

Norfolk Boreas Offshore Wind Farm

Appendix 22.8

Reptile Survey Reports

Environmental Statement

Volume 3

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Norfolk Boreas Reptile presence / likely absence surveys

Survey scope :	Reptile presence / likely absence surveys
Prepared on behalf of :	Royal HaskoningDHV
Report reference :	2017/147.3
Date of survey/s :	26/04/2018 - 22/06/2018

Bewick House, 22 Thorpe Road, Norwich, NR1 1RY, T: 01603 625540, F: 01603 598300.

Norfolk Wildlife Services is a member of the Association of Wildlife Trust Consultancies (AWTC) which is also a corporate member of the Institute of Environmental Management and Assessment (IEMA).

Report prepared by: Ben Moore GRADCIEEM

Checked by: Sally McColl MCIEEM

Approved by: Chris Smith

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1. Executive Summary

1.1. Baseline data to inform the Norfolk Boreas Environment Impact Assessment (EIA) was collected in 2017 as part of the Norfolk Vanguard Project. Following a review of this baseline data, 15 'priority areas' were identified as locations for further ecological surveys.

1.2. Habitat mosaics located within seven of the priority areas were considered potentially suitable to support common species of reptile.

1.3. The purpose of the surveys was to ascertain whether reptiles are present or likely absent within those seven priority areas.

1.4. The following guidance documents were used to inform development of the survey methodology: Froglife advice sheet 10 (Froglife, 1999) and Herpetofauna Workers Manual (Gent and Gibson, 2003).

1.5. Reptile presence/likely absence surveys were proposed to be carried out at seven survey locations, although it was decided not to proceed with survey visits at RE07 due to the heavy grazing regime on site rendering the area of low suitability for reptiles.

1.6. There were no significant limitations to the survey visits for the completed survey locations accessed.

1.7. The presence of two species of reptile was observed during the survey season: slow worm *Anguis fragilis* and grass snake *Natrix natrix*. Slow worm were present at RE05 and grass snake at RE03.

1.8. Reptiles were not recorded at any remaining survey locations where surveys took place: RE01, RE02, RE04 or RE06. It is concluded that significant populations of reptiles are likely absent from these four survey locations, although individual animals may occasionally be present.

1.9. Whilst no definite conclusions can be drawn about reptile populations within RE07, it is considered that significant populations of reptiles are likely absent.

2. Introduction

2.1. Project background

2.1.1. The Norfolk Boreas Offshore Wind Farm site is located 73km, at the closest point, off the coast of Norfolk within which wind turbines will be located. The project would comprise of an array of offshore wind turbines and offshore substations which will be connected to the shore by offshore export cables.

2.1.2. The project will also require onshore infrastructure in order to transmit and connect the offshore wind farm to the National Grid, which in summary would comprise:

- Landfall;
- Onshore cable route (60km);
- An onshore project substation; and
- Works at the Necton National Grid substation (including extension of the existing substation, interface cables, and modification of the overhead power lines).

2.1.3. Norfolk Boreas is the sister project to the proposed Norfolk Vanguard offshore wind farm project which will be located across two offshore wind farm sites, adjacent to the Norfolk Boreas offshore wind farm site. Norfolk Vanguard is being developed first and its Environmental Impact Assessment (EIA) and project design development are at a more advanced stage than for Norfolk Boreas. As both projects would connect to the existing Necton National Grid substation, there has been a strategic approach to identifying locations for all onshore infrastructure with the aim of optimising overall design and reducing impacts where practical.

2.2. Survey scope

2.2.1. Development of survey scope

2.2.1.1. As Norfolk Boreas is a Nationally Significant Infrastructure Project (NSIP) an EIA is required as part of a Development Consent Order (DCO) application under the Planning Act 2008.

2.2.1.2. Baseline data to inform the Norfolk Boreas EIA was collected in 2017 as part of the Norfolk Vanguard Project. Following a review of this baseline data, 15 'priority areas' were identified as locations for further ecological surveys, due to the potential sensitivity of the habitats present or the location of key elements of the project onshore infrastructure. Habitat mosaics located within seven of the priority areas considered potentially suitable for reptiles were identified during an Extended Phase 1 Habitat Survey conducted in February 2018 (Royal HaskoningDHV, 2018).

2.2.1.3. Norfolk Wildlife Services were appointed in February 2018 to undertake additional ecological surveys on the data gaps identified at these priority areas plus a 50m buffer.

2.2.1.4. Norfolk Boreas Offshore Wind Farm Environmental Impact Assessment: Phase 2 Ecological Surveys Scope (Royal HaskoningDHV, 2017), produced in December 2017, set out the Survey Scope for delivering reptile presence/likely absence surveys within the seven priority areas. Norfolk Wildlife Services used the Survey Scope to deliver the reptile presence/likely absence surveys. The approach used by Norfolk Wildlife Services to deliver this scope (herein the 'survey protocol') is set out in Section 3.

2.2.2. Survey Scope

Survey locations

2.2.2.1. The seven priority areas identified during the Extended Phase 1 Habitat Survey (Royal HaskoningDHV, 2018) as providing suitable habitat for common reptiles were identified as such as they provided all the suitable habitat elements required by reptiles

including hibernacula¹, sheltering sites², basking areas³ and foraging areas⁴. Expert judgement has been used to determine which areas are suitable for common reptile species.

2.2.2.2. The locations of the seven priority areas described above are shown in Appendix 1 of this report.

2.3. Aim of report

2.3.1. The aim of this report is to present the findings of reptile presence/likely absence surveys conducted within the seven priority areas.

2.4. Survey objective

2.4.1. To ascertain whether common reptiles are present or likely absent within the seven priority areas identified within Norfolk Boreas Offshore Wind Farm Environmental Impact Assessment: Phase 2 Ecological Surveys Scope (Royal HaskoningDHV, 2017) as being potentially suitable for common species of reptile.

¹ a place where a reptile seeks shelter to overwinter to protect them from bad weather and predators e.g. within tree roots, thick grass tussocks, under rubble, within mammal burrows

² a place where a reptile seeks shelter during the active season to protect against predators

³ an open area where reptiles can warm up in the sun e.g. bare ground, walls, fences, usually close to cover

⁴ places where reptiles will seek food e.g. grassland, hedgerows, ponds

3. Methodology

3.1. Section 3.1 sets out the proposed survey protocol as agreed between Royal HaskoningDHV and Norfolk Wildlife Services prior to any field work commencing, and Section 3.2 sets out how the surveys were delivered in relation to the protocol and identifies any deviations or modifications that took place during the delivery phase.

3.1. Survey protocol

Relevant guidance

3.1.1. The following guidance documents were used to inform development of the survey methodology:

- Gent, T. and Gibson, S. (2003). Herpetofauna Workers Manual. Joint Nature Conservation Committee (JNCC), Peterborough.
- Froglife (1999). Reptile survey, an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife advice sheet 10.

Survey locations

3.1.2. The survey locations are presented in Appendix 2 and descriptions of these locations are summarised in Table 1.

Table 1 Reptile presence/likely absence survey locations, description and area.

Survey Location	GPS co-ordinates	Priority area description (as provided by Royal HaskoningDHV)	Additional details (as provided by Norfolk Wildlife Services)	Approx area of suitable habitat (hectares)
RE01	TG 3463 3060	Sensitive habitats (drainage network and wet grassland) at Ridlington Street.	Woodland edge and wet grassland surrounded by arable fields to the east and west.	2.9
RE02	TG 1961 2840	HDD receptor site and floodplain habitats at River Bure.	Woodland edge and wide field margin bordering arable field. Adjacent to area of grazed wet grassland alongside the River Bure.	0.6
RE03	TG 1896 2860	HDD receptor site and floodplain habitats at River Bure.	Woodland edge and wide field margin bordering arable field.	0.6
RE04	TG 0974 2403	Sensitive habitat (drain). North of Reepham.	Wet grassland with central drain running through the survey location with various other adjoining drainage ditches. Thick gorse growing along central drain.	1.5
RE05	TG 0701 2057	Sensitive habitat (river, woodland). North of Sparham.	Rough grassland with stream running along the northern boundary. Patches of dense common reed.	1.3
RE06	TF 9470 1319	Wendling Carr CWS.	Semi-improved grassland bordered by arable fields and a stream to the south.	1.2
RE07	TG 1260 2451	Sensitive habitat (woodland) at Salle Park.	Grassland heavily grazed by horses in 2017 with adjacent stream and hedgerow. The adjacent area was surveyed in 2017.	2.4

Survey methodology

3.1.3. The reptile presence / likely absence survey methods are based upon the protocol set out in the JNCC's Herpetofauna Worker's Manual (Gent and Gibson, 2003). Field surveys will be carried out by Norfolk Wildlife Services based upon the supplied locations and methodology as detailed above (Royal HaskoningDHV, 2017).

3.1.4. Artificial refuges, consisting of felt mats, will be set out at each survey location in suitable micro-habitats, based on minimum densities of at least five to ten refuges per hectare following Froglife advice sheet 10 (Froglife, 1999).

3.1.5. Mats will be left for a minimum of 14 days before surveys to allow for settling in and for reptiles to begin using them.

3.1.6. Seven survey visits will be undertaken for each survey location following JNCC's Herpetofauna Workers Manual (Gent and Gibson, 2003). At least 48 hours will be left between survey visits.

3.1.7. During each survey visit, surveyors will walk over the survey location without casting a shadow in front of them and visually scan ahead using binoculars for reptiles basking on open areas and low branches of bushes, etc. Surveyors will carefully lift all tiles and check the space beneath for the presence of reptiles. For any reptiles encountered, their species and location will be recorded.

3.1.8. Each survey visit will take a minimum of 30 minutes at each survey location.

3.1.9. Survey visits will be undertaken in preference during April, May and September in suitable weather conditions.

3.1.10. Surveys will be undertaken where the ground temperature is between 10 and 17°C. The surveys will be undertaken either during the early morning (9am-11am) or late afternoon (approx. 4pm-7pm) when mats are most likely to be utilised. However earlier in the year, reptiles are often encountered closer to mid-day when it is warmer; conversely in very hot conditions in midsummer, reptiles may be found progressively earlier in the morning and later in the afternoon. These timings are subject therefore to judgement of surveyor.

3.1.11. Surveys will not take place in heavy rain or strong wind. Weather over preceding days can increase survey efficiency e.g. warmer weather after a cooler period or showery weather after a prolonged dry period.

3.1.12. No species licences are required for these surveys.

3.1.13. All surveys will be undertaken by suitably experienced reptile surveyors, who will either be members of Chartered Institute of Ecology and Environmental Management (CIEEM) or act according to its code of conduct. All reptile surveyors will be accompanied by a safety worker.

3.1.14. Appropriate long sleeved and long legged clothing, gloves and boots will be worn whilst surveying.

3.2. Survey delivery

3.2.1. Survey methodology as delivered

Access to survey locations

3.2.1.1. It was decided to omit RE07 from the list of survey locations due to the heavy grazing regime by horses which has resulted in the habitat being of low suitability for common reptile species and due to the likely trampling of any mats placed out.

3.2.1.2. Access was possible to all six of the agreed survey locations.

Equipment used

3.2.1.3. Equipment used for the surveys is detailed below:

- Roofing felt cut to 0.5m x 0.5m mats (initial set out survey only)
- Binoculars
- Thermometer
- Mobile phone

- Weather writer and pen
- Reptile recording form and felt location map
- Toolbox talk form

Refugia density

3.2.1.4. Details of mat density, dates of placement and first survey are summarised in Appendix 3: Refugia density. Appendix 4: Refugia locations depict the coverage of mats across the locations surveyed.

3.2.1.5. At RE01, locations for laying out of mats was restricted to ditch boundaries due to the presence of temporary electric fencing for sheep grazing.

3.2.1.6. At RE02-RE04, due to cows grazing within the majority of the suitable habitat, the mats were placed along the boundary hedgerow and adjacent woodland edge.

3.2.1.7. Refugia density at all survey locations was in accordance with the protocol.

Survey effort

3.2.1.8. At all locations surveyed, seven survey visits were undertaken.

Timing and weather conditions

3.2.1.9. Reptile presence/likely absence surveys were carried out during April to June 2018 for all survey locations.

3.2.1.10. Table 2 highlights 21 surveys that fell outside of the optimal conditions for surveying as set out in the Survey Scope.

3.2.1.11. 12 surveys were undertaken in June 2018. Although June was not identified as an optimal month for surveying reptiles as set out by Froglife (1999), the temperatures in June 2018 were still within the optimum temperature window for surveying and followed a cool May, and were considered to still provide valid survey results.

3.2.1.12. Seven surveys finished just outside the survey time period as set out in the Survey Scope, but were within the temperature range indicated in the Survey Scope, and were considered to still provide valid survey results.

3.2.1.13. Two surveys that fell outside of the optimal temperature conditions for surveying reptiles as set out in the Survey Scope but were within the temperature range indicated in Froglife (1999) and were considered to still provide valid results.

Table 2: Surveys falling outside optimal survey conditions.

Survey location	Survey No.	Survey Date	Constraint	Note (explanation)	Conclusion
RE01	1	17.05.18	Surveyed outside of survey window	Temperatures remained within optimal temperatures	Constraint not significant - survey results still valid
RE01	2	22.05.18	Survey exceeded survey window	Temperatures remained within optimal temperatures	Constraint not significant - survey results still valid
RE01	4	08.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE01	5	14.06.18	18°C	Temperature rose to 18 °C at end of survey.	Constraint not significant - survey results still valid

Survey location	Survey No.	Survey Date	Constraint	Note (explanation)	Conclusion
RE01	5	14.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE01	6	19.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE01	7	22.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE02	1	27.04.18	Survey exceeded survey window	Temperatures remained within optimal temperatures	Constraint not significant - survey results still valid
RE02	2	03.05.18	Survey exceeded survey window	Temperatures remained within optimal temperatures	Constraint not significant - survey results still valid
RE02	7	07.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE03	7	07.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE04	1	26.04.18	Survey exceeded survey window	Temperatures remained within optimal temperatures	Constraint not significant - survey results still valid
RE04	6	11.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE04	7	18.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE05	6	14.06.18	18°C	Temperature rose to 18°C at end of survey.	Constraint not significant - survey results still valid
RE05	6	14.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE05	7	22.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE06	1	26.04.18	Survey exceeded survey window	Temperatures remained within optimal temperatures	Constraint not significant - survey results still valid

Survey location	Survey No.	Survey Date	Constraint	Note (explanation)	Conclusion
RE06	4	17.05.18	Survey exceeded survey window	Temperatures remained within optimal temperatures	Constraint not significant - survey results still valid
RE06	6	14.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid
RE06	7	22.06.18	Surveyed in June	Although June isn't an optimal month for reptile presence/likely absence surveys, May was much cooler than usual and June remained within recommended temperatures.	Constraint not significant - survey results still valid

Dates of reptile presence/likely absence surveys

3.2.1.14. Table 3 shows the dates of each reptile presence/likely absence survey visit undertaken at each survey location.

3.2.1.15. Full weather and timing details are given in Appendix 5: Full details of survey conditions and personnel.

Table 3: Dates of reptile presence/likely absence surveys

Survey Location	Date refugia laid out	Survey Visit 1	Survey Visit 2	Survey Visit 3	Survey Visit 4	Survey Visit 5	Survey Visit 6	Survey Visit 7
RE01	14.05.18	17.05.18	22.05.18	30.05.18	08.06.18	14.06.18	19.06.18	22.06.18
RE02	11.04.18	27.04.18	03.05.18	11.05.18	18.05.18	22.05.18	30.05.18	07.06.18
RE03	11.04.18	27.04.18	03.05.18	11.05.18	18.05.18	22.05.18	30.05.18	07.06.18
RE04	11.04.18	26.04.18	03.05.18	10.05.18	17.05.18	24.05.18	11.06.18	18.06.18
RE05	11.04.18	26.04.18	03.05.18	10.05.18	17.05.18	24.05.18	14.06.18	22.06.18
RE06	11.04.18	26.04.18	03.05.18	10.05.18	17.05.18	24.05.18	14.06.18	22.06.18

Personnel

3.2.1.16. All surveys were undertaken by experienced reptile surveyors, who are listed below in the table below. Other named staff on surveys were safety workers: Joseph Hassall, Rebecca Evans, Stephanie Ford.

Table 4 Surveyor experience

Team member	Experience	Memberships
Ben Moore	3 years' experience of ecological surveying, including reptiles	GradCIEEM
Sally McColl	11 years' experience of ecological surveying, including reptiles	MCIEEM
Jim Allitt	15 years' experience in ecological surveying, including reptiles	-

3.2.2. Limitations

3.2.2.1. Limitations in relation to refugia density and timing and weather were set out in the previous section, and were not considered to be of significance.

3.2.2.2. Table 5 summarises the additional limitations to the surveys by location and implications. An assessment of each visit is given in Appendix 5: Full details of survey conditions and personnel.

3.2.2.3. No suitable survey was carried out for RE07 and no conclusions can be drawn on presence/likely absence of reptiles at this location.

3.2.2.4. Difficulties in gaining access to RE01 meant the start of the surveys was significantly delayed and refugia were not laid out for the full 14 days in advance of the first survey. A full seven survey visits were accomplished at this survey location in optimal conditions and so this delay is not considered to affect the results of the survey at this location.

Table 5 : Survey limitations

Survey Location	Access restrictions	Survey effort, including non-compliant visits	Conclusion
RE01	Delayed start to surveys due to access difficulties	7 survey visits	No significant limitations
RE02	None	7 survey visits	No significant limitations
RE03	None	7 survey visits	No significant limitations
RE04	None	7 survey visits	No significant limitations
RE05	None	7 survey visits	No significant limitations
RE06	None	7 survey visits	No significant limitations
RE07	N/A	N/A	No survey undertaken

4. Results

4.1. Presence / Likely absence

4.1.1. The results of the survey visits for each survey location are summarised in Tables 6 - 8 below, and are detailed in full in Table 9.

4.1.2. Reptile presence was observed at two of the survey locations, which are shown on the map in Appendix 2. Two species of reptile were recorded as present: slow worm *Anguis fragilis* at RE05 and grass snake *Natrix natrix* at RE03. These findings are summarised in Tables 7 and 8.

4.1.3. No conclusions can be drawn as to the population levels at each survey location; however, RE03 and RE05 contain extensive areas of ungrazed grassland, hedgerows, ditches and woodland and therefore have the potential to support notable populations of reptiles.

4.1.4. Juvenile slow worms were recorded at RE05 which suggests a breeding population at this survey location.

4.1.5. Significant reptile populations are considered likely absent from the remaining survey locations (RE01, RE02, RE04, RE06), with a high level of confidence based on survey results where no reptiles were detected. However, individual animals may occasionally be present within these areas.

4.1.6. No survey visits were conducted at RE07. However, based on the heavy grazing regime rendering the habitat of low suitability for reptiles, and the absence of significant populations of reptiles detected in 2017 from the adjacent survey location to the west, whilst no definite conclusions can be drawn about reptile populations at this survey location, it is considered that significant populations of reptiles are likely absent.

Table 6 Summary of presence / likely absence survey results for reptiles 2018

Survey Location	Presence/likely absence			
	Grass snake	Slow worm	Common Lizard	Adder
RE01	Not detected	Not detected	Not detected	Not detected
RE02	Not detected	Not detected	Not detected	Not detected
RE03	Present	Not detected	Not detected	Not detected
RE04	Not detected	Not detected	Not detected	Not detected
RE05	Not detected	Present	Not detected	Not detected
RE06	Not detected	Not detected	Not detected	Not detected
RE07	Not surveyed	Not surveyed	Not surveyed	Not surveyed

Table 7 : Grass snake observations

Survey Location	Grass snake	Number of survey visits observed	Refugia detected	Maximum count
RE01	Not detected	0	N/A	0
RE02	Not detected	0	N/A	0
RE03	Present	1	Mat 10	1
RE04	Not detected	0	N/A	0
RE05	Not detected	0	N/A	0
RE06	Not detected	0	N/A	0

Table 8 : Slow worm observations

Survey Location	Slow worm	Number of survey visits observed	Refugia detected	Maximum count
RE01	Not detected	0	N/A	0
RE02	Not detected	0	N/A	0
RE03	Not detected	0	N/A	0
RE04	Not detected	0	N/A	0
RE05	Present	2	Mats 14 and 15	2
RE06	Not detected	0	N/A	0

Table 9: Field observations from survey visits by date and life stage

Shaded cells are where reptiles were found.

Survey Location	Date refugia laid out	Survey Visit 1	Survey Visit 2	Survey Visit 3	Survey Visit 4	Survey Visit 5	Survey Visit 6	Survey Visit 7
RE01	14.05.18	17.05.18	22.05.18	30.05.18	08.06.18	14.06.18	19.06.18	22.06.18
RE02	11.04.18	27.04.18	03.05.18	11.05.18	18.05.18	22.05.18	30.05.18	07.06.18
RE03	11.04.18	27.04.18	03.05.18	11.05.18	18.05.18	22.05.18	30.05.18	07.06.18 1x Immature Grass Snake Mat #10
RE04	11.04.18	26.04.18	03.05.18	10.05.18	17.05.18	24.05.18	11.06.18	18.06.18
RE05	11.04.18	26.04.18	03.05.18	10.05.18 1x Juvenile Slow Worm Mat #14	17.05.18	24.05.18 2x Immature Slow Worms Mat #15	14.06.18	22.06.18
RE06	11.04.18	26.04.18	03.05.18	10.05.18	17.05.18	24.05.18	14.06.18	22.06.18

4.2. Incidental records

4.2.1. Other species recorded on the survey visits included common toad *Bufo bufo* (RE02, RE03, RE04, RE05, RE06) and common frog *Rana temporaria* (RE05).

5. Conclusion

5.1. Reptile presence/likely absence surveys were proposed at seven survey locations, but it was decided to proceed with surveying at six survey locations. No surveys were carried out at RE07 due to heavy grazing by horses rendering the area of low suitability for reptiles. Therefore whilst no definite conclusions can be drawn about reptile populations within this survey location, it is considered that significant populations of reptiles are likely absent.

5.2. Seven reptile presence/likely absence survey visits were carried out at six survey locations: RE01-RE06.

5.3. One grass snake was recorded at RE03 on the final survey.

5.4. A maximum of two slow worm were recorded at RE05 on two visits.

5.5. Reptiles were not recorded at RE01, RE02, RE04 or RE06. It is concluded that significant reptile populations are likely absent from these four survey locations. However, individual animals may occasionally be present.

6. References

- Arnold, H. R. (1995) *Atlas of Amphibians and Reptiles in Britain*. Institute of Terrestrial Ecology, HMSO, UK
- Gent, T. and Gibson, S. (2003). *Herpetofauna Workers Manual*. Joint Nature Conservation Committee (JNCC), Peterborough.
- Froglife (1999) *Reptile survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation*. Froglife Advice Sheet 10. Halesworth, Suffolk, UK. Available online at: http://www.devon.gov.uk/froglife_advice_sheet_10_-_reptile_surveys.pdf
- JNCC (online) *UK BAP priority herptile species*. Joint Nature Conservation Committee, Peterborough, UK. Available online at: <http://jncc.defra.gov.uk/>
- Royal HaskoningDHV (2017). *Norfolk Boreas Offshore Wind Farm: Phase 2 Ecological Surveys Scope 2018*. Document Reference: PB5640-003-003.
- Royal HaskoningDHV (2018) *Norfolk Boreas Offshore Wind Farm: Extended Phase 1 Habitat Survey Report 2018*. Document Reference: PB5640-005-2201.

Appendix 1: Reptile Presence/Likely Absence Survey Locations

Figure 1: Western section

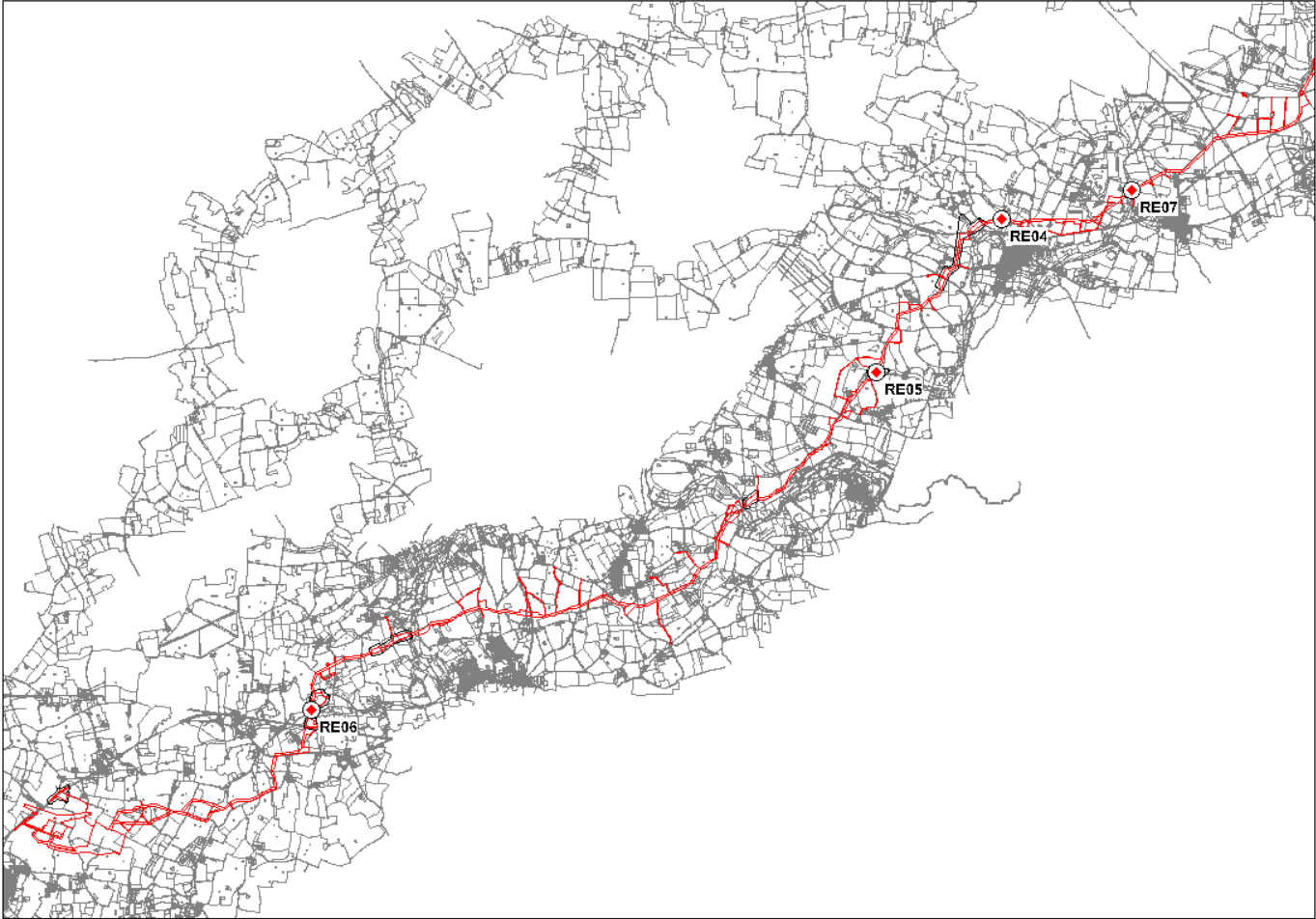


Figure 2: Eastern section



Appendix 2: Reptile Survey Presence/Likely absence

Figure 3: Western section

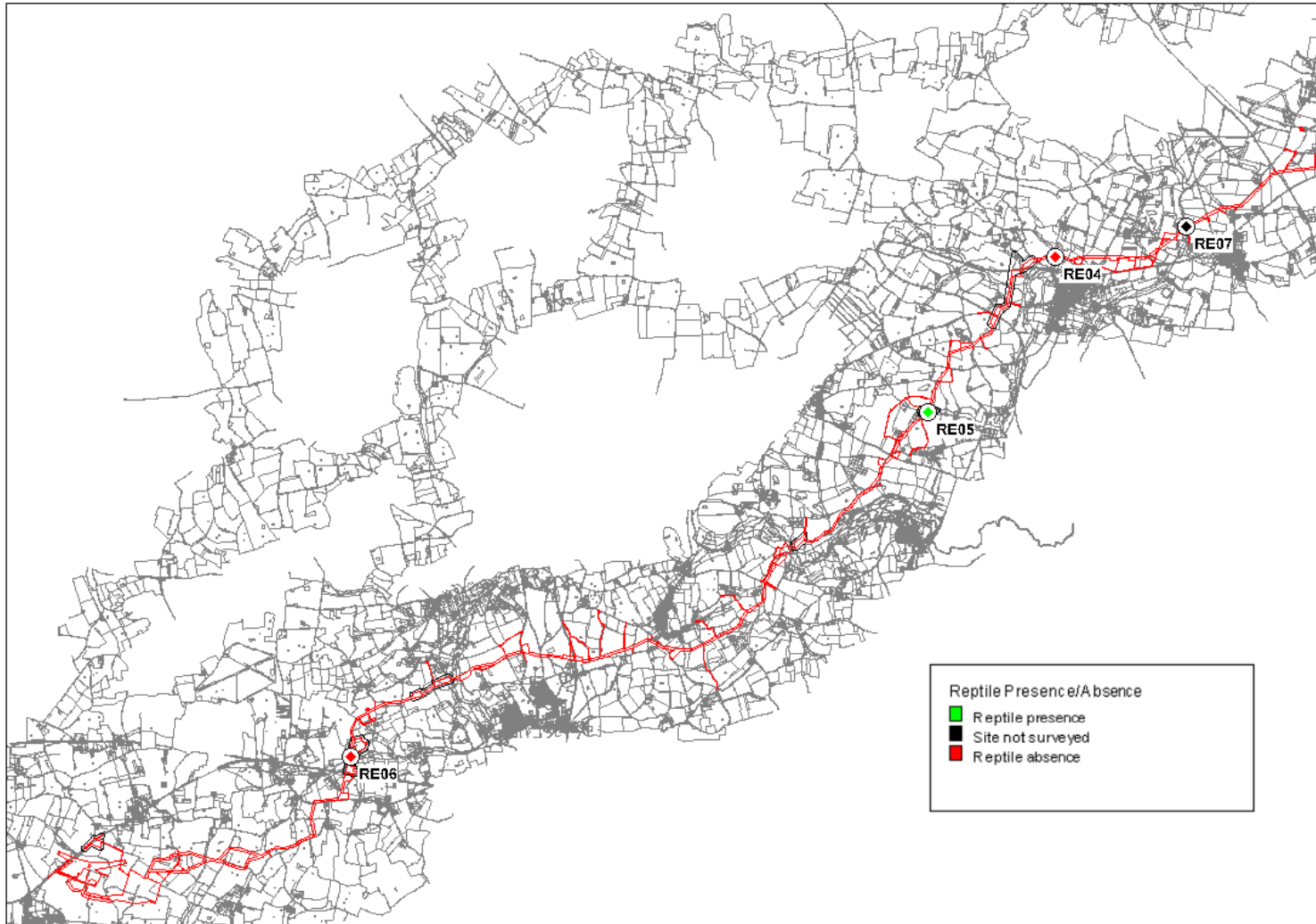
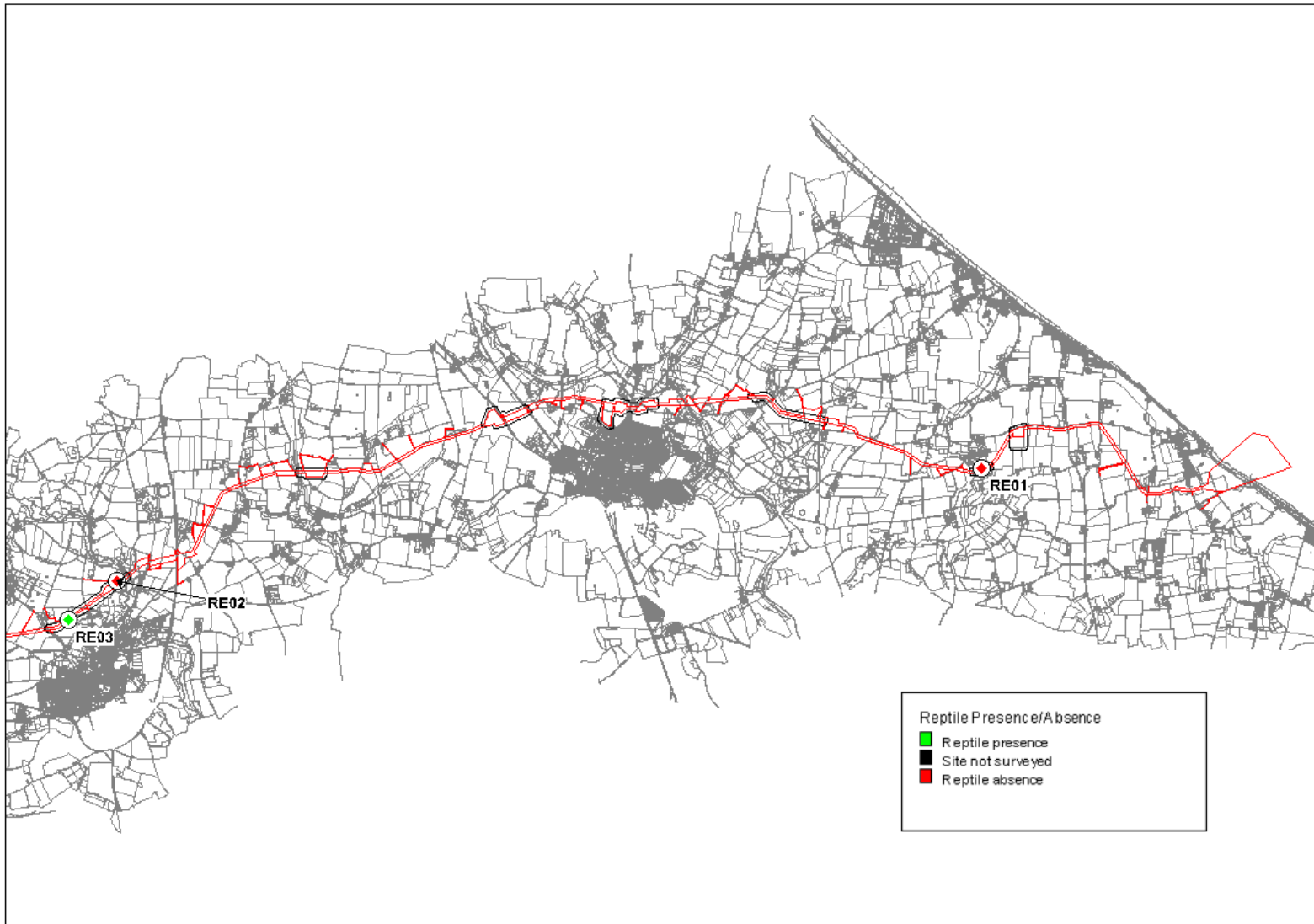


Figure 4: Eastern section



Appendix 3: Mat density and placement

Table 10 : Mat densities, dates of placement and first survey visit

Survey Location	Approx. area of suitable habitat (hectares)	Number of mats	Density of mats	Dates mats laid out	First survey visit	Number of days between laying out and 1 st survey visit
RE01	2.9	30	>10 mats per hectare	14.05.18	17.05.18	3
RE02	0.6	12	>10 mats per hectare	11.04.18	27.04.18	16
RE03	0.6	18	>10 mats per hectare	11.04.18	27.04.18	16
RE04	1.5	23	>10 mats per hectare	11.04.18	26.04.18	15
RE05	1.3	30	>10 mats per hectare	11.04.18	26.04.18	15
RE06	1.2	30	>10 mats per hectare	11.04.18	26.04.18	15

Appendix 4: Refugia location

Figure 5: RE01 Ridlington - Refugia locations – 30 mats

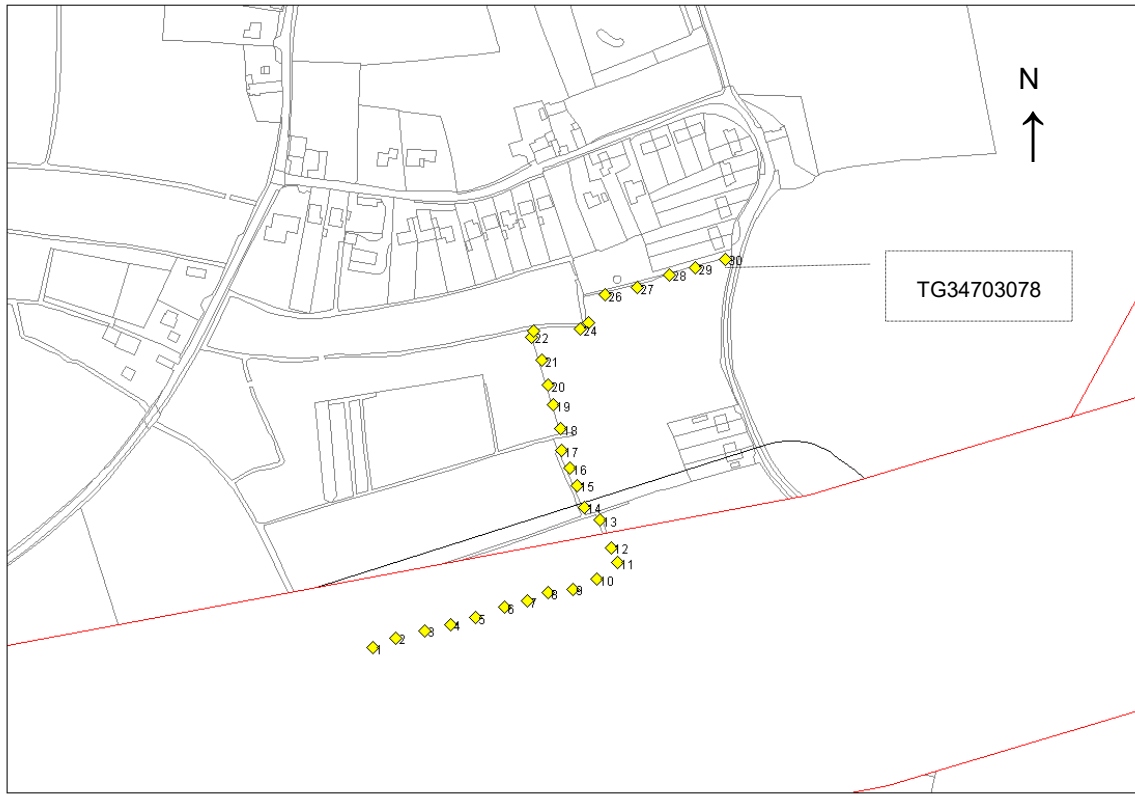


Figure 6: RE02 Bure north - Refugia locations – 12 mats

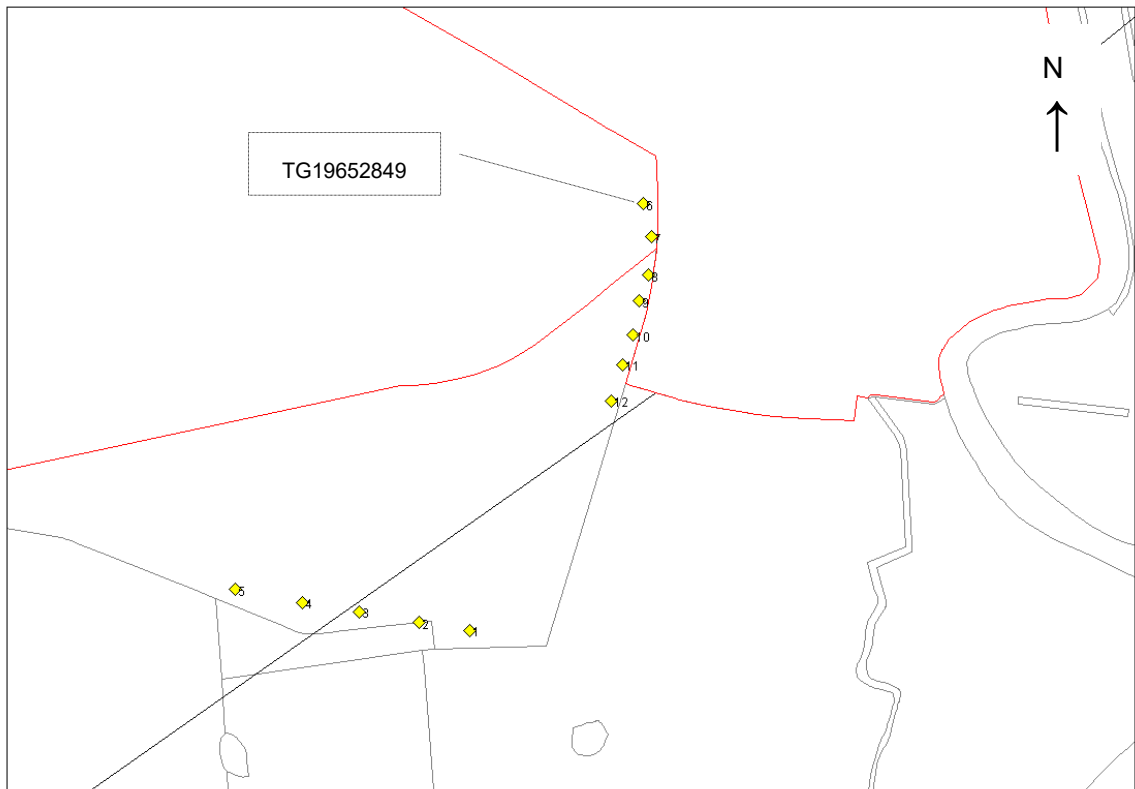


Figure 7: RE03 Bure south - refugia locations – 18 mats

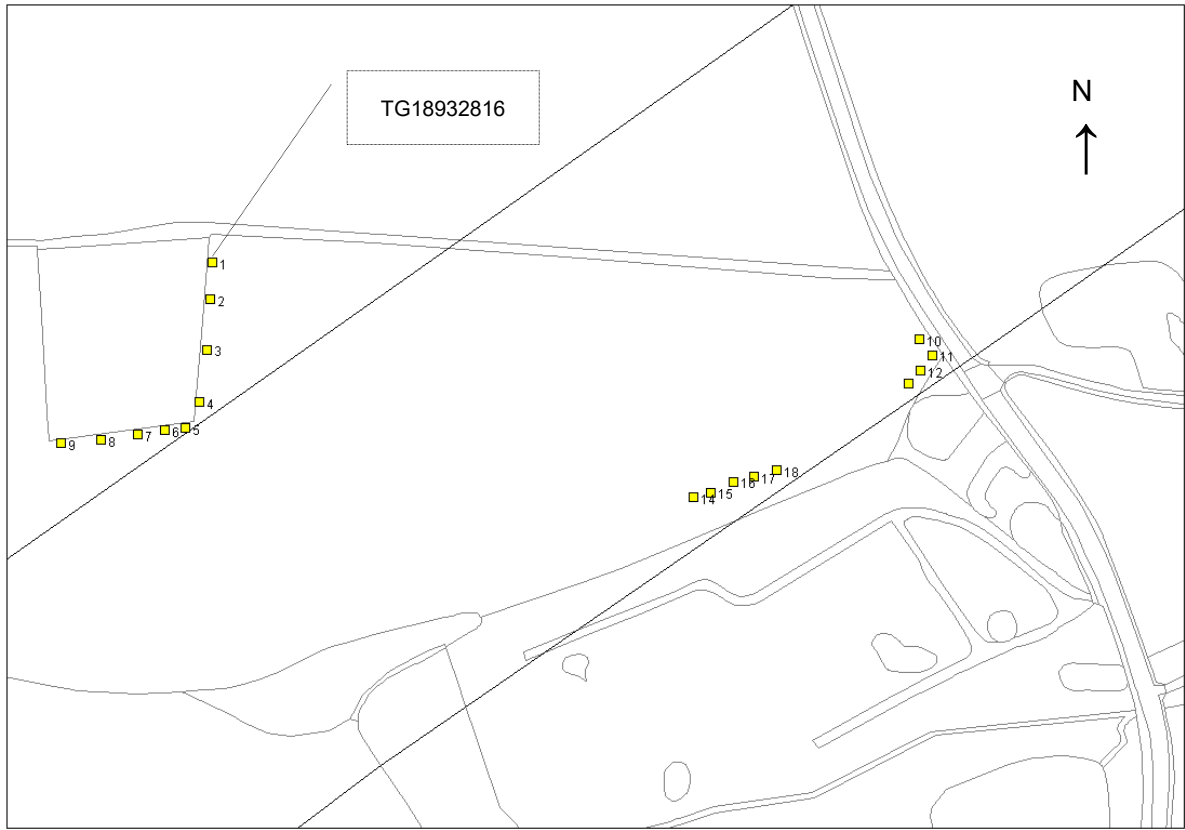


Figure 8: RE04 Reepham - refugia locations – 23 mats

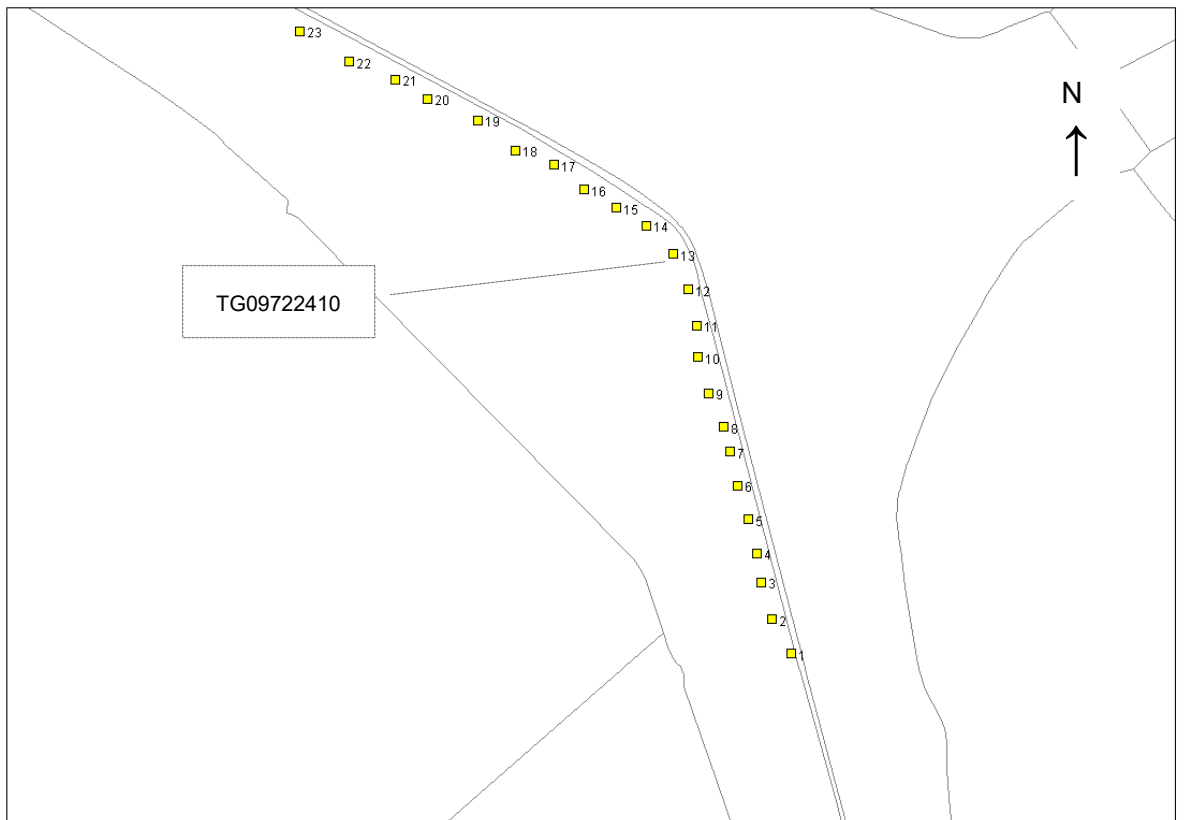


Figure 9: RE05 Sparham - refugia locations – 30 mats

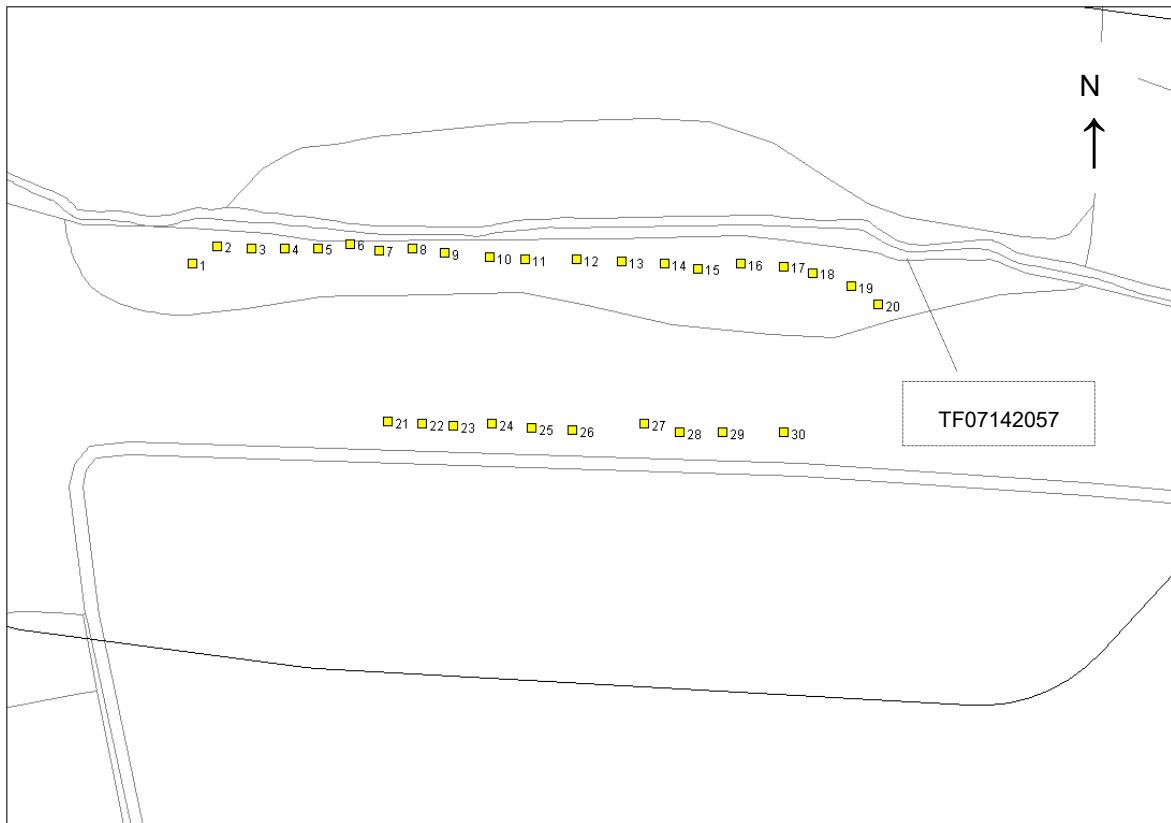
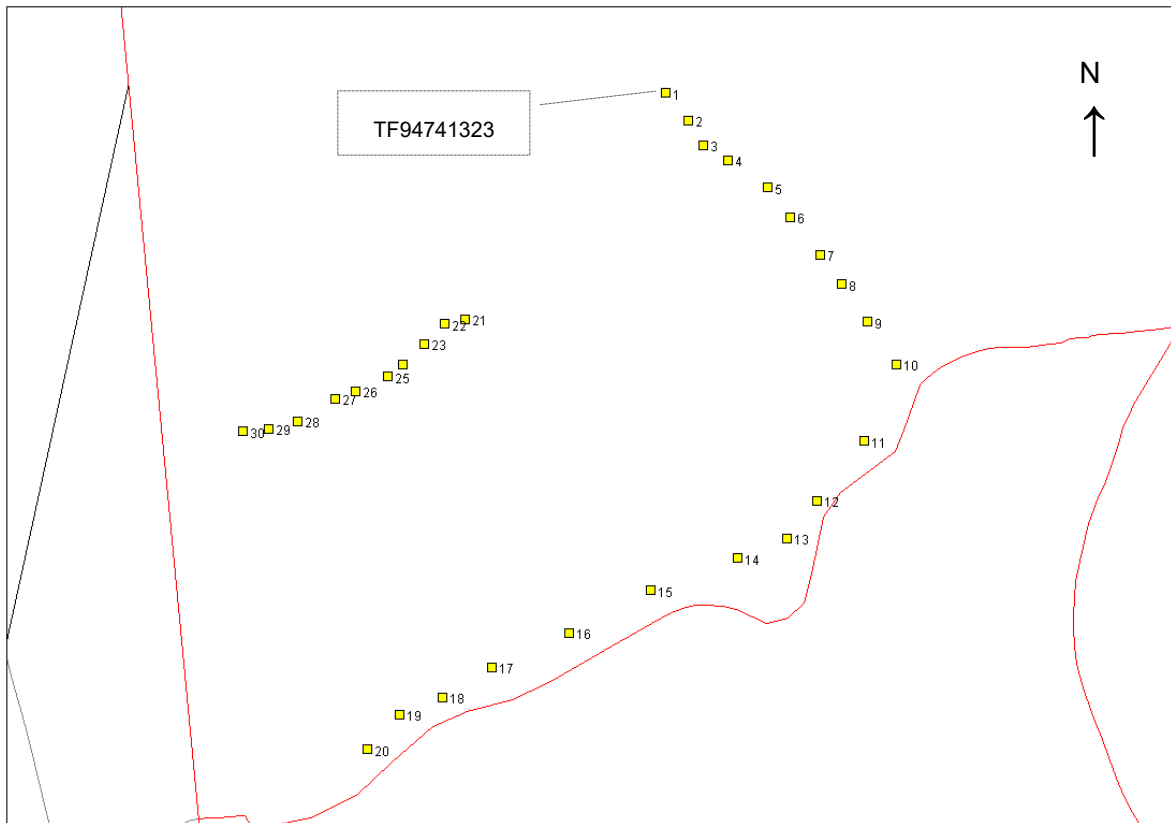


Figure 10: RE06 Wendling - refugia locations – 30 mats



Appendix 5: Full details of survey conditions and personnel

Table 11 : Dates, time and weather for reptile presence / likely absence surveys

Survey Location	Survey No.	Survey Date ⁵	Start Time	End Time	Total Time ⁶⁷	Weather	Temp (°C) ⁸	Surveyors	Constraints?
RE01	1	17.05.18	11:30	12:15	00:45:00	5/8 cloud cover, dry, BWS ⁹ 2	14	SM ¹⁰ / BM ¹¹	Yes – Survey undertaken outside of survey window
RE01	2	22.05.18	10:45	11:17	00:32:00	0/8 cloud cover, dry, BWS2	16	BM / RE ¹²	Yes – Survey exceeded survey window
RE01	3	30.05.18	10:30	11:00	00:30:00	8/8 cloud cover, dry, BWS0	16	BM / SF ¹³	No
RE01	4	08.06.18	09:10	09:45	00:35:00	4/8 cloud cover, dry, BWS1	17	SM / SF	No
RE01	5	14.06.18	09:05	09:40	00:35:00	6/8 cloud cover, dry, BWS4	18	SM / RE	Yes – reached 18°C by end of survey
RE01	6	19.06.18	09:40	10:20	00:40:00	7/8 cloud cover, drizzle previous, BWS1	15	SM / SF	No
RE01	7	22.06.18	09:45	10:35	00:50:00	3/8 cloud cover, dry, BWS3	15	SM / SF	No
RE02	1	27.04.18	10:27	11:01	00:34:00	8/8 cloud cover, slight rain, BWS1	10	BM / RE	Yes – Survey exceeded survey window
RE02	2	03.05.18	10:50	11:23	00:33:00	3/8 cloud cover, dry, BWS1	14	BM / SF	Yes – Survey exceeded survey window
RE02	3	11.05.18	10:18	10:48	00:30:00	4/8 cloud cover, dry, BWS3	15	BM / SF	No
RE02	4	18.05.18	16:20	16:51	00:31:00	1/8 cloud cover, dry, BWS1	15	BM / RE	No

⁵ March to October, but preference for April, May, June and September

⁶ Optimal time range (09:00 to 11:00; 16:00 – 19:00)

⁷ Duration minimum of 30 minutes at each survey location.

⁸ Between 10 and 17°C

⁹ Beaufort Wind Scale

¹⁰ Sally McColl

¹¹ Ben Moore

¹² Rebecca Evans

¹³ Stephanie Ford

Survey Location	Survey No.	Survey Date ⁵	Start Time	End Time	Total Time ⁶⁷	Weather	Temp (°C) ⁸	Surveyors	Constraints?
RE02	5	22.05.18	10:00	10:30	00:30:00	0/8 cloud cover, dry, BWS1	15	BM / RE	No
RE02	6	30.05.18	09:40	10:10	00:30:00	8/8 cloud cover, dry, BWS0	15	BM / SF	No
RE02	7	07.06.18	16:00	16:30	00:30:00	8/8 cloud cover, dry, BWS2	16	BM / SF	No
RE03	1	27.04.18	09:50	10:20	00:30:00	8/8 cloud cover, slight rain, BWS1	10	BM / RE	No
RE03	2	03.05.18	10:04	10:36	00:32:00	3/8 cloud cover, dry, BWS1	12	BM / SF	No
RE03	3	11.05.18	09:36	10:12	00:36:00	4/8 cloud cover, dry, BWS2	15	BM / SF	No
RE03	4	18.05.18	17:05	17:35	00:30:00	1/8 cloud cover, dry, BWS1	14	BM / RE	No
RE03	5	22.05.18	09:20	09:50	00:30:00	0/8 cloud cover, dry, BWS1	16	BM / RE	No
RE03	6	30.05.18	09:00	09:30	00:30:00	8/8 cloud cover, dry, BWS0	15	BM / SF	No
RE03	7	07.06.18	16:45	17:15	00:30:00	8/8 cloud cover, dry, BWS2	16	BM / SF	No
RE04	1	26.04.18	10:45	11:15	00:30:00	6/8 cloud cover, dry, BWS4	15	JA ¹⁴ / JH ¹⁵	Yes – Survey exceeded survey window
RE04	2	03.05.18	09:00	09:30	00:30:00	4/8 cloud cover, dry, BWS0	11	JA / JH	No
RE04	3	10.05.18	16:00	16:30	00:30:00	4/8 cloud cover, dry, BWS2	16	JA / BM	No
RE04	4	17.05.18	09:00	09:30	00:30:00	4/8 cloud cover, dry BWS4	12	JA / JH	No
RE04	5	24.05.18	10:00	10:30	00:30:00	1/8 cloud cover, dry, BWS3	16	JA / JH	No

¹⁴ James Allitt

¹⁵ Joseph Hassall

Survey Location	Survey No.	Survey Date ⁵	Start Time	End Time	Total Time ⁶⁷	Weather	Temp (°C) ⁸	Surveyors	Constraints?
RE04	6	11.06.18	10:12	10:51	00:39:00	0/8 cloud cover, dry, BWS0	17	BM / SF	No
RE04	7	18.06.18	09:50	10:20	00:30:00	4/8 cloud cover, dry, BWS1	17	BM / JH	No
RE05	1	26.04.18	10:00	10:30	00:30:00	6/8 cloud cover, dry, BWS4	15	JA / JH	No
RE05	2	03.05.18	10:00	10:30	00:30:00	4/8 cloud cover, dry, BWS0	14	JA / JH	No
RE05	3	10.05.18	16:55	17:26	00:31:00	4/8 cloud cover, dry, BWS2	16	JA / BM	No
RE05	4	17.05.18	09:50	10:20	00:30:00	4/8 cloud cover, dry, BWS4	12	JA / JH	No
RE05	5	24.05.18	09:50	10:20	00:30:00	1/8 cloud cover, dry, BWS3	16	JA / JH	No
RE05	6	14.06.18	16:00	16:30	00:30:00	6/8 cloud cover, dry, BWS3	18	JA / JH	Yes – reached 18°C by end of survey
RE05	7	22.06.18	09:20	10:02	00:42:00	0/8 cloud cover, dry, BWS2	16	BM / JH	No
RE06	1	26.04.18	10:45	11:15	00:30:00	5/8 cloud cover, dry, BWS4	14	JA / JH	Yes – Survey exceeded survey window
RE06	2	03.05.18	09:50	10:20	00:30:00	4/8 cloud cover, dry BWS1	14	JA / JH	No
RE06	3	10.05.18	17:50	18:20	00:30:00	4/8 cloud cover, dry, BWS2	16	JA / BM	No
RE06	4	17.05.18	10:50	11:20	00:30:00	4/8 cloud cover, dry, BWS4	12	JA / JH	Yes – Survey exceeded survey window
RE06	5	24.05.18	09:00	09:30	00:30:00	1/8 cloud cover, dry, BWS3	14	JA / JH	No
RE06	6	14.06.18	16:50	17:20	00:30:00	5/8 cloud cover, dry, BWS3	17	JA / JH	No
RE06	7	22.06.18	10:28	11:00	00:32:00	0/8 cloud cover, dry, BWS2	17	BM / JH	No



Norfolk Vanguard Reptile presence / absence surveys

Report prepared by Norfolk Wildlife Services Ltd.
on behalf of Royal HaskoningDHV
November 2017

Reference: 2016/131.5

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1. Document details

Report produced by

Chris Smith
Norfolk Wildlife Services
Bewick House
22 Thorpe Road
Norwich
NR1 1RY
NORFOLK
Tel. 01603 625540
Fax. 01603 598300

Agent details

Gordon Campbell
Royal HaskoningDHV
74/2 Commercial Quay
Commercial Street,
Leith
Edinburgh
EH6 6LX

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7	01/12/17	ALL	ALL	Updated as per comments on text	CS
8 (Final)	04/12/17	ALL	ALL	Methodology updated as per comments	CS

2. Executive Summary

2.1. The Extended Phase 1 Habitat Survey undertaken by Royal HaskoningDHV in February 2017 (Royal HaskoningDHV, 2017a) identified 16 habitat areas with the potential to support common reptile species within the survey area.

2.2. The purpose of the surveys was to ascertain whether reptiles are present within those habitat areas.

2.3. The following guidance documents were used to inform development of the survey methodology: Froglife advice sheet 10 (Froglife, 1999) and Herpetofauna Workers Manual (Gent and Gibson, 2003).

2.4. Reptile surveys were proposed to be carried out at 17 sites, including one site RE21 added during the delivery phase.

2.5. Reptile surveys were not able to be commenced or completed at three sites (RE05, RE14, RE16) due to access or surveying difficulties.

2.6. There were no significant limitations to the surveys for the completed sites accessed.

2.7. The presence of two species of reptile was observed during the survey season: grass snake and slow worm. Slow worm were present at RE01, RE04, and RE21, and grass snake at RE12, RE13 and RE21.

2.8. Reptiles were not detected at any remaining sites where surveys took place: RE02, RE03, RE06, RE07, RE08, RE09, RE11, RE15 and RE20. It is concluded that reptiles are likely absent from these nine sites.

2.9. It is recommended to carry out presence/absence surveys at the three sites which could not be surveyed in 2017 due to access constraints (RE05, RE14, RE16)

3. Introduction

3.1. Project background

3.1.1. Norfolk Vanguard is a proposed offshore wind farm being developed by Vattenfall Wind Power Limited (or an affiliate company), with a capacity of 1800MW, enough to power 1.3 million UK households. The offshore wind farm comprises two distinct areas, Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West) and will be connected to the shore by offshore export cables installed within the provisional offshore cable corridor. The project will also require onshore infrastructure in order to connect the offshore wind farm to the National Grid at the existing National Grid substation at Necton, which in summary will comprise the following:

- Landfall;
- Cable relay station (if required);
- Underground cables;
- Onshore substation; and
- Extension to the existing Necton National Grid substation.

3.1.2. The location of the onshore electrical infrastructure is shown on Figure 1, Appendix A of the Extended Phase 1 Habitat Survey Report (Royal HaskoningDHV, 2017a). Collectively the onshore electrical infrastructure is herein referred to as the 'onshore project area'.

3.1.3. During the development of the project, the onshore Scoping Area that was initially defined has been refined to include three landfall options, associated cable relay search zones, as well as an onshore substation search zone in proximity to the Necton National Grid substation. A 200m wide cable corridor has been identified within which the buried cable will be located, and Horizontal Directional Drilling (HDD) zones and mobilisation zones have been identified along the cable corridor.

3.1.4. The surveys described within this report were designed and based on the onshore project area which was in use when the project Extended Phase 1 Habitat Survey was undertaken (February 2017). As the project design is further refined, these search zones will decrease in size, and the final options for the siting of infrastructure (i.e. one cable relay station, one landfall, one onshore substation) will be taken forward for the final Development Consent Order (DCO) application in June 2018.

3.2. Aim of report

3.2.1. As Norfolk Vanguard is a Nationally Significant Infrastructure Project (NSIP) an Environmental Impact Assessment (EIA) is required as part of a DCO application under the Planning Act 2008.

3.2.2. Norfolk Wildlife Services were appointed in late April 2017 to undertake additional ecological surveys to support this application as set out within the Survey Scope (Royal HaskoningDHV, 2017b).

3.2.3. The Extended Phase 1 Habitat Survey (Royal HaskoningDHV, 2017a) identified the potential for legally protected species located within the project area plus a 50m buffer surrounding the project area, and provided recommendations for further surveys required to characterise the ecological baseline for the project area.

3.3. Survey objective

3.3.1. To ascertain whether reptiles are present within those habitat areas identified by the Extended Phase 1 Habitat Survey (Royal HaskoningDHV, 2017a) as being suitable for supporting common reptiles.

3.4. Survey scope

3.4.1. Development of survey scope

3.4.1.1. A Scoping Report for the EIA (Royal HaskoningDHV, 2016) was submitted to the Secretary of State on 3 October 2016 and the response in the form of a Scoping Opinion (PINS, 2016) published on 11 November 2016. That Scoping Opinion included the consultation responses of Natural England and Norfolk County Council.

3.4.1.2. An Extended Phase 1 Habitat Survey of the onshore project area was undertaken during February 2017 (Royal HaskoningDHV, 2017a). The Extended Phase 1 Habitat Survey identified the potential for legally protected species located within the project area plus a 50m buffer surrounding the project area, and provided recommendations for further surveys required to characterise the ecological baseline for the project area. These recommendations were issued to stakeholders on 17 March 2017 for comment, as part of the project Evidence Plan Process. Feedback was received from Norfolk County Council and Natural England on the 23 March 2017 and 3 April 2017 respectively that the methodologies were appropriate and acceptable.

3.4.1.3. A Survey Scope detailing the surveys required in order to deliver the Extended Phase 1 Habitat Survey Report recommendations (Royal HaskoningDHV, 2017b) was produced in March 2017. The Survey Scope (set out in Section 3.4.2) was used to tender for delivery of ecological surveys required for the project. Norfolk Wildlife Services used the methodology set out in the Survey Scope.

3.4.2. Survey Scope

Survey areas

3.4.2.1. The Extended Phase 1 Habitat Survey identified 16 habitats mosaics with the potential to support common reptile species within the survey area. These habitat mosaics have been identified as providing all the suitable habitat elements required by reptiles including hibernacula, sheltering sites, basking areas and foraging areas. Expert judgement has been used to determine which habitat mosaics are suitable for common reptile species.

3.4.2.2. The locations of the habitat mosaics described above are shown in Appendix 1 of this report.

Methodology

3.4.2.3. The reptile presence / absence surveys will follow the protocol set out in the JNCC's Herpetofauna Worker's Manual (2003). The survey will involve an artificial refuge survey at each suitable habitat location. Refuge tiles will be placed in optimal locations, in groups of 3-4, within each habitat area. Tiles will cover the majority of each habitat mosaic. During each survey visit, all tiles will be lifted and the space beneath checked for the presence of reptiles. Seven survey visits in total are required. These visits will be undertaken during April, May and September. At least 48 hours should be left between survey visits.

3.4.2.4. Weather conditions should be recorded during each visit. The surveys will be undertaken during the morning and later afternoon, in order to coincide with the optimal temperature window (10-17°C). These timings will be from 9am-11am, and from 4pm-7pm.

3.4.2.5. Refuge tiles (e.g. carpet tiles, roofing felt, or metal sheeting) of 0.5m by 0.5m should be used.

3.4.2.6. All survey should be undertaken by experienced ecologists, preferably members of the CIEEM. No species licences are required for these surveys.

3.5. Scoping of survey locations

3.5.1. The survey locations identified by the Survey Scope (Royal HaskoningDHV, 2017b) based upon the Extended Phase 1 Habitat Survey (Royal HaskoningDHV, 2017a) consist of 16 separate survey sites. The locations of these survey sites are shown in Appendix 1: Reptile survey locations.

4. Methodology

4.1. Section 4.1 sets out the proposed survey protocol as agreed between Royal HaskoningDHV and Norfolk Wildlife Services prior to any field work commencing, and Section 4.2 sets out how the surveys were delivered in relation to the protocol and identifies any deviations or modifications that took place during the delivery phase.

4.1. Survey protocol

4.1.1. This Section details the proposed survey protocol as agreed between Royal HaskoningDHV and Norfolk Wildlife Services prior to any field work commencing.

Relevant guidance

4.1.2. The following guidance documents were used to inform development of the survey methodology:

- Gent, T. and Gibson, S. (2003). Herpetofauna Workers Manual. Joint Nature Conservation Committee (JNCC), Peterborough.
- Froglife (1999). Reptile survey, An introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife advice sheet 10.

Survey locations

4.1.3. Survey locations are presented in Appendix 2 and descriptions of these locations are summarised in Table 1.

4.1.4. The survey locations provided in the Survey Scope (Royal HaskoningDHV, 2017b) did not include a 'RE10' survey location, and therefore this location number has not been used during the reptile presence / absence surveys. Instead, the survey locations go from RE9 straight to RE11.

4.1.5. An additional survey location was added (RE21) during design of other ecology surveys undertaken at this location as part of Norfolk Vanguard Project, making a total of 17 sites. This survey location was situated near to a tributary of the River Wensum with good habitat mosaics for reptiles consisting of open rides with long grass sward and woodland which offered good foraging and hibernation potential.

Table 1 Survey sites, location and area.

Survey Location	GPS co-ordinates	Site description (as provided by Royal HaskoningDHV)	Site description (as pers comm. with surveyors)	Approx area of suitable habitat (hectares)
RE01	TF946125	Rubble and fallen branches, potential reptile refugia, area of hard standing (TN140)	Rubble and fallen branches on site are potential reptile refugia, good connection to arable fields and hedgerows. Nettles and thistles grown up over site.	0.53
RE02	TF946122	Area of scrub bordering track and arable fields; potential habitat (TN141)	Area of scrub bordering track and arable fields with potential basking opportunities. Good connection to other suitable habitat via hedgerows, field edges.	0.16
RE03	TF971147	Building. Woodstack - hibernacula potential. (TN163 no photo)	Wide tussocky field margins dominated by grasses with a hedgerow adjacent with exposed root system. The site offered good habitat for basking and foraging with some hibernation potential.	0.1
RE04	TF993157	Good reptile mosaic, with scrub, woodland, grassland. Large area of hard standing Small mosaic (TN173)	Vegetated areas largely overgrown with ruderal vegetation and tall grasses. Hard standing was still present but very bare, fringes could provide some basking opportunities. Steam railway line adjacent to west boundary offered good	0.22

Survey Location	GPS co-ordinates	Site description (as provided by Royal HaskoningDHV)	Site description (as pers comm. with surveyors)	Approx area of suitable habitat (hectares)
			connectivity.	
RE05	TG035166	Optimal reptile habitat. Decomposing trees, wet tussocky grassland, watercourse, woodland mosaic. (TN196)	N/A	1.0
RE06	TG035165	Optimal reptile habitat mosaic. Ruderal patch on field margin, adjacent to watercourse. (TN199)	Ruderal vegetation on field margin, adjacent to field drain. Good connectivity to other suitable habitat via field margins and woodland.	1.1
RE07	TG038167	Mature pile, reptile hibernacula/breeding habitat. Adjacent to tussocky grassland/tall ruderal habitat. (TN204)	Manure pile on hard-standing at north of site, otherwise scrub and grass. Good connectivity to field margins and hedgerows.	0.32
RE08	TG064201	Loose sheeting piles and other debris. Adjacent to tussocky improved grassland and pond. Good hibernacula, sub-optimal reptile habitat. (TN224)	Pond on site adjacent to grassland and field margins, good connectivity via hedgerows. Good potential reptile habitat.	0.82
RE09	TG067206	Good reptile habitat mosaic. Tussocky grassland, woodland, large hibernacula. (TN231)	Grassland with drain running west to east. Adjacent to woodland, hedgerows and arable fields.	3.7
RE11	TG125243	Banks of stream heavily vegetated. Good potential for reptile, some woody debris, basking and foraging areas present. (TN277)	Area of grazing marsh adjacent to stream and area of alder carr. Banks of stream with hedgerow and trees adjacent along the eastern edge. Good potential for reptile.	2.6
RE12	TG200287	Optimal reptile habitat. Good hibernacula (dead wood), woodland edge, rough grassland. (TN289)	Wet tussocky grassland with <i>Juncus</i> and orchids, interconnecting ditches as part of the River Wensum floodplain, excellent connectivity to surrounding habitat. Woodland over-shaded with pheasant pen occupying majority of area, poor ground flora.	4.8
RE13	TG227305	Optimal reptile habitat. Good hibernacula (dead wood), woodland edge, rough grassland. (TN315)	Woodland was fairly shaded with only low-moderate ground flora, although track and back to the west of pond was grassy. Rampant Himalayan balsam. Wet grassland was tussocky with good foraging. Wet ditches and pond in woodland good for grass snake.	4.3
RE14	TG321331	Optimal reptile habitat. Good hibernacula (dead wood), woodland edge, rough grassland. (TN358)	Orchard with rough grassland surrounded by arable land and a small horse grazed field.	4.5
RE15	TG345327	Optimal reptile habitat. Good hibernacula (dead wood), woodland edge, rough grassland. (TN374)	Footprint of derelict barn; open farmland with no connecting habitat	<0.94
RE16	TG373302	Optimal reptile habitat. Good hibernacula (dead wood), woodland edge, rough grassland. (TN399)	N/A	0.37
RE20	TG075217	Woodland, log piles, linear habitat - small scale reptile mosaic habitat (TN263)	Connecting hedgerows in middle of arable landscape with drain running east to west.	0.8
RE21	TG120242	N/A	Optimal reptile habitat. Woodland edge, rough grassland.	16.3

Survey methodology

4.1.6. The reptile presence / absence survey methods are based upon the protocol set out in the JNCC's Herpetofauna Worker's Manual (Gent and Gibson, 2003). Field surveys will be carried out by Norfolk Wildlife Services based upon the supplied locations and methodology as detailed above (Royal HaskoningDHV, 2017b), including any additional agreed sites.

- 4.1.7. Artificial refuges, consisting of felt mats, will be set out at each survey location in suitable micro-habitats, based on minimum densities of at least five to ten refuges per hectare following Froglife advice sheet 10 (Froglife, 1999).
- 4.1.8. Tiles will be left for a minimum of seven days before surveys to allow for settling in and for reptiles to begin using them.
- 4.1.9. Seven survey visits will be undertaken for each site following JNCC's Herpetofauna Workers Manual (Gent and Gibson, 2003). At least 48 hours will be left between survey visits.
- 4.1.10. During each survey visit, surveyors will walk over the site without casting a shadow in front of them and visually scan ahead using binoculars for reptiles basking on open areas and low branches of bushes, etc. Surveyors will carefully lift all tiles and check the space beneath for the presence of reptiles. For any reptiles encountered, their species and location will be recorded.
- 4.1.11. Each survey visit will take a minimum of 30 minutes at each survey site.
- 4.1.12. Visits will be undertaken in preference during April, May, June and September in suitable weather conditions.
- 4.1.13. Surveys will be undertaken where the ground temperature is between 9 and 18°C. The surveys will be undertaken either during the early morning (approx. 8.30am-11am) or late afternoon (approx. 4pm-6.30pm) when mats are most likely to be utilized. However earlier in the year, reptiles are often encountered closer to mid-day when it is warmer; conversely in very hot conditions in midsummer, reptiles may be found progressively earlier in the morning and later in the afternoon. These timings are subject therefore to judgement of surveyor.
- 4.1.14. Surveys will not take place in heavy rain or strong wind. Weather over preceding days can increase survey efficiency e.g. warmer weather after a cooler period or showery weather after a prolonged dry period.
- 4.1.15. No species licences are required for these surveys.
- 4.1.16. All surveys will be undertaken by suitably experienced reptile surveyors, who will either be members of CIEEM or act according to its code of conduct.

4.2. Survey delivery

4.2.1. This Section details how the surveys were delivered in relation to the agreed protocol, identifies any deviations or modifications that took place during the delivery phase and highlights survey limitations.

4.2.1. Survey methodology as delivered

Access to survey sites

- 4.2.1.1. It was not possible to survey all sites due to access restrictions.
- 4.2.1.2. Access permission was not gained for RE14 or RE16, and as a result no surveys could be carried out at these locations.
- 4.2.1.3. Surveys at RE05 were commenced but not completed due to health and safety concerns. An initial survey visit was carried out, during which it was observed that 15 mats had been destroyed, and calving cattle were spotted grazing at this location. Surveys were subsequently discontinued at this site.
- 4.2.1.4. Access was only possible to 14 of the originally identified locations.

4.2.1.5. As noted previously, an additional survey location (RE21) was identified during the design of other ecology surveys undertaken at this location as part of Norfolk Vanguard Project.

Refugia density

4.2.1.6. Details of mat density, dates of placement and first survey are summarised in Appendix 3: Refugia density. Appendix 4: Refugia locations depict the coverage of mats across the sites surveyed.

4.2.1.7. At RE21, locations for laying out of mats were limited by the presence of deer fencing and by finding locations that would not be subject to regular mowing outside of the fences. No access was possible inside the fences. As such densities were not as high as the protocol, but represented the practicable area.

4.2.1.8. At RE20, only a small area to the south west was suitable habitat for reptiles. At RE12 and RE13 there were access restrictions to part of the sites. This was not seen as a significant constraint at any of these sites.

4.2.1.9. Refugia density at all other locations was in accordance with the protocol.

Survey effort

4.2.1.10. Access permission was retracted for RE12 after the 6th survey, meaning that one less survey than the protocol was carried out.

4.2.1.11. At all other sites, where surveys took place, seven survey visits were undertaken.

Timing and weather conditions

4.2.1.12. The surveys for sites where access was possible were carried out during May to June and September 2017. Only one survey was undertaken outside of this time: RE21 on 03/10/2017. This remains within the broader parameters given by Gent and Gibson (2003).

4.2.1.13. The weather conditions during the surveys complied with those required by protocol.

4.2.1.14. Table 2 highlights 18 surveys that fell outside of the optimal time of day for surveying reptiles as set out by Froglife (1999) but due to the weather conditions/season were considered to still provide valid results. All weather conditions during these surveys complied with those required by protocol.

Table 2: Surveys falling outside optimal survey times.

Location	Visit No.	Visit Date	Start time	Note (explanation)
RE01	6	12/09/2017	10.56	Within middle of day; temperature 16°C
RE01	7	25/09/2017	12.25	Within middle of day; temperature 17 °C
RE02	1	24/05/2017	10.20	Within middle of day; temperature 17 °C; guidelines state that early in the season reptiles are often encountered closer to mid-day when it is warmest
RE02	6	12/09/2017	11.27	Within middle of day; temperature 17 °C
RE02	7	25/09/2017	12.40	Within middle of day; temperature 17 °C; Duration 5 minutes shorter than protocol.
RE03	3	05/06/2017	06.45	Early morning; weather conditions good.
RE03	7	19/09/2017	14.15	Within middle of day; weather conditions good.
RE04	1	15/05/2017	10.35	Within middle of day; guidelines state that early in the season reptiles are often encountered closer to mid-day when it is warmest
RE04	3	05/06/2017	07.20	Early morning; weather conditions good.
RE04	4	07/06/2017	07.30	Early morning; weather conditions good.

Location	Visit No.	Visit Date	Start time	Note (explanation)
RE04	7	14/06/2017	07.40	Early morning; weather conditions good.
RE06	1	15/05/2017	11.35	Within middle of day; guidelines state that early in the season reptiles are often encountered closer to mid-day when it is warmest; Duration 10 minutes shorter than protocol.
RE06	2	18/05/2017	11.54	Within middle of day; guidelines state that early in the season reptiles are often encountered closer to mid-day when it is warmest
RE07	1	15/05/2017	13.10	Within middle of day; guidelines state that early in the season reptiles are often encountered closer to mid-day when it is warmest; Duration 10 minutes shorter than protocol.
RE07	2	18/05/2017	13.00	Within middle of day; guidelines state that early in the season reptiles are often encountered closer to mid-day when it is warmest; Duration 15 minutes shorter than protocol.
RE13	3	09/06/2017	11.00	Within middle of day; weather conditions good.
RE13	7	12/09/2017	08.45	Duration 2 minutes shorter than protocol.
RE15	1	30/05/2017	10.20	Duration 5 minutes shorter than protocol.
RE15	3	18/09/2017	16.01	Duration 6 minutes shorter than protocol.
RE15	4	20/09/2017	09.05	Duration 7 minutes shorter than protocol.
RE15	5	22/09/2017	10.27	Duration 6 minutes shorter than protocol.
RE15	6	25/09/2017	16.13	Duration 11 minutes shorter than protocol.
RE15	7	29/09/2017	10.00	Duration 7 minutes shorter than protocol.
RE21	1	06/09/2017	16.00	Duration 3 minutes shorter than protocol.
RE21	2	15/09/2017	10.42	Within middle of day; weather conditions good.
RE21	7	03/10/2017	11.00	Within middle of day; weather conditions good; Duration 5 minutes shorter than protocol.

4.2.1.15. In addition 13 surveys with a shorter duration than 30 minutes as stated in the protocol, are also included in Table 2 above. This is not considered a significant deviation for those sites where only 1 or 2 surveys were less than recommended timeframe or where surveys were shorter by 5 minutes or less.

Dates of surveys

4.2.1.16. Please see the following Table for dates of surveys at the sites.

4.2.1.17. Full weather and timing details are given in Appendix 5: Full details of survey conditions and personnel.

Table 3 Dates of surveys

Survey Location	Date refugia laid out	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7
RE01	05/05/2017	24/05/2017	06/06/2017	12/06/2017	15/06/2017	30/06/2017	12/09/2017	25/09/2017
RE02	05/05/2017	24/05/2017	06/06/2017	12/06/2017	15/06/2017	30/06/2017	12/09/2017	25/09/2017
RE03	05/05/2017	16/05/2017	01/06/2017	05/06/2017	07/06/2017	09/06/2017	12/06/2017	19/09/2017
RE04	05/05/2017	15/05/2017	03/06/2017	05/06/2017	07/06/2017	09/06/2017	12/06/2017	14/06/2017
RE05	05/05/2017	01/06/2017	N/A	N/A	N/A	N/A	N/A	N/A
RE06	08/05/2017	15/05/2017	18/05/2017	22/05/2017	24/05/2017	27/05/2017	29/05/2017	01/06/2017
RE07	05/05/2017	15/05/2017	18/05/2017	22/05/2017	24/05/2017	27/05/2017	29/05/2017	01/06/2017
RE08	08/05/2017	16/05/2017	22/05/2017	12/06/2017	26/06/2017	30/06/2017	03/09/2017	12/09/2017
RE09	05/05/2017	16/05/2017	22/05/2017	12/06/2017	26/06/2017	30/06/2017	03/09/2017	12/09/2017
RE11	05/05/2017	16/05/2017	22/05/2017	16/06/2017	26/06/2017	30/06/2017	03/09/2017	12/09/2017
RE12	08/05/2017	05/06/2017	07/06/2017	09/06/2017	12/06/2017	14/06/2017	16/06/2017	N/A
RE13	08/05/2017	18/05/2017	05/06/2017	09/06/2017	12/06/2017	14/06/2017	16/06/2017	12/09/2017
RE15	08/05/2017	30/05/2017	20/06/2017	18/09/2017	20/09/2017	22/09/2017	25/09/2017	29/09/2017
RE20	05/05/2017	16/05/2017	22/05/2017	12/06/2017	26/06/2017	30/06/2017	03/09/2017	12/09/2017
RE21	13/06/2017	06/09/2017	15/09/2017	17/09/2017	20/09/2017	28/09/2017	30/09/2017	03/10/2017

Personnel

4.2.1.18. All surveys were undertaken by experienced reptile surveyors, who are listed below in the table below. Other named staff on surveys were safety workers.

Table 4 Surveyor experience

Team member	Experience	Memberships
Rebecca Cattell	5 years' experience in ecological surveying, including reptiles.	GradCIEEM
Karl Charters	20 years' experience in ecological surveying, including reptiles	
Ben Christie	4 years' experience in ecological surveying including, reptiles	GradCIEEM
Ben Moore	2 years' experience of ecological surveying, including reptiles	GradCIEEM
Sally McColl	10 years' experience of ecological surveying, including reptiles	
Carolyn Smith	4 years' experience of ecological surveying, including reptiles	GradCIEEM
Sue Traer	15 years' experience in ecological surveying, including reptiles	MCIEEM
Jim Allitt	14 years' experience in ecological surveying, including reptiles	

4.2.2. Limitations

4.2.2.1. Table 5 summarises the limitations to the surveys by site and implications. An assessment of each visit is given in Appendix 5: Full details of survey conditions and personnel.

4.2.2.2. No suitable survey was carried out for RE05, RE14 or RE16 and no conclusions can be gained on presence/absence.

4.2.2.3. RE11 and RE21 had limitations on access. Reptiles could be present in areas of RE11 where access was not possible, although this area was grazed to a short sward by horses and was less suitable for reptiles. Reptiles may be more widely distributed or other species may be present in RE21.

4.2.2.4. The lack of a 7th visit at RE12 is not seen as a constraint, as the site appeared unsuitable for slow worms based on presence of pheasant release pens and grass snake had already been detected.

4.2.2.5. 6 out of 7 surveys were of a shorter duration than recommended at RE15. This could be seen as a significant constraint, however the site was very small and isolated in an arable landscape, so the result of no presence of reptiles would appear valid.

4.2.2.6. Mats were laid out at RE05, but due to presence of cattle were significantly disturbed. Surveys were therefore not continued.

4.2.2.7. Two of the sites had refugia removed or damaged by mowing during the period of the surveys:

- At RE08, the meadow was mown prior to September and 10 refugia were lost, leaving 18 remaining.
- At RE09, 25 of refugia were either mown over or obscured by cut vegetation prior to September, leaving 25 functional.

4.2.2.8. At both sites this affected two of the seven surveys (03/09/2017 and 12/09/2107). Mats were not replaced. However, the density of mats remained suitable for the protocol.

Table 5 : Survey limitations

Survey Location	Access restrictions	Survey effort, including non-compliant visits	Refugia numbers or disturbance	Grass snake	Slow worm	Conclusion
RE01	None	7 survey visits	None	Not detected	Present	No significant limitations
RE02	None	7 survey visits	None	Not detected	Not detected	No significant limitations
RE03	None	7 survey visits	Felts constantly moved, but alternative refuges and small site.	Not detected	Not detected	No significant limitations
RE04	None	7 survey visits	None	Not detected	Present	No significant limitations
RE05	Ditches difficult to survey as obscured by tall vegetation	Surveys abandoned after refugia laid due to presence of cattle with calves on field	Refugia disturbed and damaged by cattle (15 out of 5)	N/A	N/A	Not compliant.
RE06	None	7 survey visits	None	Not detected	Not detected	No significant limitations
RE07	None	7 survey visits	None	Not detected	Not detected	No significant limitations
RE08	None	7 survey visits	10 refugia mats damaged by being mown, but suitable density remained.	Not detected	Not detected	No significant limitations
RE09	None	7 survey visits	25 of refugia were either mown over or obscured by cut vegetation but suitable density remained.	Not detected	Not detected	No significant limitations
RE11	Partial access : Presence of stream running north to south prevented access to east of site.	7 survey visits	None	Not detected	Not detected	No coverage of east of site; east part of site grazed to a short sward by horses, and had limited habitat features for reptiles apart from the hedge/tree line adjacent to the stream; the west side of the stream had the best habitat for reptiles; therefore limited access concluded as not significant
RE12	H&S issues prevented access to area around pheasant pens	6 survey visits - partial survey effort	None	Present	Not detected	Grass snake presence on site shows efficacy of aims; concluded no significant limitations to presence/absence
RE13	Partial access : H&S and deep water prevented access around woodland pond	7 survey visits	None	Present	Not detected	Grass snake presence on site shows efficacy of aims; concluded no significant limitations to presence/absence
RE14	Access permission not confirmed from landowner	N/A	N/A	N/A	N/A	Not compliant.

Survey Location	Access restrictions	Survey effort, including non-compliant visits	Refugia numbers or disturbance	Grass snake	Slow worm	Conclusion
RE15	None	7 survey visits. Small site of derelict barn so survey visits slightly shorter than 30 minutes.	None	Not detected	Not detected	Overall no significant limitations.
RE16	Access permission not granted from landowner	No surveys undertaken	N/A	N/A	N/A	No survey undertaken.
RE20	Small area to south west of suitable habitat only	7 survey visits	None	Not detected	Not detected	No significant limitations
RE21	Partial access. Deer fencing meant no access to the centre of the site.	7 survey visits. 1 of these in October.	Low density of mats due to limited locations	Present	Present	Grass snake and slow worm presence on site shows efficacy of aims for these species; partial coverage may mean wider distribution within site

5. Results

5.1. Presence / Absence

5.1.1. Appendix 6 lists the species that could be found during the reptile survey visits and their distribution in Norfolk.

5.1.2. The results of the field surveys for each site are summarised in Table 6 below, and are detailed in Table 9.

5.1.3. Reptile presence was observed at five of the surveyed locations, which are shown on the map in Appendix 2. Two species of reptile were recorded as present: slow worm *Anguis fragilis* and grass snake *Natrix natrix*. These are summarised in Tables 7 and 8.

5.1.4. No conclusions can be drawn as to the population levels at each site; however RE21 in particular contains extensive areas of suitable habitat. Similarly RE01 has limited habitat, but good connection to other suitable habitat via arable fields and hedgerows.

5.1.5. Significant reptile populations are considered likely absent from nine of the surveyed locations, with a high level of confidence based on the survey parameters. This does not indicate that individual animals may not be occasionally present.

5.1.6. Three sites were not surveyed and no conclusions on the presence/absence of reptiles at these sites can be drawn.

Table 6 Summary of presence / absence survey results for reptiles 2017

Site ref#	Site description	Presence /absence			
		Grass snake	Slow worm	Common Lizard	Adder
RE01	Rubble & fallen branches on site are potential reptile refugia, good connection to arable fields and hedgerows. Nettles and thistles grown up over site.	Not detected	Present	Not detected	Not detected
RE02	Area of scrub bordering track and arable fields with potential basking opportunities. Good connection to other suitable habitat via hedgerows, field edges.	Not detected	Not detected	Not detected	Not detected
RE03	Wide tussocky field margins dominated by grasses with a hedgerow adjacent with exposed root system. The site offered good habitat for basking and foraging with some hibernation potential.	Not detected	Not detected	Not detected	Not detected
RE04	Vegetated areas largely overgrown with ruderal vegetation and tall grasses. Hard standing was still present but very bare, fringes could provide some basking opportunities. Steam railway line adjacent to west boundary offered good connectivity.	Not detected	Present	Not detected	Not detected
RE05		NO SURVEY	NO SURVEY	NO SURVEY	NO SURVEY
RE06	Ruderal vegetation on field margin, adjacent to field drain. Good connectivity to other suitable habitat via field margins and woodland.	Not detected	Not detected	Not detected	Not detected
RE07	Manure pile on hard-standing at north of site, otherwise scrub and grass. Good connectivity to field margins and hedgerows.	Not detected	Not detected	Not detected	Not detected
RE08	Pond on site adjacent to grassland and field margins, good connectivity via hedgerows. Good potential reptile habitat.	Not detected	Not detected	Not detected	Not detected
RE09	Grassland with drain running west to east. Adjacent to woodland, hedgerows and arable fields.	Not detected	Not detected	Not detected	Not detected
RE11	Banks of stream heavily vegetated. Good potential for reptile, some woody debris, basking and foraging areas present.	Not detected	Not detected	Not detected	Not detected

Site ref#	Site description	Presence /absence			
		Grass snake	Slow worm	Common Lizard	Adder
RE12	Wet tussocky grassland with <i>Juncus</i> and orchids, interconnecting ditches as part of the River Wensum floodplain, excellent connectivity to surrounding habitat. Woodland over-shaded with pheasant pen occupying majority of area, poor ground flora.	Present	Not detected	Not detected	Not detected
RE13	Woodland was fairly shaded with only low-moderate ground flora, although track and back to the west of pond was grassy. Himalayan balsam. Wet grassland tussocky with good foraging. Wet ditches and pond in woodland good for grass snake.	Present	Not detected	Not detected	Not detected
RE14		NO SURVEY	NO SURVEY	NO SURVEY	NO SURVEY
RE15	Footprint of derelict barn; open farmland with no connecting habitat	Not detected	Not detected	Not detected	Not detected
RE16		NO SURVEY	NO SURVEY	NO SURVEY	NO SURVEY
RE20	Connecting hedgerows in middle of arable landscape with drain running east to west.	Not detected	Not detected	Not detected	Not detected
RE21	Good reptile habitat, consisting of Christmas tree plantations with open rides. Also wet woodland edge, and rough grassland. Nearby river valley	Present	Present	Not detected	Not detected

Table 7 : Grass snake observations

Site ref#	Grass snake	On how many separate surveys observed	Location detected on	Maximum count
RE01	Not detected	0	N/A	0
RE02	Not detected	0	N/A	0
RE03	Not detected	0	N/A	0
RE04	Not detected	0	N/A	0
RE05	Not detected - incomplete survey	N/A	N/A	N/A
RE06	Not detected	0	N/A	0
RE07	Not detected	0	N/A	0
RE08	Not detected	0	N/A	0
RE09	Not detected	0	N/A	0
RE11	Not detected	0	N/A	0
RE12	Present	1	Next to drain	1
RE13	Present	2	Pond edge	1
RE14	Not detected - incomplete survey	N/A	N/A	N/A
RE15	Not detected	0	N/A	0
RE16	NO SURVEY	N/A	N/A	N/A
RE20	Not detected	0	N/A	0
RE21	Present	1	Under refugia M8	1

Table 8 : Slow worm observations

Site ref#	Slow worm	On how many separate surveys observed	Habitats	Maximum count
RE01	Present	5	Under refugia M1, M2, M3 M6, M12, M14, M19	3
RE02	Not detected	0	N/A	-
RE03	Not detected	0	N/A	-
RE04	Present	1	Under refugia M2	1
RE05	Not detected - incomplete survey			
RE06	Not detected	0	N/A	0
RE07	Not detected	0	N/A	0
RE08	Not detected	0	N/A	0
RE09	Not detected	0	N/A	0
RE11	Not detected	0	N/A	0
RE12	Not detected	0	N/A	0
RE13	Not detected	0	N/A	0
RE14	Not detected - incomplete survey	N/A	N/A	N/A
RE15	Not detected	0	N/A	0
RE16	NO SURVEY	N/A	N/A	N/A
RE20	Not detected	0	N/A	0
RE21	Present	5	Under refugia M2, M4, M6, M7 , M8	3

Table 9: Field observations from surveys by date and life stage

Codes GS - grass snake, SW - slow worm, CL - common lizard, A – adder; 1 - Adult, 2 - Immature, 3 - Juvenile, 4 - Slough, 5 – Eggs. Brackets references the refugia number or the location of observation.

Shaded cells are sites where reptiles were found.

Survey Location	GPS co-ordinates	Date refugia laid out	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7
RE01	TF946125	05/05/2017	24/05/2017 Present SW1 (M19)	06/06/2017 Not detected	12/06/2017 Present SW1 (M19)	15/06/2017 Present SW3 (M3)	30/06/2017 Present SW3 (M1) SW1 (M12) SW2(M14)	12/09/2017 Present SW2 (M2) SW2 (M6)	25/09/2017 Not detected
RE02	TF946122	05/05/2017	24/05/2017 Not detected	06/06/2017 Not detected	12/06/2017 Not detected	15/06/2017 Not detected	30/06/2017 Not detected	12/09/2017 Not detected	25/09/2017 Not detected
RE03	TF971147	05/05/2017	16/05/2017 Not detected	01/06/2017 Not detected	05/06/2017 Not detected	07/06/2017 Not detected	09/06/2017 Not detected	12/06/2017 Not detected	19/09/2017 Not detected
RE04	TF993157	05/05/2017	15/05/2017 Not detected	03/06/2017 Not detected	05/06/2017 Not detected	07/06/2017 Not detected	09/06/2017 Not detected	12/06/2017 Not detected	14/06/2017 Present SW1 (M2)
RE06	TG035165	08/05/2017	15/05/2017 Not detected	18/05/2017 Not detected	22/05/2017 Not detected	24/05/2017 Not detected	27/05/2017 Not detected	29/05/2017 Not detected	01/06/2017 Not detected
RE07	TG038167	05/05/2017	15/05/2017 Not detected	18/05/2017 Not detected	22/05/2017 Not detected	24/05/2017 Not detected	27/05/2017 Not detected	29/05/2017 Not detected	01/06/2017 Not detected
RE08	TG064201	08/05/2017	16/05/2017 Not detected	22/05/2017 Not detected	12/06/2017 Not detected	26/06/2017 Not detected	30/06/2017 Not detected	03/09/2017 Not detected	12/09/2017 Not detected
RE09	TG067206	05/05/2017	16/05/2017 Not detected	22/05/2017 Not detected	12/06/2017 Not detected	26/06/2017 Not detected	30/06/2017 Not detected	03/09/2017 Not detected	12/09/2017 Not detected
RE11	TG125243	05/05/2017	16/05/2017 Not detected	22/05/2017 Not detected	16/06/2017 Not detected	26/06/2017 Not detected	30/06/2017 Not detected	03/09/2017 Not detected	12/09/2017 Not detected

Survey Location	GPS co-ordinates	Date refugia laid out	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7
RE12	TG200287	08/05/2017	05/06/2017 Present GS1 (next to drain)	07/06/2017 Not detected	09/06/2017 Not detected	12/06/2017 Not detected	14/06/2017 Not detected	16/06/2017 Not detected	N/A
RE13	TG227305	08/05/2017	18/05/2017 Not detected	05/06/2017 GS1 (on pond)	09/06/2017 Not detected	12/06/2017 Not detected	14/06/2017 Not detected	16/06/2017 GS1 (On pond)	12/09/2017 Not detected
RE15	TG345327	08/05/2017	30/05/2017 Not detected	20/06/2017 Not detected	18/09/2017 Not detected	20/09/2017 Not detected	22/09/2017 Not detected	25/09/2017 Not detected	29/09/2017 Not detected
RE20	TG075217	05/05/2017	16/05/2017 Not detected	22/05/2017 Not detected	12/06/2017 Not detected	26/06/2017 Not detected	30/06/2017 Not detected	03/09/2017 Not detected	12/09/2017 Not detected
RE21	TG120242	13/06/2017	06/09/2017 Present SW2 (M6)	15/09/2017 Present SW1 (M2) SW2 (M4) SW2 (M7)	17/09/2017 Not detected	20/09/2017 Present SW1 (M4) SW2 (M7)	28/09/2017 Present SW1 (M4) SW2 (M7)	30/09/2017 Not detected	03/10/2017 Present SW3 (M6) GS2 (M8)

5.2. Incidental records

5.2.1. Other species found on the surveys included common toad *Bufo bufo* (RE01, RE02, RE06, RE07, RE09, RE11) and common frog *Rana temporaria* (RE08, RE09, RE11).

6. Conclusion

6.1. Reptile surveys were proposed at 17 sites, including one site RE21 added during the delivery phase. Reptile surveys were not able to be commenced or completed at RE05, RE14 or RE16 due to access or surveying difficulties.

6.2. For reptiles it is difficult to give an indication of population size because each survey visit may only reveal a small sample of the population. For presence/absence surveys results can only be expressed as present or likely absent.

6.3. The presence of two species of reptile was observed during the survey season: grass snake and slow worm. Slow worm were present at RE01, RE04, and RE21, and grass snake at RE12, RE13 and RE21.

6.4. Reptiles were not detected at any remaining sites where surveys took place: RE02, RE03, RE06, RE07, RE08, RE09, RE11, RE15 and RE20. It is concluded that reptiles are likely absent from these nine sites.

6.5. No conclusions can be drawn about the presence/absence of reptiles at sites RE05, RE14 or RE16.

6.6. The presence/absence for each survey location is summarised in the following table.

Table 10 : Summary of sites

Survey Locations	Site description	Approx area of suitable habitat (hectares)	GPS co-ordinates	Grass snake (maximum number of individuals recorded)	Slow worm (maximum number of individuals recorded)
RE01	Rubble and fallen branches on site are potential reptile refugia, good connection to arable fields and hedgerows. Nettles and thistles grown up over site.	0.53	TF946125	Not detected	Present (3)
RE02	Area of scrub bordering track and arable fields with potential basking opportunities. Good connection to other suitable habitat via hedgerows, field edges.	0.16	TF946122	Not detected	Not detected
RE03	Wide tussocky field margins dominated by grasses with a hedgerow adjacent with exposed root system. The site offered good habitat for basking and foraging with some hibernation potential.	0.1	TF971147	Not detected	Not detected
RE04	Vegetated areas largely overgrown with ruderal vegetation and tall grasses. Hard standing was still present but very bare, fringes could provide some basking opportunities. Steam railway line adjacent to west boundary offered good connectivity.	0.22	TF993157	Not detected	Present (1)
RE05	Decomposing trees, wet tussocky grassland, watercourse, woodland mosaic.	1.0	TG035166	NO SURVEY	NO SURVEY
RE06	Ruderal vegetation on field margin, adjacent to field drain. Good connectivity to other suitable habitat via field margins and woodland.	1.1	TG035165	Not detected	Not detected
RE07	Manure pile on hard-standing at north of site, otherwise scrub and grass. Good connectivity to field margins and hedgerows.	0.32	TG038167	Not detected	Not detected

Survey Locations	Site description	Approx area of suitable habitat (hectares)	GPS co-ordinates	Grass snake (maximum number of individuals recorded)	Slow worm (maximum number of individuals recorded)
RE08	Pond on site adjacent to grassland and field margins, good connectivity via hedgerows. Good potential reptile habitat.	0.82	TG064201	Not detected	Not detected
RE09	Grassland with drain running west to east. Adjacent to woodland, hedgerows and arable fields.	3.7	TG067206	Not detected	Not detected
RE11	Banks of stream heavily vegetated. Good potential for reptile, some woody debris, basking and foraging areas present.	2.6	TG125243	Not detected	Not detected
RE12	Wet tussocky grassland with <i>Juncus</i> and orchids, interconnecting ditches as part of the River Wensum floodplain, excellent connectivity to surrounding habitat. Woodland over-shaded with pheasant pen occupying majority of area, poor ground flora.	4.8	TG200287	Present (1)	Not detected
RE13	Woodland was fairly shaded with only low-moderate ground flora, although track and back to the west of pond was grassy. Himalayan balsam. Wet grassland tussocky with good foraging. Wet ditches and pond in woodland good for grass snake.	4.3	TG227305	Present (1)	Not detected
RE14	Good hibernacula (dead wood), woodland edge, rough grassland.	4.5	TG321331	NO SURVEY	NO SURVEY
RE15	Footprint of derelict barn; open farmland with no connecting habitat	0.94	TG345327	Not detected	Not detected
RE16	Good hibernacula (dead wood), woodland edge, rough grassland.	0.37	TG373302	NO SURVEY	NO SURVEY
RE20	Connecting hedgerows in middle of arable landscape with drain running east to west.	0.8	TG075217	Not detected	Not detected
RE21	Good reptile habitat, consisting of Christmas tree plantations with open rides. Also wet woodland edge, and rough grassland. Nearby river valley	16.3	TG120242	Present (1)	Present (3)

7. References

Gent, T. and Gibson, S. (2003). Herpetofauna Workers Manual (2003). Joint Nature Conservation Committee (JNCC), Peterborough.

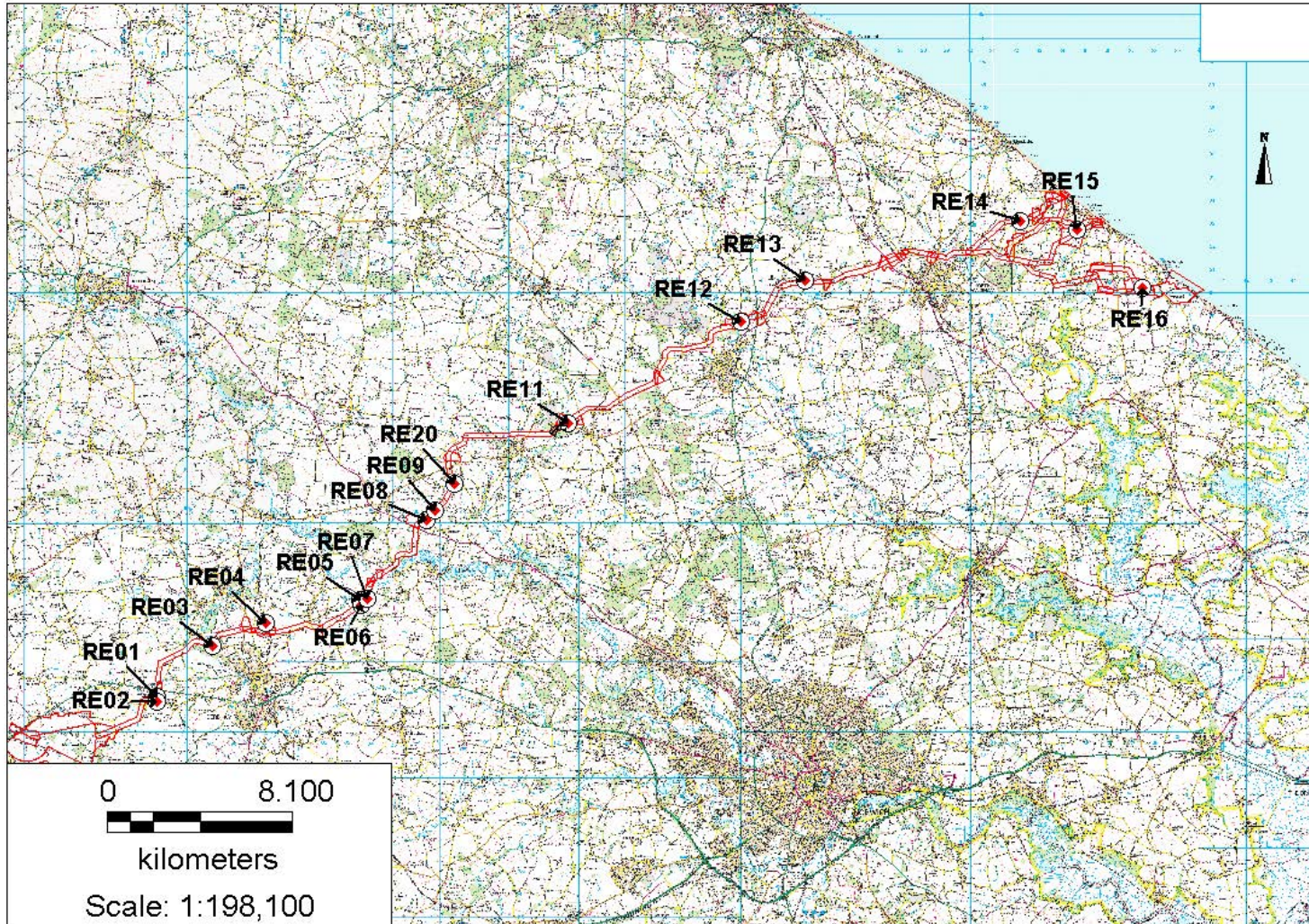
Froglife (1999). Reptile survey, An introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife advice sheet 10.

Royal HaskoningDHV (2016). Norfolk Vanguard Offshore Wind Farm Environmental Impact Assessment Scoping Report. (Doc Ref PB4476-102-001).

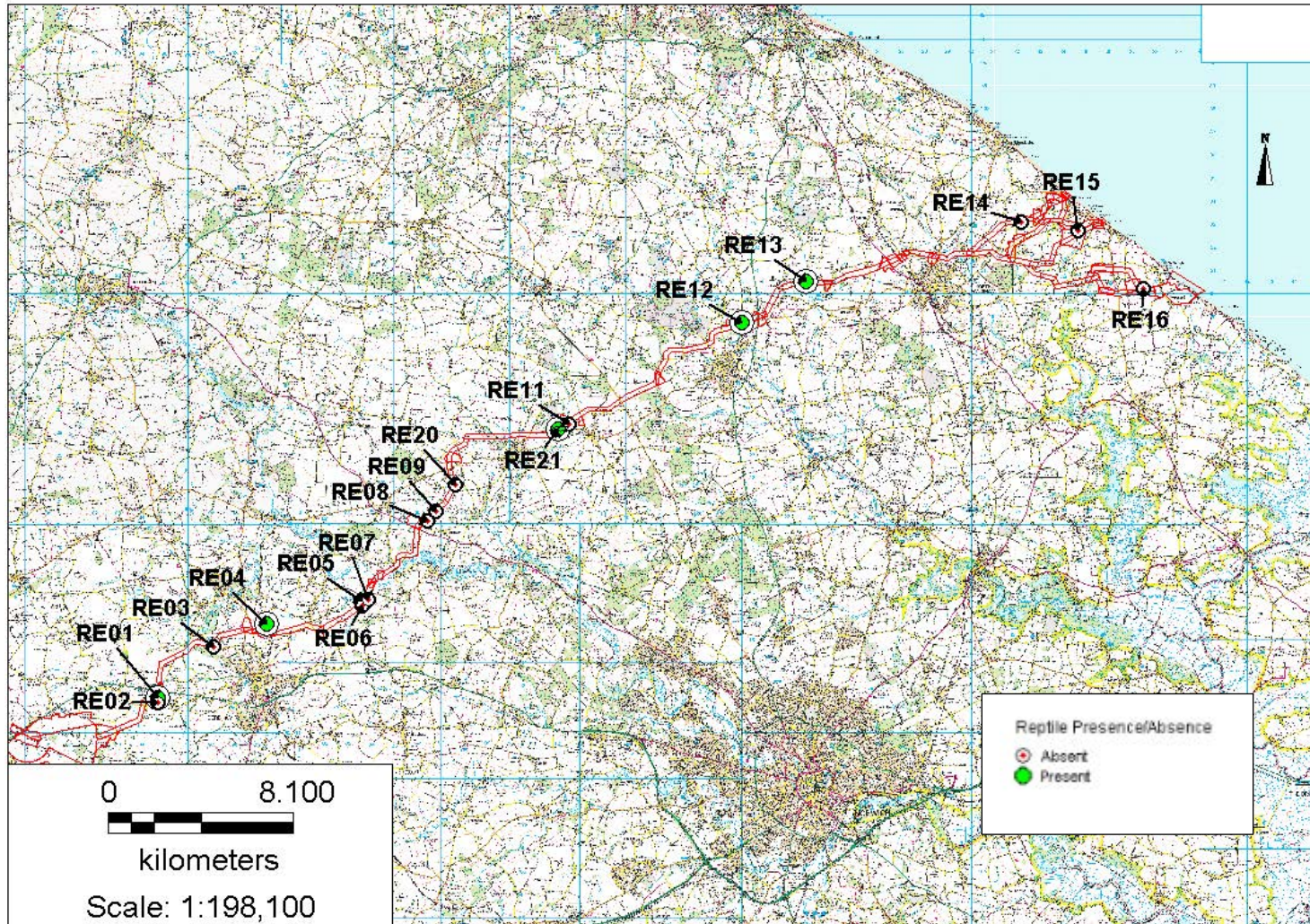
Royal HaskoningDHV (2017a). Norfolk Vanguard Offshore Wind Farm Extended Phase 1 Habitat Survey Report (Document ref: PB4476-003-040) 7.1.

Royal HaskoningDHV (2017b) PB4476.003.041 Environmental Impact Assessment Phase 2 Ecological Surveys Scope April 2017 (Document ref. PB4476.003.041)

Appendix 1: Reptile Survey Locations



Appendix 2: Reptile Survey Presence/Absence



Appendix 3: Refugia Density and Placement

Table 11 : Mat densities, dates of placement and first survey

Survey Location	Approx area of suitable habitat (hectares)	Number of refugia	Density of mats	Dates refugia laid out	First survey day	Number of days between laying out and 1 st survey
RE01	0.53	23	>10 per hectare	05/05/2017	24/05/2017	19
RE02	0.16	18	>10 per hectare	05/05/2017	24/05/2017	19
RE03	0.1	12	>10 per hectare	05/05/2017	16/05/2017	11
RE04	0.22	25	>10 per hectare	05/05/2017	15/05/2017	10
RE05	N/A	N/A	N/A	08/05/2017	N/A	N/A
RE06	1.1	23	>10 per hectare	08/05/2017	15/05/2017	7
RE07	0.32	25	>10 per hectare	05/05/2017	15/05/2017	10
RE08	0.82	28	>10 per hectare	08/05/2017	16/05/2017	8
RE09	3.7	50	>10 per hectare	05/05/2017	16/05/2017	11
RE11	2.6	31	>10 per hectare	05/05/2017	16/05/2017	11
RE12	4.8	40	<10 per hectare	08/05/2017	05/06/2017	28
RE13	4.3	33	<10 per hectare	08/05/2017	18/05/2017	10
RE14	N/A	N/A	N/A	N/A	N/A	N/A
RE15	<0.94	15	>10 per hectare	08/05/2017	30/05/2017	22
RE16	N/A	N/A	N/A	N/A	N/A	N/A
RE20	0.8	7	<10 per hectare	05/05/2017	16/05/2017	11
RE21	16.3	51	<10 per hectare	13/06/2017	06/09/2017	91

Appendix 4: Refugia location

Figure 1. RE01 Refugia locations

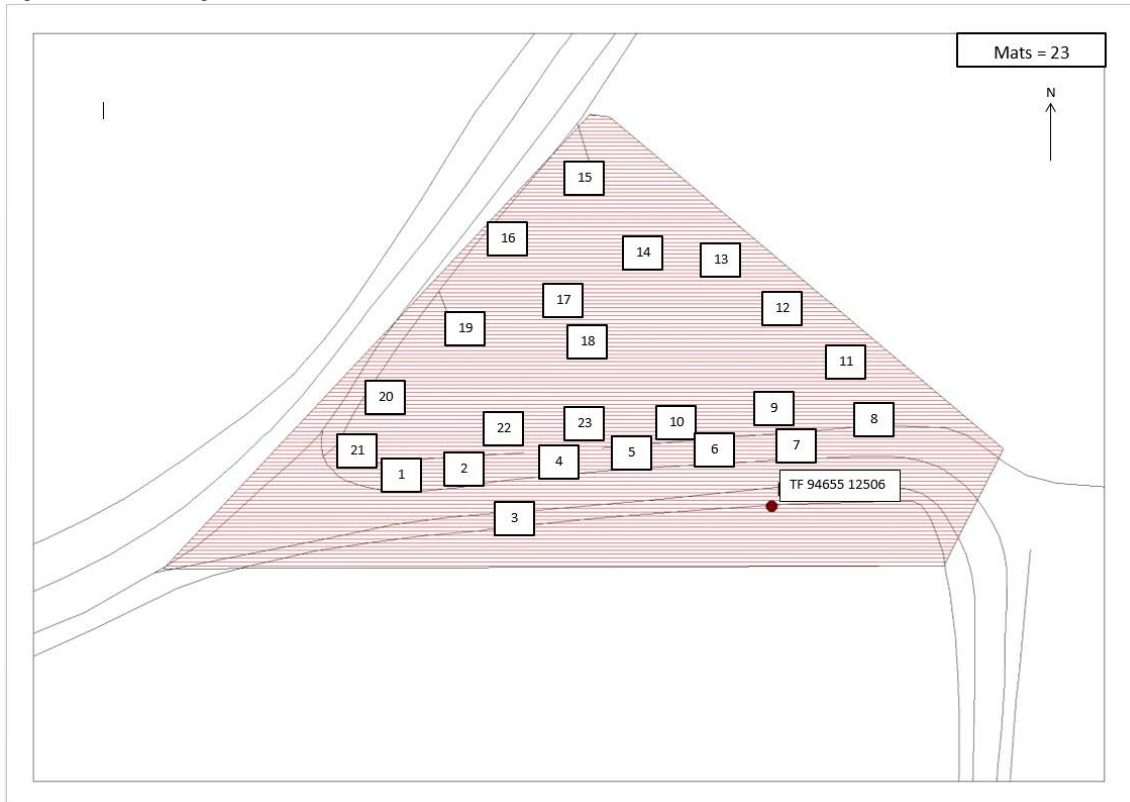


Figure 2. RE02 Refugia locations

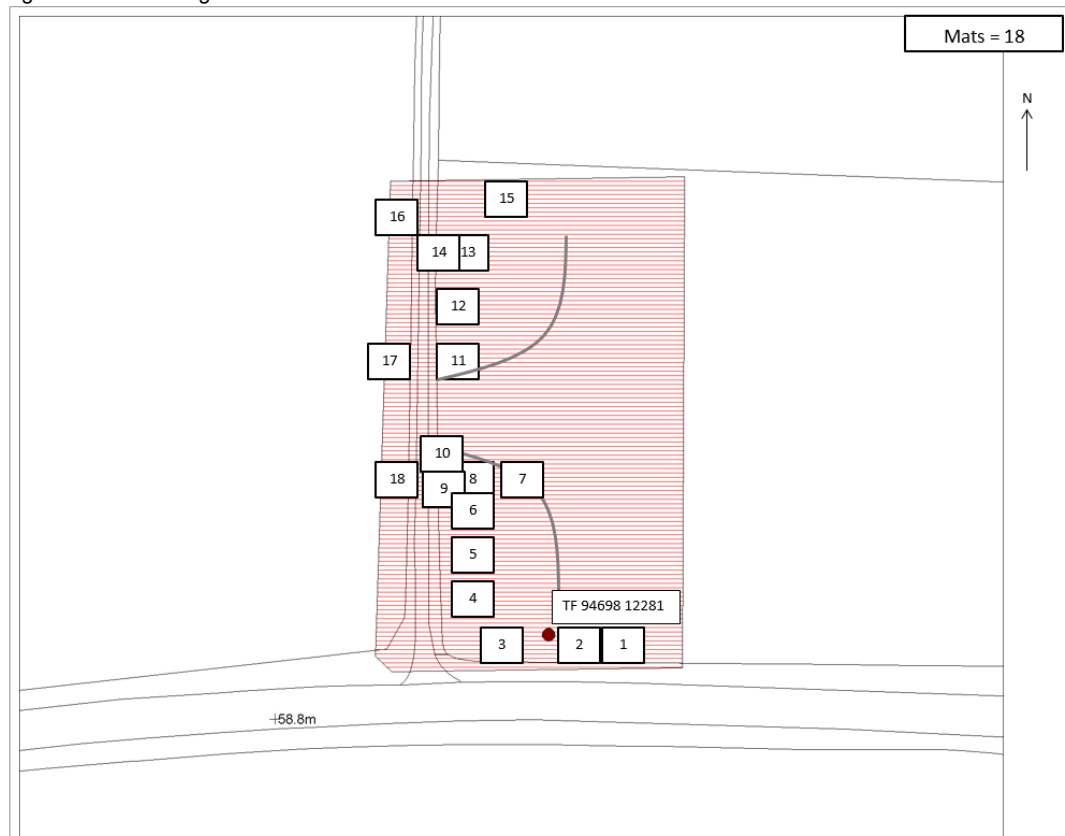


Figure 3. RE03 refugia locations



Figure 4. RE04 refugia locations

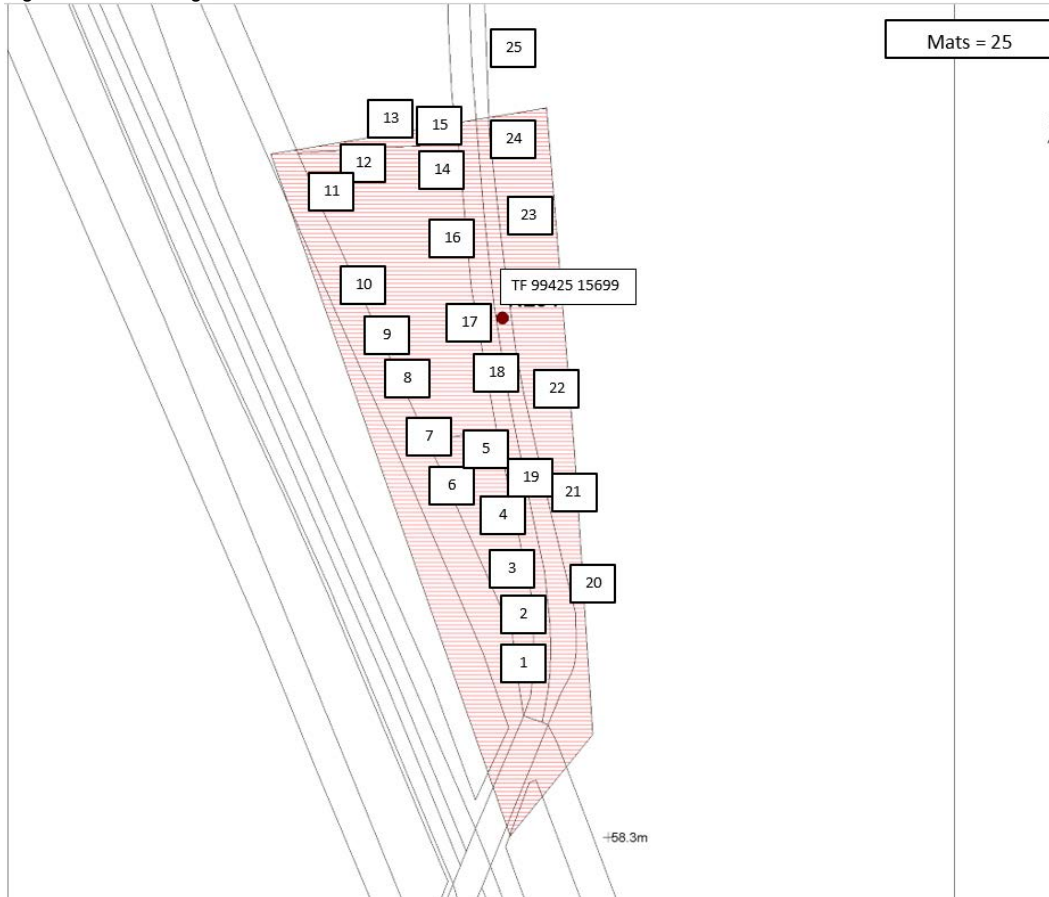


Figure 5. RE06 refugia locations



Figure 6. RE07 refugia locations



Figure 7. RE08 refugia locations



Figure 8. RE09 refugia locations

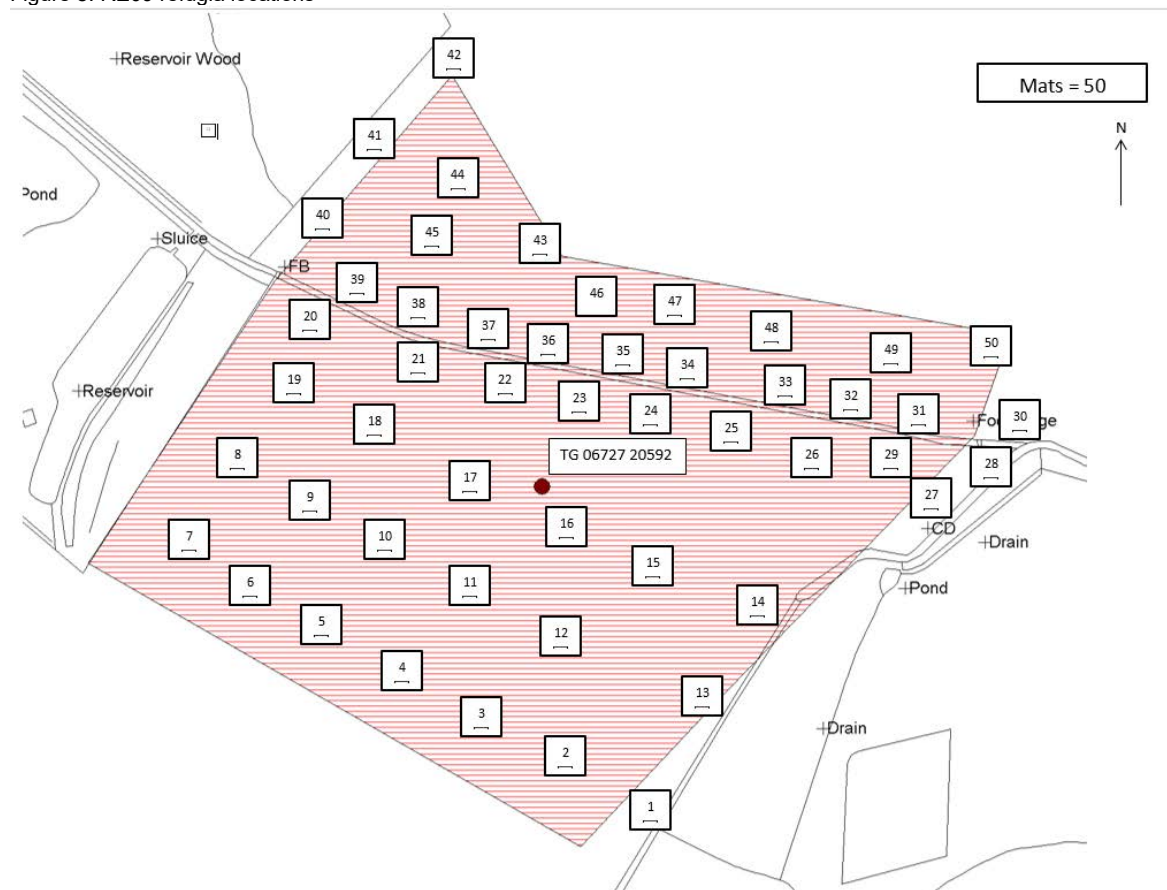


Figure 9. RE11 refugia locations



Figure 10. RE12 refugia locations

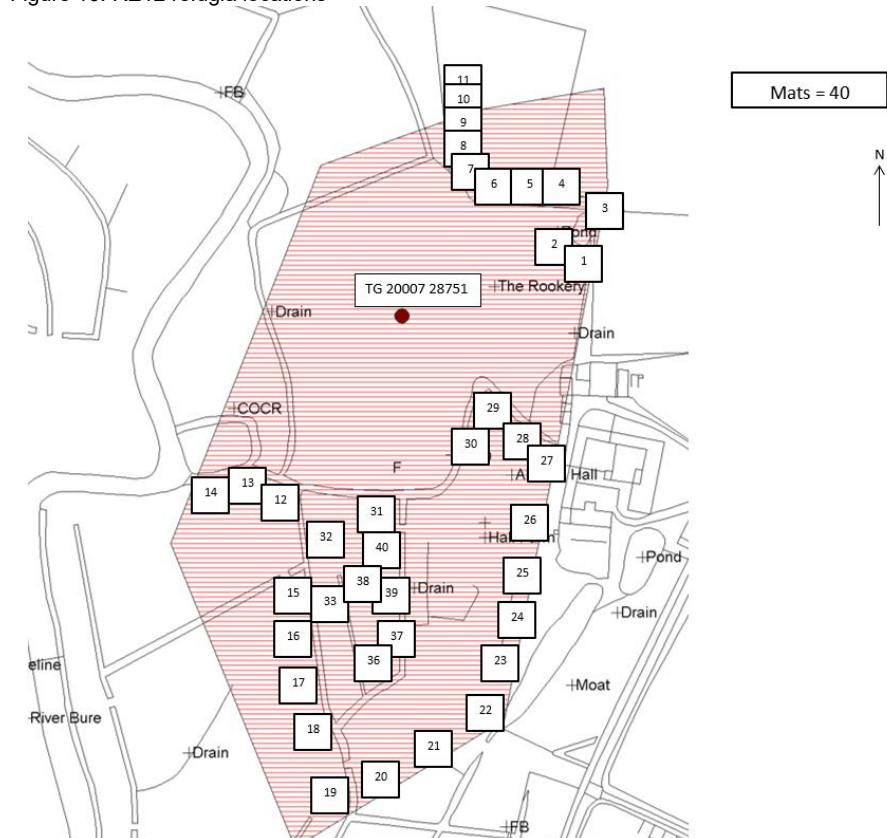


Figure 11. RE13 refugia locations



Figure 12. RE15 refugia locations

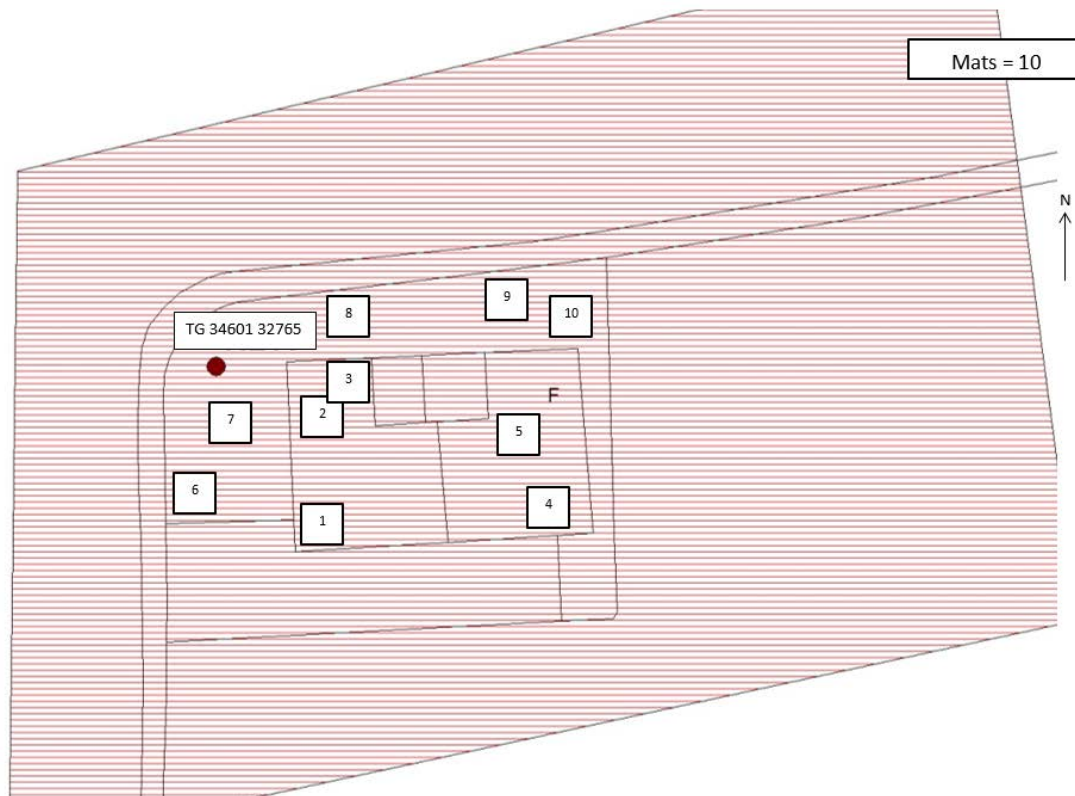


Figure 13. RE20 refugia locations

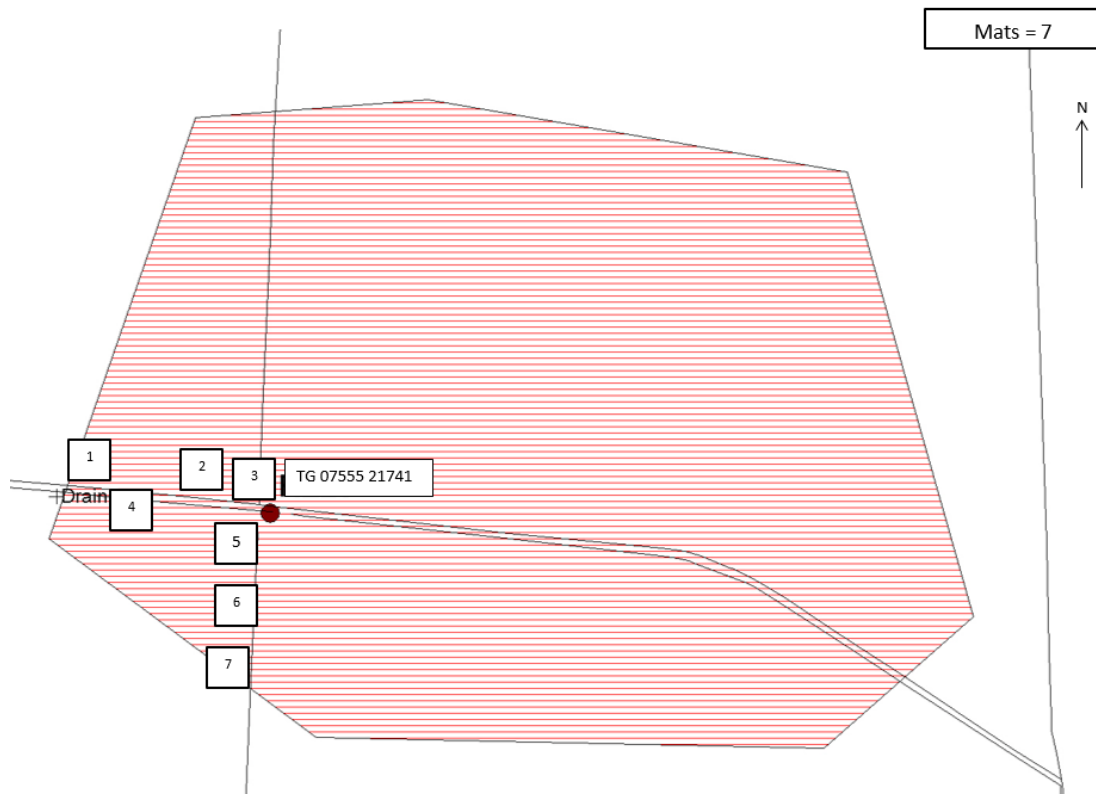


Figure 14. RE21 refugia locations



Appendix 5: Full details of survey conditions and personnel

Table 12 : Dates, time and weather for reptile surveys

Location	Visit No.	Visit Date ¹	Visit Time ²³	Weather	Temp (°C) ⁴	Surveyors	Constraints?
RE01 Scarning	1	24/05/2017	09:35 – 10:20	Very light breeze, 40% hazy cloud	17	Rebecca Cattell Mark Atherton	No
RE01 Scarning	2	06/06/2017	08:45 – 09:15	Slight drizzle, 100% cloud cover	12	James Allitt Joe Hassall	No
RE01 Scarning	3	12/06/2017	08:45 – 09:15	Dry, BWS2, 75% cloud cover	16	James Allitt Joe Hassall	No
RE01 Scarning	4	15/06/2017	09:00 – 09:55	Dry, BWS1, 10% cloud cover	17	James Allitt Joe Hassall	No
RE01 Scarning	5	30/06/2017	08:30 – 09:10	Damp, BWS3, 75% cloud cover	16	James Allitt Joe Hassall	No
RE01 Scarning	6	12/09/2017	10:27 – 10.56	Sunny, BWS4, 10% cloud cover	16	Ben Moore Joe Hassall	No
RE01 Scarning	7	25/09/17	12.25 – 12.40	Dry, BWS 2, 60% cloud cover	17	Ben Moore Joe Hassall	Outside of core hours, but late in season; weather conditions good. Minor constraint.
RE02 Scarning	1	24/05/2017	10.20 – 11.15	Very light breeze, 40% hazy cloud	17	Rebecca Cattell Mark Atherton	Survey ended outside of optimal time range, but weather conditions good. Minor constraint.
RE02 Scarning	2	06/06/2017	09:15 – 09:45	Slight drizzle, 100% cloud cover	12	James Allitt Joe Hassall	No
RE02 Scarning	3	12/06/2017	09.15 – 09.45	Dry, BWS1, 75% cloud cover	16	James Allitt Joe Hassall	No
RE02 Scarning	4	15/06/2017	09.30 – 10.30	Dry, BWS1, 25% cloud cover	17	James Allitt Joe Hassall	No
RE02 Scarning	5	30/06/2017	09.10 – 09.40	Dry, BWS3, 75% cloud cover	16	James Allitt Joe Hassall	No
RE02 Scarning	6	12/09/2017	10.56 – 11.27	Sunny, BWS4, 10% cloud cover	16	James Allitt Ben Moore	Outside of optimal time range; weather conditions good. Minor constraint.

¹ March to October, but preference for April, May, June and September

² Optimal time range (08:00 to 11:00; 16:00 - 18:30)

³ Duration minimum of 30 minutes at each survey site.

⁴ Between 9 and 18°C

Location	Visit No.	Visit Date ¹	Visit Time ²³	Weather	Temp (°C) ⁴	Surveyors	Constraints?
RE02 Scarning	7	25/09/17	12.40 - 13.05	Dry, BWS 2, 60% cloud cover	17	Ben Moore Joe Hassall	Outside of optimal time range due to being late in season; weather conditions good. Duration 5 minutes shorter than protocol, not significant. No constraint.
RE03 Dillington	1	16/05/2017	10.00 – 10.30	Dry, BWS 2, excellent visibility	16	Ben Christie Jenny Christie	No
RE03 Dillington	2	01/06/2017	09.00 – 09.30	Dry, BWS 1	15	Ben Christie Jenny Christie	No
RE03 Dillington	3	05/06/2017	06.45 – 07.15	Dry, BWS 2	12	Ben Christie Jenny Christie	Outside of optimal time range; weather conditions good. Minor constraint.
RE03 Dillington	4	07/06/2017	08.30 – 09.15	Dry, BWS 3	14	Ben Christie Jenny Christie	No
RE03 Dillington	5	09/06/2017	08.00 – 08.30	Dry, BWS 3, Dry,	15	Ben Christie Jenny Christie	No
RE03 Dillington	6	12/06/2017	08.00 – 08.30	Dry, BWS 1, 75% cloud cover	13	Ben Christie Jenny Christie	No
RE03 Dillington	7	19/09/17	14.15 – 15.00	Dry, BWS 1, 25% cloud cover	16	Ben Moore Joe Hassall	Outside of optimal time range; weather conditions good. Minor constraint.
RE04 Northall Green	1	15/05/2017	10.35 – 11.30	Dry BWS 2, excellent visibility	17	Ben Christie Jenny Christie	Outside of optimal time range but commenced within. No constraint.
RE04 Northall Green	2	03/06/2017	08.00 – 08.50	Dry, BWS 1	15	Ben Christie Jenny Christie	No
RE04 Northall Green	3	05/06/2017	07.20 – 07.55	Dry, BWS 2	12	Ben Christie Jenny Christie	Outside of optimal time range but weather conditions good. Minor constraint.
RE04 Northall Green	4	07/06/2017	07.30 – 08.15	Dry, BWS 3,	12	Ben Christie Jenny Christie	Outside of optimal time range but finishes within. No constraint.
RE04 Northall Green	5	09/06/2017	08.45 – 09.30	Dry, BWS 3, 60% cloud cover	11.5	Ben Christie Jenny Christie	No
RE04 Northall Green	6	12/06/2017	08.45 – 09.30	Dry, BWS 2, 75% cloud cover	13	Ben Christie Jenny Christie	No
RE04 Northall Green	7	14/06/2017	07.40 – 08.10	Dry, BWS 0, 10% cloud cover	16	Ben Christie Jenny Christie	Outside of optimal time range but finishes within. No constraint.

Location	Visit No.	Visit Date ¹	Visit Time ²³	Weather	Temp (°C) ⁴	Surveyors	Constraints?
RE06 Elsing	1	15/05/2017	11.35 – 11.55	Light rain at start with light - moderate breeze. Good visibility, 100% cloud cover	13	Sue Traer Dave Salmon	Outside of optimal time range but weather conditions good. Short duration. Minor constraint.
RE06 Elsing	2	18/05/2017	11.54 – 12.50	Sunny, warm, no wind. 10% cloud cover	14	Sue Traer Dave Salmon	Outside of optimal time range but weather conditions good and extended duration. No constraint.
RE06 Elsing	3	22/05/2017	09.00 – 09.30	Gentle breeze, warm, clear with 20% cloud cover	15.5	Sue Traer Dave Salmon	No
RE06 Elsing	4	24/05/2017	16.05 – 16.35	Warm, hazy sunshine. 10% cloud cover. Good visibility, light breeze	18	Sue Traer Dave Salmon	No
RE06 Elsing	5	27/05/2017	10.00 – 10.40	Warm, sunny - no cloud, light breeze. Good visibility	17	Sue Traer Dave Salmon	No
RE06 Elsing	6	29/05/2017	16.30 – 17.00	Warm, light breeze, hazy - 100% high cloud cover.	14.5	Sue Traer Dave Salmon	No
RE06 Elsing	7	01/06/2017	08.50 – 09.20	Warm, light breeze, 5% high cloud	16.5	Sue Traer Dave Salmon	No
RE07 Elsing	1	15/05/2017	13.10 – 13.30	Light - moderate breeze. Good visibility, 100% cloud cover	14	Sue Traer Dave Salmon	Outside of optimal time range but weather conditions good. Short duration. Very small site. Minor constraint.
RE07 Elsing	2	18/05/2017	13.00 – 13.15	Sunny, warm, no wind. 10% cloud cover	15	Sue Traer Dave Salmon	Outside of optimal time range but weather conditions good. Short duration. Very small site. Minor constraint.
RE07 Elsing	3	22/05/2017	9.40 – 10.10	Gentle breeze, warm, clear with 20% cloud cover	16	Sue Traer Dave Salmon	No
RE07 Elsing	4	24/05/2017	16.45 – 17.15	Warm, hazy sunshine. 10% cloud cover. Good visibility, light breeze	18	Sue Traer Dave Salmon	No
RE07 Elsing	5	27/05/2017	07.50 – 08.20	Warm, sunny - no cloud, light breeze. Good visibility.	17	Sue Traer Dave Salmon	No
RE07 Elsing	6	29/05/2017	17.10 – 17.40	Warm, light breeze, hazy - 100% high cloud cover.	14.5	Sue Traer Dave Salmon	No
RE07 Elsing	7	01/06/2017	09.30 – 10.00	Warm, light breeze, 5% high cloud	16.5	Sue Traer Dave Salmon	No
RE08 Sparham	1	16/05/2017	17.30 -18.00	Dry, BWS2, 40% cloud cover, good visibility	18	Karl Charters Ben Moore	No
RE08 Sparham	2	22/05/2017	10.00 – 10.30	Dry, Still, 0% cloud cover, good visibility	17	Karl Charters Ben Moore	No
RE08 Sparham	3	12/06/2017	08.30 – 09.00	Dry, BWS3, 70% cloud cover, good visibility	14	Karl Charters Ben Moore	No

Location	Visit No.	Visit Date ¹	Visit Time ²³	Weather	Temp (°C) ⁴	Surveyors	Constraints?
RE08 Sparham	4	26/06/2017	08.30 – 09.00	Dry, BWS2, 5% cloud cover, good visibility	13	Karl Charters Ben Moore	No
RE08 Sparham	5	30/06/2017	08.30 – 09.00	Dry, BWS2, 5% cloud cover, good visibility	16	Karl Charters Ben Moore	No
RE08 Sparham	6	03/09/2017	17.30 – 18.00	Dry, BWS1, 20% cloud cover, good visibility	13	Karl Charters Ben Moore	No
RE08 Sparham	7	12/09/2017	16.00 – 16.30	Dry, BWS3, 20% cloud cover, good visibility	16	Karl Charters Ben Moore	No
RE09 Sparham	1	16/05/2017	10.30 – 11.00	Dry, BWS 2, 40% cloud cover, good visibility	18	Karl Charters Ben Moore	No
RE09 Sparham	2	22/05/2017	10.30 – 11.00	Dry, Still, 0% cloud cover, good visibility	17	Karl Charters Ben Moore	No
RE09 Sparham	3	12/06/2017	09.00 – 09.30	Dry, BWS 3, 70% cloud cover, good visibility	17	Karl Charters Ben Moore	No
RE09 Sparham	4	26/06/2017	09.00 – 09.30	Dry, BWS 2, 5% cloud cover, good visibility	14	Karl Charters Ben Moore	No
RE09 Sparham	5	30/06/2017	09.00 – 09.30	Dry, BWS 2, 5% cloud cover, good visibility	16	Karl Charters Ben Moore	No
RE09 Sparham	6	03/09/2017	18.00 – 18.30	Dry, BWS 1, 20% cloud cover, good visibility	13	Karl Charters Ben Moore	No
RE09 Sparham	7	12/09/2017	16.30 – 17.00	Dry, BWS 3, 20% cloud cover, good visibility	16	Karl Charters Ben Moore	No
RE11 Cawston	1	16/05/2017	08.30 – 09.00	Dry, BWS 3, 30% cloud cover, good visibility	17	Karl Charters Ben Moore	No
RE11 Cawston	2	22/05/2017	08.30 – 09.00	Dry, Still, 5% cloud cover, good visibility	17	Karl Charters Ben Moore	No
RE11 Cawston	3	12/06/2017	10.30 – 11.00	Dry, BWS 3, 60% cloud cover, good visibility	15	Karl Charters Ben Moore	No
RE11 Cawston	4	26/06/2017	10.30 – 11.00	Dry, BWS 2, 20% cloud cover, good visibility	15	Karl Charters Ben Moore	No
RE11 Cawston	5	30/06/2017	10.30 – 11.00	Dry, BWS 2, 5% cloud cover, good visibility	16	Karl Charters Ben Moore	No
RE11 Cawston	6	03/09/2017	16.00 – 16.30	Dry, Still, 10% cloud cover, good visibility	13	Karl Charters Ben Moore	No
RE11 Cawston	7	12/09/2017	18.00 – 18.30	Dry, BWS 2, 30% cloud cover, good visibility	15	Karl Charters Ben Moore	No
RE12 Drabblegate	1	05/06/2017	09.30 – 10.30	Dry, BWS 3, excellent visibility	14	Ben Christie Jenny Christie	No
RE12 Drabblegate	2	07/06/2017	09.30 – 10.15	Dry, BWS 3, excellent visibility	16	Ben Christie Jenny Christie	No
RE12 Drabblegate	3	09/06/2017	10.00 – 10.45	Dry, BWS 2, excellent visibility	16	Ben Christie Jenny Christie	No
RE12 Drabblegate	4	12/06/2017	10.00 -10.45	Dry, BWS 2-3, excellent visibility	14	Ben Christie Jenny Christie	No
RE12 Drabblegate	5	14/06/2017	08.40 – 09.30	Dry, BWS 1, 60% cloud cover	16	Ben Christie Jenny Christie	No

Location	Visit No.	Visit Date ¹	Visit Time ²³	Weather	Temp (°C) ⁴	Surveyors	Constraints?
RE12 Drabblegate	6	16/06/2017	09.00 -09.45	Dry, BWS 1, 25% cloud cover	16	Ben Christie Jenny Christie	No
RE13 Banningham	1	18/05/2017	09.00 – 09.40	Dry, BWS 1, ,excellent visibility, rain overnight	12	Ben Christie Jenny Christie	No
RE13 Banningham	2	05/06/2017	08.30 -09.15	Dry, BWS 3,	14	Ben Christie Jenny Christie	No
RE13 Banningham	3	09/06/2017	11.00 – 11.45	Dry, BWS 2, 90% cloud cover	17	Ben Christie Jenny Christie	Outside of optimal time range but weather conditions good, warm following rain. No constraint.
RE13 Banningham	4	12/06/2017	11.00 -11.40	Dry, BWS 2-3, 60% cloud cover	16	Ben Christie Jenny Christie	No
RE13 Banningham	5	14/06/2017	09.40 -10.25	Dry, BWS 1, 10% cloud cover	17	Ben Christie Jenny Christie	No
RE13 Banningham	6	16/06/2017	10.00 – 10.45	Dry, BWS 2, 75% cloud cover	17	Ben Christie Jenny Christie	No
RE13 Banningham	7	12/09/2017	08.45 – 09.13	Sunny, BWS2, 10% cloud cover	16	Ben Moore Joe Hassall	Duration 2minutes shorter than protocol, not significant. Weather conditions good No constraint.
RE15 Broomholm	1	30/05/2017	10.20 – 10.45	Dry, BWS1, good visibility	17	Ben Moore Joe Hassall	Duration 5 minutes shorter than protocol, not significant. Weather conditions good No constraint.
RE15 Broomholm	2	20/06/2017	09.20 -09.50	Dry, Slight breeze, 100% cloud cover	18	Carolyn Smith Meghan Senior	No
RE15 Broomholm	3	18/09/2017	16.01 – 16.25	Dry, BWS3, Sunny, 75% cloud cover	18	Ben Moore Joe Hassall	Duration 4minutes shorter than protocol, not significant. Weather conditions good No constraint.
RE15 Broomholm	4	20/09/2017	09.05 – 09.23	Dry, 30% cloud cover	17	Ben Moore Joe Hassall	Duration short. Weather conditions good. Minor constraint.
RE15 Broomholm	5	22/09/2017	10.27 -10.51	Dry, 90% cloud cover	17	Ben Moore Joe Hassall	Duration short. Weather conditions good. Minor constraint.
RE15 Broomholm	6	25/09/2017	16.13 -16.32	Dry, BWS1, 100% cloud cover	18	Ben Moore Joe Hassall	Duration short. Weather conditions good. Minor constraint.
RE15 Broomholm	7	29/09/2017	10.00 -10.23	Dry, 30% cloud cover	17	Ben Moore Joe Hassall	Duration short. Weather conditions good No constraint.

Location	Visit No.	Visit Date ¹	Visit Time ²³	Weather	Temp (°C) ⁴	Surveyors	Constraints?
RE20 Jordon Green	1	16/05/2017	09.15 – 09.45	Dry, BWS3, 30% cloud cover, good visibility	17	Karl Charters Joe Hassall	No
RE20 Jordon Green	2	22/05/2017	09.15 – 09.45	Dry, Still, 0% cloud cover, good visibility	17	Karl Charters Joe Hassall	No
RE20 Jordon Green	3	12/06/2017	09.15 – 09.45	Dry, BWS2, 60% cloud cover, good visibility	15	Karl Charters Joe Hassall	No
RE20 Jordon Green	4	26/06/2017	09.15 – 09.45	Dry, BWS2, 5% cloud cover, good visibility	15	Karl Charters Joe Hassall	No
RE20 Jordon Green	5	30/06/2017	09.15 – 09.45	Dry, BWS2, 5% cloud cover, good visibility	15	Karl Charters Joe Hassall	No
RE20 Jordon Green	6	03/09/2017	16.45 – 17.15	Dry, BWS1, 20% cloud cover, good vis visibility	12	Karl Charters Joe Hassall	No
RE20 Jordon Green	7	12/09/2017	17.15 – 17.45	Dry, BWS3, 20% cloud cover, good visibility	15	Karl Charters Joe Hassall	No
RE21 Cawston	1	06/09/2017	16.00 – 16.27	Sunny, BWS0, clear skies	16	Ben Moore Joe Hassall	Duration 3minutes shorter than protocol, not significant. Weather conditions good No constraint.
RE21 Cawston	2	15/09/2017	10.42 – 11.31	Dry, Sunny, 50% cloud cover	14	Ben Moore Joe Hassall	Outside of optimal time range but weather conditions good and 3 reptiles observed.
RE21 Cawston	3	17/09/2017	09.03 – 09.35	Slight shower before survey start, 60% cloud cover.	16	Ben Moore Joe Hassall	No
RE21 Cawston	4	20/09/2017	10.00 – 10.31	Sunny, 25% cloud cover	18	Ben Moore Joe Hassall	No
RE21 Cawston	5	28/09/2017	09:21 – 09:55	Dry, BWS 1, 30%cloud cover.	17	Ben Moore Joe Hassall	No
RE21 Cawston	6	30/09/2017	10:11 – 10:51	Dry, BWS 2, 50% cloud cover	15	Ben Moore Joe Hassall	No
RE21 Cawston	7	03/10/2017	11.00 – 11.25	18C, Sunny, BWS3, 10% cloud cover	18	Ben Moore Joe Hassall	Duration 5minutes shorter than protocol, not significant. Outside of optimal time range. Weather conditions borderline. Two species present. No constraint.

Appendix 6: Reptiles and their distribution in Norfolk

Grass snakes (*Natrix natrix*)

Grass snakes *Natrix natrix* in particular often roam or disperse over considerable areas and may alter behavior based on available prey. They may therefore appear in unexpected localities. Populations in Norfolk are normally associated with fens and river valleys, but may also be present in woodland and drier grassland habitats. There are no known records (*Chris Smith, personal observation*) of barred grass snake *Natrix helvetica* in Norfolk, which has recently been elevated to full species status and of which there are historical known populations in the UK.

Slow worm (*Anguis fragilis*)

Slow worm *Anguis fragilis* are capable of rapid colonization of sites if there is a change in management e.g. abandonment of meadows or dereliction of brownfield sites. They are generally associated with woodland edge, scrub, tussocky grassland, bracken and brownfield areas, often on light sandy soils and where there is a good litter layer and good habitat mosaics.

Viviparous lizard (*Zootoca vivipara*)

Viviparous lizard *Zootoca vivipara* are increasingly localised in Norfolk (*Chris Smith, personal observation*) and often confined to heathland or acid grassland sites or young forestry, generally on sandier soils, but also on flood defence banks and grazing marsh with clay where there is scattered scrub or suitable refuges with basking areas.

Adder (*Vipera berus*)

Adder *Vipera berus* are very localised in Norfolk, often found in association with sites suitable for or holding viviparous lizard, but also extending more widely into all woodland and forestry habitats, where they hunt small mammals. There are good populations associated with heaths and woodland around Cawston.