Cinderford Northern Quarter, Forest of Dean

Great Crested Newt Monitoring Survey

Forest of Dean District Council

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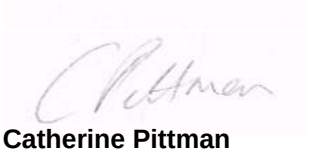

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1. Introduction

1.1 Background

1.1.1 Ecus Ltd ("Ecus") was commissioned by Forest of Dean District Council ("FDDC") in January 2017 to undertake great crested newt (*Triturus cristatus*) ("GCN") pond monitoring during 2017 and 2018 at the Cinderford Northern Quarter development ("CNQ"), in Gloucestershire (National Grid reference for site centre: SO644152).

1.1.2 This work includes:

- Undertaking GCN population size class assessments at all ponds within the assessment area;
- Undertaking habitat suitability index ("HSI") assessments on all ponds within the assessment area and environmental DNA ("eDNA") analysis specifically on Ponds 10, 17 and 29;
- Assessment of pond condition and terrestrial habitat for all ponds included within the assessment;
- Assessment of the 40 hibernacula constructed on site; and
- Undertaken monitoring at Old Engine Brook (2018 only).

1.1.3 The CNQ development is located north-west of Cinderford, within the Forest of Dean. An Area Action Plan ("AAP") for CNQ was published by FDDC in 2012. This set out regeneration opportunities, whilst aiming to safeguard the ecological importance of the area.

1.1.4 Planning permission was granted in 2014 for the development of an education facility, hotel, office and industrial spaces, new homes and spine road within the boundary of the AAP. The commercial conifer plantation on the land to the south of the AAP area has been removed and has been replaced with new ponds, grassland and broadleaved woodland habitats, to mitigate loss of habitat for protected and important species, including GCN.

1.1.5 GCN surveys previously undertaken in 2012 and 2013 by Johns Associates identified 33 ponds on site, of which 17 had confirmed GCN presence. In 2015, Ecus surveyed 20 ponds and confirmed presence of GCN within 15 ponds, and GCN breeding within six of these.

1.1.6 As part of the European Protected Species Licence ("EPSL") mitigation provisions, four new ponds, designated as N1, N2, N3 and N4, have been created to the west of the central cluster of ponds. As such the total number of ponds initially scoped into this monitoring scheme was 42 individual ponds or pond complexes. However, due to changing hydrology of the land, the number or size of certain ponds has changed over the two year monitoring period.

1.1.7 In 2017, Ecus surveyed 42 ponds and confirmed presence of GCN in 21 ponds, as well as confirming four ponds as breeding ponds.

1.1.8 The purpose of the survey work in 2018 is to provide an update on the status of the GCN population in the area and to inform the requirements for future mitigation and management.

2. Methodology

2.1 Introduction

2.1.1 The survey area is shown on Figures 1.1 – 1.3, which detail the location of the ponds. The location of the hibernacula and refugia is shown on Figure 3.1.

2.2 Habitat Suitability Index assessment

2.2.1 GCN is a habitat specialist and its presence in a given water-body is influenced by the presence of particular features such as fish, heavy shading or nearby suitable terrestrial habitat. The HSI assessment process provides a numerical value (ranging from 0 to 1), which indicates the suitability of a water-body for supporting GCN. The higher the HSI score, the more suitable (or closer to optimum habitat conditions) the water-body may be considered for GCN. However, it should be noted that the HSI score should be verified by an experienced surveyor and a low suitability score does not necessarily mean that GCN will not be present.

2.2.2 All ponds were assessed for their potential to support GCN using the HSI assessment methodology (Oldham *et al*., 2000). The HSI was assessed on commissioned ponds only and not on the additional ponds that were identified in 2017 (ponds 24b, 24c, 24d, 24e, 27d, 27e).

2.3 Pond condition and terrestrial habitat assessment

2.3.1 A pond condition and terrestrial habitat assessment were carried out for all ponds to be monitored as outlined in the project scope. Pond condition was assessed in regards to the presence of invasive species, silt levels and evidence of pollution incidence, fire or damage, in order to give a broader assessment of the condition of each of the ponds.

2.3.2 Pond condition was scored into four categories; 'poor', 'fair', 'good' and 'excellent'. The scores were based on criteria set out below in Table 1. The detailed matrix used to assess each pond is provided in Appendix 2.

Table 1 Criteria for Pond Condition Score

Pond Condition Score			
Poor	**Fair**	**Good**	**Excellent**
• If non-native invasive species are present, pond condition is considered poor; or • If non-native invasive species	• Non-native invasive species are absent; or • High silt levels but dumped rubbish is absent, or	• Non-native invasive species are absent; or • Moderate silt levels and dumped rubbish is absent; or	• Non-native invasive species and dumped rubbish are absent; and • Silt levels are low.

Pond Condition Score			
Poor	**Fair**	**Good**	**Excellent**
are absent but silt levels are high and dumped rubbish is present, then pond condition is considered poor.	• Moderate silt levels but dumped rubbish is present.	• Low silt levels but some dumped rubbish is present.	

2.4 Hibernacula suitability assessment

2.4.1 As part of the mitigation works, 40 hibernacula have been built in several locations across the survey area. These hibernacula comprise purpose built log piles approximately 2 m long, 1 m wide and 1 m high, held within wooden posts and wire. These provide suitable terrestrial refugia potential for reptiles, GCN, other amphibians and fauna.

2.4.2 The hibernacula were assessed due to their importance in providing a stable environment for shelter and overwintering. Assessment was based on criteria such as size, distance to body of water and composition. As with the HSI, this assessment provides a numerical value (ranging from 0 to 1) that indicates the suitability of each hibernaculum in relation to GCN and other amphibians alike. The higher the assessment score, the more suitable (or closer to optimum conditions/features) the hibernaculum may be considered for target species. Details of the scoring system are presented in Appendix 3.

2.5 eDNA sampling

2.5.1 Pond 10 was surveyed using eDNA sampling to provide an indication of whether GCN were present or absent from the water bodies, based on the presence of their DNA within the water. Ponds 17 and 29 were unable to be sampled for eDNA during the monitoring; Pond 29 was no longer present, whilst Pond 17 was identified as a flowing ditch, and as such considered unsuitable for eDNA sampling.

2.5.2 Water samples were taken in accordance with methodology approved by Natural England (Biggs *et al*., 2014). All samples were taken using sterile equipment provided by SureScreen Scientifics. Twenty water samples were taken from regularly distributed sample points around each water body, which were then mixed together and from this, six samples were taken to be sent for analysis. In accordance with the guidance, samples were kept cool prior to being sent to SureScreen Scientifics, who carry out the laboratory analysis of the sampled.

2.5.3 Biosecurity measures were followed to prevent contamination, including avoiding entering the water-body when taking samples, thoroughly washing boots with Virkon S solution prior to attending site, wearing gloves and using

only the sterile kit provided by the laboratory.

2.6 GCN population estimates

2.6.1 GCN surveys of the 42 ponds (those that were able to be surveyed) on site were undertaken following methodologies described in the GCN Mitigation Guidelines (English Nature, 2001). In accordance with best practice guidelines, to determine presence of the species each pond was visited four times with at least three visits occurring between mid-April and mid-May, on nights when air temperatures exceeded 5°C. If presence of GCN was confirmed within a pond, an additional two surveys were undertaken to estimate population size.

2.6.2 Surveys used a combination of techniques appropriate to the site conditions at the time of survey. Techniques used included; trapping with bottle traps, torchlight searches, egg searches and terrestrial search. The survey techniques used varied between water bodies and visits, with at least three techniques employed on each visit.

2.6.3 Ponds with no GCN recorded after four visits were scoped out of further surveys. This is in line with Natural England's acceptable level of surveying effort for GCN detection, which indicates that after four visits with no recorded GCN it is considered likely that the species is absent.

Bottle trapping

2.6.4 The number of bottle traps placed in each pond was determined based upon best practice guidelines, utilising a density of one trap per two meters of shoreline to ensure consistency in survey effort. Traps were deployed in bunches of fives to minimise the risk of leaving traps in the water through miscounting. The number of traps used in each survey visit is provided in Appendix 4.

2.6.5 Bottles were left in place overnight, and checked the following morning before 11:00 am or earlier, when air temperatures were warmer. Any animals found in the bottle traps were recorded and then immediately released. For any animals found, where possible the species, gender and an assessment of age was recorded.

2.6.6 As part of the standard survey protocols, biosecurity measures were taken to prevent the possible spread of disease. Boots were washed with Virkon solution between different groups of ponds in the same night. This was to prevent the spread of chytrid fungus (*Batrachochytrium dendrobatidis*), a known fungal disease harmful to amphibians. Virkon deactivates quickly in the environment once activated and is an industry recognised bio-control measure.

Torchlight survey

2.6.7 Torch surveys were completed using 1 million candle power Cluson Clu-Light torches, within the shallow water around the perimeter of each pond during

full darkness. A systematic approach was followed to ensure full coverage of the ponds. Records of observations were made onto field survey data forms.

2.6.8 A single torchlight survey was undertaken on the Old Engine Brook underpass. The torchlight was pointed at the ground to avoid any disturbance to any bats that may also use the underpass. The fast flowing stream in the Old Engine Brook was considered to be not suitable for GCN, so one survey visit was sufficient to identify presence / absence.

Hand search

2.6.9 Surveyors undertook a hand search of aquatic vegetation to determine presence of GCN eggs. Searches were undertaken during the bottle trapping process and were conducted systematically around the pond to ensure all sections of suitable vegetation were searched. Searches were undertaken for a minimum of ten minutes per pond by two surveyors or until the presence of eggs was confirmed. Once GCN egg presence was confirmed in a pond, no further egg searches were conducted, in order to minimise disturbance to any laid eggs.

2.6.10 Terrestrial searches were also undertaken which involved carefully searching the margins of the ponds as well as natural and artificial hibernacula present around the ponds.

2.6.11 Surveys were undertaken under the appropriate Natural England GCN licence and were led by Rebecca Yearsley (class licence registration number: 2018-34082-CLS-CLS).

2.6.12 Surveys were undertaken in two teams each with at least one GCN licensed ecologist. The additional licensed GCN ecologists included Russell Goodchild (2016-19897-CLS-CLS), Sarah Cruickshank (2018-35362-CLS-CLS) and Joseph Allsopp (2017-29643-CLS-CLS).

2.6.13 Survey dates and weather conditions are provided in Table 2 below. Pond locations were provided by the client and are shown in Figure 1.

Table 2 Conditions for GCN surveys during bottle trap deployment

Visit No.	Pond Number	Date	General weather conditions
1	1 & 19, 2, 3, 4, 8, 24, 25, 26, 27a, 27b, 27c, 28, N1, N2, N3 and N4	3 – 4 April 2018	Temp – 7°C Cloud – 90% Wind – light breeze Rain – recent
	5, 6, 7, 11, 14, 15, 16, 18a, 18b, 20, 21, 23 (a, b & c), 30, 31, 32 and 33	4 – 5 April 2018	Temp – 5°C Cloud – 0% Wind – light breeze Rain – nil
	13 and 13a	10 – 11 April 2018	Temp – 10°C Cloud – 100% Wind – very light breeze Rain – nil
	Old Engine Brook	24 April 2018	Temp – 11°C Cloud – 100% Wind – light breeze Rain - intermittent
2	1 & 19, 2, 3, 4, 5, 6, 7, 8, 9, 11, 18a, 18b, 24, 25, 26, 27a, 27b, 27c, 28, N1, N2, N3 and N4	9 – 10 April 2018	Temp – 8°C Cloud – 100% Wind – very light breeze Rain – nil
	14, 15, 16, 20, 21, 23 (a, b & c), 30, 31, 32 and 33	10 – 11 April 2018	Temp – 10°C Cloud – 100% Wind – very light breeze Rain – nil
	13 and 13a	17 – 18 April 2018	Temp – 10°C Cloud – 100% Wind – light breeze Rain – light rain
3	1 & 19, 2, 3, 4, 5, 6, 7, 8, 9, 11, 18a, 18b, 24, 25, 26, 27a, 27b, 27c, 28, N1,	16 – 17 April 2018	Temp – 10°C Cloud – 75% Wind – light breeze

Visit No.	Pond Number	Date	General weather conditions
	N2, N3 and N4		Rain – nil
	14, 15, 16, 20, 21, 23 (a, b & c), 30, 31, 32 and 33	17 – 18 April 2018	Temp – 10°C Cloud – 100% Wind – light breeze Rain – light rain
	13 and 13a	24 – 25 April 2018	Temp – 11°C Cloud – 100% Wind – light breeze Rain – intermittent
4	1 & 19, 2, 3, 4, 5, 6, 7, 8, 9, 11, 18a, 18b, 24, 25, 26, 27a, 27b, 27c, 28, N1, N2, N3 and N4	23 – 24 April 2018	Temp – 11°C Cloud – 100% Wind – very light breeze Rain – nil
	14, 15, 16, 20, 21, 23 (a, b &c), 30, 31, 32, 33	24 – 25 April 2018	Temp – 11°C Cloud – 100% Wind – light breeze Rain – intermittent
	13 and 13a	1 – 2 May 2018	Temp – 8°C Cloud – 100 % Wind – light breeze Rain – light rain
5	2, 3, 4, 5, 6, 8, 9, 11, 21, 23 (a, b & c), 24, 25, 26, 27a, 27b, 28, 30, 31, N1, N2 and N3	1 – 2 May 2018	Temp – 8°C Cloud – 100 % Wind – light breeze Rain – light rain
	13	8 – 9 May 2018	Temp – 15°C Cloud – 40% Wind – very light breeze Rain – nil
6	2, 3, 4, 5, 6, 8, 9, 11, 21, 23 (a, b & c), 24, 25, 26, 27a, 27b, 28, 30, 31, N1,	8 – 9 May 2018	Temp – 15°C Cloud – 40% Wind – very light

Visit No.	Pond Number	Date	General weather conditions
	N2 and N3		breeze Rain – nil
	13	14 – 15 May 2018	Temp – 11°C Cloud – 0 Wind – Calm Rain – nil

2.7 Survey limitations

2.7.1 As documented in previous reports, the hydrology of the land is unstable. In comparison with the 2017 surveys, some ponds had dried up since previous surveys and other ponds have now merged together to form one single water body.

2.7.2 Some of the ponds remained dry for the 2018 surveys as in 2017, which included Ponds 22, 29 and 34. Other ponds that were dry in 2017 have since reformed into shallow ponds, including Ponds 7, 13, 13a, 15, 33 and N4.

2.7.3 Pond 7 comprised a large shallow pond for the first three survey visits but subsequently dried up, which meant that the four presence / absence visits could not be completed. Unlike in 2017, Pond N4 held water on the first three survey visits but after a period of hot weather the water level reduced.

2.7.4 Additionally, some ponds had altered shape, or even increased in size, to various degrees since the previous surveys. Bottle trap numbers were adjusted accordingly where significant changes had occurred. Where changes in the hydrology resulted in ponds becoming unsuitable for bottle trapping, netting or terrestrial searches were employed as an alternative third survey technique.

2.7.5 Pond 29 (a run-off lagoon) has dried up since the industrial works that fed the pond have ceased. This has now been filled in and was not considered suitable to support GCN. This pond was therefore excluded from the assessment and was not subject to an eDNA assessment as initially proposed.

2.7.6 Pond 19 is not considered to be a separate water body, as it is directly linked to Pond 1. Therefore, Pond 19 and Pond 1 were subject to GCN surveys as a single water body.

2.7.7 As in 2017, Ponds 23 a, b & c are no longer three separate ponds and have merged to form one large pond. Pond 23 was therefore subject to GCN surveys as a single water body.

2.7.8 After excluding the dry ponds and combining the ponds considered as single water bodies, the total number of ponds surveyed was 38.

2.7.9 Pond 17 is recorded as a flowing ditch. It connects to Pond 23's southern extent for approximately three metres before the flow is directed away from Pond 23 and across the public footpath. It was therefore not subject to eDNA assessment and was considered as a whole with Pond 23 during the other survey elements.

2.7.10 All surveys were conducted when the overnight forecast was greater than 5°C in the interest of animal welfare. This lead to movement of survey dates in some instances.

2.7.11 In order to make deployment and collection more manageable and as agreed with Alistair Chapman, Sustainability Team Leader at FDDC, the traps, bottles

and canes, were left on site throughout the duration of the survey period.

2.7.12 One minor incidence of vandalism took place where some canes were stolen. A search around the area was made to ensure they were not in the vicinity so it was determined that they had been removed from site. This did not affect GCN welfare or the survey effort as the items were not deployed at the time, and spare canes were brought onto site to replace losses.

2.7.13 Only ten purpose built refugia to the mitigation specifications (see Section 2.3) were recorded on site during the assessment in 2017, and remained the case in 2018 also. It considered likely that the missing 30 refugia were disassembled and removed from site prior to the 2017 assessment.

3. Results and Evaluation

3.1 Habitat Suitability Index

3.1.1 HSI assessments were carried out on all of the ponds. Table 3 shows an overview of the individual pond scores, with detailed information presented in Appendix 1.

Table 3 Overview of pond HSI assessment

Condition	Pond No.	No. ponds
Poor	1 (& 19), 10, 12, 32	4
Below Average	13a, 17	2
Average	5, 7, 11, 13, 18a, 18b, 28, 30, 33	9
Good	2, 4, 16, 27a, 27b, 27c, N4	7
Excellent	3, 6, 8, 9, 14, 15, 20, 21, 23 (a, b & c), 24, 25, 26, 31, N1, N2, N3	16

3.1.2 Of the 38 ponds surveyed, 23 were scored as being good or excellent and 6 as below average or poor. Three ponds (22, 29 and 34) were considered unsuitable for HSI as they were dry.

3.2 Pond condition assessment

3.2.1 The pond condition assessment graded all suitable ponds (those that aren't dry) as 'fair' condition or above, apart from one pond, Pond 13a. The summary of the results are shown in Table 4 below and the complete pond condition assessment is presented in Appendix 2.

Table 4 Results of pond condition assessment

Condition	Pond No.	No. ponds
Poor	13a	1
Fair	1 (& 19), 14, 18a, 18b, 24d, 30, 32	7
Good	2, 3, 4, 5, 6, 7, 10, 11, 12, 15, 16, 20, 21, 23 (a, b & c), 24, 25, 27a, 27b, 27c, 33, N1, N2, N3, N4	24
Excellent	8, 9, 13, 17, 26, 28, 31	7

3.2.2 The results show that only one pond on site is considered to be in 'poor' condition, and that the majority are considered to be in 'good' to 'excellent' condition. Some of the ponds have improved from 'fair' in 2017 to 'good', whilst some ponds reduced from 'excellent' to 'good' due to the presence of litter.

3.2.3 The results reflect the well kept nature of the majority of the site, with few incidences of littering and no presence of non-native invasive species of plant.

3.3 Hibernacula condition assessment

3.3.1 Of the 40 purpose built hibernacula only ten remain on site (MP1 – MP10), the others apparently dismantled and removed from site. The summary results of assessment are shown on Table 5 below, with the detailed assessment presented in Appendix 3.

Table 5 Results of hibernacula suitability assessment

Condition	Refugia No.	No. of Refugia
Poor	MP16, MP17, MP34	3
Fair	MP2, MP8, MP10, MP22, MP23, MP25, MP26, MP28, MP29, MP30, MP31, MP32, MP35, MP36, MP37, MP38, MP44	17
Good	MP7, MP9, MP11, MP12, MP13, MP14, MP15, MP18, MP33, MP39, MP40, MP41, MP42, MP43, MP45, MP46, MP47, MP48, MP49, MP50, MP51, MP52, MP53, MP54, MP55, MP57, MP58	27
Excellent	MP1, MP3, MP4, MP5, MP6, MP19, MP20, MP21, MP24, MP27, MP56, MP59, MP60, MP61	14

3.3.2 The results indicate that the majority of the hibernacula offer potential based on the assessment criteria but that some still have some negative features associated with them limiting their overall score. The reasons are generally associated with a single negative score such as the habitat connectivity, proximity to water or evidence of damage.

3.3.3 Since 2017, none of the purpose built hibernacula have declined in hibernacula suitability, with four of the hibernacula improving in condition and suitability. MP6 has improved from a ‘fair’ condition to an ‘excellent’ condition. MP7 and MP9 have improved from a ‘fair’ condition to a ‘good’ condition. MP4 has improved from a ‘good’ condition to an ‘excellent’ condition. These improvements from the previous year are generally associated with an increase in habitat connectivity and the naturalness of the hibernacula appearance as a result of enhanced vegetation growth.

3.3.4 In the eastern section of the site, there are over 50 windrows and brash piles placed running parallel to the ponds N1, N2, N3 and N4, as a result of the felling of the conifer plantation (MP11 – MP61). Thirty four of these windrows are considered to have either ‘good’ or ‘excellent’ hibernacula suitability,

whilst 17 have either 'fair' or 'poor' hibernacula suitability.

3.4 GCN presence / absence survey

3.4.1 Of the 38 ponds surveyed, presence of GCN was confirmed in 23 ponds, of which ten ponds were confirmed as breeding ponds. The results are shown in Table 6. The locations of the ponds with confirmed GCN presence are shown in Figure 2.1.

Table 6 GCN presence / absence survey results

Pond Number	GCN Found? (Y/N)	Eggs Found? (Y/N)	Peak Count (Method)
1 & 19	N	N	N/A
2	Y	N	1 (Torch)
3	Y	N	4 (Bottle)
4	Y	Y	9 (Bottle)
5	Y	N	5 (Bottle)
6	Y	N	41 (Bottle)
7	Y	N	2 (Bottle & Torch)
8	Y	Y	16 (Bottle & Torch)
9	Y	N	26 (Bottle)
10	N	N	N/A – Unsuitable as fishing lake
11	Y	N	12 (Bottle)
12	N	N	N/A
13	Y	N	1 (Torch)
13a	N	N	N/A
14	N	N	N/A
15	N	N	N/A
16	N	N	N/A
17	N	N	N/A – Unsuitable for surveys as flowing ditch
18a	N	N	N/A
18b	N	N	N/A
20	N	N	N/A
21	Y	N	11 (Torch)
22	N	N	N/A – Unsuitable as dry
23a,b,c	Y	Y	5 (Torch)

Pond Number	GCN Found? (Y/N)	Eggs Found? (Y/N)	Peak Count (Method)
24	Y	N	6 (Bottle)
25	Y	Y	5 (Bottle)
26	Y	Y	11 (Torch)
27a	Y	N	1 (Bottle & Torch)
27b	Y	Y	3 (Bottle)
27c	N	N	N/A
28	Y	Y	2 (Bottle)
29	N	N	N/A – Unsuitable as dry
30	Y	N	6 (Bottle)
31	Y	N	11 (Torch)
32	N	N	N/A
33	N	N	N/A
34	N	N	N/A – Unsuitable as dry
N1	Y	Y	8 (Bottle)
N2	Y	Y	8 (Bottle)
N3	Y	Y	3 (Bottle & Torch)
N4	N	N	N/A
Old Engine Brook underpass	N	N/A	N/A – fast flowing stream

3.5 Comparison between GCN presence / absence surveys in 2017 and 2018

3.5.1 The presence of GCN was confirmed in 25 of the ponds surveyed in 2017 and 2018, of which 19 ponds had confirmed GCN presence across both years.

3.5.2 There were four ponds that had confirmed GCN presence in 2018 only and two ponds in 2017 only.

3.5.3 Six ponds were confirmed as breeding ponds in both 2017 and 2018, along with an additional four confirmed breeding ponds in 2018. The results are shown in Table 7.

Table 7 Comparison of GCN presence / absence surveys in 2017 and 2018

Pond Number	GCN Found 2017? (Y/N)	GCN Found 2018? (Y/N)	Eggs Found? (Y/N)	Peak Count 2017 (Method)	Peak Count 2018 (Method)
1 & 19	N	N	N	N/A	N/A
2	Y	Y	N	1 (Torch)	1 (Torch)
3	Y	Y	N	1 (Bottle)	4 (Bottle)
4	Y	Y	Y	2 (Bottle & Torch)	9 (Bottle)
5	Y	Y	N	5 (Bottle)	5 (Bottle)
6	Y	Y	N	55 (Bottle)	41 (Bottle)
7	N	Y	N	N/A – Unsuitable as dry	2 (Bottle & Torch)
8	Y	Y	Y	27 (Bottle)	16 (Bottle & Torch)
9	N	Y	N	N/A	26 (Bottle)
10	N	N	N	N/A – Unsuitable as fishing lake	N/A – Unsuitable as fishing lake
11	Y	Y	N	5 (Torch)	12 (Bottle)
12	N	N	N	N/A	N/A
13	N	Y	N	N/A – Unsuitable as dry	1 (Torch)
13a	N	N	N	N/A – Unsuitable as dry	N/A
14	N	N	N	N/A	N/A
15	N	N	N	N/A	N/A
16	Y	N	N	5 (Bottle & Torch)	N/A
17	N	N	N	N/A – Unsuitable for surveys as flowing ditch	N/A – Unsuitable for surveys as flowing ditch
18a	N	N	N	N/A	N/A

Pond Number	GCN Found 2017? (Y/N)	GCN Found 2018? (Y/N)	Eggs Found? (Y/N)	Peak Count 2017 (Method)	Peak Count 2018 (Method)
18b	N	N	N	N/A	N/A
20	N	N	N	N/A	N/A
21	Y	Y	N	6 (Bottle)	11 (Torch)
22	N	N	N	N/A – Unsuitable as dry	N/A – Unsuitable as dry
23a,b,c	Y	Y	Y	5 (Torch)	5 (Torch)
24	Y	Y	N	2 (Bottle & Torch)	6 (Bottle)
25	Y	Y	Y	5 (Bottle)	5 (Bottle)
26	Y	Y	Y	6 (Torch)	11 (Torch)
27a	N	Y	N	N/A	1 (Bottle & Torch)
27b	Y	Y	Y	1 (Bottle)	3 (Bottle)
27c	N	N	N	N/A	N/A
28	Y	Y	Y	2 (Bottle & Torch)	2 (Bottle)
29	N	N	N	N/A – Unsuitable as dry	N/A – Unsuitable as dry
30	Y	Y	N	5 (Torch)	6 (Bottle)
31	Y	Y	N	3 (Bottle & Torch)	11 (Torch)
32	Y	N	N	1 (Bottle)	N/A
33	N	N	N	N/A – Unsuitable as dry	N/A
34	N	N	N	N/A – Unsuitable as dry	N/A – Unsuitable as dry
N1	Y	Y	Y	9 (Bottle)	8 (Bottle)
N2	Y	Y	Y	9 (Bottle)	8 (Bottle)
N3	Y	Y	Y	9 (Bottle)	3 (Bottle & Torch)
N4	N	N	N	N/A – Unsuitable as dry	N/A

Pond Number	GCN Found 2017? (Y/N)	GCN Found 2018? (Y/N)	Eggs Found? (Y/N)	Peak Count 2017 (Method)	Peak Count 2018 (Method)
Old Engine Brook	Not surveyed	N	N	Not surveyed	N/A – fast flowing stream

3.6 eDNA sampling

3.6.1 The analysis of the eDNA sample taken from Pond 10, carried out by SureScreen Scientifics was returned with a negative result (report provided in Appendix 5).

3.6.2 This indicates that GCN eDNA was not detected or was below the threshold detection levels, and as such the results indicate there was no evidence of GCN presence within the pond.

3.6.3 Pond 10 is a large pond currently stocked for fishing (which is generally considered unsuitable for supporting GCN) and therefore this result is consistent with the initial assessment of habitat suitability made for the pond.

3.7 Additional species recorded

3.7.1 Numerous incidences of smooth newt (*Lissotriton vulgaris*), palmate newt (*Lissotriton helveticus*), common frog (*Rana temporaria*) and common toad (*Bufo bufo*) were recorded in the majority of the ponds.

3.7.2 Many of the ponds had fish species present, including three-spined stickleback (*Gasterosteus aculeatus*) in various ponds throughout the site and a perch species (*Perca spp*) in ponds 18a and 18b.

3.7.3 Throughout the site a diverse suite of aquatic invertebrates were present within the ponds including various species of diving beetle and dragonfly larvae.

4. Assessment and Recommendations

4.1 Legislation

4.1.1 GCN are a European Protected Species and as such receive protection under The Conservation of Habitats and Species Regulations 2017 ("the Habitats Regulations") and the Wildlife and Countryside Act 1981 (as amended) ("WCA 1981").

4.1.2 It is illegal to kill, injure, capture, handle or disturb them, and the places they use for breeding, resting, shelter and protection are protected from being damaged or destroyed. GCN are a Species of Principal Importance under Section 41 of the Natural Environment and Rural Communities Act 2006 ("NERC Act").

4.1.3 Smooth newt, palmate newt, common frog and common toad are included in Section 9(5) of the WCA 1981 which prohibits sale, barter, exchange, transporting for sale and advertising to sell or to buy these species. Common toad is also a Species of Principal Importance under Section 41 of the NERC Act.

4.2 GCN population assessment

4.2.1 The CNQ continues to support a good population of GCN with numbers relatively comparable to previous surveys undertaken (JNCC, 1998). However, it is considered that the population is favouring different ponds during 2018, as indicated by differing concentrations of GCN within different ponds, compared to the results in previous years.

4.2.2 Most notable is Pond 6, which had a peak count of 55 GCN in 2017 and 41 in 2018 compared to just two in 2015.

4.2.3 Pond 34 recorded a peak count of 23 GCN individuals in 2015, whilst none were recorded in 2017 or 2018 due to the pond drying.

4.2.4 Pond 31 had more comparable numbers in 2018 to 2015 with a peak count of 11 GCN in 2018, compared to 16 recorded in 2015, whilst the peak count in 2017 was three.

4.2.5 Ponds 27a, 27b and 27c recorded lower peak counts in 2017 and 2018 than in previous years; for example, Pond 27a recorded a peak count of 12 GCN compared to one in 2018.

4.2.6 It has been reported that a greater number of ponds are occupied by GCN than in previous years. GCN were confirmed in 16 of the ponds surveyed in 2013 and 15 ponds in 2015. The presence of GCN was confirmed in 25 of the ponds surveyed in 2017 and 2018, of which 19 ponds had confirmed GCN presence across both years.

4.2.7 There were four ponds that had confirmed GCN presence in 2018 only and two ponds in 2017 only. For five of the six ponds, the peak counts of GCN were low and ranged between one and five. It is worth noting that where

presence / absence surveys have not detected GCN in a given year, it is feasible that there is a very small population of GCN rather than an absence of them (English Nature, 2001). In contrast, Pond 9 recorded no GCN in 2017 whilst the peak count of GCN in 2018 was 26 individuals.

4.2.8 A total of ten ponds were confirmed as breeding ponds in 2018, of which six were identified in 2017. Six ponds were identified as breeding ponds in 2015, of which three ponds (Ponds 6, 7 and 27c) were not recorded as breeding ponds in 2017 or 2018.

4.2.9 The entire site also supports populations of smooth newts, palmate newts, common frog and common toad.

4.3 Pond and habitat condition assessment

4.3.1 Of the 38 ponds assessed using the recognised HSI methodology, 23 were scored as being 'good' or 'excellent', nine as 'average' and six as 'below average' or 'poor'.

4.3.2 The project specific pond condition assessment produced only one score for 'poor' and seven ponds were scored as 'fair'. Twenty four ponds were scored as 'good' and seven as 'excellent'. Some of the ponds have improved from 'fair' to 'good', whilst some ponds reduced from 'excellent' to 'good' due to the presence of litter.

4.3.3 On the whole, this reflects the relatively tidy nature of the site and indicates that there has been a slight improvement across the site with the exception of a few incidences of rubbish / fly tipping.

4.4 Compensatory provision for GCN assessment

4.4.1 Three of the new ponds created on site; N1, N2, and N3, had low populations of GCN within them and were confirmed as breeding ponds. The HSI assessment identified that, since the 2017 visit, the macrophyte cover has increased in ponds N1, N2 and N3.

4.4.2 This indicates that they are effective in their design and are becoming established ponds by steadily developing a strong flora and invertebrate fauna association. It is considered that some positive intervention management would be beneficial to these ponds as discussed below.

4.4.3 Unlike in 2017, Pond N4 retained a low water level starting at approximately 1 m in depth and later receding to 0.5 m in depth after a period of dry and hot weather. The pond has established minimal aquatic vegetation including soft rush and a submerged grass species. Pond N4 had a low population of palmate newts. It is considered that some positive intervention management would be beneficial to this pond as discussed below.

4.5 Hibernacula condition assessment

4.5.1 None of the ten purpose built hibernacula included within this assessment are considered to be in poor condition, with the majority considered to be in

excellent condition.

4.5.2 In the eastern section of the site adjacent to A4151, there are over 50 windrows and brash piles placed as a result of the felling of the conifer plantation. Thirty four of these windrows are considered to have either 'good' or 'excellent' hibernacula suitability, which will also function as hibernacula for a variety of species including GCN.

4.6 Recommendations

4.6.1 It is considered that the following recommendations would benefit GCN, as well as other species of amphibians and reptiles.

Re-establishment and maintenance of ponds N4 and 34

4.6.2 Although N4 managed to retain some water in 2018, there was a significant drop in the water level after a period of hot and dry weather. As such, it is recommended that N4 may need additional clay lining to block the failure in its water proofing.

4.6.3 Pond 34 has likely dried out due to the shifting hydrology of the site. Terrestrial vegetation species are present within the Pond, which suggests it has been dry for some time and unlikely to be wetted naturally unless there is another hydrological shift on site. Digging out an additional 0.5 m would increase the likelihood of this pond becoming permanently wet again.

4.6.4 Ponds not filled with water, such as Pond 34, do not necessarily constitute a detrimental feature for wildlife. They provide damp hollows which serve as another habitat for the area. Therefore, repair work which would improve the ponds for GCN may not be necessary to make the ponds suitable for other wildlife.

4.6.5 Additionally, with the shifting hydrology of the site they may become wet in the future; this kind of shifting water levels is useful in preventing large populations of fish becoming established.

Removing the fish species from ponds

4.6.6 Fish, including three-spined stickleback, are known to predate the eggs and larvae of GCN. Therefore, removing fish from the ponds would potentially increase the survival rate of newt eggs and larvae and have the positive impact of increasing over time the amount of breeding adults.

4.6.7 Ponds that would benefit from this include ponds 2, 3, 5, 27b and 27c. Ponds 1 & 19, 18a and 18b all had fish, notably perch which is often introduced to waterways by anglers. These ponds are next to Steam Mills Lake (pond 10), which is a coarse fishing pond. It is considered that removing the fish stock from these would not have a lasting positive impact as they are likely to be restocked by anglers. Pond 12 is the managed Meadowcliffe fishing lake and is stocked with coarse fish.

4.6.8 The most efficient method for removing fish from ponds is likely to be through electrofishing. This, to be effective, would likely have to be repeated over a

number of years, due to the hardy nature of stickleback and their eggs. This method of management would not guarantee that fish would not return, while it would also carry the risk, albeit a low one, of harming any overwintering efts.

Brash Piles

4.6.9 It is recommended the size of some of the existing brash piles be increased, as well as increasing the number of brash piles on site. The use of by-products of vegetation clearance, such as dead wood and scrub, for brash piles are favoured over structured log piles as it provides numerous crevices to refuge in with a more natural appearance. This is considered preferential to replacing the purpose built hibernacula as they are prone to theft, and the dismantlement of each one, particularly in the winter, risks death and injury to amphibians and reptiles, including GCN. Encouraging a moss layering on top of the brash piles is recommended to increase the humidity and stability of the refugia (Langton *et al*., 2001).

4.6.10 Areas to concentrate improving and increasing brash piles would ideally be those between ponds that have high populations of GCN and those that have low populations or do not have any at all but with the suitable conditions to support them. This would help encourage the newts to move into areas they are currently absent from. Examples of good locations, in order of priority, include the areas:

- Between ponds 2, 3, 4, 5 and 6;
- Between the cluster of ponds 24, 25, 26, 27a, 27b, 27c and 28;
- Between ponds 16 and 21, concentrated to the woodland south of pond 12 (coarse fishing pond);
- Between the cluster of ponds 22, 23a, 23b, 23c, 32 and 33;
- Between ponds 9 and 11; and
- Between ponds 8, N1, N2, N3 and N4.

Pond de-vegetation

4.6.11 Partial de-vegetation of aquatic flora will improve several ponds for GCN and other amphibians, increasing breeding display areas which are an important component of the life cycle and a key requirement for the species. This could be achieved over the winter months with equipment such as ‘lake rakes’ that enable rapid de-vegetation of ponds and water bodies without the used having to enter the water. Ponds that would benefit the most from this include ponds 24 and 25.

Pond shading

4.6.12 The thinning of trees around ponds in heavily wooded areas is recommended as this would allow light through to the ponds, increasing the presence of aquatic flora. This in turn would also stimulate plant growth at the ground level, improving habitat connectivity and foraging habitat for a variety of

animals including GCN and other amphibians and reptiles. This is recommended in particular for Ponds 17 and 30.

Aquatic plant introduction

4.6.13 The planting of suitable aquatic flora within several ponds is recommended to increase egg laying opportunities and day time cover for GCN and other amphibians. Species could include pondweed (*Potamogeton spp*) and bulrush (*Typha spp*). These examples can be quite invasive in small pond situations and so care should be taken as to ensure an appropriate planting scheme to the size of the pond.

4.6.14 For smaller ponds it may be more appropriate to use species such as marsh marigold (*Caltha palustris*), lesser spearwort (*Ranunculus flammula*), water plantain (*Alisma plantago-aquatica*) or water forget-me-not (*Myosotis scorpiodes*) which are generally less invasive but still provide opportunities for use by GCN. Ponds that would benefit from this include ponds 5, 13a, 16, 30 and 31 and N1, N2, N3 and N4.

4.6.15 The plants listed above are found within the CNQ and translocation of these species to un-vegetated ponds from local ponds would limit the incidences of introducing undesirable invasive species.

Pollution Incidences

4.6.16 A reporting mechanism for pollution and tipping incidences, as well as general site and pond conditions is recommended. The appointment of a site inspector to periodically inspect the entirety of the site and to report on any degradation to the habitats there. It is recommended that litter, such as containers and cans, plastic bags and glass, are cleared up as those items have potential to cause harm to a variety of animals including GCN.

5. References

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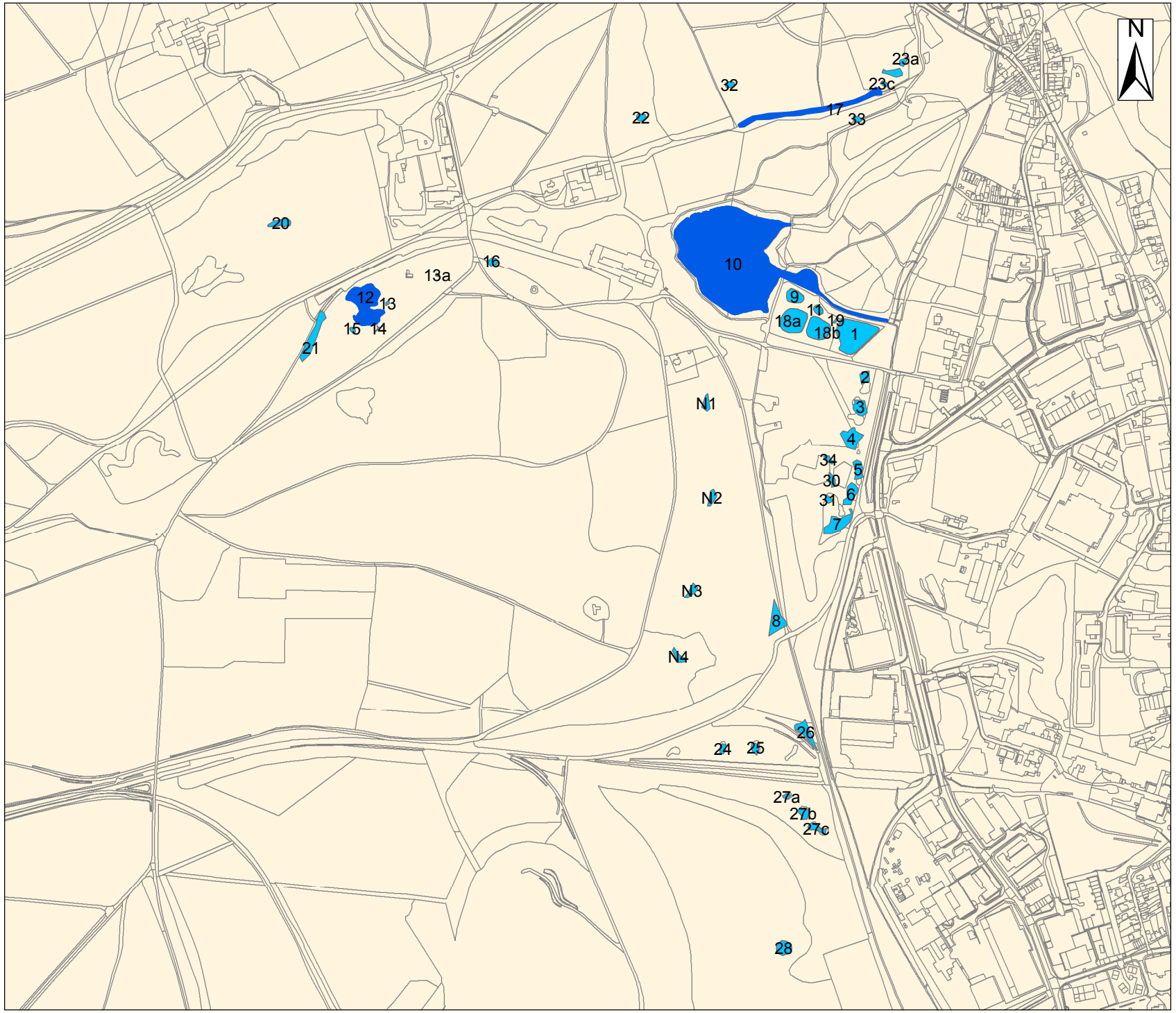
Figure 1.1 Pond location plan



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Legend

- Location of monitoring ponds
- Location of other waterbodies

0 250 500
Meters

Forest of Dean District Council

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Figure 1.1
Pond Location Plan

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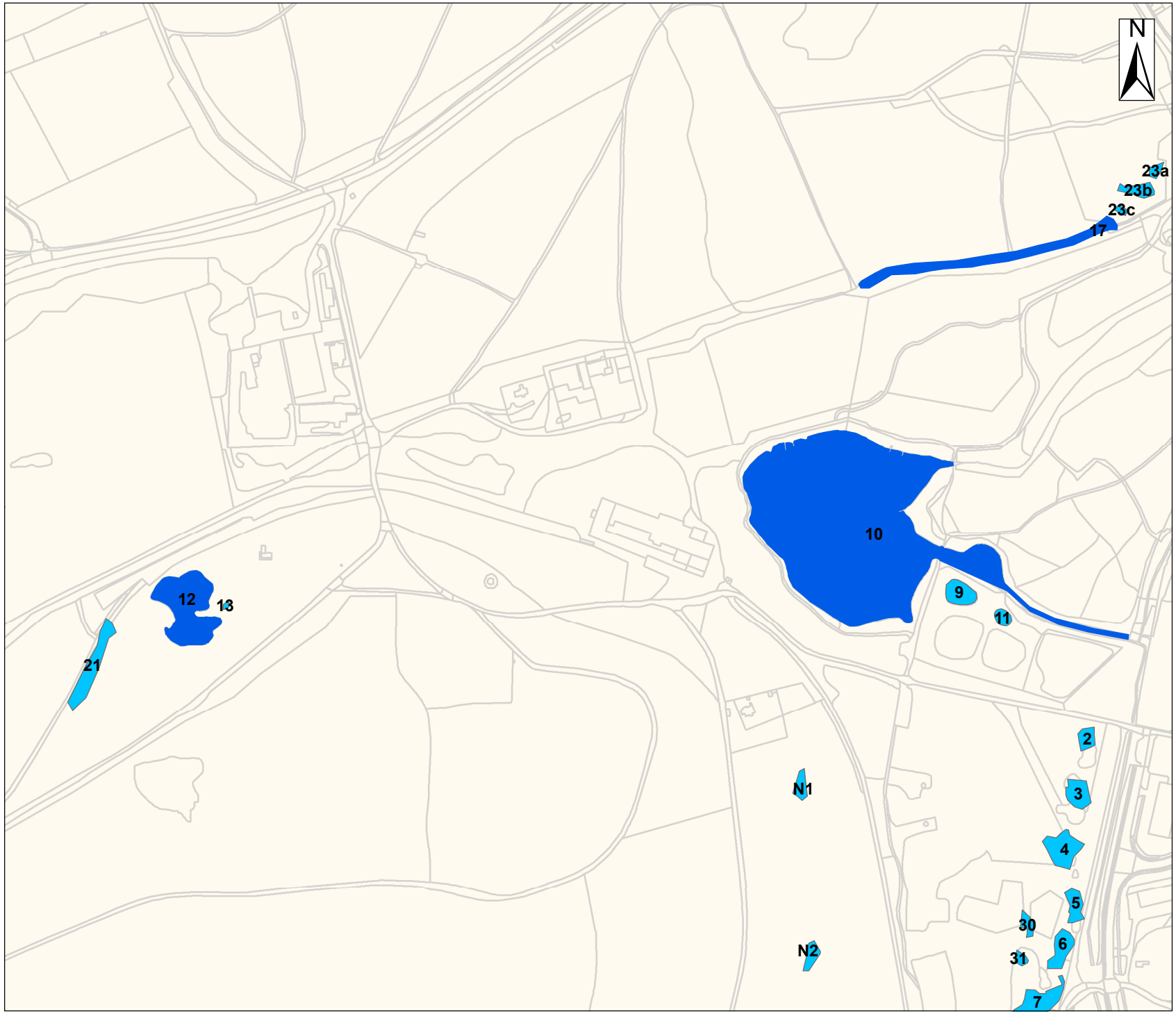
Date: July 2018 | Scale: 1:9,000 @A4 | Drg.Ref: RY/10856/1.1

Figure 1.2 Pond location plan – northern section



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Legend

- Location of monitoring ponds
- Location of other waterbodies

0 130 260
Meters

Forest of Dean District Council

Cinderford Northern Quarter Great Crested Newt Monitoring Assessment

Figure 1.2
Pond Location Plan- Northern Section

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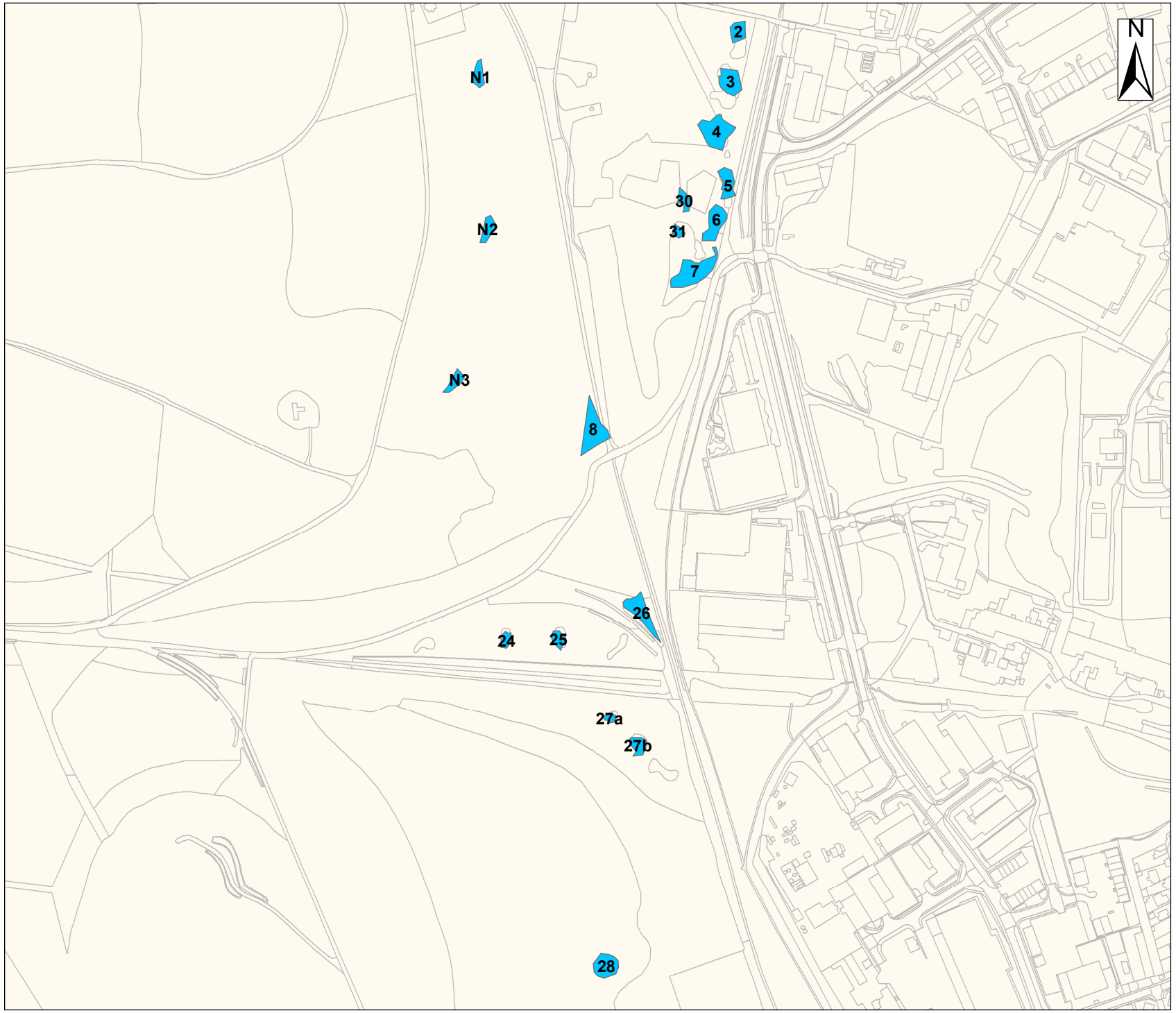
Date: July 2018 | Scale: 1:5,000 @A4 | Drg.Ref: RY/10856/1.2

Figure 1.3 Pond location plan – southern section



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Legend

- Location of monitoring ponds
- Location of other waterbodies

0 150 300
Meters

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Figure 1.3
Pond Location Plan- Southern section

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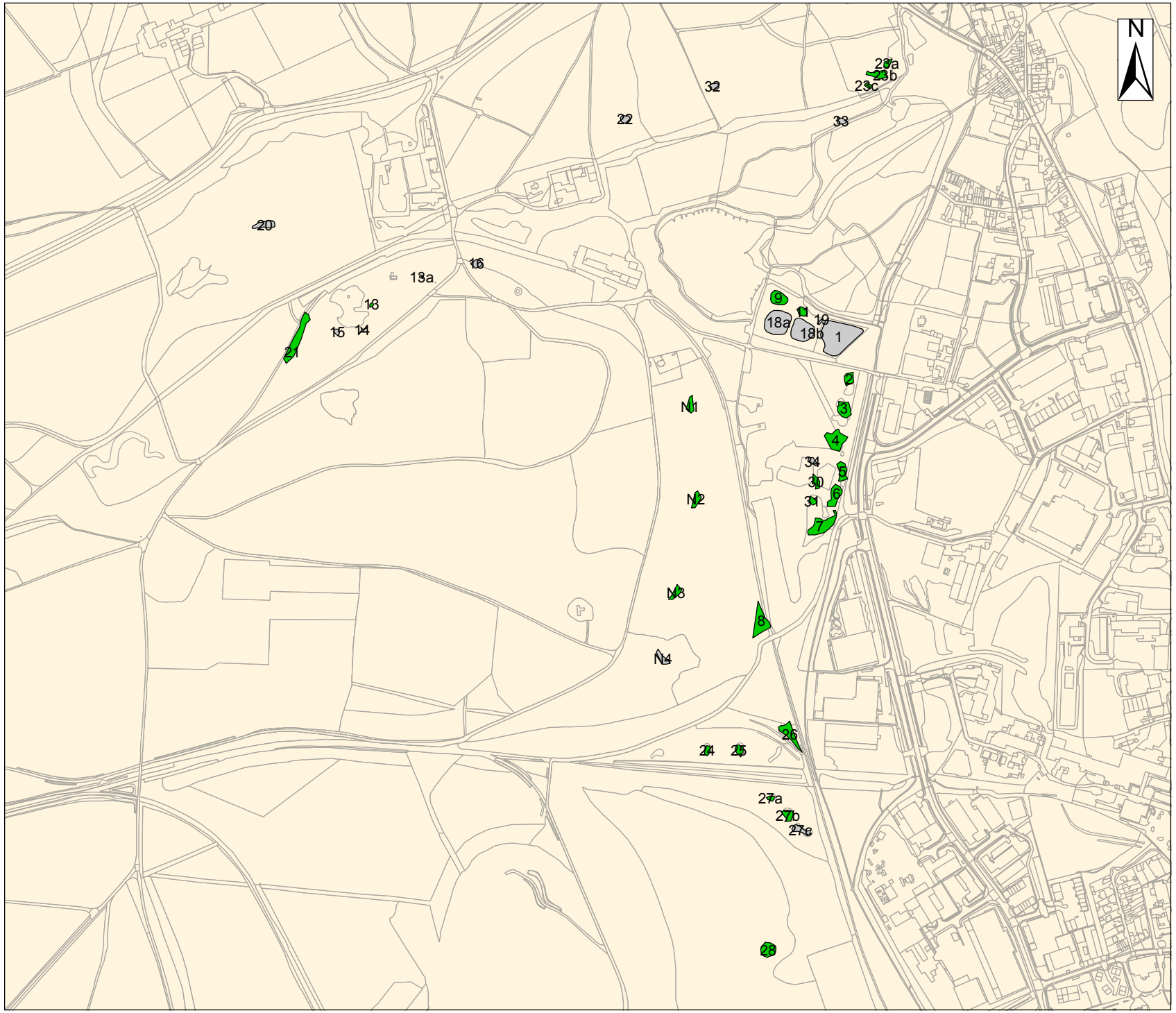
Date: July 2018 | Scale: 1:5,500 @A4 | Drg.Ref: RY/10856/1.3

Figure 2.1 Confirmed GCN pond location plan



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Legend

- Ponds without confirmed GCN
- Ponds with confirmed GCN

0 250 500
Meters

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Cinderford Northern Quarter Great Crested Newt Monitoring Assessment

Figure 2.1
Confirmed Great Crested Newt Ponds Location Plan

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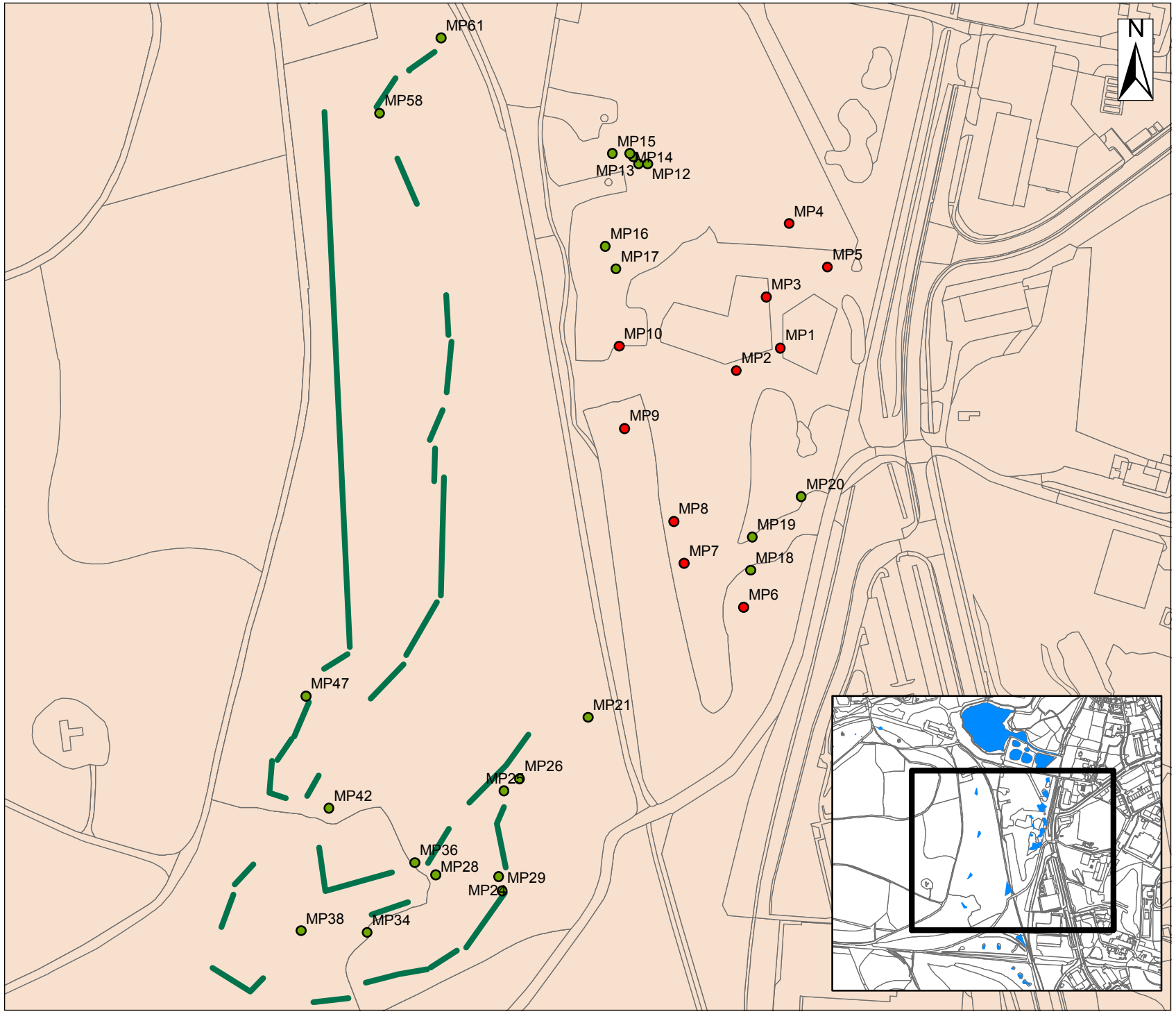
Date: July 2018 | Scale: 1:9,000 @A4 | Drg.Ref: RY/10856/2.1

Figure 3.1 Hibernacula and refugia location plan



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Legend

- Hibernacula
- Logpile
- Windrow location

0 80 160
Meters

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Figure 3.1
Hibernacula and Refugia Location Plan

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Date: July 2018 | Scale: 1:3,000 @A4 | Drg.Ref: RY/10856/3.1

Appendix 1 HSI assessment table

Water body	Individual Habitat Feature Assessment											Prediction (Likelihood of GCN)
	Location	Area (sq. m)	Pond Permanence	Water Quality	Shade	Waterfowl	Fish	Pond Density	Terrestrial Habitat Quality	Macrophyte Cover	Final HSI Score	
1 & 19	1	0.8	0.9	1	0.6	0.67	0.01	1	0.67	0.45	0.49	Poor
2	1	0.4	0.9	1	0.6	1	0.33	1	1	0.45	0.71	Good
3	1	0.925	0.9	1	0.8	1	0.33	1	1	1	0.86	Excellent
4	1	0.1	0.9	1	0.7	1	1	1	1	0.9	0.75	Good
5	1	0.3	0.9	1	0.6	1	0.33	1	1	0.4	0.68	Average
6	1	0.955	0.9	1	1	0.67	1	1	1	1	0.95	Excellent
7	1	0.2	0.1	0.67	1	1	1	1	1	1	0.65	Average
8	1	0.97	0.5	1	1	0.67	1	1	1	1	0.89	Excellent
9	1	0.94	0.9	1	1	0.67	0.67	1	0.67	0.7	0.84	Excellent
10	1	0.8	0.9	1	1	0.01	0.01	1	0.67	0.35	0.33	Poor
11	1	0.1	1	0.67	1	0.67	0.67	1	0.67	1	0.68	Average
12	1	0.8	0.9	0.67	1	0.01	0.01	1	1	0.55	0.35	Poor
13	1	0.05	0.5	0.67	1	1	1	1	1	1	0.66	Average
13a	1	0.05	0.5	0.33	0.7	1	1	1	1	0.5	0.56	Below Average
14	1	0.4	0.5	0.67	1	1	1	1	1	0.95	0.81	Excellent
15	1	0.4	0.5	0.67	1	1	1	1	1	0.85	0.80	Excellent
16	1	0.6	0.9	0.67	1	1	1	1	1	0.4	0.75	Good
17	1	0.1	0.5	0.67	0.2	1	1	1	1	0.7	0.58	Below Average
18a	1	0.97	0.9	0.33	1	0.67	0.33	1	0.33	0.35	0.61	Average
18b	1	0.97	0.9	0.33	1	0.67	0.33	1	0.33	0.35	0.61	Average
20	1	1	1	0.67	1	1	1	1	0.67	0.7	0.89	Excellent
21	1	0.91	1	1	1	0.67	1	1	1	0.8	0.93	Excellent
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Unsuitable
23abc	1	0.8	0.9	0.67	0.8	0.67	1	1	1	0.6	0.83	Excellent
24	1	0.4	1	0.67	1	0.67	1	1	1	0.8	0.82	Excellent
25	1	0.4	1	1	1	0.67	1	1	1	0.9	0.87	Excellent

26	1	1	0.5	1	1	0.67	1	1	1	1	0.90	Excellent
27 a	1	0.2	0.5	0.67	1	1	0.67	1	1	0.85	0.72	Good
27 b	1	0.8	0.5	0.67	1	0.67	0.33	1	1	0.7	0.73	Good
27 c	1	0.6	0.5	0.67	1	0.67	0.33	1	1	1	0.73	Good
28	1	0.4	0.1	0.67	0.8	1	1	1	1	0.6	0.65	Average
30	1	0.2	1	0.67	0.2	1	1	1	1	0.3	0.62	Average
31	1	0.2	1	1	1	1	1	1	1	0.7	0.82	Excellent
32	1	0.05	0.1	0.01	0.8	1	1	1	0.67	0.3	0.31	Poor
33	1	0.05	0.5	0.67	0.8	0.67	1	1	1	0.65	0.60	Average
34	1	N/A	0.1	N/A	1	1	1	1	1	N/A	N/A	Unsuitable
N1	1	0.6	0.9	0.67	1	0.67	1	1	1	0.55	0.82	Excellent
N2	1	0.6	0.9	0.67	1	0.67	1	1	1	0.55	0.82	Excellent
N3	1	0.6	0.9	0.67	1	0.67	1	1	1	0.65	0.83	Excellent
N4	1	0.05	0.5	0.67	1	1	1	1	1	0.35	0.60	Average

Appendix 2 Pond condition methods & assessment report

All possible combinations of the pond condition criteria outcomes and the corresponding pond condition score				
Pond Condition Score	**Pond Condition Criteria**			
	Invasive species	**Major damage**	**Silt levels**	**Dumped rubbish**
Poor	Present	Absent	Low	Present
Poor	Present	Absent	Low	Absent
Poor	Present	Absent	Moderate	Present
Poor	Present	Absent	Moderate	Absent
Poor	Present	Absent	High	Present
Poor	Present	Absent	High	Absent
Poor	Absent	Present	Low	Present
Poor	Absent	Present	Low	Absent
Poor	Absent	Present	Moderate	Present
Poor	Absent	Present	Moderate	Absent
Poor	Absent	Present	High	Present
Poor	Absent	Present	High	Absent
Poor	Present	Present	Low	Present
Poor	Present	Present	Low	Absent
Poor	Present	Present	Moderate	Present
Poor	Present	Present	Moderate	Absent
Poor	Present	Present	High	Present
Poor	Present	Present	High	Absent
Poor	Absent	Absent	High	Present
Fair	Absent	Absent	High	Absent
Fair	Absent	Absent	Moderate	Present
Good	Absent	Absent	Moderate	Absent
Good	Absent	Absent	Low	Present
Excellent	Absent	Absent	Low	Absent

Pond	Pond Description	Photo	Pond Condition Assessment Criteria	Score per Index	Total HSI score and overall pond condition score
1 & 19	Grid reference: Pond 1: SO 64515 15221 Pond 19: SO 64493 15282 Pond 1 and Pond 19 are located within a cluster of ponds (new ponds to the east and more mature ponds to the south). Pond 1 is approximately 60 m x 50 m and over 1 m deep. Pond 19 is a short stretch of channel lying immediately to the northwest of Pond 1. Pond 19 is not considered to be a separate water body in its own right, as it is directly linked to Pond 1. Spawning media noted including water mint. Other aquatic species included bulrush, soft rush, duckweed, yellow iris and water horsetail. Significant populations of coarse fish were noted representing predatory pressure on GCN. Terrestrial habitats available nearby are woodland and semi-natural grasslands with a good number of refuges available.	 	Location	1	Total HSI Score: 0.49 Poor suitability with fair pond condition
			Pond area	0.8	
			Pond drying	0.9	
			Water quality	1	
			Shade	0.6	
			Fowl	0.67	
			Fish	0.01	
			Pond count	1	
			Terrestrial habitat	0.67	
			Macrophytes	0.45	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Present – small amounts of litter	
2	Grid reference: SO 64535 15182 Northern-most pond within a linear cluster of ponds (located to the west of Forest Vale Road). Pond 2 is approximately 20 m x 10 m and over 1 m deep. Plants present were water horsetail, bulrush, water mint, bog bean, sweet grass and yellow iris. A small stickleback population present represents a small predatory pressure on GCN in this pond. Grassland and woodland provides excellent terrestrial habitat throughout with abundant refugia present.	 	Location	1	Total HSI Score: 0.71 Good suitability with good pond condition
			Pond area	0.4	
			Pond drying	0.9	
			Water quality	1	
			Shade	0.6	
			Fowl	1	
			Fish	0.33	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.45	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

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3	Grid reference: SO 64537 15150 Part of a cluster of ponds to the west of Forest Vale Road. Pond 3 is approximately 30 m x 50 m and over 1 m deep. Abundant bulrush was noted along with cuckoo flower, bog bean, duckweed, water mint, water horsetail, bog pondweed and yellow iris. Abundant stickleback were noted representing a significant predatory pressure on GCN populations. Grassland and woodland provides excellent terrestrial habitat throughout with abundant refugia present.	 	Location	1	Total HSI Score: 0.86 Excellent suitability with good pond condition
			Pond area	0.93	
			Pond drying	0.9	
			Water quality	1	
			Shade	0.8	
			Fowl	1	
			Fish	0.33	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	1	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
4	Grid reference: SO 64536 15076 Pond 4 is a part of a cluster of ponds to the west of Forest Vale Road. Pond 4 is approximately 60m² and 0.5 - 1m deep and is made up of three small sections that all connect. Abundant bog pondweed and Glyceria present as egg laying media. Other species present are duckweed, water horsetail, bulrush, soft rush, hard rush and a submerged grass species. Grassland and woodland provides excellent terrestrial habitat throughout with abundant refugia present.	 	Location	1	Total HSI Score: 0.75 Good suitability with good pond condition
			Pond area	0.1	
			Pond drying	0.9	
			Water quality	1	
			Shade	0.7	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.9	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

5	Grid reference: SO 64529 15020 Part of a cluster of ponds to the west of Forest Vale Road. Pond 5 is made up of two sections, a small section and a large section, and is approximately 30 m x 5 m in size and over 1 m deep. Macrophyte populations were sparse but the species recorded were water horsetail, bulrush, *Glyceria* sp., water mint and marginal soft rush. Overhanging trees surround this pond and provide shade and dead leaves. Some of the aquatic vegetation and the dead leaves provide some potential for egg laying. Very clear water. Grassland and woodland provides excellent terrestrial habitat throughout with abundant refugia present.	 	Location	1	Total HSI Score: 0.68 Average suitability with good pond condition
			Pond area	0.3	
			Pond drying	0.9	
			Water quality	1	
			Shade	0.6	
			Fowl	1	
			Fish	0.33	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.4	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
6	Grid reference: SO 64523 14975 This is the largest pond of a cluster of ponds to the west of Forest Vale Road. Pond 6 was previously recorded as approximately 70 m x 50 m in size but it is now approximately 30 m x 15 m in size. It is over 1 m deep with very clear water and abundant macrophytes. Water mint and *Glyceria* sp. were readily available as spawning media. Other species recorded were bog bean, water lily, bulrush, soft rush, water horsetail and sweet grass. Grassland and woodland provides excellent terrestrial habitat throughout with abundant refugia present.	 	Location	1	Total HSI Score: 0.95 Excellent suitability with good pond condition
			Pond area	0.9	
			Pond drying	1	
			Water quality	1	
			Shade	0.7	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	1	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

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7	Grid reference: SO 64490 14892 This is the most southerly of the cluster of ponds to the west of Forest Vale Road. With a size of approximately 20 m x 20 m. In 2013, this pond was recorded as being 0.3 m deep in water after heavy rainfall and then dried up for all subsequent visits. In 2017, it was dry throughout all survey visits. During the first three weeks of GCN surveys in 2018, pond 7 had variable depths of a maximum of 0.5 m. After the fourth week, the pond was completely dried up after recent hot weather. The Habitat Suitability Assessment was completed on 17th April 2018 before the pond dried up. Grassland and woodland provides excellent terrestrial habitat throughout with abundant refugia present.	Before pond dried up:  After pond dried up: 	Location	1	When water was present – Total HSI Score: 0.65 Average suitability with good pond condition
			Pond area	0.2	
			Pond drying	0.1	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	1	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
8	Grid reference: SO 64393 14797 Approximately 80 m to the southwest of the cluster of ponds lying to the west of Forest Vale Road. Pond 8 has significantly increased in size since the 2017 surveys and is approximately 60 m x 35 m in size and up to 0.5 – 1 m deep in places. Abundant *Glyceria sp.* and leaves were present providing egg laying media throughout. Past surveys in this pond have experienced frequent changes in water levels due to heavy rainfalls and changing hydrology. Species recorded were bulrush, soft rush, broadleaf dock, water starwort, water mint, water horsetail and sweet grass.	 	Location	1	Total HSI Score: 0.89 Excellent suitability with excellent pond condition
			Pond area	0.97	
			Pond drying	0.5	
			Water quality	1	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	1	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	

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9	Grid reference: SO 64410 15323 Located within a cluster of five ponds in the east of the Northern Quarter, Pond 9 measures approximately 35 m x 30 m with a maximum depth of 1 m. Pond 9 has been newly-created (estimated in the last 5-10 years). Areas of open water are present, with some stands of *Glyceria* sp. available as potential spawning vegetation. Other species noted included hard rush, water horsetail, bulrush and bog pondweed. Brent geese were observed at this pond in 2013, and Canada geese were observed in nearby ponds in 2017, which represents a predatory pressure on any amphibian species. Breeding coots were recorded in 2017 in the abundant bulrush. The pond is surrounded by suitable terrestrial habitat, including rough grassland and woodland, with refugia also available nearby. The 2013 report states that the area immediately adjacent to the pond comprises bare soil, which is no longer the case. However there are sections of bare soil that still remain in the surrounding areas between the cluster of ponds.		Location	1	Total HSI Score: 0.84 Excellent suitability with excellent pond condition
			Pond area	0.94	
			Pond drying	0.9	
			Water quality	1	
			Shade	1	
			Fowl	0.67	
			Fish	0.67	
			Pond count	1	
			Terrestrial habitat	0.67	
			Macrophytes	0.7	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	
10	Grid reference: SO 64365 15315 Pond 10 is a large fishing pond, measuring approximately 22,000 m² in size, that is frequently used by a privately owned angling club. Pond 10 is vast, open and very deep. There is very minimal marginal vegetation and the edges of the pond are steep. A number of fishing platforms are located around the edge of the pond. Species noted were water lily, yellow iris, bulrush and soft rush, none of which are suitable as spawning media. Some water mint and *Glyceria* sp. were also noted. Several fowl species, including Canada geese, grey lag, mallard duck and gulls, were noted. The presence of a large stock of fish, as well as fowl, poses a large predatory pressure on amphibians and their eggs, indicating that this pond is unsuitable.	 	Location	1	Unsuitable for great crested newts – Fishing pond Total HSI Score: 0.33 Poor suitability with good pond condition
			Pond area	0.8	
			Pond drying	0.9	
			Water quality	1	
			Shade	1	
			Fowl	0.01	
			Fish	0.01	
			Pond count	1	
			Terrestrial habitat	0.67	
			Macrophytes	0.35	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

11	Grid reference: SO 64462 15299 Located in the same cluster as Pond 9, Pond 11 is also recently-created, but is slightly smaller, with a maximum depth of approximately 0.5 m. Areas of open water are present, with some limited *Glyceria* sp. and colts foot available as potential spawning vegetation. Bulrush is abundant and there is marginal soft rush. Evidence of waterfowl was observed around the margins of the pond. Suitable terrestrial habitat is available around Pond 11, comprising rough grassland and woodland, with refugia and hibernacula also present. The 2013 report states that the area immediately adjacent to the pond comprises bare soil, which is no longer the case. However there are sections of bare soil that still remain in the surrounding areas between the cluster of ponds.	 	Location	1	Total HSI Score: 0.68 Average suitability with good pond condition
			Pond area	0.1	
			Pond drying	1	
			Water quality	0.67	
			Shade	1	
			Fowl	0.67	
			Fish	0.67	
			Pond count	1	
			Terrestrial habitat	0.67	
			Macrophytes	1	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
12	Grid reference: SO 63732 15294 Pond 12 is located south-west of the former Northern United colliery and comprises a small lake surrounded by a small cluster of 4 ponds. It measures approximately 45 m in width and 70 m in length, with a maximum depth of over 1 m. The surface area of the water body is dominated by open water, with very little aquatic vegetation which could be used for egg-laying. Species noted were yellow iris, water mint, willow herbs, and marginal grasses and sedges. Suitable terrestrial habitat is present around the pond, comprising woodland, with refugia and hibernacula also noted. The lake is managed for angling and supports a number of fishing platforms.	 	Location	1	Unsuitable for great crested newts – Fishing pond Total HSI Score: 0.35 Poor suitability With good pond condition
			Pond area	0.8	
			Pond drying	0.9	
			Water quality	0.67	
			Shade	1	
			Fowl	0.01	
			Fish	0.01	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.55	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

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13	Grid reference: SO 63744 15322 Pond 13 is part of a cluster of 4 ponds to the south west of the former Northern United colliery. During the 2017 surveys the pond was dry and largely grassed over with less than 5 cm depth of water. In the 2018 surveys the water levels in this ponds have increased and the pond is now approximately 5 m x 10 m in size. Vegetation noted was soft rush, *Lemna* sp. and cuckoo flower. Aquatic vegetation within the pond is dominated by *Glyceria* sp., which provides good opportunities for egg laying. This pond is shaded on all sides by adjacent trees. The surrounding terrestrial habitat is good, comprising woodland, scattered shrub and bracken, with numerous refugia and hibernacula.	 	Location	1	Total HSI Score: 0.66 Average suitability with excellent pond condition
			Pond area	0.05	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	1	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	
13a	Grid reference: SO 63811 15384 Pond 13a is located to the east of ponds 12, 13 and 14 within the woodland and was previously dry in 2017, but is now approximately 3 m x 5 m in size and has a maximum depth of 0.3 m. Aquatic vegetation was limited to submerged grass species.		Location	1	Total HSI Score: 0.56 Below average suitability With poor pond condition
			Pond area	0.05	
			Pond drying	0.5	
			Water quality	0.33	
			Shade	0.7	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.5	
			Invasive species	Absent	
			Major damage	Present – Trampled banks, silting up water	
			Silt levels	Moderate	
			Dumped rubbish	Present – plastic bags, plant pots	

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14	Grid reference: SO 63762 15290 Pond 14 is part of the cluster of 4 ponds to the south west of the former Northern United colliery. The pond is irregular in shape and has increased in size since the 2017 surveys to approximately 200 m², with a maximum depth of 1 m. There is a small amount of Lemna sp. present. Many of the macrophytes are encroaching non-aquatic species , such as rushes and grasses. Species identified were *Glyceria* sp., spagnum moss and soft rush. The surrounding terrestrial habitat comprises woodland. There was no evidence of fish or waterfowl at this pond.	 	Location	1	Total HSI Score: 0.81 Excellent suitability with fair pond condition
			Pond area	0.4	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.95	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Present – Tyre, plastic, glass	
15	Grid reference: SO 63691 15264 Pond 15 is part of the cluster of 4 ponds to the south west of the former Northern United colliery. In 2017, the water levels were very low and the pond was only 7 m x 7 m however the water levels have risen at the time of the 2018 surveys. The pond is approximately 20 m x 10 m in size, with a maximum depth of 0.5 m. Woody debris (fallen trees) were noted. The surface of the pond is almost completely covered by *Glyceria* sp., which provides a suitable substrate for egg laying. Other species noted were spagnum moss, water mint, cuckoo flower and bulrush. The surrounding terrestrial habitat comprises woodland.		Location	1	Total HSI Score: 0.80 Excellent suitability with good pond condition
			Pond area	0.4	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.85	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

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16	Grid reference: SO 63811 15384 Pond 16 is located within mixed woodland, and is approximately 25 m x 15 m in size with a n approximate maximum depth of 2 m. Some potential egg laying vegetation is present, (fallen leaves and very limited *Glyceria* sp.), with large areas of open water also noted. Adjacent terrestrial habitat comprises woodland, grassland and scrub, which is suitable for great crested newts. There was no evidence of fish in this pond at the time of survey. Evidence of damage to the ground caused by people and boars was noted.	 	Location	1	Total HSI Score: 0.75 Good suitability with good pond condition
			Pond area	0.6	
			Pond drying	0.9	
			Water quality	0.67	
			Shade	0.6	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.4	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
17	Grid reference: SO 64526 15625 Pond 17 is a long thin stream that runs parallel to the path in the Hawkwell Inclosure. At the time of the visit in 2017, the stream was mostly dry apart from one section , indicating that the condition of this stream is influenced by the weather. In the 2018 survey, the long thin stream was approximately 50 m² in size, with a depth of 10 cm apart from the one larger section. Species noted were yellow iris and soft rush. There was no aquatic vegetation that would be suitable for egg laying. However, there were dead leaves in the stream that provide some potential as egg laying media. As there is running water in this stream, it was deemed unsuitable for great crested newts.		Location	1	Unsuitable for great crested newts – Running stream Total HSI Score: 0.58 Below average suitability with excellent pond condition
			Pond area	0.1	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	0.2	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.7	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	

18a	Grid reference: SO 64475 15247 Ponds 18a and 18b are within a cluster of 5 ponds in the east of the Northern Quarter site. These newly-created ponds lie adjacent to each other, and measure approximately 30m x 30m with a maximum depth of 0.5-1m. Areas of open water are present in both ponds, with a limited abundance of aquatic macrophytes for egg laying (small areas of *Glyceria* sp., water mint and bog pondweed were noted). Other species noted were soft rush, horsetail and bulrush. In 2018, macrophyte cover was noted to have increased since the 2017 surveys from 0% to 5%. Adjacent ponds are used for angling, and Ponds 18a and 18b have evidence of use by waterfowl. At least two Canada geese were present throughout the 2017 surveys and remained present in 2018 also. Abundant geese excrement surrounded the pond particularly on the embankment between the two ponds. Surrounding terrestrial habitat is suitable for great crested newt, comprising woodland and rough grassland. The area immediately adjacent to the pond previously comprised bare soil but some vegetation has since began colonising, however there is still currently minimal cover for migrating amphibians. It was noted that there was litter deposited next to pond 18b, on the side closest to the road.	 	Location	1	Total HSI Score: 0.61 Average suitability with fair pond condition
			Pond area	0.97	
			Pond drying	0.9	
			Water quality	0.33	
			Shade	1	
			Fowl	0.67	
			Fish	0.33	
			Pond count	1	
			Terrestrial habitat	0.33	
			Macrophytes	0.35	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Present - general litter	
18b		 	Location	1	Total HSI Score: 0.61 Average suitability with fair pond condition
			Pond area	0.97	
			Pond drying	0.9	
			Water quality	0.33	
			Shade	1	
			Fowl	0.67	
			Fish	0.33	
			Pond count	1	
			Terrestrial habitat	0.33	
			Macrophytes	0.35	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Present – general litter	

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20	Grid reference: SO 63543 15446 The 2013 report originally stated that pond 20 was approximately 90 m x 15 m in size, with a maximum depth greater than 1 m, and the 2017 surveys found that the pond had substantially reduced to 15 m x 8 m with a maximum depth of 25 cm. In 2018 pond 20 had increased in size to approximately 50 m x 15 m. The majority of the pond margin (60%) was subject to poaching by deer and wild boar, and evidence of waterfowl was also noted. Macrophytes cover most of the pond, with soft rush (*Juncus effusus*) covering approximately 50% of the pond. The pond is located within woodland 100 m north of pond 21. No suitable aquatic vegetation was identified for egg-laying purposes. The previous report confirmed with Peter Kelsall of the Forestry Commission that this pond had been created on a restored opencast site and holds acidic water.		Location	1	Total HSI Score: 0.89 Excellent suitability with good pond condition
			Pond area	1	
			Pond drying	1	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	0.67	
			Macrophytes	0.7	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
21	Grid reference: SO 63594 15248 Pond 21 appears to have established along the line of a former tramway and lies to the west of a cluster of ponds (comprised of ponds 12, 13, 14 & 15). Pond 21 has increased in size since 2017 from approximately 50 m x 15 m and about 1 m deep to approximately 80 m x 15 m. Beds of abundant *Glyceria* sp. and bog pondweed provide abundant spawning potential in this pond. Other species noted were soft rush, water mint and cuckoo flower. Open water is clear and terrestrial vegetation comprising of grassland and open woodland provide abundant refuge potential. The remains of an old vehicle previously found in 2017 are still present but has since deteriorated further. It is nearby to the pond but does not affect the main body of the pond.		Location	1	Total HSI Score: 0.93 Excellent suitability with good pond condition
			Pond area	0.91	
			Pond drying	1	
			Water quality	1	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.8	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

22	Grid reference: N/A The area in the south of the Hawkwell Inclosure was searched for ponds with the description given from the previous report. The pond was not found and was assumed to be dried up as there were a few ditches that had similar descriptions. If there was water present in the pond, spawning would be limited to the use of dead leaves. Nearby ancient oak woodland provides ample refuge and foraging potential.	No photograph	Location	1	Unsuitable for HSI - Dry
			Pond area	N/A	
			Pond drying	N/A	
			Water quality	N/A	
			Shade	N/A	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	N/A	
			Invasive species	N/A	
			Major damage	N/A	
			Silt levels	N/A	
			Dumped rubbish	N/A	
23a, 23b & 23c	Grid reference: SO 64630 15702 Likewise to the 2017 survey this pond comprised a single large area of water but it was substantially larger at approximately 110 m x 50 m in size. In previous years the water levels were reported to fluctuate and occasionally form three separate ponds. The pond did not shrink to form three separate ponds in 2017 and 2018 during the survey period, however, it was noted that there was substantial variation in pond levels across the whole pond. Aquatic species noted were watermint bog bean, bog pondweed and sweet grass, however considering the size of the pond aquatic vegetation was limited. Abundant soft rush was recorded marginally. A large proportion of the pond extended back into the woodland, which meant that trees were both within the pond and overhanging the much of the pond. The dead leaves from the trees provide some potential as egg laying media. The surrounding terrestrial habitat comprises of woodland, scrub and lots of deadwood, which provides ample refuge and foraging potential.	  	Location	1	Total HSI Score: 0.83 Excellent suitability with good pond condition
			Pond area	0.8	
			Pond drying	0.9	
			Water quality	0.67	
			Shade	0.6	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.8	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

24	Grid reference: SO 64298 14549 This is a recently excavated pond within Laymoor Quag noted as 'a stronghold for great crested newts'. Pond 24 is approximately 10 m x 30 m in size and between 0.5 m to 1 m deep. Abundant bog pondweed and occasional *Glyceria* sp. provides spawning potential. Soft rush and water horsetail were also noted. The bog pondweed covers the whole of the pond, which meant that visibility through the water column was low/moderate. Tussocky grassland and nearby woodland provide abundant foraging potential and many log piles in the area provide good refuges for newts.		Location	1	Total HSI Score: 0.82 Excellent suitability with good pond condition
			Pond area	0.4	
			Pond drying	1	
			Water quality	0.67	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.8	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
24b	Grid reference: SO 64282 14550 Pond 24b is a newly formed pond located to the west of Pond 24a, which has most likely formed due to the changing hydrology. Pond 24b measures less than 5 m x 5 m in size and is less than 25 cm in depth. Vegetation includes: grass species, *Glyceria* sp., a buttercup species and rushes. Pond 24b was not assessed for Habitat Suitability in 2018 as it was not included in the commission.	 	Location	1	Total HSI Score: 0.58 Below average suitability with excellent pond condition
			Pond area	0.05	
			Pond drying	0.1	
			Water quality	1	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.85	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	

24c	Grid reference: SO 64266 14551 Pond 24c is a newly formed pond located to the west of pond 24a and 24b, which has most likely formed due to the changing hydrology. Pond 24c measures less than 5 m x 10 m in size and is less than 25 cm in depth. Vegetation includes: grass species, bog pondweed and soft rush. Pond 24c was not assessed for Habitat Suitability in 2018 as it was not included in the commission.		Location	1	Total HSI Score: 0.55 Below average suitability with excellent pond condition
			Pond area	0.05	
			Pond drying	0.1	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.8	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	
24d	Grid reference: SO 64239 14550 Pond 24d is a newly formed pond located to the far west of pond 24a, 24b and 24c. It was noted that there was a pipe leading to this pond, so it is likely that this pond was formed from runoff water exiting this pipe. Pond 24d measures approximately 10 m x 15 m in size and is approximately 0.5 m in depth. Aquatic vegetation was very limited to a small section of bog pondweed. Most of the vegetation was marginal rush and grass species. Algae was present on the surface of the water, which suggests the water is high in nutrients (potentially from the runoff by nearby agricultural fields). Pond 24d was not assessed for Habitat Suitability in 2018 as it was not included in the commission.	 	Location	1	Total HSI Score: 0.61 Average suitability with fair pond condition
			Pond area	0.3	
			Pond drying	0.1	
			Water quality	0.67	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.5	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	High	
			Dumped rubbish	Absent	

24e	Grid reference: SO 64291 14561 Pond 24e is a newly formed pond located north of pond 24a and 24b, which has most likely formed due to the changing hydrology. Pond 24e measures less than 5m x 5m in size and is less than 25cm in depth. Vegetation includes: soft rush, *Glyceria* sp. and buttercup species. Pond 24e was not assessed for Habitat Suitability in 2018 as it was not included in the commission.		Location	1	Total HSI Score: 0.58 Below average suitability with excellent pond condition
			Pond area	0.05	
			Pond drying	0.1	
			Water quality	1	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.85	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	
25	Grid reference: SO 64357 14548 As with pond 24, this is a recently excavated pond within Laymoor Quag noted as 'a stronghold for great crested newts'. Pond 25 has been excavated to the same dimensions as pond 24 and is approximately 10m x 30m in size and between 0.5m to 1m deep. Abundant bog pondweed and occasional *Glyceria* sp. provides spawning potential. Cuckoo flower, soft rush and bulrush were also noted. Unlike pond 24, pond 25 has an area of open water. Water was moderate visibility. The north west edge of the pond has collapsed, which has provided a gradual slope allowing easier access into the pond and areas of shallow water. Tussocky grassland and nearby woodland provide abundant foraging potential and many log piles in the area provide good refuges for newts.		Location	1	Total HSI Score: 0.87 Excellent suitability with good pond condition
			Pond area	0.4	
			Pond drying	1	
			Water quality	1	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.9	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

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26	Grid reference: SO 64457 14548 Pond 26 is located immediately adjacent to the path to the east of Laymoor Quag. There is an area of clear open water at the southern narrower end of the pond. *Glyceria* sp. beds dominated the pond by at least 50%, providing good spawning potential. Marginal rush species were also noted. Other species noted were water horsetail, spagnum moss, broadleaf dock and pond water crows foot. Tussocky grassland and nearby woodland provide abundant foraging potential and many log piles in the area provide good refuges for newts. Evidence of wild boar activity was present within close proximity to the pond.	 	Location	1	Total HSI Score: 0.90 Excellent suitability with excellent pond condition
			Pond area	1	
			Pond drying	0.5	
			Water quality	1	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	1	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	
27a	Grid reference: SO 64412 14465 This is the southern most pond of a cluster of three ponds lying to the south of Laymoor Quag. Pond 27a has reduced in size since the 2013 report, from 60 m x 20 m to approximately 10 m x 10 m, and is approximately 0.5 m deep. A small stickleback population was noted in 2013, but fish were not found in the 2017 or 2018 surveys. However, fish were noted in two of the other ponds in this cluster so it is possible that there may still be a small stickleback population present, which presents a predatory pressure on GCN within these ponds. Abundant bog pondweed was recorded. Other species noted were *Glyceria* sp., soft rush, spagnum moss and a buttercup species. Tussocky grassland with abundant deadwood provides numerous refuges throughout this area.		Location	1	Total HSI Score: 0.72 Good suitability with good pond condition
			Pond area	0.2	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	0.67	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.85	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

27b	Grid reference: SO 64439 14438 This is the central pond of a cluster of three ponds lying to the south of Laymoor Quag. Pond 27b is approximately 30m x 30m and up to 0.5m deep. Water mint and bog pondweed provide spawning potential. Other vegetation noted was cuckoo flower, spagnum moss, water horsetail, bulrush and *Glyceria* sp. Tussocky grassland with abundant deadwood provides numerous refuges throughout this area.	 	Location	1	Total HSI Score: 0.73 Good suitability with good pond condition
			Pond area	0.8	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	1	
			Fowl	0.67	
			Fish	0.33	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.7	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
27c	Grid reference: SO 64462 14409 This is the southern pond of a cluster of three ponds lying to the south of Laymoor Quag. Pond 27c is irregular in shape and is approximately 20m long and 10 m wide in the widest sections and 5 m wide at the narrowest point. Pond 27c is less than 0.5m deep. Abundant bog pondweed and occasional water mint provide spawning opportunities. Abundant bulrush was noted, whilst water horsetail, soft rush, cuckoo flower and broadleaf dock were also noted. Tussocky grassland with abundant deadwood provides many refuges throughout this area.	 	Location	1	Total HSI Score: 0.73 Good suitability with good pond condition
			Pond area	0.6	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	1	
			Fowl	0.67	
			Fish	0.33	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	1	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

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27d	Grid reference: SO 64429 14454 Pond 27d is a newly formed pond located north west of 27b by approximately 10 m, which has most likely formed due to the changing hydrology. Pond 27d measures approximately 5 m x 5 m and is less than 0.5m deep. Vegetation includes: *Glyceria* sp., water horsetail and soft rush. Tussocky grass, brambles and deadwood surrounds the pond, which provides a good terrestrial habitat for ample foraging and refuge opportunities. Pond 27d was not assessed for Habitat Suitability in 2018 as it was not included in the commission.		Location	1	Total HSI Score: 0.54 Below average suitability with good pond condition
			Pond area	0.05	
			Pond drying	0.1	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.6	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
27e	Grid reference: SO 64399 14448 Pond 27e is a newly formed pond located south west of 27a by approximately 15 m, which has most likely formed due to the changing hydrology. Pond 27e measures less than 5 m x 5 m and is less than 25 cm deep. Vegetation includes: *Glyceria* sp., water horsetail and soft rush. Tussocky grass, brambles and deadwood surrounds the pond, which provides a good terrestrial habitat for ample foraging and refuge opportunities. Pond 27e was not assessed for Habitat Suitability in 2018 as it was not included in the commission.		Location	1	Total HSI Score: 0.56 Below average suitability with good pond condition
			Pond area	0.05	
			Pond drying	0.1	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.85	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

28	Grid reference: SO 64457 14205 Located to the south of ponds 27a, b, and c, pond 28 is approximately 20 m x 20 m in size with clear water. Similarly to the 2017 surveys, the water levels reduced after a couple of weeks in 2018. A larger area of macrophytes was recorded compared to 2017 and included water starwort, bog bean, water mint, soft rush, water horsetail and broadleaf dock. Nearby woodland and grassland provides abundant potential for foraging and refuge.	 	Location	1	Total HSI Score: 0.65 Average suitability with excellent pond condition
			Pond area	0.4	
			Pond drying	0.1	
			Water quality	0.67	
			Shade	0.8	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.6	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	
30	Grid reference: SO 64496 15041 This pond lies 50 m to the east of a cluster of ponds (Ponds 2,3,4,5,6,8) to the west of Forest Vale Road. Pond 30 is approximately 15 m x 7 m in size and approximately 0.5 m deep. In contrast to the 2013 report, water mint and bog pond weed were not noted, therefore spawning media was limited to dead leaves. Other species noted were water horsetail, broadleaf dock and soft rush. Emergent vegetation was limited and the water was clear. This pond is shaded by the trees surrounding it. One tree has grown at an angle leaning over the pond and many of its branches are just above the water. Grassland and woodland provides excellent terrestrial habitat throughout with abundant refugia present.		Location	1	Total HSI Score: 0.62 Average suitability with fair pond condition
			Pond area	0.2	
			Pond drying	1	
			Water quality	0.67	
			Shade	0.2	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.3	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Present - Litter	

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31	Grid reference: SO 64478 14996 This pond lies to the south of Pond 30, within the cluster of ponds to the west of Forest Vale Road. Pond 31 is approximately 10 m x 10 m in size and up to 1 m deep. Spawning media was sparse and limited to *Glyceria* sp. with occasional bog pond weed and water mint. Water horsetail and marginal soft rush were also noted. Grassland and woodland provides excellent terrestrial habitat throughout with abundant refugia present.		Location	1	Total HSI Score: 0.82 Excellent suitability with excellent pond condition
			Pond area	0.2	
			Pond drying	1	
			Water quality	1	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.7	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Low	
			Dumped rubbish	Absent	
32	Grid reference: SO 64306 15693 Pond 32 is located alongside the footpath through the Hawkwell Inclosure. This pond is no longer long and narrow as in the 2013 report as most of the pond has since dried up, and the pond now measures less than 5 m x 5 m in size. The water levels in this pond did not vary as previously reported. The water level remained shallow during the 2017 surveys and in 2018 the depth of the water had increased to an approximate maximum depth of 1 m. No aquatic vegetation was present and spawning media is limited to dead leaves. Nearby habitats consist mainly of woodland with an adundance of refugia.		Location	1	Total HSI Score: 0.31 Poor suitability with fair pond condition
			Pond area	0.05	
			Pond drying	0.1	
			Water quality	0.01	
			Shade	0.8	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	0.67	
			Macrophytes	0.3	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	High	
			Dumped rubbish	Absent	

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33	Grid reference: SO 64541 15614 A small pond to the south of the Hawkwell Inclosure. It is less than 0.5m deep and formed by two main sections which are hydrologically connected. Some macrophyte cover was present providing some egg laying media. Species noted were water mint, grass species and soft rush. Nearby habitats consist of grassland and woodland with plenty of refugia present for amphibians. The water levels were found to fluctuate frequently and was found dry up on a number of visits in 2017.		Location	1	Total HSI Score: 0.60 Average suitability with good pond condition
			Pond area	0.05	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	0.8	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.65	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
34	Grid reference: SO 64501 15072 Pond 34 no longer resembles a pond in the 2017 and 2018 visit and is a boggy grassland. There is no aquatic vegetation and there is no substantial body of water.		Location	1	Unsuitable for HSI - Dry
			Pond area	N/A - dry	
			Pond drying	0.1	
			Water quality	N/A - dry	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	N/A - dry	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	N/A	
			Dumped rubbish	Absent	

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N1	Grid reference: SO 64279 15152 This pond is one of four man-made ponds within an area of the forest that has been felled. The banks of the pond have been built up with clay mud. The turbidity of the water and the rusty orange colour from the clay mud have reduced since the survey visit in 2017. Some aquatic vegetation provides potential as spawning media, such as *Glyceria* sp. and *Potamogeton* sp. Soft rush and broadleaf dock was also noted. The marginal vegetation and immediate surrounding habitat has increased since the 2017 surveys. The surrounding area comprises of tussocky grassland, bracken, wood chippings and man-made log piles, which provides abundant potential for refuge and foraging.		Location	1	Total HSI Score: 0.82 Excellent suitability with good pond condition
			Pond area	0.6	
			Pond drying	0.9	
			Water quality	0.67	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.55	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
N2	Grid reference: SO 64291 15022 This pond is one of four man-made ponds within an area of the forest that has been felled. The banks of the pond have been built up with clay mud. The turbidity of the water and the rusty orange colour from the clay mud have reduced since the survey visit in 2017. Some aquatic vegetation provides potential as spawning media, such as *Glyceria* sp. and *Potamogeton* sp. Soft rush was also noted. The marginal vegetation and immediate surrounding habitat has increased since the 2017 surveys. The surrounding area comprises of tussocky grassland, bracken, wood chippings and man-made log piles, which provides abundant potential for refuge and foraging.		Location	1	Total HSI Score: 0.82 Excellent suitability with good pond condition
			Pond area	0.6	
			Pond drying	0.9	
			Water quality	0.67	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.55	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

N3	Grid reference: SO 64279 14912 This pond is one of four man-made ponds within an area of the forest that has been felled. The banks of the pond have been built up with clay mud. The turbidity of the water and the rusty orange colour from the clay mud have reduced since the survey visit in 2017. Some aquatic vegetation provides potential as spawning media, such as *Glyceria* sp. and *Potamogeton* sp. Soft rush was also noted. The marginal vegetation and immediate surrounding habitat has increased since the 2017 surveys. The surrounding area comprises of tussocky grassland, bracken, wood chippings and man-made log piles, which provides abundant potential for refuge and foraging.		Location	1	Total HSI Score: 0.83 Excellent suitability with good pond condition
			Pond area	0.6	
			Pond drying	0.9	
			Water quality	0.67	
			Shade	1	
			Fowl	0.67	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.65	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	
N4	Grid reference: SO 64245 14723 This pond is one of four man-made ponds within the area of the forest that has been felled. The banks of the pond have been built up with clay mud. Pond N4 was completely dry in 2017 and had no vegetation, terrestrial or aquatic, within the clay banks. In 2018, the had filled with water and the approximate maximum depth was 1 m, however after a period of hot weather this reduced to approximately 0.5 – 0.75 m. The size of the pond is approximately 10 m x 5 m. There is some limited aquatic vegetation within the pond included a submerged grass species and soft rush. The structure of the pond may require adjustment in order to provide the breeding potential for great crested newts as the other N ponds. The surrounding area comprises of tussocky grassland, bracken, wood chippings and man-made log piles, which provides abundant potential for refuge and foraging.	 	Location	1	Total HSI Score: 0.60 Average suitability with good pond condition
			Pond area	0.05	
			Pond drying	0.5	
			Water quality	0.67	
			Shade	1	
			Fowl	1	
			Fish	1	
			Pond count	1	
			Terrestrial habitat	1	
			Macrophytes	0.35	
			Invasive species	Absent	
			Major damage	Absent	
			Silt levels	Moderate	
			Dumped rubbish	Absent	

Appendix 3 Hibernacula condition assessment

Assessment Criteria	Score	Description
Size	1	Optimum (2m*1m*1m +)
	0.5	Minimum (2m*1m*1m)
	0.01	Insufficient (less than the minimum
Signs of damage or theft	1	None
	0.01	Signs of damage
Basking opportunities	1	Extensive vegetation cover on south facing side
	0.5	Moderate vegetation cover on south facing side
	0.01	No vegetation cover on south facing side
Naturalness of appearance	1	Good appearance
	0.5	Moderate appearance
	0.01	Poor appearance
Surrounding terrestrial habitat	1	Excellent surrounding habitat
	0.67	Good surrounding habitat
	0.33	Moderate surrounding habitat
	0.01	Poor surrounding habitat
Signs of flooding	1	Well-drained soil
	0.5	Moderately drained soil
	0.1	Poorly drained soil
Shading opportunities	1	Extensive vegetation cover on north facing side
	0.5	Moderate vegetation cover on north facing side
	0.01	No vegetation cover on north facing side
Habitat connectivity	1	Good connectivity
	0.5	Moderate connectivity
	0.01	Poor connectivity
Proximity to water	1	<10 metres
	0.5	10 – 50 metres
	0.01	50 – 100 metres

Calculation:

- Refugia Condition Assessment (RCA) product score = each score per index multiplied together (i.e. size score * signs of damage score * basking opportunities score * etc…)
- Overall refugia condition score (using POWER function in Excel) = POWER (product score, (1/No. of index's))
- Example of calculation (MP1):
- RCA product score = 1 * 1 * 1 * 0.5 * 1 * 1 * 1 * 0.5 * 1 = 0.25
- Overall refugia condition score = POWER (0.25, (1/9)) = 0.86 (Excellent)

Table A3.1 Overall refugia condition score with corresponding condition rating

Overall refugia condition rating	Overall refugia condition score
Poor	0 – 0.29
Fair	0.30 – 0.49
Good	0.50 – 0.74
Excellent	0.75 – 1

Table A3.2 Refugia condition results

Refugia	Overall refugia condition score	Overall rating	Refugia	Overall refugia condition score	Overall rating
MP1	0.86	Excellent	MP32	0.48	Fair
MP2	0.46	Fair	MP33	0.51	Good
MP3	0.76	Excellent	MP34	0.25	Poor
MP4	0.76	Excellent	MP35	0.46	Fair
MP5	0.79	Excellent	MP36	0.32	Fair
MP6	0.76	Excellent	MP37	0.27	Poor
MP7	0.53	Good	MP38	0.48	Fair
MP8	0.33	Fair	MP39	0.51	Good
MP9	0.53	Good	MP40	0.51	Good
MP10	0.49	Fair	MP41	0.51	Good
MP11	0.60	Good	MP42	0.56	Good
MP12	0.56	Good	MP43	0.51	Good
MP13	0.59	Good	MP44	0.48	Fair
MP14	0.60	Good	MP45	0.51	Good
MP15	0.60	Good	MP46	0.51	Good
MP16	0.27	Poor	MP47	0.51	Good
MP17	0.25	Poor	MP48	0.51	Good
MP18	0.72	Good	MP49	0.68	Good
MP19	0.86	Excellent	MP50	0.59	Good
MP20	0.86	Excellent	MP51	0.72	Good
MP21	0.77	Excellent	MP52	0.72	Good

Refugia	Overall refugia condition score	Overall rating	Refugia	Overall refugia condition score	Overall rating
MP22	0.48	Fair	MP53	0.72	Good
MP23	0.49	Fair	MP54	0.69	Good
MP24	0.93	Excellent	MP55	0.69	Good
MP25	0.37	Fair	MP56	0.77	Excellent
MP26	0.38	Fair	MP57	0.61	Good
MP27	0.79	Excellent	MP58	0.74	Good
MP28	0.41	Fair	MP59	0.93	Excellent
MP29	0.48	Fair	MP60	0.77	Excellent
MP30	0.48	Fair	MP61	0.74	Excellent
MP31	0.48	Fair			

Purpose Built Hibernacula

- These hibernacula were identified as being purpose built using wooden posts and wiring. As apposed to natural hibernacula found or windrows/log piles created from the felling of trees in the central section
- 10 in total
- Majority were of optimum size (apart from MP2 and MP8) which is reflected in the index score column

Refugia	Refugia Description	Photo	Refugia Condition Assessment Criteria	Score per Index	Overall refugia condition score
MP1	- Shade provided by nearby trees - Moderate habitat connectivity		Size	1	0.86 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	1	
MP2	- Shade provided by lone standing tree - Exposed with limited vegetation cover		Size	0.01	0.46 FAIR
			Surrounding habitat	0.67	
			Signs of flooding	0.5	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	1	

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MP3	- Moderate shading opportunities, partly shaded by tree cover		Size	1	0.76 EXCELLENT
			Surrounding habitat	0.67	
			Signs of flooding	0.5	
			Shading opportunities	1	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	1	
MP4	- Good shading from trees on south facing side providing good basking opportunities, however, limited shading on north facing side - The poles used when first constructing the hibernacula have been pulled off, potentially by wild boars, however this does not affect the structure of the hibernacula.		Size	1	0.76 EXCELLENT
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.5	

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MP5	- Some shading provided by trees on south facing side		Size	1	0.79 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	0.5	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	1	
MP6	- Areas of surrounding terrestrial habitat torn up by wild boars and lots of litter - Good shading opportunities as it is situated in shaded woodland area - Pond 7 is less than 10 metres away and has recently been filled with water so the proximity to water value was increased. Pond 7 did then dry up after three survey visits.		Size	1	0.76 Excellent
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.5	

MP7	- Nearby terrestrial habitat torn up by wild boars - Quite shaded area, limiting basking opportunities		Size	1	0.53 GOOD
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	
MP8	- South facing side shaded by trees - North facing side exposed to sun		Size	0.01	0.33 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

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MP9	- Not much tree cover to provide shade - Good cover of vegetation, in particular moss species (*K.praelongia, P.formosum*)		Size	1	0.53 GOOD
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	
MP10	- Extensive moss cover but little shade provided by trees - Good cover of moss species such as *R.squarrosus* and *H.cupressiforme*		Size	1	0.49 FAIR
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

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Extra Hibernacula

- As well as the purpose built hibernacula, any other natural hibernacula were also assessed
- This included log piles, windrows and other features that appear suitable to accommodate amphibian species
- Windrows were a by-product of the felling of coniferous trees running parallel to ponds N1, N2, N3 and N4

MP11	- Approximately 6 metres long - Extensive vegetation cover on north facing side - Heavily covered in vegetation in general, potentially reducing basking opportunities	 	Size	1	0.60 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP12	- Moderate vegetation cover on south facing side	 	Size	1	0.56 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

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MP13	- Slightly larger than optimal in terms of length and height	 	Size	1	0.59 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP14	- Extensive bramble cover all over but tree cover more open		Size	1	0.60 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	

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MP15	- Slightly larger than optimal size (3 m*3 m*1 m) - Extensive vegetation cover on north facing side		Size	1	0.60 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP16	- Suboptimal in size (2 m*2 m*1 m) and circular in shape		Size	1	0.27 POOR
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	0.01	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

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MP17	- Less than the minimum size (1 m*1 m*1 m) - Heavy vegetation cover, sparse tree cover - Heavy cover of grass species		Size	0.5	0.25 POOR
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	0.01	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	
MP18	- Not standard size, approximately 5 m * 1 m * 0.5 m - Well-drained soil at time of survey but could flood if Pond 7 comes back annually - No vegetation cover on north facing side, poor shading - No shading and poor vegetation cover, therefore good basking opportunities - Pond 7 was dry at time of survey but if Pond was full, proximity to water would be less than 10 metres	 	Size	0.5	0.72 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.5	

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MP19	- Approximately 4 m*3 m*0.5 m - Well-drained soil at time of survey but could flood if Pond 7 comes back annually - Limited vegetation cover and no shading - Pond 7 was dry at time of survey but if Pond was full, proximity to water would be less than 10 metres		Size	1	0.86 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.5	
MP20	- Approximately 2 m*3 m*1 m - Shading from bramble and hawthorn on south facing side - Nearest pond is approximately 20 metres away		Size	1	0.86 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	1	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.5	

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MP21	- Approximately 8 – 10 metres long - Some exposed areas providing basking opportunities - Moderate shading provided by trees - Currently within water that has spread from Pond 8		Size	1	0.77 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	0.1	
			Shading opportunities	1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	1	
MP22	- Windrow created from the felling of trees in the central section, near Ponds N1, N2,N3 and N4 - Approximately 50 m*2 m*2 m in size - Some vegetation cover but no shading provided by trees	 	Size	1	0.48 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	0.01	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.5	

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MP23	- Windrow created from the felling of trees in the central section, near Ponds N1, N2,N3 and N4 - Approximately 30 m*2 m*2 m in size	  	Size	1	0.49 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	0.01	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.5	
MP24	- Approximately 5 m*3 m*3 m in size - Limited vegetation and tree cover		Size	1	0.93 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.5	

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MP25	- Very limited vegetation and tree cover		Size	0.5	0.37 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	0.5	
			Signs of damage	0.01	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.5	
MP26	- Approximately 3 m*2 m*2 m - Limited shading opportunities from vegetation cover and tree cover - Majority of vegetation cover made up of bracken		Size	1	0.38 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	0.01	
			Naturalness of appearance	0.5	
			Habitat connectivity	1	
			Proximity to area of water	0.5	

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MP27	- Windrow created from the felling of trees in the central section, near Ponds N1, N2,N3 and N4 - Roughly 40 m *5 m* 3 m in size - Extensive vegetation cover provided by bracken on both sides	  	Size	1	0.79 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.5	
MP28	- Moderate vegetation cover provided by surrounding scrub		Size	1	0.41 FAIR
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

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MP29	- Approximately 10 m * 2 m * 1 m - Moderate shading provided by trees - Over a 100 metres from nearest body of water		Size	1	0.48 FAIR
			Surrounding habitat	1	
			Signs of flooding	0.5	
			Shading opportunities	1	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	0.5	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP30	- Windrow created from the felling of trees in the central section, near Ponds N1, N2,N3 and N4 - Approximately 30 m *3 m *2 m in size - Over a 100 metres from nearest body of water	 	Size	1	0.48 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

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MP31	- Part of same windrow as MP30	 	Size	1	0.48 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	
MP32	- Part of same windrow as MP30 and MP31, but greater in length	 	Size	1	0.48 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

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MP33	- Approximately 40 m *2 m *1 m in size - Over 100 metres from nearest body of water	 	Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP34	- Approximately 3 m *2 m *0.5 m in size - Over 100 metres from nearest body of water		Size	0.01	0.25 POOR
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	0.5	
			Signs of damage	0.5	
			Naturalness of appearance	0.5	
			Habitat connectivity	1	
			Proximity to area of water	0.01	

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MP35	- Approximately 30 m *2 m *1 m in size - Over 100 metres from nearest body of water	 	Size	1	0.46 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP36	- Approximately 10 m *2 m *1 m in size - Over 100 metres from nearest body of water		Size	1	0.32 FAIR
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.01	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

MP37	- Approximately 50 m *3 m *2 m in size	 	Size	1	0.27 POOR
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.01	
			Proximity to area of water	0.01	
MP38	- Approximately 15 m *5 m *4 m in size - Over 100 metres from nearest body of water		Size	1	0.48 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	

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MP39	- Approximately 50 m *3 m *3 m - Over 100 m metres from nearest body of water	  	Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP40	- Approximately 50 m*3 m*3 m - Over 100 m metres from nearest body of water	 	Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	

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MP41	- Part of the same windrow as MP40, but this particular section 20 m*3 m*3 m in size	 	Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP42	- Approximately 10 m*0.5 m*0.5 m in size - Over 100 metres from the nearest water body		Size	1	0.56 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	

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MP43	- Approximately 30 m*3 m*4 m in size - Over 100 metres form the nearest body of water		Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP44	- Approximately 20 m*1 m*1 m in size - Over 100 metres form the nearest body of water	 	Size	1	0.48 FAIR
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.05	
			Basking opportunities	0.05	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.01	

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MP45	- Approximately 25 m*2 m*1.5 m in size - Over 100 metres from nearest body of water		Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP46	- Approximately 25 m*2 m*1.5 m in size - Over 100 metres from nearest body of water - Extensive vegetation cover from bracken and foxglove		Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	

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MP47	- Approximately 25 m*2 m*1.5 m in size - Over 100 metres from nearest body of water - Extensive vegetation cover from bracken and foxglove, which could potentially reduce basking opportunities		Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	
MP48	- Part of same windrow as MP47 but this particular section was 30 m*1 m*1 m in size		Size	1	0.51 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.01	

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MP49	- Extremely long windrow running parallel to coniferous woodland area - Approximately 100 m*2 m*2 m in size - Surrounding habitats is partly good, however, some areas are bare and open	 	Size	1	0.68 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	0.5	
			Habitat connectivity	0.5	
			Proximity to area of water	0.5	
MP50	- Approximately 30 m*3 m*3 m in size - Limited shading opportunities provided by tree cove, however, some potentially provided by extensive vegetation cover (bracken and foxglove)	 	Size	1	0.59 GOOD
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	0.5	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.5	

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MP51	- Approximately 30 m*3 m*4 m - Limited shading opportunities provided by tree cove, however, some potentially provided by extensive vegetation cover (bracken and foxglove) - Approximately 20 metres from nearest body of water	 	Size	1	0.72 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	0.5	
MP52	- Approximately 100 m*3 m*4 m in size		Size	1	0.72 GOOD
			Surrounding habitat	1	
			Signs of flooding	0.5	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	1	

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MP53	- Approximately 20 m*2 m*1 m in size	 	Size	1	0.72 GOOD
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	1	
MP54	- Approximately 25 m*2 m*2 m in size	 	Size	1	0.69 GOOD
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	1	

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MP55	- Approximately 30 m*2 m*2 m in size	 	Size	1	0.69 GOOD
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	1	
MP56	- Approximately 20 m*2 m*1 m in size	 	Size	1	0.77 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	1	

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MP57	- Approximately 40 m*2 m*2 m in size	 	Size	1	0.61 GOOD
			Surrounding habitat	1	
			Signs of flooding	0.5	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	0.5	
			Proximity to area of water	0.5	
MP58	- Approximately 6 m*2 m*2 m in size		Size	1	0.74 GOOD
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	1	

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MP59	- Approximately 25 m *2 m*4 m in size - Extensive vegetation cover from nettle and foxglove may increase shading	 	Size	1	0.93 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.5	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	1	
MP60	- Approximately 30 m*2 m *2 m in size - Extensive vegetation cover from nettle and foxglove may increase shading - Vegetation cover is so extensive that potentially basking spots could be limited		Size	1	0.77 EXCELLENT
			Surrounding habitat	1	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	1	

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MP61	- Approximately 10 m*5 m*1 m in size and circular in shape - Extensive vegetation cover from nettle and foxglove may increase shading - Vegetation cover is so extensive that potentially basking spots could be limited	 	Size	1	0.74 EXCELLENT
			Surrounding habitat	0.67	
			Signs of flooding	1	
			Shading opportunities	0.1	
			Basking opportunities	1	
			Signs of damage	1	
			Naturalness of appearance	1	
			Habitat connectivity	1	
			Proximity to area of water	1	

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Appendix 4 Bottle trapping details

A4.1 Number of bottle traps used at each pond

Pond	Number of traps used	Notes	Pond	Number of traps used	Notes
1 (& 19)	15		21	60	
2	15		22	0	Dry
3	30		23 (a,b,c)	100	
4	15		24	20	
5	30		25	20	
6	40		26	35	
7	40 then 0	Dry after 3 weeks	27a	10	
8	35		27b	30	
9	25		27c	35	
10	0	Not included	28	15	
11	20		29	0	Dry
12	0	Fishing pond	30	10	
13	5		31	10	
13a	5		32	5	
14	15		33	10	
15	5	Shallow	34	0	Dry
16	35		N1	30	
17	0	Dry	N2	30	
18a	40		N3	30	
18b	40		N4	25	
20	40				

Appendix 5 eDNA analysis report

SureScreen Scientifics

Folio No: E2539
Report No: 1
Order No: 015500
Client: ECUS LTD
Contact: Rebecca Yearsley
Contact Details: rebecca.yearsley@ecusltd.co.uk
Date: 03/05/2018

TECHNICAL REPORT

ANALYSIS OF ENVIRONMENTAL DNA IN POND WATER FOR THE DETECTION OF GREAT CRESTED NEWTS

Date sample received at Laboratory: 30/04/2018
Date Reported: 03/05/2018
Matters Affecting Results: None

RESULTS

Lab Sample No.	Site Name	O/S Reference	SIC	DC	IC	Result	Positive Replicates
1637	Cinderford Pond 10	SO6436415309	Pass	Pass	Pass	Negative	0

SUMMARY

When Great Crested Newts (GCN); Triturus cristatus inhabit a pond, they deposit traces of their DNA in the water as evidence of their presence. By sampling the water, we can analyse these small environmental DNA (eDNA) traces to confirm GCN habitation, or establish GCN absence.

The water samples detailed below were submitted for eDNA analysis to the protocol stated in DEFRA WC1067 (Latest Amendments). Details on the sample submission form were used as the unique sample identity.

RESULTS INTERPRETATION

Lab Sample No.- When a kit is made it is given a unique sample number. When the pond samples have been taken and the kit has been received back in to the laboratory, this sample number is tracked throughout the laboratory.

Site Name- Information on the pond.

O/S Reference – Location/co-ordinates of pond.

SIC- Sample Integrity Check. Refers to quality of packaging, absence of tube leakage, suitability of sample (not too much mud or weed etc.) and absence of any factors that could potentially lead to results errors. Inspection upon receipt of sample at the laboratory. To check if the Sample is of adequate integrity when received. Pass or Fail.

DC- Degradation Check. Analysis of the spiked DNA marker to see if there has been degradation of the kit since made in the laboratory to sampling to analysis. Pass or Fail.

IC- Inhibition Check- PCR inhibitors can cause false results. Inhibitors are analysed to check the quality of the result. Every effort is made to clean the sample pre-analysis however some inhibitors cannot be extracted. An unacceptable inhibition check will cause an indeterminate sample and must be sampled again.

Result- NEGATIVE means that GCN eDNA was not detected or is below the threshold detection level and the test result should be considered as no evidence of GCN presence. POSITIVE means that GCN eDNA was found at or above the threshold level and the presence of GCN at this location at the time of sampling or in the recent past is confirmed. Positive or Negative.

Positive Replicates- To generate the results all of the tubes from each pond are combined to produce one eDNA extract. Then twelve separate analyses are undertaken. If one or more of these analyses are positive the pond is declared positive for the presence of GCN. It may be assumed that small fractions of positive analyses suggest low level presence but this cannot currently be used for population studies. In accordance with Natural England protocol, even a score of 1/12 is declared positive.

METHODOLOGY

The laboratory testing adheres to strict guidelines laid down in WC1067 Analytical and Methodological Development for Improved Surveillance of The Great Crested Newt, Version 1.1

The analysis is conducted in two phases. The sample first goes through an extraction process where all six tubes are pooled together to acquire as much eDNA as possible. The pooled sample is then tested via real time PCR (also called q-PCR). This process amplifies select part of DNA allowing it to be detected and measured in ‘real time’ as the analytical process develops. qPCR combines PCR amplification and detection into a single step. This eliminates the need to detect products using gel electrophoresis. With qPCR, fluorescent dyes specific to the target sequence are used to label PCR products during thermal cycling. The accumulation of fluorescent signals during the exponential phase of the reaction is measured for fast and objective data analysis. The point at which amplification begins (the Ct value) is an indicator of the quality of the sample. True positive controls, negatives and blanks as well as spiked synthetic DNA are included in every analysis and these have to be correct before any result is declared so they act as additional quality control measures.

The primers used in this process are specific to a part of mitochondrial DNA only found in GCN ensuring no DNA from other species present in the water is amplified. The unique sequence appropriate for GCN analysis is quoted in DEFRA WC 1067 and means there should be no detection of closely related species. We have tested our system exhaustively to ensure this is the case in our laboratory. We can offer eDNA analysis for most other species including other newts.

Analysis of eDNA requires scrupulous attention to detail to prevent risk of contamination. Kits are manufactured by SureScreen Scientifics to strict quality procedures in a separate building and with separate staff, adopting best practice from WC1067 and WC1067 Appendix 5. Kits contain a ‘spiked’ DNA marker used as a quality control tracer (SureScreen patent pending) to ensure any DNA contained in the sampled water has not deteriorated in transit. Stages of the DNA analysis are also conducted in

different buildings at our premises for added

SureScreen Scientifics Ltd also participate in Natural England's proficiency testing scheme and we also carry out inter-laboratory checks on accuracy of results as part of our quality procedures.

Reported by: Sam Humphrey **Approved by:** Derry Hickman

End Of Report