# Appendix 7.2 Ecology Data Collection and Interpretation Methods

# Appendix 7.2: Data Collection and Interpretation Methods **Desk Study**

- Details of statutory sites designated for nature conservation, including Special Areas of Conservation, Special 7.1 Protection Areas, Ramsar Sites, Sites of Special Scientific Interest, National Nature Reserves, Local Nature Reserves and non-statutory sites including Ancient Woodlands occurring within 2km of the Site were gathered from 'Multi-Agency Geographic Information for the Countryside' (MAGIC) website (http://www.magic.gov.uk).
- 7.2 Details of non-statutory sites and legally protected and notable species within 1km of the Hampstead and Highgate Pond chains were obtained from Greenspace Information for Greater London (GiGL) in spring 2014. This included London Invasive Species Initiative (LISI) records.
- 7.3 A record search was also undertaken with the London Bat Group. Details of roosts, casualties and field records within 2km of the Hampstead and Highgate Pond chains were provided.
- 7.4 A review of existing terrestrial and aquatic ecology and water quality data held by the City of London was also undertaken as part of the desk study. Where appropriate these data sources are described in more detail in the following sections.

# Phase 1 Habitat Survey and Terrestrial Invasive Plant Species Survey

- Recent desk study data relating to habitats and plant species present on Hampstead Heath has been provided 7.5 by the City of London and comprises:
  - A flora survey undertaken by the London Natural History Society (1997-2003); •
  - A vegetation survey of the Heath carried out by Scott Wilson (2008/09); and •
  - Maps of the known locations of locally rare plant species, and the invasive species Japanese knotweed, giant hogweed and Himalayan balsam.
- 7.6 The Hampstead Heath Management Plan (2007-2017), produced by Land Use Consultants (2007), was reviewed and yielded the following information:
  - A broad habitat map (Figure 18: Hampstead Heath Broad Habitat Types [habitats mapped from aerial photographs, previous surveys and ground truthing];
  - A veteran tree map (Figure 9: Hampstead Heath aerial photograph with veteran tree survey 2006); and •
  - Historical maps of the Heath including previous extent of woodland and hedgerows. •
- 7.7 A Phase 1 habitat survey was undertaken in accordance with Joint Nature Conservation Committee (JNCC) quidelines<sup>1</sup> in July and August 2013. The survey area is shown in Plate 7.2.1 and comprises the Hampstead and Highgate Pond chains, where the Proposed Development will be focused, and surrounding land to provide context. At the time when surveys were designed (spring/summer 2013) the Proposed Development was not expected to encroach on Hampstead Heath Woods SSSI, but as a precautionary measure the eastern edge of the designated site was also included in the survey area. To confirm, there will be no encroachment on the SSSI.
- 7.8 The Phase 1 habitat classification and associated field survey technique provide a standardised system to record semi-natural vegetation and other wildlife habitats. The approach is designed to cover large areas of countryside relatively rapidly. It presents the user with a basic assessment of habitat type and potential

importance for nature conservation. Each habitat type/feature is identified by way of a brief description of its defining features. It is then allocated a specific name and unique mapping code.

- 7.9 A survey of terrestrial plant species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) was undertaken at the same time as the Phase 1 habitat survey. The list is extensive and these plants are found in a range of different habitats. The survey checked in particular for the presence of Japanese knotweed, giant hogweed and Himalayan balsam. Other invasive species may not have been recorded, but it is considered that this survey was sufficient to identify any major constraints posed by terrestrial invasive plant species. The locations of all stands of invasive plants were recorded using handheld GPS devices, as recommended by the JNCC (2010).
- 7.10 Further details of the methods adopted are provided in the habitat and invasive species technical survey report in Appendix 7.13Error! Bookmark not defined.



Plate 7.2.1 Survey area for Phase 1 habitat survey and breeding bird survey, including approximate extent in hectares (Cities Revealed photography copyright The GeoInformation Group, 2010)

# Pond Quality Assessment

- 7.11 No desk study data is available that allows the classification of the pond habitat quality.
- 7.12 To inform the Proposed Scheme pond quality assessments were undertaken using the Predictive SYstem for Multimetrics (PSYM) survey method. This is the standard method for assessing the biological quality of still waters in England and Wales developed by the Ponds Conservation Trust. This method assesses biological water quality of still waters using plant and invertebrate assemblages. Analyses use a combination of environmental variable data and the following six pond metrics:
  - Number of submerged and emergent plant species.
  - Trophic Ranking Score (TRS); here plant species are assigned scores depending on their affinity to particular nutrient status waters and an average value provides the TRS.
  - Uncommon species index; this is the number of plant species which can be described as having a rarity value of Local or above.

<sup>&</sup>lt;sup>1</sup> Joint Nature Conservation Committee (2010) Handbook for Phase 1 habitat survey – a technique for environmental audit

- Average Score per Taxon (AST) for the aquatic invertebrate community. •
- Number of dragonfly and alderfly families. •
- Number of beetle families. •
- 7.13 The PSYM method requires survey data to be submitted to the Pond Conservation Trust, which undertakes a comparative analysis of the data with reference to a national dataset, in order to assess pond quality. The relationship between the observed and expected metrics as predicted for an unimpaired water body is used to calculate the Index of Biological Integrity (IBI) percentage score which is then used to group ponds into the following four categories:
  - 0 25 % Very poor
  - 25 50 % Poor
  - 50 75 % Moderate
  - 75 100 % Good
- 7.14 All pond surveys were undertaken in July 2013.
- 7.15 Further details of the methods adopted are provided in the pond technical survey report provided as Appendix 7.14:
  - APEM (2013) Macroinvertebrate and macrophyte survey of 13 ponds on Hampstead Heath. Report 412170 for City of London.

# Aquatic Macrophytes

- 7.16 Recent desk study data relating to the aquatic macrophyte assemblages of the ponds in the Hampstead and Highgate chains is limited to the following:
  - Environmental Advice Centre Ltd (2002). Corporation of London Hampstead Heath ponds survey of ponds (REF: J485/V1/12.2002).
    - Includes assessment of higher aquatic vegetation in Stock Pond; Kenwood Ladies' Bathing Pond; Bird Sanctuary Pond, Model Boating Pond; Highgate Men's Bathing Pond and Highgate No.1 Pond undertaken in May and August 2002.
- 7.17 Aquatic macrophyte surveys were undertaken as a component of the PSYM pond habitat assessment investigation conducted in July 2013. The presence of pond macrophytes was determined using a boat to investigate the perimeter of each pond. Submerged plants were sampled using a graphel. Macrophyte abundance was recorded using the DAFOR scale where D = 50-100% cover; A = 20-50% cover; F = 5-20%cover; O = 1-5% cover and R below 1% cover. Where accurate estimation of cover was deemed impracticable (e.g. submerged plants), dominant species were as D and all other species as R.
- 7.18 Species identification of macrophytes took place *in situ*, with the aid of a hand lens where necessary. Where required samples were removed, placed in labelled sample bags and stored below 4°C for later laboratory examination and speciation.
- 7.19 Further details of the methods adopted are provided in the survey technical report in Appendix 7.14Error! Bookmark not defined.

# Great Crested Newts

Recent desk study data relating to great crested newts comprises: 7.20

- GiGL records for the search area (i.e. within 1km of the Site).
- Data from amphibian surveys undertaken at Hampstead Heath between 1997 and 2000 and 2007 and 2012 have been supplied in raw data format by the City of London.
  - form of visual pond survey and spawn counts during March and April. The survey was reinstated in 2007 using the same method. Until 2008 only casual records of newts were available. In 2008 and 2009 some specific newt monitoring began, with survey techniques including netting, torchlight surveys and very limited bottle trapping<sup>2</sup>.
- 7.21 The previous amphibian surveys have not been undertaken in accordance with Natural England guidelines<sup>3</sup>. As a result, between May and June 2013 an assessment of pond suitability for great crested newts was undertaken and further great crested newt surveys, following Natural England guidelines<sup>3</sup>, were conducted where required. The survey area was defined as up to 250m from the Hampstead and Highgate Pond chains<sup>4</sup>. A total of 18 waterbodies were identified within the Heath and a further eight waterbodies outside the Heath (see Plate 7.2.2). Access was not granted to two waterbodies outside the Heath on privately owned land, namely Fitzroy Pond (located approximately 125m east of Kenwood Ladies' Bathing Pond) and Athlone House pond (located approximately 235m north of Stock Pond). Athlone House Pond was visually assessed 'over the fence', but could not be surveyed, while Fitzroy Pond could not be assessed.
- 7.22 All of the accessible waterbodies were subjected to Habitat Suitability Index (HSI) assessment. This technique was originally developed by Oldham *et al* (2000)<sup>5</sup> for the US Fish and Wildlife Service and is now widely employed by organisations such as Froglife to evaluate the guality and guantity of habitat for herpetofauna.
- 7.23 The HSI assessment uses the following criteria to establish the suitability of a pond for supporting great crested newts:
  - Geographic location;
  - Pond area;
  - Pond permanence;
  - Water quality;
  - Pond shading;
  - Number of waterfowl;
  - Occurrence of fish;
  - Pond density;
  - Proportion of 'newt friendly' habitat; and
  - Macrophyte content
- 7.24 The above information is fed into standard formula to give a score, which equates to 'poor' (<0.5), 'below average' (0.5-0.59), 'average' (0.6-0.69), 'good' (0.7-0.79) or 'excellent' (>0.8) habitat suitability categories

Annual counts of frog and toad spawn have been made on the Heath from 1997 to 2000, taking the

<sup>&</sup>lt;sup>2</sup> In terms of to the Hampstead and Highgate Pond chains, bottle trapping was undertaken at Highgate No.1 Pond for one night in 2011

<sup>&</sup>lt;sup>3</sup> Natural England (2001) *Great crested newt mitigation guidelines* <sup>4</sup> Great crested newts can use terrestrial habitat up to 500m from a breeding pond (Natural England (2001) *Great crested newt* mitigation guidelines). However, the latest research suggests that newts are likely to travel no more than 250m from ponds where suitable habitats for foraging and hibernation exist (Cresswell & Whitworth (2004) An assessment of the efficiency of capture technique and the value of different habitats for the great crested newt, English Nature Research Report 576) <sup>5</sup> Oldham, R. S., Keeble, J., Swan, M.J.S. and Jeffcote, M. (2000) Evaluating the suitability of habitat for the great crested newt Herpetological Journal 10 (4): 143-155

for great crested newts. As many of the waterbodies included within the assessment are large lakes, entering a true pond area automatically results in a HSI score of 0.00. Therefore, the pond area criterion is omitted from the HSI calculations as per the Amphibian and Reptile Group (ARG) UK Advice Note 5 instructions<sup>6</sup>. This is applicable to all waterbodies whose surface area is greater than 2000  $m^2$ .

- 7.25 All waterbodies scoring 'poor' in the HSI assessment were omitted from presence/likely absence surveys. Some of the waterbodies scoring 'below average' (e.g. Stock Pond, Bird Sanctuary Pond, Wood Pond and Meg's Pond) were also omitted as they were considered to be unsuitable for great crested newt due to lack of aquatic vegetation and presence of potential predators (fish and water birds). Presence/likely absence surveys were undertaken on five waterbodies in accordance with Natural England guidelines, namely Secret Garden Pond, Kenwood Ladies' Bathing Pond, Bird Sanctuary scrapes, Cohen's Field Pond and Orchard Pond (the locations of these waterbodies are shown on Map 1 in Appendix 7.15). Bottle trapping was considered inappropriate to use on this site due to the presence of pond liners, high level of public access and the depth of many of the larger waterbodies, however, torchlight surveys, sweep netting and egg searching were employed. Where access was not possible by foot, some of the waterbodies were surveyed by boat both during the HSI assessment and presence/likely absence surveys to ensure full coverage of the larger lakes was achieved and the habitat could be appropriately assessed.
- 7.26 Further details of the methods adopted are provided in the great crested newt technical report in Appendix 7.15Error! Bookmark not defined.

Plate 7.2.2 Survey area for HSI assessment and further great crested newt surveys (Cities Revealed photograph copyright The GeoInformation Group, 2010)

# Reptiles

- 7.27 Recent desk study data, and survey data, relating to reptiles is as follows:
  - GiGL records for the search area (i.e. within 1km of the Site).

- London Essex and Hertfordshire Amphibian and Reptile Trust (LEHART) (2009). Reptile Survey of Hampstead Heath 2008-2009.
  - was undertaken in summer and autumn of 2008 (phase 1) and spring and early summer of 2009 disturbance/interference; this was not considered to be a constraint by LEHART as the core grass of the survey period, which is in line with published survey guidance<sup>7.8</sup>.
- Results of reptile surveys undertaken by the City of London between 2010 and 2013 have been supplied in raw data format by the City of London.
  - The survey area has consisted of four transect routes across the Heath (see Plate 7.2.3). Each conditions. As with LEHART's survey, a combination of direct observation and artificial refugia have Scheme (NARRS) guidance<sup>9</sup>.
- 7.28 The City of London has also provided historical datasets from 1980 to 1994, which have been incorporated into the Hampstead Heath Ponds Project GIS Database.
- 7.29 The survey data gathered by the City of London during their 2013 reptile survey was used to inform the assessment.



- <sup>7</sup> Gent, T. & Gibson, S. (2003) Herpetofauna Workers Manual
- <sup>8</sup> Froglife (1999) *Reptile Survey An Introduction to Planning, Conducting and Interpreting Surveys for Snake and Lizard Conservation* Froglife Advice Sheet 10
- <sup>9</sup> Herpetological Conservation Trust (2007) National Amphibian and Reptile Recording Scheme Reptile Survey Guide

This survey was preceded by a desk study of existing historical and contemporary records to allow resources to be targeted at the most likely areas for reptile presence on the Heath. The survey work (phase 2), and involved a combination of direct observation and the provision of artificial refugia (the 135 refugia were located within fenced areas off-limits to the public in order to minimise the risk of snake populations were known to be similarly located in the off-limits areas). Six visits were made in optimal weather conditions in each of the two phases of the survey; totalling 12 visits over the course

Following training provided by LEHART during 2008 and 2009, a team, comprising the City of London staff and local volunteers, has continued to survey for reptiles on Hampstead Heath on a yearly basis. transect has been walked a minimum of five times between April and October during suitable weather been used to record reptiles. The survey work has followed National Amphibian and Reptile Recording

<sup>&</sup>lt;sup>6</sup> Amphibian and Reptile Groups of the United Kingdom (2010) ARG UK Advice Notes 5: Great Crested Newt Habitat Suitability Index

Plate 7.2.3 Reptile survey transect routes (Cities Revealed photography copyright The GeoInformation Group, 2010)

## Bats

- 7.30 Recent desk study data relating to bats comprises:
  - GiGL records for the search area (i.e. within 1km of the Site).
  - Records of roosts within 2km of the Siteprovided by the London Bat Group.
  - Bat records for Hampstead Heath between 2000 and 2012 provided by the City of London.
    - These records have been obtained through roost emergence surveys and general activity surveys at the Heath.
  - Ecology Network (2013). Hampstead Heath Ponds Bat activity surveys •
    - In anticipation of the Proposed Development, Ecology Network was commissioned by the City of London to work in conjunction with its staff to establish a potential method for comprehensive bat activity surveys at the Heath. The study involved undertaking (two) bat activity surveys at Highgate Pond No. 1 and a bat activity transect of the Hampstead and Highgate Pond chains, including the southern boundary of Hampstead Heath Woods SSSI, during early to mid-September 2012.
- 7.31 The method for the bat activity surveys undertaken at the Heath in 2013 closely followed the methods used by Ecology Network Ltd, with some minor adjustments. These included:
  - Inclusion of the Catchpit in the transect route;
  - The duration of point counts was extended from two minutes to three minutes; and •
  - Walking the transect rather than cycling. •
- 7.32 The surveys were carried out in accordance with Bat Conservation Trust guidelines<sup>10</sup>. Manual detector bat surveys were undertaken at Hampstead Heath on a monthly basis from July to September 2013. Two transects were walked across the site, comprising east and west sections (see Plate 7.2.4). 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 bat commuting routes/preferred foraging areas. Point count locations were spaced along the transect route concentrating on the ponds and Catchpit. Each surveyor was equipped with a Pettersson 240x time expansion bat detector. The Pettersson detectors were connected to Edirol R-90 recorders for the duration of the surveys. Recordings made with the Pettersson detectors were later analysed using Sonobat (v2.9.7) to confirm the identity of any species encountered. 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) and times of encounters. Maps and survey sheets were analysed suing ArcMap GIS (Version 10) to provide summaries of the distribution of bat records (overall and by species) and levels of general activity to assess bat activity 'hotspots' across the site.
- 7.33 In addition to manual detector surveys, a programme of automated monitoring was undertaken across the survey area between August and September 2013 using 12 passive bat detectors. The detectors were sited at each of the Hampstead and Highgate Ponds and the Catchpit to enable bat activity to be recorded over a

continuous period. The Wildlife Acoustics SM2BAT+ detectors were placed in trees next to ponds or in the case of Model Boating Pond, on a small manmade raft at the southern end of the pond. The exact locations of automated detectors are shown in the bat activity technical survey report in Appendix 7.16. 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 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 during each survey month;
- Frequency of bat activity at each detector location; and
- Frequency of individual species activity at each detector location
- 7.34 Further details of the methods adopted are provided in the bat activity technical survey report in Appendix 7.16Error! Bookmark not defined..
- 7.35 Ground level tree assessments (GLTA) for roosting bats have been undertaken between March and May 2014. All of the trees surveyed as part of the arboricultural assessment have been appraised for their bat roost potential by experienced bat ecologists. The assessment was carried out in accordance with Bat Conservation Trust guidelines<sup>10</sup>.
- 7.36 Building/structure assessments for roosting bats were also carried out in March 2014 and included the Kenwood Ladies' Bathing Pond changing rooms, the toilet block off Millfield Lane and the viaduct over Viaduct Pond. The assessments were carried out in accordance with Bat Conservation Trust guidelines<sup>10</sup>.

<sup>&</sup>lt;sup>10</sup> Bat Conservation Trust (2012). *Bat Surveys: Good Practice Guidelines 2<sup>nd</sup> Edition* 



### Plate 7.2.4 Bat activity survey transect routes

# Birds

- 7.37 Recent desk study data, and survey data, relating to birds is as follows:
  - GiGL records for the search area (i.e. within 1km of the Site). •
  - Bird sightings data from Hampstead Heath between 2011 and 2013 have been supplied in raw data format by the City of London.
  - Data from wetland bird surveys undertaken by the City of London between winter 2011 and spring 2014 have been supplied in raw data format by the City of London.
    - The British Trust for Ornithology's (BTO) Wetland Bird Survey (WeBS) is the monitoring scheme for non-breeding waterbirds in the UK. The principal aims of WeBS are to identify population sizes, determine trends in numbers and distribution and to identify important sites for waterbirds. The survey involves visiting a wetland site once a month throughout the winter and counting the waterfowl there. The BTO welcome counts from all months of the year, but the main period they ask surveyors to concentrate on is September through to March. At the Heath the Hampstead and Highgate Ponds are surveyed for waterbirds every month.

- 7.38 To supplement the existing bird sightings data and to provide specific information on the Site, a breeding bird survey was undertaken in 2013. The principal survey method employed was a variation of the Common Bird Census (CBC) method<sup>11</sup> and BTO/Royal Society for the Protection of Birds (RSPB) guidelines<sup>12</sup>.
- 7.39 Six survey visits were carried out between early May and the end of June, with at least seven days between each visit. The survey area is shown in Plate 7.2.1 and comprises the Hampstead and Highgate Pond chains, where the Proposed Development will be focused, and surrounding land to provide context. At the time when surveys were designed (spring/summer 2013) the Proposed Development was not expected to encroach on Hampstead Heath Woods SSSI, but as a precautionary measure the eastern edge of the designated site was also included in the survey area. To confirm, there will be no encroachment on the SSSI. The survey area was sub-divided into two zones (the Hampstead Pond zone and the Highgate Pond zone). One separate ornithological surveyor was used to survey each of these zones.
- 7.40 Surveyors used a range of high quality optics (comprising tripod mounted telescopes and/or binoculars) during each survey visit and field maps to record the registrations/numbers of each bird species observed. Surveying commenced one hour after sunrise. The starting position for each survey varied between visits in order to reduce survey bias.
- 7.41 Further details of the methods adopted are provided in the breeding bird technical survey report in Appendix 7.20 Error! Bookmark not defined.
- 7.42 The survey data gathered by the City of London during their 2013 and 2014 wetland bird survey was used to inform the assessment.

# Fungi

- 7.43 Recent desk study data relating to fungi comprises:
  - Annual species lists for Hampstead Heath compiled by the London Fungus Group between 2008 and 2012 have been supplied in raw data format by the City of London.
    - the London Fungus Group (notably Group Leader, Andrew Overall). Recordings have been made throughout the year.
- 7.44 A fungi survey was undertaken by Andrew Overall of the London Fungus Group between August and November 2013. The survey area is shown in Plate 7.2.5 and comprises the Hampstead and Highgate Pond chains, where the Proposed Development will be focused, and surrounding land to provide context. At the time when surveys were designed (spring/summer 2013) the Proposed Development was not expected to encroach on Hampstead Heath Woods SSSI, but as a precautionary measure the eastern edge of the designated site was also included in the survey area. To confirm, there will be no encroachment on the SSSI.
- 7.45 Two visits per month were undertaken during August and September and three visits were made during October and November when more fungi were expected to be apparent. The survey was carried out on a search and record basis. Due to the size of the survey area, one visit per month was made to the Hampstead Pond chain and one to the Highgate Pond chain. During October and November when three visits per month were made, the third visit was split between the two chains. Where possible, species were identified in the field. If not possible, collections were made for identification by microscope. Where uncommon or rare species were recorded GPS readings were taken and specimens were collected, dried, written up and deposited as voucher specimens at the Fungal Herbarium, Royal Botanic Gardens, Kew.

Data have been generated through Fungi Forays, workshops and visits to the Heath by members of

<sup>&</sup>lt;sup>11</sup> Bibby, C.J., Burgess, N.D., Hill, D.A. and Mustoe, S. (2000) Bird Census Techniques 2<sup>nd</sup> Edition <sup>12</sup> Gilbert, G., Gibbons, D.W. and Evans, J. (1998). Bird Monitoring Methods: A Manual of Techniques for Key UK Species

- 7.46 Some further survey work was conducted in spring 2014 within fenced off areas off-limits to the public. Six visits were carried out during March and April 2014 and survey techniques followed those used in 2013.
- 7.47 Full details of the methods adopted are provided in the fungi technical survey report and in Appendix 7.21Error! Bookmark not defined. and addendum report in Appendix 7.22Error! Bookmark not defined.



7.48

Plate 7.25 Survey area for fungi survey (Cities Revealed photography copyright The GeoInformation Group, 2010)

# Terrestrial Invertebrates

- 7.49 Recent desk study data relating to terrestrial invertebrates is as follows:
  - GiGL records for the search area (i.e. within 1km of the Site).
  - Butterfly transect data for Hampstead Heath provided by the City of London (2010-2013) and available from the UK Butterfly Monitoring Scheme website (1977-2009).
    - A butterfly monitoring scheme has taken place at Hampstead Heath since 1977. The transect route does not include the Highgate Pond chain, nevertheless the data recorded – over many years – provides an accurate representation of the species to be found on the Heath. Monitoring takes place on a weekly basis from April to October each year.
  - Various entomological reports produced for the City of London on Hampstead Heath since the early 1990s provided by the City of London.
    - The reports cover a number of insect groups including spiders, beetles and dragonflies, and a range of habitats including grassland, scrub and woodland. Monitoring of grassland and woodland invertebrates has been undertaken over successive years. Some surveys have been species-specific, such as those focusing on large orb-web spiders.
- 7.50 A review of existing invertebrate data held by the City of London for Hampstead Heath was undertaken during summer 2013. A total of 35 key documents were reviewed extending from 1991 to 2010. The review included the methods used during the surveys/monitoring, the species groups covered, the rare and notable species

recorded<sup>13</sup> and the relevance of the surveys/monitoring to the Proposed Development. Recommendations were made for additional works required to provide sufficient information for the Environmental Impact Assessment.

- 7.51 Further details of the methods adopted are provided in the review of existing invertebrate data report in Appendix  $7.23^{14}$ .
- 7.52 As recommended in the review of existing invertebrate data report, a walkover survey was carried out during autumn/winter 2013 to identify potentially important terrestrial invertebrate habitat. The survey area is shown in Plate 7.2.6 and comprises the Hampstead and Highgate Pond chains, where the Proposed Development will be focused, and surrounding land to provide context. At the time when surveys were designed the Proposed Development was not expected to encroach on Hampstead Heath Woods SSSI, but as a precautionary measure the eastern edge of the designated site was also included in the survey area. To confirm, there will be no encroachment on the SSSI. The survey was based on features of the habitat itself that may support scare species or diverse communities of invertebrates. No attempt was made to identify any species present during the survey visits.
- Further details of the methods adopted are provided in the phase 1 invertebrate technical survey report in 7.53 Appendix 7.24 Error! Bookmark not defined..



Plate 7.2.6 Survey area for phase 1 invertebrate survey (Cities Revealed photography copyright The GeoInformation Group, 2010)

# Aquatic Invertebrates

7.54 The most recent desk study data for pond aquatic invertebrates is available from the following report:

<sup>&</sup>lt;sup>13</sup> For the purpose of the review it has been necessary to limit the discussion of rare invertebrate species to Red Data Book (RDB) and notable species and no mention of the many scarce species present has been provided, these RDB and notable species should be considered a priority when assessing the impacts of the Proposed Development and when considering habitat management works

<sup>&</sup>lt;sup>14</sup> ECOSA (2014) Hampstead Heath Ponds Project Review of Existing Invertebrate Data Report for City of London

- Environmental Advice Centre Ltd (2002). Corporation of London Hampstead Heath ponds survey of ponds (REF: J485/V1/12.2002).
  - Includes assessment of higher aquatic vegetation in Stock Pond; Kenwood Ladies' Bathing Pond; Bird Sanctuary Pond, Model Boating Pond; Highgate Men's Bathing Pond and Highgate No.1 Pond undertaken in May and August 2002.
- Data from non-native invasive crayfish species trapping undertaken in June and August 2013 have been supplied in raw data format by the City of London.
  - Data provides species identification and total number of crayfish captured following the deployment of 10 traps in each pond.
- 7.55 Aquatic invertebrate surveys were undertaken as a component of the PSYM pond habitat assessment investigation conducted in July 2013. A three-minute macroinvertebrate sample was collected from standing water areas within each pond by dividing the three minutes between each of the identified microhabitats in proportion to their extents, with a further one-minute search made searching for animals which may otherwise be missed in the 3-minute sample (e.g. those under stones and logs). Macroinvertebrates were sampled using a 1 mm mesh D-frame pond net, by inverting the net and sweeping several different levels of the water column (surface, midwater, and just above the sediment). Sweeps included both the open water and the zone occupied by stems of the dominant emergent vegetation in each mesohabitat. Stony or sandy substrate was lightly kicked to disturb and capture any benthic macroinvertebrates. Samples were preserved in 90% Industrial Methylated Spirits solution immediately upon collection, and transported to a UKAS accredited laboratory. Macroinvertebrates were identified to species level where practical with reference to Environment Agency Operating Instruction BT001<sup>15</sup>.
- 7.56 Baseline data interpretation has been undertaken through the calculation of standard biological metrics including the number of taxa (measure of species richness), the Biological Monitoring Working Party (BMWP) scores and Average Score per Taxon (ASPT)<sup>16</sup>. Under the BMWP macroinvertebrate families have values allocated (1 to 10) according to their assumed tolerance to organic pollution. Although the BMWP scores were conceived for flowing water habitats they can applied to still waters in the assessment of levels of organic pollution. The BMWP score for a sample (pond) refers to the sum of the values assigned to the BMWP families recorded in the sample. The Average Score per Taxon (ASPT) is the BMWP score divided by the number of BMWP scoring families (for details refer to Wright, Sutcliffe and Furse, 2000).
- 7.57 The overall conservation value of the macroinvertebrate assemblages within the survey area were assessed using the Community Conservation Index<sup>17</sup> (CCI). This index incorporates both rarity and taxon richness. Individual species are assigned a Conservation Score (CS) based on their known conservation status in the UK, both locally and nationally. CCIs can range from 0 to >40, but a general guide to interpretation of scores is as follows:
  - 0 to 5.0 sites supporting only common species and/or a community of low taxon richness. Low conservation value.
  - 6.0 to 10.0 sites supporting at least one species of restricted distribution and/or a community of moderate taxon richness. Moderate conservation value.

- 11.0 to 15.0 sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness. Fairly high conservation value.
- 16.0 to 20.0 sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness. High conservation value.
- >20.0 sites supporting several rarities, including species of national importance, or at least one extreme rarity (e.g. taxa included in the British RDBs) and/or a community of very high taxon richness. Very high conservation value (potentially of national significance and may merit statutory protection).
- 7.58 Further details of the methods adopted are provided in the technical survey report in Appendix 7.14:
  - APEM (2013) Macroinvertebrate and macrophyte survey of 13 ponds on Hampstead Heath. Report 412170 for City of London.

# **Fisheries**

- 7.59 The most recent, and therefore applicable, desk study data for fish populations is available from the following reports:
  - Environmental Advice centre Ltd (2002). Corporation of London Hampstead Heath Highgate ponds fish survey (REF: J551/V1/11.2002).
  - Fish surveys of six ponds in the Highgate Pond Chain using a combination of electric fishing (boat deployment) and seine netting conducted in October 2002.
  - CB Fisheries (2002). An investigation into the resident fish stocks in Highgate No.3 (Model Boating).
    - 2002.
  - CB Fisheries (2002). An investigation into the resident fish stocks in Highgate No.2 (Highgate Men's Bathing Pond).
  - CB Fisheries (2002). An investigation into the resident fish stocks in Hampstead Pond No.3 (Mixed Bathing).
    - 2002.
  - CB Fisheries (2002). An investigation into the resident fish stocks in the Vale of Health.
  - Electric fishing survey of the Vale of Health Pond undertaken in April 2002.
  - Bernice Brewster (2007). Hampstead Heath Ponds Report.
- 7.60 To inform the Proposed Scheme fisheries surveys were undertaken using a multi-metric sampling regime typically comprising seine netting, boat run electric fishing and point sample electric fishing in accordance with Environment Agency best practice guidance (e.g. Beaumont et al., 2002). The suite of sampling methods adopted was determined on a pond by pond basis, in relation to pond size, depth and habitat structure. Further details of the methods adopted are provided in the fisheries technical survey report in Appendix 7.25:
  - APEM (2013) Baseline survey of fish communities in 13 ponds on Hampstead Heath. Report 412170 for City of London.
- 7.61 All fish captured were speciated and enumerated. Fish measurements (fork length to nearest millimetre) were also recorded to allow assessment of population demographics through the production of length frequency histograms where appropriate. Where large numbers of individual species were recorded in a pond a sub-set

Electric fishing (boat deployment) and seine netting survey of Model Boating Pond undertaken in April

Electric fishing (boat deployment) survey of Highgate Men's Bathing Pond undertaken in March 2002.

Electric fishing (boat deployment) and seine netting survey of Mixed Bathing Pond undertaken in April

<sup>&</sup>lt;sup>15</sup> Murray-Bligh, J.A.D. (1999). *Procedure for collecting and analysing macro-invertebrate samples*. Quality Management Systems for Environmental Monitoring: Biological Techniques BT001. Version 2.0. Bristol, Environment Agency

<sup>&</sup>lt;sup>16</sup> Biological Monitoring Working Party (1978). Final report: assessment and presentation of the quality of rivers in Great Britain. Unpublished report, Department of the Environment, Water Data Unit.

<sup>&</sup>lt;sup>17</sup> Chadd, R. and Extence, C., 2004. The conservation of freshwater macroinvertebrate populations: a community-based classification scheme. Aquatic Conservation: Marine and Freshwater Ecosystems 14: 597-624.

of the population was measured to ensure that processing time did not impact on fish welfare. Fisheries surveys were undertaken in July 2013.

# Phytobenthos, Cyanobacteria and Zooplankton

- 7.62 The most recent desk study data for pond phytobenthos, cyanobacteria and zooplankton is available from the following reports:
  - Environmental Advice Centre Ltd (2002). Corporation of London Hampstead Heath ponds survey of ponds (REF: J485/V1/12.2002).
    - Includes assessment of Phytoplankton and zooplankton in Stock Pond; Kenwood Ladies' Bathing Pond; Bird Sanctuary Pond, Model Boating Pond; Highgate Men's Bathing Pond and Highgate No.1 Pond undertaken in May and August 2002.
  - Environmental Advice Centre Ltd (2003). Corporation of London Hampstead Heath Highgate lakes microbiological and algal assessment (REF: J648/V1/12.2003).
    - Includes assessment of phytoplankton in Stock Pond; Kenwood Ladies' Bathing Pond; Bird Sanctuary Pond, Model Boating Pond; Highgate Men's Bathing Pond and Highgate No.1 Pond undertaken in May and August 2002.
  - AMEC Science and Environmental UK (2005-2010). Hampstead Heath phytoplankton analysis.
    - Phytoplankton schedules for the bathing ponds on Hampstead Heath (Highgate Men's Bathing Pond, Kenwood Ladies' Bathing Pond and Mixed Bathing Pond).
- 7.63 In support of the Proposed Scheme phytobenthos, cyanobacteria and zooplankton surveys were undertaken in May (early season) and July (late season) for all ponds in the Hampstead and Highgate pond chains. All surveys methods were conducted using UKAS<sup>18</sup> accredited methods and methods compliant under the Water Framework Directive (WFD)<sup>19</sup>.
- 7.64 Further details of the methods adopted are provided in the phytobenthos, cyanobacteria and zooplankton technical survey report in Appendix 7.26:
  - APEM (2013) APEM (2013) Baseline survey of Phytobenthos, Zooplankton and Cyanobacteria in 13 ponds on Hampstead Heath. Report 412170 for City of London.

# Limitations, Constraints and Deviations

7.65 Limitations are provided in the individual survey reports provided in the technical survey reports provided as Appendix 7.13 to 7.26.

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<sup>&</sup>lt;sup>18</sup> UKAS Testing Laboratory 4441.

<sup>&</sup>lt;sup>19</sup> WFD-UKTAG (2008) UKTAG Rivers Assessment Methods Macrophytes and Phytobenthos. Phytobenthos – Diatom Assessment of

Lake Ecological Quality (DARLEQ). SNIFFER, Edinburgh. 19pp.