Appendix 7.16: Bat Activity Survey Report

ECOSA
Ecological Survey & Assessment Limited

HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 BAT SURVEY

Final Document Rev.2

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Phase 1 and 2 Ecological Assessments • NVC • EcIA • Management Plans • Protected Species Licensing
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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 BAT SURVEY

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EXECUTIVE SUMMARY

- Ecological Survey & Assessment (ECOSA) Limited have been contracted by the City of London Corporation to undertake Phase 2 bat survey work to inform development of the Hampstead Heath Flood and Water Quality Management Works scheme and its accompanying Environmental Impact Assessment (EIA).

- Hampstead Heath is a 275 hectare open space located within the London boroughs of Camden and Barnet. The site lies within the urban landscape of Greater London surrounded on all sides by residential areas. The Heath represents the largest open space of its kind in the area, supporting a variety of habitats including grassland, wetland, mature trees, and woodland. Much of the Heath is used for recreational purposes such as walking, fishing and swimming.

- A series of manual detector bat survey transects were carried out on a monthly basis from July to September 2013. Transects were accompanied by the erection of twelve automated detectors on site during August and September 2013. Manual and automated detector survey results indicated that Hampstead Heath supports at least nine species of bat.

- Soprano pipistrelle was the species recorded most frequently and made up 47% of all bat passes recorded during the manual detector surveys. Soprano pipistrelle, Daubenton's bat and Nathusius' pipistrelle showed a high level of affinity to the waterbodies on site.

- Common pipistrelle was frequently recorded but their distribution was generally associated with woodland edge habitat rather than waterbodies.

- There was no pattern to the noctule records across the site, although the species was relatively abundant with 986 passes logged from the automated detector surveys.

- Serotine, long-eared bat species, Leisler's bat and Natterer's bat were recorded at low densities. Each of these species was logged no more than 15 times from both manual and automated detector surveys combined.

- A brief assessment is made of the potential impacts of the Flood and Water Quality Management Works including recommendations for timing of works and cumulative effects.

1.0 INTRODUCTION

1.1 Background

Ecological Survey & Assessment (ECOSA) Limited have been contracted by the City of London Corporation (CoL) to undertake a Phase 2 bat survey of Hampstead Heath to inform the Hampstead Heath Flood and Water Quality Management Works and inform the accompanying Environmental Impact Assessment (EIA) for the scheme. ECOSA were appointed by CoL on 4th July 2013.

The CoL, as appointed custodian of the Hampstead Heath site, has an obligation to maintain the area for recreational purposes in its preferred natural state. Within their 2007-2017 Hampstead Heath Management Plan[1], the corporation's committees have identified various environmental improvement objectives covering a wide range of ecological issues. As part of this, the CoL intends to enhance the conservation value of the Heath's ponds as well as improve flood management and water quality at the site. Plans for the Hampstead Heath Flood and Water Quality Management Works are currently under development by the CoL in consultation with English Heritage, the owners of the northeast Kenwood area of the site. To inform their production, a detailed programme of surveys is needed develop a comprehensive hydrological management strategy. As part of this, it was deemed necessary to carry out Phase 2 bat surveys to assess the species diversity and abundance at the Hampstead Heath site.

1.2 Aims and Scope of Report

This report provides an assessment of the species diversity and abundance of bats within Hampstead Heath. This report provides the methodology and results of the 2013 surveys and provides an outline of the potential associated impacts the proposed hydrological management works may have on bats. This report is not an Ecological Impact Assessment (EcIA) but will be in support of, and appended to, the EcIA, which is being written by others.

1.3 Site Setting and Description

Hampstead Heath comprises a 275 hectare area of open space located within the London Boroughs of Barnet and Camden. Immediately to the northeast lies the London village of Highgate. To the north the Heath is bordered by East Finchley and by Golders Green to the northwest. On the western side is Child's Hill. The London village of Hampstead is located adjacent to the southwest of the site, beyond which lies South Hampstead.

[1] Land Use Consultants and City of London (2007) Towards a Plan for the Heath 2007-2017 – Hampstead Heath Management Plan Part 1

Kentish Town borders the southeast of the Heath. Dartmouth Park and Upper Holloway comprise the eastern adjacent areas to the site.

The Hampstead heath site is set within the predominantly urban landscape of the Greater London. The river Thames runs approximately 8.5 km to the south of the site, beyond the city boroughs of Camden and Westminster. To the north, the City of London extends for at least 10 kilometres before reaching the border towns of Hertford, Cheshunt and St Albans, amongst others. Greenspace areas located within relative proximity to the site include Primrose Hill Park approximately 2 km to the south. Whittington Park and Dartmouth Park lie within 600 m and 1.5 km respectively to the east of the site. Queens Wood and Highgate Wood, to the north of the site, comprise the largest nearby woodland areas. Also to the north is the heavily managed amenity grassland of Highgate Golf Club. Approximately 8km to the west lies Gladstone Park. Few nearby open spaces are of equivalent size to the Heath and most are managed as ornamental parkland.

Hampstead Heath supports a variety of valuable habitats for wildlife such as ancient hedgerows, wetland, grassland, scrub and trees. The site is known to support several protected species such as grass snake *Natrix natrix*. As a public "park", its primary use is for recreational activities such as walking, angling and cycling. Visitor numbers each year are considered to be around 7 million. The area subject to the bat survey comprises approximately 170 hectares, encompassing parts of the Parliament Hill Fields, Pryors Field, Cohen's Fields, East Heath and Vale of Health.

1.4 Site Proposals

This report has been provided to inform the Hampstead Heath Flood and Water Quality Management Works scheme and the accompanying EIA. The proposals comprise works to maintain dam structures within the Hampstead Heath site, in the interests of improving flood control such that surrounding residential areas are safeguarded during flooding events. Water quality is also to be improved across the pond system to enhance their ecological value and, for those relevant water bodies, to meet bathing water quality standards. It is also proposed to install a new 'dry dam' at a location within woodland on site.

1.5 Survey Area

The survey area was predetermined by the route of the bat transect surveys and covers many the Hampstead Heath and Highgate Chain of Ponds, including the Vale of Health.

The location and name of each pond covered by the surveys and an accompanying description is recorded in **Appendix 1**.

2.0 SURVEY METHODS

2.1 Introduction

This section details the methods used for the manual and automated detector bat surveys carried out at Hampstead Heath, Greater London.

2.2 Manual Detector Surveys

Manual detector bat surveys were undertaken at the Hampstead Heath site on a monthly basis from July to September 2013.

Two predetermined transects were walked across the site, comprising east and west sections (**Appendix 2**). Transect surveys were punctuated by regular point counts, during which the surveyors stopped walking for a period of three minutes to record bat activity at that point. Each transect was walked twice on each survey visit comprising an 'outbound' route with ten point counts and an 'inbound' route covering the same transect and point counts in reverse. Where possible the transect routes followed the edges of on-site waterbodies. Surveyors recorded the time, species, location and direction of flight for each bat encountered. All bat encounters were recorded on a site plan and survey sheet. Particular attention was paid to establishing bat commuting routes/preferred foraging areas.

Point count locations were spaced along the transect route concentrating on the 11 predetermined waterbodies and proposed dry dam location. The surveys conformed to current Bat Conservation Trust guidelines[2].

2.2.1 Survey Equipment, Personnel and Timings

During the Phase 2 manual detector surveys each surveyor was equipped with a Pettersson 240x time expansion bat detector. The Pettersson detectors were connected to Edirol R-90 recorders for the full duration of the surveys.

The Phase 2 surveys were led by Simon Mason (NE Licence No.20130085), assisted by three suitably qualified and experienced ECOSA surveyors. **Table 1** provides details of the manual detector survey dates and weather conditions.

[2] Hundt L (2012) *Bat Surveys: Good Practice Guidelines*, 2nd edition, Bat Conservation Trust (BCT)

Table 1 Manual detector surveys timings

Survey Date	Survey Type	Duration	Weather Conditions	Sunset/ Sunrise Time
31st July 2013	Dusk	21:10-00:45	20% cloud cover, 18°C, light winds, dry	20:51
28th August 2013	Dusk	20:24-23:30	0% cloud cover, 18°C, still, dry	19:56
25th September 2013	Dawn	03:50-06:20	100% cloud cover, 14°C, light winds, dry	06:49

2.2.2 Data Analysis

All manual detector surveys resulted in annotated field maps of bat locations and flight directions as well as records of bat species (including any behavioural notes e.g. foraging, commuting etc.) and times of encounters. Maps and survey sheets were analysed using ArcMap GIS (Version 10) to provide summaries of the distribution of bat records (overall and by species) and levels of general activity in order to assess bat activity 'hotspots' across the site.

Recordings made with the Pettersson detectors were later analysed using Sonobat® (v2.9.7) to confirm the identity of any species encountered.

2.2.3 Limitations

Some bat species, e.g. long-eared bat species, do not produce strong echolocations, and therefore these bats can be difficult to observe and record during Phase 2 manual detector surveys, leading to under-recording.

For some groups, notably *Myotis*[3] bat species, specific identification is not always possible and bats have been referred to as e.g. *Myotis* bat. For a small number of recordings specific or generic identification was not possible and these have been referred to as 'unidentified *Myotis* bat species' or 'unidentified pipistrelle bat species[4]'.

[3] There are seven species of *Myotis* bats in Britain. *Myotis* bats are very difficult to identify specifically, this can generally only be done by examination of physical features and Phylogenetic Analysis Identification of bat droppings. Many of these bats are common and will utilise buildings for roosting often occupying small and inaccessible voids. For the purpose of this report all species shall be referred to as *Myotis* bats unless a specific identification has been possible.

[4] There are three species of pipistrelle bat, the common pipistrelle *Pipistrellus pipistrellus*, the soprano pipistrelle *Pipistrellus pygmaeu*s and the Nathusius' pipistrelle *Pipistrellus nathusii*. The species can be separated by their echolocations, examination of physical characteristics and Phylogenetic Analysis Identification of bat droppings. Unless confirmation of identification has been made by visual identification the three species shall be referred to in this report as pipistrelle bat. All three species will roost in similar locations within buildings. The soprano pipistrelle has a tendency to form larger roosts numbering 100's of bats and is associated with wetland habitat. Nathusius' pipistrelle bats frequently share maternity roosts with soprano pipistrelle bats.

2.3 Automated Bat Survey

In addition to manual detector surveys, a programme of automated monitoring was undertaken across the survey area between August and September 2013 using twelve passive bat detectors. The detectors were placed at predetermined locations at each of the 11 ponds plus the proposed location of the dry dam, to enable bat activity to be recorded over a continuous period.

2.3.1 Survey Equipment, Personnel and Timings

The devices were programmed and erected by Simon Mason an experienced bat ecologist who is suitably experienced in automated detectors functionality and deployment.

The Wildlife Acoustics SM2BAT+ detectors utilised were placed in trees next to ponds or, in the case of Location 3, on a small manmade raft at the southern end of the Model Boating Pond. The exact location of automated detectors is shown in **Appendix 3**. **Table 2** provides details of the automated detector survey dates and weather conditions.

Table 2 Automated detector survey timings

Date	Average Weather Conditions*	Sunset Time	Sunrise Time
8-9th August 2013	Clear, 17°C, slight breeze, dry	20:36	05:37
9-10th August 2013	Clear, 15°C, light winds, dry	20:34	05:38
10-11th August 2013	Clear, 15°C, light winds, dry	20:32	05:40
11-12th August 2013	Clear, 14°C, light winds, dry	20:30	05:41
12-13th August 2013	Part cloudy, 14°C, light winds, dry	20:29	05:43
19-20th September 2013	Clear, 14°C, light winds, dry	19:06	06:43
20-21st September 2013	Part cloudy, 12°C, light winds, dry	19:03	06:45
21-22nd September 2013	Mostly cloudy, 16°C, light winds, dry	19:01	06:47
22-23rd September 2013	Clear, 14°C, light winds, dry	18:59	06:48
23-24th September 2013	Clear, 15°C, light winds, dry	18:56	06:50

*Data sourced from www.wunderground.com

2.3.2 Data Analysis

At the end of each survey period, all remote bat detectors were retrieved from the site, data was downloaded and then analysed using Kaleidoscope Pro© (Version 1.1.20). This program has been designed to analyse large volumes of bat call data using an automated classifier (Bats of United Kingdom Version 1.0.5). The more unusual species and a random sample of records were then checked within Sonobat to verify their identities.

The data can was then exported to Microsoft Excel for detailed analysis (i.e. counts of bat registrations) of various parameters. In summary, the automated detector data were used to assess the following:

- Species present within the site;
- Species recorded at each detector location and during each survey month;
- Frequency of bat activity at each detector location; and
- Frequency of individual species activity at each detector location.

2.3.3 Limitations

It should be noted that the number of registrations recorded is not a measure of the number of bats present at each location; the number of registrations can only be used to provide a quantitative assessment of the level of bat activity at a particular location (i.e. the greater the number of registrations, the greater the level of bat activity), and the data cannot differentiate between, for example, one bat passing the detector ten times or ten bats passing the detector on one occasion.

Three of the automated detectors failed during the survey period, one during August (Location 7) and two during September (Location 8 and Location 11). The equipment failure was unfortunate but given that none of the failures overlapped locations, each received at least one month of data collection. Therefore the records made are considered to provide a robust assessment of the bats at the site especially when combined with the transect survey data.

There automated bat data analysis software does not provide perfect results as the program has difficulty differentiating between calls that contain two or more species. However, it does provide an accurate record of species activity and diversity when large datasets are unable to be manually checked. It also introduces standardisation into the classification of bat calls. Where manual analysis of data is used there is significant scope for individual bias and interpretation to affect the survey results. The data was

regularly sampled by an experienced bat ecologist in order so verify the results of the automated software.

3.0 RESULTS

3.1 Introduction

This section details the results of the Phase 2 bat surveys undertaken at Hampstead Heath, Greater London between July and September 2013.

3.2 Summary

Overall, the combined surveys (manual and automated) recorded a total of nine bat species within the site, as listed in **Table 3**. The assemblage of bat species recorded is considered typical of an open parkland habitat in southern England and includes species characteristic of the range of habitat types found within the site with the key habitats being open water, grassland and woodland.

Table 3 Bat species recorded during automated and manual detector surveys combined

Common Name	Scientific Name
Common pipistrelle	*Pipistrellus pipistrellus*
Soprano pipistrelle	*Pipistrellus pygmaeus*
Nathusius' pipistrelle	*Pipistrellus nathusii*
Daubenton's bat	*Myotis daubentonii*
Natterer's bat	*Myotis nattereri*
Noctule	*Nyctalus noctula*
Leisler's bat	*Nyctalus leisleri*
Serotine	*Eptesicus serotinus*
Long-eared bat species[5]	*Plecotus species*

Details of the bat species recorded during the manual and automated surveys are provided below.

3.3 Manual Detector Surveys

An overview of the bats recorded during the manual detector surveys is presented in **Table 4**. This does not include bats recorded during the point counts. Maps showing the

[5] There are two species of long-eared bat, the brown long-eared bat *Plecotus auritus* and the grey long-eared bat *Plecotus austriacus*. These species can only be separated by examination of physical characteristics and Phylogenetic Analysis Identification of bat droppings. Unless confirmation of identification has been made by visual identification the two species shall be referred to in this report as long-eared bat. The brown long-eared bat is the commoner of the two species typically being found roosting within large roof voids although small voids and trees are also utilised. The grey long-eared bat is rare and confined to southern England and like the brown long-eared typically roosts in roof voids.

distribution of bat species recorded in each survey month are provided in **Appendix 4**. These maps provide an indication of distribution but not an exact representation of individual bats recorded in anyone area.

Table 4 Bats recorded during manual detector survey transects

Species	31st July 2013	28th August 2013	25th September 2013	Grand Total
Common pipistrelle	41	37	15	**93**
Soprano pipistrelle	25	17	5	**47**
Unidentified *Myotis* species	7	8	3	**18**
Noctule	7	5	0	**12**
Daubenton's bat	4	1	2	**7**
Nathusius pipistrelle	0	2	4	**6**
Unidentified pipistrelle species	3	2	1	**6**
Long-eared bat species	0	2	1	**3**
Serotine	0	0	3	**3**
Natterer's bat	1	0	1	**2**
Grand Total	**88**	**74**	**35**	**197**

3.3.1 Species Accounts

Common pipistrelle

This was the most abundant species recorded during the manual detector surveys accounting for 47% of the records. The species was widely distributed across the site with a small negative bias away from those areas of open grassland. Activity was much reduced on the September dawn survey.

Soprano Pipistrelle

This species accounted for 23% of records made on transect surveys and soprano pipistrelle was recorded in all three survey months. The distribution of records shows a bias towards the species being recorded close to waterbodies. As with common pipistrelle the number of records reduced during the September dawn survey.

Unidentified *Myotis* species

Records of unidentified *Myotis* species were concentrated around the eastern pond chain and observations in the field would suggest that the majority of these records relate to Daubenton's bat. However, this cannot be guaranteed given the presence of other *Myotis* species within the site. These records made up 9% of the overall records total.

Noctule

Noctule records were widely scattered across the site and made up only a small percentage of the overall total. Given the species tendency for high flying aerial hawking a broad scattering of records would be expected.

Daubenton's Bat

This species was identified from a combination of social calls which are highly distinctive and those *Myotis* calls recognisable as this species using known parameters[6]. The seven records identified to species level were all recorded close to water. This was expected given the species preference for feeding over aquatic habitats. Point count data revealed a concentration of records around the Model Boating Pond in the east of the site.

Nathusius' Pipistrelle

This species is difficult to differentiate from the common pipistrelle. However, recordings of bats with a peak frequency below 40 kilohertz (kHz) are indicative of this species. There was a bias towards records of this species from the east of the site, especially around the Model Boating Pond. A single record was made from the east of the site close to the Mixed Bathing Pond. The species became commoner throughout the survey period, although having such a small survey sample makes this difficult to quantify.

Unidentified Pipistrelle Species

A small number of records were of unidentified pipistrelle species these records were scattered across the site but tended to come from the eastern transect.

Long-eared Bat Species

Three records of long-eared bats were made during the transect surveys. Long-eared bats are characterised by quiet echolocation and therefore they can be underecorded on surveys. However, three records is a small amount and it is considered that the species is genuinely less prevalent at the site than many other species.

[6] Russs, J. (2012) British Bat Calls: A Guide to Species Identification, Pelagic Publishing

Serotine

All three serotine records were from the transect survey carried out in September. Given the small number of records it is hard to draw conclusions about the species usage of the site other than that it is fairly uncommon.

Natterer's Bat

Natterer's bat was the second *Myotis* species to be recorded at the site. There were two records, one in July and one in September. Both records were on the edge of woodland.

3.3.1 Summary

A total of at least eight species were recorded during the manual detector surveys. The diversity of species is considered typical of the diverse parkland habitat present on site. The species were all widespread and common species and no EU Habitats Directive Annex II species were recorded. However, the context of the site within Central London would indicate that Hampstead Heath provides important habitat for a number of bats species that are otherwise rare locally. This is especially true of those species that prefer aquatic habitats such as Daubenton's bat, Nathusius' pipistrelle and soprano pipistrelle.

3.4 Automated Detector Surveys

A total of 47750 bat registrations were recorded from the twelve SM2 detectors. An overview of the bats recorded during the automated detector surveys is presented in **Appendix 5**.

3.4.1 Species Accounts

Common pipistrelle

A combined total of 12165 common pipistrelle registrations were recorded during the automated survey periods. Location 2 and Location 12 accounted for 38% of all common pipistrelle registrations. These detectors were situated close to surrounding residential dwellings, possibly suggesting that the species was foraging around street lamps in these areas. Common pipistrelle was the second most abundant species recorded.

Soprano Pipistrelle

Soprano pipistrelle was the species recorded most frequently with 47% of all passes attributed to this species (=22302 registrations). There was a relatively even spread of records across the site although the most records were from the SM2 located adjacent to

the Bird Sanctuary Pond in the east of the site. Given that Location 11 only recorded for the August period the 2070 registrations recorded was exceptional.

Unidentified *Myotis* species

Unidentified *Myotis* species records made up 20% of the total bat passes (=9625 registrations). 45% of these records were from Location 3 which was situated on a small man-made island on the Model Boating Pond. This would indicate that the majority of these records relate to Daubenton's bat, a theory supported by the results of the transect survey. The northern four ponds in the eastern chain of waterbodies from the Model Boating Pond to the Stock Pond accounted for 83% of all *Myotis* species records. The Vale of Health pond was the only waterbody in the west of the site to have a large number of registrations recorded (1053 in August).

Given these results it is obvious that *Myotis* species are relatively abundant at the site with a bias toward those ponds in the east of the site.

Noctule

Noctule was recorded widely across the site without a definitive pattern, much like the manual detector survey data. No SM2 locations recorded consistently high levels of Noctule activity. As an example, Location 4 recorded 199 passes in September but only one in August. The species high flying aerial hawking behaviour suggests that this pattern would continue if further survey work were undertaken.

Nathusius' Pipistrelle

Nathusius' pipistrelle breeds in the United Kingdom but also migrates through the country during the autumn from Scandinavia. Concentrations of the species were recorded during August at Location 1 and Location 10 (162 passes and 191 passes respectively). No other location recorded more than 37 passes during August. The species appeared to become more abundant during the September period when up to 699 passes were recorded at Location 10 and all locations recorded more passes of the species than in August.

Long-eared Bat Species

There were relatively few long-eared bat species records with only one recorded pass in August and five passes in September. This may be partly due to the quiet echolocation of this species but is also likely to represent the genuine rarity of the species.

Serotine

Nine serotine bat passes were recorded from the automated detector surveys. This would indicate that the species is rather uncommon at the site. There was no particular pattern of occurrence across the site.

Leisler's Bat

Three records of Leisler's bat were recorded, two records at Location 10 and one record at Location 9.

3.4.2 Summary

Automated detector survey revealed at total of at least eight species across the site and logged a single species not recorded during the manual detector surveys, the Leisler's bat. The results generally conform to those made during the manual detector surveys and are typical of parkland with a range of different habitats. However, the range of species recorded from the automated detector survey was significant in the context of the surrounding built-up areas which offer little opportunities for bats. As with the manual detector survey no EU Habitats Directive Annex II species were recorded.

3.5 Bat Activity at Proposed Dry Dam

Moderate levels of bat activity were recorded at the proposed 'dry dam' site during the automated detector surveys (Location 9). A total of 1671 bat registrations recorded during August and 821 bat registrations recorded during September. On both occasions, the majority of bat passes were of soprano pipistrelle (1340 passes in August, 640 passes in September). The second most frequent bat recorded during both surveys was common pipistrelle (312 passes in August, 114 passes in September). Noctule was the third most frequent species with 11 passes recorded in August and a significant increase in September to 56 passes. Nathusius' pipistrelle was not recorded in August but a total of ten passes were recorded in September. Other species recorded very infrequently included Leisler's bat, long-eared bat species, serotine and *Myotis* species. With a total of eight species recorded, this represents a moderate diversity of species.

Two point counts during each manual detector transect survey were located on the paths to the east and west of the proposed dry dam. Species recorded during the transect surveys included occasional passes from common and soprano pipistrelle.

4.0 EVALUATION, IMPACTS AND RECOMMENDATIONS

4.1 Introduction

This section presents a summary evaluation of the site based on the results Phase 2 bat surveys. The results and evaluation have been used to provide a brief assessment of the ecological impacts of the Flood and Water Quality Management Works on bats.

4.2 Summary Evaluation

The site is considered to have a moderate level of bat diversity when viewed at a national scale however when put into the context of the sites location within Central London this diversity becomes more significant. The combined results of manual and automated detector surveys indicate that the eastern row of ponds have a higher level of bat activity than those in the south-west. However, it is clear that all the waterbodies on site provide feeding habitat for a number of species. Overall, the site was assessed to be of high value to bats especially when put in context of the local area. Within the site the ponds are of particular importance to soprano pipistrelle, Daubenton's bat and Nathusius' pipistrelle.

The potential location for the dry dam recorded a moderate level of bat activity with the commonest species being common pipistrelle and soprano pipistrelle. All other bat species were recorded at lower levels and the proposed dam site recorded an extremely low level of *Myotis* bat species activity in comparison with the rest of the site.

4.3 Potential Impacts of Proposed Works

Alterations made to the waterbodies on site should be carefully considered given the abundance of some species of bats on site at these features. The ponds are likely to provide vital foraging habitat for a number of species. Without mitigation there is potential for impacts on the local bat population through planned works.

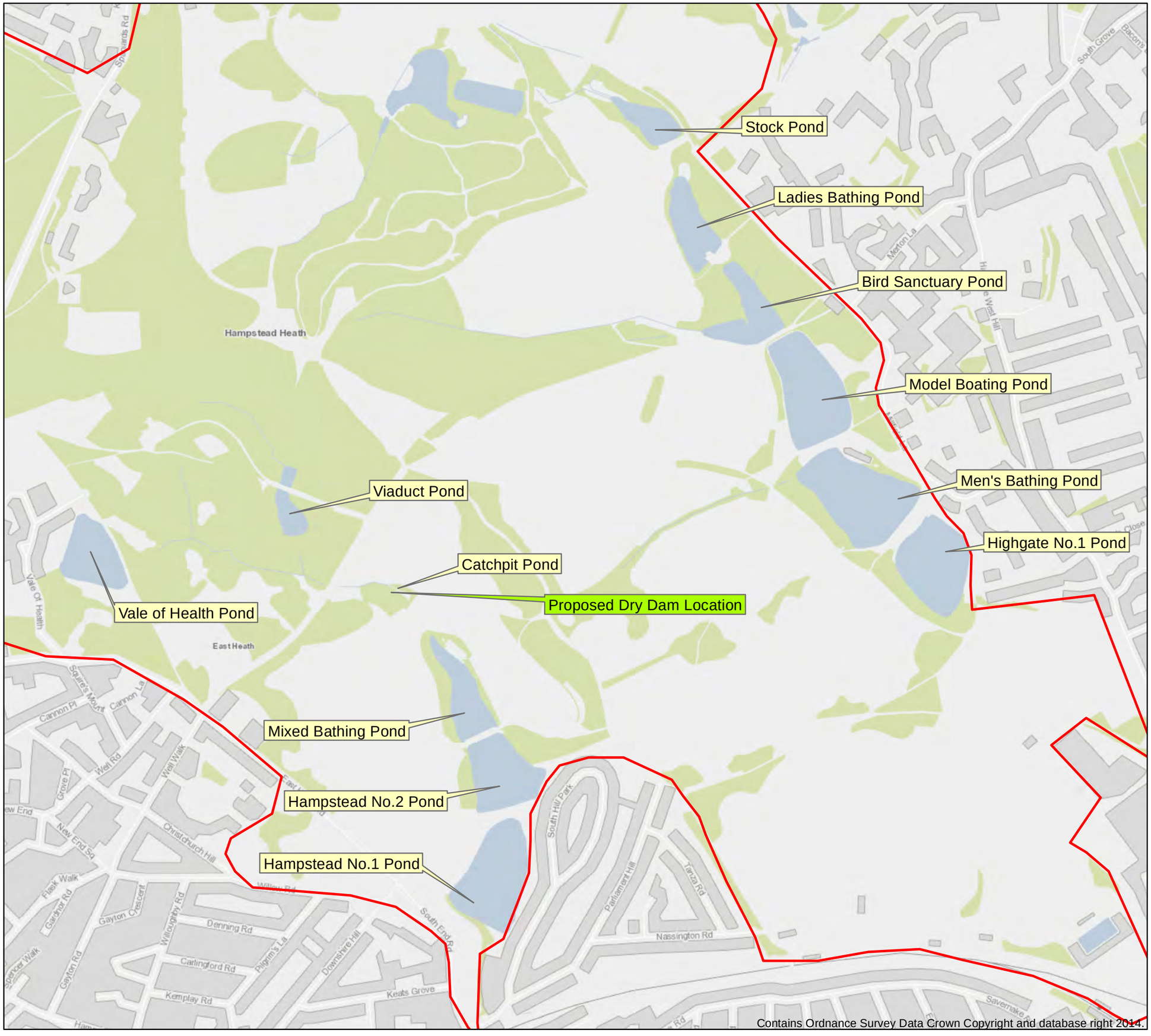
Given the levels of bat activity recorded during the bat surveys, the broadleaved woodland and grass rides within the location of the proposed dry dam provide good quality foraging habitat which is used by a moderate number of bats. The loss of trees and scrub to construct the new dry dam will result in the reduction in available foraging habitat. However, given the large amount of similar high quality habitat within the wider area, the loss of this vegetation is not anticipated to have a significant adverse impact on the local bat population.

4.4 Recommendations

It is recommended that any works to waterbodies are carried out during the period from November-February when bats are hibernating. Consideration should be given to the cumulative impact of carrying out works on multiple ponds at any one time. This is especially relevant when the taking into account the abundance of bat species with an affinity for aquatic habitats.

Whilst a specific assessment of the suitability of trees to support bat roosts has not been undertaken as part of this survey, it is noted that there are a number of mature trees with potential to support roosting bats within the vicinity of the new dry dam and other waterbodies on site. Should these be affected by future works the potential presence of bat roosts will need to be considered.

Appendix 1 Pond Locations Map and Descriptions



HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 BAT SURVEYS

Pond Locations

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

ECOSA
Ecological Survey & Assessment

Ten Hogs House, Manor Farm Offices,
Flexford Road, North Baddesley, SO52 9DF
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www.ecosa.co.uk

Pond Number	Feature	Figure	Description
5	Catchpit Pond		Catchpit Pond is located within the south-western area of the Heath. It is approximately 100m^2 in size and part of the Hampstead Pond Chain. This waterbody is concrete lined and constructed to act as a silt deposit, intercepting deposits ahead of the downstream Mixed Bathing Pond. The Catchpit Pond is chocked with Canadian pondweed *Elodea canadensis* and duckweed *Lemna* species. The pond is fenced off from public access and is surrounded by woodland. It is heavily silted, resulting in a shallow water depth of 10-30 cm.
6	Vale of Health	 **Figure 1** Vale of Heath Pond	The Vale of Health Pond is approximately 9,000m^2 in size and situated on the western edge of the survey area (**Figure 1**). The pond is bordered by residential properties and road to the north and east. Willows overhang the waterbody on the eastern side. Aquatic vegetation coverage is low, restricted to a few patches of lily species *Nymphaea* species and yellow flag iris *Iris pseudacorus* beds along the pond's southern margin.
7	Viaduct Pond	 **Figure 2** Viaduct Pond	Situated in the northern-most position of the Hampstead Pond Chain is the headwater pond, a 3,500m^2 waterbody known as the Viaduct Pond (**Figure 2**). The pond is up to 2m deep in places, but heavy organic silt deposits cover large areas of its bed. Its banks are densely vegetated with willow, shading the majority of marginal water areas. The southern bank of this waterbody is devoid of vegetation due to the pressure of public access. A viaduct crosses the pond at its northern end carrying an access path. The south-east margin supports sedge *Carex* species and canary reed grass *Phalaris arundinacea* beds, whilst its northern and southwest aspects are overgrown with willow. White water lily *Nymphaea alba* and duckweed are present in small amounts on the extreme edges of the waterbody.

Pond Number	Feature	Figure	Description
8	Mixed Bathing Pond	 **Figure 3** Mixed Bathing Pond	The Hampstead Ponds Chain Mixed Bathing Pond (**Figure 3**) is a triangular, 7,000m^2 recreational pond which lies to the north of Hampstead Ponds 1 and 2. Recreational activities at the lake include bathing and angling. At its northern-most point, the pond is heavily overgrown and its banks are occupied with changing facilities for bathers. The constructed southern bank allows access to the waterbody whilst the eastern and western sides are covered with dense vegetation interspersed with coppiced and mature trees. The pond margins are extensively shaded and aquatic vegetation is restricted to a few patches of water lily.
9	Hampstead No.2 Pond	 **Figure 4** Hampstead No.2 Pond	At 11,000m^2, Hampstead Pond Number 2 (**Figure 4**) is a medium sized waterbody located adjacent to South Hill Park Gardens, Hampstead within the Hampstead Pond Chain. Residential properties are present on the lake's southern edge. The northern and southern banks have been reinforced with concrete and sheet piling. On the north mature trees shade the pond margins to a small extent. Trees and shrubs dominate the east and west pond margins. Bank erosion, due to public access, is considerable in places along the western edge. The eastern margin supports beds of yellow flag iris and common reedmace *Typha latifolia*. Duckweed was present in the southeast corner of the water. Towards the centre of the waterbody, an artificial island supports waterfowl.
10	Hampstead No.1 Pond	 **Figure 5** . Hampstead No.1 Pond	At the southern boundary of Hampstead Heath, Hampstead Pond Number 1 (**Figure 5**) occupies the southernmost position in the Hampstead Pond Chain. It is a moderate sized lake of 12,000m^2, bordered by residential gardens to the east. The eastern margins support yellow flag iris and pendulous sedge *Carex pendula*. Both the eastern and southern edges are heavily shaded by mature trees. To the north and west, banks are relatively steep. Erosion has occurred by the public visiting an access point on the reinforced western bank to feed the many waterfowl species. Submerged hornwort *Ceratophyllum.* species covers around half of the water's surface and mats of duckweed and filamentous algae are also present.

Pond Number	Feature	Figure	Description
13	Stock Pond	 **Figure 6** Stock Pond	The Stock Pond is the northern-most in the Highgate Pond Chain. A relatively small, shallow lake of approximately 3,000m^2, the Stock Pond, is surrounded by trees, lacks any aquatic vegetation and is heavily silted (**Figure 6**).
14	Ladies Bathing Pond	 **Figure 7** Ladies Bathing Pond	Located immediately south of the Stock Pond within the Highgate Pond Chain, the Ladies Bathing Pond is a small recreational swimming lake of approximately 6,000m^2 (**Figure 7**). The lake is deep with limited shallow margins. Marginal vegetation includes yellow flag iris, white water lily, yellow water lily *Nuphar lutea,* water mint *Mentha aquatica* and sweet rush *Acorus calamus*. Owing to its use for bathing, aquatic macrophytes are regularly cleared from the water body. Dense tree coverage surrounds the lake on three sides; the northern edge is open to grassland which is used for sunbathing during the summer.
15	Bird Sanctuary Pond	 **Figure 8** Bird Sanctuary Pond	The main pool of the Bird Sanctuary Pond (**Figure 8**), a relatively small lake approximately 6,000m^2, occupies the central position within the five main ponds of the Highgate Pond Chain. Terrestrial vegetation comprises tree fringes on all sides and marginal aquatic vegetation is abundant, dominated by yellow flag iris and common reed *Phragmites australis*. Stands of common reed have been recently planted around the edges to provide cover for waterfowl.

Pond Number	Feature	Figure	Description
16	Model Boating Pond	 **Figure 9** Model Boating Pond	At 15,000m^2, the Model Boating Lake (**Figure 9**) within the Highgate Pond Chain is one of the largest water bodies on the Heath. It is an amenity lake of approximately 2 metres depth. The waterbody is surrounded by hard-standing, footpaths and open grassland. No aquatic vegetation was visible during the survey. The lake's banks are artificial, constructed from steel piling with wood trimming. Severe bank erosion has occurred along much of its shoreline.
17	Men's Bathing Pond	 **Figure 10** Men's Bathing Pond	Adjacent to Millfield Lane, Highgate, within the Highgate Pond Chain, the Men's Bathing Pond (**Figure 10**) is the largest waterbody assessed at Hampstead Heath at 18,000m^2. The waterbody is surrounded by woodland, but is banked by an open grass slope to the north. Its banks have been artificially reinforced via steel piling and wooden supports. The Lake's amenity uses include bathing and course fishing. Yellow flag iris and sweet rush beds are supported by the lake margins. The lake's depth is thought to be considerable, limiting aquatic vegetation.
18	Highgate No.1 Pond	 **Figure 11** Barn Highgate No.1 Pond	Occupying the most southerly position in the Highgate Pond Chain, Highgate Pond Number 1 (**Figure 11**) is a large lake of 12,000m^2 located east of Brookfield Mansions, Highgate. Its surroundings largely comprise open grassland with scattered willow trees overhanging the water's edge. The north bank is densely wooded. The banks are artificially reinforced with wooden piling, but are in poor repair, experiencing heavy erosion from public access and extensive waterfowl activity. Aquatic vegetation is restricted to the edges, comprising of yellow flag iris, sweet rush, common reed and reedmace. No submerged/floating aquatic vegetation is present.

Appendix 2 Transect Survey Routes

HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Survey Routes

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Transects

East

West

Point Count Locations

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

ECOSA
Ecological Survey & Assessment

Ten Hogs House, Manor Farm Offices,
Flexford Road, North Baddesley, SO52 9DF
Tel: 02380 261065 Email: info@ecosa.co.uk
www.ecosa.co.uk

Appendix 3 SM2 Locations

HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 AUTOMATED BAT DETECTOR SURVEYS

SM2 Locations

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

SM2 Locations

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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Appendix 4 Bat Activity Surveys

HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Species: Common Pipistrelle

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Species: Soprano Pipistrelle

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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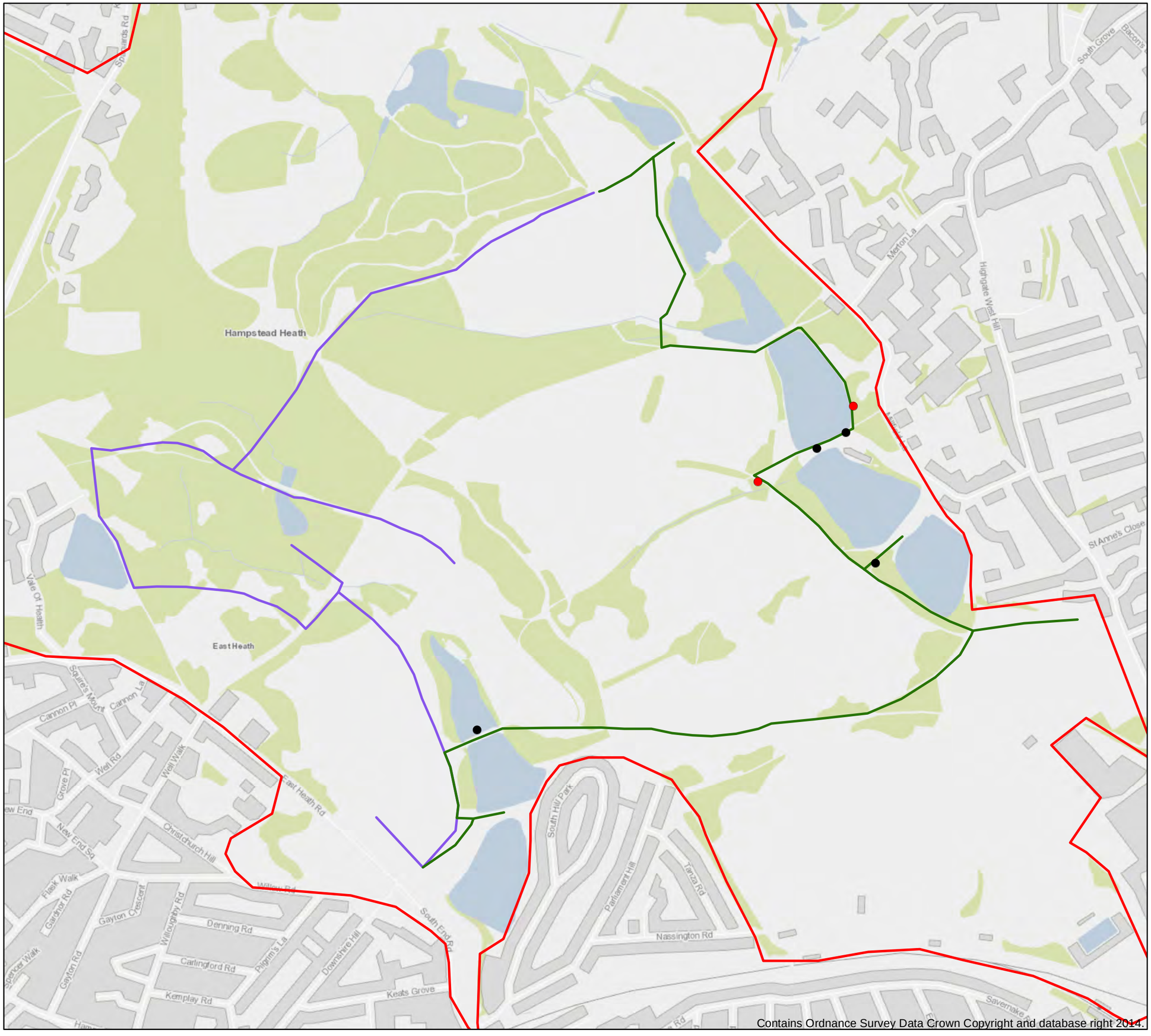

HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Species: Nathusius' Pipistrelle

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Unidentified Pipistrelle Species

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Species: Daubenton's Bat

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Species: Natterer's Bat

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Unidentified Myotis Bat Species

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Species: Noctule

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Species: Serotine

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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HAMPSTEAD HEATH PONDS PROJECT, GREATER LONDON

PHASE 2 MANUAL BAT DETECTOR SURVEYS

Transect Surveys
Species: Long-eared Bat

Client:	City of London Corporation
Date:	Janaury 2014
Status:	Final

KEY

Site Boundary

Survey Month

- July
- August
- September

Transects

- East
- West

Scale at A3: 1:6,000

0 40 80 160 240 320 Metres

N

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Appendix 5 SM2 Data Summary

Table 6 August 2013 bat pass data from twelve SM2+ recorders

Species	Location	1	2	3	4	5	6	7	8	9	10	11	12	Total Passes	% Total Passes
Common pipistrelle		669	744	157	175	298	516	no data	777	312	169	288	1802	**5907**	**0.23**
Soprano pipistrelle		1312	682	57	1755	711	1172	no data	204	1340	1830	2070	1238	**12371**	**0.49**
Nathusius' pipistrelle		162	4	10	34	10	37	no data	14	0	191	7	5	**474**	**0.02**
Noctule		2	1	25	1	7	38	no data	227	11	109	10	12	**443**	**0.02**
Myotis species		1	123	2068	825	1048	751	no data	1053	5	7	1	76	**5958**	**0.24**
Long-eared Bat		0	0	0	0	0	0	no data	0	1	0	0	0	**1**	**0.00**
Serotine		1	0	3	0	1	0	no data	0	1	0	0	0	**6**	**0.00**
Leisler's Bat		0	0	0	0	0	0	no data	0	1	1	0	0	**2**	**0.00**
Total Passes		**2147**	**1554**	**2320**	**2790**	**2075**	**2514**	no data	**2275**	**1671**	**2307**	**2376**	**3133**	**25162**	
% Total Passes		**0.09**	**0.06**	**0.09**	**0.11**	**0.08**	**0.10**	no data	**0.09**	**0.07**	**0.09**	**0.09**	**0.12**		

Table 7 September 2013 bat pass data from twelve SM2+ recorders

Species	Location	1	2	3	4	5	6	7	8	9	10	11	12	Total Passes	% Total Passes
Common pipistrelle		175	1323	378	823	862	624	701	no data	114	554	no data	704	**6258**	**0.28**
Soprano pipistrelle		1617	1314	537	1957	128	1228	1081	no data	640	604	no data	825	**9931**	**0.44**
Nathusius' pipistrelle		140	660	192	272	28	110	32	no data	10	699	no data	37	**2180**	**0.10**
Noctule		91	38	75	199	1	4	12	no data	56	62	no data	5	**543**	**0.02**
Myotis species		91	135	2280	578	130	262	10	no data	1	86	no data	94	**3667**	**0.16**
Long-eared bat		0	1	0	2	0	1	0	no data	0	0	no data	1	**5**	**0.00**
Serotine		0	0	3	0	0	0	0	no data	0	0	no data	0	**3**	**0.00**
Leisler's bat		0	0	0	0	0	0	0	no data	0	1	no data	0	**1**	**0.00**
Total Passes		**2114**	**3471**	**3465**	**3831**	**1149**	**2229**	**1836**	no data	**821**	**2006**	no data	**1666**	**22588**	**1.00**
% Total Passes		**0.09**	**0.15**	**0.15**	**0.17**	**0.05**	**0.10**	**0.08**	no data	**0.04**	**0.09**	no data	**0.07**	**1.00**	

Table 8 Combined August and September 2013 bat pass data from twelve SM2+ recorders

Species / Location	1	2	3	4	5	6	7	8	9	10	11	12	Total Passes	% Total Passes
Common pipistrelle	844	2067	535	998	1160	1140	701	777	426	723	288	2506	**12165**	**0.25**
Soprano pipistrelle	2929	1996	594	3712	839	2400	1081	204	1980	2434	2070	2063	**22302**	**0.47**
Nathusius' pipistrelle	302	664	202	306	38	147	32	14	10	890	7	42	**2654**	**0.06**
Noctule	93	39	100	200	8	42	12	227	67	171	10	17	**986**	**0.02**
Myotis species	92	258	4348	1403	1178	1013	10	1053	6	93	1	170	**9625**	**0.20**
Long-eared bat	0	1	0	2	0	1	0	0	1	0	0	1	**6**	**0.00**
Serotine	1	0	6	0	1	0	0	0	1	0	0	0	**9**	**0.00**
Leisler's bat	0	0	0	0	0	0	0	0	1	2	0	0	**3**	**0.00**
Total Passes	**4261**	**5025**	**5785**	**6621**	**3224**	**4743**	**1836**	**2275**	**2492**	**4313**	**2376**	**4799**	**47750**	**1.00**
% Total Passes	**0.09**	**0.11**	**0.12**	**0.14**	**0.07**	**0.10**	**0.04**	**0.05**	**0.05**	**0.09**	**0.05**	**0.10**	**1.00**	

Table 9 Percentage of each species recorded at each SM2 location during August 2013

Species / Location	1	2	3	4	5	6	7	8	9	10	11	12
Common pipistrelle	0.11	0.13	0.03	0.03	0.05	0.09	0.00	0.13	0.05	0.03	0.05	0.31
Soprano pipistrelle	0.11	0.06	0.00	0.14	0.06	0.09	0.00	0.02	0.11	0.15	0.17	0.10
Nathusius' pipistrelle	0.34	0.01	0.02	0.07	0.02	0.08	0.00	0.03	0.00	0.40	0.01	0.01
Noctule	0.00	0.00	0.06	0.00	0.02	0.09	0.00	0.51	0.02	0.25	0.02	0.03
Myotis species	0.00	0.02	0.35	0.14	0.18	0.13	0.00	0.18	0.00	0.00	0.00	0.01
Long-eared bat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
Serotine	0.17	0.00	0.50	0.00	0.17	0.00	0.00	0.00	0.17	0.00	0.00	0.00
Leisler's bat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00

Table 10 Percentage of each species recorded at each SM2 location during September 2013

Species / Location	1	2	3	4	5	6	7	8	9	10	11	12
Common pipistrelle	0.03	0.21	0.06	0.13	0.14	0.10	0.11	0.00	0.02	0.09	0.00	0.11
Soprano pipistrelle	0.16	0.13	0.05	0.20	0.01	0.12	0.11	0.00	0.06	0.06	0.00	0.08
Nathusius' pipistrelle	0.06	0.30	0.09	0.12	0.01	0.05	0.01	0.00	0.00	0.32	0.00	0.02
Noctule	0.17	0.07	0.14	0.37	0.00	0.01	0.02	0.00	0.10	0.11	0.00	0.01
Myotis species	0.02	0.04	0.62	0.16	0.04	0.07	0.00	0.00	0.00	0.02	0.00	0.03
Long-eared bat	0.00	0.20	0.00	0.40	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20
Serotine	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leisler's bat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00

Table 11 Percentage of each species recorded at each SM2 location during 2013 (Aug and Sept combined)

Species / Location	1	2	3	4	5	6	7	8	9	10	11	12
Common pipistrelle	0.07	0.17	0.04	0.08	0.10	0.09	0.06	0.06	0.04	0.06	0.02	0.21
Soprano pipistrelle	0.13	0.09	0.03	0.17	0.04	0.11	0.05	0.01	0.09	0.11	0.09	0.09
Nathusius' pipistrelle	0.11	0.25	0.08	0.12	0.01	0.06	0.01	0.01	0.00	0.34	0.00	0.02
Noctule	0.09	0.04	0.10	0.20	0.01	0.04	0.01	0.23	0.07	0.17	0.01	0.02
Myotis species	0.01	0.03	0.45	0.15	0.12	0.11	0.00	0.11	0.00	0.01	0.00	0.02
Long-eared bat	0.00	0.17	0.00	0.33	0.00	0.17	0.00	0.00	0.17	0.00	0.00	0.17
Serotine	0.11	0.00	0.67	0.00	0.11	0.00	0.00	0.00	0.11	0.00	0.00	0.00
Leisler's bat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.67	0.00	0.00