Bat Activity Transect Surveys

4.62 Bat activity transect surveys carried out in 2022 updated previous such surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1).

4.63 The part of the Site proposed for development was assessed as being of moderate suitability for foraging bats, due to the dominance of large arable fields. In line with industry guidance, monthly dusk walked activity transects were therefore undertaken at the Site between May and October 2022, including one dusk and dawn transect (Collins, 2016). The aim of these surveys was to identify the bat assemblage at the Site, and to interpret the behaviour and distribution of bats within the Site.

4.64 Dusk surveys commenced at sunset and continued for two hours after sunset, and dawn surveys commended two hours before sunrise and continued until sunrise. These bat activity transect surveys repeated the level of survey effort employed in 2018 (see Appendix 1).

4.65 Each transect was walked by two surveyors, a least one of whom were experienced in bat activity surveys. The direction (i.e., clockwise or anticlockwise) of the transect route was altered to ensure that different parts of the Site were surveyed at different times of the night. This approach removes bias that could be introduced into the survey data if the transect was always walked in the same direction. The transects covered all suitable habitats within the Site, with a particular focus on hedgerows and woodland, which are likely to provide suitable commuting and foraging habitat for bats. Transect routes are shown on Figures 6d and 6e.

4.66 An Anabat Scout ultrasonic bat detector was used during each transect survey, which allows recording of bat calls for later analysis. Field notes were made during the survey, included a record of the time of each bat encounter, allowing results to be cross-referenced with the recorded data, and a record of any behaviours observed, such as or circling or hunting vocalisations (indicating foraging) or direct flight (indicating commuting).

4.67 Survey dates and weather conditions are listed in Table 2. Weather conditions during the surveys were suitable for bat activity.

Table 2: Dates, times and weather conditions recorded during the bat activity transect surveys

Date	Transect number	Surveyors	Time	Weather conditions
28/04/2022	1	Kai Hayes & Hannah Smith	20:24 – 22:24	Cloud 3/8. Wind Bf 1-1, no rain, and temperature: at start: 11^{0}C, at end: 9^{0}C
28/04/2022	2	Tom Flynn & Thomas Scott	20:24 – 22:35	Cloud 7/8, Wind Bf 1-2. No rain, and temperature: at start: 12^{0}C, at end: 8^{0}C
30/05/2022	1	Kai Hayes & Alix Harrington	21:12 – 22:36	Cloud 7/8, Wind Bf 1-1, no rain, and temperature at start: 13^{0}C, at end: 9^{0}C
30/05/2022	2	Jamie Peacock & Thomas Scott	21:12 – 22:36	Cloud 7/8, Wind Bf 1-1, no rain, and temperature at start: 13^{0}C, at end: 9^{0}C
27/06/2022	1	Kai Hayes & Joe Bishop	21:28 – 23:38	Cloud 2/8, Wind Bf 2-0, no rain, and temperature at start: 15^{0}C, at end: 13
27/06/2022	2	Sarah Joscelyne & Andy Hearn	21:28 – 23:30	Cloud 2/8, Wind Bf 2-0, no rain, and temperature at start: 15^{0}C, at end: 13
26/07/2022	1	Philip Chapman & Louise Morton	20:23 – 23:04	Cloud 8-8, Wind Bf 1-1, no rain, and temperature at start: 22^{0}C, at end 19^{0}C
26/07/2022	2	Jamie Peacock & Thomas Scott	21:04 – 23:18	Cloud 3/8, Wind Bf 1-1, no rain, and temperature at start: 18^{0}C, at end: 15^{0}C
18/08/2022	1	Kai Hayes & Thomas Scott	20:23 – 22:23	Cloud 8/8, Wind Bf 4-4, light drizzle, and temperature at start: 21^{0}C, at end: 19^{0}C
18/08/2022	2	Jamie Peacock & Louise Morton	20:23 – 22:23	Cloud 8/8, Wind Bf 4-4, light drizzle, and temperature at start: 21^{0}C, at end: 19^{0}C

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19/08/2022	1	Kai Hayes & Thomas Scott	03:56 – 05:56	Cloud 7/8, Wind Bf 5-2, some rain prior to survey, and temperature at start: 18°C, at end: 17°C.
19/08/2022	2	Jamie Peacock & Louise Morton	03:56 – 05:56	Cloud 7/8, Wind Bf 5-2, some rain prior to survey, and temperature at start: 18°C, at end: 17°C
20/09/2022	1	Jamie Peacock & Louise Morton	19:09 – 21:09	Cloud 8/8, Wind Bf 0-0, no rain, and temperature at start: 17°C, at end: 15°C
20/09/2022	2	Thomas Scott & Jennie Cadd	19:09 – 21:09	Cloud 8/8, Wind Bf 0-0, no rain, and temperature at start: 17°C, at end: 15°C
13/10/2022	1	Kai Hayes & Jamie Townsend	18:17 – 20:17	Cloud 3/8, Wind Bf 1-1, no rain, and temperature at start: 13°C, at end: 10°C
13/10/2022	2	Callum Waldie & Natalie Sabin	18:17 – 20:17	Cloud 3/8, Wind Bf 1-1, no rain, and temperature at start: 13°C, at end: 10°C

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4.68 Automated bat surveys carried out in 2022 updated previous such surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1). These involved fixed-point automated detectors, used to monitor bat activity over a more extended period than is possible via walked transects. The automated detectors were deployed each month between May and October 2022.

4.69 The four automated detectors were placed to complement the transect sruveys and to capture higher quality habitat features likely to be used by bats, whilst also providing a good distribution over the part of the Site proposed for development. Detector locations, as follows, are shown on Figure 6a:

- L1 – southern entrance of the Science Park, near a low tree-lined double hedgerow.
- L2a – western side of the railway embankment.
- L2b – centre of the Site, on Sandy Lane.
- L3 –southern boundary of the Site, on a hedgerow with trees.

4.70 The detectors recorded data for five consecutive nights in each deployment. They were programmed to begin recording half an hour before sunset until half an hour after sunrise, allowing continuous monitoring during the period when bats are active (i.e., sunset to sunrise). Survey hours varied throughout the survey season according to daylight hours and have been calculated for each recording session in order to accurately calculate activity rates. The automated detector surveys were conducted using Songmeter SM2 and SM4, and Anabat Swift bat detectors; these are full spectrum bat detectors used to automatically record bat echolocation calls.

4.71 Table 3 shows the dates the detectors were deployed and the number of nights of data analysed at each location across the survey season. This gives a total of 120 nights of survey.

Table 3: Dates and number of nights of data from automated detectors across the survey period.

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April	22/03/2022	29/03/2022	L1, L2a, L2b, L3	5
May	05/05/2022	12/05/2022	L1, L2a, L2b, L3	5
June	17/06/2022	24/06/2022	L1, L2a, L2b, L3	5
July	08/07/2022	15/07/2022	L1, L2a, L2b, L3	5
August	12/08/2022	19/08/2022	L1, L2a, L2b, L3	5
September	09/09/2022	16/09/2022	L1, L2a, L2b, L3	5

4.72 The bat detectors were set to record files in WAC format, which were later converted using Kaleidoscope (software created by Wildlife Acoustics) to files in ZC (Zero Crossing) format. The ZC output files were subsequently viewed and analysed using AnaLookW software (produced by Titley Electronics).

4.73 The Kaleidoscope analysis parameters used were as follows:

- Kaleidoscope Version 5.1.6.
- Outputs – ZC files using a division ratio of 8.
- Noise files were also filtered and kept (and scanned and checked in AnaLook).
- Default signal of interest settings were used (16-120 kHz, 2-500 ms, minimum no. of calls = 2).

4.74 The calls were analysed using AnaLookW software to give an indication of the species of bat present and their relative levels of activity. This software enables analysis of the relative activity of different species of bats by counting the minimum number of bat calls recorded within discrete sound files. For the purpose of the analysis, a bat pass is defined as a single, uninterrupted sequence of echolocation calls lasting a maximum of 15 seconds. The species analysis follows the call parameters as described in Russ (2012). The assessment of relative bat activity between species is based on the relative abundance of recorded calls of each species within each survey period (i.e., each five-day period of automated monitoring per month) and across the combined study period.

4.75 It should be recognised that a series of separate sound files could represent multiple bats calling infrequently (e.g., as they each pass overhead moving in one direction) or a small number of bats (or even one individual) calling frequently (e.g., bats making repeated foraging passes up and down a feature). This cannot be determined unless bats can be directly observed at all times. Despite this, an indication of overall patterns of use of the Site by different species can be established based on the regularity of recording.

4.76 Where possible, bat calls were identified to species level. However, species of the genus *Myotis* are grouped together as their calls are similar in structure and have overlapping call parameters, making species identification problematic (Russ, 2012). For long-eared bats *Plecotus* species, calls of grey long-eared bats *Plecotus austriacus* and brown-long-eared bats *Plecotus auritus* cannot be distinguished due to overlapping call parameters. However, since grey long-eared bats are restricted to the extreme south of the UK (Harris & Yalden, 2008), any *Plecotus* calls recorded are assumed to be from brown long-eared bats.

4.77 The following criteria based on measurements of peak frequency were used to classify calls:

• Common noctule	*Nyctalus noctule*	≥ 20 – 25kHz
• Leisler's bat	*Nyctalus leisleri*	≥ 25 kHz
• Serotine	*Eptesicus serotinus*	≥ 27kHz
• Barbastelle bat	*Barbastella barbastellus*	≥ 32kHz
• Nathusius' pipistrelle	*Pipistrellus nathusii*	≥ 39kHz
• Common pipistrelle	*Pipistrellus pipistrellus*	⩾ 42 and <49kHz
• Brown long eared bat	*Plecotus auritus*	≥ 45 – 50 kHz
• Soprano pipistrelle	*Pipistrellus pygmaeus*	≥ 51kHz
• *Myotis sp.*	*Myotis*	≥ 30 – 100 kHz

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4.78 Surveys for dormouse *Muscardinus avellanarius* carried out in 2022 updated previous surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1).

4.79 The survey targeted hedgerows at the Site that provide suitable habitat for this species and are likely to be affected by the Proposed Development. Hedgerows in areas proposed for greenspace in the Green Infrastructure parameter plan were not surveyed; this plan indicates that all of these are to be retained, except for hedgerow 38 (see Figure 3), parts of which will require removal for the proposed road bridge over the rail line. Two hedgerows that run south of Begbroke Science Park (along the old access road) and a hedgerow along the south-eastern boundary of the Site were also not surveyed, as they are heavily managed by trimming, are species-poor, and are therefore considered to provide poor habitat for dormice.

4.80 The survey method and effort were based on industry standard guidance (Bright et al., 2006). A total of 194 dormouse nest tubes (of standard industry specification) were set out at approximately 20 m intervals in areas of suitable habitat on 22 April 2022 by Jamie Townsend and Tom Scott, Ecologists at BSG Ecology. Locations of tubes are shown in Figure 7. Survey visits to examine the nest tubes to look for signs of dormouse (e.g., characteristic nests or hairs, or the animals themselves) were carried out approximately monthly between May 2022 and late-September 2022 by Hannah Smith, independent ecologist, who holds a Natural England dormouse survey licence (number 2016-21251-CLS-CLS).

4.81 Survey tubes were checked for signs of dormouse on 25 May, 29 June, 20 July, 24 August, and 21 September 2022. Using the points-based system to assess survey effort of Bright et al. (2006), this survey achieved a score of 17.9 points (tubes were deployed for 70% of the month of September, so a corresponding proportion of the 7 points for that month were counted). Taking into account the fact that 194 (rather than the minimum number of 50) nest tubes were deployed, the score was doubled. The score, of 35.8 points is therefore above the minimum of 20 points recommended for determining absence of dormouse (Bright et al., 2006).

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4.82 Water vole surveys carried out in 2022 updated previous surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1).

4.83 The water vole surveys were based on industry guidance (Dean et al., 2016) and covered all suitable habitat for this species on Site, comprising Rowel Brook in the north of the Site and a tributary which flows into this from the east. A ditch in the south of the Site was also surveyed due to the presence of water being noted here during some of the survey visits in spring 2022. The extent of the survey is shown on Figure 8.

4.84 The survey visits were undertaken on 16 May 2022, 12 September 2022, and 12 October 2022 by Kai Hayes, Jamie Townsend, and Tom Scott, Ecologists at BSG Ecology.

4.85 All accessible stretches of these watercourses within or on the boundary of the Site were surveyed. The survey involved systematically searching for evidence of water vole, including latrines (communal areas of droppings), feeding stations, grazed lawns, burrows, runs, and footprints. The habitats present were also assessed for their suitability to support the species (based on characteristics of the banks, channel depth, and vegetation cover). Survey timing and effort took into account the recommendations of standard industry guidance (Dean et al., 2016).

4.86 During the October survey, Rowel Brook held noticeably less water than the other two surveys due to an extremely dry and hot summer. This may have reduced the suitability of the watercourse for water vole

4.87 Ditches forming the southern boundary of the Site east of the railway line are outside the Site boundary and were not surveyed.

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4.88 Otter surveys carried out in 2022 updated previous surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1).

4.89 In order to determine whether otter is present at the Site, an otter survey was conducted by searching for signs of this species at the same time as the water vole survey detailed above. The survey covered the same sections of watercourse as the water vole survey (see Figure 8). The otter survey was based on the survey method of the Environment Agency (2010). This involved searching for evidence of otter and other riparian mammal species (such as American mink *Neovison vison*) along the stream and ditch banks and around any bridges. Such evidence can include spraints (droppings), footprints, runs (paths worn through vegetation adjacent to the water) slides (areas of steep bank showing signs of regular use by otters to access the water), and holts (burrows).

4.90 Particular attention was paid to prominent bankside or in-stream features such as tree trunks, branches, rocks, areas of bare ground, culverts and inflowing ditches or pipes, since these types of structures are often used as sprainting sites (otter spraints are used to indicate territories). Areas of mud were inspected for the presence of footprints.

[illegible]

4.91 Breeding bird characterisation surveys carried out in 2022 updated previous surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1).

4.92 In order to provide information on the use of the Site by breeding birds, a breeding bird characterisation survey was carried out over the period April–June 2022. This involved monthly visits to the Site during which all habitats at the Site were walked over, with attention being paid especially to linear features and woodland areas. Adjacent to and within areas of woodland/trees, frequent stops were made to listen and scan for singing and calling birds. Large open areas were covered either from the edges, through direct observation, or were crossed by the surveyors. Birds observed beyond the boundary of the Site were also noted in order to provide further contextual information. Bird locations were mapped and behaviour recorded using standard British Trust for Ornithology (BTO) codes and symbols on field maps during each survey. The maps obtained as a result of the three visits were then collated to produce a single territory map. Breeding was assumed for all species which displayed breeding behaviour (such as carrying nesting material or food) and for species displaying territorial behaviour in suitable habitat.

4.93 The survey visits were carried out on 25 April, 13 May, and 9 June 2022 by Natalie Sabin, Ecologist at BSG Ecology, Joe Bishop, Senior Ecologist at BSG Ecology, and Bill Haines, independent ecologist, all of whom are experienced field ornithologists. During all visits, the weather conditions were suitable for breeding bird surveys (i.e., no rain, or wind exceeding 5 on the Beaufort Scale).

[illegible]

4.94 GCN surveys carried out in 2021 and 2022 updated previous surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1).

4.95 GCNs breed in waterbodies and can be found within terrestrial habitat up to 500 m from (though typically within 250 m of) such aquatic habitat. Ponds within the Site and within 500 m of the Site were identified using Ordnance Survey maps.

4.96 Based on the most recent desk study and survey work, there are six ponds within the Site (numbered 1 to 6 on Figure 10). Seven further ponds outside the Site (numbered 7 to 13) were considered for their ecological linkage to the Site for GCN. The Oxford Canal at the east of the Site, and the A44 dual carriageway at the west of the Site are considered significant barriers to the movement of GCN. Therefore, ponds beyond these (such as ponds 9 and 10) were not surveyed.

4.97 All ponds within the Site were subject to the following sequential surveys for GCN: a HSI assessment (in 2018, updated in 2021), eDNA survey (in 2018, updated in 2021), and (where a positive eDNA result was obtained, indicating presence of GCN), overnight surveys (bottle trapping and torching; in 2018, updated in 2022). Where access was available, ponds outside the site with potential for ecological linkage to the Site for GCN were also subject to survey (this included pond 8).

4.98 Two ponds (ponds 11 and 12) to the southeast of the Site, beyond the railway line, have potential ecological connectivity to the Site for GCN but were not accessible for survey due to third-party

ownership. The part of the Site in closest proximity to these ponds was therefore subject to a terrestrial survey for GCN using artificial refuges.

4.99 A pond identified ca. 75 m west of the Site in 2018 (pond 7 on Figure 10) was found to have been filled in and no longer present in May 2021.

4.100 A pond ca. 15 m to the south of the Site (pond 13) is located adjacent to a part of the Site indicated as retained agricultural land on the PR8 policy map. This pond is ca. 540 m from the closest area proposed for built development in PR8. This pond was therefore not subject to survey.

Habitat Suitability Index Assessment

4.101 A HSI assessment was carried out for ponds 1, 2, 3, 4, 5, 6, and 8, based on site visits carried out in April 2021. Ponds 7, 9, 10, 11, 12, and 13 were not surveyed for the reasons discussed above.

4.102 HSI values are calculated by allocating scores to features associated with a pond such as size, quality of surrounding habitat, and presence of fish. These scores are then used to calculate the overall HSI score for each waterbody. The HSI score is a number between 0 and 1, with 0 being the least suitable and 1 being the most suitable for GCN. The HSI score allows each waterbody to be placed in one of five categories defining its suitability for GCN as follows: <0.5: poor; 0.5–0.59: below average; 0.6–0.69: average; 0.7 – 0.79: good; >0.80: excellent.

eDNA Survey

4.103 Ponds 1, 2, 3, 5, 6, and 8 were subject to an environmental DNA (eDNA) survey to detect the presence or absence of GCN in 2021. 'Environmental' DNA is DNA that is released into aquatic environments through the shedding of skin cells, urine, faeces and saliva. It can persist in water for several weeks and when water samples are collected, they can be tested for this DNA. Pond 4 was not surveyed due to the presence of this species already having being confirmed in 2018. Ponds 7, 9, 10, 11, 12, and 13 were not surveyed for the reasons discussed above.

4.104 The eDNA survey was undertaken on 14 May 2021 by Oliver Kemp and Jamie Peacock, Ecologists at BSG Ecology. Jamie Peacock holds a Natural England survey licence for GCN (number 2016-20471-CLS-CLS).

4.105 Natural England has approved a protocol for collecting and testing samples which, if followed, they will accept as evidence of presence or likely absence of GCN (Natural England, 2015). This protocol was followed in in this survey. Water samples were collected from the perimeter of ponds and sent to a certified laboratory (Surescreen Scientifics Ltd) to be analysed for presence of GCN DNA.

Overnight surveys

4.106 In order to provide an estimate of population size class, overnight surveys for GCN were carried out of pond 4. These surveys was limited to this pond only because GCN had been recorded form this pond in 2018, whereas all of the other ponds which were subject to eDNA survey returned negative results, indicating the absence of GCN.

4.107 The overnight surveys were based on industry standard guidance (English Nature, 2001). This recommends that to estimate population size class, six appropriately timed overnight survey visits should be undertaken. The overnight surveys should utilise two methods: torch survey and bottle-trapping. At least three of the overnight visits should be carried out between mid-April and mid-May.

4.108 Torch surveys involved searching for GCN after sunset using two Clulite 1 million candle power torches. All accessible parts of the pond's margins were slowly walked and searched.

4.109 Bottle trapping was also carried out. Bottle traps (constructed from 2 L plastic drinks bottles) were set in suitable parts of the pond at dusk and left in place overnight. Bottle traps were checked for amphibians the following morning within 12 hours of setting, and any animals caught were released at the point of capture. As pond 4 is lined with concrete, it was not possible to support traps on bamboo canes inserted into the pond base. Traps were therefore modified by adding weights to the

funnel end, allowing them to float vertically below the surface, supported by polystyrene floats at the top. Traps were tethered to the bank to avoid loss. Twelve bottle traps were used in the survey.

4.110 Egg searches were conducted to determine whether GCN were breeding in pond 4. This involved searching marginal and aquatic vegetation for the distinctive leaf folding pattern and egg size and colour produced by GCN. Results from egg searches are only useful for indicating presence/absence and breeding status, and not population size.

4.111 Overnight surveys were carried out on the dates and under the weather conditions listed in Table 4, which also shows surveyors. The surveys were led by Dr Tom Flynn MCIEEM, Principal Ecologist at BSG Ecology who holds a Natural England GCN survey licence (number 2015-17735-CLS-CLS) and has carried out surveys for this species since 2005. Other surveyors were Thomas Scott, Ecologist at BSG Ecology, Joe Bishop, Senior Ecologist at BSG Ecology, Kai Hayes, Ecologist at BSG Ecology, Hannah Smith, Independent Ecologist, and Jamie Townsend, Ecologist at BSG Ecology. A surveyor holding a Natural England survey licence for GCN, or their accredited agent, was present on each survey visit.

Table 4: Survey dates, weather conditions and surveyors during overnight surveys for GCN

1	19/04/2022	Tom Flynn and Thomas Scott	5	2	none	1	2
2	28/04/2022	Tom Flynn, Kai Hays and Hannah Smith	7	2	none	1	2
3	05/05/2022	Joe Bishops and Kai Hayes	8	5	none	1	2
4	12/05/2022	Kai Hayes and Thomas Scott	13	1	none	2	2
5	19/05/2022	Joe Bishops and Kai Hayes	10	1	heavy	2	2
6	26/05/2022	Kai Hayes, Joe Bishop and JamieTownsend.	15	2	none	2	2

4.112 The above guidance recommends that to determine population size class, the peak count obtained from six survey visits should be used, with at least three of these visits carried out between mid-April and mid-May. GCN populations (which can include multiple ponds, depending upon the distance and habitats between them) can then be classed as 'small' for maximum counts of up to 10 adults, 'medium' for maximum counts between 11 and 100, and 'large' for maximum counts exceeding 100 adults.

4.113 Weather conditions during the survey visits (including temperature) were suitable for the surveys (see summary data in Table 2 above). Turbidity and vegetation cover were within acceptable limits for torchlight surveys on all six survey visits (the ranges were 1–2 and 2–2 respectively). There were no constraints or limitations on the effectiveness of the survey.

Terrestrial Survey for GCN

4.114 As off-site ponds P11 and P12 (see Figure 10) could not be surveyed due to no access being granted by the landowner, and these are within 250 m of Proposed Development, it was considered appropriate to carry out a terrestrial survey for GCN. The purpose of this survey was to determine whether GCN are using suitable terrestrial habitat within parts of the Site closest to ponds P11 and P12.

4.115 The closest terrestrial habitat suitable for GCN within the Site is a triangular shaped area of scrub and rough grassland in the south of the Site. This area is between 40 and 150 m from Ponds 11 and 12. To survey this area for terrestrial GCN, a total of 20 artificial refuges consisting of carpet tiles measuring 50 cm by 50 cm were placed around the perimeter of the area (the centre was inaccessible due to the presence of dense scrub). These tiles were in addition to 20 artificial reptile shelters placed in this area for the reptile survey (see *Reptile Survey* below), which also provided

suitable sheltering sites for GCN. The 40 artificial refuges were set out on 21 March 2022 and checked by surveyors on six occasions during daytime between 13 April 2022 and 20 June 2022.

4.116 The use of artificial refuges without the use of the dug-in drift fencing that is specified in industry standard guidance for terrestrial GCN survey (English Nature, 2001) was considered a proportionate level of survey effort, given the limited potential for ponds 11 and 12 to be breeding ponds and (from aerial photographs) the abundance of suitable terrestrial habitat in their vicinity outside the Site.

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4.117 Reptile surveys carried out in 2022 updated previous surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1).

4.118 Areas of suitable reptile habitat on Site was identified from the results of the Phase 1 habitat survey and reptile surveys carried out in 2018 and 2022. Suitable reptile habitat at the site is limited to certain field margins, and some areas of rough grassland. To determine whether reptiles were present (and if so, which species), a presence/absence survey for reptiles was carried out in 2022,following industry standard guidance (Froglife, 1999).

4.119 A total of 110 artificial refuges (each comprising a piece of roofing felt 100 x 50 cm (i.e., 0.5 m^2) were placed within areas of suitable habitat on Site on 21 April 2022 (see Figure 11 for locations). Due to the nature of the Site (predominantly arable fields) it is difficult to accurately map the area of suitable reptile habitat and hence to calculate the density of refuges that should be deployed. However, based on the recommendations of Froglife (1999), which refer to a refuge density of 5–10 refuges per hectare, the 110 refuges used were sufficient to cover 10–20 ha of suitable habitat (i.e., 5–11 % of the 177 ha Site), which is is considered to be significantly more than the area of suitable reptile habitat on Site.

4.120 The artificial refuges were checked for reptiles on seven occasions between 05 May and 20 June 2022. Survey visits were carried out on the dates and under the weather conditions indicated in Table 5. The timing and weather conditions were suitable for reptile surveys (Froglife, 1999). All surveyors had previous experience and training in reptile survey. The surveyors were Jamie Townsend, Ecologist at BSG Ecology, Kai Hayes, Ecologist at BSG Ecology, and Thomas Scott, Ecologist at BSG Ecology.

Table 5: Dates and weather conditions of reptile survey visits

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Setup	21/03/2022	JT & TS	N/A	N/A	N/A
1	06/05/2022	KH	14-18	2	Strong sun, light wind
2	13/05/2022	KH & TS	17-18	1	Strong sun and breeze
3	25/05/2022	KH	15-17	8	Occasional sun, light breeze
4	01/06/2022	TS	13-16	5	Occasional sun, light breeze
5	07/06/2022	KH	14-18	4	Strong sun, very light breeze
6	13/06/2022	KH	16-18	5	Occasional sun, very light breeze
7	20/06/2022	KH & TS	16-18	4	Strong sun, strong breeze
* Surveyors: JT: Jamie Townsend, Ecologist at BSG Ecology; KH: Kai Hayes, Ecologist at BSG Ecology; TS: Thomas Scott, Assistant Ecologist at BSG Ecology.					

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4.121 Winter bird characterisation surveys were carried out at the Site in over the period December 2021 to February 2022.

4.122 In order to provide information on the use of the Site by winter birds, a winter bird survey was carried out over the period January to February 2022 by Phil Chapman, Senior Ecologist at BSG Ecology,

an experienced ornithologist. The survey involved monthly visits, during which the arable and grassland fields at the Site were scanned with binoculars from a suitable location during daylight, and then viewed after dark using a thermal imaging camera (FLIR T650sc). Survey visits were carried out on 08 December 2021, 25 January 2022, and 15 February 2022. Weather conditions on these visits were suitable for the survey.

[illegible]

4.123 Surveys for brown hairstreak butterfly *Thelca betulae* were carried out at the Site in 2022.

4.124 The Phase 1 habitat survey identified hedgerows containing blackthorn *Prunus spinosa,* which is the larval food plant of the brown hairstreak butterfly, and Oxfordshire is known to support important populations of this Species of Principal Importance (SPI). A targeted winter egg search survey was conducted as this is the most effective means for identifying the presence of this species. These surveys may also indicate the presence of black hairstreak *Satyrium pruni,* which is also as SPI and may be revealed by the same survey method.

4.125 Egg searches for brown hairstreak were carried out at the Site on 08 February 2022 Jamie Peacock, Ecologist at BSG Ecology, and John Baker MCIEEM, Principal Ecologist at BSG Ecology. Both have previous experience of egg search surveys for black and brown hairstreak butterflies.

4.126 Both hairstreak species typically lay their eggs on blackthorn bushes, at the base of branches where new growth meets old. Hedgerows within the Site with the greatest abundance of blackthorn growth were therefore selected and searched for the presence of eggs of both species. Hedgerows subject to survey are indicated in Figure 3. In each of these spot check areas, the blackthorn growth was systematically checked for the presence of eggs. Approximately 1 minute was spent searching each 1 m^3 of suitable habitat for a maximum of 20 minutes (i.e., 20 m^3) in each spot check area.

4.127 February is considered to be a suitable time of year to undertake such a survey as the stems on which the eggs are laid are clear of leaves and flowers that would otherwise obscure them from view. The weather on the survey day was suitable for the survey.

[illegible]

4.128 Aquatic macroinvertebrate surveys carried out in 2022 updated previous surveys of the Site carried out by BSG Ecology in 2018 (see Appendix 1).

4.129 Aquatic macroinvertebrates samples were collected at a total of three sampling points along the section of the Rowel Brook within the Site on 11 May 2022 by Jamie Peacock, Ecologist at BSG Ecology, and Glyn Brown, independent ecologist, and on 11 October 2022 by Jamie Peacock and Louise Morton, Ecologist at BSG Ecology. The brook and its tributary were at a normal flow level during both surveys.

4.130 Sample 1 was taken from a tributary to the east of the Rowell Brook. Samples 2 and 3 were taken from Rowel Brook itself. Sampling locations are shown in Figure 8. Since the 2022 work updates and builds on an existing data set, three sampling points were considered sufficient survey effort to characterise the current invertebrate community of Rowel Brook at the Site.

4.131 Macroinvertebrates were collected using a standard three-minute kick sample using a 1 mm mesh hand net. Three minutes of net sampling was carried out with the time divided equally between all of the mesohabitats present. Stony or sandy substrates were lightly kick-sampled to disturb and capture macroinvertebrate inhabiting the stream bed. Care was taken to avoid deep accumulations of soft sediment since this makes later sorting extremely difficult. Similarly, the netting of large volumes of plant material was avoided. One minute of hand searching (of rocks, logs, leaf packs and other submerged debris) for invertebrates (e.g., limpets, caddis larvae, pond skaters, riffle, and whirligig beetles) was then carried out to capture species that might otherwise have been missed during the net sampling.

4.132 Coarse debris was checked for clinging invertebrates before being removed from the net. Samples were preserved immediately in 70% industrial methylated spirit for subsequent laboratory analysis.

4.133 At each sampling point, habitat details such as channel characteristics, adjacent land use, and macrophyte cover and composition were recorded on a standard form. In addition, water chemistry was measured using a multi-parameter meter. Recordings of conductivity, pH, total dissolved solids, and dissolved oxygen were taken.

M[illegible]

4.134 In the laboratory, aquatic macroinvertebrates were separated from material collected incidentally as a by-catch of the kick-sampling process. All macroinvertebrate individuals present in the sample were identified to family-level under a stereoscopic microscope (x70) using current identification keys.

4.135 Macroinvertebrate samples were identified by Jamie Peacock (and Louise Morton, under supervision and checking by Jamie Peacock), Ecologists of BSG Ecology. Jamie Peacock has training and experience in macroinvertebrate identification, and a qualification in family level identification from the Freshwater Biological Association.

L[illegible]

4.136 Any limitations to the desk study and surveys are discussed in the text above. These include a lack of access to survey the offsite ponds 11 and 12, and bat surveys of building B2 and tree 3 at Begbroke Science Park being limited to inspections rather than emergence surveys. These limitations will need to be taken into account in the ecological impact assessment of the Proposed Development, and in the specification of appropriate mitigation. However, given the extent of the survey effort for bats across the Site, particularly in the vicinity of the Science Park, and for GCN across the Site (particularly in onsite areas in the vicinity of ponds 11 and 12) these limitation as not considered to be significant constraints to a thorough ecological impact assessment of the PR8 planning application.

[illegible]

4.137 The Ecology Officer at Cherwell District Council (Charlotte Watkins) was consulted by email on the scope of ecology baseline surveys for the PR8 planning application on 12 May 2021. She responded by email on 20 May 2021, noting that '*The proposed update surveys and justifications all look reasonable*'.

4.138 The Ecology Officer was consulted again on the scope for ecology baseline surveys for the PR8 planning application on 13 May, 30 May, and 19 October 2022. She responded by email on 20 October 2022, noting that '*The scope seems appropriate to me although I do not know this site particularly well. As long as anything omitted (such as Otter) is justified within your reports then I would not anticipate any issues with scope*'.

4.139 These consultation emails are provided in Appendix 2.

R

D

5.1 There are no statutory wildlife sites within the Site.

5.2 Statutory sites within the desk study search area are shown on Figure 1 and listed in Table 6.

Table 6: Statutory designated wildlife sites within 5 km of the Site.

N	D		Ar	A d d r
Rushy Meadow	SSSI[1]	Damp meadow.	8.7	10 m NE
Oxford Meadows	SAC[2]	Floodplain grassland, including grazed pasture and hay meadows.	267.4	1.8 km S
Pixey and Yarnton Meads	SSSI	Floodplain hay meadows.	85.6	1.8 km S
Wolvercote Meadows	SSSI	Floodplain hay meadows.	9.2	2.4 km S
Blenheim Park	SSSI	Oak-dominated pasture woodland and lakes.	225.2	2.5 km NW
Portmeadow with Wolvercote Common and Green	SSSI	Grazed floodplain grassland.	166.7	2.5 km S
Shipton on Cherwell and Whitehill Farm Quarries	SSSI	Notified for its geological interest: white limestone containing abundant and important fossils.	27.7	2.7 km N
Wytham Ditches and Flushes	SSSI	Ditches supporting species-rich eutrophic aquatic and fen flora.	5.7	2.7 km SW
Cassington Meadows	SSSI	Hay meadows and fen.	7.0	2.8 km SW
Hook Meadows and the trap Grounds	SSSI	A series of poorly-drained unimproved neutral meadows.	11.3	3.6 km S
Wytham Woods	SSSI	A complex of ancient woodland, wood pasture, common land and old limestone grassland.	426.5	3.6 km SW
Woodeaton Quarry	SSSI	Notified for its geological interest: a Bathonian section and white limestone formation.	6.4	4.0 km E
Shipton-on-Cherwell and Whitehill Farm Quarries SSSI	SSSI	Notified for its geological interest: a section from near the base of the White Limestone up to the Lower Cornbrash (with important fossil reptiles) at Shipton Quarry; and the highly fossiliferous Shipton Member of the White Limestone at Whitehill Quarry.	4	4.4 km N
Woodeaton Wood	SSSI	Woodland forming an intact relic of the ancient Shotover Forest.	14.1	4.8 km E
New Marston Meadows	SSSI	A series of agriculturally unimproved neutral meadows on the flood plain of the River Cherwell.	44.4	4.9 km SE
Long Hanborough Gravel Pit	SSSI	Notified for its geological interest: This site provides exposures in the gravel of the Pleistocene Hanborough Terrace of the Evenlode Valley.	4.3	5.0 km W

[1] Site of Special Scientific Interest
[2] Special Area of Conservation