Mature	Poor	C	Dense ivy cover	Low
T88	Weeping willow <i>Salix x sepulcralis</i>	16	1	102	2	Mature	Fair	B	Multiple rot holes	High
T91	Weeping willow <i>Salix x sepulcralis</i>	15	1	97	2	Mature	Fair	B	Dense ivy, deadwood in canopy and some rot holes	High
G115	Railway poplar <i>Populus x Canadensis</i> "Aurea" x 3 trees	29	1	94	0	Mature	Fair	B	Dead wood and woodpecker holes	High
T136	Horse chestnut <i>Aesculus hippocastanum</i>	15	2	80	2	Mature	Poor	U	Rot holes and cavities close to ground level	Low
T146	Ash <i>Fraxinus excelsior</i>	24	1	90	5	Early mature	Fair	C	Small cavity on trunk and some lifted bark	Low
T151	Horse chestnut <i>Aesculus hippocastanum</i>	24	1	88	1	Mature	-	B	Small split in trunk and lifted bark	Low
T153	Horse chestnut <i>Aesculus hippocastanum</i>	25	1	70	1	Mature	Good	A	Rot hole	Low

Bat Survey Report
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Tree/Tree Group No.	Species	Height (m)	Stem count	DBH (cm)	Crown clearance height (m)	Life stage	Physical condition	Retention category	Roosting features	Bat Rooting Potential
T163	Horse chestnut <i>Aesculus hippocastanum</i>	24	1	103	2	Mature	Poor	U	Rot hole and cavity close to ground	Medium
T180	Crack willow <i>Salix fragilis</i>	16	1	76	3	Early mature	Fair	C	Open cavity in trunk 1 m from ground level	Low

Appendix D Bat Activity Survey Results

Table 5: Bat Species Recorded (and number of soundfiles) during the Walked Transect

Month	<i>Myotis</i> spp.	Noctule	Common pipistrelle/ Nathusius pipistrelle (40kHz)	Common pipistrelle	Soprano pipistrelle	Common pipistrelle/ Soprano pipistrelle (50kHz)	Nathusius' pipistrelle	Grand Total
May	3	23	1	52	81	16	4	180
June	2	0	0	26	37	9	0	74
July (Dusk)	0	32	0	11	20	2	0	65
July (Dawn)	0	31	0	25	56	6	0	118
August	4	13	1	9	20	0	0	47
September	0	37	0	10	42	4	0	93
Grand Total	9	136	2	133	256	37	4	577
% Total	1.56	23.57	0.35	23.05	44.37	6.41	1.96	100

Appendix E Automated Static Detector Survey Results

Table 6: Automated Static Detector Survey Results

Season	Species												
	Detector	<i>Myotis</i> sp.	Noctule	<i>Nyctalus</i> sp.	Serotine	<i>Nathusius</i> 'p ipistrelle	Common pipistrelle/ <i>Nathusius</i> pipistrelle (40kHz)	Common pipistrelle	Common pipistrelle/ soprano pipistrelle (50kHz)	Soprano pipistrelle	Barbastelle	Leisler's	Grand Total
May	S1	1	54	0	0	9	5	688	55	241	0	0	1053
	S2	4	77	0	0	2	4	237	17	106	0	0	447
May Total		5	131	0	0	11	9	925	72	347	0	0	1500
June	S1	3	34	0	0	1	1	77	1	16	0	0	133
	S2	0	69	0	0	0	2	28	5	5	0	0	109
June Total		3	103	0	0	1	3	105	6	21	0	0	242
July	S1	0	17	0	0	0	1	10	0	6	0	0	34
	S2	0	30	0	0	0	0	0	0	2	0	0	32
July Total		0	47	0	0	0	1	10	0	8	0	0	66
August	S1	3	295	4	2	2	1	89	6	93	0	0	495
	S2	2	68	0	0	0	0	17	4	32	0	0	123
August Total		5	363	4	2	2	1	106	10	125	0	0	618
September	S1	1	136	2	1	40	9	58	19	149	1	1	417
	S2	1	99	1	0	20	4	22	12	57	0	2	218
September Total		2	235	3	1	60	13	80	31	206	1	3	635
October	S1	0	4	0	0	20	1	18	1	10	0	0	54
	S2	0	5	0	0	1	3	12	1	70	0	0	92
October Total		0	9	0	0	21	4	30	2	80	0	0	146
Grand Total		15	888	7	3	95	31	1256	121	787	1	3	3207
Percentage (of total)		0.47	27.69	0.22	0.09	2.96	0.97	39.17	3.77	24.54	0.03	0.09	100

Appendix F Dusk Emergence/Dawn Re-entry Survey Results

F.1 Detailed Survey Data

Table 7: Dusk Survey Location L1, 14th June 2016, Ed Austin

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
21:40	Noctule	2	00:18	N
21:44	Pip55	1	00:22	N
21:48	Pip55	9	00:26	N
21:49	Pip55	6	00:27	N
21:50	Pip55	6	00:28	N
21:51	Pip55	8	00:29	N
21:52	Pip55	5	00:30	N
21:53	Pip55	5	00:31	N
21:54	Pip55	4	00:32	N
21:55	Pip55	5	00:33	N
21:56	Pip45	1	00:34	N
21:56	Pip50	3	00:34	N
21:56	Pip55	1	00:34	N
21:57	Pip50	1	00:35	N
21:57	Pip55	2	00:35	N
22:00	Pip50	1	00:38	N
22:02	Pip55	1	00:40	N
22:04	Pip55	1	00:42	N
22:05	Pip55	1	00:43	N
22:06	Pip45	3	00:44	N
22:06	Pip55	4	00:44	N
22:07	Pip45	5	00:45	N
22:07	Pip50	2	00:45	N
22:07	Pip55	3	00:45	N
22:08	Pip45	4	00:46	N
22:08	Pip50	2	00:46	N
22:08	Pip55	1	00:46	N
22:09	Myotis	2	00:47	N
22:09	Noctule	2	00:47	N
22:09	Pip45	5	00:47	N
22:09	Pip55	2	00:47	N
22:10	Pip55	1	00:48	N
22:11	Pip55	3	00:49	N
22:12	Myotis	3	00:50	N
22:12	Pip45	1	00:50	N
22:12	Pip55	7	00:50	N
22:13	Myotis	3	00:51	N

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
22:13	Pip45	7	00:51	N
22:13	Pip55	2	00:51	N
22:14	Myotis	2	00:52	N
22:14	Pip45	6	00:52	N
22:14	Pip55	5	00:52	N
22:15	Myotis	4	00:53	N
22:15	Pip45	4	00:53	N
22:15	Pip55	4	00:53	N
22:16	Myotis	3	00:54	N
22:16	Pip45	3	00:54	N
22:16	Pip55	6	00:54	N
22:17	Myotis	3	00:55	N
22:17	Pip45	3	00:55	N
22:17	Pip55	4	00:55	N
22:18	Myotis	3	00:56	N
22:18	Pip45	5	00:56	N
22:18	Pip55	6	00:56	N
22:19	Myotis	4	00:57	N
22:19	Pip45	6	00:57	N
22:19	Pip55	5	00:57	N
22:20	Myotis	2	00:58	N
22:20	Pip45	6	00:58	N
22:20	Pip55	3	00:58	N
22:21	Myotis	2	00:59	N
22:21	Pip45	4	00:59	N
22:21	Pip55	4	00:59	N
22:22	Myotis	1	01:00	N
22:22	Pip45	7	01:00	N
22:22	Pip55	8	01:00	N
22:23	Myotis	1	01:01	N
22:23	Pip45	3	01:01	N
22:23	Pip55	8	01:01	N
22:24	Myotis	3	01:02	N
22:24	Pip45	2	01:02	N
22:24	Pip55	8	01:02	N
22:25	Myotis	2	01:03	N
22:25	Pip45	3	01:03	N
22:25	Pip55	5	01:03	N
22:26	Myotis	1	01:04	N
22:26	Noctule	1	01:04	N
22:26	Pip45	1	01:04	N
22:26	Pip55	9	01:04	N
22:27	Pip45	2	01:05	N
22:27	Pip50	2	01:05	N
22:27	Pip55	7	01:05	N
22:28	Myotis	2	01:06	N

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
22:28	Pip45	2	01:06	N
22:28	Pip50	3	01:06	N
22:28	Pip55	4	01:06	N
22:29	Myotis	3	01:07	N
22:29	Pip45	1	01:07	N
22:29	Pip55	8	01:07	N
22:30	Myotis	2	01:08	N
22:30	Pip45	1	01:08	N
22:30	Pip50	1	01:08	N
22:30	Pip55	7	01:08	N
22:31	Myotis	2	01:09	N
22:31	Pip45	2	01:09	N
22:31	Pip50	1	01:09	N
22:31	Pip55	6	01:09	N
22:32	Myotis	2	01:10	N
22:32	Pip45	7	01:10	N
22:32	Pip55	3	01:10	N
22:33	Myotis	2	01:11	N
22:33	Pip45	5	01:11	N
22:33	Pip55	1	01:11	N
22:34	Myotis	4	01:12	N
22:34	Pip45	6	01:12	N
22:34	Pip55	6	01:12	N
22:35	Myotis	2	01:13	N
22:35	Pip45	4	01:13	N
22:35	Pip55	4	01:13	N
22:36	Myotis	2	01:14	N
22:36	Pip45	6	01:14	N
22:36	Pip55	1	01:14	N
22:37	Myotis	2	01:15	N
22:37	Pip45	8	01:15	N
22:37	Pip55	1	01:15	N
22:38	Myotis	5	01:16	N
22:38	Pip45	5	01:16	N
22:39	Myotis	2	01:17	N
22:39	Pip45	8	01:17	N
22:40	Myotis	1	01:18	N
22:40	Pip45	5	01:18	N
22:40	Pip55	1	01:18	N
22:41	Myotis	2	01:19	N
22:41	Pip45	5	01:19	N
22:41	Pip55	1	01:19	N
22:42	Myotis	2	01:20	N
22:42	Pip45	6	01:20	N
22:42	Pip55	1	01:20	N
22:44	Myotis	2	01:22	N

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
22:44	Pip45	2	01:22	N
22:44	Pip50	2	01:22	N
22:44	Pip55	2	01:22	N
22:45	Myotis	1	01:23	N
22:45	Pip45	3	01:23	N
22:45	Pip55	3	01:23	N
22:46	Myotis	3	01:24	N
22:46	Pip45	8	01:24	N
22:46	Pip50	1	01:24	N
22:47	Myotis	2	01:25	N
22:47	Pip45	9	01:25	N
22:48	Myotis	2	01:26	N
22:48	Pip45	8	01:26	N
22:48	Pip55	2	01:26	N
22:49	Myotis	2	01:27	N
22:49	Pip45	9	01:27	N
22:49	Pip55	1	01:27	N
22:50	Myotis	1	01:28	N
22:50	Pip45	4	01:28	N
22:51	Myotis	2	01:29	N
22:51	Pip45	4	01:29	N
22:53	Myotis	3	01:31	N
22:53	Pip45	4	01:31	N
22:54	Myotis	5	01:32	N
22:54	Pip45	1	01:32	N
22:55	Myotis	2	01:33	N
22:55	Pip45	6	01:33	N
22:56	Pip45	7	01:34	N
22:56	Pip55	1	01:34	N
22:57	Myotis	2	01:35	N
22:57	Pip45	9	01:35	N
22:58	Myotis	3	01:36	N
22:58	Pip45	3	01:36	N
22:58	Pip55	1	01:36	N
22:59	Myotis	1	01:37	N
22:59	Pip45	5	01:37	N
23:00	Myotis	1	01:38	N
23:00	Pip45	8	01:38	N
23:01	Myotis	1	01:39	N

Table 8: Dusk Survey L2 14th June 2016, Natalie White

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
21:43	Noctule	1	00:21	N
21:44	Noctule	1	00:22	N
21:47	Noctule	1	00:25	N
21:48	Noctule	1	00:26	N

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
21:53	Pip55	1	00:31	N
21:55	Noctule	1	00:33	N
21:58	Noctule	2	00:36	N
21:58	Pip55	1	00:36	N
21:59	Noctule	1	00:37	N
22:00	Noctule	2	00:38	N
22:02	Noctule	1	00:40	N
22:03	Noctule	1	00:41	N
22:04	Noctule	1	00:42	N
22:05	Noctule	2	00:43	N
22:08	Noctule	1	00:46	N
22:10	Noctule	2	00:48	N
22:12	Noctule	3	00:50	N
22:13	Noctule	3	00:51	N
22:13	Pip45	3	00:51	N
22:14	Noctule	1	00:52	N
22:15	Myotis	2	00:53	N
22:15	Noctule	1	00:53	N
22:16	Noctule	2	00:54	N
22:17	Noctule	3	00:55	N
22:19	Myotis	2	00:57	N
22:21	Myotis	2	00:59	N
22:21	Pip45	1	00:59	N
22:21	Pip55	1	00:59	N
22:22	Myotis	2	01:00	N
22:22	Pip55	1	01:00	N
22:23	Myotis	2	01:01	N
22:23	Pip45	1	01:01	N
22:23	Pip55	1	01:01	N
22:24	Myotis	1	01:02	N
22:24	Noctule	1	01:02	N
22:25	Noctule	2	01:03	N
22:25	Pip45	1	01:03	N
22:26	Noctule	1	01:04	N
22:27	Pip45	1	01:05	N
22:27	Pip55	1	01:05	N
22:28	Pip45	1	01:06	N
22:29	Myotis	2	01:07	N
22:29	Pip45	1	01:07	N
22:30	Noctule	2	01:08	N
22:31	Pip45	2	01:09	N
22:32	Pip45	2	01:10	N
22:32	Pip55	3	01:10	N
22:33	Myotis	1	01:11	N
22:33	Pip45	2	01:11	N
22:33	Pip55	1	01:11	N
22:34	Pip55	3	01:12	N
22:35	Pip55	1	01:13	N
22:36	Pip45	1	01:14	N
22:36	Pip55	1	01:14	N
22:37	Pip55	1	01:15	N
22:38	Myotis	2	01:16	N
22:39	Pip45	1	01:17	N
22:41	Pip55	1	01:19	N
22:43	Myotis	1	01:21	N
22:43	Pip50	1	01:21	N
22:44	Myotis	1	01:22	N
22:45	Myotis	1	01:23	N

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
22:45	Pip40	1	01:23	N
22:46	Pip45	1	01:24	N
22:47	Myotis	1	01:25	N
22:49	Pip45	2	01:27	N
22:50	Myotis	2	01:28	N
22:50	Pip45	3	01:28	N
22:51	Myotis	1	01:29	N
22:51	Pip45	2	01:29	N
22:52	Pip45	1	01:30	N
22:52	Pip55	1	01:30	N
22:53	Myotis	1	01:31	N
22:54	Pip45	1	01:32	N
22:55	Myotis	3	01:33	N
22:55	Pip45	1	01:33	N
22:56	Pip45	1	01:34	N
22:57	Myotis	1	01:35	N
22:59	Myotis	1	01:37	N
22:59	Pip45	2	01:37	N
23:00	Pip55	1	01:38	N
23:01	Myotis	1	01:39	N
23:01	Pip45	2	01:39	N
23:02	Pip45	1	01:40	N
23:03	Pip45	1	01:41	N
23:04	Pip45	1	01:42	N
23:04	Pip55	1	01:42	N
23:05	Pip45	4	01:43	N
23:06	Pip45	3	01:44	N
23:07	Pip45	1	01:45	N

Table 9: Dusk Survey L3 14th June 2016, Stephen Foot

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
21:57	Pip55	1	00:35	N
22:12	Pip45	3	00:50	N
22:12	Pip50	2	00:50	N
22:12	Pip55	3	00:50	N
22:13	Myotis	1	00:51	N
22:13	Noctule	2	00:51	N
22:13	Pip45	1	00:51	N
22:13	Pip55	1	00:51	N
22:14	Myotis	4	00:52	N
22:14	Pip45	2	00:52	N
22:14	Pip50	1	00:52	N
22:14	Pip55	1	00:52	N
22:15	Myotis	1	00:53	N
22:15	Pip45	1	00:53	N
22:15	Pip55	4	00:53	N
22:16	Pip45	1	00:54	N
22:16	Pip55	2	00:54	N
22:17	Myotis	3	00:55	N
22:17	Pip45	4	00:55	N
22:18	Myotis	3	00:56	N

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
22:18	Pip45	1	00:56	N
22:18	Pip55	1	00:56	N
22:19	Myotis	2	00:57	N
22:19	Pip45	3	00:57	N
22:19	Pip55	1	00:57	N
22:20	Myotis	2	00:58	N
22:21	Pip45	1	00:59	N
22:22	Myotis	1	01:00	N
22:22	Pip45	1	01:00	N
22:22	Pip55	2	01:00	N
22:23	Myotis	1	01:01	N
22:25	Myotis	1	01:03	N
22:25	Pip45	1	01:03	N
22:25	Pip55	1	01:03	N
22:26	Myotis	2	01:04	N
22:26	Noctule	1	01:04	N
22:26	Pip45	3	01:04	N
22:26	Pip55	1	01:04	N
22:27	Myotis	1	01:05	N
22:27	Pip55	4	01:05	N
22:28	Noctule	3	01:06	N
22:28	Pip45	1	01:06	N
22:28	Pip50	1	01:06	N
22:28	Pip55	4	01:06	N
22:29	Pip55	2	01:07	N
22:30	Pip55	4	01:08	N
22:31	Noctule	1	01:09	N
22:31	Pip55	4	01:09	N
22:32	Pip50	1	01:10	N
22:34	Pip50	1	01:12	N
22:35	Pip45	1	01:13	N
22:39	Pip45	1	01:17	N
22:44	Pip55	1	01:22	N
22:45	Pip55	1	01:23	N
22:49	Pip45	2	01:27	N
22:49	Pip50	2	01:27	N
22:49	Pip55	1	01:27	N
22:50	Pip45	2	01:28	N
22:51	Pip45	5	01:29	N
22:52	Myotis	1	01:30	N
22:52	Pip45	5	01:30	N
22:54	Pip45	4	01:32	N
22:55	Pip45	4	01:33	N
22:58	Pip45	1	01:36	N
22:59	Pip45	1	01:37	N
23:00	Pip45	5	01:38	N

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
23:00	Pip55	1	01:38	N
23:01	Pip45	4	01:39	N
23:02	Pip45	7	01:40	N
23:03	Pip45	3	01:41	N
23:04	Pip45	5	01:42	N
23:05	Pip45	5	01:43	N

Table 10: Tree Group G115 Dawn Survey 4th August 2016, Stephen Foot

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
04:03	Pip45	1	01:30	N
04:11	Pip55	1	01:22	N
04:21	Pip45	2	01:12	N

Table 11: Tree Group G115 Dawn Survey 4th August 2016, Ed Austin

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
03:47	Pip55	1	01:46	N
03:56	Pip55	1	01:37	N
04:03	Pip45	2	01:30	N
04:10	Pip55	1	01:23	N
04:20	Pip45	2	01:13	N
04:53	Pip45	1	00:40	N
04:59	Pip45	1	00:34	N

Table 12: Tree T88 Dusk Survey 22nd August 2016, Stephen Foot

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
21:13	Noctule	1	01:02	N
21:14	Pip55	2	01:03	N
21:18	Pip50	2	01:07	N
21:20	Pip55	1	01:09	N
21:24	Pip50	1	01:13	N
21:48	Noctule	1	01:37	N
21:49	Noctule	1	01:38	N

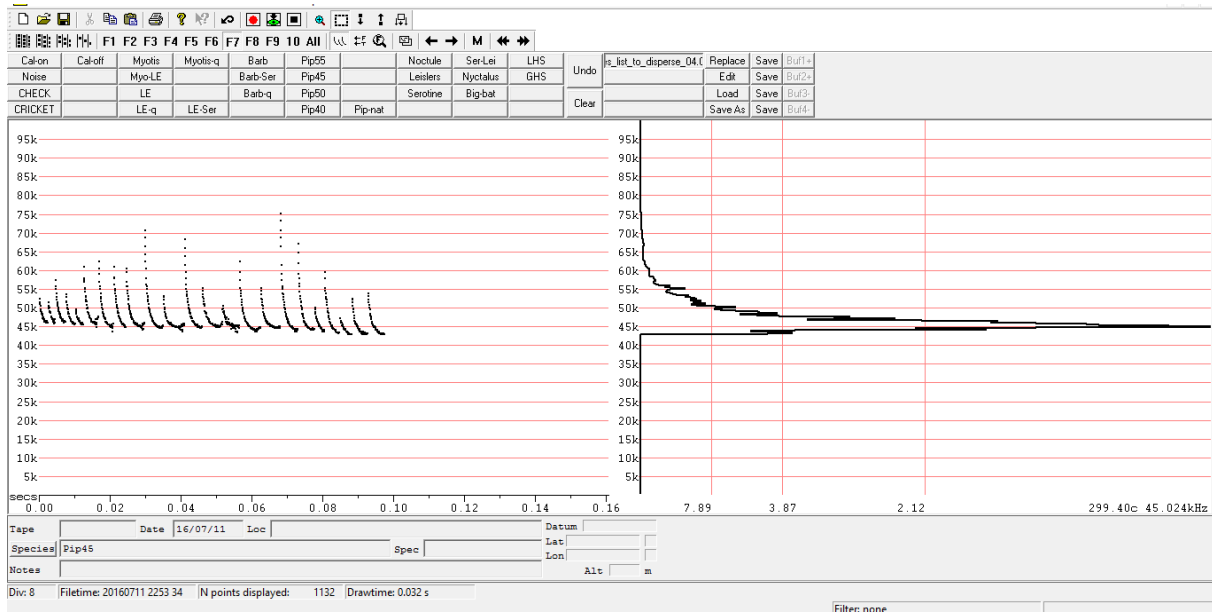
Table 13: Tree T91 Dusk Survey 22nd August 2016, Ed Austin

Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
20:46	Pip55	1	00:35	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
20:59	Noctule	1	00:48	N
21:02	Pip55	1	00:51	N
21:04	Pip55	1	00:53	N
21:04	Pip55	1	00:53	N

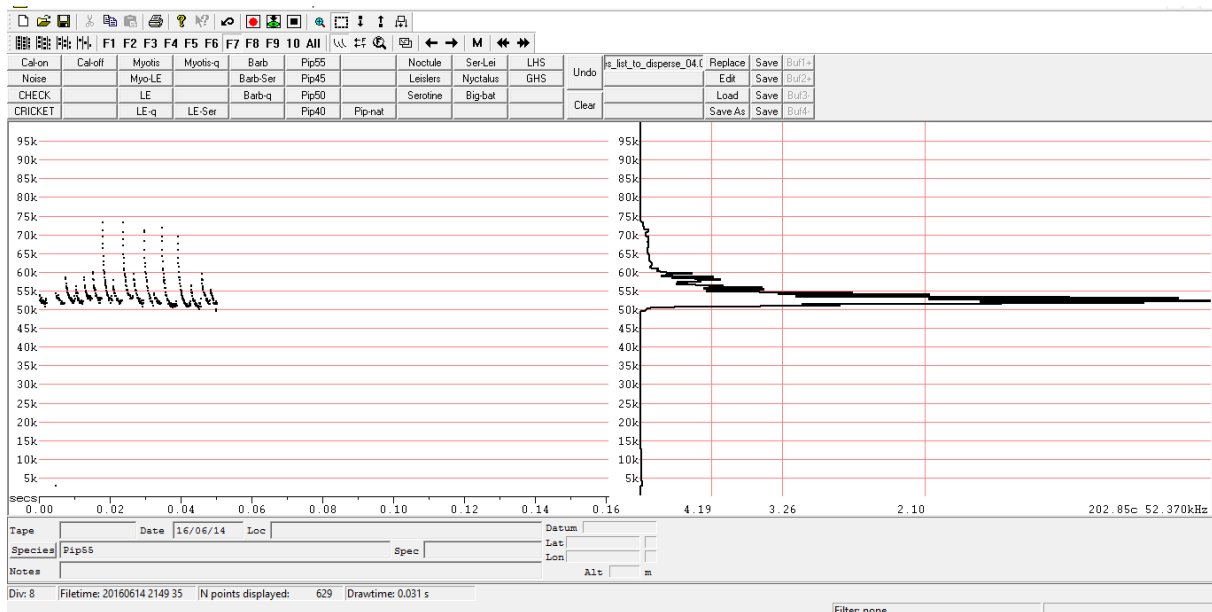
Time	Species	Number of Passes	Time before/after Sunset (hours and minutes)	Emerge/Return to Roost (Y/N)
21:10	Noctule	1	00:59	N
21:10	Noctule	1	00:59	N
21:12	Noctule	1	01:01	N
21:12	Noctule	1	01:01	N
21:13	Noctule	1	01:02	N
21:13	Noctule	1	01:02	N
21:13	Noctule	1	01:02	N
21:13	Noctule	1	01:02	N
21:14	Pip55	1	01:03	N
21:14	Pip55	1	01:03	N
21:17	Pip55	1	01:06	N
21:17	Pip55	1	01:06	N
21:21	Pip55	1	01:10	N
21:21	Noctule	1	01:10	N
21:21	Noctule	1	01:10	N
21:22	Pip55	1	01:11	N
21:22	Pip55	1	01:11	N
21:24	Noctule	1	01:13	N
21:24	Pip55	1	01:13	N
21:24	Pip55	1	01:13	N
21:24	Pip55	1	01:13	N
21:26	Noctule	1	01:15	N
21:27	Noctule	1	01:16	N
21:28	Pip45	1	01:17	N
21:31	Pip45	1	01:20	N
21:33	Pip-Nat	1	01:22	N
21:33	Pip-Nat	1	01:22	N
21:40	Pip55	1	01:29	N
21:42	Noctule	1	01:31	N
21:42	Noctule	1	01:31	N
21:48	Noctule	1	01:37	N
21:48	Noctule	1	01:37	N
21:48	Noctule	1	01:37	N
21:51	Pip55	1	01:40	N
21:52	Noctule	1	01:41	N
21:52	Pip55	1	01:41	N
21:52	Pip55	1	01:41	N
21:54	Pip55	1	01:43	N

F.2 Example Sonograms of Species Recorded

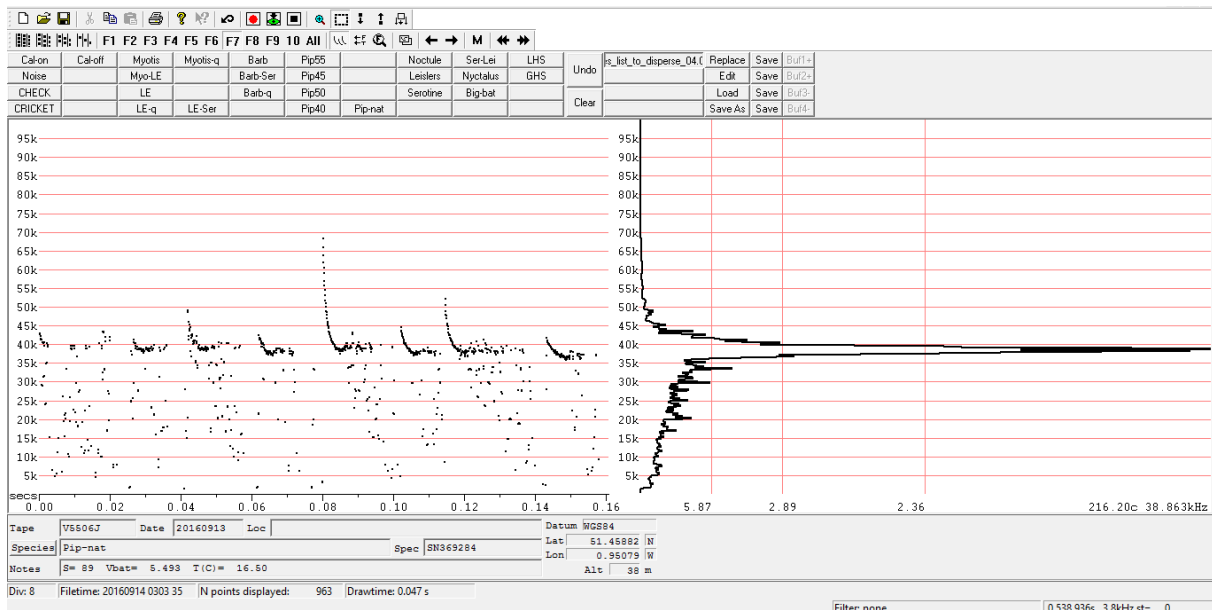
Common pipistrelle recorded during the dusk activity transect survey on 11th July



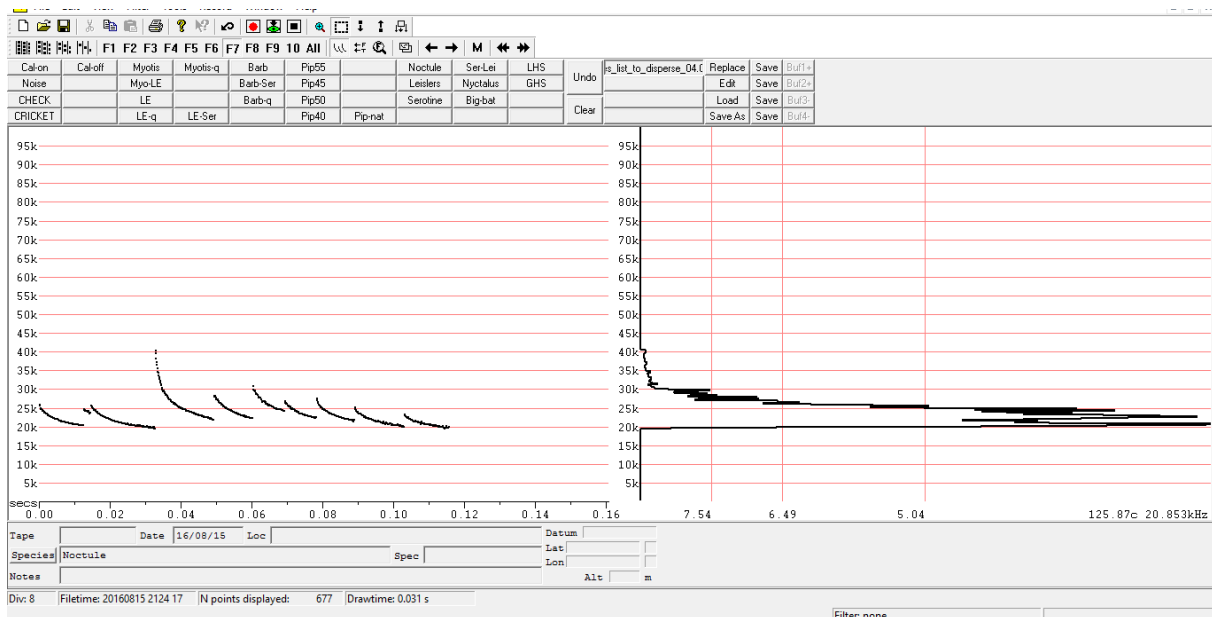
Soprano pipistrelle recorded during the dusk emergence survey of the horseshoe bridge on 14th June



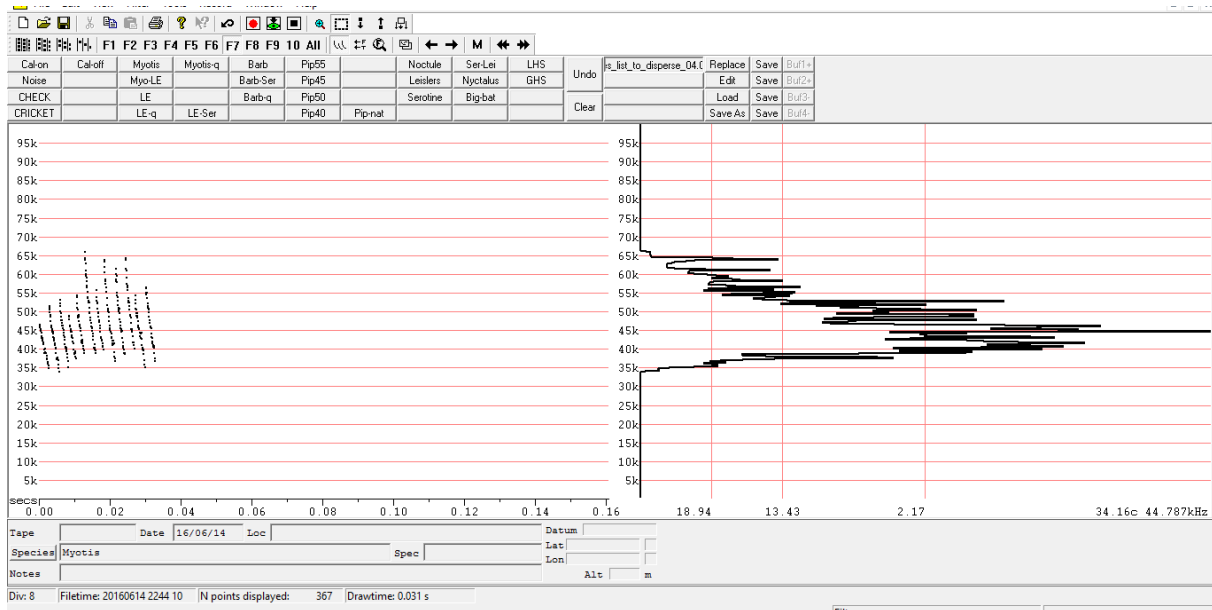
Nathusius' pipistrelle recorded at detector S1 during the September suite of surveys



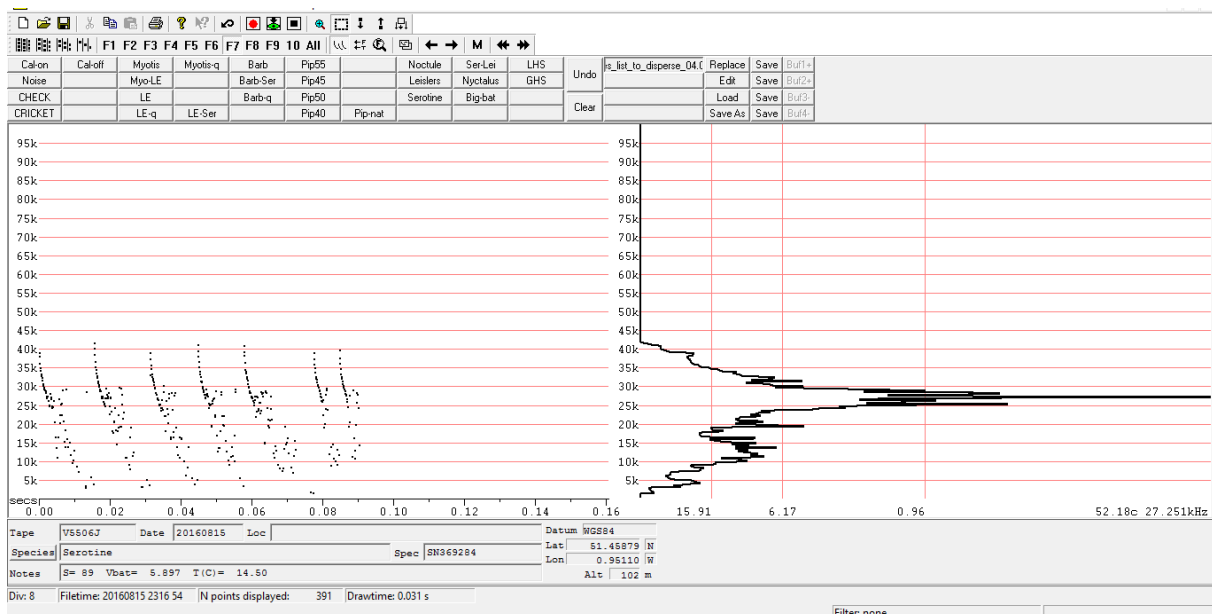
Noctule bat recorded foraging over street lights on dusk activity transect in August



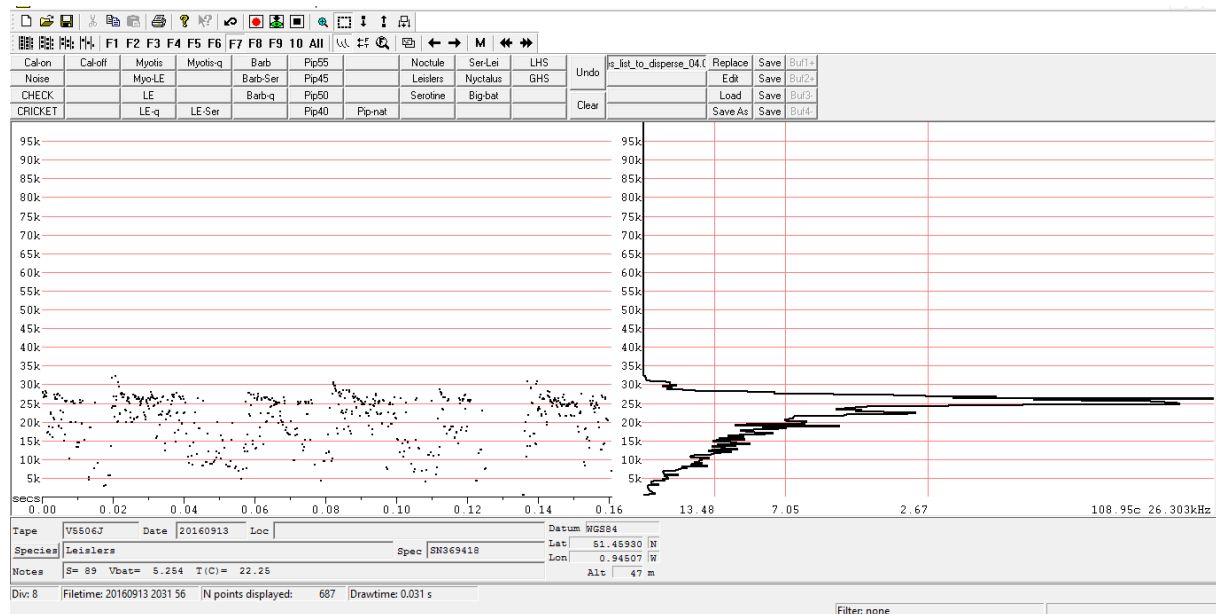
Myotis sp. (Daubenton's bat given observed flight patterns and call parameters) recorded during dusk emergence survey on 14th June.



Serotine recorded at static detector S1 in August



Leisler's bat recorded at detector EX5 during the September suite of surveys



Barbastelle recorded at static detector EX5 during the September suite of surveys

