FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 8

BIODIVERSITY

List of Appendices

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 8.1

ORNITHOLOGY
REPORT

Results report for ornithological surveys

Fahy Beg Wind Farm, Co. Clare

Report prepared by Woodrow Sustainable Solutions Ltd on behalf of RWE Renewables

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Statement of Authority

This report has been written by Aoife Moroney, who also ran the collision risk models and compiled the CRM results report. Aoife is an Ecologist – Ornithologist with Woodrow Sustainable Solutions Ltd. She has completed a B.Sc. in Engineering at University College Dublin and M.Sc. in Environmental Engineering (specialising in Environmental Management) at the Technical University of Denmark and the Royal Institute of Technology, Sweden. She has also recently completed a Post-graduate Certificate in Ecological Survey Techniques at the University of Oxford. Aoife is highly proficient in data analysis and management as well as mapping using ArcGIS and QGIS. She regularly carries out ornithological surveys and compiles ornithological reports, including carrying out Collision Risk Modelling to inform wind farm planning.

This report has been checked and approved by Mike Trewby. Mike is the company's lead ornithologist and field work manager. Mike worked for Birdwatch Ireland from 2003 to 2010 conducting research on red-billed chough, red grouse and breeding seabirds. Prior to joining Woodrow in 2016, Mike worked as an independent ornithological consultant, and he has over 20 years fieldwork and research experience in the field of ecology. Mike regularly undertakes impact assessments for large scale developments and is a full member of CIEEM.

Ornithological surveys were carried out by Geoff Oliver (GO), Mikee Hoit (MH), Joe Kelly (JK), Daelyn Purcell (DP), Ken Westman (KW) and Mike Trewby (MT).

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- Post-Grad studies – Wetlands Biogeochemistry Centre, Louisiana State University, 1992
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1 Overview

Woodrow Sustainable Solutions Ltd. was commissioned by RWE Renewables to undertake ornithological survey work for the proposed Fahy Beg Wind Farm. The proposal is for an eight-turbine wind farm. The proposed wind farm is located at National Grid Reference: R 63806 70185, approximately 1.5 km north of the village of Bridgetown. The River Shannon flows in a south-westerly direction approximately 3.5 km from the site.

Ornithological surveys, compliant with SNH (2017), commenced for the proposed development in October 2019 and were completed in November 2021.

Summer (breeding season) surveys undertaken included:

- Vantage point (VP) watches recording flight activity through the 500 m turbine buffer
- Breeding bird surveys:
  - Breeding birds, incorporating an adapted Brown & Shepherd and O'Brien & Smith methodology
  - Dusk surveys for crepuscular/nocturnal species
- Wider area surveys:
  - Breeding raptors covering the 2 km turbine buffer

Winter (non-breeding season) surveys undertaken included:

- Vantage point (VP) watches recording flight activity through the 500 m turbine buffer
- Winter site walkover surveys
- Wider area wintering waterbird surveys (year 1 only)
- Hen harrier roost searches

For the purpose of the ornithological surveys, the "study area" was defined as the 500 m turbine buffer – see **Figure 1**.

Figure 2 shows the extent of the 2 km turbine buffer within which breeding raptor surveys were undertaken and also shows the VP locations used for speculative hen harrier roost search surveys.

Wider area wintering waterbird bird surveys covered suitable habitat within a 5 km turbine buffer – see **Figure 3**. This was to incorporate the western bank of the River Shannon, which is hydrologically connected to the study area via the Black River. This area was visible from VP2 and was scanned periodically for larger waterbirds during VP watches, especially for whooper swans, which would be relatively conspicuous over a long range if foraging in the green fields stretching away from the western bank of the Shannon.

This report documents the results from the desk study and surveys to provide the baseline ornithological information required to inform an ornithological impact assessment for the proposed development. This includes avian Collision Risk Modelling (CRM) for target species which is detailed in **Appendix VI** of this report.

2 Desk-based study

An initial desk-based review of the study area and wider area was compiled to determine the appropriate surveys required to inform any potential for ornithological constraints. A preliminary assessment of avian habitat suitability and availability was undertaken using ortho-imagery and 6-inch mapping, which was viewed using Bing Maps, Google Earth Pro, Google Maps, Ordnance Survey Ireland – GeoHive. This was further informed by scoping visits to the area undertaken in October 2019.

The NPWS Designations Viewer was used to identify the location of sites designated for nature conservation, specifically Special Protection Areas (SPAs) and the bird species (Qualifying Interests) for which these sites have been designated. Shapefiles and metadata for designated sites have been downloaded and are updated annually for use by Woodrow ecologists on local GIS. EPA Maps, a mapviewer was used to investigate hydrological connectivity to sites designated for nature conservation. Special Protection Areas (SPA) within 15 km of (or with a hydrological connection to) the proposed development are listed in **Table 1** and are shown in **Figure 4**.

Bird records from the last 10 years were collated from the National Biodiversity Data Centre (NBDC) database, using the report function on Biodiversity Maps to generate a biological records data report. The majority of these records are based on the Bird Atlas 2007-11 (Balmer *et al*., 2013). The search area extended to *c*. 10 km from the potential development lands, which fall within two adjacent national grid squares R66 and R67. These records were reviewed to investigate the target species potentially occurring within the 500 m turbine buffer and wider area to inform survey design and identify any potential ornithological constraints. These historical records and their conservation status (Gilbert *et al*. 2021) are list in **Table 2**.

Biodiversity Maps was also used to examine other relevant data sets including the BirdWatch Ireland bird sensitivity to wind energy layer, as per Mc Guinness *et al*. (2015). For the species assessed, the 500 m turbine buffer was classified as having a low sensitivity for avian constraints. The majority of the wider area (2 km buffer) was also classed as low sensitivity, with the area of open bog/heathland and conifer plantation to the north of the proposed development (Glennagalligh Mountain and Slieve Bearnagh) classed as medium sensitivity. This classification was driven by proximity to areas identified for breeding hen harrier and red grouse. The results from the national hen harrier (Ruddock *et al*., 2016) and red grouse (Cummins *et al*., 2010) surveys were reviewed to investigate breeding distribution for both species.

Based on SNH (2017) guidelines, migratory populations of wintering geese and swans are considered as species notably sensitive to wind farm developments. To characterise the distribution of these, populations data from recent population monitoring have been reviewed, including:

- Boland & Crowe (2008) and Lewis *et al*. (2019b) for greylag goose distribution
- Burke *et al*. (2021) for whooper swan
- Fox *et al*. (2021) for Greenland white-fronted goose distribution.

2.1 Special Protection Areas (SPAs)

All SPAs within 15 km of the study area (or with a direct hydrological connection) are listed in **Table 1** and **Figure 4** shows the location of SPAs within 15 km of the proposed development. There are no

SPAs within 5 km of the study area. There is a downstream hydrological connection to the River Shannon and River Fergus Estuaries SPA, which is designated for a large number of wetland and waterbirds, see **Table 1**. This connection is via the Black River (EPA code: 25B22), the catchment which drains the majority of the proposed development area. The western end of the proposed development area is also hydrologically connected to this SPA, via the Broadford River (EPA code: 27B02) and eventually flows into the Shannon Estuary via the Owenogarney River (EPA code: 27O01) at Bunratty.

SNH guidelines recommend that core foraging ranges of species should be examined to assess connectivity between the site and surrounding SPAs (SNH, 2016, 2017). As detailed in **Table 1**, the closest SPA to the study area is Lough Derg (Shannon) SPA, which lies 6.1 km north-east. This SPA supports nationally important wintering populations of mute swan, wigeon, teal, shoveler, tufted duck, goldeneye, little grebe, great crested grebe, cormorant and coot (Lewis *et al*., 2019b).

There is a greylag goose population associated with the Lough Derg (Shannon) SPA and small flocks of Greenland white-fronted geese have historically occurred around Portumna and in the Scarriff Bay area (NPWS, 2014 – site synopsis for Lough Derg (Shannon) SPA: 004058). Based on SNH (2016), the proposed development area is considered to lie within potential core foraging distances for greylag geese (15-20 km) and Greenland white-fronted geese (5-8 km). However, the historical white-front sites are no longer in use and greylag geese on Lough Derg are considered to be part of the feral (resident) population, as opposed to the migratory Icelandic population that are of higher conservation concern (Lewis *et al*., 2019b). Geese and swans are species which take regular commuting flights and, as such, VP surveys are used determine whether the study area lies within a regular commuting route.

As can be seen in **Figure 4** and **Table 1**, the study area lies between two SPAs designated for hen harrier and merlin, including:

- Slievefelim to Silvermines Mountains SPA 11.5 km south-east
- Slieve Aughty Mountains SPA 15 km north-west

According to SNH (2016), the study area lies outside of the reported 5 km core foraging area for merlin. While the core breeding season foraging range for hen harrier is reported as 2 km, a maximum foraging range of 10 km is reported (SNH, 2016); and ornithological surveys should therefore take care to assess whether this QI species is utilising the proposed development area (SNH, 2017). This will be informed using flightline data from VP surveys, wider area breeding raptor surveys and hen harrier roost surveys.

2.2 Wintering waterbirds

The only waterbodies within the 500 m turbine buffer are small 1st or 2nd order streams and drains which are associated with hedgerows, treelines and scrub. These are not capable of supporting significant densities of waterbirds. The closest larger water bodies are *c*. 2.5 km from the development site and include the River Shannon, the Ardnacrusha Canal and Mc Namara's Lake, which lies between Bridgetown and O'Briensbridge. The study area is not documented as supporting any nationally or internationally important numbers of wintering waterbirds or sensitive wintering wetland species, especially swans or geese (Crowe, 2005; Boland & Crowe, 2012; Lewis *et al*., 2019b). The nearest areas containing internationally/nationally important populations of waterbirds are Lough Derg (6.1 km north-east) and the River Shannon Estuary (14.3 km south-west), which are designated as SPAs – see **Figure 4**.

Agricultural fields along the banks of the River Shannon and Ardnacrusha Canal were judged to have the potential to support wintering waterbirds, including whooper swans and migratory grey geese. There are no historical records of swans or geese consistently occurring along the western banks of the Ardnacrusha Canal or between the sluice gate (Parteen Wier) and Killaloe. The closest whooper swan flocks are reported from the Birdhill area and along the River Shannon south of Castleconnell, areas which are *c*. 5 km west and *c*. 7.5 km from the proposed development (500 m turbine buffer), respectively (NBDC Biodiversity Maps – Birds of Ireland, Crowe *et al*., 2015 and Burke *et al*., 2021). Only small flocks (< 50 birds) have been recorded and for this species distances > 5 km are considered beyond the zone of influence for proposed developments (SNH, 2016). Similarly, small numbers of greylag geese (< 30 birds) are reported for the area in the winter. These are likely to be part of the feral (resident) population that breed along the River Shannon and on Lough Derg, as opposed to the migratory Icelandic population that are of higher conservation concern (Balmer *et al*., 2013, Boland & Crowe, 2008; Lewis *et al*., 2019b).

In terms of wintering waders, several species can often be found inland away from coastal hotspots, in particular snipe, golden plover and lapwing, as well as curlew, black-tailed godwits and ringed plover. The site is relatively distant from the large concentrations of wintering waterbirds attracted to Lough Derg, the River Shannon and its estuary. In addition, based on the limited habitat availability on the upland slopes of the site, where woodland impinges into the heathland, it was considered unlikely the area would consistently support any significant numbers of wintering waders. The occurrence of plantations and long-established broadleaved woodland were judged to offer potential habitat for wintering woodcock.

2.3 Breeding waders

There are no recent records of curlew, golden plover or lapwing within either of the 10 km squares covering the site. The agriculturally improved nature of the farmland present in the southern part of the 500 m turbine buffer was judged to be largely unsuitable for supporting breeding waders, although there are some less managed fields dominated by *Juncus* species providing potential cover for nesting curlew and occasional patches of wet ground offering potential habitat for breeding snipe. Open heathland to the north of the 500 m turbine has the potential to support upland breeding waders including golden plover and curlew, as well as snipe. However, the fragmented nature of the open bog, due to commercial forestry, means it is unlikely to support viable breeding wader populations.

The large areas of plantation and long-established broadleaved woodland have the potential to support breeding woodcock. Historically, woodcock have been confirmed breeding within both 10-km squares encompassing the proposed development. However, the most recent Bird Atlas did not record breeding in this region, although wintering birds were recorded (Balmer *et al*., 2013). A recent reduction in Irish breeding range for woodcock means that the breeding population is red listed (Gilbert *et al*. 2021), although the winter component which see an influx of continental birds remains green listed.

2.4 Birds of prey

Habitat availability within the 2 km buffer (see **Figure 2**) was considered potentially suitable for breeding hen harrier, buzzard, sparrowhawk, merlin and kestrel. The area also has the potential to support long-eared owls and barn owls.

Hen harriers

The last National Breeding Hen Harrier Survey conducted in 2015 confirmed the presence of breeding hen harrier within one of the 10 km squares encompassing the proposed development (Ruddock *et al*., 2016). The study reported up to four pairs within the northern square [R67] and noted possible breeding within the southern square [R66], although the occurrence of archetypical hen harrier breeding habitat is lacking in the southern square. In terms of habitat suitability, the 2 km buffer (see **Figure 2**) is considered to have some potential to support this ground-nesting species, including heathland and open thicket plantation in the north, which stretches from the southern extent of Glennagalligh Mountain to the summit of Lackareagh Mountain, directly adjacent to the 500 turbine buffer. A factor likely to limit occupation of the upland habitats on Lackareagh Mountain, closer to the proposed development, is the narrow availability of the more open foraging habitat capable of maintaining the densities of upland passerines and red grouse required to support a pair of breeding hen harrier. The larger expanses of open upland habitat and associated forestry located *c*. 2.5 km north of the 500 m turbine buffer, stretching north from Glennagalligh Mountain and onto Slieve Bearnagh, are considered to provide more substantive home range options for breeding hen harriers.

Though traditionally hen harrier prefer to nest within heather, following the decline of this habitat in Ireland pairs are increasingly being recorded utilising young conifer plantations (Wilson *et al.,* 2006). It is therefore important to note that, depending on ongoing forestry operations in the area, habitat suitability is likely to change over the next 5-10 years, leading to areas of clearfell/second rotation becoming occupied prior to or during construction and operation of the proposed wind farm.

Merlin

In terms of other upland raptors, the presence of conifer plantation and older woodland adjacent to open bog provides potential breeding habitat for merlin. Like hen harrier, merlin are traditionally a ground-nesting species that have taken to utilising old tree nests of other species, in particular those of corvids, due to the absence of suitable habitat in Ireland (Lusby *et al*., 2017). As for hen harriers, the narrow availability of the more open foraging habitat directly north of the proposed development area limits the overall suitability for merlin and this species is likely to favour areas further north on Slieve Bearnagh.

Other raptors

Buzzard, sparrowhawk and kestrel are widespread resident species in Ireland and, based on habitat availability, are likely to be breeding within the 2 km buffer. While buzzard and sparrowhawk are both green listed, the conservation status for kestrel was upgraded over the course of the baseline study from amber to red (Colhoun & Cummins, 2013 and Gilbert *et al*., 2021). As reported in Lewis *et al*. (2019a), both breeding numbers and distribution of kestrels have declined significantly, which is thought to have been driven by changes in prey availability due to agricultural intensification (Wilson-Parr & O'Brien, 2019), as well as secondary rodenticide poisoning. Flight behaviour means kestrels are a species emerging as notably susceptible to collision with turbines and this is acknowledged within the CRM, which is run with a lowered avoidance rate for kestrel (95% avoidance rate).

In Ireland, cliffs in quarries can provide suitable nesting ledges for breeding peregrines (Moore *et al.,* 1997). The sand and gravel quarries south of the proposed development do not provide suitable cliffs and the 2 km buffer was assessed as providing no suitable nesting habitat for peregrines. The closest obviously suitable habitat was identified at a quarry *c.* 8.5 km southwest from the proposed development area. There are also reports of a breeding site to the northwest of the proposed development site (Balmer *et al*., 2013), again beyond the 2 km buffer.

Owls

The lower-lying, open agricultural areas with associated scrub and veteran trees in old growth woodland/treelines provide suitable nesting and foraging habitat for barn owl, and there are contemporary records for the species in the wider area. In Ireland, foraging distances from nest sites can extend up to 6 km and even as far as 9 km; however, the core breeding season home range is documented to be 4 to 5 km from the nest (Lusby & Cleary, 2014, TII 2021). This is further than the 1 km search area recommended by the SNH (2017) survey guidelines for breeding barn owls (owls other than short-eared owls). Likewise, the documented extent for breeding season home ranges for Irish barn owls exceeds the *zone of sensitivity* given for barn owls in relation to wind farm developments in Mc Guinness *et al*. (2015), which is 2 km.

Barn owls are reported as successfully breeding at a large wind farm in Scotland, with the number of pairs increasing after the provision of nest boxes, e.g. Crystal Rig Wind Farm[1]. It is generally considered that low level flight behaviour of barn owls (typically < 3-4 m) limits collision risk with larger turbines in the UK (and Ireland) where lattice towers are not commonly employed (Barn Owl Trust, 2015).

The woodland habitats within the 500 m buffer are suitable for long-eared owls and it is likely that this green listed species breeds in the area. As for barn owls, impacts from wind farm developments are more likely to be associated with removal of suitable habitats than potential collision risk.

The occurrence of heathland/bog in association with plantations within the 2 km turbine buffer provides potential habitat for breeding short-eared owl. However, this species, although more regularly recorded in habitats backing the coast over the winter, is a notably rare and occasional breeder in Ireland (Hutchinson, 1989) and is therefore unlikely to breed in the vicinity of the proposed development. This species is also highly nomadic, with recent GPS data recording one female breeding in both Scotland and Norway within the same year (Darvill, 2020). As such, it may be less vulnerable to landuse changes than barn owl, which remain in the same territory throughout their lives with traditional nest sites sometimes being occupied by successive generations (Lusby & O'Cleary, 2014). The closest reported sporadic breeding locations are within the SPA encompassing the Mullaghareirk Mountains, Counties Limerick/Cork/Kerry (NPWS, 2015: – site synopsis for Stack's to Mullaghareirk Mountains, west Limerick hills and Mount Eagle SPA: 004161).

1 As reported at: http://www.pes.eu.com/wind/ornithological-plan-leads-to-barn-owl-success/

2.5 Other species of conservation concern

Kingfisher

Kingfishers are known to occur along watercourses downstream of the proposed development (Balmer *et al.*, 2013). This species is listed on Annex I of the Birds Directive, however, there are no SPAs designated for kingfisher within the zone of influence for the proposed development. While there are watercourses within the 500 m turbine buffer (see **Figure 3**), these 1st order streams were considered too small to support any substantial kingfisher foraging or commuting activity. In addition, the banks of the streams were found to be unsuitable for breeding kingfishers and did not provide any of the exposed banks favoured by this species.

Red grouse

Red grouse occur almost exclusively in open bog and heathland. Suitable habitat occurs to the north of the 500 m turbine buffer on Lackareagh Mountain, with more extensive areas stretching over Slieve Bearnagh. Red grouse are known to occur on the hills to the north of the proposed development (Cummins *et al.*, 2010). However, the occurrence of woodland and agriculturally improved grassland within the 500 m turbine buffer effectively excludes this species from occurring within the proposed development area. Red grouse populations occurring in the wider area are beyond the 500 m *zone of sensitivity* reported for this species in Mc Guinness *et al.* (2015) and therefore will not be affected by this proposal.

Swift

As for kestrel, the conservation status of swifts was upgraded over the course of the baseline study from amber to red (Colhoun & Cummins, 2013; Gilbert *et al.*, 2021). There is potential for swifts to forage through the proposed development area over the summer months while nesting in the buildings of nearby towns and villages. Depending on weather conditions swifts often forage at heights of 50 to 100 m placing them within the collision risk zone of wind turbines. As swifts are habituated to manmade structures, it is considered unlikely that foraging birds will be displaced by operational turbines. Conversely this species (along with swallows and other hirundines) may be actively drawn towards turbines to glean insects that are attracted to/more active around turbine towers and hardstands (Rydell *et al.*, 2012). While the mechanism and potential effects are poorly understood at this stage, it is considered likely that this behaviour leads to heightened collision risk for this species. In Germany 3% of 1,192 reported fatalities due to collisions with wind turbines between 1989 and 2010 were swifts, which when combined with swallow mortality was proportionally higher than would be expected for small, fast-flying and mobile species like swifts and hirundines (Dürr, 2010 in Rydell *et al.*, 2012).

Nightjar

Areas of forestry plantation in upland habitats, specifically drier areas in young plantation and clearfell, as well as associated scrub and bracken have the potential to support another crepuscular/nocturnal breeding species, namely nightjars. This red listed species is a very rare breeder in Ireland with plantations on the Galtees and Knockmealdowns in Counties Tipperary/Waterford supporting the limited number of contemporary breeding records. It is considered very unlikely that nightjars occur in the vicinity of the proposed development.

Rare passerines

As detailed in SNH (2017), it is considered that most passerines are at low risk from collision with wind turbines; as flight behaviour makes them less susceptible to collisions and population dynamics (e.g. high fecundity and rapidly attaining sexual maturity). This means that any fatalities due to collisions are unlikely to impact on passerine communities at the population level. The exception may be rarer breeding passerines, which in an Irish context would include whinchat, ring ouzel, tree sparrow and yellowhammer. There are no documented populations of rare breeding passerines occurring in the vicinity of the proposed development (Balmer *et al.,* 2013).

Table 1: Special Protection Areas (SPAs) within 15 km of the proposed Fahy Beg Wind Farm

SPA	Distance to proposed site	Qualifying Interests (QIs)
Lough Derg (Shannon) SPA Site code: 004058	*c.* 6.1 km north-east	• Cormorant *(Phalacrocorax carbo)* [A017] • Tufted Duck *(Aythya fuligula)* [A061] • Goldeneye (*Bucephala clangula*) [A067] • Common Tern *(Sterna hirundo)* [A193] • Wetland and Waterbirds [A999]
Slievefelim to Silvermines Mountains SPA Site code: 004165	*c.* 11.5 km south-east	• Hen Harrier *(Circus cyaneus)* [A082]
River Shannon and River Fergus Estuaries SPA Site code: 004077	*c.* 14.3 km south-west in direct distance & *c.* 28 km via the River Shannon	• Cormorant *(Phalacrocorax carbo)* [A017] • Whooper Swan *(Cygnus cygnus)* [A038] • Light-bellied Brent Goose (*Branta bernicla hrota)* [A046] • Shelduck *(Tadorna tadorna)* [A048] • Wigeon *(Anas penelope)* [A050] • Teal *(Anas crecca)* [A052] • Pintail *(Anas acuta)* [A054] • Shoveler *(Anas clypeata)* [A056] • Scaup *(Aythya marila)* [A062] • Ringed Plover *(Charadrius hiaticula)* [A137] • Golden Plover *(Pluvialis apricaria)* [A140] • Grey Plover *(Pluvialis squatarola)* [A141] • Lapwing *(Vanellus vanellus)* [A142] • Knot *(Calidris canutus)* [A143] • Dunlin *(Calidris alpina)* [A149] • Black-tailed Godwit *(Limosa limosa)* [A156] • Bar-tailed Godwit *(Limosa lapponica)* [A157] • Curlew *(Numenius arquata)* [A160] • Redshank *(Tringa totanus)* [A162] • Greenshank *(Tringa nebularia)* [A164] • Black-headed Gull *(Chroicocephalus ridibundus)* [A179] • Wetland and Waterbirds [A999]
Slieve Aughty Mountains SPA Site code: 004168	*c.* 15 km north-west	• Hen Harrier *(Circus cyaneus)* [A082] • Merlin *(Falco columbarius)* [A098]

Table 2: NBDC bird records for target species within 10km from 2011-2022

Species listed on Annex I of the EU Birds Directive are indicated with * and the BOCCI column refers to whether conservation concern status applies to wintering (Win) or breeding (Br) populations.

Common Name	Scientific Name	BoCCI Status	Count	Date of last record
Red listed species are those which are of highest conservation concern where the population is rapidly declining in abundance or range, has experienced a historic rapid decline (without recovery) or are globally threatened.				
Barn Owl	*Tyto alba*	Red Br	2	31/10/2019
Common Goldeneye	*Bucephala clangula*	Red Win	4	31/12/2011
Common Kestrel	*Falco tinnunculus*	Red Br	10	31/12/2011
Common Pochard	*Aythya ferina*	Red Br. & Win	2	31/12/2011
Common Redshank	*Tringa totanus*	Red Br. & Win	2	31/12/2011
Common Snipe	*Gallinago gallinago*	Red Br. & Win	6	31/12/2011
Common Swift	*Apus apus*	Red Br	8	06/06/2011
Dunlin*	*Calidris alpina*	Red Br. & Win	2	31/12/2011
European Golden Plover*	*Pluvialis apricaria*	Red Br. & Win	2	31/12/2011
Greater Scaup	*Aythya marila*	Red Win	2	31/12/2011
Grey Wagtail	*Motacilla cinerea*	Red Br	8	31/12/2011
Red Grouse	*Lagopus lagopus*	Red Br	9	25/07/2017
Amber listed species are those with unfavourable European status, occur in internationally important numbers or are moderately declining in abundance or range. May also be Amber listed if population occurs in very small numbers.				
Barn Swallow	*Hirundo rustica*	Amber Br	18	31/12/2011
Black-headed Gull	*Larus ridibundus*	Amber Br. & Win	11	31/12/2011
Common Coot	*Fulica atra*	Amber Br. & Win	12	31/12/2011
Common Kingfisher*	*Alcedo atthis*	Amber Br	7	31/12/2011
Common Tern*	*Sterna hirundo*	Amber Br	3	31/12/2011
Eurasian Teal	*Anas crecca*	Amber Br. & Win	4	31/12/2011
Great Cormorant	*Phalacrocorax carbo*	Amber Br. & Win	5	31/12/2011
Great Crested Grebe	*Podiceps cristatus*	Amber Br. & Win	11	31/12/2011
Greylag Goose	*Anser anser*	Amber Win	4	31/12/2011
Hen Harrier*	*Circus cyaneus*	Amber Br	6	31/12/2011
House Martin	*Delichon urbicum*	Amber Br	7	31/12/2011
Lesser Black-backed Gull	*Larus fuscus*	Amber Br. & Win	2	31/12/2011
Mallard	*Anas platyrhynchos*	Amber Br. & Win	12	31/12/2011
Mute Swan	*Cygnus olor*	Amber Br. & Win	12	31/12/2011
Ruff*	*Philomachus pugnax*	Amber Passage	2	31/12/2011
Sand Martin	*Riparia riparia*	Amber Br	7	31/12/2011
Tufted Duck	*Aythya fuligula*	Amber Br. & Win	12	31/12/2011
Whooper Swan*	*Cygnus cygnus*	Amber Br. & Win	2	31/12/2011
Green List birds are not considered threatened.				
Common Moorhen	*Gallinula chloropus*	Green	8	31/12/2011
Eurasian Sparrowhawk	*Accipiter nisus*	Green	8	31/12/2011
Grey Heron	*Ardea cinerea*	Green	4	31/12/2011
Little Grebe	*Tachybaptus ruficollis*	Green	7	31/12/2011
Common Gull	*Larus canus*	Green	5	31/12/2011
Peregrine Falcon*	*Falco peregrinus*	Green	2	31/12/2011
Water Rail	*Rallus aquaticus*	Green	2	31/12/2011
White-throated Dipper	*Cinclus cinclus*	Green	5	31/12/2011

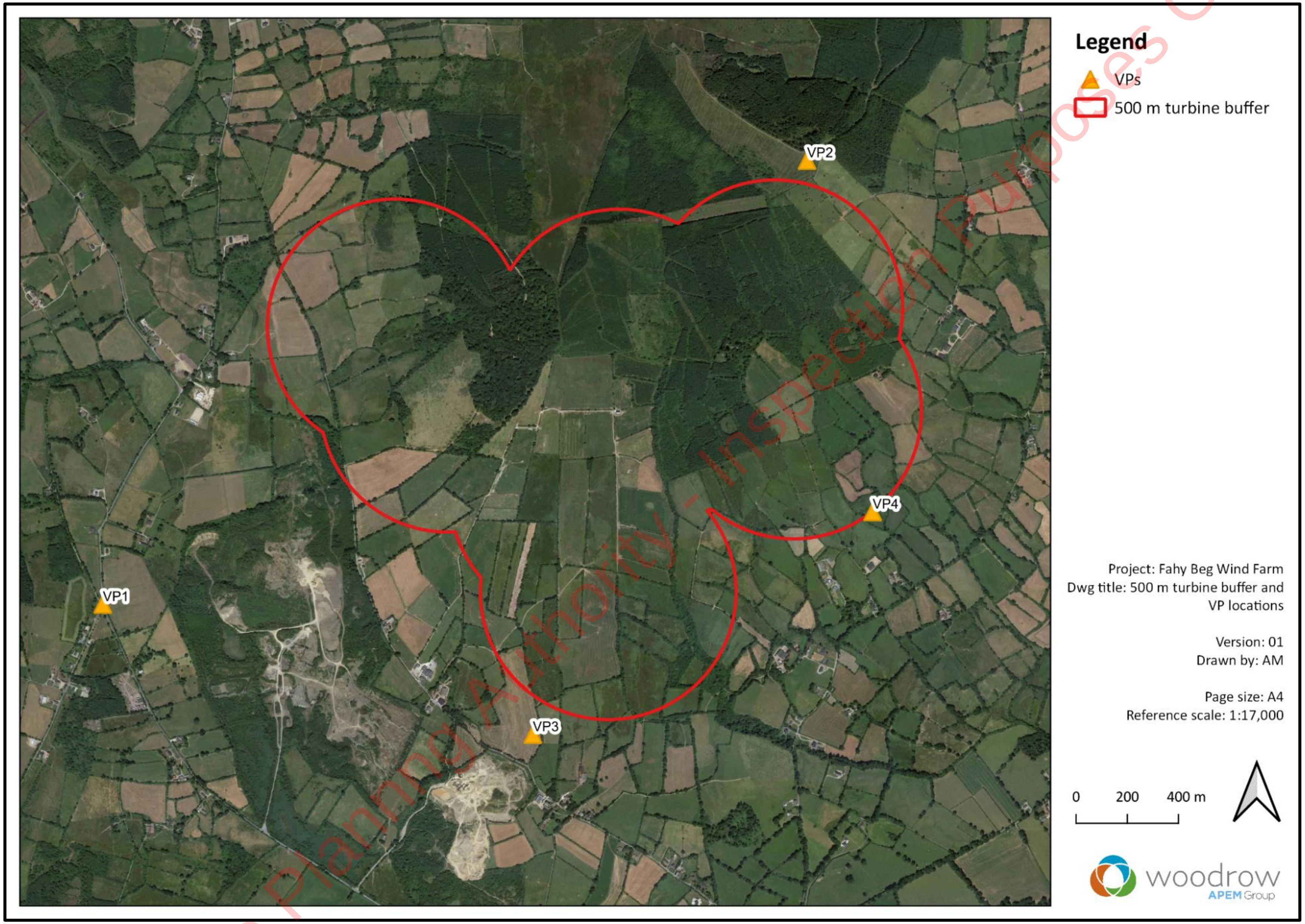

Figure 1: VPs used for collecting flight line data and 500 m buffer of proposed turbine locations

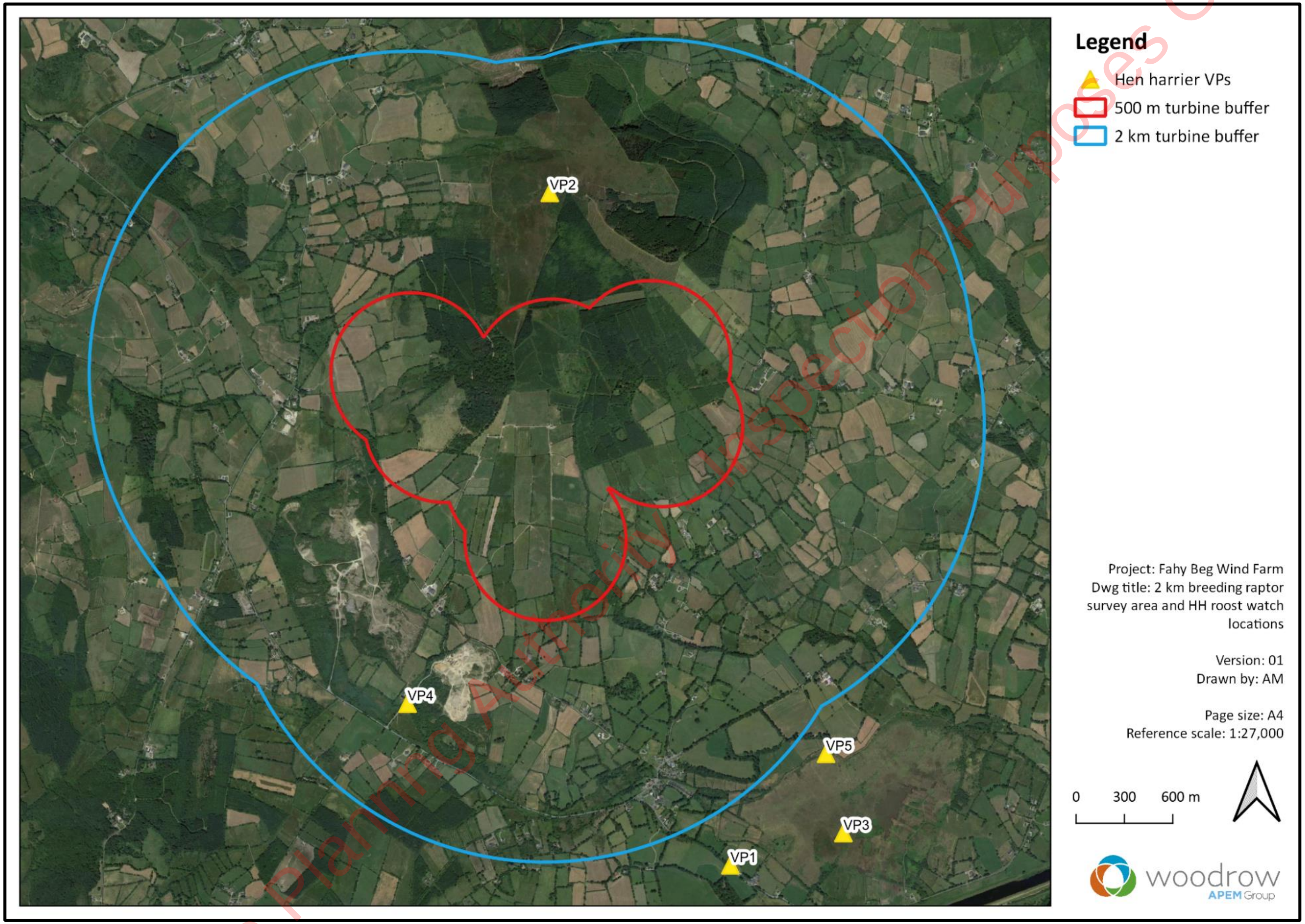

Figure 2: Survey area (2 km turbine buffer) for breeding raptors and hen harrier roost watch VPs

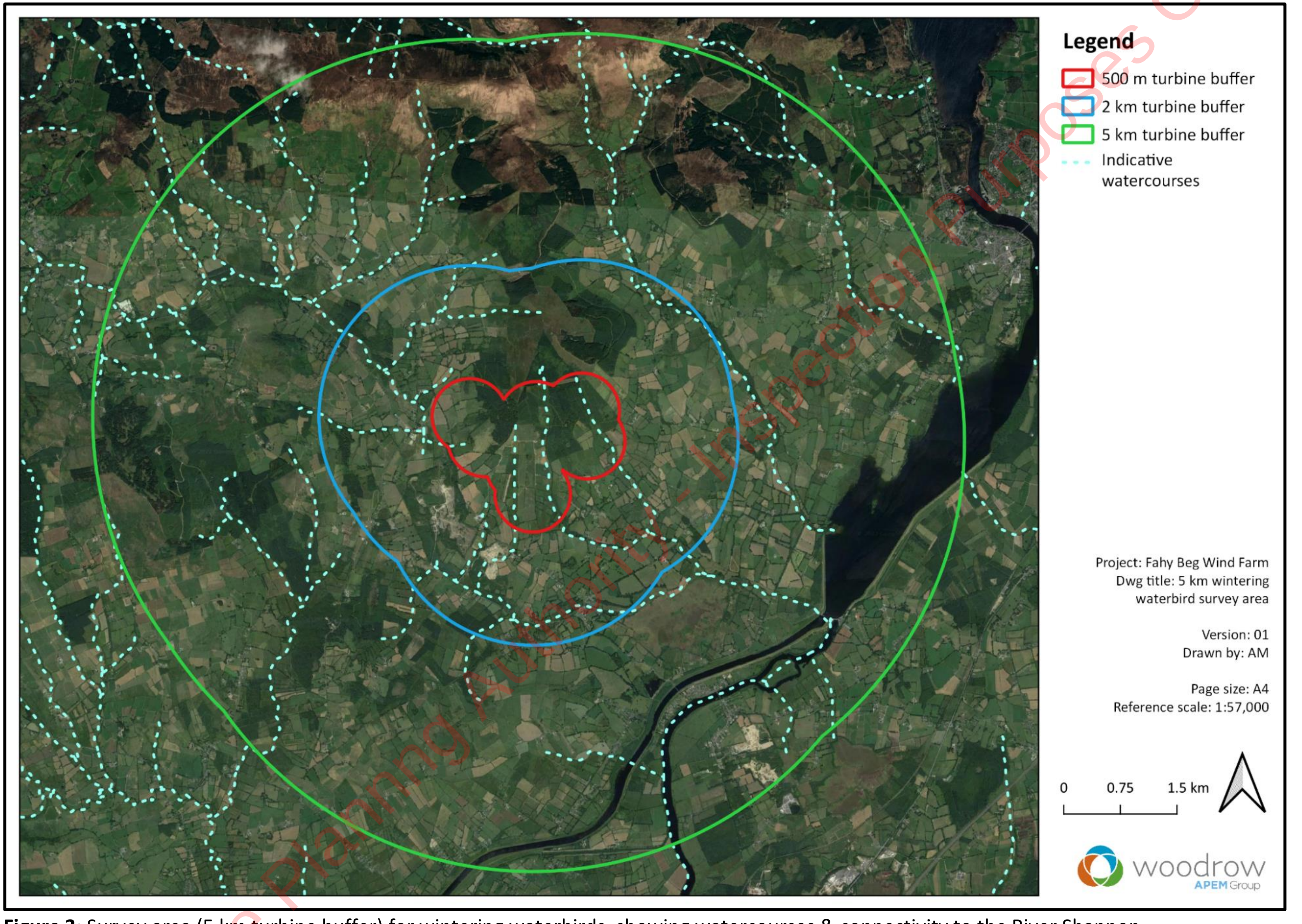

Figure 3: Survey area (5 km turbine buffer) for wintering waterbirds, showing watercourses & connectivity to the River Shannon

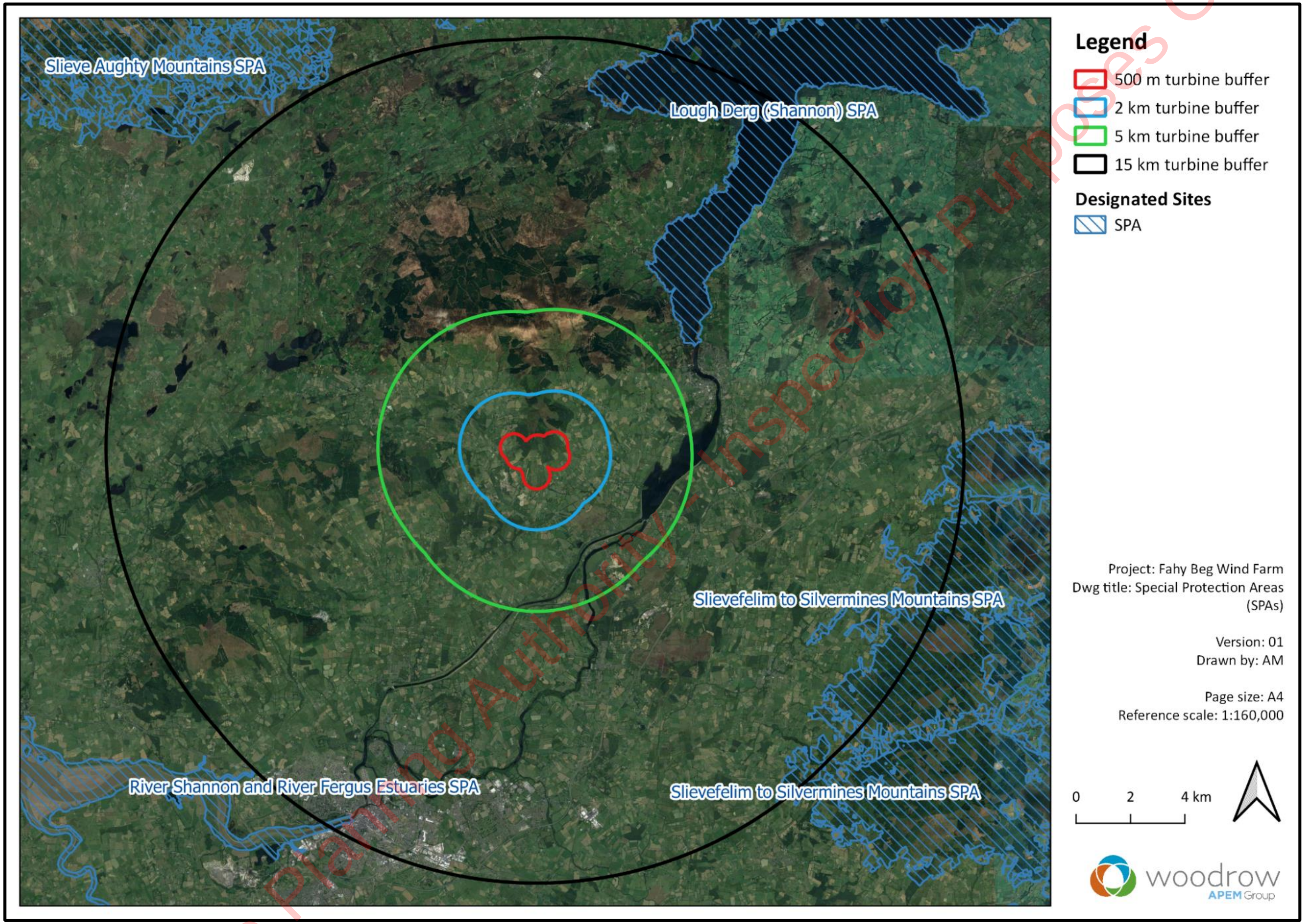

Figure 4: Special Protection Areas (SPAs) within 15 km of the proposed turbine locations

3 Methodology & survey effort

Scottish Natural Heritage (SNH) (2017) guidelines provide recommended survey methodologies for the assessment of avian populations within and adjacent to onshore wind farms. Survey methodologies utilised for ornithological surveys are outlined in the following sections and adhere to the relevant SNH guidance.

Two-years of ornithological surveys are recommended by the SNH guidelines, unless it can be clearly demonstrated that a single year of data is sufficiently robust and appropriate for assessing the potential impacts of the proposal.

3.1 Vantage Point (VP) watches

VP watches record flight-line activity in relation to the 500 m turbine buffer to provide data on selected target species for assessing avian collision risk. Four VPs were used to cover the study site the locations of which are shown in **Figure 1**. These four VPs provide complete coverage (99.66%) of the 500 m buffer around proposed turbine locations – see **Appendix II** for viewshed map and **Table A6.4** in **Appendix VI**. The VPs selected to cover the study area are compliant with the SNH (2017) guidelines, which stipulate that viewsheds from VPs should not extend more than 2 km and that the angle of view should also not be extended beyond an arc of 180 degrees.

Based on viewsheds extending 2 km, the viewsheds of the VPs all overlap somewhat. Therefore, it is acknowledged that as a function of coverage (survey effort), the flight seconds reported cumulatively for all the VP watches will provide an overestimate for flight times. This is corrected for in the CRM. The conducting of VP watches simultaneously by two or more surveyors was therefore avoided in order to avoid any duplication of flight records. To limit observer fatigue, surveyors did not typically undertake VP watches of more than 3-hours in duration without a break, unless inclement periods of weather meant watches were paused for short durations until conditions improved.

Target species are those identified as being at risk from displacement effects caused by wind farm developments or from collision with turbines. Target species for which flight-line data was captured included the following species groups:

- Waders;
- Wildfowl (ducks, geese and swans);
- Other waterbirds (including cormorants, divers, grebes, herons, rails, crakes and gulls);
- Raptors and owls;
- Any species listed on Annex I of the Birds Directive;
- Any species listed as Red on the BoCCI 2020-26 (Gilbert *et al*., 2021)

  Note: During the study swifts were upgraded to red listed (Gilbert *et al*., 2021); and therefore, in the second breeding season (2021) swifts were included as target species during VP surveys.

VP watches involve the surveyor observing birds from a stationary position using binoculars and a telescope. In accordance with SNH (2017), the viewshed of the VP is scanned at 5 minute intervals. When a target species is seen, the surveyor estimates the height of the bird and its usage of the area by drawing its flight path on a map and noting its behaviour. Flight heights are estimated visually. Other data collected includes the number of birds, time of detection and duration of flight, as well as sex and age class if relevant. A list of all non-target species encountered within the environs of the development area is also compiled during watches, though priority is given to recording target species in the case of busier survey days.

As detailed in **Table 3**, a minimum of 36 hours of watches have been collected per VP per season, amounting to 582 hours of watches for all four VPs.

3.2 Collision Risk Modelling

VP watches are conducted to collect flight line data which can then be used to model collision risk. For target species generating sufficient levels of flight time within the zone of collision risk, data sets are run through a CRM, as detailed in SNH (2000) and Band *et al*. (2007), employing avoidance rates as given in SNH (2016, 2018). This provides estimates of the number of collisions per annum and for the lifetime of the proposed wind turbines (30 years). A detailed methodology of the CRMs used, along with results, is provided in **Appendix VI.**

Table 3: Dates and duration of VP watches undertaken at the proposed Fahy Beg Wind Farm

Non-breeding season 2019-20				
Date	**VP1**	**VP2**	**VP3**	**VP4**
10/10/2019	1	1		
18/10/2019	3	3		
21/10/2019			3	3
22/10/2019	3		3	3
25/10/2019		1		
26/10/2019		2	3	
27/10/2019	1.5			3
28/10/2019	1.5	2		2
04/11/2019	3			
12/11/2019		3		
14/11/2019			3	3
16/11/2019	3			
22/11/2019		3		
23/11/2019	2	3		
24/11/2019			2	
25/11/2019			2	
27/11/2019				2
29/11/2019				2
11/12/2019			3	3
12/12/2019		3		
29/12/2019		3	3	
30/12/2019	1			3
31/12/2019	2			
12/01/2020	1.5		3	
15/01/2020	2.5			
19/01/2020		3		
30/01/2020	1			
31/01/2020	1		2	3
01/02/2020		3		
03/02/2020	2			
04/02/2020			3	3
20/02/2020		3	3	
25/02/2020	3			
02/03/2020	3		3	
03/03/2020		3		3
10/03/2020	1			3
Total	**36**	**36**	**36**	**36**

Breeding season 2020				
Date	**VP1**	**VP2**	**VP3**	**VP4**
16/03/2020	3			
18/03/2020			3	
24/03/2020		3		3
17/04/2020	3		3	
18/04/2020		3		3
23/04/2020	3	3		
25/04/2020			3	3
27/04/2020		3		
01/05/2020	3		3	
02/05/2020		3		3
08/05/2020	3		3	
13/05/2020		3		3
19/05/2020		3		
20/05/2020	3			
24/05/2020			3	3
03/06/2020	3		3	
05/06/2020		3		3
22/06/2020	3	3		
25/06/2020			3	3
08/07/2020	3		3	
11/07/2020				3
23/07/2020	3		3	
28/07/2020		3		3
19/08/2020	3		3	
21/08/2020		3		
23/08/2020				3
24/08/2020	3	3		
26/08/2020			3	
28/08/2020				3
31/08/2020		3		
Total	**36**	**39**	**36**	**36**

Non-breeding season 2020-21				
Date	VP1	VP2	VP3	VP4
25/09/2020		3		3
29/09/2020	3		3	
14/10/2020			3	
15/10/2020		3		3
16/10/2020	3			
23/10/2020	3			
26/10/2020		3		
27/10/2020			3	3
06/11/2020	3		3	
07/11/2020				3
16/11/2020		3		
23/11/2020	3		3	
26/11/2020		3		3
01/12/2020	3			
04/12/2020			3	
08/12/2020		3		3
12/12/2020	3			
15/12/2020			3	
24/12/2020				3
28/12/2020		3		
02/01/2021				3
04/01/2021			3	
05/01/2021	3	3		
06/01/2021				3
07/01/2021			3	
29/01/2021	3	3		
11/02/2021	3			
13/02/2021			3	
14/02/2021		3		
16/02/2021				3
20/02/2021	3			
21/02/2021			3	
22/02/2021		3		3
02/03/2021	3		3	
04/03/2021				3
15/03/2021		3		
Total	36	36	36	36

Breeding season 2021				
Date	VP1	VP2	VP3	VP4
20/03/2021	3			
27/03/2021			3	
29/03/2021		3		3
03/04/2021	3		3	
05/04/2021		3		3
12/04/2021			3	3
16/04/2021		3		
23/04/2021	3			
04/05/2021		3		
06/05/2021	3		3	
08/05/2021			3	
12/05/2021				3
17/05/2021		3		
19/05/2021				3
24/05/2021	6			
01/06/2021	3			3
02/06/2021		3		
03/06/2021			3	
04/06/2021	3			
08/06/2021		3		
18/06/2021			3	3
21/06/2021			3	3
25/06/2021	3			
29/06/2021		3		
01/07/2021	3			
02/07/2021			3	
06/07/2021		3		
09/07/2021				3
20/07/2021	3			
21/07/2021		3		
23/07/2021			3	
31/07/2021				3
03/08/2021	3			
04/08/2021		3		
06/08/2021				3
08/08/2021			3	
13/08/2021	3		3	
20/08/2021		3		
21/08/2021				3
Total	39	36	36	36

3.3 Breeding bird surveys

The purpose of the site walkovers or point counts, according to SNH guidelines, is to give a broad overview of bird activity in the study area using a route which is representative of the important ornithological features/habitats present (SNH, 2017). Breeding bird surveys aim to provide information on the distribution of breeding birds throughout the proposed development site and ornithological study area, highlighting the locations of potentially sensitive species to be flagged as ecological constraints, e.g. breeding waders or raptors. Various methods are employed depending on the habitat type and the expected species. Walkovers through the proposed development site (including the 500 m turbine buffer) employed a range of surveys determined by desk-based study such as proximity to designated sites, habitat availability and associated avian assemblages.

Based on topography and habitat availability, the desk-based study determined that the 500 m turbine buffer had the potential to support a range of target species, including upland breeding birds (e.g. hen harrier, merlin, red grouse, golden plover, curlew and snipe), lowland breeding waders (e.g. snipe, curlew and lapwing) and crepuscular/nocturnal woodland species (e.g. woodcock and long-eared owls).

For upland areas the Brown & Shepherd survey technique, as modified by SNH guidance (2005 rev 2010) was employed, which requires an increase in the number of visits per season from two to four. According to SNH (2017), breeding wader surveys should be at least 7 days apart, covering the whole breeding season. A search radius covering suitable habitat within 800 m of the proposed turbine locations is recommended, especially for breeding curlew. During these surveys, all other bird species encountered were also noted, along with behaviour to provide an indication of breeding status. The dates of these surveys are shown in **Table 4**.

The woodland edge in the northern part of the 500 m turbine buffer, facing out into the surrounding bog, was judged to provide a limited area of potential nesting habitat for tree nesting merlin. These areas within the 500 m turbine buffer were covered during walkovers, when surveyors looked for merlin signs, such as plucking posts. This area was also covered during wider area surveys when surveyors employed targeted VPs to cover suitable habitat. Additional breeding raptor surveys were undertaken in the wider area to increase coverage of suitable merlin and hen harrier habitats – see **Section 3.4**. As detailed in the desk-based study, within the 500 m turbine buffer suitable nesting habitat for merlin and hen harrier occurring in combination with sufficient expanses of foraging habitat was limited and likely to preclude the occurrence of these species within this buffer.

Suitable wet areas within the 500 m turbine buffer were covered for breeding snipe. Surveys running from dawn to three hours after or late afternoon to dusk (as detailed in O'Brien & Smith, 1992) were employed to increase the chances of detecting breeding behaviour, including chipping or drumming snipe.

Dusk surveys were carried out at woodland areas to identify roding woodcock (territorial males), as detailed in Gilbert *et al*. (1998). These surveys were carried out roughly 15 minutes before sunset and 60 minutes after sunset between May and June, as recommended by the UCC Irish Woodcock Project (UCC Ornithology Group, 2021). During dusk surveys, surveyors also listened for other crepuscular and nocturnal species, including owls and nightjars. Four dusk surveys were carried out per season, as shown in **Table 4**.

Table 4: Breeding bird survey effort

Breeding 2020		
Date	**Survey**	**Surveyor**
19/05/2020	Breeding woodcock survey	JK
20/05/2020	Dawn snipe survey/upland breeding bird survey	JK
28/05/2020	Breeding woodcock survey	JK
08/06/2020	Breeding woodcock survey	JK
15/06/2020	Breeding woodcock survey	JK
17/06/2020	Dawn snipe survey/upland breeding bird survey	JK
25/06/2020	Dawn snipe survey/upland breeding bird survey	JK
23/07/2020	Dawn snipe survey/upland breeding bird survey	JK
30/07/2020	Dawn snipe survey/upland breeding bird survey	JK

Breeding 2021		
Date	**Survey**	**Surveyor**
05/04/2021	Dawn snipe survey/upland breeding bird survey	DP
26/04/2021	Dawn snipe survey/upland breeding bird survey	DP
23/05/2021	Breeding woodcock survey	DP
24/05/2021	Breeding woodcock survey	DP
26/06/2021	Breeding woodcock survey	DP
27/06/2021	Upland breeding bird survey	DP
27/06/2021	Breeding woodcock survey	DP
29/06/2021	Upland breeding bird survey	DP
30/06/2021	Upland breeding bird survey	DP

3.4 Wider area breeding raptor surveys

SNH (2017) recommends surveying the wider area (hinterland) for up to 2 km from the proposed turbines for most breeding raptor species, including hen harrier and merlin. This can be extended if the site lies within the potential zone of influence to Special Protection Areas – SPAs (SNH, 2016). In this instance, the site was not in close proximity to any SPAs designated for raptors (the closest being >11 km south-east) and the 2 km search radius was considered appropriate – see **Figure 2**.

A combination of 'mini-VPs', as well as driven and walked transects were used to search potential nesting habitat within the hinterland over the breeding seasons of 2020 and 2021. Survey methods for breeding raptors follow those outlined in Hardey *et al*. (2013). As noted in Section 2, suitable breeding habitat for hen harrier and merlin was identified within the 2 km turbine buffer in the form of open bog habitat adjacent to woodland and conifer plantation. A total of 6 visits were carried out during summer 2020 and 8 visits were carried out during summer 2021. These surveys are detailed in **Table 5**.

Table 5: Wider area breeding raptor survey effort

Breeding 2020	
Date	**Surveyor**
26/05/2020	JK
28/05/2020	JK
09/06/2020	JK
15/06/2020	JK
21/07/2020	JK
30/07/2020	JK

Breeding 2021	
Date	**Surveyor**
24/03/2021	DP
25/03/2021	DP
03/04/2021	DP
25/04/2021	DP
17/05/2021	DP
31/05/2021	DP
21/06/2021	DP
26/06/2021	DP

3.5 Winter site walkovers

Winter walkovers of the study area were undertaken during winter 2019-20 and winter 2020-21, during which surveyors walked the study area noting down all species encountered, ensuring to cover a sample of all habitats present. As such, winter walkovers provide useful information on the distribution of winter bird species within the site and how they are utilising each habitat type. As mentioned in Section 2, walkovers are also a more suitable survey method for species which are difficult to detect during VP watches, such as wintering woodcock. The dates of the winter site walkovers carried out during winter 2019-20 and winter 2020-21 can be found in **Table 6**.

Table 6: Non-breeding season site walkover survey effort

Non-breeding 2019-20	
Date	**Surveyor**
12/02/2020	MH
25/02/2020	KW

Non-breeding 2020-21	
Date	**Surveyor**
02/11/2020	JK
24/11/2020	JK
25/11/2020	JK
08/01/2021	DP
05/02/2021	DP
07/03/2021	DP
15/03/2021	DP

3.6 Wider area wintering waterbird surveys

In assessing the impact of the proposed wind farm, it is important to provide contextual data on the numbers of waterbirds (target species) in the wider area relative to the usage of the site by these species. SNH guidelines require monitoring of swan and geese foraging and roosting locations when occurring in the environs of the site, and specifically where SPAs are designated for these species. Study areas of up to 500 m from the site for foraging locations and up to 1 km from the site for roost locations are recommended, although this may be extended where high levels of activity are anticipated.

In Ireland, swan and goose distribution is often not well documented beyond designated sites. In addition, many wintering waterbirds occur outside of SPAs. As such, the number of surveys undertaken was subject to the results of the initial scoping visits and how much waterbird activity was noted within the site. The surveys were based on the approach employed by IWeBS (Irish Wetland Bird Surveys) and the survey area was extended up to 5 km from the site to cover the banks of the River Shannon.

Three wider area wintering waterbird surveys were conducted over winter 2019-20. Surveys were conducted on 17 October 2019, 13 December 2019 and 16 & 17 March 2020. During these surveys, counts were undertaken of waterbird species at all publicly accessible/viewable bogs, ponds, canals, rivers and other wetland habitats within a 2.5 km, 5 km and 2 km buffer of the proposed turbine locations on the respective survey dates. Other species, notably raptors, present during the survey were also recorded. The desk-based study identified that the agricultural fields along the banks of the River Shannon and Ardnacrusha Canal were the most likely area to support wintering waterbirds, including whooper swans and migratory grey geese. This area could be viewed for VP2 and any swans in green fields would be particularly evident.

Wider area winter waterbird surveys covered features along the final stretch of the turbine delivery route, including Mc Namara's Lake, located c. 2.5 km from the closest proposed turbine and is a small fishing lough (c. 4 ha) on the north bank of the Ardnacrusha Canal between O'Briensbridge and Bridgetown. In October species recorded here were limited to small numbers of grey heron (1), mute swan (1), mallard (3) and black-head gulls (5), with no birds were records at this location in December. There was no March visit to the lough.

As highlighted in the desk-based study, the limited habitat availability on the upland slopes of the site, means it was considered unlikely the area would consistently support any significant numbers of wintering waterbirds. This was confirmed by the surveys undertaken in winter 2019-20, which revealed very low densities of wintering waterbirds in the wider area. Consequently, it was assessed that it would not be necessary to repeat these surveys in Year 2 (winter 2020-21).

3.7 Hen harrier roost searches

During the initial desk review, the habitat to the north of the 500 m turbine buffer was assessed as having the potential to be utilised by roosting hen harrier and a raised bog north of O'Briensbridge also had the potential to provide some cover. Therefore, speculative hen harrier roost searches were undertaken.

SNH (2017) guidance stipulates in relation to surveying for communal raptor roosts, including those of hen harriers, that roost sites within 2 km of a proposed wind farm should be identified.

With respect to the proposed development, the approach to surveying for hen harrier roosts was determined by two factors:

- Availability of potentially suitable roosting habitat in the vicinity of the proposed development, as described by Clarke & Watson (1990) and in the Irish national hen harrier winter roost survey guidelines (O'Donoghue, 2019); and
- Hen harrier activity observed during VP watches, site walkovers and wider area surveys.

SNH (2017) defers to Hardey *et al*. (2013) for specific roost survey methodology requiring surveyors to employ professional judgement in identifying and targeting potential roosts based on observed flight activity within or adjacent to a site. Hardey *et al*. (2013) recommend locating birds in the late afternoon and then attempting to track them back to roosts. O'Donoghue (2019) notes that the best time to conduct a roost watch is at least 40 minutes before sunset until dark or 30 minutes before sunrise until at least 30 minutes after sunrise.

Hen harrier roost watches were continued on for a third season in winter 2021-22. The dates of these surveys are given in **Table 7**, along with their corresponding VP locations that are mapped in **Figure 2**.

Table 7: Hen harrier roost searches

Non-breeding 2019-20		
Date	**Surveyor**	**VP**
06/02/2020	GO	VP1
12/02/2020	MH	VP1
26/02/2020	KW	VP2

Non-breeding 2020-21		
Date	**Surveyor**	**VP**
26/10/2020	JK	VP2
02/11/2020	JK	VP2
25/11/2020	JK	VP3
05/12/2020	JK	VP3
15/12/2020	JK	VP4
04/01/2021	JK	VP4
30/01/2021	JK	VP3
05/02/2021	DP	VP5
13/02/2021	JK	VP3

Non-breeding 2021-22		
Date	**Surveyor**	**VP**
26/10/2021	JK	VP2
28/10/2021	JK	VP3
30/10/2021	JK	VP4
02/11/2021	JK	VP2
07/11/2021	JK	VP3
16/11/2021	JK	VP3
02/12/2021	JK	VP4
09/12/2021	JK	VP3
14/12/2021	JK	VP2
03/01/2022	JK	VP2
11/01/2022	JK	VP4
27/01/2022	JK	VP3

3.8 Survey limitations

Survey limitations included:

- Access to the full ornithological study area (500m turbine buffer) for walkover surveys could only be undertaken on lands where permission had been granted.
- Due to delays in getting landowner permissions to access lands, surveyors only completed two walkovers in winter 2019-20, when ideally three visits would have been undertaken. This was compensated for in Year 2 with more extensive coverage.
- In winter 2019-20, hen harrier roost searches were only carried out in February, as opposed to more regular speculative survey of suitable habitat spread over the winter, as described in Hardey *et al*. (2013) and O'Donoghue (2019). This was accounted for by carrying out a third season of hen harrier roost searches in winter 2021-22.

Despite these minor limitations, it is considered that sufficient data was collected over the study period to identify any ornithological constraints that may arise for the proposed wind farm and inform the ornithological impact assessment.

4 Survey Results

Table 8 provides a complete list of bird species encountered during all ornithological survey work carried out at the proposed Fahy Beg Wind Farm along with their conservation status and an indication of their breeding status within the study area and/or wider area.

Table 8: Bird species recorded during surveys at Fahy Beg Wind Farm between 2019 and 2022

The column giving the BTO code also indicates species listed on Annex I of the EU Birds Directive with * and the BOCCI status refers to whether conservation concern status applies to wintering (Win) or breeding (Br) populations.

BTO Code	Common Name	BOCCI Status	Winter 2019/20	Summer 2020	Winter 2020/21	Summer 2021	Wider Area	Likely breeding within the study area?
Red listed species are those which are of highest conservation concern where the population is rapidly declining in abundance or range, has experienced a historic rapid decline (without recovery) or are globally threatened.								
BO	Barn owl	Br.		✓		✓		Likely territory south-west of the study area boundary, in the vicinity of the quarries. Alternative, site identified at Ballyknavin
CU	Curlew	Br. & Win.	✓					Potential breeding habitat in wider area. Not recorded during breeding season. Single observation in Nov-2019 to west of VP1 (out of site)
GL	Grey wagtail	Br.	✓		✓			Recorded along the Black River, outside of the survey area. Likely breeding in the wider area.
GP*	Golden plover	Br. & Win.			✓			Not recorded within the study area during the breeding season. Flock of 12 birds recorded during the winter
K	Kestrel	Br.	✓	✓	✓	✓	✓	Likely breeding in the wider area.
L	Lapwing	Br. & Win.			✓		✓	Not recorded within the study area during the breeding season.
MP	Meadow pipit	Br.	✓		✓	✓		**Yes.** Suitable wet grassland habitat in the south of the site for this ground-nesting species.
RE	Redwing	Win.	✓		✓			No. Winter visitor.
SI	Swift	Br..				✓		Recorded foraging in the area – no nesting habitat in the study area
SN	Snipe	Br. & Win.	✓		✓		✓	Possible breeding habitat within the open bog habitat, north of the study area boundary as well as wet grassland in the south of the site. Not recorded within the study area during the breeding season.
SP	Scaup (Greater)	Win.					✓	No suitable breeding habitat within the study area.
WK	Woodcock	Br.	✓		✓			No. Though suitable habitat exists within the study area, birds were only observed during the winter seasons. Targeted dusk surveys did not record any roding behaviour.
Y	Yellowhammer	Br.	✓		✓			Not recorded during breeding bird walkover surveys.

BTO Code	Common Name	BOCCI Status	Winter 2019/20	Summer 2020	Winter 2020/21	Summer 2021	Wider Area	Likely breeding within the study area?
Amber listed species are those with unfavourable European status, occur in internationally important numbers or are moderately declining in abundance or range. May also be Amber listed if population occurs in very small numbers.								
BH	Black-headed gull	Br. & Win.		✓		✓	✓	No suitable breeding habitat within the study area.
BL	Brambling	Win.			✓			No. Winter visitor.
CO	Coot	Br. & Win.					✓	No suitable breeding habitat within the study area.
CA	Cormorant	Br. & Win.				✓	✓	No suitable breeding habitat within the study area.
GC	Goldcrest	Br.	✓		✓	✓		**Yes.** Common resident. Likely breeding within the beech woodland and conifer plantation.
GG	Great crested grebe	Br. & Win.					✓	No suitable breeding habitat within the study area.
GR	Greenfinch	Br.	✓		✓			**Yes.** Common resident. Likely breeding in the study area or wider area.
GJ	Greylag goose	Win.			✓			Not recorded during the breeding season. Unlikely breeding in the study area.
HH*	Hen harrier	Br.		✓			✓	Not recorded during surveys, although potential breeding habitat within open bog habitat within 2km buffer.
HG	Herring gull	Br. & Win.				✓		No suitable breeding habitat within the study area.
HS	House sparrow	Br.	✓		✓	✓		**Yes.** Common resident, likely breeding in residential and agricultural buildings.
LB	Lesser black-backed gull	Br. & Win.		✓		✓	✓	No suitable breeding habitat within the study area.
LI	Linnet	Br.	✓		✓	✓		Potential breeding habitat within the study area, though no breeding/territorial behaviour was noted during the surveys.
MA	Mallard	Br. & Win.				✓	✓	Not recorded as breeding in the study area. Common resident. Likely breeding in the wider area.
ML*	Merlin	Br.	✓					Not recorded during surveys, although potential breeding habitat within plantation adjacent to open bog habitat, north of the study area boundary.
SM	Sand martin	Br.		✓				Breeding within the sand and gravel quarry to south of the study area.
SF	Spotted flycatcher	Br.				✓		**Yes.** Pairs recorded during breeding bird surveys and suitable breeding habitat in the form of broadleaf woodland/well vegetated hedgerows.
SG	Starling	Br.	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
SL	Swallow	Br.		✓		✓		**Yes**. Nesting habitat in abandoned residential/agricultural buildings.
TU	Tufted duck	Br. & Win.					✓	No suitable breeding habitat within the study area.
WS*	Whooper swan	Br. & Win.			✓		✓	No. Winter visitor and rare breeding species in Ireland.
WW	Willow warbler	Br.		✓	✓	✓		**Yes.** Common summer visitor, breeding within woodland, scrub and treelines.

BTO Code	Common Name	BOCCI Status	Winter 2019/20	Summer 2020	Winter 2020/21	Summer 2021	Wider Area	Likely breeding within the study area?
Green List birds are not considered threatened.								
B	Blackbird	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
BC	Blackcap	N/A				✓		**Yes.** Common and widespread summer visitor with a smaller wintering population in Ireland. Breeding in the study area and wider area.
BT	Blue tit	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
BF	Bullfinch	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
BZ	Buzzard	N/A	✓	✓	✓	✓	✓	**Yes.** Possible breeding recorded within the woodland in the north of the study area and fledged young recorded I 2020.
CH	Chaffinch	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
CC	Chiffchaff	N/A		✓		✓		**Yes.** Breeding in the study area and wider area.
CT	Coal tit	N/A	✓	✓	✓	✓		**Yes.** Breeding in the study area or wider area.
CR	Common crossbill	N/A	✓		✓	✓		**Yes.** Potential to breed within conifer plantation habitat.
CK	Cuckoo	N/A		✓		✓		**Yes.** Common summer visitor, likely breeding in open areas of the site.
D	Dunnock	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
FF	Fieldfare	N/A	✓		✓			**No.** Winter visitor.
GO	Goldfinch	N/A	✓	✓	✓			**Yes.** Common resident. Breeding in the study area and wider area.
GT	Great tit	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
H	Grey heron	N/A	✓		✓	✓	✓	Not recorded as breeding within the study area. Common resident likely breeding in the wider area.
HC	Hooded (grey) crow	N/A	✓	✓	✓			**Yes.** Common resident. Likely breeding in the study area or wider area.
JD	Jackdaw	N/A	✓	✓	✓	✓		**Yes.** Common resident. Likely breeding in the study area or wider area.
J	Jay	N/A	✓	✓	✓	✓		**Yes.** Likely breeding within beech woodland and conifer plantation habitat.
LR	Lesser redpoll	N/A	✓		✓			**Yes.** Likely breeding within conifer plantation habitat.
LT	Long-tailed tit	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
MG	Magpie	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area
M	Mistle thrush	N/A	✓	✓	✓			**Yes.** Common resident. Breeding in the study area and wider area.
PE*	Peregrine	N/A			✓			Not recorded within the study area or wider area during the breeding season. No suitable breeding habitat within the study area or wider area (2 km buffer).
PH	Pheasant	N/A		✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
PW	Pied wagtail	N/A	✓	✓	✓	✓		**Yes.** Common resident. Likely breeding in the study area or wider area.
RN	Raven	N/A	✓	✓	✓	✓		Potentially breeding in the woodland north of the study area.

BTO Code	Common Name	BOCCI Status	Winter 2019/20	Summer 2020	Winter 2020/21	Summer 2021	Wider Area	Likely breeding within the study area?
RB	Reed bunting	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
R	Robin	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
RO	Rook	N/A	✓	✓	✓			**Yes.** Common resident. Likely breeding in the study area or wider area.
SW	Sedge warbler	N/A				✓		No breeding behaviour observed during breeding bird surveys. Limited potential breeding habitat in the site, with vegetated settlement ponds in the quarry providing some potential habitat.
SK	Siskin	N/A	✓	✓	✓	✓		**Yes.** Likely breeding within conifer plantation habitat.
ST	Song thrush	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.
SH	Sparrowhawk	N/A	✓	✓	✓	✓	✓	**Yes.** Possible breeding site within the beech woodland in the north of the study area. Confirmed breeding in 2022.
SC	Stonechat	N/A		✓	✓	✓		**Yes.** Breeding in the study area and wider area.
TC	Treecreeper	N/A	✓		✓			**Yes.** Likely breeding in the beech woodland in the north of the study area.
WM	Whimbrel	N/A				✓		No. Passage migrant.
WH	Whitethroat	N/A		✓	✓	✓		**Yes.** Recorded on multiple occasions throughout the study area during the breeding bird surveys. Likely breeding within hedgerows.
WP	Woodpigeon	N/A	✓	✓	✓			**Yes.** Common resident. Breeding in the study area and wider area.
WR	Wren	N/A	✓	✓	✓	✓		**Yes.** Common resident. Breeding in the study area and wider area.

4.1 Vantage Point (VP) Watches

Flight times for target species recorded within the 500 m turbine buffer are provided in **Table 9**, which shows data for two years (Sep-2019 to Aug-2021) and has been used to generate CRMs for selected target species. Flight time is split into different altitudinal levels in order to better understand the extent to which target species fly within the Collision Risk Zone (CRZ). Flight seconds are also provided for each season in **Table 10**, **Table 11**, **Table 12** and **Table 13**. Including swift, which were only included as a target species in summer 2021, a total of 13 target species were recorded flying through the study area during the survey period. Flight lines have been digitised and maps are provided in **Appendix III**.

Table 9: Flight time recorded within 500 m turbine buffer – 2019 to 2021

Target Species	**No. of obs. in 500m turbine buffer** Ave.no. of birds (range)	**A: 0-30m** (seconds)	**B: 30-180m (CRZ)** (seconds)	**C: >180m** (seconds)
Black-headed gull	**5 observations** 9 birds (5-15 birds)		**506**	2,160
Buzzard	**90 observations** 1.4 birds (1-4 birds)	40	**16,454**	18,164
Cormorant	**1 observation** 2 birds		**100**	
Greylag goose	**1 observation** 6 birds		**48**	
Hen harrier	**1 observation** 1 bird		**43**	
Kestrel	**82 observations** 1.05 birds (1 to 3 birds)	293	**4,680**	25
Lesser black-backed gull	**4 observations** 7.75 birds (2 to 13 birds)		**60**	1,560
Merlin	**1 observation** 1 bird	50		
Peregrine	**1 observation** 1 bird		**30**	
Sparrowhawk	**23 observations** 1.04 birds (1-2 bird)	82	**133**	75
Swift Only timed over 1 summer	**6 observations** 3.33 birds (2-5 birds)		**877**	
Whimbrel	**1 observation** 12 birds		**420**	
Whooper swan	**1 observation** 3 birds		**39**	

Table 10: Target species flight seconds recorded from VP watches: Winter 2019-20

Target Species	A: <30m	B: 30-180m CRZ	C >180m
Buzzard	40	**1,745**	1,170
Kestrel	129	**588**	25
Merlin	50		
Sparrowhawk	30	**33**	75

Table 11: Target species flight seconds recorded from VP watches: Breeding season 2020

Target Species	A: <30m	B: 30-180m CRZ	C >180m
Black-headed gull		**506**	
Buzzard		**10,305**	5,144
Hen harrier		**43**	
Kestrel	24	**357**	
Lesser black-backed gull		**60**	
Sparrowhawk	20		

Table 12: Target species flight seconds recorded from VP watches: Winter 2020-21

Target Species	A: <30m	B: 30-180m CRZ	C >180m
Buzzard		**1,216**	1,800
Greylag goose		**48**	
Kestrel		**1,993**	
Peregrine		**30**	
Sparrowhawk	2	**100**	
Whooper swan		**39**	

Table 13: Target species flight seconds recorded from VP watches: Breeding season 2021

Target Species	A: <30m	B: 30-180m CRZ	C >180m
Black-headed gull			2,160
Buzzard		**3,188**	10,050
Cormorant		**100**	
Kestrel	140	**1,742**	
Lesser black-backed gull			1,560
Sparrowhawk	30		
Swift*		**877**	
Whimbrel		**420**	

*Note that summer 2021 was the only season to include swift data in VP watches

4.2 Breeding bird surveys

Maps showing the distribution of breeding activity from target species across the site are provided in **Appendix IV**.

Breeding bird walkovers covering the wind farm site were undertaken five times during the 2020 breeding bird season. As well as this, four dusk surveys were carried out targeting crepuscular species such as breeding woodcock. All breeding bird surveys were conducted under optimal weather conditions for surveying, as can be seen in **Appendix V**.

A total of 36 different bird species were recorded during the walkover surveys in summer 2020. **Table 14** lists the species recorded on each visit according to their BTO codes. Target species are underlined and birds that were noted to be exhibiting breeding/territorial behaviour are highlighted in **bold**. The codes and full names are provided in **Appendix I**.

No woodcock were recorded during the dusk surveys. The only target species to be recorded over the dusk surveys carried out was a barn owl on 19 May 2020 at 21:50 heading west along the Roadstone quarry, located south-west of the 500m turbine buffer. During the 2021 breeding season, recently fledged barn owls were recorded on the periphery of the quarry while surveyors were conducting bat surveys, confirming breeding in the area of the quarry.

Table 14: Summary of breeding bird walkover and dusk surveys carried out in summer 2020

Date	**Survey**	**Species** (BTO code – see Appendix I)
19/05/2020	Breeding woodcock survey	BO
20/05/2020	Dawn snipe survey/upland breeding bird survey	**B**, BF, **CH**, CK, GO, GT, J, JD, K, M, PH, **R**, RO, **SC**, **ST**, **WH**, WP, **WR**, WW
28/05/2020	Breeding woodcock survey	No target species recorded
08/06/2020	Breeding woodcock survey	No target species recorded
15/06/2020	Breeding woodcock survey	No target species recorded
17/06/2020	Dawn snipe survey/upland breeding bird survey	**B**, BF, BT, CC, CH, **D**, GT, JD, M, MG, RB, RO, SG, SL, SM, ST, **WH**, WP, WR, WW
25/06/2020	Dawn snipe survey/upland breeding bird survey	B, CC, CH, **GT**, HC, J, JD, M, MG, PH, PW, **R**, RO, SG, SH, **ST**, WH, WP, WW
23/07/2020	Dawn snipe survey/upland breeding bird survey	B, BF, BT, BZ, CH, CT, D, GO, GT, HC, JD, K, M, MG, PW, R, RO, SG, SL, SM, WP, WR
30/07/2020	Dawn snipe survey/upland breeding bird survey	B, BF, BT, CH, D, GO, GT, HC, J, JD, LT, M, MG, PW, R, RO, SC, SG, SH, SL, SM, WP, WR

In summer 2021, 5 breeding bird surveys were carried out and 4 dusk surveys were undertaken. During this, 33 different bird species were recorded, as listed in **Table 15**. As in **Table 14**, species are listed according to their BTO codes. Again, target species are <u>underlined</u> and birds that were noted to be exhibiting breeding/territorial behaviour are highlighted in **bold**. No target species or species of interest were recorded during the four dusk surveys undertaken.

Table 15: Summary of breeding bird walkover and dusk surveys carried out in summer 2021

Date	**Survey**	**Species** (BTO code – see Appendix I)
05/04/2021	Dawn snipe survey/upland breeding bird survey	**B**, **BC**, BT, CH, **CT**, **D**, **GC**, **GT**, LT, MP, PH, PW, **R**, RN, **ST**, SW, **WR**, WW
26/04/2021	Dawn snipe survey/upland breeding bird survey	**B**, **BC**, BF, BT, **CH**, CK, **CT**, D, **GC**, **GT**, K, LT, <u>MA</u>, MP, **R**, **ST**, **WH**, **WR**, **WW**
23/05/2021	Breeding woodcock survey	No target sp. recorded
24/05/2021	Breeding woodcock survey	No target sp. recorded
26/06/2021	Breeding woodcock survey	No target sp. recorded
27/06/2021	Upland breeding bird survey	B, **BC**, BT, <u>BZ</u>, **CC**, **CH**, CT, D, GC, **GT**, J, LI, LT, MP, PW, **R**, SC, SF, **WR**, **WW**
27/06/2021	Breeding woodcock survey	No target sp. recorded
29/06/2021	Upland breeding bird survey	B, **BC**, **BT**, <u>BZ</u>, **CC**, CH, CT, GC, GT, <u>HG</u>, HS, J, <u>K</u>, LT, MP, PW, **R**, **RB**, SC, ST, **WH**, WR, WW
30/06/2021	Upland breeding bird survey	B, BC, BF, BT, **CC**, CH, **CR**, CT, D, GC, J, LI, LT, MP, PH, **R**, SC, SF, **WH**, WR, WW

4.3 Wider area breeding raptor surveys

Table 16 and **Table 17** show the number of target species recorded on each survey date in the wider area throughout the 2020 and 2021 breeding seasons, respectively. A total number of 7 target species were recorded during the wider area surveys undertaken in summer 2020. Of these species, common buzzard was the most frequently recorded with 13 observations over the 6 survey dates. In summer 2021, a total number of 5 target species were recorded during the wider area surveys undertaken. Of these species, common buzzard was again the most frequently recorded with 46 observations over the 8 survey dates.

Table 16: Counts of target species recorded in the wider area - summer 2020

Species	26 May 2020	28 May 2020	09 Jun 2020	15 Jun 2020	21 Jul 2020	30 Jul 2020
Buzzard	2	4	3	4	2	1
Hen harrier	1					
Kestrel		2	1		1	
Sparrowhawk		1		1		5
Lesser black-backed gull					5	
Cormorant					1	
Mallard					2	

Table 17: Counts of target species recorded in the wider area - summer 2021

Species	24 Mar 2021	25 Mar 2021	03 Apr 2021	25 Apr 2021	17 May 2021	31 May 2021	21 Jun 2021	26 Jun 2021
Buzzard	8	6	5	3	7	5	8	5
Hen harrier		1						
Kestrel	5	3	2	4	1	4	3	3
Sparrowhawk	1	3	1	1	3	1	1	1
Whooper swan			29					

Based on the results of the wider area breeding raptor surveys carried out in summer 2020 and 2021, breeding territories were identified for buzzard, sparrowhawk, kestrel and barn owl within the 500 m and 2 km buffer, which are shown in **Figure 5**. Based on observations of breeding/territorial behaviour recorded over the 2021 and 2022 breeding seasons, it is estimated that there is:

- One barn owl territory located within the quarries on the southwestern boundary of the 500 m turbine buffer. The other barn owl territory at Ballyknavin/Kilroughil, as shown in **Figure 5** was a site report by locals. However, buildings in this area were not found to be occupied when surveyed in 2020 and 2021. It is thought that the two sites may be interchangeable.
- One kestrel territory, with the nest located south of the 500 m turbine buffer, adjacent to the quarries.
- Three sparrowhawk territories were recorded, with one nest site and a pair found breeding within the 500 m turbine buffer in the beech woodland in the western part of the site. The other two pairs were recorded on the periphery of the 2 km turbine buffer.
- Five buzzard territories, with two sites located within the 500 m turbine buffer and a further three sites within the 2 km turbine buffer. Not all the areas where breeding/territorial behaviour was observed were occupied in both years and it is thought there are two, possibly three, pairs within the 2 km turbine buffer.

A total of four species were recorded breeding, including barn owl, kestrel, sparrowhawk and buzzard. No hen harrier, peregrine or merlin were recorded breeding within the 2 km turbine buffer.

There was only a single merlin observed over the 2 years, which was a female recoded during the winter – see map in **Appendix III**. Hen harriers were recorded within the 500 m and 2 km turbine buffers, however there were only a total of three observations over the 2-year survey period, including:

- From VP2 on 19-May-2020, a male hen harrier was recorded for 43 seconds in the north-eastern part of the 500 m turbine buffer. This male was noted foraging and travelling north along the boundary of the conifer plantation – see map in **Appendix III**.
- During the wider area breeding raptor surveys on 26-May-2020, a male hen harrier was recorded travelling north over the woodland on Lackareagh Mountain, north of the 500 m turbine buffer.
- During wider area breeding raptor surveys on 25-Mar-2021, a female hen harrier was observed commuting west from the area of the quarry.

The closest area of potentially suitable habitat for breeding merlin and hen harrier was on Lackareagh Mountain. However, disturbance from quad bike and scrambler enthusiasts was considered likely to limit usage of the by merlin and hen harrier. As identified by the desk-based study, the larger expanses of open upland habitat and associated forestry located *c*. 2.5 km north of the 500 m turbine buffer, stretching north from Glennagalligh Mountain and onto Slieve Bearnagh, are considered to provide more substantive home range options for breeding hen harriers and merlin.

In relation to potential breeding cliff for peregrine falcons, the wider area surveys confirmed that there were no suitable cliffs within 2 km of the proposed development site. The quarry to the south of the site did have low sandy edges and these were assessed as highly unlikely to be occupied by breeding peregrine. Over the 2 year study, peregrines were only recorded once flying through the 500 m turbine buffer over the winter – see map in **Appendix III**.

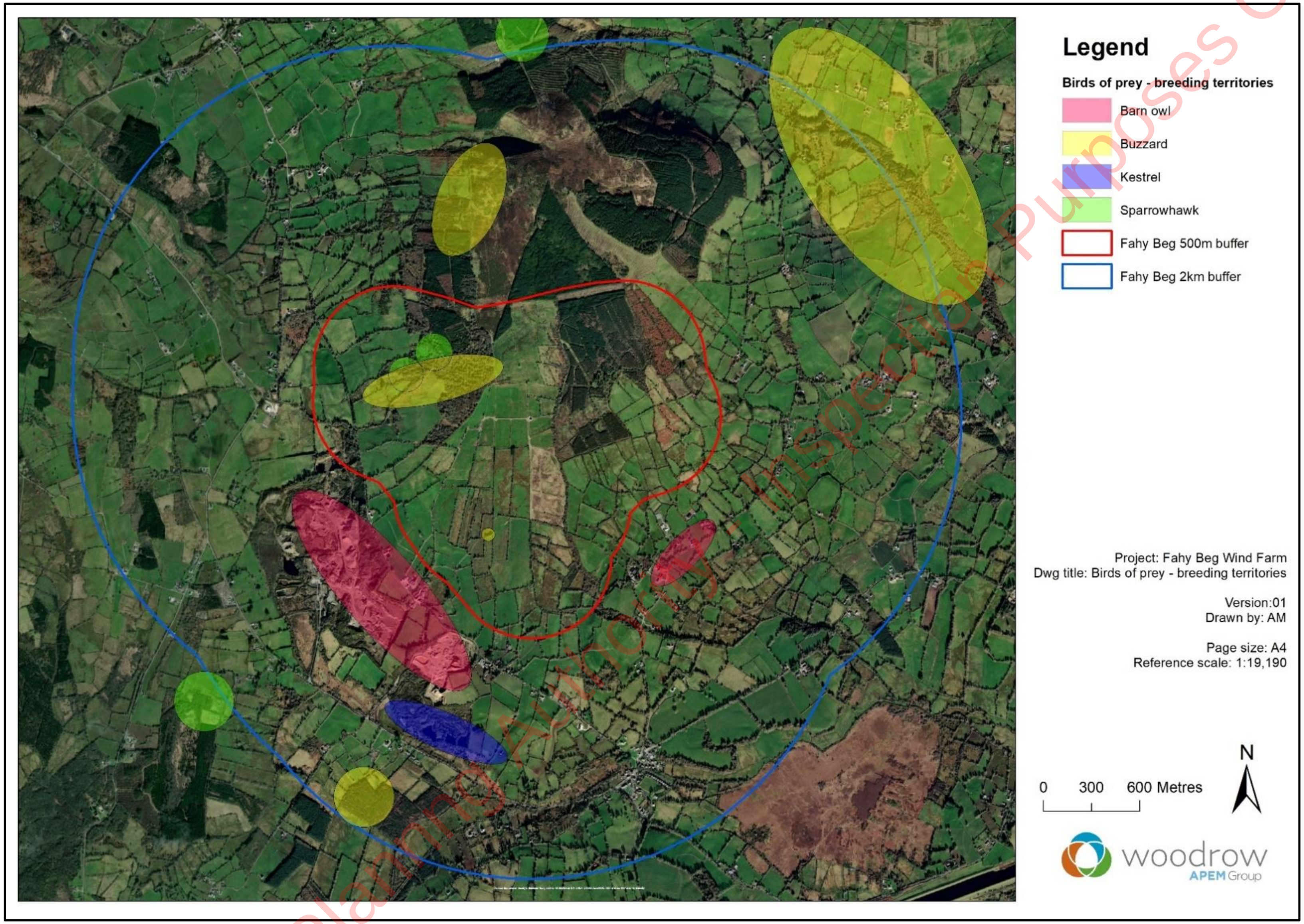

Figure 5: Breeding raptor territories identified within 2km of the proposed wind farm

4.4 Winter site walkovers

Maps showing target species winter bird activity and distribution across the site are provided in **Appendix III**.

Winter site walkovers covering the wind farm site were undertaken twice during the 2019-20 non-breeding season. All winter site walkovers were conducted under optimal weather conditions for surveying. A total of 41 different bird species were recorded during the surveys. **Table 18** lists the species recorded on each visit and with target species underlined.

Table 18: Summary of winter walkover surveys carried out in winter 2019-20

Date	Species
12/02/2020	B, BF, BT, BZ, CH, CR, CT, D, FF, GC, GR, GL, GO, GT, HC, HS, J, JD, K, LI, LR, LT, M, MG, MP, PW, R, RB, RE, RN, RO, SG, SK, ST, TC, WK, WP, WR, Y
25/02/2020	B, BF, BT, BZ, CH, CT, D, FF, GC, GT, HC, K, LT, M, MP, PW, R, SH, SK, SN, ST, TC, WP, WR

During the 2020-21 non-breeding season, winter walkovers covering the wind farm site were undertaken six times. A total of 37 different bird species were recorded during the walkover surveys. **Table 19** lists the species recorded on each visit. As in **Table 18**, species are listed according to their BTO codes with target species underlined.

Table 19: Summary of winter walkover surveys carried out in winter 2020-21

Date	Species
02/11/2020	B, CH, D, FF, GO, GT, HC, JD, LT, MG, PW, R, RE, RO, SC, SG, SH, WP, WR
24/11/2020	BT, CH, D, FF, GO, GT, HC, M, MG, RE, RO, SC, SN, WP
25/11/2020	B, BF, BT, CH, D, FF, GC, HC, J, JD, K, LT, MG, R, RE, RO, SG, WP
08/01/2021	B, BT, BF, CT, D, FF, GC, GP, GT, GL, J, LT, M, PE, PH, PW, R, SN, SH, WK, WR
05/02/2021	B, BT, CH, CT, D, GT, PH, RE, R, ST, SH, SG, SN, WW, WR
07/03/2021	B, BT, BF, BZ, CH, CT, D, FF, GC, GT, J, LT, MP, PH, R, RB, SH, SN, ST, WK, WR
15/03/2021	B, BT, BZ, CH, CT, D, FF, GC, GT, J, MP, R, RE, SH, ST, WK, WR

4.5 Wider area wintering waterbird surveys

Table 20 and **Figure 6** show the number of wintering waterbirds recorded on each survey date and their location in relation to the survey area. As can be seen in **Figure 6**, waterbird activity was very limited within the 2 km turbine buffer, with the majority of activity recorded along the River Shannon *c.* 3 km to the southeast of the proposed development. The only waterbirds noted within the survey area during wider area waterbird surveys were a pair of commuting mallards. These findings determined that there were no potentially sensitive wintering waterbird population occurring in significant numbers within the zone of influence of the proposed wind farm development, in particular whooper swans and migratory geese.

There are no potential wetland within the 2 km turbine buffer capable of support roosting swans or geese. Therefore, repeating wider area waterbird surveys in Year 2 (winter 2020-21) was not required.

Table 21 shows any other species noted during the wider area surveys. As found in the other surveys carried out across the survey period, buzzard activity was notably higher than any other species especially during the March visit when buzzard soaring (territorial) behaviour was noted over the broadleaved woodland in the western part of the site. Displaying sparrowhawk were also active over this woodland in March.

Table 20: Wintering waterbird numbers in the wider area during winter 2019-20

Species	17-Oct-2019 (3 km search)	13 Dec-2019 (5 km search)	16/17-Mar-2020 (2 km search)
Black-headed gull	5	9	
Coot		9	
Cormorant		12	
Great crested grebe		2	
Grey heron	1	1	
Lapwing		10	
Mallard	3	6	0/2
Mute swan	1		
Scaup (Greater)		5	
Snipe			1/0
Tufted duck		545	
Whooper swan		3	

Table 21: Other species recorded within the wider area during winter 2019-20

Species	17-Oct-2019	13-Dec-2019 5 km search	16/17-Mar-2020 2 km search
Buzzard		1	Max. count 5 birds (3 sub-adult) -soaring (territorial) behaviour observed over broadleaved wood in site
Kestrel			1 hunting
Sparrowhawk			Territorial behaviour observed over broadleaved wood in site

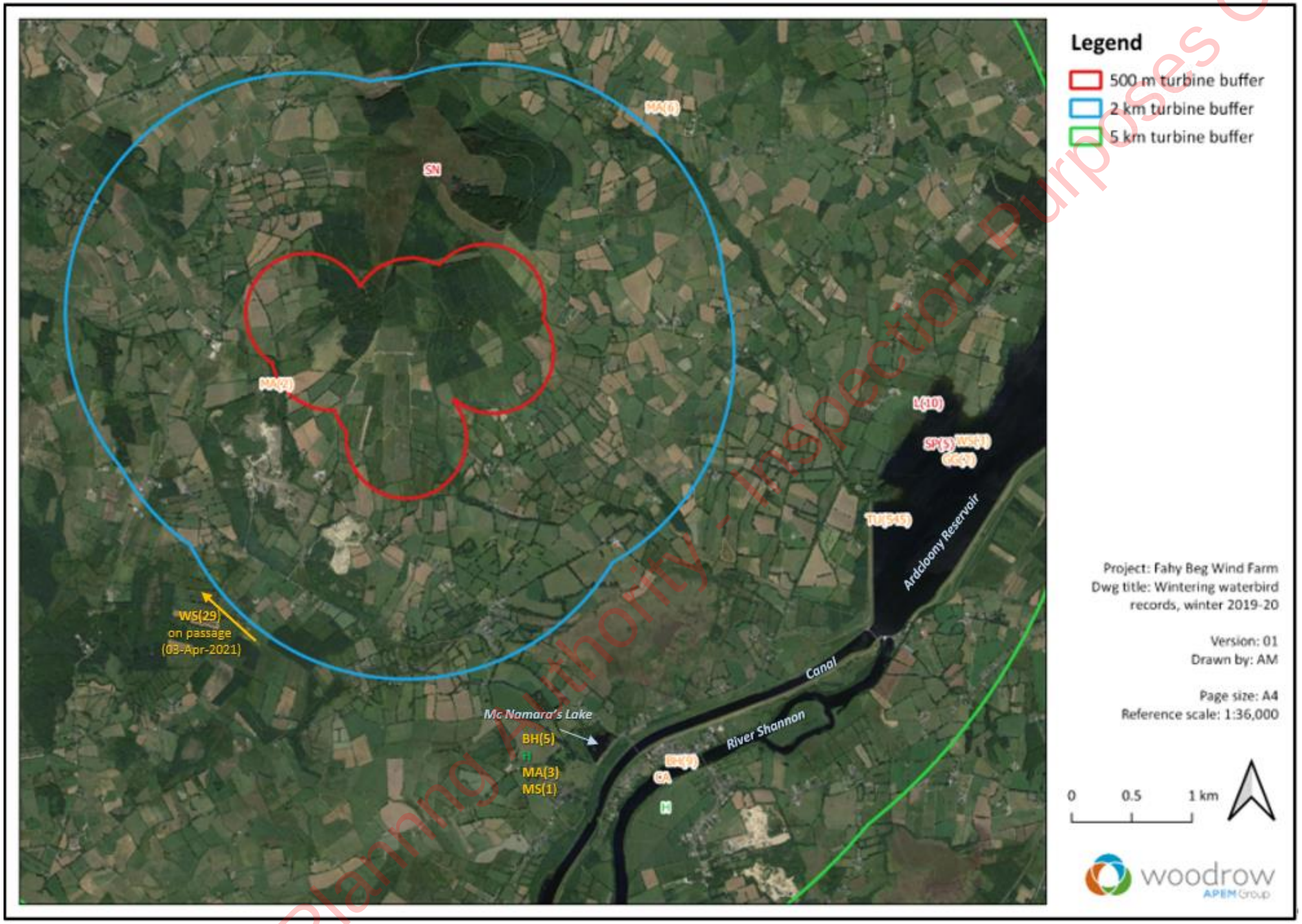

Figure 6: Wider area wintering waterbird records

Records are labelled using BTO codes with counts shown in parenthesis and text in red, amber or green to indicate BoCCI status (Gilbert *et al*. 2021)

4.6 Hen harrier roost searches

Though some suitable roost habitat exists within the 2 km turbine buffer, no hen harrier roosts were identified during the targeted hen harrier roost searches that were undertaken over winter 2019-20, winter 2020-21 and winter 2021-22. No hen harriers were recorded over the winter survey period during any of the surveys, including wider area surveys. The three hen harrier recorded where breeding season records.

Based on limited habitat suitability for roosting hen harriers within the 500 m turbine buffer and the low usage recorded, survey effort provides a high level of confidence that there is not a roost in regular use over the winter. Similarly, survey effort for roost searches in the wider area provides strong evidence that there are no regularly utilised roosts, although there is some potentially suitable roosting habitat. The closest areas of potentially suitable habitat on Lackareagh Mountain was observed to be utilised by quad bike and scrambler enthusiasts creating periodic disturbance events likely to limit suitability.

4.7 Summary results for Collision Risk Model

The full details of the CRM run for selected target species are included in **Appendix VI**. CRMs were run for target species with a total aggregate flight time (i.e. number of individuals x flight time) of > 200 seconds within the Collision Risk Zone (CRZ) (i.e. within the collision risk height range and 500 m buffer) over the study period. For all target species recorded at Fahy Beg aggregated flight times below 200 seconds would amount to a negligible collision risk. The flight height range included within the CRZ was defined as 30 to 180 m, which was a precautionary range based on the lowest minimum swept height and highest maximum swept height of the turbine specifications proposed.

CRMs were run for four species, including:

- Black-headed gull 506 flight seconds in CRZ
- Buzzard 16,454 flight seconds in CRZ
- Kestrel 4,680 flight seconds in CRZ
- Whimbrel 420 flight seconds in CRZ

Note: Data for swifts was only collected over one year and modelling was not conducted as a result.

Models were run for five turbine type specified, including

- Nordex turbines: N131, N133
- Enercon turbine: E-138
- Vestas turbine: V136

Full turbine specification used in the models are provided in **Appendix VI** - Table A6.1.

Table 22 and **Table 23** provide summaries of predicted collisions for target species representative of best and worst case turbine scenarios respectively. Predicted collisions are weighted values - adjusted to correct for overlapping viewsheds, turbine downtime and seasonal bird activity, with appropriate species-specific avoidance rates applied.

The CRM found that the N131 generated the highest predicted collision risk (worst-case scenario) and the E138 would result in lowest collision risk (best-case scenario). This result was driven by the higher average operational speeds of the N131 (average rotational period: 5.22 sec), and even though the E138 has a larger risk volume, the average operational speeds are lower (average rotational period: 7.89 sec).

The CRM generated notably low levels of theoretical collision risk for two of the target species analysed and less than 0.005 collisions (weighted) were predicted over the 30-year life span of the project were predicted for black-head gull and whimbrel. This level of predicted collisions would be considered negligible and would not affect these species at the population level, i.e. collision mediated mortality would not add significantly (>1%) to background levels of mortality.

Reflective of higher levels of flight time in the CRZ and relatively low avoidance rates, predicted collision risk for buzzard and kestrel were relatively high and, depending on turbine specifications, were estimated at:

- 0.36 to 0.46 collisions per annum for buzzard
- 0.21 to 0.28 collisions per annum for kestrel.

These levels of predicted collision risk warrant further investigation in terms of effects on buzzard and kestrel on populations.

Table 22: Summary of predicted collisions – worst-case scenario Nordex N131
Note: Outputs shown are weighted & with avoidance rates applied

Species	Occurrence in model	Season (hrs)	Avoidance rate	Predicted collisions per				
				Annum without avoidance	Annum with avoidance	Decade	30 years	1 bird every
Black-headed gull	All-year	4,380	0.99	0.6449	0.0052	0.05	0.15	193.82 years
Buzzard	All-year	4,380	0.98	23.0667	0.4613	4.61	13.84	2.17 years
Kestrel	All-year	4,380	0.95	5.5534	0.2777	2.78	8.33	3.60 years
Whimbrel	Passage (Apr/May)	460	0.98	0.4295	0.0086	0.09	0.26	116.41 years

Table 23: Summary of predicted collisions – best-case scenario Enercon E138
Note: Outputs shown are weighted & with avoidance rates applied

Species	Occurrence in model	Season (hrs)	Avoidance rate	Predicted collisions per				
				Annum without avoidance	Annum with avoidance	Decade	30 years	1 bird every
Black-headed gull	All-year	4,380	0.99	0.5142	0.0041	0.04	0.12	243.08 years
Buzzard	All-year	4,380	0.98	17.9641	0.3593	3.59	10.78	2.78 years
Kestrel	All-year	4,380	0.95	4.2283	0.2114	2.11	6.34	4.73 years
Whimbrel	Passage (Apr/May)	460	0.98	0.3607	0.0072	0.07	0.22	138.61 years

5 Discussion

5.1 Waterbirds

Wildfowl – swans, geese & ducks

Across all the surveys undertaken, there were only two observations of swans or geese recorded within the 500 m turbine buffer during the survey period, including:

- Three **whooper swans** in December 2020, commuting east through the buffer for 13 seconds (39 seconds aggregate flight seconds) at 100-150 m - see map in **Appendix III**.
- Six **greylag geese** in January 2021, commuting east through the buffer for 8 seconds at 80-100 m – see map in **Appendix III**.

The low frequency of flights recorded through the buffer for both species indicates that the proposed development area is not located on a regular commuting route, e.g. between a roost and foraging area. During wider area surveys in March 2021, a flock of 29 whooper swans were recorded approximately 2 km south-west of the site and the flock was observed to be commuting north-west. The aggregated flight times generated by both these species was <200 seconds and therefore a CRMs were not run.

The 500 m turbine buffer and the surround area was not considered archetypal swan or goose foraging habitat and no foraging flocks were recorded in the area. As outlined in the desk-based study the majority of the wildfowl activity recorded in the wider area was associated with the north bank of the Shannon, around O'Briensbridge and the Ardcloony reservoir.

Therefore, based on the low level of flights and limited foraging habitat or roosts in the area, the proposed development is assessed as highly unlikely to affect whooper swans or greylag geese, as well as other species of swans, geese and ducks occurring in the wider area and those ecologically connected to Natura 2000 sites.

Waders

As for wildfowl, all wader activity recorded within the study area during the VP surveys was associated with commuting birds, rather than with birds using the area for breeding and/or foraging. Observations of wader species were notably low, and the following species were recorded during VP watches:

- One **curlew** in November 2019 recorded flying well west of the 500 m turbine buffer around VP1.
- 12 **lapwing** in January 2021 recorded flying east from area of VP1 towards the quarry – the flock did not enter the 500 m turbine buffer.
- 12 **whimbrel** in May-2021 on passage recorded fly east through the middle of the site for 35 seconds at 80 to 100 m

During site walkover surveys a flock of 12 **golden plover** was recorded commuting through the study area in January 2021.

The winter site walkovers recorded both **snipe** and **woodcock** activity within the study area. Single snipe were flushed on three separate survey dates within the wet, agricultural grassland in the south of the site. Woodcock were also recorded on four separate occasions within the study area. The distribution of these observations indicate that woodcock are using the beech woodland and conifer plantation in the west and east of the site over the winter.

As for wildfowl, wintering wader activity in the wider area was largely associated with the north bank of the River Shannon and the Ardcloony reservoir. There were no significant movements of birds detected between the River Shannon and the proposed development site.

No breeding waders, including roding woodcock and drumming snipe were recorded during the dusk surveys conducted.

As the only wader species recorded within the collision risk zone during VP watches, a CRM was run for the single flock of whimbrel recorded. The predicted collision risk for whimbrel based on the flight times recorded are shown in **Table A6.11** of **Appendix VI**. For the worst case scenario (N131), the predicted collision risk (weighted and applying avoidance rate of 98%) was 0.26 collisions over 30 years, which is considered insignificant, in terms effects at the population level.

Therefore, based on the low frequency of flight activity, limited utilisation of foraging habitat and lack of suitable roosts in the area, the proposed development is assessed as being highly unlikely to affect most wintering waders, with the possible exceptions of woodcock and snipe utilising the site. Wintering woodcock and small numbers of snipe could be displaced by construction activities, with removal of woodland potentially having a longer term displacement on woodcock. Likewise, the absence of breeding waders within the study area means the proposed development will not affect any wader populations of conservation concern, including golden plover, curlew, lapwing, snipe and woodcock.

Gulls

Gull species recorded within the 500 m turbine buffer included lesser black-backed gull, herring gull and black-headed gull. The density of use by gull species was relatively low, including:

- One observation of **herring gull**, involving 5 birds foraging within agricultural fields south-east of the 500 m turbine buffer. No flight lines were observed.
- Four observations of **lesser black-backed gulls**, with only two small flocks (2 to 13 birds) recorded flying/commuting through the 500 m turbine buffer. Aggregated flight seconds within the buffer amounted to 1,560 seconds, however only 60 seconds were recorded at collision risk height, with the majority of time at > 180 m. Activity was only observed over the breeding season.
- Five observations of **black-headed gulls**, with only three small flocks (5 to 12 birds) flying/commuting through the 500 m turbine buffer. Aggregated flight seconds within the buffer amounted to 2,160 seconds, with 506 seconds recorded at collision risk height and the majority of time at > 180 m. Activity was only observed over the breeding season.

A CRM was only run for black-headed gulls, as this was the only species recording flight seconds >200 seconds within the collision risk zone. The predicted collision risk for black-headed gull based on the flight times recorded are shown in **Table A6.11** of **Appendix VI**. For the worst case scenario (N131), the predicted collision risk (weighted and applying avoidance rate of 99%) was 0.15 collisions over 30 years, which is considered insignificant, in terms of effects at the population level.

Given the low-level usage recorded, the proposed development site and its environs were not considered important for all the gull species observed. Therefore, the proposed development will not affect any gull populations.

Other waterbirds

For **cormorants**, over the two-year study only one commuting flights of two birds was recorded within the 500 m turbine buffer, with other observations recorded in the wider area linked to usage of the River Shannon. Given the low-level of usage recorded, the proposed development site is not considered important for cormorant and will not affect populations in the wider area.

Grey herons were not observed foraging within or commuting through the study area. Grey heron activity recorded during the VP watches was largely associated with the quarries in the south-west of the 500 m buffer, where the proposed substation, temporary compounds and associated infrastructure will be located. Grey herons were recorded a number of times flying over the quarries, as well as flying in a south easterly direction towards the quarries. As such, impacts on grey heron are considered to be associated with disturbance during construction, especially during works in the quarry associated with track construction and the proposed sub-station. Given the low-level of usage recorded, the proposed development site is not considered important for grey herons and this green listed target species is not considered to be an important ecological receptor.

5.2 Birds of prey

Buzzard

Buzzards were the most commonly recorded target species over the baseline study, with 90 observations recorded within the study area during VP watches – see map in **Appendix III**. Buzzard observations generated the highest number of flight seconds (34,658 seconds) over the two-year study, with 16,454 seconds occurring at collision risk height. Typically, single birds were recorded regularly foraging or commuting through the buffer, with occasionally up to 4 birds observed simultaneously. As shown in **Figure 5**, there were two buzzard territories located within the study area, one territory within the long-established woodland in the western part of the site and the other in a mature treeline in the southern part of the site. Further breeding/territorial behaviour was observed at three other locations within the 2 km turbine buffer. It is considered that the area supports 2 to 3 pairs of breeding buzzard.

Woodland habitats within the proposed works corridor are important for this widespread and commonly occurring species of raptor. There is potential for breeding birds to be affected by felling operations required for the proposed development.

Increasingly, as post-construction monitoring programmes improve, buzzards are a species emerging as notably susceptible to collision with turbines. This is acknowledged within the CRM, which is run with a lowered avoidance rate (98% avoidance rate). Recently fledged birds developing their powers of flight may be particularly sensitive to collision risk. Based on observed flight activity within the 500 m turbine buffer, the collision risk (weighted and applying avoidance rate) was predicted to be 13.84 collisions over 30 years, equivalent to 1 bird every 2.17 years (worst-case scenario).

The buzzard population in Ireland has increased exponentially over the last 20 years and is still expanding into new areas; seemingly only limited by the availability of nesting habitat, typically in trees (Lusby, 2011 and Balmer *et al*. 2013). The success of buzzards in Ireland can be attributed to having notably high fecundity for a raptor (capable of fledging broods of 6 young); and the species' ability to exploit numerous food sources, ranging from carrion, worms and larger more mobile prey items like rabbits. Buzzards also employ a variety of foraging techniques (e.g. sitting in tree or active hunting flights), depending on habitat, seasonality and prey types; which has allowed them to expand into a wider range of ecological niches when compared to other raptors. Although no population estimate is available for buzzards in Ireland, as indicated by the BoCCI Green listing the species is now a common and widespread raptor in Ireland. Therefore, on a country wide population basis the magnitude of effect from direct and indirect operational impacts would be considered negligible and at the national population level any effects are considered not significant.

Kestrel

After buzzards, kestrels were the most regularly recorded target species within the 500 m turbine buffer with 4,680 flight seconds recorded within the collision risk zone over the two-year study. As shown in by the flightline maps in **Appendix III**, kestrels regularly foraged through the 500 m turbine buffer over both the winter and breeding seasons. One pair was identified as breeding within the 2 km turbine buffer (see **Figure 5**) and the breeding season home range of these birds falls within the 500 m turbine buffer. No breeding site were identified in the 500 m turbine buffer.

Therefore, based on flight activity within the 500 m turbine buffer this site is important to at least one pair of breeding kestrel and is also utilised over the winter. Within the proposed development site, the mosaic of different habitats creates lots of edge effects which can be exploited by foraging kestrels. There are breeding options within the proposed development site; however, the closest active nest site identified during the baseline study was *c*. 1 km from the closest proposed turbine.

Flight behaviour means kestrels are a species emerging as notably susceptible to collision with turbines and this is acknowledged within the collision risk model, which is run with a lowered avoidance rate for kestrel (95% avoidance rate). Based on observed flight activity within the 500 m turbine buffer, the collision risk (weighted and applying avoidance rate) was predicted to be 8.33 collisions over 30 years, equivalent to 1 bird every 3.6 years. Kestrels are red listed, however despite declining numbers, kestrel remain a common and widespread raptor in Ireland (9,918-17,393 pairs cited in Lewis *et al*. 2019a) and on a country wide population basis this magnitude of effect on a single pair would be considered negligible, i.e. < 1% population effect, as per Percival (2003). If considering the magnitude of the effect on the local kestrel populations (e.g. 10 to 40 birds within 10 km^2) then the magnitude of effect would be assessed as moderate, with a 2 to 8% increase in annual background mortality rate due to collisions based on an annual survival rate of 0.69 (as published on BTO BirdFacts based on Village, 1990).

Sparrowhawks

Sparrowhawks were recorded hunting and flying through the area over both the breeding season and non-breeding season – see flight line map in **Appendix III**. A total of 290 seconds was recorded within the 500 m turbine buffer, of which 133 seconds was determined to be within collision risk height (30-185m). This was below threshold (200 seconds) for running a collision risk model. On balance this species tends to fly relatively low (below rotor swept height), especially when hunting. However, display flights and when commuting long distances results in flight time within the collision risk zone; and as reviewed in Madder & Whitfield (2006), relying on VP watch data and the resultant CRMs may not be an appropriate methodology for assessment of collision risk in a small raptor species like sparrowhawk. It is acknowledged that the application of CRMs to smaller, evasive species like sparrowhawk may not provide an accurate estimate of collision risk, as these species can be difficult to detect over the full extent of the viewsheds for VPs, due diminutive size, cryptic nature and/or flight behaviour. Fatalities have been reported from Irish wind farm sites (e.g. Cullen & Williams, 2010).

One sparrowhawk breeding territory was identified within the 500 m turbine buffer, with two other territories located in the wider area – see **Figure 5**. In 2021 and again in 2022 (Ben O'Dwyer pers. com.) breeding territories within the proposed development area were located with the long-established woodland. Felling is not proposed at this location; however, pairs often have several alternative nest sites, which may occur within an area where felling is required. While woodland habitats within the proposed works corridor are important; it is understood that sparrowhawk, which often nests in commercial forestry plantation, is relatively tolerant of felling operations and provided felling is not undertaken during the breeding season pairs should be able to readily relocate in the remaining woodland adjacent to any felled areas.

Sparrowhawks are a common and widespread raptor in Ireland (8,746 – 14,252 pairs in Lewis *et al.* 2019a) and, on a country wide population basis, the magnitude of effect on 1 or 2 pairs would be considered negligible. In addition, the conservation status for sparrowhawks has recently been downgraded from Amber (Colhoun & Cummins, 2013) to Green (Gilbert *et al.*, 2021) listed. Therefore, the magnitude of effect of the proposed development on sparrowhawk is likely to be assessed as negligible and considered not significant at the national population level.

Hen harrier

Hen harriers are an important Annex I species to consider in relation to wind farm developments. No hen harriers were recorded breeding or roosting within the 2 km turbine buffer and the habitat within the 500 m turbine buffer was considered to have limited suitability for breeding or roosting. The desk-based study noted that hen harriers do breed within one of the 10 km squares [R67] encompassing the proposed development site. However, the larger expanses of open upland habitat and associated forestry located *c*. 2.5 km north of the 500 m turbine buffer, stretching north from Glennagalligh Mountain and onto Slieve Bearnagh, are considered to provide more substantive home range options for breeding hen harriers. The northern boundary of the 500 m turbine buffer marks the southern extent of suitable habitat, and this may explain the low usage of the area by hen harriers. Over the 2 years of the baseline study, there were a total of three hen harrier records, including:

- 19-May-2020: male heading north along plantation in the north-eastern part of the 500 m turbine buffer.
- 26-May-2020: male heading north over the woodland on Lackareagh Mountain, north of the 500 m turbine buffer.
- 25-Mar-2021: female was observed commuting west from the area of the quarry.

Considering the exceptionally low usage of the 500 m turbine buffer and that no roosts or breeding sites were detected within the 2 km turbine buffer, beyond providing habitat for the occasional foraging hen harrier, the proposed development site and surrounding area was not found to be important for hen harriers. Furthermore, the low usage of the proposed development site over the baseline study demonstrates that the area is not ecologically linked to SPAs designated for hen harrier.

Merlin

Over the 2 year baseline study usage of the 500 m turbine buffer was found to be exceptionally low and limited to a single bird over the winter. No roosts or breeding sites were detected within the 2 km turbine buffer. There was no suitable nesting for breeding merlin within the 500 m turbine buffer. Therefore, beyond providing habitat for the occasional foraging bird over the winter, the proposed development site and surrounding area was not found to be important for merlin. As identified by the desk-based study, the larger expanses of open upland habitat and associated forestry located *c*. 2.5 km north of the 500 m turbine buffer, stretching north from Glennagalligh

Mountain and onto Slieve Bearnagh, are considered to provide more substantive home range options for breeding merlin. Furthermore, the low usage of the proposed development site over the baseline study demonstrates that the area is not ecologically linked to SPAs designated for merlin.

Peregrine falcon

Over the 2 year baseline study usage of the 500 m turbine buffer was found to be exceptionally low and limited to a single bird over the winter. There is no suitable nesting habitat for peregrine within the 2 km turbine buffer, which probably explains the relatively low levels of peregrine activity recorded in the general area. Given the low-level usage recorded and lack of suitable nesting habitat the proposed development site and its environs were not considered important for peregrine falcons.

Barn owl

Barn owl were recorded once during the dusk surveys carried out in the 2020 and 2021 breeding seasons. Two ad hoc barn owl records were also noted during bat surveys carried out in summer 2021. At the start of the study, locals informed surveyors of a pair breeding in a derelict cottage at Ballyknavin/Kilroughil, as shown in **Figure 5**.

Observations during the baseline study were associated with the quarries located *c.* 300 m south-west of the 500 m turbine buffer. On one occasion, a pair were recorded perched on machinery within the Roadstone quarry. It has been found that barn owl home ranges are comparatively larger in Ireland than those in the UK, and barn owls can forage up to 6 km from nest sites during the breeding season (Lusby & O'Cleary, 2014). Therefore, the presence of barn owl within this area does not necessarily confirm breeding status. However, the derelict farm buildings and mature trees with cavities in this area do provide suitable nesting habitat for barn owl and the surrounding open, agricultural grassland provides suitable foraging habitat (TII, 2021). As barn owls forage alone, the presence of two juveniles perched together in the quarry (as observed during a bat transect on 24-Aug-2021, Sara Fissolo pers. comm.) provides further evidence of a nearby nest site. It should be noted that barn owl remain in the same territory throughout their lives and traditional nest sites can be occupied by successive generations (Lusby & O'Cleary, 2014).

The possible barn owl breeding territories identified in **Figure 5**, are beyond reported disturbance thresholds for barn owls, as reviewed in Ruddock & Whitfield (2007). The expert opinion collated is highly variable, with the majority within the range of 30 to 100 m from breeding sites, although values as low as 10 m and as high 250 m were also cited. The reason for this variability is recognised as a function of the nest site characteristics (e.g. building in an active farmyard vs a more isolated site), behavioural traits of breeding pair (e.g. habituation to human activity) and the type of disturbance activities involved. Specifically in relation to wind farm developments the *zone of sensitivity* applied by Mc Guinness *et al*. (2015) for barn owls is 2 km.

As covered in the desk-based study, barn owls are considered to be at lower risk of colliding with larger turbines that do not have lattice towers, as they hunt at low levels typical 3-4 m above the ground (Barn Owl Trust, 2015).

Overall, it is considered that potential impacts will be associated with land-use changes due to the proposed development, e.g, removal of hedgerow, treelines and overall reduction of connectivity.

5.3 Other species of conservation concern

Swift

Swift, which have moved from amber to red listed in the most recently published BoCCI (Gilbert *et al*., 2021), are emerging as species susceptible to turbine mediated mortality (Rydell *et al*., 2012). Therefore, in the second breeding season (2021) swifts were included as target species during VP surveys and flight line data was collected. However, as this was not implemented ubiquitously across the season the flight times recorded are only indicative and do represent a full breeding season, therefore a collision risk model was not run for this species. The area does not hold any suitable nesting habitat for this species, and they are unlikely to breed within the 2 km turbine buffer. Birds are known to travel considerable distances from breeding sites to forage (up to 20 km). The proposed development site is within the foraging range of swifts nesting in buildings within larger urban centres like Limerick City and Nenagh.

Swifts were observed foraging within the 500 m turbine buffer six times during the 2021 breeding season, will foraging parties ranging from 2 to 6 birds. Flight lines are shown in **Appendix III**. Flocks were recorded foraging for prolonged periods at 80 to 150 m, with aggregated flight time in the CRZ amounting to 877 seconds; however, this is likely to be an underestimate. The air space over the Roadstone quarry also recorded some the swift foraging activity and it is likely that birds were attracted to insects rising out of the sediment ponds and dense vegetation.

It is estimated that the number of collisions required to produce a 1% increase over baseline mortality would be 49 to 251 collisions/annum, based on the national (RoI) population of 68,920 birds - range: 25,520 to 130,540 birds (Crowe *et al*. ,2014) and an annual adult survival rate of 0.808 (Balmer & Peach, 1997). Based on the indicative levels of flight activity recorded, this level of mortality is judged to be highly unlikely to occur at this location. Therefore, the magnitude of effect due to potential collisions is negligible.

Red and amber listed passerines

Other red listed species of conservation concern recorded during the baseline study included meadow pipit, grey wagtail and yellowhammer. Meadow pipit were recorded breeding in the wet, agricultural grassland in the middle and south of the site. Grey wagtail was recorded once along the Black River, which flows north to south along the western side of the site. Yellowhammers were recorded twice during winter surveys and this species was not recorded breeding in the area. As with most common and widespread passerines, populations of meadow pipit and grey wagtail are not at risk from collisions with turbines. On sites where yellowhammers breed, they can be susceptible to changes in land-use however, the absence of cereal production in the environs of the proposed development means this species is unlikely to be breeding in the area.

Nine amber listed species of conservation concern were recorded during the baseline study including: brambling, goldcrest, greenfinch, house sparrow, linnet, sand martin, spotted flycatcher, starling, and swallow. It is considered that inappropriately timed removal of vegetation during construction has the potential to result in direct/indirect disturbance to Amber listed breeding passerines that nest in scrub, hedgerow, treelines and woodland habitats, within or directly adjacent to the proposed works corridor. There was a sand martin colony recorded within Roadstone quarry and this located to the west the of the wind farm access track which runs through the quarry.

In relation the timing of construction works, it is important to consider potential impacts on the general assemblage of woodland/farmland birds and the annotated species list in **Table 8** provides details on the occurrence of all green listed species in relation to the proposed development.

6 Conclusions

This report, including the CRM detailed in **Appendix VI** provides the ornithological baseline information required to undertake a robust ornithological impact assessment for the proposed development. Ornithological surveys conducted between October 2019 and January 2022, the results of which are presented in this report, comply fully with SNH (2017) guidelines for informing impact assessment of onshore wind farms. The information contained in this report includes robust baseline data, which can be used to assess the likely significant effects of the proposed development on the avi-fauna in the area. No substantial limitations were identified in terms of scale, scope or context in the preparation of this report.

Wintering waterbird activity through and around the site was very low and there was no breeding wader activity recorded within the 500 m turbine buffer. Therefore, the site is not considered to be important for waterbirds and it can be concluded the proposed development will not impact significantly on any waterbird population, including those with SPAs designated for breeding or wintering waterbirds.

Bird of prey activity was higher for some species, including the green listed buzzard and sparrowhawk which breed within the 500 m turbine buffer and red listed kestrel and barn owl breeding in habitat adjacent to the 500 m turbine buffer. Disturbance to breeding birds during the construction phase of the project is the main potential impact and inappropriately timed removal of vegetation within the works corridor has the potential to result in direct/indirect disturbance to breeding birds that nest in scrub, hedgerow, treelines and woodland habitats, within or directly adjacent to the works corridor. The breeding raptors recorded in the environs of the proposed development are not considered to be susceptible to long-term displacement effects associated with operational wind farms.

The proposed development site was not found to be important for any Annex I raptor species, including hen harrier, merlin or peregrine. Therefore, it can be concluded the proposed development will not impact significantly on any Annex I raptor populations, including those within SPAs designated for these species.

The population effects of predicted collision risk was investigated for buzzard (0.36 to 0.46 collisions per annum) and kestrel (0.21 to 0.28 collisions per annum). For buzzard, which are green listed, the population effects for the predicted collision risk was assessed as negligible (>1%). Likewise, for kestrel, which although red listed remains a common and widespread raptor in Ireland, the population effects for the predicted collision risk was assessed as negligible (>1%) at a national population level. However, if the predicted collision risk is assessed for the local population, then the magnitude of effect would be assessed as low to moderate (2 to 8% increase in annual background mortality rate). Recently fledged, naïve birds are considered likely to be affected most. To minimise collision risk for kestrels it is recommended that mitigation measures are implemented to limit kestrel foraging activity around turbines. This can be achieved through habitat management targeted at reducing prey availability in an area of 80-100 m around turbines, especially for turbines where tree felling is required to implement bat buffers. Enhancement measures could also be implemented to increase the breeding success of the local kestrel population. This would involve erecting nest boxes in the wider area, which would also provide nesting options for barn owls.

Overall, the proposed development presents a very low risk to the bird populations occurring in the environs of the site. For species where some concerns have been raised, including breeding raptors and barn owls, measures to limit or compensate for potential negative impacts can be implemented.

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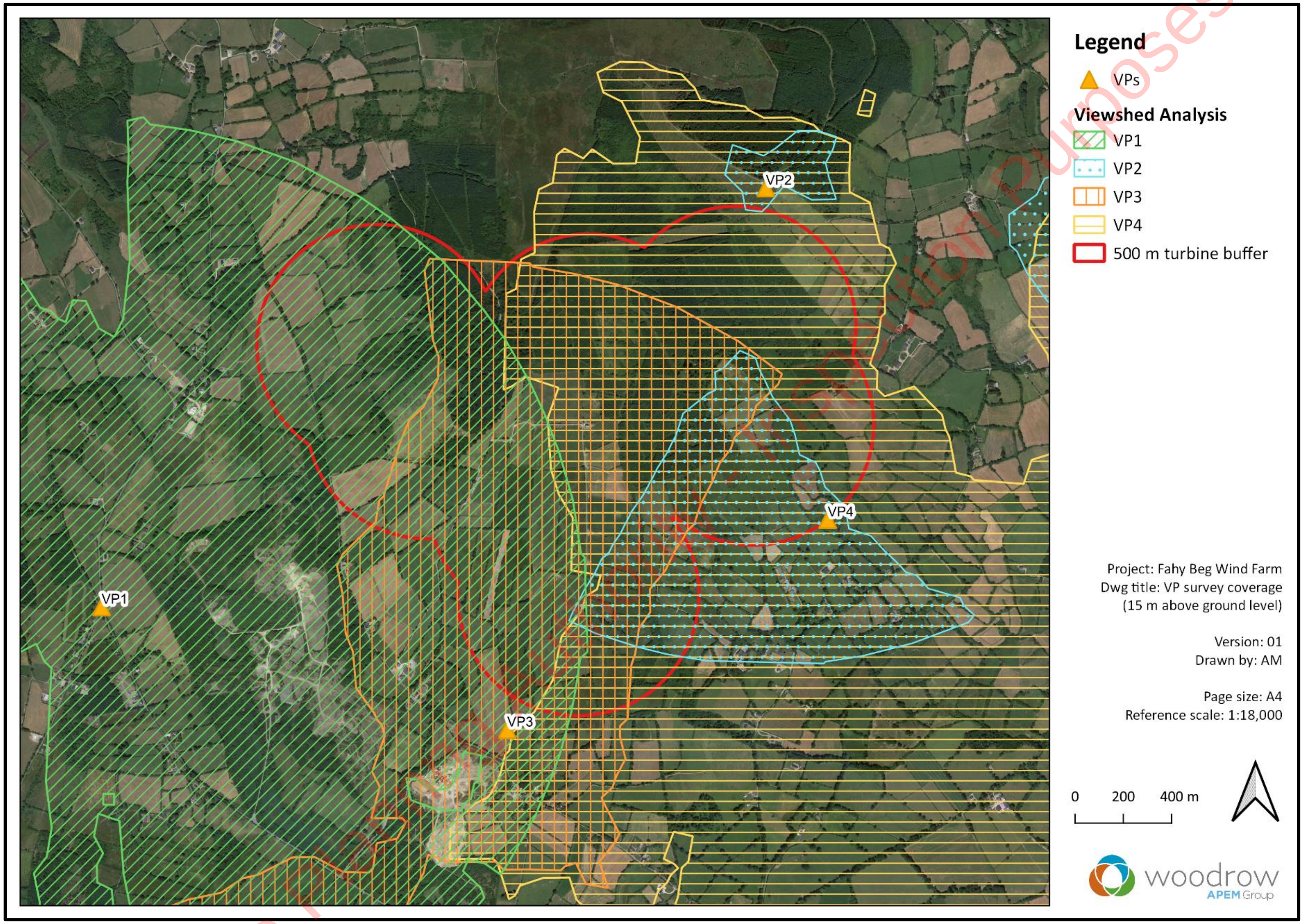
Appendix I - BTO Species Codes

BTO SPECIES CODES

AC	Arctic Skua	GA	Gadwall	LE	Long-eared Owl	SM	Sand Martin
AE	Arctic Tern	GX	Gannet	LT	Long-tailed Tit	SS	Sanderling
AV	Avocet	GW	Garden Warbler	MG	Magpie	TE	Sandwich Tern
BO	Barn Owl	GY	Garganey	MA	Mallard	VI	Savi's Warbler
BY	Barnacle Goose	GC	Goldcrest	MN	Mandarin Duck	SQ	Scarlet Rosefinch
BA	Bar-tailed Godwit	EA	Golden Eagle	MX	Manx Shearwater	SP	Scaup
BR	Bearded Tit	OL	Golden Oriole	MR	Marsh Harrier	CY	Scottish Crossbill
BS	Berwick's Swan	GF	Golden Pheasant	MT	Marsh Tit	SW	Sedge Warbler
BI	Bittern	GP	Golden Plover	MW	Marsh Warbler	NS	Serin
BK	Black Grouse	GN	Goldeneye	MP	Meadow Pipit	SA	Shag
TY	Black Guillemot	GO	Goldfinch	MU	Mediterranean Gull	SU	Shelduck
BX	Black Redstart	GD	Goosander	ML	Merlin	SX	Shorelark
BJ	Black Tern	GI	Goshawk	M.	Mistle Thrush	SE	Short-eared Owl
B.	Blackbird	GH	Grasshopper Warbler	MO	Montagu's Harrier	SV	Shoveler
BC	Blackcap	GB	Great Black-backed Gull	MH	Moorhen	SK	Siskin
BH	Black-headed Gull	GG	Great Crested Grebe	MS	Mute Swan	S.	Skylark
BN	Black-necked Grebe	ND	Great Northern Diver	N.	Nightingale	SZ	Slavonian Grebe
BW	Black-tailed Godwit	NX	Great Skua	NJ	Nightjar	SN	Snipe
BV	Black-throated Diver	GS	Great Spotted Woodpecker	NH	Nuthatch	SB	Snow Bunting
BT	Blue Tit	GT	Great Tit	OP	Osprey	ST	Song Thrush
BU	Bluethroat	GE	Green Sandpiper	OC	Oystercatcher	SH	Sparrowhawk
BL	Brambling	G.	Green Woodpecker	PX	Peafowl/Peacock	AK	Spotted Crake
BG	Brent Goose	GR	Greenfinch	PE	Peregrine	SF	Spotted Flycatcher
BF	Bullfinch	GK	Greenshank	PH	Pheasant	DR	Spotted Redshank
BZ	Buzzard	H.	Grey Heron	PF	Pied Flycatcher	SG	Starling
CG	Canada Goose	P.	Grey Partridge	PW	Pied Wagtail	SD	Stock Dove
CP	Capercaillie	GV	Grey Plover	PG	Pink-footed Goose	SC	Stonechat
C.	Carrion Crow	GL	Grey Wagtail	PT	Pintail	TN	Stone-curlew
CW	Cetti's Warbler	GJ	Greylag Goose	PO	Pochard	TM	Storm Petrel
CH	Chaffinch	GU	Guillemot	PM	Ptarmigan	SL	Swallow
CC	Chiffchaff	FW	Guineafowl (Helmeted)	PU	Puffin	SI	Swift
CF	Chough	HF	Hawfinch	PS	Purple Sandpiper	TO	Tawny Owl
CL	Cirl Bunting	HH	Hen Harrier	Q.	Quail	T.	Teal
CT	Coal Tit	HG	Herring Gull	RN	Raven	TK	Temminck's Stint
CD	Collared Dove	HY	Hobby	RA	Razorbill	TP	Tree Pipit
CM	Common Gull	HZ	Honey Buzzard	RG	Red Grouse	TS	Tree Sparrow
CS	Common Sandpiper	HC	Hooded Crow	KT	Red Kite	TC	Treecreeper
CX	Common Scoter	HP	Hoopoe	ED	Red-backed Shrike	TU	Tufted Duck
CN	Common Tern	HM	House Martin	RM	Red-breasted Merganser	TT	Turnstone
CO	Coot	HS	House Sparrow	RQ	Red-crested Pochard	TD	Turtle Dove
CA	Cormorant	JD	Jackdaw	FV	Red-footed Falcon	TW	Twite
CB	Corn Bunting	J.	Jay	RL	Red-legged Partridge	WA	Water Rail
CE	Corncrake	K.	Kestrel	NK	Red-necked Phalarope	W.	Wheatear
CI	Crested Tit	KF	Kingfisher	LR	Redpoll (Lesser)	WM	Whimbrel
CR	Crossbill (Common)	KI	Kittiwake	RK	Redshank	WC	Whinchat
CK	Cuckoo	KN	Knot	RT	Redstart	WG	White-fronted Goose
CU	Curlew	LM	Lady Amherst's Pheasant	RH	Red-throated Diver	WH	Whitethroat
DW	Dartford Warbler	LA	Lapland Bunting	RE	Redwing	WS	Whooper Swan
DI	Dipper	L.	Lapwing	RB	Reed Bunting	WN	Wigeon
DO	Dotterel	TL	Leach's Petrel	RW	Reed Warbler	WT	Willow Tit
DN	Dunlin	LB	Lesser Black-backed Gull	RZ	Ring Ouzel	WW	Willow Warbler
D.	Dunnock	LS	Lesser Spotted Woodpecker	RP	Ringed Plover	OD	Wood Sandpiper
EG	Egyptian Goose	LW	Lesser Whitethroat	RI	Ring-necked Parakeet	WO	Wood Warbler
E.	Eider	LI	Linnet	R.	Robin	WK	Woodcock
FP	Feral Pigeon	ET	Little Egret	DV	Rock Dove (not feral)	WL	Woodlark
ZL	Feral/hybrid goose	LG	Little Grebe	RC	Rock Pipit	WP	Woodpigeon
ZF	Feral/hybrid mallard type	LU	Little Gull	RO	Rook	WR	Wren
FF	Fieldfare	LO	Little Owl	RS	Roseate Tern	WY	Wryneck
FC	Firecrest	LP	Little Ringed Plover	RY	Ruddy Duck	YW	Yellow Wagtail
F.	Fulmar	AF	Little Tern	RU	Ruff	Y.	Yellowhammer

Appendix II – Viewshed Analysis



Appendix III – Flight lines maps for target species and table with flight attributes

Table providing flightline data collected during VP watches. The ID number in the first column cross-reference with maps showing flight lines, which follow on from the table.

Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
Non-breeding season 2019-20												
1	1	22/10/2019	1304	BZ	Buzzard	1	0	60	20-60m	M		Soaring
2	1	22/10/2019	1304	BZ	Buzzard	1	147	100	20-100m	F		Soaring
3	1	22/10/2019	1322	H	Grey heron	1	0	40	20-40m			Flying
4	1	22/10/2019	1341	SH	Sparrowhawk	1	0	30	20-30m	F		Hunting
5	1	04/11/2019	1153	K	Kestrel	1	0	20	10-20-15m			Flying
6	1	04/11/2019	1235	K	Kestrel	1	0	40	15-25-40-20-10-5m			Flying
7	1	04/11/2019	1249	CU	Curlew	1	0	60	25-40-60m			Flying
8	1	04/11/2019	1329	K	Kestrel	1	0	50	20-80-50m			Circling
9	1	04/11/2019	1357	BZ	Buzzard	1	15	10	10-5-3m			Flying
10	1	23/11/2019	1612	H	Grey heron	1	0	100	100m			Flying
11	1	23/11/2019	1615	H	Grey heron	1	0	50	50m			Flying
12	1	03/02/2020	1611	BZ	Buzzard	1	0	10	10-20m			Flying
13	1	02/03/2020	1125	K	Kestrel	1	0	30	25-100	F	Adult	Flying
14	1	02/03/2020	1207	K	Kestrel	1	0	30	25-100	F	Adult	Flying
15	1	10/03/2020	1207	BZ	Buzzard	1	46	100	50-100	M	Adult	Flying
16	2	18/10/2019	1343	BZ	Buzzard	1	617	80	25-80m			Soaring
17	2	18/10/2019	1346	BZ	Buzzard	1	285	100	25-100			Soaring
18	2	12/11/2019	1432	SH	Sparrowhawk	1	0	10	10m	M	Adult	Flying
19	2	23/11/2019	1120	SH	Sparrowhawk	1	0	5	5m	F	Adult	Flying
20	2	12/12/2019	1228	SH	Sparrowhawk	1	0	25	25m			Flying
21	2	12/12/2019	1228	SH	Sparrowhawk	2	70	200	35-200m	M+F		Displaying
22	2	29/12/2019	1138	K	Kestrel	1	10	15	10-20m			Hunting
23	2	29/12/2019	1223	SH	Sparrowhawk	1	10	50	50-10m			Flying

Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
24	2	29/12/2019	1315	BZ	Buzzard	1	0	10	5-15m			Perched
25	2	03/03/2020	1017	BZ	Buzzard	2	136	100	50-100	M+F	Adult	Flying
26	2	03/03/2020	1042	BZ	Buzzard	1	36	100	50-100	M	Adult	Flying
27	3	21/10/2019	1224	SH	Sparrowhawk	1	5	1	1-2m	M		Hunting
28	3	21/10/2019	1245	BZ	Buzzard	1	168	40	10-40m	F		Soaring
29	3	21/10/2019	1048	BZ	Buzzard	1	135	40	10-40m	M		Soaring
30	3	22/10/2019	1553	K	Kestrel	1	0	20	20m	F		Hunting
31	3	22/10/2019	1633	K	Kestrel	1	0	20	20m	M		Hunting
32	3	22/10/2019	1759	K	Kestrel	1	67	10	10m	F		Hunting
33	3	26/10/2019	1342	K	Kestrel	1	20	10	15-0m	M	Adult	Hunting
34	3	26/10/2019	1634	BZ	Buzzard	1	10	5	5m			Flying
35	3	14/11/2019	1606	K	Kestrel	1	25	200	200-0m			Flying
36	3	24/11/2019	1432	K	Kestrel	1	0	10	10m			Flying
37	3	11/12/2019	1415	K	Kestrel	1	25	150	150m			Hunting
38	3	12/01/2020	1356	K	Kestrel	1	10	15	15m	M	Adult	Mobbing
39	3	31/01/2020	1509	SH	Sparrowhawk	1	25	10	5-20m	M		Hunting
40	3	31/01/2020	1618	K	Kestrel	1	25	20	10-40m			Hunting
41	3	31/01/2020	1553	BZ	Buzzard	1	240	30	10-75m			Circling
42	3	31/01/2020	1608	K	Kestrel	1	0	10	5-20m			Hunting
43	3	31/01/2020	1640	K	Kestrel	1	0					Hunting
44	3	04/02/2020	1153	K	Kestrel	1	20	7	1-10m			Flying
45	3	04/02/2020	1159	BZ	Buzzard	1	0	15	10-20m			Mobbed
224	3	20/02/2020	1552	K	Kestrel	1	15	10	5-15m			Flying
46	3	20/02/2020	1544	K	Kestrel	1	160	20	10-20m			Hunting
47	3	20/02/2020	1623	BZ	Buzzard	1	70	150	150m			Displaying
48	3	20/02/2020	1601	K	Kestrel	1	0	10	10m	M	Adult	Perched
49	3	02/03/2020	1342	BZ	Buzzard	2	116	80	30-80m	M+F	Adult	Soaring
50	4	21/10/2019	1733	BZ	Buzzard	1	28	20	20m			Flying

Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
51	4	22/10/2019	851	SH	Sparrowhawk	1	15	30	20-30m	F		Flying
52	4	27/11/2019	1118	K	Kestrel	1	24	10	10m			Flying
53	4	30/12/2019	1222	ML	Merlin	1	50	5	5m	F	Adult	flying
54	4	31/01/2020	1204	BZ	Buzzard	1	180	200	200m			Circling
55	4	31/01/2020	1214	K	Kestrel	1	120	20	20m			Hunting
56	4	31/01/2020	1225	BZ	Buzzard	2	110	100	50-150	M+F		Displaying
57	4	31/01/2020	1251	BZ	Buzzard	1	30	300	300m			Soaring
58	4	31/01/2020	1256	K	Kestrel	1	120	20	10-30m			Hunting
59	4	31/01/2020	1310	SH	Sparrowhawk	1	15	200	200m			Circling
60	4	31/01/2020	1335	BZ	Buzzard	1	15	30	30m			Flying
61	4	31/01/2020	1347	BZ	Buzzard	2	960	200	200m			Displaying
62	4	31/01/2020	1421	BZ	Buzzard	1	60	20	10-30m			Flying
63	4	31/01/2020	1443	SH	Sparrowhawk	1	15	10	5-25m	M		Hunting
64	4	10/03/2020	1425	K	Kestrel	1	38	25	10-25m	M	Adult	Hunting
65	4	10/03/2020	1448	BZ	Buzzard	2	328	100	50-100	M+F	Adult	Flying
66	4	10/03/2020	1529	K	Kestrel	1	52	20	10-25m	M	Adult	Flying
67	4	10/03/2020	1612	K	Kestrel	1	43	20	10-25m	M	Adult	Flying
Breeding season 2020												
68	1	16/03/2020	1351	BZ	Buzzard	1	0	50	50-100	M	Adult	Flying
69	1	17/04/2020	1338	K	Kestrel	1	0	20	20-50m	M	Adult	Flying
70	1	17/04/2020	1419	K	Kestrel	1	0	40	20-50m	M	Adult	Hunting
71	1	17/04/2020	1508	K	Kestrel	1	0	40	20-50m	M	Adult	Flying
72	1	17/04/2020	1541	K	Kestrel	1	0	10	10-30m	M	Adult	Flying
73	1	23/04/2020	1107	BZ	Buzzard	1	0	100	100-300m	M	Adult	Soaring
74	1	23/04/2020	1135	BZ	Buzzard	1	0	100	100-300m	M	Adult	Soaring
75	1	23/04/2020	1148	BZ	Buzzard	2	1496	150	150-300m	M+F	Adult	Soaring
76	1	23/04/2020	1247	BZ	Buzzard	2	2564	200	200-300m	M+F	Adult	Soaring
77	1	01/05/2020	1104	K	Kestrel	2	0	40	40-100m	M+F	Adult	Flying

Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
78	1	08/05/2020	1005	K	Kestrel	1	0	80	80-100m	M	Adult	Flying
79	1	08/05/2020	1116	BZ	Buzzard	1	0	100	100-200m		Adult	Soaring
80	1	08/05/2020	1202	BZ	Buzzard	1	0	100	100-200m		Adult	Soaring
81	1	20/05/2020	1512	K	Kestrel	1	0	20	20-60m	M	Adult	Hunting
82	1	20/05/2020	1625	K	Kestrel	1	0	20	20-60m	M	Adult	Flying
83	1	22/06/2020	916	K	Kestrel	1	0	20	20m	M		Flying
84	1	22/06/2020	1035	BH	Black-headed gull	6	0	20	20m		Adult	Flying
85	1	23/04/2020	1255	K	Kestrel	1	0	10	10-20m	M	Adult	Flying
86	1	23/07/2020	1432	BZ	Buzzard	3	0	150	100-200m		juv-adults	Gliding
87	1	23/07/2020	1507	BZ	Buzzard	1	0	150	100-150m		Adult	Gliding
88	1	24/08/2020	932	K	Kestrel	1	0	20	20-40m	M	Adult	Hunting
89	2	24/03/2020	1052	K	Kestrel	1	0	25	25-50m	M	Adult	Flying
90	2	24/03/2020	1124	K	Kestrel	1	58	25	25-50m	M	Adult	Flying
91	2	23/04/2020	1438	BZ	Buzzard	2	924	150	150-200m	M+F	Adult	Soaring
92	2	23/04/2020	1505	BZ	Buzzard	1	211	100	100-150m	M	Adult	Soaring
93	2	02/05/2020	1325	BZ	Buzzard	1	420	150	150-200m		Adult	Soaring
94	2	13/05/2020	1507	SH	Sparrowhawk	1	8	10	10-20m	M	Adult	Flying
95	2	19/05/2020	1509	HH	Hen harrier	1	43	20	20-50m	M	Adult	Flying
96	2	19/05/2020	1648	K	Kestrel	1	18	20	20-50m	M	Adult	Hunting
97	2	05/06/2020	1348	BZ	Buzzard	1	322	150	100-150m			circling
98	2	22/06/2020	1227	BZ	Buzzard	2	2400	80	80-100m		Adult	Soaring
99	2	22/06/2020	1412	BZ	Buzzard	1	370	80	80-100m		Adult	Soaring
100	2	21/08/2020	922	BZ	Buzzard	1	50	150	100-200m		Adult	Flying
101	2	31/08/2020	1707	BZ	Buzzard	3	900	300	200-300m	M+F		Soaring
102	3	18/03/2020	1224	K	Kestrel	1	37	40	30-60m	M	Adult	Flying
103	3	18/03/2020	1305	SH	Sparrowhawk	1	0	10	10-25m	F	Adult	Flying
104	3	18/03/2020	1320	K	Kestrel	1	30	25	25-50m	M	Adult	Flying
105	3	17/04/2020	1712	BZ	Buzzard	1	23	50	30-60m	M	Adult	Flying

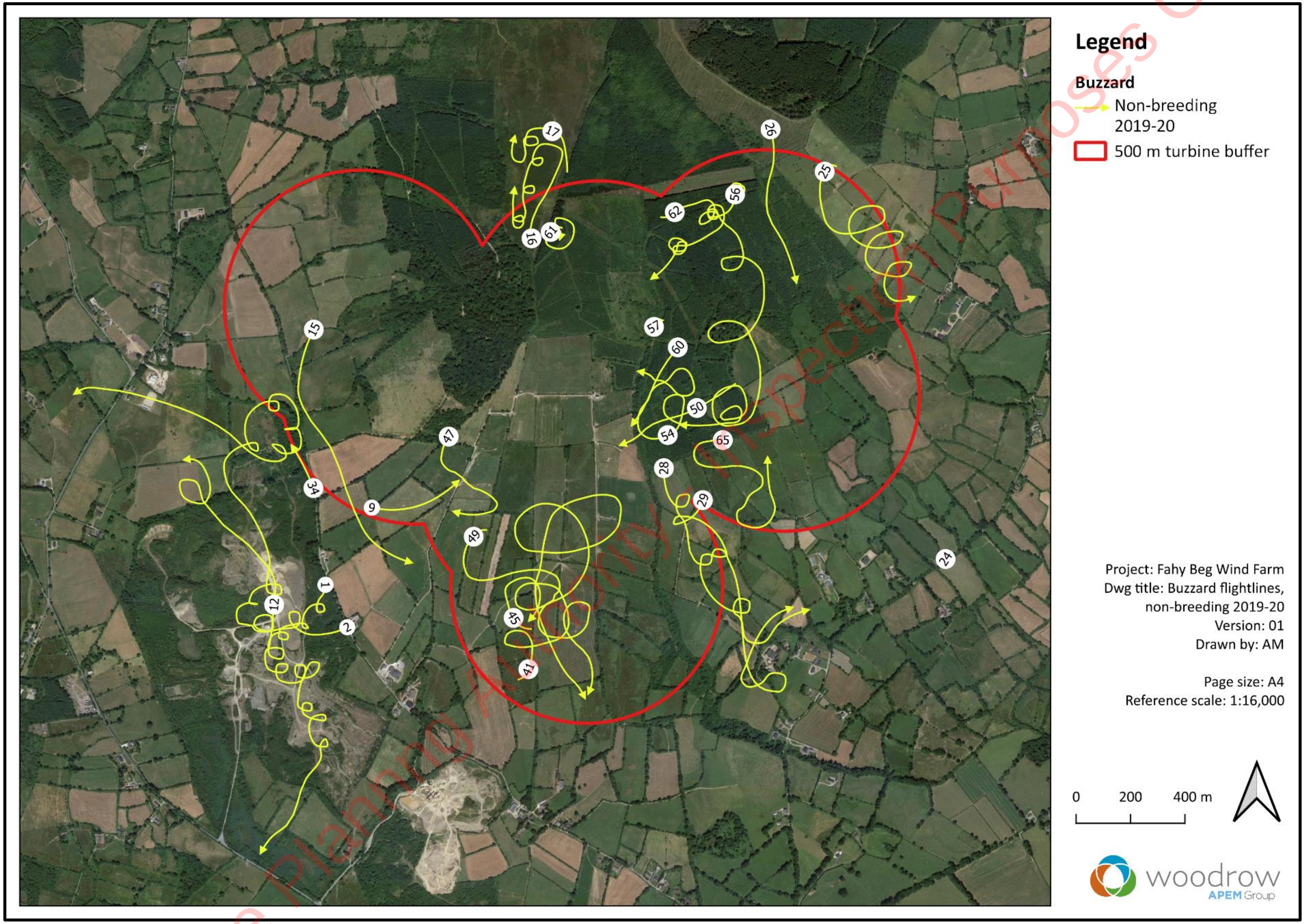
Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
106	3	25/04/2020	1348	BZ	Buzzard	2	1136	100	100-200m	M+F	Adult	Soaring
107	3	08/05/2020	1354	K	Kestrel	1	52	40	30-60m	M	Adult	Hunting
108	3	08/05/2020	1520	BZ	Buzzard	1	238	100	100-150m		Adult	Soaring
109	3	24/05/2020	1327	BZ	Buzzard	1	220	150	100-200m		Adult	Soaring
110	3	24/05/2020	1448	BZ	Buzzard	1	88	150	100-200m		Adult	Soaring
111	3	03/06/2020	1240	BH	Black-headed gull	7	448	30	30m		Adult	Flying
112	3	25/06/2020	1520	BZ	Buzzard	2	1680	200	200m	M+F	Adult	Soaring
113	3	26/08/2020	1810	BZ	Buzzard	1	180	100	100-150m		Adult	Flying
114	4	24/03/2020	1447	BZ	Buzzard	1	28	40	30-50m	F	Adult	Flying
115	4	18/04/2020	1311	K	Kestrel	1	24	10	10-20m	M	Adult	Carrying food
116	4	18/04/2020	1324	LB	Lesser black-backed gull	2	60	50	50-80m		Adult	Flying
117	4	25/04/2020	1028	SH	Sparrowhawk	1	12	4	4-10m	M	Adult	Hunting
118	4	02/05/2020	1128	BZ	Buzzard	1	144	100	100-150m	M	Adult	Soaring
119	4	02/05/2020	1204	BZ	Buzzard	2	764	100	100-200m	M+F	Adult	Soaring
120	4	13/05/2020	1116	K	Kestrel	1	68	60	30-80m	M	Adult	Hunting
121	4	13/05/2020	1142	K	Kestrel	1	53	60	30-80m	M	Adult	Hunting
122	4	13/05/2020	1204	BZ	Buzzard	1	148	80	80-150m		Adult	Soaring
123	4	13/05/2020	1322	K	Kestrel	1	34	80	30-80m	M	Adult	Soaring
124	4	25/06/2020	1116	K	Kestrel	1	55	20	20-80m	M	Adult	Circling
125	4	11/07/2020	1048	BZ	Buzzard	4	0	150	150-250m		juv-adults	Soaring
126	4	11/07/2020	1214	BZ	Buzzard	2	840	150	150-250m			Circling
127	4	28/08/2020	1740	BH	Black-headed gull	5	140	40	40-60m			Flying
128	4	28/08/2020	1822	K	Kestrel	1	0	20	20-40m	M	Adult	Hunting
Non-breeding season 2020-21												
129	1	29/09/2020	1022	BZ	Buzzard	3	0	150	150-200m		Adult	Soaring
130	1	23/10/2020	1455	SH	Sparrowhawk	1	0	100	100-150m	F	Adult	soaring
131	1	06/11/2020	1438	K	Kestrel	1	0	30	20-50m	M	Adult	Hunting
132	1	23/11/2020	1055	SH	Sparrowhawk	1	0	4	4-10m	F	Adult	Hunting

Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
133	1	12/12/2020	920	K	Kestrel	1	0	60	30-60m	F	Adult	Hunting
134	1	05/01/2021	1345	L	Lapwing	12	0	60	60-80m		Adult	Flying
135	1	29/01/2021	1320	K	Kestrel	1	0	50	30-50m	M	Adult	Hunting
136	1	02/03/2021	1310	BZ	Buzzard	1	0	150	150-30m	M	Adult	Soaring
137	2	25/09/2020	1340	BZ	Buzzard	1	20	100	100-200m		Adult	Flying
138	2	15/10/2020	1330	K	Kestrel	2	345	50	30-50m	M+F	Adult	Hunting
139	2	28/12/2020	1209	PE	Peregrine	1	30	100	100-150m	F	Adult	Flying
140	2	28/12/2020	1242	SH	Sparrowhawk	1	0	100	100-150m	F	Adult	circling
141	2	05/01/2021	1127	BZ	Buzzard	1	20	60	60-100m		Adult	Mobbed
142	2	05/01/2021	1209	BZ	Buzzard	1	38	40	40-60m	F	Adult	Gliding
143	2	29/01/2021	935	BZ	Buzzard	1	18	50	50-80m		Adult	Flying
144	2	29/01/2021	952	GJ	Greylag goose	6	48	80	80-100m		Adult	Flying
145	2	29/01/2021	1125	BZ	Buzzard	2	108	100	100-150m		Adult	Gliding
146	2	14/02/2021	1125	BZ	Buzzard	1	65	100	100-150m		Adult	soaring
147	2	22/02/2021	1025	SH	Sparrowhawk	1	65	100	100-150m	F	Adult	soaring
148	2	15/03/2021	1532	BZ	Buzzard	2	1800	200	200-300m	M+F	Adult	Soaring
149	3	27/10/2020	1511	BZ	Buzzard	3	630	80	80-100m		Adult	Circling
150	3	04/12/2020	1148	BZ	Buzzard	1	44	20	20-50m		Adult	Flying
151	3	04/01/2021	1116	H	Grey heron	1	10	40	40-60m		Adult	Flying
152	3	04/01/2021	1210	SH	Sparrowhawk	1	10	5	5-10m	M	Adult	Hunting
153	3	21/02/2021	1440	K	Kestrel	1	275	30	20-30m	F	Adult	Hunting
154	3	02/03/2021	1411	K	Kestrel	1	300	30	20-40m	F	Adult	Hunting
155	4	25/09/2020	948	K	Kestrel	1	78	20	20-50m	F	Adult	Hunting
156	4	25/09/2020	1012	K	Kestrel	1	45	20	20-50m	F	Adult	Hunting
157	4	15/10/2020	130	BZ	Buzzard	1	230	100	100-150m		Adult	Circling
158	4	08/12/2020	1109	WS	Whooper swan	3	39	100	100-150m		Adult	Flying
159	4	08/12/2020	1140	K	Kestrel	1	0	60	30-60m	F	Adult	Flying
160	4	02/01/2021	1420	K	Kestrel	1	20	60	30-60m	M	Adult	Flying

Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
161	4	02/01/2021	1335	SH	Sparrowhawk	1	25	80	80-100m	M	Adult	Flying
162	4	02/01/2021	1355	BZ	Buzzard	1	25	80	80-100m		Adult	Flying
163	4	16/02/2021	948	K	Kestrel	1	40	80	80-100m	M	Adult	Flying
164	4	16/02/2021	1107	K	Kestrel	1	0	20	20-30m	M	Adult	Hunting
165	4	22/02/2021	1315	BZ	Buzzard	1	65	60	60-100m		Adult	Flying
Breeding season 2021												
166	1	23/04/2021	1425	K	Kestrel	1	0	30	30-40m	M	Adult	Flying
167	1	06/05/2021	948	BZ	Buzzard	1	0	100	100-200m		Adult	Gliding
168	1	06/05/2021	1016	LB	Lesser black-backed gull	7	2100	100	100-200m		Adult	Flying
169	1	24/05/2021	1520	K	Kestrel	1	0	20	20-60m		Adult	Flying
170	1	01/06/2021	1320	BH	Black-headed gull	15	0	80	80-100m		Adult	Flying
171	1	01/06/2021	1320	LB	Lesser black-backed gull	9	0	80	80-100m		Adult	Flying
172	1	01/06/2021	1406	SI	Swift	2	0	160	100-150m		Adult	Flying
173	1	04/06/2021	1135	BZ	Buzzard	2	480	100	100-150m	Pair	Adult	Flying
174	1	25/06/2021	1420	K	Kestrel	1	0	100	100-150m			Flying
175	1	25/06/2021	1448	SI	Swift	2	0	80	80-150m			Flying
176	1	25/06/2021	1535	K	Kestrel	1	0	20	20-50m	M		Flying
177	1	01/07/2021	1325	BZ	Buzzard	1	0	80	80-100m		Adult	Soaring
178	1	20/07/2021	1650	SH	Sparrowhawk	1	0	100	100-150m		Adult	Soaring
179	1	03/08/2021	1038	K	Kestrel	1	0	25	20-40m	M	Adult	Flying
180	1	13/08/2021	1420	K	Kestrel	1	0	50	50-80m		Adult	Gliding
181	1	13/08/2021	1425	H	Grey heron	1	0	50	50-80m		Adult	Flying
182	2	29/03/2021	1107	BZ	Buzzard	1	0	150	150-250m	M	Adult	Soaring
183	2	05/04/2021	1620	BZ	Buzzard	1	90	100	100-200m		Adult	Soaring
184	2	16/04/2021	1205	BZ	Buzzard	2	360	100	100-150m	Pair	Adult	Soaring
185	2	04/05/2021	1307	K	Kestrel	1	120	25	20-50m	M	Adult	Hunting
186	2	04/05/2021	948	WM	Whimbrel	12	420	80	80-100m		Adult	Flying

Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
187	2	17/05/2021	1036	BZ	Buzzard	2	720	100	100-200m	Pair	Adult	Soaring
188	2	08/06/2021	1310	BZ	Buzzard	1	0	200	200-300m		Adult	Flying
189	2	08/06/2021	1435	BZ	Buzzard	2	120	200	200-300m	Pair	Adult	Flying
190	2	29/06/2021	1028	CA	Cormorant	2	100	80	80-100m		Adult	Flying
191	2	29/06/2021	1044	K	Kestrel	1	120	15	10-30m	M	Adult	Flying
192	2	06/07/2021	1548	SI	Swift	5	106	80	80-100m		Adult	Flying
193	2	21/07/2021	1738	BZ	Buzzard	3	1200	200	200-300m		Adult	Soaring
194	2	04/08/2021	830	BZ	Buzzard	3	720	200	150-250m		Adult	Soaring
195	3	27/03/2021	948	K	Kestrel	1	480	50	30-50m	F	Adult	Hunting
196	3	12/04/2021	1317	K	Kestrel	1	600	30	30-40m	M	Adult	Flying
197	3	06/05/2021	1209	BZ	Buzzard	1	38	60	60-100m		Adult	Mobbed
198	3	21/06/2021	1120	BZ	Buzzard	4	2880	200	200-300m		Adult	Soaring
199	3	21/06/2021	1142	LB	Lesser black-backed gull	13	1560	200	200-300m		Adult	Flying
200	3	21/06/2021	1207	K	Kestrel	1	40	20	20-30m	M	Adult	Flying
201	3	23/07/2021	1825	K	Kestrel	1	120	30	30-60m	M	Adult	Soaring
202	3	08/08/2021	1115	SI	Swift	5	35	100	100-150m		Adult	Flying
203	3	08/08/2021	1307	BZ	Buzzard	2	960	200	200-250m		Adult	Soaring
204	3	08/08/2021	1338	BZ	Buzzard	1	120	100	100-150m		Adult	Flying
205	3	13/08/2021	1138	BZ	Buzzard	1	300	200	200-300m		Adult	Soaring
206	3	13/08/2021	1205	BZ	Buzzard	1	480	200	150-300m		Adult	Soaring
207	4	29/03/2021	1335	K	Kestrel	1	78	40	40-50m	M	Adult	Hunting
208	4	29/03/2021	1353	K	Kestrel	1	44	50	30-50m	M	Adult	Hunting
209	4	29/03/2021	1507	BZ	Buzzard	2	1200	250	250-300	M+F	Adult	Soaring
210	4	05/04/2021	1248	BZ	Buzzard	2	1800	200	150-300m	Pair	Adult	Soaring
211	4	12/04/2021	1820	K	Kestrel	1	75	30	30-40m		Adult	Flying
212	4	19/05/2021	1525	SH	Sparrowhawk	1	8	10	10-20m	M	Adult	Hunting
213	4	19/05/2021	1538	BZ	Buzzard	1	300	150	150-200m		Adult	Soaring
214	4	18/06/2021	1325	SI	Swift	2	26	80	80-100m		Adult	Flying

Map ID No.	VP No.	Date	Time	BTO	Species	No. of birds	Flight time 500m buffer (sec)	Flight height (m)	Range in flight height	Sex	Age	Behaviour
215	4	18/06/2021	1407	K	Kestrel	1	60	20	20-50m		Adult	Flying
216	4	21/06/2021	1722	BZ	Buzzard	1	600	100	100-150m		Adult	Soaring
217	4	21/06/2021	1748	K	Kestrel	1	120	15	15-30m	M	Adult	Flying
218	4	21/06/2021	1807	BH	Black-headed gull	12	2160	200	200-300m		Adult	Flying
219	4	09/07/2021	915	SI	Swift	4	30	100	80-100m		Adult	Flying
220	4	09/07/2021	1116	SH	Sparrowhawk	1	9	10	10-20m	M	Adult	Flying
221	4	31/07/2021	1507	K	Kestrel	3	780	100	80-100m		Adult	Soaring
222	4	31/07/2021	1648	K	Kestrel	1	35	20	15-30m	M	Adult	Flying
223	4	21/08/2021	1610	K	Kestrel	1	20	30	30-60m	M	Adult	Flying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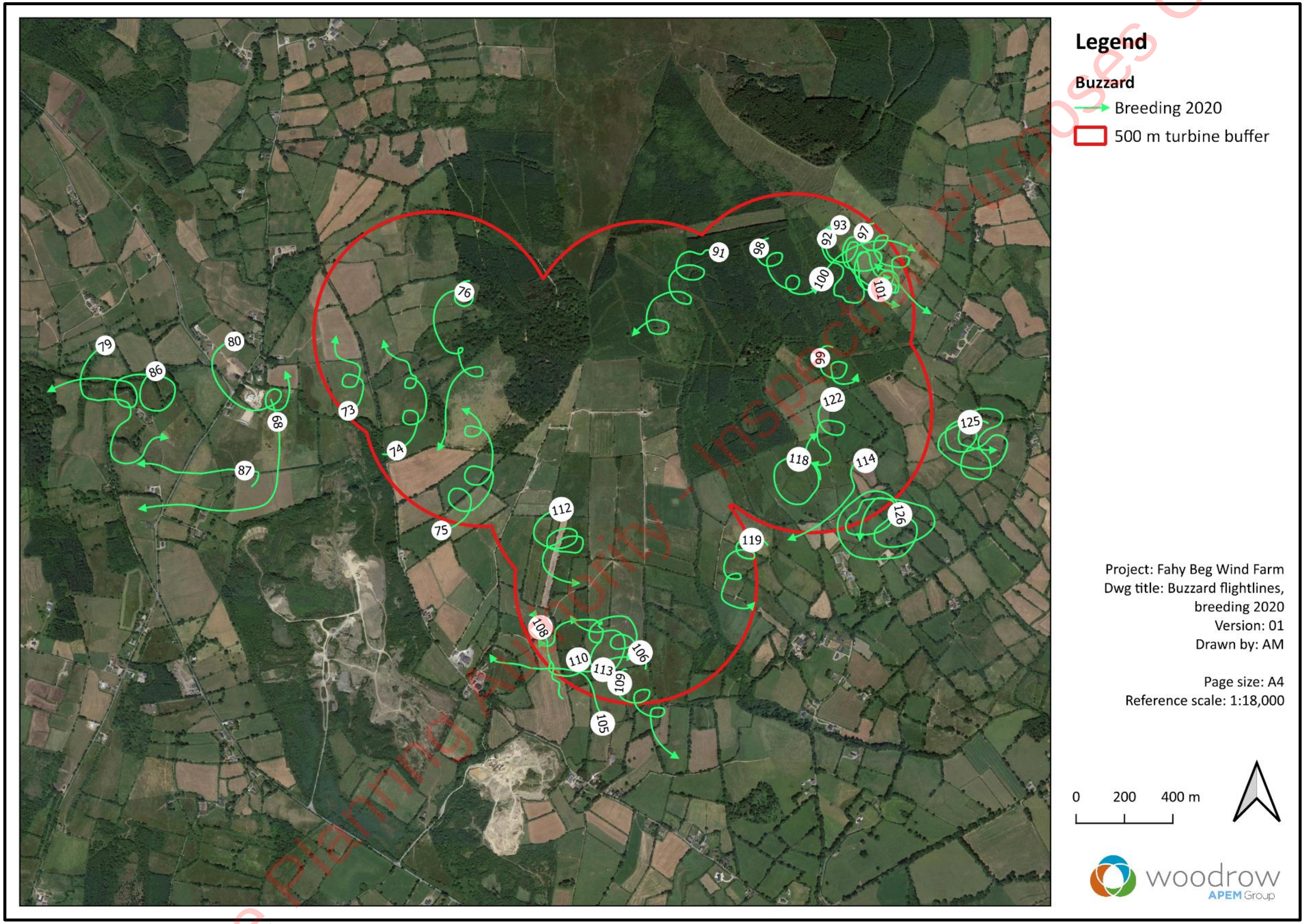
Buzzard
Non-breeding 2019-20
500 m turbine buffer
Project: Fahy Beg Wind Farm
Dwg title: Buzzard flightlines, non-breeding 2019-20
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:16,000
0 200 400 m
woodrow APEM Group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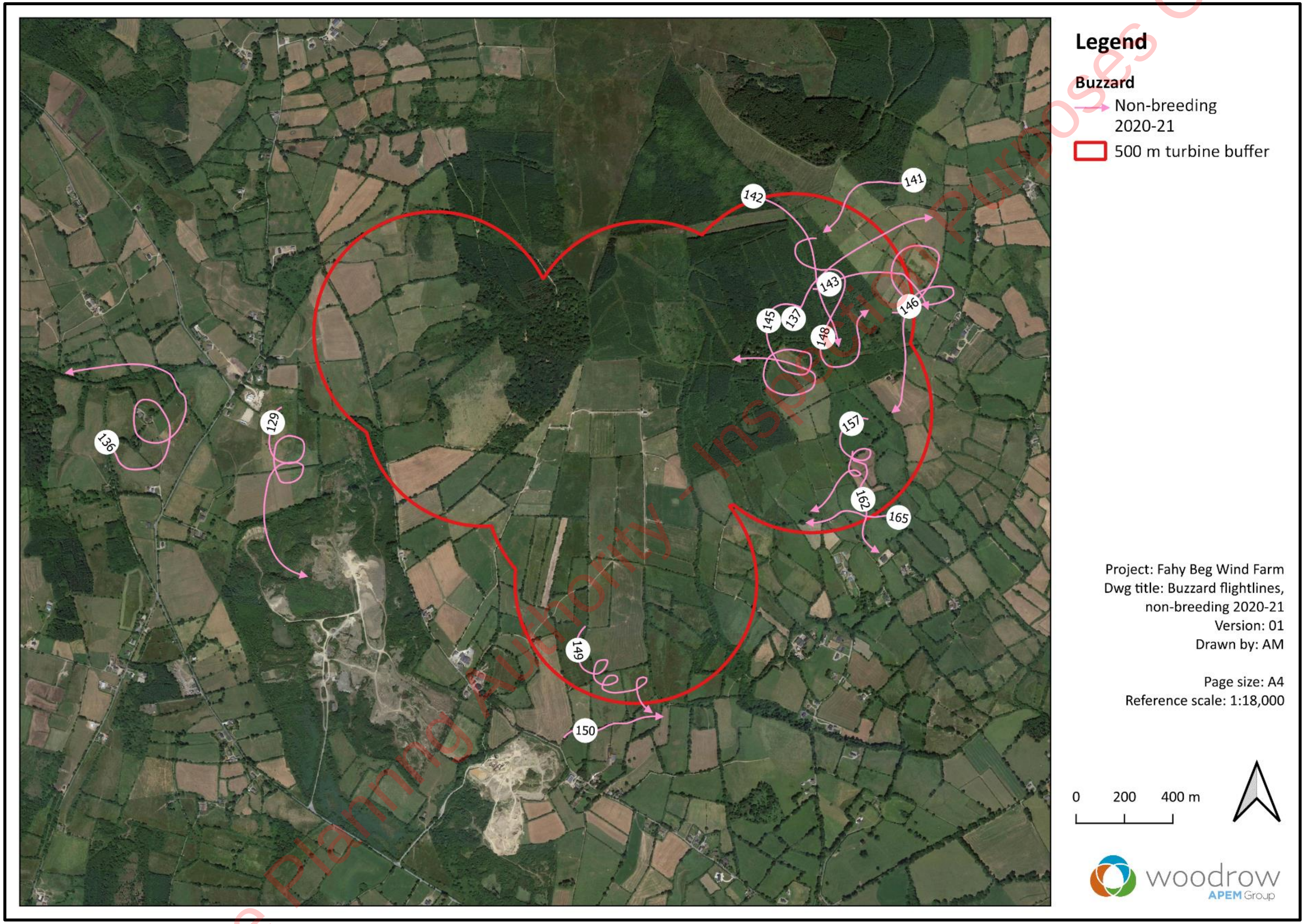
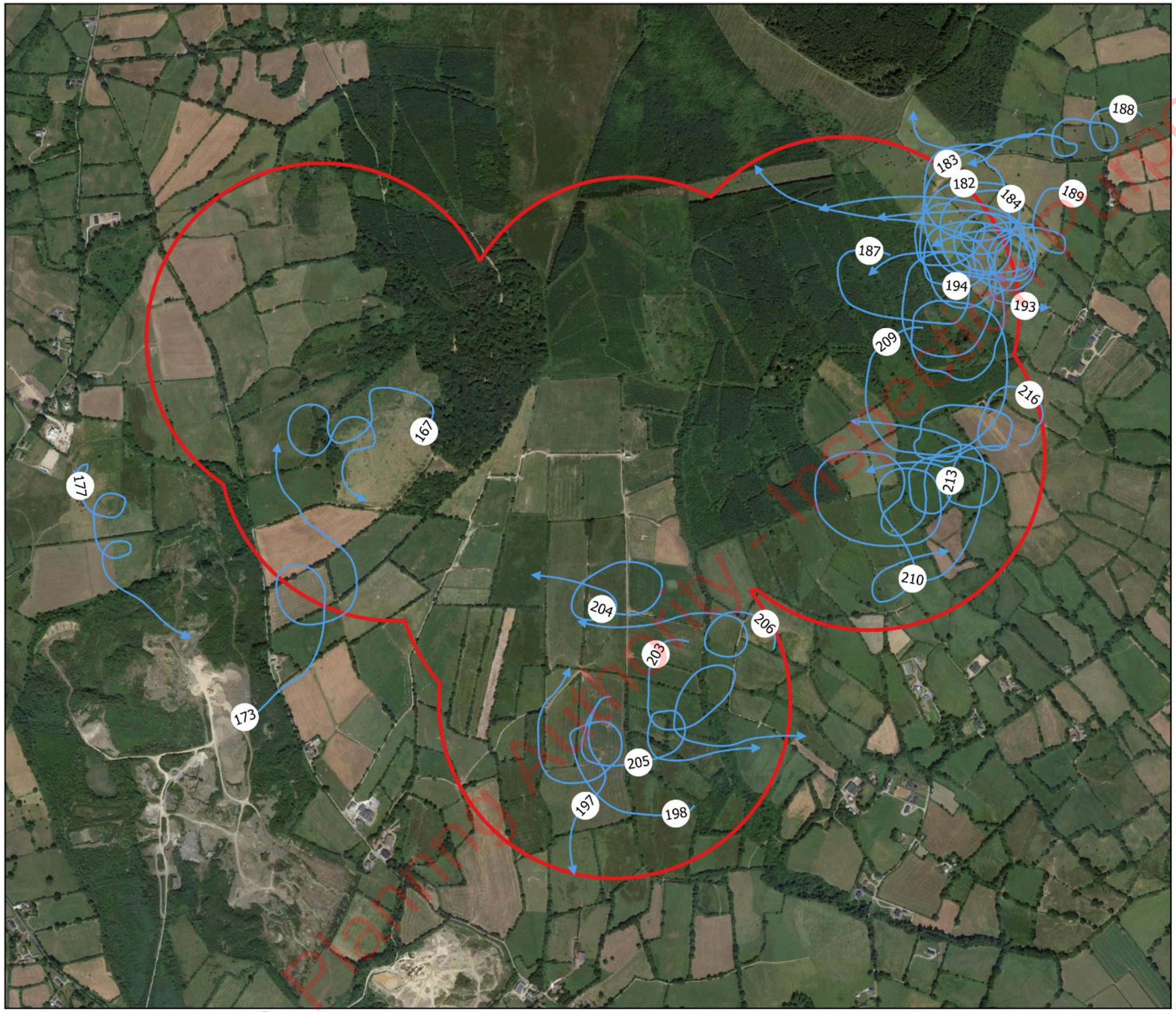
Buzzard
Breeding 2020
500 m turbine buffer
Project: Fahy Beg Wind Farm
Dwg title: Buzzard flightlines, breeding 2020
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:18,000
0 200 400 m
woodrow APEM Group


Legend
Buzzard
Non-breeding 2020-21
500 m turbine buffer
142
141
143
145
137
148
146
136
129
157
162
165
149
150
Project: Fahy Beg Wind Farm
Dwg title: Buzzard flightlines, non-breeding 2020-21
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:18,000
0 200 400 m
woodrow APEM Group



Legend

Buzzard

Breeding 2021

500 m turbine buffer

Project: Fahy Beg Wind Farm
Dwg title: Buzzard flightlines, breeding 2021
Version: 01
Drawn by: AM

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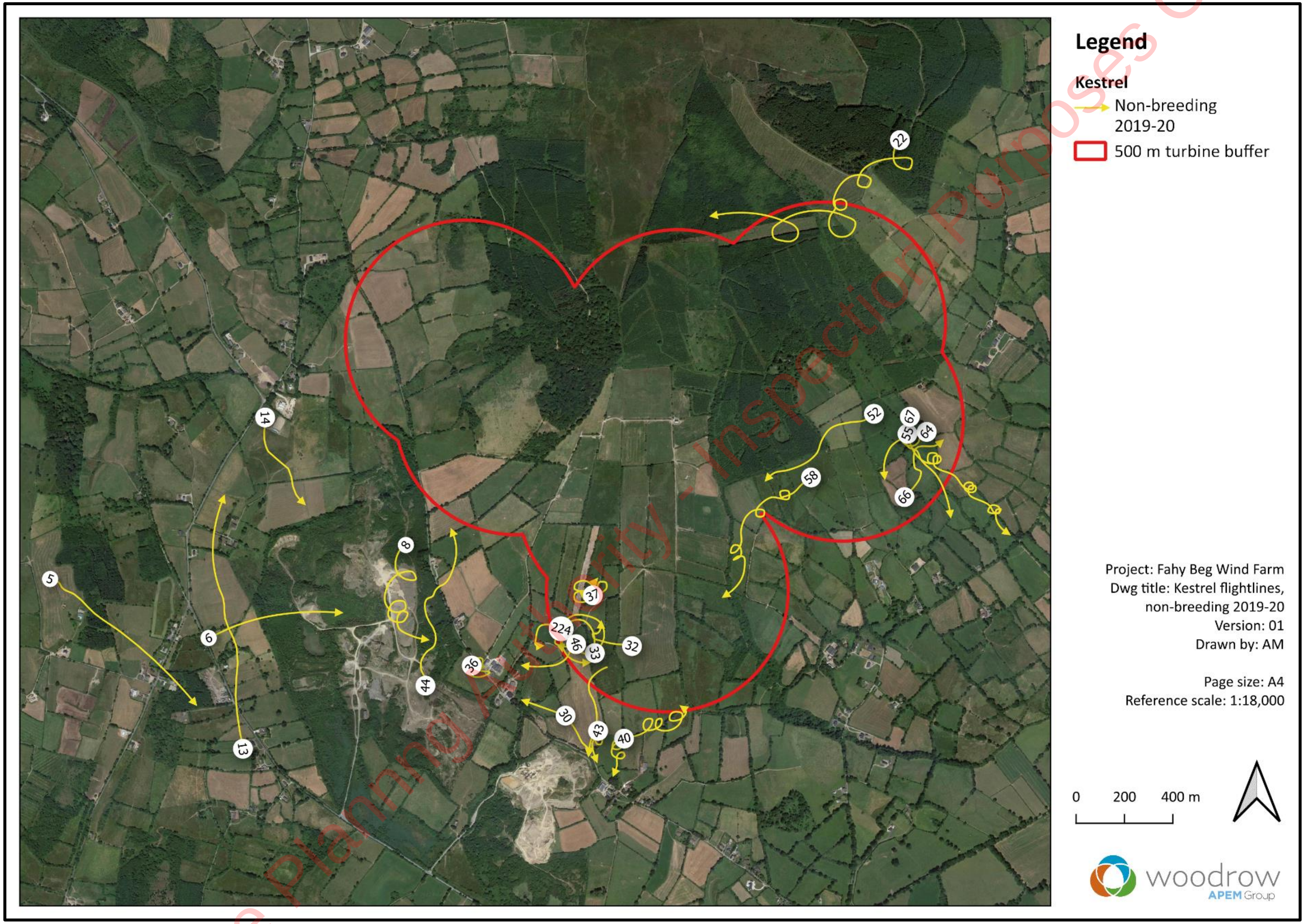
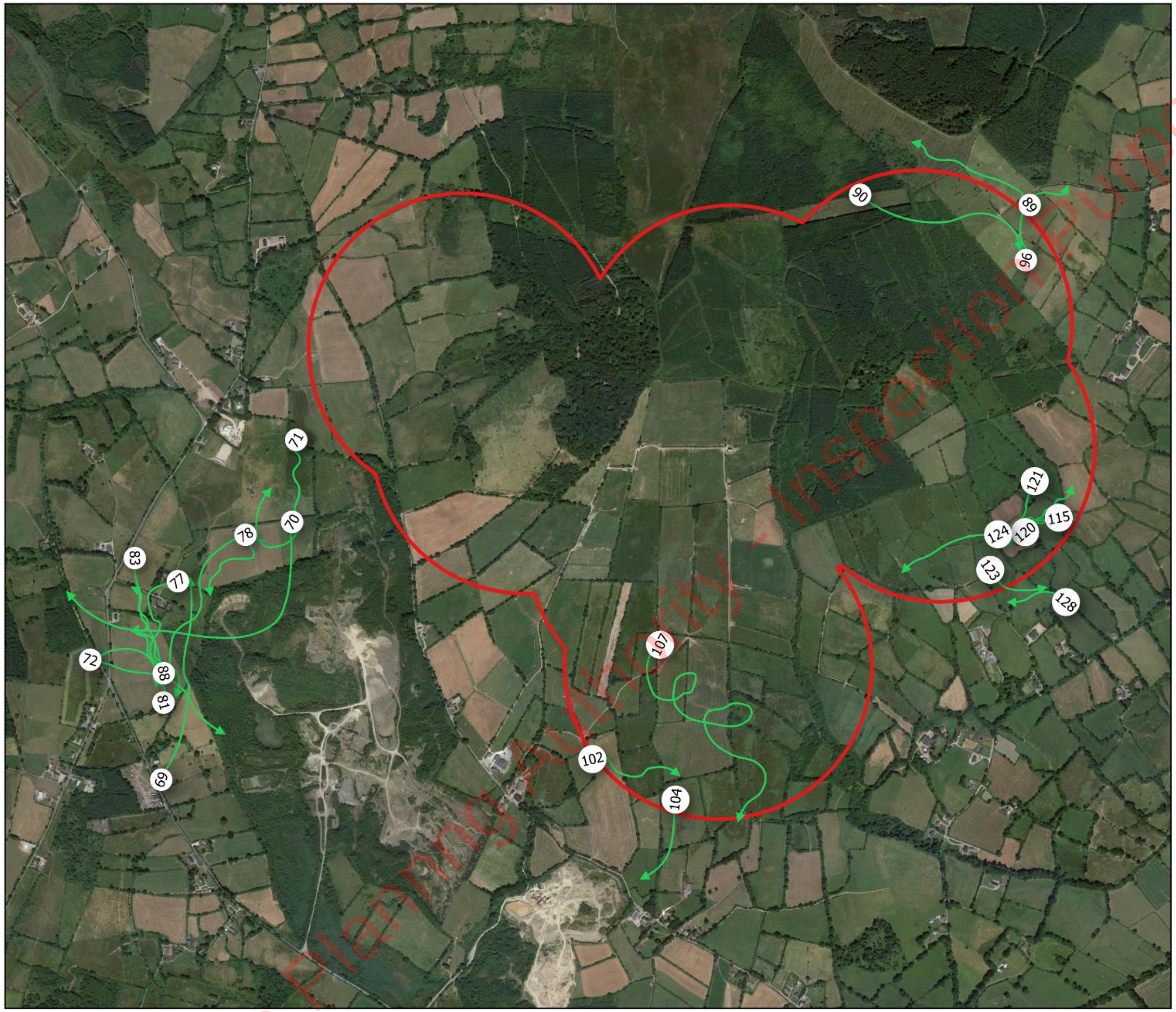
0 150 300 m


Legend
Kestrel
Non-breeding 2019-20
500 m turbine buffer
22
52
67
55
64
58
66
14
8
5
6
13
37
224
46
33
32
36
44
30
43
40
Project: Fahy Beg Wind Farm
Dwg title: Kestrel flightlines, non-breeding 2019-20
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:18,000
0 200 400 m
woodrow
APEM Group



Legend

Kestrel

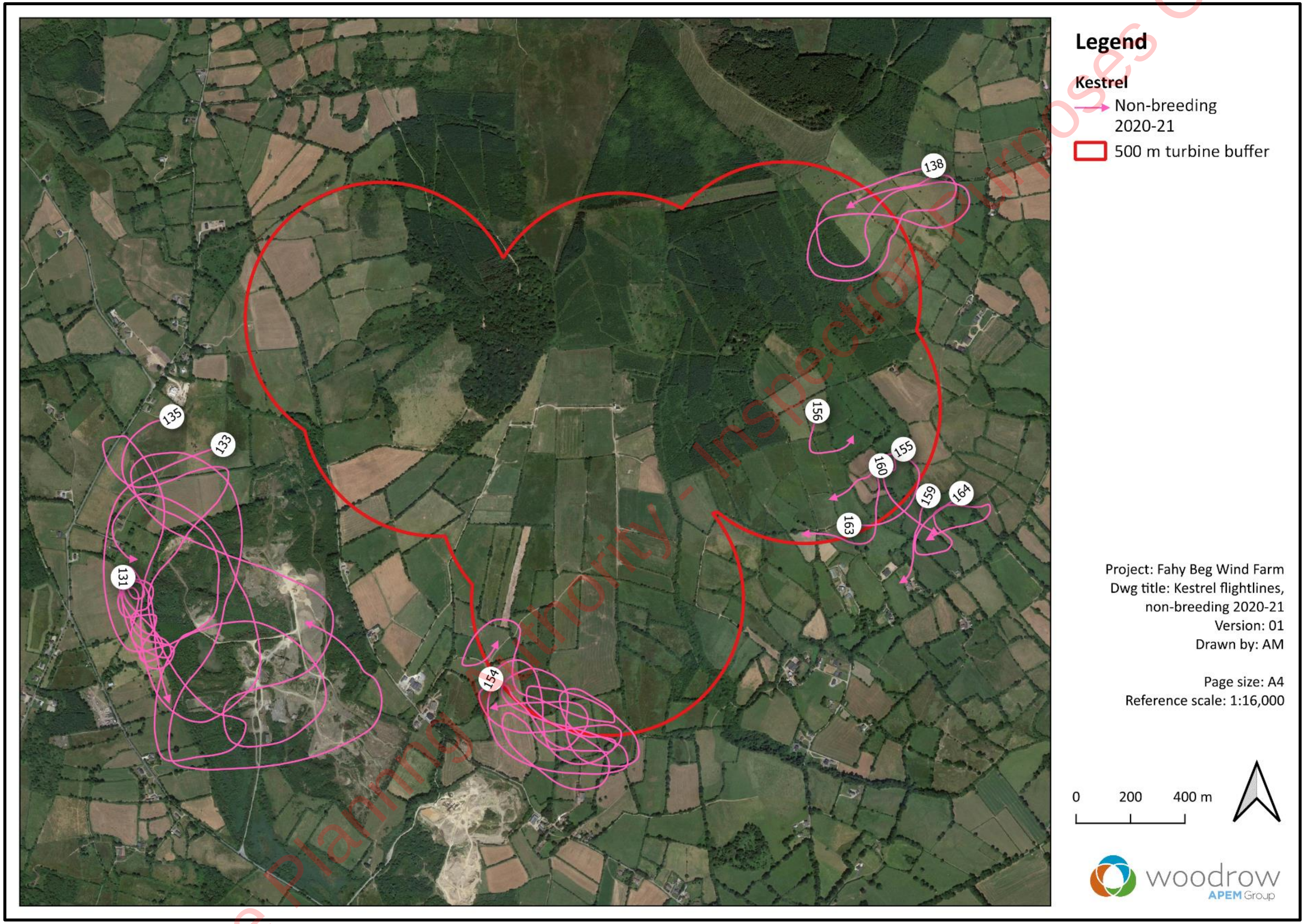
Breeding 2020

500 m turbine buffer

Project: Fahy Beg Wind Farm
Dwg title: Kestrel flightlines, breeding 2020
Version: 01
Drawn by: AM

Page size: A4
Reference scale: 1:16,000

0 200 400 m


138
135
133
156
155
160
159
164
163
131
154
Legend
Kestrel
Non-breeding 2020-21
500 m turbine buffer
Project: Fahy Beg Wind Farm
Dwg title: Kestrel flightlines, non-breeding 2020-21
Version: 01
Drawn by: AM
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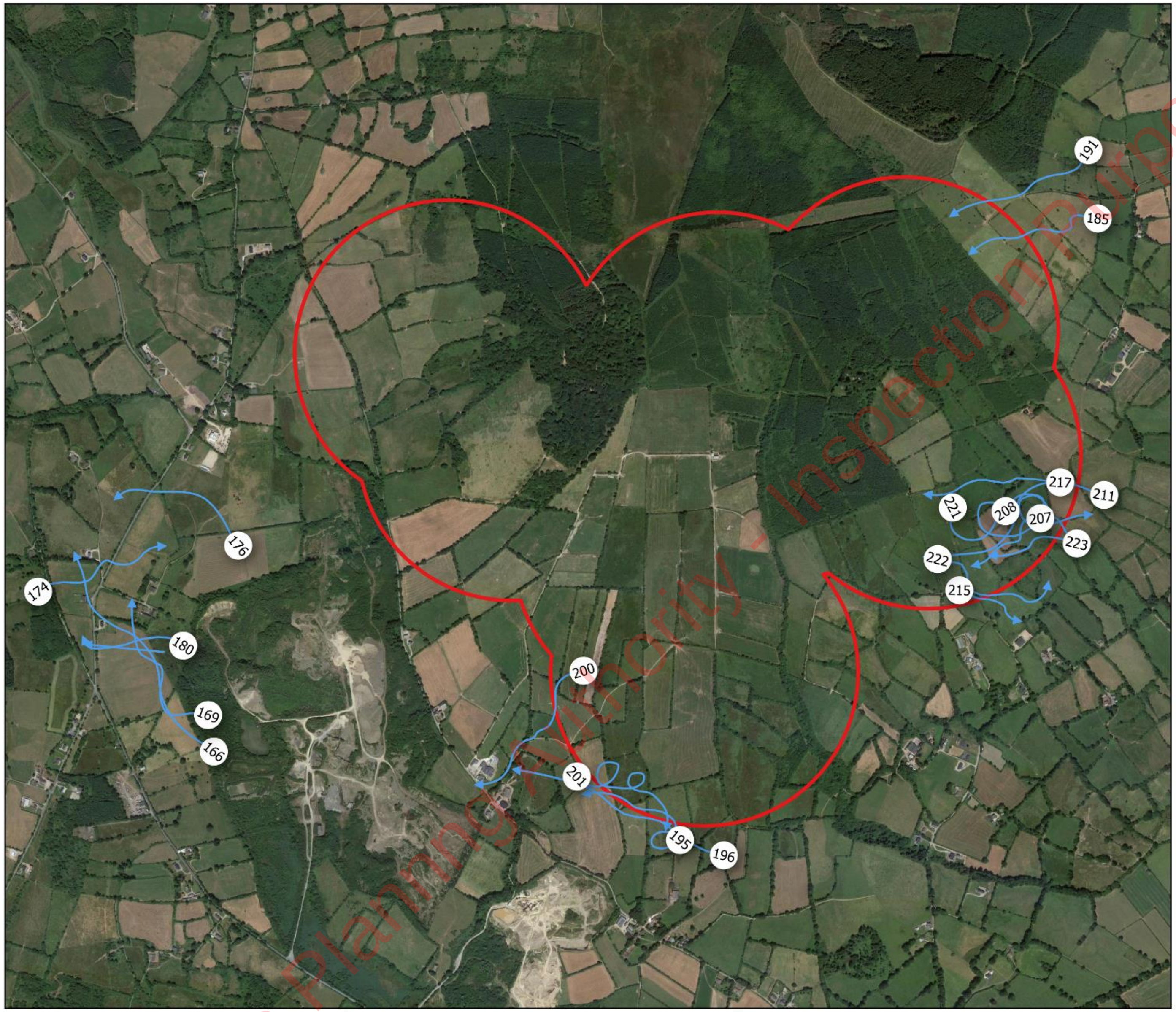
Reference scale: 1:16,000
0
200
400 m
woodrow
APEM Group



Legend

Kestrel

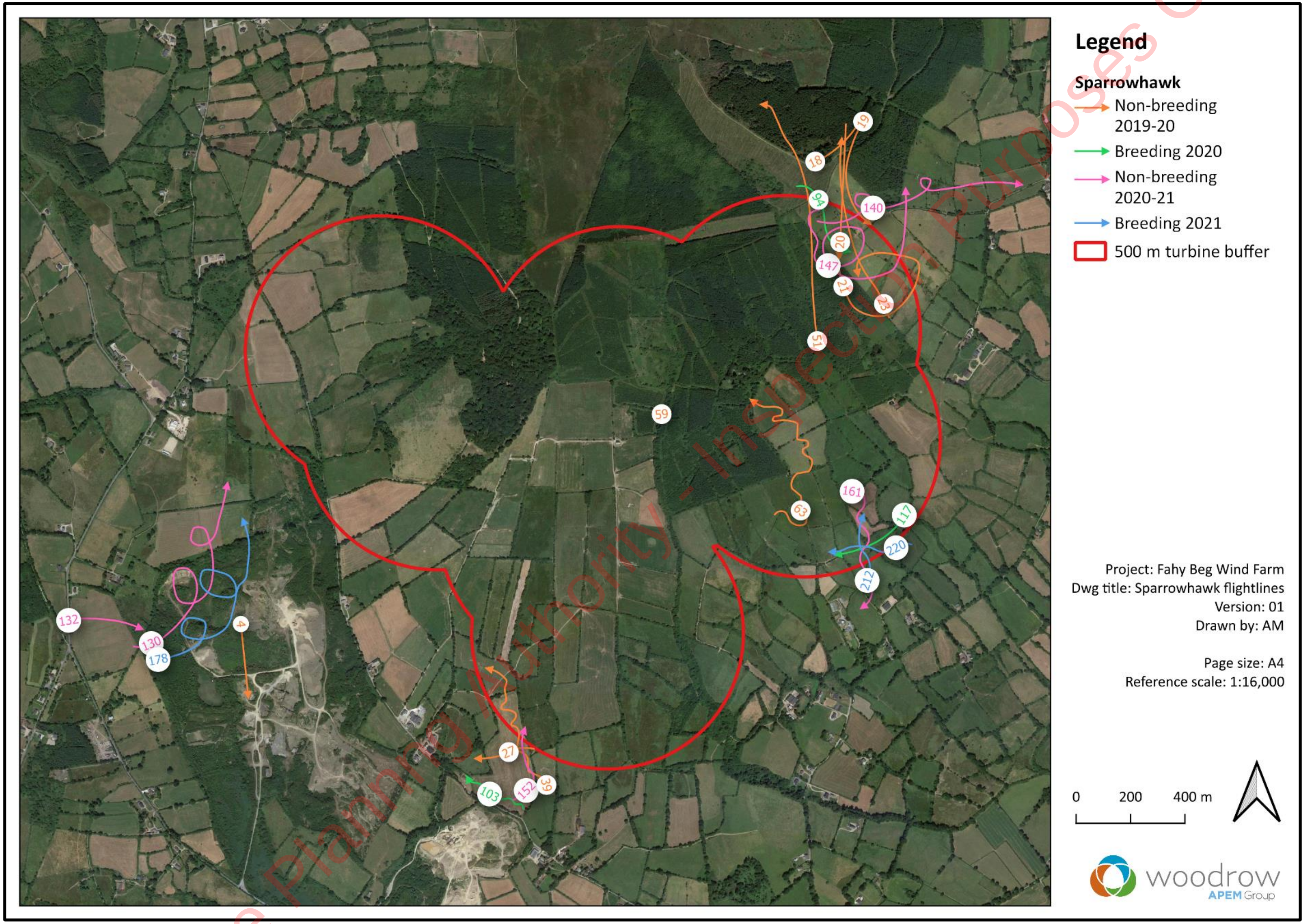
Breeding 2021

500 m turbine buffer

Project: Fahy Beg Wind Farm
Dwg title: Kestrel flightlines, breeding 2021
Version: 01
Drawn by: AM

Page size: A4
Reference scale: 1:16,000

0 200 400 m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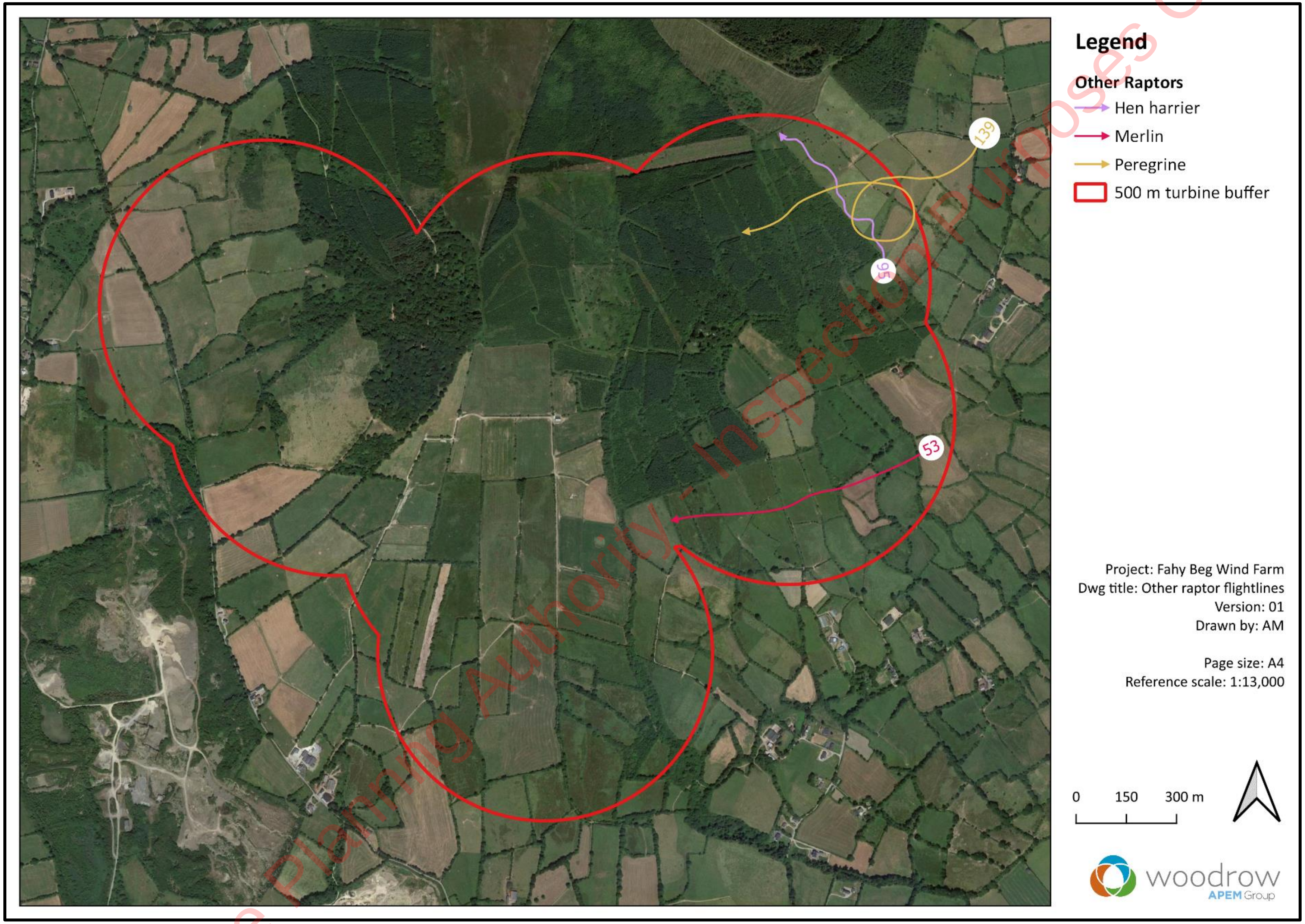
Sparrowhawk
Non-breeding 2019-20
Breeding 2020
Non-breeding 2020-21
Breeding 2021
500 m turbine buffer
Project: Fahy Beg Wind Farm
Dwg title: Sparrowhawk flightlines
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:16,000
0 200 400 m
woodrow APEM Group


Legend
Other Raptors
Hen harrier
Merlin
Peregrine
500 m turbine buffer
139
95
53
Project: Fahy Beg Wind Farm
Dwg title: Other raptor flightlines
Version: 01
Drawn by: AM
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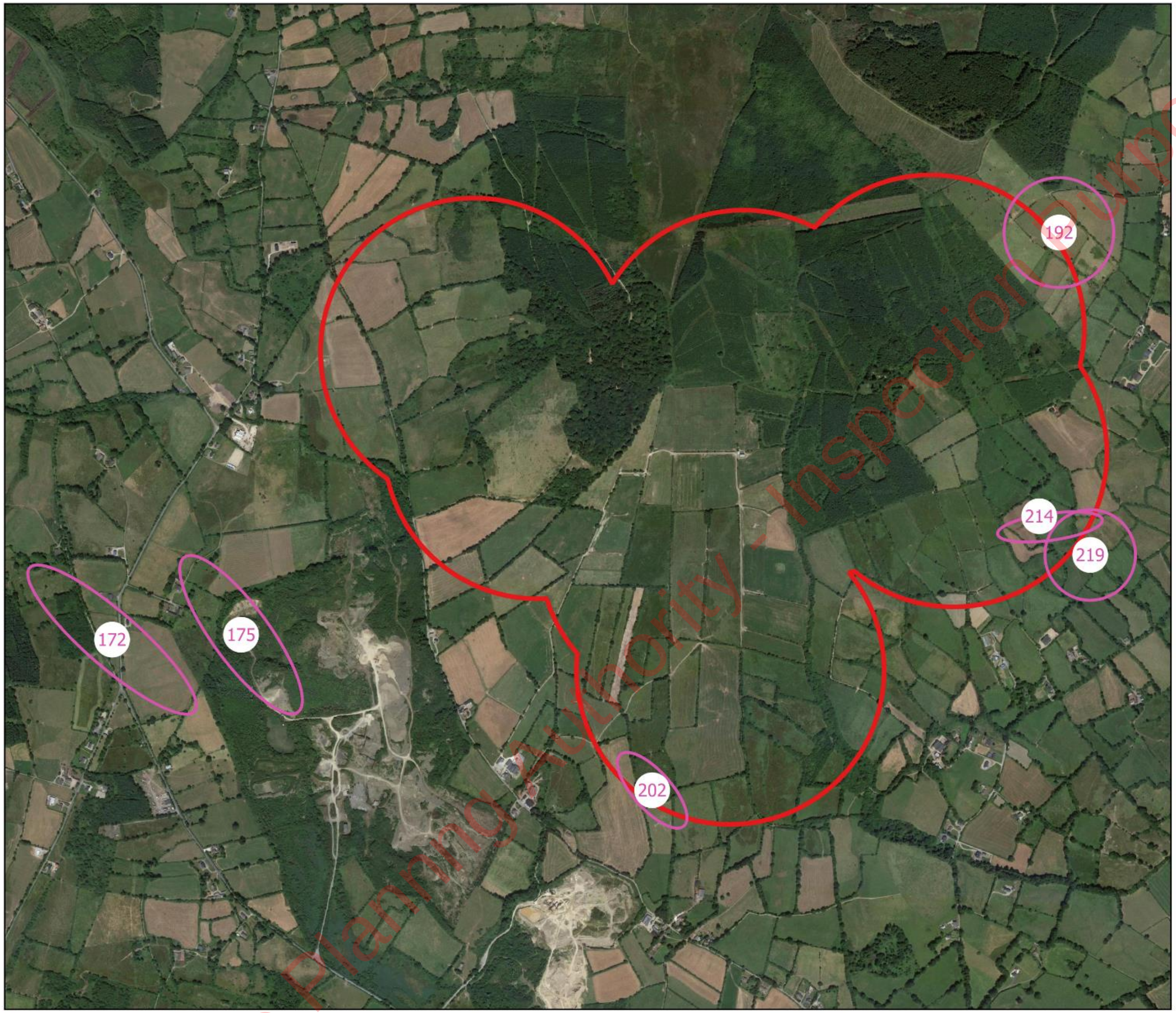
0
150
300 m
woodrow
APEM Group



Legend

Swift (breeding 2021)

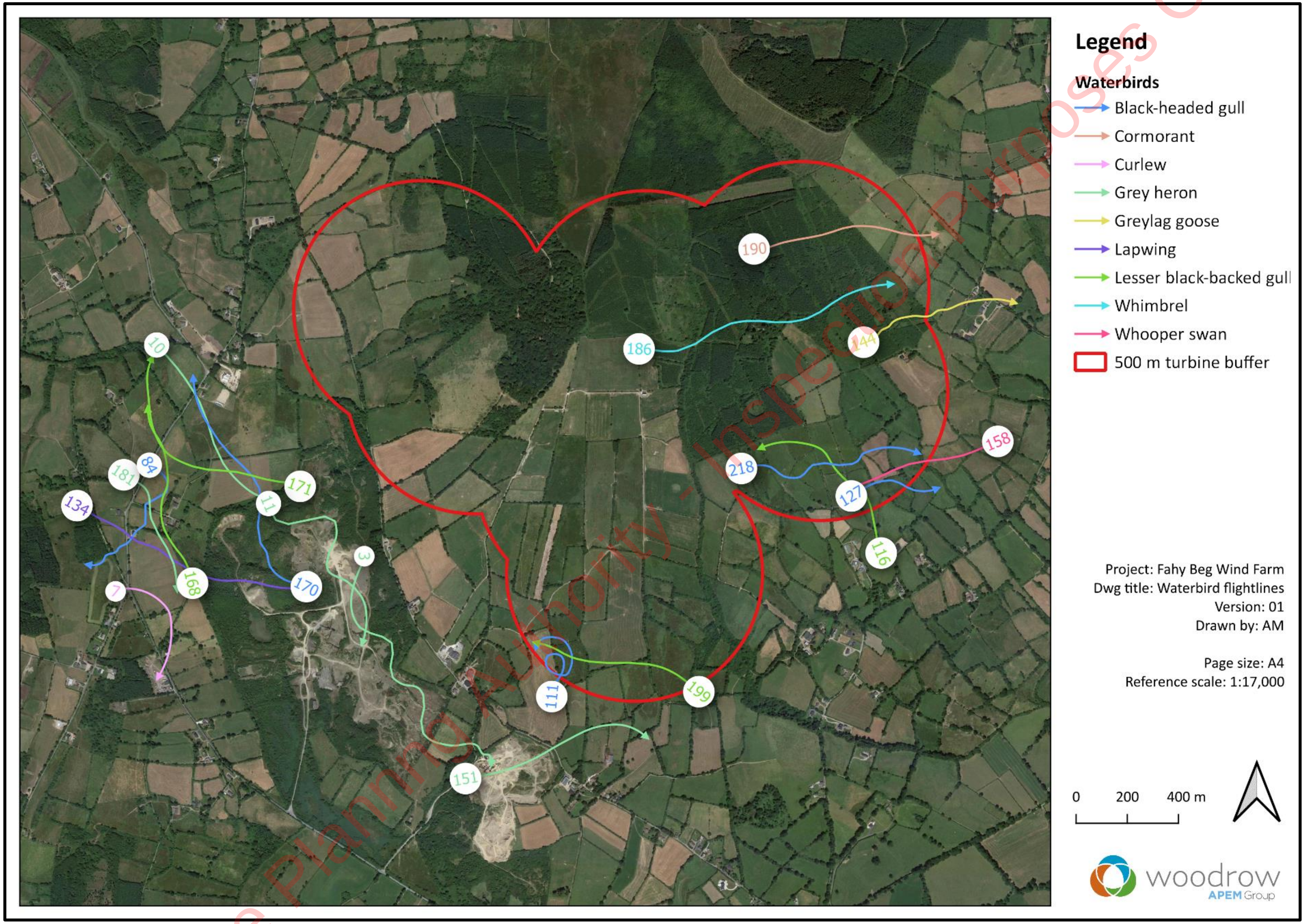
500 m turbine buffer

Project: Fahy Beg Wind Farm
Dwg title: Swift foraging areas

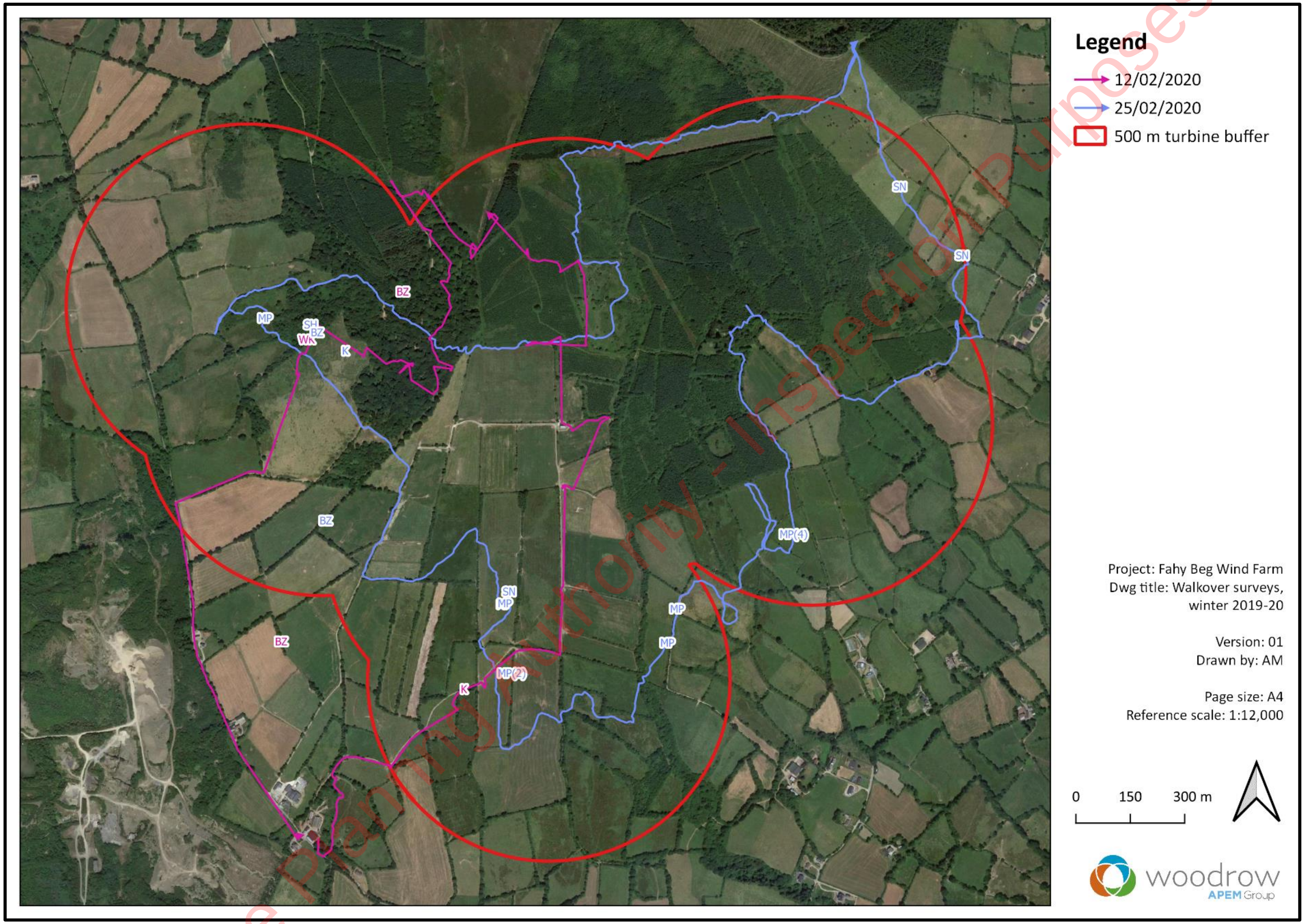
Version: 01
Drawn by: AM

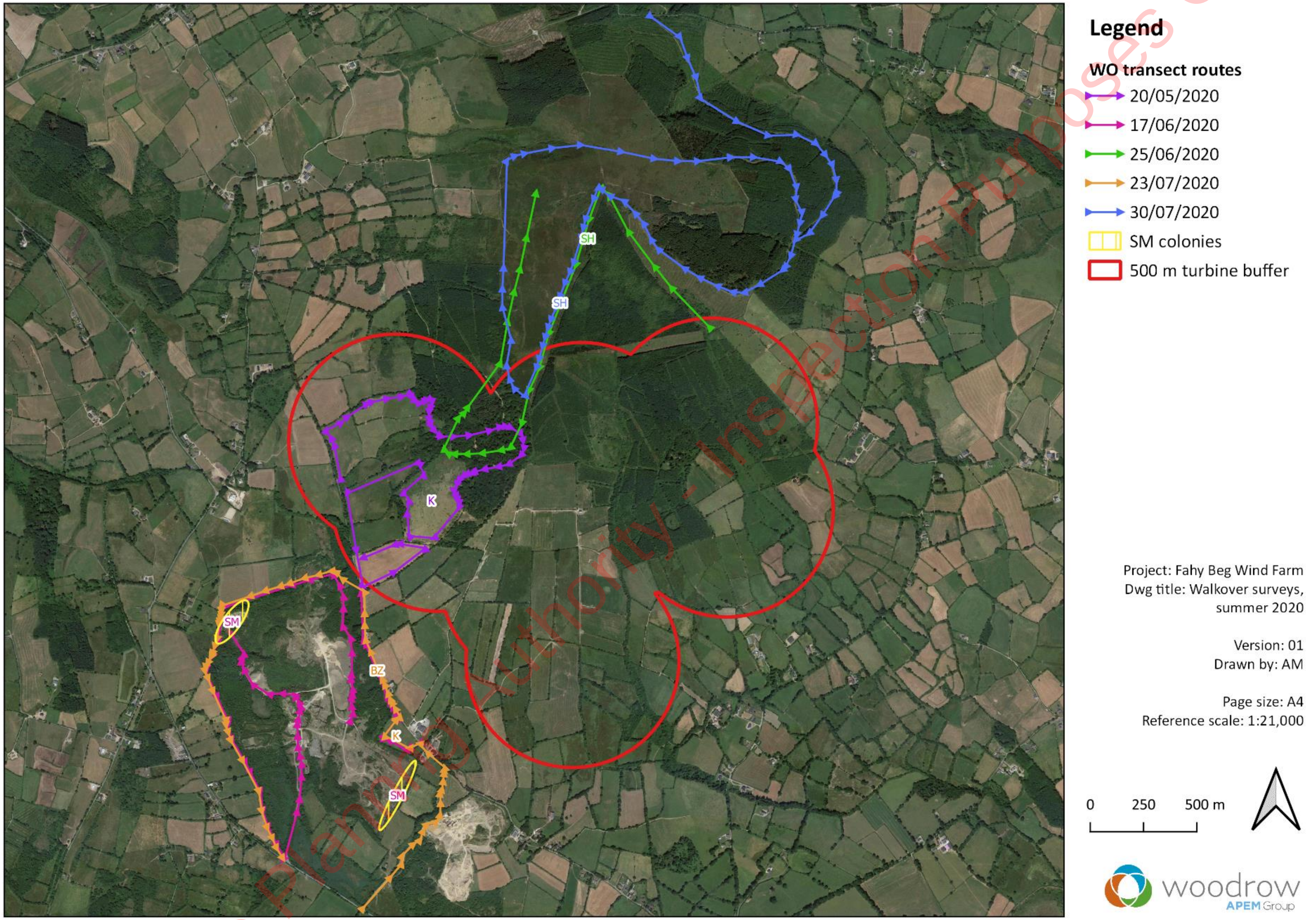
Page size: A4
Reference scale: 1:16,000

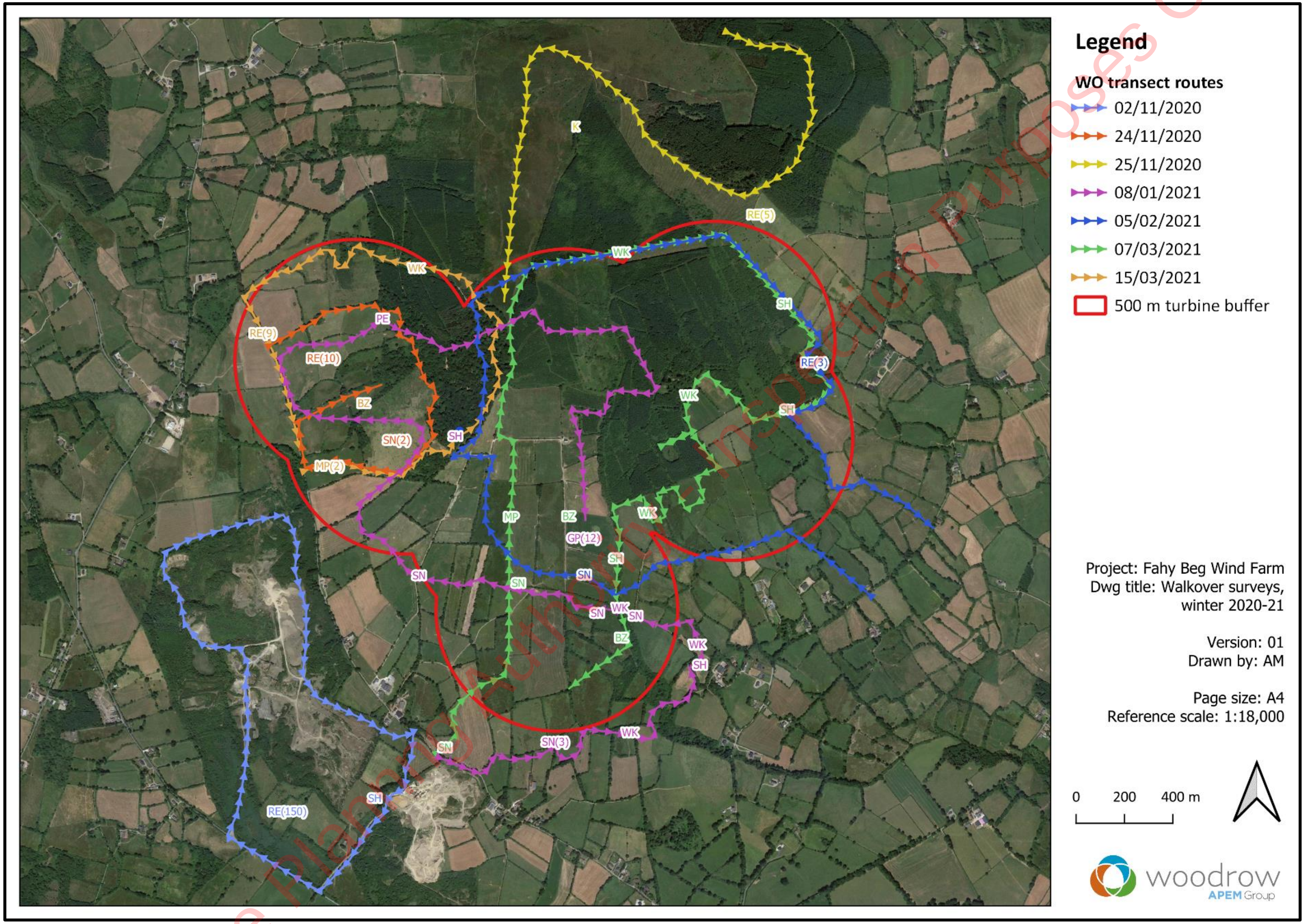
0 200 400 m

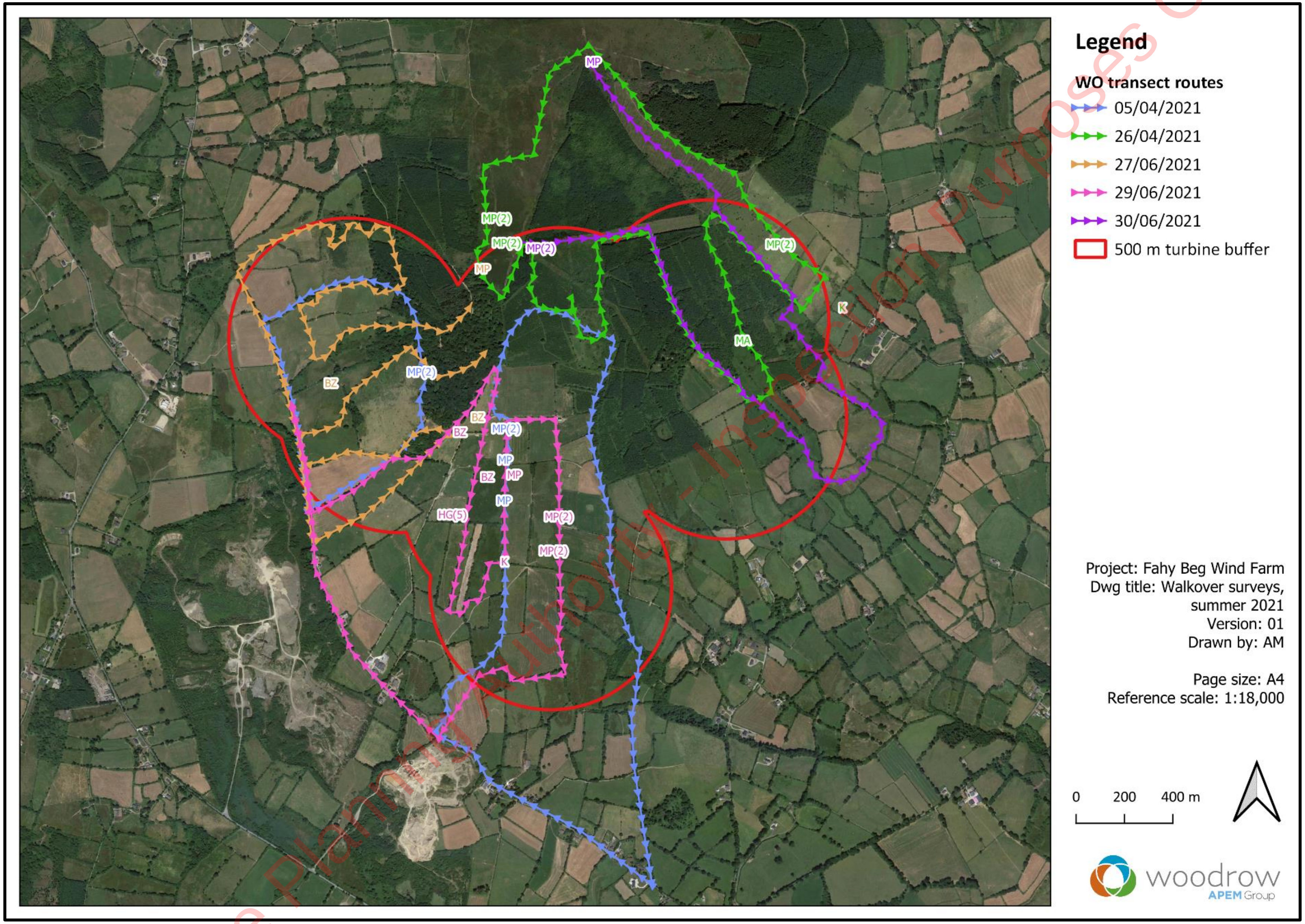

Legend
Waterbirds
Black-headed gull
Cormorant
Curlew
Grey heron
Greylag goose
Lapwing
Lesser black-backed gull
Whimbrel
Whooper swan
500 m turbine buffer
Project: Fahy Beg Wind Farm
Dwg title: Waterbird flightlines
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:17,000
0 200 400 m
woodrow APEM Group

Appendix IV – Maps showing distribution of target species recorded during walkover surveys




Legend
WO transect routes
20/05/2020
17/06/2020
25/06/2020
23/07/2020
30/07/2020
SM colonies
500 m turbine buffer
SH
SH
K
SM
BZ
K
SM
Project: Fahy Beg Wind Farm
Dwg title: Walkover surveys, summer 2020
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:21,000
0
250
500 m
woodrow
APEM Group


Legend
WO transect routes
02/11/2020
24/11/2020
25/11/2020
08/01/2021
05/02/2021
07/03/2021
15/03/2021
500 m turbine buffer
Project: Fahy Beg Wind Farm
Dwg title: Walkover surveys, winter 2020-21
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:18,000
0 200 400 m
woodrow APEM Group


Legend
WO transect routes
05/04/2021
26/04/2021
27/06/2021
29/06/2021
30/06/2021
500 m turbine buffer
Project: Fahy Beg Wind Farm
Dwg title: Walkover surveys, summer 2021
Version: 01
Drawn by: AM
Page size: A4
Reference scale: 1:18,000
0 200 400 m
MP
MP(2)
BZ
HG(5)
K
MA

Appendix V – Survey effort tables showing weather conditions

Table A5.1: Survey effort for VP watches showing weather conditions 2019-2021

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding season 2019-20	10/10/2019	1	1	1.00	1054	None	MT	2	W	moderate	7-8	11	wet	occasional light misty drizzle	None	low cloud on top of hill
Non-breeding season 2019-20	18/10/2019	1	2	3.00	800	None	KW	1	S	poor-good	8	5-8	wet	showers	None	Rain and low cloud
Non-breeding season 2019-20	22/10/2019	1	3	3.00	1200	BZ, H, SH	KW	2	S	good	8	7-8	wet	None	None	None
Non-breeding season 2019-20	27/10/2019	1	4	1.50	1540	None	GO	2	N	good	2-4	6	not rec	None	None	None
Non-breeding season 2019-20	28/10/2019	1	5	1.50	1540	None	GO	4-5	NE	good	1-3	8-10	moist	None	None	None
Non-breeding season 2019-20	04/11/2019	1	6	3.00	1150	BZ, CU, K	MH	2-4	N-NNW-NNE	good	5-8	9	damp	light showers	None	None
Non-breeding season 2019-20	16/11/2019	1	7	3.00	1025	None	GO	1-2	SW-S	moderate - good	8	3	wet	None	None	slight mist
Non-breeding season 2019-20	23/11/2019	1	8	2.00	1455	H	GO	3-4	NW	moderate-good	4-6	8-10	wet	None	None	Low cloud
Non-breeding season 2019-20	30/12/2019	1	9	1.00	1335	None	GO	1-2	SW	poor-mod	8	10	wet	Drizzle	None	Low cloud, rain
Non-breeding season 2019-20	31/12/2019	1	10	2.00	1012	None	GO	2-3	NE	mod	7-8	9-10	wet	None	None	Low cloud, fog
Non-breeding season 2019-20	12/01/2020	1	11	1.50	1502	None	GO	2	SW	good	4-6	8	wet	None	None	None
Non-breeding season 2019-20	15/01/2020	1	12	2.50	1355	None	GO	3-4	SW	good	2-6	7	wet	None	None	None
Non-breeding season 2019-20	30/01/2020	1	13	1.00	1534	None	GO	3-5	SW	mod	7-8	8	wet	None	None	light mist
Non-breeding season 2019-20	31/01/2020	1	14	1.00	1025	None	GO	2-5	SW	good	2-7	8	wet	None	None	None
Non-breeding season 2019-20	03/02/2020	1	15	2.00	1504	BZ	GO	4-5	NW	mod-good	2-6	8	wet	showers	None	2 showers
Non-breeding season 2019-20	25/02/2020	1	16	3.00	1110	None	GO	3-5	W	good	2-8	2-4	wet	hail showers	None	Low cloud, hail
Non-breeding season 2019-20	02/03/2020	1	17	3.00	1000	K	JK	5	W-SW	Good	5-6	5	Wet	Showers	None	None
Non-breeding season 2019-20	10/03/2020	1	18	1.00	1200	BZ	JK	6	SW	Good	5	9	Wet	None	None	None
Non-breeding season 2019-20	10/10/2019	2	1	1.00	1506	None	MT	2-3	W	good	8	11-12	wet	light shower	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding season 2019-20	18/10/2019	2	2	3.00	1130	BZ	KW	1	NW	moderate-good	6-8	9-10	wet	showers	None	rain and low cloud at times
Non-breeding season 2019-20	25/10/2019	2	3	1.00	1235	None	GO	1	E	mod-poor	8	6	damp	light	distant noise- blasting at quarry?	low cloud, distant mist
Non-breeding season 2019-20	26/10/2019	2	4	2.00	1040	RN	GO	1-2	N-NW	good	8	6	moist	None	last quarter of survey: blasting at quarry	None
Non-breeding season 2019-20	28/10/2019	2	5	2.00	1315	None	GO	2-4	NE	not rec	2-4	6-10	moist	None	1315-1330 2 hikers	slight heat haze looking into sun
Non-breeding season 2019-20	12/11/2019	2	6	3.00	1125	None	GO	3-5	NW	Good	2-3	6-10	moist	None	? Illegible	Distant mist
Non-breeding season 2019-20	22/11/2019	2	7	3.00	1250	None	GO	2-3	SW	good-moderate	4-8	7	damp	None	None	low cloud, distant mist
Non-breeding season 2019-20	23/11/2019	2	8	3.00	1125	SH	GO	2	N	moderate-good	7-8	8	not rec	occasional showers	None	Low cloud, distant mist, fog during shower, misty at times
Non-breeding season 2019-20	12/12/2019	2	9	3.00	1005	SH	GO	4-5	SW-N-W	poor-good	4-8	9-10	wet	First half hour	None	Low cloud
Non-breeding season 2019-20	29/12/2019	2	10	3.00	1005	BZ, K, SH	GO	4-6	S	mod	6-8	10	dry	None	motorbikes	mist
Non-breeding season 2019-20	19/01/2020	2	11	3.00	1220	None	GO	3-4	S	good	2-8	7	frost	None	motorbikes	None
Non-breeding season 2019-20	01/02/2020	2	12	3.00	1332	None	GO	4-7	SW	mod-good	4-6	10	wet	None	None	Distant mist
Non-breeding season 2019-20	20/02/2020	2	13	3.00	1114	None	GO	4-5	NW	good	4-8	3-8	wet	hail showers	flooded fields beside R. Shannon	Distant mist
Non-breeding season 2019-20	03/03/2020	2	14	3.00	930	BZ	JK	5	W-SW	Good	5-6	4	Wet	Light Showers	Helicopter Flying low over site 11:20	Periodic Showers
Non-breeding season 2019-20	21/10/2019	3	1	3.00	1130	BZ, SH	KW	0-1	NW	good	2-3	10	dry	None	None	None
Non-breeding season 2019-20	22/10/2019	3	2	3.00	1530	K	KW	3	S	good	8	7-8	not rec	None	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding season 2019-20	26/10/2019	3	3	3.00	1330	BZ, K	GO	2-4	NW	good	2-8	9-11	moist	occasional shower	None	None
Non-breeding season 2019-20	14/11/2019	3	4	3.00	1330	K	GO	3-6	N-NW	excellent	2-5	6-8	moist	None	None	None
Non-breeding season 2019-20	24/11/2019	3	5	2.00	1433	K	GO	2	SE	moderate-good	8-7	8	wet	light showers	None	Light rain showers, misty at times
Non-breeding season 2019-20	25/11/2019	3	6	2.00	1332	None	GO	1-3	NE	good	7	8	wet	None	Machinery in quarry	None
Non-breeding season 2019-20	11/12/2019	3	7	3.00	1320	K	GO	2-4	W	good	2-8	6	wet	one shower	Machinery in quarry for short period	None
Non-breeding season 2019-20	29/12/2019	3	8	3.00	1325	None	GO	2-3	S-SW	good-mod	5-8	10-11	wet	None	None	low cloud
Non-breeding season 2019-20	12/01/2020	3	9	3.00	1155	K	GO	2-3	SW	good	2-8	7-10	wet	two showers	None	low cloud
Non-breeding season 2019-20	31/01/2020	3	10	2.00	1505	BZ, K, SH	GO	4-5	SW	good-mod	7-8	10-11	not rec	None	None	low cloud
Non-breeding season 2019-20	04/02/2020	3	11	3.00	915	BZ, K	GO	2-3	NW	good	2-4	5-8	wet	None	None	None
Non-breeding season 2019-20	20/02/2020	3	12	3.00	1455	BZ, K	GO	3-5	NW	good	2-8	7-8	wet	one shower	None	None
Non-breeding season 2019-20	02/03/2020	3	13	3.00	1330	BZ	JK	5	W-SW	Good	5-6	7	Wet	Showers	None	Periodic Showers
Non-breeding season 2019-20	21/10/2019	4	1	3.00	1530	BZ	KW	0-1	NW	good	1-2	6-8	wet	None	None	None
Non-breeding season 2019-20	22/10/2019	4	2	3.00	830	SH	KW	2	S	good	8	5-6	dry	None	None	None
Non-breeding season 2019-20	27/10/2019	4	3	3.00	1202	None	GO		N-NE	good	3-5	9-10	moist	None	None	None
Non-breeding season 2019-20	28/10/2019	4	4	2.00	1040	BZ	GO	4-5	N-NE	good	3-5	6-8	moist	None	motorbikes	None
Non-breeding season 2019-20	14/11/2019	4	5	3.00	1020	None	GO	4-5	N	excellent	1-2	4-6	moist	None	Blasting at 11:40	None
Non-breeding season 2019-20	27/11/2019	4	6	2.00	1025	K	GO	2	NW	mod-good	4-8	7-8	wet	None	helicopter at 1113	Low cloud
Non-breeding season 2019-20	29/11/2019	4	7	2.00	1216	None	GO	2-4	NE	good	2-3	7		None	None	None
Non-breeding season 2019-20	11/12/2019	4	8	3.00	1005	None	GO	3-4	W	good	2-6	5-6	wet	two showers	Tractor in fields to east	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding season 2019-20	30/12/2019	4	9	3.00	1020	ML	GO	1-2	S-SW	mod	8	10	wet	None	None	Low cloud, fog
Non-breeding season 2019-20	31/01/2020	4	10	3.00	1150	BZ, K, SH	GO	3-6	SW	mod-good	6-8	9-11	wet	None	None	Low cloud, mist
Non-breeding season 2019-20	04/02/2020	4	11	3.00	1245	None	GO	2-4	NW	good	2-4	8	wet	None	None	None
Non-breeding season 2019-20	03/03/2020	4	12	3.00	1300	None	JK	5	W-SW	Good	5-6	6	Wet	Light Showers	None	Periodic Showers
Non-breeding season 2019-20	10/03/2020	4	13	3.00	1400	BZ, K	JK	5	SW	Good	5-6	10	Wet	None	None	None
Breeding season 2020	16/03/2020	1	1	3.00	130	BZ	JK	5	S	Good	5-6	8	Wet	Mist	None	Mist
Breeding season 2020	17/04/2020	1	2	3.00	1330	K	JK	3-5	NE	Good	5-6	16	Dry	None	None	None
Breeding season 2020	23/04/2020	1	3	3.00	1000	BZ, K	JK	3-5	NE	Good	5-6	13	Dry	None	None	None
Breeding season 2020	01/05/2020	1	4	3.00	930	K	JK	4	SW	Good	4	9	Wet	showers	None	None
Breeding season 2020	08/05/2020	1	5	3.00	920	BZ, K	JK	5	SE	Good	5	14	Dry	None	None	None
Breeding season 2020	20/05/2020	1	6	3.00	1445	K	JK	5	SE	Good	5-6	19	Dry	None	None	None
Breeding season 2020	03/06/2020	1	7	3.00	830	None	JK	5-6	NW	Good	7-9	12	Dry	None	None	None
Breeding season 2020	22/06/2020	1	8	3.00	800	BH, K	JK	5-6	S	Good	5-6	13	Dry	None	None	None
Breeding season 2020	08/07/2020	1	9	3.00	1330	None	JK	5	SE	Mod	6-7	15	Wet	Rain	None	Low cloud
Breeding season 2020	23/07/2020	1	10	3.00	1330	BZ	JK	5	W-SW	Mod - Good	6-7	20	Wet	Drizzle	None	Mist Drizzle
Breeding season 2020	19/08/2020	1	11	3.00	700	None	JK	5	NE	Good	7-8	12-18	Wet	Low cloud some light mist	None	Low cloud
Breeding season 2020	24/08/2020	1	12	3.00	830	K	JK	5-6	SE	Good	7-8	14-18	Wet	None	None	None
Breeding season 2020	24/03/2020	2	1	3.00	1030	K	JK	4	S	Good	6-7	9	Wet	None	None	None
Breeding season 2020	18/04/2020	2	2	3.00	730		JK	3-5	NE	Good	5-6	12	Wet	Low cloud	None	Low Cloud
Breeding season 2020	23/04/2020	2	3	3.00	1400	BZ	JK	5	NE	Good	5-6	17-18	Dry	None	None	None
Breeding season 2020	27/04/2020	2	4	3.00	1340		JK	5	N	Good	5-6	12	Dry	None	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding season 2020	02/05/2020	2	5	3.00	1300	BZ	JK	4	W	Good	4	14	Dry	None	None	None
Breeding season 2020	13/05/2020	2	6	3.00	1400	SH	JK	5	NE	Good	4	12	Dry	None	None	None
Breeding season 2020	19/05/2020	2	7	3.00	1445	HH, K	JK	5	NW	Good	5-6	21	Dry	None	None	None
Breeding season 2020	05/06/2020	2	8	3.00	1230	BZ	JK	5-6	NW	Good	5-6	14	Dry	None	None	None
Breeding season 2020	22/06/2020	2	9	3.00	1200	BZ	JK	5-6	S	Good	5-6	19	Wet	Light showers	None	None
Breeding season 2020	28/07/2020	2	10	3.00	830	None	JK	4	NW	Mod - Good	6-7	14	Wet	Showers	None	Showers
Breeding season 2020	21/08/2020	2	11	3.00	715	BZ	JK	5	SW	Good	8-9	12-18	Wet	Low cloud some light mist	None	Light mist
Breeding season 2020	24/08/2020	2	12	3.00	1215	None	JK	5	SE	Good	7-8	18	Wet	None	None	None
Breeding season 2020	31/08/2020	2	13	3.00	1620	BZ	JK	5	SE	Good	6-7	18	Wet	None	None	None
Breeding season 2020	18/03/2020	3	1	3.00	1215	K, SH	JK	5	W	Good	6-7	6	Wet	None	None	None
Breeding season 2020	17/04/2020	3	2	3.00	1700	BZ	JK	3-5	NE	Good	5-6	16	Wet	Showers	None	None
Breeding season 2020	25/04/2020	3	3	3.00	1300	BZ	JK	5	E -NE	Good	5-6	17	Dry	None	None	None
Breeding season 2020	01/05/2020	3	4	3.00	1300	None	JK	4	SW	Good	4	11	Wet	showers	None	None
Breeding season 2020	08/05/2020	3	5	3.00	1300	BZ, K	JK	5	SE	Good	5	20	Dry	None	None	None
Breeding season 2020	24/05/2020	3	6	3.00	1250	BZ	JK	5	SW	Good	5	17	Dry	None	None	None
Breeding season 2020	03/06/2020	3	7	3.00	1200	BH	JK	5-6	N-NW	Good	5-6	16	Dry	None	None	None
Breeding season 2020	25/06/2020	3	8	3.00	1420	BZ	JK	5-6	NW	Good	5-6	24	Dry	None	None	None
Breeding season 2020	08/07/2020	3	9	3.00	900	None	JK	5	SE	Good	6-7	12	Wet	Mist some drizzle	None	Low cloud
Breeding season 2020	23/07/2020	3	10	3.00	1000	None	JK	4	SW	Good	6-7	17	Wet	Misty	None	Mist
Breeding season 2020	19/08/2020	3	11	3.00	1230	None	JK	6	NE	Good	8-9	16-20	Wet	Light showers	None	Showers
Breeding season 2020	26/08/2020	3	12	3.00	1700	BZ	JK	5	W-SW	Good	6-7	20	Wet	None	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding season 2020	24/03/2020	4	1	3.00	1400	BZ	JK	4	S	Good	6-7	13	Wet	None	None	None
Breeding season 2020	18/04/2020	4	2	3.00	1145	K, LB	JK	3-5	NE	Good	5-6	12	Wet	Low cloud	None	None
Breeding season 2020	25/04/2020	4	3	3.00	930	SH	JK	5	E	Good	5-6	12	Dry	None	None	None
Breeding season 2020	02/05/2020	4	4	3.00	920	BZ	JK	4	W	Good	4	8	Wet	showers	None	None
Breeding season 2020	13/05/2020	4	5	3.00	1100	BZ, K	JK	5	NE	Good	4	9	Dry	None	None	None
Breeding season 2020	24/05/2020	4	6	3.00	915	None	JK	5	SW	Good	5	12	Dry	None	None	None
Breeding season 2020	05/06/2020	4	7	3.00	845	None	JK	5-6	NW	Good	5-6	12	Dry			
Breeding season 2020	25/06/2020	4	8	3.00	1100	K	JK	5-6	NW	Good	5-6	21	Dry	None	None	None
Breeding season 2020	11/07/2020	4	9	3.00	945	BZ	JK	4-5	NW	Good	4-5	12	Dry	None	None	None
Breeding season 2020	28/07/2020	4	10	3.00	1215	None	JK	5	NW	Good	6-7	16	Wet	Light Showers	None	Showers
Breeding season 2020	23/08/2020	4	11	3.00	830	None	JK	5	SW	Good	7-8	15-18	Wet	Showers	None	Showers
Breeding season 2020	28/08/2020	4	12	3.00	1645	BH, K	JK	4-5	N - NW	Good	6-7	18	Wet	None	None	None
Non-breeding season 2020-21	29/09/2020	1	1	3.00	745	BZ	JK	5	SE	good	7-8	12-15	Dry	None	None	None
Non-breeding season 2020-21	16/10/2020	1	2	3.00	1130	None	JK	4	SE	Good	5-6	11	Dry	None	None	None
Non-breeding season 2020-21	23/10/2020	1	3	3.00	1400	SH	JK	3-4	SW	Good	4-5	10	Dry	None	None	None
Non-breeding season 2020-21	06/11/2020	1	4	3.00	1400	K	JK	4	SE	Good	3-4	11	Dry	None	None	None
Non-breeding season 2020-21	23/11/2020	1	5	3.00	945	SH	JK	4	SE	Good	7-8	9	Wet	None	None	None
Non-breeding season 2020-21	01/12/2020	1	6	3.00	1100	None	JK	3	SW	Good	7-8	9	Wet	None	None	None
Non-breeding season 2020-21	12/12/2020	1	7	3.00	900	K	JK	3	SW	Good	6-7	6	Dry	None	None	None
Non-breeding season 2020-21	05/01/2021	1	8	3.00	1345	L	JK	3	N-NW	Good	3-4	4	Wet	None	None	None
Non-breeding season 2020-21	29/01/2021	1	9	3.00	1245	K	JK	3	SW	Good	6-7	9	Wet	None	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding season 2020-21	11/02/2021	1	10	3.00	930	None	JK	4	SE	Good	7-8	2	Wet	occasional snow showers	None	None
Non-breeding season 2020-21	20/02/2021	1	11	3.00	1400	None	JK	6	SW	Good	6-7	10	Wet	Showers	None	None
Non-breeding season 2020-21	02/03/2021	1	12	3.00	1100	BZ	JK	3	East	Good	3-4	9	Dry	None	None	some haze
Non-breeding season 2020-21	25/09/2020	2	1	3.00	1200	BZ	JK	4-5	NW	good	7-8	15	Wet	Showers	None	None
Non-breeding season 2020-21	15/10/2020	2	2	3.00	1530	K	JK	4	NE	Good	5-6	15	Dry	None	None	None
Non-breeding season 2020-21	26/10/2020	2	3	3.00	1215	None	JK	4	NW	Good	6-7	12	Wet	Showers some heavy	None	Showers
Non-breeding season 2020-21	16/11/2020	2	4	3.00	1015	None	JK	5	S-SW	Good	7-8	10	Wet	None	None	None
Non-breeding season 2020-21	26/11/2020	2	5	3.00	1345	None	JK	2-3	SE	Good	7-8	7	Wet	None	None	None
Non-breeding season 2020-21	08/12/2020	2	6	3.00	1245	None	JK	5	NW	Good	3-4	6	Wet	None	None	None
Non-breeding season 2020-21	28/12/2020	2	7	3.00	1000	PE, SH	JK	5	NW	Good	4-5	5	Dry	None	None	None
Non-breeding season 2020-21	05/01/2021	2	8	3.00	1000	BZ	JK	3	N-NW	Good	3-4	3	Wet	None	None	None
Non-breeding season 2020-21	29/01/2021	2	9	3.00	900	BZ, GJ	JK	3	SW	Good	6-7	8	Wet	None	None	None
Non-breeding season 2020-21	14/02/2021	2	10	3.00	1030	BZ	JK	5	SW	Good	6-7	10	Wet	None	None	None
Non-breeding season 2020-21	22/02/2021	2	11	3.00	900	SH	JK	4	SE	Good	5-6	10	Wet	None	None	None
Non-breeding season 2020-21	15/03/2021	2	12	3.00	1520	BZ	JK	4	S-SW	Good	7-8	9	Dry	None	None	None
Non-breeding season 2020-21	29/09/2020	3	1	3.00	1130	None	JK	5	SE	good	7-8	15	Dry	None	None	None
Non-breeding season 2020-21	14/10/2020	3	2	3.00	1130	None	JK	4	N-NW	Good	8-9	11	Dry	None	None	None
Non-breeding season 2020-21	27/10/2020	3	3	3.00	1345	BZ	JK	5	SW	Good	6-7	11	Wet	Showers some heavy	None	Showers
Non-breeding season 2020-21	06/11/2020	3	4	3.00	1030	None	JK	3	N-NE	Good	3-4	8	Dry	None	None	None
Non-breeding season 2020-21	23/11/2020	3	5	3.00	1315	None	JK	4	S-SE	Good	7-8	11	Wet	None	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding season 2020-21	04/12/2020	3	6	3.00	1100	BZ	JK	4	NW	Good	3-4	4	Wet	None	None	None
Non-breeding season 2020-21	15/12/2020	3	7	3.00	915	None	JK	4	SE	Good	4-5	7	Wet	None	None	None
Non-breeding season 2020-21	04/01/2021	3	8	3.00	1030	H, SH	JK	3	NW	Good	5-6	3-4	Wet	None	None	None
Non-breeding season 2020-21	07/01/2021	3	9	3.00	1300	None	JK	3	NE	Good	6-7	3	Snow	None	None	None
Non-breeding season 2020-21	13/02/2021	3	10	3.00	1000	None	JK	5	SE	Good	7-8	6	Wet	Showers	None	None
Non-breeding season 2020-21	21/02/2021	3	11	3.00	1430	K	JK	4	S-SW	Good	4-5	9	Wet	None	None	None
Non-breeding season 2020-21	02/03/2021	3	12	3.00	1445	K	JK	3	S-SE	Good	3-4	10	Dry	None	None	some haze
Non-breeding season 2020-21	25/09/2020	4	1	3.00	815	K	JK	4-5	NW	good	7-8	8-12	Wet	Showers	None	None
Non-breeding season 2020-21	15/10/2020	4	2	3.00	1200	BZ	JK	4	NE	Good	5-6	14	Dry	None	None	None
Non-breeding season 2020-21	27/10/2020	4	3	3.00	1000	None	JK	4	SW	Good	4-5	9	Wet	Showers some heavy	None	Showers
Non-breeding season 2020-21	07/11/2020	4	4	3.00	900	None	JK	4	NE	Good	7-8	10	Wet	None	None	None
Non-breeding season 2020-21	26/11/2020	4	5	3.00	1000	None	JK	3	SE	Good	7-8	6	Wet	None	None	None
Non-breeding season 2020-21	08/12/2020	4	6	3.00	930	K, WS	JK	5	NW	Good	3-4	5	Wet	None	None	None
Non-breeding season 2020-21	24/12/2020	4	7	3.00	1045	None	JK	4	NW	Good	5-6	4	Dry	None	None	None
Non-breeding season 2020-21	02/01/2021	4	8	3.00	1230	BZ, K, SH	JK	3	NW	Good	6-7	4	Dry	None	None	None
Non-breeding season 2020-21	06/01/2021	4	9	3.00	945	None	JK	3	N-NW	Good	3-4	2	frost	None	None	None
Non-breeding season 2020-21	16/02/2021	4	10	3.00	900	K	JK	4	S-SW	Good	6-7	9	Dry	None	None	None
Non-breeding season 2020-21	22/02/2021	4	11	3.00	1315	BZ	JK	4	SE	Good	5-6	9	Wet	None	None	None
Non-breeding season 2020-21	04/03/2021	4	12	3.00	1000	None	JK	3	NE	Good	8-9	7	Dry	None	None	some haze
Breeding season 2021	20/03/2021	1	1	3.00	1030	None	JK	3	NW	Good	6-7	11	Dry	None	None	None
Breeding season 2021	03/04/2021	1	2	3.00	930	None	JK	3	SE	Good	3-4	12	Dry	None	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding season 2021	23/04/2021	1	3	3.00	1330	K	JK	3	SE	Good	5-6	16	Dry	None	None	None
Breeding season 2021	06/05/2021	1	4	3.00	730	BZ, LB	JK	3	N-NW	Good	3-4	7	Dry	None	None	None
Breeding season 2021	24/05/2021	1	5	3.00	1415	K	JK	3	NW	Good	5-6	11	Dry	None	None	None
Breeding season 2021	01/06/2021	1	6	3.00	1300	None	JK	3	NW	Good	6-7	15	Dry	None	Silage cutting	None
Breeding season 2021	04/06/2021	1	7	3.00	900	BZ	JK	4	SE	Good	6-7	16	Dry	None	None	None
Breeding season 2021	25/06/2021	1	8	3.00	1400	None	JK	3	NW	Good	6-7	14	Dry	None	None	None
Breeding season 2021	01/07/2021	1	9	3.00	1100	BZ	JK	3	SW	Good	6-7	17	Dry	None	None	None
Breeding season 2021	20/07/2021	1	10	3.00	1600	SH	JK	2	N-NE	Good	1-2	26	Dry	None	None	None
Breeding season 2021	03/08/2021	1	11	3.00	900	K	JK	2	SE	Good	5-6	16	Dry	None	None	None
Breeding season 2021	13/08/2021	1	12	3.00	1315	H, K	JK	5	SW	Good	6-7	17	Dry	None	None	None
Breeding season 2021	29/03/2021	2	1	3.00	900	BZ	JK	3	SW	Good	6-7	14	Dry	None	None	None
Breeding season 2021	05/04/2021	2	2	3.00	1600	BZ	JK	3	NW	Good	7-8	8	Dry	None	None	None
Breeding season 2021	16/04/2021	2	3	3.00	930	BZ	JK	4	S	Good	7-8	12	Dry	None	None	None
Breeding season 2021	04/05/2021	2	4	3.00	1300	K, WM	JK	3	NW	Good	5-6	10	Dry	None	None	None
Breeding season 2021	17/05/2021	2	5	3.00	800	BZ	JK	3	SW	Good	5-6	10	Dry	None	None	None
Breeding season 2021	02/06/2021	2	6	3.00	830	None	JK	3	NE	Good	7-8	16	Dry	None	None	None
Breeding season 2021	08/06/2021	2	7	3.00	1230	BZ	JK	4	S-SW	Good	7-8	17	Dry	None	None	None
Breeding season 2021	29/06/2021	2	8	3.00	945	CA, K	JK	3	NW	Good	3-4	20	Dry	None	None	None
Breeding season 2021	06/07/2021	2	9	3.00	1530	SI	JK	3	NW	Good	7-8	16	Dry	None	None	None
Breeding season 2021	21/07/2021	2	10	3.00	1700	BZ	JK	2	SE	Good	1-2	28	Dry	None	None	None
Breeding season 2021	04/08/2021	2	11	3.00	830	BZ	JK	3	N	Good	5-6	18	Dry	None	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding season 2021	20/08/2021	2	12	3.00	800	None	JK	3	SE	Good	7-8	16	Wet	Showers	None	None
Breeding season 2021	27/03/2021	3	1	3.00	930	K	JK	5	SW	Good	7-8	8	Wet	None	None	None
Breeding season 2021	03/04/2021	3	2	3.00	1400	None	JK	3	SE	Good	4-5	14	Dry	None	None	None
Breeding season 2021	12/04/2021	3	3	3.00	1230	K	JK	3	W	Good	6-7	11	Wet	Showers	None	None
Breeding season 2021	06/05/2021	3	4	3.00	1045	BZ	JK	3	N-NW	Good	3-4	12	Dry	None	None	None
Breeding season 2021	08/05/2021	3	5	3.00	800	None	JK	4	SW	Good	5-6	14	Dry	None	None	None
Breeding season 2021	03/06/2021	3	6	3.00	1115	None	JK	4	SE	Good	7-8	15	Wet	None	None	None
Breeding season 2021	18/06/2021	3	7	3.00	830	None	JK	3	NW	Good	6-7	15	Dry	None	None	None
Breeding season 2021	21/06/2021	3	8	3.00	945	BZ, K, LB	JK	4	N-NE	Good	5-6	13	Dry	None	None	None
Breeding season 2021	02/07/2021	3	9	3.00	1430	None	JK	3	NE	Good	6-7	19	Dry	None	None	None
Breeding season 2021	23/07/2021	3	10	3.00	1630	K	JK	2	NW	Good	2-3	24	Dry	None	None	None
Breeding season 2021	08/08/2021	3	11	3.00	1100	BZ, SI	JK	3	SW	Good	6-7	18	Dry	None	None	None
Breeding season 2021	13/08/2021	3	12	3.00	930	BZ	JK	4	SW	Good	6-7	15	Dry	None	None	None
Breeding season 2021	29/03/2021	4	1	3.00	1315	BZ, K	JK	3	SW	Good	6-7	15	Dry	None	None	None
Breeding season 2021	05/04/2021	4	2	3.00	1200	BZ	JK	3	NW	Good	7-8	7	Dry	None	None	None
Breeding season 2021	12/04/2021	4	3	3.00	1630	K	JK	3	W-SW	Good	6-7	11	Wet	Showers	None	None
Breeding season 2021	12/05/2021	4	4	3.00	830	None	JK	4	NE	Good	8-9	10	Wet	None	None	None
Breeding season 2021	19/05/2021	4	5	3.00	1430	BZ, SH	JK	3	SW	Good	6-7	11	Dry	None	None	None
Breeding season 2021	01/06/2021	4	6	3.00	900	None	JK	3	NW	Good	6-7	12	Dry	None	None	None
Breeding season 2021	18/06/2021	4	7	3.00	1300	K, SI	JK	3	NW	Good	6-7	17	Dry	None	None	None
Breeding season 2021	21/06/2021	4	8	3.00	1700	BH, BZ, K	JK	4	N-NE	Good	5-6	15	Dry	None	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding season 2021	09/07/2021	4	9	3.00	830	SH, SI	JK	3	SE	Good	7-8	16	Dry	None	None	None
Breeding season 2021	31/07/2021	4	10	3.00	1415	K	JK	3	NW	Good	6-7	20	Dry	None	None	None
Breeding season 2021	06/08/2021	4	11	3.00	10:00	None	JK	3	W-SW	Good	7-8	16	Wet	Showers	None	None
Breeding season 2021	21/08/2021	4	12	3.00	1400	K	JK	3	SW	Good	6-7	18	Wet	Showers	None	None

Table A5.2: Survey effort for site walkovers showing weather conditions 2019-2022

Season	Visit	Date	Start time	End time	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Non-breeding 2019-20	1	12/02/2020	800	1530	MH					
Non-breeding 2019-20	2	25/02/2020	1230	1800	KW					
Breeding 2020	3	20/05/2020	530	830	JK		SE	3-5	5-6	
Breeding 2020	4	17/06/2020	530	830	JK		NW		10	
Breeding 2020	5	25/06/2020	730	1030	JK		NW	3-5	17-22	
Breeding 2020	6	23/07/2020	630	930	JK		SW		12-15	Drizzle
Breeding 2020	7	30/07/2020	630	930	JK		SE		11-15	
Non-breeding 2020-21	8	02/11/2020	930	1230	JK		W	6-7	7	
Non-breeding 2020-21	9	24/11/2020	900	1200	JK	4	S	7	12	Showers
Non-breeding 2020-21	10	25/11/2020	1030	1330	JK	3	S	3-4	8	
Non-breeding 2020-21	11	08/01/2021	800	1400	DP	4	N	2	0-3	None
Non-breeding 2020-21	12	05/02/2021	1130	1530	DP	3	W	8	6-8	Showers
Non-breeding 2020-21	13	07/03/2021	1045	1415	DP					
Non-breeding 2020-21	14	15/03/2021	1145	1445	DP	4	W	8	5-8	Drizzle
Breeding 2021	15	05/04/2021	700	1300	DP	4-5	NE	7	4-8	Showers
Breeding 2021	16	26/04/2021	700	1300	DP	2	NW	3	3-12	None
Breeding 2021	17	27/06/2021	845	1445	DP	5	NE	6	12-20	None
Breeding 2021	18	29/06/2021	800	1200	DP	4	NW	4	9-17	None
Breeding 2021	19	30/06/2021	715	1030	DP	3	NW	8	9-13	None

Table A5.3: Survey effort for dusk surveys showing weather 2020-21

Season	Date	Visit no.	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp (C)	Rain
Breeding season 2020	19/05/2020	1	1.5	2100	BO	JK		SW	3-6	15	None
Breeding season 2020	28/05/2020	2	1.5	2115	None	JK	Not rec				
Breeding season 2020	08/06/2020	3	1.5	2115	None	JK		NW	3-6	12	None
Breeding season 2020	15/06/2020	4	1.5	2130	None	JK	Not rec				
Breeding season 2021	23/05/2021	1	1.5	2120	None	DP	4	SW	6	10	None
Breeding season 2021	24/05/2021	2	1.5	2120	None	DP	5	NW	8	10	None
Breeding season 2021	26/06/2021	3	1.5	2145	None	DP	4	NE	6	13	None
Breeding season 2021	27/06/2021	4	1.5	2145	None	DP	4	NW	7	13	None

Table A5.4: Survey effort for breeding raptor surveys showing weather 2020-21

Season	Visit	Date	Start time	End time	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Breeding 2020	1	26/05/2020	830	1600	JK		W-SW	0-3	12-20	None
Breeding 2020	2	28/05/2020	915	1115	JK		SE	0-3	18-24	None
Breeding 2020	3	09/06/2020	930	1130	JK		SW	3-5	12-15	None
Breeding 2020	4	15/06/2020	830	1030	JK		E	3-5	17	None

Season	Visit	Date	Start time	End time	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Breeding 2020	5	21/07/2020	700	1330	JK		S-SW	4-6	12-20	None
Breeding 2020	6	30/07/2020	1000	1630	JK		SE	6-7	17	None
Breeding 2021	1	24/03/2021	650	1250	DP	5	SW	8	7-11	None
Breeding 2021	2	25/03/2021	700	1300	DP	4-5	W	6	6-10	Showers
Breeding 2021	3	03/04/2021	800	1400	DP	2-3	NE	2	6-14	None
Breeding 2021	4	25/04/2021	700	1300	DP	4-5	E	1	8-17	None
Breeding 2021	5	17/05/2021	1145	1745	DP	4	NE	6	10-12	Showers
Breeding 2021	6	31/05/2021	1500	2100	DP	4	SW	7	12-14	None
Breeding 2021	7	21/06/2021	850	1450	DP	6	N	6	11-17	None
Breeding 2021	8	26/06/2021	1200	1800	DP	5	SE	7	14-16	None

Table A5.5: Survey effort for hen harrier roost watches showing weather conditions 2019-22

Season	Date	Visit no.	Duration (hr)	Start Time	Wind Force	Wind Dir	Rain	Temp	Target Sp	Surveyor
Non-breeding season 2019-20	06/02/2020	1	2		Not rec				none	GO
Non-breeding season 2019-20	12/02/2020	2	1.5	16:45	0-3	W	Drizzle	Cold	none	MH
Non-breeding season 2019-20	26/02/2020	3	1.75		Not rec				none	KW
Non-breeding season 2020-21	26/10/2020	1	2		Not rec				none	JK
Non-breeding season 2020-21	02/11/2020	2	2	15:30	4-6	W	Showers	7	none	JK
Non-breeding season 2020-21	25/11/2020	3	2	15:00	0-3	S-SW	Dry	8	none	JK
Non-breeding season 2020-21	05/12/2020	4	2	14:50	4-6	NW	Dry	5	none	JK
Non-breeding season 2020-21	15/12/2020	5	2	14:50	4-6	SE	Dry	6-7	none	JK
Non-breeding season 2020-21	04/01/2021	6	2	15:00	3	N	Dry	3-5	K.	JK
Non-breeding season 2020-21	30/01/2021	7	2	15:45	4	NE	Dry	4	SN	JK
Non-breeding season 2020-21	05/02/2021	8	2	16:00	0-3	W	Drizzle	Cold	none	DP
Non-breeding season 2020-21	13/02/2021	9	2	16:15	5	SE	Dry	6	SN	JK
Non-breeding season 2021-22	26/10/2021	1	2	16:45	3	SW	Dry	15	BZ	JK
Non-breeding season 2021-22	28/10/2021	2	2	16:30	3	SW	Dry	14	PE, SN	JK
Non-breeding season 2021-22	30/10/2021	3	2	16:35	3	SW	Dry	11	K.	JK
Non-breeding season 2021-22	02/11/2021	4	2	15:30	3	NW	Dry	9	None	JK
Non-breeding season 2021-22	07/11/2021	5	2	15:20	0-3	SW	Dry	12	WN	JK
Non-breeding season 2021-22	16/11/2021	6	2	15:15	0-3	SW	Drizzle	12	K.	JK
Non-breeding season 2021-22	02/12/2021	7	2	14:50	3	NW	Showers	7	None	JK
Non-breeding season 2021-22	09/12/2021	8	2	15:20	5	W	Showers	9	K.	JK
Non-breeding season 2021-22	14/12/2021	9	2	15:15	3	S-SE	Showers	5	None	JK
Non-breeding season 2021-22	03/01/2022	10	2	15:00	3	SW	Showers	10	None	JK
Non-breeding season 2021-22	11/01/2022	11	2	15:15	3	SW	Dry	7	BZ	JK

Season	Date	Visit no.	Duration (hr)	Start Time	Wind Force	Wind Dir	Rain	Temp	Target Sp	Surveyor
Non-breeding season 2021-22	27/01/2022	12	2	15:40	3	NW	Dry	9	BH, SH	JK

Table A5.6: Survey effort for wider area waterbird surveys showing weather conditions winter 2019-20

Season	Visit	Date	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Non-breeding 2019-20	1	1710/2019	MH					
Non-breeding 2019-20	2	13/12/2019	MH	4	W	5	6-9	Showers
Non-breeding 2019-20	3	16/03/2020	KW					
Non-breeding 2019-20	3	17/03/2020	KW					

Appendix VI – Collision Risk Modelling Report

Avian Collision Risk Modelling Report

Fahy Beg Wind Farm, Co. Clare

Report prepared by Woodrow Sustainable Solutions Ltd on behalf of RWE Renewables

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Table of Contents - CRM

Overview

Woodrow Sustainable Solutions Ltd. was commissioned by RWE to undertake ornithological survey work for the proposed Fahy Beg Wind Farm between 2019 and 2022. The proposed wind farm is located at National Grid Reference: R 63806 70185, approximately 1.5 km north of the town of Bridgetown, Co. Clare. The proposal is for an 8-turbine wind farm.

The intention of this report is to display modelled data, based on observed bird usage of the area, to provide an indication of the likely collision risk imposed by the proposed wind farm on potentially sensitive avian populations. The report uses bird usage data derived from vantage point (VP) watches conducted by appropriately experienced ornithological surveyors.

Flight line data for selected target species was collected from four vantage points (VPs). The survey period covered two breeding bird seasons and two winter seasons of VP watches. This amounted to a total of 579 hours of VP watch data. Further information on VP locations and survey effort can be found in the main ornithological report and supporting appendices, which provides details of timings for VP watches and demonstrates that the minimum requirement of 36 hours per VP per season was achieved for four seasons (2 years).

The flight risk volume applied in this analysis is based on a buffer extending 500 m from the proposed turbines, which equates to area of 358.17 ha. Five turbine models have been specified, the Nordex N131, N133 (110 m hub height), N133 (102.5m hub height), Enercon E-138 and Vestas V136, and the model has been run for each scenario. The collision risk zone was defined as 30 to 180 m. This was a precautionary range based on the lowest minimum swept height and highest maximum swept height of the five turbine models, as detailed in Table A6.1. Note that as the CRZ was defined as a precautionary range based on all five turbine models, both hub heights of the N133 will have the same risk volume due to the rotor diameters being the same.

The conducting of VP watches simultaneously by two or more surveyors was avoided in order to avoid any duplicate records. To limit observer fatigue, surveyors did not typically undertake VP watches of more than 3-hours in duration without a break, unless inclement periods of weather meant watches were paused for short durations until conditions improved.

Collision Risk Modelling (CRM) was undertaken for those target species with > 200 flight seconds occurring with the potential collision risk zone (CRZ) over the two years (i.e. at collision risk height and within the turbine envelope = 500 m turbine buffer). CRMs were run for four 4 species, including:

- Black-headed gull 506 flight seconds in CRZ
- Buzzard 16,454 flight seconds in CRZ
- Kestrel 4,680 flight seconds in CRZ
- Whimbrel 420 flight seconds in CRZ

Though recorded within the study area, CRM was not undertaken for cormorant, greylag goose, hen harrier, lesser black-backed gull, merlin, peregrine, sparrowhawk and whooper swan, as flight times of these species within the collision risk zone were too low to draw any significant conclusions. Swift, which have moved from amber to red listed in the most recently published BoCCI (Gilbert *et al.*, 2021), are emerging as species susceptible to turbine mediated mortality. Therefore, in the second breeding season (2021) swifts were included as target species during VP surveys and flight line data was collected. However, as this was not implemented ubiquitously across the season, the flight times recorded are only indicative and do represent a full breeding season. As such, a collision risk model was not run for this species.

Further information on the species recorded within the study area along with the number of observations per species can be found in the main ornithological report.

Methodology

The collision risk analysis was undertaken using the Scottish Natural Heritage (SNH) model and guidelines, based on Band *et al*. (2007). The SNH model uses two approaches for different situations (SNH, 2000). The first approach is for birds that take regular flights through a wind farm area and the second is for birds that may occupy an area, including a wind farm, as a regular territory. The model approach used in this case is the second approach, relating to birds occupying a given area.

Stage 1 - Number of birds flying through rotors

This stage involved a number of sequential steps:

1. Identify a 'flight risk volume' V_w which is the area of the windfarm multiplied by the height of the rotors, as shown in Equation 1.

$$V_w = Area_{windfarm} * rotor\ diameter \qquad (1)$$

2. Calculate the combined volume swept out by the windfarm rotors using Equation 2:

$$V_r = X\pi R^2(d + l) \qquad (2)$$

   where X is the number of wind turbines, d is the depth of the rotor back to front, and l is the length of the bird.

3. Estimate the bird occupancy n within the flight risk volume. This is the number of birds present, multiplied by the time spent flying in the flight risk volume, within the period (usually one year) for which the collision estimate is being made.

4. The bird occupancy, in bird-seconds, of the volume swept by the rotors b is then calculated using Equation 3.

$$b = n\left(\frac{V_r}{V_w}\right) \qquad (3)$$

5. Calculate the time taken for a bird to make a transit through the rotor and completely clear the rotors t, see Equation 4:

$$t = \frac{d + l}{v} \qquad (4)$$

   where v m/sec is the speed of the bird through the rotor.

6. To calculate the number of bird transits through the rotors N, divide the total occupancy of the volume swept by the rotors in bird-secs by the transit time t, as shown in Equation 5:

$$N = \frac{n\left(\frac{V_r}{V_w}\right)}{t} \qquad (5)$$

   Note in this calculation that the factor $(d + l)$ actually cancels itself out, so only assumed values need be used - it is used above to help visualise the calculation.

Within this stage, a weighting system can be applied to the value for bird occupancy n, which is intended to take account of the fact that the observations arise from different vantage points (VPs), that different vantage points cover varying area extents (in terms of total hectarage), and that the combination of the areas seen from all VPs may not always incorporate the entire site being assessed. The weighting factor for each VP is worked out by the percentage cover of the viewshed of each VP (see viewshed maps in **Appendix II**), as well as the combined percentage cover of all the VPs. This report includes calculations for both unweighted and weighted occupancy values.

Stage 2 - Probability of bird being hit when flying through the rotors

This stage uses data relating to bird and rotor characteristics in order to compute the likelihood of a bird being hit when flying through the rotor. The turbine and operational model inputs are shown in Table A6.1 and **Table A6.2** provides the model input for dimensions/attributes of target species. This, together with the output from Stage 1, allows for a model output of the likely number of collisions per year.

Data relating to the likelihood of a bird being hit when flying through the rotor is derived from a spreadsheet available from NatureScot (formerly Scottish Natural Heritage). The outputs from this spreadsheet are provided for each target species in **Table A6.3**.

Following the above steps, the number of bird transits per year through the rotors can be combined with the probability of a bird being hit when flying through the rotor to give a likely collision risk per year (assuming no avoidance). An avoidance figure is then applied to get a predicted likely collision rate, and thus a likely mortality rate. This stage also takes into account the proportion of time that turbines are likely to be operational.

Avoidance rates are given in SNH (2018) and Furness (2019), which are used to provide estimates of the number of collisions per annum and for the life of the project (30 years).

Table A6.1: Turbine and operational inputs

Turbine parameter	Unit	N131	N133	E138	V136
Number of blades		3	3	3	3
Hub height	m	106	102.5/110	107.5	105
Rotor diameter	m	131	133	138	136
Minimum swept height	m	40.5	36/43.5	38.5	37
Maximum swept height	m	171.5	169/176.5	176.5	173
Maximum rotor depth d	m	4	4	4	4
Maximum rotor chord	m	4	4	4	4.1
Blade pitch*	°	25	25	25	25
Dynamic operating range	rpm	7.9-14.4	6.9-13.9	4.4-10.8	5.6-14.0
Average rotation period	s	5.22	5.77	7.89	6.12
Turbine operation time	%	0.85	0.85	0.85	0.85

*Note: Pitch varies between -5° and 90° depending on windspeed. This model employs a conservative value of 25°. A pitch of 13° would be considered a value representing typical operating conditions, with a pitch of 25° to 30° considered the mean for large off-shore turbines.

Table A6.2: Avian biometrics and flight speeds inputs used in models

Sources: bird biometrics from Snow *et al*. (1998) and flight speeds from Alerstam *et al*. (2007), Bruderer & Bolt (2001) and Provan & Whitfield (2006)

	Length		Wing-span		
Species	Range (cm)	Average (cm)	Range (cm)	Average (cm)	Flight Speed (m/s)
Black-headed gull	34-37	**36**	100-110	**105**	**11.9**
Buzzard	51-57	**54**	113-128	**121**	**11.6**
Kestrel	32-35	**34**	71-80	**76**	**10.1**
Whimbrel	40-46	**41**	80-83	**82**	**16.3**

Table A6.3: Average collision probability and avoidance rates
Source: SNH (2018) and Furness (2019)

Species	N131	N133	E138	V136	Avoidance Rate
Black-headed gull	7.13%	6.61%	5.39%	6.30%	0.992
Buzzard	8.11%	7.49%	5.99%	7.12%	0.98
Kestrel	7.86%	7.22%	5.68%	6.86%	0.95
Whimbrel	5.80%	5.43%	4.62%	5.21%	0.98

Viewshed spatial coverage

The VP locations used were the same during all survey periods. Viewshed spatial coverages for each VP were calculated using ArcGIS Pro. The lowest minimum swept height of the turbine models is 36 m (N133, 102.5 m hub height). The viewshed analysis was performed using a surface offset of 15 m and this mapped what airspace is visible to surveyors (height 1.75m) above 15m. This was considered a precautionary estimate of the visible area based on the presence of mature forestry and woodland within the site, while ensuring a full view of the CRZ. Spatial coverage of these VPs, both in relation to the spatial area of the viewshed within the study area and proportion of the study area, is given in **Table A6.4**. The locations of the VPs and their viewsheds are mapped in **Appendix II**.

Table A6.4: Spatial visual coverage of 500 m buffer and collision risk zone (CRZ)

Vantage Point (VP)	Area of CRZ visible within 500m turbine buffer (ha)	% Coverage	VP survey effort non-breeding season (hrs)	VP survey effort breeding season (hrs)	Total VP survey effort (hrs)
VP1	152.03	42.81%	72.00	72.00	144
VP2	59.65	16.80%	72.00	75.00	147
VP3	192.46	54.19%	72.00	72.00	144
VP4	204.4	57.55%	72.00	72.00	144

Recorded flight activity

Surveys were undertaken for four seasons between October 2019 and August 2021. Flight times within the study area (500 m turbine buffer) and at risk height are provided in **Table A6.5** for the 4 target species included in the model**.**

Table A6.5: Flight seconds in CRZ for target species recorded from each VP

Species	Observable period	VP1	VP2	VP3	VP4	Total (flight seconds)
Black-headed gull	Year-round	0		406	100	**506**
Buzzard	Year-round	2,755	6,845	3,134	3,720	**16,454**
Kestrel	Year-round		1,146	1,458	2,076	**4,680**
Whimbrel	Passage (April/May)		420			**420**

It should also be noted that, in Ireland, whimbrel are a passage migrant. Studies have shown that whimbrel tend to make stopovers in Ireland during their spring migration and not their autumn migration (Carneiro *et al*., 2019; Alves *et al*., 2016) and it was consequently determined that the period in which whimbrel are likely to be recorded in Ireland is from mid-April to mid-May. This was accounted for in the model. There was also only one observation of whimbrel during the study period, which further reduces the statistical power of the results. Again, this should be considered when interpreting the data.

Collision risk assessment

As detailed above, the collision risk assessment is undertaken in two stages, with Stage 1 being to ascertain the number of bird flights through the rotors and Stage 2 being to ascertain the probability of a bird being hit by the rotors as it passes through.

The model inputs for both turbine and bird parameters, as well as the basis of weighting for observational effort are provided in Table A6.1 to **Table A6.4**.

Stage 1 - Number of birds flying through rotors

The first part of Stage 1 is defining the 'flight risk volume' V_w. This is derived from the area of the 500 m turbine buffer (3,551,549 m^2) multiplied by the rotor diameter (rotor swept area). The values for each turbine model are shown in **Table A6.6** and calculated using Equation 1. The 'rotor swept volume' V_r is then worked out based on the rotor swept area multiplied by the number of turbines, the depth of the rotor and the length of the bird. This is shown for the specified turbine models in **Table A6.7** and calculated using Equation 2.

Table A6.6: Flight risk volume V_w for each turbine model

Turbine Model	V_w
N131	$= 3551549(131) = 465252919$
N133	$= 3551549(133) = 472356017$
E-138	$= 3551549(138) = 490113762$
V136	$= 3551549(136) = 483010664$

Table A6.7: Risk Volume V_r and rotor transit time t for each species and turbine model

		Black-headed gull	Buzzard	Kestrel	Whimbrel
V_r (m^3)	**N131**	470120.2397	489528.8735	467963.7249	475511.5269
	N133	484584.6350	504590.4226	482361.7697	490141.7982
	E138	521704.4371	543242.6937	519311.2975	527687.2862
	V136	506692.1481	527610.6313	504367.8722	512502.8379
t (s)		0.3664	0.3914	0.4297	0.2706

The next stage of the calculations is to determine the bird occupancy n within the flight risk volume. This is worked out individually for each VP and then averaged to find the mean occupancy across the site. The observation effort (see Equation 6) of each VP (in hectare hours) is first calculated by multiplying the area viewed from the VP (see **Table A6.4**) by the number of VP hours undertaken (recommended 36 hours per VP per season by SNH). Occupancy n is then calculated, using Equation 7, by dividing the flight time at risk height (in hours) by the observation effort and then multiplying that value by the study area (500 m turbine buffer) and the total hours the target species are active across the site.

The time the birds are active is defined as the product of the number of days in the season/year and the mean day length. This is assumed to be an average of 12 hours daylight for 365 days in the year for species that were present throughout the year (i.e. 4,380 hours). For wintering species 1,704 hours was used and for species that were only present during the breeding season 2,400 hours was applied. For whimbrel, a passage migrant from in late April/early May, 460 hours was estimated. The figures calculated for occupancy, in bird-seconds, are shown in **Table A6.8**.

$$Observation\ effort = Area_{viewshed} * Survey\ effort \qquad (6)$$

$$n = \frac{Flight\ time\ at\ risk\ height\ (hrs)}{Observation\ effort} * Area_{500m\ turbine\ buffer} * Daylight\ hours \qquad (7)$$

Table A6.8: Occupancy n (bird-secs) values calculated for each vantage point

Species	VP1	VP2	VP3	VP4
Black-headed gull	0.0000	0.0000	6.3301	1.4681
Buzzard	54.3775	337.3146	48.8636	54.6121
Kestrel	0.0000	56.4737	22.7323	30.4771
Whimbrel	0.0000	15.2157	0.0000	0.0000

As previously described, a weighting factor was also used to account for the varying extents of cover for each VP as well as the combined cover of each VP not accounting for the entire site. Weighted values for n were calculated using the values for percentage cover described in **Table A6.4**. In this case, the combined VPs do not cover the entirety of the site and therefore the total cover is 0.9966.

$$n_{weighted} = \frac{n_{VP1}(0.43) + n_{VP2}(0.17) + n_{VP3}(0.54) + n_{VP4}(0.58)}{0.9966}$$

Once a value for n and $n_{weighted}$ has been calculated for each VP, this is then used to generate the mean activity for the site as a percentage of time (i.e. a percentage occupancy) within the risk zone, n_{avg}. This is calculated by adding the values for n calculated for each VP then dividing by the number of VPs. In this case, both weighted and unweighted values for n_{avg} were obtained, as shown in **Table A6.9**.

Table A6.9: Values obtained for n_{avg} and $n_{weightedavg}$ (bird-secs)

Species	n_{avg}	$n_{weightedavg}$
Black-headed gull	1.9495	1.0725
Buzzard	123.7919	34.5795
Kestrel	27.4208	9.8701
Whimbrel	3.8039	0.6411

The bird occupancy of the rotor swept volume b is then worked out using Equation 3 by multiplying n_{avg} by $\frac{V_r}{V_w}$.

The bird occupancy of the swept volume b is used to ascertain the number of bird transits through the rotors N by dividing b by the rotor transit time t, see Equation 4-5. The number of transits through the rotors N is then adjusted by a factor of 0.85[2] to obtain Tn, which takes into account likely wind turbine down time. Calculations for the number of transits through the rotors are shown in **Table A6.10**.

[2] This operational period of 85% is referenced from a report by the British Wind Energy Association (BWEA) (2007) which identifies the standard operational period of the wind turbines in the UK to be roughly 85%.

Table A6.10: Values obtained for number of transits through the rotors T_n

		Unweighted			Weighted		
	Species	b	N	T_n	b	N	T_n
N131	Black-headed gull	7.0918	19.3561	16.4527	3.9014	10.6484	9.0511
	Buzzard	468.9042	1198.0811	1018.3689	130.9815	334.6663	284.4664
	Kestrel	99.2900	231.0665	196.4065	35.7392	83.1719	70.6962
	Whimbrel	13.9961	51.7316	43.9719	2.3588	8.7186	7.4109
N133	Black-headed gull	7.2001	19.6516	16.7038	3.9610	10.8109	9.1893
	Buzzard	476.0630	1216.3724	1033.9166	132.9812	339.7757	288.8094
	Kestrel	100.8058	234.5942	199.4051	36.2849	84.4417	71.7755
	Whimbrel	14.2098	52.5214	44.6432	2.3949	8.8518	7.5240
E138	Black-headed gull	7.4708	20.3904	17.3318	4.1099	11.2174	9.5348
	Buzzard	493.9601	1262.1007	1072.7856	137.9805	352.5493	299.6669
	Kestrel	104.5955	243.4136	206.9015	37.6490	87.6162	74.4738
	Whimbrel	14.7440	54.4959	46.3215	2.4849	9.1845	7.8069
V136	Black-headed gull	7.3625	20.0948	17.0806	4.0503	11.0548	9.3966
	Buzzard	486.8013	1243.8094	1057.2380	135.9808	347.4398	295.3239
	Kestrel	103.0797	239.8858	203.9030	37.1033	86.3464	73.3945
	Whimbrel	14.5303	53.7061	45.6502	2.4489	9.0514	7.6937

Stage 2 - Probability of bird being hit when flying through the rotors

Table A6.3 provides the collision probability of the selected target species passing through the rotors. The average collision probability is applied within the CRM and is based the collision probability of a bird travelling upwind and one travelling downwind. All collision probability calculations were undertaken using the setting for birds flapping, as opposed to the setting for gliding birds. This is appropriate for birds, like golden plover and snipe that predominately employ a flapping mode of flight. The flapping setting generates higher values for collision probability in species that incorporate gliding in their flight behaviour, in particular larger raptors, like buzzards. The higher (flapping) value has been retained for these species and will generate a more precautionary estimate for collision risk.

Table A6.11: Collision risk model results

The turbine models and specifications with highest and lowest predicted collision risk indicated in red and green, respectively

		Unweighted					Weighted				
		Collisions/year		Stats			Collisions/year		Stats		
	Species	No avoidance	With avoidance	Per 10 years	Per 30 years	1 bird every x years	No avoidance	With avoidance	Per 10 years	Per 30 years	1 bird every x years
N131	Black-headed gull	1.1723	0.0094	0.09	0.28	106.62	0.6449	0.0052	0.05	0.15	193.82
	Buzzard	82.5771	1.6515	16.52	49.55	0.61	23.0667	0.4613	4.61	13.84	2.17
	Kestrel	15.4284	0.7714	7.71	23.14	1.30	5.5534	0.2777	2.78	8.33	3.60
	Whimbrel	2.5484	0.0510	0.51	1.53	19.62	0.4295	0.0086	0.09	0.26	116.41
N133	Black-headed gull	1.1038	0.0088	0.09	0.26	113.24	0.6073	0.0049	0.05	0.15	205.85
	Buzzard	77.3903	1.5478	15.48	46.43	0.65	21.6178	0.4324	4.32	12.97	2.31
	Kestrel	14.3994	0.7200	7.20	21.60	1.39	5.1830	0.2592	2.59	7.77	3.86
	Whimbrel	2.4246	0.0485	0.48	1.45	20.62	0.4086	0.0082	0.08	0.25	122.36
E138	Black-headed gull	0.9348	0.0075	0.07	0.22	133.72	0.5142	0.0041	0.04	0.12	243.08
	Buzzard	64.3101	1.2862	12.86	38.59	0.78	17.9641	0.3593	3.59	10.78	2.78
	Kestrel	11.7469	0.5873	5.87	17.62	1.70	4.2283	0.2114	2.11	6.34	4.73
	Whimbrel	2.1403	0.0428	0.43	1.28	23.36	0.3607	0.0072	0.07	0.22	138.61
V136	Black-headed gull	1.0763	0.0086	0.09	0.26	116.14	0.5921	0.0047	0.05	0.14	211.11
	Buzzard	75.2985	1.5060	15.06	45.18	0.66	21.0335	0.4207	4.21	12.62	2.38
	Kestrel	13.9791	0.6990	6.99	20.97	1.43	5.0317	0.2516	2.52	7.55	3.97
	Whimbrel	2.3769	0.0475	0.48	1.43	21.04	0.4006	0.0080	0.08	0.24	124.81

Table A6.12: Weight results for collision risk models with avoidance

The turbine models and specifications with highest and lowest predicted collision risk indicated in **red** and **green**, respectively

	Species	Collisions/year	Per 30 years	1 bird every x years
N131	Black-headed gull	0.0052	0.15	193.82
	Buzzard	0.4613	13.84	2.17
	Kestrel	0.2777	8.33	3.60
	Whimbrel	0.0086	0.26	116.41
N133	Black-headed gull	0.0049	0.15	205.85
	Buzzard	0.4324	12.97	2.31
	Kestrel	0.2592	7.77	3.86
	Whimbrel	0.0082	0.25	122.36
E138	Black-headed gull	0.0041	0.12	243.08
	Buzzard	0.3593	10.78	2.78
	Kestrel	0.2114	6.34	4.73
	Whimbrel	0.0072	0.22	138.61
V136	Black-headed gull	0.0047	0.14	211.11
	Buzzard	0.4207	12.62	2.38
	Kestrel	0.2516	7.55	3.97
	Whimbrel	0.0080	0.24	124.81

Results and observations

The output figures from stage 1 (bird transits through the rotors per year) and stage 2 (probability of a bird being hit while passing through the rotors) are multiplied to get an estimated collision/mortality rate per year in the absence of any avoidance. An avoidance rate is then applied to this value – see **Table A6.3**. Unweighted and weighted results are detailed in**Table A6.11** each of the five turbines specified. For clarity **Table A6.12** provides the weight results for collision risk models only, with avoidance rates applied for each target species assessed.

The results generated by running this version of the CRM are considered to represent relatively high levels of theoretical collision risk posed to the target species recorded within the turbine envelope based on the flight data collected from October 2019 to August 2021, due to the parameters entered into the model being notably precautionary, including turbine dimensions (especially the max chord for the blades and pitch), relatively high rotational period and selecting flapping flight behaviour for each species. It is also important to note that, as is always the case with a modelled approach, the collision risk model outputs are only considered to be indicative of the level of risk of fatalities resulting from the proposed wind farm site and should be considered in conjunction with other discussions within the main report. For instance, the outputs from the model do not take account of potential displacement of birds from the wind farm envelope, which for species breeding within or directly adjacent to the site may be more of a cause for concern. It is also acknowledged that the application of CRMs to smaller, evasive species like sparrowhawk and snipe may not provide an accurate estimate of collision risk, as these species can be difficult to detect over the full extent of the viewsheds for VPs, due diminutive size, cryptic nature and/or flight behaviour.

The CRMs found that the N131 generated the highest predicted collision risk (worst-case scenario) and the E138 would result in lowest collision risk (best-case scenario). This result may be driven by the higher average operational speeds of the N131 (average rotational period: 5.22 sec), and even though the E138 has a larger risk volume the average operational speeds are lower (average rotational period: 7.89 sec).

The CRMs generated notably low levels of theoretical collision risk for two of the target species analysed and less than 0.05 collisions (weighted) were predicted over the 30-year life span of the project were predicted for black-head gull and whimbrel. This level of predicted collisions would be considered negligible and would not affect these species at the population level, i.e. collision mediated mortality would not add significantly (>1%) to background levels of mortality.

Reflective of higher levels of flight time in the collision risk zone and somewhat low avoidance rates, predicted collision risk for buzzard and kestrel were relatively high and depending on turbine specification was estimated at:

- 0.36 to 0.46 collisions per annum for buzzard
- 0.21 to 0.28 collisions per annum for kestrel

These levels of predicted collision risk warrant further investigation in terms of effects on buzzard and kestrel on populations, which is discussed in the main ornithology result report. The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003). Estimates of the potential increase in annual mortality rates for target species are discussed within the main ornithology result report, for kestrel and buzzard.

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FEHILY
TIMONEY

CONSULTANTS IN ENGINEERING,
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& PLANNING

Appendix 8.2

HABITAT SURVEY
REPORT

Fahy Beg Wind Farm

Habitat Survey of Proposed Wind Farm Site

Prepared By:

Delichon Ecology

Prepared For:

Fehily Timoney & Company

Fahy Beg Wind Farm
Habitat Survey of Proposed Wind Farm Site

Revision	Document Number	Description	Prepared by	Checked by	Date
0	44_21	Habitat Survey	ED	ED	18/11/2021
1	44_21	Habitat Survey	ED	ED	28/03/2022
2	44_21	Habitat Survey	ED	ED	24/08/2022
3	44_21	Habitat Survey	ED	ED	10/10/2022
4	44_21	Habitat Survey	ED	ED	10/10/2022

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1. INTRODUCTION

Delichon Ecology were commissioned by Fehily Timoney & Company to undertake a habitat survey of a proposed wind farm site in Fahy Beg, O'Briensbridge, Co. Clare. The habitat survey was undertaken on Friday July 30th 2021 and Monday August 16th 2021.

1.1 Study Area

Fahy Beg Wind Farm is located approximately 5.7km south-east of the village of Broadford and 3.0km north-west of O'Briensbridge, at its closest points, in east Co. Clare. The site is accessed via an internal quarry access road and access tracks, local access roads and farm access tracks.

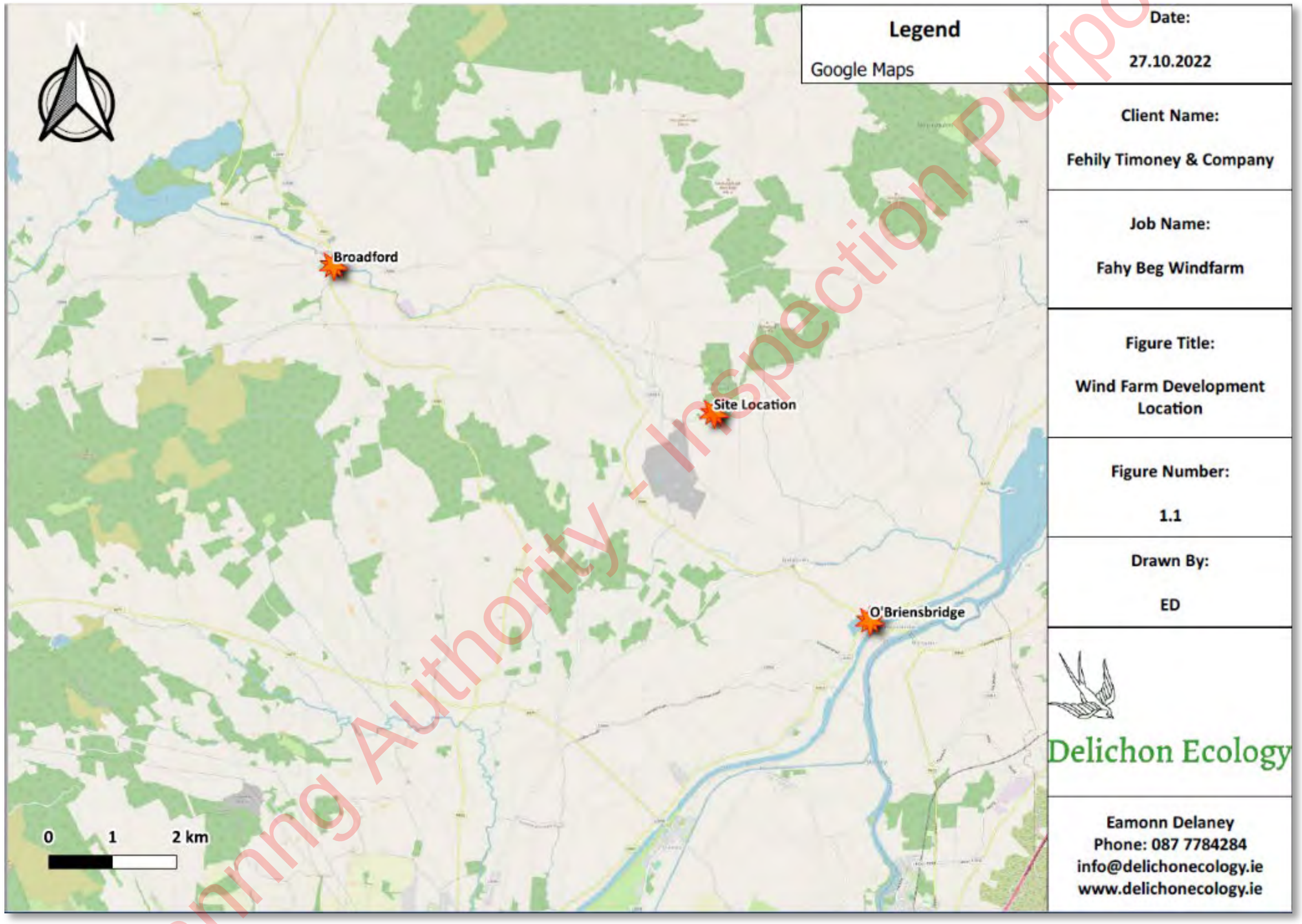

Figure 1-1 - Wind farm development location

1.2 Statement of Authority

Eamonn Delaney undertook desk and field surveys and compiled and completed this Ecological Impact Assessment report. Eamonn holds a B.Sc. (Hons) in Science, and M.Sc. in Environmental Science. Eamonn has 14 years' experience in ecological consultancy. Eamonn is a full and Chartered Member of the Chartered Institute of Ecology and Environmental Management (CIEEM).

2 METHODOLOGY

2.1 Assessment Guidance Methodology

The habitat survey and assessment had regard to the following guidelines:

- EPA (2002) *Guidelines on the information to be contained in Environmental Impact Statements*, Environmental Protection Agency;
- EPA (2003), *Advice Notes on current practice in the preparation of Environmental Impact Statements*, Environmental Protection Agency;
- Fossitt, J. (2000) A Guide to Habitats in Ireland. Heritage Council, Kilkenny.
- NRA (2009) *Guidelines for the Assessment of Ecological Impacts of National Road Schemes Rev. 2*, National Roads Authority;
- NRA (2008) *Ecological Surveying Techniques for Protected Flora and Fauna During the Planning of National Road Schemes*, National Roads Authority;
- (NRA, 2008c) *Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads*, National Roads Authority;
- Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland;
- CIEEM (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, Version 1.1 Updated September 2019*. Chartered Institute of Ecology and Environmental Management, Winchester; and
- EPA (2022) *Guidelines on the information to be contained in Environmental Impact Assessment Reports*, Environmental Protection Agency.
- Smith, G. F., O'Donoghue, P., O'Hora, K. & Delaney, E. (2011) *Best Practice Guidance for Habitat Survey and Mapping.* Heritage Council, Kilkenny.

The assessment was carried out in two stages, firstly through a desktop study and secondly by field survey work in order to identify, describe and map areas of know or potential ecological value.

2.2 Desk Study

Sources of information that were used to inform the assessment were:

- Environmental Protection Agency (EPA) EnVision Mapping https://gis.epa.ie/EPAMaps/;
- EPA Catchments Website – for the 2nd cycle River Basin Management Planning www.catchments.ie;
- Geological Survey of Ireland online mapping www.gsi.ie;
- Information on the conservation status of birds in Ireland (Colhoun & Cummins, 2013);
- NPWS online maps and data, site synopsis and conservation objectives www.npws.ie
- National Biodiversity Data Centre (NBDC) online maps and data www.biodiversityireland.ie;
- OSI Map Viewer www.osi.ie;
- Botanical Society of Britain and Ireland online maps and data https://bsbi.org/maps;

- Any other relevant ecological reports and literature (published scientific literature and 'grey' literature).

2.3 Field Survey

The principal aim of the field survey was to identify and map habitats and their component plant species within the proposed windfarm site. A Phase 1 Habitat Survey was undertaken as part of the site walkover survey. The methodology used during this survey was based on the Heritage Council's *Best Practice Guidance for Habitat Survey and Mapping* (2011)[1]. The classification of habitats recorded during the field survey is based on the *A Guide to Habitats in Ireland* (Fossitt, 2000)[2]. The *Guide to Habitats in Ireland* classifies habitats according to a hierarchical framework with Level 1 habitats representing broad habitat groups, Level 2 representing habitat subgroups and Level 3 representing individual habitat types. The Phase 1 Field Survey focused on identifying habitats to Level 3 of the *Guide to Habitats in Ireland*. Any other records of interest (e.g. invasive plant species) were also marked on field maps and locations were recorded using GPS handheld units.

The annotation of vegetation occurring within sites was undertaken using the DAFOR scale. This scale refers to plant species in terms of dominance, abundance, frequency, occasional and rare (DAFOR). All species were readily identifiable during the survey. Plant nomenclature for vascular plants follows 'New Flora of the British Isles' (Stace, 2019)[3], while mosses and liverworts nomenclature follows 'Mosses and Liverworts of Britain and Ireland - a field guide' (British Bryological Society, 2010)[4].

2.4 Evaluation

All ecological receptors within the project's zone of influence were assessed according to criteria for site evaluation outlined in the NRA *Guidelines for Ecological Impact Assessment of National Road Projects* (NRA, 2009). The geographic frame of reference used to determine the ecological value of receptors as they occurred within the project zone of influence are presented in

Table 2-1 - Ecological Site Assessment Scheme

Ratings for Ecological Sites
International Importance: 'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. Proposed Special Protection Area (pSPA). Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended).

[1] Smith, G. F., O'Donoghue, P., O'Hora, K. & Delaney, E. (2011) *Best Practice Guidance for Habitat Survey and Mapping.* Heritage Council, Kilkenny.
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[3] Stace, C. (2019) New Flora of the British Isles. Fourth Edition. C&M Floristics
[4] Atherton, I. Bosanquet S. & Lawley, M (2010) Mosses and Liverworts of Britain and Ireland a field guide. British Bryological Society

Ratings for Ecological Sites
Features essential to maintaining the coherence of the Natura 2000 Network. Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). Biosphere Reserve (UNESCO Man & the Biosphere Programme). Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe. Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).
National Importance: Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.

Ratings for Ecological Sites
County Importance: Area of Special Amenity. Area subject to a Tree Preservation Order. Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. County important populations of species or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared. Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (higher value): Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality;

Ratings for Ecological Sites
Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (lower value): Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; Sites or features containing non-native species that are of some importance in maintaining habitat links.

In summary, the habitats found are evaluated based on their naturalness, value and vulnerability, as well as their inclusion within the European site network. Habitats that are considered to be good examples of Annex I and Annex I Priority habitats are classed as being of International or National Importance. Semi-natural habitats with high biodiversity in a county context and that are vulnerable, are considered to be of County Importance. Habitats that are semi-natural, or locally important for wildlife, are considered to be of Local Importance (higher value) and sites containing small areas of semi-natural habitat or maintain connectivity between habitats are considered to be of Local Importance (lower value).

3 RESULTS

3.1 Phase 1 Habitat Survey

The findings of the Phase 1 habitat survey are described below, while habitat maps showing the extent of habitats within the proposed wind farm study area are presented in **Figure 3.1** to **Figure 3.3**.

The habitat study survey area supports extensive areas of conifer woodland (WD4) and improved agricultural grassland (GA1). The proposed wind farm site will be accessed via the western boundary of a disused quarry site, the footprint of which supports scrub (WS1), young broadleaved woodland (WD1), other artificial lakes and ponds (FL8) and areas of recolonising bare ground and spoil and bare ground (ED2). The proposed access road turns east, crossing a local road and then entering the footprint of the proposed wind farm site. Immediately east of the local access road, the lands comprise low-lying improved agricultural grassland (GA1) bound by treelines (WL2) and hedgerows (WL1), with localised areas of rushy wet grassland (GS4). Continuing east, the topography of the study area continues to increase rapidly toward an extensive area of beech dominated mixed broadleaved woodland (WD1), which is bound to the north and east by conifer woodland (WD4). The southernmost areas of the study area support improved (GA1) and semi-improved agricultural grassland habitats, in addition to localised areas of wet grassland (GS4) habitats. These distribution and occurrence of these habitats are influenced by recent and ongoing maintenance, particularly drainage maintenance. The eastern southernmost sections of the study area are drained by tributaries of the Bridgetown (Clare)_010 river while the western half of the study area is drained by the Broadford_010 river.

Descriptions of habitats within the habitat study survey area site are provided below.

Improved Agricultural Grassland (GA1)

The western and southernmost sections of the habitat study survey area support extensive areas of improved agricultural grassland which primarily supports grazing cattle. These habitats are typically species poor and include perennial rye grass (*Lolium perenne*), Yorkshire fog (*Holcus lanatus*), common bent (*Agrostis capillaris*), creeping bent (*Agrostis stolonifera*), creeping buttercup (*Ranunculus repens*), white clover (*Trifolium repens*), creeping thistle (*Cirsium palustre*) and ragwort (*Jacobaea vulgaris*). Near the southern boundary of the study area, the improved agricultural grassland habitats have generated through ongoing improvement of poor draining lands. Such lands support localised occurrences of common rush (*Juncus effusus*), due to poor drainage or localised changes in topography.

Dry Meadows and Grassy Verge Grassland (GS2)

Discrete and localised sections of this habitat occur to the east of the quarry entrance and near the eastern boundary of the study area. In both cases, this habitat has developed where ongoing management, such as grazing or mowing, of improved agricultural grassland or semi-improved grassland has ceased. This has led to the development of dense tussocky grasses and tall thick sward height.

Dry meadows and grassy verge grassland located east of the quarry entrance are characterised by dense grasses including cock's-foot (*Dactylis glomerata*), Yorkshire fog, common bent and false oat grass (*Arrhenatherum elatius*). Accompanying grasses and herbs include creeping buttercup, yarrow (*Achillea millefolium*), ragwort, broadleaved dock (*Rumex obtusifolius*), lesser stitchwort (*Stellaria graminea*), tormentil (*Potentilla erecta*) and greater bird's foot trefoil (*Lotus pedunculatus*). Gorse (*Ulex europaeus*) scrub is beginning to encroach on these GS2 fields from the field margins.

This habitat also occurs near the eastern boundary of the study area, where it has also developed from the lack of recent or ongoing management, leading to the development of a dense grass sward and the spread and expansion of bracken (*Pteridium aquilinum*) scrub.

Dry Humid Acid Grassland (GS3)

Dry humid acid grassland is located near the northern and eastern boundary of the study area. These habitats are typically located on unimproved or semi-improved grassland on sloping terrain, that has received very little ongoing management over the short term. Plant species composition within these grassland areas near the study area's eastern boundary include sweet vernal grass (*Anthoxanthum odoratum*), common bent, yarrow, common knapweed (Centaurea nigra), articulated rush (Juncus articulatus), ribwort plantain (Plantago lanceolata), common sorrel (Rumex acetosa), cat's ear (Hypochaeris radicata), occasional devil's bit scabious (Succisa pratensis) and lesser stitchwort (Stellaria graminea). These habitats are being actively encroached by dense bracken scrub (HD1).

The areas of this habitat located near the northern boundary of the study area are again located on unmanaged sloping ground that is being encroached by spreading gorse (Ulex europaeus) and bramble scrub. These areas are defined from nearby areas of wet grassland due to reductions in articulated rush cover and the occurrence of frequent common bent, creeping bent, ribwort plantain, Yorkshire fog, cat's ear and occasional devil's bit scabious, tormentil and lousewort (Pedicularis sylvatica).

Wet Grassland (GS4)

Wet grassland occurs is localised areas throughout the study area, typically in mosaic with improved agricultural grassland and less typically with gorse scrub, where the grassland has not been managed through ongoing grazing or cutting.

Where it occurs with improved grassland, it is typically associated with localised, low-lying areas that are poor draining or that receive and collect local surface water flows from areas of higher terrain.

Wet grassland within the study area is typically rush dominated, mostly common rush. Flushed areas support articulated rush and sharp flowered rush. Associated grass species include Yorkshire fog, creeping bent, common bent and sweet vernal grass. Forb species include marsh thistle, greater bird's foot trefoil, meadowsweet (*Filipendula ulmaria*), marsh bedstraw (*Galium palustre*), ragwort, creeping bent, marsh ragwort (*Senecio aquatilis*), lesser spearwort (*Ranunculus flammula*), water mint (*Mentha aquatica*) and the moss *Calliergonella cuspidata*. Near the southern boundary of the study area, this habitat occurs in mosaic with in localised pockets amongst expansive areas of improved grassland. These habitats typically support abundant common rush.

A rideline area within a conifer plantation located near the northern boundary of the study area supports wet grassland exhibiting extensive rush growth with spreading bramble (*Rubus fruticosus* agg.) and occasional grey willow (*Salix cinerea* subsp. *oelifolia*).

Two pockets of more diverse wet grassland are located near the northern boundary of the study area, within an opening of otherwise afforested land that has not been actively managed in recent years. These lands are moderate to steep sloping which influences a flushed and diverse wet grassland habitat that also exhibits some calcareous affinities. Plant species composition includes abundant articulated rush and frequent devil's bit scabious. Other accompanying species in the understorey of the tall rush growth includes common marsh bedstraw, greater bird's foot trefoil, water mint, meadow buttercup (*Ranunculus acris*), tormentil, hairy sedge (*Carex hirta*), self heal (*Prunella vulgaris*), crested dog's tail (*Cynosurus cristatus*), marsh violet (*Viola palustris*), eyebright (*Euphrasia* agg.), glaucous sedge (*Carex flacca*), autumn hawkbit (*Scorzoneroides autumnalis*) and lesser stitchwort. The southernmost polygon of this habitat type supports localised reductions of rush growth and greater occurrences of marsh thistle (*Cirsium dissectum*) and purple moor grass (*Molinia caerulea*). These areas of grassland are considerably diverse when considered in the context of the study area and the surrounding hinterland. The diversity of this grassland and its plant species composition supports affinities with and corresponds to the Annex I grassland habitat *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) (6410). Willow and gorse scrub are actively spreading from the east and south-eastern corner of this habitat.

Dense Bracken (HD1)

Dense bracken scrub is typified by the presence of abundant bracken (*Pteridium aquilinum*) with occasional occurrences of bramble and gorse. Discrete sections of this habitat occur near the site's eastern boundary, where it has established upon unmanaged agricultural grassland habitats.

Scrub (WS1)

Extensive areas of scrub are located near the western boundary of the study area, associated with the margin of the quarry footprint, supports an extensive area of mixed scrub. Species composition includes hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*), elder (*Sambucus nigra*), goat willow (*Salix caprea*), grey willow, gorse and broom (*Cytisus scoparius*).

Willow, hawthorn and gorse scrub occurs near the north-eastern boundary of the study area, primarily along the margins and within the internal ridelines of the extensive areas of conifer plantation.

Gorse, bramble and willow scrub also occurs in mosaic with small areas of wet grassland near the western boundary of the study area.

Mixed Broadleaved Woodland (WD1)

A large area of mature mixed broadleaved woodland is located near the centre of the Study area. The woodland is characterised by abundant beech (*Fagus sylvatica*) in the canopy layer localised and occasional pubescent birch (*Betula pubescens*) and localised and locally frequent occurrences of mature pedunculate oak (*Quercus robur*). The beech trees are long established, many of which are structurally robust and provide suitable habitat and refuge for birds and mammals. This broadleaved woodland is long established, and is identified in 1st edition OS mapping at Ballymoloney Wood.

Much of the woodland's understorey structure is open, with large areas supporting little or no shrub species cover. Bramble occurs in localised abundances within the understory but is not extensive. Ground layer species in higher drier areas include rough meadow grass (*Poa trivialis*), wood dock (*Rumex sanguineus*), wood avens (*Geum urbanum*), enchanter's nightshade (*Circaea lutetiana*), Atlantic ivy (*Hedera hibernica*), hedge woundwort (*Stachys sylvatica*), germander speedwell (*Veronica chaemedrys*), tufted hair grass (*Deschampsia cespitosa*), *Viola* sp. and bluebell (*Hyacinthoides non-scripta*). Localised low-lying habitats support locally frequent remote sedge (*Carex remota*) with wood sorrel (*Oxalis acetosella*), opposite leaved golden saxifrage (*Chrysosplenium oppositifolium*), broad buckler fern (D*ryopteris dilatata*) and the mosses *Polytrichum commune*, *Rhytidiadelphus triquetrus* and *Climacium dendroides*.

The southern and westernmost fringes of this woodland are more low lying and change from a canopy layer dominated by beech to a mixed canopy supporting sycamore, pubescent birch and grey willow, in addition to frequent to locally abundant beech.

Areas of young ash plantation woodland located near the northern boundary of the study area also correspond to this woodland category.

Young mixed broadleaved woodland is also located near the western boundary of the study area, established on the boundary of the quarry site, most likely for screening purposes. This woodland supports young broadleaved trees including grey willow, sycamore (*Acer pseudoplatanus*), ash (*Fraxinus excelsior*) and pubescent birch.

Conifer Woodland (WD4)

This habitat relates to the extensive areas of conifer woodland located on areas of higher terrain in the northern part of the study area. The main tree species associated with this habitat includes Sitka spruce (Picea sitchensis), lodgepole pine (*Pinus contorta*) with localised areas of larch (*Larix* sp.).

Oak-Birch-Holly Woodland (WN1)

This habitat includes a small pocket of pubescent birch dominated woodland near the western boundary of the study area. The woodland supports abundant pubescent birch in the canopy layer with occasional pedunculate oak and occasional hawthorn. The understorey supports abundant bramble, rough meadow grass, enchanter's nightshade, wood avens and polypody fern (*Polypodium* sp.).

Oak-Ash-Hazel Woodland (WN2)

A tributary of the Bridgetown (Clare)_010 watercourse flows near the centre of the study area, flowing in a north to south direction. Near the southern boundary of the study area, the river channel and associated margins deepen and supports oak-ash-hazel woodland. This woodland is narrow (ca 35m wide) and is located on very steep margins with a ca. 20m drop between the valley margins and the riverbed. The woodland is characterised by hazel (*Corylus avellana*) in the canopy layer, which forms individual multi-stemmed stands. The ground layer species assemblage within the woodland is relatively well developed and supports bluebell, greater wood rush (*Luzula sylvatica*), ivy, wood sedge (*Carex sylvatica*), herb Robert (*Geranium robertianum*), wood sorrel, wood avens, broad buckler fern, greater stitchwort (*Stellaria holostea*), spindle (*Euonymous europaeus*), sanicle, hard fern (*Blechnum spicant*) and *Viola* sp. The watercourse flowing through this woodland is narrow and sinuous and due to shading from the adjoining woodland, supports no instream macrophytes.

Wet willow-alder-ash woodland (WN6)

This area of wet willow-alder-ash woodland is located immediately west of the large mixed broadleaved woodland block characterised by abundant beech growth. This woodland area supports a noted reduction in beech cover in the canopy, replaced by pubescent birch with occasional grey willow and ash. This is a young woodland habitat, and the ground layer is undeveloped comprising abundant bramble scrub and young grey willow trees.

Spoil and Bare Ground (ED2)

This habitat is associated with the western boundary of the study area and includes the access roads and open areas of ground associated with past quarrying practices and ongoing maintenance and access operations. This is a species poor habitat, but may include localised occurrences of the species listed for the Recolonising Bare Ground (ED3) habitat described below.

Recolonising Bare Ground (ED3)

Areas of recolonising bare ground are associated with the western boundary of the study area and includes the access roads and open areas of ground associated with past quarrying practices and ongoing maintenance and access operations. Ruderal plant species and early colonising grasses have established along the margins of access roads or where quarrying or excavation practices have ceased. Plant species assemblage is varied and reasonably diverse and includes bird's foot trefoil (Lotus corniculatus), Yorkshire fog, sweet vernal grass, yellow-wort (*Blackstonia perfoliata*), ox eye daisy (*Leucanthemum vulgare*), coltsfoot (*Tussilago farfara*), purple loosestrife (Lythrum salicaria), common knapweed, selfheal, articulated rush, perforate St. John's wort (*Hypericum perforatum*), common bent, false oat grass, common centaury (*Centaurium erythraea*), ragwort, mouse-ear hawkweed (*Pilosella officinarum*), cat's-ear, foxglove (*Digitalis purpurea*), wall lettuce (*Mycelis muralis*), hoary willowherb (*Epilobium parvifolium*), autumn hawkbit, greater plantain (*Plantago major*), and seedling pubescent birch. This habitat occurs in mosaic with mixed scrub near the northernmost sections of the quarry, occurring in openings of the willow, gorse, broom and birch scrub.

Other Artificial Lakes and Ponds (FL8)

The western and south-western margins of the study area support a series of unused artificial ponds and lakes. These artificial waterbodies were used to attenuate water during the quarry's operational phase. These are primarily deep open waterbodies and plant species growth comprises abundant broadleaved pondweed (*Potamogeton natans*). These waterbodies are fringed by areas of scrub and young mixed broadleaved woodland.

Reed and Large Sedge Swamp (FL8)

This habitat occurs at the southern boundary of the quarry site, and is associated with low lying lands which supports water moving south from higher areas of the quarry located to the north. It is also associated with the margins artificial pond areas that have become overgrown or are encroaching with emergent aquatic vegetation. These habitats where they occur on site and are dominated by common reed (*Phragmites australis*) with encroaching willow and gorse scrub growing along the drier margins.

Drainage Channels (FW4)

Drainage channels are located on the margins of steeply sloped improved agricultural grassland and wet grassland habitats and fringing the access road serving the quarry site. These are generally fringed by earth banks and / or hedgerow habitats. Waterflow within these channels are seasonal and the channel morphology is narrow with stony substrates.

Eroding Upland River (FW1)

The southern and eastern section of the study area are drained by upper tributaries of the Bridgetown (Clare)_010 river waterbody. The western boundary of the study area is drained by an upper tributary of the Broadford_010 waterbody. These tributaries are narrow sinuous channels located on steep sloping terrain and support varying levels of water within the channel. Where these channels occur on site, they are located along field margins and are fringed by treelines, hedgerows, scrub and semi-natural woodland. Due to the eroding and ephemeral nature these watercourses support little or no instream aquatic plant species.

Hedgerows (WL1)

Hedgerow habitats occur along the margins of the improved grassland and other pastoral grassland habitats. These hedgerows support varying levels of management and consequent structural condition. In the better draining areas of the study area, hedgerows support hawthorn, blackthorn (*Prunus spinosa*), elder and honeysuckle with overtopping ash. Poorer draining areas of the site support more grey willow cover, in addition to common birch. Near the southern boundary of the study area, some hedgerows comprise abundant gorse growing on an earth embankment.

Treelines (WL2)

Treelines occur consistently with hedgerows along the boundaries of pastoral habitats. In some instances, such as those treelines located near the study area's western and southern boundaries, the treeline habitat has formed from an unmanaged or an overgrown hedgerow. These treelines typically support tall thin and semi-mature ash trees and occasional pedunculate oak, pubescent birch and mountain ash overtopping hawthorn, blackthorn and gorse. Wetter sections of the site support more willow cover, in addition to mountain ash and pubescent birch.

Buildings and Artificial Surfaces (BL3)

This habitat includes a ruined dwelling located in the northern part of the study area. The margins of this building supports spreading bramble and fuschia (*Fuschia magellanica*) scrub in addition to an established stand of Japanese knotweed (*Reynoutria japonica*). The Japanese knotweed is a multi-stemmed stand and is 3-4 metres high and 5-6 metres wide.

Habitat Evaluations

Table 3-1 - Evaluation of habitats within the proposed windfarm site

Habitat	Evaluation	Evaluation Rationale
Eroding upland rivers (FW1)	Local Importance – Higher Value	The Bridgetown (Clare)_010 and Broadford_010 watercourses are considered to be of high local importance due to their corridor functionality and potential resource for avifauna, mammals and aquatic / emergent plant species.
Drainage ditches (FW4)	Local Importance – Higher Value	Drainage channels and streams of low and negligible flow are considered to be of local importance to avifauna and small mammals as a viable foraging habitat and localised refuge.
Improved agricultural grassland (GA1)	Local Importance – Lower Value	This is a species poor habitat that offer little ecosystem services to avifauna, mammals and invertebrates.
Dry meadows and grassy verges (GS2)	Local Importance – Higher Value	This is a habitat of moderate species diversity and has developed from unmanaged pastoral land. These grasslands provide greater ecosystem services to mammals, avifauna and invertebrates, than areas of intensively managed pastoral lands.
Dry humid acid grassland (GS3)	Local Importance – Higher Value	This is a habitat of moderate species diversity. These grasslands provide greater plant species diversity and ecosystem services to mammals, avifauna and invertebrates, than areas of intensively managed pastoral lands.
Wet grassland (GS4)	Local Importance – Higher Value County Importance	A habitat likely to be of local importance to avifauna and small mammals as a viable foraging habitat and localised refuge. Wet grassland within the study area is isolated and typically surrounding by improved grassland habitats. Two areas of diverse and flushed wet grassland on peaty soils located near the northern boundary of the site correspond to the Annex I grassland habitat ‘*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) (6410)’. These wet grassland habitats are evaluated as being of County Importance.
Dense bracken (HD1)	Local Importance – Lower Value	A habitat of poor floristic value. However dense bracken can provide suitable cover and refuge for faunal species in the locality in terms of cover, refuge and connectivity.
Scrub (WS1)	Local Importance – Higher Value	A habitat of moderate floristic value. However scrub habitats provide valuable ecosystem services for other semi-natural habitats and faunal species in the locality in terms of cover, refuge and connectivity.

Habitat	Evaluation	Evaluation Rationale
Mixed broadleaved woodland (WD1)	County Importance Local Importance – Higher Value Local Importance – Lower Value	The mature beech woodland habitat, near the centre of the site, identified as Ballymoloney Wood on OS mapping, is considered to be of County Importance. This is due to the condition of the trees in the canopy and their importance to species such as bats, pine marten and breeding birds. In and of itself, this woodland supports moderate plant species diversity. Most importantly, it represents a large area of broadleaved woodland area within the locality and is likely to provide valuable ecosystem services for a range of habitats and species in the local area. It is also a long established woodland that did support historical connectivity with other broadleaved woodland habitats to the south and south-west, including demesne woodland at Ballyquin House and woodlands at Glenomra Wood SAC, located 3.0km south-west. The young broadleaved woodland areas associated with the quarry margins are considered to be of Local Importance -Higher Value, given their inherent botanical composition, ecological corridor functionality and ecosystem services for local ecological receptors. The area of young ash plantation is considered to be of Local Importance, Lower value as they are young, underdeveloped habitats of poor – moderate species diversity.
Conifer woodland (WD4)	Local Importance – Lower Value	A habitat of poor floristic value. However conifer woodland can provide suitable habitat for faunal species in the locality in terms of cover, refuge and connectivity.
Oak-birch-holly woodland (WN1)	Local Importance – Higher Value	A small area of young semi-natural woodland with a poorly developed ground layer.
Oak-ash-hazel woodland (WN2)	Local Importance – Higher Value	The semi-natural woodland is considered to be Local Importance – Higher Value, due to its species diversity and its importance to species such as bats, pine marten and breeding birds. This woodland represents an important broadleaved woodland area within the locality, and it is likely to provide valuable ecosystem services for a range of habitats and species in the local area.
Wet willow-alder-ash woodland (WN6)	Local Importance – Higher Value	A small area of young semi-natural woodland with a poorly developed ground layer
Spoil and bare ground (ED2)	Local Importance – Lower Value	A habitat of low botanical diversity with little ecological services to fauna in the locality.

Habitat	Evaluation	Evaluation Rationale
Recolonising bare ground (ED3)	Local Importance – Higher Value	This is a habitat of good floristic diversity, primarily ruderal species. These habitats due to their botanical diversity are likely to be of local importance for invertebrate fauna.
Other Artificial Lakes and Ponds (FL8)	Local Importance – Higher Value	A habitat of low botanical diversity. However these wetland habitat provides valuable cover and suitable habitat for breeding birds and invertebrates.
Reed and Large Sedge Swamp (FS1)	Local Importance – Higher Value	A habitat of low botanical diversity. However these wetland habitat provides valuable cover and suitable habitat for breeding birds and invertebrates.
Hedgerows (WL1)	Local Importance – Higher Value	Hedgerows and treelines within the study area provide viable and valuable commuting, foraging and refuge habitats for small birds and mammals. They also provide suitable habitat for burrowing mammals, breeding birds and roosting bats.
Treelines (WL2)	Local Importance – Higher Value	Hedgerows and treelines within the study area provide viable and valuable commuting, foraging and refuge habitats for small birds and mammals. They also provide suitable habitat for burrowing mammals, breeding birds and roosting bats.

Photos of the study area

	
Image 3-1 – Dry meadows and grassy verge grassland near the southern boundary of the study area	**Image 3-2 – Large artificial pond located near the study area's western boundary**
	
Image 3-3 – Improved agricultural grassland located near the study area's western boundary	**Image 3-4 - Mixed scrub recolonising the margins of the quarry, near the study area's western boundary**

Image 3-5 – Localised abundances of remote sedge growing within the ground layer of beech dominated woodland

Image 3-6 – Beech dominated woodland with open shrub layer

Image 3-7 – Rushy wet grassland located near the western boundary of the study area	**Image 3-8 – Farm access track serving the eastern half of the study area**
	
Dry humid acid grassland located near the eastern boundary of the study area	**Dense bracken located near the eastern boundary of the study area**
	
Understorey of conifer woodland plantation	**Rushy wet grassland with encroaching scrub near the southern boundary of the study area**

	
Improved agricultural grassland located near eastern boundary of the study area	**Semi-improved improved agricultural grassland near the southern boundary of the study area**
	
Oak-ash-hazel woodland located on the margins of the Bridgetown (Clare)_010 river	**Derelict dwelling located within the northern section of the study are**

	
Bridgetown (Clare)_010 river located near the southern boundary of the study area	**Bridgetown (Clare)_010 tributary located near the north-eastern boundary of the study area**
	
Japanese knotweed located adjoining private dwelling near the northern boundary of the study area	**Diverse wet grassland with affinities to Molina meadows 6410 near the northern boundary of the study area**

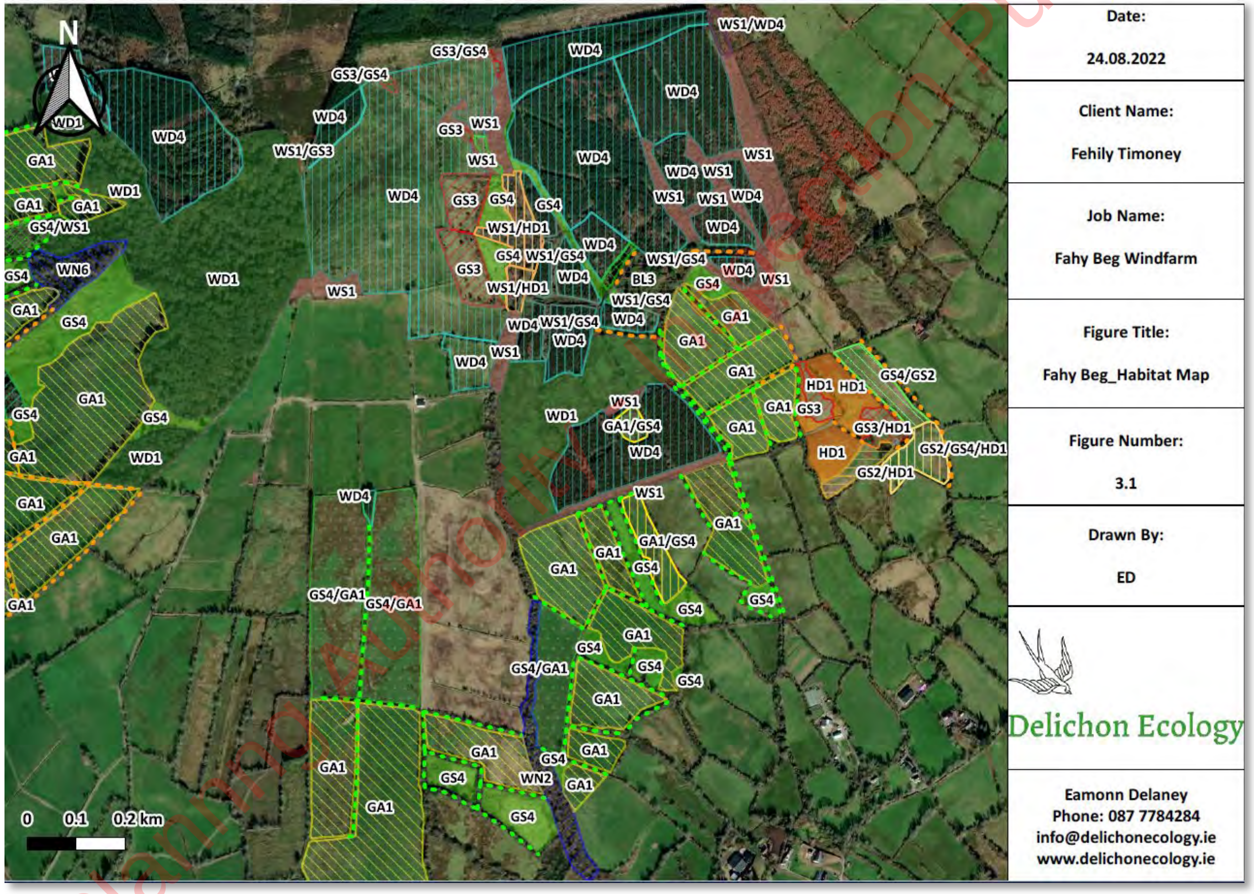

Figure 3-1 - Habitat Map – Eastern section of the study area

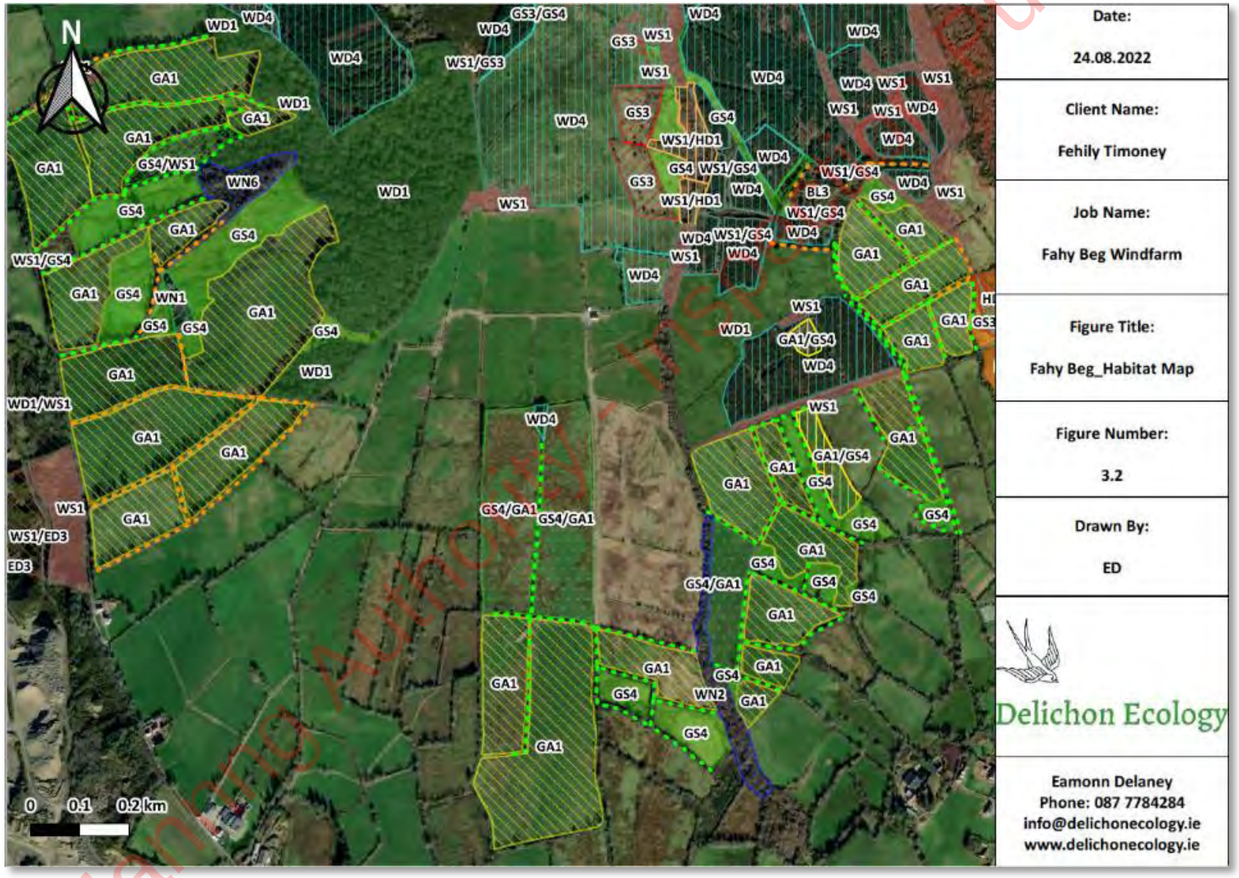

Figure 3-2 - Habitat Map – Centre of the proposed study area

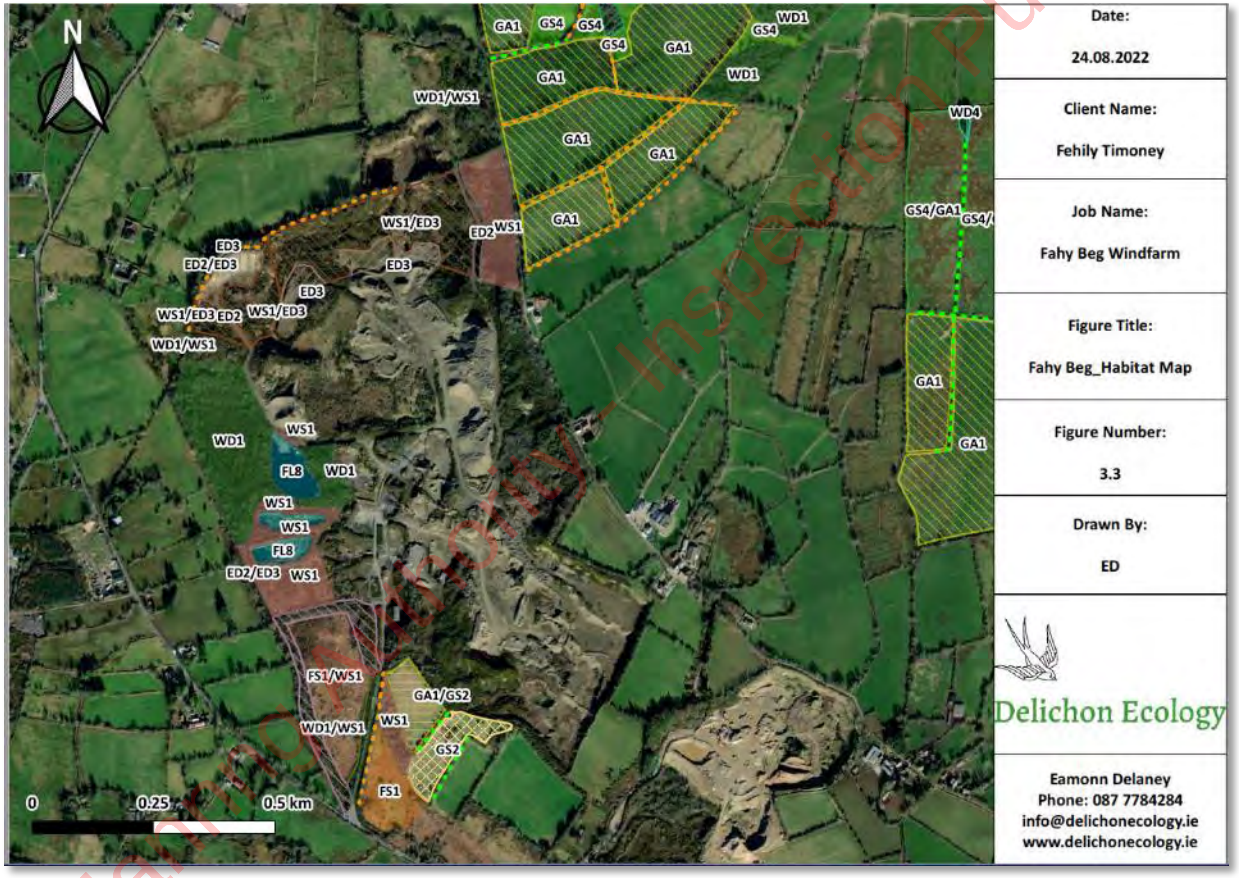

Figure 3-3 - Habitat Map – West of the proposed study area

Figure 3-4 - Habitat Map – Legend

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 8.3

BAT/OTTER GCR SURVEYS REPORT

FAHY BEG WIND FARM GRID CONNECTION

Bat and Otter surveys at selected watercourse crossings

Version: 15th December 2022

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1. INTRODUCTION

Following initial surveys of the finalised grid connection route for the proposed Fahy Beg Wind Farm, it was identified that five watercourse crossings required further surveys for bats and otter.

Ecofact were commissioned to carry out these further surveys which included bat and otter surveys at the selected crossing points along the grid connection. Surveys for Otter holts or any other signs of Otter activity to 150m up and downstream of crossing points were completed. Visual inspections for bats including borescope surveys were completed at these five bridge sites. This was completed by Dr William O'Connor under **Licence No.: DER/BAT 2022-107 (survey licence).**

Follow up emergence surveys were subsequently completed at two of the bridge sites where signs of bat usage were recorded.

This report concerns the n=5 crossings along the proposed grid route, detailed in Table 1 and Figure 1.

Table 1 Location of the n=5 subject bridge crossing sites.

Bridge number	Crossing description
1	Pipe culvert on L3056 beside McDonagh Motors Unmapped stream – considered be unmapped upstream section of the Athlunkard stream which is mapped as emerging from south side of Ardnacrusha headrace
2	Bridge on R465 over Glenlon South stream (crossing upstream of aquatic survey site 12)
3	Bridge on R465 over Blackwater River (crossing downstream of aquatic survey site 13)
4	Bridge on R471 over Glenomra wood stream
5	Bridge over Bridgetown (Clare) stream on R466.

The surveys were completed during September 2022 on behalf of Fehily Timoney and Company.

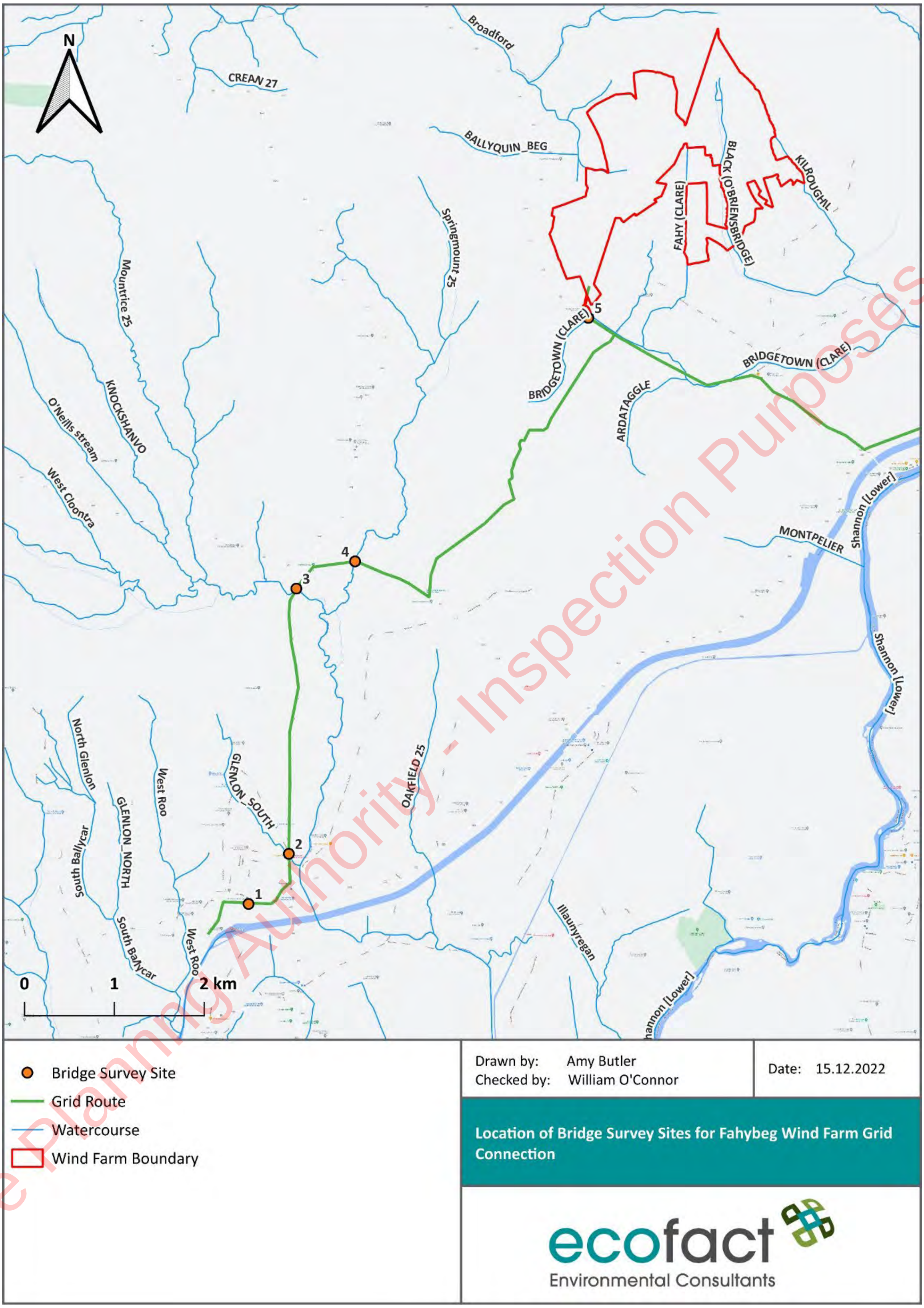

Figure 1 Location of the n=5 subject bridge crossing sites.

2. METHODOLOGY

Ecofact were commissioned to carry out these further surveys which included bat and otter surveys at the selected crossing points along the grid connection Visual inspections for bats including endoscope surveys were completed at these five bridge sites. Follow up emergence surveys were subsequently completed at two of the bridge sites where signs of bat usage were recorded.

Otter surveys were undertaken as a visual assessment of signs of Otter activity with reference to the Chanin (2003) manual. Surveys for Otter holts or any other signs of Otter activity were completed up to 150m up and downstream of the crossing points.

The bat survey methodology initially involved a daytime assessment. The methodology followed that of Billington and Norman (1997) and a rating as follows was provided for each bridge site.

- 0 = no potential (no suitable crevices)
- 1 = crevices present may be of use to bats
- 2 = crevices ideal for bats but no evidence of usage
- 3 = evidence of bats (e.g., bats present, droppings etc.)

Certain factors such as the presence of cobwebs in crevices on the bridge, or low profile of the structure, indicates that active bat use is unlikely. If bat potential was not ruled out the bridge was carefully examined for evidence of use which may present in the form of actual bats present in crevices (examined with a borescope), bat droppings, urine staining, grease marks (oily secretions from glands) and claw marks. Where bats were found or bat-use could not be ruled out, an emergence survey was completed.

Emergence surveys were completed at two bridge sites, and this involved a dusk to two hours after survey using handheld detectors.

3. RESULTS

3.1 *Bat surveys*

3.1.1 *Daytime bat surveys*

The daytime bat surveys were completed on the 19th and 20th September 2022. The results and outcome of the surveys are summarised in Table 1.

The bridge at Site 1 was too low and had no access / potential for bats. This bridge was rated as '0 = no potential' under the Billington and Norman (1997) scheme. The bridge at Site 2 had potential and bats were confirmed present in the bridge. Two unidentified *Myotis* sp. bats were observed in a large crevice just inside the upstream face of the bridge. There were other suitable crevices, but no other bats were seen. The Bridge at Site 3 is very high, and it was not possible to access the cervices to use a borescope. There were a number of suitable crevices, and they were examined from under the bridge with a close focusing binoculars. It was considered that the crevices showed signs of usage with no cobwebs present on some of the crevices and signs of possible staining. Bridge 4 had crevices suitable for use by bats, but no bats were found during the survey and no signs of bats were recorded in any of the crevices. Some vegetation clearance had recently taken place at this site. Bridge 5 was not considered to have suitable habitat for bats. The bridge is too low, and cervices are limited. No bats or bat signs were recorded during the survey. Due to the poor access and low height of the bridge it is assessed as being unsuitable for bats.

Emergence activity surveys were recommended for Sites 2 and 3, due to the presence of bats at Site 3 and the fact that bridge 3 had bat potential but the crevices could not be surveyed.

3.1.1 Emergence bat surveys

The emergence survey at Bridge 2 was undertaken on the 29th of September 2022. This was a cool night at the end of the survey season, but it was a dry night and suitable for the survey work.

Prior to the emergence survey at Bridge 2 the bridge was checked again, and no bats were recorded. The emergence survey was undertaken from 30 mins before dusk until two hours after and no bats were recorded emerging from the bridge. The bridge is a confirmed bat roost however, but it is just not used every night and is only used by a small umber of bats, and indeed just two bats were recorded. The bats present are considered likely to be Natterer's bat, but this could not be confirmed. During the survey both Common and Soprano Pipistrelles were active in the area.

The emergence survey at Bridge 3 was also undertaken on the 29th of September 2022. The emergence survey was undertaken from 30 mins before dusk until two hours after. This bridge was confirmed to be a Soprano Pipistrelle roost. The number of bats that emerged from the bridge was c.5 individuals. A small number of Daubenton's bats were also recorded at this site later in the survey. It is not thought that they emerged from the bridge but were recorded foraging on the river.

3.2 Otter surveys

The Otter surveys were also completed on the 19th and 20th September 2022. Water levels were low and there had been no significant rain in preceding days. Conditions were therefore ideal for the survey. The results and outcome of the surveys are summarised in Table 1, and discussed below,

Bridge Site 1 was also assessed as having no Otter potential. This stream / drain was visibly polluted and is too small to contain fish or provide any habitat for Otters. The watercourse at Bridge Site 2 is also too small to contain fish / be of interest to Otters. No signs of Otter activity were recorded. The River Blackwater at Bridge Site 3 is an important salmonid watercourse and has optimum Otter habitat present. Otter signs we recorded upstream of the bridge with footprints present on sand on left bank of the river c.50m upstream of the bridge. There were also Otter footprints in an exposed sand /silt deposit under the bridge. A suspected Otter slide/couch was recorded c.100m downstream of the bridge. Otters appeared to enter the water here sliding though vegetation. However, it was not very active. No spraints were recorded. No holts were present, but Otters are using this site.

Otter activity was also recorded at Bridge Site 4. Suspected Otter footprints were recorded at the bridge and c. 50m downstream of the bridge. There are no holts again, but Otters are active at this site.

The watercourse at Site 5 does not provide habitat for fish and it is very unlikely that Otters would use this site. There is a large wetland area upstream of the bridge. There are no Otter holts or important Otter features near this bridge. It is highly unlikely that Otters would use this site. area.

Table 1 Summary of the findings of the bat and otter surveys at selected bridges.

		Bats	Otters	Recommendations
1		No bats present. No bat potential. Rating = 0.	No otter signs recorded. No Otter potential.	None.
2		Bats present – two *Myotis* sp. bats recorded Other suitable crevices present. Rating = 3.	No otter signs recorded	Bats were present in the bridge in crevices during the daytime inspection. Emergence watch was completed but bats were not recorded. Treat as a confirmed minor bat roost.
3		Bat signs and potential. Bridge was too high to be surveyed using a borescope. Rating = 2.	Otter activity and potential slide / couch / holt 100m d/s of bridge	The arch was too high for an inspection, so an emergence watch was completed. Confirmed as a Soprano Pipistrelle roost. Otters active at the site, but no holts or other features at bridge.
4		No bats present but has potential. Rating = 2.	Otter signs recorded (footprints, spraints)	Bats could use this bridge on other nights, but no signs were found – only potential. Otters active here but no holts, slides etc.
5		No bats, no potential. Rating = 0.	No Otter signs	None.

3. CONCLUSIONS AND RECOMMENDATIONS

The Otter and Bat surveys were completed at the five subject bridge sites in September 2022. No specific recommendations or mitigation for bats or Otters is required at Bridges 1 and 5.

Bridge 2 is a confirmed minor bat roost and unidentified Myotis bats, possibly Natterer's bat, was recorded roosting in the bridge on the first visit. During the emergence watch no bats were recorded using the bridge. This is a minor roost and before works take place on the bridge it will be necessary to obtain a derogation licence. This would allow the disturbance of any bat(s) present. Installing the grid connection route is unlikely to affect the long-term use of the bridge by bats as long as the existing crevices are maintained. However, it is recommended to instal a bat box at this site to compensate for the disturbance and secure the site for bats. A 1FF Schwegler Bat Box is recommended.

Bridge 3 is a confirmed minor Soprano Pipistrelle bat roost (c.5 individuals). During the emergence watch bats were recorded emerging from this bridge. This is a minor roost and before works take place on the bridge it will be necessary to obtain a derogation licence. This would allow the disturbance of any bat(s) present. Installing the grid connection route is unlikely to affect the long-term use of the bridge by bats. However, it is recommended to instal two bat boxes at this site to compensate for any disturbance, and as this is an ideal high arch bridge which would benefit from bat boxes. Two 1FF Schwegler Bat Boxes are recommended. The works on this bridge should ideally be undertaken during the October to April period.

In relation to Otters, no recommendations are made for bridge 2 as Otters are not likely to use this watercourse. The River Blackwater at Site 3 is an important Otter habitat – but there are no holts or other features near the bridge. Otters are moving upstream and downstream here foraging. There was a suspected couch/slide located approximately 100m downstream of the bridge. But there is no holt here and this feature was not very active. The bridge is so high here that any works on the bridge deck or sides of the bridge would not have any implications for Otters. Otters are also using the river at Site 4 but there are no holts of other sensitive Otter features present. Access for Otters under the bridge would need to be maintained during the works, especially at night. But otherwise, Otters would not be affected by works here.

REFERENCES

Billington, G. E. and Norman, G. M. (1997). *The conservation of bats in bridges project: a report on the survey and conservation of bat roosts in bridges in Cumbria*. Kendal, English Nature.

Chanin, P. (2003) Monitoring the Otter (Lutra lutra). Conserving Natura 2000. Rivers Monitoring Series No 10, English Nature, Peterborough.

PLATES

Plate 1 Bridge Site 1 was assessed as having no bat potential; it is too low for bats to use and has no suitable crevices / access.

Plate 2 Bridge Site 1 was also assessed as having no Otter potential. This stream / drain was visibly polluted and is too small to contain fish or provide any habitat for Otters.

Plate 3 Bridge Site 2 was assessed as having bat potential and bats were present at the time of the survey.

Plate 4 Unidentified *Myotis* sp. bats present in one of crevices at Bridge Site 2.

Plate 5 Underneath of Bridge Site 2. This is a minor roost at most with limited other crevices present and only one bat was recorded.

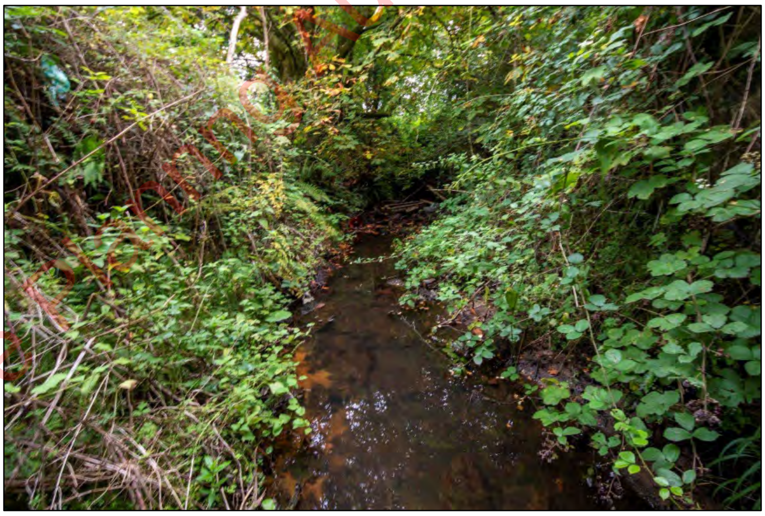

Plate 6 The watercourse at Bridge Site 2 is too small to contain fish / be of interest to Otters. No signs of Otter activity were recorded.

Plate 7 The River Blackwater at Bridge Site 3 is an important salmonid watercourse and has optimum Otter habitat present.

Plate 8 Bridge Site 3 had bat potential also but was too high to survey the crevices.

Plate 9 The River Blackwater at Bridge Site 3 is an important salmonid watercourse and has optimum Otter habitat present. Otter signs were recorded in the survey section upstream of the bridge.

Plate 10 The River Blackwater has optimum Otter habitat present. Otter signs were also recorded in the survey section downstream of the bridge.

Plate 11 Potential Otter slide feature located 100m downstream of Bridge Site 3.

Plate 12 Signs of Otter activity recorded near Bridge Site 3.

Plate 13 Bridge Site 4 had some suitable crevices and bat potential. However, no bats or signs of bat usage were recorded during the survey.

Plate 14 The watercourse at Bridge Site 4 provides Otter habitat and signs of Otter activity were recorded.

Plate 15 Signs of Otter activity recorded at Bridge Site 4.

Plate 16 The bridge at Site 5 was rated as being unsuitable for bats. No signs of bats or Otters were recorded.

Plate 17 The watercourse at Bridge Site 5 is too small I contain fish / be of interest to Otters. No signs of Otter activity were recorded.

Plate 18 Wetland area upstream of the bridge at Site 5. The presence of any Otter holts was ruled out.

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 8.4

BAT REPORT

BAT SURVEY REPORT TO INFORM THE PROPOSED

FAHY BEG WIND FARM, CO. CLARE

Results of the 2020 and 2021 active bat seasons and habitat suitability assessments

Report prepared by Woodrow APEM Group

Report by:

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August 2022

DOCUMENT CONTROL

Document	Bat Survey Results Report for the Proposed Fahy Beg Wind Farm, Co. Clare. 2020 - 2021
Client	RWE
Prepared by	Woodrow APEM Group, Upper Offices, Ballisodare Centre, Station Road, Ballisodare, Co Sligo, F91 PE04, Ireland.
Report Compiled by	Oisín O Sullivan (Ecologist)
Checked Internally	Róisín NigFhloinn
Approved by	Mike Trewby
Status / Version / Date	Final Draft / D05 / 03.11.2022

STATEMENT OF AUTHORITY

Bat surveys conducted at Fahy Beg over 2020 and 2021 were undertaken by appropriately experienced staff from Woodrow APEM Group ('Woodrow'), and site visits for surveying and static deployments were supervised by specialist bat surveyors including: Oisín O Sullivan, Sara Fissolo, Aoife Moroney, Louise Gannon, Rachel Irwin, Kristi Leyden, and Mike Trewby. Trainee bat surveyors were also employed under supervision and included Nicole Fleming, Patrick Devereux and Joe Kelly. Manual verification of bat sonograms, data analysis using Ecobat and reporting, was undertaken by Oisín O'Sullivan, Sara Fissolo, and Louise Gannon. The report was compiled by Oisín O'Sullivan and has been reviewed Róisín NigFhloinn.

Oisín O'Sullivan is an Ecologist with Woodrow. Oisín has completed a B.Sc. in Ecology and Environmental Biology at University College Cork. His final year thesis involved bat surveys of urban habitats in Cork City. His work is focused on bat data analysis including bat call identification and bat roost/habitat suitability surveys. Oisín has developed a high level of proficiency with Kaleidoscope, Ecobat and BatExplorer, the analysis software used to assess bat calls and activity. In addition, Oisín has experience in marine and freshwater habitat surveying from his time studying at UCC. Since joining Woodrow, Oisín has written multiple bat activity reports and coordinates the bat surveys for all sites, including several largescale windfarm sites. Oisín is a Qualifying member of Chartered Institute of Ecology and Environmental Management (CIEEM) and holds a license to survey bat roosts from the Department of Culture Heritage and the Gaeltacht.

Sara Fissolo, Seasonal Bat Surveyor with Woodrow. Her main experience lies in carrying out preliminary bat roost assessments and she is competent when undertaking emergence/re-entry bat survey and activity surveys for bats and reporting on the same. She also carries out bat call analysis using Kaleidoscope and BatExplorer software. Sara holds a license to survey bat roosts from the Department of Culture Heritage and the Gaeltacht. She is a qualifying member of CIEEM, and a member of Bat Conservation Ireland (BCI).

Aoife Moroney is an Assistant Ecologist with Woodrow. She has completed a B.Sc. in Engineering at University College Dublin and M.Sc. in Environmental Engineering (specialising in Environmental Management) at the Technical University of Denmark and the Royal Institute of Technology, Sweden. She is currently undertaking a Post-graduate Certificate in Ecological Survey Techniques at the University of Oxford. She has also been involved with multiple conservation and research projects in southern Africa. Aoife has developed a high level of proficiency with Kaleidoscope, Ecobat and BatExplorer, the analysis software used to assess bat calls and activity. She is the process of applying for membership of the CIEEM and holds a license to survey bat roosts from the Department of Culture Heritage and the Gaeltacht.

Louise Gannon is a graduate ecologist with Woodrow. Louise has completed a B.Sc. in Environmental Science. Her main experience lies in carrying out emergence/re-entry bat survey and activity transect surveys for bats, deployment of static bat detectors and reporting on the same. She also carries out bat call analysis using Kaleidoscope and BatExplorer, the analysis software used to assess bat calls and activity. Louise was also developing expertise in conducting roost searches of buildings, bridges and trees under the supervision of licenced members of Woodrow staff - Oisín O'Sullivan and Sara Fissolo.

The report has been reviewed by Róisín NigFhloinn. Róisín is an Associate Director with Woodrow. She has completed an undergraduate degree in Natural Sciences at Trinity College Dublin, specialising in Botany, and M.Sc. in Ecology and Management of the Natural Environment at the University of Bristol, England. She is a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM). She regularly carries out review and assessment for Ecological Impact Assessment, Biodiversity Chapters for Environmental Impact Assessment (EIA) and to inform the Appropriate Assessment (AA) process for both largescale and smaller scale development projects. Róisín has more than 12 years' experience in habitat surveys, mammal surveys, bird and bat surveys for a number of large infrastructure schemes, commercial and residential projects.

Kristi Leyden has over five years' experience working as an ecological consultant in Ireland and the UK. During this time, she has led botanical surveys (National Vegetation Classification, Phase 1 habitat, rare plants, invasive alien species) as well as undertaking national scale botanical surveys and assessments of range of Annex I habitats. She has also carried out protected species surveys including bats (preliminary roost assessment, emergence/re-entry and activity surveys), otter, badger, red squirrel and herptofauna (great crested newts and reptiles). Kristi has worked on a wide range of developments, some of which include wind farms, overhead power lines, gas lines, hydro schemes, quarries and commercial and residential developments. Kristi is experienced in producing baseline reports and has undertaken Appropriate Assessment screenings, NIS and inputted into Ecological Impact Assessments.

Rachel Irwin was a graduate ecologist at Woodrow and spent two seasons coordinating PRF surveys for bats, emergence/ re-entry roost surveys, transects and deployment of static bat detectors for numerous large wind farms sites in both the Republic of Ireland and Northern Ireland; as well as other developments including quarries and smaller residential projects. Rachel has developed expertise in conducted roost searches of buildings, bridges and trees under the supervision of licenced members of Woodrow staff. During her time at Woodrow, Rachel has become accomplished at manually identification of bat sonograms utilising Kaleidoscope and BatExplorer. Towards end of each active bat season, she was responsible for compiling bat reports. She also assists senior members of staff with reporting for Ecological Impact Assessment (EcIA), Biodiversity Chapters for Environmental Impact Assessment Reports (EIAR) and to inform the Appropriate Assessment (AA) process. She is a Qualifying member of the Chartered Institute of Ecology and Environmental Management (CIEEM).

Mike Trewby is Principal Ecologist with Woodrow and is the company's field work manager. He is an experienced ecologist with over 20 year's fieldwork and research experience. He is a full member of the CIEEM and conducts detailed, technical ecological assessments of projects including for wind farm and quarry developments, as well as for other large and smaller scale infrastructure and development projects, delivering ecological reporting to a high standard. He has developed his technical expertise in conducting faunal surveys to inform detailed impact assessment and compliance monitoring reports.

Nicole Fleming is a BSc graduate of Freshwater and Marine Biology with 3 years' experience working in the construction industry. With this background she was hired by Woodrow Sustainable Solutions as a graduate ECoW. Nicole also assists in many surveys (bats, birds and habitats), data collection and analysing, this allowing her to be an all-rounder in assisting her senior colleagues in all projects. Nicole's skills range from identification of marine and freshwater species, water and soil analysis, GIS, excel and statistical programmes to knowledge working alongside construction projects allowing her to liaises with project leaders and supervisors on where to enforce mitigation measures and delivering inductions and tool box talks to contractors and workforce with the purpose of ensuring that ecological and environmental impacts are being avoided.

Patrick Devereux is a BSc graduate in Applied Freshwater and Marine Biology. He has also completed courses in bird ID and classification. Working with Woodrow he has been heavily involved with bird surveys. Since beginning work, he has gained experience in bats surveys accompanying more experienced staff on transect and roost surveys.

Joe Kelly has a degree in Wildlife Biology and Environmental science and also qualified with a Diploma in Management & QA Engineering. He has experience across a variety of sectors both public and private. He is a lifelong birdwatcher with excellent bird identification skills and a wide range of bird survey experience also has experienced in assisting bat surveys.

CONTENTS

1 INTRODUCTION

1.1 Protected status of bats in Ireland

Bats are protected by law in the Republic of Ireland under the Wildlife Act 1976 and subsequent amendments (2000 and 2010). Under the Wildlife Act, it is an offence to intentionally disturb, injure or kill a bat or disturb its resting place. Under this legislation it is unlawful to destroy, alter or disturb known bat roosts without an appropriate derogation licence, as issued by the National Parks and Wildlife Service (NPWS).

All bat species fall under Annex IV of the EU Habitats Directive (1992), whereby member states have a burden of responsibility to protect bats and their resting places wherever they occur. The EU Habitats Directive has been transposed into Irish law with the European Communities (Birds and Natural Habitats) Regulations 2011. The lesser horseshoe bat (*Rhinolophus hipposideros*), which occurs only in Counties Cork, Kerry, Limerick, Clare, Mayo and Galway in the Republic of Ireland, is listed in Annex II of the EU Habitats Directive 1992. The level of protection offered to the lesser horseshoe bat effectively means that areas important for this species are designated as Special Areas of Conservation (SACs). For remaining bats, the EU requires that they are strictly protected. Among Ireland's obligations under the Habitats Directive, is the obligation to 'maintain favourable conservation status' of Annex-listed species.

Ireland has ratified two international conventions, which afford protection to bats amongst other species. These are known as the 'Bern' and 'Bonn' Conventions. The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982) exists to conserve all species and their habitats, including bats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries, which covers certain species of bat.

1.2 Requirements for impact assessment

In order to comply with the requirements of the EU Habitats Directive 1992 and the EC Habitats Regulations 2011, wind farm applications in Ireland need to be assessed as to their potential impact on bat populations. To inform the impact assessment at the proposed Wind Farm Site a range of bat surveys were undertaken including a desk-based study and field surveys. As of 2021 the appropriate methodological approach for assessing bat population on proposed wind farm sites is *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* (SNH *et al*., 2019, updated 2021).

1.3 Outline of the scope of works

This report considers the proposed Fahy Beg Wind Farm (**Figure 1**), providing details on the methodologies and results of bat surveys undertaken to investigate the bat usage and habitat suitability of the wind farm site.

In compliance with SNH *et al*. (2019, as updated 2021) guidelines, static bat recording equipment was deployed three times at selected locations representative of the proposed turbine layout for the Wind Farm Site. The three deployments each lasting a minimum of 10 nights covered the spring, summer and autumn active season for bats and were undertaken in conjunction with continuous monitoring of climatic conditions on the site to ensure recording windows were inline within compliant weather parameters.

Informed by an assessment of potential bat roost features within the proposed wind farm site, manual roost emergence/re-entry surveys and bat activity transects were undertaken. The observations recorded during roost emergence/re-entry survey and bat activity surveys contextualise how bats utilise the proposed wind farm site.

1.4 Layout of report

This report was written to serve as a technical results report to be included within the Environmental Impact Assessment Report (EIAR) for the Fahy Beg Wind Farm Site. It provides details of methodologies and survey effort for the suite of bat surveys conducted for the proposed development, including tabulated results, maps and charts, as well as reports from roost suitability surveys, bat activity surveys and seasonal static bat detector surveys. These surveys allow for the baseline bat populations and habitat suitability of the proposed development to be described and to facilitate and inform a robust impact assessment. A preliminary impact assessment for bats is provided for the proposed wind farm site, including the sub-station and access track through the Roadstone quarry. Impact on bats associated with the grid connection route and turbine transport route are assessed separately within the EIAR.

1.5 Limitations & issues pertinent to interpretation of bat survey results

In the case of bat surveys, survey limitations often relate to weather conditions at the time of the surveying and equipment failing in the field, for example microphones can be damaged by livestock or can lose sensitivity when exposed to prolonged episodes of heavy rainfall.

The following sections provide details for any potential limitations to bat surveys conducted in 2020 and 2021. Overall, it considered that the combined survey approach and coverage over the 2020 and 2021 survey seasons, provides robust data from which a full insight into the use of the proposed development by bats can be obtained. As such, this information can be used to assess the potential impacts of the proposed wind farm development on the local bat population. Given the survey methodologies used to ensure full coverage of proposed development across the bat activity season 2020/2021, it is considered that the data obtained complies, in full, with the recommend guidelines set out within *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* (SNH *et al*. 2021). Please note that the NIEA guidance document NIEA, Natural Environment Division (2022) *Guidance on Bat Surveys, Assessment & Mitigation for Onshore Wind Turbine Developments* was first released during August 2021, towards the end of the final survey season. Applying this guidance, survey effort is compliant to the guidance for a medium risk site.

1.5.1 Coverage

At the time of deployment turbine locations were known to be subject to change and detectors were placed with the intention of producing the best coverage of potential turbine locations. For the most part, detectors placed at provisional turbine locations remained within approximately 100m of revised turbine locations with the exceptions of D.02 and D.06.

In 2020 D.02 was positioned on a treeline adjacent to a field of pasture and was located *c*. 150m to the south of the proposed turbine location, while in 2021 the detector was positioned within the open field, closer to the proposed turbine location.

In 2020 the location of D.06 was *c.*73m away from the associated proposed turbine location and in 2021 the detector was *c.*204m from the proposed turbine location due to changes in site layout. However, it is situated in a very similar environment to the proposed turbine location, on plantation edge lined with young broadleaf treelines, in close proximity to improved grassland. It is also a similar approximate distance from the river running north of south to the east of both locations (*c.*100m to D.06 in 2021). Given that the proposed turbine location is within conifer plantation, while during 2021, D.06 sits on the interface of plantation to open field and is closer to the river, it is considered that the activity recorded at D.06 in 2021 will likely be higher than the activity that would be recorded at the associated proposed turbine location.

1.5.2 Livestock

During the 2020 survey season in Fahy Beg two detectors had to be moved due to livestock interference. Detectors at D.04 and D.07 were both moved in between the spring and summer deployments. Throughout the report, for the initial spring deployment these detectors are referred to as D.04a and D.07a, while subsequent deployments are referred to as D.04b and D.07b. The location of D.07b is *c.*40m from D.07a and remains within *c.* 80m of the proposed turbine location. The distance from D.04a to D.04b is *c.* 50m however the detector was moved closer to the proposed turbine location. During the 2021 survey season there was only one detector movement. The detector at D.07 was moved for the autumn deployment after the fence protecting the detector location was breached by livestock. The relocations of these detector are shown in **Figure 4** and **Figure 5**, while the coordinates of the different locations are provide in **Table 2** and **Table 3**.

Areas holding features of moderate and high roost potential were identified in the west of the site. However, there was limited access during the survey season due to the presence of a bull in the field adjacent to this area of woodland, which limited the number of emergence/re-entry surveys that could be undertaken. Specifically in the case of the large tree with PRFs, including butt rot, at R 63212 70779. For this tree a roost inspection with an endoscope was carried out during the active bat season. Based on the final site layout this tree lies on the edge of the precautionary 300m zone of influence buffer around turbines (**Figure 1**) and will not be removed as part of the proposed development, therefore the lack of emergence/re-entry surveys is not considered to be limit the baseline data.

1.5.3 Equipment

Equipment failures/technical issues in 2020 was limited to the following four detectors over the course of the survey:

- The detector at D.02 during the spring deployment suffered a technical issue in which the data files were corrupted and recorded bat calls were rendered unidentifiable.
- The context detector at D.09 during the spring deployment stopped recording on night 5 of its deployment, likely due to increased battery drain from recording high activity.
- The detector at D.04b during the summer deployment stopped recording after 8 nights likely due to the battery draining faster as a result of high activity being recorded there.
- The detector at D.06 during the autumn deployment suffered a data corruption issue and produced no data.

Despite these technical issues its is considered that that the data collected during this survey remains robust and compliant with SNH *et al.* (2021). Limitations were mitigated by the use of two additional context detectors per deployment, which exceeds the minimum number of detectors required, as stipulated by the SNH *et al.* (2021) guidelines, along with an extended duration in deployment period during the summer deployment (17 to 18 nights recorded on nine detectors)

During the 2020 active season the weather station was placed in a sheltered location to avoid interference from livestock. Therefore, the wind speeds recorded are considered to below the actual wind speeds likely to be experienced across more open areas within the site. For this reason, the weather analysis in **Baseline conditions** investigating bat activity relative to weather conditions did not include weather data from 2020.

For added protection from wildlife and livestock, the weather station installed on the site in 2021 was placed behind the client's fencing, used also to protect their Lidar equipment. This was along a conifer plantation edge in a gap between the plantation and a treeline, bordering improved grassland. Subsequently, it is considered that the wind speed measurements recorded in 2021 were potentially lower than those experienced on the site as a whole. For this reason, the 2021 wind speed recordings are presented using the highest wind speed recorded per hour rather than the mean value, as it is considered that this provides a more accurate context for wind speeds experienced on the site, when compared to data collected from Shannon airport historical data (available on request). This also produces a more precautionary model for the bat activity relative to conditions figure displayed in **Baseline conditions**.

As can be seen in **Appendix 3: Weather** Data, there also appears to be multiple one-to-two-hour periods during the autumn 2021 deployment for which the weather station did not record, and the reason for this could not be ascertained. However, a probable cause is the increase in night duration in autumn, and the weather station being unable to charge fully using its solar panel. This was surmised as the gaps in data most frequently occurred in the last few hours prior to sunrise of the next day (05:00 and 06:00).

Figure 1 - Proposed turbine locations and potential 300m zone of influence

2 METHODOLOGY

Pre-planning surveys for bats at proposed wind farm sites aim to identify the species occurring within the proposed development area, and to provide an understanding of how local bat populations utilise the area in terms of density of use for foraging, roosting (maternity and hibernation) and social interactions. This information allows for the identification and assessment of the potential impacts the proposed development is likely to have, and for appropriate avoidance and/or mitigation measures to be implemented as part of the design phase of the project.

Bat surveys were conducted by Woodrow at Fahy Beg over the 2020 and 2021 active bat seasons to ensure compliance with the most recently published guidelines pertaining to bat surveying, impact assessment and mitigation for bats at onshore wind turbines (SNH *et al*., 2021). This guidance document supersedes some aspects of the previous guidelines (Collins, 2016 updating Hundt, 2012 & BCI, 2012) and requires a site-by-site approach to survey design, with the only prescriptive element being the positioning, number and duration of static bat detector deployments, as well as the strongly recommended continual monitoring of site-specific weather data on rainfall, temperature and wind speeds.

As a minimum, the latest SNH *et al*. (2021) guidelines require three deployments of static detectors aimed at covering spring (April to May), summer (June to mid-August) and autumn (mid-August to October), each with a minimum deployment period of 10 nights (within compliant weather parameters). Seasonal deployments of static detectors are set out at all potential turbine locations for proposals comprising ten or less turbines, with a third of any additional locations also covered up to a maximum of 40 detectors. Compliant weather conditions are defined as: temperatures at ≥ 8°C at dusk, maximum ground level wind speed of 5 m/s and no, or only very light, periodic rainfall.

Additional requirements of the SNH *et al*. (2021) guidelines include swarming surveys, and winter roost inspections if potential hibernation roosts are identified. Transect and/or vantage point surveys are seen as methods used to complement the static detector surveys, with applicability being discretionary, based on professional judgement, and on a case-by-case site-specific basis.

2.1 Desk study and site investigation

A desk-based review of habitat availability in the environs of the proposed development, and the available bat data was used to inform the scope of the bat surveys required. As recommended by both BCI (2012) and SNH *et al*. (2021) the area covered by the desk-based review was extended to 10 km surrounding the wind farm site. The desk-based study included:

- Reviewing distances from closest Natura 2000 sites designated for bats (the only bat SACs in Ireland are for lesser horseshoe bat *Rhinolophus hipposideros*).
- Examining aerial imagery and 6-inch maps to identify potential bat foraging and roosting habitats.
- Lundy *et al*. (2011) provides a high-level assessment of potential habitat suitability for different species of bat occurring in Ireland.
- Review of data received from BCI within 10 km of the wind farm site and the results of Biodiversity Maps report for the 10-km squares covering the site [R66 & R67], including species recorded and known roosting sites.

2.2 Roost assessment surveys

The most recent guidelines (SNH *et al*., 2021) recommend that "*features that could support maternity roosts and significant hibernation and/or swarming sites (both of which may attract bats from numerous colonies from a large catchment) within 200 m plus rotor radius of the boundary of the proposed development should be subject to further investigation*".

Turbine specification, as well as locations are regularly altered during the design phase of projects, and as a precaution Woodrow conduct roost assessment surveys within 300 m of the potential build area. Features along the access tracks between turbines (within *c.*30 m) were also assessed for roost features. Wide reaching roost and foraging habitat assessment of the wind farm site were undertaken during March 2020, as part of a scoping exercise.

Surveyors utilised the assessment criteria described in Collins (2016) – see Page 35, Table 4.1, which provides guidelines for assessing potential suitability of habitat features as bat roosts and for foraging bats. This allows surveyors to assign features, a 'negligible', 'low', 'moderate' or 'high' status in terms of their potential for bats, i.e., the presence of Potential Roost Features (PRFs). Based on the features present and the location of the trees or other structures, the potential use of the feature can also be considered, and classified (as in Hundt, 2012):

- Maternity (breeding roost);
- Summer / transitional (to include transitional, occasional, satellite, night and day roosts); and,
- Hibernation roost.

Surveyors initially employed non-invasive external and internal inspection techniques for any building encountered, and trees were assessed from the ground.

If deemed appropriate full building/tree inspections can be undertaken under licence from NPWS and would include inspecting any potential hibernation roosts. Based on the findings of PRF surveys roost inspections were required at the buildings of a derelict farmstead [52.784666, -8.528396] and a mature beech tree with severe butt rot [52.787075, -8.546137], as shown in **Figure 7**. Three of the buildings within the abandoned farmstead have potential for hibernation roosts.

Though outside the zone of influence for roosts (300m turbine buffer) a house on an organic farm to the south of the site had a bat roost highlighted to Woodrow by the owners and further surveys were conducted on this building.

Based on the findings of the roost assessment surveys features classed as having moderate to high suitability for bats and/ or demonstrating likely occupancy, (e.g., dropping found) were targeted for further bat activity surveys, including dusk emergence/dawn re-entry surveys. As outlined in **Section 1.5.2** areas to the west of the site were not subject to this due to the presence of livestock. As outlined above, a roost inspection was conducted on the tree with severe butt rot during the active bat season on the 13-May-2021. However, this tree is on the very edge of the precautionary zone of influence buffer (**Figure 1**) and will not lie within a 200m buffer to blade tip (SNH *et al*. 2021) and will not be removed as part of this development.

In the preliminary roost potential survey in 2020 the long-established beech woodland was highlighted as a constraint as it contains many trees of 'moderate' roost potential with the occasional presence of 'high' potential features within the woodland. Sample areas were assessed in more depth employing the use of a thermal imaging camera and those with features accessible to surveyors were examined with an endoscope. Emergence and re-entry surveys were also conducted on the best examples of moderate potential trees found during this sampling exercise, as shown in **Figure 8**. Given the high number of moderate PRFs distributed throughout the long-established woodland, it was not feasible to assess every tree. This sampling exercise allows for the roost potential for the woodland as a whole to be characterised, which then facilitates an assessment of the potential impact and proposals for appropriate mitigation to be formulated.

2.3 Roost emergence/re-entry surveys

As summarised in **Table 1**, multiple dusk emergence/dawn re-entry surveys were completed in both 2020 and 2021, typically prior to or after undertaking walkover (transect) surveys of the site. The locations of emergence/re-entry surveys is shown in **Figure 8**. Transect and dusk emergence/dawn re-entry surveys were undertaken using Elekon Batlogger M bat detectors to collect geo-referenced records of bat activity, which were then analysed using BatExplorer. During the June survey a Wildlife Acoustics EM3 detector was also used, and the data from this detector was analysed using Kaleidoscope. **Appendix 1: Roost survey** locations contains images of the features surveyed.

2.4 Winter roost inspections

SNH Guidelines (SNH *et al*., 2021) recommend that winter roost surveys should also be carried out for any potential hibernation roost within 200m plus rotor radius of developable area. The survey was conducted on the 04-Mar-2021, within the timeframe in which bats would still be hibernating. Surveys involved searching for and collecting bat faecal samples, closer examination of roost potential, and the use of a thermal imaging camera. The following structures/features of high roost potential (see **Figure 8**) and judged to have potential for occupation as a winter roost were examined:

- A derelict cottage and surrounding buildings of the abandoned farmstead in the east of the site. [52.784621, -8.528125]
- A beech tree, with severe butt rot in the west of the site. [52.7868704, -8.54610011]

2.5 Bat activity surveys – walked/driven transects

The SNH *et al.* (2021) guidance considers the application of transect surveys to be discretionary, with survey requirements designed on a site-by-site basis. Transects are complementary to data collected from static bat detectors; and are important for identifying flight lines and for gaining understanding of bat abundance within the survey area. Driven transects can provide useful information on the wider landscape in the vicinity of the proposed development site. If driven transects are undertaken, it is important that appropriate microphones are used and are directed above the vehicle. It is also important to remain at a constant low speed (< 10 km/h). Point counts (of a fixed duration) can be incorporated into transects to survey specific features to provide information on comparative density of use.

Four transects were completed in 2020. Five transects were completed in 2021, which included coverage of the proposed sub-station and site access track through the Roadstone quarry. Survey dates and weather conditions for transects conducted in 2020 and 2021 are provided in **Table 1**, with the transect routes illustrated **Figure 2** and **Figure 3**, for 2022 and 2021, respectively .

Field records were made of bat species encountered, number of bat passes, activity (where known: e.g., foraging, commuting, advertising), travelling direction and approximate height (where known). Temperature and wind speed were measured at intervals throughout the survey. Batloggers recorded temperature throughout the surveys.

Table 1 - Summary of emergence and transect survey effort

Date	Start time	End time	Location	Survey type	Weather Conditions
11-Jun-2020 Sunset: 21:59	21:18	23:25	52.784621, -8.528125	Emergence Survey - At abandoned farmstead on the eastern side of the site, *ad hoc* observation that wind increased throughout the survey duration. (K. Leyden)	Wind: 3km/h, S Temp: 12° - 14° Precipitation: Dry
12-Jun-2020 Sunset: 22:00	21:55	00:43	Figure 2	Transect Survey - Walked transect, first half of transect conducted in the centre of the site, second half of transect conducted moving north in the eastern side of the site (K. Leyden)	Wind: 3km/h, ESE Temp: 13° - 14° Precipitation: Dry
31-Jul-2020 Sunset: 21:26	20:44	22:36	52.784621, -8.528125	Emergence Survey - At abandoned farmstead on the eastern side of the site (M. Trewby)	Wind: 3kmp/h, SE Temp: 13° - 14° Precipitation: Light rain
	22:41	23:51	Figure 2	Transect survey - Walked transect from abandoned farmstead to the farmhouse, driven transect from the farmhouse to the west of the site with a walked perimeter transect of the field between T1 and T2 (M. Trewby)	Wind: 3 km/h Temp: 13° - 14° Precipitation: Light rain
18-Aug-2020 Sunset: 20:52	20:26	21:57	52.776226, -8.522304	Emergence Survey - The eastern facing side of the farmhouse in the east of site (N. Fleming)	Wind: 2km/h Temp: 16° - 18° Precipitation: Dry
	20:35	22:05	52.784621, -8.528125	Emergence survey - Abandoned farmstead in the east of the site. (A. Moroney)	Wind: 2km/h Temp: 16° - 18° Precipitation: Dry
	22:05	23:35	Figure 2	Transect survey - Walked transect in the east of the site with a driven transect to the south of the site (A. Moroney)	Wind: 2km/h Temp: 16° - 18° Precipitation: Dry
01-Sep-2020 Sunset: 20:20	20:20	21:00	52.776226, -8.522304	Emergence survey - The western facing side of the farmhouse on the eastern side of the site (J. Kelly)	Wind: 3km/h Cloud: Overcast Temp: 18° Precipitation: Dry
	20:30	21:57	Figure 2	Transect survey - Walked transect on the track north from the farmhouse (A. Moroney)	Wind: 3km/h Cloud: Overcast Temp: 18° Precipitation: Dry
13-May-2021 Sunset: 21:20	21:11	22:50	52.782603, -8.543186	Emergence survey – Butt rot “mushroom” tree at the southern end of Beech woodland (O. O Sullivan & P. Devereux).	Wind: 10km/h Temp: 10° Precipitation: Dry
	22:50	00:20	Figure 3	Transect survey – Walked and driven transect of field with T2 and adjacent fields to the south and west along with connecting road. (O. O Sullivan & P. Devereux)	Wind: 10km/h Temp: 10° Precipitation: Dry
23-Jun-2021 Sunset: 22:02	21:45	23:26	52.784621, -8.528125	Emergence survey – Abandoned farmstead, one surveyor on derelict farm house and another on adjacent derelict cattle shed. (O. O Sullivan & S. Fissolo).	Wind: 0km/h Temp:14° Precipitation Dry:
	23:36	00:53	Figure 3	Transect survey – Walked transect of track to abandoned farmstead. Short driven transect. Walked transect in the fields southwest of T4. (O. O Sullivan & S. Fissolo).	Wind: 0km/h Temp:14° Precipitation Dry
24-Jun-2021 Sunrise: 05:11	03:44	05:26	52.784621, -8.528125	Re-entry survey – Abandoned farmstead, derelict house. (O. O Sullivan & S. Fissolo).	Wind: 0km/h Temp: 12° Precipitation: Dry
12-Jul-2021 Sunset: 21:57	22:00	23:23	52.785244, -8.536020	Emergence survey – Ash tree in conifer plantation. (O. O Sullivan & A. Moroney)	Wind: 2km/h Temp: 17° Precipitation: Light Rain, stopped at 22:25

Date	Start time	End time	Location	Survey type	Weather Conditions
	23:23	01:20	Figure 3	Transect survey – Walked transect through conifer plantation, past abandoned farmstead and down dirt track in the east of the site, second section of walked transect through improved grassland in the south of the site (S. Fissolo & O. O Sullivan).	Wind: 2km/h Temp: 15° Precipitation: Dry
11-Aug-2021 Sunset: 21:10	20:55	22:35	52.784621, -8.528125 52.785084, -8.538532	Emergence survey – Derelict cottage in abandoned farmstead (O. O Sullivan & A. Moroney) Emergence survey – 2 mature beech trees in the Northeast of long-established beech woodland close to its border fence with conifer woodland (S. Fissolo & L. Gannon)	Wind: 0 km/h Temp: 13° Precipitation: Dry Temp: 14°
	22:40	23:30	Figure 3	Transect survey – Walked transect from abandoned farmstead through conifer plantation in the centre north of the site with a 15-minute point count on western limit of conifer plantation (O. O Sullivan & A. Moroney) Transect survey – Walked transect of long-established beech woodland and adjacent field (S. Fissolo & L. Gannon).	Wind: 0km/h Temp: 12° Precipitation: Dry
12-Aug-2021 Sunrise: 06:11	04:45	07:41	52.785244, -8.536020 52.782603, -8.543186	Re-entry survey – At the mature ash tree in a small clearing of conifer plantation (O. O Sullivan & A. Moroney). Re-entry survey – At mature beech tree with butt rot and complex internal mushroom growth (S. Fissolo & L. Gannon).	Wind: 0km/h Temp: 13° Precipitation: Dry
24-Aug-2021 Sunset: 20:43	20:22	23:03	Figure 3	Transect survey – Walked transect through quarry following grid connection route where possible (S. Fissolo & L. Gannon).	Wind: 6km/h Temp: 19° Precipitation: Dry
25-Aug-2021 Sunrise: 06:32	04:30	06:50	52.783645, -8.540876 52.783672 -8.5409	Re-entry survey – 2 mature beech trees in the long-established woodland (S. Fissolo & L. Gannon).	Wind: 6km/h Temp: 12.5° Precipitation: Dry
14-Sep-2021 Sunrise: 07:08	05:35	07:21	52.784293, -8.539199	Re-entry survey – 2 Mature beech trees in the long-established woodland (O. O Sullivan & P. Devereux).	Wind: 2.2km/h Temp: Temp: 19° Precipitation: Dry
28-Sep-2021 Sunrise: 07:29	05:57	07:45	52.784621, -8.528125	Re-entry survey – Derelict cottage in abandoned farmstead in the east of the site (O. O Sullivan & S. Fissolo)	Wind: 0km/h Temp: 12°C Precipitation: Dry

2.6 Static bat detector surveys

Static detector surveys were undertaken using Wildlife Acoustics Song Meters (SM2 and SM4) on three occasions covering spring, summer and autumn in 2020 and 2021. Static bat detectors were deployed to record the types of bat species present and to provide an overview of how bat activity is broadly distributed over the site and specifically at selected turbine locations.

In 2020 and 2021, static monitors were deployed on three occasions within the wind farm site. The location of all static detectors for each deployment in 2020 is shown in **Figure 4**, which also displays the movement of detectors from D.04a to D.04b and D.07a to D.07b between the spring and summer deployments. The location of all static detectors for each deployment in 2021 are shown in **Figure 5**. Each deployment included two context detectors; detectors used to sample specific habitat features rather than turbine locations. This provides further context to bat activity within the site to supplement and provide a comparison for the turbine locations, for example comparing bat activity along habitat features vs bat activity in open areas removed from features, emulating post-construction conditions around turbines.

In 2021 some of the detector locations were moved due to updated turbine layout being issued, while the labels were kept as the same general area was being surveyed. The following changes should be noted between **Figure 4** and **Figure 5**:

1. D.02 was moved to the adjacent improved grassland from a treeline along the field.
2. D.04 was moved to an open area of improved grassland from the adjacent treeline.
3. D.05 was moved from the ash tree in plantation to a treeline on plantation edge bordering gorse scrub.
4. D.06 was 174 m southeast but was adjacent to conifer plantation.
5. D.10 the context detector was moved from its position beside a stream and into the long-established beech woodland in the western part of the site.

2.7 Monitoring climatic of conditions

Monitoring climatic of conditions was undertaken through the deployment of an on-site fully automated weather station with 3G connectivity.

The Davis Vantage Vue wireless integrated sensor suite weather station deployed, provided data on a real-time basis. This allows weather station functionality to be checked on a daily basis during the survey season and for action to be taken if a station fails or there are concerns regarding the data. This obviates the need for a second (backup) weather station. The weather station collected the full range of weather data, including temperature, wind speed and rainfall, which allows surveyors to determine whether deployments nights were compliant with the prescribed weather parameters (≥ 8°C at dusk, max. ground level wind speed of 5m/s and minimal rainfall).

Deployment periods can then be adjusted to ensure 10 nights of compliant data are captured. In addition, site specific weather data can be useful for investigating the recorded patterns of site usage by bats, for instance exposed, open sites can receive an influx of foraging bats during nights that are warm and relatively still, especially towards the end of the summer and into the autumn, as bats disperse from maternity roosts (Woodrow per. obs.).

2.8 Calibration and testing of recording equipment

Calibration and testing of recording equipment is required by the SNH *et al*. (2021) guidelines, and as a standard operating procedure Woodrow have a stringent schedule of testing all bat recording equipment prior to and during deployment in the field. Checks are logged in excel, providing an audit trail to ensure that all data can be relied on and form a robust and defendable data set. Unique numbering of static detectors, SD cards and microphones allows for reverse checking, if any issues arise, e.g., following a microphone failure. Checks undertaken include pre-deployment device setting and battery checks, and post- and pre- deployment microphone sensitivity checks.

2.9 Analysis

For data collected using Song Meter 2s (SM2s) and Song Meter 4s (SM4s) analysis of sound recordings was undertaken using Kaleidoscope software to confirm species (or genus for *Myotis* species) and exact number of bat passes for each transect survey or deployment. For data collected using the Batloggers, analysis of sound recordings was undertaken using BatExplorer software. Russ (2012) and Middleton *et al*. (2014) were used to aid in identification of bat calls during data analysis.

All sounds files were run through auto-identification and then manual verification was undertaken by Woodrow operatives. The settings for signal detection used for analysis with Kaleidoscope are provided in **Appendix 2: Kaleidoscope Analysis** Settings. Recordings identified as noise were determined to fall outside of the recording parameters for the survey and were manually classified as noise. Common and soprano pipistrelles which Kaleidoscope determined to be a match ratio of 100% (every pulse recorded matched the species call parameters) were considered to be accurate to a level not requiring manual verification. Recordings in which multiple species were recorded were split into separate passes. The number of passes generated were considered synonymous with Registrations, as defined by Ecobat, which is considered to be species presence within a 15 second sound file. SNH *et al*. (2021) guidelines recommend using the online tool Ecobat to allow for a measure of relative bat activity using a ranking system by comparing the data collected with bat survey information collected from similar areas during similar times of year. Through correspondence with the UK mammal society, we learned that a Ecobat bases its median pass rates for pipistrelles classified to genus level on all pipistrelle species activity. In order to avoid complications with inflated median levels of pipistrelle activity the small number of calls which could only be classified to a genus level for pipistrelles were not included in the presentation of Ecobat analysis results for 2020. However, updates to the Ecobat app removed this problem in 2021 and those records are presented.

Up until recently, the reference system for Ecobat was strongly oriented on UK bat populations, and it was not clear whether reference data sets were relevant to Ireland. Comparative Irish data sets are now considered to have surpassed thresholds to allow for more robust assessments. Ecobat allows users to upload activity data and compare it to results within a reference range filtered by geographic location, time of year and the make of bat detector used. This generates robust reports tailored for a dataset's specific location, timeframe and equipment. The continued use of Ecobat improves its future accuracy as the data from each survey uploaded adds to their reference database (Lintott *et al.* 2017). There is potential for Ecobat to overestimate activity levels based on a lower level of its use on the island of Ireland. The effect of this is not possible for us to quantify as we do not know to what level other surveyors or consultancy are using the analysis software. It is considered however, that the 2021 results are more accurate estimations of median activity levels given that the 2020 data provides a baseline for the analysis.

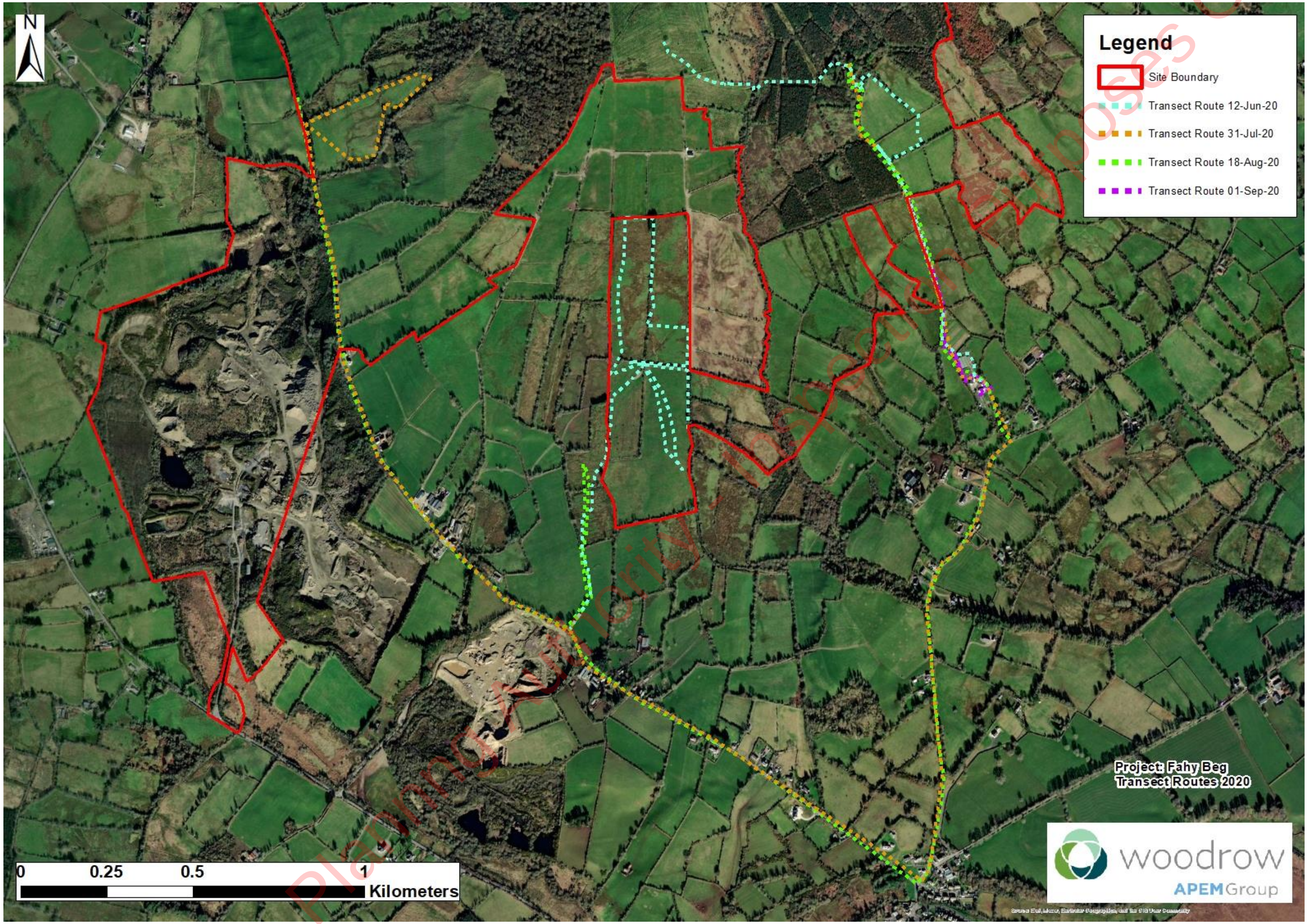

Figure 2 - Transect routes surveyed 2020

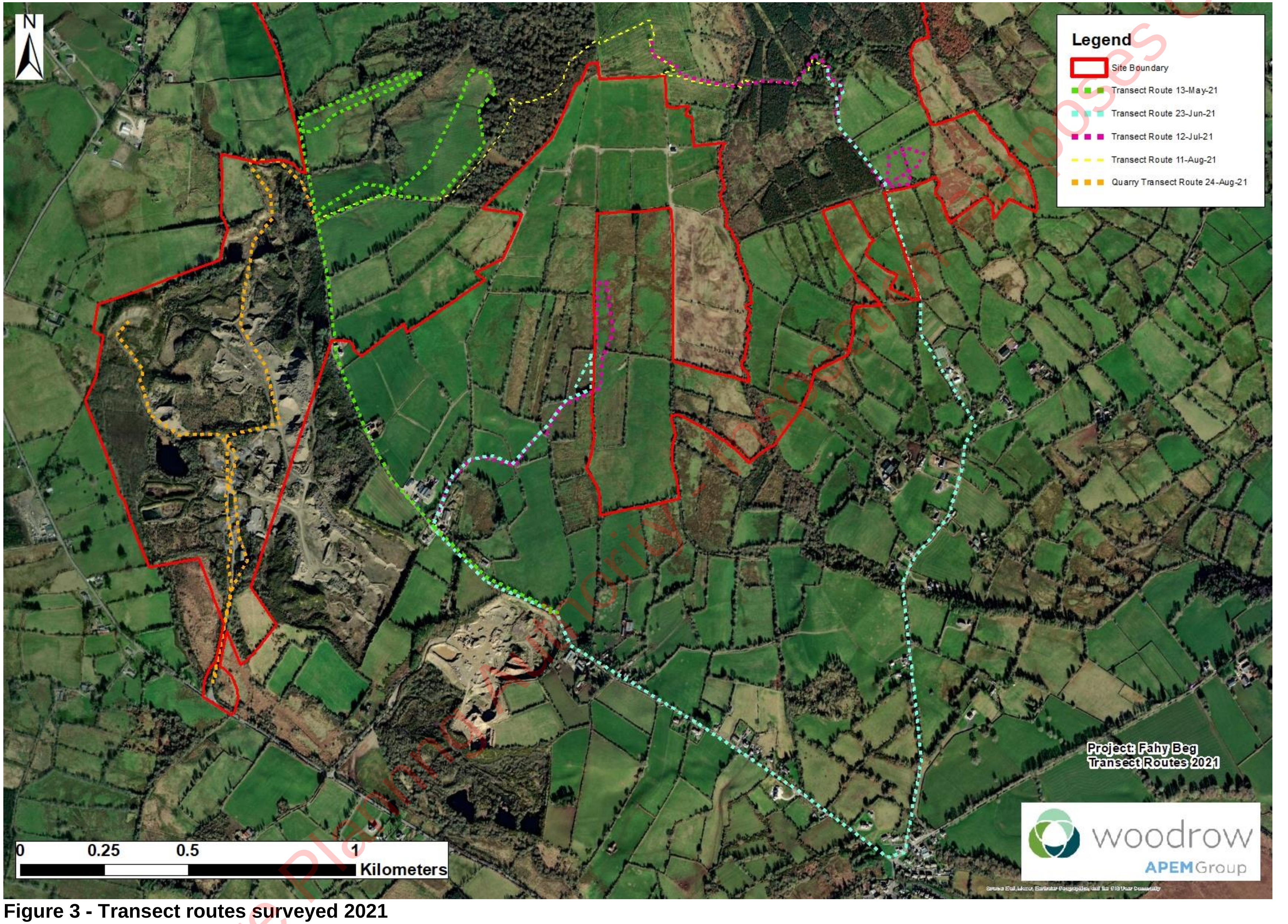

Figure 3 - Transect routes surveyed 2021

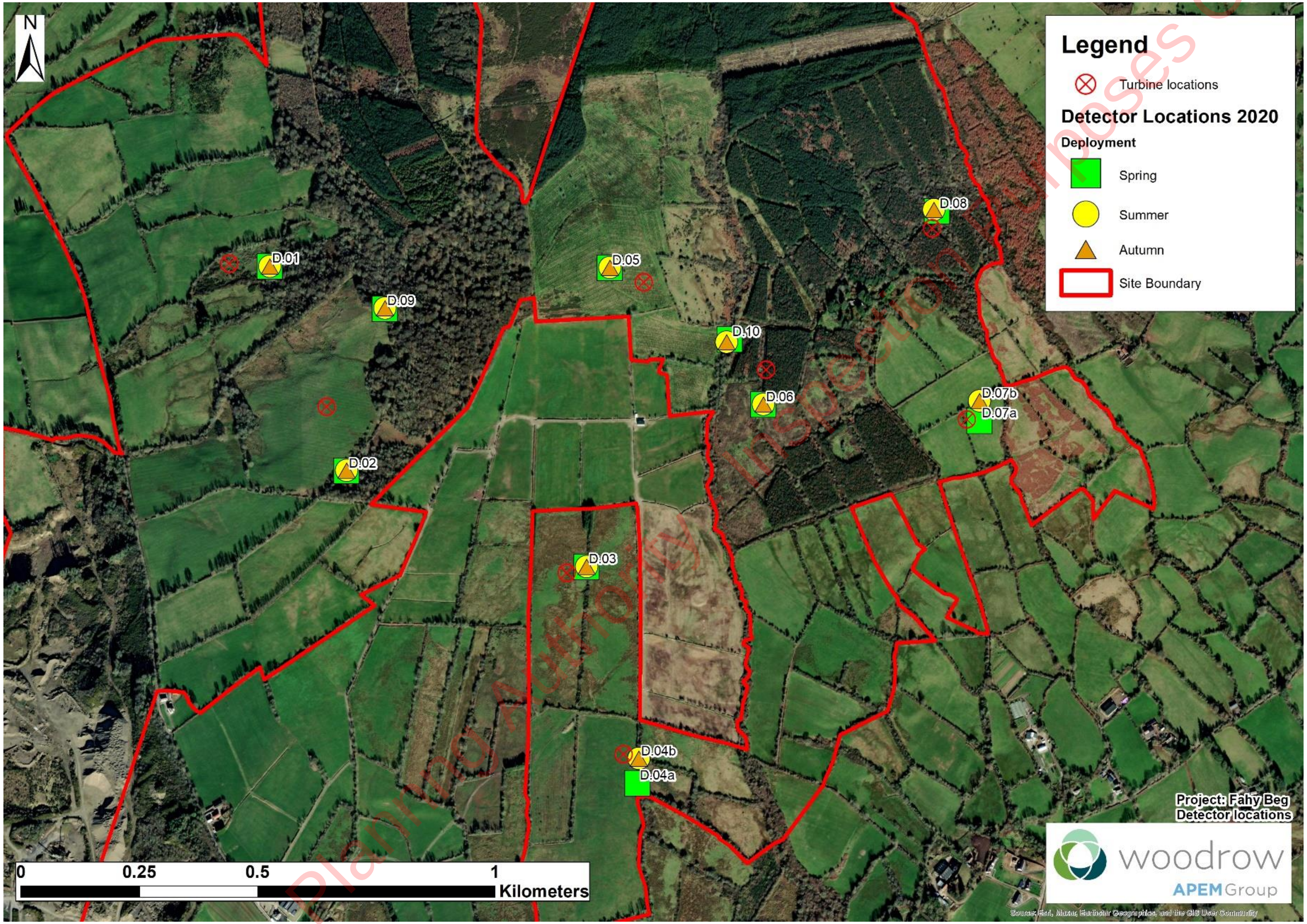

Figure 4 - Static detector deployment locations 2020

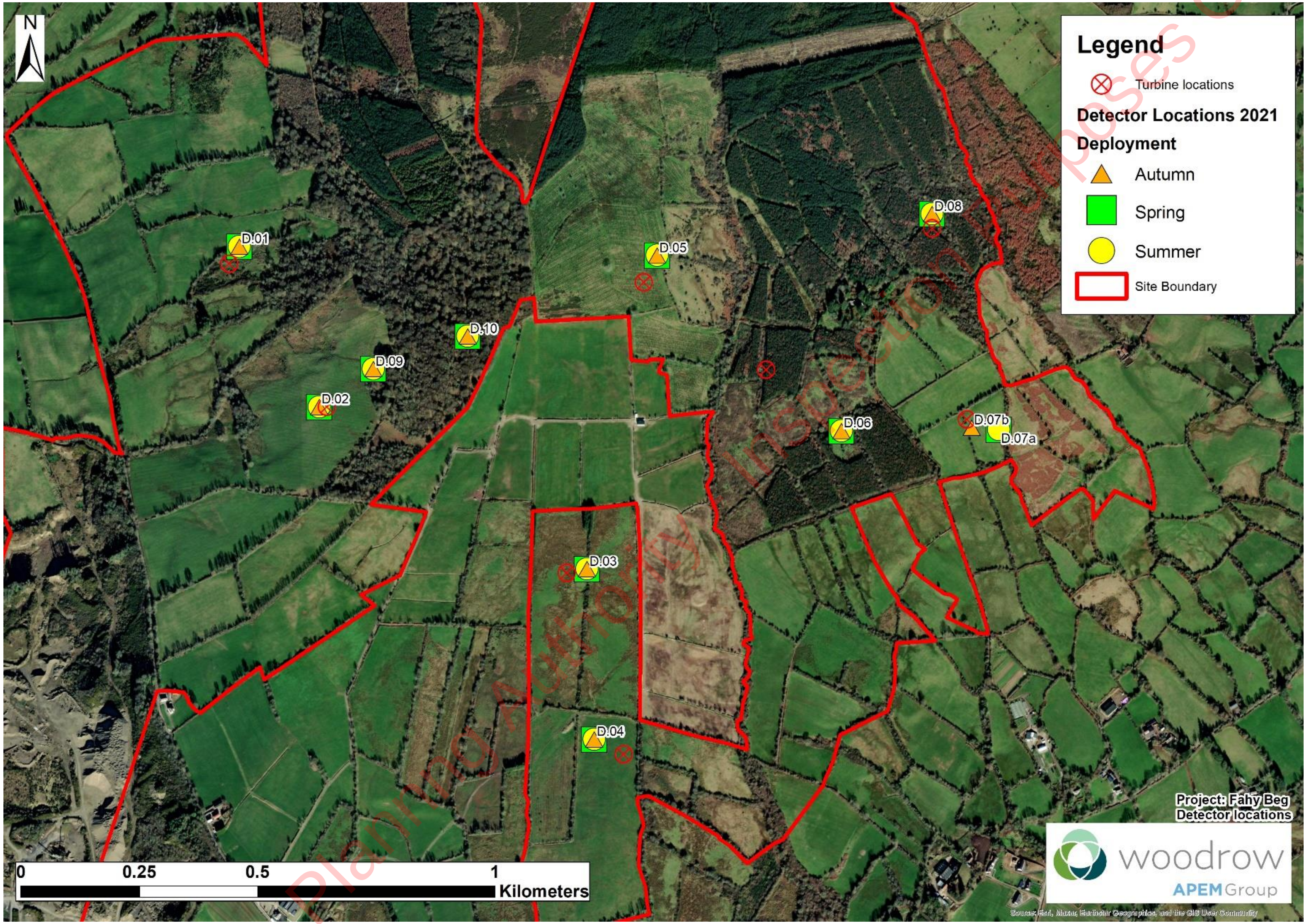

Figure 5 - Static detector deployment locations 2021

Table 2 - Static detector survey effort 2020

Map ID	Latitude	Longitude	Associated feature	Spring Deployment 25-May-2020		Summer Deployment 31-Jul-2020		Autumn Deployment 01-Sep-2020	
				Unit	Run time	Unit	Run time	Unit	Run time
D.01	52.78523	-8.54662	On ash tree to north of turbine location	WSS036	17 Nights (8894min)	WSS033	17 Nights (11111min)	WSS046	16 Nights (12074 min)
D.02	52.78135	-8.54417	On large semi-mature broadleaf c east of tracks along hedgerow	WSS038	No Data	WSS035	17 Nights (11111min)	WSS043	16 Nights (12074 min)
D.03	52.77957	-8.53664	On hawthorn on edge of grazing field	WSS039	17 Nights (8894min)	WSS024	17 Nights (11111min)	WSS050	16 Nights (12074 min)
D.04a	52.77548	-8.53499	On tree in hedgerow on side of grazing field	WSS028	17 Nights (8894min)	n/a	n/a	n/a	n/a
D.04b	52.77594	-8.53497	On oak tree in hedgerow/ treeline along old road and adjacent to field	n/a	n/a	WSS040	8 Nights (5110min)	WSS044	16 Nights (12074 min)
D.05	52.78525	-8.53598	On ash tree in middle of clearing between young conifer plantation.	WSS034	17 Nights (8894min)	WSS030	18 Nights (11734min)	WSS048	15 Nights (11330min)
D.06	52.78267	-8.53115	On young willow at edge of plantation in small clearing	WSS025	16 Nights (8416min)	WSS054	18 Nights (11734min)	WSS047	No Data
D.07a	52.78239	-8.52439	In open field c 70m from hedgerow	WSS023	17 Nights (8894min)	n/a	n/a	n/a	n/a
D.07b	52.78277	-8.52439	In hedgerow surrounded by improved grassland	n/a	n/a	WSS026	18 Nights (11734min)	WSS045	16 Nights (12074 min)
D.08	52.78636	-8.52576	In alder tree on edge of small clearing between plantations	WSS027	17 Nights (8894min)	WSS052	18 Nights (11734min)	WSS049	16 Nights (12074 min)
D.09	52.78444	-8.54300	Approximately 5m into beech woodland adjacent to improved grassland - open understorey beneath canopy of trees and next to small stream	WSS037	4.5 Nights (2194min)	WSS029	17 Nights (11111min)	WSS042	13 Nights (9654min)
D.10	52.78390	-8.53222	In sycamore adjacent to stream and ride between young plantation and wooded stream valley	WSS031	17 Nights (8894min)	WSS053	18 Nights (11734min)	WSS041	16 Nights (12074 min)

Table 3 - Static detector survey effort 2021

Map ID	Latitude	Longitude	Associated feature	Spring Deployment 13-May-2021		Summer Deployment 23-Jun-2021		Autumn Deployment 13-Sep-2020	
				Unit	Run time	Unit	Run time	Unit	Run time
D.01	52.78559	-8.54757	On an ash tree in treeline and area of gorse and bramble to the east and improved grassland to the west	WSS028	12 Nights (6917min)	WSS053	18 Nights (9233min)	WSS025	14 Nights (10597min)
D.02	52.78256	-8.54503	In improved grassland with long-established beech woodland *c.* 100m north	WSS035	12 Nights (6917min)	WSS037	18 Nights (9233min)	WSS052	14 Nights (10597min)
D.03	52.77953	-8.53663	Hawthorn treeline	WSS053	12 Nights (6917min)	WSS031	18 Nights (9233min)	WSS028	14 Nights (10597min)
D.04	52.77630	-8.53636	Fenced off in improved grassland	WSS027	12 Nights (6917min)	WSS035	18 Nights (9233min)	WSS034	14 Nights (10597min)
D.05	52.78548	-8.53451	On corner of hawthorn treeline edge of conifer 30m west	WSS036	12 Nights (6917min)	WSS036	18 Nights (9233min)	WSS038	14 Nights (10597min)
D.06	52.78218	-8.52871	On young tree adjacent to the ring for opening and conifer shelter belt	WSS033	12 Nights (6917min)	WSS055	18 Nights (9233min)	WSS037	14 Nights (10597min)
D.07a	52.78223	-8.52379	In improved grassland *c.*6m from deep drainage ditch	WSS055	12 Nights (6917min)	WSS033	18 Nights (9233min)	n/a	n/a
D.07b	52.78226	-8.52463	On a hawthorn treeline in the centre of improved grassland	n/a	n/a	n/a	n/a	WSS030	14 Nights (10597min)
D.08	52.78631	-8.52592	On tall fallen tree in clearing between conifer plantation	WSS031	12 Nights (6917min)	WSS051	18 Nights (9233min)	WSS032	14 Nights (10597min)
D.09	52.78329	-8.54335	On treeline edge of long-established woodland, interface to improved grassland containing D.02	WSS037	12 Nights (6917min)	WSS052	18 Nights (9233min)	WSS040	14 Nights (10597min)
D.10	52.78392	-8.54041	In long-established beech woodland	WSS029	12 Nights (6917min)	WSS028	17 Nights (8733min)	WSS033	7.5 Nights (6040min)

3 SURVEY RESULTS

This section provides the detailed results for bat surveys conducted during the 2020 and 2021 survey periods. These survey results are summarised in **Baseline conditions**. **Appendix 1: Roost survey** locations provides additional context with plates illustrating locations at which emergence and re-entry surveys were conducted.

3.1 Desk based study

A data request was submitted to BCI for known roost records within 10km of the site. A total of 41 bat records were provided of which 16 were bat roosts. The closest roost to the site is within 1km (this was surveyed by Woodrow and originally highlighted through a BCI data request). With the exception of this roost, all BCI roost records are approximately ≥5km from the site. The BCI data shown in **Table 4** shows bat data recorded in transect and ad hoc surveys with distances from site provided, and that indicates eight species have been recorded in the environs, including:

Common pipistrelle	*Pipistrellus pipistrellus*
Soprano pipistrelle	*Pipistrellus pygmaeus*
Leisler's bat	*Nyctalus leisleri*
Brown long-eared bat	*Plecotus auritus*
Daubenton's bat	*Myotis daubentonii*
Natterer's bat	*Myotis nattereri*
Whiskered bat	*Myotis mystacinus*
Lesser horseshoe bat	*Rhinolophus hipposideros*

The only Natura 2000 sites designated for bats in Ireland are for lesser horseshoe bats (*Rhinolophus hipposideros*). The area of interest in Co. Clare/Co. Limerick is within the potential range for this species. The closest Special Areas of Conservation (SAC) for this species is Danes Hole, Poulnalecka Cave (000030) of which the eastern most point lies *c.* 8.5km of the western most point of the site. The site synopsis for Poulnalecka Cave SAC notes that this SAC is considered to be one of the eastern most points of the species range. Two further SACs are situated both *c.*13km - 14km west of the site, the Ratty River Cave SAC (002316) and Kilkishen House SAC (002319). The locations of these SACs buffered for lesser horseshoe foraging range (core sustenance zones) are shown relative to the site in **Figure 6**. The foraging range (core sustenance zone) for lesser horseshoe bats from maternity roosts is approximately 2.5km and seasonal movements between summer and winter roosts reported as 5 to 10km (Collins *et al.* 2016). This places the proposed development site within the potential zone of influence of lesser horseshow bat populations ecologically linked to SACs designated for this species.

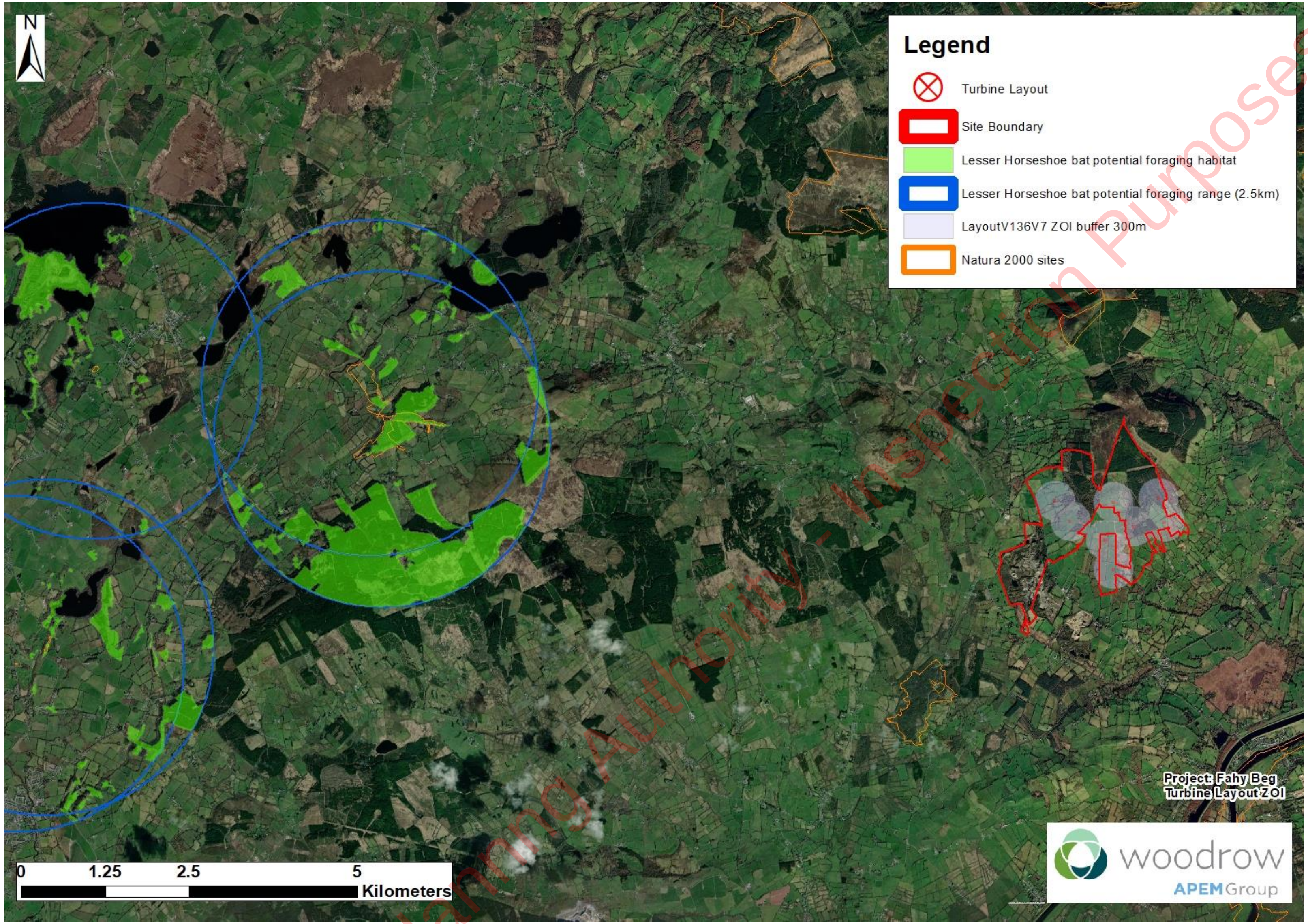

Figure 6 - Fahy Beg relative to the 3 lesser horseshoe bat (LHS) SACs buffered by 2.5km core sustenance zone with potential LHS foraging habitat shown

Table 4 - BCI Roost and Survey data within 10km of the site

Roosts			
Name	***Dist. from buildable turbine envelope centre***	***Species observed***	
Private	*c.* 5.7km	*Pipistrellus pipistrellus; Pipistrellus pygmaeus; Pipistrellus spp.*	
Private	*c.* 5km	*Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus; Plecotus auritus*	
Private	*c.* 5km	*Nyctalus leisleri; Pipistrellus pipistrellus ; Pipistrellus pygmaeus; Pipistrellus spp.*	
Private	*c.* 4.8km	*Pipistrellus pipistrellus; Pipistrellus pygmaeus; Pipistrellus spp.*	
Private	*c.* 7km	*Nyctalus leisleri*	
Private	*c.* 5.5km	*Plecotus auritus*	
Private	*c.* 8.5km	*Rhinolophus hipposideros*	
Private	*c.* 8.3km	*Unidentified bat*	
Private	*c.* 5.7km	*Myotis mystacinus/brandtii; Myotis natterreri; Nyctalus leisleri; Pipistrellus pygmaeus; Pipistrellus spp.; Plecotus auritus*	
Private	*c.* 9.5km	*Species data not provided*	
Private	*c.* 9.6km	*Pipistrellus pygmaeus; Plecotus auritus*	
Private	< 1km	*Plecotus auritus*	
Private	*c.* 5km	*Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus; Unidentified bat*	
Private	*c.* 10km	*Myotis spp.; Plecotus auritus; Rhinolophus hipposideros*	
Private	*c.* 5.7km	*Myotis daubentonii*	
Tree Roost; R494 Ballina - Birdhill	*c.* 6km	*Pipistrellus pipistrellus; Pipistrellus pygmaeus*	
Transects Survey data			
Name	***Dist. from buildable turbine envelope centre***	***Species***	
Errina Bridge	*c.* 5km	*Myotis daubentonii;Unidentified bat*	
Killaloe Town Centre Transect	*c.* 5.7km	*Myotis daubentonii;Unidentified bat*	
O Briensbridge Transect	*c.* 4km	*Myotis daubentonii;Unidentified bat*	
Rockvale Bridge Transect	*c.* 10km	*Myotis daubentonii*	
Ad-hoc observations			
Survey	***Dist. from buildable turbine envelope centre***	***Species***	***Date***
BATLAS 2010	*c.* 9km	*Myotis daubentonii; Pipistrellus pipistrellus*	10/09/2009
BATLAS 2010	*c.* 5km	*Pipistrellus pygmaeus*	10/09/2009
BATLAS 2010	*c.* 3.7km	*Pipistrellus pygmaeus*	28/07/2008
BATLAS 2010	*c.* 9.5km	*Myotis daubentonii; Pipistrellus pipistrellus*	10/09/2009
BATLAS 2010	*c.* 6.7km	*Myotis mystacinus/brandtii; Nyctalus leisleri*	10/09/2009
BATLAS 2010	*c.* 8.6km	*Myotis daubentonii; Nyctalus leisleri; Pipistrellus pygmaeus*	10/09/2009
BATLAS 2010	*c.* 6.5km	*Myotis daubentonii; Nyctalus leisleri*	10/09/2009
BATLAS 2010	*c.* 2.6km	*Myotis spp.; Pipistrellus pipistrellus; Plecotus auritus*	28/07/2008
BATLAS 2010	*c.* 6.9km	*Myotis daubentonii; Nyctalus leisleri; Pipistrellus pygmaeus*	10/09/2009
BATLAS 2010	*c.* 3.1km	*Myotis daubentonii; Nyctalus leisleri*	28/07/2008
BATLAS 2010	*c.* 11.7km	*Myotis daubentonii; Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus; Unidentified bat*	09/10/2009
BATLAS 2010	*c.* 4.3km	*Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus*	15/07/2009
EIS Survey	*c.* 11km	*Pipistrellus pipistrellus; Pipistrellus pygmaeus*	19/09/2005
EIS Survey	*c.* 10.1km	*Pipistrellus pipistrellus; Pipistrellus pygmaeus*	19/04/2007
EIS Survey	*c.* 6.3km	*Pipistrellus pygmaeus*	13/04/2000
EIS Survey	*c.* 3.8km	*Pipistrellus pygmaeus*	17/07/2005
EIS Survey	*c.* 7km	*Myotis daubentonii; Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus*	16/06/2009
EIS Survey	*c.* 7km	*Myotis daubentonii; Pipistrellus pygmaeus*	08/05/2007
EIS Survey	*c.* 7km	*Nyctalus leisleri; Pipistrellus pygmaeus*	03/05/2012
EIS Survey	*c.* 7km	*Myotis spp.; Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus; Plecotus auritus*	02/05/2012
EIS Survey	*c.* 6.5km	*Myotis spp.; Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus*	24/05/2011

3.2 Bat habitat and roost suitability assessment

Based on Lundy *et al*., (2011) habitat suitability index, the overall suitability for the two 5x5 km squares which the wind farm site is spread between have been scored as holding moderate/high suitability for all bat species combined. For individual species it was ranked as having moderate/high suitability for common pipistrelle, brown long-eared bats, and natterer's bat. Leisler's bat and soprano pipistrelles scored moderate to high on the suitability index while Daubenton's bats scored moderate to high. Whiskered bats scored moderate/low on the index. Suitability for Nathusius' pipistrelle and lesser horseshoe bats was ranked as low for both species.

The habitat within the wind farm site is comprised of improved grassland, conifer plantation, and long-established beech woodland. The detector locations D.01 and D.02 are in the western side of the site on edge. D,01 is situated on a treeline connected to the western side of the mature beech woodland while D.02 is situated in a field of improved grassland with the beech woodland to its north and west. D.05, D.06, and D.08 are situated in or adjacent to conifer plantation to cover proposed turbines within the plantation.

Preliminary surveys of potential roost features found several structures of moderate or higher potential roost within the site, some of which lie within the 300m turbine Zone of Influence for bats. **Figure 7** shows the following roost features classed as moderate and higher within the site:

- Structures at the abandoned farmstead were determined to vary from low (ruins with no rooves, overgrown and relatively exposed) to high roost potential (abandoned house and stable with many entry points and crevices features). Some mature beech trees surrounding these ruins have butt rot roost features though suitability is lowered as they are hollowed completely making them more exposed from above. [52.784666, -8.528396]
- The farmhouse currently in use within a kilometre to the south of the site contained a known roost in the BCI database. [52.776226, -8.522304]
- The long-established beech woodland on the west side of the site contained many trees which were of moderate and in some cases high roost potential, however, the initial survey of this area was not exhaustive as each individual tree could not be surveyed. For this reason, the area has been classified as "Moderate*" [area can be seen in **Figure 7**]
- Mature hawthorn treeline with dense ivy, rot holes, and tree unions. This treeline is connected to the long-established beech woodland [52.78365503, -8.55159133 to 52.78593174, -8.54623464].
- A tree with severe butt rot considered to be of high roost potential was found in the most north western point of the beech woodland. [52.787075, -8.546137]
- A mature ash tree with knot holes, cankers, and transverse snaps, classed as having moderate roost potential in a clearing within conifer plantation in the north of the site. [52.78525, -8.53598]

Table 5 - Summary of bat habitat and roost suitability based on the 2021 detector layout

Detector Location	Foraging features and assessment of vegetation removal required for detector locations/provisional turbine buffer (*c.*100m)	Roost potential within *c.* 300m of detectors of moderate or higher suitability
D.01	In an open field of improved grassland which contains treelines, providing good foraging features. Within 100m of the long-established beech woodland. The edge of this habitat provides a strong linear feature for foraging bats.	The long-established beech woodland lies within *c.* 90m to the east of this detector location. The high roost potential tree with butt rot lies within *c.* 250m to the north east of this location.
D.02	In an open field of improved grassland. The long-established beech woodland is *c.* 90m to the east & northeast of this turbine location. The interface of woodland to improved grassland provides a strong linear foraging feature.	The long-established woodland is within 300m of D.02. The closest point is *c.* 110m to the northeast of the detector location.
D.03	In a field of improved grassland. The detector location is directly adjacent to a hedgerow which has foraging potential for bats. There are also treelines/hedgerows bordering fields of semi-improved grassland farmland to the north and improved grassland west of the turbine *c.* 100m distance from both.	There are no potential roost features classed as moderate or higher within 300m of the proposed location for turbine associated with this detector.
D.04	In a field of improved grassland. There are treelines to the north (*c.* 50m), west (*c.* 40m), and east (*c.* 90m) which hold foraging potential for bats.	There are no potential roost features classed as moderate or higher within 300m of the proposed location associated with this detector.
D.05	In a conifer plantation with the plantation edge *c.* 20m to its east. With a treeline *c.* 15m to the east bordering open fields with patches of gorse. The edge of this plantation provides a linear feature along which bats can forage. The clearing with the old ash tree *c.* 80m to the west of the turbine location also provides a linear feature for foraging bats.	This detector was within 300m of the mature ash tree classed as having moderate roost potential within conifer plantation.
D.06	In conifer plantation bordered by broadleaf treelines, which are adjacent to more conifer plantation to the east *c.* 30m, and open fields to the south *c.* 50m to turbine location.	There are no potential roost features classed as moderate or higher within 300m of the proposed turbine location associated with D.06.
D.07	In a field of improved grassland with a treeline *c.* 70m to the north and south, with hedgerows *c.* 20m to the east and *c.* 55m to the west. These linear features are likely used by commuting and foraging bats	There are no potential roost features classed as moderate or higher within 300m of the proposed location for the turbine associated with D.07.
D.08	In a clearing between two conifer plantations. There are several broadleaf treelines within this plantation.	The derelict buildings of the abandoned farmstead classed as having high bat roost potential are located *c.* 250m to the southwest of this detector location

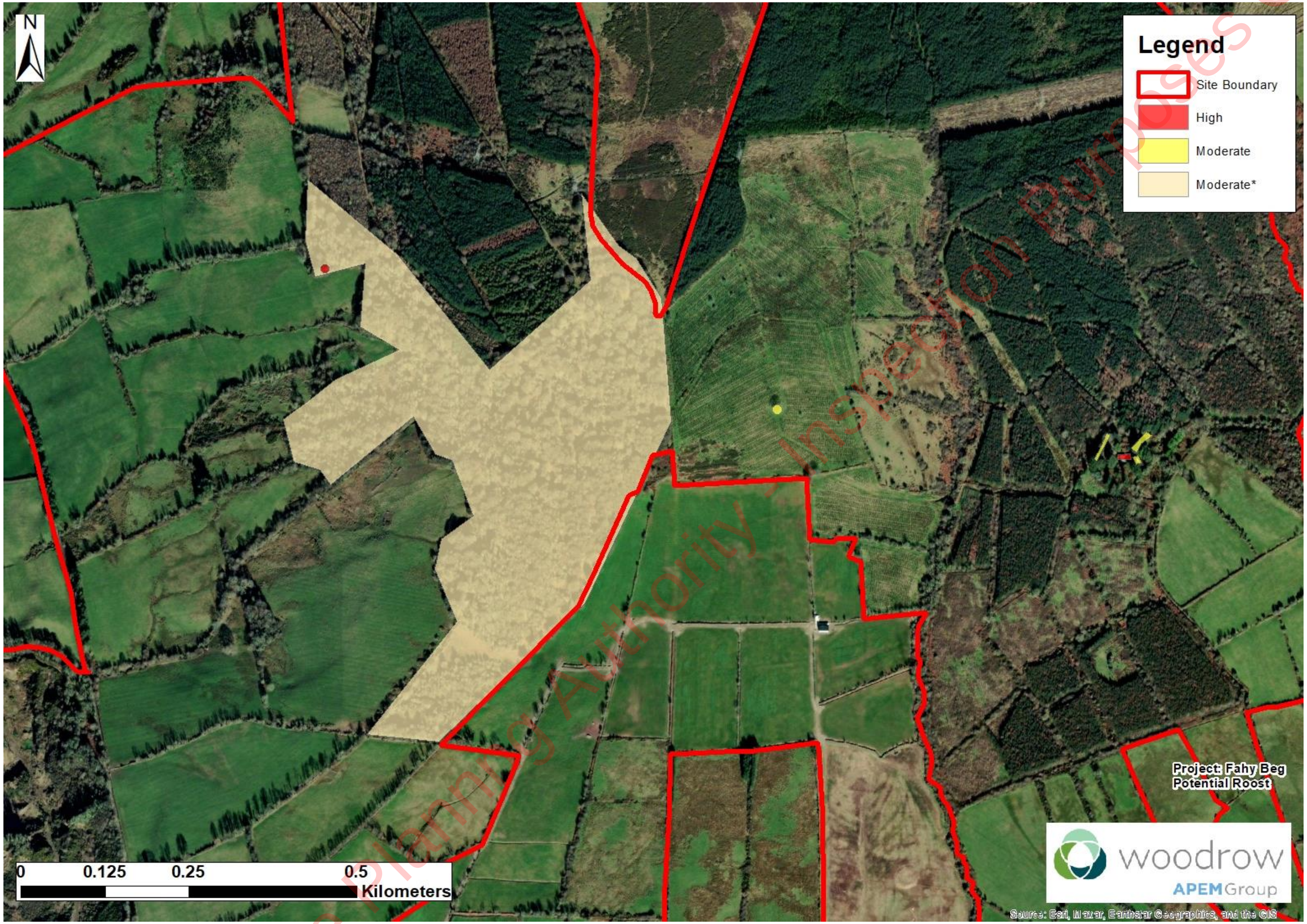

Figure 7 - Bat roost potential of woodland areas and features within the site

3.2.1 Roost surveys

The locations of moderate or high roost potential can be seen in **Figure 7**. Roost feature locations for which emergence and re-entry surveys were conducted are shown in **Figure 8**, while sample pictures of these locations can be found in **Appendix 1: Roost survey** locations.

Roost surveys 2020

Emergence survey 1:

Date: 11-Jun-2020 *Sunset:* 21:55 *Start:* 21:25 *End:* 23:25

Derelict cottage: Frequent soprano pipistrelle calls were recorded from 22:07 to 22:17 potentially from the same individual. Though not heard by the surveyor the detector recorded lesser horseshoe calls on two occasions, first at 22:38 then at 22:45. Given that the surveyor was unaware of its presence it is not possible to ascertain if it emerged from the cottage. During a fifteen-minute window between 23:06 and 23:21 multiple common and soprano pipistrelles were recorded but it is noted that they were commuting in the vicinity of the cottage rather than emerging from it.

Result: **No emergence recorded**

Emergence survey 2:

Date: 31-Jul-2020 *Sunset:* 21:26 *Start:* 20:44 *End:* 22:41

Derelict cottage: Despite wet conditions common pipistrelle calls were recorded between 21:51 and 22:24 taking shelter from light rain in the shed adjacent to the cottage. *Myotis* spp. were recorded at 22:28 and again at 22:36. These bats may also have emerged from the cottage given the later emergence times of *Myotis* spp.

Result: **No emergence recorded**

Emergence survey 3:

Date: 18-Aug-2020 *Sunset:* 20:55 *Start:* 20:25 *End:* 22:05

Derelict cottage: The first recorded bat was a soprano pipistrelle which passed at 21:13 but was not visible to the surveyor, emergence from the suspected roost could not be determined. At 21:30 and 21:37 two common pipistrelles were recorded commuting through the area. Soprano and common pipistrelles were noted to be commuting through and foraging in this area in low numbers (2 – 5).

Farmhouse c.720m from site boundary: This survey took place on the east facing side of the farmhouse. From the first recorded bat until recording at the house ceased there was a near constant social cacophony being produced from this roost, much of which was audible without detectors. These social calls matched those recorded at large soprano pipistrelle roosts. The first emergence recorded was a soprano pipistrelle at 21:13 emerging from the right gable of the house. Between this time and the end of the roost watch the surveyor recorded 54 emerging soprano pipistrelles and multiple foraging individuals. The majority of these emergences came from the right gable of the house; however, several individuals were noted to have emerged from the tiling on the left side of the roof. The detector used recorded 140 soprano calls (including social) during this time period There were also several passes of Leisler's and brown long-eared bats noted to be foraging in the area.

Results: **Confirmed soprano pipistrelle roost at farmhouse**

No emergence recorded at derelict cottage

Emergence survey 4:

Date: 01-Sep-2020 *Sunset:* 20:24 *Start*: 20:20 *End:* 21:00

Farmhouse c. 720m from site boundary: The first soprano pipistrelle emergence from the farmhouse occurred at 20:41. As with the previous survey at this location there was an almost constant social cacophony between 18 and 30kHz some of which was audible without the use of a detector. 40 soprano pipistrelles were recorded to have emerged between the start and end time of the roost survey.

Results: **Confirmed soprano pipistrelle roost in farmhouse**

Roost surveys 2021

Emergence survey 5:

Date: 13-May-2021 *Sunset:* 21:21 *Start:* 21:11 *End:* 22:50

Mature beech tree with mushroom butt rot on the southern edge of beech woodland: The first bat recorded was a Soprano pipistrelle at 21:33. Common pipistrelles, Soprano pipistrelles and Leisler's bats were recorded throughout the survey. No bats were seen emerging from the feature. Common pipistrelles were noted foraging north and south of the roost. Leisler's bats were recorded at 22:00 unseen but in the open with long intervals between calls. They were noted again at 22:08, commuting from west to east through the woodland.

Result: **No emergence recorded**

Emergence survey 6:

Date: 23-Jun-2021 *Sunset:* 22:00 *Start:* 21:45 *End:* 23:30

Derelict cottage: There were several commuting common and soprano pipistrelles and a single commuting Liesler's bat recorded commuting nearby the house within the first hour after sunset. An individual common pipistrelle was recorded emerging from the first-floor window beside the ruined section of the derelict cottage. Two lesser horseshoe bat passes were recorded and noted at 23:17 and 23:23 but the bats responsible were not seen. Between 23:23 and 23:27 common pipistrelles a soprano pipistrelle and a Leisler's bat were recorded foraging in the vicinity of the cottage.

Cow shed ruin: No bats were recorded emerging from the cow shed ruin during this survey. Both common and soprano pipistrelles were recorded foraging adjacent to the building for the duration of the survey.

Results: **Confirmed common pipistrelle roost in derelict cottage**

No emergence recorded from cow shed

Re-entry survey 1:

Date 24-Jun-2021 *Sunrise:* 05:11 *Start:* 03:44 *End:* 05:26

Two unseen Leisler's bat passes were recorded at 03:51 and 04:22 and a single unseen soprano pipistrelle pass was recorded at 04:38. A confirmed common pipistrelle re-entry into a crevice in the roof tiling of the derelict cottage was recorded at 04:42.

Result: **Confirmed common pipistrelle roost in derelict cottage**

<u>**Emergence survey 7:**</u>

Date: 12-Jul-2021 *Sunset:* 21:57 *Start*: 22:00 *End:* 23:36

Ash tree During this survey only 7 common pipistrelle passes were recorded, all of which were unseen or attributed to distant individuals foraging near the plantation edge. No emerging bats were detected.

Result: **No emergence recorded**

<u>**Emergence survey 8**</u>

Date: 11-Aug-2021 *Sunset:* 21:10 *Start*: 20:55 *End*: 22:25

Derelict house: No bats were recorded emerging during this survey. However, between 21:40 and 21:58 four common pipistrelles and one soprano pipistrelle were recorded commuting with all of them travelling in a westerly or north westerly direction. During the duration of the survey from the first pass at 22:50, onwards, there was constant foraging behaviour of both common and soprano pipistrelle. It was noted by surveyors that these calls were produced by between two or three individual pipistrelles.

Two mature beech trees in NE of beech woodland: Though this survey recorded a very high level of pipistrelle foraging activity within the woodland no bats were recorded emerging from the moderate roost potential beech trees. Each surveyor also separately recorded lesser horseshoe bat passes, one at 22:01 and the other at 22:05. Due to dense canopy cover ascertaining exact numbers of foraging bats proved difficult though multiple recordings feature a minimum of three separate bats calling at once.

Result: **No emergence recorded**

<u>**Re-entry survey 2**</u>

*Date:*12-Aug-2021 *Sunrise*: 06:10 *Start*: 04:40 *End:* 6:25

Ash tree in plantation: Only two Leisler's bat passes were recorded during the re-entry survey at the ash tree clearing in the conifer plantation. The first, recorded by both surveyors at 05:42 was noted as being distant. The second, only recorded by one surveyor was recorded at 05:45 and was noted as being a lone foraging bat above plantation to the north of the ash tree.

Mature beech with mushroom butt rot along the southern edge of beech woodland: A lesser horseshoe bat was recorded and noted but not observed at 04:59. Though the focus of this survey was the roost feature foraging pipistrelles were recorded frequently in the beech woodland between 04:39 and 05:25. No bats were recorded entering the tree with butt rot.

Result: **No re-entry recorded**

<u>**Re-entry survey 3**</u>

Date: 28-Sep-2021 *Sunrise*: 06:32 *Start*: 04:30 *End*: 06:50

Derelict cottage: Intermittent drizzle at the beginning of the survey may have resulted in no recorded activity but when the rain stopped multiple bats were recorded shortly after. Both surveyors recorded a soprano pipistrelle foraging at the back of the house. A lesser horseshoe was recorded and seen directly above the chimney of the house and then seen re-entering the building at 07:13 on the open 1st floor wall, confirming it as a lesser horseshoe roost.

Result: **Confirmed lesser horseshoe bat roost in derelict cottage.**

Roost inspection

Date: 13-May-2021

Tree with severe butt rot west of site: A precautionary endoscope inspection under licence was carried out on the tree in the west of the site to determine its potential use as a roost in the absence of emergence surveys. This inspection found no bats or evidence of roosting bats.

Result: No confirmed roost

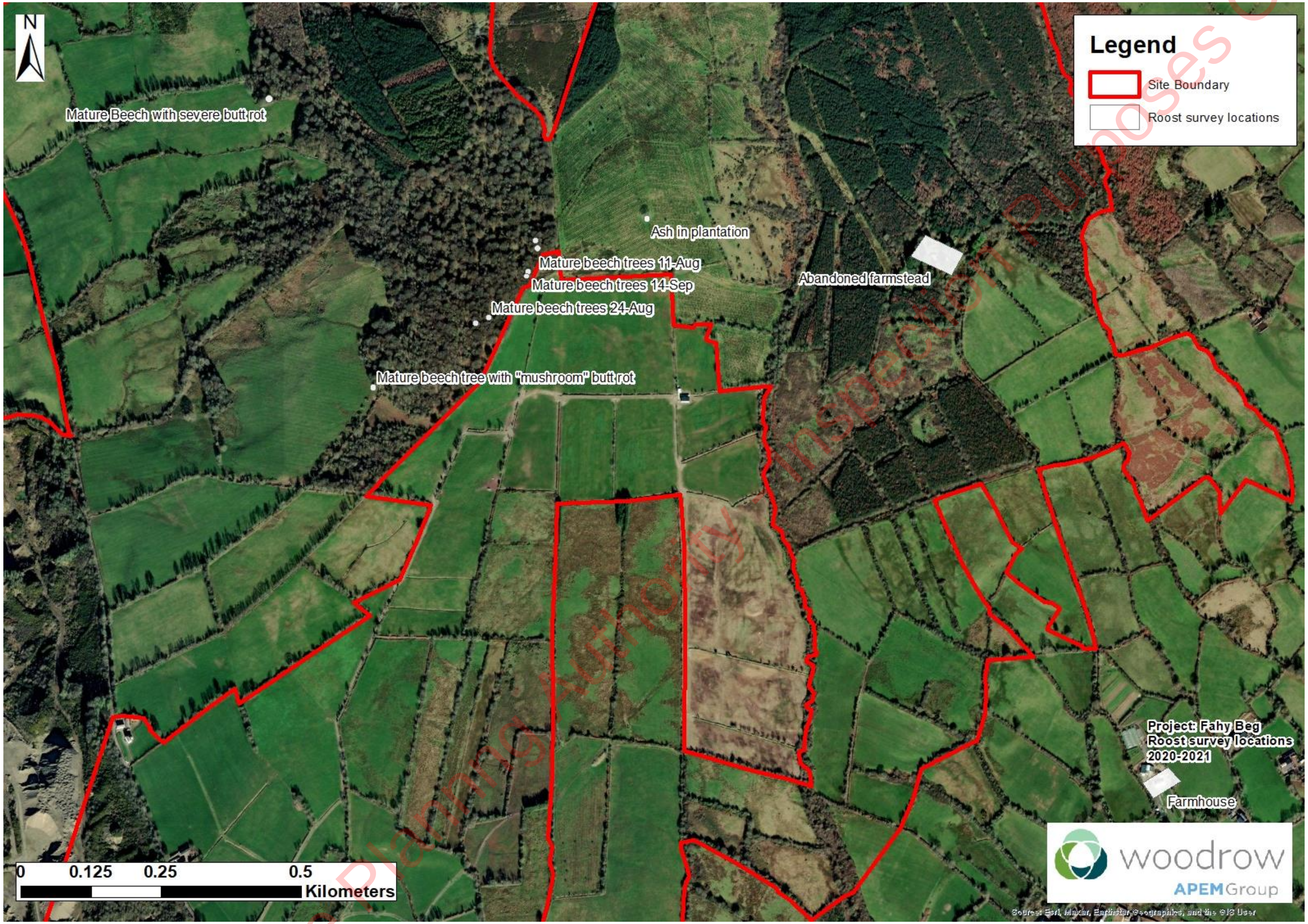

Figure 8 - Roost survey locations 2020-2021

3.2.2 Winter roost inspection surveys

Beech tree with severe butt rot: [52.784621, -8.528125]

The tree with severe butt rot in the west of the site was examined for hibernation roosts. While not conclusive, some faecal samples were collected and there was evidence of bats feeding (moth wings on the ground), there was a layer detritus covering much of this evidence. There were only two faecal samples present. This suggests it was not in current use as a hibernation roost. However, the presence of this evidence suggests its use as a night roost during the active bat season.

Derelict cottage and surrounding buildings: [52.784621, -8.528125]

Several faecal samples were collected from the ruined stable and the derelict cottage. The majority of samples collected did not appear to be recent. Some samples collected in the fireplace of the derelict cottage could be recent. The cottage has multiple entry points to the second floor and large spaces with entry points between floors. Even though the presence of a hibernation roost could not be confirmed there is a reasonable likelihood of one being present in this structure.

Genetic analysis of the faecal samples collected are summarised in **Table 6**.

Table 6 - Genetic analysis results of faecal samples collected during winter inspection

Sample reference	Collection location	Common name	Species name	Grade score (%)
BAT014C	Tree with butt rot	Inconclusive	Inconclusive	0%
BAT014F	Cow shed ruin	Inconclusive	Inconclusive	0%
BAT014G	Derelict cottage (fireplace)	Lesser horseshoe bat	*Rhinolophus hipposideros*	99.5%

3.3 Transect surveys

The following section summarises the transect results recorded in both 2020 and 2021. The distribution of bats recorded along transects are displayed in **Figure 9**, **Figure 10**, **Figure 11**, **Figure 12**, **Figure 13**, **Figure 14**, **Figure 15**, **Figure 16** and **Figure 17**. The total pass results, obtained using Elekon Batlogger M bat detectors, are presented in **Table 7** and **Table 8**.

Transect 1:

Figure 9 *Date:* 12-Jun-2020 *Sunset:* 21:55 *Start:* 21:55 *End:* 00:21

During the first transect the central fields of the site were surveyed to begin with. At 22:38 several soprano pipistrelles passes were recorded along the ash treeline perimeter of this field. However, despite being recorded they could not be seen so it is not known if they were foraging or commuting. Multiple foraging common pipistrelles were recorded along the entry lane to this field while the surveyors departed this field at approximately 23:38. The second half of this transect covered the track on the eastern side of the site between the farmhouse and the derelict cottage. Common and soprano pipistrelles were detected at the farmhouse. Common pipistrelles and *Myotis* spp. were detected at the derelict cottage noted to be foraging in the area around the cottage at 00:11. The transect continued to track up to the centre north of the site only recording a single soprano pipistrelle along the route at 00:25 and did not record any further activity along this track or at the ash tree in a clearing of conifer at the end of the route. During this transect common pipistrelles were the most frequently recorded bat (77 passes) with only small numbers of soprano pipistrelles (7 passes) and *Myotis* spp. (5 passes) being recorded.

Transect 2:

Figure 10 *Date:* 31-Jul-2020 *Sunset:* 21:26 *Start:* 22:42 *End:* 23:51

The first walked section of this transect covered the track between the derelict cottage and the farmhouse on eastern side of the site. Along this track no bats were recorded but this was likely impacted by a light rain at this time which eased off as the survey progressed. The first driven section of the transect was conducted from the farmhouse along the main road to the south of the site and then tracking west, along this driven route common pipistrelles and soprano pipistrelles were recorded. A second walked transect was conducted in a field on the western edge of the site. During this transect, primarily foraging common pipistrelles were recorded along the treeline of the field though activity decreased higher up the hill of the field. An individual brown long-eared bat was recorded on the treeline on the southern end of the field. Common pipistrelles were the most active during this transect (133 passes). Soprano pipistrelles were less active (26 passes) while only a single brown-long-eared bat pass was recorded.

Transect 3:

Figure 11 *Date:* 18-Aug-2020 *Sunset:* 20:55 *Start:* 22:05 *End:* 23:35

The first walked section of this transect covered the track from the farmhouse to the derelict cottage and back. Along this route, multiple common and soprano pipistrelles were recorded foraging above the track. There were also two *Myotis* spp. bats recorded which were likely foraging along the small drainage stream adjacent to the track. The driven transect from the farmhouse to the field south of the site recorded soprano and common pipistrelles along its route along with a single Leisler's bat. The walked transect recorded common and soprano pipistrelles foraging along the treelines adjacent to the track leading towards the southern end of the site while three Leisler's bat passes were recorded in the centre of a field at this location. The final driven part of the transect recorded multiple common pipistrelles, soprano pipistrelles and a single Leisler's bat foraging along the treeline adjacent to the road for all of its length. A spot count was taken at the edge of the field on the western side of the site at which 23 common pipistrelle passes, 19 soprano pipistrelle passes, and a single Leisler's bat was recorded. These bats were noted to be foraging between the field gate and the trees on the opposite side of the road. During this transect common pipistrelles were the most active species (124 passes), followed by soprano pipistrelles (67 passes) with only a small number of Leisler's bats (15 passes) and *Myotis* spp. (3 passes) being recorded.

Transect 4:

Figure 12 *Date:* 01-Sep-2020 *Sunset:* 20:27 *Start:* 20:30 *End:* 22:00

This short walked transect went from the farmhouse to the derelict cottage and back. It recorded high levels of bat along the track and its adjacent stream and treelines which surveyors noted as commuting bats. The Leisler's bat calls recorded on this transect were heard but not seen by surveyors so the distinction between foraging and commuting through this habitat could not be made. Soprano pipistrelles were the most active species (30 passes). Common pipistrelles were less active than on any of the previous transects (17 passes), while only a single *Myotis* spp. pass was recorded.

Transect 5:

Figure 13 *Date:* 13-May-2021 *Sunset:* 21:20 *Start:* 22:50 *End:* 00:20

A driven section of this transect was carried out along the southern edge of the beech woodland while a walked transect was simultaneously carried out down the eastern edge of the improved grassland field. Both surveyors recorded common and soprano pipistrelles foraging along the treelines. Both surveyors also recorded unseen Leisler's at different times. A driven transect conducted on the road recorded multiple common and soprano pipistrelles foraging along the treelines adjacent to the road. A final short, walked section of transect was conducted in the field on the western edge of the site.

The north-western treeline edge of this field had multiple common pipistrelles foraging along its length and passes of *Myotis* spp. and brown long-eared bats were also recorded.

Transect 6:

Figure 14 *Date:* 23-Jun-2021 *Sunset:* 22:02 *Start:* 23:31 *End:* 00:53

The first section of this survey was a walked transect from 23:31 until 00:15 along the track to the abandoned farmstead in the east of the site. There were multiple calls of unseen bats recorded, several common and soprano pipistrelles were seen and recorded foraging along the treelines either side of the track. A driven transect was completed then from 00:15 until 00:27. Much like the previous transect common and soprano pipistrelles were recorded foraging along the treelines by the road. A walked transect was recommenced south of the centre of the site, tracking northwards until the end of the survey at 00:53. Soprano and common pipistrelles were recorded while adjacent to treelines but not in the improved grassland along this track.

Transect 7:

Figure 15 *Date:* 12-Jul-2021 *Sunset:* 21:57 *Start:* 23:23 *End:* 01:20

This transect contained two walked sections. The first covered the northern centre section of the site and tracked eastward to the abandoned farmstead. Only a small number of individual common pipistrelles were recorded foraging along gaps in the plantation forestry (3 individuals producing several passes at different points in the plantation). Both common and soprano pipistrelles were once again recorded foraging along the track in the east of the site. A section of transect covered the improved grassland field in the eastern section of the site and recorded no bats in the field or along the hawthorn hedgerow in its centre. A second walked section of transect covered an area in the southern centre of the site. There were between 2 and 3 common and soprano pipistrelles foraging at the farmyard and the path out on the farmyard through which was walked for access to the south of the site. Another common pipistrelle and soprano pipistrelle were recorded foraging along a treeline in the south of the site occasionally going over the improved grassland.

Transect 8:

Figure 16 *Date:* 11-Aug-2021 *Sunset:* 21:10 *Start:* 22:40 *End:* 23:30

This transect was a walked transect carried out by four surveyors. Two surveyors covered a track from the abandoned farmstead to the western edge of the conifer plantation within the site while the other two surveyors covered a transect through the beech woodland in the north west of the site. Visibility was poor on this night and it was noted to be particularly dark. Within the beech woodland there was constant foraging of common and soprano pipistrelles beneath the canopy between the trees. An exact number was difficult to ascertain as many of the bats could not be seen but based on the review of call data it was likely multiple individuals of both species contributing to the constant foraging. It was noted on the southern edge of the woodland a minimum of three common pipistrelles were foraging simultaneously. A single Leisler's bat was recorded during this section of the transect.

The second group of surveyors recorded continuous common pipistrelle foraging in the woodland adjacent to the abandoned farmstead. However, the section through the plantation forestry in the north of the site recorded only occasionally foraging individual common and soprano pipistrelles and a single *Myotis* species bat. Several Leisler's bat calls were recorded at the ash tree within plantation; however, these calls were identified using call data and were not heard by surveyors during the transect. A 15-minute point count at the western edge of the conifer recorded only a single common pipistrelle and a single soprano pipistrelle.

Transect 9:

Figure 17 *Date:* 24-Aug-2021 *Sunset:* 20:43 *Start:* 20:22 *End:* 23:03

This transect covered the quarry in the south of the site. Common pipistrelles were recorded foraging along the disused track allowing access into the north of the quarry. Leisler's bats were recorded flying between 15m and 30m height in open areas such as above sand mounds. One *Myotis* spp. bat was recorded at the northern end of the quarry with two more passes recorded at the southern end. Common pipistrelles were noted to be flying inside a large shed on the quarry site.

Table 7 - Number of bat passes recorded during 2020 transect surveys

Species	Transect			
	12-Jun-2020	**31-Jul-2020**	**01-Aug-2020**	**01-Sep-2020**
Myotis spp.	5	0	3	1
Nyctalus leisleri	0	0	15	30
Pipistrellus pipistrellus	77	133	124	17
Pipistrellus pygmaeus	7	26	67	90
Plecotus auritus	0	1	0	0
Total	**89**	**160**	**209**	**138**

Table 8 - Number of bat passes recorded during 2021 transect surveys

Species	Transect					
	13-May-2021	**23-Jun-2021**	**12-Jul-2021**	**11-Aug-2021** Beech woodland	**11-Aug-2021** Conifer plantation	**24-Aug-2021**
Myotis spp.	2	6	1	0	1	4
Nyctalus leisleri	9	1	0	23	0	18
Pipistrellus pipistrellus	249	94	97	139	122	83
Pipistrellus pygmaeus	26	66	28	40	15	79
Pipistrellus spp.	0	0	0	0	0	2
Plecotus auritus	0	0	0	1	1	1
Total	**286**	**167**	**126**	**203**	**139**	**187**

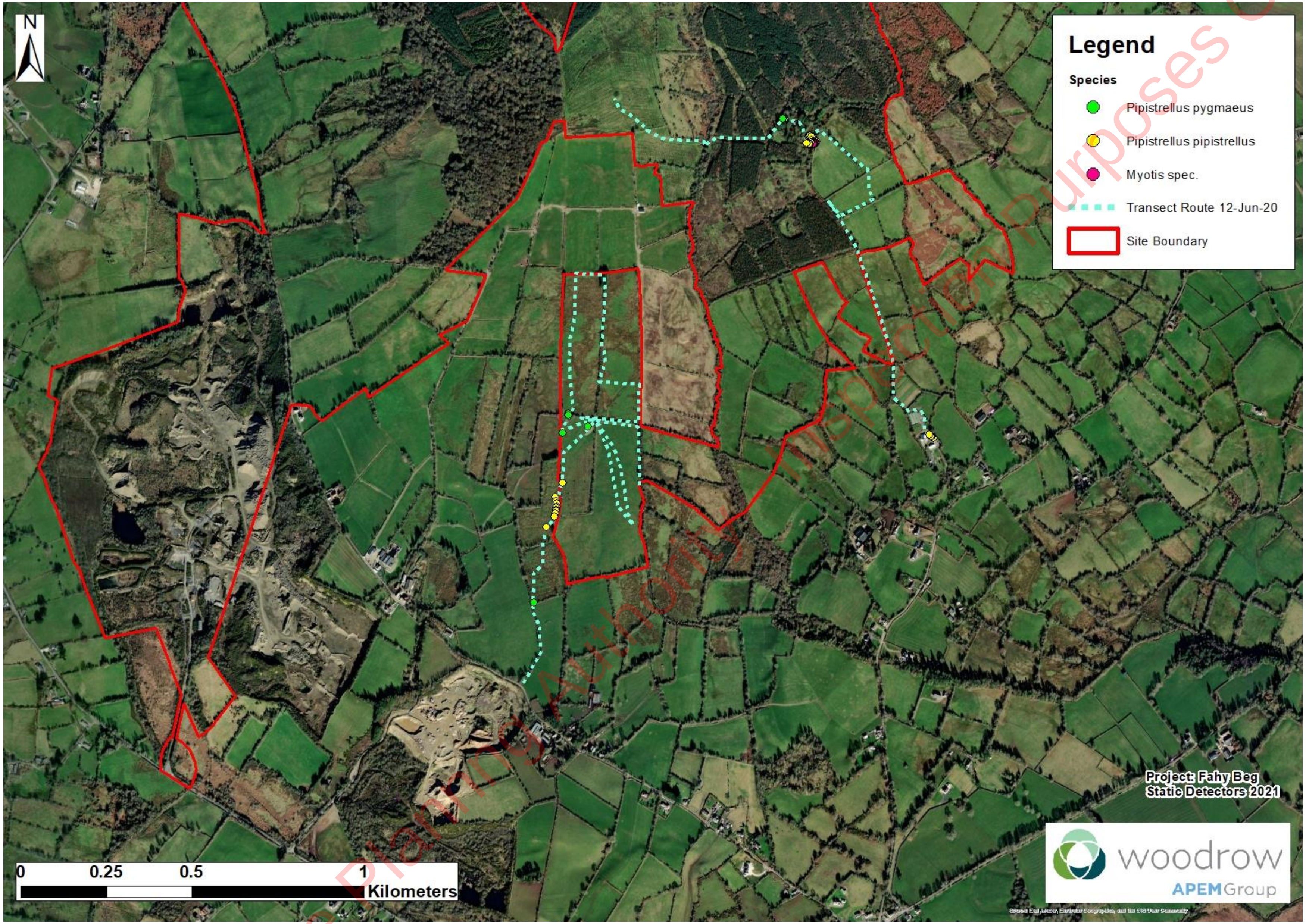

Figure 9 - Transect results 12-Jun-2020

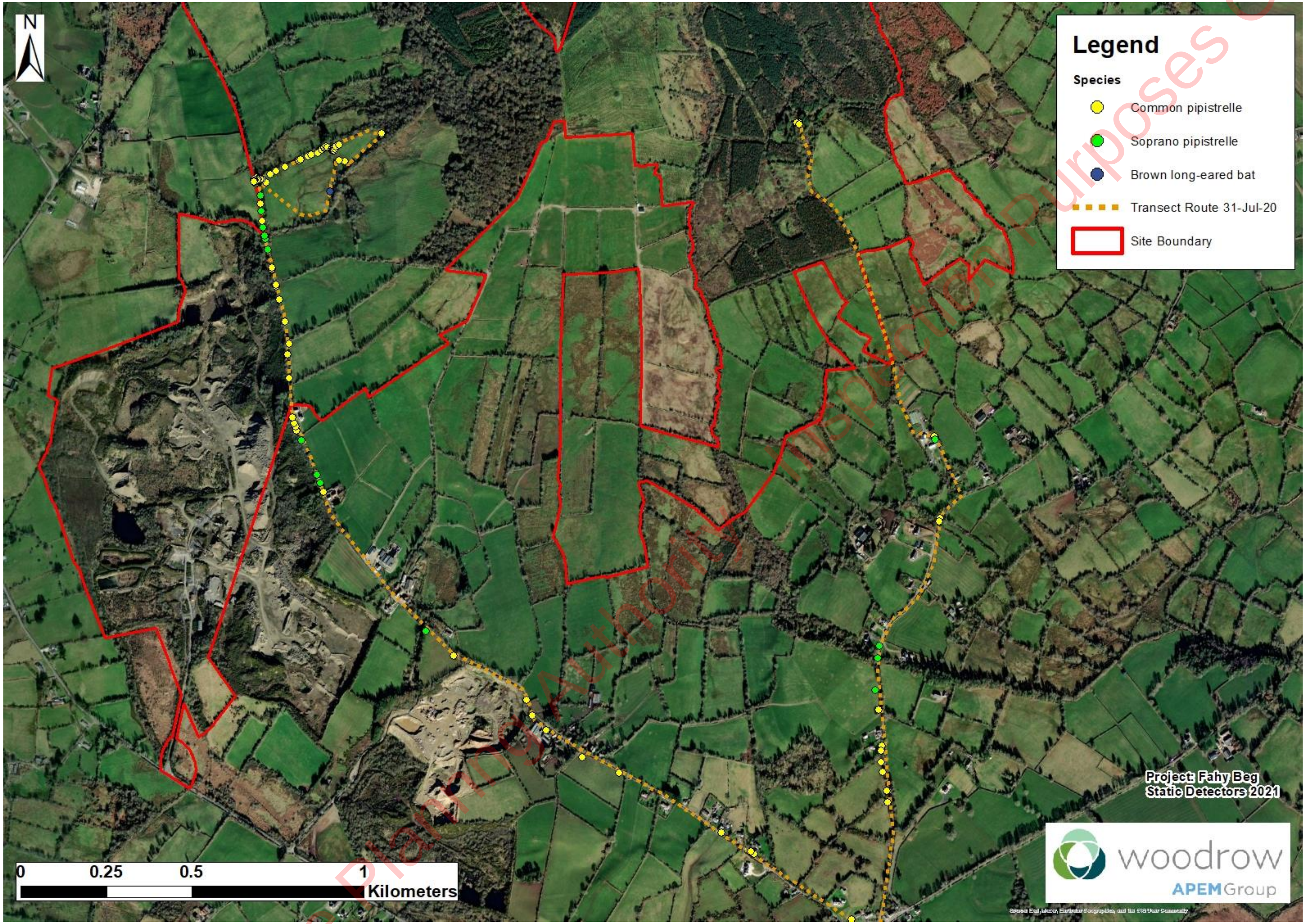

Figure 10 - Transect results 31-Jul-2020

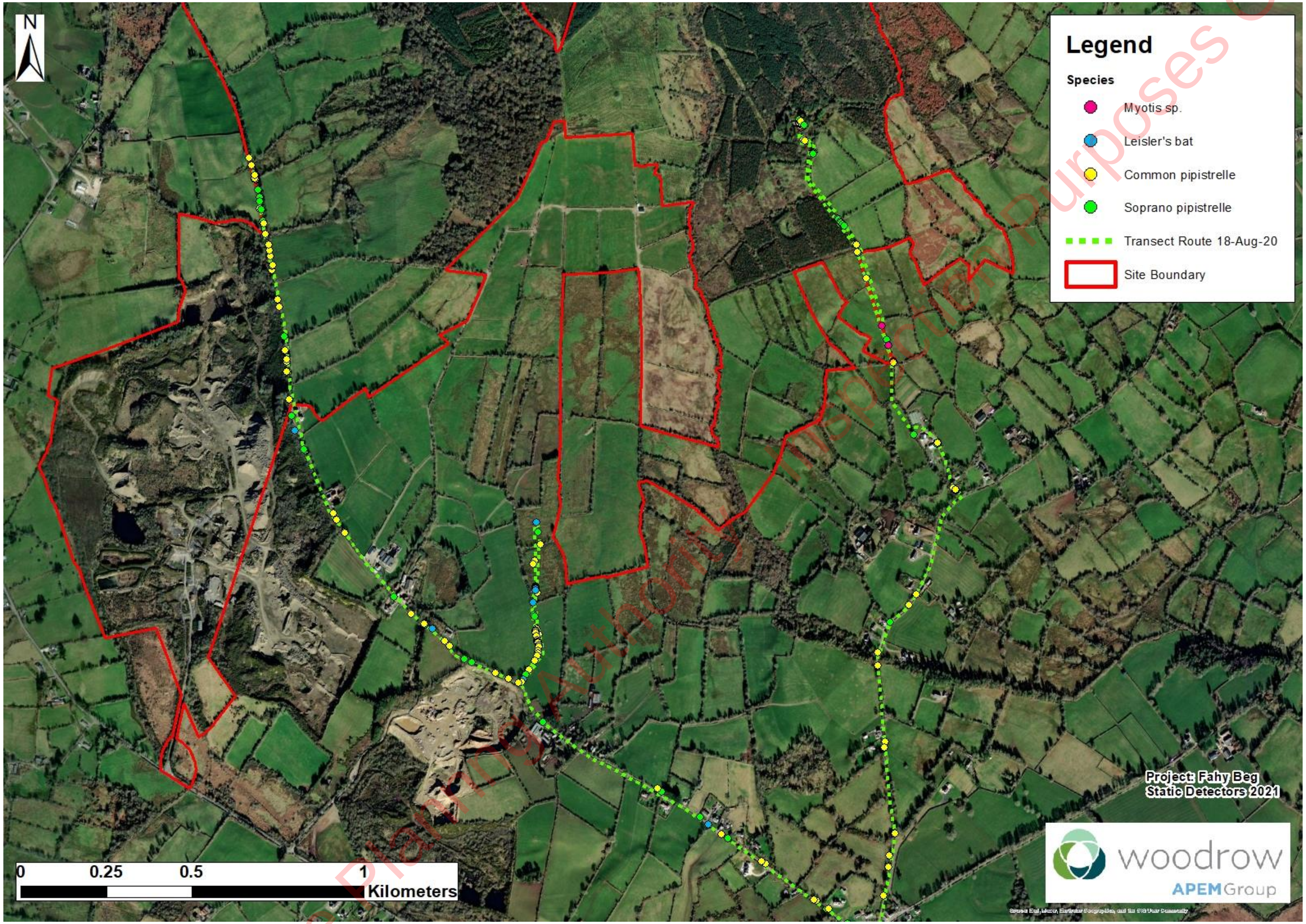

Figure 11 - Transect results 18-Aug-2020

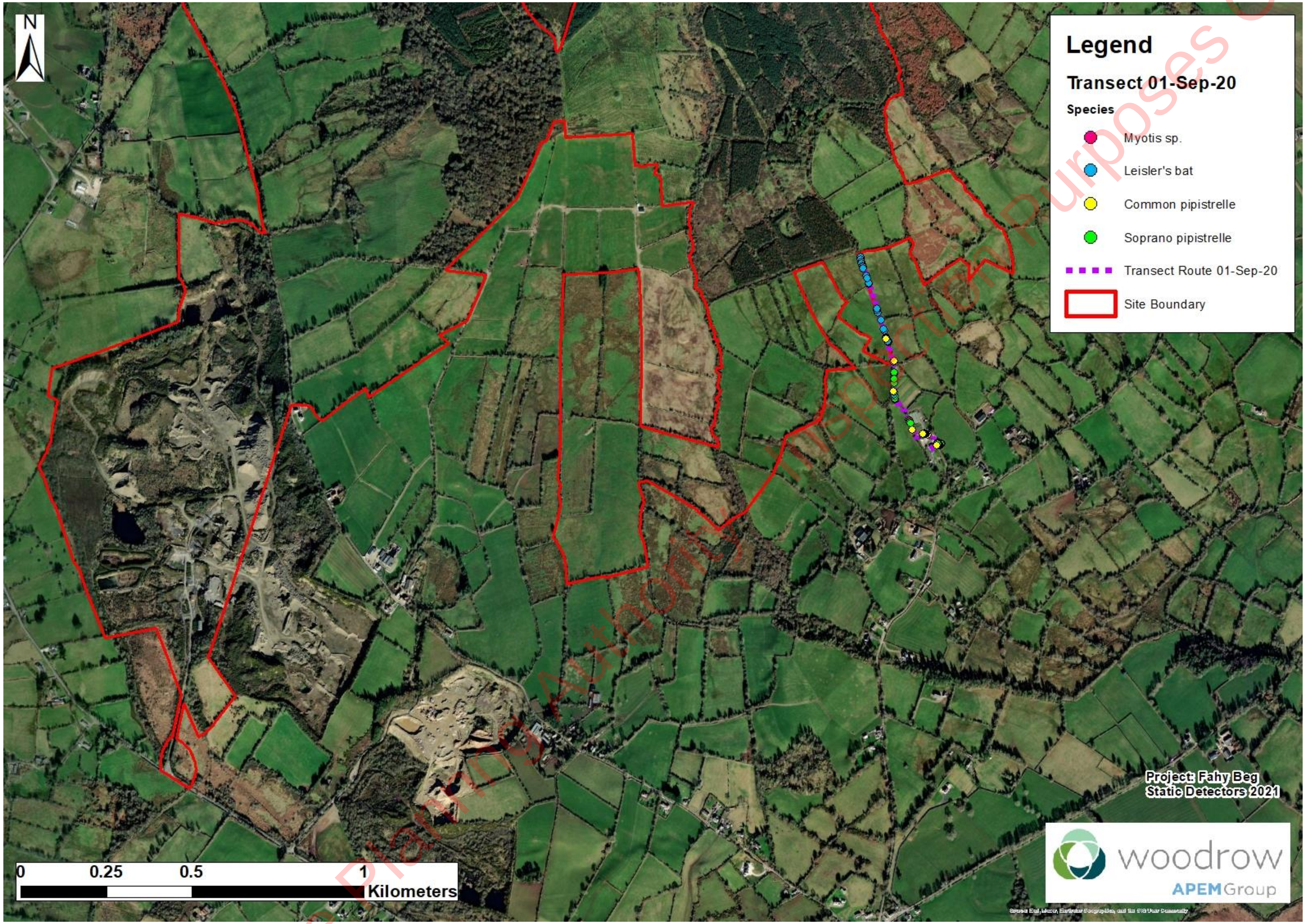

Figure 12 - Transect results 01-Sep-2020

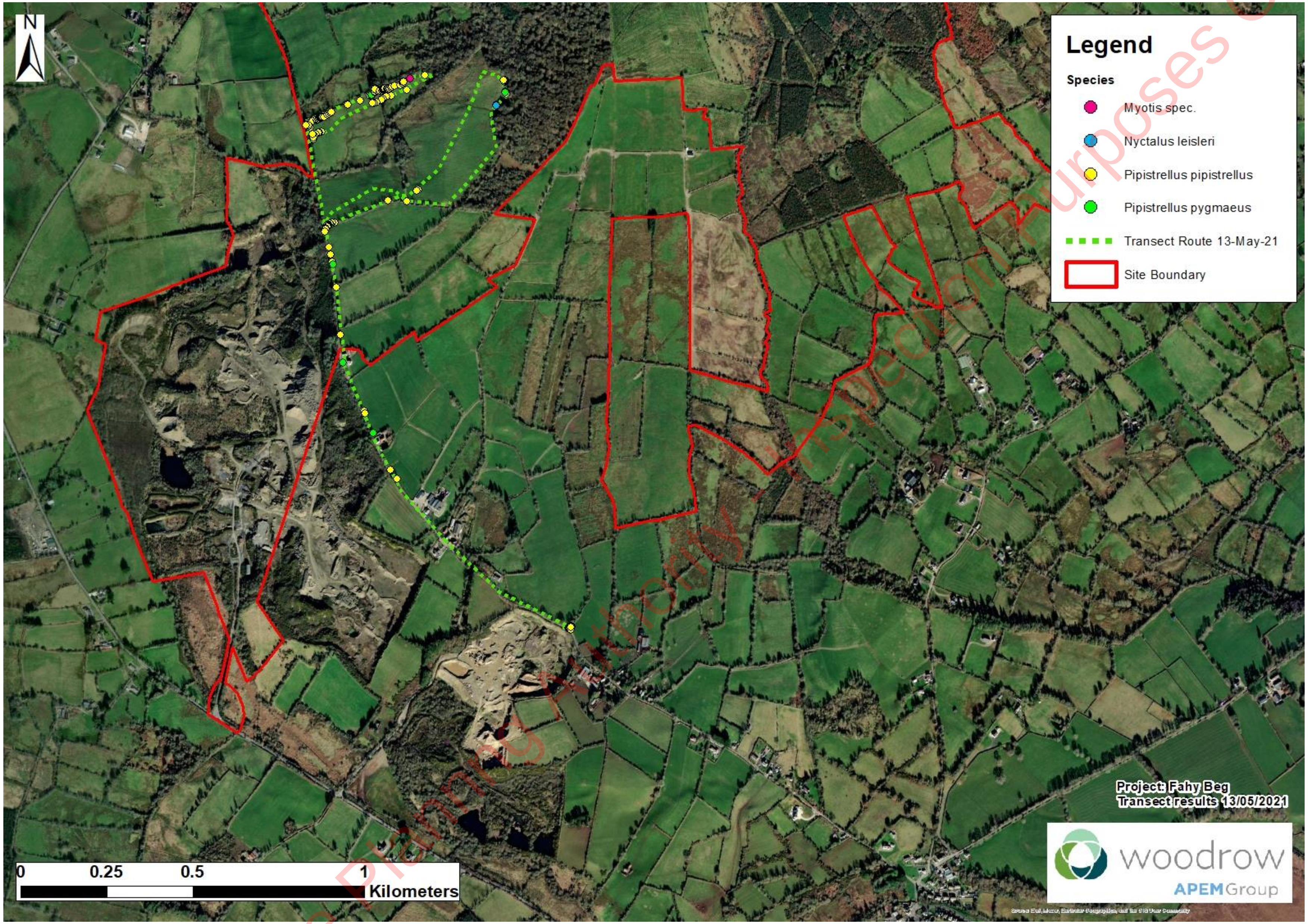

Figure 13 - Transect results 13-May-2021

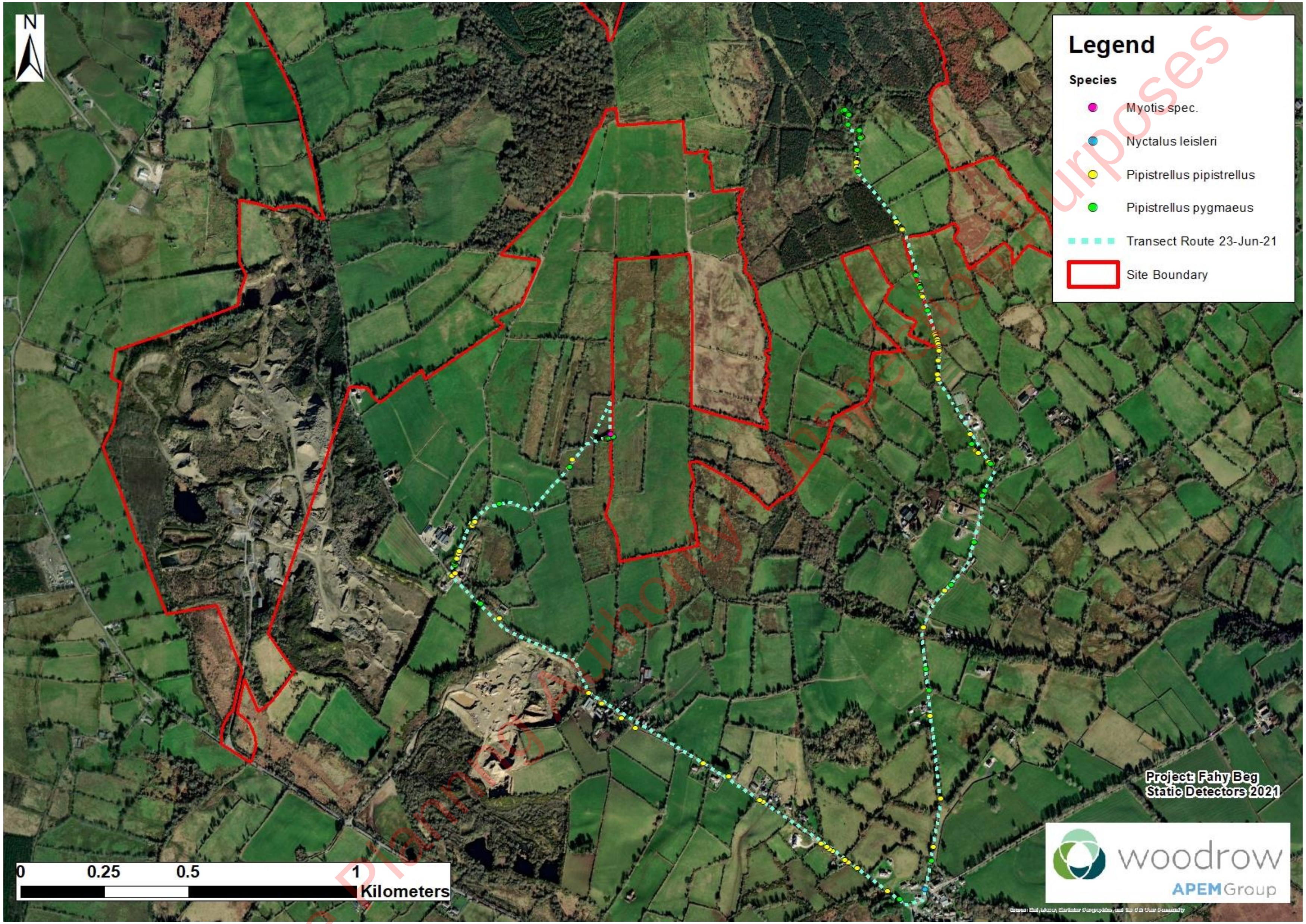

Figure 14 - Transect results 23-Jun-2021

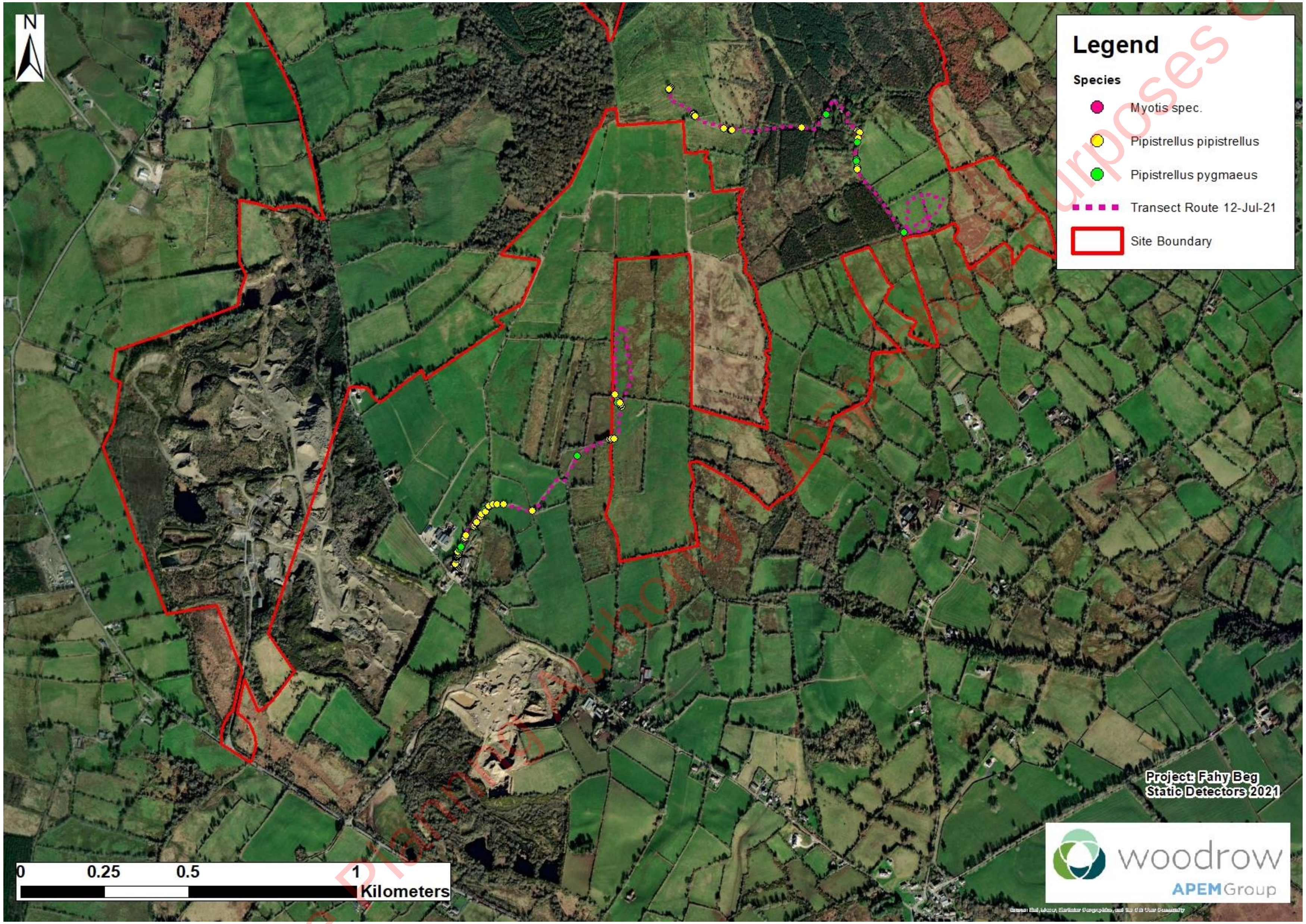

Figure 15 - Transect results 12-Jul-2021

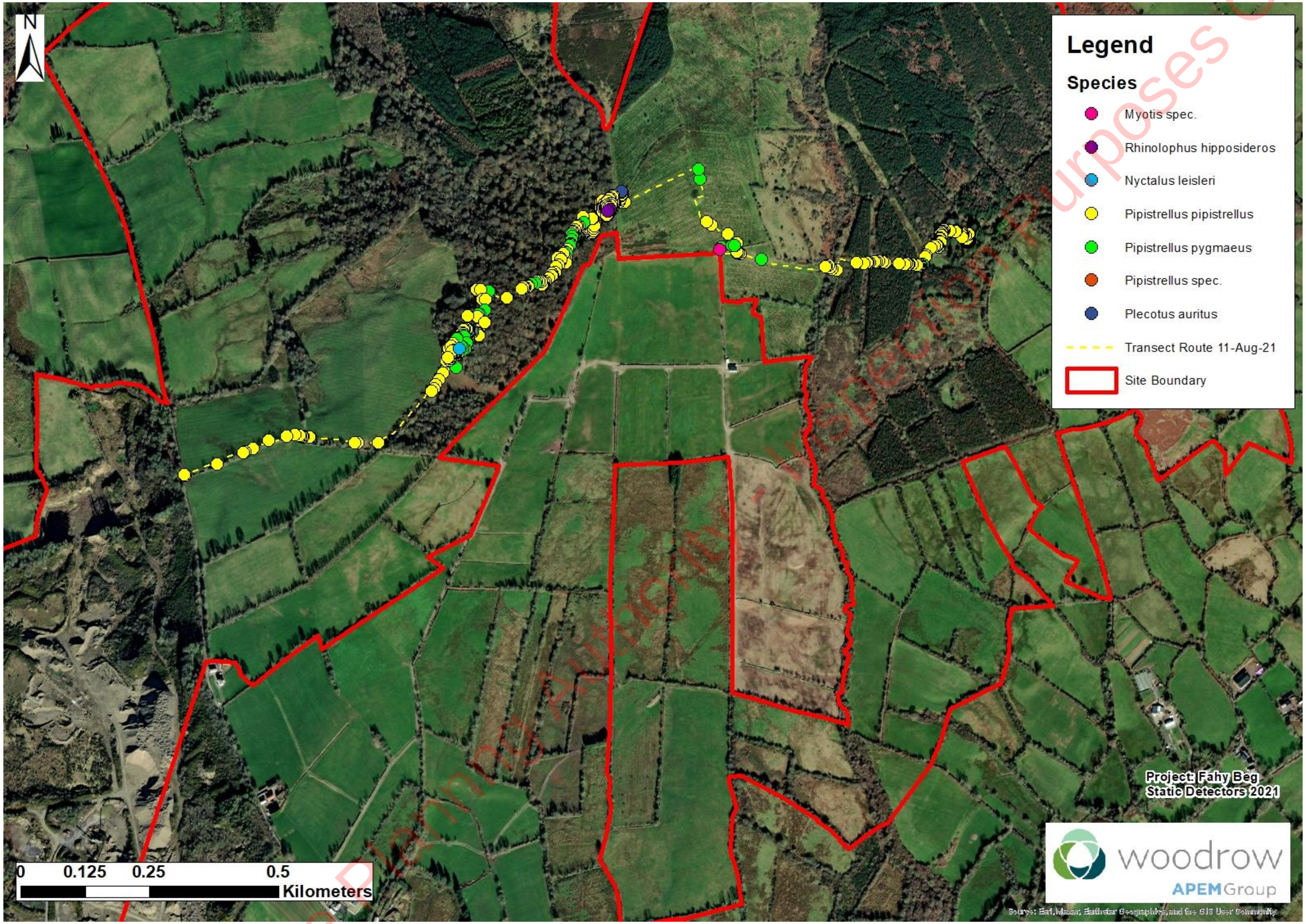

Figure 16 - Transects results 11-Aug-2021

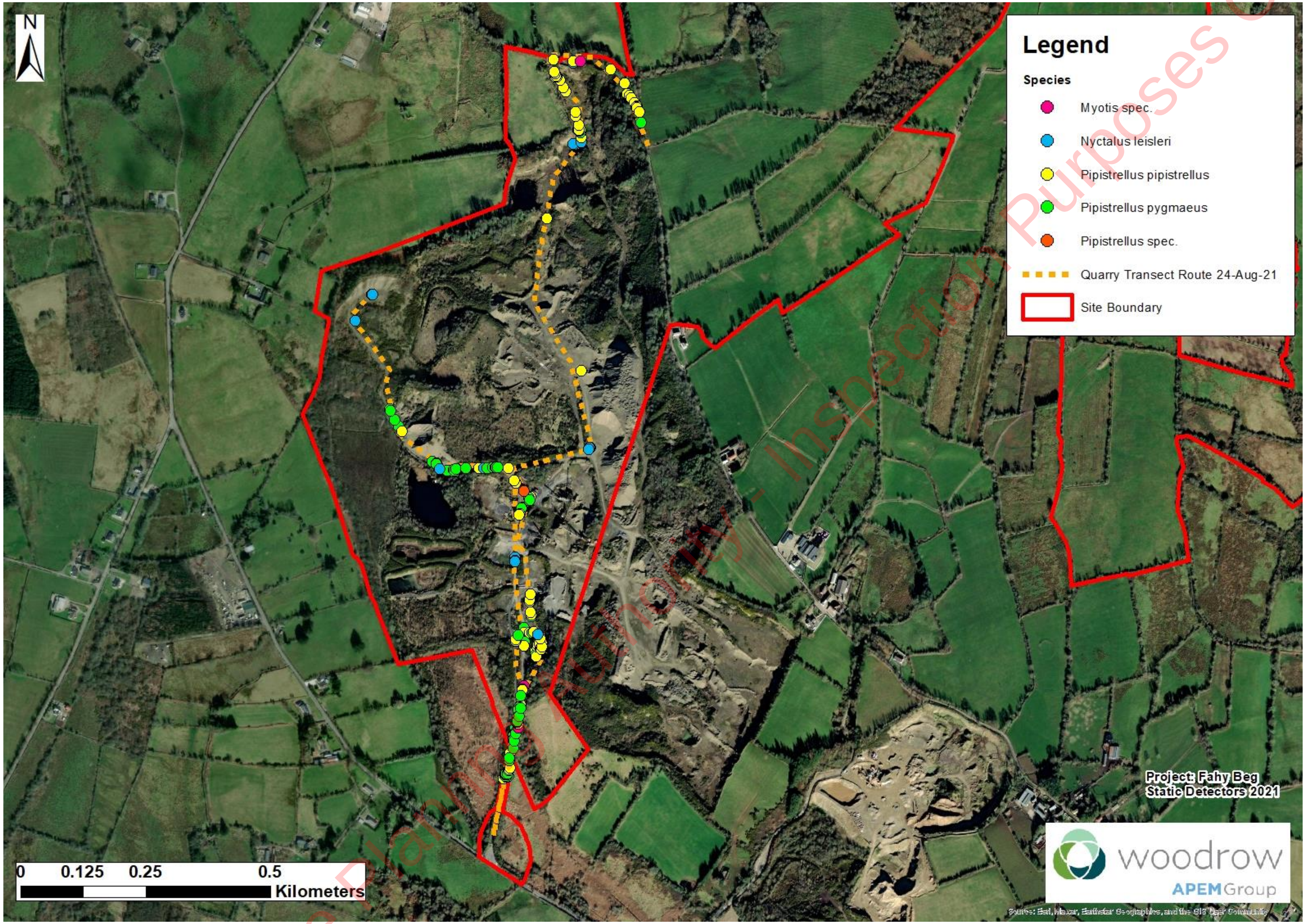

Figure 17 - Transect results 24-Aug-2021

3.4 Static detector surveys

In compliance with SNH *et al*. (2021) guidelines, static bat detectors were deployed three times per season over the 2020 and 2021 active seasons at or in areas adjacent to the eight proposed turbines and two context locations at Fahy Beg Wind Farm – see **Figure 4**, **Figure 5, Table 2,** and, **Table 3**. Weather conditions during the three deployment periods were proven to be compliant with SNH *et al*. (2021) requirements, that is, 10 nights above thresholds for minimum dusk temperature (8°C), wind speeds below 5m/s at ground level, and below thresholds for overnight for rainfall.

Geographical and temporal context for activity levels was examined through the analysis of the data with Ecobat. The percentiles generated by Ecobat for specific nights of bat activity allow for the objective classification of bat activity as 'Low', 'Moderate' or 'High'. As Ecobat uses median percentile data it is less influenced by large variance in the data. **Table 9** shows the levels of bat activity categories by Ecobat percentile scores, which is suggested by SNH *et al.* (2021) for use in the assessment of risk to local bat population from wind farm developments.

Table 9 – Bat activity levels categorised by percentile scores
Source: SNH *et al*. (2021)

Ecobat Percentile	Bat Activity Level
81 - 100	High
61 - 80	Moderate/High
41 - 60	Moderate
21 - 40	Moderate/Low
0 - 20	Low

The following sections detail the results from static monitoring surveys for each of the three seasonal deployments.

Weather data for the three deployment periods has been extracted and is shown graphically in **Appendix 3: Weather** Data for spring, summer and autumn deployments respectively.

This initial analysis examines the data for the site as a whole examining all values taken across all the detectors over the duration of all three deployments to provide site-wide median activity levels for bats in the wind farm site. The median activity levels on a site-wide basis, as analysed and categorised by Ecobat, showed common and soprano pipistrelles to have a high level of activity, Leisler's bats have a moderate/high level of activity, and *Myotis* spp. have moderate median activity levels. The remaining species; lesser horseshoe bat, Nathusius' pipistrelle, and brown long-eared bats had low median levels of activity. The median activity levels for 2021 remained the same with two exceptions; soprano pipistrelle activity dropped to moderate/high levels and Nathusius' pipistrelle levels increased to moderate/low. The overall activity levels for 2020 and 2021 are summarised in **Table 10** and **Table 11** respectively. **Figure 18**, **Figure 19**, **Figure 20**, **Figure 21**, **Figure 22**, and **Figure 23** display these results graphically.

Table 10 - Summary table showing key metrics for each species recorded 2020

Species	Median Percentile	95% Confidence Intervals	Max Percentile	Nights Recorded	Median Activity Levels
Myotis species	**47**	76.5 - 94	97	267	**Moderate**
Leisler's bat	**63**	82 - 94.5	97	341	**Moderate/High**
Nathusius' pipistrelle	**14**	31 - 69	69	25	**Low**
Common pipistrelle	**90**	94 - 97.5	100	372	**High**
Soprano pipistrelle	**84**	94 - 99.5	100	359	**High**
Brown long-eared bat	**20**	39 - 39	59	130	**Low**
Lesser horseshoe bat	**14**	14 - 14	31	11	**Low**

Table 11 - Summary table showing key metrics for each species recorded 2021

Species	Median Percentile	95% Confidence Intervals	Max Percentile	Nights Recorded	Median Activity Levels
Myotis species	**44**	75 - 96.5	100	247	**Moderate**
Leisler's bat	**64**	67 - 85.5	94	366	**Moderate/High**
Nathusius' pipistrelle	**25**	16 - 46.5	59	6	**Moderate/Low**
Common pipistrelle	**84**	98.5 - 100	100	366	**High**
Soprano pipistrelle	**70**	99.5 - 100	100	342	**Moderate/High**
Brown long-eared bat	**16**	30 - 56	65	128	**Low**
Lesser horseshoe bat	**16**	34-34	51	31	**Low**

Table 12 - Median percentiles for each species at each deployment location across all years

			Median Percentiles						
		Location	*Myotis* spp.	Leisler's bat	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	Lesser horseshoe bat
2020	Spring	D.01	47	61	14	96	80	14	14
		D.02	0	0	0	0	0	0	0
		D.03	56	52	23	76	31	14	0
		D.04a	61	39	14	77	50	14	14
		D.05	14	49	0	87	85	0	14
		D.06	54	66	14	87	72	41	0
		D.07a	74	56	56	78	52	0	0
		D.08	36	52	0	77	57	14	14
		D.09	41	52	14	85	41	33	31
		D.10	14	0	0	23	14	0	0
	Summer	D.01	80	71	0	97	86	41	0
		D.02	61	72	0	93	89	31	14
		D.03	65	82	14	95	96	31	0
		D.04b	90	92	14	97	100	14	0
		D.05	23	74	0	93	82	23	0
		D.06	31	54	0	97	89	14	0
		D.07b	36	52	31	89	87	14	0
		D.08	31	59	0	80	68	14	0
		D.09	47	75	0	97	98	14	0
		D.10	31	54	0	97	89	14	0
	Autumn	D.01	20	63	0	91	80	20	0
		D.02	39	86	0	96	88	20	0
		D.03	49	74	0	86	85	20	0
		D.04b	86	92	20	93	99	35	0
		D.05	71	57	0	87	85	39	0
		D.06	0	0	0	0	0	0	0
		D.07b	44	49	0	90	87	20	20
		D.08	54	39	0	82	80	39	0
		D.09	57	65	0	97	95	30	0
		D.10	20	30	0	81	78	0	0

			Median Percentiles						
		Location	*Myotis* spp.	Leisler's bat	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	Lesser horseshoe bat
2021	Spring	D.01	44	59	0	84	53	34	34
		D.02	34	70	0	62	16	25	0
		D.03	59	64	34	93	84	16	16
		D.04	44	59	0	51	34	16	0
		D.05	0	57	0	34	39	16	16
		D.06	57	51	0	80	75	16	16
		D.07a	44	51	0	43	44	51	0
		D.08	34	39	0	44	16	16	16
		D.09	16	65	0	84	51	0	16
		D.10	34	34	0	76	90	25	16
	Summer	D.01	53	76	0	95	71	16	51
		D.02	16	64	0	68	56	16	0
		D.03	48	68	0	88	90	16	0
		D.04	44	83	0	77	44	34	0
		D.05	25	76	0	79	43	0	16
		D.06	44	75	0	82	64	16	0
		D.07a	44	79	0	77	66	16	0
		D.08	39	16	0	68	59	16	0
		D.09	16	68	0	77	78	16	16
		D.10	53	51	0	96	95	39	16
	Autumn	D.01	55	62	0	96	87	25	16
		D.02	16	84	0	82	44	44	0
		D.03	34	84	0	66	54	34	0
		D.04	34	59	0	90	83	16	16
		D.05	16	51	0	64	70	25	25
		D.06	34	43	0	59	68	16	16
		D.07b	51	66	16	89	65	16	25
		D.08	84	50	0	76	95	16	16
		D.09	16	78	0	98	92	25	16
		D.10	87	48	0	100	100	16	51

3.4.1 Static monitoring results for spring 2020 (25-May-2020 to 11-Jun-2020)

Static detectors were deployed for a total of up to a total of 17 consecutive nights. With the exception of D.06 (16 nights). D.09 (4.5 nights) and D.02 (equipment failure) all of the statics recorded for the 17-night deployment as detailed in the survey effort table, **Table 2.**

Weather data for the spring deployment shows compliance with SNH *et al*. (2021) guidelines of temperatures >8°C at dusk and wind speeds <5 m/s (18 km/h) and little or no rain, for 15 out of the 17 nights deployed as detailed in **Figure A3.1**. There was a single night, the 09-Jun during which it rained for approximately 6 hours though rainfall was only over 1mm for a one-hour period. The rest of the rainfall throughout the survey period was sporadic and below 1mm on all dates. The spring deployment experience particularly high temperatures and low wind speeds for the time of year. The only occasion on which the temperature dropped below 10°C for more than an hour was the morning of the 06-Jun, which occurred close to 5am. Bats likely foraged actively for this night while it was still warm. The weather recorded during this period was highly suitable for bat activity.

Table 12 shows the percentile activity levels. These are varied greatly across location and in the spring specifically D.04a and D.07a showed high activity. Common and soprano pipistrelles both show high levels of activity across all detectors and seasons with the exception of D.10 in and for soprano pipistrelles specifically D.03 in Spring.

Leisler's bats showed moderate/high activity (**Table 12**), with the highest levels (moderate/high) recorded at; D.01 and D.06. Nathusius' pipistrelle activity was sporadic across the seasons but was at its highest in spring being measured as moderate/high at D.07a. Brown long-eared bats had low/moderate activity where they were detected with the exception of D.06 which recorded moderate activity. During the spring lesser horseshoe bats were recorded at D.01, D.04a, D.05, D.08, and D.09. With the exception of D.09, each of these locations only recorded a single pass producing a median percentile of low activity. Lesser horseshoe activity was moderate/low at D.09.

3.4.2 Static monitoring results for summer 2020 (31-Jul-2020 to 19-Aug-2020)

Static detectors were deployed for 18 consecutive nights during the summer season, as detailed in **Table 2.**

D.04b recorded for 8 of the 18 nights. D.01, D.02, D.03, and D.09 recorded for 17 of the 18 nights, while the remaining detectors recorded for the full duration of the deployment.

Weather data for the summer deployment (**Figure A3.2**) shows compliance with SNH *et al.* (2021) guidelines with compliant conditions recorded for 18 of the 19 deployment nights. Mean hourly windspeed did not rise above 8km/h at any point during the summer deployment. The night of the 17-Apr-2020 experienced heavy persistent rainfall. Aside from this instance rainfall of greater than 1mm for a duration of more than 2 hours was not recorded.

Table 12 shows that *Myotis* spp. activity was moderate/high at D.01, D.02, D.03, and high at D.04a. Pipistrelle activity was high at all locations during summer with the exception of soprano pipistrelles at D.08. Nathusius' pipistrelle activity was once again infrequent and occurred at low activity levels at D.03 and D.04b, and low/moderate activity levels at D.07b. Leisler's bat activity was high at D.03 and D.04b, moderate/high at D.01, D.02, D.05, and D.09 and was moderate at all other locations. Brown long-eared bats reached moderate activity levels at D.01, had low/moderate at D.02, D.03, and D.05 and low activity at all other locations. During the summer deployment lesser horseshoe bats were only recorded at D.02 and had low activity levels.

3.4.3 Static monitoring results for autumn 2020 (01-Sep-2020 to 17-Sep-2020)

Static detectors were deployed for 16 consecutive nights during the autumn season. As seen in **Table 2**, three detectors did not record for this entire duration; D.05 which recorded for 15 nights, D.09 which recorded for 13 nights, and D.06 which suffered a data corruption error.

The weather data for this deployment is displayed in **Figure A3.3**. Rainfall during this period exceeded 1mm during the night time on two occasions, the 08-Sep and the 11-Sep. However, this rain was only persistent on the 08-Sep. Windspeed remained below 5km/h for the entire deployment while evening temperatures were consistently above 10°C. The weather station failed to record for a two-hour period prior between 06:00 and 08:00 on the 15-Sep and on another 6-hour period between the 02:00 and 08:00 on the 16-Sep. However, given the weather (approximately 20°C, <18km/h windspeeds, and <1mm rain) recorded before and after this missing data it is considered that nightly conditions overall remained compliant.

Table 12 shows that *Myotis* spp. activity was high at D.04b and moderate/high at D.05. Other locations ranged from low to moderate activity levels. Common pipistrelle activity was high across all detector locations. Soprano pipistrelle activity was moderate/high at D.01, D.08, and D.10 but high at all other locations. Nathusius' pipistrelles were recorded to have low activity at a single location, D.04b. Leisler's bat activity was high at D.02, and D.04b, moderate at D.07b and D.05, moderate/high at D.01, D.03, and D.09, and low at D.08 and D.10. Brown long-eared bats had low activity at D.01, D.02, D.03, and D.07b and low/moderate activity at all other locations where they were recorded. Lesser horseshoe bats were only recorded at one location in autumn, D.07b at low activity levels.

3.4.4 Static monitoring results for spring 2021 (13-May-2021 to 25-May-2021)

Static detectors were deployed for 12 consecutive nights during the spring season, detailed in **Table 3**, with all detectors recording for the full duration. The weather data for this deployment is displayed in **Figure A3.4**. It shows that there were several instances of sub-optimal weather conditions. There were two hours of heavy rain on the night of the 14-May-2021, however, this is alongside a single hour of drizzle and dry conditions until 01:00 on 15-May-2021, alternating between drizzle and heavy rain. It rained heavily for 4 hours on the morning of the 20-May-2021, however the rest of the night had dry conditions. Between 03:00 on 20-May-2021 and 01:00 on the 21-May-2021 there was consistent wind speeds above 18km/h (5m/s) and heavy rain. Evening temperatures were above 8ºC during the deployment. These non-compliant conditions account for 20 hours of the deployment, the deployment as a whole having recorded for 12 nights is considered compliant for 10 nights worth of data.

Shown in **Table 12** *Myotis* spp. moderate activity in the majority of locations with the exceptions of D.02, D.08, D.10 having moderate/low activity and D.09 having low activity. No *Myotis* spp. were recorded at D.05. Leisler's bat activity was moderate/high at D.02, D.03, and D.09, moderate/low at D.08, and D.10 and moderate at all other locations.

Also shown in **Table 12**, Common pipistrelle activity was high at D.01, D.03, and D.09. Common pipistrelle activity was moderate/high at D.02, D.06, and D.10, and moderate at all other locations with the exception of D.05, recording moderate/low activity. Soprano pipistrelles had high activity at D.03 and D.10, moderate/high at D.06, moderate at D.01, D.07 and D.09, moderate low at D.04 and D.05, and low at D.02 and D.08.

Nathusius' pipistrelles were only recorded at D.03 at moderate/low activity levels. Brown long-eared bats had moderate activity at D.07a, moderate/low activity at D.01, D.02 and D.10, and had low activity at all other locations. Brown long-eared bats were not recorded at D.09. Lesser horseshoe bats were recorded across seven locations in the site, with low activity at; D.03, D.05, D.06, D.08, D.09, and D.10.

3.4.5 Static monitoring results for summer 2021 (23-Jun-2021 to 12-Jul-2021)

Static detectors were deployed for 18 consecutive nights during the summer season with the exception of D.10 which recorded 17 nights. Recording times for this deployment are shown in **Table 3**. Wind speeds were above compliant levels (>18km/hr or 5 m/s) for 6 night time hours of the summer deployment. These conditions occurred for an hour in the early morning of the 25-Jun-2021, two hours in the early morning of 26-Jun-2021, an hour in the morning of 27-Jun-2021, and two consecutive hours from midnight onwards on 28-Jun-2021. Heavy rain (>0.5mm) was recorded for 7 night time hours of the deployment, three of which were consecutive and occurred between 00:00 and 03:00 on 03-Jul-2021. The other 4 hours occurred in isolated incidents on the 04-Jul-2021, 06-Jul-2021, 07-Jul-2021, and 11-Jul-2021. A single hour of temperature below 8ºC was recorded, however, this was recorded during the morning and no evening temperatures dropped below 8ºC. The deployment is considered compliant with 13-night hours of non-compliant conditions accounting for a very small proportion of the 18-night deployment. **Figure A3.5** displays a macro-view of weather conditions during the 2021 summer deployment.

Myotis spp. had activity levels similar to those recorded in the 2021 spring deployment with D.01, D.03, D.04, D.06, D.07, and D.10 recording moderate activity. D.05 and D.08 recorded moderate/low activity, while D.02 and D.09 recorded low activity. Leisler's bat activity was high at D.04, low at D.08, and moderate at D.10. All other locations recorded moderate/high activity for Leisler's bat activity.

Nathusius' pipistrelles were not recorded during the summer 2021 period. Common pipistrelles had high activity levels at D.01, D.03, D.06, and D.10, while moderate/high activity was recorded at all other locations. Soprano pipistrelle activity was high at two locations; D.03 and D.10. Soprano pipistrelle was moderate/high at D.01, D.06, D.07, and D.09, while all other locations recorded moderate median activity levels. Brown long-eared bats were absent at D.05 and recorded to have moderate/low activity levels at D.04 and D.10. All other locations recorded low activity for this species. Lesser horseshoe bats were recorded at 4 locations during this deployment. D.05, D.09, and D.10 recorded low median activity levels (1 pass per night recorded) while D.01 proved to be a notable outlier recording moderate activity (4 passes recorded in 1 night all within a 1-minute timeframe).

3.4.6 Static monitoring results for autumn 2021 (13-Sep-2021 to 27-Sep-2021)

Static detectors were deployed for 14 consecutive nights with all recording for the duration with the exception of D.10, which recorded 7.5 nights of data as a result of heightened activity and longer nights causing higher than normal battery consumption. These recording times are shown in **Table 3**. An overview of weather conditions during this deployment is displayed in **Figure A3.6**. Wind speed exceeded compliant levels for a single hour at 01:00 on the 17-Sep-2021 during this deployment. There were 5 hours of heavy rain during this night time hours of this deployment, only two of which were consecutive, between 05:00 and 07:00 on 17-Sep-2021. The other nights with individual hours of heavy rain were; 19-Sep-2021, 20-Sep-2021, and 26-Sep-2021. Considering these wind and rain data along with the fact that no temperature reading below 8°C was recorded during this deployment it is considered compliant relative to weather conditions.

Myotis spp. median activity was recorded to be low at D.02, D.05, and D.09. Moderate/low activity was recorded for *Myotis* spp. at D.03, D.04, and D.06. Moderate activity was recorded at D.01 and D.07b, while D.08 and D.10 recorded high activity making them notable outliers to other deployments in 2021. Leisler's bat activity was recorded to be high at D.02 and D.03, moderate/high at D.01, D.07b, and D.09 with all other locations recording moderate activity.

Nathusius' pipistrelles were recorded as low and only at D.07b during this deployment. Common pipistrelles were recorded as having moderate/high activity at D.03, D.05, and D.08. The detector at D.06 recorded moderate common pipistrelle activity while all remaining detectors recorded high activity. Soprano pipistrelles had moderate median activity at D.02 and D.03, moderate/high activity at D.05, D.06, and D.07b. All other locations recorded high activity for soprano pipistrelles. It is of note that both common and soprano pipistrelles had a median activity percentile of 100 at D.10.

Brown long-eared bats were recorded at moderate activity levels at D.02. Moderate/low activity for brown long-eared bats was recorded at D.01, D.03, D.05 and D.09. All other locations recorded low activity levels for the species. Lesser horse shoe bats were recorded at their most frequent and higher activity levels overall during this deployment in 2021. The species was absent from D.02 and D.03 and had low activity at D.01, D.04, D.06, D.08, and D.09. However, they were recorded to have moderate/low activity levels at D.05, and D.07b, and moderate activity at D.10.

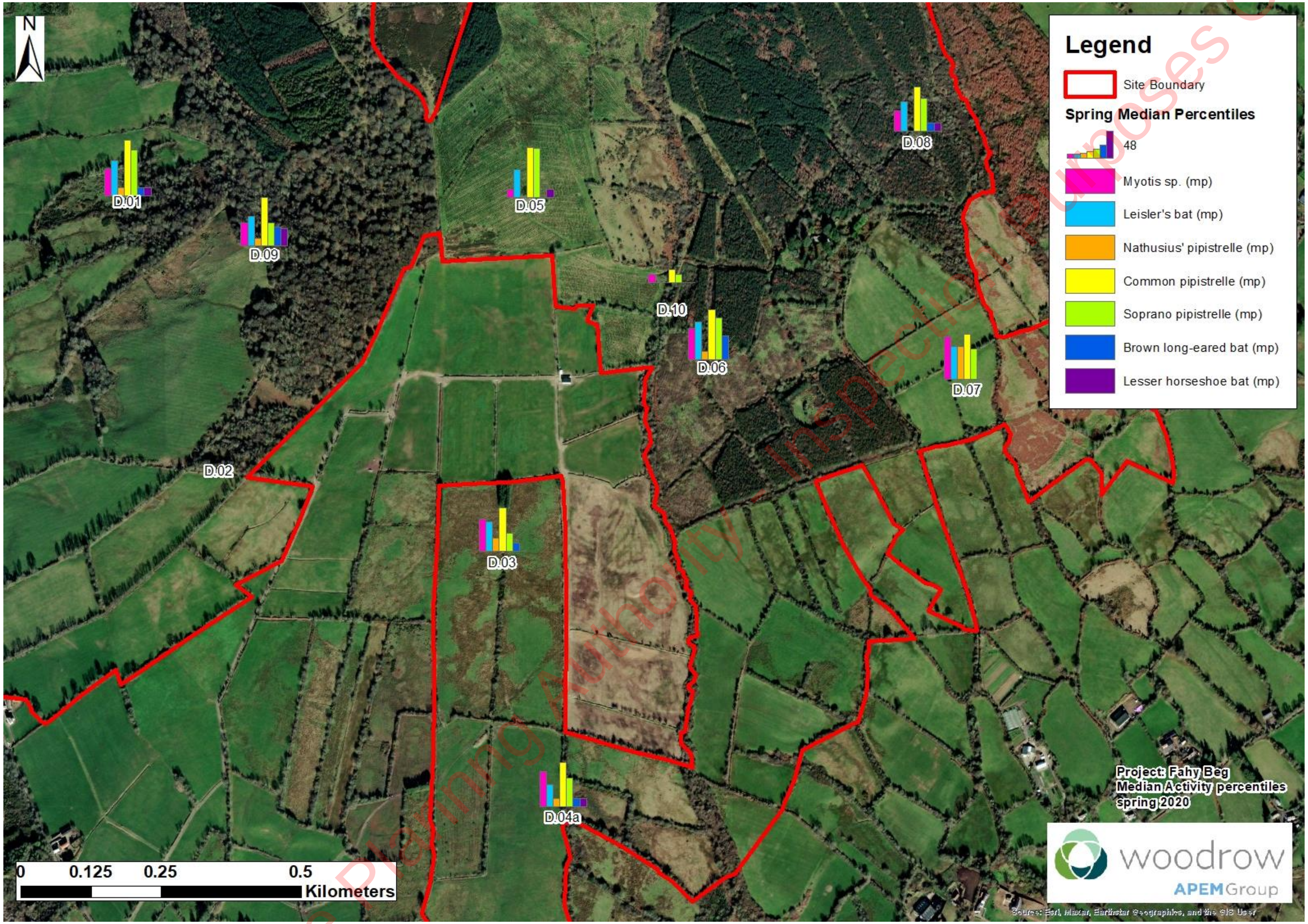

Figure 18 - Median activity percentiles spring 2020

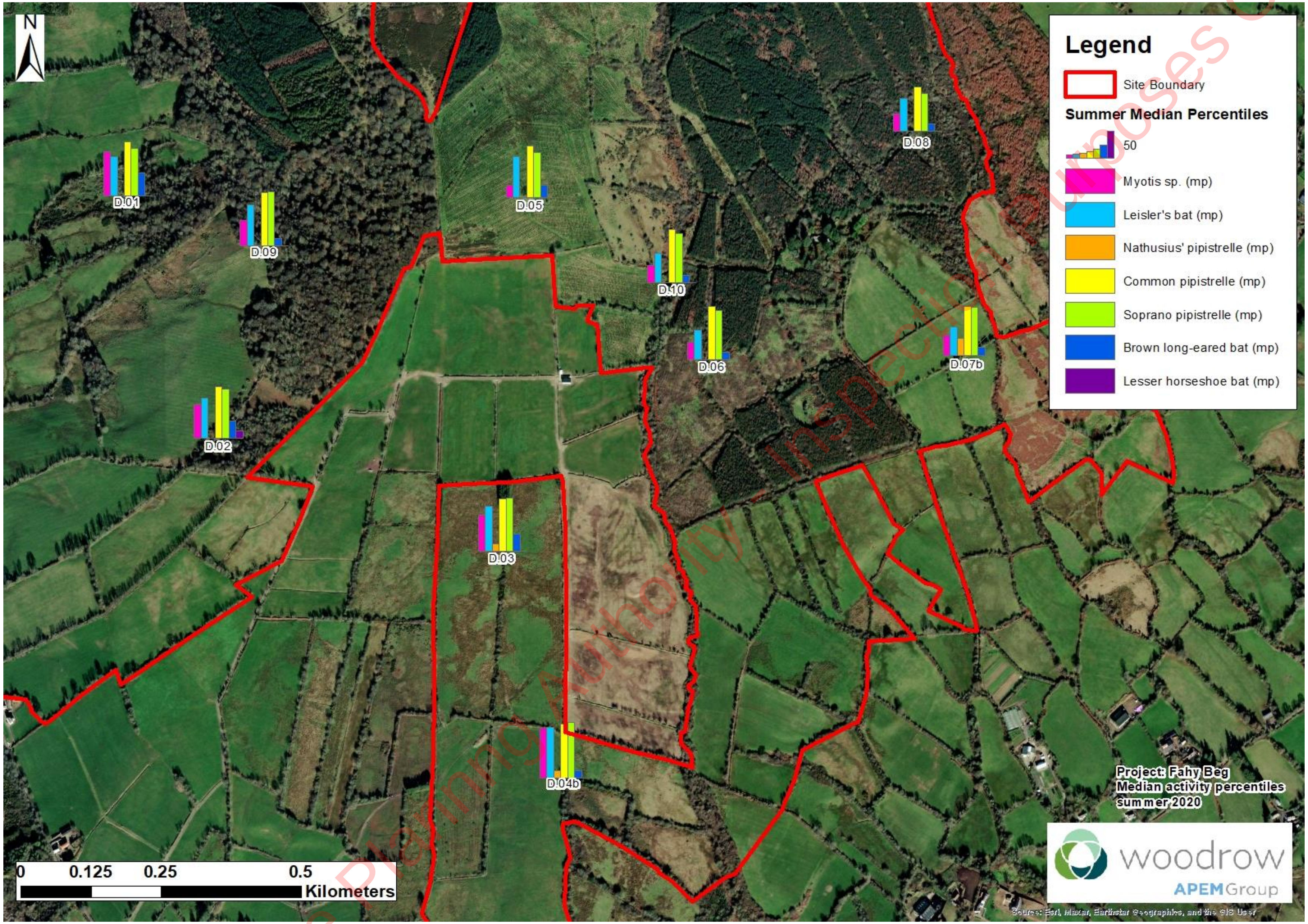

Figure 19 - Median activity percentiles summer 2020

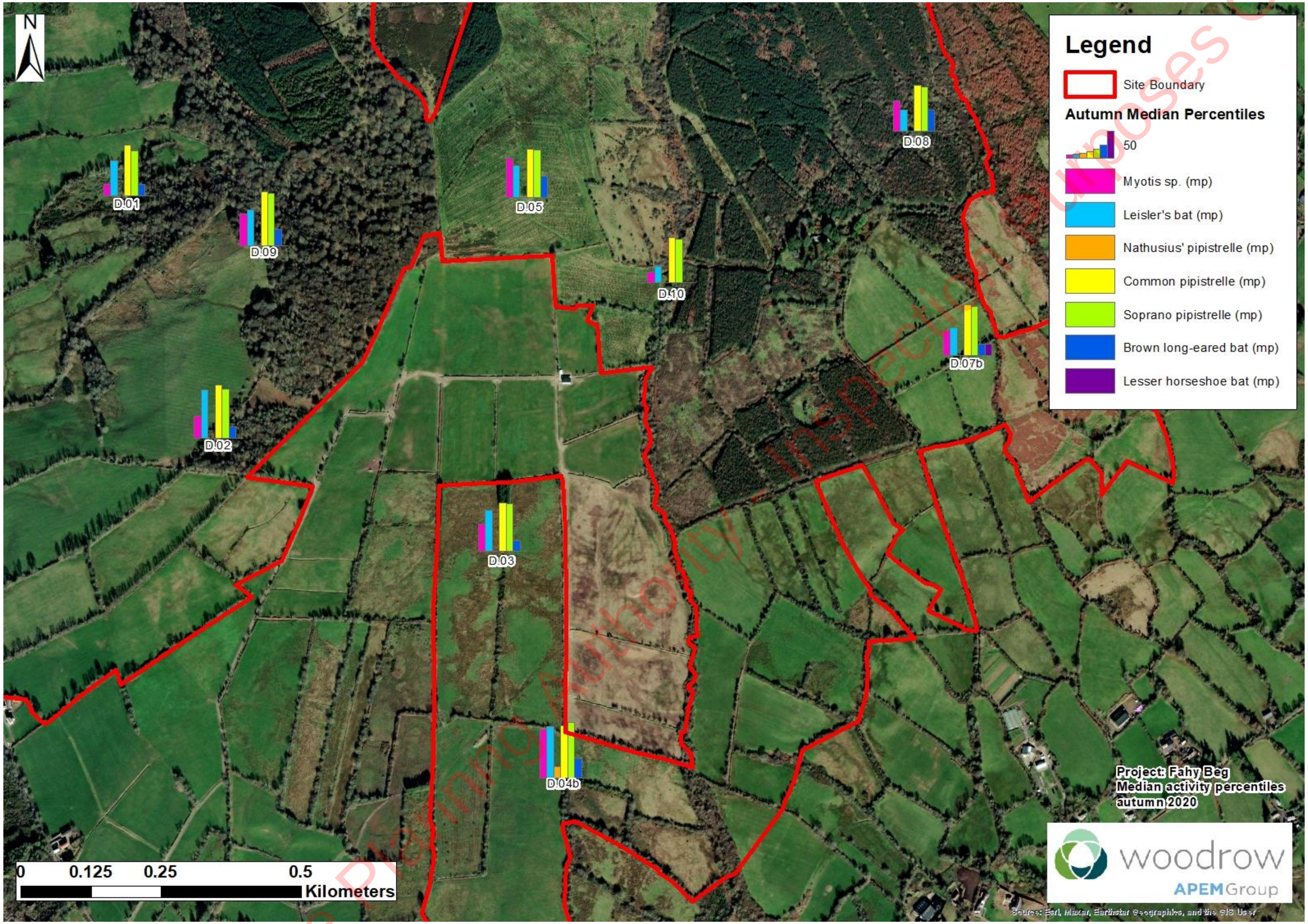

Figure 20 - Median activity percentiles autumn 2020

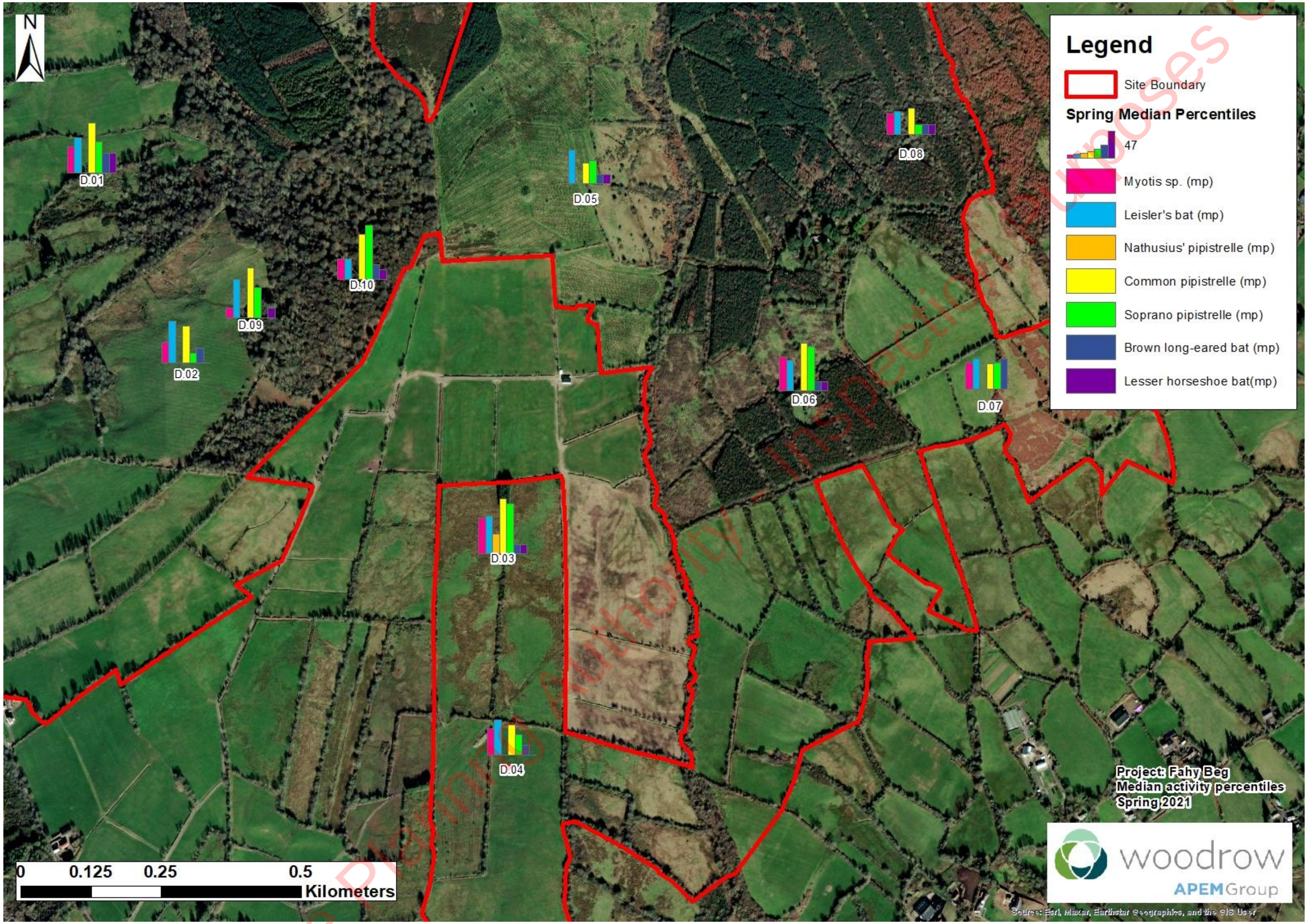

Figure 21 - Median activity percentiles spring 2021

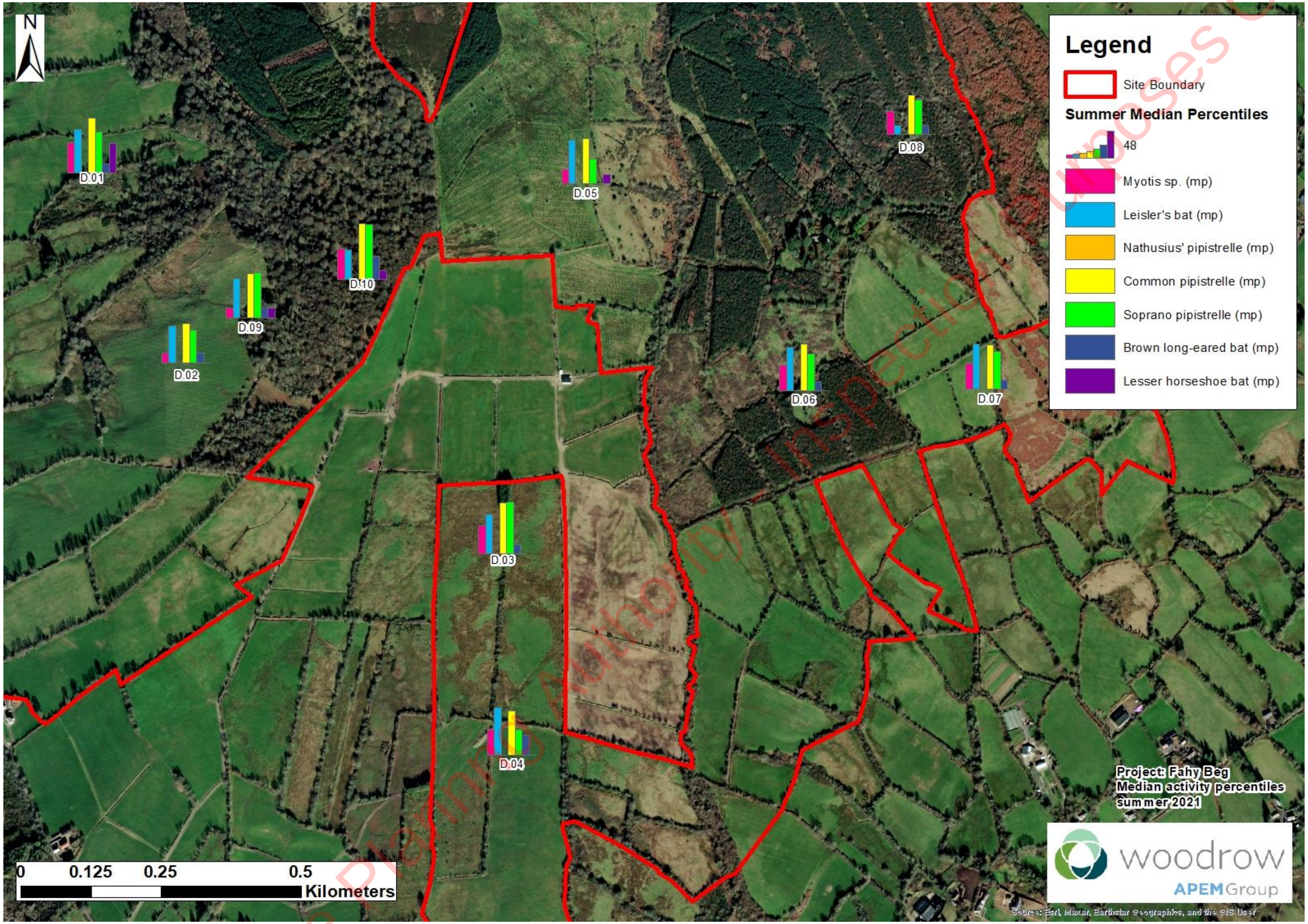

Figure 22 - Median activity percentiles summer 2021

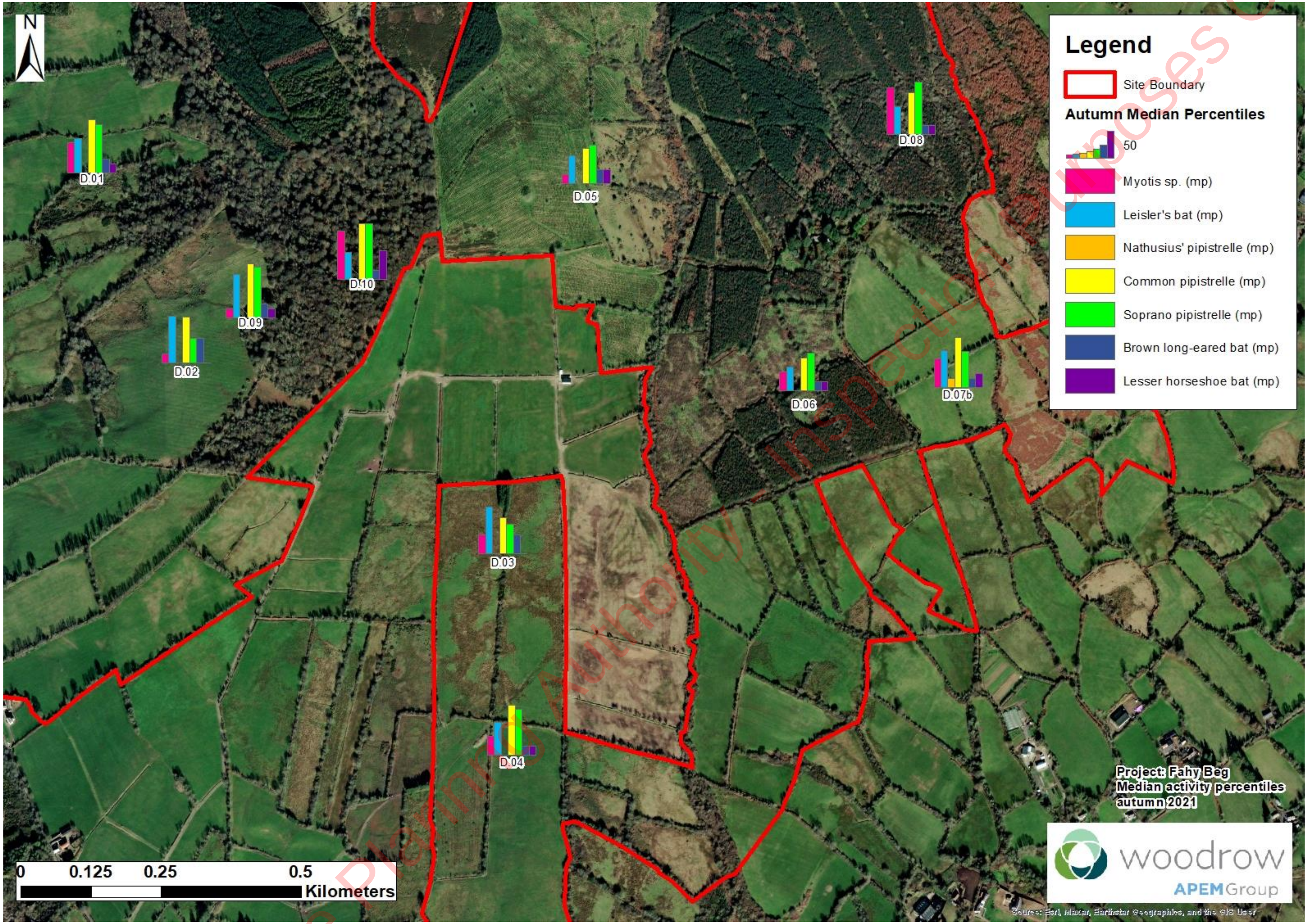

Figure 23 - Median activity percentiles autumn 2021

4 BASELINE CONDITIONS

4.1 Habitat availability and roost suitability

The majority of land within the site boundary is comprised of improved grassland, separated by hedgerows, and hawthorn treelines. On the western side of the site there is an area of long-established beech woodland. On the northern edge of the site there is an area of conifer plantation. There is more conifer plantation to the east of the site though there are mixed broadleaf treelines within the plantation. In the eastern side of the site there is a stream running north to south bordered either side by broadleaf treelines, sitting in a hollow, several metres lower than the surrounding area. This area was assessed to be of high foraging potential, with the presence of water, shelter from the wind, and semi-mature broadleaf treelines. However, this was not supported during the static detector survey in 2020, see D.10 for 2020 in **Table 12**.

Areas in which conifer plantation and woodland interface with improved grassland provide foraging opportunities for bats, particularly pipistrelles. This was demonstrated during the static and transect surveys, particularly in the western side of the site in areas such as D.01, D.02, D.09 2020 and D.09 for 2021. (**Table 12**). One area which seemed to be of particular foraging and commuting importance in 2020 was the treeline along which D.04a/b were placed. Across both years and all seasons, the western treeline of D.01, appeared to be of particular foraging and commuting importance for all species detected with the exception of the poorly represented Nathusius' pipistrelle.

Three areas of hawthorn treeline in the west of the site were originally classed as having moderate roost potential. Upon reassessment in 2021 it was found that trees in these tree lines were of low roost potential.

An area of particular foraging importance is the long-established beech and multiple moderate roost potential trees were recorded during a survey sampling the woodland. Within this woodland one specific tree with severe butt rot has been classed as having high bat roost potential. In 2021, seven trees within the woodland were assessed using emergence or re-entry surveys, while several trees with features in reach of surveyors with a ladder were assessed using an endoscope during the roost suitability surveys. No roosts were confirmed during these surveys; however, the woodland should still be considered of importance to roosting bats given the abundance of suitable potential roost features. If any trees require felling here, it will be necessary to conduct further pre-felling surveys to identify any mitigation and/or compensatory measures that need to be implemented to ensure that bat populations and individual bats are conserved during the works.

In the north of the site a mature ash tree of moderate roost potential exists in the centre of a conifer plantation. The derelict farmhouse and its surrounding buildings varied in suitability from low to high with the main building being of high potential. **Figure 7** illustrates the locations of these areas of roost potential, while **Table 5** outlines any identified features with roost potential, which were considered to be of moderate or greater potential, and which lie within the 300m zone of influence of provisional turbine locations.

4.2 Roost survey results

Table 13 details the summarised results of roost surveys conducted in 2020 and 2021. **Figure 8**, shows the locations where these surveys were conducted. Images of these locations can be found in; **Appendix 1: Roost survey** locations

Table 13 - Roost survey results summary

Location name	Coordinates	Species	Roost type	Evidence
Farm house	52.776226 -8.522304	Soprano pipistrelle	Maternity (Large)	Emergence
Derelict cottage	52.784621 -8.528125	Common pipistrelle Lesser horseshoe bat	Satellite roost (<5 Individuals)	Re-entry Faecal
Mature beech trees in long-established woodland	**Figure 8**	n/a	No confirmed roosts	Emergence Re-entry
Ash in plantation	52.785244 -8.536020	n/a	No confirmed roost	Emergence Re-entry
Tree with severe butt rot	52.7868704 -8.54610011	n/a	Potential night roost	Insect parts Endoscope inspection (No bats)

4.3 Summary of static deployment data

Taking an overview of static deployment results there is a number of patterns which can be discerned, notably: in 2020, bat activity overall is considered to be high. This is largely driven by the fact that common and soprano pipistrelle activity was high across the site. Leisler's bat activity was considered moderate/high. It is also worth noting common and soprano pipistrelles experienced a maximum of 100th percentile median activity on one of its nights recording while Leisler's bat and *Myotis* spp. experienced maximum activity nights of 97th percentile median activity (**Table 10**). In both 2020 and 2021, differences in median activity levels were influenced much more by detector location than season.

In 2021 the overall activity summary for the whole years summer recording showed similar activity levels to 2020 with only two species having differing median activity levels across the two years. Soprano pipistrelles decreased from a high activity classification to a moderate/high activity level, while Nathusius' pipistrelles increased from a low activity level to a moderate/low activity level (**Table 10**; **Table 11**). Once again, the highest median activity levels were produced by common and soprano pipistrelles.

The following are some notable points taken from the results of the static deployments:

- During both years of surveying, as a general trend there was an increase in bat activity from spring to summer followed by a decrease in the autumn. However, some open areas recorded higher activity in the autumn.
- Excluding pipistrelles, in 2020 the only other locations with 'High 'activity recorded for individual species was 'High' Leisler's bat activity at D.03 and D.04b in summer and D.02 and D.04b in autumn, and 'High' *Myotis* spp. activity at D.04b in summer and autumn.
- In 2021, excluding pipistrelles, notable high results were recorded for; *Myotis* spp. at D.08 and D.10 in autumn. Activity was also 'High' for Leisler's bat D.02 and D.03 in summer, D.03 and D.03 in autumn
- The Annex II species, lesser horseshoe bat was recorded on the site, though only as sporadic individual calls across 7 different locations of the site in 2020, with their activity at these locations classed as low in all cases with the exception of moderate/low activity at D.09 in spring. However, over the course of surveys in 2021 lesser horseshoe bats were recorded in small numbers, across multiple locations, more consistently throughout the three deployments. Though only a small number of calls were recorded, they were analysed as having moderate activity at D.01 in summer and D.10 in autumn.
- All detectors in 2020 (with the exception of D.07a) were placed along linear or edge features, which are frequently exploited by foraging pipistrelles.
- The 2021 deployment of static detectors sought to contextualise this data with detectors placed in more open environments. The impact of several detectors in the open and the comparison of data to a more robust Ecobat dataset can be seen when comparing species activity on a site wide basis, but more specifically in terms of pipistrelle activity in locations such as D.02, D.04, and D.07 (**Table 12**).
- The highest activity levels for both years of study were produced by common and soprano pipistrelles at D.10 in the autumn of 2021 and soprano pipistrelles at D.04b in the summer of 2020, all having median percentile activity level of 100.
- An examination of bat species passes relative to weather conditions in 2021 can be seen in **Figure 24**. The following holds true across all species; the 95% confidence interval ellipse highlights an area above 6°C and below max ground level wind speeds of approximately

4m/s. While those parameters show the conditions at which 95% of bats were recorded foraging, they do forage in poorer conditions during spring, with all species (with the exception of the data poor Nathusius' pipistrelle), having several passes recorded between 0°C and 4°C. This figure gives a preliminary insight into the specific weather conditions at which bats are active and provides an important guide should mitigation in the form of curtailment be required.

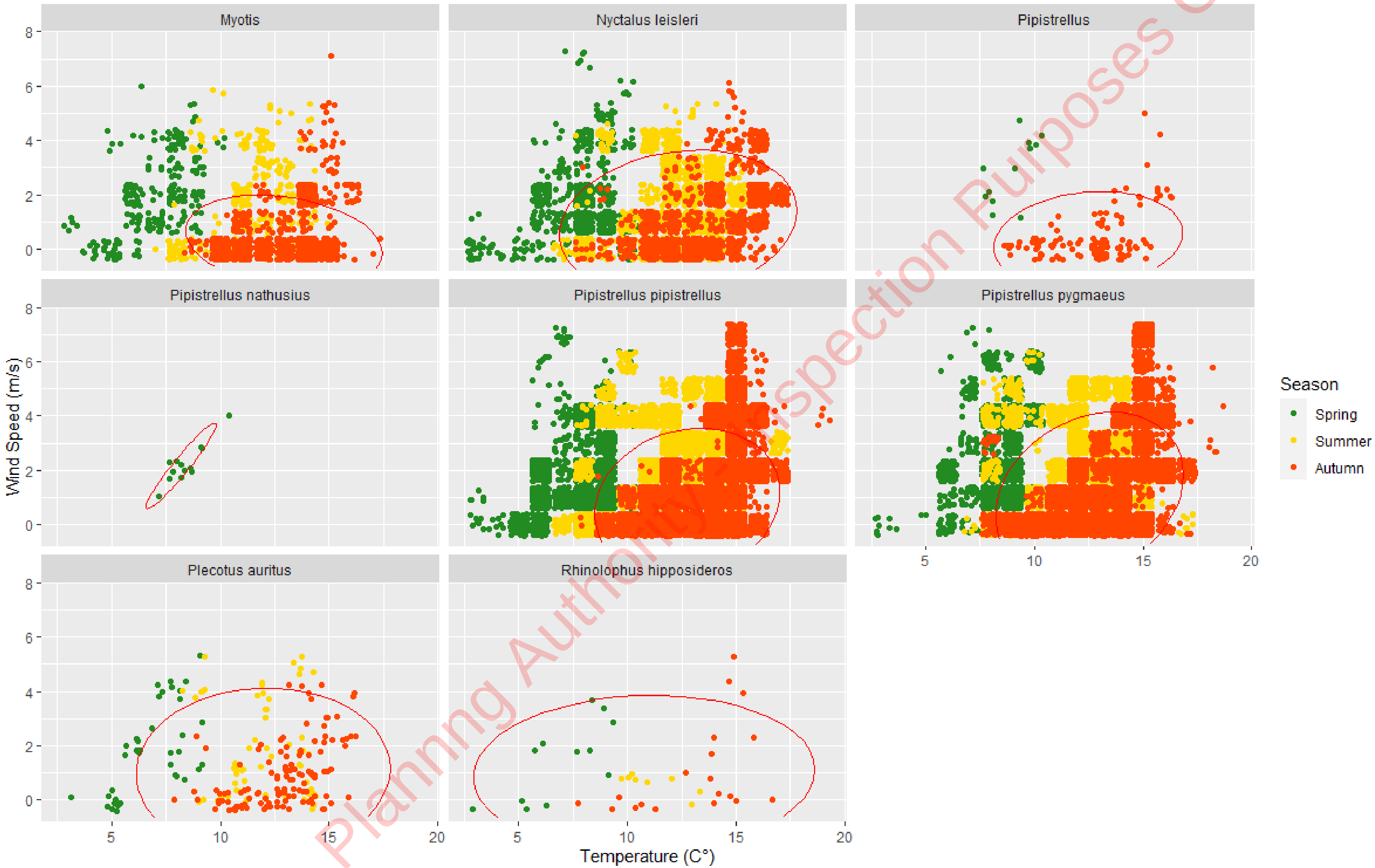

Figure 24 - Bat passes relative to temperature and wind speed in 2021 with 95% confidence ellipses made using multivariate t-distribution

4.4 Species activity within the windfarm site

During the 2020 and 2021 seasons, bat activity was recorded within the survey area for a minimum of seven species, including common pipistrelle, soprano pipistrelle, Leisler's bat, *Myotis* species, brown long-eared bat, Nathusius' pipistrelle, and lesser horseshoe bats. The majority of bat activity was attributed to soprano and common pipistrelles. Soprano and common pipistrelles were recorded in all months during transect and static surveys and were the most commonly encountered species for static surveys during all of the seasonal deployments.

4.4.1 Pipistrelle species

Common and soprano pipistrelles were recorded throughout the survey area and at all deployments in 2020 and 2021. Common pipistrelles were the most active species within the site.

The Ecobat analysis shows that common pipistrelles were the species most frequently recorded to have high median activity levels (**Table 12**). Common pipistrelles were recorded as having high median activity for the following:

- 2020
    - D.01, D.05, D.06, D.09 during spring;
    - all locations in summer with the exception of D.08; and,
    - all locations in autumn.
- 2021
    - D.01, D.03, and D.09 during spring;
    - D.01, D.03, D.06, and D.10 during summer; and,
    - D.01, D.02, D.04, D.07b, D09, and D.10 during autumn.

Common pipistrelles were also the most active species recorded for three of the four transect surveys of the site in 2020. The transect survey conducted on the 01-Sep-2020 recorded more soprano pipistrelles (**Table 7**), though this is likely a function of the surveys start location being at the known farmhouse roost to the south of the site. The transect surveys show that the treelines and hedgerows within the improved grassland of the site are in use by bats for foraging and commuting throughout the site. Foraging common and soprano pipistrelles were recorded foraging along the road traversing the site on the surveys conducted on the 31-Jul-2020 and 18-Aug-2020 (**Figure 8**).

In 2021 common pipistrelles were the most abundant species on all transects conducted (**Table 8**). Transect results were similar to 2020, showing common pipistrelles foraging and commuting along treelines and forestry edge with no records made in improved grassland more than several metres from features. **Figure 13** displays this exceptionally well. In 2021 the derelict farmhouse was confirmed to be in use by an individual pipistrelle (**Table 13**).

In both 2020 and 2021 soprano pipistrelles were less active than common pipistrelles however, both species show the same trend in how their activity levels change between deployments, with lowest activity levels recorded in spring, while highest activity levels were in the summer and then a reduction of activity again in autumn. During autumn they retained activity levels higher than those recorded in spring. A slight difference in trend was recorded in 2021 with more locations showing activity increases from spring to summer and even more still from summer to autumn (**Table 12**). This is likely a result of weather conditions in autumn 2021 having similar temperatures and lower wind speeds than those in summer of the same year (**Figure A3.5**, **Figure A3.6**)

While common pipistrelle bat were active at consistently high levels, soprano pipistrelle bat had comparatively lower levels at three locations relative to the rest in spring and autumn of 2020 (D.03, D.09, and D.10). The median activity levels for soprano pipistrelle at D.09 in spring (41 percentile) does not match common pipistrelle activity levels (high). However, the activity at D.04b in summer is high, more specifically the highest activity recorded on site in 2020 (100 percentile **Table 12**).

Soprano pipistrelle bat matched common pipistrelle in having 100 percentile median activity in D.10 in the autumn of 2021, further demonstrating the use of this area as foraging habitat.

During 2020 Nathusius' pipistrelles were recorded at low activity levels as classed by Ecobat (**Table 10**). The number of Nathusius' pipistrelle recorded decreases from spring to summer and further still into autumn, with only one call recorded in the autumn deployment. A similar trend was repeated in 2021 differing slightly with a complete absence in summer. This is likely a result of the migratory pattern exhibited by Nathusius' pipistrelle, which involves migration to Western Europe in autumn and winter, with a return migration to Eastern Europe in late spring (Russ 2001). The deployment timeframes potentially documented the final individuals leaving/passing through on route to Western Europe but ended prior to numbers increasing again for the winter.

4.4.2 Leisler's bat

Leisler's bat were the third most active species, classed as having moderate/high median activity in 2020 (**Table 10**). Areas at which high activity were measured include; D.03 and D.04b in summer, and D.02 and D.04b in autumn (**Table 12**). The location classed as having the highest levels of activity was D.04b in summer and spring. This result was not replicated in 2021. In 2021 activity for Leisler's bat were high on three occasions; at D.04 in summer and at D.02 and D.03 in autumn.

Leisler's bat will frequently fly at heights greater than other species and are also less reliant on the use of linear features generally increasing their risk of turbine collision. This is shown with Leisler's bat have moderate to moderate/high activity for the majority of locations within the site during both years, showing a lesser reliance on habitat features.

Leisler's bat were not recorded during the first two transects conducted on 12-Jun-2020 and on 31-Jul-2020. On the subsequent surveys (18-Aug-2020 and 01-Sep-2020) they were recorded, though in low numbers. The transect survey on 18-Aug-2020 recorded several individual Leisler's bat foraging with three passes recorded on the walked section of the transect into the field south west of D.04. (**Figure 11**). A spot count at the end of the survey at the entrance to the fields in the west of the site only recorded a single Leisler's pass. The transect survey on 01-Sep-2020 which covered a relatively small amount of the site but recorded 30 Leisler's passes of bats foraging along the track in the east of the site (**Figure 12**).

In 2021 Leisler's bat were recorded on a higher proportion of transects only being absent on one of the six transects (12-Jul-2021; **Table 8**). Transect surveys in May and June in 2021 only recorded several individual passes, while a higher number were recorded 11-Aug-2021 (23) and 24-Aug-2021 (18), which were recorded in the long-established woodland and quarry respectively.

4.4.3 Myotis species

During the 2020 recording period *Myotis* species activity was measured to be at its highest at D.04b, recording high activity in summer and autumn (90 and 86 percentile respectively). In 2021 there were only two instances of high activity; at D.08 and D.10 in autumn (**Table 12**).

In 2020 recordings of *Myotis* spp. during the transect surveys (**Table 7**) are limited to the eastern side of the site, with foraging records being taken for individuals adjacent to derelict farmhouse on 12-Jun-2020 (5 passes; **Figure 9**). During the transects on the 18-Aug-20 and 01-Sep-2020 several individuals were recorded foraging along the track leading to the derelict farm house in the east of the site (**Figure 11**; **Figure 12**). During the emergence survey at the derelict farmhouse on 31-Jul-2020 a *Myotis* spp. were recorded on the site several times within its usual emergence time. However, it is unclear if this species emerged from any of the farmhouse buildings. The bat was recorded flying within the shed during poor weather conditions. This is not a confirmed use of this building as a roost as it was not observed resting/roosting within it, but warranted further examination in 2021.

No *Myotis* bats were recorded emerging from the farmhouse or surrounding sheds during 2021. During the 2021 transect surveys *Myotis* spp. were recorded in low numbers on all transects with the exception of the transect through the long-established beech woodland in August (**Table 8**). The highest number of passes in a single transect was to the southwest of the site along the access track to the site (6 passes; **Figure 14**). Though only recorded in low numbers on transects they were seemingly more widespread across the site recorded as can be seen in **Figure 21**, **Figure 22**, and **Figure 23**.

4.4.4 Brown long-eared bat

It is acknowledged that accurately monitoring brown long-eared activity can prove quite difficult as this species is known to make low amplitude calls and frequently forage using their eyes or ears rather than echolocation (Collins, 2016 and Russ, 2012). As a result, brown long-eared bats are frequently underrepresented in surveys which rely on the use of bat detectors.

A single brown long-eared bat was recorded during the 2020 transect surveys in a field in the west of the site (south of D.01). Brown long-eared median activity was classed as low on a site-wide basis (**Table 9**). The slightly higher levels of activity recorded in the west of the site is likely due to the presence of the long-established beech woodland as brown long-eared bats are frequently associated with broadleaf woodland. On two occasions during 2020 brown long-eared were recorded to have moderate median activity levels; D.06 in spring and D.01 in summer. In 2021 brown long-eared bats once again were recorded at moderate activity levels at two locations; D.07 in spring and D.02 in autumn.

4.4.5 Lesser horseshoe bat (LHS)

Only 13 lesser horseshoe bat passes were recorded by static bat detectors deployed during 2020. The location with the highest number of passes was D.02 which recorded 4 passes in summer. Their highest median activity level was at D.09 at moderate/low in spring. In 2021 they were recorded more widely across the site and at slightly higher median activity levels. They were recorded at moderate/low activity levels on three occasions; D.01 spring, and D.05 and D.07b in autumn. They were also recorded at moderate activity levels at D.01 in summer and D.10 in autumn. It is important to note that each of these moderate percentile classifications references 4 individual call registrations at these locations in their respective season. The low number of registrations leading to elevated percentile classifications for lesser horseshoe bat suggests that the reference data set used by Ecobat for this species is impoverished. The assertion, accounting for the limitations of the Ecobat reference data set, is that overall activity levels are low and the proposed development site is only likely to be utilised by a small numbers of lesser horseshoe bats.

As shown in **Figure 4**, the proposed site lies within approximately 10-15km of three lesser horseshoe SACs (west of the site). The nearest of these being Danes Hole, Poulnalecka Cave SAC (000030), a site which is considered be one of the eastern most points in the Irish distribution of this species (NPWS, 2013). The proposed development site well beyond the core foraging range of lesser horseshoe bats (2.5km). However, it is estimated that lesser horseshoe summer and winter roosts are usually no more than 5 to 10km apart (Collins *et al.* 2016). This puts the proposed development just within the 10km winter to summer range for lesser horseshoe bats. Therefore, there is potential for bats using the Danes Hole, Poulnalecka Cave SAC as a winter roost to commute to the wind farm site during the summer season.

Only two lesser horseshoe bat passes were recorded during the emergence surveys conducted in 2020. These passes were recorded at the derelict farmhouse and occurred at 43 and 50 minutes after sunset. The median time of emergence for lesser horseshoe bats is approximately 31 minutes after sunset. (Jones & Rydell, 1994). Further surveys of the derelict cottage in 2021 confirmed its use as a roost by at least one lesser horseshoe bat during the maternity season and was classed as a satellite roost, which is a roost used by males and non-breeding females (**Table 13**). Occupation by < 5 individuals is considered a small roost and to put the significance of this roost into context, typically the presence of 100 or more LHS bats in summer or the presence of 50 or more in winter has been applied as the criteria for a site to qualify for SAC designation.

4.5 Association of bat activity with features

The results of both transect and static surveys conducted in 2020 clearly show the strong association between bat passes and linear features (**Figure 9** to **Figure 17**). With the exception of a single detector in the spring season all deployments during this survey were along linear features such as treelines, stream, and woodland or forestry edge. In the west and south of the site, particularly treelines connected to the area of long-established woodland are important features for commuting and foraging bats.

In the 2021 survey season, more static detectors were deployed in open locations in order to contextualise the use of linear features. This was done with a particular emphasis on open locations adjacent to linear features in the west and south of the site for which static surveys recorded the highest levels of activity. Keeping this in mind, some detectors were retained along linear features in order to provide the most accurate representation of proposed turbine locations at the time of surveys. Between 2020 and 2021 the following detectors were moved to or retained in more open locations; D.02, D.04, and D.07, while the following were retained along linear features D.01, D.03, D.06, D.08, and D.09. The detectors D.05 and D.10 were placed within woodlands, D.05 being in a spruce plantation and D.10 being in the long establish woodland within the proposed development site.

Though activity levels on a site wide basis were measured to be much the same across the two years (**Table 10**; **Table 11**), activity specifically at D.02, D.04, and D.07 for pipistrelles were lower in 2021, while Leisler's activity stayed at a similar level. The most analogous detectors for comparison between open and linear habitats are D.09 and D.02 during 2021 which for the majority of species, particularly pipistrelles, shows higher activity at D.09 (**Table 12**). The highest activity in the site was within the long-established beech woodland, with the detector within the woodland (D.10) recording median percentiles of 100 for both soprano and common pipistrelles in autumn.

Lesser horseshoe bats are highly reliant on linear features for commuting and foraging and will very infrequently cross open habitats (Bontadina *et al*., 2002). Given that a small lesser horseshoe roost was found onsite all linear features and woodland within the site are within the foraging range of the species (2.5km). Use of the site by lesser horseshoes was documented well through static surveys with calls being recorded at all locations with the exception of D.02, D.03, D.04b, D.06, and D.10 in 2020, and D.02 and D.07a in 2021 (**Table 12**). While the removal of linear features is an effective form of mitigation for reducing risk collisions for bats (SNH *et al*., 2021), the impact of vegetation and linear feature removal on foraging lesser horseshoe bats will need to be considered and appropriate mitigation in the form of onsite replanting and enhancement will be required as an integral element of the proposed development. Connectivity between woodland habitats along features with documented use by lesser horseshoe bats should be retained or replanted in order to reduce any impact on this species.

5 ASSESSMENT OF POTENTIAL IMPACTS

5.1 Ecological evaluation of bat species

Bats are protected by law in the Republic of Ireland under the Wildlife Act 1976 and subsequent amendments (2000 and 2010). Under the Wildlife Act, it is an offence to intentionally disturb, injure or kill a bat or disturb its resting place. Under this legislation it is unlawful to destroy, alter or disturb known bat roosts without an appropriate derogation licence, as issued by the National Parks and Wildlife Service (NPWS).

All bat species fall under Annex IV of the EU Habitats Directive (1992), whereby member states have a burden of responsibility to protect bats and their resting places wherever they occur. The EU Habitats Directive has been transposed into Irish law with the European Communities (Birds and Natural Habitats) Regulations 2011. In order to comply with the requirements of these regulations wind farm applications in Ireland need to be assessed as to their potential impact on bat populations.

In order to undertake an assessment of the potential impact of the proposal on bats, it is important to take into account not only what bat species and numbers are present on the site, but also how susceptible those species are to impacts from wind turbines and how susceptible populations of the species occurring are to the impacts in an Irish context.

SNH *et al*. (2021) provides guidelines for conducting risk assessment for bat species occurring on wind farms; however, it is not fully clear how the assessment methodology relates to Irish bat populations. Therefore, the assessment of the Fahy Beg Wind Farm site draws on several sources to emulate the SNH guidance, including Marnell *et al.* (2009) and Wray *et al*. (2010) for the bat population assessments in Ireland (see **Table 14**). For collision risk of bat species to wind turbines (see **Table 15**) SNH *et al*. (2021) is used.

As listed in **Table 14**, on an all-Ireland basis Leisler's bats are considered to be *Near Threatened*, while all other species are categorised as *Least Concern* (Marnell *et al.*, 2009).

As shown in **Table 15**, Leisler's bats and Nathusius' pipistrelles are considered as *high risk* of direct impacts from with wind turbines, as they regularly fly in the open and at heights, which may put them at risk of collision or barotrauma from turbines. The SNH *et al*. (2021) guidelines consider both common and soprano pipistrelles to be at *high risk* of direct impacts from wind turbines; based on a study investigating bat collisions at wind farm sites across the UK (Mathews *et al*, 2016), which found both these species to be amongst the most commonly recorded casualties during searches of turbines. The SNH *et al*. (2021) guidelines update Natural England guidance, which had classified common and soprano pipistrelle as *medium risk* species (NE, 2014), based on flight behaviours of common and soprano pipistrelles that habitually fly low and close to landscape features, such as hedgerows. *Myotis* species, brown long-eared bats and lesser horse bats are considered as *low risk* based on behaviour and foraging techniques of these species.

Based on population status in Ireland and risk level in relation to adverse interactions with turbines, it is important to ascertain, which bat populations may be threatened due to impacts from wind turbines, and this assessment is shown in **Table 16**. On the basis of this information, it is clear that particular attention should be paid to Leisler's bats and Nathusius' pipistrelles, which are believed to be susceptible to impacts from wind turbines and have populations of *high population vulnerability*, in the context of wind turbine developments in Ireland. Leisler's bats are generally considered to forage habitually at height in more open landscapes and are less associated with habitat features than other bat species. Nathusius' pipistrelles are known to be migratory and may fly at height during migration. For this assessment we adhere to SNH *et al*. (2021) guidance, under which common and soprano pipistrelles are considered to have *medium population vulnerability* to wind farm developments in Ireland due to behaviour in relation to turbines. Whiskered bats are also classed as *moderately vulnerable*, due scarcity range in Ireland. Lesser horseshoe bats, brown long-eared bats and the two other Irish *Myotis* species (Daubenton's bat and Natterer's bat) are considered to have *low vulnerability* to wind farm developments in Ireland, being rarer species (populations of 10,000 to 100,000) exhibiting low collision risk with turbines.

Table 14 – Conservation status of bat species in Ireland (Marnell *et al*. 2009)

Species	**Rarity in Ireland** Wray *et al*. (2010)	**Irish status** (Marnell *et al*., 2009)
Daubenton's bat *Myotis daubentonii*	Rarer (Frequent/widespread)	Least concern
Whiskered bat *Myotis mystacinus*	Rarest (Scarce/widespread)	Least concern
Natterer's bat *Myotis nattereri*	Rarer (Scarce/widespread)	Least concern
Leisler's bat *Nyctalus leisleri*	Rarer (Frequent/widespread)	Near threatened
Common pipistrelle *Pipistrellus pipistrellus*	Common (Widespread)	Least concern
Soprano pipistrelle *Pipistrellus pygmaeus*	Common (Widespread)	Least concern
Nathusius'pipistrelle *Pipistrellus nathusii*	Rarer (Rare/restricted)	Least concern
Brown long-eared bat *Plecotus auritus*	Rarer (Frequent/widespread)	Least concern
Lesser horseshoe bat *Rhinolophus hipposideros*	Rarer (Rare/restricted)	Least concern

Table 15 – Level of collision risk to individual bats from wind turbines
Sources: Adapted from SNH *et al*. (2021)

Collision risk		
Low risk	**Medium risk**	**High risk**
Myotis species Brown long-eared bat Lesser horseshoe bat		Leisler's bat Nathusius' pipistrelle Common pipistrelle (SNH, 2021) Soprano pipistrelle (SNH, 2021)

Table 16 – Level of potential vulnerability of bat populations in Ireland
Sources: Adapted from Wray *et al*. (2010) & SNH *et al*. (2021)
Yellow = ***low*** population vulnerability Beige = ***medium*** population vulnerability Red = ***high*** population vulnerability

Ireland		**Collision risk**		
		Low risk	**Medium risk**	**High risk**
Relative abundance	**Common species**			Common pipistrelle Soprano pipistrelle
	Rarer species	Daubenton's bat Natterer's bat Brown long-eared bat Lesser horseshoe bat		Leisler's bat Nathusius' pipistrelle
	Rarest species	Whiskered bat		

5.2 Valuing bat populations

The nature conservation value of a receptor is based upon a geographic hierarchy of importance. The following categories are used to inform the assessment of impacts:

International: sites, habitats and species populations of international or European importance;

National: sites, habitats & species populations of national importance;

Regional: sites, habitats & species populations of importance in a regional (South-west) context;

County: sites, habitats & species populations of importance in a county context;

Local: sites, habitats & species populations of importance in a parish or district context;

Low: sites, habitats & species populations of less than local importance, still of some value.

Approaches to attributing nature conservation value to species have been developed for bats (see Wray *et al*. 2010). The approach to scoring foraging habitat and commuting features is summarised in **Table 17.**

Using the criteria set out in **Table 17** and based on the baseline data collected during surveys, it is considered that the study area scored:

- 5 for roosts/potential roosts nearby
- 4 for foraging habitat characteristics
- 4 for type and complexity of linear features
- The following for number of bats
  - 20 for number of bats for common pipistrelle and soprano pipistrelle
  - 20 for number of bats for Leisler's bat
  - 10 for number of bats for lesser horseshoe bat, *Myotis* species and brown long-eared bat

On a site wide basis this equates to species specific scores of:

- 31 for common pipistrelles and soprano pipistrelles. This ranks the wind farm site as holding foraging and commuting populations of these species that are of ***Regional Importance****.*
- 34 for Leisler's bat. This ranks the wind farm site as holding foraging and commuting populations of this species of ***Regional Importance***
- 38 for *Myotis* species (whiskered bat if occurring*). This ranks the wind farm site as holding foraging and commuting populations of this species of ***Regional Importance***
- 24 for Lesser horseshoe bats, *Myotis* species (Daubenton's bat and Natterer's bat), and brown long-eared bats. This ranks the wind farm as holding foraging and commuting populations of ***County Importance***
- 19 for Nathusius' pipistrelle. This ranks the wind farm site as holding a foraging and commuting population of ***Local Importance***.

***Note**: Whiskered bats are considered to occur locally in small numbers across Ireland and it is acknowledged that it is a species that can go undetected during surveys (McAney, 2006). There are two potential records received from BCI within 10-km of the site. One record is a roost *c*.5.7km from the site while the second is a survey record *c*.6.7m. Neither record makes the distinction between whiskered bat or Brandt's bat, however, the presence of either species is a rare occurrence. There are no NBDC records of whiskered bats within 10km of the site. Based on habitat availability, the species could potentially occur on a site like Fahy Beg Wind Farm. However, the risk of collision for

Myotis species is considered low further consideration is only given to this species within its Genus (i.e. as *Myotis* species).

With the exception of Nathusius' pipistrelle (and whiskered bat if present), the bat species recorded utilising the wind farm site are generally considered common and widespread in an Irish context (Marnell *et al*., 2009 & Roche *et al*., 2014). Taking into account the EU Annex IV protected status of bats, the bat assemblage is considered to represent a feature of ***Regional Importance***.

Table 17 – Scoring system for valuing sites and foraging areas/ commuting routes for bats

Score	Species	Score	Number of bats	Score	Roosts/ potential roosts nearby	Score	Foraging habitat characteristics / Type and complexity of linear features
2	Common	5	Individual bats	1	None	1	Site without established vegetation e.g. urban
						1	Absence of (other) linear features
				3	Small number	2	Suburban areas or intensive agriculture
						2	Unvegetated fences and large field sizes
5	Rarer	10	Small number	4	Moderate number or not known	3	Isolated woodland, less intensive agriculture etc
						3	Walls, with many gaps or flailed hedgerows, isolated well grown hedgerows, and moderate field sizes
				5	Large number or close to protected areas for bats	4	Large connected woodland blocks, mixed agriculture etc
						4	Well-grown and well-connected hedgerows, small field sizes)
20	Rarest	20	Large number	20	Close to or within SAC for bats	5	Mosaic of pasture, woodlands and wetlands
						5	Complex network of mature well-established hedgerows, small fields and rivers/streams

Importance	Score
International	> 50
National	41-50
Regional	31-40
County	21-30
Local	11-20
Not important	1-10

5.3 Risk Assessment

The following sections provide a preliminary assessment of the potential impacts on bats during two phases of the project, including construction phase impacts and operational phase impacts. The results of the definitive impact assessment will be provided within the EIAR - Biodiversity Chapter, which will also assess the potential impacts during a decommissioning phase.

An initial (Stage 1) potential risk assessment for the Fahy Beg Wind Farm site was carried out using the risk assessment matrix provided in SNH *et al*. (2021) – Table 3a. For habitat risk, *High* was entered into the matrix as the wind farm site was assessed to have the following three conditions from the *High* risk habitat section in SNH *et al* (2021):

- *Numerous suitable buildings, trees (particularly mature ancient woodland) or other structures with moderate-high potential as roost sites on or near the site, and/or confirmed roosts present close to or on the site.*
- *Extensive and diverse habitat mosaic of high quality for foraging bats.*
- *Site is connected to the wider landscape by a network of strong linear features such as rivers, blocks of woodland and mature hedgerows.*

For project size the *Medium* category was selected, as this is the best fits the proposed Fahy Beg Wind Farm as it features aspects from both the small and large project sizes (<10 turbines – small, turbines >100m – large). These two parameters returned a site risk score of **4**, which is considered a ***high site risk***.

The next of step of the risk assessment (Stage 2) uses a second matrix (Table 3b in SNH *et al*., 2021) to derive an overall risk assessment based on the activity level of high collision risk species, which in this instance are Leisler's bat, common pipistrelle, soprano pipistrelle, and Nathusius' pipistrelle. The Stage 2 - risk assessment matrix is reproduced in **Table 18** and for each of the four high collision risk species the activity score is multiplied by the site risk score, which as stated above was determined to be 4 – high risk site. Active levels are derived from Ecobat percentiles presented in the results section.

Table 18 – Stage 2: Overall risk assessment matrix
Source: SNH *et al*. (2021)

Potential site risk level	**Ecobat activity category** (or equivalent justified categorisation)					
	0 Nil	**1 Low**	**2 Low-moderate**	**3 Moderate**	**4 Moderate-high**	**5 High**
1 Lowest	0	1	2	3	4	5
2 Low	0	2	4	6	8	10
3 Medium	0	3	6	9	12	15
4 High	0	4	8	12	15	18
5 Highest	0	5	10	15	20	25

Location and season specific risk assessment values generated using the matrix presented in **Table 18** are presented in **Table 19.** Ecobat scores from 2021 were used during this risk assessment as it is considered the more robust dataset especially given that the Ecobat report produced in 2021 had the 2020 data incorporated into its reference dataset. This table highlights species at risk levels in specific locations and seasons.

Table 19 - Risk assessment value for deployment locations
Applies matrix in Table 18, specific to species, location, and season using the 2021 Ecobat analysis results for high collision risk species

Collision risk species		Leisler's bat	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle
Spring	D.01	12	0	18	12
	D.02	15	0	15	4
	D.03	15	8	18	18
	D.04	12	0	12	8
	D.05	12	0	8	8
	D.06	12	0	15	15
	D.07a	12	0	12	12
	D.08	8	0	12	4
	D.09	15	0	18	12
	D.10	8	0	15	18
Summer	D.01	15	0	18	15
	D.02	15	0	15	12
	D.03	15	0	18	18
	D.04	18	0	15	12
	D.05	15	0	15	12
	D.06	15	0	18	15
	D.07a	15	0	15	15
	D.08	4	0	15	12
	D.09	15	0	15	15
	D.10	12	0	18	18
Autumn	D.01	15	0	18	18
	D.02	18	0	18	12
	D.03	18	0	15	12
	D.04	12	0	18	18
	D.05	12	0	15	15
	D.06	12	0	12	15
	D.07b	15	4	18	15
	D.08	12	0	15	18
	D.09	15	0	18	18
	D.10	12	0	18	18

The outputs of the overall risk assessment are then considered in the context of any potential impacts at the population level for species assessed having high population vulnerability (see **Table 16**), which in Irish context are Leisler's bat and Nathusius' pipistrelle.

Table 20 provides a summary of bat population vulnerability to wind farm impacts (see **Table 16**), species activity recorded at the Fahy Beg Wind Farm site and the regional importance attached to bat populations found to occur at the Fahy Beg Wind Farm site (locally to internationally important based on Wray *et al*, 2010 – see **Table 17**).

Table 20 – Summary of collision risk impact assessment
Including bat population vulnerability to wind farm impacts, species activity recorded and the regional importance attached to bat populations found to occur at the Fahy Beg Wind Farm Site

Species	Population vulnerability wind farms impacts	Overall activity levels at Fahy Beg WF (Ecobat)	Site wide risk levels at Fahy Beg WF for high collision risk spp.	Population Importance at Fahy Beg WF (Scoring based on Wray *et al*., 2010)
Leisler's bat	High	Moderate/High	15	Regional (34)
Nathusius' pipistrelle	High	Moderate/Low	8	Local (19)
Soprano pipistrelle	High	Moderate/High	15	Regional (31)
Common pipistrelle	High	High	18	Regional (31)
Myotis species	Low	Moderate	Low collision risk	County-Regional (24-39)
Brown long-eared bat	Low	Low	Low collision risk	County (24)
Lesser horseshoe bat	Low	Low	Low collision risk	County (24)

5.4 Impact on bats

Wind turbines and associated infrastructure present a number of potential impacts to bats, namely:

1. Damage of or disturbance to roost sites during construction
2. Loss or fragmentation of habitat
3. Collision with rotor blades and barotrauma
4. Displacement or disturbance of commuting or migration routes

The first two of these are most relevant to the construction phase of the project, while the latter two relate to potential impacts in the operational phase. The following sections provide an assessment of the potential impacts on bats during the two phases of the project, including construction phase impacts and operational phase impacts.

5.5 Construction phase: potential direct impacts on bats

Direct effects on bats during construction include vegetation removal, resulting in a loss of potential roost sites in mature trees or the removal/modification to existing buildings.

No demolition or modification of existing buildings has been proposed as part this project, notably the derelict building occupied by small numbers of common pipistrelle and lesser horseshoe bat will remain *in situ*. Throughout the proposed construction corridor vegetation clearance will be required to facilitate access and construction activities, including creating gaps through treelines/hedgerows. In addition, felling required to implement proposed turbulence reduction buffers/bat feature buffers and substation standoffs has the potential to directly impact on roosting bats.

Felling is likely to be proposed for the following areas around turbines:

- Scrub removal and surgery of broadleaf trees to facilitate the sub-station and access track through the Roadstone quarry.
- The removal or surgery of broadleaf trees within the long-established woodland for the construction of the access track between turbines.
- The removal of ash and hawthorn treeline at T1
- The removal of the hawthorn hedgerow near T3, T4, & T8
- The removal of conifer plantation at T5 & T6. There is a single ash tree of moderate potential within 100m of the turbine location T5.
- The removal of conifer and mixed broadleaf plantation surrounding T7.

As highlighted in the baseline survey results, the long-established beech woodland in the west of the site supports veteran trees, classed as having largely moderate PRFs with the occasional high PRF. The proposed assess track through this woodland will require vegetation removal including the felling of veteran trees with the potential to support bat roosts and in absence of mitigation the risk of directly impacting bat roosts is high.

The assessment of negligible potential for roost sites within conifer plantation likely to be affected by vegetation clearance means that direct effects on roosting bats is highly unlikely within this habitat type where is occurs around proposed turbines and along wind farm access tracks. The conifer plantation where T5 proposed contains a single tree of moderate potential which was surveyed, and no roost was recorded. The broadleaf treeline within the felling area of T4 was classed as having low roost potential. Other hedges, scrub and woodland within likely felling areas around proposed turbine locations was classed as supporting negligible or low PRFs and therefore direct effects on roosting bats is considered unlikely across much of the proposed construction area.

Using Table 2 from Wray *et al*. 2010 to assess the value of roost types, the presence of any potential roosts within the likely felling buffers are of ***Local*** importance. Therefore, the removal of these trees in the absence of mitigation are considered to be ***Significant*** at the at the ***Local*** level.

5.6 Construction phase: potential secondary impacts on bats

Potential secondary impacts on bats resulting from construction works are limited to the loss of foraging and commuting habitats/features utilised by bats. Disturbance of roosting and foraging bats through lighting impacts was considered; however, it is understood that there will be no night-time working at the site and as such no additional lighting will be required during the construction phase of the works. In addition, the species utilising this site most – Leisler's bat, soprano pipistrelle and common pipistrelle – are less sensitive to light pollution than the less commonly recorded species – lesser horseshoe bats, brown long-eared bats and *Myotis* species. Lesser horseshoe bats are notably sensitive to light pollution.

The proposed development site holds a number of hedgerows, treelines, and woodland that are known to be used by foraging and commuting bats. The baseline study shows that linear features, the long-established woodland and connecting treelines and hedgerows are highly active foraging grounds for bats. These features are of particular importance to lesser horseshoe bats which are heavily reliant on features for commuting and foraging. Vegetation removal as a result of the proposed felling detailed in the previous section will also impact on bat foraging patterns within the site, particularly given the high levels of activity seen in conifer plantations. The removal of vegetation capable of disrupting connectivity within the site is likely to occur at all turbine locations, with the except of T2 and at the proposed substation.

In the absence of mitigation, vegetation removal has the potential secondary impacts of the proposal upon bats are considered, without mitigation, to be ***Significant*** at the ***Regional*** scale.

Danes Hole, Poulnalecka Cave SAC (000030) is a lesser horseshoe bat SAC of which the eastern most point lies within 8.5km of the site. Given that the migratory range between summer and winter roosting sites for this species is 10km (Collins 2016), there is potential for individuals which hibernate in the to the SAC to utilise the wind farm site for summer roosting and foraging. For this reason there are potential impacts from this the removal of foraging and commuting habitat on the lesser horseshoe bat population ecologically linked to this SAC.

5.7 Operational phase: Potential direct impacts on bats

Both direct collision with rotor blades and barotrauma (injuries to internal air cavities and blood vessels caused by sudden change in air pressure behind a moving blade), have been found to directly impacts bats (e.g. Cryan & Barclay, 2009, Rydell *et al*., 2010, Cryan *et al*. 2014, & Mathews *et al*., 2016). The evaluation of Irish bat species likely to be at risk from collision and barotrauma is detailed in **Table 16**; and is in part related to the likelihood of different species flying at rotor blade height in an open landscape. The SNH *et al*. (2021) guidance incorporates the 50m set-back distance between the rotor swept area and habitat features (such as forestry edge and treelines/ hedgerows). However, this guidance mainly applies to certain species, such as common and soprano pipistrelles, which are known to follow linear habitat features when foraging or commuting. It is not relevant to areas where linear features are absent or sites where Leisler's bat activity is high, since this species is just as likely to fly over open terrain as along habitat features.

Different bat species have different foraging behaviours and ecological requirements, infrastructure such as wind turbines may affect different species in different ways. Each bat species recorded at the wind farm site is considered in the following sections. It is important to note that the probability of impact is lower for those turbines located away from habitat features. In open habitat, the probability of such an impact is considered less likely. However, where turbines are located within close proximity to features such as hedgerows and treelines (notably T1, T3, T4, T5, T6, T7 and T8), there is potential for a greater occurrence of bats within the rotor-swept area, resulting in increased potential for impact.

The potential operational impacts of the proposed development on bat populations in the area need to be considered in the context of proposed mitigation measures for bats. Mitigation will include minimum separation distances from likely (foraging and commuting) features of 50 m to the rotor swept areas for all turbines. This necessitates a requirement for vegetation clearance; and then re-planting appropriate areas to compensate for the habitat loss and ensure integrity of the wider area for foraging and commuting bats. As proposed felling will take place during the construction phase, any likely significant effects of felling operations on roosting and foraging bats are assessed under construction related impacts.

5.7.1 Likely direct operational phase effects on common and soprano pipistrelles

As listed in **Table 16**, both common pipistrelle and soprano pipistrelle are considered to be of high risk of injury or mortality from turbines, resulting from either barotrauma (injuries to internal air cavities and blood vessels caused by sudden change in air pressure behind a moving blade) or collision, based on the behaviour and foraging techniques of this species. Both species typically show an affinity to habitat features such as woodland/plantation edge, scrub, treelines and hedgerows; however, pipistrelles are also known to forage more regularly in open habitat. Some of the proposed infrastructure at the site is close to features that are used by these species for foraging/ commuting. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found that these two species of pipistrelle were amongst the casualties most commonly recorded during turbine searches.

As summarised in **Table 20**, common and soprano pipistrelles are widespread and common throughout Ireland; however due to flight behaviour, population vulnerability to windfarm developments for both species is classed as *high risk* (**Table 16**). Both species were classed as having an overall risk assessment of *high* on a site-wide basis (**Table 20**). As presented in **Table 19** evaluation of location specific species risk levels found that common pipistrelles were only a medium risk at D.04, D.05, D.07a, and D08 during the spring and at D.06 during the autumn, while all other locations and seasons were classed as *high* risk. On a location and season specific basis they received a *medium* overall risk level at D.02 throughout all seasons. They were also received an overall *medium* risk evaluation at D.01, D.04, D.05, D.07a, D.08, and D.09 in spring, D.04, D.05, and D.08 in summer, and D.03 in autumn.

Without mitigation, potential impacts of the operational phase upon common pipistrelle and soprano pipistrelle are considered to be ***Significant*** at the ***Regional*** level.

5.7.2 Operational phase: Potential impacts on Nathusius' pipistrelle

As listed in **Table 16**, Nathusius' pipistrelles are considered as *high risk* of injury or mortality from wind turbines resulting from either barotrauma or collision; as this species regularly flies in the open and at heights. Nathusius' pipistrelles are strong flyers and known to be migratory in parts of their European range and may fly at height during migration. A review of turbine related bat fatalities in Europe (Rydell *et al*., 2010) found that 13% of the casualties were Nathusius' pipistrelles.

As summarised in **Table 20**, Nathusius' pipistrelles are classed as having high population vulnerability to wind farm developments due the assumed vulnerability of the population and flight behaviour. It is acknowledged that there is limited population assessment data available for this species in Ireland; however, indications are that the range and frequency with which this species are recorded is increasing. In an Irish context, the apparent range expansion could be an apparition caused by increased survey effort and improved survey techniques. Even when considering seasonal or localised risk the assessment remains medium. Even though this species was only recorded at low levels at two locations (D.03 spring and D.07b autumn) in 2021 the species was assessed to have an overall risk level of *medium* on both a site wide basis and at these locations (**Table 19**).

Without mitigation, potential impacts of the operational phase on Nathusius' pipistrelles are considered to be ***Significant*** at the ***County*** level.

5.7.3 Operational phase: Potential direct impacts on Leisler's bat

As listed in **Table 16**, Leisler's bats are considered as being at high risk of impact from wind turbines, based on species behaviour and foraging techniques, in terms of both the likelihood of barotrauma or collision. Leisler's bats are strong and fast in flight, regularly foraging over, or taking direct flights across, open habitats at heights within the collision risk zone for wind turbines. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found that common noctule bats (*Nyctalus noctula*), were amongst the casualties most commonly recorded during turbine searches (along with common and soprano pipistrelles). Common noctule bats are not known to occur in Ireland; however, it is a similar species to Leisler's bats (lesser noctule bats) in terms flight behaviour, and therefore similar levels of collision-risk would be predicated. Leisler's bats are very sparsely distributed in England and Wales, and only occasionally recorded in Scotland; and this explains why it was not encountered during turbine searches based in the UK. Leisler's bat is listed as Near Threatened on the Irish Red List of Terrestrial Mammals (Marnell *et al*. 2009).

On a site-wide basis Leisler's bats were assessed to have an overall risk level of *high* (**Table 20**). On a location and season specific basis, the only locations which were not assessed as *high* risk at least once were D.08 and D.10, assessed as *medium* risk throughout. The other locations assessed as *medium* were D.01, D.04, D.05, D.06, and D.07a in spring and D.04, D.05, and d.06 in autumn.

Without mitigation, potential impacts of the operational phase upon Leisler's bat are considered to be ***Significant*** at the ***County to Regional*** level.

5.7.4 Operational phase: Potential direct impacts on *Myotis* species

As listed in **Table 16**, bats of the genus *Myotis* are considered as being at low risk of impact from wind turbines based on species behaviour and foraging techniques. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found a single carcass of a *Myotis* bat during the searches (a Natterer's bat - *Myotis nattereri*). *Myotis* species are rarely recorded flying at heights above the canopy (20 to 30m) and tend to prefer a more cluttered habitat due to their short range, high frequency echolocation characteristics. Furthermore, their relatively slow flight speed allows them to manoeuvre well and therefore have the agility to avoid collision events (Mathews *et al*., 2016 & Rydell *et al*., 2010). Because of the behaviour exhibited by these species, the probability of direct operational impact is *Unlikely*

Given the low collision risk for this species even without further mitigation, potential direct impacts of the operational phase upon *Myotis* species are considered to be ***Not Significant.***

5.7.5 Operational phase: Potential direct impacts on brown long-eared bat

As summarised in **Table 16**, brown long-eared bats are considered as being at low risk of impact from wind turbines. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found a single brown long-eared bat carcass during the searches. The standard mode of flight behaviour exhibited by this species results in the probability of an impact from wind turbines to be *Unlikely*.

Given the low collisions risk of this species, even without further mitigation, potential impacts of the operational phase upon brown long-eared bat are considered to be ***Not Significant.***

5.7.6 Operational phase: Potential direct impacts on lesser horseshoe bat

As summarised in **Table 16**, lesser horseshoe bats are considered as being at low risk of impact from wind turbines. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK did not find any lesser horseshoe bat carcasses during the searches. However, this study does note that only a limited number of sample wind farms were within the known range for lesser horseshoe bat. This species is known to forage within dense woodland and actively avoid open areas (Bontadina *et al.* 2002) further reducing the probability of collision events given the likely need for turbine to feature buffers. The standard mode of flight behaviour exhibited by this species results in the probability of an impact from wind turbines to be *Unlikely*.

Given the low collision risk of this species. even without further mitigation, potential impacts of the operational phase upon , lesser horseshoe bat are considered to be ***Not Significant.***

5.8 Operational phase: Potential secondary impacts on bats

As proposed felling operations will take place during the construction phase, any likely significant effects of vegetation removal on roosting and foraging bats should be assessed under construction related impacts.

Disturbance of roosting bats and disturbance of foraging bats though lighting impacts during the operational phase is *Unlikely* for most species, as the installation of additional lighting proposed will be minimal. The notable exception are lesser horseshoe bats which are highly sensitive to light pollution. The species utilising the site the most – Leisler's bat, soprano pipistrelle and common pipistrelle – are less sensitive to light pollution than the less commonly recorded species – lesser horseshoe bat, brown long-eared bats, and *Myotis* species.

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APPENDIX 1: ROOST SURVEY LOCATIONS


Plate 1 - Tree with severe butt rot.


Plate 2 - Derelict farmhouse showing emergence/re-entry points

Plate 3 - Entry/emergence points on derelict farmhouse (closer view)

Plate 4 - Derelict cattle shed

Plate 5 - Ash tree in conifer plantation

Plate 6 - PRF on ash in plantation

Plate 7 - PRF on ash in plantation

Plate 8 - Mushroom rot tree

Plate 9 - Mushroom rot tree interior view

Plate 10 - Beech tree featuring peeling bark, tear out, and knot holes (surveyed 11-Aug-2021)

Plate 11 - Standing dead beech with fluting, broken branches, tear outs, and a knot hole (surveyed 14-Sep-2021)

Plate 12 - Veteran beech with compression fork in beech woodland (surveyed 24-Aug-2021)

APPENDIX 2: KALEIDOSCOPE ANALYSIS SETTINGS

The following appendix details the relevant Kaleidoscope processing settings as they appear in the settings.ini file (available on request).

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APPENDIX 3: WEATHER DATA

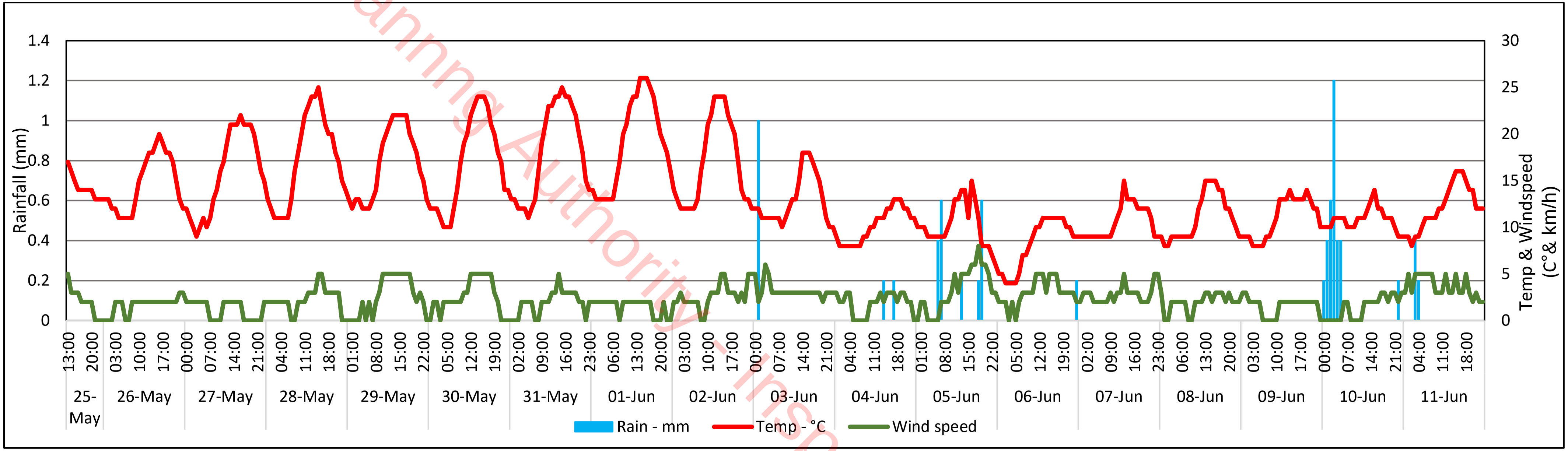

Figure A3.1 - Mean hourly weather conditions for the duration of the 2020 spring deployment

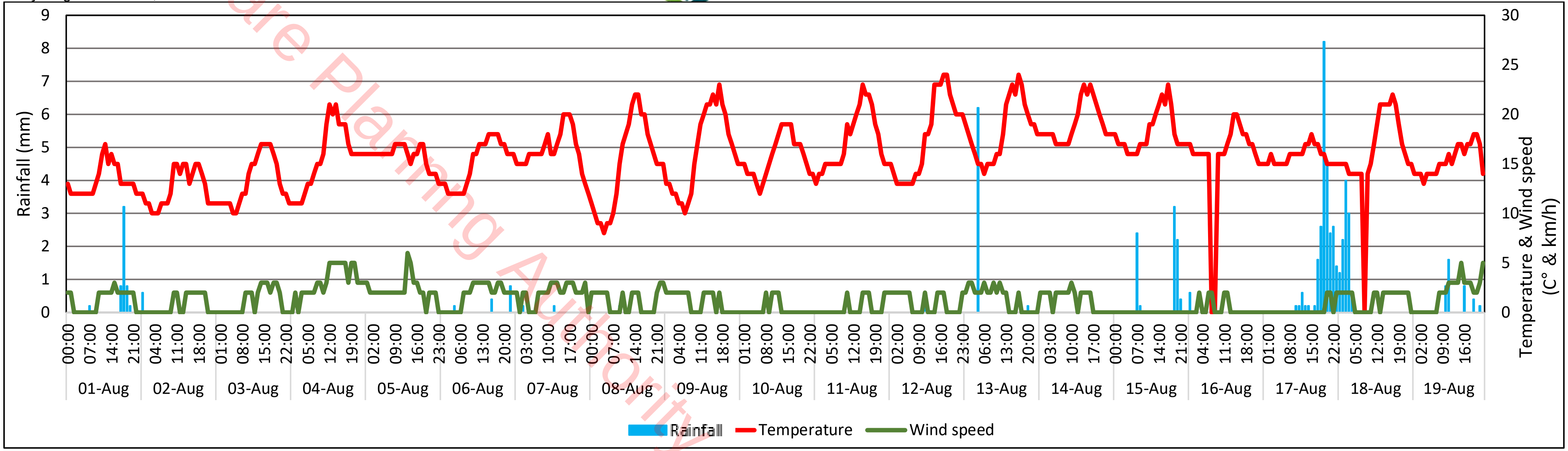

Figure A3.2 - Mean hourly weather conditions for the duration of the 2020 summer deployment

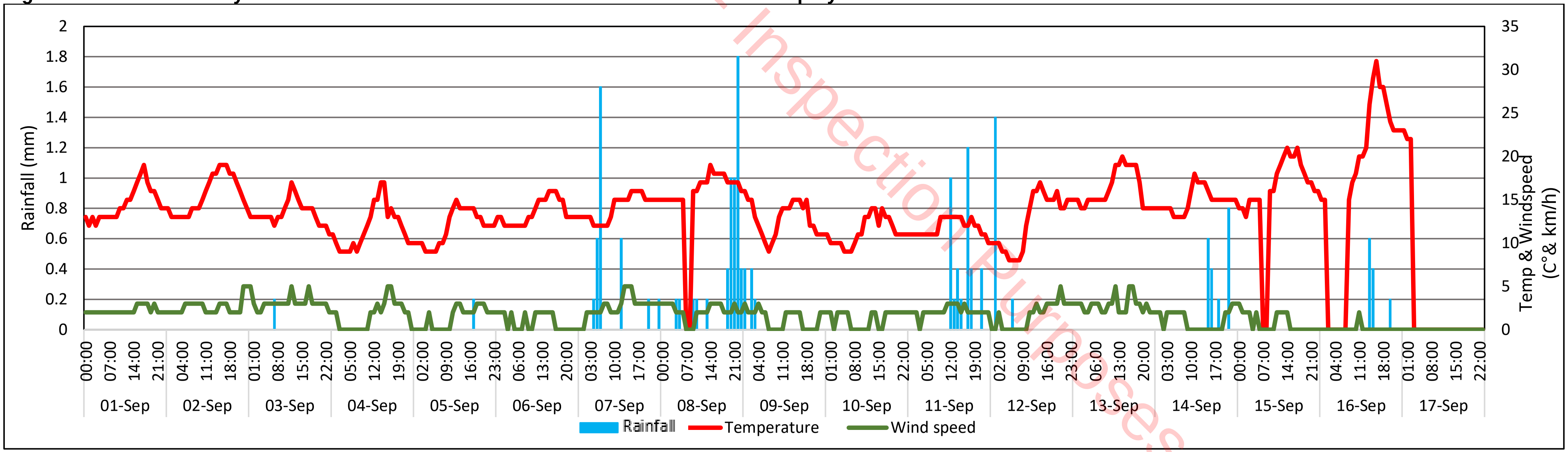

Figure A3.3 - Mean hourly weather conditions for the duration of the 2020 autumn deployment

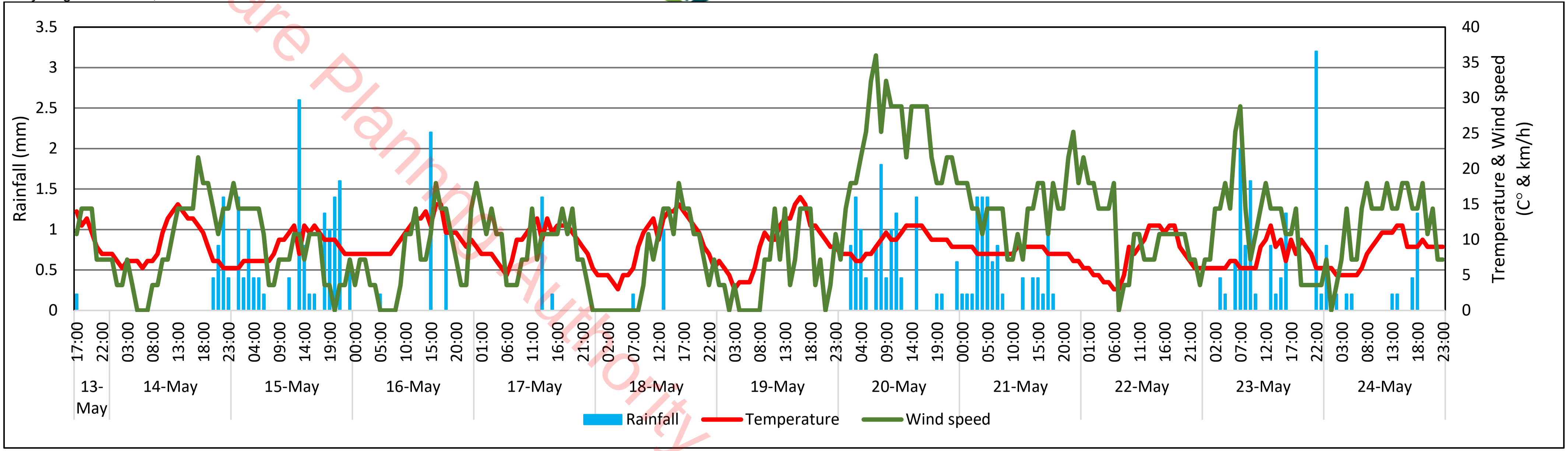

Figure A3.4 - Mean hourly weather conditions for the duration of the 2021 spring deployment

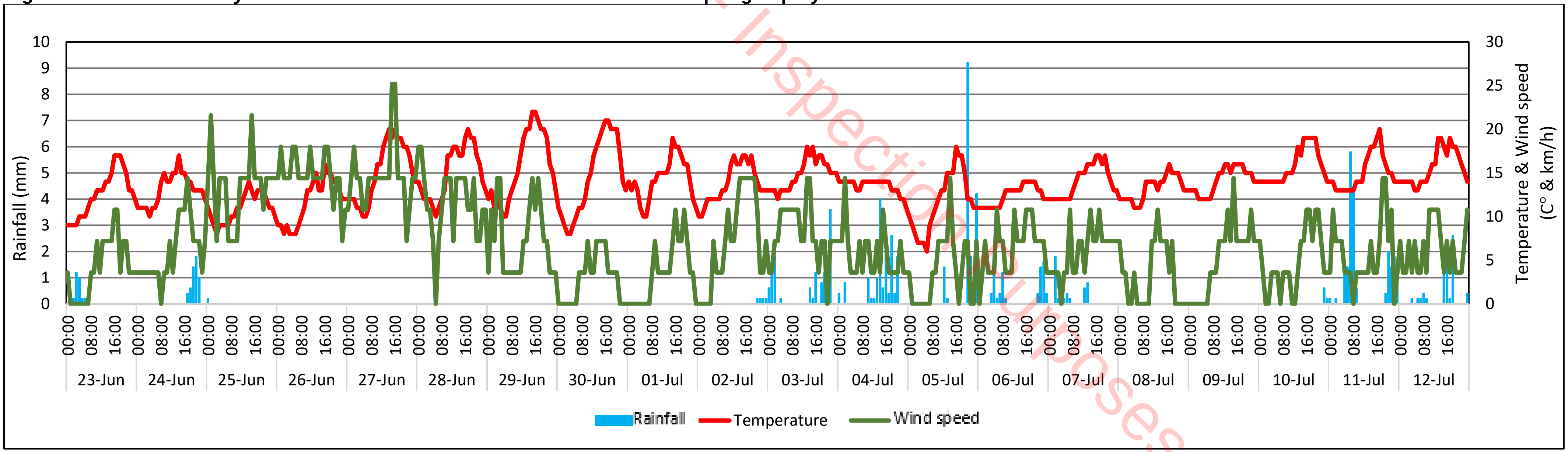

Figure A3.5 - Mean hourly weather conditions for the duration of the 2021 summer deployment

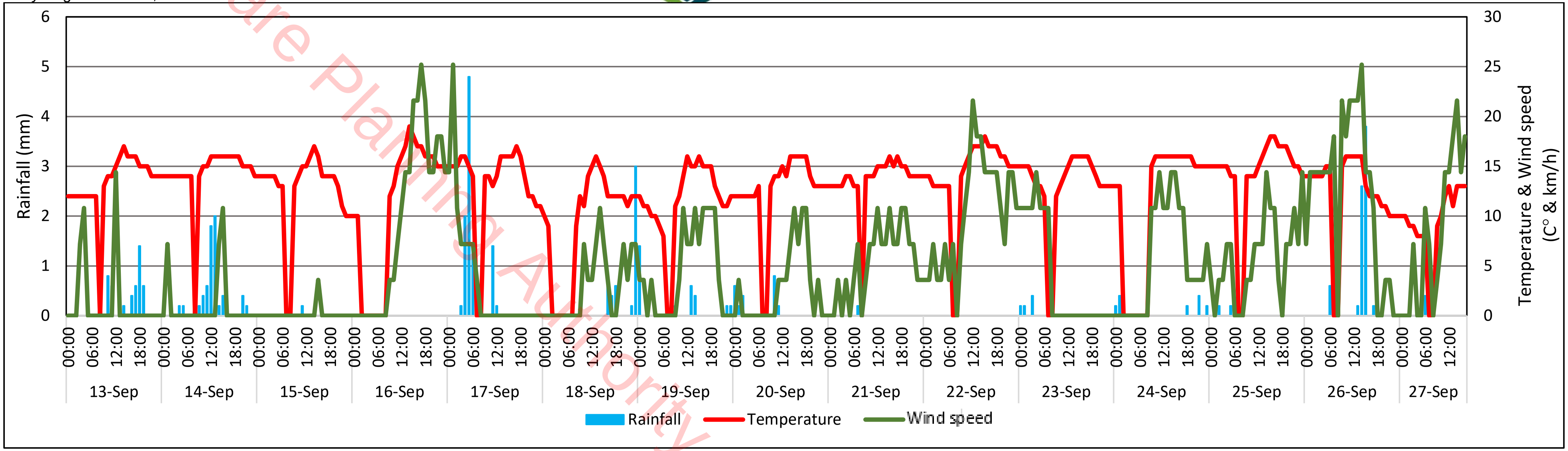

Figure A3.6 - Mean hourly weather conditions for the duration of the 2021 autumn deployment

APPENDIX 4: ECOBAT PERCENTILES BOXPLOTS

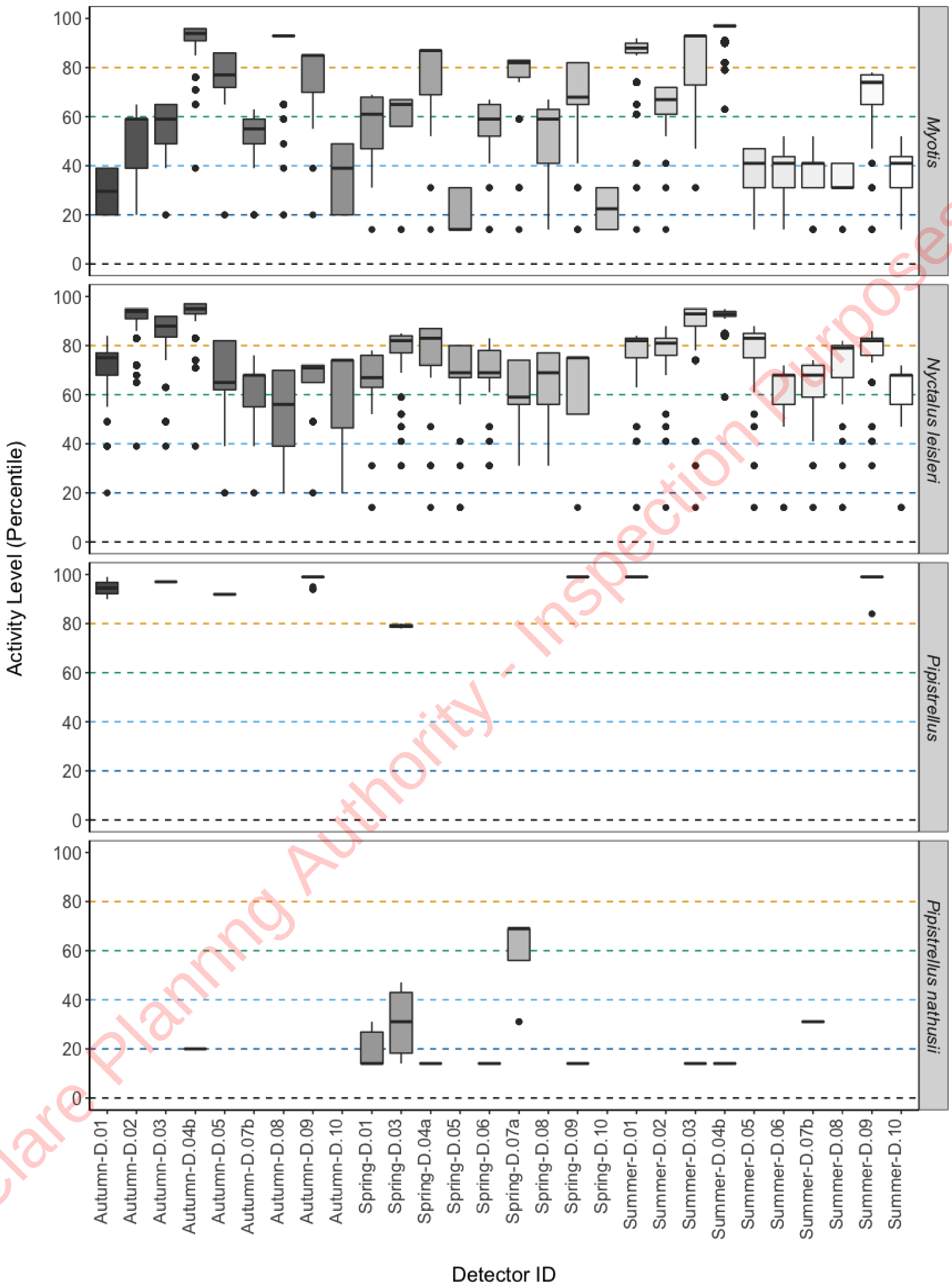

Figure A4.1 - Median percentile activity per species boxplots 2020

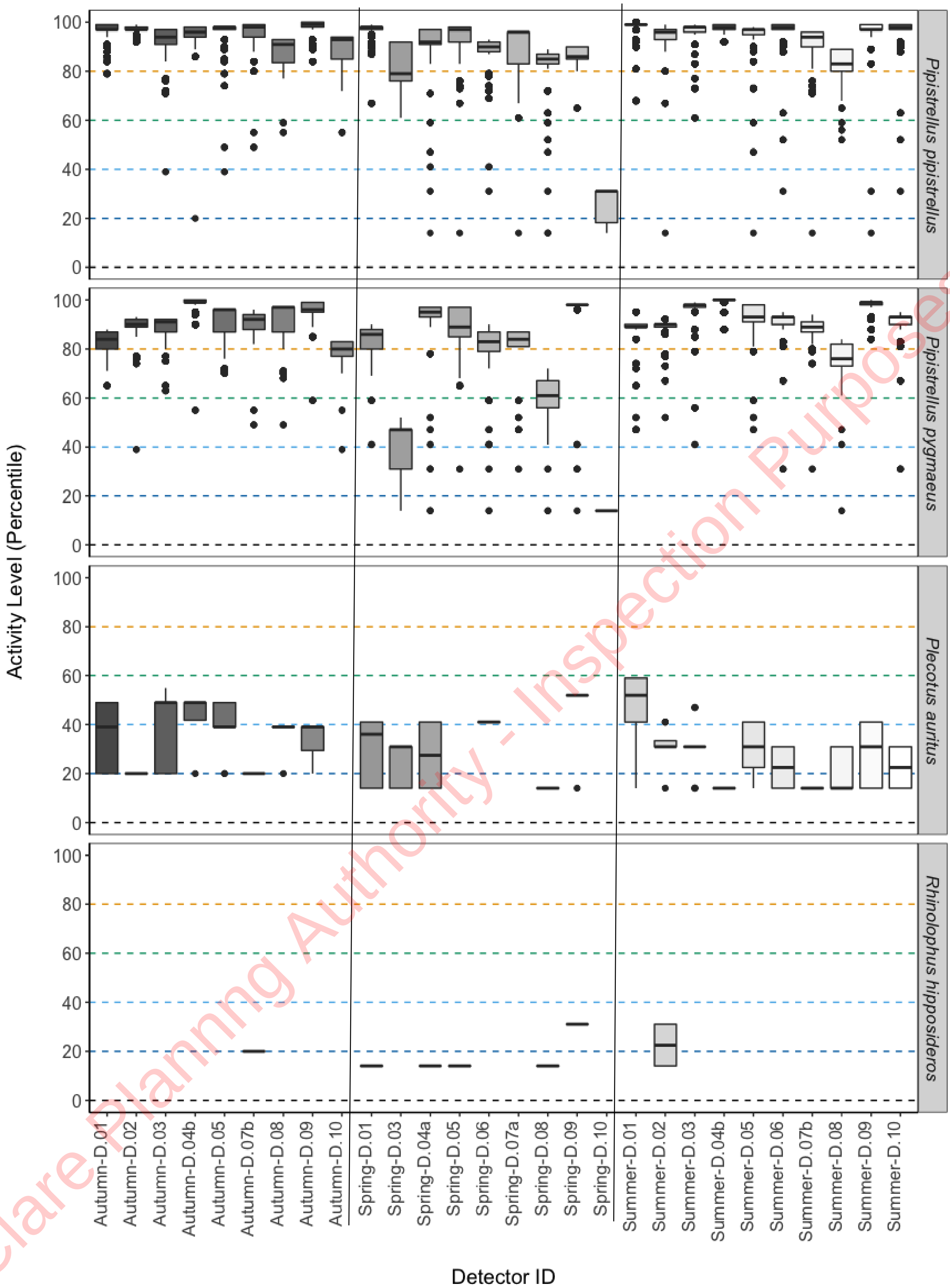

Figure A4.2 - Median percentile activity per species boxplots 2020 cont.

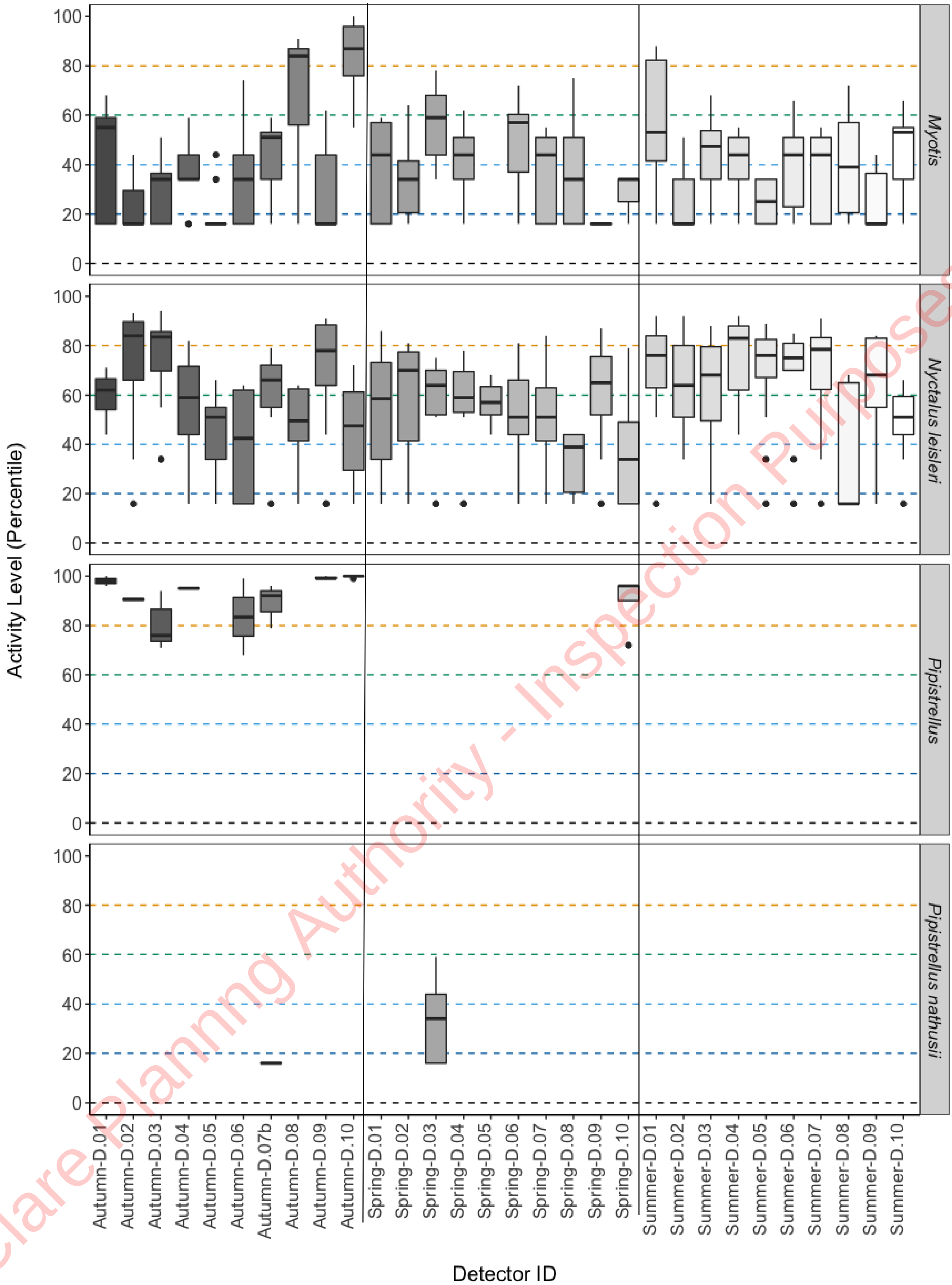

Figure A4.3 - Median percentile activity per species boxplots 2021

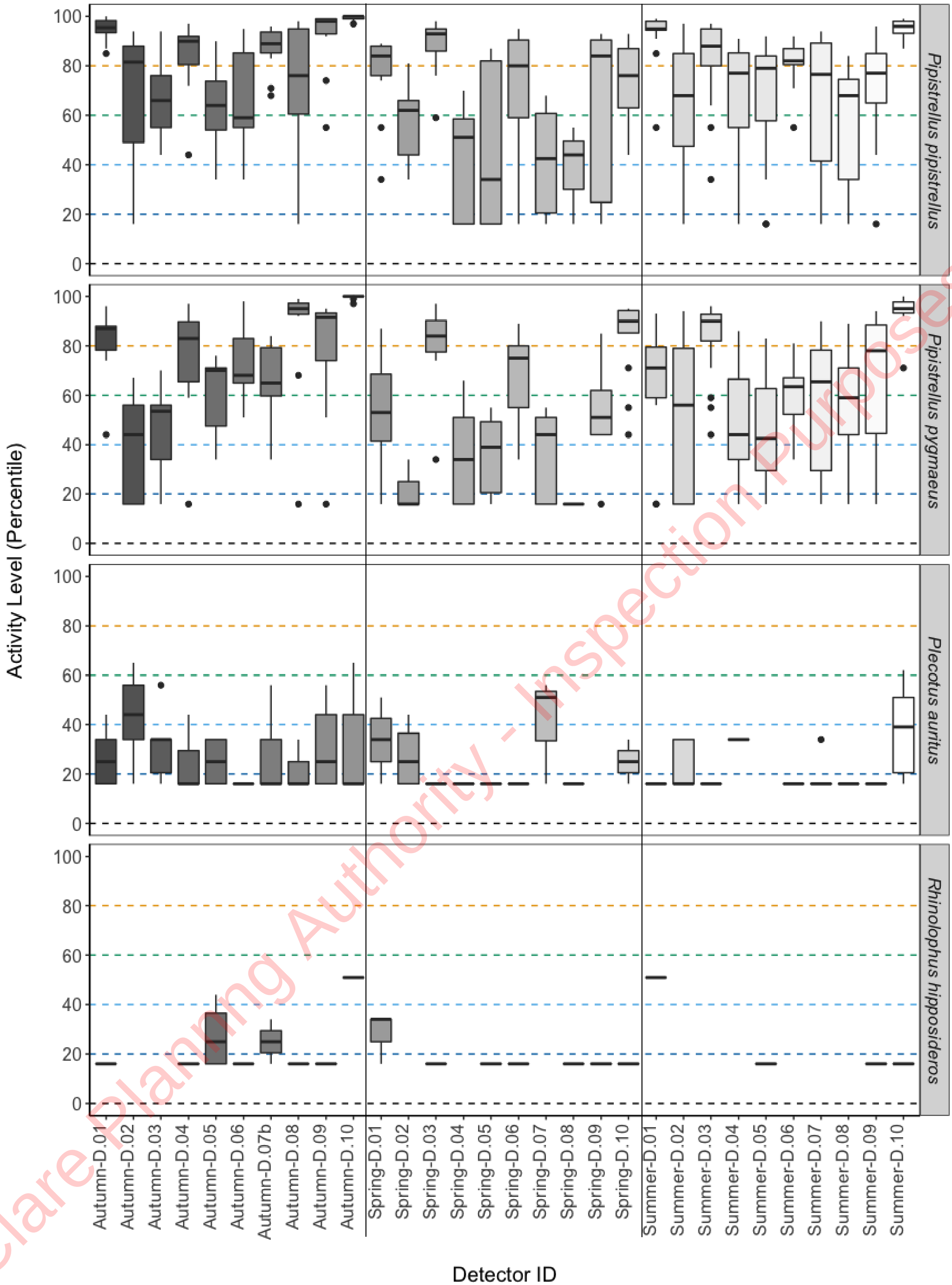

Figure A4.4 - Median percentile activity per species boxplots 2021 cont.

APPENDIX 5: STATIC LOCATIONS 2020


Plate 13 - D.01


Plate 16 - D.04a


Plate 14 - D.02


Plate 17 - D.05


Plate 15 - D.03


Plate 18 - D.06


Plate 19 - D.07a


Plate 22 - D.10


Plate 20 - D.08


Plate 21 - D.09

APPENDIX 6: STATIC LOCATIONS 2021

Plate 23 - D.01

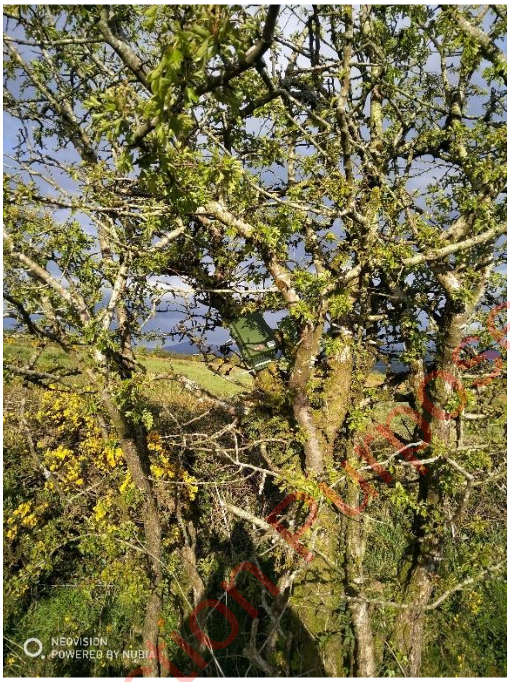

Plate 25 - D.03

Plate 24 - D.02

Plate 26 - D.04

Plate 27 - D.05
(microphone extended to hawthorn branch above)

Plate 29 - D.07a

Plate 28 - D.06

Plate 30 - D.07b


Plate 31 - D.08


Plate 33 - D.10


Plate 32 - D.09

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 8.5

Aquatic Ecology Report

FAHY BEG WIND FARM
AQUATIC ECOLOGY ASSESSMENT

Version: 15th December 2022

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TABLE OF CONTENTS

1. INTRODUCTION

This report provides a description of the receiving aquatic environment of the proposed Fahy Beg wind farm project. Two grid connection options are also considered. The proposed Fahy Beg Wind farm is located to the north of Bridgetown, Co. Clare and is c. 3.5km west of Lough Derg. The wind farm site Is located mostly in the Lackareagh Mountain area.

This document provides an assessment of the impact of the proposed development on aquatic habitats, aquatic ecological communities, and individual aquatic species. The aims of the aquatic ecology assessment are:

- To carry out a desktop study in order to determine the surface water features affected by the proposed development and surrounding area;
- To carry out a baseline fisheries and aquatic ecological survey of the affected aquatic areas;
- To predict the potential direct, indirect and cumulative impacts of the proposed development on aquatic species and habitats.
- To propose mitigation measures in the construction and operation of the wind farm so as to minimise potential impacts on fisheries and aquatic ecology receptors.

Field survey work to inform the current assessment included kick/sweep sampling and visual assessments as well as electrical fishing surveying during September 2021. An additional visit to some sites was made in late March 2022 to search for spawning Brook Lamprey.

1.1 Project Description

In summary, the proposed project will consist of the following:

- Construction of 8 no. wind turbines with a blade tip height range from 169 m to 176.5 m, a hub height range from 102.5 m to 110 m and a rotor diameter range from 131 m to 138 m;
- Construction of turbine foundations and crane pad hardstanding areas;
- Construction of new site tracks and associated drainage infrastructure;
- Upgrading of existing tracks and associated drainage infrastructure where necessary;
- Use of up to 2 no. existing quarry and agricultural field accesses including upgrades to same as necessary;
- Creation of 1no. new construction access between quarry lands and wind farm entrance.
- All associated drainage and sediment control;
- Installation of new watercourse or drain crossings;
- Re-use or upgrading of existing internal watercourse and drain crossings;
- Construction of 1 no. onsite 38kV electrical substation to ESB Networks (ESBN) specifications and associated compound including:
    - Welfare facilities;
    - Electrical infrastructure;
    - Parking;
    - Wastewater holding tank;
    - Rainwater harvesting tank;
    - Security fencing;

  - All associated infrastructure, services and site works including landscaping;
- Temporary accommodation works associated with the Turbine Delivery Route to facilitate the delivery of turbine components;
- 2no. Temporary construction site compounds and associated ancillary infrastructure including parking;
- Tree felling to facilitate construction and operation of the proposed development;
- Installation of medium voltage electrical and communication cabling underground between the proposed turbines and the proposed on-site substation and associated ancillary works;
- Installation of medium voltage (up to 38kV) and communication cabling underground between the proposed on-site substation and the existing Ardnacrusha substation and associated ancillary works. The proposed grid connection cable works will include 8 no. existing watercourse and drain crossings and the installation of up to 14 no. pre-cast joint bays;
- Erection of 1 no. permanent meteorological mast to a height of 100m above ground level.

Figure 1 gives the location of the proposed Fahy Beg wind farm, the proposed grid connection routes, and the survey sites. Figure 2 shows an aerial view of the Wind Farm site. Figure 3 shows the site with respect to the Lower River Shannon SAC and watercourses in the relevant hydrometric areas.

2. METHODOLOGY

2.1 Relevant guidance

The current assessment has been prepared taking account of relevant guidance published by the Environmental Protection Agency (EPA) including '*Guidelines on the Information to be contained in Environmental Impact Assessment Reports*' (EPA, 2017) and '*Advice Notes for Preparing Environmental Impact Statements*' (EPA, 2015). In addition, the impact assessment also takes account of the '*Guidelines for Ecological Impact Assessment in the UK and Ireland (Terrestrial, Freshwater, Coastal and Marine)*' (Chartered Institute of Ecology and Environmental Management, 2018). The Heritage Council publication '*Best Practice Guidance for Habitat Survey & Mapping'* (The Heritage Council, 2011) is also referenced.

Relevant guidance published by the National Roads Authority (NRA), and applicable to assessing watercourses in Ireland, was also followed, including '*Guidelines for the Assessment of Ecological Impacts of National Road Schemes – Revision 2*' (NRA 2009a), '*Ecological surveying techniques for protected flora and fauna during the planning of National Road Schemes – Version 2*' (NRA 2009b), '*Environmental Impact Assessment of National Road Schemes – A practical guide*' (NRA 2008a) and '*Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes'* (NRA 2008b).

2.2 Legislative Context

A diversity of flora and fauna, rare at a national level, are protected under the provisions of the Wildlife Act, 1976 and Wildlife (Amendment) Act, 2000; which includes the Flora Protection Order (1999). The Habitats Directive 1992 has been transposed into Irish legislation as the European Union (Natural Habitats) Regulations SI 94/1997 and amended in 1998 and 2005. The Habitat Regulations have been updated in 2011 as the European Communities (Birds and Natural Habitats) Regulations (2011) to bring the Irish transposition of these regulations into line with the requirements of the EU Habitats Directive (1992).

Under the Fisheries (Consolidation) Act, 1959, it is an offence to disturb the bed of a river; therefore, it will be necessary to get written permission from Inland Fisheries Ireland to proceed with the works in any areas where disturbance to the spawning and nursery areas of both salmonids and lampreys will occur as a result of the proposed development. Salmon, all lamprey species and their habitats are further protected under the EU Habitats Directive, 1992.

Under Section 3 of the Local Government (Water Pollution) Act, 1977 (as amended by Sections 3 and 24 of the 1990 Act) it is an offence to cause or permit any polluting matter to enter waters. Suspended solids would be a key parameter here. Likewise any visual evidence of oil/fuel in the river would constitute an offence.

Section 171 of the Fisheries (Consolidation) Act 1959 creates the offence of throwing, emptying, permitting or causing to fall onto any waters deleterious matter. Deleterious matter is defined as not only as any substance that is liable to injure fish but is also liable to damage their spawning grounds or the food of any fish or to injure fish in their value as human food or to impair the usefulness of the bed and soil of any waters as spawning grounds or other capacity to produce the food of fish.

2.3 Desk Study

A desktop study was undertaken to describe the aquatic ecology of the study area to identify the previous records of aquatic species and designated areas of protection. This involved accessing the National Biodiversity Data Centre (NBDC) (www.biodiversityireland.ie) and the databases available here. The National Parks and Wildlife Service (www.npws.ie) website and online maps were accessed in relation to designated areas, qualifying interests and site synopses on relevant Special Areas of Conservation with regard to aquatic ecology.

The Environmental Protection Agency (www.gis.epa.ie/EPAMaps/) websites including Catchments.ie (www.catchments.ie) and publications relating to the Water Framework Directive (WFD) were accessed in relation to water quality status and water quality pressures in the study area.

Previous reports prepared by the Environmental Protection Agency, Inland Fisheries Ireland and various other studies on the Lower River Shannon were reviewed in relation to aquatic fauna in the study area. This also included the National Otter Survey of Ireland database.

Aerial imagery was accessed online in order to gain a better understanding of the study area and its surrounding habitats. All documents reviewed are included in the bibliography section of the current report.

2.4 Selection of Watercourses for Assessment

All watercourses / water bodies which could be affected directly (i.e. within the site) or indirectly (i.e. drain areas close to the site) were considered as part of the current appraisal. Aquatic habitat surveys were completed on all watercourses draining the proposed wind farm site and a total of 23 sites were selected for detailed assessment. The purpose of these sites is to provide baseline information and can also be used for monitoring during the construction of the proposed wind farm. The location of the sites is given in Table 1 and shown in Figure 1. This is considered to be a very high-resolution survey for the study area in question. The surveys completed at each site were at a level required to make an evaluation of biological water quality, fisheries value, aquatic habitat value, and presence of rare/protected/notable aquatic species at each site.

2.5 Field Surveys

2.5.1 Habitat Surveys

Habitat Surveys were carried out on the entire study area. Survey Site locations are illustrated in Figure 2. The survey was completed with reference to the Environment Agency's "*River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003*" (EA, 2003) and "*A Guide to Habitats in Ireland*" (Fossitt, 2000). River habitat types as well as flora and vegetation were characterised at each survey site. All sites were assessed in terms of:

- Stream width and depth and other physical characteristics
- Substrate type, listing substrate fractions in order of dominance, i.e., large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- Instream vegetation, and percentage coverage of the stream bottom at the sampling site (as applicable) and on the bankside
- Estimated cover by bankside vegetation, giving percentage shade of the sampling site.

2.5.2 Aquatic Macroinvertebrate Surveys

Qualitative sampling of benthic (or bottom dwelling) macroinvertebrates was undertaken at the suitable survey sites using kick-sampling (Toner et al., 2005). Survey Site locations are illustrated in Figure 1. This procedure involved the use of a 'D' shaped hand net (mesh size 0.5 mm; 350 mm diameter) which was submerged on the riverbed with its mouth directed upstream. The substrate upstream of the net was then kicked for one minute in order to dislodge invertebrates, which were subsequently caught in the net. This procedure was undertaken at three points along/across the watercourse. Vegetation sweeps were also undertaken over a further 1-minute period to ensure a representative sample of the fauna present at the site was collected. Specific sweep netting assessments were completed to determine presence / absence of White-clawed crayfish and juvenile lamprey species.

Macroinvertebrates provide an estimation of the current health of the waterbody and the type of substrate. They are divided into 5 categories (A, B, C, D, E – "A" being the most sensitive and "E" being the most tolerant). A desk study was completed and used resources such as the NBDC species maps to identify if any rare/protected species have been recorded in the area. All samples of invertebrates were combined for each site and live sorted on the riverbank and fixed in ethanol for subsequent laboratory identification. The relative abundance of macroinvertebrates was recorded on-site at each site. Further identification was undertaken in the laboratory using a stereoscope.

Table 1 Relationship between Q-value and Ecological Status for macroinvertebrates.

Q Value*	WFD Status	Pollution	Condition**
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

** These values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.*
*** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses*

2.5.3 Fish Surveys

2.5.3.1 Salmonid Surveys

Each survey site was assessed for potential Salmon nursery and fishery habitat. Survey Site locations are illustrated in Figure 10. An electrical fishing survey was undertaken at selected sites during September 2021.This was completed under authorisation from the Department of Environment, Climate and Communications under Section 14 of the Fisheries (Consolidation) Act (1959). Sites were surveyed following the methodology outlined in the CFB (2008) guidance "*Methods for the Water Framework Directive-Electric fishing in wadable reaches*". A portable electrical fishing unit (Smith Root-LR 24backpack) was used to carry out the survey. The sites were fished continuously for 5 minutes each. Captured fish were collected into a container of river water using dip nets. The fish were released alive and spread evenly over the sampling area. No mortalities were recorded. Strict biosecurity measures were followed during all fieldwork (IFI, 2010). During this survey any other fish species recorded were also noted.

2.5.3.2 Juvenile Lamprey Surveys

Each survey site was assessed for potential Lamprey nursery and fishery habitat. Juvenile Lamprey surveys generally followed the methodology for ammocoete surveys given in the manual *'Monitoring the River, Brook and Sea Lamprey, Lampetra fluviatilis, L. planeri* and *Petromyzon marinus'* by Harvey & Cowx (2003). Electrical fishing for juvenile lampreys was carried out at selected sites. Lamprey identification followed '*Identifying Lamprey. A Field Key for Sea, River and Brook Lamprey'* by Gardiner R (2003).

An additional visit to some sites was carried out at the end of March 2022. These were sites 4, 9, 12,14, 19, 21 and 22. This was carried out to search for Brook Lamprey spawning activity.

Table 2 Location of the aquatic ecology sites assessed for the proposed Fahy Beg Wind Farm site.

Site No.	Catchment	Sub-catchment	Watercourse Name	Order	Segment Code	EPA Code
1	Lower Shannon	Shannon[Lower]_SC_080	River Black [O'Briensbridge]	3rd	25_1163	25B22
2	Lower Shannon	Shannon[Lower]_SC_080	River Black (O'Briensbridge)	2nd	25_2293	25B22
3	Lower Shannon	Shannon[Lower]_SC_080	River Black (O'Briensbridge)	2nd	25_2648	25B22
4	Lower Shannon	Shannon[Lower]_SC_080	River Black (O'Briensbridge)	2nd	25_2648	25B22
5	Lower Shannon	Shannon[Lower]_SC_080	Kilroughil Stream	1st	25_2711	25K69
6	Lower Shannon	Shannon[Lower]_SC_080	River Bridgetown (Clare)	2nd	25_1163	25B23
7	Lower Shannon	Shannon[Lower]_SC_080	River Bridgetown (Clare)	2nd	25_474	25B23
8	Lower Shannon	Shannon[Lower]_SC_080	River Bridgetown (Clare)	1st	25_2517	25B23
9	Lower Shannon	Owenogarney_SC_010	Broadford River	2nd	27_1315	27B02
10	Lower Shannon	Owenogarney_SC_010	Broadford River	1st	27_380	27B02
11	Lower Shannon	Shannon[Lower]_SC_100	River Blackwater [Clare]	4th	25_3883	25B06
12	Lower Shannon	Shannon[Lower]_SC_100	River Blackwater [Clare]	3rd	25_3221	25B06
13	Lower Shannon	Shannon[Lower]_SC_100	River Blackwater [Clare]	3rd	25_13109	25B06
14	Lower Shannon	Shannon[Lower]_SC_100	Glenomra Wood Stream	3rd	25_3221	25B06
15	Lower Shannon	Shannon[Lower]_SC_100	Glenomra Wood Stream	3rd	25_13111	25B06
16	Lower Shannon	Kileengarrif_SC_010	River Ballyard 25	1st	25_3408	25B77
17	Lower Shannon	Shannon[Lower]_SC_080	River Ardcloony	2nd	25_2596	25A03
18	Lower Shannon	Shannon[Lower]_SC_080	River Ardcloony	2nd	25_2596	25A03
19	Lower Shannon	Shannon[Lower]_SC_080	River Kilmastulla	5th	25_3881	25K04
20	Lower Shannon	Shannon[Lower]_SC_080	River Kilmastulla	5th	25_3881	25K04
21	Lower Shannon	Shannon[Lower]_SC_080	River Roolagh	1st	25_2679	25R20
22	Lower Shannon	Shannon[Lower]_SC_080	River Ballyteige 15	2nd	25_2794	25B17
23	Lower Shannon	Shannon[Lower]_SC_080	River Ballyteige 15	2nd	25_2794	25B17

Table 3 Relationship between Q-Value and Ecological Status for macroinvertebrates.

Q Value*	WFD Status	Pollution Status	Condition**
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

* These values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.

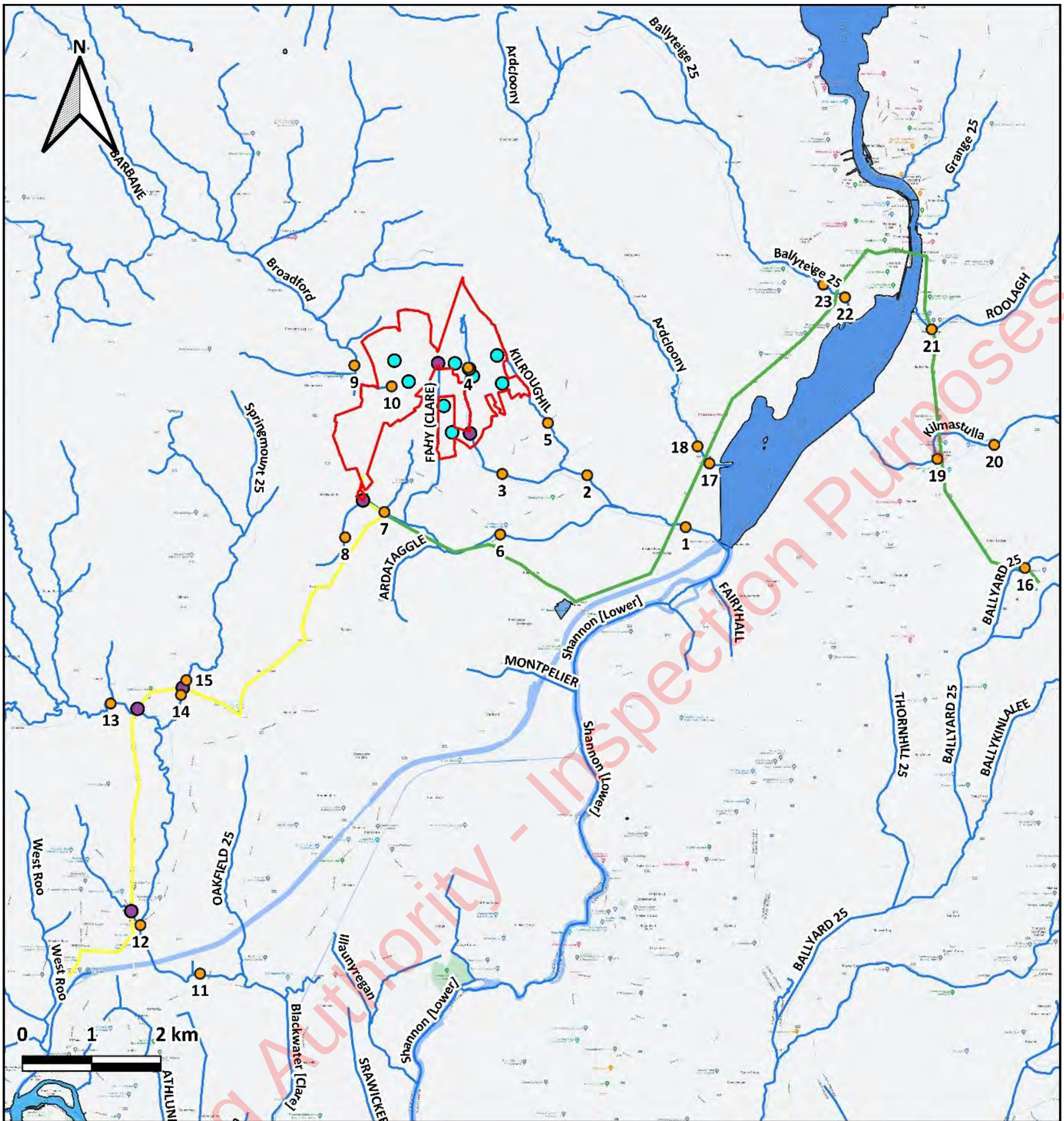
** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses

2.6 Evaluation

The evaluation of impact significance is a combined function of the value of the affected feature (its ecological importance), the type of impact and the magnitude of the impact. It is therefore necessary to identify the value of ecological features within the study area in order to evaluate the significance and magnitude of possible impacts. Ecological features are assessed on a scale ranging from international-national-county-local. The local scale is approximately equivalent to one 10 km square but can be operationally defined to reflect the character of the area of interest. This scheme, taken from NRA (2009a) is shown in Appendix 2 as is the Criteria for assessing impact magnitude.

2.7 Personnel

The surveys and assessments were completed by Dr. William O' Connor *PhD, MSc, BSc, CBiol, CEnv, FRSB, MCIEEM, MIFM* with the assistance of Eoin McMahon, Grace Walsh BSc, MSc, and Amy Butler, BSc, MCIEEM.



Site Boundary
Survey Sites
Turbine Layout
Turbine Delivery Route (TDR)
Grid Connection Route
Crossing Points
Watercourse
Lakes

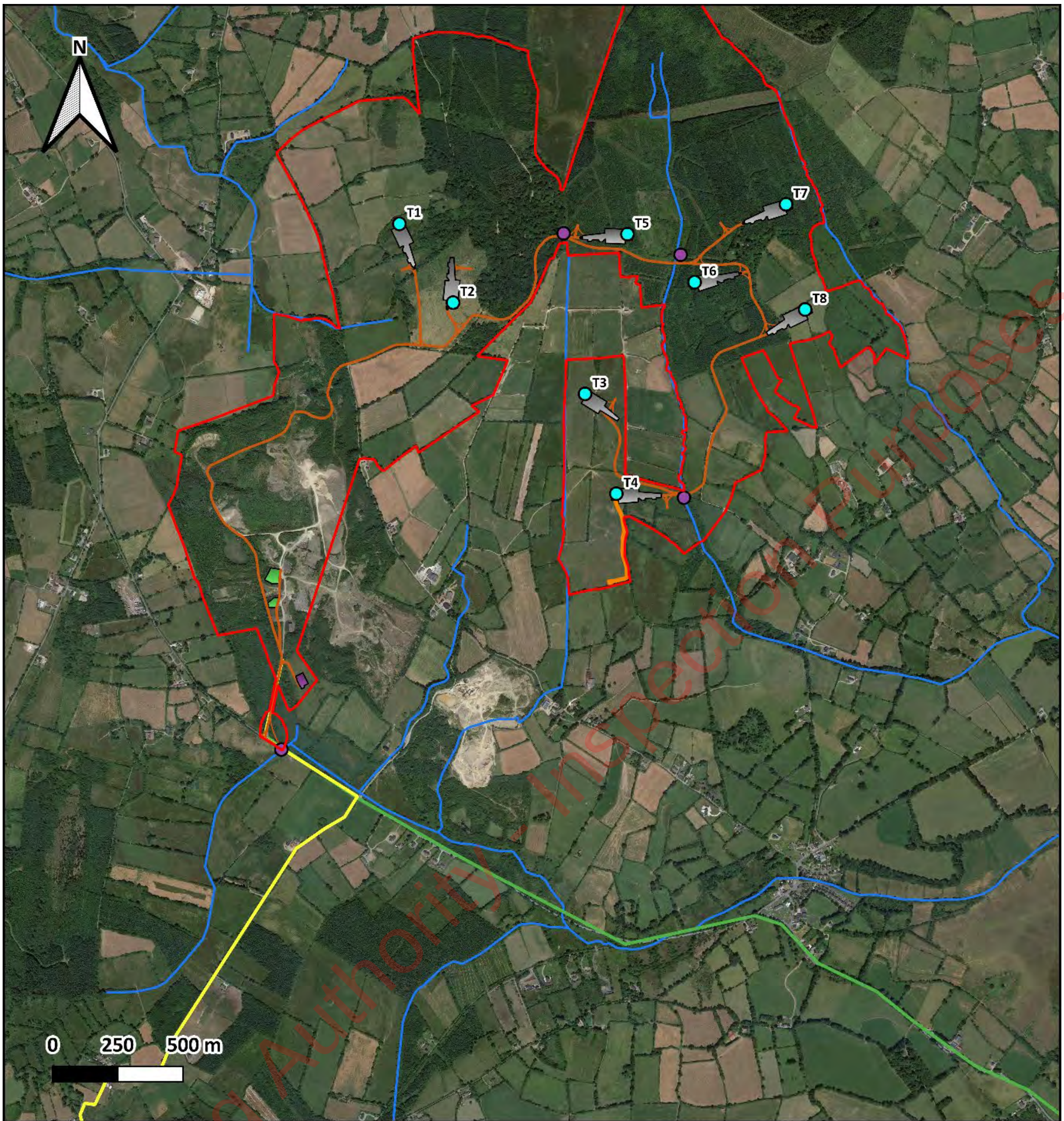
Date: 20.9.2022

Drawn by: Grace Walsh, Amy Butler
Checked by: William O'Connor

Proposed Survey Sites for Proposed Fahybeg Wind Farm

ecofact
Environmental Consultants

Figure 1 Proposed Survey Sites for Proposed Fahybeg Wind Farm



Site Boundary Crossing Points Turbine Layout Turbine Delivery Route (TDR) Grid Connection Route Substation Compounds Turbines Hardstandings Met Mast and Assoicated Track Roads and Turbine Bays	Date: 09.11.2022 Aerial View of Proposed Fahy Beg Wind Farm showing Turbine Layout and Grid Route Options	Drawn by: Grace Walsh, Amy Butler Checked by: William O'Connor ecofact Environmental Consultants

Figure 2 Aerial View of Proposed Fahy Beg Wind Farm showing Turbine Layout and Grid Route Options

3. RECEIVING ENVIRONMENT

3.1 SACs designated for aquatic interests

The only Natura 2000 river system in the study area is the Lower River Shannon Special Area of Conservation (002165). The Lower River Shannon SAC spans over all the estuary and as far upstream as far as just north of Ennis. The Lower River Shannon SAC stretches from Killaloe, Co. Clare to Loop Head/Kerry head. It is designated for a wide range of habitats and species. Those present in the River Fergus include Atlantic Salmon (*Salmo salar*) and Otter (*Lutra lutra*). Sea Lamprey (*Petromyzon marinus*), Brook Lamprey (*Lampetra planeri*) and River Lamprey (*Lampetra fluviatilis*). Other notable fish species designated in the SAC include Smelt (*Osmerus eperlanus*) and Pollan (*Coregonus autumnalis pollan*). Much of the land in the SAC has been improved or reclaimed and flood protection is common. Domestic and industrial waste in Limerick is an ongoing threat. In the Shannon estuary part of the SAC there are several species protected under Annex I of the E.U. Birds Directive. The proposed Wind Farm is c. 4rkm upstream of the SAC.

3.2 Shannon Catchment

The River Shannon is the largest river in Ireland spanning some 360.5km in length down the Island, with a catchment area of 11,700km^2. The catchment area of the river, including that of the estuary, covers approximately 1/6 of the area of the Republic of Ireland.

The River Shannon rises in the Cuilcagh Mountain Range in Co. Cavan. The Shannon has a total surface water area of 41,000ha of surface waters upstream of Limerick city, which drains a total catchment area of approximately 11,800km^2. The section from its source to Lough Allen contains major tributaries such as the Inny River, Boyle River and the River Camlin. The Rivers Suck, Brosna, Little Brosna, Cappagh/Kilcrow, Nenagh and Graney are major tributaries along the middle section of the river. The Mulkear River joins the Shannon upstream of Limerick cite. There are a number of large lakes located within the Shannon catchment area, including Loughs Allen, Key, Gara, Boderg, Bofin, Forbes, Sheelin, Ree, Ennel and Owel. The largest of the Shannon lakes, L. Derg. Due to the large size of the Shannon, it is usually split into the upper and lower Shannon catchments.

3.2.1 Lower Shannon

The Lower Shannon catchment covers an area of 1,820km^2 and comprises Lough Derg as well as the Mulkear catchment. The catchment is characterised by flat limestone plains, a small proportion of which are karstified to the east of Lough Derg (EPA, 2021). The River Shannon flows into Lough Derg at Portumna and travels c. 39rkm through Lough Derg. The Shannon flows out of Lough Derg through the steep-sided gap between the Slieve Bernagh and Arra Mountains where the towns of Ballina and Killaloe are located on the east and the west bank of the river respectively (EPA, 2021).

Downstream of Killaloe, the Lower River Shannon flows into Parteen Reservoir. Parteen Weir is located c. 6rkm downstream. At Parteen Regulating Weir, the river is diverted via a 12.6km headrace which travels to the 86MW hydroelectric generating station at Ardnacrusha. Downstream of Ardnacrusha hydroelectric station, the tailrace canal is c. 2.1km in length, and joins with the River Shannon c. 660m downstream of Parteen bridge. Downstream of Parteen Regulating Weir, the old River Shannon main channel flows south-west, through Castleconnell, Castletroy and then continues to Limerick City where it is joined by the tailrace canal c. 500m downstream of the Lax weir ruin.

3.2.2 Shannon Estuary North Catchment

The Shannon Estuary North Catchment includes the River Fergus catchment and all watercourses entering the tidal area between Thomond Bridge and George's Head, Co. Clare. The catchment drains a total area of 1658 km^2. The catchment includes the southern tip of the Clare Peninsula, east to the Slieve Bearnagh Hills and north to Ballyvaughan including most of the central and southern parts of the Burren. From Loop Head to Kildysart much of the catchment is drained by small rivers. The River Fergus which rises southeast of Kilfenora is the largest tributary in the catchment. The Owenogarney River, another significant tributary rises near the summit of Moylussa flowing through Sixmilebridge, Bunratty to the Shannon Estuary.

3.3 Overview of Study Area

3.3.1 Wind Farm Site

3.3.1.1 Black [O'Briensbridge] Catchment

The River Black [O'Briensbridge] catchment is a minor catchment located in Co. Clare. The river rises in a forestry area on Lackareagh Mountain. It is also joined by the 2nd order River Bridgetown (Clare) from the west. The River Black [O'Briensbridge] then joins the River Shannon just downstream of Parteen Weir where it is siphoned into the Shannon. The EPA carries out biological water quality monitoring at one site in the catchment which was rated Q4 in 2017 equivalent to WFD status "Moderate". The catchment is considered "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. The TDR has one crossing point in this catchment and the GCR route has one also. There are eight wind turbines proposed on the site which is c. 2.2km^2 in size.

<u>Survey Sites</u>

Survey Site 1 is located on the River Black [O'Briensbridge] (EPA Segment Code: 25_1163). This site is located immediately downstream of where the river crosses under the regional road R463. The TDR runs along this road. This is c. 700m upstream of where the River Black [O'Briensbridge] joins the River Shannon. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. Survey Site 2 is located on the River Black (O'Briensbridge) (EPA Segment Code: 25_2293). This site is located c. 1.8rkm upstream from Site 1. The site is located on an unnamed road c. 1.5km northeast of Bridgetown. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027.

Survey Site 3 is located c. 1.3rkm upstream of Site 2 on the River Black (O'Briensbridge) (EPA Segment Code: 25_2648). This site is c. 880m north of Bridgetown. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. The site is c. 800rm downstream from a crossing point. Survey Site 4 is located c. 1.8rkm upstream from Site 3, and c. 2.5km north of Bridgetown. The site is located on the River Black (O'Briensbridge) (EPA Segment Code: 25_2648). This site is located within the proposed windfarm site and c. 200-300m from two proposed turbine locations. Adjacent to the site the landuse is rough grassland and forestry. The river rises c. 770m upstream from this point. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027.

Survey Site 5 is located on the 1st order Kilroughil Stream (EPA code: 25K69; EPA Segment Code: 25_2711). This site is c. 1.2rkm upstream from Site 2. This drains the eastern extent of the windfarm site. The surrounding landuse is predominantly agriculture, however there is forestry in the upper reaches. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. Survey Site 6 is located on the River Bridgetown (Clare) (EPA Segment Code: 25_1163) at Bridgetown. This is c. 600rm downstream of the EPA monitoring station in the catchment (EPA monitoring station: 25B23 0100). This station was rated Q4. This site is also c. 2.4rkm downstream from a crossing point. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027.

Survey Site 7 is located on the River Bridgetown (Clare) (EPA Segment Code: 25_474). The site is located adjacent to the regional road R466 c. 1.4rkm upstream of the EPA monitoring site. This site is c. 375rm downstream of a crossing point. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. Survey Site 8 is located on the River Bridgetown (Clare) (EPA Segment Code: 25_2517). The site is located c. 660rm upstream of a crossing point. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027.

3.3.1.2 Broadford River

The Broadford River (EPA code: 27B02) rises to the west of the site and drains an area near two proposed wind turbines. These are Turbines 1 and 2. This is a minor stream which is part of the River Owenogarney (EPA Code: 27O01). The stream rises at the site and flows north-west as far as Doon Lough (EPA Segment Code: 27_121). On reaching Doon Lough it is a 3rd order river having been joined by the several 1st order streams and the 2nd order River Cloonconry Beg (EPA code: 27C17). Doon Lough is drained by the 4th order River Owenogarney which flows in a south-southwest direction through Sixmilebridge and flows into the River Shannon estuary at Bunratty. The upper reaches of this river are "At risk" of not meeting their WFD objectives by 2027. Pressures in the catchment include invasive species, agriculture, hydromorphology and unknown anthropogenic pressures.

In the most recent round of monitoring by the EPA the Broadford River was described as "*In the Broadford River, Station 0500 improved from poor to moderate ecological condition. Station 0600 continued to be of good ecological quality. Station 0700 was assessed for the first time since 1991 and was found to be in good ecological condition, this is a deterioration from high ecological condition at the last assessment. The lowermost station 0800 has declined from high to moderate ecological condition since the previous assessment.*"

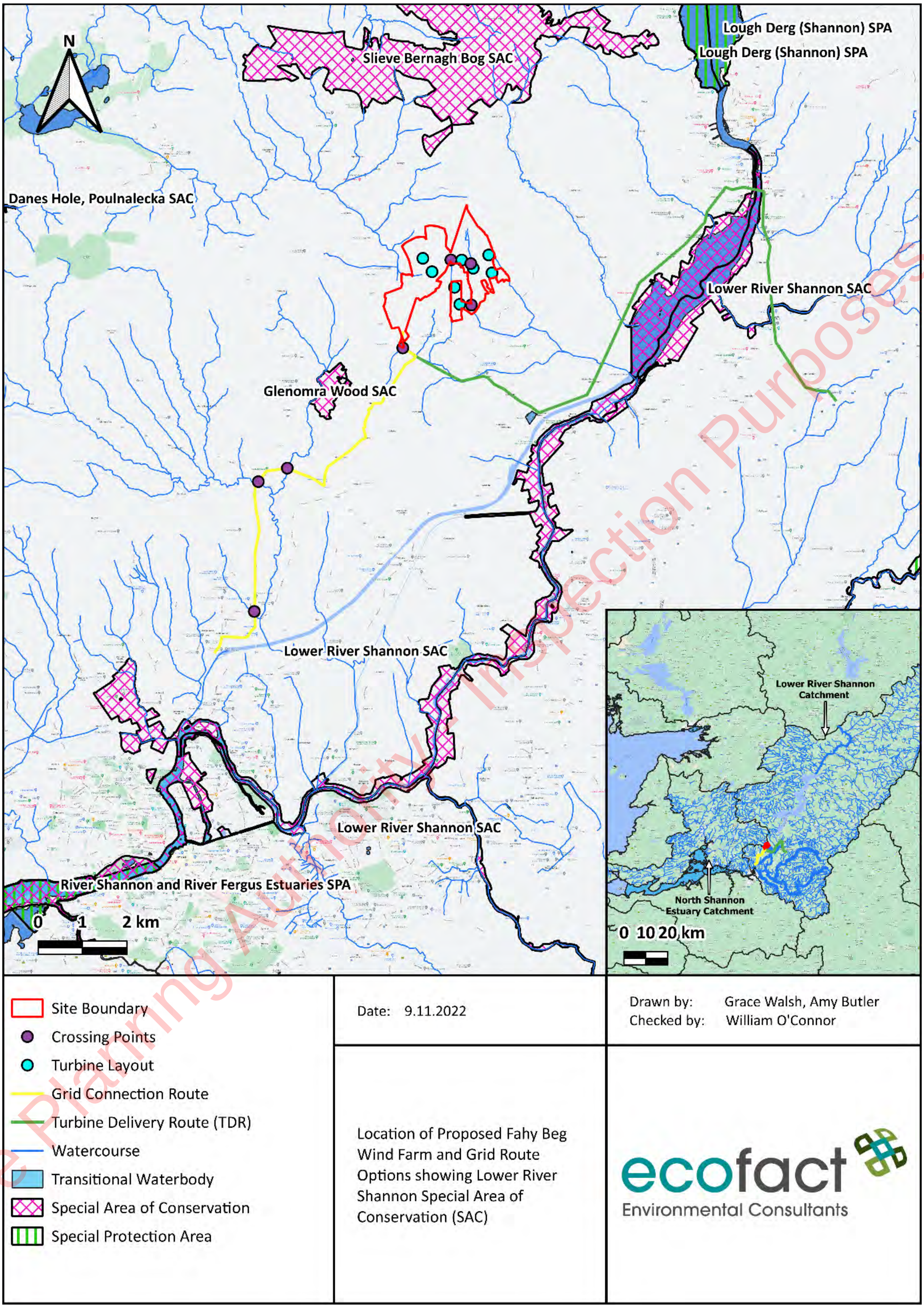


Figure 3 Location of Proposed Fahy Beg Wind Farm and Grid Route Options showing Lower River Shannon Special Area of Conservation (SAC)

Survey Sites

Survey Site 9 is located on the 2nd order Broadford Stream (EPA Segment Code: 27_1315). This site is located just east of a local road (L3022-8). This site is also located downstream of a quarry. There is an EPA monitoring station (EPA Station Code: 27B02 0500) located c. 2.3rkm downstream. This station was rated Q3-4 in 2019 equivalent to WFD status "Moderate". The waterbody at the site is considered "At Risk" and has been at risk from channelisation. Survey Site 10 is located at the source of the Broadford Stream (EPA Segment Code: 27_380). This site is located upstream from a quarry and within the wind farm site. Site 10 is c. 770rm upstream from Site 9. The waterbody at the site is considered "At Risk" and has been under pressure from channelisation. The waterbody is "Moderate" WFD status for the period 2013-2018

3.3.2 Grid Connection Route

3.3.2.1 Blackwater [Clare] Catchment

The River Blackwater [Clare] (EPA code: 25B06) rises in a forestry area north of Woodcock Hill, Co. Clare. It flows easterly from here and is joined by the 4th order River Snaty 25 (EPA code: 25S34). The river is also joined by the 2nd order O' Neill stream (EPA code: 25O02) and River Mountrice 25 (EPA code: 25M03), the 1st order Knockdonagh (EPA code: 25K84) and the 3rd order Glemomra Wood Stream (EPA code: 25G12). It is also joined by several small 1st order streams. From where the river rises it flows in an easterly direction to where it crosses the regional road R465. From here the River Blackwater [Clare] flows south to where it crosses under the Ardnacrusha Headrace Canal after which it turns easterly again before redirecting south and entering the River Shannon at Plassey. The section of the River Blackwater [Clare] c. 300m upstream of its confluence with the River Shannon is designated as part of the Lower River Shannon Special Area of Conservation.

The Water Framework Directive sets out objectives to be met by river waterbodies in Ireland before 2027. Waterbodies are then assessed for their potential risk of not meeting these objectives set out by WFD, and therefore are assigned a Risk rating. Waterbodies that are At Risk can then be prioritised for implementation of measures. The River Blackwater [Clare] is within the Shannon [Lower]_SC_100 sub catchment. Of the four waterbodies in the River Blackwater [Clare] two are considered "At Risk" and two are considered "Not at Risk". The upper reaches are "At Risk". In the previous waterbody risk assessment, the risks to these waterbodies were forestry and agriculture.

Survey Sites

Survey Site 11 is located on the River Blackwater [Clare] (EPA Segment Code: 25_3824). This site is located c. 940m downstream of Ardnacrusha Headrace. The site is where the river crosses a small access road c. 2.1km northeast of Parteen. There is an EPA monitoring station c. 1rkm downstream from the site. This station (Station code: 25B06 0250) was rated Q4 in 2017. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027.Survey Site 12 is located on the River Blackwater [Clare] (EPA Segment Code: 25_3883) just upstream from where it is culverted under the Ardnacrusha Headrace. This site is where the river crosses the R436 regional road and is just downstream of where the 1st order River Glenlon_South (EPA code: 25G86) join the River Blackwater [Clare]. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. There is an EPA monitoring station at the site which was rated Q4 in 1999 and has not been surveyed since. This is equivalent to WFD status "Good". This site is c. 4.2rkm downstream from a crossing point of the grid connection route.

Survey Site 13 is located on the River Blackwater [Clare] (EPA Segment Code: 25_13109) and is c. 4.7rkm upstream from Survey Site 12 and c. 500rm upstream of a crossing point of the grid connection route. This site is located c. 5km north of Parteen on an unnamed road. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. There is an EPA monitoring station c. 500rm downstream which was rated Q4 in 2019 equivalent to WFD status "Good". A further 2.2rkm upstream a site was rated Q4-5 in 2017 equivalent to WFD status "High". Survey Site 14 is located on the 3rd order Glenomra Wood Stream (EPA Segment Code: 25_3221). The site is located c. 800m upstream of the Glenomra Wood Stream's confluence with the River Blackwater [Clare]. This site is located c. 85rm downstream of a crossing point of the grid connection route which is located on the regional road R471. This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. There is an EPA monitoring station at the crossing point which was rated Q4-5 in 2017 equivalent to WFD status "High". Survey Site 15 is located on the 3rd order Glenomra Wood Stream (EPA Segment Code: 25_13111). This site was located c. 200rm upstream from Survey Site 14. This section of the river is considered "High" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027.

3.3.3 Turbine Delivery Route (TDR)

3.3.3.1 River Ballyard 15

Survey Site 16 is located on the River Ballyard 25 (EPA code: 25B77, EPA segment code: 25_3408). The TDR crosses the River Ballyard (EPA code: 25B77, EPA segment code: 25_3408) at Birdhill, Co. Tipperary. The River Ballyard is part of the River Mulkear catchment. This is a small 1st order waterway. The watercourse rises c. 1.4rkm upstream from here. There is no EPA monitoring station on this waterbody and there are no tributaries. The waterbody is considered "Not at Risk".

3.3.3.2 Ardcloony River

The Ardcloony River (EPA code: 25A03) is another minor river in the catchment. The river rises in the Ballycuggaran area at the foot of Moylussa. The river is joined by one 2nd order stream which is the Cassagh Stream (EPA code: 25C95). From the river's source is flows south-southeast to where it flows into the River Shannon at Parteen reservoir upstream of Parteen Weir. There is one recent EPA monitoring station on the river (EPA Station Code: 25A03 0100) which was rated Q5 in 2019 equivalent to WFD status "High". This river does not drain any of the proposed wind farm site, however the TDR does cross it between Sites 18 and 17.

The section of the Ardcloony River c. 300m upstream of where it flows into Parteen Reservoir is designated as part of the Lower River Shannon Special Area of Conservation.

Survey Site 17 is located on the 2nd order River Ardcloony (EPA Segment Code: 25_2596). This site is located c. 150 downstream of the R463 road which the TDR runs along. This site is c. 200rm downstream of Site 18. This site is c. 2rkm downstream from the EPA monitoring station which was rated Q5 in 2019. This section of the river is considered "High" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. Survey Site 18 is located on the 2nd order River Ardcloony (EPA Segment Code: 25_2596). This site is c. 200rm upstream of Site 17 and c. 150rm upstream of the TDR. This section of the river is considered "High" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027.

3.3.3.3 River Kilmastulla

The River Kilmastulla (EPA code: 25K04) rises in the north of the Silvermines c. 15km east of Killaloe, Co. Clare. There are several small 1st order streams in the upper reaches of this catchment. The main tributaries are the 3rd order River Garryclogher, the 3rd order Yellow Bridge Stream (EPA code: 25Y01), the 3rd order River Patrickswell 25 (EPA code: 25P09), the 3rd order River Castlecranna (EPA code: 25C71) and the 4th order River Knockadromin (EPA code: 25K49). The River Kilmastulla flows into Parteen Reservoir c. 3.5rkm downstream of Ballina/Killaloe.

The River Kilmastulla upstream of EPA monitoring station (EPA Station Code: 25K04 0910) is considered "At Risk" as far upstream as the waterbody Kilmastulla_020 which is "Under Review". The upper reaches of the River Kilmastulla are also "At Risk" of not meeting their WFD objectives by 2027. Pressures on this catchment include mines.

In the most recent round of monitoring from 2018, the EPA described the River Kilmastulla as "*While the condition of four of the six sites on the Kilmastulla is still unsatisfactory in 2018, the good ecological condition of Station 1000 recorded in 2012 and 2015 has been maintained and, for the first time since recording began at Station 0800 in 1974, the composition of the invertebrate fauna at this site had just improved sufficiently to indicate good ecological conditions here.*"

The River Kilmastulla from where it flows into Parteen Reservoir, as far upstream as its confluence with the River Knocknadromin (c. 4rkm) is designated as part of the Lower River Shannon SAC.

Survey Sites

Survey Site 19 is located on the 5th order River Kilmastulla (EPA Segment Code: 25_3881). This site is located c. 1.7rkm upstream from Parteen Reservoir. The site is located c. 390rm downstream of Cool Bridge between Birdhill and Ballina, Co. Tipperary. There is an EPA monitoring station (EPA Station Code: 25K04 1000) located at Cool Bridge. This site was rated Q4 in 2018 equivalent to WFD status "Good". This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027. Survey Site 20 is located on the 5th order River Kilmastulla (EPA Segment Code: 25_3881). This site is c. 1.2rkm upstream of Survey Site 19. The TDR runs along the R494 road between the two sites. The closest EPA monitoring station (EPA Station Code: 25K04 0910) was rated Q3-4 in 2018 equivalent to WFD status "Moderate". This section of the river is considered "Good" WFD status for the period 2013-2018 and is "Not at Risk" of not meeting its objectives as set out in the WFD by 2027.

3.3.3.4 Roolagh River

The TDR crosses the Roolagh River (EPA code: 25R20, EPA Segment Code: 25_2679). The Roolagh River rises 2.5km east of Ballina, Co. Tipperary. From here the river flows southwest for c. 4.5rkm until is drains into Parteen Reservoir. There is no EPA monitoring station on this waterbody and there are no tributaries. The waterbody is considered "At Risk" of not meeting its WFD objectives by 2027. The pressures on this river are wastewater discharges and dams, barriers, locks and weirs.

Survey Site 21 is located on the Roolagh River (EPA code: 25R20, EPA Segment Code: 25_2679). This site is located c. 100m downstream of the TDR and the regional R494 road. There is no EPA monitoring station on this waterbody and there are no tributaries. The waterbody is considered “At Risk” of not meeting its WFD objectives by 2027. This section of the river is considered “Moderate” WFD status for the period 2013-2018. The pressures on this river are wastewater discharges and dams, barriers, locks and weirs.

3.3.3.5 Ballyteige 25 River

The River Ballyteige 25 (EPA code: 25B17) is also a minor catchment. This river rises in the Ballycuggaran. The river is joined by two 1st order streams in the upper reaches on of which is an unnamed waterway (EPA Segment Code: 25_784) and the other is the Gortmagy Stream (EPA code: 25G78). In the upper reaches this river drains forestry while the lower reaches drain mostly agricultural lands. The river is considered “At risk” of not meeting its WFD objectives by 2027. Wastewater discharges are a pressure (eutrophication and main suspected cause of pollution) as are dams, barriers, locks and weirs.

Survey Sites

Survey Site 22 is located on the River Ballyteige 25 (EPA Segment Code: 25_2794), c. 500rm upstream of Lough Derg. This location is c. 1.5km southwest of Killaloe. The site is c. 150rm downstream from the TDR and the R463 reginal road. This section of the river is considered “Moderate” WFD status for the period 2013-2018 and is “Not at Risk” of not meeting its objectives as set out in the WFD by 2027. The pressures on this river are wastewater discharges and dams, barriers, locks and weirs. Survey Site 23 is located c. 400rkm upstream from Survey Site 22. This location is c. 1.5km southwest of Killaloe. The site is c. 250rm upstream from the TDR. The surrounding landuse is agriculture and forestry. This section of the river is considered “Moderate” WFD status for the period 2013-2018 and is “Not at Risk” of not meeting its objectives as set out in the WFD by 2027. The pressures on this river are wastewater discharges and dams, barriers, locks and weirs.

3.4 Previous Aquatic Ecology Records

Inland Fisheries Ireland surveyed two sites on the Broadford River in 2013 located directly upstream of Doon Lough and at Broadford village. There were six fish species recorded in the Broadford during the 2013 survey which were Gudgeon, salmon, perch, brown trout, three-spined stickleback and minnow (Kelly *et al.* 2014).

In 2016 Inland Fisheries Ireland carried out an electrofishing survey on the River Kilmastulla at five sites. There was a total of seven fish species recorded which were Brown Trout, European eel, Lamprey sp, Minnow, Salmon, Stone Loach and 3-spined Stickleback (Kelly *et al.* 2017).

A review of the National Biodiversity Data Centre maps was undertaken to evaluate the aquatic ecology of the area but no relevant records were identified. NPWS data for the hectads overlapping the proposed development has been assessed. Records include European Otter, Brook Lamprey, River Lamprey, Sea Lamprey, Opposite-leaved Pondweed and white-clawed Crayfish.

An aquatic ecology assessment was carried out for the Killaloe Bypass project. The survey was visual only and no sampling was undertaken (Roughan & O’ Donovan Consulting Engineers 2012).

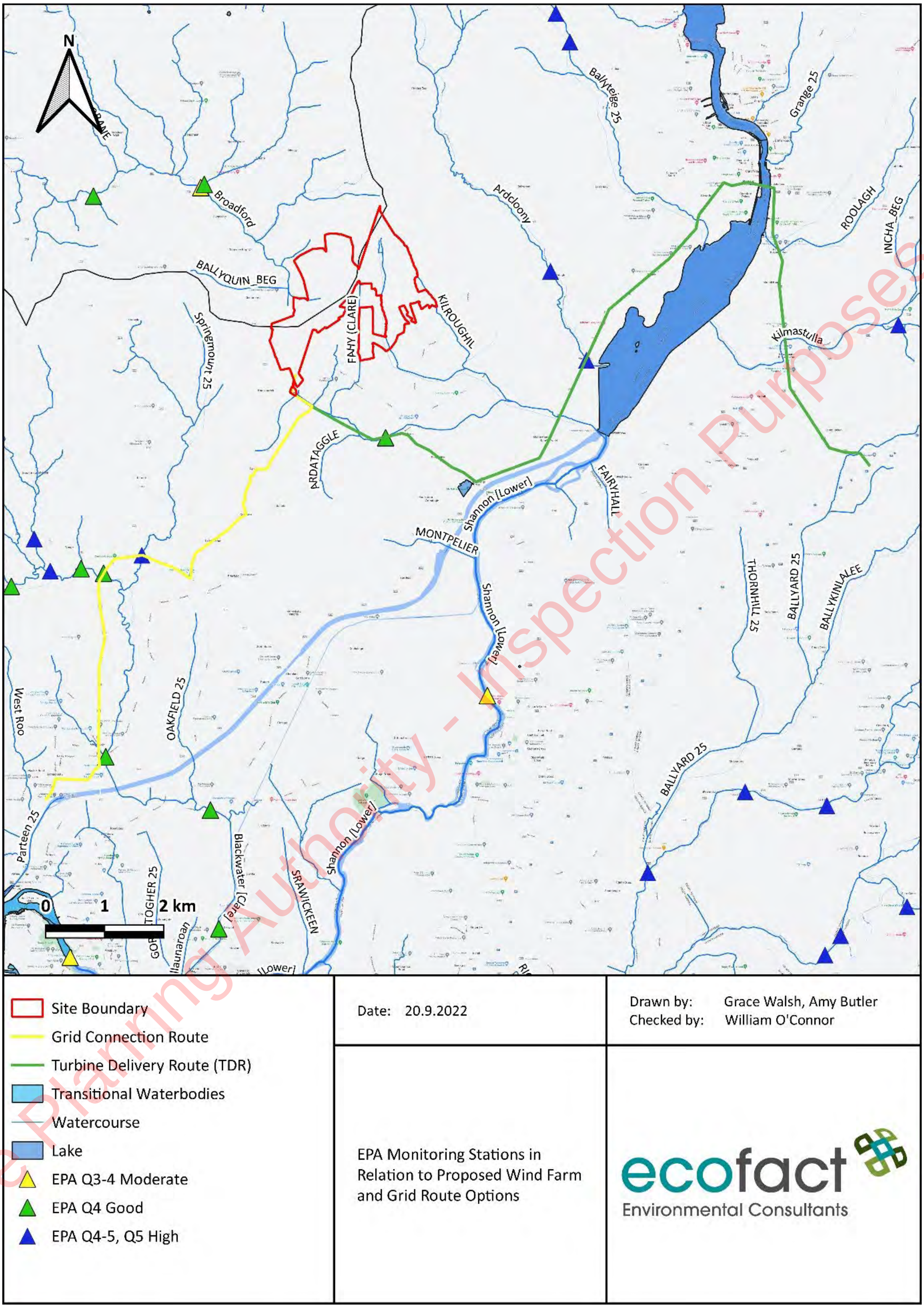


Figure 4 EPA Monitoring Stations in Relation to Proposed Wind Farm and Grid Route Options

3.5 Baseline Aquatic Ecology Surveys 2021

3.5.1 Wind Farm Site

3.5.1.1 Survey Site 1

Survey Site A1 was located on the River Black [O'Briensbridge] (EPA Segment Code: 25_1163). The river at the site was c. 4m in wetted width. The average depth was c. 25cm with a maximum of c. 35cm. There were very low levels of instream vegetation however canopy cover was high at c. 80%. The dominant habitat here was glide. Siltation was heavy on the inner bank which had a low gradient. On the outer side the substrate was courser consisting of gravel. The bank here was also steeper. Both banks were well vegetated. There were no filamentous algae present, overall the gradient was medium and no filamentous algae were present. Siltation levels were normal.

Downstream of this site there is a culvert / siphon that brings the river under Ardnacrusha headrace and into the River Shannon below Parteen weir. This structure is a fish migration barrier affecting Salmon and River and Sea Lampreys.

Salmonid nursery habitat was present at this site. Lamprey habitat was also present at the site. There were good stocks of Brown Trout recorded at this site. Brown Trout were recorded in Small Numbers with a Catch Per Unit Effort (CPUE) of 1.6 fish caught per minute. Three-spined Stickleback and Stone Loach were recorded as Present. Brook Lamprey were recorded. There were 5 individuals. The CPUE for lamprey was 1.67 fish caught per minute. Biological water quality was assigned a rating of Q4 equivalent to WFD status "Good".

3.5.1.2 Survey Site 2

Survey Site A2 was located on the River Black [O'Briensbridge] (EPA Segment Code: 25_2293). The river at the site has a wetted width of c. 4m. The average depth was c. 20cm. There were very low levels of instream vegetation and canopy cover was c. 60%. Both banks were heavily vegetated. The dominant habitat at the site was riffle and the substrate was mostly cobble. The overall gradient was moderate. Siltation was normal. The same as for Site A1 there is a culvert/siphon downstream blocking upstream fish migration.

There was salmonid nursery habitat present. Lamprey habitats were also present. There were good stocks of Brown Trout recorded at this site. Brown Trout were recorded in Small Numbers with a CPUE 2.4 fish caught per minute. Three-spined Stickleback and Stone Loach were recorded as Present. The CPUE for both species was 0.8 and 0.2 fish caught per minute respectively. Brook Lamprey were recorded in small numbers. There were 6 individuals recorded with a CPUE of 2 fish caught per minute. Biological water quality was assigned a rating of Q4 equivalent to WFD status "Good".

3.5.1.3 Survey Site 3

Survey Site A3 was located on the River Black [O'Briensbridge] (EPA Segment Code: 25_2648). The river at the site was tiny and very overgrown. There was a bridge at the site. Destructive works were ongoing with gravel being laid very close to the river and vegetation clearance had occurred. Due to this there was a lot of exposed soil also. The wetted width at the site was c. 1m and a depth of c. 10cm.

The habitat was a mixture of riffle and glide. Siltation at this site was high and eroding banks were present. The site had undergone artificial drainage.

There was salmonid nursery habitat present. Lamprey habitats were present. Brown Trout were the only species recorded at this site. They were recorded as Present. The CPUE for Brown Trout was 0.4 fish caught per minute.

Biological water quality was assigned a rating of Q4 equivalent to WFD status "Good". However, the river is impacted downstream of the bridge due to a one-off house development which has included infilling of the stream.

3.5.1.4 Survey Site 4

Survey Site A4 was located on the River Black (O'Briensbridge). The site was dry during the survey and no fishing was carried out. However, as this is a small section of the stream and at the time of the survey has no fish habitat present. This site is of little to no ecological importance and there are no sensitive receptors here. Survey Site A3 is considered sufficient to provide baseline data on this stretch of river.

This site was visited in March 2022 to check for spawning brook lamprey. None were recorded.

3.5.1.5 Survey Site 5

Survey Site A5 was located on the Kilroughil Stream (EPA segment code: 25_2711). The stream was small with a wetted width of c. 1m. The average depth was c. 20cm. The substrate present at the site was a mixture of rock/cobble and the habitat was riffle. There was c. 55% canopy cover. The gradient at the site was medium. Siltation levels were normal.

There was salmonid nursery habitat present. There was no Lamprey habitat present. Brown Trout were the only species recorded at this site. They were recorded as Present. The CPUE for Brown Trout was 0.6 fish caught per minute.

Biological water quality was assigned a rating of Q4 equivalent to WFD status "Good".

3.5.1.6 Survey Site 6

Survey Site A6 was located on the River Bridgetown (Clare) (EPA Segment code: 25_1163). The river at the site had a wetted width of c. 3m and the channel had been drained. Some recent development works had taken place. There were several large boulders in the stream. There was also c. 40% instream vegetation. The gradient was low, and siltation was high. Eroding banks were present. Filamentous algae were also recorded at this site. Canopy cover was low overall. There were clear water quality issues at this site.

Salmonid and Lamprey spawning / nursery habitats were present. Four fish species recorded at this site. These were Brown Trout, Minnow, Three-spined Stickleback and Stone Loach. Brown Trout were common with a CPUE of 7.4 fish caught per minute. Three-spined stickleback were Common with a CPUE of 2 fish caught per minute. Both Minnow and Stone Loach were recorded as Present with a

CPUE of 0.6 fish per minute for both species. Brook Lamprey were recorded in Small Numbers. There were 3 individuals recorded with a CPUE of 1 fish caught per minute fishing.

Biological water quality was assigned a rating of Q3 equivalent to WFD status “Poor”. An overall evaluation of “Moderate” was given to this site.

3.5.1.7 Survey Site 7

Survey Site A7 was located on the River Bridgetown (Clare) (EPA Segment Code: 25_474). The wetted width at the site was c. 1m. The gradient at the site was low and siltation high. There were eroding banks present. There have recently been extensive river works at this site and therefore it was not electrofished. The site was visually assessed, however. The river appeared sluggish and there were high levels of fringing instream vegetation. There was some salmonid habitat present upstream and Lamprey habitat was present. It was considered likely that Brown Trout and Brook Lamprey do occur at the site.

The overall status of the site was considered less than “Good”.

3.5.1.8 Survey Site 8

Survey Site A8 was located on the River Bridgetown (Clare) (EPA Segment Code: 25_2517). The river here was dry during the survey. The banks appeared steep and were well vegetated.

3.5.1.9 Survey Site 9

Survey Site A9 was located on the Broadford River. This site was not fished. The site was partially dry during the survey and considered too small for electrofishing. The stream had a wetted with of c. 1m with a low gradient and high siltation. Eroding banks were present. The channel has previously been drained. Cattle have access to the stream and the banks were very muddy. Canopy cover was c. 40%. The stream was very small and had no fisheries potential.

This site was visited in March 2022 to check for spawning brook lamprey. None were recorded.

3.5.1.10 Survey Site 10

Survey Site A10 was located on the Broadford River. This site was not fished or kick sampled as it was a tiny stream with no fish habitat present. The stream had a wetted with of c. 1m with a low gradient and high siltation. Eroding banks were present. The channel has previously been drained. Canopy cover was c. 75% and the banks were heavily vegetated.

3.5.2 Grid Connection Route

3.3.2.1 Survey Site 11

Survey Site A11 was located on the River Blackwater [Clare] (EPA Segment Code: 25_3883). The river at the site had a wetted width of c. 6m. There was a medium gradient to the river. No filamentous algae were recorded, and siltation levels were normal. Floating river vegetation was present here. Canopy cover at the site was c. 50% and the habitat was a mixture of riffle and glide.

There was salmonid nursery and fishery habitat present at the site. There was no coarse fishery or nursery habitat. Lamprey habitat was recorded.

There were seven fish species recorded at this site. Species recorded as Present include Dace, Stone Loach, Three-spined stickleback, Minnow and Eel. The CPUE for Stone Loach and Three-spined stickleback was 0.2 fish caught per minute. The CPUE for Eel and Dace was 0.2 fish caught per minute. Brown Trout were recorded in Small Numbers and Salmon were Common. There was 1 Brown Trout caught per minute fished and 7.6 Salmon. There were two lamprey species recorded at this site. There were 12 individual Brook Lamprey found and 2 River Lamprey transformers. Overall, there were 4 lamprey caught per minute fished.

Biological water quality was assigned a rating of Q4 equivalent to WFD status "Good". Overall, this was a high quality river of Special Area of Conservation standard.

3.3.2.2 Survey Site 12

Survey Site A12 is located on the River Blackwater [Clare] (EPA Segment Code: 25_3221). The site had a wetted width of 6m. The gradient was low overall, and siltation was normal. The river here is deep and sluggish. The habitat was predominantly glide and canopy over was c. 40%.

The site was visually assessed as it is very deep and there are access issues. Therefore electrofishing and Q-sampling were not carried out. There is salmonid nursery habitat present but no salmonid fishery habitat. There was lamprey habitat at the site. The culvert downstream was also visited. The fish pass was inspected and found to be not working. Several of the boards on the pass were broken. This culvert blocks river lamprey migration.

The site was not assessed but it is considered likely to have a biological water quality status of Q4 equivalent to an overall status of "Good".

This site was visited in March 2022 to check for spawning brook lamprey. None were recorded.

3.3.2.3 Survey Site 13

Survey Site A13 was located on the River Blackwater [Clare] (EPA Segment Code: 25_13109). The site had a wetted width of 6m. There was a medium gradient and moderate siltation. Eroding banks and artificial features were both present at the site. This artificial feature was a road / slipway that went into the river and was used as a cattle crossing. There were water quality issues at the site from agricultural impacts. The river is culverted downstream, and this results in an upstream migration barrier for River and Sea Lamprey.

There was salmon nursery habitat present at the site, but salmon fishery habitat was absent. There was no coarse nursery or fishery habitat present. Lamprey habitat did occur at the site.

Salmon and Brown Trout were both recorded at this site. There were recorded as Present and in Small Numbers respectively. There were 0.6 Salmon caught per minute fished and 1.2 Brown Trout. This indicated that Salmon do pass the downstream culvert. Three-spined stickleback and Stone loach were recorded as Present and Minnow in Small Numbers. The CPUE for the 3 species was 0.4, 0.8 and 1 fish caught per minute respectively.

Biological water quality was assigned a rating of Q3-4 equivalent to WFD status “Moderate”.

3.3.2.4 Survey Site 14

Survey Site A14 was located on the Glenomra Wood Stream (EPA Segment Code: 25_3221). The wetted width at this site was c. 2m. The gradient overall was low, and siltation was normal. Eroding banks were present. There was low canopy cover at c. 15%. The habitat was a mixture of riffle and glide.

Important salmonid nursery habitat was present. There was no salmonid fishery habitat at the site. There was no coarse fishery or nursery habitat present. There was no lamprey habitat present at the site.

Brown Trout were considered likely to be present. They were recorded as Present and 0.6 fish were caught per minute.

Biological water quality was assigned a rating of Q4 equivalent to WFD status “Good”.

This site was visited in March 2022 to check for spawning brook lamprey. None were recorded.

3.3.2.5 Survey Site 15

Survey Site A15 was located on the Glenomra Wood Stream (EPA Segment Code: 25_13111). This was a small stream with a wetted width of c. 1m. The gradient at the site was low and siltation was normal.

This site was considered too small to be suitable for electrofishing or Q-sampling. Salmonid nursery habitat was present. There was no salmonid fishery habitat at the site. There was no coarse fishery or nursery habitat present. There was no lamprey habitat present at the site.

Brown Trout are considered to be present at this site.

The stream was not assessed but it is considered likely to be Q3-4 and less then Good status overall.

3.5.3 Turbine Delivery Route

3.3.3.1 Survey Site 16

Survey Site A16 was located on the River Ballyard 25 (EPA Segment Code: 25_3408). The stream at this site is small and has a wetted width of c. 1m. There is high canopy cover in the area and conifer plantations are present. The gradient of the site was low, and siltation was normal.

The stream was small and had no fisheries potential. The site was not assessed due to this but is considered less than good status.

3.3.3.2 Survey Site 17

Survey Site A17 was located on the River Ardcloony (EPA Segment Code: 25_2596). The wetted width at this site was c. 5m. The gradient was medium and siltation was normal. Eroding banks were present and the channel had not been drained.

Salmonid nursery habitat and spawning habitat was present. There was no coarse fishery or nursery habitat present. There was no lamprey habitat present at the site.

This site was not fished and it is considered that the site is similar to the upstream site (Survey Site A18). The ESB dam downstream blocks fish migration to this stream. Salmon are likely to be present and are likely stocked from Parteen Hatchery. Brown Trout, Brook Lamprey, Stone Loach and Three-spined stickleback are likely present.
The river was not assessed however it is considered to be Q4 Good status.

3.3.3.3 Survey Site 18

Survey Site A18 was located on the River Ardcloony (EPA Segment Code: 25_2596). The site had a wetted width of 5m. The gradient of the site was medium and siltation was normal. There were eroding banks at the site. The habitat at the site was mostly glide with some riffle habitat also present. Canopy cover was high at c. 70%. The banks at the site were steep and vegetated.

Salmonid nursery habitat and spawning habitat was present. There was no coarse fishery or nursery habitat present. There was no lamprey habitat present at the site.

There were five fish species recorded at this site. Salmon and Brown Trout were both recorded in Small Numbers. There was one age class of Salmon present. These Salmon appeared to have been stocked fish. The CPUE for Salmon was 0.8 fish caught per minute and for Brown Trout was 2.2. Minnow, three-spined stickleback and Stone loach were recorded as Present. The CPUE for each was 1, 1, and 0.4 fish caught per minute respectively.

The river was not considered suitable for Q-sampling however it is considered to be Q4 Good status.

3.3.3.4 Survey Site 19

Survey Site A19 was located on the River Kilmastulla (EPA Segment Code: 25_3881). The wetted width at the site was 5m. The gradient was medium and siltation levels were moderate. Filamentous algae was present as were eroding banks. The habitat type was riffle and canopy cover was c. 10%. The site had been drained. The river is affected by mine drainage and arterial drainage resulting in many invertebrate groups missing. Some recent river works have also occurred including vegetation clearance and potentially dredging. The River Kilmastulla flows into the River Shannon downstream of Parteen weir and is therefore fish passage is not impacted by the Shannon scheme.

Salmonid nursery habitat and spawning habitat was present. There was no coarse fishery habitat present, but nursery habitat was present. Lamprey habitat was present at the site.

There were seven fish species recorded at this site in previous Ecofact surveys. Salmon and Brown Trout are both present. In addition, Dace, Eel, Minnow and Three-spined Stickleback have been recorded. The three species of lamprey, River, Sea and Brook have also been recorded. There was also evidence of Otter at this site.

The river is considered Q3 for biological water quality and was considered “Moderate” status overall. This is an SAC quality river and some of the lower reaches are within the Lower River Shannon SAC.

This site was visited in March 2022 to check for spawning brook lamprey. None were recorded.

3.3.3.5 Survey Site 20

Survey Site A19 was located on the River Kilmastulla (EPA Segment Code: 25_3881). The wetted width at the site was 5m. The gradient was medium and siltation levels were moderate. Filamentous algae was present as were eroding banks. The site had been drained. The river is affected by mine drainage and arterial drainage resulting in many invertebrate groups missing. Some recent river works have also occurred including vegetation clearance and potentially dredging. Some recent river works have also occurred. The River Kilmastulla flows into the River Shannon downstream of Parteen weir and is therefore fish passage is not impacted by the Shannon scheme.

Salmonid nursery habitat and spawning habitat was present. There was no coarse fishery habitat present, but nursery habitat was present. Lamprey habitat was present at the site.

There were seven fish species recorded at this site in previous Ecofact surveys. Salmon and Brown Trout are both present. In addition, Dace, Eel, Minnow and Three-spined Stickleback have been recorded. The three species of lamprey, River, Sea and Brook have also been recorded.

The river is considered Q3 for biological water quality and was considered “Moderate” status overall. This is an SAC quality river and some of the lower reaches are within the Lower River Shannon SAC.

3.3.3.6 Survey Site 21

Survey Site A21 is located on the River Roolagh (EPA Segment Code: 25_2679). The river at the site had a wetted width of c. 2m. Canopy cover was c. 60%. The gradient at the site was low and siltation was normal. Filamentous algae was present at this site. The northern bank is well vegetated and the southern bank is mostly bare and covered with grass.

There was some salmonid nursery habitat at the site which was not high quality. There was no salmonid fishery habitat. There was no coarse fishery habitat present, but nursery habitat was present. Lamprey habitat was present not present at the site.

This site was not assessed due to the size. The river is considered to likely be Q3 with an overall status of “Moderate”.

This site was visited in March 2022 to check for spawning brook lamprey. None were recorded.

3.3.3.7 Survey Site 22

Survey Site A23 was located on the River Ballyteige 25 (EPA Segment Code: 25_2794). This river is known locally at the River Killestry. The river at the site had a wetted width of 3m. The river had a medium gradient and moderate siltation. Filamentous algae was present as were eroding banks. This site had been drained. There have been some recent river works upstream and downstream some rehabilitation works have been undertaken. There is a bridge with a wire fence across the river between survey Site A22 and A23 which appears to block livestock access upstream and downstream.

There was salmonid nursery habitat present at the site but no fishery habitat. There was no coarse fishery or nursery habitat at the site. Lamprey habitat was present.

This site was not assessed but is considered to be the same (Q3-4) as the upstream site (Survey Site A23). There was evidence of Otter downstream of the bridge. Otter prints were recorded at a cattle drink downstream.

This site was visited in March 2022 to check for spawning brook lamprey. None were recorded.

3.3.3.8 Survey Site 23

Survey Site A23 was located on the River Ballyteige 25 (EPA Segment Code: 25_2794). This river is known locally at the River Killestry. The river at the site had a wetted width of 3m. The river had a medium gradient and moderate siltation, Filamentous algae was present as were eroding banks. This site had been drained. There have been some recent river works upstream.

There was salmonid nursery habitat present at the site but no fishery habitat. There was no coarse fishery or nursery habitat at the site. Lamprey habitat was present.

There were two species recorded at this. These were Brown Trout present in Small Numbers and Stone Loach recorded as Present. Brown Trout CPUE was 0.8 fish caught per minute fished. There were 0.2 Stone Loach caught for every minute fished. Brook Lamprey were also recorded. There were two individuals recorded resulting in a CPUE of 0.67 brook lamprey caught per minute fished.

This site was considered to be Q3-4 equivalent to WFD status “Moderate”.

Table 3. Evaluation of each site for its ecological importance showing rationale for these evaluations.

Site no.	Watercourse	EPA code	Evaluation of Importance	Rationale summary
1	River Black [O'Briensbridge]	25B22	Local importance (higher value)	Fisheries value present with salmonid and lamprey habitat recorded at the site; rated as Q4 (good status); Brown Trout and Brook lamprey were recorded
2	River Black (O'Briensbridge)	25B22	Local importance (higher value)	Fisheries value present with salmonid and lamprey habitat recorded at the site; rated as Q4 (good status); Brown Trout and Brook lamprey were recorded
3	River Black (O'Briensbridge)	25B22	Local importance (lower value)	Salmonid habitat present and is a small stream; rated Q4 (good status) but there impacts in the form of a one-off house and infilling; low numbers of brown trout were recorded
4	River Black (O'Briensbridge)	25B22	Local importance (lower value)	No fisheries values as no fish were recorded as watercourse as dry; biological water quality not assessed as river was dry
5	Kilroughil Stream	25K69	Local importance (higher value)	Salmonid habitat present; brown trout recorded; very small stream rated as Q4 (good status)
6	River Bridgetown (Clare)	25B23	Local importance (higher value)	Salmonid and lamprey habitats present; Brown trout and brook lamprey were recorded, assessed as Q3 (poor status); very heavily silted and evidence of instream fisheries works
7	River Bridgetown (Clare)	25B23	Local importance (higher value)	Unsuitable for assessment as river has been recently dredged. Due to this no fisheries habitat present. It is considered to be less then good status and salmonid habitat does occur upstream. Brown Trout and Brook Lamprey likely present
8	River Bridgetown (Clare)	25B23	Local importance (lower value)	No fisheries values as no fish were recorded as watercourse as dry; biological water quality not assessed as river was dry
9	Broadford River	27B02	Local importance (lower value)	No fisheries values as no fish were recorded; watercourse was partially dry; biological water quality not assessed as river was partially dry with lack of flow
10	Broadford River	27B02	Local importance (lower value)	Very small stream with no fisheries value; wasn't biologically assessed due to size and lack of flow; no fisheries potential
11	River Blackwater [Clare]	25B06	County Importance	Salmonid and lamprey habitat present; floating river vegetation present; good numbers of juvenile salmon and brown trout; Brook and River lamprey present; rated as Q4 (good status), SAC quality river
12	River Blackwater [Clare]	25B06	Local importance (higher value)	Salmonid and lamprey habitat present; not assessed as river was deep and sluggish, no spawning habitats present, culvert downstream blocks migration; Salmon, Brown Trout and Brook Lamprey recorded.
13	River Blackwater [Clare]	25B06	Local importance (higher value) / County Importance	Spawning and nursery salmonid and lamprey habitat present; rated Q3-4 (moderate status); juvenile salmon, brown trout, brook lamprey (significant numbers), minnow and stone loach were present; impacts included cattle crossing and agricultural inputs

Site no.	Watercourse	EPA code	Evaluation of Importance	Rationale summary
14	Glenomra Wood Stream	25B06	Local importance (higher value)	Important salmonid nursery habitat; brown trout likely present; assigned Q4 (good status)
15	Glenomra Wood Stream	25B06	Local importance (higher value)	Salmonid nursery habitat; trout likely present, considered to be Q3-4 (good status)
16	River Ballyard 15	25B77	Local importance (lower value)	Very small stream; no fish habitat present; not assessed due to small size and low flow but considered likely Q3-4 (moderate)
17	River Ardcloony	25A03	Local importance (higher value)	Nursery and spawning salmonid habitat; lamprey habitat present; Salmon (likely stocked), Brown Trout, Brook lamprey, Stone loach and three-spined stickleback were recorded, not assessed but likely Q4 (good status) as is Site 18 upstream; migration partially blocked by ESB dams
18	River Ardcloony	25A03	Local importance (higher value)	Nursery and spawning salmonid habitat; lamprey habitat present; Salmon (likely stocked), Brown Trout, Brook lamprey recorded; migration partially blocked by ESB dams; rated Q4 (good status)
19	River Kilmastulla	25K04	Local importance (higher value) / County Importance	Salmonid and lamprey habitat present; previous survey have recorded Salmon, all three lamprey species, dace, minnow, European eel and three-spined stickleback were recorded; river is impacted from mine drainage and arterial drainage
20	River Kilmastulla	25K04	Local importance (higher value)	Salmonid and lamprey habitat present; previous survey have recorded Salmon, all three lamprey species, dace, minnow, European eel and three-spined stickleback were recorded; river is impacted from mine drainage and arterial drainage
21	River Roolagh	25R20	Local importance (higher value)	Moderate salmonid nursery habitat present; too small to fully assess but considered Q3 (moderate status)
22	River Ballyteige 25	25B17	Local importance (higher value)	Moderate salmonid nursery habitat present; too small to fully assess but considered Q3-4 (moderate status)
23	River Ballyteige 15	25B17	Local importance (higher value)	Spawning and nursery salmonid habitat and lamprey habitats present; Brown trout, brook lamprey, stone loach, and three-spined stickleback recorded; salmon recorded in previous surveys; recent dredging and river realignment; migration partially blocked by ESB dam. Rated Q3-4 (moderate status).

4. POTENTIAL IMPACTS

Wind farm developments, as with all major construction projects, have the potential to have significant negative impacts on aquatic habitats and the key ecological receptors in the aquatic environment. Wind farm projects are often located near the sources of streams or rivers. These reaches are generally minor watercourses and are therefore potentially vulnerable to even relatively small pollution events. Such areas can also be important salmonid spawning and nursery areas; or can act as vectors of pollution to downstream areas. Minor headwaters and upper reaches can be of importance to protected or ecologically important features downstream.

The impacts of wind farm developments on aquatic areas generally occur only during the construction phase. Ongoing operation and maintenance of wind farms is unlikely to result in any significant effects in the receiving aquatic environment. Impacts may also potentially occur during wind farm decommissioning.

The proposed development will require clearance of trees/vegetation, particularly conifer plantation to build site access roads, turbine foundations, borrow pits, hardstanding areas, cable trenches and provide site drainage. These operations can impact on the quality of habitats present for aquatic organisms. Wind farm construction can increase suspended solids loading of watercourses, alter recharge or drainage/runoff patterns and change surface water quantity thereby increasing flood risk for downstream watercourses, eroding watercourse banks and edges, widening channels and altering stream beds.

The potential impacts of the proposed wind farm development are outlined below for the construction, operation and decommissioning (as applicable) phases of the project. These are the potential impacts that could potentially occur in the absence of mitigation measures.

4.1 Wind Farm Development

The watercourses on the proposed Wind Farm site itself are all small 2nd and 1st order streams. These sites are in the upper reaches of the Broadford River, River Bridgetown (Clare) and River Black (O'Briensbridge). Of these two sites were dry during the survey and another 3 were unsuitable for a fishery survey due to lack of habitat and recent river dredging works. These river stretches are of very little fisheries value. However, downstream at the receptor sites where the rivers increase in size fish diversity and habitat quality improves.

4.1.1 Construction Phase

4.1.1.1 Direct

The proposed wind farm site is drained by the River Fahy (Clare), River Black (O' Briensbridge) and the River Kilroughill. These are all located in the River Black (O' Briensbridge) catchment. The River Broadford also drains the northern most section of the wind farm site. In addition, the Wind Farm is c. 4rkm upstream from the Lower River Shannon SAC. While the watercourses onsite are not sensitive the Lower River Shannon SAC is a sensitive ecological area.

There is potential for releases of suspended solids and other substances associated with upgrading, realigning and construction of access roads within the site and also during the excavation work associated with these types of works. Installation, upgrading and/or extension of an internal road network on a wind farm site and excavations can result in increased silt runoff. Vegetation clearance will be required along with tree felling, potentially resulting in the release of suspended solids. Suspended solids in even quite small quantities may have a serious effect on the spawning sites of salmonids. Spawning habitat on the windfarm site is not common and does not occur on the Broadford River or the upper reaches of the River Black (O'Briensbridge) and River Bridgetown (Clare) at the sites which were dry.

The proposal also includes for four stream crossings. These are located upstream of site 10, between sites 3 and 4, at site 4 and on an unmapped stream to the west of T7. There are no sensitive ecological receptors at site 4, upstream of site 10 or between sites 3 and 4. There may be some fisheries habitat between sites 3 and 4 in the form of low-quality brown trout habitat. Upstream of site 10 and at site 4 box culverts will be installed. Between sites 3 and 4 a clear span bridge will be put in place. The fourth crossing point (west of T7) which will be a box culvert, is located on an unnamed stream on the windfarm site. This stream is not considered to be of any ecological importance.

Engineering works in the vicinity of streams and at stream crossings can also impact directly on physical habitat, for example nursery areas for fish. Permanent loss of aquatic habitats can also occur where access roads are constructed over or in close proximity to streams/rivers. Obstruction to upstream movement of fish, particularly salmon and trout, due to construction of culverts can also potentially occur.

'Improved' drainage of the site can potentially result in increased erosion of nearby streams and may result in lower water levels in dry weather, which will reduce the habitat available to fish. Any operations which result in loss of sediment will also result in increased nutrients being released from the soil. This has the potential to cause eutrophication of streams thereby lowering the capacity of the streams to support fish and invertebrate fauna. The construction of the wind farm is not expected to significantly affect the drainage regime on the site, with direct impacts affecting watercourses and aquatic ecology minimised via the protection of water quality within the site. The site surveys also revealed that the watercourses draining this area are being impacted by background water quality issues, such as agricultural practises and channel maintenance. Potential direct construction phase impacts on aquatic ecology, in the absence of mitigation, are assessed as being *slight negative, short-term and in the local context*. Best practice mitigation is required to avoid potential impacts.

4.1.1.2 Indirect

The most likely potential indirect impact during the construction phase of the wind energy development on receiving watercourses and aquatic habitats arises indirectly via impacts affecting water quality, such as accidental releases of silt laden runoff. Other potential impacts affecting aquatic ecology during the construction phase could also occur as a result of accidental spillage of cement or hydrocarbons stored on site impacting upon water quality. Waste from on-site toilets and wash facilities could also potentially impact on aquatic ecology.

Indirect water quality impacts can potentially occur during the construction of access roads, the laying of cable route as well as any works required to facilitate the indicative turbine delivery route. These works could result in silt run-off, pollution events originating from the site works and machinery used, which could indirectly affect areas elsewhere in the catchment. These indirect impacts could give rise to the potential for impacts affecting fish and fisheries, as well as aquatic invertebrate communities within the study area.

Any engineering works which cause runoff of sediments can also increase the levels of nutrients in receiving streams. This can result in the enrichment or eutrophication of the affected streams and catchment areas further downstream, and a possible change in overall water quality status. Suspended solids or sediment in a river is also a major concern and can have serious negative impacts on aquatic invertebrate and instream flora. There were no aquatic species listed on Annex II of the EU Habitats Directive (1992) found occurring on the proposed Wind Farm site.

There is also a risk that machinery or materials imported onto the site could act as a vector for introducing or dispersing non-native invasive species. Potential indirect construction phase impacts on aquatic ecology, in the absence of mitigation, are assessed as being *slight negative, short-term and in the local context*. Mitigation is required to avoid potential impacts.

4.1.1.3 Cumulative

The area of the proposed site is subject to additional pressures on water quality and aquatic ecology, particularly in relation to agricultural activities and drainage maintenance works. Where wind farm construction and agricultural activities occur at the same time there is the potential for in-combination or cumulative impacts on local watercourses. The risk of such impacts would, for example, greatly increase if such works were taking place during the winter months or times of very high rainfall. Conifer forestry and peat extraction and associated operations could also have the potential to adversely affect water quality in the area; therefore, could impact watercourses in-combination with the proposed Fahy Beg wind farm. There is a proposal for another windfarm in the area. This wind farm called Carrownagowan Wind Farm is located c. 5.5km north of the current proposed wind farm. If both of these developments were constructed at the same time, there is the potential for cumulative impacts. It is noted however that the Carrownagowan Wind Farm is located mostly in the upper reaches of the Owenogarney River catchment which drains to the Shannon Estuary North Catchment. This is located in a different hydrometric area to the proposed Fahy Beg Wind Farm. Potential cumulative impacts on aquatic ecology, in the absence of mitigation, are assessed as being *moderate negative, short-term and in the local context*.

4.1.2 Operational

Operational wind farms are not normally considered to have the potential to significantly impact on the aquatic environment. The main risk to watercourses is when oils and lubricants are used on the site. If such substances leaked from the turbines or maintenance areas or were disposed of inappropriately, there is a risk of water pollution. However, the likelihood of this occurring is very low and the potential significance of this impact can be mitigated through proper management. In addition, the watercourses on the proposed development site are of low ecological value. Spills of any oil or fuels from site vehicles onto the access roads may find their way to the local stream network. However, this is unlikely to be a significant impact considering the low numbers of vehicles involved and the high-quality standards that are implemented on a well-managed site.

Upgrading of the site track/road network could allow increased public access to the site. This could potentially result in illegal dumping of domestic rubbish which could impact the watercourses in the area by causing deterioration in water quality. Potential operational phase impacts on aquatic ecology are assessed as being *imperceptible negative, temporary and in the local context.*

4.1.3 Decommissioning

The decommissioning phase of the proposed wind farm site gives rise to similar potential impacts as can be realised during the construction phase; although the magnitude of the impact of decommissioning is normally reduced as all infrastructure is already in place on the site. With suitable planning and provision of adequate mitigation potential impacts on the receiving aquatic environment during decommissioning can be minimised. Potential decommissioning impacts on aquatic ecology, in the absence of mitigation, is assessed as being *slight negative, short-term and in the local context.*

4.2 Grid Connection Route

The grid connection route crosses the River Blackwater [Clare] catchment. The survey sites are located on the River Blackwater [Clare] and Glenomra Wood Stream. The survey sites in this region ranged from Q3-4 to Q4. Some of the sites were of very high quality and up to Special Area of Conservation standard. Annex I species recorded in this area include Salmon, River Lamprey, Brook Lamprey and at one site Sea Lamprey are also likely to be present. This river flows into the Lower River Shannon SAC downstream. There are some fish passage issues in this catchment.

4.2.1 Construction Phase

4.2.1.1 Direct

The grid connection route crosses the Glenon South Stream east of Ardnacrusha. It also crosses the River Blackwater [Clare] and the Glenomra Wood Stream. These sites are all in the River Blackwater [Clare] Catchment. The route also crosses the upper reaches of the River Bridgetown [Clare] where it connects to the Wind Farm site.

There is potential for releases of suspended solids and other substances associated with these types or works. Vegetation clearance will be required as well as excavation works. These activities could result in increased silt runoff. Suspended solids in even quite small quantities may have a serious effect on the spawning sites of salmonids.

Engineering works in the vicinity of streams and at stream crossings can also impact directly on physical habitat, for example nursery areas for fish. There is salmonid and lamprey nursery and spawning habitats at some of these sites. Salmon and Brook Lamprey are present along the proposed grid connection route. Mitigation is required to avoid these potential impacts. If instream works are required there is also the potential for direct disturbance to aquatic species and the destruction of habitats. This can occur from machines, personnel and equipment entering the water and trampling these areas. There is the potential for some impacts and mitigation is required to avoid potential impacts.

4.2.1.2 Indirect

The most likely potential impact during the construction phase of the grid connection route on receiving watercourses and aquatic habitats arises indirectly via impacts affecting water quality, such as accidental releases of silt laden runoff and vegetation removal resulting in erosion. There are sensitive ecological receptors downstream including the lower reaches of the River Blackwater [Clare], River Shannon and Lower River Shannon SAC.

For large watercourses horizontal drilling will be employed. Where culverts are existing ducts will be installed over or under the existing culvert. It is proposed that open trenching may be used for minor drains where there are no sensitive ecological receptors. These works as a precautionary measure should be undertaken out of the salmonid close season (September 30th – June 1st). In addition a silt fence will be placed downstream and regularly maintained.

The grid connection will be underground for its entire length. Impacts could occur from the associated excavation works. These works could result in silt run-off, pollution events originating from the site works and machinery used, which could indirectly affect areas elsewhere in the catchment including the Lower River Shannon SAC. These indirect impacts could give rise to the potential for impacts affecting fish and fisheries, as well as aquatic invertebrate communities within the study area.

Any engineering works which cause runoff of sediments can also increase the levels of nutrients in receiving streams. This can result in the enrichment or eutrophication of the affected streams and catchment areas further downstream, and a possible change in overall water quality status. Suspended solids or sediment in a river is also a major concern and can have serious negative impacts on aquatic invertebrate and instream flora. Aquatic species listed on Annex II of the EU Habitats Directive (1992) occurring within the study area include Brook Lamprey, Sea Lamprey, River Lamprey and Salmon. Potential impacts affecting these species could occur as a result of water quality impacts arising through accidental pollution events including the increased erosion which may give rise to elevated suspended solids and siltation effects. These species are located in the River Blackwater [Clare] catchment. There is also floating river vegetation at the lower reaches of this river. This is potentially Annex I habitat *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260) which is a qualifying interest of the Lower River Shannon SAC. This habitat can be impacted by water quality deterioration, increased siltation and invasive non-native species. Floating river vegetation was also recorded at site A11.

There is also a risk that machinery or materials imported onto the site could act as a vector for introducing or dispersing non-native invasive species. Potential indirect construction phase impacts on aquatic ecology, in the absence of mitigation, are assessed as being *slight negative, short-term and in the local context*. Mitigation is required to avoid potential impacts.

4.2.1.3 Cumulative

Upstream of the proposed Grid connection route the River Blackwater [Clare] is under significant pressures and is at risk of not meeting its objectives as set out in the WFD by 2027. Along the route itself the river is not “At Risk” and downstream the river is “Under Review”. The sites are subject to additional pressures on water quality and aquatic ecology, particularly in relation to agricultural activities. There are also fish passage impacts. Where construction and agricultural activities occur at the same time there is the potential for in-combination or cumulative impacts on local watercourses. The risk of such impacts would, for example, greatly increase if such works were taking place during the winter months or times of very high rainfall. Conifer forestry and associated operations could also have the potential to adversely affect water quality in the area; therefore, could impact watercourses in-combination with the proposed Fahy Beg wind farm. There is a proposal for another windfarm in the area. This wind farm called Carrownagowan Wind Farm is located c. 5.5km north of the current proposed wind farm. If both of these developments were constructed at the same time there is the potential for cumulative impacts. It is noted however that the Carrownagowan Wind Farm is located mostly in the upper reaches of the Owenogarney River catchment which drains into the Shannon Estuary North Catchment. This is located in a different hydrometric area then all sites on the proposed grid connection. Potential cumulative impacts on aquatic ecology, in the absence of mitigation, are assessed as being *moderate negative, short-term and in the local context*.

It is noted that the proposed Carrownagowan grid connection is in the same catchment as the proposed Fahy Beg grid connection. These grid connections overlap for a section along the R471 and a section of local road. This has been taken into account in the cumulative impact assessment and it is considered that that there will be no cumulative impacts.

4.2.2 Operational

Impacts on aquatic ecology during the operational phase of the proposed development are unlikely. There is the potential for spills of any oil or fuels from site vehicles finding its way to the local stream network. In addition, if repairs need to be carried out and soil is excavated there is the potential for impacts regarding suspended solids. However, this is unlikely to be a significant impact considering the low numbers of vehicles involved and the unlikelihood of maintenance. Potential operational phase impacts on aquatic ecology are assessed as being *imperceptible negative, temporary and in the local context.*

4.2.3 Decommissioning

During the decommissioning phase, the grid connection will be left in place. Therefore it is considered that there is no potential for impacts.

4.3 Turbine Delivery Route

4.3.1 Construction Phase

4.3.1.1 Direct

The TDR crosses several watercourses. It crosses through the River Black (O' Briensbridge) catchment, the River Ardcloony, the River Ballyteige 25, Lough Derg, the Roolagh Stream, the River Kilmastulla and the River Ballyard 25. Sections of the route where is crosses the River Ballyteige 25, Lough Derg and the River Kilmastulla are located within the Lower River Shannon SAC. Therefore, there is the potential for direct impacts on the aquatic ecology of the Lower River Shannon SAC.

There is potential for releases of suspended solids and other substances associated with these types or works. Vegetation clearance will be required as well as excavations works to facilitate the transport of the turbines. These activities can result in increased silt runoff. Suspended solids in even quite small quantities may have a serious effect on the spawning sites of salmonids. There is important salmon spawning habitat present in some of the subject rivers here including the River Kilmastulla and River Ardcloony. Engineering works in the vicinity of streams and at stream crossings can also impact directly on physical habitat, for example nursery areas for fish. This habitat is present in the River Ardcloony, River Kilmastulla and River Ballyteige 25.

4.3.1.2 Indirect

The most likely potential impact during the construction phase of the proposed TDR on receiving watercourses and aquatic habitats arises indirectly via impacts affecting water quality, such as accidental releases of silt laden runoff and vegetation removal resulting in erosion. These indirect impacts would occur downstream from the source of the impact. There are sensitive ecological receptors downstream including the River Shannon and Lower River Shannon SAC. Other potential impacts affecting aquatic ecology during the construction phase could also occur as a result of accidental spillage of cement or hydrocarbons used by machines to fell trees and clear vegetation as well as for excavation works.

To facilitate the TDR vegetation clearance and tree felling will occur. These works could result in silt run-off, pollution events originating from the site works and machinery used, which could indirectly affect areas elsewhere in the catchment including the Lower River Shannon SAC. These indirect impacts could give rise to the potential for impacts affecting fish and fisheries, as well as aquatic invertebrate communities within the study area.

Any engineering works which cause runoff of sediments can also increase the levels of nutrients in receiving streams. This can result in the enrichment or eutrophication of the affected streams and catchment areas further downstream, and a possible change in overall water quality status. Suspended solids or sediment in a river is also a major concern and can have serious negative impacts on aquatic invertebrate and instream flora. Aquatic species listed on Annex II of the EU Habitats Directive (1992) occurring within the study area include Brook Lamprey, Sea Lamprey, River Lamprey and Salmon. Some of the Salmon appeared to be stocked fish. Potential impacts affecting these species could occur as a result of water quality impacts arising through accidental pollution events including increased erosion which may give rise to elevated suspended solids and siltation effects. These species are located in the River Ardcloony, River Kilmastulla and the River Ballyteige 25.

There is also a risk that machinery or materials imported onto the site could act as a vector for introducing or dispersing non-native invasive species. Potential indirect construction phase impacts on aquatic ecology, in the absence of mitigation, are assessed as being *slight negative, short-term and in the local context*. Mitigation is required to avoid potential impacts.

4.3.1.3 Cumulative

Some of the watercourses present in the area of the proposed TDR are under significant pressures and at risk of not meeting their objectives as set out in the WFD by 2027. These include the River Ballyteige 25 and the River Roolagh. These waterways are under pressure from changes to hydromorphology and urban wastewater. During the aquatic ecology survey other pressures on the subject waterbodies were noted. The sites are subject to additional pressures on water quality and aquatic ecology, particularly in relation to agricultural activities. There are also impacts from recent river works including vegetation removal and potentially dredging on the River Kilmastulla. There are mine and arterial drainage impacts on this river. There are also fish migration issues. The River Ballyteige 25 has also been impacted by dredging and realignment also. Where construction and the above activities occur at the same time there is the potential for in-combination or cumulative impacts on local watercourses. The risk of such impacts would, for example, greatly increase if such works were taking place during the winter months or times of very high rainfall. Conifer forestry and associated operations could also have the potential to adversely affect water quality in the area; therefore could impact watercourses in-combination with the proposed TDR. There is a proposal for another windfarm in the area. This wind farm called Carrownagowan Wind Farm is located c. 5.5km north of the current proposed wind farm. If the Carrownagowan Wind Farm and TDR were constructed at the same time there is the potential for cumulative impacts. It is noted however that the Carrownagowan Wind Farm is located mostly in the upper reaches of the Owenogarney River catchment which flows into the Shannon Estuary North Catchment. This is located in a different hydrometric area to all sites on the proposed route to market for electricity. Potential cumulative impacts on aquatic ecology, in the absence of mitigation, are assessed as being *moderate negative, short-term and in the local context*.

4.3.2 Operational

Impacts on aquatic ecology during the operational phase of the proposed TDR are considered low. Once the turbines have been delivered and installed onsite there will be no further operational works to the TDR. It is stated that some replanting works will take place. Replanting should take consideration of the current plant species present and the ones removed and replant these species.

5. MITIGATION MEASURES

5.1 Wind Farm Site

5.1.1 Construction Phase

A Construction Environmental Management Plan has been completed for the proposed project. The final CEMP will be drawn up by the Contractor appointed for the works prior to the commencement of any works on site. All mitigation measures included in this document for the proposed development have been incorporated into the CEMP. Compliance with the CEMP, the procedures, work practises and controls will be mandatory and must be adhered to by all personnel and contractors employed on the construction of the proposed development.

A Surface Water Management Plan should be included in the CEMP. This has regard to guidelines included in '*Guidelines for the crossing of watercourses during the construction of national road schemes*' (NRA, 2008b) and '*Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*' (IFI, 2016). This is considered to be the key mitigation measure for the protection of aquatic species located in downstream receiving waters. The Surface Water Management Plan sets out measures to avoid siltation, erosion, surface water run-off and accidental pollution events which all have the potential to adversely affect water quality within the site during the construction phase. It also includes preparatory works on the site, including installation of silt fences and bunds.

All access tracks will be designed to minimise excavation on the site and reduce the risk of sediment runoff. A sealed silt fence will be placed at both sides of points where rivers or streams are crossed and to a minimum of 10m upstream and downstream of each crossing at both sides of the road. Swales for turbine bases and hard standings will be constructed.

All infrastructures will have a setback distance of 50 m away from all streams within the site except for the watercourse crossings. Where site tracks are existing rather than a new site track, this buffer will not apply. If access tracks cross watercourses they will be constructed as clear span bridges or precast concrete culverts. No instream wet concrete operations or construction will be permitted, and installation of any instream elements will completed in dry conditions. There are also four stream crossings proposed within the windfarm site. Where access tracks pass close to watercourses, silt fencing will be used to protect the streams. The maintenance and monitoring of such silt fences will be subject to an on-site quality management system which is set out in the CEMP. Stream crossings should be constructed during low flow conditions and within a 5-day weather window. How this will take place should be detailed in the SWMP. A silt fence should be placed downstream of all works and regularly maintained. Materials used to install culverts and stream crossings should be ore-cast.

Spoil heaps from the excavations for the turbine bases and trenches (where cables are to be buried) will be covered with geotextile and surrounded by silt fences to filter sediment from the surface water run-off from excavated material. Any berms will be covered with a geo-textile matting to avoid sediment runoff; berms will be surrounded by silt fencing until vegetation has been established in the following growing season. If cables will be installed in trenches, they will be located underneath and directly adjacent to access tracks as far as possible. Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods to avoid acting as a conduit for surface water flows. Clay bunds will be constructed within any cable trenches at intervals.

An Emergency Erosion and Silt Control Response Plan is included as a contingency in the CEMP, the final version of which will be distributed for consultation, which will detail the required measures for the Contractor to implement in the event of a 'worst case' scenario on the site. Timing of the proposed instream works will also take account of the fisheries constraints within the study area, where no works will be undertaken in the instream environment during the salmonid close season (October–March annually), which also avoids the lamprey spawning season.

Secure concrete washout areas are designated on site and detailed in the CEMP, the final version of which will be distributed for consultation. Standing water in the excavations at the turbine bases will contain an increased concentration of suspended solids. The excavations will be pumped into temporary settlement basins as necessary which will be lined and which will drain into existing or proposed drainage channels on site. The settlement basins will be constructed in advance of any excavations for the turbine bases.

Wheel washing facilities will be provided at the site entrance draining to silt traps. Additional silt fencing will be kept on site for the ongoing maintenance of the structures provided. Portaloos will be used to provide toilet facilities for site personnel. Sanitary waste will be removed from site via a licensed waste disposal contractor and will not be discharged on site.

Any diesel or fuel oils stored on site will be bunded to 110 % of the capacity of the storage tank. Such facilities will not be located near any drain or watercourse. Design and installation of fuel tanks will be in accordance with best practice guidelines. Refuelling of plant during construction will be carried out in an appropriately designed designated area, away from watercourses. Drip trays and spill kits will be kept available on site. Appropriate containment facilities will be provided to ensure that any spills from the vehicle are contained and removed off site.

Appropriate preventative measures are detailed in the CEMP to ensure that non-native aquatic/riparian species are not introduced into the site. These measures should follow as relevant the manual '*The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads*' by NRA (2010).

5.1.2 Operational Phase

The operational wind farm will have a negligible effect on aquatic ecological interests and fisheries, as there are no further potential impacts on surface water run-off or watercourses within the site. During the operation phase, oils will required for cooling the transformers giving rise to the potential for oil spills within the site. However, the transformers will be bunded to over 110 % of the volume of oil within them.

It is not envisaged that maintenance will involve any significant impacts on the hydrological regime of the area. Weekly inspections of the erosion and sediment control measures on site will be required during the construction period, followed by fortnightly inspections until the risk of erosion or siltation has declined following the successful establishment of vegetation during the operational phase.

Access to the site will be limited using a gate to prevent illegal dumping on the site and the unauthorised use of off-road vehicles etc.

5.1.3 Decommissioning Phase

In the event of decommissioning of the proposed wind farm, activities will take place in a similar fashion to the construction phase. There will be disturbance to underlying soils and therefore a risk again of silt laden run-off entering the receiving watercourse. The mitigation measures outlined above for the construction phase will also be implemented as relevant for the protection of aquatic ecological interests during the decommissioning phase.

5.2 Grid Connection Route

5.2.1 Construction Phase

A Construction Environmental Management Plan has been completed for the proposed project. This includes the Wind Farm site, the proposed grid connection route and TDR. The final CEMP will be drawn up by the Contractor appointed for the works prior to the commencement of any works on site. All mitigation measures included in this document for the proposed development will be incorporated into the CEMP. Compliance with the CEMP, the procedures, work practises and controls will be mandatory and must be adhered to by all personnel and contractors employed on the construction of the proposed development.

A Surface Water Management Plan should be included in the CEMP. This will have regard to guidelines included in '*Guidelines for the crossing of watercourses during the construction of national road schemes*' (NRA, 2008b) and '*Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*' (IFI, 2016). This is considered to be the key mitigation measure for the protection of aquatic species located in downstream receiving waters. The Surface Water Management Plan will set out measures to avoid siltation, erosion, surface water run-off and accidental pollution events which all have the potential to adversely affect water quality within the site during the construction phase. This will be focused on areas of the grid connection route near waterways and at crossing points. Works on river banks can potentially lead to destabilisation, erosion and increased siltation downstream. The four river crossings will be carried out using horizontal directional drilling.

A sealed silt fence will be placed at both sides of points where rivers or streams are crossed and to a minimum of 10m upstream and downstream of each crossing at both sides of the road. The maintenance and monitoring of such silt fences will be subject to an on-site quality management system which will be set out in the CEMP.

Spoil heaps from any excavations will be covered with geotextile and surrounded by silt fences to filter sediment from the surface water run-off from excavated material. Spoil heaps will not be stored within the Lower River Shannon SAC and will be placed at least 10m from the river. Any berms will be covered with a geo-textile matting to avoid sediment runoff; berms will be surrounded by silt fencing until vegetation has been established in the following growing season. If cables will be installed in trenches, they will be located underneath and directly adjacent to access tracks as far as possible. Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods to avoid acting as a conduit for surface water flows. Clay bunds will be constructed within any cable trenches at intervals.

An Emergency Erosion and Silt Control Response Plan have been included as a contingency in the CEMP, the final version of which will be distributed for consultation, which will detail the required measures for the Contractor to implement in the event of a 'worst case' scenario on the site. Timing of the proposed works will also take account of the fisheries constraints within the study area, where no works will be undertaken in the instream environment during the salmonid close season (October–March annually), which also avoids the lamprey spawning season.

Machinery will be stored in the site compound. Wheel washing facilities will be provided at the site entrance draining to silt traps. Portaloos will be used to provide toilet facilities for site personnel. Sanitary waste will be removed from site via a licensed waste disposal contractor and will not be discharged on site.

Any diesel or fuel oils stored on site will be bunded to 110 % of the capacity of the storage tank. Such facilities will not be located near any drain or watercourse. Design and installation of fuel tanks will be in accordance with best practice guidelines. Refuelling of plant during construction will be carried out on a designated and appropriately managed area, away from watercourses. Drip trays and spill kits will be kept available on site. Appropriate containment facilities will be provided to ensure that any spills from the vehicle are contained and removed off site.

Appropriate preventative measures are detailed in the CEMP to ensure that non-native aquatic/riparian species are not introduced into the site. These measures should follow as relevant the manual '*The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads*' by NRA (2010).

5.2.2 Operational Phase

The operational grid connection route would have a negligible effect on aquatic ecological interests and fisheries, as there are no further potential impacts on surface water run-off or watercourses within the site. During the operational phase there is the potential for impacts regarding maintenance. If there are faults with the cable route excavations may be required. However, the scale of this is considered minor. Weekly inspections of the erosion and sediment control measures on site will be required during the construction period, followed by fortnightly inspections until the risk of erosion or siltation has declined following the successful establishment of vegetation during the operational phase.

5.2.3 Decommissioning Phase

If the wind farm is decommissioned the proposed grid connection route will be left in place. Therefore, there is no potential for impacts.

5.3 Turbine Delivery Route

5.3.1 Construction Phase

A Construction Environmental Management Plan has been completed for the proposed project. This will include the Wind Farm site and the chosen grid connection route and TDR. The final CEMP will be drawn up by the Contractor appointed for the works prior to the commencement of any works on site. All mitigation measures included in this document for the proposed development will be incorporated into the CEMP. Compliance with the CEMP, the procedures, work practises and controls will be mandatory and must be adhered to by all personnel and contractors employed on the construction of the proposed development.

A Surface Water Management Plan should be included in the CEMP. This will have regard to guidelines included in '*Guidelines for the crossing of watercourses during the construction of national road schemes*' (NRA, 2008b) and '*Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*' (IFI, 2016). This is considered to be the key mitigation measure for the protection of aquatic species located in downstream receiving waters. The Surface Water Management Plan will set out measures to avoid siltation, erosion, surface water run-off and accidental pollution events which all have the potential to adversely affect water quality within the site during the construction phase. This will be focused on areas of the grid connection route near waterways and at crossing points. It will also include preparatory works on the site, including installation of silt fences and bunds.

Where excavation is required a sealed silt fence will be placed at both sides of points where rivers or streams are crossed and to a minimum of 10m upstream and downstream of each crossing at both sides of the road. The maintenance and monitoring of such silt fences will be subject to an on-site quality management system which will be set out in the CEMP.

An Emergency Erosion and Silt Control Response Plan will be included as a contingency in the CEMP, the final version of which will be distributed for consultation, which will detail the required measures for the Contractor to implement in the event of a 'worst case' scenario on the site. Timing of the proposed works will also take account of the fisheries constraints within the study area, where no works will be undertaken in the instream environment during the salmonid close season (October–March annually), which also avoids the lamprey spawning season.

Machinery will be stored in the site compound. Wheel washing facilities will be provided at the site entrance draining to silt traps. Portaloos will be used to provide toilet facilities for site personnel. Sanitary waste will be removed from site via a licensed waste disposal contractor and will not be discharged on site.

Any diesel or fuel oils stored on site will be bunded to 110 % of the capacity of the storage tank. Such facilities will not be located near any drain or watercourse. The design and installation of fuel tanks will be in accordance with best practice guidelines. Refuelling of plant during construction will be carried out in a designated and appropriately managed area away from watercourses. Drip trays and spill kits will be kept available on site. Appropriate containment facilities will be provided to ensure that any spills from the vehicle are contained and removed off site.

Appropriate preventative measures will be detailed in the CEMP to ensure that non-native aquatic/riparian species are not introduced into the site. These measures should follow as relevant the manual *'The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads*' by NRA (2010).

5.2.2 Operational Phase

The operational wind farm will have a negligible effect on aquatic ecological interests and fisheries, as there are no further potential impacts on surface water run-off or watercourses within the site. During the operation phase, oils will be required for cooling the transformers giving rise to the potential for oil spills within the site. However, this will not be associated with the TDR as no further works will take place here during the operational phase.

It is not envisaged that maintenance will involve any significant impacts on the hydrological regime of the area. Weekly inspections of the erosion and sediment control measures on site will be required during the construction period, followed by fortnightly inspections until the risk of erosion or siltation has declined following the successful establishment of vegetation during the operational phase.

6. RESIDUAL IMPACTS

The proposed wind farm will have an overall slight negative impact on aquatic ecology and fisheries during the construction phase in the local context in the absence of mitigation measures. The watercourses on the proposed Wind Farm site are all small streams without sensitive ecological receptors. The grid connection route would also have a slight negative impact on aquatic ecology and fisheries in the absence of mitigation. The GCR traverses sensitive ecological areas near salmonid and lamprey nursery and spawning habitat. Impacts will be effectively reduced to an imperceptible negative impact with the mitigation measures proposed. The limitation through mitigation of impacts arising from water quality pollution events such as siltation and run-off of suspended solids will significantly reduce the potential for impacts affecting aquatic ecological interests within the site.

Localised water quality impacts as a result of construction phase will be reduced by undertaking the most sensitive elements of the works outside the salmonid close season and protection of water quality following the implementation of the water management measures. Sensitive elements or work include all instream works in addition to works near watercourses where significant releases of silt / sediment could occur.

All mitigation measures provided for the protection of aquatic ecology and fisheries (particularly Annex II Species recorded during the current surveys and the Lower River Shannon SAC) within the proposed development sites, will effectively protect aquatic ecological interests downstream of the proposed developments.

It is important to note that the failure to implement the mitigation measures proposed for the minimisation of impacts affecting aquatic ecology and fisheries would negate the results of the impact assessment provided in the current assessment.

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https://catchments.ie/wp-content/files/subcatchmentassessments/25D_6%20Shannon[Lower]_SC_080%20Subcatchment%20Assessment%20WFD%20Cycle%202.pdf

PLATES

Plate 1 Survey Site A1 located on the 3rd order River Black [O'Briensbridge]. There were siltation and water quality issues obvious at this site.

Plate 2 Brown Trout stocks were good at Site A1 however Salmon were absent. There is a culvert / siphon downstream which is a fish migration barrier affecting salmon.

Plate 3 Brook Lamprey were recorded at Site A1. There is a culvert / siphon downstream which is a fish migration barrier affecting Sea and River Lamprey.

Plate 4 Survey Site A2 on the River Black (O'Briensbridge).

Plate 5 Brown Trout recorded at Survey Site A2 with a Pisciola leech attached just above the tail fin.

Plate 6 Young of the year River Lamprey recorded at Site A2.

Plate 7 Survey Site A3 on the River Black (O'Briensbridge). There were ongoing destructive works occurring at this site associated with a nearby one-off house.

Plate 8 Alternative view of Survey Site A3 showing extensive works taking place.

Plate 9 Survey Site A5 on the Kilroughil Stream. There were no major water quality issues on this stream and it was in good condition. Livestock potentially have access.

Plate 10 A Brown Trout recorded on the Kilroughil Stream at survey Site A5. This species was present in small numbers.

Plate 11 Survey Site A6 located on the River Bridgetown [Clare]. There were siltation and water quality issues at this site but good stocks of Brown Trout were present.

Plate 12 Brown Trout and Brook Lamprey recorded at survey Site A6 on the River Bridgetown [Clare].

Plate 13 Site 7 on the River Bridgetown (Clare) where recent river maintenance works had been undertaken. Due to this the site was only assessed visually.

Plate 14 Site 7 on the River Bridgetown (Clare) looking upstream.

Plate 15 Survey Site A8 on the 1st order River Bridgetown (Clare) during the survey.

Plate 16 Survey Site A9 on the River Broadford. This is a very small stream with no fisheries potential.

Plate 17 Survey Site A10 on the 1st order Broadford River. This was a very small stream with no fish present.

Plate 18 Survey Site A11 on the River Blackwater [Clare]. This was a high-quality river with floating river vegetation.

Plate 19 Salmon recorded at survey Site A11. Salmon were present in good numbers at this site.

Plate 20 The solitary wasp *Mellinus arvensis* were present on the bank at survey Site A11.

Plate 21 River Lamprey recorded at survey Site A11.

Plate 22 Survey Site A12 on the River Blackwater [Clare]. The habitat is glide at this site and it was rated Q4.

Plate 23 Outfall present at Survey Site A12.

Plate 24 Ardnacrusha Power Station on the headrace canal. The River Blackwater [Clare] is culverted under this waterbody.

Plate 25 The River Blackwater culvert under the headrace canal. This causes an upstream migration barrier for fish. This is downstream of survey Site A12.

Plate 26 The fish pass at the culvert which was not working during the site visit. The boards on the fish pass were broken. This is downstream of survey Site A12.

Plate 27 Electrofishing at survey Site A13 on the River Blackwater [Clare]

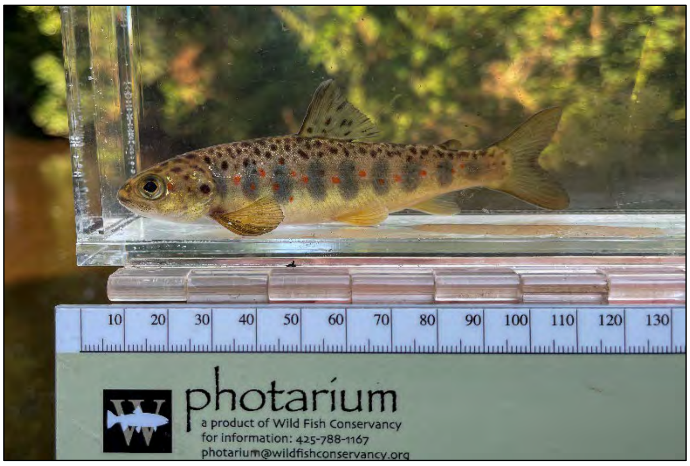

Plate 28 Salmon 1+ recorded at survey Site A13 on the River Blackwater [Clare]. Salmon were present in Small Numbers, and this indicated that Salmon are able to migrate upstream through the culvert.

Plate 29 Survey Site A14 on the Glenomra Wood Stream. This site had important salmonid nursery habitat.

Plate 30 Brown Trout recorded at survey Site A14.

Plate 31 Survey Site A18 on the River Ardcloony. Salmon, Brown Trout and Brook Lamprey were recorded here.

Plate 32 Salmon parr recorded at Site A18. This fish showed characteristics of a hatchery fish.

Plate 33 Survey Site A17 on the River Ardcloony.

Plate 34 Survey Site A19 on the River Kilmastulla. The river here is affected by mine and arterial drainage.

Plate 35 Survey Site A21 on the Roolagh River. There were water quality issues at this site.

Plate 36 Survey Site A22 on the River Ballyteige 15. There was salmonid spawning and nursery habitat in this site.

APPENDIX 1 RESULTS

Table A1.1 Location of the aquatic ecology sites aquatic survey sites assessed for the proposed Fahy Beg Farm site and grid connection options.

Site	Watercourse name	Biological Water quality	Aquatic habitat	Fish population	Rare / notable species	Overall evaluation
1	River Black [O'Briensbridge]	Q4	Salmonid and lamprey habitats present. Downstream culvert / siphon blocks fish passage.	Culvert / siphon blocks passage of lampreys and salmon	Brown Trout Brook Lamprey	Good status
2	River Black (O'Briensbridge)	Q4	Salmonid and lamprey habitats present. Downstream culvert / siphon blocks fish passage.	Culvert / siphon blocks passage of lampreys and salmon	Brown Trout Brook Lamprey	Good status
3	River Black (O'Briensbridge)	Q4 – but impacted downstream of the bridge by one-off house development, including infilling of stream.	Small stream but has salmonid habitats present.	Low numbers of Brown trout	Brown Trout	Good Status (but impacts at the site apparent)
4	River Black (O'Briensbridge)	Dry	Dry	Dry	Dry	Dry
5	Kilroughil Stream	Q4	Salmonid habitats present – but this is a very small stream	Brown trout	Brown trout	Good status
6	River Bridgetown (Clare)	Q3	Salmonid and lamprey habitats present. Some instream fisheries works at this site. Very heavily silted.	Brown Trout Brook Lamprey	Brown Trout Brook Lamprey	Moderate status
7	River Bridgetown (Clare)	Recently dredged so not assessed	River had been dredged – sluggish upstream but some salmonids habitats present	Not surveyed as the river had recently been dredged.	Brown Trout and Brook Lampreys likely to be present.	Less than Good Status
8	River Bridgetown (Clare)	Dry	Dry	Dry	Dry	Dry
9	Broadford River	n/a partially dry stream	Partially dry stream	Partially dry stream – no fisheries potential	None	n/a
10	Broadford River	Too small to assess	Tiny stream – not a fish habitat	Tiny stream – not a fish habitat	None	n/a

Site	Watercourse name	Biological Water quality	Aquatic habitat	Fish population	Rare / notable species	Overall evaluation
11	River Blackwater [Clare]	Q4	Salmonid and lamprey habitats present, floating river vegetation.	Good numbers of juvenile salmon and trout present. Both Brook Lampreys and River Lampreys recorded. Also, eels, minnows, Three-spined Stickleback, and Stone Loach.	Salmon Brown Trout River Lamprey Brook Lamprey Sea Lamprey (likely) Floating River Vegetation	Good status SAC quality river channel
12	River Blackwater [Clare]	Not assessed (but likely Q4)	Salmonid and lamprey habitats present – but river is deep and sluggish and no spawning habitats at this site. Downstream culvert partially blocks fish passage.	Culvert blocks passage of lampreys – but salmon were present at the site upstream from here.	Salmon Brown Trout Brook Lamprey	Good status
13	River Blackwater [Clare]	Q3-4	Cattle crossing at site and evidence of agricultural impacts. Salmonid and lamprey spawning and nursey habitats present. Downstream culvert partially blocks fish passage.	Good numbers of juvenile salmon and trout present. Brook Lampreys present in significant numbers. Minnows and Stone Loach also at this site.	Salmon Brown Trout Brook Lamprey	Slightly polluted and instream modifications. Less than Good Status.
14	Glenomra Wood Stream	Not assessed (but likely Q4)	Salmonid stream	Trout likely present	Brown trout	Good Status
15	Glenomra Wood Stream	Not assessed (but likely Q4)	Salmonid stream with agricultural impacts	Trout likely present	Brown trout	Good Status
16	River Ballyard 15	Not assessed (but likely Q3-4)	Small stream with no fish habitat	Small stream with no fish habitat	n/a	n/a
17	River Ardcloony	Q4 (not assessed but likely to be the same as	Salmonid stream with spawning and nursery habitats present. Lamprey habitats are	Salmon (likely to be stocked from Parteen hatchery)	Salmon (likely to be stocked) Brown	Good status

Site	Watercourse name	Biological Water quality	Aquatic habitat	Fish population	Rare / notable species	Overall evaluation
		upstream site)	present. Fish migration is partially blocked by the ESB dams.	Brown Trout Brook Lamprey Stone Loach Three-spined stickleback	Trout Brook Lamprey	
18	River Ardcloony	Q4	Salmonid stream with spawning and nursery habitats present. Lamprey habitats are present. Fish migration is partially blocked by the ESB dams.	Salmon (likely to be stocked from Parteen hatchery) Brown Trout Brook Lamprey Stone Loach Three-spined stickleback	Salmon (likely to be stocked) Brown Trout Brook Lamprey	Good status
19	River Kilmastulla	Q3	Salmonid and lamprey habitats present. River is affected by mine drainage and arterial drainage. It flows into the River Shannon downstream of Parteen weir so fish passage is not affected by the Shannon scheme.	Not surveyed but previous surveys by Ecofact have found salmon, three species of lampreys, dace, minnow, eels and three-spined stickleback.	Salmon Brown Trout River Lamprey Brook Lamprey Sea Lamprey	Moderate Status
20	River Kilmastulla	Q3	As other site	As other site	As other site	Moderate Status
21	River Roolagh	Not assessed (but likely Q3-4)	Salmonid stream with impacts	Trout likely present	Brown trout	Less than Good Status
22	River Ballyteige 25	Q3-4 (not assessed but likely to be the same as upstream site)	As other site	As other site	As other site	Moderate status
23	River Ballyteige 15	Q3-4	Salmonid stream with spawning and nursery habitats present. Lamprey habitats are present. Fish migration is partially blocked by the ESB dams. River works have taken place here – dredging and realignment.	Brown Trout Brook Lamprey Stone Loach Three-spined stickleback	Brown trout Brook lampreys Salmon have been recorded here in the past by Ecofact staff.	Moderate status

Table A.1.2 Results of the River Corridor Survey (RHS) Assessments of the aquatic survey sites assessed for the proposed Fahy Beg Farm site and grid connection options.

Site Code	Watercourse Name	EPA Code	Drained (Y/N)	Wetted Width (m)	Gradient (Low/Med/High)	Siltation (Heavy/Moderate/Normal/Free)	Filamentous algae (Y/N)	Eroding Banks (Y/N)	Braided Channel (Y/N)	Artificial Features (Y/N)
1	River Black [O'Briensbridge]	25B22	N	4	M	N	N	N	N	N
2	River Black (O'Briensbridge)	25B22	N	4	M	N	N	N	N	N
3	River Black (O'Briensbridge)	25B22	Y	1	M	H	N	Y	N	N
4	River Black (O'Briensbridge)	25B22	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
5	Kilroughil Stream	25K69	N	1	M	N	N	N	N	N
6	River Bridgetown (Clare)	25B23	Y	3	L	H	Y	Y	N	Y
7	River Bridgetown (Clare)	25B23	Y	1	L	H	N	Y	N	N
8	River Bridgetown (Clare)	25B23	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
9	Broadford River	27B02	Y	1	L	H	N	Y	N	N
10	Broadford River	27B02	Y	1	L	H	N	Y	N	N
11	River Blackwater [Clare]	25B06	N	6	M	N	N	N	N	N
12	River Blackwater [Clare]	25B06	N	6	L	N	N	N	N	Y
13	River Blackwater [Clare]	25B06	N	6	M	M	Y	N	N	Y
14	Glenomra Wood Stream	25B06	N	2	L	N	N	N	N	N
15	Glenomra Wood Stream	25B06	N	2	L	N	N	N	N	N
16	Ballyard 15	25B77	Y	1	L	N	N	N	N	N
17	River Ardcloony	25A03	N	5	M	N	N	Y	N	N
18	River Ardcloony	25A03	N	5	M	N	N	Y	N	Y
19	River Kilmastulla	25K04	Y	5	M	M	Y	Y	N	N
20	River Kilmastulla	25K04	Y	5	M	M	Y	Y	N	N
21	Roolagh River	25R20	N	5	M	N	Y	N	N	N
22	River Ballyteige 15	25B17	Y	3	M	M	Y	Y	N	N
23	River Ballyteige 15	25B17	Y	3	M	M	Y	Y	N	N

Table A.1.3 Results of the fisheries habitat assessments of the aquatic survey sites assessed for the proposed Fahy Beg Farm site and grid connection options.

	Watercourse Name	Salmonid Nursery (Y/N)	Salmonid Fishery (Y/N)	Coarse Nursery (Y/N)	Coarse Fishery (Y/N)	Salmon (P/A)	Trout (P/A)	Coarse Fish (P/A)	Eel (P/A)	Lamprey Habitat (P/A)	Lamprey (Y/N)	Crayfish (P/A)	FWPM (P/A)
1	River Black [O'Briensbridge]	Y	N	N	N	A	P	A	A	P	Y	A	A

	Watercourse Name	Salmonid Nursery (Y/N)	Salmonid Fishery (Y/N)	Coarse Nursery (Y/N)	Coarse Fishery (Y/N)	Salmon (P/A)	Trout (P/A)	Coarse Fish (P/A)	Eel (P/A)	Lamprey Habitat (P/A)	Lamprey (Y/N)	Crayfish (P/A)	FWPM (P/A)
2	River Black (O'Briensbridge)	Y	N	N	N	A	P	A	A	P	Y	A	A
3	River Black (O'Briensbridge)	Y	N	N	N	A	P	A	A	P	Y	A	A
4	River Black (O'Briensbridge)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
5	Kilroughil Stream	Y	N	N	N	A	P	A	A	A	N	A	A
6	River Bridgetown (Clare)	Y	N	N	N	A	P	A	A	P	Y	A	A
7	River Bridgetown (Clare)	Y	N	N	N	A	P	A	A	A	N	A	A
8	River Bridgetown (Clare)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
9	Broadford River	N	N	N	N	A	A	A	A	N	A	A	A
10	Broadford River	N	N	N	N	A	A	A	A	N	A	A	A
11	River Blackwater [Clare]	Y	Y	N	N	P	P	P	P	P	Y	A	A
12	River Blackwater [Clare]	Y	N	N	N	P	P	P	P	P	Y	A	A
13	River Blackwater [Clare]	Y	N	N	N	P	P	P	P	P	Y	A	A
14	Glenomra Wood Stream	Y	N	N	N	A	P	A	A	A	N	A	A
15	Glenomra Wood Stream	Y	N	N	N	A	P	P	A	A	N	A	A
16	Ballyard 15	N	N	N	N	A	A	A	A	N	A	A	A
17	River Ardcloony	Y	Y	N	N	P	P	A	A	P	Y	A	A
18	River Ardcloony	Y	Y	N	N	P	P	A	A	P	Y	A	A
19	River Kilmastulla	Y	Y	Y	N	P	P	P	P	P	Y	A	A
20	River Kilmastulla	Y	Y	Y	N	P	P	P	P	P	Y	A	A
21	Roolagh River	Y	N	N	N	A	L	L	P	A	A	A	A
22	River Ballyteige 15	Y	N	N	N	P*	P	P	A	P	Y	A	A
23	River Ballyteige 15	Y	N	N	N	P*	P	P	A	P	Y	A	A

Y = Yes, N= No, P = Present, A = Absent, L = not recorded but likely to occur in the waterbody.
*Previous records.

Table A.1.4 Biological water quality and WFD status of the aquatic survey sites assessed for the proposed Fahy Beg Farm site and grid connection options.

Site Code	Watercourse Name	EPA Code	EPA Q Value	Ecofact Q Value	WFD Status	WFD Waterbody Status
1	River Black [O'Briensbridge]	25B22	n/a	Q4	Good	n/a
2	River Black (O'Briensbridge)	25B22	n/a	Q4	Good	n/a

Site Code	Watercourse Name	EPA Code	EPA Q Value	Ecofact Q Value	WFD Status	WFD Waterbody Status
3	River Black (O'Briensbridge)	25B22	n/a	Q4	Good	n/a
4	River Black (O'Briensbridge)	25B22	n/a	Dry	n/a	n/a
5	Kilroughil Stream	25K69	n/a	Q4	Good	n/a
6	River Bridgetown (Clare)	25B23	Q4 (600 rm upstream	Q3	Poor	Good
7	River Bridgetown (Clare)	25B23	n/a	Recently dredged so not assessed	n/a	n/a
8	River Bridgetown (Clare)	25B23	n/a	Dry	n/a	n/a
9	Broadford River	27B02	n/a	n/a partially dry stream	n/a	n/a
10	Broadford River	27B02	n/a	Too small to assess	n/a	n/a
11	River Blackwater [Clare]	25B06	Q3-4 (1km downstream)	Q4	Good	Good
12	River Blackwater [Clare]	25B06	n/a	Not assessed	n/a	n/a
13	River Blackwater [Clare]	25B06	n/a	Q4	Good	n/a
14	Glenomra Wood Stream	25B06	Q4 in 1999	Q4	Good	Good
15	Glenomra Wood Stream	25B06	n/a	Not assessed	n/a	n/a
16	Ballyard 15	25B77	n/a	Not assessed	n/a	n/a
17	River Ardcloony	25A03	Q4 c. 2km upstream	Not assessed	n/a	High
18	River Ardcloony	25A03	Q4 c. 2km upstream	Q4	Good	High
19	River Kilmastulla	25K04	Q4	Q3	Good	n/a
20	River Kilmastulla	25K04	n/a	Q3	Good	n/a
21	Roolagh River	25R20	n/a	Not assessed	n/a	n/a
22	River Ballyteige 15	25B17	n/a	Not assessed	n/a	n/a
23	River Ballyteige 15	25B17	n/a	Q3-4	Moderate	n/a

Table A.1.5 Summary results of the electrical fishing surveys undertaken at the aquatic survey sites assessed for the proposed Fahy Beg Farm site and grid connection options.

Site Code	Watercourse Name	Salmon	Brown Trout	Eel	Brook Lamprey	River Lamprey	Minnow	Three-spined stickleback	Stone Loach	Dace
1	River Black [O'Briensbridge]		**		**			*	*	
2	River Black (O'Briensbridge)		**		**			*	*	
3	River Black (O'Briensbridge)		*							
4	River Black (O'Briensbridge)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
5	Kilroughil Stream		*							

Site Code	Watercourse Name	Salmon	Brown Trout	Eel	Brook Lamprey	River Lamprey	Minnow	Three-spined stickleback	Stone Loach	Dace
6	River Bridgetown (Clare)		****		**		*	***	*	
7	River Bridgetown (Clare)	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
8	River Bridgetown (Clare)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
9	Broadford River	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
10	Broadford River	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
11	River Blackwater [Clare]	****	**	*	**	*	*	*	*	*
12	River Blackwater [Clare]	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
13	River Blackwater [Clare]	*	**		****		**	*	*	
14	Glenomra Wood Stream	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
15	Glenomra Wood Stream	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
16	Ballyard 15	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
17	River Ardcloony	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
18	River Ardcloony	**	**		**		*	*	*	
19	River Kilmastulla	**	**	*	**	*	*	**	*	*
20	River Kilmastulla	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
21	Roolagh River	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
22	River Ballyteige 15		**		*				*	
23	River Ballyteige 15	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished

*Present, **Small Numbers, ***Common, ****Numerous

Table A1.6 Results of the 5-minute electrical fishing surveys at the survey sites (CPUE fish/min) assessed for the proposed Fahy Beg Farm site and grid connection options.

Site Code	Watercourse Name	Salmon	Brown Trout	Eel	Minnow	Three-spined stickleback	Stone Loach	Dace
1	River Black [O'Briensbridge]	0	1.6	0	0	0.6	0.2	0

Site Code	Watercourse Name	Salmon	Brown Trout	Eel	Minnow	Three-spined stickleback	Stone Loach	Dace
2	River Black (O'Briensbridge)	0	2.4	0	0	0.8	0.2	0
3	River Black (O'Briensbridge)	0	0.4	0	0	0	0	0
4	River Black (O'Briensbridge)	Dry	Dry	Dry	Dry	Dry	Dry	Dry
5	Kilroughil Stream	0	0.6	0	0	0	0	0
6	River Bridgetown (Clare)	0	7.4	0	0.6	2	0.6	0
7	River Bridgetown (Clare)	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
8	River Bridgetown (Clare)	Dry	Dry	Dry	Dry	Dry	Dry	Dry
9	Broadford River	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
10	Broadford River	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
11	River Blackwater [Clare]	7.6	1	0.2	1	0.6	0.6	0.2
12	River Blackwater [Clare]	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
13	River Blackwater [Clare]	0.6	1.2	0	1	0.4	0.8	0
14	Glenomra Wood Stream	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
15	Glenomra Wood Stream	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
16	Ballyard 15	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
17	River Ardcloony	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
18	River Ardcloony	0.8	2.2	0	1	1	0.4	0
19	River Kilmastulla	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
20	River Kilmastulla	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
21	Roolagh River	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished
22	River Ballyteige 15	0	0.8	0	0	0	0.2	0
23	River Ballyteige 15	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished	Not fished

Table A1.7 Results of the 3-minute lamprey surveys at the survey sites (CPUE fish/min) assessed for the proposed Fahy Beg Farm site and grid connection options.

Site Code	Watercourse Name	Potential lamprey habitat present (Y/N)	Brook Lamprey	River Lamprey (Transformers)	CPUE
1	River Black [O'Briensbridge]	P	5	0	1.67
2	River Black (O'Briensbridge)	P	6	0	2
3	River Black (O'Briensbridge)	P	0	0	0

Site Code	Watercourse Name	Potential lamprey habitat present (Y/N)	Brook Lamprey	River Lamprey (Transformers)	CPUE
4	River Black (O'Briensbridge)	Dry	Dry	Dry	n/a
5	Kilroughil Stream	A	0	0	0
6	River Bridgetown (Clare)	P	3		1
7	River Bridgetown (Clare)	A	Not fished	Not fished	n/a
8	River Bridgetown (Clare)	Dry	Dry	Dry	n/a
9	Broadford River	N	Not fished	Not fished	n/a
10	Broadford River	N	Not fished	Not fished	n/a
11	River Blackwater [Clare]	P	12	2	4
12	River Blackwater [Clare]	P	Not fished	Not fished	n/a
13	River Blackwater [Clare]	P	45	0	15
14	Glenomra Wood Stream	A	Not fished	Not fished	n/a
15	Glenomra Wood Stream	A	Not fished	Not fished	n/a
16	Ballyard 15		Not fished	Not fished	n/a
17	River Ardcloony	P	Not fished	Not fished	n/a
18	River Ardcloony	P	5	0	1.67
19	River Kilmastulla	P	Not fished	Not fished	n/a
20	River Kilmastulla	P	Not fished	Not fished	n/a
21	Roolagh River	P	Not fished	Not fished	n/a
22	River Ballyteige 15	P	2	0	0.67
23	River Ballyteige 15	P	Not fished	Not fished	n/a

Table A1.8 Summary statistics for length (cm) for salmonids recorded at the survey sites assessed for the proposed Fahy Beg Farm site and grid connection options.

Site Code	Watercourse Name	Species	N	Mean	Min	Max	StDev
1	Kilroughil Stream	Brown trout	8	7.53	6.90	8.20	0.44
2	River Ardcloony	Atlantic salmon	12	8.40	6.20	15.80	2.58
3	River Ardcloony	Brown trout	2	6.85	6.70	7.00	0.21
5	River Ballyteige 15	Brown trout	3	9.80	6.00	16.00	5.41
6	River Black (O'Briensbridge)	Brown trout	37	7.71	4.50	16.40	2.36
11	River Black [O'Briensbridge]	Brown Trout	43	6.86	4.90	12.00	1.95
13	River Blackwater [Clare]	Atlantic salmon	9	9.52	4.90	14.10	2.96
18	River Blackwater [Clare]	Brown trout	15	11.27	6.70	14.10	2.14
22	River Bridgetown (Clare)	Brown trout	4	7.58	6.60	9.10	1.08

Table A1.9 Summary statistics for length (cm) for lampreys recorded at the survey sites assessed for the proposed Fahy Beg Farm site and grid connection options.

Site Code	Watercourse Name	Species	N	Mean	Min	Max	StDev
6	River Bridgetown (Clare)	Brook/River Lamprey	3	8.30	7.10	9.80	1.37
11	River Blackwater [Clare]	Brook/River Lamprey	12	8.70	6.60	11.60	1.64
11	River Blackwater [Clare]	River Lamprey (Transformers)	2	10.70	10.40	10.90	0.35
13	River Blackwater [Clare]	Brook/River Lamprey	45	7.70	4.50	11.40	1.83
18	River Ardcloony	Brook/River Lamprey	5	8.30	5.40	10.80	2.06
22	River Ballyteige 15	Brook/River Lamprey	2	9.20	9.10	9.30	0.14

APPENDIX 2 CRITERIA USED TO EVALUATE HABITATS AND IMPACTS

Table A.1 Criteria used to determine the value of ecological resources (taken from NRA, 2009).

	Criteria
International Importance	'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. Proposed Special Protection Area (pSPA). Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended). Features essential to maintaining the coherence of the Natura 2000 Network Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level) of the following: • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. • Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). • World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). • Biosphere Reserve (UNESCO Man & The Biosphere Programme) • Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). • Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). • Biogenetic Reserve under the Council of Europe. • European Diploma Site under the Council of Europe. • Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).
National Importance	Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level) of the following: • Species protected under the Wildlife Acts; and/or • Species listed on the relevant Red Data list. • Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.
County Importance	Area of Special Amenity. Area subject to a Tree Preservation Order. Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of the following: • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; • Species protected under the Wildlife Acts; and/or • Species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. County important populations of species; or viable areas of semi-natural habitats; or natural heritage features identified in the National or Local BAP; if this has been prepared. Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.

	Criteria
Local Importance (higher value)	Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; • Species protected under the Wildlife Acts; and/or • Species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; • Sites or features containing common or lower value habitats, including naturalised species that are essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importan	Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; Sites or features containing non-native species that are of some importance in maintaining habitat links.

Table A.2 Criteria for assessing impact magnitude (NRA, 2009).

Impact magnitude	Definition
No change:	No discernible change in the ecology of the affected feature.
Imperceptible Impact:	An impact capable of measurement but without noticeable consequences.
Slight Impact:	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Impact:	An impact that alters the character of the environment that is consistent with existing and emerging trends.
Significant Impact:	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound Impact:	An impact which obliterates sensitive characteristics.

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APPENDIX 8.6

MARSH FRITILLARY REPORT

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ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED FAHY BEG WIND FARM, CO. CLARE

Marsh Fritillary Report

Prepared for:

RWE Renewables Ireland Limited

Date: January 2023

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1. INTRODUCTION

The NPWS were contacted as part of consultations for the development of the proposed Fahy Beg Wind Farm (Chapter 5: EIA Scoping, Consultation and Key Issues). A detailed response from NPWS was received on 19th April 2021. The response noted marsh fritillary surveys should be carried out as per standard marsh fritillary Larval Web Survey methodology.

The purpose of this report is to assess the distribution of marsh fritillary within the project area and assess the extent of suitable habitat for this species. The potential impacts of the development on this species will be outlined, and mitigation measures prescribed if required.

1.1 The Marsh Fritillary

1.1.1 Legislation and Protection

Marsh fritillary (*Euphydryas aurinia*) is a species listed on Annex II of the Habitats Directive. As an Annex II species, this species and its habitat are protected within Special Areas of Conservation where it is listed as a Qualifying Interest. This butterfly species is listed as 'Vulnerable' by the Red List of Irish Butterflies, indicating that it is at risk of extinction (Regan et al., 2010).

1.1.2 Ecology

The marsh fritillary can be found in a range of habitats including bogs, wet heath, transition mires, calcareous grassland and fens up to 300m (Regan et al., 2010). Reductions in population size have occurred due to habitat loss and fragmentation.

1.1.3 Life Cycle

1.1.3.1 Eggs

Females emerge in mid-May, with eggs laid soon after. Clutches of up to 350 eggs are laid on the underside of the basal leaves of large devil's bit scabious plants (*Succisa pratensis*). The subspherical eggs are approx. 0.8mm heigh. Initially they are white, turning brown after eight days. They finally turn purple-brown after 12 days.

Source: "Euphydryas aurinia eggs" by Gilles San Martin is licensed under CC BY-SA 2.0.
https://www.flickr.com/photos/9082612@N05/5741326936

Plate 1-1: Eggs of the marsh fritillary on the underside of a leaf.

1.1.3.2 Larvae or Caterpillars

Black, hairy larvae hatch from early to mid-June, immediately spinning a web close to the ground on the leaves of devil's bit scabious. The feed on the underside of these leaves. Initially, the webs are small and inconspicuous. During summer they become enlarged and are obvious by late September due to withered and consumed leaves that become enmeshed in the web. At this stage, the larval web becomes brown and shiny.

At this stage, larvae often leave this web, moving no more than a metre to construct a new web on fresh leaves. Later, when milder, sunny weather returns in spring, the larvae emerge to bask in the sun.

Source: "*Euphydryas aurinia*, Marsh Fritillary web, North Wales, Sept 2013" by janetgraham84 is licensed under CC BY 2.0.
https://www.flickr.com/photos/130093583@N04/30380422455

Plate 1-2: Marsh fritillary web and caterpillars

1.1.3.3 Pupae

The pupa is white, with black and orange markings. The pupae attach to twig or a stem of grass, located close to the ground. This occurs from late April to May. It is harder to observe the pupae, compared with the larvae.

"Marsh Fritillary (*Euphydryas aurinia*) butterfly pupa" by Deanster1983 who's on and off is licensed under CC BY-ND 2.0.
https://www.flickr.com/photos/33465428@N02/4506612468

Plate 1-3: Pupa of the marsh fritillary

1.1.3.4 Adult Butterfly

Brightly patterned adults with black, white and orange markings, are on the wing at the end of May to late June/early July. Numbers on the wing peak in late May and early June. Weather conditions influence the flight season, with cool cloudy weather prolonging flight until early July. Adults spend a lot of this time basking on vegetation including meadow thistle *Cirsium dissectum*. These butterflies do not travel large distances.

Breeding locations of marsh fritillary tend to vary from year to year. Therefore, the presence of larvae is the only reliable indicator of breeding.

Source: "*Euphydryas aurinia*" by Sinkha63 is licensed under CC BY-NC-SA 2.0.
https://www.flickr.com/photos/27450151@N05/4944511751

Plate 1-4: Adult marsh fritillary butterfly

1.2 Development Summary

The proposed project assessed is comprised of the following key elements:

- The wind farm site ('the Site');
- The grid connection (the 'GCR');
- The turbine delivery route (the 'TDR').

1.2.1 The Site

The Site includes the wind turbines, internal access tracks, hard standings, permanent meteorological mast, onsite substation, internal electrical and communications cabling, temporary construction compound, drainage infrastructure and all associated works related to the construction of the wind farm. The Site includes lands in the townlands of Fahy Beg, Fahy More North, Ballymoloney, Ballyknavin, Ballyquin More, Woodpark and Leitrim in Co. Clare.

The habitats within the proposed wind farm site are dominated by mixed broadleaved woodland WD1, conifer plantation WD4, improved agricultural grassland GA1 and wet grassland GS4.

1.2.2 The GCR

It is proposed to supply the power from Fahybeg Wind Farm to the Irish electricity network via an underground 38kV cable to the existing 110kV Substation at Ardnacrusha. On leaving the proposed site, the grid connection traverses the R466, un-named local roads, L3046, R471, R465, and L3056 en route to Ardnacrusha.

The dominant habitat along the GCR outside the wind farm site is buildings and artificial surfaces BL3 represented by road surfaces, bounded by dry meadows and grassy verges GS2. The roads are also bounded by hedgerows WL1, treelines WL2 and a mosaic of these habitats. Other habitats abutting the grid connection include improved agricultural grassland GA1, wet grassland GS4, amenity grassland GA2, wet willow- alder-ash woodland, WN6, mixed broadleaved woodland WD1 and conifer plantation WD4. The proposed GCR does not overlap the woodland or agricultural grassland habitats listed above.

1.2.3 The TDR

The TDR commences at the Port of Foynes and finishes at the wind farm site. The TDR follows the N69 eastwards before joining the N18/M7 travelling east and then north until M7 Junction 27 Birdhill. The route then follows the R494 towards Killaloe. The route will cross the Shannon via the Killaloe bypass bridge and then run south-west along the R463 to O'Briensbridge. At O'Briensbridge Cross the route turns right and follows the R466 to the proposed site entrance. The TDR utilises the Killaloe bypass which is currently under construction.

The habitats at TDR nodes include buildings and artificial surfaces BL3, spoil and bare ground ED2, recolonising bare ground ED3, depositing/lowland rivers FW2, drainage ditches FW4, improved agricultural grassland GA1, amenity grassland (improved) GA2, dry meadows and grassy verges GS2, wet grassland GS4, (Mixed) broadleaved woodland WD1, hedgerows WL1, treelines WL2, scrub WS1, immature woodland WS2 and ornamental/non-native shrub WS3. Mesotrophic lakes FL4 is present in the vicinity of one node (Node 27).

2. METHODS

2.1 Desk Study

A desk study was carried out to collate and review available information, datasets and documentation sources pertaining to the natural environment (including marsh fritillary records) in which the proposed project is situated.

Records available on the NPWS and the National Biodiversity Data Centre (NBDC) websites were reviewed, in addition to records of rare/sensitive species within the 10km grid squares overlapped by a 5km buffer surrounding the wind farm site obtained by request from NPWS (received 21st March 2022).

2.2 Field Study

A marsh fritillary survey was carried out during 19th – 20th September 2022, in calm, clear weather. Surveys were conducted by Ben O'Dwyer (FT Ecologist; BSc. Wildlife Biology). Surveys were completed in accordance with NRA methodology (Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes) (NRA, 2009).

Areas of higher floristic diversity were assessed for possible occurrence of marsh fritillary *Euphydryas aurinia.* In particular, any areas of wet grassland or mosaics containing wet grassland were checked for the presence of the butterfly's foodplant, devil's-bit scabious *Succisa pratensis*. The most extensive areas of *S. pratensis* in the site are located in the fields east of proposed turbine T05, and in the northern-western part of the field where the proposed turbine T02 is located (northwest of T02) (Figure 3-1).

Scattered patches of *S. pratensis* were found locally on the site, including a field west of the T02 field, the existing track/woodland ride through Ballymoloney Wood, and along the existing track south of the fields east of T05.

All occurrences of *S. pratensis* were inspected in detail. Larval web searches were carried out along transects through the areas supporting high densities of *S. pratensis*, and searches were also carried out opportunistically wherever this plant was observed.

3. RESULTS

3.1 Desk Study

Marsh fritillary was historically recorded in the two Hectads (R66 & R67) overlapping the proposed wind farm site.

3.2 Field Study

The detailed survey of the proposed site focused on habitats with potential to support marsh fritillary's larval food plant (devil's bit scabious *Succisa pratensis*). A number of locations supporting *S. pratensis* were recorded and mapped.

Areas with *S. pratensis* were searched thoroughly for larval webs and marsh fritillary caterpillars. This search recorded a total of four larval webs, with caterpillars also present at all. All confirmed larval webs with caterpillars were located in wet grassland and dry/humid acidic grassland fields east of T5 and north of a section of proposed access track. All of these records are outside the proposed development footprint and the proposed footprint does not overlap any areas with *S. pratensis* at this location.

Elsewhere in the site, limited areas (total of 152m^2) of *S. pratensis* are overlapped by proposed access tracks and a part of the T2 hard standing. The T2 hard standing and access track running south-east from T1 overlap parts of the largest area of *S. pratensis* outside the fields east of T5. A total of four potential marsh fritillary larval webs were observed in this area (outside the proposed footprint); however, no caterpillars were present to assign the webs definitively to this species. The majority of these webs were old and degraded.

While there is sufficient density of S. *pratensis* to support marsh fritillary in this area, the habitat condition was observed to be sub-optimal for larvae (grazing was light and vegetation was high and dense). This area appears to be less favoured by cattle due to soft ground and abundant rushes.

One further potential marsh fritillary larval web with no caterpillars was recorded in a smaller area *of S. pratensis* located in a field where no infrastructure is proposed.

All locations of larval webs and potential webs are detailed in Figure 3-1.

Plate 3-1: Marsh fritillary larval web & larvae east of T5

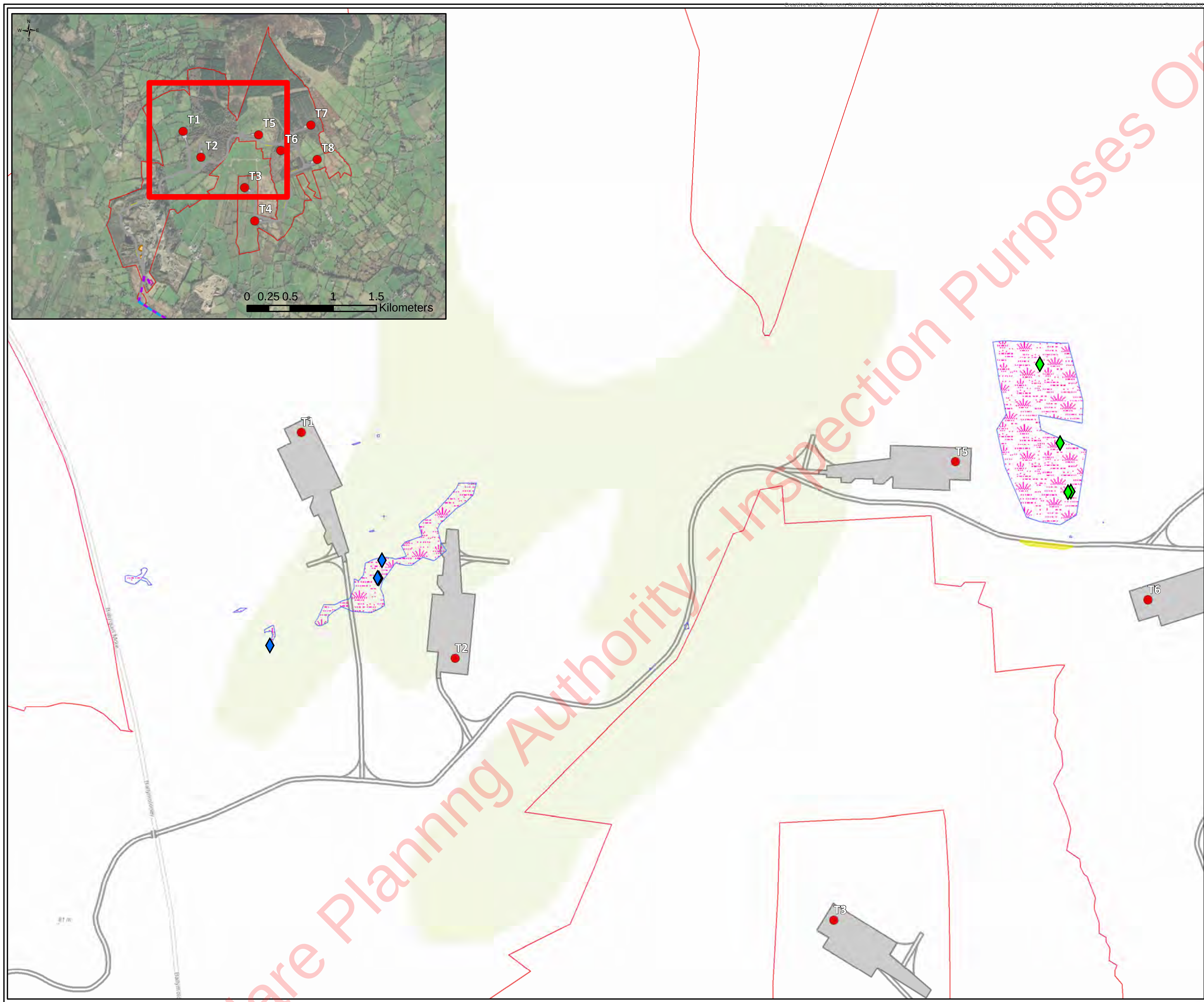
Plate 3-2: Third-instar marsh fritillary larvae east of T5

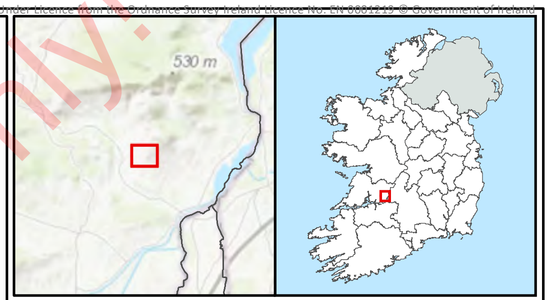
Path: R:\Map Production\2020\P20-003\Workspace\EIAR\Ecology\Marsh Fritillary Survey\P20-003_GIS_Fig3-1_Marsh_Fritillary_Survey_A3.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community





Legend

- Wind Farm Site Boundary
- Proposed Turbine Layout
- Onsite Access Roads
- Turbine Hardstanding Area
- Passing Bays
- Devil's Bit

Marsh Fritillary Survey Points

- Marsh Fritillary Larval Web
- Potential Larval Web

TITLE: Marsh Fritillary Survey	
PROJECT: Fahy Beg Wind Farm, Co. Clare	
FIGURE NO: 3-1	
CLIENT: RWE Renewables Ireland Ltd.	
SCALE: 1:5000	**REVISION:** 0
DATE: 12/12/2022	**PAGE SIZE:** A3

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4. IMPACTS

Chapter 8: Biodiversity, assessed the potential impacts on ecology, including marsh fritillary, associated with the proposed development. Methodology for assessing the significance of these effects is detailed within Chapter 8, and the results are summarised below.

4.1 Construction

There is a risk that construction works in areas with devil's bit scabious (*S. pratentis*) could disturb, injure or kill marsh fritillary larvae in the event of their presence. No larvae were recorded in the proposed footprint, however the presence of several potential larval webs and abundance of *S. pratentis* in areas overlapped by the proposed footprint means such effects cannot be ruled out.

Aside from direct effects to larvae, some potential larval habitat will be lost. Approximately 410m^2 of rough grassland containing marsh fritillary larval foodplant *S.pratentis* will be lost within the proposed footprint. This loss equates to c. 1.2% of the total area supporting *S.pratentis* at the site, which covers c. 32,600m$^{2.}$

The EIAR determined that the proposed impact of habitat loss is Short-term Imperceptible at the Local Scale; however, the potential injury or death of larvae could be a Short-term Significant effect.

4.2 Operation

As technical maintenance activities will be confined to the built infrastructure of the wind farm, and no turbine buffers overlapping grassland which potentially require maintenance (mowing) in the absence of regular grazing are located in areas with *S.pratentis*, there will be no operational stage impacts on marsh fritillary.

4.3 Decommissioning

There is potential for *S. pratensis* to establish on landscaped features formed from excavated topsoil, and also potentially for marsh fritillary larvae to inhabit these areas. In the event that landscaped features supporting *S. pratensis* and marsh fritillary larvae were excavated to reinstate turbine hard standings, the EIAR determined a Significant Short-term effect could occur at the Local scale.

5. MITIGATION

A preconstruction survey of the proposed footprint and adjacent areas will be completed during August/September prior to construction to reconfirm the finding of the EIAR. If marsh fritillary larvae are present in the proposed footprint or zone of influence, translocation to suitable habitat outside the infrastructure footprint will be carried out. This will be achieved by marking the location of pupae/larvae, and carefully excavating the surrounding sod under ecological supervision. Translocated sods will be placed in receptor sites which have been excavated to receive the sods. Receptor sites will be located nearby in similar habitat with abundant S. pratensis.

If required, translocation will be carried out immediately following the survey during September to ensure pupae/larvae can be relocated.

The same mitigation for construction will apply for decommissioning, i.e. pre-decommissioning survey and translocation if required.

5.1 Translocation

The optimal methodology for translocation is as follows. The most favourable method for translocating marsh fritillary is the uprooting and replanting of stands of the foodplant, devil's-bit scabious containing the larval web along with the larval colony. The optimal season for translocation is between late August, when the larval web is well-formed and conspicuous, and late September, when the web starts to become less compact, and larvae begin to disperse into more scattered groups. In addition, the tendency for some of the foliage to wither towards the end of September renders the consumed foodplant leaves less obvious against the general background foliage.

6. DISCUSSION AND CONCLUSION

Marsh fritillary larval webs were recorded outside the proposed development footprint; there is potentially suitable larval habitat (rough grassland with abundant *S.pratensis*) which is partly overlapped by the proposed development. Furthermore, all areas where marsh fritillary was identified are not within an SAC. With the implementation of mitigation (monitoring and translocation), residual impacts will be reduced to Imperceptible levels.

7. REFERENCES

Regan, E.C., Nelson, B., Aldwell, B., Bertrand, C., Bond, K., Harding, J., Nash, D., Nixon, D., & Wilson, C.J. (2010) Ireland Red List No. 4 – Butterflies. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland

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APPENDIX 8.7

ECOLOGICAL RESOURCE EVALUATION

Table 1: Ecological Resource Evaluation Criteria

Resource Evaluation	Defining Criteria
International Importance	• 'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA), candidate Special Area of Conservation (cSAC) or proposed Special Protection Area (pSPA). • Sites that fulfil the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended). Features essential to maintaining the coherence of the Natura 2000 Network. • Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. • Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. • Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). • World Heritage Site (Convention for the Protection of World Cultural and Natural Heritage, 1972). • Biosphere Reserve (UNESCO Man and The Biosphere Programme). • Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). • Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). • Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe. • Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).
National Importance	• Site designated or proposed as a Natural Heritage Area (NHA). • Statutory Nature Reserve. • Refuge for Fauna and Flora protected under the Wildlife Acts. • National Park. • Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA) • Statutory Nature Reserve • Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park • Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. • Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive
County Importance	• Area of Special Amenity. • Area subject to a Tree Preservation Order. • Area of High Amenity, or equivalent, designated under the County Development Plan.

Resource Evaluation	Defining Criteria
	• Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. • Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. • County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared. • Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. • Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (Higher Value)	• Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared • Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list • Sites containing semi natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (Lower Value)	• Sites containing small areas of semi natural habitat that are of some local importance for wildlife • Sites or features containing non-native species that are of some importance in maintaining habitat links.

Table 2: Avifauna Receptor Evaluation Criteria

Sensitivity of Key Receptor	Percival 2007 Criteria	NRA Resource Evaluation	NRA Criteria	Combined Criteria
Very High.	Species is cited interest of SPA. Species present in Internationally important numbers.	International Importance.	Resident or regularly occurring populations (assessed to be important at the national level) of the following:	Species is cited interest of SPA. Species present in Internationally important numbers.

Sensitivity of Key Receptor	Percival 2007 Criteria	NRA Resource Evaluation	NRA Criteria	Combined Criteria
			Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive	Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive
High	Other non-cited species which contribute to integrity of SPA. Ecologically sensitive species (<300 breeding pairs in UK) and less common birds of prey. Species listed on Annex 1 of the EU Birds Directive. Regularly occurring relevant migratory species which are rare or vulnerable	National Importance	Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list	Other non-cited species which contribute to integrity of SPA. Ecologically sensitive species (<300 breeding pairs nationally) and less common birds of prey. Species listed on Annex 1 of the EU Birds Directive. Regularly occurring relevant migratory species which are rare or vulnerable. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list (in this case BOCCI Red list).
Medium	Species present in regionally important numbers (>1% of regional population). Species occurring within SPA's but not crucial to the integrity of the site. Species listed as priority species in the UK BAP subject to special	County Importance	Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; County important populations of species.	Species present in regionally important numbers (>1% of regional population). Species occurring within SPA's but not crucial to the integrity of the site. Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;

Sensitivity of Key Receptor	Percival 2007 Criteria	NRA Resource Evaluation	NRA Criteria	Combined Criteria
	conservation measures		Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.	County important populations of species. Species that are rare or are undergoing a decline in quality or extent at a national level.
Low	Species covered above which are present very infrequently or in very low numbers. Any other species of conservation interest not covered above, e.g. species listed on the red or amber lists of the BoCC.	Local Importance (High Value)	Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list.	Locally important populations of priority species identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Amber listed species.
Negligible	Species that remain common and widespread	Local Importance (Low Value)	n/a	Species that remain common and widespread. Green Listed Species.

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APPENDIX 8.8

INVASIVE SPECIES MANAGEMENT PLAN

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED FAHY BEG WIND FARM, CO. CLARE

Invasive Species Management Plan

Prepared for:

RWE Renewables Ireland Ltd.

RWE

Date: January 2023

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Invasive Species Management Plan

REVISION CONTROL TABLE, CLIENT, KEYWORDS AND ABSTRACT

User is responsible for Checking the Revision Status of This Document

Rev. No.	Description of Changes	Prepared by:	Checked by:	Approved by:	Date:
0	For Issue	KM/SJ/NSC	BOD	JH	11/01/2023

Client: RWE Renewables Ireland Ltd.

Keywords: Invasive Species, proposed Fahy Beg Wind Farm, Management, Co. Clare

Abstract: This document provides an Invasive Species Management Plan to provide guidance and strategies for the management of invasive plant species at the proposed Fahy Bag Wind Farm, Co. Clare

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1. INTRODUCTION

RWE Renewables Ireland Ltd. has commissioned Fehily Timoney & Company (FT) to prepare an Invasive Species Management Plan as part of the proposed Fahy Beg Wind Farm development. Fehily Timoney & Company (FT) has prepared this Invasive Species Management Plan (ISMP) to comply with Regulations 49 and 50, Schedule III of the European Communities (Birds and Natural Habitats) Regulations 2011 to 2021 (not to cause the spread of non-native invasive plant species listed in the Third Schedule), and to ensure non-native invasive plant species not listed in the Third Schedule are not spread to adjacent lands or Natura 2000 (European) sites. The report details a programme for the monitoring and control of invasive species at landholdings of and adjacent to the site, grid connection route (GCR) and turbine delivery route (TDR) at the proposed Fahy Beg Windfarm.

In total, 21 invasive/non-native species were recorded. The field survey identified eight invasive or non-native species within the main wind farm site. Of these, two species (Japanese knotweed and Himalayan knotweed) are listed in the Third Schedule. Along the GCR, 14 invasive species were identified. Two of these species (Japanese knotweed, giant hogweed) are listed in the third schedule. Finally, 11 invasive species were recorded along the TDR (at locations where temporary accommodation works are required), none of which are listed in the Third Schedule.

1.1 Legislative Context

In Ireland, the spread and propagation of species listed in the Third Schedule of S.I. No. 477/2011 European Communities (Birds and Natural Habitats) Regulations 2011 to 2021 is an offence. Under Regulation 49 (2) - save in accordance with a licence granted under paragraph (7), any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow in any place specified in relation to such plant in the third column of Part 1 of the Third Schedule, any plant which is included in Part 1 of the Third Schedule, shall be guilty of an offence. Under Regulation 50 it is an offence to transport a vector material listed in Part 3 of the Third Schedule except under licence.

In October 2017, Ireland's 3rd National Biodiversity Action Plan (NPWS, 2017), for the period 2017-2021 was launched. This Plan sets out actions through which a range of government, civil and private sectors will undertake to achieve Ireland's 'Vision for Biodiversity' and follows on from the work of the first and second National Biodiversity Action Plans. Target 4.4 states that 'Harmful invasive alien species are controlled and there is reduced risk of introduction and/or spread of new species.' This is supported by seven actions, those relevant to this management plan are:

4.4.3. Continue and enhance measures for eradication, where feasible, control and containment of invasive species

4.4.4. Encourage horticultural nurseries to produce native species, varieties and landraces from appropriate native sources for public and private sector plantings. Public bodies will endeavour to plant native species in order to reduce importation of non-native species, varieties and landraces.

4.4.6. Publish legislation to address required provisions under the EU Regulation on invasive alien species (No. 1143/2014) and on responsibilities and powers regarding invasive alien species, giving IFI responsibility for aquatic invasive species.

The Clare County Development Plan 2017-2023 (Clare County Council, 2016) and Draft Clare County Development Plan 2023-2029 (Clare County Council, 2021) includes invasive species objectives. These objectives are as follows:

CDP 2017-2023 14.26 A. To raise awareness of the threat of alien invasive species and take all necessary steps to prevent the spread of non-native invasive species and noxious weeds in the Plan area, including requiring landowners, developers and boat operators to adhere to best practice guidance in relation to their control;

CDP 2017-2023 14.26 B. To require all development proposals to address the presence or absence of invasive alien species on the proposed development site and to require the preparation of an Invasive Species Management Plan where such species are present;

CDP 2017-2023 14.26 C. To implement the requirements of EU Regulations 1143/2014 on the Prevention and Management of the Introduction and Spread of Invasive Alien Species.

CDP 2017-2023 16.9 B. To prepare improvement plans and design briefs for larger derelict areas, incorporating an alien invasive species management plan as necessary;

CDP 2023-2029 15.29. It is an objective of the Development Plan:

- *a) To raise awareness of the threat of alien invasive species and how they can spread, and take all necessary steps to prevent the spread of non-native invasive species and noxious weeds in the Plan area, including requiring landowners, developers and boat operators to adhere to best practice guidance in relation to their control;*
- *b) To require all development proposals to address the presence of invasive alien species on the proposed development site and to require an Invasive Species Management Plan where such species are present;*
- *c) To carry out surveys of invasive species across the County;*
- *d) To implement the requirements of EU Regulations 1143/2014 on the Prevention and Management of the Introduction and Spread of Invasive Alien Species and to manage invasive hydrological connectivity issues to European Sites to prevent the spread of invasive species to sensitive sites;*
- *e) To facilitate the work of agencies addressing the issue of terrestrial and aquatic invasive alien species*

1.2 Site Description

The proposed Fahy Beg Wind Farm comprises four main elements:

Fahy Beg Wind Farm;
Turbine delivery route (TDR);
Grid connection route (GCR);
Biodiversity Enhancement Areas

1.2.1 Wind Farm Site

The proposed wind farm site includes lands in the townlands of Fahy Beg, Ballymoloney, Ballyknavin, Ballyquin More, Woodpark and Leitrim, Co. Clare.

The habitat survey study area supports extensive areas of conifer woodland (WD4) and improved agricultural grassland (GA1). The proposed wind farm will be accessed via the western boundary of an inactive quarry site, the footprint of which supports scrub (WS1), young broadleaved woodland (WD1), other artificial lakes and ponds (FL8) and areas of recolonising bare ground and spoil and bare ground (ED2). The proposed access road turns east, crossing a local road and then entering the footprint of the proposed wind farm. Immediately east of the local access road, the lands comprise low-lying improved agricultural grassland (GA1) bounded by treelines (WL2) and hedgerows (WL1), with localised areas of rushy wet grassland (GS4). Continuing east, the topography of the study area slopes sharply toward an extensive area of beech dominated mixed broadleaved woodland (WD1), which is bounded to the north and east by conifer woodland (WD4). The southernmost areas of the study area support improved (GA1) and semi-improved agricultural grassland habitats, in addition to localised areas of wet grassland (GS4) habitats. These distribution and occurrence of these habitats are influenced by recent and ongoing maintenance, particularly drainage maintenance. The eastern southernmost sections of the study area are drained by the Black (O'Briensbridge) and Bridgetown (Clare)_010 rivers and their tributaries while the western half of the study area is drained by the Broadford_010 river.

1.2.2 Grid Connection Route

The proposed grid connection will pass through the townlands of Leitrim, Ballybrack, Fahy More South, Aharinaghmore, Tooreen, Aharinaghbeg, Knockdonagh, Roo East, Blackwater, Rosmadda West, Parkroe, Lackyle and Ballykeelaun.

The dominant habitats along the GCR are Buildings and artificial surfaces (BL3), Dry Meadows & Grassy Verges (GS2), Hedgerows (WL1), Treelines (WL2), Improved agricultural grassland (GA1) and Wet grassland (GS4). Amenity grassland (GA2) is present in built-up areas. Isolated stands of Wet willow-alder-ash woodland (WN6). Mixed broadleaved woodland (WD1) and Conifer plantation (WD4) are also present abutting the GCR. Lowland/depositing rivers (FW2) are intersected by the GCR at a total of five locations (four EPA-mapped channels and one unmapped stream). Drainage ditches (FW4) in the form of roadside and field drains are present along the GCR.

1.2.3 Turbine Delivery Route

The turbine delivery route (TDR) from the port into which the components are shipped to the wind farm site will use the national primary route network as much as possible. It is proposed to deliver turbines to the site from Foynes, Co. Limerick via the N69 travelling east for c.34 km then joining the eastbound N18 at Junction 2, Limerick and continuing east for c. 4 km onto the M7. It will continue along the M7 for c.21 km before departing the M7 at Junction 27 and continuing north on the R494 towards Killaloe for ca. 7km. It then turns left onto the proposed bypass and utilises the new Shannon River crossing before turning left onto the R463 travelling southbound then continues south on the R463 for c. 8km before turning right onto the R466. and following the R466 to the entrance of the site. Loads will continue north on the R466 to the proposed site entrance.

Habitats present in and around TDR nodes (locations where accommodation works are required) include Buildings and artificial surfaces BL3, Improved agricultural grassland GA1, Ornamental/non-native shrub WS3, Hedgerows WL1, Mixed broadleaved woodland WD1, Recolonising bare ground ED3, Amenity grassland GA2, Immature woodland WS2, Dry meadows and grassy verges GS2, Depositing/lowland river FW2, Treelines WL2, Drainage ditches FW4, Wet grassland GS4, and Scrub WD1.

2. METHODOLOGY

2.1 Relevant Guidance

The methodology and guidance for this management plan has been devised in consideration of the following relevant guidance:

NRA, (2010) Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads. Revision 1, December 2010. National Roads Authority.

Property Care Association, (2018). Practical Management of Invasive Non-Native Weeds in Britain and Ireland. Packard Publishing Ltd.

Kelly et al., (2008). Best Practice Management Guidelines Japanese Knotweed *Fallopia japonica*. Prepared for NIEA and NPWS as part of Invasive Species Ireland.

Tu, (2009) Assessing and Managing Species within Protected Areas. Protected Area Quick Guide Series. Editor J., Ervin, Arlington, VA. The Nature Conservancy, 40 pp.

Stokes et al., (2004). Invasive Species in Ireland. Unpublished report to Environment and Heritage Service and National Parks and Wildlife Service. Quercus, Queens University Belfast, Belfast.

AM-SOP-009 Information and Guidance Document on Japanese Knotweed

RAPID, 2018. Good Practice Management- Japanese Knotweed (*Fallopia japonica*).

INNSA, 2017. Code of Practice – Managing Japanese Knotweed

A desktop study was carried out to identify existing records of invasive flora species both within and adjacent to the proposed Fahy Beg Wind Farm, as well as habitat suitability of the footprint of the development for the invasive species. This study allows the surveyor to narrow down the source of the species introduction and its likelihood of spreading. The following open sources of information were consulted:

Invasive Species Ireland website (Invasive Species Ireland, 2022)

Invasive Alien Species in Ireland website (Invasives.ie, 2022)

OSI Aerial photography and 1:50000 mapping

National Parks and Wildlife Service (NPWS) web mapping (NPWS, 2022)

National Biodiversity Data Centre (NBDC) web mapping (National Biodiversity Data Centre, 2022)

Environmental Protection Agency (EPA) web mapping (EPA, 2022)

2.2 Mapping

A habitat survey was undertaken as part of the site walkover survey of the main windfarm site on 30th July and 16th August 2021. Detailed relevé surveys to check for Annex I-linked woodland habitats were carried out on 14th May 2021. Surveys focused on the composition of mature trees making up Ballymoloney woods within the optioned lands were carried out on 23rd March 2022. Habitat surveys covering an additional area within the quarry were completed on 20th July 2022. A site survey along the grid connection was undertaken on 14th and 19th July 2022. Habitat surveys at proposed accommodation works locations along the turbine delivery route (TDR) were completed during 20th – 22nd July 2022.

During the site visits detailed above, a visual inspection of the extent of the species was undertaken by an experienced ecologist at all sites. The location and extent of the invasive species were documented using a handheld GPS to allow for mapping.

3. EXISITING ENVIRONMENT

Historical records of invasive species plants from the relevant national datasets were assessed through the National Biodiversity Data Centre (search completed 19th December 2022). The invasive species listed in Table 3-1 have been recorded within the 10km grid squares (R66, R67) overlapping the main windfarm site. A total of 12 invasive plant species have been recorded in these 10km grid squares, of which nine are listed in Schedule III under Regulations 49 and 50 of the EC (Birds and Natural Habitats) Regulations 2011, which makes it an offence to cause the spread of plant species listed on the Schedule. Only two invasive species were found in the 2km grid squares overlapping the proposed wind farm, of which one is a Schedule III, High Impact species (Japanese knotweed). Sycamore was the other invasive species within the 2km grid squares and is classified as a "Medium Risk" species.

Invasive species of flora recorded within 1km grid squares that overlap the grid connection route are also detailed in Table 3-1.

Table 3-1: Invasive Species within 10km and 2km grid squares overlapping the proposed Fahy Beg Wind Farm and 1km squares overlapping the Grid Connection Route.

Species	1km (GCR)	2km	10km	Invasive Impact*	Legal Status
Canadian Waterweed (*Elodea canadensis*)	-	-	R66, R67	High Risk	Schedule III
Curly Waterweed (*Lagarosiphon major*)	-	-	R67	High Risk	Schedule III
Giant Hogweed (*Heracleum mantegazzianum*)	R5962	-	R66	High Risk	Schedule III
Himalayan Honeysuckle (*Leycesteria formosa*)	-	-	R66, R67	Medium Risk	None
Himalayan Knotweed (*Persicaria wallichii*)	-	-	R66, R67	Medium Risk	Schedule III
Indian/Himalayan Balsam (*Impatiens glandulifera*)	-	-	R66, R67	High Risk	Schedule III
Japanese Knotweed (*Fallopia japonica*)	R5861	R67F	R66, R67	High Risk	Schedule III
Nuttall's Waterweed (*Elodea nuttallii*)	-	-	R66, R67	High Risk	Schedule III
Rhododendron ponticum	-	-	R66	High Risk	Schedule III
Sycamore (*Acer pseudoplatanus*)	R5965, R6167	R67F	R66, R67	Medium Risk	None
Three-cornered Garlic (*Allium triquetrum*)	-	-	R66	Medium Risk	Schedule III
Traveller's-joy (*Clematis vitalba*)	-	-	R66	Medium Risk	None

*Impact classified according to Invasives.ie, 2022

3.1 Results of Field Survey and Mapping

The field survey detected 21 invasive/non-native species within the Site and along the Grid Connection and TDR. Of the species recorded, two are listed on the Third Schedule (Japanese knotweed, Himalayan knotweed).

3.1.1 Main Wind Farm Site

The field survey identified eight invasive/non-native species within the main wind farm site. Details of the impact of these species and their locations are included in Table 3-2.

Table 3-2: Non-native invasive species at the wind farm site.

Species	Invasive Impact	Location
Japanese knotweed *Fallopia japonica*	Third Schedule Risk of High Impact	Derelict farm between T6 & T7
Himalayan knotweed *Persicaria wallichii*	Third Schedule Risk of Medium Impact	Western part of quarry
Cherry laurel *Prunus lauroceracus*	Risk of High Impact	Derelict farm between T6 & T7
Sycamore *Acer pseudoplatanus*	Risk of Medium Impact	Western boundary of site (quarry boundary woodland)
Fuchsia *Fuchsia magellanica*	Not Assessed	Derelict farm between T6 & T7
Wilson's honeysuckle *Lonicera nitida*	Not Assessed	Derelict farm between T6 & T7
Lawson cypress *Chamaecyparis lawsoniana*	Not Assessed	Derelict farm between T6 & T7
New Zealand holly *Olearia macrodonta*	Not Assessed	Derelict farm between T6 & T7

3.1.2 Grid Connection

The field survey identified 14 non-native/invasive species along the GCR. Details of the impact of these species and their locations are included in Table 3-3.

Table 3-3: Non-native invasive species recorded along the GCR.

Species	Invasive Impact	Location
Butterfly bush *Buddleja davidii*	Risk of Medium Impact	Ardnacrusha
Cherry laurel *Prunus lauroceracus*	Risk of High Impact	Ardnacrusha R465 R471
Fuchsia *Fuchsia magellanica*	Not Assessed	Ardnacrusha Un-named local road off Harol's Cross Un-named local road joining R466
Giant hogweed *Heracleum mantegazzianum*	Third Schedule Risk of High Impact	Un-named local road Ballyboucher
Himalayan honeysuckle *Leycesteria formosa*	Risk of Medium Impact	R465
Japanese knotweed *Fallopia japonica*	Third Schedule Risk of High Impact	Ardnacrusha
Montbretia *Crocosmia x crocosmiiflora*	Low risk of Impact	Ardnacrusha R465 R471 Un-named local road off Harol's Cross Un-named local road Ballyboucher
Red osier dogwood *Cornus sericea*	Low risk of Impact	Ardnacrusha
Snowberry *Symphoricarpos albus*	Low risk of Impact	Ardnacrusha R465 R471 Un-named local road off Harol's Cross Un-named local road Ballyboucher Un-named local road joining R466 R466
Sycamore *Acer pseudoplatanus*	Risk of Medium Impact	Dispersed throughout GCR
Traveller's joy *Clematis vitalba*	Risk of Medium Impact	Un-named local road off Harol's Cross
Wall cotoneaster *Cotoneaster horizontalis*	Risk of Medium Impact	Ardnacrusha Un-named local road joining R466
Wilson's honeysuckle *Lonicera nitida*	Not Assessed	Ardnacrusha

Species	Invasive Impact	Location
Winter heliotrope *Petasites fragrans*	Low risk of Impact	Ardnacrusha R465

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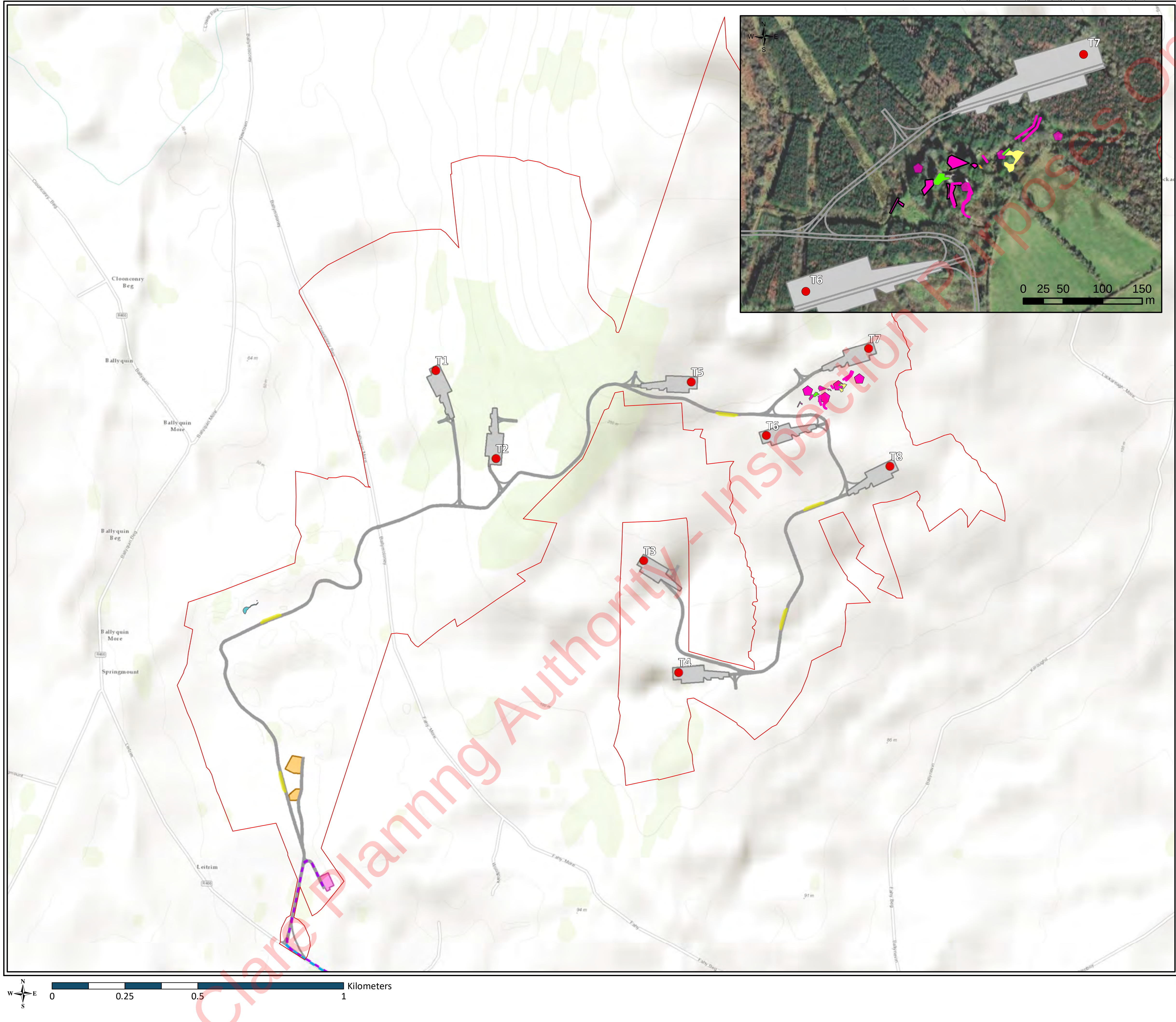

Legend

- Wind Farm Site Boundary
- Proposed Turbine Layout
- Onsite Access Roads
- Turbine Delivery Route
- Grid Connection Route
- Substation Compound
- Construction Compound
- Turbine Hardstanding Area
- Passing Bays

Invasive Species

Species

- Fuchsia
- Fuchsia
- Cherry laurel
- Fuchsia
- Himalayan knotweed
- Japanese knotweed
- Japanese Knotweed and Fuchsia

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PROJECT:	Fahy Beg Wind Farm, Co. Clare		
FIGURE NO:	8.11		
CLIENT:	RWE Renewables Ireland Ltd.		
SCALE:	1:12500	REVISION:	0
DATE:	24/11/2022	PAGE SIZE:	A3

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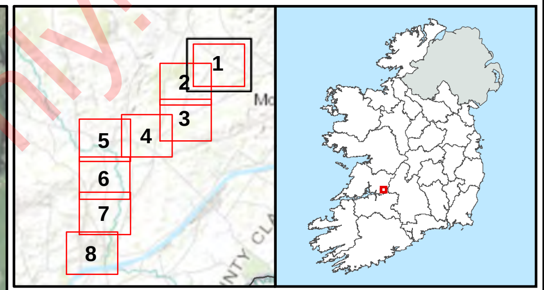

Legend

- Wind Farm Site Boundary
- Onsite Access Roads
- Turbine Delivery Route
- Grid Connection Route
- Substation Compound
- Snowberry

TITLE: Invasive Species - Grid Connection Route Page 1 of 8	
PROJECT: Fahy Beg Wind Farm, Co. Clare	
FIGURE NO: 8.12	
CLIENT: RWE Renewables Ireland Ltd.	
SCALE: 1:6250	REVISION: 0
DATE: 30/11/2022	PAGE SIZE: A3

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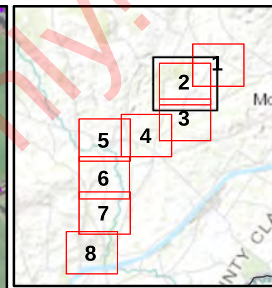

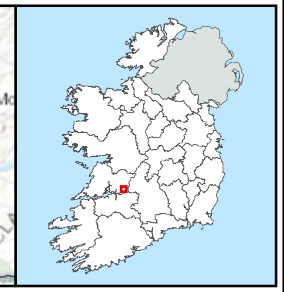

Legend

- Turbine Delivery Route
- Grid Connection Route

Invasive Species

- Fuchsia
- Wall cotoneaster
- Snowberry

N W E S

0 125 250 500 Meters

TITLE: Invasive Species - Grid Connection Route Page 2 of 8	
PROJECT: Fahy Beg Wind Farm, Co. Clare	
FIGURE NO: 8.12	
CLIENT: RWE Renewables Ireland Ltd.	
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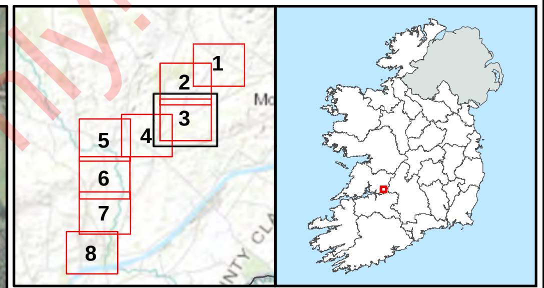

Legend

- Grid Connection Route

Invasive Species

- Giant hogweed
- Cherry laurel
- Fuchsia
- Montbretia
- Snowberry
- Giant hogweed
- Cherry laurel & Traveller's joy
- Montbretia
- Snowberry
- Snowberry & Traveller's joy

TITLE:	Invasive Species - Grid Connection Route Page 3 of 8
PROJECT:	Fahy Beg Wind Farm, Co. Clare
FIGURE NO:	8.12
CLIENT:	RWE Renewables Ireland Ltd.
SCALE: 1:6250	REVISION: 0
DATE: 30/11/2022	PAGE SIZE: A3

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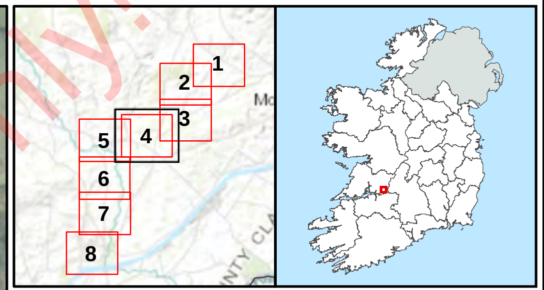

Legend

Grid Connection Route

Invasive Species

- Giant hogweed
- Cherry laurel
- Fuchsia
- Montbretia
- Snowberry
- Giant hogweed
- Cherry laurel
- Cherry laurel & Traveller's joy
- Montbretia
- Snowberry
- Snowberry & Traveller's joy

TITLE: Invasive Species - Grid Connection Route Page 4 of 8	
PROJECT: Fahy Beg Wind Farm, Co. Clare	
FIGURE NO: 8.12	
CLIENT: RWE Renewables Ireland Ltd.	
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DATE: 30/11/2022	**PAGE SIZE:** A3

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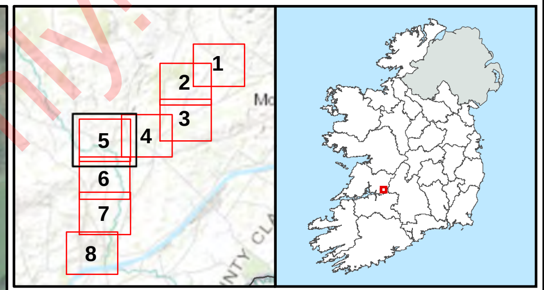

Legend

Grid Connection Route

Invasive Species

Montbretia

Cherry laurel

Montbretia

Snowberry

Winter heliotrope

TITLE: Invasive Species - Grid Connection Route Page 5 of 8	
PROJECT: Fahy Beg Wind Farm, Co. Clare	
FIGURE NO: 8.12	
CLIENT: RWE Renewables Ireland Ltd.	
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DATE: 30/11/2022	**PAGE SIZE:** A3

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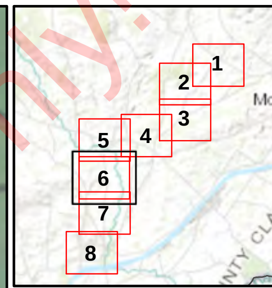

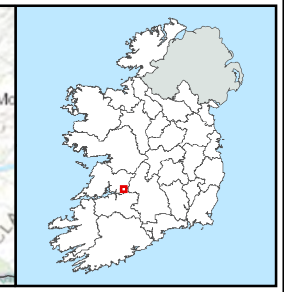

Legend

Grid Connection Route

Invasive Species

Cherry laurel

Snowberry

Snowberry

TITLE: Invasive Species - Grid Connection Route Page 6 of 8	
PROJECT: Fahy Beg Wind Farm, Co. Clare	
FIGURE NO: 8.12	
CLIENT: RWE Renewables Ireland Ltd.	
SCALE: 1:6250	**REVISION:** 0
DATE: 30/11/2022	**PAGE SIZE:** A3

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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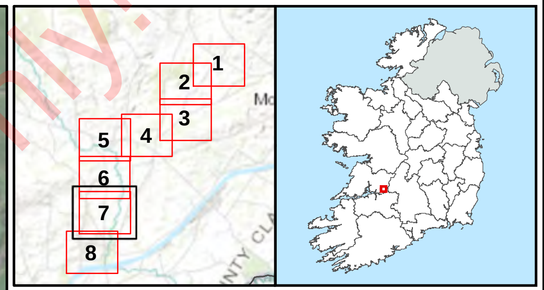

Legend

Grid Connection Route

Invasive Species

- Cherry laurel
- Himalayan honeysuckle
- Montbretia
- Cherry laurel
- Snowberry
- Winter heliotrope

TITLE: Invasive Species - Grid Connection Route Page 7 of 8	
PROJECT: Fahy Beg Wind Farm, Co. Clare	
FIGURE NO: 8.12	
CLIENT: RWE Renewables Ireland Ltd.	
SCALE: 1:6250	**REVISION:** 0
DATE: 30/11/2022	**PAGE SIZE:** A3

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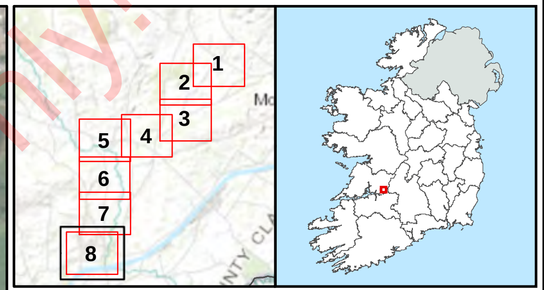

Legend

- Grid Connection Route

Invasive Species

- Buddleia
- Cherry laurel
- Japanese Knotweed and Fuschia
- Montbretia
- Red osier dogwood
- Snowberry
- Wall cotoneaster
- Winter heliotrope
- Cherry laurel
- Fuchsia
- Montbretia
- Red osier dogwood
- Snowberry
- Snowberry & Montbretia
- Wilson's honeysuckle
- Winter heliotrope
- Winter heliotrope & Montbretia
- Winter heliotrope. Occ. Snowberry
- Winter heliotrpe & Wilson's Honeysuck

TITLE: Invasive Species - Grid Connection Route Page 8 of 8	
PROJECT: Fahy Beg Wind Farm, Co. Clare	
FIGURE NO: 8.12	
CLIENT: RWE Renewables Ireland Ltd.	
SCALE: 1:6250	REVISION: 0
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Turbine Delivery Route

This section details the occurrence of invasive species at points of interest (TDR nodes) along the TDR which are relevant in terms of ecological impacts (any node where works are proposed falls into this category).

A total of 12 invasive species were recorded across 12 locations along the TDR. Of these 12 invasive species none are classified as High Risk, four are Medium Risk, four are Low Risk and four are not assessed (NBDC, 2022). See Table 3-4 for more information.

Table 3-4: Invasive & non-native species recorded at TDR points of interest (areas requiring accommodation works)

Species	Invasive Impact	Location
Node 3 - Foynes Port Access Road / N69		
Red osier dogwood *Cornus sericea*	Low risk of Impact	Ornamental planting bounding oversail area footprint – northern verge.
Traveller's joy *Clematis vitalba*	Risk of Medium Impact	In & adjacent oversail area footprint – northern verge.
Butterfly bush *Buddleja davidii*	Risk of Medium Impact	Immediately adjacent to oversail areas – north & south verges
Node 6 – N69 Tree Canopy		
No invasive species		
Node 8 - Clarina Roundabout		
Butterfly bush *Buddleja davidii*	Risk of Medium Impact	Immediately adjacent to oversail areas – north & south verges
Norway maple *Acer platanoides*	Low risk of Impact	Ornamental planting adjacent to load bearing footprint
Traveller's joy *Clematis vitalba*	Risk of Medium Impact	C. 8m south of load bearing footprint
Japanese rose *Rosa rugosa*	Risk of Medium Impact	C. 14m north-west of load bearing footprint
Winter heliotrope *Petasites fragrans*	Low risk of Impact	C. 16m west of load bearing footprint

Species	Invasive Impact	Location
Node 9 – Dock Road West Roundabout		
Norway maple *Acer platanoides*	Low risk of Impact	Ornamental planting adjacent to load bearing footprint
Small-leaved lime *Tilia cordata*	Not assessed	Ornamental planting adjacent to load bearing footprint
Node 10 – Dock Road East Roundabout		
Norway maple *Acer platanoides*	Low risk of Impact	Ornamental planting c. 14m north of oversail footprint
Small-leaved lime *Tilia cordata*	Not assessed	Ornamental planting c. 14m north of oversail footprint
Node 11 – M7 Junction 27		
No invasive species		
Node 12 – R494 Birdhill Roundabout		
No invasive species		
Node 18 – R494 Roundabout Templehollow		
No invasive species		
Node 19 – R463 Roundabout north-east of Cloverfield		
Winter heliotrope *Petasites fragrans*	Low risk of Impact	In/adjacent to consented Killaloe bypass roundabout footprint.
Butterfly bush *Buddleja davidii*	Risk of Medium Impact	In/adjacent to consented Killaloe bypass roundabout footprint.
Node 20 – R463 Bends south of Cloverfield		
No invasive species		
Node 21 – R463 Bends south-west of Bellisle		
Snowberry *Symphoricarpos albus*	Low risk of Impact	In vegetation trimming (oversail) footprint

Species	Invasive Impact	Location
Node 23 – R463 Ardcloony Bridge		
Giant butterbur *Petasites japonicus*	Not assessed	Adjacent to oversail footprint.
Node 25/26 – R463 Bends south of Knockadrohid		
Sycamore *Acer pseudoplatanus*	Risk of Medium Impact	In vegetation trimming (oversail) footprint
Wilson's honeysuckle *Lonicera nitida*	Not Assessed	In vegetation trimming (oversail) footprint
Traveller's joy *Clematis vitalba*	Risk of Medium Impact	Outside oversail footprint (opposite verge).
Fuchsia *Fuchsia magellanica*	Not Assessed	Outside oversail footprint (opposite verge).
Node 27 – R463/R466 Junction		
Winter heliotrope *Petasites fragrans*	Low risk of Impact	In load bearing/oversail/vegetation clearance footprint
Traveller's joy *Clematis vitalba*	Risk of Medium Impact	On north-western road verge. Not adjacent to any proposed works.
Nodes 28-30 – R466 Bends Northwest of O'Briensbridge Cross		
Winter heliotrope *Petasites fragrans*	Low risk of Impact	In oversail/vegetation clearance footprint
Snowberry *Symphoricarpos albus*	Low risk of Impact	In oversail/vegetation clearance footprint
Node 31 – R466 Bends Southeast of Bridgetown		
Winter heliotrope *Petasites fragrans*	Low risk of Impact	In load bearing footprint (southern verge)
Snowberry *Symphoricarpos albus*	Low risk of Impact	In oversail footprint (northern verge)
Node 32 – R466 Left Bend at Bridgetown		
Sycamore *Acer pseudoplatanus*	Risk of Medium Impact	In load bearing/vegetation clearance footprint (northern verge)

4. INVASIVE SPECIES ACCOUNTS

The International Union for Conservation of Nature (IUCN) in their 'IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species' 2000 report describes non-native invasive species (referred to as an invasive species) as:

> *"an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity".*

The 21 invasive/non-native species below were recorded within the Site, and along the GCR and TDR. The species in bold are included in the Third Schedule, the remaining species are identified in Kelly et al., (2008). Accounts of these species, summaries of their ecology, distribution, growth, and management periods are included below.

Butterfly bush *Buddleja davidii*

Cherry laurel *Prunus lauroceracus*

Fuchsia *Fuchsia magellanica*

Giant butterbur *Petasites japonicus*

Giant hogweed *Heracleum mantegazzianum*

Himalayan knotweed *Persicaria wallichii*

Himalayan honeysuckle *Leycesteria formosa*

Japanese knotweed *Fallopia japonica*

Japanese rose *Rosa rugosa*

Lawson cypress *Chamaecyparis lawsoniana*

Montbretia *Crocosmia x crocosmiiflora*

New Zealand holly *Olearia macrodonta*

Norway maple *Acer platanoides*

Red osier dogwood *Cornus sericea*

Small-leaved lime *Tilia cordata*

Snowberry *Symphoricarpos albus*

Sycamore *Acer pseudoplatanus*

Traveller's joy *Clematis vitalba*

Wall Cotoneaster *Cotoneaster horizontalis*

Wilson's honeysuckle *Lonicera nitida*

Winter heliotrope *Petasites fragrans*

4.1 Butterfly bush *Buddleja davidii*

4.1.1 Species Ecology

The butterfly bush is a multi-stemmed shrub that can reach 4m in height. From June to September, the arching branches bear conical panicles of lilac flowers, which may occasionally be white, pink, red or purple. Leaves are long and serrated along the edges. In the winter, flower heads and seed capsules remain despite the plant being deciduous. Up to 3 million seeds are produced per plant and can remain dormant in the soil for many years. Butterfly bush is common throughout Ireland. It spreads through abundant seed dispersal by wind and draught behind vehicles. While being a valuable source of nectar, especially for butterflies, it can cause structural damage to buildings by rooting in cracks in masonry. Butterfly bush has been assessed as having a risk of Medium Impact to native biodiversity by the National Biodiversity Data Centre.

"*Buddleja davidii* Budleja Davida 2015-08-30 01" by Agnieszka Kwiecień, Nova is licensed under CC BY-SA 4.0.(https://commons.wikimedia.org/w/index.php?curid=64364967)

Figure 4-1: Flowers and leaves of butterfly bush

4.1.2 Timeframe

Optimal time for treatment and/or movement of material is outside of flowering and seed-bearing periods and treatment should be undertaken in winter and spring.

4.2 Cherry laurel *Prunus laurocerasus*

4.2.1 Species Ecology

Cherry laurel is an evergreen shrub that forms dense thickets of either a single stem or multiple stems (especially if it has been trimmed). It has thick 5-15cm long oblong-ovate leaves; glossy green on surface and pale underneath. Leaves are arranged alternately on short leaf stalks and leaf edges are toothed with pointed tips. Small white fragrant flowers are held in clusters (racemes) and flowers are comprised of five petals and many yellow stamens. The clustered fruits are purple/black and cherry like. Cherry laurel has been assessed by the National Biodiversity Data Centre as having a risk of High Impact on native biodiversity.

Source: "Cherry Laurel" by edenpictures is licensed CC BY 2.0 (https://www.flickr.com/photos/10485077@N06/49845235411)

Figure 4-2 Characteristic Features of Cherry Laurel

4.2.2 Timeframe

Cherry laurel can be cut down at any time of year; the herbicide glyphosate can also be applied throughout the year, however May to October inclusive is a sub-optimal period. Of principle concern when cutting and/or moving vegetation or surrounding soil is the movement of viable seeds. As such the optimal time for cutting is outside the flowering and fruiting period.

4.3 Fuchsia *Fuchsia magellanica*

4.3.1 Species Ecology

These deciduous shrubs reach about 1.5m in height and favour coastal and rocky ground. They flower from July to October and flowers are roughly 2cm long, bell shaped and violet and pink in colour.

Particularly near the coast, it is widely used as a hedging plant, because it is a vigorous and fast grower. It produces flowers in great abundance from midsummer until the early winter. These flowers are pollinated by hummingbirds in their Chilean homeland, but by insects in Ireland. Sausage-shaped fruits are produced by some stands of the plant. There is evidence of some spread of the species by seed away from planted shrubs or hedges. Spread may also occur from fragments of plants thrown out with garden rubbish. The invasive impact of this plant has not been assessed.

"Chilco (*Fuchsia magellanica*)." by Andres Bertens is licensed under CC BY-NC-SA 2.0. https://www.flickr.com/photos/146065760@N04/44757312840

Figure 4-3: Fuchsia leaves and flowers

4.3.2 Timeframe

Fuschia can be treated in spring by cutting and with the use of herbicide. Affected areas must be retreated if there is any regrowth.

4.4 Giant butterbur *Petasites japonicus*

4.4.1 Species Ecology

Giant butterbur is native to China, Japan and Sakhalin (Russia). Giant butterbur produces large kidney shaped leaves. It can be found in habitats with varying amounts of light, including roadsides, forest gaps and shaded forest understories. In its natural habitat in Japan, it is the preferred food plant of female brown bears. This perennial plant can reach heights of 1.5m. Flowers are cream to white, and appear in February on short erect stems. This is a dioecious species, with male and female flowers produced on separate individuals. The risk of impact of this species has not been assessed by the National Biodiversity Data Centre.

"File:Fuki no tou (*Petasites japonicus*) , フキノトウ - panoramio.jpg" by z tanuki is licensed under CC BY 3.0. (https://commons.wikimedia.org/w/index.php?curid=57777666)

Figure 4-4: Flowers of giant butterbur

4.4.2 Timeframe

It can be dug up any time of the year when soil is suitably dry.

4.5 Giant hogweed *Heracleum mantegazzianum*

4.5.1 Species Ecology

This is an extremely large (up to 5m tall) perennial herb which lives between 3-5 years. Stems are up to 10cm thick at the base, coloured green with purple blotches; root is pale yellow. Leaves are pinnate (opposite pairs of leaflets with one terminal leaflet) up to 1m length and 2.5m across; 10mm cream-white flowers are borne in umbels (disc-like clusters) up to 50cm in diameter. The mechanism of spread is by seed, with up to 50,000 seeds being produced when the plant reaches maturity (3-5 years), after which it dies. As such the plant may have a low growth form early in the season, as new plants develop from seed.

Its ecological impacts include outcompeting native flora when dense stands produced by prolific seeding colonise areas, and increased riverbank erosion when the plants die back in winter. Seeds usually disperse within the vicinity of the parent plant; there is potential for them to be transported further however by transport on animals, human intervention (e.g. machinery or soil movement) or in flowing water (this species is known to colonise river corridors).

It also poses a serious human health hazard, as contact with the sap can cause a condition called phytophotodermatis, which causes painful blistering of the skin, which can persist for years with exposure to sunlight re-triggering symptoms.

This species has been assessed by the National Biodiversity Data Centre as having a risk of high impact on native Irish species.

"Giant Hogweed (*Heracleum mantegazzianum*)" by Jeremy Halls is licensed under CC BY-SA 2.0. (https://www.flickr.com/photos/33239614@N02/12704706783)

Figure 4-5: Giant hogweed leaves

4.5.2 Timeframe

The optimum time to control giant hogweed is around April/May, when the first foliage appears and the largest seedlings establish a leaf rosette.

4.6 Himalayan knotweed *Persicaria wallichii*

4.6.1 Species Ecology

Himalayan knotweed was introduced to Ireland as an ornamental garden plant. Originating in the Indian subcontinent, this species is now widespread across Ireland and grows in similar conductions to Japanese knotweed. However it emerges later in the spring and flowers later, in comparison with Japanese knotweed. This species is perennial and rhizomatous, with bamboo like stems growing up to 1.8m in height. It has upright stems and think, pointed leaves. It grows densely along roadsides, waste ground, riverbanks and damp grasslands, shading out native species.

Spread of this species in Ireland is vegetative. Fragments of rhizome or pieces of stem with nodes can be spread by machinery, water, traffic and dumping of waste. from fragments of the rhizome or pieces of stem containing nodes.

The National Biodiversity Data Centre has assessed Himalayan knotweed as having a risk of Medium Impact to native biodiversity.

"Afghaanse duizendknoop - *Persicaria wallichii*" by gertjanvannoord is licensed under CC BY-ND 2.0.(https://www.flickr.com/photos/145907835@N07/35833242560)

Figure 4-6: Himalayan knotweed leaves

4.6.2 Timeframe

The timeframe for treatment of this species is similar to that of Japanese knotweed, see Section 4.8.2 below.

4.7 Himalayan honeysuckle *Leycesteria formosa*

4.7.1 Species Ecology

This deciduous shrub can grow to a height of 2m and produces purple flowers and berries. This plant reproduces via fruit that are widely dispersed by birds and small mammals, allowing it to thrive across a range of habitats. This plant has been used in the past as cover for pheasants and is sold today as an ornamental shrub. This plant forms dense thickets that exclude native flora. Himalayan honeysuckle is widespread throughout Ireland but more common in the southeast. It has been assessed by the National Biodiversity Data Centre as having a medium risk of impact on native Irish species.

"*Leycesteria formosa* Seattle WA" by vikisuzan is licensed under CC BY-NC-SA 2.0. (https://www.flickr.com/photos/7721261@N05/955676405)

Figure 4-7: Characteristics of Himalayan Honeysuckle

4.7.2 Timeframe

Physical control is to be undertaken in spring before seeds are produced, to reduce the likelihood of reproductive spread.

4.8 Japanese knotweed *Fallopia japonica*

According to the Invasive Species Ireland Project who have carried out a risk assessment of Japanese Knotweed (*Fallopia japonica*), which is distributed throughout the island of Ireland, the species is “one of the highest risk (most unwanted) non-native invasive species in Ireland”. The species poses a risk to open and riparian areas where it spreads rapidly to form dense stands, excluding native vegetation and prohibiting regeneration. This process has been known to reduce diversity and alter semi-natural and locally important habitats for wildlife. Once stands become established, they are extremely persistent and difficult to remove. Japanese knotweed can grow through weaknesses in both tarmac and concrete. Population clusters must be completely removed, under appropriate licencing, before site works or specific projects within the site can commence (Kelly et al., 2008).

4.8.1 Species Ecology

Although Japanese knotweed plants flower, all flowers in Ireland and Britain are female, precluding the possibility of sexual reproduction. The means of spread is entirely through the movement of rhizomes or rhizome fragments in soil or cut stems. Japanese knotweed has an extraordinary ability to spread vegetatively from crown, stem and rhizome (underground root) if disturbed. Even tiny amounts of cut stem, crown or rhizome can produce a new plant.

Controlling the spread of the species is therefore dependent on preventing the spread of the stem, crown or rhizome. Japanese knotweed causes numerous impacts, both ecological and economic. It is capable of outcompeting native plants and blocking commuting corridors of native mammals, and damaging buildings, tarmacadam and concrete. In waterways, it can block and reduce water flow, increasing the risk of flooding. In winter, when it dies back, it can leave riverbanks bare and open to erosion.

Red/purple shoots appear early in spring, which in some cases have an asparagus-like appearance but, as the canes grow, the leaves unfurl, and the plant takes its more characteristic appearance. The mature canes are like bamboo, being hollow, and have a characteristic pattern of purple speckles. The leaves are shield-shaped with pointed tips and a flat base, arranged in a zig-zag formation. The plant can grow to over 3m in height. Flowering occurs in late summer/autumn (End July – typically August) and consists of small creamy white flowers. During the winter the leaves die back and reveal orange/brown woody erect stems. Rhizomes are bright orange inside and can extend to a depth of 3m and a width of 7m around the visible growth above ground.

Source: "Expansion of Japanese Knotweed" by U.S Fish and Wildlife Service – Northeast Region is licensed with CC PDM 1.0 (https://www.flickr.com/photos/43322816@N08/5951588772)

Figure 4-8: Characteristic Features of Japanese Knotweed

4.8.2 Timeframe

Japanese Knotweed shoots typically appear between March and April. During this time energy stores from the root system are used to facilitate initial growth. The summer growth period commences in May and lasts until July, typical growth occurs during this time. Flowering begins in August and lasts until October. During this time the pale flowers can be seen.

Figure 4-2 indicates the suitable period which glyphosate herbicide is used to remove Japanese Knotweed. It is suitable to use glyphosate herbicide on knotweed between the months of May and October, with August, September and October being the preferred months of use.

Japanese growing season	J	F	M	A	M	J	J	A	S	O	N	D

- Appearance of shoots
- Summer growth period
- Onset of flowering
- Winter dieback with canes visible

Glyphosate	J	F	M	A	M	J	J	A*	S*	O*	N	D

Suitable for use
* Preferred period of use

Figure 4-9: Japanese Knotweed Growth season summary (Kelly, et al., 2008).

4.9 Japanese rose *Rosa rugosa*

4.9.1 Species Ecology

This rose species grows as a compact shrub, up to 2m tall, and produces suckers. Stems bear a mix of numerous broad-based and smaller needle-like thorns. Leaves are shiny, furrowed/wrinkled, and hairy (5-9 leaflets make up pinnate leaves). Flowers are usually deep pink (sometimes white), five petalled, 6-10cm across, and slightly wrinkled. Fruits are large red hips.

It was introduced to Europe in the 18th century and has spread into the wild by dispersing from gardens and garden waste. It is still widely available commercially. Some birds including thrushes eat the rosehips, thus acting as a vector for dispersal. Transport of rootstock and seeds in soil could also result in spread.

In terms of impacts it is of primary concern in dune habitats and other coastal areas, where it can colonise and form dense thickets. It has been assessed by the National Biodiversity Data Centre as having a risk of medium impact on native Irish species.

"*Rosa rugosa* (Морской шиповник) - rosehips" by Tatters ✾ is licensed under CC BY-NC 2.0.(https://www.flickr.com/photos/62938898@N00/7999765622)

Figure 4-10: Fruit of Japanese rose

4.9.2 Timeframe

Removal of Japanese rose should occur before flowering (i.e. in early spring) to ensure seeds are not produced, leading to further dispersal.

4.10 Lawson's cypress *Chamaecyparis lawsoniana*

4.10.1 Species Ecology

Lawson's cypress is native to southwestern Oregon and northwestern California. It can grow in a variety of soil types, including poor soil, in a wide range of temperatures. This species is tolerant of shade. It has a wide range of cultivars, with varying forms and growth rates. Lawson's cypress can root from cuttings. Sexual reproduction is more common, with both sexes borne on the same branches. This tree first reproduces at approx. 5-9 years. The risk of impact has not been assessed by the National Biodiversity Data Centre.

"J20160926-0056—*Chamaecyparis lawsoniana*—RPBG" by John Rusk is licensed under CC BY 2.0. (https://www.flickr.com/photos/12303842@N00/29470424294)

Figure 4-11: Seed cones and leaf structure of Lawson's cypress

4.10.2 Timeframe

Removal of occur in early spring prior to pollination, to ensure seeds are not produced, leading to further dispersal.

4.11 Montbretia *Crocosmia x crocosmiiflora*

4.11.1 Species Ecology

Montbretia (*Crocosmia* X *crocosmiflora*) is an invasive perennial that grows from underground corms. The X within its scientific name indicates it is a hybridised species. The species was developed in France for horticultural use and has since escaped and is naturalised throughout Ireland. Montbretia can survive in most open habitat types such as wet grassland, gardens and roadsides.

Due to fast growth rates, Montbretia outcompetes other species, dominating the habitats to which it is introduced. This dominance can impact native species and processes within these habitats. Dense tussocks of Montbretia can prevent the regeneration of seedlings and saplings, thus preventing natural re-generation of woodland (DAFM, 2016).

Montbretia flowers are reddish to orange in colour. They can be between 25 to 55mm long and are arranged loosely along two opposite sides of the flower stem, in a zig-zag formation. They have a hollow tubular corolla with six petals. The green leaves are 'grass-like', long, narrow, soft, and hairless. Leaves also have pointed tips and can reach 30-80cm long.

Montbretia spreads vegetatively using underground corms and rhizome fragments. The corm is bulb-like and stores energy for survival during the winter months. It is estimated that each Montbretia plant can produce 14 new corms annually. These corms are thought to break off from the parent plant, thus spreading further into the habitat. The corms, corm fragments and rhizomes can be spread unintentionally because of ground disturbance, dumping of garden waste and by attaching to machinery.

Source: "Montbretia (*Crocosmia* x *crocosmiiflora*)" by Andres Bertens is licensed CC BY-NC-SA 2.0 (https://www.flickr.com/photos/146065760@N04/46722665512)

Figure 4-12: Montbretia flower

4.11.2 Timeframe

Montbretia growth begins in early spring with leaves sprouting from the ground in March. The plant flowers between July and September. The most effective time to remove Montbretia is just before full flowering occurs in summer (DAFM, 2016).

4.12 New Zealand holly *Olearia macrodonta*

4.12.1 Species Ecology

New Zealand holly is a medium sized evergreen shrub, native to New Zealand. IT has ovate, grey-green, spiny-toothed leaves, which are white-felted underneath and reach 9cm in length. The white flowers are small and fragrant and borne in large clusters during the summer.

The impact of this species on native Irish species has not been assessed by the National Biodiversity Data Centre.

"New Zealand Holly (*Olearia macrodonta*)" by Peter O'Connor aka anemoneprojectors is licensed under CC BY-SA 2.0.(https://www.flickr.com/photos/58414938@N00/9212341853).

Figure 4-13: Flowers of New Zealand holly

4.12.2 Timeframe

Removal of New Zealand holly should occur in spring before flowering to ensure seeds are not produced, leading to further dispersal.

4.13 Norway maple *Acer platanoides*

4.13.1 Species Ecology

The Norway maple is deciduous broadleaf tree that reaches heights of 25m. The bark of this tree is grey with fine ridges. Twigs are slender and brown with small white spots. In winter, this species is identified by individual green and red buds. Leaves are palmate, five-lobes and with few pointed teeth. Flowers are bright green growing in clusters of up to 30. Winged seeds fall in autumn and are dispersed by wind. It is classified as having a low risk of impact by the National Biodiversity Data Centre.

"*Acer platanoides*" by Nacho 13 is licensed under CC BY 2.0. (https://www.flickr.com/photos/7858710@N02/5185515109)

Figure 4-14: Features of Norway maple.

4.13.2 Timeframe

Removal of Norway maple should occur during early spring before flowering to ensure seeds are not produced, leading to further dispersal.

4.14 Red osier dogwood *Cornus sericea*

4.14.1 Species Ecology

Red Osier Dogwood is a deciduous shrub that stands up to 6m tall. Between June and July (and sporadically in autumn) it produces small dense creamy white-yellow flowers. These flowers are four-petalled (8-10mm) in a flat topped head, with a faintly foetid smell. This species produces white berries. The leaves are pointed ovals in shape with tapering points, opposite, stalked with prominent veins and redden in autumn. These red leaves make it easy to identify in winter. Figure 4-4 displays characteristic features of red osier dogwood.

Red Osier Dogwood has the potential to outcompete native hedgerow or woodland. It has only been recorded in a few wetland habitats across Ireland. It is classified by the National Biodiversity Data Centre as having a risk of low impact on native Irish species.

"N20141030-0063—*Cornus sericea* ssp sericea—RPBG" by John Rusk is licensed under CC BY 2.0. (https://www.flickr.com/photos/12303842@N00/15511684778)

Figure 4-15: Pointed oval leaves, creamy white flowers in a flat top head, and red stems of red osier dogwood.

4.14.2 Timeframe

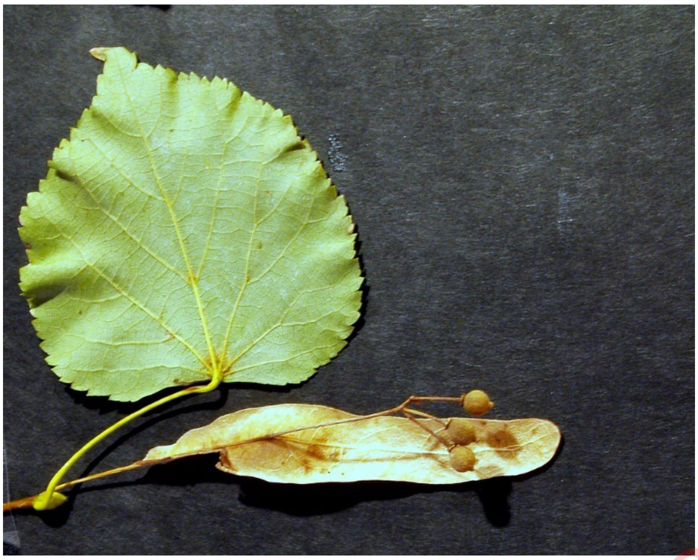
Red osier dogwood spreads via its seeds contained within its white berry-like fruits or frequently via vegetative runners, resulting in colonies of shrubs. Therefore, it is recommended to avoid treatment during fruiting, and conduct treatment in winter and spring.

4.15 Small-leaved lime *Tilia cordata*

4.15.1 Species Ecology

The small-leaved lime is a deciduous tree reaching over 20m in height. The grey-brown bark is smooth and develops flaky plates as it ages. The brown-red twigs appear shiny in sunlight. Leaves are heart shaped, between 3-8 cm in length and feature a pointed tip.

These leaves are hairless on top but have reddish-brown tufts on vein-joints on the leaf underside. This hermaphroditic species has green-yellow flowers with five petals, which grow in clusters of four to ten. Fruits are smooth with pointed tips. This introduced species has not been assessed by the National Biodiversity Data Centre for impacts on biodiversity and is long-established in Ireland.



"*Tilia cordata* (Littleleaf linden)" by maggie_and_her_camera is licensed under CC BY-NC 2.0. (https://www.flickr.com/photos/13389908@N03/1411317188)

Figure 4-16: Fruit and leaf of small-leaved lime

4.15.2 Timeframe

Removal of small-leaved lime should occur in early spring before flowering to ensure fruits and seeds are not produced, leading to further dispersal.

4.16 Snowberry *Symphoricarpos albus*

4.16.1 Species Ecology

Snowberry is an invasive, often overlooked, species that is often present in hedgerows. Other than its pale white fruit, the species seems to blend into the other species within the habitat. Snowberry is a twiggy and straggly plant, which can reach over 2.5m high, often suspended using suckers. Snowberry impacts habitats and species as it forms dense thickets that outcompete native vegetation.

Snowberry produces small pale-pink 'funnel-shaped' flowers with five pale-petalled flowers (4-6mm across), which flower from June to September. Its oval leaves are small and untoothed. In autumn the berries are round (1.5-2cm diameter) and whiten when ripe. Each berry contains two seeds. This plant was introduced from North America. It is thought that bird species within Ireland have not yet adapted to feed upon berries of such a colour, as no native plant in Ireland holds ripe white berries.

"J20171012-0029—*Symphoricarpos albus* var *laevigatus*—RPBG" by John Rusk is licensed under CC BY 2.0. (https://www.flickr.com/photos/12303842@N00/37092360283)

Figure 4-17: Snowberry berries and leaves

4.16.2 Timeframe

Snowberry comes into flower from June to September; their berries are ripe in Autumn. As such, the optimal time for treatment would be outside the flowering and fruiting period.

4.17 Sycamore *Acer pseudoplatanus*

4.17.1 Species Ecology

The sycamore tree can grow up to 35m tall and has a distinctive fruit with wings. Originally it was thought to be damaging to native woodlands and to support a much narrower range of diversity than native species. However, it has been shown to support a wide range of lichens and other species. The principal concern would be sycamore dominated woodlands, though sycamore seedlings are out competed by ash under sycamore canopy and vice versa, suggesting that there is a pattern of succession in mixed woodlands. Undisturbed woodlands have relatively few trees compared to disturbed sites, even when sycamore trees are present at nearby sites. Poor growth in dry conditions suggests that careful management of forests can mitigate any effects of sycamore invasion. Sycamore is of medium invasive impact when growing in native woodland areas.

Source: "Lobed leaf of Sycamore (*Acer pseudoplatanus*)" by Science and Plants for Schools is licensed under CC BY-NC-SA 2.0. (https://www.flickr.com/photos/71183136@N08/6981990192)

Figure 4-18: Sycamore Leaf

4.17.2 Timeframe

Control and disposal of plant material is best carried out in spring before seeds are produced. As is common with invasive species, careful monitoring and follow-up applications of herbicides may be necessary.

4.18 Traveller's joy *Clematis vitalba*

4.18.1 Species Ecology

This deciduous perennial is a climber that can reach heights of 10-15m meters and will use structures and other plants to climb. The flower produces 2cm (across) fragrant cream flowers comprised of four sepals and many spread out stamens. Flowers are borne in clusters from July to September. Seed clusters are produced and have a feathered (achenes) appearance and are white to grey in colour. Leaves are opposite pinnately compound with three to five levels and are elliptical shaped with rough toothed margins.

This garden escapee reproduces predominantly via seed, but re-growth from vegetative material has also been known to occur. It is mainly found in alkaline soils and is common along Irish roadsides and hedgerows. This plant impacts surrounding plants by using them as a climbing frame and competing for light. It can form a dense carpet covering the crowns of trees. It has been assessed by the National Biodiversity Data Centre as having a medium risk of impact on native Irish species.

"Traveller's Joy - *Clematis vitalba*" by Ian Cunliffe is licensed under CC BY-SA 2.0. (https://www.geograph.org.uk/photo/1166298)

Figure 4-19: Leaves and flowers of traveller's joy.

4.18.2 Timeframe

Removal is most successful when carried out in winter when the vines can be more easily removed.

4.19 Wall Cotoneaster *Cotoneaster horizontalis*

4.19.1 Species Ecology

Wall cotoneaster is a deciduous, low growing shrub typically 50cm tall. It reproduces via bright orange-red fruit that are highly attractive to birds, which disperse the seeds. Typically found in artificial or sparsely vegetated habitats, it is thought to displace and compete with native flora and particularly grassland species. The flowers are white in colour and seen from May to June each year.

It has been assessed by the National Biodiversity Data Centre as having a medium risk of impact on native Irish species. Wall cotoneaster is widespread throughout Ireland.

"*Cotoneaster horizontalis*" by M. Martin Vicente is licensed under CC BY-SA 2.0.(https://www.flickr.com/photos/32179778@N00/8016706541).

Figure 4-20: Berries and leaves of wall cotoneaster

4.19.2 Timeframe

Treatment should be carried out before the plant flowers in May/June.

4.20 Wilson's honeysuckle *Lonicera nitida*

4.20.1 Species Ecology

Wilson's honeysuckle is a woody shrub with many thin, round glandular/hairy stems, arching branches and a bushy growth habit. The leaves are miniscule, opposite, oval, green and waxy. Flowers are also small, usually in pairs at leaf-axils, five-lobed, white-pale yellow, and covered in glands with a robust stigma extending above the petals.

It is widely planted and established, and primarily associated with roadsides and hedgerows. This plant produces berries, which could potentially be dispersed by animals or human intervention. Its risk of impact on native Irish species has not been assessed.

"Boxleaf Honeysuckle (*Lonicera nitida*)" by Peter O'Connor aka anemoneprojectors is licensed under CC BY-SA 2.0.(https://www.flickr.com/photos/58414938@N00/3907165157)

Figure 4-21: Wilson's Honeysuckle

4.20.2 Timeframe

Physical control should preferably be undertaken in spring before seeds are produced, to reduce the likelihood of reproductive spread.

4.21 Winter heliotrope *Petasites fragrans*

4.21.1 Species Ecology

Winter heliotrope (*Petasites fragrans*) is an invasive plant species, native to North Africa and the Mediterranean. It often forms dense carpets of kidney-shaped leaves, 20-50cm wide, and is not often confused with other species. Heliotrope prefers damp areas and embankments, both within waste ground areas and cultivated land. It can often be found along roadways and drains.

These deciduous plants produce large roundish leaves up to 30cm in diameter. These are downy underneath. Its pale pink flowers have a distinctive sweet smell and flower in December and January. Foliage forms a dense carpet with a height of approximately 30cm. Its rhizomatous root system allows vegetative spreading. The winter heliotrope plants in Ireland are all clone males, originating from a single male, through fragmentation. These male plants are unable to produce seed and thus rely on root systems and fragmentation to spread. The species is thought to be widespread, but under recorded, in Ireland. Thought to have been introduced in the 1800s, first reported in pre-1866 records, it's believed that the species was originally either planted as winter ground cover or as a foodplant for bees (Reynolds, 2002)

Source: "*Petasites fragrans* (Winter Helitotrope)" by Hugh Knott is licensed with CC BY-ND 2.0 (https://www.flickr.com/photos/148695759@N02/34108451431)

Figure 4-22: Characteristic Features of Winter Heliotrope

4.21.2 Timeframe

It can be dug up any time of the year when soil is suitably dry. Spraying with chemicals should be done in February-March or July-September.

5. PROPOSED MEASURES FOR MANAGEMENT OF INVASIVE SPECIES

5.1 Recommended Measures

While it is extremely important and more efficient to contain invasive species at the point of infestation, care shall also be taken to ensure the management plan (Section 6) shall also be adhered to ensure that the species is not spread outside the works area. Furthermore, none of these invasive species will be planted as part of landscaping the proposed Fahy Beg Wind Farm.

Invasive Species Ireland (ISI) notes that invasive non-native species are the second greatest threat (after habitat destruction) to worldwide biodiversity. Invasive species negatively impact Ireland's native species; changing habitats and ultimately threatening ecosystems which impacts on biodiversity as well as economics as they are costly to eradicate.

Through prevention, early detection, rapid response, eradication, and control measures, we can reduce the risk of their introduction, establishment, spread, and impact (Invasives.ie, 2022).

Specific consideration will be given to particular locations, due to their potential for disturbance during works. As a general rule, where invasive species are within the footprint of proposed works, they must be contained and disposed of correctly. Where they are outside the proposed footprint, avoidance can be relied on where feasible to prevent their spread. As such, options for avoidance, control and removal are detailed below.

5.1.1 Prevention of spread within the works footprint

Prevention of the spread of invasive species will be achieved by:

- The full implementation of the invasive species management plan (Section 6) in conjunction with a competent and experienced Invasive Species Specialist Contractor.
- Supervision of control measures and treatment works by an appropriately qualified ecologist or invasive species specialist.
- Raising awareness to site workers via toolbox talks given by a suitably qualified person as part of site introduction; informing workers what to look out for and what procedure to follow if they observe an invasive species.
- Only planting or sowing native species within the proposed Fahy Beg Wind Farm site, GCR and TDR will be allowed.
- Where invasive species have been physically removed and soil disturbed, this soil will be seeded or replanted (including 5cm deep mulch) with native plant species. This will prevent erosion and the easy colonisation of bare soil by invasive species in the area.
- Unwanted material originating from the site (including soil, rhizomes and other material) will immediately be transported off site by an appropriately licensed waste contractor and disposed of properly at a suitably licenced facility, in accordance with the (NRA, 2010) guidelines, i.e., where cut, pulled or mown non-native invasive plant material arises, its disposal will not lead to a risk of further spread of the plants. Care will be taken near watercourses as water is a fast medium for the dispersal of plant fragments and seeds. Material that contains rhizomes, flower heads or seeds will be disposed to licensed landfill. All disposals will be carried out in accordance with the Waste Management Acts.
- Signs will warn people working within the site that there is invasive species contamination.

Ensure appropriate biosecurity measure are in place, these will include the Check Clean Dry method, along with those outlined below:

- Remove the build-up of soil on equipment
- Keep equipment clean
- Do not move fouled equipment from one site to another
- Footwear and clothing of operatives working near invasive species should be checked for seeds, fruits, knotweed rhizomes or other viable material before exiting the site
- All vehicles exiting the site will be examined to prevent the transport of rhizomes, seeds and other plant material.

Follow instructions provided for containment of invasive species (Section 5.2).

5.2 Containment

The three most common ways a site can become infected are:

Importation of infected soil.

Contamination on vehicles and equipment.

Illegal dumping.

Containment of invasive species at the Site, GCR and TDR will be achieved by:

A pre-construction survey to reconfirm the findings of the EIAR during the growing season immediately prior to the construction phase. This will mark out the extent of invasive plant species. This survey shall inform the finalised draft of the invasive species management plan prior to the commencement of works. Prior to the construction phase, invasive species are to be treated (Section 5.2 for treatment methods).

A licensed invasive species contractor shall be engaged to remove invasives prior to development.

Cordoning of invasive species outside the works footprint shall include a buffer of 1m the area of infestation. When larger buffers are required this shall be specified in Section 5.2. This will prevent plants with underground rhizomes being transported to other sections of the site and it will also prevent contact with plants which could result in the transport of seed, fruit or vegetation to other parts of the site. No construction works will occur within exclusion zones prior to the eradication of invasive species.

No contaminated soil (contamination from non-native species) or vegetation shall be removed from site unless proper biosecurity (Refer to Section 5.1 above) is observed and removal by an appropriately licensed waste contractor to a suitably licenced facility.

New sightings of the invasive plant species identified within the Site, or along the GCR and TDR (refer to Section 3.1) shall be relayed to the contractor for invasive species control. These areas shall follow the same protocol as the current infected areas.

It is possible, particularly in the first year of control, that new plants will sprout following the initial removal/treatment, either because shade suppression will be reduced or due to soil disturbance. As such, several additional visits will likely be required. Three visits, May/June, July/August and September/October should be sufficient to catch all regrowth, although, a cautionary approach is advisable.

Plants that germinate after September/October are very unlikely to have sufficient time to complete their life cycle and produce seeds.

5.3 Species Specific Measures

5.3.1 Butterfly bush *Buddleja davidii*

Butterfly bush that is present adjacent to TDR Node 2, Node 8 and Node 19 and along the GCR within private gardens at Ardnacrusha is likely to spread within the area regardless of potential transport by humans, due to its mode of spread by wind. Nonetheless, efforts will be taken to prevent the spread of this species as follows:

- Disturbing ripe seed heads will be avoided during the turbine delivery by implementing an exclusion zone;
- Bags will be placed over the flower spikes to avoid dislodging and spreading seeds during the turbine delivery;
- Machinery will be checked for the presence of seed to avoid accidental transportation.

If this species has spread into the proposed works zone prior to TDR/GCR works and trimming/felling are required any reproductive plant material will be carefully disposed of following NRA (2010) Guidelines (See Section 5.1). Any equipment used will be inspected and thoroughly cleaned, as will the footwear and clothing of operatives removing invasive species material. Any material arising from cleaning of equipment and footwear will be disposed of in a manner which will not cause the spread of invasive species.

5.3.2 Cherry laurel *Prunus laurocerasus*

Cherry laurel was found within the Site and along the GCR. In neither of these instances is cherry laurel within the proposed development footprint, however efforts will be taken to prevent the spread of the species (Section 5.1).

If cherry laurel spreads within the development footprint, the following option is proposed:

Option 1: Physical Control

This method involves cutting the main stem of the plant near ground level and digging out the stump and any visible roots. This option is not usually practical in areas where there are other invasive plants present as the disturbed soil can allow for the setting of seeds or the spread of rhizomes of adjacent species.

The following general recommendations will also be adhered to as part of the plan:

- Construction works will only be allowed within exclusion zones once the species has been fully eradicated.
- No treatment measures are to take place in these areas without supervision and agreement by appointed cherry laurel eradication specialist.
- The cherry laurel plant contains cyanide and as per good practice will only be handled with gloves. This plant will be disposed of via an appropriately licensed waste facility.
- Equipment, clothing and footwear will be checked following treatment operations or work in the vicinity of the species and cleared of fruits/seeds as necessary.

5.3.3 Fuchsia *Fuchsia magellanica*

Fuchsia was present within the Site, GCR and TDR, but is not within the footprint of works/oversail. The general measures (Section 5.1) will be employed to prevent the spread of this species. The following option is also proposed in the event that this species spreads within the proposed development:

Option 2: Physical Control

In the event of fuchsia being disturbed by construction, mechanical excavation will be used to treat this species.

5.3.4 Giant butterbur *Petasites japonicus*

Giant butterbur was present along the TDR, adjacent to the oversail. The EIAR did not determine this species would be impacted by the development, however the measures detailed in Section 5.1 will be employed to prevent the spread of this species. Recommendations are also proposed in the event that this species spreads within the proposed development.

In the event of giant butterbur being disturbed by construction, treatment methods will follow those prescribed for winter heliotrope (Section 5.3.21).

5.3.5 **Giant hogweed** *Heracleum mantegazzianum*

The EIAR determined that this species could be disturbed by works along the GCR, due to close proximity. The following management considerations should be taken into account:

- Seed can remain viable for up to 15 years; however most will persist for only 1-2 years
- Soil within 4m of parent plants is likely to contain a large number of seeds
- Most seeds are found within the top 5cm of soil
- Plants can regenerate from the central crown of the main root
- Giant hogweed produces phytotoxic sap, which poses a serious human health hazard.

These factors result in a number of basic requirements:

- Follow-up monitoring for regrowth (spring - autumn) will be required for several years following implementation of control/eradication measures.
- No machinery or construction operatives should enter a 5m exclusion zone around plants.
- Soil from the 5m exclusion zone around plants should only be moved under controlled circumstances.
- A risk assessment should be carried out in advance of control/eradication works, and all personnel involved will require adequate PPE to prevent contact of plant material with skin.

One key option is proposed for the treatment of giant hogweed:

Option 1: Physical Control

- Young plants can be pulled or removed using hand tools.
- Larger plants can be cut back, and the lower stem and main root removed separately.
- The central root crown must be removed to prevent regeneration.

Ripe seed-heads should be covered with bags and cut separately before digging/cutting to prevent the accidental spread of seed.

Smaller seedlings should be left to grow for several weeks as larger plants are easier to remove.

Mechanical cutting devices should not be used, as they can stimulate growth and spray sap onto operators.

Vector material will be transported off site by an appropriately licensed waste contractor to a suitably licenced facility.

Addition Option: Chemical Control

Foliar sprays of glyphosate or 2,4-D can be used for large infestations; broad-spectrum herbicides will also kill off non-target species however.

Foliar spraying should be undertaken in mid spring during dry mild weather, before the stem has fully elongated. If undertaken later in the year, plants should be cut back to ground level and re-growth sprayed.

Where a site contains sensitive vegetation, herbicide can be applied by stem injection or using a 'weed wiper'.

Operatives treating giant hogweed require a valid certificate for herbicide application.

5.3.6 Himalayan knotweed *Persicaria wallichii*

Himalayan knotweed was present within the main Site but is not overlapped by or near proposed infrastructure. However, this species is a Third Schedule listed species. In Ireland, the spread and propagation of species listed in the Third Schedule of S.I. No. 477/2011 European Communities (Birds and Natural Habitats) Regulations 2011 to 2021 is an offence. Therefore, the measures proposed for Japanese knotweed (Section 5.3.8) are proposed to control and prevent the spread of this species.

5.3.7 Himalayan honeysuckle *Leycesteria formosa*

Himalayan honeysuckle was present along the GCR, but was not within the area of proposed works. However the measures detailed in Section 5.1 will be employed to prevent the spread of this species. Options for the treatment of Himalayan honeysuckle are proposed below, in the event that this species spreads within the development.

Option 1: Physical Control

Seedlings and/or small plants can be pulled out of the ground along with the root system (BMCC, 2015).

Additional Option: Chemical Control

More established plants can be cut to near ground level and the freshly cut wound immediately painted with herbicide (BMCC, 2015).

5.3.8 Japanese knotweed *Fallopia japonica*

Stands of Japanese knotweed are present within the Main Wind Farm Site. It is also located along the Grid Connection Route (set back 9m from the road). This is a species listed in the Third Schedule, and while it is outside the footprint of works, it is an offence to spread or propagate this species. Therefore, it is proposed to control (within the Site) and prevent (Site and GCR) the spread of this species. The following site hygiene measures will be implemented during the proposed works:

- Japanese knotweed root systems can extend up to 7m in a lateral direction (but usually only up to 5 m), and 2m deep from the over ground parent plant. This buffer zone and infested area will be fenced off prior to and during works where possible to avoid spreading seeds or plant fragments around or off-site.
- Erection of adequate site hygiene signage in relation to the management of non-native invasive material as appropriate and to inform contractors of the risk.
- All staff shall be made aware of nature of threat via toolbox talks as part of site inductions.
- Ensure all site users are aware of measures to be taken and alert them to the presence of the Invasive Species Management Plan.
- Site works will only be allowed within exclusion zones following the removal of Japanese knotweed and contaminated soil.
- All machinery vehicles, equipment, footwear, and clothing operating within area of infestation to be thoroughly checked and cleaned in appropriately contained area prior to leaving the area to protect against further spreading of Japanese knotweed.
- Avoid if possible using machinery with tracks in infested areas.
- No stockpiling of contaminated soil will occur on-site.
- For soil imported to the site for infilling, the contractor will gain documentation from suppliers stating that it is free from invasive species.

One option is proposed for the treatment of Japanese knotweed, as described below.

Option 1: Physical Control

Japanese Knotweed root systems can extend up to 7m in a lateral direction (but usually only up to 5 m), and 2m deep from the over ground parent plant. The Japanese knotweed stands, in addition to this buffer area, will be excavated.

Material (soil, vegetation, etc.) contaminated with Japanese knotweed can only be transported offsite under the conditions of a relevant licence from the National Parks and Wildlife Service (NPWS). The material can only be removed to a prearranged EPA licenced waste transfer facility by the licenced haulier. Excavation for off-site disposal, great care needs to be taken to avoid excess waste and ensure the excavated Japanese knotweed does not contaminate surplus soil that is currently free from infestation during excavations. When transporting soil infested with Japanese knotweed, it is essential to carry out strict hygiene measures. If proper standards are not followed, this may lead to Japanese knotweed spreading. Japanese knotweed is a particular problem along transport corridors, where it interferes with the line of vision and can cause accidents.

Trucks that transport the material should only be filled up to a maximum of 20cm from the top. The void must be sealed with a well-secured membrane.

There must be enough membrane to seal the soil into a temporary cell for transporting. It is very important that the soil is contained to prevent any material being lost when it is moved. To contain the soil in the short-term, you can use a lower specification of membrane.

The final fate of knotweed material transported off-site would be deep burial or incineration at an appropriately licensed facility.

Additional Option (Chemical Treatment)

Japanese knotweed is highly invasive and physical methods undertaken together with chemical treatment can prevent re-infestation.

At least two weeks prior to excavation, Japanese knotweed can be treated with a non-persistent herbicide e.g. glyphosate.

5.3.9 Japanese rose *Rosa rugosa*

Japanese rose was recorded at one location c. 15m northwest of the load bearing footprint along the TDR. While control of this species is currently not necessary, efforts will be made to prevent the spread of this species. Additionally, the following option is proposed in the event of the spread of this species within the works footprint:

Option 1: Physical Control

Mechanical excavation may be used to treat Japanese rose if it will be disturbed by construction.

5.3.10 Lawson cypress *Chamaecyparis lawsoniana*

Lawson cypress was not located near any proposed infrastructure. Lawson cypress is unlikely to pose an invasion threat. Therefore, no treatment measures are necessary. However, in the event of Lawson cypress spreading to the works area, the following option is proposed:

Option 1: Physical Control

In the event of Lawson cypress spreading within the works area, these trees will not be mature and instead will be young trees or seedlings. Young plants can be pulled or removed using hand tools.

5.3.11 Montbretia *Crocosmia x crocosmiiflora*

The EIAR determined that this species could be disturbed by works along the GCR, due to close proximity.

One option for the treatment of Montbretia at the site has been proposed to avoid the spread of this species. The following general recommendations will be adhered to as part of the plan:

- No treatment measures of Montbretia are to be conducted without supervision and agreement by the appointed invasive species specialist.
- No material shall be taken from areas of infestation, unless for disposal. All material will be transported by an appropriately licensed waste contractor and received by an appropriately licensed facility.

Option 1: Physical control

Digging by hand can be used to extract corms and additional root system from the site. This must be completed before seeds are produced, pre-July. If corms are damaged during excavation it is likely that new growth would form from these. Tools and PPE must be cleaned before exit from the area of infestation. Subsequent excavated removed from the site, using appropriately licenced transport, to an appropriately licenced facility equipped to deal with such volumes (IWS, 2018). Any areas of disturbed soil will be seeded with native grass species and compacted to prevent sediment runoff. As such, digging must be carried out during spring/early summer to allow time for grass to establish.

5.3.12 New Zealand holly *Olearia macrodonta*

New Zealand holly is not overlapping or in proximity to any proposed infrastructure. The primary means of preventing spread of this species will be avoidance. In the event of New Zealand holly being present within the works area, the following option is proposed:

Option 1: Physical control

In the event of New Zealand holly being disturbed by construction, mechanical excavation will be used to treat this species.

5.3.13 Norway maple *Acer platanoides*

Norway maple is only present within areas of ornamental planting adjacent to the load bearing footprint. The EIAR determined that spread of this species is unlikely, however in the event of spread of this species into the load bearing footprint, the following option is proposed:

Option 1: Physical control

In the event of Norway Maple spreading within the load bearing footprint, these trees will not be mature and instead will be young trees or seedlings. Young plants can be pulled or removed using hand tools.

It is vital that reproductive Norway Maple plant material is carefully disposed of. The contractor must appropriately dispose of Norway Maple plant material in accordance with the NRA (2010) guidelines, where cut or mown non-native invasive plant material arises, its disposal will not lead to a risk of further spread of the plants. Care will be taken near watercourses as water is a fast medium for the dispersal of plant fragments and seeds. Material that contains flower heads or seeds will be disposed of by burial at a depth of no less than 2m, or disposal to licensed landfill in the case of non-native invasive species. All disposals will be carried out in accordance with the Waste Management Acts.

5.3.14 Red osier dogwood *Cornus sericea*

The EIAR determined that this species could be disturbed by works along the TDR, due to close proximity. It is also present along the GCR at Ardnacrusha. The red osier dogwood present in the oversail footprint will be assessed prior to TDR node works. If trimming and felling are required any reproductive plant material will be carefully disposed of following NRA (2010) Guidelines (See Section 5.2.1). Any equipment used will be inspected and thoroughly cleaned, as will the footwear and clothing of operatives removing invasive species material. Any material arising from cleaning of equipment and footwear will be disposed of in a manner which will not cause the spread of invasive species.

5.3.15 Small-leaved lime *Tilia cordata*

Small-leaved lime is unlikely to pose an invasion threat. Furthermore, it is outside the footprint of proposed works. Therefore, no treatment measures are necessary.

5.3.16 Snowberry *Symphoricarpos albus*

EIAR determined that this species could be disturbed by works along the GCR and TDR, due to close proximity. The following recommendations will be adhered to, and one option is proposed for treatment:

Snowberry is spread both by seed, a buffer area of 1m will be left to prevent further contact with plants, possibly causing seeds to fall or become attached to machinery or people. Disturbed seeds may result in the propagation of a new snowberry population elsewhere.

Staff shall be made aware of this buffer zone when working within areas of infestation.

Areas of infestation will be fenced off from other works areas including a buffering distance of up to 1m to create exclusion zones.

Construction works will not be allowed within exclusion zones until the species has been fully removed but may continue outside of these areas.

No treatment measures to take place in these areas without supervision and agreement by appointed eradication specialist.

All machinery and vehicles operating within areas of infestation to be thoroughly checked and if necessary cleaned prior to leaving the area to protect against further spreading of snowberry.

No material shall be taken from areas of infestation, unless for disposal. All material will be transported by an appropriately licensed waste contractor and received by an appropriately licensed facility.

All staff shall be made aware of nature of threat via toolbox talks as part of site inductions. Toolbox talks shall be undertaken with all personnel accessing the site to ensure that the details of the invasive species management plan are adhered to and to raise awareness of the potential treat of invasive species.

If operating within an area of known infestation all machinery, vehicles, equipment, foot ware and clothing will need to be cleaned thoroughly (if necessary, using steam cleaners) in a contained area to avoid further contamination.

Option 1: Physical control

Excavation of the entire root system is thought to be a very effective method of snowberry control. This must be done before the plants' seeds ripen in autumn. Plant matter from this process can be disposed of using a licenced landfill site.

Any reproductive plant material will be carefully disposed of following NRA (2010) Guidelines. Any equipment used will be inspected and thoroughly cleaned, as will the footwear and clothing of operatives removing invasive species material. Any material arising from cleaning of equipment and footwear will be disposed of in a manner which will not cause the spread of invasive species.

5.3.17 Sycamore *Acer pseudoplatanus*

The EIAR determined that this species could be disturbed by felling along the TDR. It is also present along the GCR and within the Site.

Control will focus on the correct disposal of cut material in areas where sycamore felling and trimming is required. Sycamore reproductive plant material is required to be carefully disposed of.

The contractor must appropriately dispose of Sycamore plant material in accordance with the NRA (2010) guidelines, where cut, pulled or mown non-native invasive plant material arises, its disposal will not lead to a risk of further spread of the plants. Care will be taken near watercourses as water is a fast medium for the dispersal of plant fragments and seeds. Material that contains flower heads or seeds will be disposed of to licensed landfill in the case of non-native invasive species. All disposals will be carried out in accordance with the Waste Management Acts.

5.3.18 Traveller's joy *Clematis vitalba*

The EIAR determined that this species could be disturbed by works along the TDR, due to close proximity. This species will be treated using the following option:

Option 1: Physical control (and additional option of Chemical Treatment)

Seedlings can be pulled out of the ground and larger plants can be cut to the stem (and foliage will die) and roots and stem removed. Roots can then be grubbed out with material stored above the ground, so plants cannot take root again.

Additional Option: Chemical Treatment

For more mature plants, the stem can be cut near ground level and herbicide applied to the outer rim of the stem. The stem is likely to produce regrowth in the next growing season and herbicide will need to be applied to this growth. Glyphosate can be used in late spring and summer and Triclopyr can be applied in summer. This option can be used where plants infest the crowns of trees.

The contractor must appropriately dispose of Traveller's joy plant material and soil containing plant material in accordance with the NRA (2010) guidelines, where cut, pulled or mown non-native invasive plant material arises, its disposal will not lead to a risk of further spread of the plants. Care will be taken near watercourses as water is a fast medium for the dispersal of plant fragments and seeds. Material that contains flower heads or seeds will be disposed to licensed landfill. All disposals will be carried out in accordance with the Waste Management Acts.

5.3.19 Wall Cotoneaster *Cotoneaster horizontalis*

While this species is present along the GCR, the EIAR determined that its spread is unlikely as it outside the works footprint. One option is proposed for the treatment of this species, in the event it spreads within the works footprint:

Option 1: Physical Control

The stems and rootstock will be excavated, ensuring all root material and suckers are removed. Physical control should preferably be undertaken before seeds are produced, to reduce the likelihood of reproductive spread.

Any reproductive plant material will be carefully disposed of following NRA (2010) Guidelines. Any equipment used will be inspected and thoroughly cleaned, as will the footwear and clothing of operatives removing invasive species material. Any material arising from cleaning of equipment and footwear will be disposed of in a manner which will not cause the spread of invasive species.

Additional Option: Chemical Treatment

The plant can be cut to stump, with treatment of herbicide. Alternatively, chemical control through foliar application of glyphosate can be used.

5.3.20 Wilson's honeysuckle *Lonicera nitida*

The EIAR determined that this species could be disturbed by works along the TDR, due to close proximity. The control options proposed are detailed in Section 5.3.19 - Wall Cotoneaster.

5.3.21 Winter heliotrope *Petasites fragrans*

The EIAR determined that this species could be disturbed by works along the GCR and TDR, due to close proximity. One method is proposed for the treatment of this species:

Option 1: Physical control

Excavation of winter heliotrope can be completed at any time of year when soils are suitably dry. All plant material, particularly the rhizomes, should be excavated and processed appropriately. Regular follow-up treatment should be completed to combat re-sprouting (NRA, 2010).

Contaminated plant matter, soils and other materials should be removed off-site to an appropriately licensed facility. This will be carried out in accordance with the NRA (2010) guidelines.

Areas of bare soil should be re-vegetated as soon as possible to reduce the amount of suitable habitat for this species.

Additional Option (Herbicide Treatment)

An alternative treatment method is using herbicide. A glyphosate based chemical should be used after flowering in February to March, or in mid to late summer. Additional follow-up applications will be required. Foliar spraying, wiper applicator, or spot treatment of infestations should be completed within the appropriate time frames, after flowering (typically February to March) (NRA, 2010).

6. MANAGEMENT PLAN

The management of any invasive species is achieved by the assessment and mapping of the invasive species, containment once found, continual monitoring and record keeping as well as the safe disposal of invasive species material. It is recommended that surveys be carried out periodically at the site to monitor the extent of invasive flora and the success of the control and management measures. These can be carried out by FT, or a contractor specialised in invasive flora treatment. Monitoring should continue during the construction works and as part of the post construction monitoring to make sure successful control has been achieved. All invasive species which occur within the area utilised by people and machinery during the proposed construction works will be controlled/removed from the works area before commencement of works.

6.1 Containment

For the efficient use of resources namely, financial, and physical effort, it is important to prevent the further spread of invasive species. Containment will be achieved using measure outlined in Section 5 and those presented below:

- Landholder to be informed of location of the invasive species and the management plan.
- Ensure anyone treating the infestation is a suitably qualified trained professional who follows the management plan.

The site will be re-surveyed prior to treatment/construction works to confirm the findings of the original survey.

6.2 Schedule

Periodic re-surveying for all invasive species will be required, to ensure that treatment measures were effective, and to trigger further treatment if necessary. Refer to Table 6-1.

Please note that the schedule may require amendment following any given site visit.

Table 3-1: Schedule for Management of Invasive Species

Time	Details of Measures
Pre-construction (isolation of invasive)	A pre-construction survey (to reconfirm the findings of the EIAR) will be undertaken during the growing season to mark out the extent of invasive species within the footprint of the project prior to any works commencing on-site. All invasive species observed shall include a suitable buffer (see Section 5.3) surrounding the area of infestation. This will prevent plants with underground rhizomes being transported to other sections of the site and it will also prevent contact with plants, which could result in the transport of seed, fruit or vegetation. Treatment of invasive species using one or more of the treatment options proposed in Section 5. Only once treatment has been completed and invasive species have been removed from within the area of works will works commence. Toolbox talk shall be given to all personnel accessing the site.

Time	Details of Measures
	Site to be monitored continually for signs of regrowth of all invasive species during operation. Disposal of all cut and excavated plant matter, if chosen to be processed off-site, must be done so through a licenced waste processor. Adequate licences may also need to be obtained for the transportation of such matter.
During Construction	Following treatment, site to be monitored for signs of regrowth/spread to new areas. Toolbox talks shall be given to all personnel accessing the site, informing them of the locations of the invasive species and instructing them not to enter these areas (unless they are licensed invasive species contractors or ecologists). Designated curtailment areas will be demarcated for the transport of invasive species offsite. Machinery to be used in the control of invasive species will be itemised, and only those machinery will be used for excavation. The build-up of soil on equipment will be removed and fouled equipment will not be moved between sites, or between the curtailment area (demarcated areas with invasive species and for transport of invasives)/clean down area and the rest of the site. Footwear and clothing of operatives working near invasive species should be checked for rhizomes, seeds, fruits, or other viable material before exiting the site. Boot brushes will also be utilised. All vehicles exiting the site will be examined to prevent the transport of seeds/rhizomes/plant material. If re-growth of invasive species is discovered, further treatment/control will be completed using the treatment methods in Section 5. Site to be monitored during remediation works for signs of regrowth of all invasive species.
Post Construction	For 5 years following construction, site to be monitored annually for signs of regrowth of invasive species.

6.3 Mapping, Evaluation and Record Keeping

During the pre-remediation and remediation phase the following will take place before control measures:

- Check that the area of infestation is still cordoned off and a warning/information sign is still in place
- Photographs of the area(s) of invasive species infestation
- Map the extent via recording GPS coordinates and measure the length and width of infestation (including above and below ground rhizome growth) and plot on map
- Evaluate the status/condition of the infestation
- Make sure the above steps are recorded.

At the end of each site visit the recorded data should be compared with the findings of this report. Preparation of a short report on the progress of treatment following treatment works, and any subsequent monitoring.

6.4 Appropriate Disposal

6.4.1 Storage

As described in Section 5, all cut and excavated plant matter will be stored securely in line with the relevant treatment methodology.

6.4.2 Disposal

Disposal of plant matter and soil off-site will be complete through an appropriately licenced haulier and waste facility.

7. DISCUSSION AND CONCLUSION

There is a legal obligation not to spread plants listed on the Third Schedule of Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 to 2021; the relevant species at the proposed Fahy Beg Wind Farm Site, GCR and TDR, and therefore those of principal concern, are Japanese knotweed, Himalayan knotweed and giant hogweed. Additionally, of concern for the invasive species management plan are a number of invasive species either present within the works area, within the site or along/adjacent to the TDR and GCR. Liaison with landholders of adjacent lands may be necessary to effectively control invasive species in the area and to prevent re-infestation.

It is required that a competent and experienced invasive species management contractor is appointed to treat and control invasive species. A dedicated invasive species survey is recommended to be undertaken by the appointed contractor to re-confirm the findings of the previous survey and to identify any new areas/species of infestation.

It is recommended that infested and cleared areas will be appropriately demarcated and signed to prevent access to unauthorised personnel. Additionally, appropriate biosecurity to prevent spread of invasive species is recommended., as stated in Section 5.

7.1 Conclusion

The report details a programme for the mapping and control of invasive species at the proposed Fahy Beg Wind Farm Site, GCR and TDR.

The plan will prevent the spread of identified non-native invasive species within and from any works areas and reduce the potential risk for the introduction and/or spread of new invasive species within the site pre, during and post construction.

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APPENDIX 8.9

Badger Report

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