Kintradwell Wind Farm

Technical Appendix 8.1 – Desk Study

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1. Introduction

1.1 Background

ITPEnergised was commissioned by RES to carry out an ecological desk study for an area of land at Kintradwell, north of Brora (hereafter referred to as the 'Site'). The Site has central Ordnance Survey Grid Reference NC 91546 11173.

The Site is predominantly comprised of heath, marshy grassland, woodland and improved grassland. Several watercourses, including the Kintradwell Burn, Clynemilton Burn, Allt an t-Salainn, Allt Garbh-chalais, Allt na Cuile and Loth Burn, flow through the Site towards the North Sea, south of the Site boundary. The Site is bounded to the south by the North Sea and is surrounded to the north, east and west by further heath, valleys and agricultural land.

The survey results are intended to facilitate the identification of potential constraints to development and where mitigation and/or further survey work may be required to inform a future planning application, as appropriate.

1.2 Development Proposal

The protected species survey was undertaken to support a future planning application for the proposed development of Kintradwell Wind Farm ('the Proposed Development').

2. Legislation, Policy and Guidelines

An overview of relevant legislation, policy and guidance is provided below.

2.1 Legislation

Full consideration has been given to all relevant nature conservation legislation to terrestrial ecology when carrying out this assessment, however, please be aware that other legislation relating specifically to ornithology is not outlined in this report. Legislation of relevance to terrestrial ecology includes the following:

- The Conservation of Natural Habitats and Wild Flora and Fauna (the "Habitats Directive") 1992 (92/43/EEC);
- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended);
- Wildlife and Countryside Act 1981 (as amended) (the WCA);
- The Nature Conservation (Scotland) Act 2004 (as amended); and
- The Wildlife and Natural Environment (Scotland) Act 2011 (as amended) (the "WANE Act").

2.2 Best Practice Ecological Guidance

As part of the baseline report, cognisance has been taken of the Chartered Institute of Ecology and Environmental Management (CIEEM) good practice guidelines and survey methods, notably the standard methods developed for Preliminary Ecological Appraisals (CIEEM, 2017) and Ecological Impact Assessment (CIEEM, 2018).

2.3 Biodiversity Priorities

2.3.1 Scottish Biodiversity List

Scottish Ministers created the Scottish Biodiversity List (SBL) (Scottish Government, 2013) in 2005 to satisfy the requirements under Section 2(4) of the Nature Conservation (Scotland) Act 2004 and assist public bodies

in carrying out conservation of biodiversity, as well as to provide the general public with information regarding conservation within Scotland. The SBL comprises species and habitats listed using both scientific and social criteria. Only scientific criteria are considered relevant to this report. They include the following:

- All UK Priority Species present in Scotland;
- Species which Scotland has an international obligation to safeguard;
- All species defined as nationally rare at a UK level that are present in Scotland;
- Species with populations present (resident, wintering or breeding) in 5 or fewer 10km squares or sites in Scotland;
- All species that are endemic to Scotland;
- Any sub-species or race that is widely recognised and accepted by the scientific (or other relevant) community and that is endemic to Scotland, if it also meets one of the other criteria; and
- Natural and semi-natural habitats that are known to be particularly important for supporting assemblages of plant or animal groups that are data deficient, such as fungi, bryophytes, lichens, algae and invertebrates.

2.3.2 Local Biodiversity Reporting

The Highland Biodiversity Action Plan (BAP) aims to (Highland Environment Forum, 2015):

- *'encourage and promote land management for biodiversity;*
- *take biodiversity into account during building and maintenance works;*
- *encourage and help communities, local groups and volunteers to carry out practical biodiversity projects;*
- *raise awareness of biodiversity and related issues, and help children and young people to learn about local nature and wildlife;*
- *tackle invasive non-native species by undertaking practical projects and promoting good practice; and*
- *improve the management and sharing of biological records, and encourage the collection of new records, specifically targeting under-recorded species'*.

The Highland BAP also sets out the priorities for the years 2015-2020 and these priorities are grouped into the following categories (Highland Environment Forum, 2015):

- Sustainable Management of Habitats and Species;
- Planning, Development and Infrastructure;
- Local Biodiversity Projects;
- Awareness and Knowledge;
- Invasive Non-Native Species; and
- Biological Recording and Data Management.

3. Methods

An ecological desk study was carried out using a range of publicly available information sources to provide an understanding of the ecological context of the Site and wider area.

In terms of nature conservation designations, the desk study identified international and national statutory designations for terrestrial ecology qualifying features, such as Special Areas of Conservation (SACs), Sites of Special Scientific Interest (SSSIs) or National Nature Reserves (NNRs) within 5km of the Site boundary. Local Nature Reserves (LNRs), as well as non-statutory designations, such as Local Wildlife Sites (LWS), Sites of

Interest for Nature Conservation (SINCs) or woodland areas included on the Ancient Woodland Inventory (AWI), were identified within a 2km distance from the Site boundary.

Existing records for protected or otherwise notable species (e.g. SBL/Highland BAP priority species) were identified within a 2km distance of the Site boundary, the search area was extended to 10km for bat roosts. Only records from the last 10 years were considered relevant to the study.

External data sources were consulted for historical records for protected or otherwise notable species (e.g. Scottish Biodiversity List/Local Biodiversity Action Plan priority species) were identified within 2km of the Site boundary. Only records from within the last 10 years were considered relevant to the study. External data sources included the following online databases:

- National Biodiversity Network Atlas (NBN, 2020);
- Scottish Natural Heritage SiteLink (SNH, 2020);
- MAGIC: Nature on the Map (MAGIC, 2020); and
- SNH Ancient Woodland Inventory (AWI) (SNH, 2017).

Additional records were obtained from the following:

- Highland Biological Recording Group [HBRG]) (2019);
- Kintradwell Burn Proposed Hydro Scheme - Fish Population Survey (Waterside Ecology, 2010a);
- Kintradwell Burn Proposed Hydro Scheme – Otter Survey Report (Waterside Ecology, 2010b);
- Kintradwell Burn Proposed Hydro Scheme – Kintradwell Otter and Pine Marten Survey (Waterside Ecology, 2010c); and
- East Sutherland Deer Management Group, Deer Management Plan (Milner, 2016).

4. Results

4.1 Designated Sites

See Figure 8.1.1 for statutory and non-statutory sites designated for nature conservation, identified within the 5km search area. Four international nature conservation designations covering three geographical areas were identified during the desk study as well as three national conservation designations areas (Table 1). For reasons of brevity, only sites of ecological (excluding ornithology) have been included here. Any sites designated for supporting geological and/or earth science features only have been excluded.

Table 1: Statutory Nature Conservation Designations within 5km of the Site Boundary

Site	Designation	Distance from Site	Qualifying Features
Ballinreach Coastal Gorges	SSSI	Within S Site boundary	The site is designated for the following: ○ Geology (stratigraphy); and ○ Upland birch woodland. This site has been designated for its birch woodland and the geological interest of the exposed Upper Jurassic sedimentary rocks.
Moray Firth	SAC	Adjacent (140m) SE of the nearest Site boundary	Annex II species that are a primary reason for selection of this site: ○ Bottlenose dolphin (*Tursiops truncatus*). Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site:

Site	Designation	Distance from Site	Qualifying Features
			○ Sandbanks which are slightly covered by sea water all the time.
Loth Gorge	SSSI	Overlies the site boundary.	The site is nationally important for supporting upland birch woodland.
Ballinreach Coastal Gorges	SSSI	Just beyond the south-eastern site boundary.	The site is nationally important for geological interest of the exposed Upper Jurassic sedimentary rocks.
Caithness and Sutherland Peatlands	Ramsar site (also SPA designated)	4km NW	This site is internationally important because it contains the following Habitats Directive Annex I features: ○ Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of ○ the *Isoëto-Nanojuncetea*; ○ Natural dystrophic lakes and ponds; ○ Northern Atlantic wet heaths with Erica tetralix; ○ Blanket bogs; Transition mires and quaking bogs; and ○ Depressions on peat substrates of the Rhynchosporion. The site supports a number of rare species of wetland plants and animals. The plants include three nationally rare mosses, eight nationally scarce vascular plants and four nationally scarce mosses. The insect fauna includes several nationally scarce species and one nationally rare species. The site supports nationally important breeding populations of ten waterfowl species. During the breeding season the site regularly supports dunlin (*Calidris alpina schinzii*) - 1860 pairs, representing an average of 7.4% of the breeding population (Count, as at mid-1990s).
	SAC		Annex I habitats that are a primary reason for selection of this SAC site: ○ Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*; ○ Natural dystrophic lakes and ponds; and ○ Blanket bogs (* if active bog) * Priority feature. Annex II species that are a primary reason for selection of this site ○ Otter (*Lutra lutra*); and ○ Marsh saxifrage (*Saxifraga hirculus*). Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site ○ Northern Atlantic wet heaths with *Erica tetralix*; ○ Transition mires and quaking bogs; and ○ Depressions on peat substrates of the Rhynchosporion.
Coir' an Eoin	SSSI		The SSSI site overlies this conglomerate part of the Caithness and Sutherland Peatlands SPA/SAC/Ramsar designation and is designated for the following:

Site	Designation	Distance from Site	Qualifying Features
			○ Blanket bog; and ○ Golden plover (breeding).
Carroll Rock	SSSI	4.72km W	The site is designated for the following: ○ Upland birch woodland.

The desk study did not identify any further statutory designated sites of national or international importance within 5km of the Site, or statutory local sites within a 2km distance, respectively.

No non-statutory designated sites, including areas of ancient woodland, were identified within 2km of the Site boundary.

4.2 Invasive Species

The following non-native invasive species were identified within 2km of the Site boundary:

- Japanese knotweed (*Fallopia japonica*); and
- Rhododendron (*Rhododendron ponticum*).

Invasive non-native species (INNS) listed in order to stop further spread in Scotland are listed under Schedule 9 of the WCA 1981 (as amended by the Wildlife and Natural Environment (Scotland) Act 2012 [the WANE Act]).

4.3 Terrestrial Animals

Data obtained from Highland Biological Recording Group as well as previous surveys carried out at Kintradwell Burn (Waterside Ecology, 2010b and 2010c) provided records of seven protected or otherwise notable species within 2km of the Site boundary; see Table 2.

Table 2: Records of Protected or Otherwise Notable Species within 2km of the Site Boundary

Common name	Scientific name	Protection	Records
Common frog	*Rana temporaria*	WCA	A single record of common frog was identified 400m NE of the Site boundary in 2015.
Adder	*Vipera berus*	WCA	Two records of adder were identified within 2km of the Site boundary, the closest being located 350m N of the Site boundary recorded in 2015.
Common lizard	*Zootoca vivipara*	WCA	A single record of common lizard was identified 400m NE of the Site boundary in 2015.
Otter	*Lutra lutra*	Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)	Waterside ecology identified otter spraints along Kintradwell Burn as well as several places that could be used as rest up areas and hovers however there was no evidence of use (2010b). An additonal survey found further spraints along Kintradwell Burn as well as footprints (Waterside Ecology, 2010c). Otters were deemed to be frequenting a small section of Kintradwell Burn between the A9 bridge and the mouth of the Burn and only using further upstream infrequently.

Common name	Scientific name	Protection	Records
Pine marten	*Martes martes*	WCA	Waterside Ecology identified fresh footprints in the wooded area along Kintradwell Burn (2010b) as well as pine marten scat (2010c). Kintradwell Burn was deemed to be used sporadically and infrequently by pine marten.
Water vole	*Arvicola amphibius*	WCA	A single record of water vole was identified 300m SW of the Site boundary in 2017.
West European Hedgehog	*Erinaceus europaeus*	WCA	A single record of hedgehog was identified 800m SW of the Site boundary in 2018.

Bat roosts were also identified within 10km of the Site boundary. The data obtained from the Highland Biological Recording Group identified roosts in derelict buildings near Loch Brora approximately 4.8km west of the Site boundary for both pipistrelle bats (*Pipistrellus sp*.) and brown long-eared bats (*Plecotus auritus*), however these roosts were last recorded in 2008.

5. Further Species Data

5.1 Fish

The Kintradwell Estate have provided survey results, undertaken in 2010, for the now operational Kintradwell Burn Hydro Scheme. During the application process, the Kintradwell Estate commissioned full aquatics surveys. These were undertaken by Waterside Ecology and included electric fish surveys and habitat assessments, which found the following (Waterside Ecology,2010):

- No obstacles to migration were identified in the survey reach of the Kintradwell Burn;
- Suitable habitat for trout was present throughout the survey reach;
- The Kintradwell Burn lacks holding pools and spawning habitat for salmon;
- The Kintradwell Burn supports an exceptionally high density trout population;
- Eels are well distributed throughout the mainstream of the Burn;
- Salmon were absent from all surveys; and
- The tributary proposed for diversion lacks spawning habitat and is of little or no importance to the trout population.

Brora District Salmon Fishery Board have stated “we do not believe that migratory fish can get past the waterfall on the Loth River” which is a short distance from the A9 road bridge. “This obstacle is listed on the Marine Scotland NMPI Map under ‘obstacles to Fish Passage”.

5.2 Deer

Deer population data for the area was sourced through the East Sutherland Deer Management Group (ESDMG) and details of the regional management plan was informed following the Deer Management Plan that the group has adopted. The Kintradwell Estate is one of 20 main members of the Group and forms part of the Eastern Sub-Group of the ESDMG landholding. The current Deer Management Plan (DMP) covers the 2016 - 2025 period (Milner, 2016) and is designed to be regularly updated (approx. every six months) and as and when new members join the ESDMG, with the first review taking place in 2020 and every five years subsequently.

The last helicopter count of deer in the area was conducted in March 2017. On the hill, only red deer have been recorded. The last foot count in spring 2019 revealed around 202 stags, 219 hinds and 58 calves associated with the Kintradwell Estate. Currently, there has been a shortage of mature stags having suffered from 2 consecutive years of poor calving; the numbers taken this season have been reduced to reflect this. This decision is in line with most estates in the ESDMG. Cull targets are set group wide as the ESDMG are working towards a target density as set out in the Group's DMP. Group-wide it was noted that members have been reducing deer numbers fairly significantly, however as the last two years have not been good for deer calving the culls have been reduced.

Within the Kintradwell Estate, there is a deer fence that keeps the deer from accessing the low ground which runs parallel to the A9 well above the lower fields. A large number of deer will winter further north than the intended access route. However, a group of stags do shelter occasionally during winter in the steep valley adjacent to the existing hill road. A significant number of deer on the estate use the steeper ground to the north east of landholding included within the ESDMG, this is simply because the steep valleys in this area offer the best shelter.

There are no deer fences between ESDMG land and the neighbouring estates of Gordonbush and Kildonan, although there is a fence separating ESDMG land from Crakaig to the North. Although, recent localised changes in land management is thought to have restricted deer movement in towards to southwest, leading to fewer deer holding in that area.

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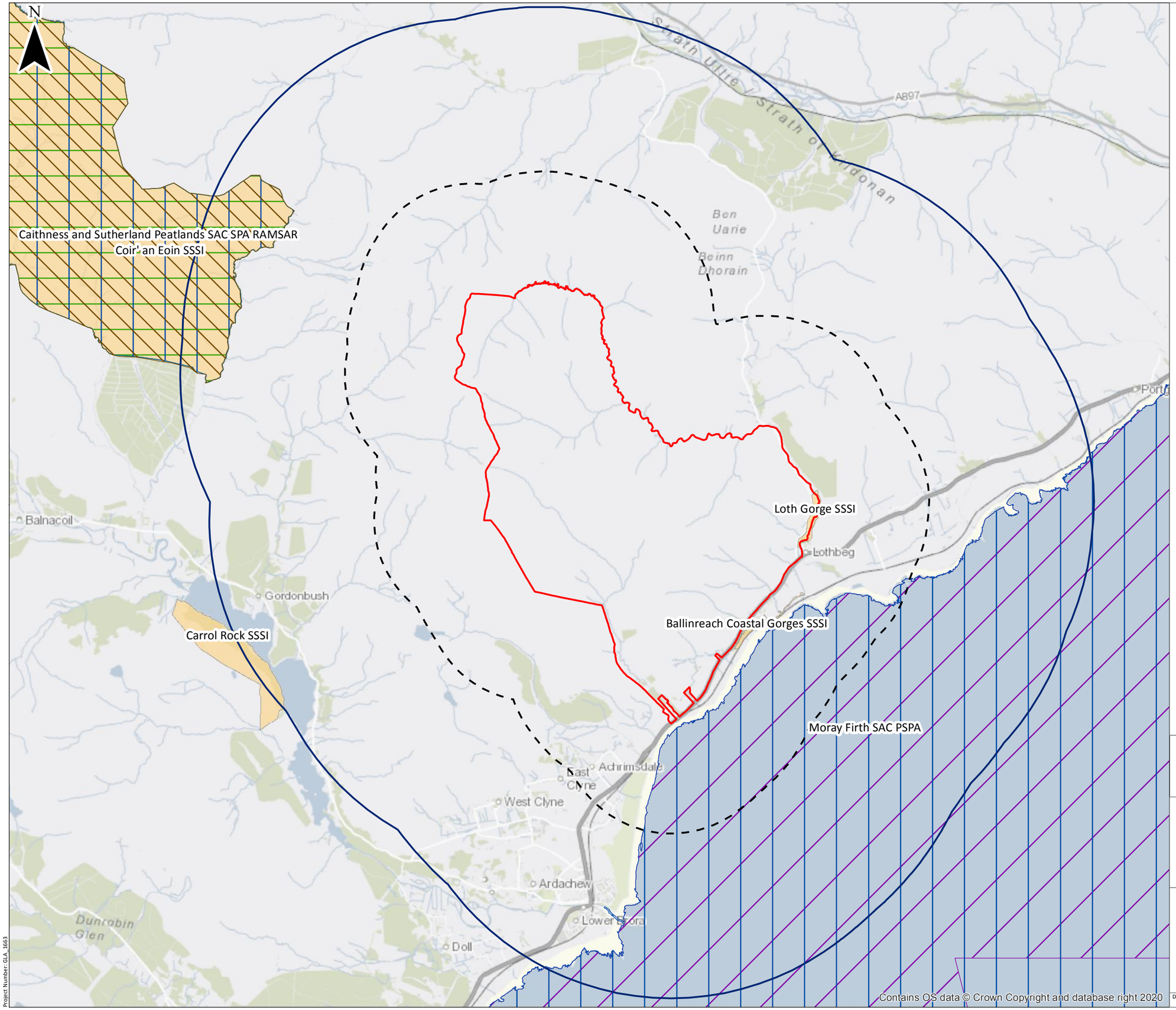
Figures

Figure TA 8.1.1: Nature Conservation Designations



KEY

- Site Boundary
- Buffer (2km)
- Buffer (5km)
- RAMSAR
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Proposed Special Protection Area (PSPA)
- Site of Special Scientific Interest (SSSI)

0 1 2 3 4 km

Scale 1:66,000 @ A3

Kintradwell Wind Farm
EIA Report

Figure TA8.1.1

Nature Conservation Designations

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Kintradwell Wind Farm

Technical Appendix 8.2 – National Vegetation Classification Survey Report

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Kintradwell Wind Farm

National Vegetation Classification Report

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Introduction

Whytock Ecology Ltd. was commissioned by ITPEnergised to carry out a National Vegetation Classification (NVC) survey for a proposed wind farm development at Kintradwell, East Sutherland. The purpose of the NVC survey is record and map habitats that are found within the survey area. This information will then be used to identify sensitive features of botanical or ecological interest. The results will inform the windfarm design process and provide an ecological assessment of the botanical features on site.

Survey area

The proposed Kintradwell wind farm is located approximately 4 kilometres (km) to the north of Brora, East Sutherland. The site rises from near sea level to a height of 545m on the highest peak of Càrn Garbh. The survey boundaries are displayed on Figure 1 in Annex B.

The majority of the site supports large swathes of wet heath, dry heath and blanket bog set on steep-sided hills with wind-swept plateaus on the summits. Within the expanses of peatland communities are a series of slightly more fertile grassland communities that generally follow watercourses in the valley bottoms. These grasslands are well grazed, by both sheep and deer. At lower elevations of the site there are more fertile soils which supports a range of grazing pastures. A mixture of semi-mature conifer plantations and young broadleaved plantations occupy small areas within the lower altitudes of the site.

NVC Survey Methods

The survey was carried out by Rory Whytock ACIEEM from the 9th to the 13th of September 2019. The surveys were carried out in dry conditions with good visibility throughout.

The NVC communities within the survey boundary were mapped by eye and classified according to Rodwell (1998a, 1998b, 2003). Five quadrats were set up for each broad habitat type where detailed floristic samples were recorded to allow the habitat to be categorised later into the appropriate NVC community. Small areas of interest and general descriptions of features were made using target notes as per Phase 1 survey methodology (JNCC, 2010). The NVC survey area was mapped in the field then digitised using GIS to produce a detailed map of dominant and subdominant community composition. Areas supporting communities which are potentially dependent on groundwater systems were also classified.

Higher plant nomenclature follows that of Stace (2010), bryophyte nomenclature follows that of the Hill *et al.* (2008) and lichens follow Coppins (2002).

Limitations

The surveys were carried out at the optimal time of year for botanical surveys and as such there were few limitations. Some very early flowering plants may have missed due to the timing of the survey but this should not affect the outcome of the survey results.

NVC Survey Results

The NVC survey recorded a total of 27 communities. Where these communities were floristically distinct, they were assigned into corresponding sub-communities. The communities recorded during the survey are:

- Mires and flushes: M2, M3, M6, M10, M17, M19, M20, M23, M25 + M30
- Wet heaths: M15
- Dry heaths: H10, H12, H17, H18 + H22
- Grasslands and bracken: U4, U5, U6, U16, U20, MG6, MG7 + MG10
- Woodland and scrub: W4 + W23
- Springs: M32

A number of semi-natural habitats were not recorded as they are not included in the NVC system. The habitats that did not fit into any of the NVC communities are:

- Running water
- Standing water
- Conifer plantation
- Broadleaved plantation
- Bare ground

The following sections describe the NVC communities recorded on site and detail the flora, structure and condition of each of the habitats. A map of the survey results can be found in Annex B, with target notes describing notable species or features found during the survey located in Annex A.

Mires and flushes

M2 Sphagnum cuspidatum/fallax bog pool community

This is a community that is typically formed in small depressions within saturated wet peat. The pools are often small in size and found in clusters within areas of M17 *Trichophorum germanicum – Eriophorum vaginatum* blanket more. The vegetation in the pools lacks diversity and is dominated by *Sphagnum fallax* and *S. cuspidatum* with scattered shoots of *Eriophorum angustifolium*. Due to the small size of each pool, vegetation from the surrounding habitat often encroaches the edge of the pools. Frequently recorded species occurring toward the margin of the pool include *Sphagnum magellanicum, S. papillosum*, *Narthecium ossifragum* and *Erica tetralix*. Species such as *Vaccinium oxycoccos* and *Drosera anglica* were recorded infrequently.

Only the M2b *Sphagnum fallax* sub-community was recorded during the survey. It is distinguished from the M2a sub-community by a lack of *Rhynchospora alba* and an abundance of *S. fallax* (Elkington *et al.*, 2001).

M3 Eriophorum angustifolium bog pool community

This community is typically found in degraded areas of peatland habitats on bare, exposed peat caused by erosion or peat peat cutting activities. M3 bog pools can also be found in more natural settings such as depressions in relatively undisturbed mires where the ground becomes waterlogged. The dominant species of this community, *Eriophorum angustifolium*, occurs with few associates but *Juncus effusus*, *Sphagnum fallax* and *Sphagnum palustre* can occur in various amounts. This community was recorded in only one location within the survey area, near the western boundary, where it was contained within an eroded channel. There are no sub-communities associated with this community.

M6 Carex echinata - Sphagnum fallax/denticulatum mire

This community is a soliginous mire found on peat substrates that are fed primarily by base-deficient water. These mires are situated in valley bottoms, sloping valley sides or channels within the site as small where water flows slowly over a peaty surface. The vegetation is varied and is represented by four sub-communities, three of which were recorded during the surveys. The community is defined by the dominance of base-intolerant *Sphagnum* species such as *S. fallax, S. cuspidatum, S. palustre* and occasionally *S. denticulatum* though the latter species is a species often of more base-rich flushes. The Sphagnum layer is overwhelmingly dominant throughout this community but often contains a number of rush or grass species. M6 can be differentiated from similar NVC communities such as M23 *Juncus effusus/acutifloris – Galium palustre* mires as these typically lack the abundance of *Sphagnum* found in M6 communities.

The M6a *Carex echinata* sub-community contains a range of sedge species with *C. echinata* often being the most abundant, with lesser amounts of *C. panicea* and *C. nigra*. The M6b *Carex nigra - Nardus stricta* sub-community is often found on slightly drier ground. This is illustrated by the community containing species better suited for drier conditions such as *Nardus stricta, Juncus squarrosus* and *Anthoxanthum odoratum*. Other sedge species mentioned previously can also be found in this community but often occur at much lower frequencies. The M6c *Juncus effusus* sub-community lack more diverse assemblage of species found in M6a and M6b with *Juncus effusus* dominating much of the vascular plant assemblage though *Ranunculus repens* and *R. acris* were recorded infrequently.

M10 Carex dioica – Pinguicula vulgaris mire

This community was sparsely distributed throughout the southern half of the survey area. Individual stands were all located near springs or over sparsely rocky ground. This community is dependent on base rich water flushing the surface vegetation which prevents them from drying out. The base rich conditions allow suitable habitat for species such as *Carex viridula subsp. oedocarpa*, *C. panicea*, *Pinguicula vulgaris* and varying amounts of *C. dioica*. Bryophytes were well represented in these mires with

Scorpidium revolvens, Palustriella falcata and *Philonotis calcarea* all recorded. Some species more suited to acidic conditions were recorded within this community, this was largely due to the small nature of these mires with encroachment of species from the surrounding acidic peaty substrates being common.

Of the three sub-communities that represent this mire only the M10a *Carex viridula subsp. oedocarpa - Juncus bulbosus* was recorded during the field surveys. This community is the most common and widespread of the three sub-communities and is frequently found in small amounts in acidic habitats. The other sub-communities contain a more calcicolous flora than is found in M10a.

M17 Trichophorum germanicum - Eriophorum vaginatum blanket mire

This is a community that was found to cover medium to large areas but was thinly scattered throughout the survey area. M17 was found where the peat was waterlogged which allowed a significant sphagnum layer to dominate underneath tussocks of *Tricophorum germanicum*, *Erica tetralix* and lesser amounts of *Calluna vulgaris*. Sphagnum species are prevalent as extensive patches or carpets on the ground layer and include many important mat-forming mosses such as *Sphagnum papillosum* and *Sphagnum capillifolium* with some rare species such as *S. fuscum senso stricto* and *S. austinii* forming conspicuous hummocks in places. M2 communities are frequently found within this habitat type where the peat is waterlogged.

The M17a *Drosera rotundifolia-Sphagnum* and M17b *Cladonia* species sub-communities were both recorded during the survey. M17a was the most widespread and was found in areas where the peat surface had not suffered from too much degradation from burning or high intensity grazing. The M17b sub-community was found near the centre of the site at a moderate altitude on the top of a hill. Other hills in the were either too high and supported a more alpine suite of species or too low in altitude and were not exposed to the wind as where the M17b was recorded. This latter sub-community contained lesser amounts of sphagnum, no doubt due to the drying effects of the wind on the top of the hill and contained greater amounts of *Racomitrium lanuginosum* which often formed medium to large tufts throughout the area. *Cladonia* lichens were also more abundant including *C. arbuscula, C. portentosa* and *C. uncialis*.

M19 Calluna vulgaris – Eriophorum vaginatum blanket mire

This habitat is dominated by large swathes of *Calluna vulgaris, Eriophorum vaginatum* and sparse but regular and widespread shoots of *Eriophorum angustifolium*. Bryophytes are dominated by common pleurocarpous mosses including *Hylocomium splendens, Pleurozium schreberi, Rhytidiadelphus loreus* and *Hypnum jutlandicum*. Sphagnum species are not as well represented in this community as either M17 or M18 *Erica tetralix – Sphagnum papillosum* blanket mires. *S. capillifolium* is the most common *Sphagnum* species, though *S. papillosum* and *S. fuscum s.s.* were also present in small amounts.

Two sub-communities were recorded within the survey area; M19a *Erica tetralix* and M19c *Vaccinium vitis-idaea - Hylocomium splendens* sub communities. M19a was found at lower altitudes in the survey area

and contained a rather uniform composition of vegetation throughout the recorded areas. *Trichophorum germanicum* was frequent with species such as *Narthecium ossifragum* and *Drosera rotundifolia* in wetter areas. The M19c sub-community contained a range of species more commonly found in northern and western districts of the UK (Averis *et al.,* 2004). This is characterised by presence of species such as *Vaccinium vitis-idaea* found to be particularly common throughout with *Rubus chamaemorus* and *Empetrum nigrum* in lesser abundance but widespread throughout.

M20 Eriophorum vaginatum blanket and raised mire

This is a community where *Eriophorum vaginatum* is overwhelmingly dominant and contains thick tussocks allowing very little other species to compete. The community is found in a wide variety of locations throughout the survey area, often on gently sloping ground where water is able to collect but not able to persist for long.

This community is characteristic of ombrogenous peatland habitats that have been negatively affected by long term grazing and burning management regimes. These practices render the habitats floristically species poor and are often found adjacent to erosion channels which will have also contributed to water loss from the peatland surface further degrading the habitat.

There are two sub-communities associated with M20 mire, both of which were recorded during in the survey area. The M20a species poor sub-community lacks diversity and largely dominated by *Eriophorum vaginatum*. Other species do occur but are only present in small amounts, including *Deschampsia flexuosa, Eriophorum angustifolium* and sparse amounts of *Calluna vulgaris* or *Vaccinium myrtillus*. The M20b *Calluna vulgaris-Cladonia* sub-community is slightly more varied in its floristic composition with greater amounts of *Calluna vulgaris* and *Vaccinium myrtillus*. Additional species such as *Empetrum nigrum* and *Cladonia arbuscula* are also found in M20b but Sphagnum species remains infrequent and patchy in its distribution. Pleurocarpous mosses are confined to common drought-tolerant species such as *Hylocomium splendens, Pleurozium schreberi* and *Hypnum jutlandicum*.

M23 Juncus effusus/acutifloris – Galium palustre rush pasture

M23 habitats are found in valley bottoms and gentle slopes and can cover large areas of open ground, though within the survey area the habitat is mainly recorded in linear stands along watercourses. The habitat is dominated by rush species which gives it a dark green colour which can be seen from a distance. This habitat is closely associated with M6 *Carex echinata – Sphagnum fallax* mires and is often found adjacent to them but M23 differs in having a greater diversity of graminid species and a lesser amount of *Sphagnum* species.

There was a notable lack of the M23a *Juncus acutiflorus* sub-community within the study area, this is the more floristically diverse of the two M23 communities. All stands of M23 habitat within the survey area were dominated instead by *Juncus effusus* almost exclusively. Other vascular plants found in this habitat included *Viola palustris, Succsia pratensis, Galium palustre, Cirsium palustre* and *Ranunculus repens*.

M25 Molinia caerulea – Potentilla erecta mire

This is a community that occurs on moderately wet areas on shallow peat. This community can cover vast areas of hill sides throughout many upland areas of the UK, its scarcity within the survey area is likely due to regular burning practices that although create drier soil surface conditions, will remove the tussocks and dominance of *Molinia* which is a key feature of this community.

Other than the dominance of *Molinia* within this community type, species such as *Erica tetralix, Calluna vulgaris* and *Trichophorum germanicum* occur as scattered shoots throughout the habitat. Bryophyte diversity is poor and restricted to robust common pleurocarpous mosses such as *Hylocomium splendens* and *Hypnum jutlandicum*. The liverworts *Lophocolea bidentata* and *Lopozia sudetica* were often found nestled in the lower half of the *Molinia* hummocks.

The M25 mire on site did not clearly conform to either of the sub-communities for this community. This is likely due to small areas occupied by the communities which allows encroachment from surrounding habitats which influence the floristic composition.

M30 Related vegetation of seasonally inundated habitats

One small area is described as this rather poorly-defined community type. It is similar in composition to M29 *Hypericum elodes – Potamogeton polygonifolius* soakaway but lacks *Hypericum elodes* which is rare in the east of the UK. *Eriophorum angustifolium, Sphagnum cuspidatum* and *Potamogeton polygonifolius* are the most abundant species within the small pools that have formed in a hollow. *Sphagnum denticulatum* was also recorded which indicate an element of base richness from the surrounding area but it was only present in small quantity and further base rich tolerant species were lacking.

Wet heaths

M15 Trichophorum germanicum – Erica tetralix wet heath

This community occupies the largest area within the survey area and forms extensive homogenous stands covering large areas of the hills. It is a habitat that occurs on shallow, ombrogenous peat substrates and has relatively few constant species associated with it. The abundance of this habitat within the survey area is largely due to the habitat occurring on both shallow and deep peat. Where the habitat occurs on deep peat, the habitat has modified through overgrazing and muirburn. This has dried out the peat surface and resulted in a loss of many sphagnum species, particularly peat forming mosses such as *Sphagnum papillosum* and *S. capillifolium*. The areas where M15 now occupies areas of deep peat would have initially been blanket mire communities such as M17 or M19.

The M15 community illustrates a wide variation in its flora including species that occur as dominants or co-dominants. Species that were recorded in high frequency included *Trichophorum germanicum*, *Erica tetralix* and *Calluna vulgaris*.

There are four sub-communities that are associated with this habitat type, three of which were recorded within the survey area. M15a *Carex panicea* sub-community is found in small patches scattered throughout the site. *Trichophorum germanicum* remains the dominant species in this sub-community but the ground flora is sparse and there are numerous areas of bare wet peat that is interspersed with the glaucous shoots of *Carex panicea*. *Sphagnum tenellum* is the most common Sphagnum, though *S. capillifolium* and *S. papillosum* occur in small patchy areas throughout. In the drier areas of this community, *Nardus stricta* is occasional whereas where the water table is close to the surface species such as *Drosera rotundifolia* and *Narthecium ossifragum* become more frequent.

The M15b typical sub-community occupies the largest areas on site and contains varying amounts of *T. germanicum, Calluna vulgaris* and *Erica tetralix*. *Molinia caerulea* is frequent in many areas but does not form the large hummocks associated with M25 *Molinia caerulea – Potentilla erecta* communities. Instead the Molinia shoots occur as thinly spread scattered shoots. Sphagnum species occur in slightly greater quantities than M15a habitats with patches of *S. capillifolium* and *S. papillosum*, though still not forming the extensive patches and carpets as is seen in M17 communities.

The M15d *Vaccinium myrtillus* sub-community occurs on soils which are slightly drier than the previously described sub-communities and contain a greater variety of grasses. Species such as *Nardus stricta, Deschampsia flexuosa, Juncus squarrosus* and *Vaccinium myrtillus* are all frequent within this community. As M15d is drier in nature than the two other recorded sub-communities, bryophytes such as *Pleurozium schreberi, Hypnum jutlandicum* and *Dicranum scoparium* are common as opposed to an assemblage of Sphagnum species.

Dry heaths

H10 Calluna vulgaris - Erica cinerea heath

H10 heaths are found on well drained shallow peatland on gently sloping ground in the uplands. *Calluna vulgaris* and *Erica cinerea* form a dark tussocky sward that dominates much of the vegetation. Beneath the canopy of dwarf shrubs there is ordinarily a thick carpet of common pleurocarpous mosses including *Hylocomium splendens, Pleurozium schreberi, Hypnum jutlandicum* and *Rhytidiadelphus loreus*. In addition to the bryophytes, vascular plant such as *Carex binervis, Potentilla erecta* and *Galium saxatile* are common. Much of the H10 habitat found within the survey area is very impoverished, however, and lacks all but the most dominant species. Routine burning practices has created homogenous stands of *Calluna vulgaris* and *Erica cinerea* that are co-dominant with one another but contain few other species. Bryophytes have been lost from vast swathes of the H10 community, with only the occasional *Leucobryum glaucum* hummock present. The compact hummocks that are formed by *L. glaucum* will protect the species from burning activities compared with many other bryophyte species.

The H10a typical sub-community was the only one of the four sub-communities present within the survey boundary. This sub-community has no real distinguishing features and with the lack of variety through the previously described muirburn practices, many of the areas were difficult to place into a

sub-community. The H10a typical sub-community was the most appropriate however due to the lack of species that defines the other communities.

H12 Calluna vulgaris - Vaccinium myrtillus heath

A dry heath community with *Calluna vulgaris* and *Vaccinium myrtillus* as co-dominants. *Vaccinium vitis-idaea* and *Deschampsia flexuosa* formed the main bulk of the rest of the vascular vegetation. The vegetation is thick and interspersed with a rich variety of robust bryophytes growing through the dwarf shrubs. Moss species recorded include *Rhytidiadelphus loreus, Hylocomium splendens, Pleurozium schreberi* and *Hypnum jutlandicum*.

This habitat was not ascribed to a sub-community as it did not clearly fit into any of the three described sub-communities. It has some affinities with the H12b *Vaccinium vitis-idaea - Cladonia portentosa* sub-community as there was a small amount of *Vaccinium vitis-idaea* recorded. However, a number of grass species such as *Festuca ovina* and *Nardus stricta* were sparsely spread throughout the habitat which is closer in line with H12c *Galium saxatile-Festuca ovina* sub-community. Where these grasses occur, the bryophyte layer is less prominent and the sward structure is more open in nature. It is likely that the effects of grazing on this habitat has reduced the bryophyte layer and allowed *Nardus stricta* and *Festuca ovina* to establish.

H17 Calluna vulgaris - Arctostaphylos alpinus heath

Large areas of this community were found on the wind exposed hill tops throughout the survey area, becoming more extensive towards the north of the site. The vegetation is largely composed of montane plant species and wind clipped dwarf shrubs. Characteristic species of this community include *Carex bigelowii, Arctostaphylos alpinus, Arctostaphylos uva-ursi* and *Racomitrium lanuginosum*. *Calluna vulgaris* was frequent but was limited to stunted, prostate stems that have been modified by exposure to the wind, severe temperature changes and frost heave. Montane plants such as *Diphasiastrum alpinum, Carex bigelowii* and *Salix herbacea* were frequent throughout the habitat. These montane species show affinities to U10 habitat, though H17 is distinguished from that community by the presence of dwarf shrubs.

There are two sub-communities described for this habitat type, all of the areas on site conform to the H17a *Loiseleuria procumbens - Platismatia glauca* sub-community which contains the more montane specialists.

H18 Vaccinium myrtillus - Deschampsia flexuosa heath

This is a habitat which is found on well drained slopes in the uplands where it has some amount of shelter from the prevailing winds and not too close to the bottom of the valleys where the gradients are shallower and surface run-off is reduced. The habitat requires free draining soils that are neutral to acidic in nature on a mixture of shallow peat and mineral soils (Averis *et al.,* 2004). This is a heath community where *Vaccinium myrtillus* is the dominant dwarf shrub and *Calluna vulgaris* and *Erica tetralix*

are thinly scattered. This community is thought to be derived from H12 communities that have been burned and overgrazed which stifles the regeneration of *Calluna vulgaris* allowing *Vaccinium myrtillus* to establish itself as the dominant shrub (Averis *et al.,* 2004).

Growing through the vascular plants is a complex matrix of robust pleurocarpous mosses that are often found in other heath and mire communities such as *Rhytidiadelphus loreus, Pleurozium schreberi, Hylocomium splendens* and *Hypnum jutlandicum*. *Plagiothecium undulatum* was locally frequent but was restricted to a small number of areas.

H18a *Hylocomium splendens - Rhytidiadelphus loreus* sub-community was the only habitat type recorded during the survey. The carpet of robust mosses is distinctive in this sub-community as is the locally frequent *Blechnum spicant*. H18a is separated from H18b *Alchemilla alpina-Carex pilulifera* and H18c *Racomitrium lanuginosum - Cladonia* species sub-communities by the lack or relative infrequency of species found in their respective title descriptions.

H22 Vaccinium myrtillus - Rubus chamaemorus heath

This is another community which is restricted to one area within the survey area. Dwarf shrubs are abundant in this habitat with *Calluna vulgaris, Vaccinium vitis-idaea, Empetrum nigrum* and *Vaccinium myrtillus* all found to be frequent. There is also a deep carpet of robust mosses including *Rhytidiadelphus loreus, Rhytidiadelphus squarrosus, Hylocomium splendens, Pleurozium schreberi* and irregular but conspicuous *Sphagnum capillifolium* hummocks. The liverworts *Barbilophozia floerkii* and *Lophozia ventricosa* were also recorded but were restricted to very small areas in distribution. Other vascular species recorded include *Rubus chamaemorus, Festuca ovina, Deschampsia flexuosa, Galium saxatile* and *Potentilla erecta*. *Cornus suecic*a was also recorded within this habitat but was restricted to one small area.

Both *Vaccinium myrtillus* and *Calluna vulgaris* are co-dominant within the habitat which is characteristic of H22b *Plagiothecium undulatum - Anastrepta orcadensis* sub-community. No *Anastrepta orcadensis* was recorded on this occasion but it is the co-dominance of the dwarf shrubs *C. vulgaris* and *V. myrtillus* that are important in defining this sub-community as opposed to the presence of *A. orcadensis*.

Grasslands

U4 Festuca ovina - Agrostis capillaris - Galium saxatile grassland

This is a grassland community where frequent grazing maintains a short sward length. It is a typical habitat of moderate altitudes on free draining, slightly acidic soils. This habitat is found to be widespread throughout the survey area and forms small intricate mosaics with other habitats on shallow peat or mineral substrates. Species within this community are varied which is illustrated by having five sub-communities to accommodate the differences in composition. The most frequently recorded grass species are *Festuca ovina*, *Agrostis capillaris* and *Anthoxanthum odoratum,* though *Cynosurus cristatus* can also be locally frequent in some stands. Other vascular plants such as *Galium saxatile* and *Potentilla erecta* were constant throughout. Bryophytes were more restricted in these communities with

Rhytidiadelphus squarrosus being the most dominant but *Calliergonella cuspidata, Pleurozium schreberi* and *Hylocomium splendens* being frequent in areas that are damp and less exposed to the elements.

Two sub-communities were recorded; U4a Typical sub-community and U4e *Vaccinium myrtillus – Deschampsia flexuosa* sub-community. U4a has no real distinguishing features on its own but moss species can become dominant amongst intricate patches of *Galium saxatile*. *Rhytidiadelphus loreus* is also frequently recorded in these habitats also. U4e is also contains a mossy assemblage of species similar to U4a but *Deschampsia flexuosa* and *Nardus stricta* occur in greater frequency alongside short, thinly scattered shoots of *Vaccinium myrtillus* which are widespread throughout.

U5 Nardus stricta – Galium saxatile grassland

U5 grassland has a patchy distribution and is largely confined to eastern areas within the survey area. This community is found at moderate altitudes on rather moist, acidic soils often with a mix of peat substrates. *Nardus stricta* is the most frequent grass and often grows in thick wiry clumps. Other species recorded within the community include *Agrostis capillaris, Festuca ovina* and lesser quantities of *Deschampsia flexuosa* and *Anthoxanthum odoratum*. *Galium saxatile* can form intricate patches in places and is generally widespread throughout. A familiar suite of mosses including *Hylocomium splendens, Pleurozium schreberi, Hypnum jutlandicum* and *Rhytidiadelphus squarrosus* are present in varying amounts throughout the community.

Of the five sub-communities within the U5 habitat type only the U5a Species poor sub-community was recorded within the survey area. As the sub-community name describes, the habitat is floristically poor and dominated by *Nardus stricta* and *Agrostis capillaris*. A range of other species were recorded including *Juncus squarrosus, Luzula multiflora, Molinia caerulea, Potentilla erecta, Carex binervis* and *Vaccinium myrtillus*. However, these were patchy in their distribution and generally scarce within the habitat.

U6 Juncus squarrosus – Festuca ovina grassland

This is a habitat found on mineral deficient soils, often on shallow, moist, peaty substrates. This is another habitat which is formed normally through a combination of intensive grazing and burning practices. The thick, dark green basal rosettes of *Juncus squarrosus* are the most prominent feature of this habitat type. These are mixed with *Anthoxanthum odoratum, Agrostis canina, Deschampsia flexuosa*, *Galium saxatile* and *Potentilla erecta* shoots growing through bryophytes including *Hylocomium splendens*, *Pleurozium schreberi, Rhytidiadelphus squarrosus* and *Calliergonella cuspidata*.

There was only one area recorded as U6 community within the survey area which was variable in its botanical composition. As such it does not conform to either of the four sub-communities associated with this habitat type.

U16 Luzula sylvatica-Vaccinium myrtillus tall-herb community

One U16 habitat was recorded in the survey area, located a north facing slope of the Coire Riabhach valley. This is a community found on mountain ledges and near vertical slopes in the uplands. *Luzula sylvatica* is abundant with numerous shoots of *Vaccinium myrtillus*. A range of other species were recorded including *Dryopteris dilatata, Oxalis acetosella, Sphagnum subnitens, Gymnocarpium dryopteris* and *Digitalis purpurea*.

The community on site is small in size and isolated from other U16 communities in the local vicinity. As such the area is rather species poor, with the most notable feature being the overwhelming dominance of *Luzula sylvatica*. As such, this habitat falls into the U16c Species poor sub-community.

U20 Pteridium aquilinum – Galium saxatile community

Pteridium aquilinum is the overwhelmingly dominant species within this habitat. Where U20 habitat occurred, fronds of *Pteridium aquilinum* carpeted much of the ground and smothered most of the growth of other species. Where the fronds were more scattered and allowed other species to grow, species such as *Oxalis acetosella*, *Galium saxatile*, *Viola riviniana* and *Rumex acetosella* were found. Pleurocarpous mosses formed large conspicuous patches with *Rhytidiadelphus loreus, Pleurozium schreberi*, *Hypnum cupressiforme s.l.* and *Hylocomium splendens* which are found to be frequent to abundant in places.

Throughout the habitat on site, species diversity was low and therefore corresponds to U20c Species poor sub-community. The lack of diversity associated with this habitat renders it of little conservation value.

MG6 Lolium perenne – Cynosurus cristatus grassland

This habitat was recorded primarily to the southern side of the survey area in the lower ground which are more enriched with nutrients as a result of agricultural improvement. This is an area dominated by nutrient demanding species including *Lolium perenne*, *Cynosurus cristatus*, *Bellis perennis* and *Trifolium repens*. The habitats on site also contain varying amounts *Anthoxanthum odoratum* and as such conforms to the MG6b *Anthoxanthum odoratum* sub-community. This is a habitat which is of high value for grazing but low in biodiversity and of little conservation value.

MG7 Lolium perenne leys and related grasslands

This is a species poor grassland that is dominated by *Lolium perenne*. Other species such as *Plantago major, Bellis perennis* and *Poa annua* were recorded within this habitat though are found in low frequency. *Trifolium repens* was one of the few species other than *Lolium perenne* that was found to be relatively frequent within the community. Similar to MG6 habitats on site, MG7 is of high value for grazing but low in biodiversity and of little conservation value.

MG10 Holcus lanatus – Juncus effusus rush-pasture

This distribution of this habitat is restricted within the survey area. *Juncus effusus* tussocks dominate the landscape in this community, between these tussocks is a species poor sward of *Holcus lanatus*, *Agrostis stolonifera* and *Poa trivialis*, though the latter species is rarer in its frequency. Forb species in this community included *Ranunculus repens*, *Ranunculus acris* and *Cardamine pratensis*. It is distinct from other rush dominated communities by the higher frequency of grasses which are frequently grazed which maintains the open, short sward of the grass pasture between the tussocks of rush species.

All habitats on site conform to the MG10a Typical sub-community. This particular community has no distinguishing features itself but rather, is defined by the lack of species contained within the other sub-communities such as *Juncus inflexus* in MG10b or *Iris pseudacorus* in MG10c.

Woodland and scrub

W4 Betula pubescens – Molinia caerulea woodland

The habitat has affinities that are closest to W4 *Betula pubescens -Molinia caerulea* woodland with co-dominant species including *Salix cinerea* and *Salix aurita*. Other tree species include *Betula pubescens* and *Sorbus aucuparia* but are found in lower frequencies. The ground flora is sparse but species such as *Molinia caerulea, Dryopteris dilatata* and *Deschampsia flexuosa*. The habitat is closely associated bracken and forms mosaic, *Pteridium aquilinum* therefore encroaches into the edges of these woodland habitats where light levels are allowed.

The habitat has been assigned to W4a *Dryopteris dilatata – Rubus fruticosus* sub-community which is a habitat of drier ground than the other sub-communities of W4 wet woodland. *Molinia caerulea* is common within this habitat type but Sphagnum species are rare.

W23 Ulex europaeus - Rubus fruticosus agg. scrub

Intimately linked to U20 and W4 habitats, W23 forms a mosaic with these two habitats in many places. *Ulex europaeus* is overwhelmingly dominant within this community to the exclusion of most other species.

All of the habitats on site are of the W23a *Anthoxanthum odoratum* sub-community. This is characterised by ground flora including *Agrostis capillaris, Holcus lanatus, Galium saxatile* and *Anthoxanthum odoratum*. Where grass species are frequent, they form a habitat similar to stands of U4 *Festuca ovina - Agrostis capillaris – Galium saxatile* grassland, particularly where the cover of *U. europaeus* is scattered which allows enough light to reach the ground. Dense stands of *Ulex europaeus* leaves little ground flora to grow due to the exclusion of light.

Springs

M32 Philonotis fontana – Saxifraga stellaris spring

This community form small indiscrete habitats that are widespread throughout the survey area. The distribution of the habitat is largely confined to flushed channels over friable substrates in steep-sided gullies. They are formed when acidic runoff from peatland which mixes with the exposed mineral soil in the gullies. The composition of the vegetation was variable in each stand, this is likely due to the amount of mineral soil that the flushed water is exposed to. The amount of mineral soils that the water is exposed to changes the chemical composition, this will also vary according to rock type that the water is in contact with. The chemical composition of the water creates a variety of niches for different species.

These habitats have a rich array of bryophyte species including *Philonotis fontana, Scapania undulata, Dichodontium palustre, Bryum pseudotriquetrum* and *Sphagnum denticulatum*. Vascular plants are equally as varied as the bryophytes and are dominated by species such as *Chrysosplenium oppositifolium*, *Montia fontana*, *Epilobium palustre* and *Saxifraga stellaris*, though the latter species was irregular in its occurrence and frequency. Other species which were recorded included *Carex nigra, Carex echinata, Eriophorum angustifolium, Pellia epiphylla* and *Aneura pinguis*.

The high frequency of Chrysosplenium oppositifolium and Saxifraga stellaris recorded within these communities characterise the stands on site as M32b *Montia fontana - Chrysosplenium oppositifolium* sub-community.

Non NVC habitats

A number of habitats that are not classified within the NVC system were encountered during the survey. The following habitats were recorded:

- Bare ground
- Conifer plantation
- Young broadleaved plantation
- Mixed mature plantation
- Buildings
- Running water
- Agricultural /game crops

The conifer plantations were mature to semi-mature and were floristically impoverished and contained a sparse covering of common mosses. As such, the botanical importance of these habitats is negligible. There were a few small areas of young broadleaved plantation, trees were small in size (circa 3m in height) and contained a mixture of predominantly native broadleaved species. The mixed mature woodland is part of a garden within the estate grounds and does not conform to any of the NVC habitat types.

Evaluation of botanical features

Notable species

Most species that were recorded were within their respective geographical limits and ranges. One nationally scarce species was recorded; *Arctostaphylos alpinus*. This was locally frequent in most stands of H17 habitats distributed throughout the site.

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

GWDTEs are classified according to SEPA (2017), defining each NVC community on their potential dependency on groundwater. Groundwater dependency is often linked to wetlands that contain flora that is dependent upon the chemical composition of the water fed from a groundwater source. SEPA defines the habitats with regard to their potential for groundwater dependency, therefore not all communities listed may be truly groundwater dependent. Despite this, it should be assumed to be the habitats listed are GWDTE unless further investigations demonstrate that this is not the case.

Table 1 lists the NVC communities that have a potential for groundwater dependency. The table categorises each habitat type according to whether they are likely to be moderately or highly groundwater dependent as defined by SEPA (2017). In total, there are five communities listed as moderate and five communities listed as high potential for groundwater dependency.

Table 1: Potential GWDTE recorded on site

NVC code	NVC community name	GWDTE
M15	*Trichophorum germanicum - Erica tetralix* wet heath	**Moderate**
M25	*Molinia caerulea - Potentilla erecta* mire	**Moderate**
M30	Related vegetation of seasonally inundated habitats	**Moderate**
MG10	*Holcus lanatus - Juncus effusus* rush pasture	**Moderate**
U6	*Juncus squarrosus - Festuca ovina* grassland	**Moderate**
M6	*Carex echinata - Sphagnum fallax/denticulatum* mire	**High**
M10	*Carex dioica - Pinguicula vulgaris* mire	**High**
M23	*Juncus effusus/acutiflorus - Galium palustre* rush pasture	**High**
M32	*Philonotis fontana - Saxifraga stellaris* spring	**High**
W4	*Betula pubescens - Molinia caerulea* wet woodland	**High**

Maps showing the location of all GWDTE habitats can be found in Annex B. Mosaics of GWDTE were rare within the survey area. As such, the process of assigning GWDTE classifications was straightforward. Any potential groundwater dependent habitats set within mosaics with other habitats were allocated according to the highest class of GWDTE score found within the polygon.

Annex I habitats

A list of rare, threatened or endemic habitats are described within Annex I of the Habitats Directive 92/43/EEC (1992). These habitats are those that are considered to be of conservation value within a European context. A list of NVC communities corresponding to Annex I habitat types that were recorded within the survey area are found in table below.

NVC codes	NVC community	Annex I description	Annex I code
M10a	*Carex dioica - Pinguicula vulgaris* mire	Alkaline fens	7230
H17a	*Calluna vulgaris - Arctostaphylos alpinus* heath	Alpine and boreal heaths	4060
H22b	*Vaccinium myrtillus - Rubus chamaemorus* heath	Alpine and boreal heaths	4060
M17a, M17b	*Trichophorum germanicum - Eriophorum vaginatum* blanket mire	Blanket bog	7130
M19a, M19c	*Calluna vulgaris – Eriophorum vaginatum* blanket mire	Blanket bog	7130
M20a, M20b	*Eriophorum vaginatum* blanket and raised mire	Blanket bog	7130
M25	*Molinia caerulea – Potentilla erecta* mire	Blanket bog	7130
M2	*Sphagnum cuspidatum/fallax* bog pool community	Blanket bog	7130
M3	*Eriophorum angustifolium* bog pool community	Blanket bog	7130
H10a	*Calluna vulgaris - Erica cinerea* heath	European dry heaths	4030
H12	*Calluna vulgaris - Vaccinium myrtillus* heath	European dry heaths	4030
H18a	*Vaccinium myrtillus - Deschampsia flexuosa* heath	European dry heaths	4030
M15a, M15b, M15d	*Trichophorum germanicum – Erica tetralix* wet heath	Northern Atlantic wet heath with *Erica tetralix*	4010

It is important to note that although an NVC community may align with an Annex I habitat type, it does not necessarily mean that a specific area of an NVC community constitutes Annex I habitat. Various factors, including quality, area, geographical location and substrates, all need to be considered in this respect. The extents and, particularly due to historical management and deer pressures, often relatively low quality and degraded nature of these potential Annex I habitats within the Study Area mean that, although they may be of relatively good quality, they are not necessarily classifiable as Annex 1.

Blanket bog – 7130

Most stands of blanket bog that were recorded within the survey area may potentially be classed as Annex I habitats. Most of the larger stands are considered to be "active" which indicates that the presence of peat building mosses such as *S. papillosum, S. magellanicum* and *S. austinii* are still allowing the peat surface to increase. Some of the more fragmented and isolated stands of blanket bog have a limited amount of the peat building mosses, though they were still present in most stands so are still considered to be "active", although this is limited due to the historical management and deer pressures that are evident.

Bog pool communities such as M2 and M3 are also included within the Annex I blanket bog type if they are contained within other blanket mires such as M17, M18 and M19. All M2 and M3 communities within the survey area were found within these habitats and are therefore assigned to the Annex I category.

M25 habitats are considered to be Annex I habitat when they are situated on deep peat (>0.5m). Without peat depth data it is unclear what areas can be assigned to Annex I categories. However, the quality of the M25 habitats within the survey area were poor and are not considered to be of a quality suitable for Annex I status.

European dry heaths - 4030

There are a range of dry heath communities found on site that can be considered to be included in the European dry heath Annex I status. Many areas of H10 and H12 communities were very impoverished through overgrazing and regular burning. As such, these areas are not of Annex I quality.

Northern Atlantic wet heath with Erica tetralix - 4010

Large areas of M15 habitat cover the survey area and are typical of their type, though some areas may occur on deep peat (>0.5m) and derived from other habitats but have become established as M15 through overgrazing and burning pressures. As the habitat is typical of its type, all areas of M15 are considered to be of potential Annex I quality.

Alpine and boreal heaths – 4060

Two habitats were recorded on site that fall into this category; H17 and H22. The most extensive habitat within the survey area is H17 which occurs at modest attitudes (c. 500m) for alpine communities. However, the species assemblage within the habitats on site are of a quality that are suitable for Annex I status. H22 habitat is found at lower altitudes but due to its location within steep sided valleys and isolated situation has not been subjected to the same grazing and burning pressure of many of the other habitats on site. As such it is a good representation of the habitats type and also considered to an Annex I habitat.

Alkaline fens - 7230

All M10 habitats that were found within the survey area are included in this category as they were species rich and representative of their type.

Summary

Whytock Ecology Ltd. carried out the NVC surveys over five days between the 9th and the 13th of September 2019. The surveys recorded a total of 27 NVC communities with a number of associated sub-communities. The landscape was predominantly acidic in character with large homogenous stands of wet heath and blanket bog carpeting most of the upland areas. Calcicolous habitats were rare within the survey area and limited to small flushes and mires and springs wet within steep sided valleys. Areas located in lower altitudes of the site contain a mix of scrub, woodland and grazing pastures.

A total of ten potential GWDTE communities were present including five classed with moderate potential and five with high potential for groundwater dependency. Furthermore, a total of 18 communities and sub-communities are considered to be of potential Annex I habitat quality.

Much of the vegetation has been altered over time primarily through overgrazing and burning, this has led to a shift in communities tending to favour a drier floristic composition. These areas are typical of many areas of upland Scotland as the practices are linked to common land management practices associated with deer and grouse shooting.

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Annex A – Target notes

Target note number	Grid reference	Description
1	NC 92289 07501	Young plantation woodland c 2-3m high
2	NC 92168 07662	Game cover crop
3	NC 92213 07828	Game cover/fodder crop
4	NC 91769 08041	Game cover crop
5	NC 91702 08097	Semi-mature conifer plantation
6	NC 91248 08315	Bare ground/landslip
7	NC 91232 08893	Semi-mature conifer plantation
8	NC 91157 09782	Bothy
9	NC 91309 08568	Extensive recent muirburn
10	NC 91142 08762	Small to medium sized stream, medium flow with small riffles. C. 2m wide and 1m deep
11	NC 91091 08932	Landslip/quarry, some *Potamogeton* dominated pools
12	NC 90554 09963	Base rich flushes with *Scorpidium revolvens, P. vulgaris* and a mix of *Carex spp*.
13	NC 92064 11456	Short prostate *C. vulgaris* community with *A. alpinus*
14	NC 91804 11417	Bog pools set within M17 habitat. *D. anglica and S. austinii* present
15	NC 90109 12475	Steep heath community with complex series of M32 flushes
16	NC 90109 12475	Remains of plane crash
17	NC 90109 12475	Extensive wind clipping of dwarf shrubs, sub-montane community including *A. alpinus, S. herbacea, A. uva-ursi, Carex bigelowii* and *Racomitrium lanuginosum*
18	NC 88866 13511	*Carex panicea* sub-community of M15
19	NC 88462 13345	Extensive erosion in M17 habitat, lots of hags and erosion channels
20	NC 89743 12027	Bog pool community within M17 habitat. *D. anglica, S. fuscum* and *S. austinii* all notable
21	NC 90126 10823	Dwarf cornell – *Cornus suecica*
22	NC 88951 11039	*Sphagnum fuscum* hummocks
23	NC 89727 12742	Medium sized stream, with medium flow. 1-2m wide and 0.5m deep
24	NC 90187 11667	*Sphagnum austinii* hummock
25	NC 91605 08193	U4, tight sward and well grazed by sheep
26	NC 92132 07751	Young plantation woodland c. 2-3m high, some *Chamerion angustifolium* between the trees
27	NC 92248 07728	W4 woodland - *Salix* scrub community with some areas that look to be seasonally inundated with water, species poor area with little ground flora
28	NC 92175 07504	Mature plantation woodland, some natural species including *F. excelsior, P. sylvestris* and *F. sylvatica.* Linked with the garden and does not fit to any NVC type

Annex B - Maps

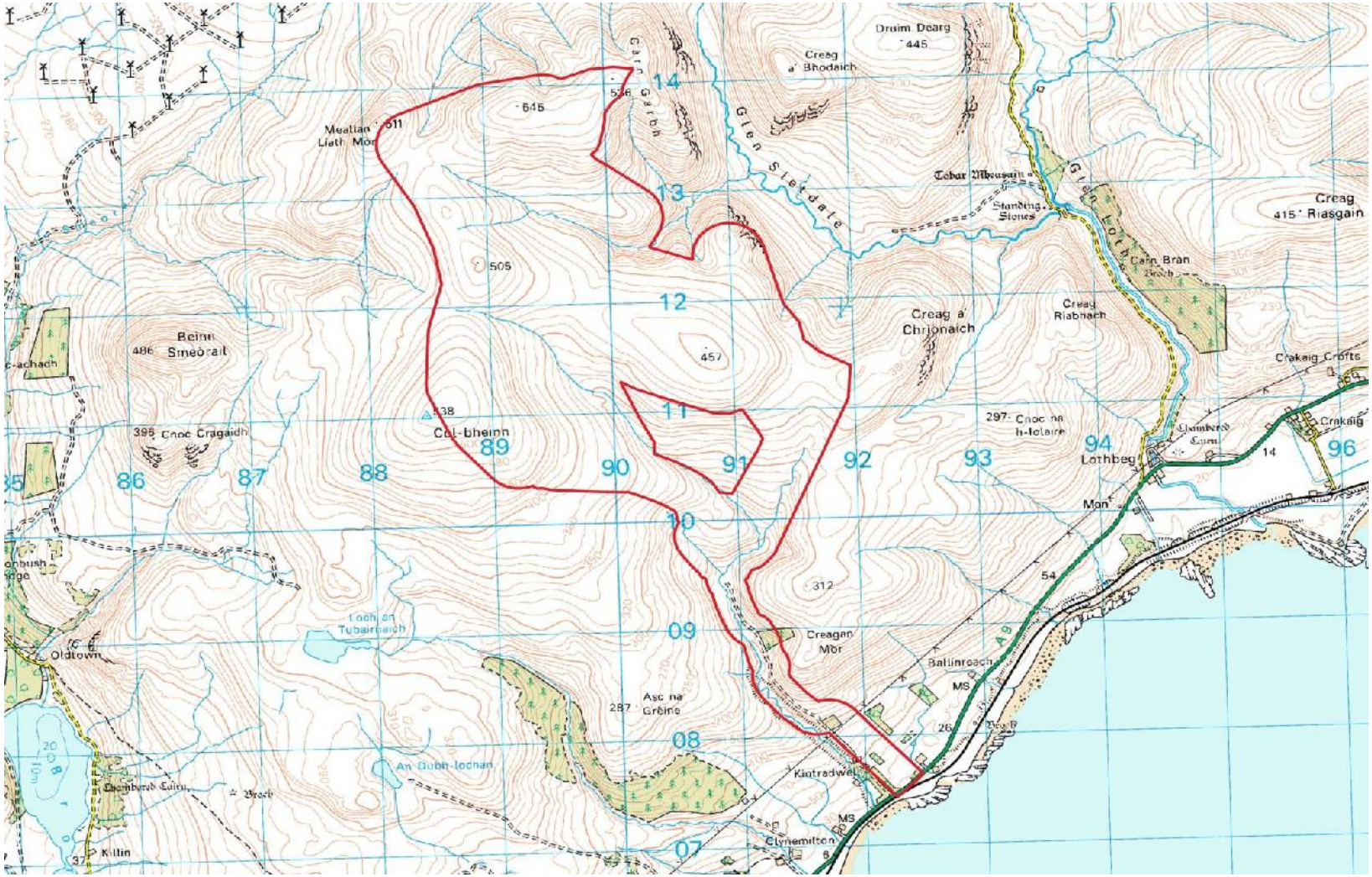

Figure 1: Kintradwell survey boundaries marked with red lines. The inside of the central polygon was not surveyed. Contains OS data © Crown Copyright (License Number: 00001) (2012)

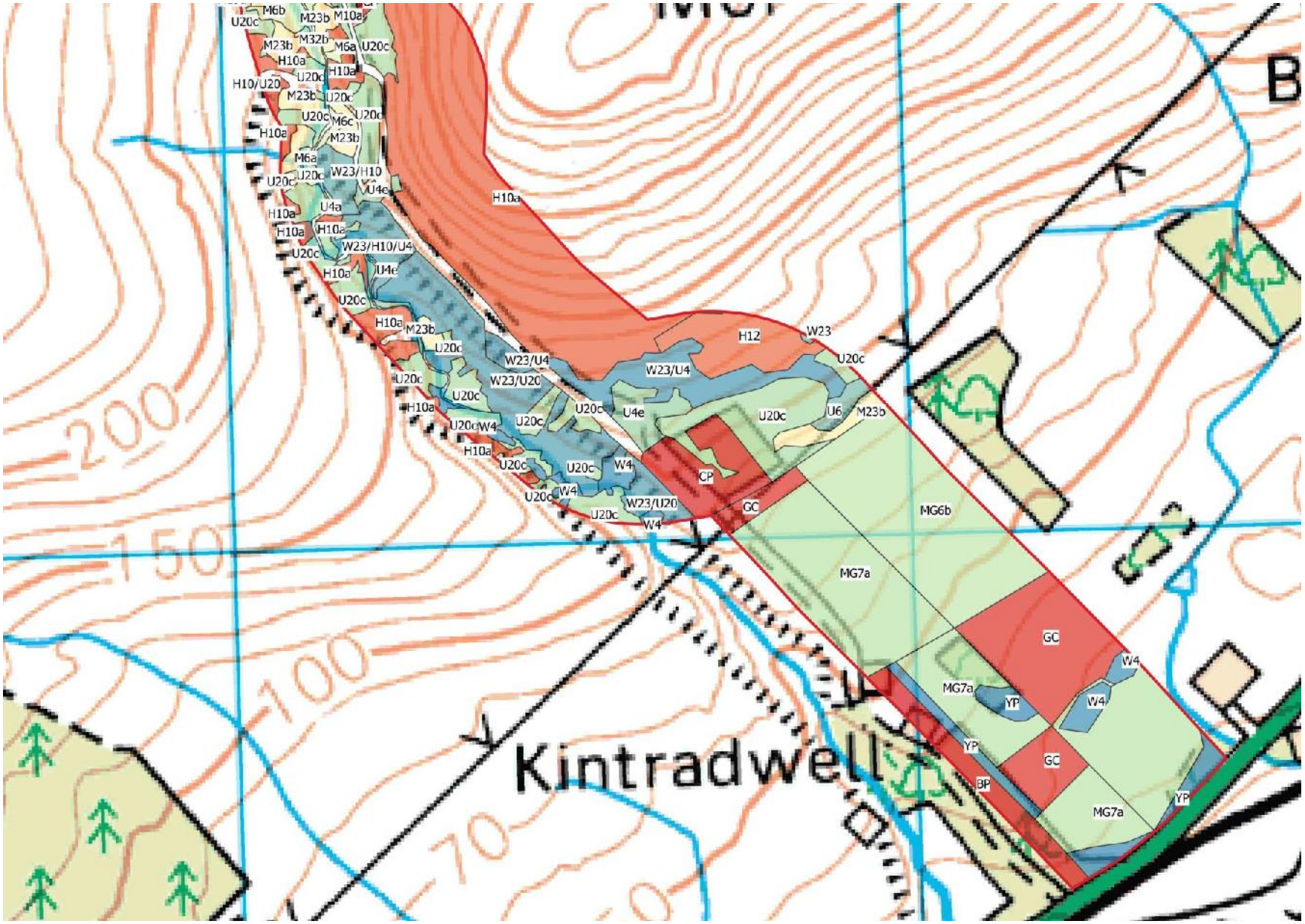

Figure 2: NVC map at the southern side of the survey area. Labelled with NVC sub-community codes (where assigned). Contains OS data © Crown Copyright (License Number: 00001) (2012)

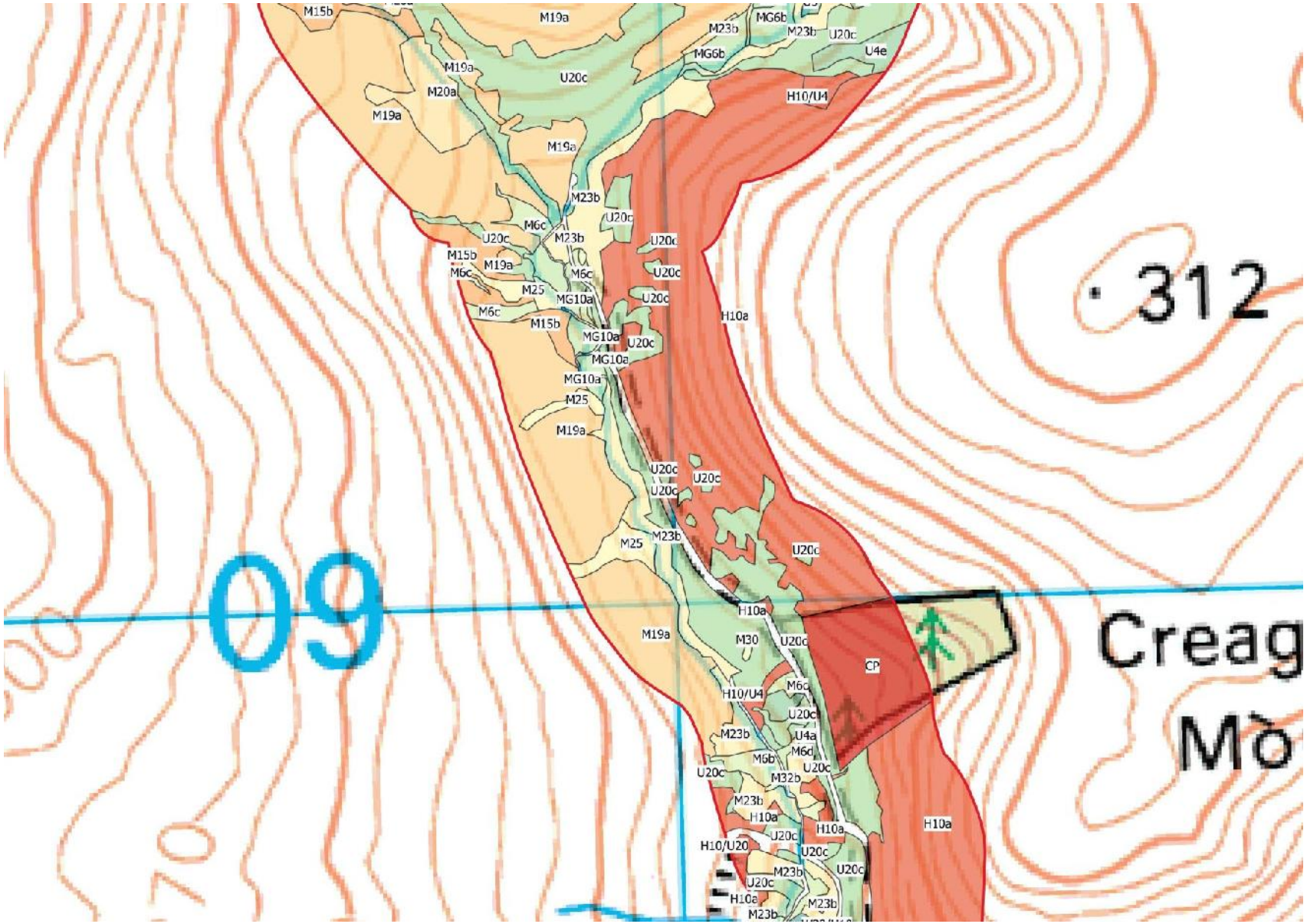

Figure 3: NVC map at the southern side of the survey area. Labelled with NVC sub-community codes (where assigned). Contains OS data © Crown Copyright (License Number: 00001) (2012)

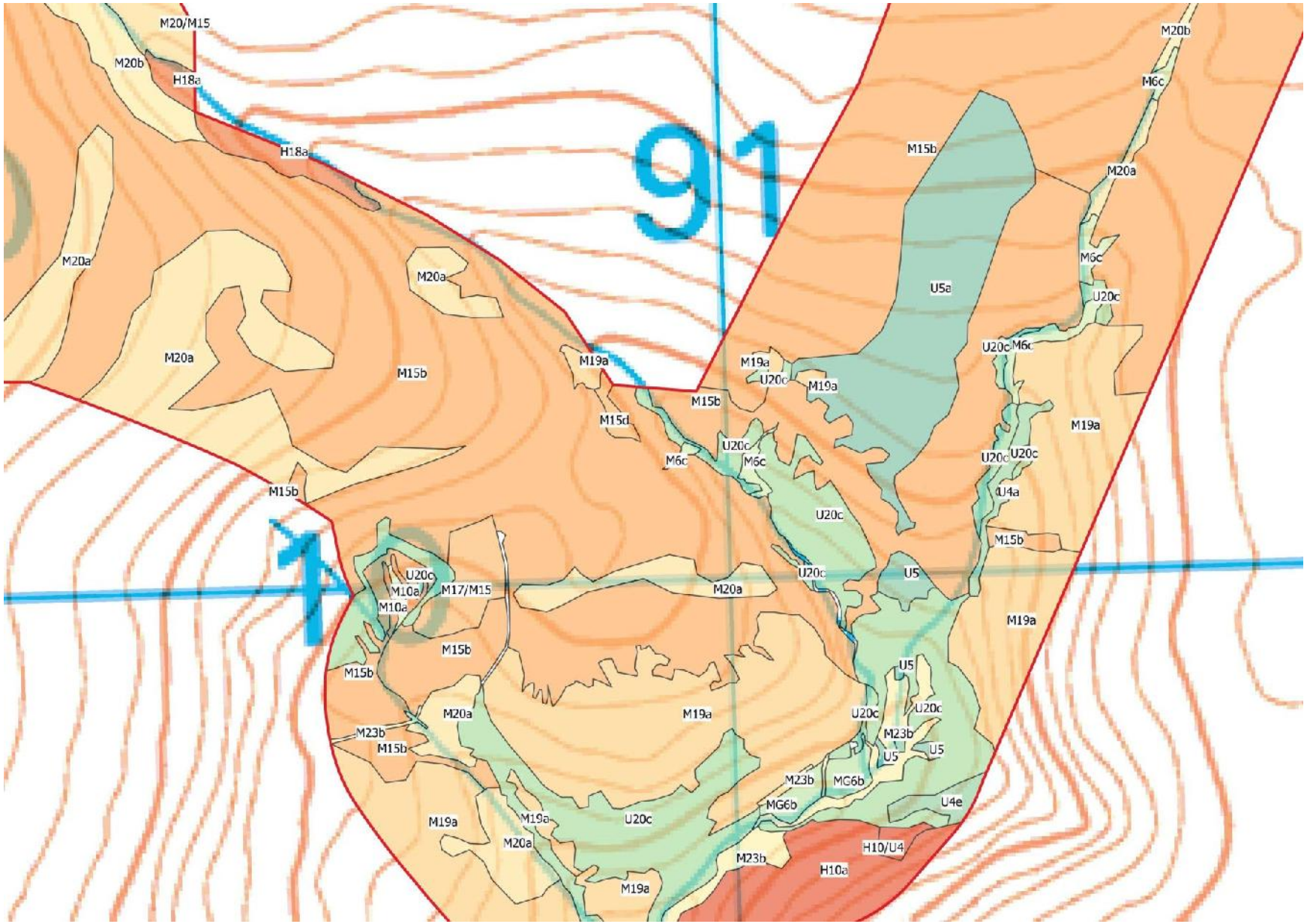

Figure 4: NVC map at the southern side of the survey area. Labelled with NVC sub-community codes (where assigned). Contains OS data © Crown Copyright (License Number: 00001) (2012)

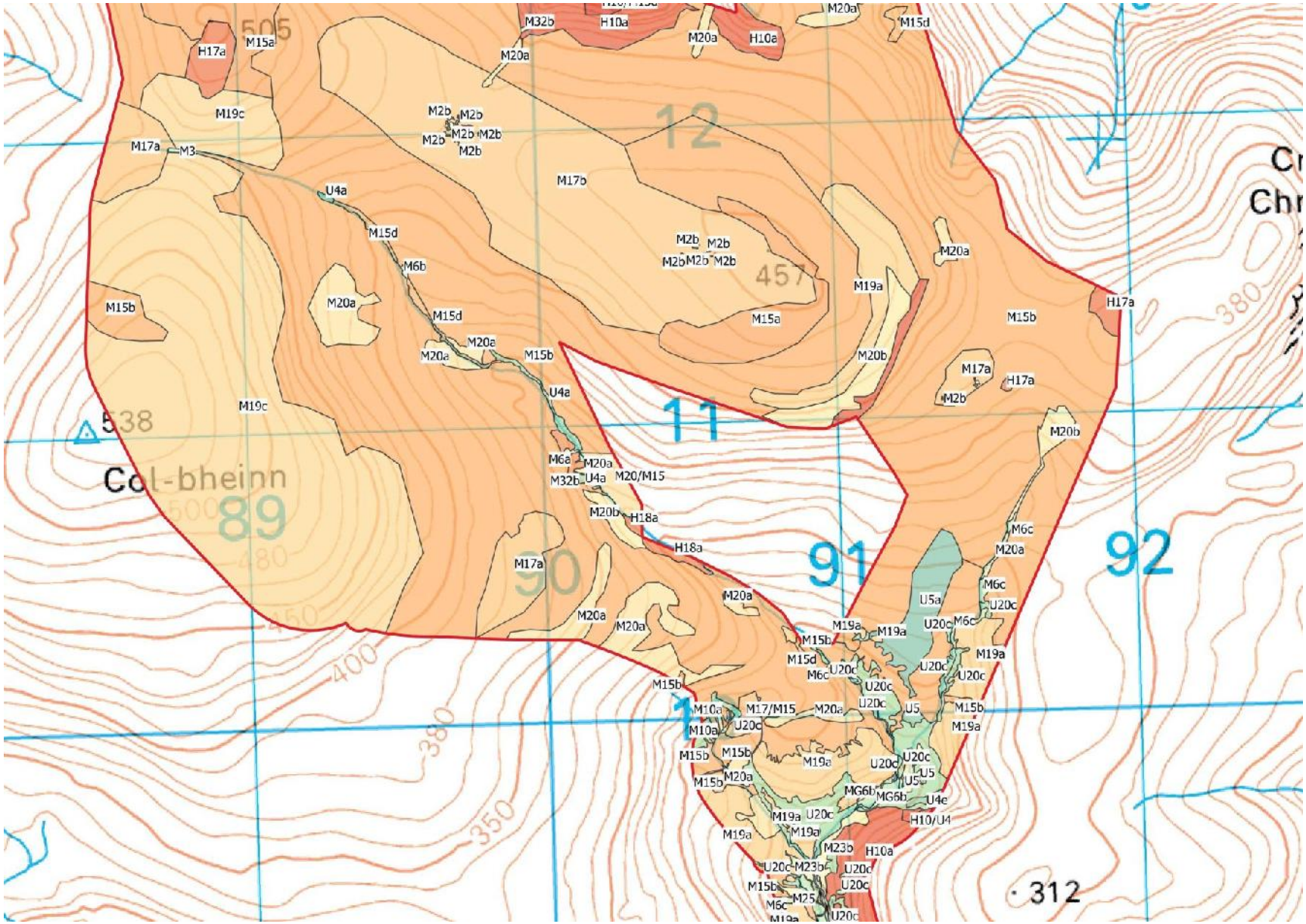

Figure 5: NVC map centered at the middle of the survey area. Labelled with NVC sub-community codes (where assigned). Contains OS data © Crown Copyright (License Number: 00001) (2012)

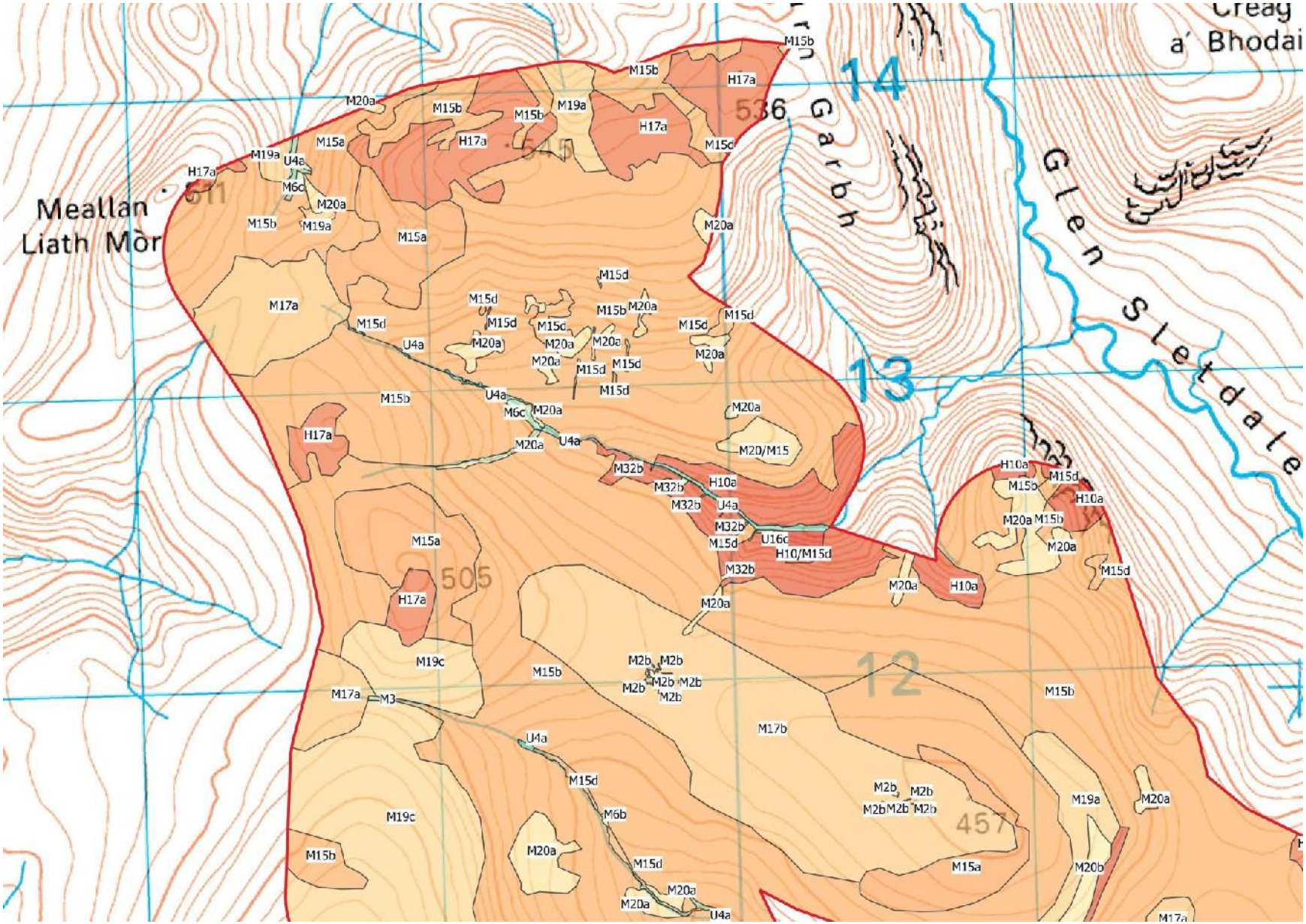

Figure 6: NVC map centered at the northern part of the survey area. Labelled with NVC sub-community codes (where assigned). Contains OS data © Crown Copyright (License Number: 00001) (2012)

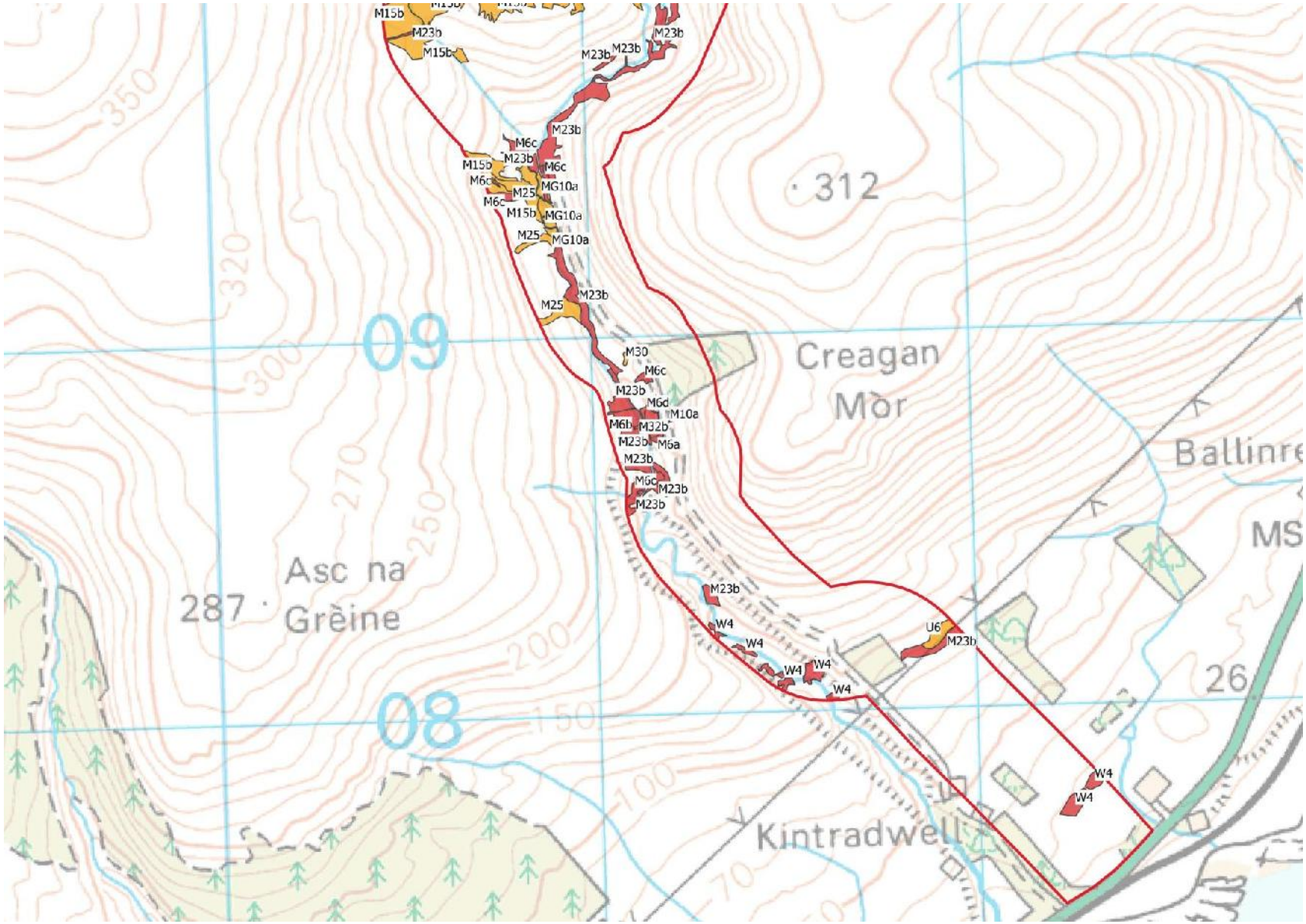

Figure 7: GWDTE map centered at the southern part of the survey area. Labelled with NVC sub-community codes (where assigned) and displaying potentially moderate and high GWDTEs. Contains OS data © Crown Copyright (License Number: 00001) (2012)

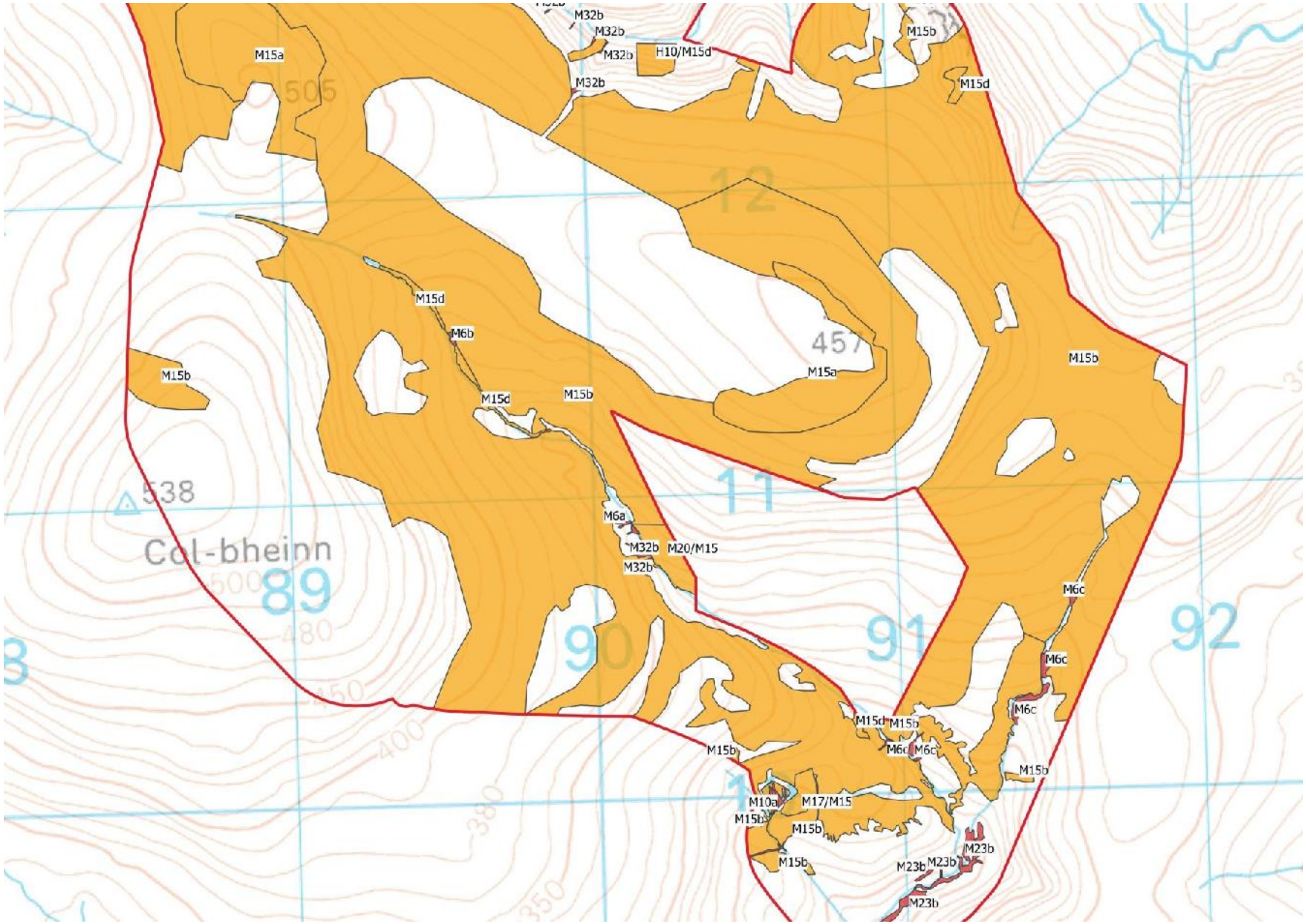

Figure 8: GWDTE map centered at the southern part of the survey area. Labelled with NVC sub-community codes (where assigned) and displaying potentially moderate and high GWDTEs. Contains OS data © Crown Copyright (License Number: 00001) (2012)

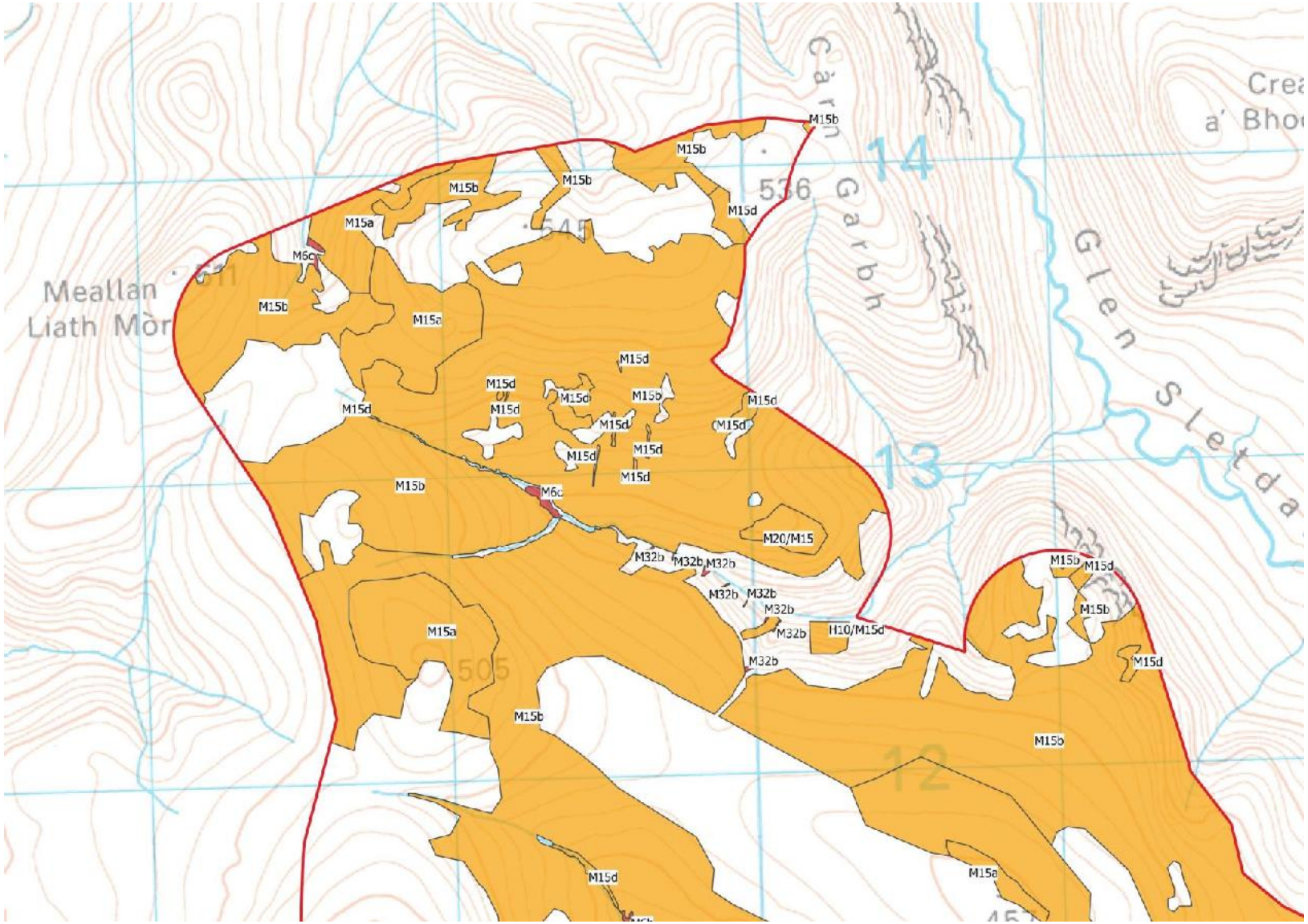

Figure 9: GWDTE map centered at the southern part of the survey area. Labelled with NVC sub-community codes (where assigned) and displaying potentially moderate and high GWDTEs. Contains OS data © Crown Copyright (License Number: 00001) (2012)

Annex C - Photographs

Figure 10: *Arctostaphylos alpinus* (broad green and red leaves) growing in H17 heath

Figure 11: *Cornus suecica* growing at grid reference NC 90126 10823

Figure 12: M2 *Sphagnum fallax/denticulatum* bog pool community

Figure 13: Typical M15 *Trichophorum germanicum – Erica tetralix* wet heath community in the foreground

Figure 14: M19c *Calluna vulgaris – Eriophorum vaginatum* blanket mire, *Vaccinium vitis-idaea-Hylocomium splendens* sub-community. Large homogenous stands in western areas of the site

Figure 15: M32b *Philonotis fontana – Saxifraga stellaris* spring, *Montia fontana - Chrysosplenium oppositifolium* sub-community

Figure 16: *Sphagnum austinii* hummock

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Kintradwell Wind Farm

Technical Appendix 8.3 – Protected Species Survey Report

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Project/Proposal No:	GLA_1663
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1. Introduction

1.1 Overview

ITPEnergised (ITPE) was appointed by RES to undertake a protected species survey for otter (*Lutra lutra*), water vole (*Arvicola amphibius*), badger (*Meles meles*) and pine marten (*Martes martes*), as well as assessing the suitability of habitat for reptiles, for an area of land at Kintradwell, north of Brora (hereafter referred to as the 'Site'). The Site has central Ordnance Survey Grid Reference NC 91546 11173.

The Site is predominantly comprised of wet and dry heath, mire and improved grassland habitats. Several watercourses, including the Kintradwell Burn, Clynemilton Burn, Allt an t-Salainn, Allt Garbh-chalais, Allt na Cuile and Loth Burn, flow through the Site towards the North Sea, south of the Site boundary. The Site is bounded to the south by the North Sea and is surrounded to the north, east and west by further heath, valleys and agricultural land.

The purpose of the survey was to investigate all suitable habitat within the Site and a wider 250m study area (where accessible) for any evidence of use by protected species.

The survey results are intended to facilitate the identification of potential constraints to development and where mitigation and/or further survey work may be required to inform a future planning application, as appropriate.

1.2 Development Proposal

The protected species survey was undertaken to support a future planning application for the proposed development of Kintradwell Wind Farm ('the Proposed Development').

2. Legislation and Guidelines

2.1 Legislation

2.1.1 Otter

Otter is protected under Schedule 5 of The Wildlife and Countryside Act 1981 (as amended) and receives protection under Section 9 of the Act. Otter is also a European Protected Species and so afforded protection under the Conservation (Natural Habitats, &c.) Regulations 1994. As such, it is an offence to deliberately or recklessly:

- Capture, injure or kill an otter;
- Harass an otter or group of otters;
- Disturb an otter in a holt or any other structure or place it uses for shelter or protection;
- Disturb an otter while it is rearing or otherwise caring for its young;
- Obstruct access to a holt or other structure or place otters use for shelter or protection, or otherwise deny the animal use of that place;
- Disturb an otter in a manner or in circumstances likely to significantly affect the local distribution or abundance of the species; and
- Disturb an otter in a manner or in circumstances likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young.

It is also an offence to:

- Damage or destroy a breeding site or resting place of such an animal (whether or not deliberately or recklessly); and
- Keep, transport, sell or exchange, or offer for sale or exchange any wild otter (or any part or derivative of one) obtained after 10 June 1994.

It should be noted that otter shelters are legally protected whether an otter is present or not.

Otter is also included on the Scottish Biodiversity List (SBL), where it is listed for avoidance of negative impacts (Scottish Government, 2013) and as a UK priority species in the Sutherland Biodiversity Action Plan (Sutherland Biodiversity Group, 2003).

2.1.2 Water Vole

Water vole receives partial protection through its listing on Schedule 5 of The Wildlife and Countryside Act 1981 (as amended). In Scotland, this legal protection is currently restricted only to the water voles' places of shelter or protection; it does not extend to the animal itself. It is an offence to intentionally or recklessly:

- Damage, destroy or obstruct access to any structure or place that water voles use for shelter or protection; or
- Disturb a water vole while it is using any such place of shelter or protection.

Water vole is a Priority Species on the SBL where it is listed for both conservation action and for avoidance of negative impacts. This species has suffered significant declines in recent decades, mainly due to habitat loss and degradation, population fragmentation and predation by American mink (*Mustela vison*).

Water vole are listed in the Sutherland Biodiversity Action Plan as a UK priority species (Sutherland Biodiversity Group, 2003).

2.1.3 Badger

Badgers are fully protected under the Protection of Badgers Act 1992, amended by the Wildlife and Natural Environment (Scotland) Act 2011, which makes it an offence to:

- Take, injure or kill a badger;
- Possess or cruelly ill-treat a badger;
- Interfere with a badger sett;
- Sell and possess a live badger; and
- Mark and ring a badger.
- Interfering with a badger sett includes:
- Damaging or destroying a sett or any part of it;
- Obstructing access to a sett;
- Disturbing a badger whilst it is in a sett; and
- Causing or allowing a dog to enter a badger sett.

Should such actions be undertaken, despite having no intention to do so, they would still be considered an offence.

The 1992 Protection of Badgers Act defines a badger sett as "any structure or place which displays signs indicating current use by a badger". A sett in an occupied territory is therefore classified as being in current use even if it is only used seasonally or occasionally by badgers, and it is afforded the same protection as an inhabited sett.

2.1.4 Pine Marten

Pine marten are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). Additionally, certain methods of killing or taking pine marten is illegal under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).

It is an offence to intentionally or recklessly:

- Kill, injure or take a pine marten;
- Damage, destroy or obstruct access to a nest or den – i.e. any structure or place which such an animal uses for shelter or protection; and
- Disturb such an animal when it is occupying a nest or den for shelter or protection (except when this is inside a dwelling house).

It is also an offence to:

- Possess or control, sell, offer for sale or possess or transport for the purpose of sale any living or dead pine marten or any derivative of such an animal; and
- Knowingly cause or permit any of the above acts to be carried out.

Pine Marten are listed in the Sutherland Biodiversity Action Plan as a UK priority species (Sutherland Biodiversity Group, 2003).

2.1.5 Reptiles

Under the Wildlife and Countryside Act 1981 (as amended), common lizard (*Zootoca vivipara*), slow worm (*Anguis fragilis*) and adder (*Vipera berus*) are protected against:

- Intentional or reckless killing and injury; and
- Trade – i.e. sale, barter, exchange, transport for sale, or advertise for sale or to buy.

Adder and slow worm are listed in the Sutherland Biodiversity Action Plan as a local priority species (Sutherland Biodiversity Group, 2003).

2.2 Best Practice Ecological Guidance

As part of the protected species survey, cognisance has been taken of the following best practice guidelines and survey method publications:

2.2.1 Otter

- Competencies for Species Survey: Otter (CIEEM, 2013a); and
- Monitoring the Otter *Lutra lutra* (Chanin, 2003).

2.2.2 Water Vole

- Competencies for Species Survey: Water Vole (CIEEM, 2013b); and
- The Water Vole Mitigation Handbook (Dean *et al*., 2016).

2.2.3 Badger

- Competencies for Species Survey: Badger (CIEEM, 2013c); and
- Surveying for Badgers: Good Practice Guidelines (Scottish Badgers, 2018).

2.2.4 Pine Marten

- Competencies for Species Survey: Pine Marten (CIEEM, 2013d);
- National Pine Marten Survey of Ireland 2005 (O'Mahony, O'Reilly and Turner, 2006); and

- A guide to Identifying evidence of Pine Martens in Wales (Vincent Wildlife Trust, 2017).

2.2.5 Reptiles

- Competencies for Species Survey: Reptiles (CIEEM, 2014); and
- Surveying for Reptiles (Froglife, 2016).

3. Methods

The field survey of the Site and 250m buffer was undertaken on 7-9 and 28-30 August 2019.

3.1 Otter

A thorough search was undertaken of the riparian zone and up to 20m away from the water's edge (where suitable habitat was found to be present). Throughout the survey, overhanging banks, cavities, bankside vegetation and riparian features, such as boulders and mud, were searched for the following signs of otter use:

- Spraints – otter dung, which is used for marking territories, is often located on prominent features within the channel or on the bank (including weirs, bridges, rocks, tree roots, watercourse confluences, etc.); and
- Footprints – located in soft mud, silt or sand banks.

Other potential evidence of otter presence was also searched for in the survey. The following signs, when interpreted in conjunction with spraints and footprints, can provide data to support an assessment of otter activity on a site. They cannot, however, be used in isolation to definitively indicate otter presence/absence:

- Resting-up places – comprising couches (areas of flattened vegetation) or hovers (lay-up areas, including ledges under rocks or hollows under fallen trees or roots).
- Potential holt sites – holes or dens;
- Runs and trails – pathways from the water into dense cover or around bankside trees;
- Slides – down banks as an entry to waterbodies; and
- Feeding remains – e.g. remains of fish and amphibians.

3.2 Water Vole

A thorough search was undertaken in the riparian zone and up to 20m away from the water's edge for evidence of water voles.

Potential evidence of water vole searched for included the following:

- Latrines – water vole droppings are often concentrated in discreet latrine sites near the nest, at range boundaries and places where they regularly enter and exit the water;
- Feeding stations and feeding remains – feeding remains in the form of neat piles of chewed lengths of vegetation are often found in runways and at haul-out platforms;
- Tunnel/burrow entrances – these are typically found along the water's edge on top of the bank up to 5m from the water's edge. Holes on top of the banks often have grazed 'lawns' around them;
- Paths and runs at the water's edge;
- Footprints – these may be identified in soft mud or silt;

- Sightings and or sounds of water voles entering the water; and
- Droppings – while most droppings will be deposited in latrines, some may also be found scattered along runways in vegetation.

Specifically, for watercourses, the approximate depth and speed of water flow, the waterway width, bankside vegetation and surrounding land use, was also recorded, as these factors may determine the suitability of habitat for supporting water voles.

It should be noted that any single field sign recorded in isolation, especially when ambiguous (e.g. a burrow or footprints) would not be definitive in confirming presence.

3.3 Badger

As part of the survey, field signs including setts, day beds, badger faeces in dung pits, evidence of foraging, badger paths, scratching posts, hair and footprints were actively searched for. The survey was based on the methods described by Scottish Badgers (2018). The survey included all hedgerows, field boundaries, watercourses, paths and other linear features within the Site and an additional 250m survey buffer.

On identification of a badger sett, the observer noted the number of entrances, in addition to a description of the activity level and status of the sett. The status of a sett was evaluated and determined based on descriptions presented in Scottish Badgers good practice guidelines (2018), which assigns setts into one of four categories:

- Main sett (used throughout the year and constitutes the main breeding sett);
- Annexe sett (forms part of the main sett area, but is not directly linked by an underground passage to the main sett, either due to a barrier (e.g. separated by a watercourse or ditch) or by distance);
- Subsidiary sett (offers an alternative large sett complex to the main sett but is usually although not always at least 50m away and are not always obviously linked by a well-used path); and
- Outlier sett (often comprising just one or two holes and is infrequently used by badgers).

Each sett entrance is classified according to its degree of usage:

- Well used: are clear of vegetation and debris, sides worn smooth but not necessarily excavated recently;
- Partially used: not in regular use and have debris in the entrance; and
- Disused: not in use for some time, are partially blocked and could not be used without considerable effort.

It should be noted that the status of a badger sett can change over a relatively short period of time. For example, some badger social groups will move the location of the main sett to other less used setts within their territory in response to external factors, such as disturbance.

3.4 Pine Marten

As part of the survey, field signs, including scats and potential den sites, were actively searched for. Differences between field signs of pine marten and other species can be determined in a number of different ways.

- Scat – Found in areas of woodland and can be differentiated from other similar species such as fox due to aroma, size and constituent parts as they tend to be made up of a variety of food including eggs, insects, berries and bone.
- Footprints – Pine marten are mustelids so have five toes compared to species that may be mistaken including fox and dog, both of which have four toes.

- Den Sites – Pine martens prefer to utilise woodland habitats where they can use their climbing abilities to access tree cavities, squirrel dreys and wind-throw. Evidence of use may also be seen from prey remains surrounding den sites including feathers and small mammal bones

3.5 Reptiles

A thorough search was undertaken of all suitable habitat with open aspect areas that are well drained, south-facing, mostly sunny, sheltered and relatively undisturbed. Suitable habitats include grassland, heathland, moorland, open woodland and young plantations.

3.6 Survey Limitations

Although badger can be surveyed for all year round, it is recognised that the badger survey was undertaken outwith the optimal time of year (mid-September – mid-May). The survey took place during the later stages of the "sub-optimal" survey window, however the results of the survey findings for badger are still considered representative of this species activity within the Site and wider area and robust enough for the purposes of assessing baseline conditions.

Site conditions were suitable for survey, with no heavy rain preceding survey to potentially wash away notable field evidence of otter.

No further survey limitations are associated with the protected species survey.

4. Results

4.1 Otter

Figure 8.3.1 presents the results of the 2019 otter survey, as well as relevant Target Note (TN) locations detailing further information obtained from the survey. The results are described in detail in the following section; the TNs are presented in full in Appendix A.

Several otter spraints were found on rocks on the Kintradwell Burn (TN1, TN2, TN3, TN4, TN5 and TN6), Loth Burn (TN7, TN8, TN9, TN10, TN11 and TN12) and Clynemilton Burn (TN13 and TN14). Comprising fish bones and insects and the spraints were ranging in age.

A hover was identified on the Loth Burn, under a large boulder and sprainting was identified on top of the boulder (TN15). Another hover was also identified on the Loth Burn, with ancient spraint remains comprising fish bones within it (TN16).

No other evidence of otter presence was identified during the survey.

4.2 Water Vole

No evidence to suggest the presence of water vole was identified during the survey. Sections of the Loth Burn, Kintradwell Burn and Clynemilton Burn that demonstrated suitable banks for building burrows, or holes that could be used by water vole, were found to be fast-flowing.

4.3 Badger

No evidence of badger presence was recorded on Site during the survey programme.

A mammal push-through was identified at the base of a fence along the track at the east of the Study Area (TN17). Mammal hair was identified on the fence, but given the length and colour, it is most likely red fox (*Vulpes vulpes*).

The valleys and woodland provide suitable sett-building habitat. The upland areas of the Site are unsuitable for sett building, given the flat topography and wetland habitat. Given the high mobility of badger, they could commute and forage throughout the Site.

4.4 Pine Marten

Surveys were conducted during the optimal time of year for observing scats and dens. No evidence to suggest the presence of pine marten was identified during the survey. The woodland habitat provides suitable areas to construct dens in old trees, with features suitable for habitation, and the woodland type provides good coverage for commuting and foraging.

4.5 Reptiles

No evidence of any reptiles, such as adder, was identified during the survey.

The majority of the upland habitat is wetland and does not support significant vegetation. The steep slopes could be used by reptiles during summer, however, there is a lack of suitable over-wintering habitat. Given the lack of suitable habitat and limited food resources, it is unlikely that reptiles such as adder are present in the upland areas of the Site.

The lowland slopes are better suited to support adder. Given the dry heath and track from the lodge to the bothy there are sections in the southern reach of the Site that have limited potential to support adder.

5. Evaluation

Evidence of otter was found indicating use of the lower reaches of the Loth Burn, Kintradwell Burn and Clynemilton Burn. Signs indicative of otter found within the Study Area were limited, but included sprainting and two places of rest (hovers). All field signs for otter were located along the lower reaches of the watercourses within the Study Area. No evidence of water vole activity was recorded within the Study Area. The sections of the Loth Burn, Kintradwell Burn and Clynemilton Burn that demonstrated suitable features to support water vole were fast-flowing, so it is unlikely that this species would be able to establish along these stretches of watercourse, thereby making presence unlikely.

While no evidence of badger was identified within the Site boundary and 50m survey buffer, badger is a highly mobile species and there is potential for this species to move in to areas of better quality habitat (i.e. the woodland associated with the lower levels of the southern and south-eastern parts of the Study Area).

While no evidence of pine marten was identified within the Site boundary and 50m buffer, pine marten is a highly mobile species and they may move into areas of preferable habitat (i.e. areas of woodland associated with the lower, southern parts of the Site).

While no evidence of reptiles was identified within the Study Area there are sections within the south of the Study Area, on the south-facing slopes that could be used by reptiles, including adder.

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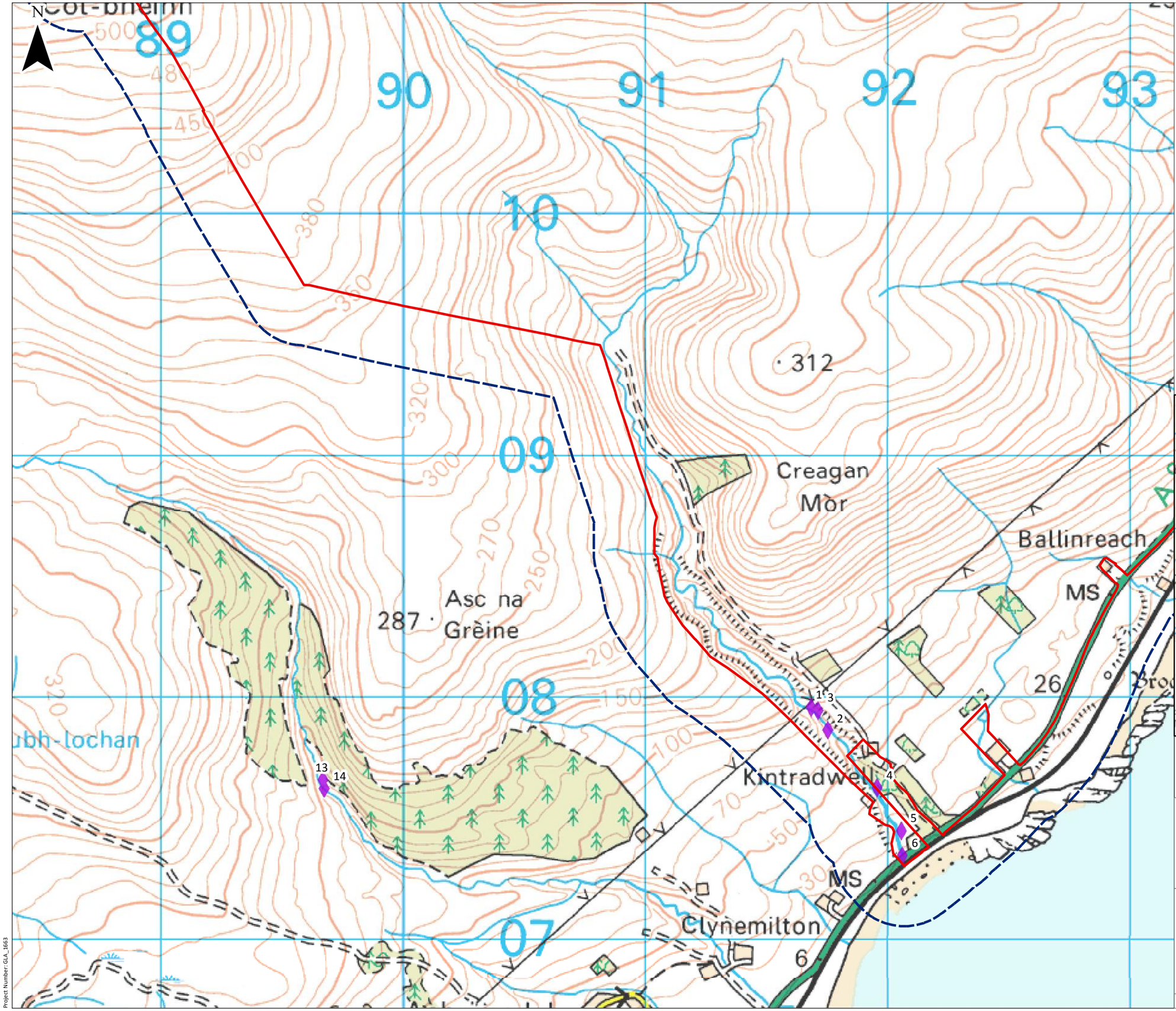
Figures

Figure TA 8.3.1: Protected Species Survey Results

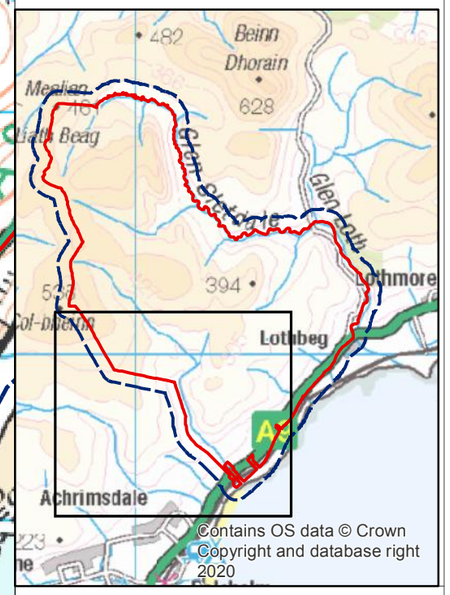


KEY

- Kintradwell Site Boundary
- Buffer (250m)

Target Notes

- Hover + Spraint
- Spraint
- Mammal Push-Through



0 0.35 0.7 km

Scale 1:15,000 @ A3

Kintradwell Wind Farm
EIA Report

Figure TA8.3.1

Protected Species Survey Results

Date: 11/11/2020	Drawn by: AG	Checked by: MF	Version: V1

Project Number: GLA_1663

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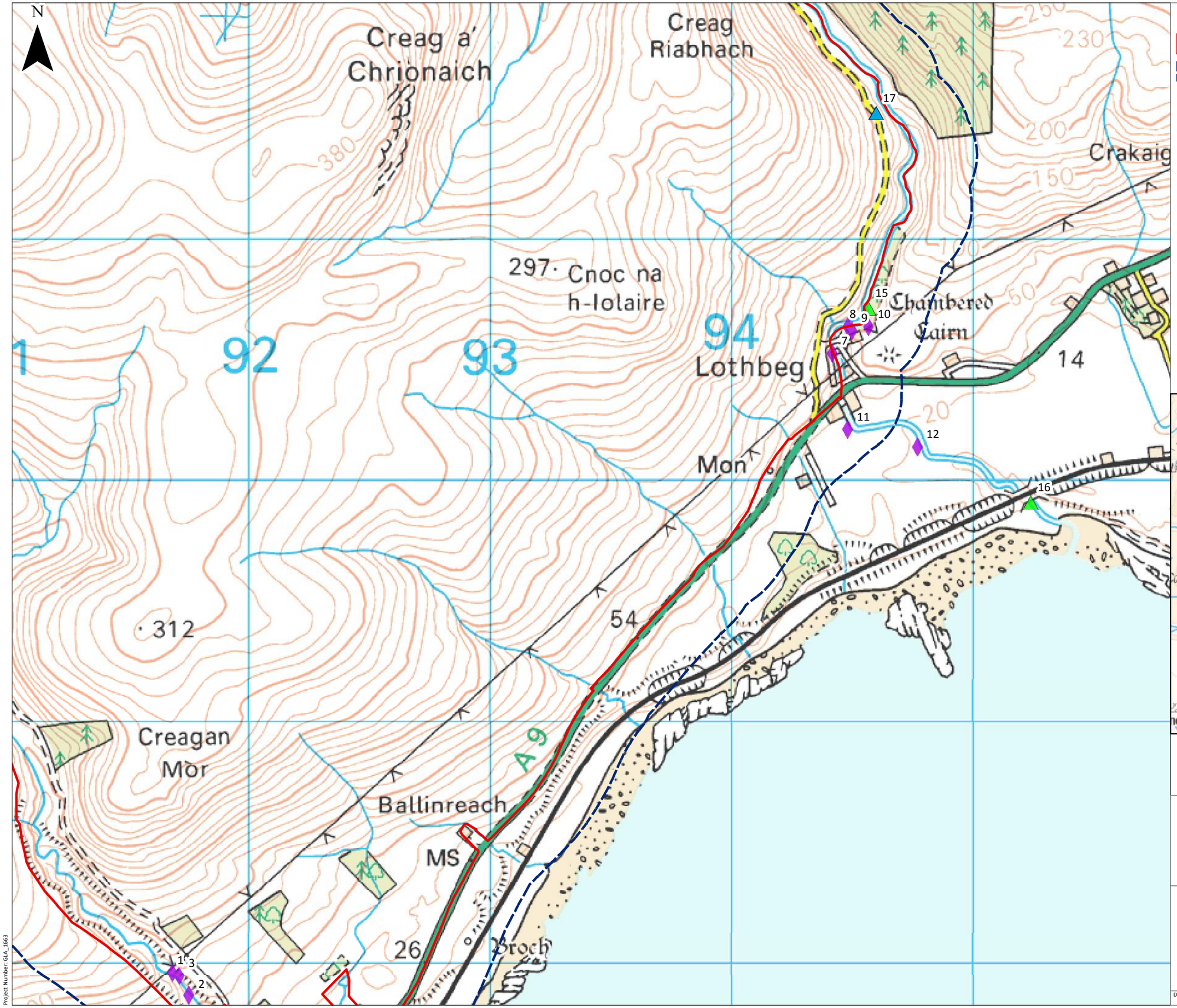

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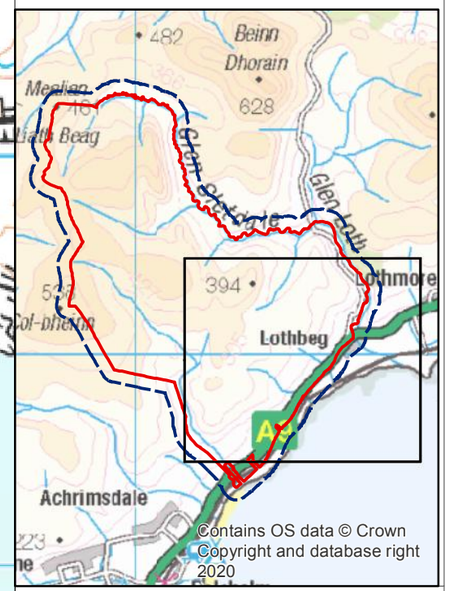

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0 0.35 0.7 km

Scale 1:15,000 @ A3

Kintradwell Wind Farm
EIA Report

Figure TA8.3.1

Protected Species Survey Results

Date:	Drawn by:	Checked by:	Version:
11/11/2020	AG	MF	V1

Project Number: GLA_1663

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Kintradwell Wind Farm

Technical Appendix 8.4 – Bat Survey Report

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Project/Proposal No:	GLA_1663
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Document Information

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VERSION 1.2

NOVEMBER 30, 2019

TECHNICAL APPENDIX

KINTRADWELL WIND FARM, SUTHERLAND

BAT SURVEY

REPORT REF: 19/029/ITP/R01

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EXECUTIVE SUMMARY

- Surveys following current guidance in relation to bats and onshore wind turbines were undertaken during the bat activity season of 2019 across the proposed Kintradwell Wind Farm Site and adjacent habitats.
- Three survey periods including the deployment of 14 static detectors within the Turbine Envelope and a further three static detector locations along the access track corridor was completed across the spring, summer and autumn survey periods. In addition, the weather within the Turbine Envelope was recorded using a deployed weather station.
- Overall the habitats present within the Turbine Envelope were of low suitability for bats with the most suitable features consisting of small upland watercourses. These watercourses were suboptimal due to the lack of significant riparian vegetation (trees and scrub) although due to the topography some sections provided highly sheltered environments.
- The suitability of the habitats within the access track corridor was comparatively high, particularly within the lowland sections of the site close to the coast.
- Initial habitat assessments identified no significant roost features within the Turbine Envelope but a single structure (Kintradwell Bothy) located within the access track area was identified to support potential roost features. This bothy was subsequently subject to roost emergence surveys and a single common pipistrelle was confirmed to be using the building as a non-breeding summer roost. If this building is to be affected then further works will be required to ensure no breach of wildlife legislation.
- Activity surveys identified relatively high levels of activity at a number of locations within the access track corridor although the highest activity was at Kintradwell Farm ponds which was subject to survey during spring only and not within the access track corridor. Activity was primarily from common pipistrelle although activity from soprano pipistrelle, brown long-eared bat, *Myotis* sp. and a small number of Nathusius' pipistrelle were also recorded within the access track corridor.
- The Turbine Envelope supported comparatively very low activity rates, especially during spring and autumn. Species assemblage was again dominated by common pipistrelle, although soprano pipistrelle, *Myotis* sp. and brown long-eared bat were also recorded. Bat activity was overwhelming concentrated along watercourses and not at turbine locations.
- Pipistrelle species are assessed to be at high risk from wind turbines primarily due to their use of open habitats and their fast flight speed. However, the very low levels of activity within the Turbine Envelope and in particular at turbine locations, suggests that the proposed turbines are unlikely to have anything more than a negligible effect on local bat populations.
- Any associated works which may negatively impact upon the lowland habitats and in particular the linear habitats connecting Kintradwell Farm, west to the Kintradwell Burn woodland should be avoided as this is likely to represent an important commuting corridor.

1 INTRODUCTION

The report details the methods and results of an ecological survey focusing on bats to provide robust baseline information to inform the Environmental Impact Assessment Report (EIAR) of the proposed Kintradwell Wind Farm, located in Sutherland, hereafter referred to as the 'Proposed Development' (Figure 1).

The bat surveys focused on 'the Site' delineated by the planning application red line boundary, although the focus of surveys, hereafter referred to as the 'Survey Area', was the 'Turbine Envelope' which was extended to include a 300m buffer to turbines and a 30m buffer to the anticipated access track route. The surveys included an assessment of the suitability of the habitat and periods of automated ground-level static surveys. Additional emergence surveys focusing on key potential roost sites was also undertaken.

The Site is situated in Sutherland, with access off the A9 trunk road 4km north of Brora with the Turbine Envelope located 7km north of Brora. The Site extends to approximately 3,200 hectares although the Survey Area covers an area of approximately 750ha. The Proposed Development comprises of 22 turbines with a tip height of up to 149.9m and a rotor diameter of up to 136m. Associated infrastructure will include: site access, access tracks, crane hardstanding, turbine foundations, underground cabling, on-site substation and maintenance building, temporary construction compound(s), laydown areas, compound for potential battery storage, concrete batching plant, potential excavations/borrow workings, and one or more permanent meteorological masts.

The primary aim of the surveys is to obtain detailed information to assess:

- The level of activity of all bat species recorded at the Site both spatially and temporally;
- The risk of turbine-related mortality for all bat species recorded; and
- The likely significant environmental effect on the relevant species' population status if predicted impacts are not mitigated.

2 LEGISLATIVE CONTEXT

All bat species in Scotland are protected by the Conservation (Natural Habitats, &c.) Regulations 1994 as amended in Scotland and are commonly referred to as European Protected Species (EPS). The Regulations transpose into Scottish law the European Community's Habitats Directive (92/43/EEC).

It is an offence to deliberately or recklessly:

- capture, injure or kill a bat;
- harass an individual or group of bats;
- disturb a bat while it is occupying a structure or place used for shelter or protection;
- disturb a bat while it is rearing or otherwise caring for its young;
- obstruct access to a breeding site or resting place, or otherwise deny the animal use of the breeding site or resting place;
- disturb a bat in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs;
- disturb a bat in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young;
- disturb a bat while it is migrating or hibernating;

It is also an offence of strict liability to:

- damage or destroy a breeding site or resting place of a bat even if they are not in use at the time (i.e. a summer roost during the winter period).

Of the 18 UK bat species, ten occur in Scotland: common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *P. pygmaeus*, Nathusius' pipistrelle *P. nathusii*, Natterer's *Myotis nattereri*, Daubenton's *M. daubentonii*, noctule *Nyctalus noctula*, brown long-eared bats *Plecotus auritus*, Leisler's *N. leisleri* and whiskered/Brandt's *M. mystacinus/M. brandtii* bats.

In addition to the above a number of bat species are included within the Scottish Biodiversity List, including: Brandt's, Daubenton's, whiskered, Natterer's, noctule, Nathusius', common pipistrelle, soprano pipistrelle and brown long-eared.

Bats are also detailed within the UK BAP and highlighted within the Highland BAP.

Bats at wind farms are likely to be considered an example of incidental killing as described in guidance to the Habitats Directive and may not constitute an offence. However, where incidental killing occurs at a certain level, it may cease to be incidental. As a result an assessment of risk is required and mitigation strategies developed to minimise the impacts on bats and reduce the risk of breach of legislation.

3 METHODOLOGY

3.1 DESK STUDY

To provide additional contextual information a data collection exercise with respect to bats was undertaken extended to include a 5km buffer to the Proposed Development.

A review of bat survey data from proposed wind energy projects within 10km of the Development was also undertaken.

A number of information sources were used to obtain ecological background information for the Survey Area. Information on statutory sites was obtained from the website of the statutory agency Scottish Natural Heritage (SNH) via the "Site Link Portal" (http://www.snh.org.uk/snhi/).

A review of information held on the National Biodiversity Network (NBN) Atlas website (www.nbnatlas.org) was also undertaken to provide contextual background information for the location.

Aerial photography, both publically available (e.g. www.bingmaps.co.uk) and through Emapsite (www.emapsite.com) of the Survey Area was also used to guide field surveys.

Discussions with SNH and the Scoping Response was also used to inform survey design.

3.2 SURVEY DESIGN

All methodology follows the current guidance in relation to bats and onshore wind turbines (Hundt 2012; Collins 2016; Scottish Natural Heritage 2019) unless otherwise specified. Surveys of the Survey Area were undertaken between May and October 2019 by James Bunyan (SNH Bat License 114861) of Tracks Ecology.

Preliminary assessments of the Proposed Development identified that the area was dominated by upland habitats with few features suitable for roosts or high value foraging/commuting habitats. As a result the Proposed Development was assessed to be of low risk (Hundt 2012).

3.3 HABITAT ASSESSMENT

A walkover assessment of the Survey Area, guided by a review of aerial imagery, was undertaken on 24th May, 25th May and 1st July 2019 by James Bunyan. The aim of this survey was to identify any potential or confirmed roost sites, to assess the location and suitability of habitats for foraging and commuting and to identify if further surveys, such as emergence/re-entry or detailed roost inspection surveys were required. All areas of the Survey Area were assessed with an emphasis on features located within 300m of turbine locations (Figure 2).

3.4 ROOST EMERGENCE SURVEY

Where features supporting bat roost potential were identified and may be subject to disturbance, roost emergence surveys were undertaken. These surveys followed Bat Conservation Trust (BCT) guidelines (Collins 2016) and were undertaken during the bat activity season by a team two surveyors. All surveys were led by James Bunyan. Surveyors were positioned at key locations to enable observations of all areas of concern. Surveyors continually assess locations and where required adjust position to gain most appropriate line of sight. This is particularly the case during dawn surveys.

Surveyors used Wildlife Acoustics Echo Meter Touch detectors connected to an Apple iOS devices. Recordings of the bat activity were undertaken with sonograms being identified to species level (where possible) on completion of the survey.

3.5 BAT ACTIVITY SURVEY

In line with recent guidance in relation to onshore wind energy projects (Scottish Natural Heritage 2019) activity surveys were limited to the deployment of automated static detectors.

Three survey periods were undertaken during spring (Survey 1), summer (Survey 2) and autumn (Survey 3). On each survey occasion 14 Wildlife Acoustics SM2 detectors were deployed recording in either full spectrum or zero crossing. Current guidance (Scottish Natural Heritage 2019) details that all detectors used for automatic monitoring of bats should use full-spectrum recording to obtain the maximum resolution of recorded bat calls. In terms of equipment required to undertake such surveys, this represented a significant increase in investment. Although SNH did not support any deviation from this guidance (within Scoping discussions), there was recognition of this significant change in requirements and through consultation, an approach using both zero crossing (Anabat Express) and full-spectrum (Anabat Swift) detectors was agreed upon. As a result, a combination of zero crossing and full-spectrum detectors were used across the Turbine Envelope. In addition, to quantify the variation in the effectiveness of the two detectors a period of paired detector deployment was undertaken along the access route. This involved the deployment of a zero crossing detector and a full spectrum detector at the same location simultaneously. From this data a correction factor was calculated to enable bat activity levels obtained from zero crossing detectors to be adjusted to an estimated activity level for a full spectrum detector. Both the actual and adjusted values for zero crossing detectors are presented within this report.

Survey deployment periods were for a minimum of ten days and extended to ensure that ten days of suitable weather conditions, as far as was practicable for the time of year, were sampled. Ten static detectors were located at the location of proposed turbines along with a further four located at suitable habitat features within the Turbine Envelope.

A number of limitations (see Section 3.6) were experienced in relation to the static detector deployment primarily in relation to the use of zero crossing and full spectrum detectors as discussed. The full details of the static detector types, locations and deployment details is

presented in Table 1. All detectors were set to commence recording 30mins before sunset and continue until 30mins after sunrise.

To place the bat activity levels into context site specific weather monitoring was undertaken through the deployment of a weather station. Within the centre of the Site (NC897119) a Davis Vantage Vue Weather Station combined with a WeatherLink - Windows USB data logger was deployed for the duration of each of the survey periods. The weather station was mounted on a pole at approximately 2m in height in open ground.

3.6 SONOGRAM ANALYSIS

Analysis of both full spectrum WAV files and zero crossing files was undertaken using Anabat Insight v1.9.0.4-g. All files were analysed with the assistance of bespoke species filters (using zero cross outputs) to identify and separate common and soprano pipistrelle. This automated analysis was then subject to manual checks of approximately 20% of all calls, where concerns over the accuracy were present, further manual species identification was undertaken. All sonogram files excluded by the pipistrelle filters were then subject to manual checking of WAV sonograms and where bat calls were present, manual identification was undertaken. Species identification broadly followed that presented in Russ (2012) taking into account the geographical location of the Site, habitats present and ecologists own expertise and site knowledge.

Some species of bat are also difficult to confidently identify from sonogram analysis alone. As a result not all calls were identified to species level with all species from the *Myotis* genera identified to genera level only.

Absolute measures of bat activity is not possible to reliably calculate for automated field studies as during recording session it is not possible to differentiate between one bat passing the detector ten times or ten different bats passing the detector on a single occasion. As a result relative measures are used and must be taken into consideration when interpreting results.

The index of bat activity was taken to be a sonogram file (maximum length of 15secs) recorded from the static detectors. Although this is to some degree and arbitrary measure, the activity levels are comparable across detectors and is a frequently used index. For the purpose of this report each file containing a call from a species is termed a ‘pass’. Data is then converted to passes per hour adjusting for location specific night time duration (sunset to sunrise) and days of deployment (adjusted to each detectors period of functioning).

Sonogram data for each detector location during each of the survey sessions was organised and used for analysis of activity levels across static detector locations and across survey periods. In addition the data was also organised into the required format to upload for additional analysis within the secure online tool Ecobat (http://www.ecobat.org.uk/). This analysis tool enables comparisons to be made in a spatial context allowing a geographically relevant assessment of activity levels. It should be noted that there is no function within Ecobat to know what volume of data is being used for geographic comparisons and as the system is in its infancy, interpreting comparative measures, especially within the remote Scottish Highlands will require caution.

The Ecobat analysis approach includes a variety of outputs useful for ascertaining the importance of a site with respect to bat distribution and activity levels. In the Scottish Highlands, the issue of spatial and temporal variation is very pronounced with the potential for bat detectors to record no activity at locations generally unsuitable for bats, for example some wind farm sites. Ecobat can analyse rates of activity including or excluding ‘zero activity’ nights. Within this document figures presented are those calculated including all ‘zero

activity' nights unless otherwise stated. In comparison to excluding 'zero activity' nights, this will result in lower activity rates being presented, but taking into account the location of the Site, this is assessed as being the approach which will produce the most accurate assessment of activity. Analysis provided by Ecobat with respect to the geographical context providing a comparative measure of high, moderate or low activity, however, is based on the exclusion of 'zero activity' nights and although presented here, is likely to be an over-estimation of true activity levels.

3.7 LIMITATIONS

A number of minor limitations were experienced during the bat surveys:

- Small periods of temperature data were not recorded by the weather station logger during the spring survey period. This does not represent a significant limitation as the deployment period was extended to account for poor weather.
- As a transition to the 2019 guidance from SNH (Scottish Natural Heritage 2019) a combination of zero crossing (Anabat Express) and full spectrum (Anabat Swift) detectors were used. Full spectrum detectors were used at higher risk locations and a period of 'calibration' was undertaken using both detectors deployed side by side. A correction factor was then calculated and applied to site wide zero crossing results to obtain an adjusted activity rate. Although this represents a limitation and results in an increased degree of error, the significance of this limitation is assessed to be low, especially taking into account the general activity levels in the Turbine Envelope.
- It is difficult to ensure that acceptable weather conditions are experienced during bat survey work in the Highlands on exposed sites at altitude. However, to compensate for this risk detector deployment sessions were extended, especially during the spring and autumn periods to ensure that adequate weather conditions were obtained. As a result no significant limitation was experienced.
- Minor issues with functioning of static detectors resulted in two detectors failing part way through the spring deployment period. During all other survey periods detectors functioned for the duration of the deployment period and as a result the loss of small amounts of sampling is not considered a significant limitation.

Although a number of limitations exist the data obtained provides a clear picture of bat activity across the Site and wider environs and as a result it is not anticipated that the limitations affect the robustness of the results to a significant degree.

Table 1 Summary of automated static detector deployment

		Detector	Survey 1						Survey 2						Survey 3					
			For-mat	Deploy Date	Collection Date	Failure Date	Min. Active Nights	Total night time hours	For-mat	Deploy Date	Collection Date	Failure Date	Min. Active Nights	Total night time hours	For-mat	Deploy Date	Collection Date	Failure Date	Min. Active Nights	Total night time hours
Turbine Envelope		S1	FS	24/05/19	23/06/19	N/A	30	183.75	ZC	26/07/19	09/08/19	N/A	14	106.4	ZC	13/09/19	01/10/19	N/A	18	210.32
		S2	ZC	24/05/19	23/06/19	29/05/19	5	33.07	FS	26/07/19	09/08/19	N/A	14	106.4	FS	13/09/19	01/10/19	N/A	18	210.32
		S3	FS	24/05/19	23/06/19	N/A	30	183.75	FS	26/07/19	09/08/19	N/A	14	106.4	ZC	13/09/19	01/10/19	N/A	18	210.32
		S4	ZC	24/05/19	23/06/19	N/A	30	183.75	ZC	26/07/19	09/08/19	N/A	14	106.4	ZC	13/09/19	01/10/19	N/A	18	210.32
		S5	ZC	24/05/19	23/06/19	N/A	30	183.75	ZC	26/07/19	09/08/19	N/A	14	106.4	ZC	13/09/19	01/10/19	N/A	18	210.32
		S6	ZC	24/05/19	23/06/19	N/A	30	183.75	ZC	26/07/19	09/08/19	N/A	14	106.4	ZC	13/09/19	01/10/19	N/A	18	210.32
		S7	ZC	24/05/19	23/06/19	N/A	30	183.75	ZC	26/07/19	09/08/19	N/A	14	106.4	ZC	13/09/19	01/10/19	N/A	18	210.32
		S8	ZC	24/05/19	23/06/19	N/A	30	183.75	ZC	26/07/19	09/08/19	N/A	14	106.4	FS	13/09/19	01/10/19	N/A	18	210.32
		S9	FS	24/05/19	23/06/19	N/A	30	183.75	FS	26/07/19	09/08/19	N/A	14	106.4	FS	13/09/19	01/10/19	N/A	18	210.32
		S10	ZC	24/05/19	23/06/19	03/06/19	10	64.83	ZC	26/07/19	09/08/19	N/A	14	106.4	ZC	13/09/19	01/10/19	N/A	18	210.32
		S11	FS	24/05/19	23/06/19	N/A	30	183.75	FS	26/07/19	09/08/19	N/A	14	106.4	FS	13/09/19	01/10/19	N/A	18	210.32
		S12	FS	24/05/19	23/06/19	N/A	30	183.75	FS	26/07/19	09/08/19	N/A	14	106.4	FS	13/09/19	01/10/19	N/A	18	210.32
		S13	FS	24/05/19	23/06/19	N/A	30	183.75	FS	26/07/19	09/08/19	N/A	14	106.4	FS	13/09/19	01/10/19	N/A	18	210.32
		S14	ZC	24/05/19	23/06/19	N/A	30	183.75	ZC	26/07/19	09/08/19	N/A	14	106.4	ZC	13/09/19	01/10/19	N/A	18	210.32
Access Route	Spring	North	FS	01/07/19	17/07/19	N/A	16	99.23	FS	09/08/19	19/08/19	N/A	10	85	FS	01/10/19	11/10/19	N/A	10	128.48
		North	ZC	01/07/19	17/07/19	N/A	16	99.23	ZC	09/08/19	19/08/19	N/A	10	85	ZC	01/10/19	11/10/19	N/A	10	128.48
		Central	FS	01/07/19	17/07/19	N/A	16	99.23	FS	09/08/19	19/08/19	N/A	10	85	FS	01/10/19	11/10/19	N/A	10	128.48
		Central	ZC	01/07/19	17/07/19	N/A	16	99.23	ZC	09/08/19	19/08/19	N/A	10	85	ZC	01/10/19	11/10/19	N/A	10	128.48
		South	FS	01/07/19	17/07/19	N/A	16	99.23	FS	09/08/19	19/08/19	N/A	10	85	FS	01/10/19	11/10/19	N/A	10	128.48
		South	ZC	01/07/19	17/07/19	N/A	16	99.23	ZC	09/08/19	19/08/19	N/A	10	85	ZC	01/10/19	11/10/19	N/A	10	128.48
	Summer/Autumn	North	FS	01/07/19	17/07/19	N/A	16	99.23	FS	09/08/19	19/08/19	N/A	10	85	FS	01/10/19	11/10/19	N/A	10	128.48
		North	ZC	01/07/19	17/07/19	N/A	16	99.23	ZC	09/08/19	19/08/19	N/A	10	85	ZC	01/10/19	11/10/19	N/A	10	128.48
		Central	FS	01/07/19	17/07/19	N/A	16	99.23	FS	09/08/19	19/08/19	N/A	10	85	FS	01/10/19	11/10/19	N/A	10	128.48
		Central	ZC	01/07/19	17/07/19	N/A	16	99.23	ZC	09/08/19	19/08/19	N/A	10	85	ZC	01/10/19	11/10/19	N/A	10	128.48
		South	FS	01/07/19	17/07/19	N/A	16	99.23	FS	09/08/19	19/08/19	N/A	10	85	FS	01/10/19	11/10/19	N/A	10	128.48
		South	ZC	01/07/19	17/07/19	N/A	16	99.23	ZC	09/08/19	19/08/19	N/A	10	85	ZC	01/10/19	11/10/19	N/A	10	128.48

4 RESULTS

4.1 DESK STUDY

No statutorily designated sites protected for bats are within 10km of the Site.

The Scoping Opinion confirmed that bats need to be considered within the EIAR and survey design should follow that of the new guidance from SNH (2019). Specific requirements in relation to the use of zero crossing and full spectrum detectors were outlined and agreed with SNH (see Section 3.4).

Publically available records highlighted just two records for common pipistrelle and brown long-eared bat within 10km of the Site centre. No records are present for within 4km of the Site centre with the nearest record located 5km west, close to Gordonbush.

Nine wind farm applications are within 10km (The Highland Council 2019) of the Site and each of these was reviewed with respect to the level of bat activity, and likely significant effects (Table 2). Details in relation to bat surveys were obtained on three of these.

Table 2: Wind Farm developments within 10km of the Site.

Wind Farm Development (Planning Ref)	Details	Status	Distance from Site Boundary	Bat Species Present	Likely Significant Effect
Gordonbush Extension (15/02598/S36)	15 turbines 52,500kw	Approved	2.0km W	*P.pipistrellus, P.pygmaeus, M.naterreri, P.auritus*	None
West Garty 2 (14/04486/S36)	17 turbines 51,000kw	Refused	3km E	*P.pipistrellus*	None
Balnacoil (13/03312/FUL)	15 turbines 45,000kw	Refused	6.5km W	*P.pipistrellus, P.pygmaeus*	None
Kilbraur Extension (09/00111/S36SU)	4 turbines 10,000kw	Constructed	9km W	Unknown*	Unknown*
Kilbraur (04/00125/FULSU)	10 turbines 25,000kw	Constructed	8km W	Unknown*	Unknown*
Gordonbush Windfarm (03/00236/S36SU)	35 turbines 71,750kw	Constructed	0.75km W	Unknown*	Unknown*
Crakaig (96/00076/FULSU)	8 turbines 4,800kw	Refused	1.0km E	Unknown*	Unknown*
West Garty (95/00282/FULSU)	16 turbines 9,600kw	Refused	3km E	Unknown*	Unknown*
Gartymore (95/00296/FULSU)	14 turbines 10,500kw	Refused	5.5km E	Unknown*	Unknown*

* Project details or bat assessment information not present within Highland Council planning portal.

4.2 HABITAT ASSESSMENT

The Site is located in a predominantly upland setting with the habitats within the Turbine Envelope dominated by blanket bog, wet heath and flushed areas with a highly variable topography. The peaks of Col-bheinn (542m asl) in the west of the Site and unnamed peaks up to 545m asl in the north of the Site are dominant with a number of slightly lower peaks also present. The Turbine Envelope is largely drained to the west with Kintradwell Burn

flowing southwest and an unnamed tributary of the Sletdale Burn, draining east, the main watercourses present. These watercourses are largely small peatland burns while on the upper slopes but quickly turn into fast flowing rocky burns as they cut through the steep slopes.

Other than the watercourses very few relevant landscape features exist within the Turbine Envelope itself. A very small number of trees are present within the steep watercourse cuttings on the southern side of the unnamed tributary of the Sletdale Burn. These included four rowan *Sorbus aucuparia* trees. One of these (TN18) supported some damage that offered low suitability for use by bats. The other three trees at this location did not support any potential roost features.

Within the Turbine Envelope, both the main watercourses and smaller tributaries, were sub-optimal for use as foraging resources as no significant riparian vegetation (trees/scrub) was present. They may, however, support foraging during calm conditions and act as landscape features for navigation.

At the northern end of the access route, the Kintradwell Bothy (TN18) was located close to the confluence of the Kintradwell Burn and Badenahaulish Burn. The bothy was a small stone building with thick stone walls supporting a simple pitched roof of stone tiles over a timber frame. The interior of the bothy comprised a single room with false timber ceiling creating a small inaccessible roof void. An additional small inaccessible store room was present on the northwest corner. No signs of bats using the building were identified but there were a number of potential ingress points under the thick stone tiles. Further ingress opportunities were present at eaves height on the northern elevation at the join of the storeroom roof to the main roof.

At lower elevations areas of coniferous woodland, young broadleaved woodland, hedges, stone walls and areas of scrub were all present. Although these areas are likely to offer some suitability for sheltered foraging and act as navigation aids for commuting no features suitable to potentially support roosting bats were identified.

Although outwith the Access Track survey area and not subject to detailed assessment, the main Kintradwell Burn supported mature broadleaved woodland (although not identified within the Ancient Woodland Inventory (AWI)) along its banks for approximately 750m inland with a further 1km or so providing good sheltered foraging and commuting habitat with scattered trees and scrub. Beyond 1.75km inland the river valley supports no significant riparian vegetation and becomes less sheltered in nature, although it is assessed that this burn is likely to provide the most suitable foraging habitat within the local area and act as a movement corridor for bats heading up the glen on to higher ground. A brief description of all features within the Survey Area is detailed in Table 3 and presented on Figure 2.

Table 3: Preliminary Roost Assessment features.

Name	Notes	Roost Potential	X	Y
TN1	Stone wall within the lowland sections of the Site along the proposed access route a number of dry stone walls are present along with other linear features such as post and wire fences. These do not represent any potential roost features but may be used for navigation.	None	292319	907583
TN2	Hedge within the lowland agricultural areas a small number of hedges are present along field boundaries. No trees suitable for roosting are present within these but they are likely to act as navigation aids for commuting bats.	None	292186	907701

TN3	The agricultural landscape supports small patches of young, largely native trees. These are not suitable for roosting but may offer some commuting and foraging resources.	None	292227	907711
TN4	The agricultural landscape supports small patches of young, largely native trees. These are not suitable for roosting but may offer some commuting and foraging resources.	None	292159	907735
TN5	In places, significant scrub dominated by European gorse *Ulex europeaus* is present. These may provide some suitability for foraging with increased insect biomass on a seasonal basis.	N/A	291561	908088
TN6	A small area of coniferous plantation woodland with an open and varied structure. The trees present do not offer any significant roosting potential but are likely to provide sheltered foraging.	Low	291699	908108
TN7	Dense coniferous woodland plantation with areas of wind blow. The trees present do not offer any significant roosting potential but are likely to provide sheltered foraging.	Low	291250	908906
TN8	Short sections of the Kintradwell Burn are within the access track survey area. These areas are generally open with no significant riparian vegetation. The river is likely to support commuting and foraging bats especially during calm weather conditions.	N/A	290964	909150
TN9	Small fast flowing tributary of the Kintradwell Burn, size of watercourse is unlikely to represent any significant feature for foraging but may be used as navigation aid.	N/A	290725	909697
TN10	Kintradwell Bothy, identified as supporting moderate roost potential under sections of the roof. Located at confluence of Kintradwell and Badenahaughlish Burn offering good foraging and commuting habitats.	Moderate	291156	909781
TN11	Section of the Kintradwell Burn which extends up steep sections. No significant riparian vegetation but the river is likely to support commuting and foraging bats especially during calm weather conditions.	N/A	291172	909854
TN12	Further upstream the Kintradwell burn forms a small fast flowing burn with some areas of pooling. The river is likely to support commuting and foraging bats especially during calm weather conditions.	N/A	290535	910508
TN13	Significant sections of the upper reaches of Kintradwell Burn are flowing underground with little or no water present at surface. Areas may still offer some navigational value, but are unlikely to offer a foraging resource.	N/A	288953	911916
TN14	Small bog pools located on the saddle of the Site. Location is very exposed and supports a typically low biomass within the water.	N/A	289716	912024
TN15	Small rowan tree within steep cutting close to unnamed burn. Tree does not offer any potential roosting features	None	290041	912424
TN16	Large rowan tree within steep cutting close to unnamed burn. Tree does not offer any potential roosting features	None	290057	912454
TN17	Small rowan tree within steep cutting close to unnamed burn. Tree does not offer any potential roosting features	None	290092	912492
TN18	Larger rowan tree within steep cutting. One good feature but restricted suitability no internal cavity minor dead limbs no significant opportunities for roosting.	Low	290097	912498
TN19	Unnamed burn is fast flowing and steep with series of pools and falls. Valley is deep and protected from wind and is likely to offer good foraging and commuting links between the	N/A	289814	912709

	lowland habitats to the east and the upland sections of the Site.			
TN20	Small burn characteristic of upland peatlands with some fast flowing sections as burn cuts through peatland. Limited suitability for foraging or commuting.	N/A	289071	913054
TN21	Small burn characteristic of upland peatlands with some fast flowing sections as burn cuts through peatland. Limited suitability for foraging or commuting.	N/A	288285	913221
TN22	Small burn characteristic of upland peatlands with some fast flowing sections as burn cuts through peatland. Limited suitability for foraging or commuting.	N/A	288492	913600
TN23	Small burn characteristic of upland peatlands with some fast flowing sections as burn cuts through peatland. Limited suitability for foraging or commuting. Location is exposed to weather.	N/A	289516	913931

Wider Habitat and Connectivity

The wider environs can be split into two areas, to the north, west and east are landscapes dominated by the open upland habitats. The lowland coastal strip dominates the landscape to the south. The northern latitude and generally open habitats of low suitability result in local bat populations generally being at low density with low species diversity.

4.3 ROOST EMEREGNCE SURVEYS

Based on the results of the Habitat Assessment, the Kintradwell Bothy was subject to two roost emergence surveys during August and September 2019 (Table 4).

Table 4: Roost emergence survey details

Survey	Surveyors	Detector	Start		Finish	
28/08/19 Dusk Sunset: 20:31	James Bunyan Eleonora DiCuffa	EM Touch EM Touch	Time Temp. Weather	20:15 14°C Light cloud, dry and still.	Time Temp. Weather	22:00 10°C Light cloud, dry and still.
12/09/19 Dawn Sunrise: 06:38	James Bunyan Eleonora DiCuffa	EM Touch EM Touch	Time Temp. Weather	05:10 11°C Overcast, dry with blustery wind	Time Temp. Weather	06:38 11°C Overcast, dry with light winds

The first dusk survey was undertaken under optimal conditions for the location and a number of bats were observed in the locality of the bothy. At 20:50 a common pipistrelle was observed emerging from the northern side of the building from beneath a raised stone tile. No other emergences were identified, but a number of commuting and foraging flights from common pipistrelle and a single pass of a brown long-eared bat were recorded. The brown long-eared bat was recorded flying up the Kintradwell Burn at 21:24, relatively early for the species considering the absence of nearby potential roost sites.

During the dawn survey, conditions were not optimal but remained suitable for bat activity and no bats were recorded.

4.4 BAT ACTIVITY SURVEY

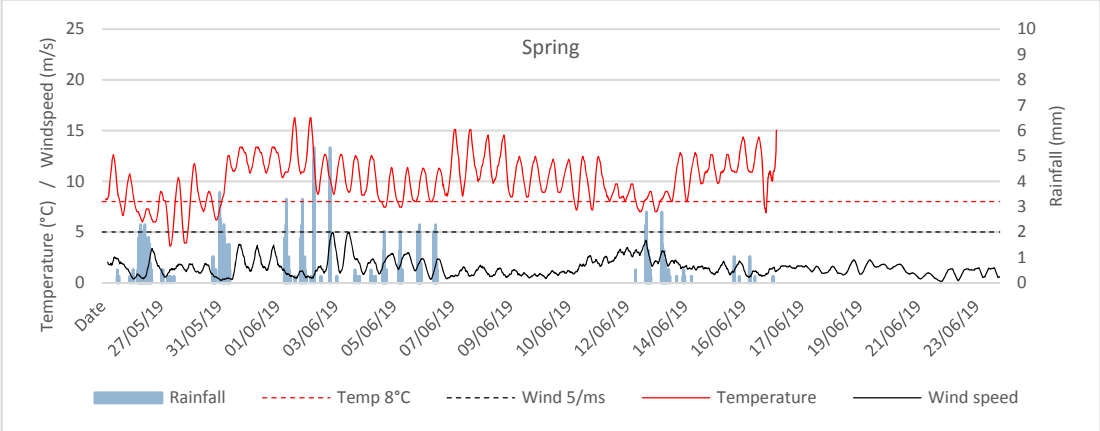
Weather

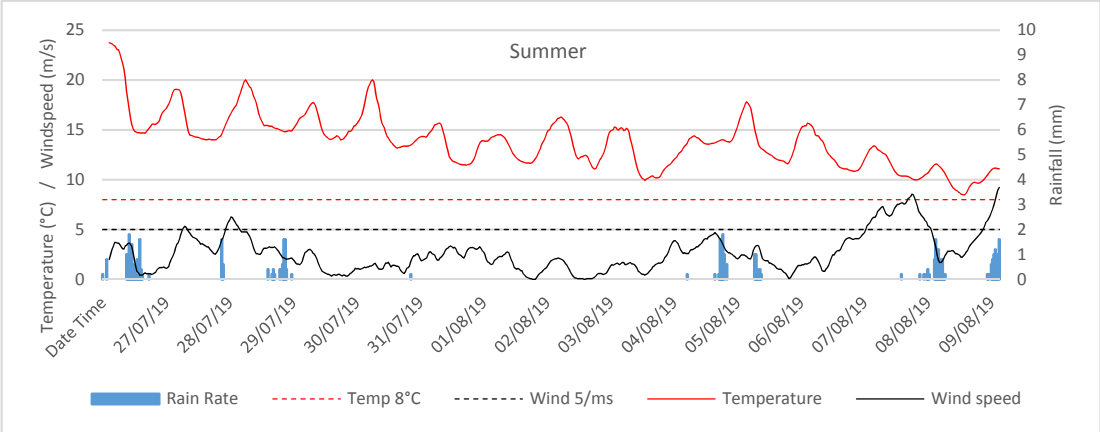
Current guidance (Scottish Natural Heritage 2019) stipulates that surveys should capture a sufficient number of nights with appropriate weather conditions for bat activity. Lower temperature requirements are identified for Scotland with a minimum recommended temperature of 8°C at dusk and wind speeds less than 5m/s.

During the spring surveys temperatures were generally in excess of the 8°C although on a number of nights early on in the survey period temperatures were cool, dipping to below 5°C for at least two nights. Wind speeds never exceeded the recommended maximum of 5m/s although a number of rainfall events occurred. However, due to the prolonged period of deployment the recommended duration of at least 10 days suitable weather conditions were achieved. Temperature data was missing for a number of days at the end of the spring period due to a malfunction in the data logger.

The summer surveys were undertaken under mild conditions with the minimum temperature not dropping below the 8°C level throughout the period. Rainfall was generally light and a significant number of rain free periods were recorded. Wind was broadly at acceptable levels although the later few days of the survey experienced windy conditions.

The autumn period was more unsettled with frequent showers and windier conditions as would be expected with the time of year, especially in the latter part of the survey period. Cool periods were experienced at the start and end of the survey period, with temperatures dropping to around 5°C for a number of days. However, due to the prolonged period of deployment the recommended duration of suitable weather conditions were achieved.





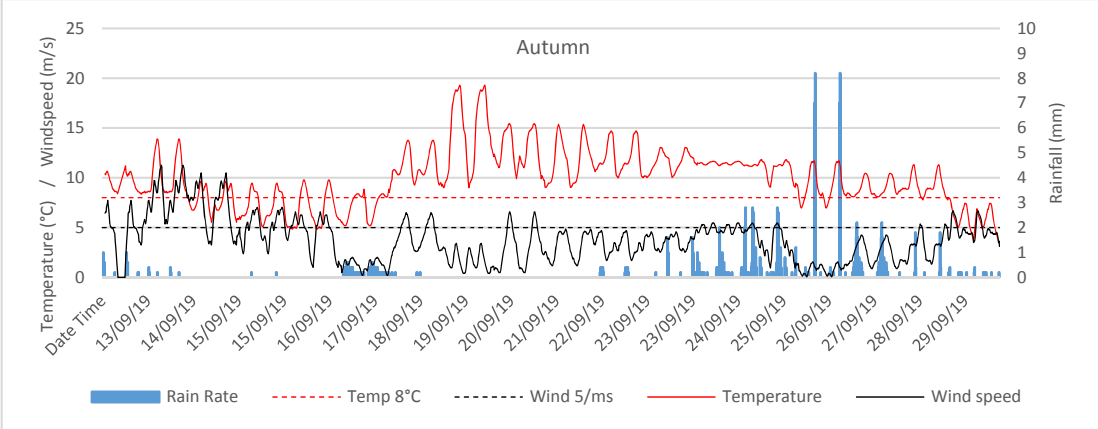


Chart 1: Weather parameters recorded on Site during static detector deployment.

Zero crossing correction factor

Due to the process of zero cross recording it is understood that where activity levels are high or bat calls are at low power, bat registrations may be missed during the analysis. As a result there is a shift towards using full spectrum recording and analysis.

The results of the paired detector deployments within the access track area of the Site are detailed in Table 5. In the majority of cases the zero crossing detectors recorded more bats than that of the paired full spectrum detector. A correction factor based on the median value of the calculated rations between each of the recording formats. The median value was used rather than the mean due to the high variation in the number of bat calls detected at the locations, with the median value recorded at the location of the highest bat activity. The resulting value of 1.698 was then used as a multiplier for calculating activity rates for zero crossing detector results within the Turbine Envelope. All subsequent analysis is based on these corrected results unless otherwise stated.

Table 5: Calculation of correction factor for zero crossing detectors.

Detector Location (all surveys)	**Count of bat passes (all species)**		**Correction Factor (1/2)**
	Full Spectrum Recordings (Anabat Swift) (1)	**Zero crossing (Anabat Express) (2)**	
Survey 1 - Central	43	48	0.896
Survey 1 - North	94	126	0.746
Survey 1 - South	5528	3255	1.698
Survey 2+3 - Central	500	157	3.185
Survey 2+3 - North	89	20	4.450
Survey 2+3 - South	1201	0	-
Mean			2.195
Median			1.698

Overall Site Activity

The results of the static detector surveys identified the presence of at least five species; common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle, brown long-eared bat and *Myotis* sp. bats. However, over 95% of all the passes recorded were from common pipistrelle with 1.7% from soprano pipistrelle, 2.2% *Myotis* sp., 0.8% from brown long-eared bat and just eight passes (0.06%) from Nathusius' pipistrelle. In total, 12,544 passes were identified across the survey with over 88% of these recorded by the 6 pairs of statics deployed within the Access Track Survey Area.

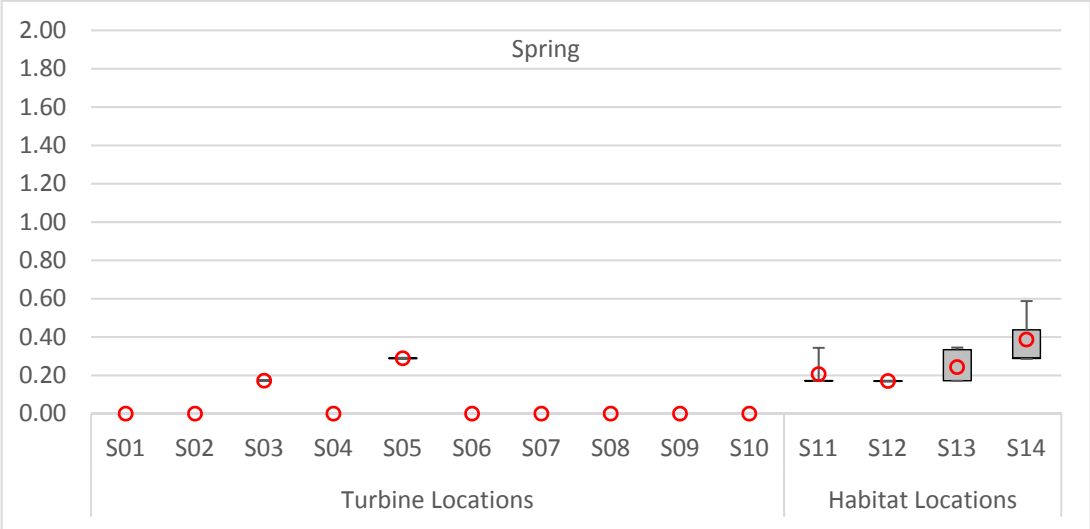
Bat pass rates are often highly variable between nights, with some nights having few or no passes and other nights having high activity, this is particularly pronounced on sites within the Scottish Highlands. In these circumstances, the median is likely to be a more useful summary of the typical activity than is the mean (Lintott & Mathews 2018). As a result median pass rates are primarily the presented data along with an indication of means where relevant.

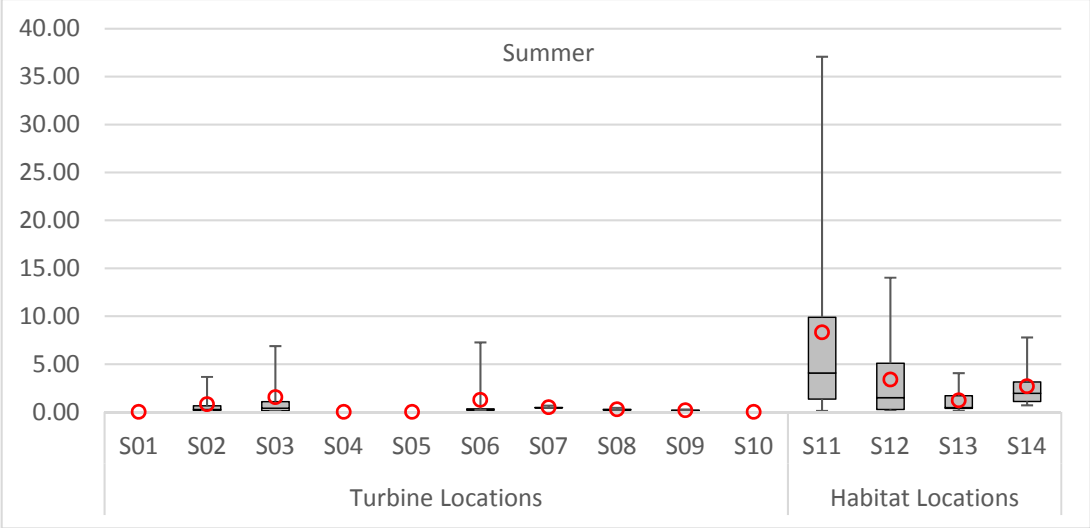
Turbine Envelope

Within the Turbine Envelope, bat activity was variable across the survey sessions but overall low. Detectors S01 to S10 were located at turbine locations with S11 to S14 located at habitat features (watercourses) (Chart 2). During spring and autumn activity levels across the Turbine Envelope were all low with no median activity rate of greater than activity greater than 0.4 passes per hour. In particular activity levels across turbine locations, was very low with a total 71 bat passes in spring (over 30 nights deployment) and 12 bat passes in autumn (over 18 nights deployment). The summer deployment period supported increased activity with 194 (over 14 nights deployment) bat passes at turbine locations. It should be recognised that the analysis of the data excludes 'zero activity' nights and as a result activity levels are likely to be an over estimate.

During the summer survey activity at turbine locations remained very low with no median activity rate higher than 0.4 passes per hour and a maximum pass rate within any one night of approximately seven passes per hour at detector S03 (Turbine 20) and S06 (Turbine 18).

The location of the Site within northern Scotland results in careful analysis of the activity levels in the context of the location which is likely to result in reduced activity level. Northern Scotland is also on the edge of the species range for the majority of the UK bat species and this must also be taken into account.





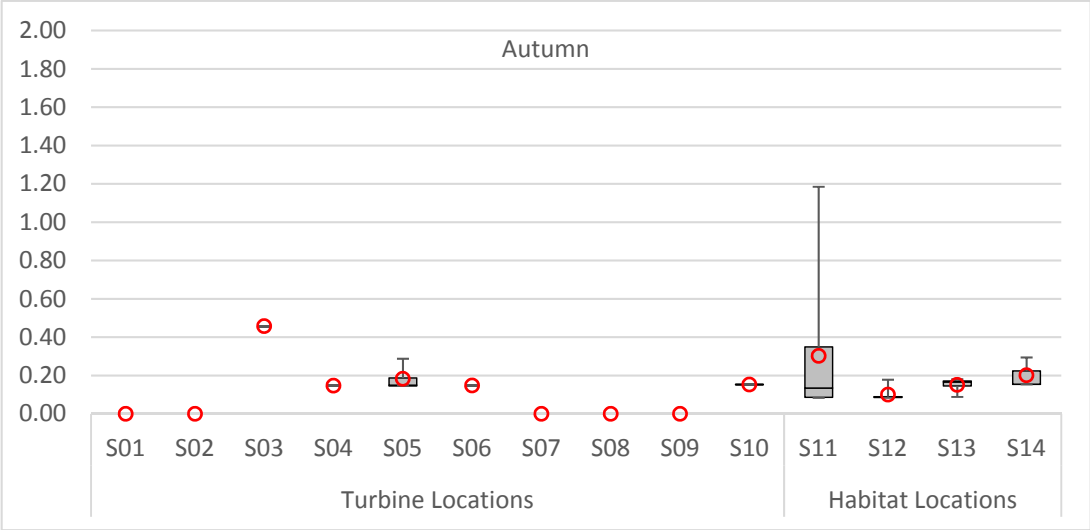


Chart 2: The median nightly pass rate (bat passes per hour) and mean (red circles) of all bats across survey seasons.

The species composition of activity across the Turbine Envelope was also variable (Chart 3). Where significant activity was present and across the Turbine Envelope in total common pipistrelle dominates the activity. At turbine locations, the total number of bat passes is low and as such the composition of species is likely to provide a guide only. Where increased number of passes are recorded a more accurate assessment of species composition can be ascertained. Based upon the activity at habitat locations (which are located on watercourses), *Myotis* sp. appears to favour locations S12 and S13 but not at S11 or S14.

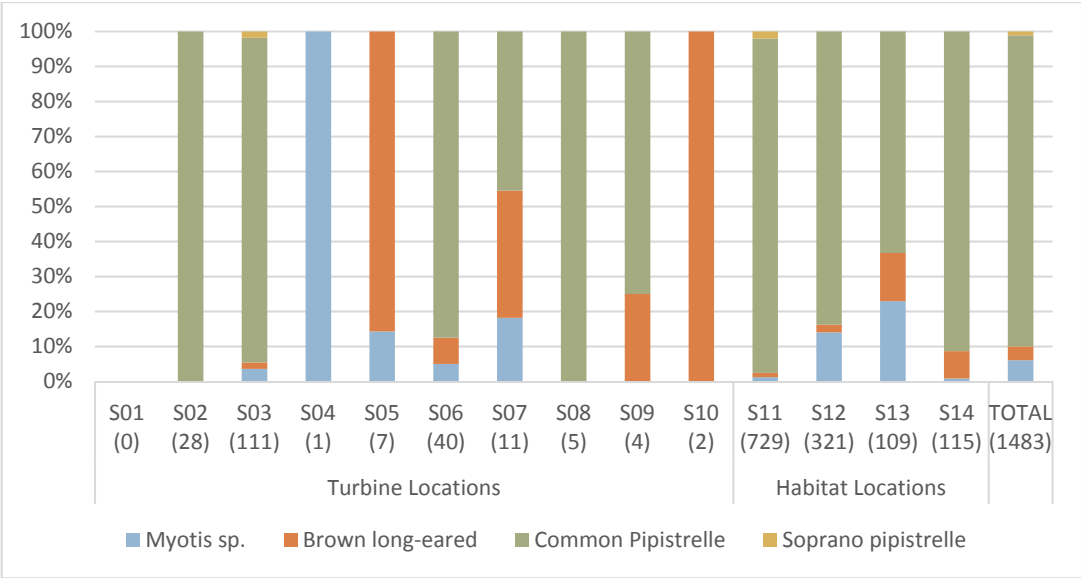


Chart 3: Species composition at each detector location within Turbine Envelope and across all detectors (Total). Total number of passes in parenthesis.

Table 6 presents the activity levels within the context of the geographic location and temporal coverage as analysed by Ecobat. As discussed in Section 3.5 this approach excludes 'zero activity' nights and as a result is likely to represent data skewed towards high activity levels. The analysis compares activity levels to centrally held data recorded within 30 days of the survey date and within 100km^2 of the detector location. The results clearly identify the detectors located at habitat locations along the watercourses within the Site (S11 – S14) as supporting the higher activity levels.

It is worth noting that 'High' activity is identified at detector S03 (Turbine 20) and 'Moderate/High' activity at S06 (Turbine 18) and S02 (Turbine 4) during the summer deployment this is in line with the activity levels presented in Chart 1. All other detectors are identified as supporting 'Moderate' or lower activity levels. However, as noted, caution is required interpreting these results and should be assessed in context of the pass rates displayed in Chart 1.

Activity levels can vary significantly throughout the activity season which may indicate a number of potential features being close by, such as maternity roosts, swarming sites and hibernation roosts. The activity levels of static detectors within the Turbine Envelope (S01-S14) did not support activity from bats prior to the recognised specific emergence time ranges (Russ 2012) for each species with the exception of two locations during the summer survey. At S14 both common and soprano pipistrelle were recorded at sunset approximately 20 minutes prior to recognised emergence time. Similarly, at S07 a small number of passes of brown long-eared bat was recorded approximately 30 minutes before recognised emergence soon after sunset. Based on the general results and the results of the habitat assessment, these early emergences are assessed to be a response to weather conditions and not an indication of roosts being in close proximity to these locations. These registrations occurred between 29th July and 2nd August during a period of calm warm weather.

Chart 5 shows the time from 15 minutes before to 90 minutes after sunset. Bat passes overlapping species-specific grey bars (indicators of recognised emergence times, or occurring earlier than this time range, may potentially indicate the presence of a nearby roost.

Table 6: Summary table showing the number of nights recorded bat activity fell into each activity band for each species. Data excludes 'zero activity' nights (See Section 3.5) (Habitat detector locations shaded).

Detector ID	Species Group	Number of nights of relative spatial and temporal activity level				
		High	Moderate/ High	Moderate	Moderate/ Low	Low
Survey 1 – S05	*Plecotus auritus*	0	0	0	0	2
Survey 2 – S02		0	0	0	0	2
Survey 2 – S03		0	0	0	0	2
Survey 2 – S06		0	0	0	1	2
Survey 2 – S07		0	0	0	0	3
Survey 2 – S08		0	0	0	0	1
Survey 3 – S03		0	0	0	1	0
Survey 3 – S04		0	0	0	0	1
Survey 3 – S05		0	0	0	0	1
Survey 2 - S12	*Pipistrellus pygmaeus*	0	0	1	1	0
Survey 2 - S14		0	0	4	1	0
Survey 1 – S03	*Pipistrellus pipistrellus*	0	0	0	0	1
Survey 1 - S12		0	0	0	0	2
Survey 1 - S13		0	0	0	2	4
Survey 1 - S14		0	0	0	0	3
Survey 2 – S02		0	1	0	0	2
Survey 2 – S03		1	0	1	3	2
Survey 2 – S06		0	1	0	0	4
Survey 2 – S07		0	0	0	0	3
Survey 2 – S08		0	0	0	0	2
Survey 2 – S09		0	0	0	0	3
Survey 2 - S11		4	1	1	2	3
Survey 2 - S12		3	2	0	3	4
Survey 2 - S13		0	2	3	1	3
Survey 2 - S14		0	2	2	2	1
Survey 3 – S06		0	0	0	0	1
Survey 3 - S11		0	0	2	1	4
Survey 3 - S12		0	0	0	0	5
Survey 3 - S13		0	0	0	0	6
Survey 3 - S14		0	0	0	0	2
Survey 1 - S11	*Myotis*	0	0	0	1	2
Survey 2 - S11		0	1	3	0	0
Survey 2 - S12		0	0	1	0	1
Survey 2 - S14		0	0	0	0	1
Survey 2 – S02		0	0	0	0	1
Survey 2 – S03		0	0	0	0	1
Survey 2 – S07		0	0	0	0	3
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Survey 3 - S05		0	0	0	0	3

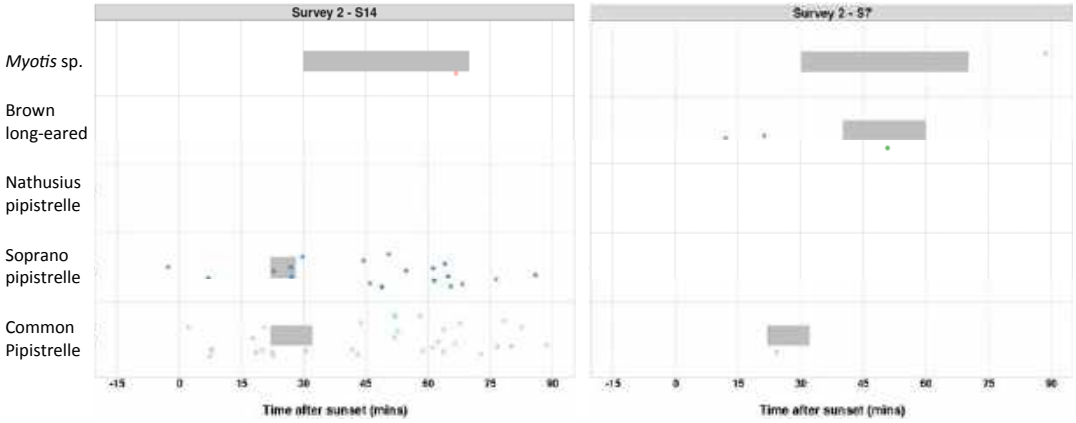

Chart 5: Time of bat passes from 15 minutes before to 90 minutes after sunset for locations S14 and S07 during the summer survey. Blue dots represent pass and grey bars indicate species-specific emergence time ranges.

The activity measured within the Site was all very low with no significant differences identified across the Site over the three survey seasons. Figure 3 - 7 presents the findings of the activity levels in a geographic context for each species highlighting once more the higher activity at the detector locations located at the habitat features (watercourse) and the comparative low activity levels across the Site.

Access Track Corridor

In contrast to the activity levels recorded at higher altitude on the open moorland habitats of the Turbine Envelope, activity levels along the proposed access track corridor were significantly higher at some locations (Chart 6). The position of the static detectors altered after the spring survey due to the proposed access track location evolving. Based on results from the deployed full spectrum detectors only, during spring the detectors located in the north and the central locations of the track recorded very low activity, whereas the detector located in the south of the track recorded high activity with a median of 48 passes per hour. This southern location was adjacent to a series of farm ponds with mature woodland surrounding and in comparison to the other locations offered highly suitable habitat for both foraging and roosting in nearby trees. Activity on a nightly basis was, however, highly variable.

During the summer and autumn surveys, detector locations were relocated to locations along the proposed access track route and overall habitat suitability at these locations was less suitable. As a result activity levels were significantly lower with median activity levels of up to ten passes per hour at the southern location and less than four passes per hour at the central and northern locations. Autumn supported less activity, with all locations supporting approximately two passes per hour.

It is worth noting that a total of six passes from Nathusius' pipistrelle were recorded across two separate dates within the access track corridor. The location is at the very edge of the known distribution for the species and very few records exist from this for north. The presence of the species is likely to be at very low densities and may be a result of a single bat passing through the area.

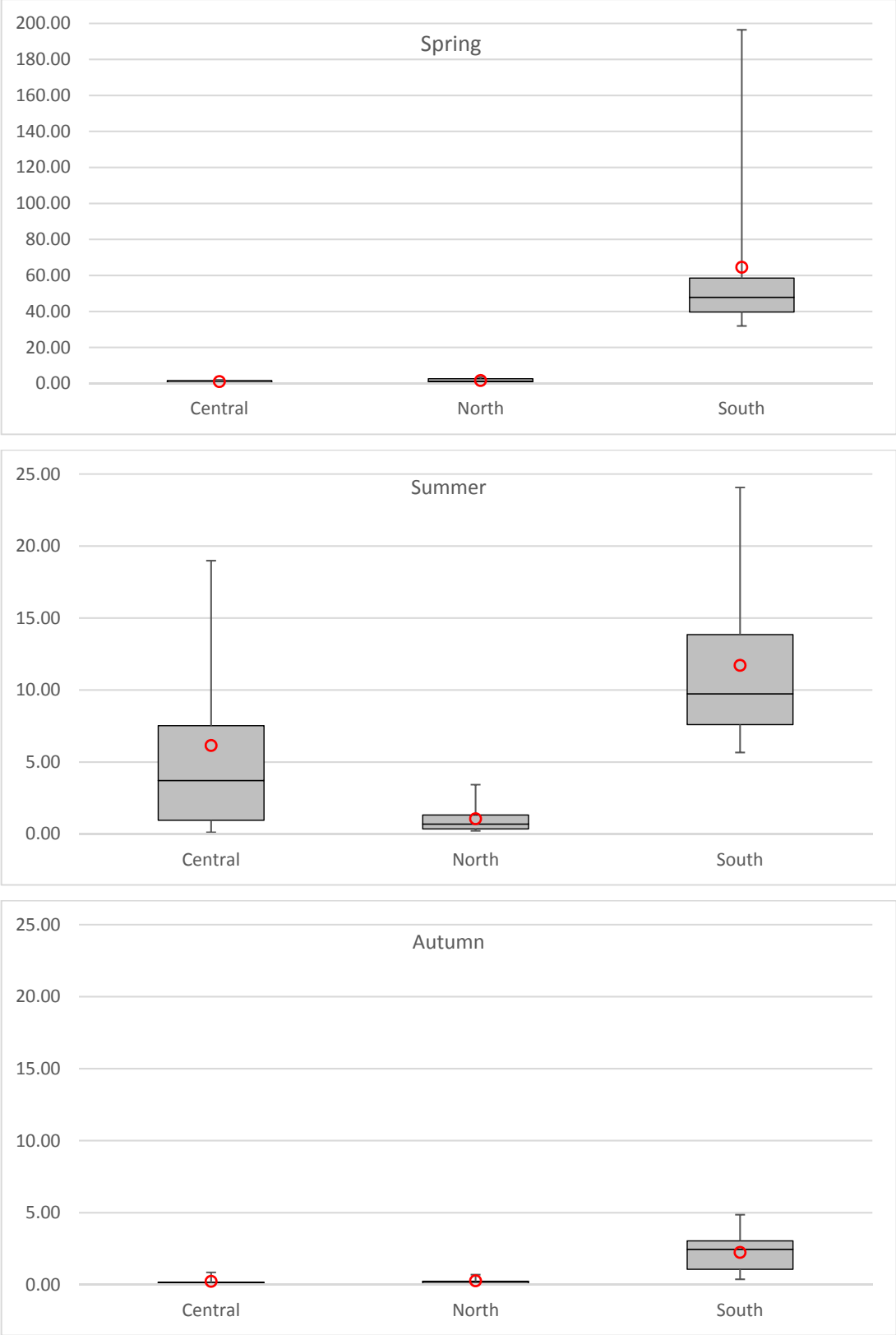

Chart 6: The median nightly pass rate (bat passes per hour) and mean (red circles) of all bats across survey seasons.

The activity levels of static detectors along the access track corridor supported significant activity from bats prior to the recognised specific emergence time ranges (Russ 2012) at a number of locations. In particular the activity at the southern location during spring recorded

extensive activity prior to recognised emergence times for common and soprano pipistrelle, *Myotis* sp. and brown long-eared bat (Chart 7). During summer and autumn the new locations of the detectors also recorded bat activity prior to recognised emergence times at the southern locations.

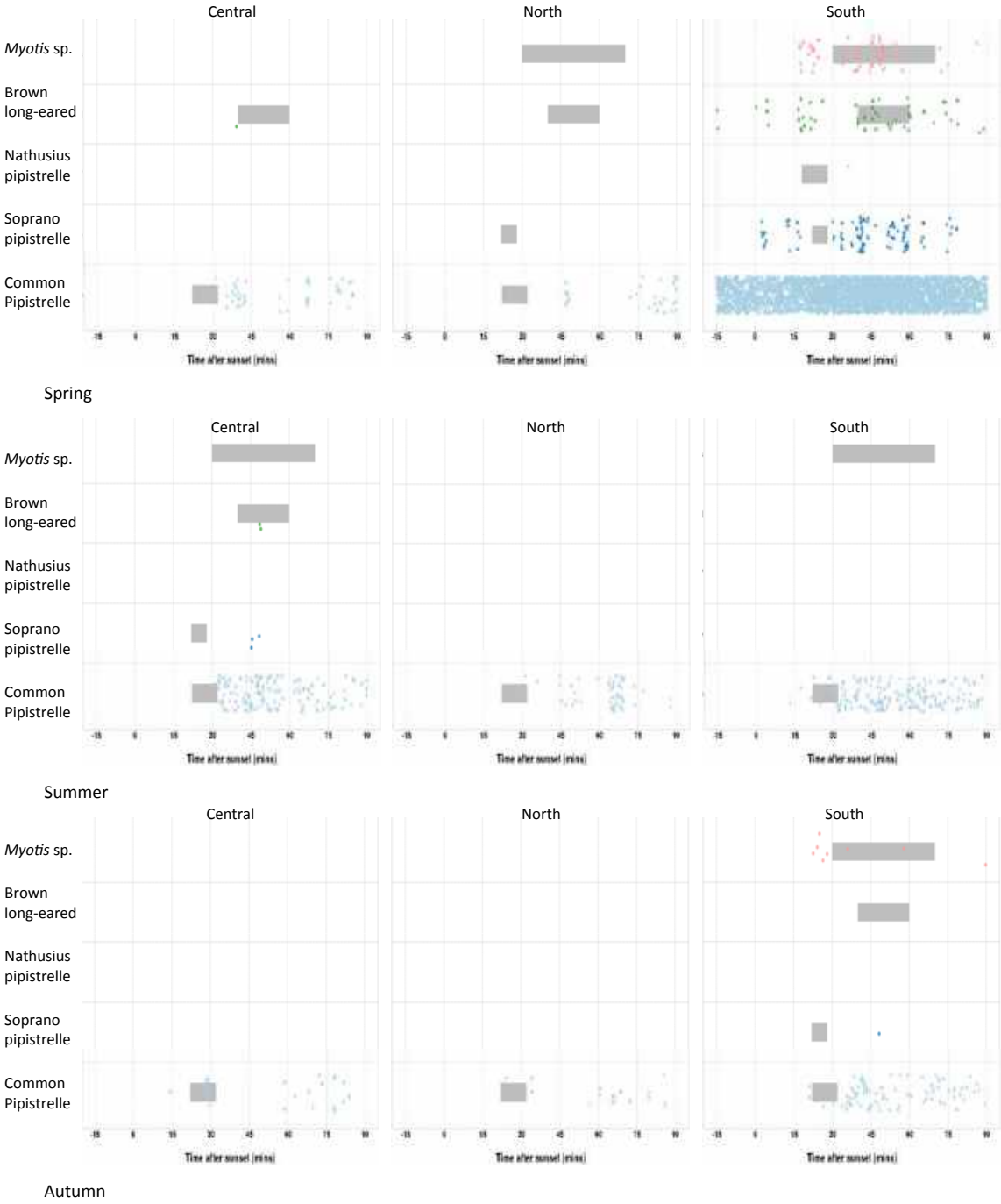

Chart 7: Time of bat passes from 15 minutes before to 90 minutes after sunset for access track locations. Blue dots represent pass and grey bars indicate species-specific emergence time ranges.

5 DISCUSSION

The proposed Kintradwell Wind Farm Site is characterized by an area of upland, exposed habitat which offers sub-optimal habitat for bats in terms of foraging and commuting. With

respect to roosting, the Site offers no significant potential within the Turbine Envelope, however, within the potential access route corridor a small non-breeding summer roost of common pipistrelle (supporting a single individual) was identified within the Kintradwell Bothy. If this bothy is to be affected by any works then it will be necessary to consider whether or not the roost will be disturbed or destroyed. If there is a risk of disturbance, then additional survey work and implementation of a Species Protection plan under a European Protected Species License or Bat Low Impact License will be required prior to works commencing.

Activity levels across the Turbine Envelope were very low with a total of 277 bat (all species) passes across all detectors over three deployment occasions. This resulted in median activity rates not exceeding one pass per hour across detectors located at turbines.

Activity levels along watercourses within the Turbine Envelope supported high activity levels with medians activity levels up to five passes per hour, but all these locations were greater than 250m from proposed turbine locations.

The majority of the activity within the Turbine Envelope was from common pipistrelle which is considered to be a species of high risk from wind turbine mortality. However, based upon these results it is concluded that the frequency of use of the Turbine Envelope and in particular the proposed turbine locations in exposed locations away from habitat features is low enough that the risk of killing and injury of bats from the wind turbines is very low.

In contrast, the detectors located at lower altitude along the access track route supported increased activity. The highest activity was located around the farm ponds during the spring survey session. This was not surprising as the location offered some of the best foraging and commuting habitat in the local area. Of note was the presence of Nathusius' pipistrelle on a small number of nights. This species is at the very edge of its range at this location and only a small number of records exist for this far north.

No roost locations within the access track corridor were identified and in general the habitat is of low suitability. However, there are a number of habitat edges and potential commuting routes crossing or located adjacent to the access track route. Of particular note is the potential habitat link east west across the access corridor at the location of the southern access route detector during the summer and autumn surveys. This location supports young woodland, hedgerows and stone walls (TNs 2, 3 and 4) which support comparatively high activity levels of up to 10 passes per hour during summer. It may be the case that this location provides a link between the Kintradwell Farm buildings and associated ponds and the Kintradwell Burn woodland corridor. As a result any construction through this location should seek to mitigate the works by improving linkages with appropriate planting and control of lighting. Any planting proposals at this location should seek to improve any canopy linkage over the new access road through maintenance and protection of existing trees/hedgerows with additional planting where required.

It should be noted that these results highlight the importance of the watercourses as commuting links and foraging resources. It is likely that the watercourses are utilised as a network and depending on weather conditions they are used to obtain access to the high ground within the Turbine Envelope area. Any landscape management plans proposed within the Site should minimise impacts on these features and seek to improve such areas where possible. However, it should be noted that altering the habitats close to turbines, increasing the suitability for use by bats (for example through woodland/scrub planting) should take this into account and generally be avoided within a minimum of 50m from turbine locations.

6 REFERENCES

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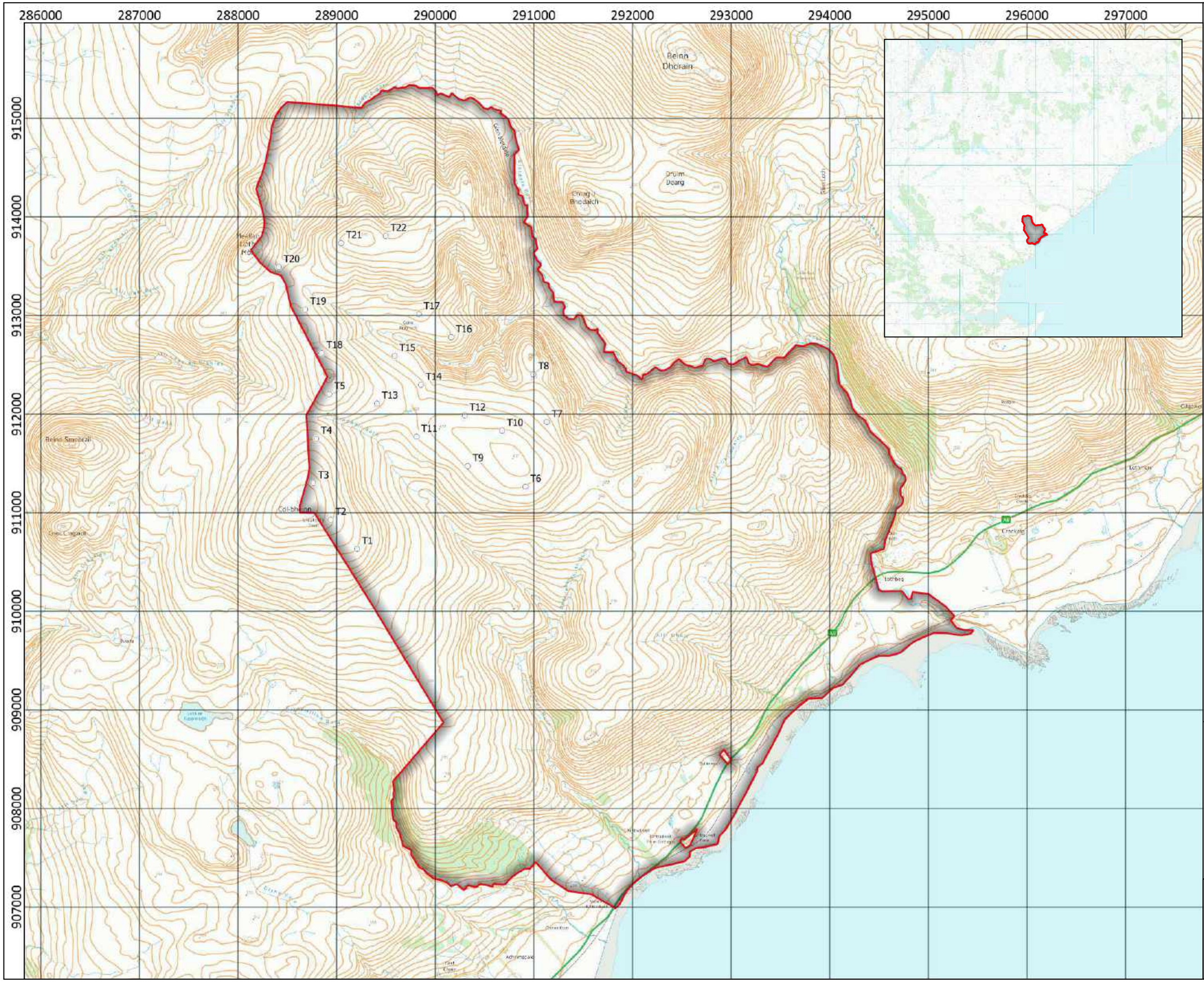
APPENDIX A – FIGURES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Drum Dearg
Beinn Smoirail
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Cnoc Bhreidaich
Cnoc Ghiarraidh
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Kintradwell Wind Farm, Sutherland

Figure 2: Habitat Assessment Results

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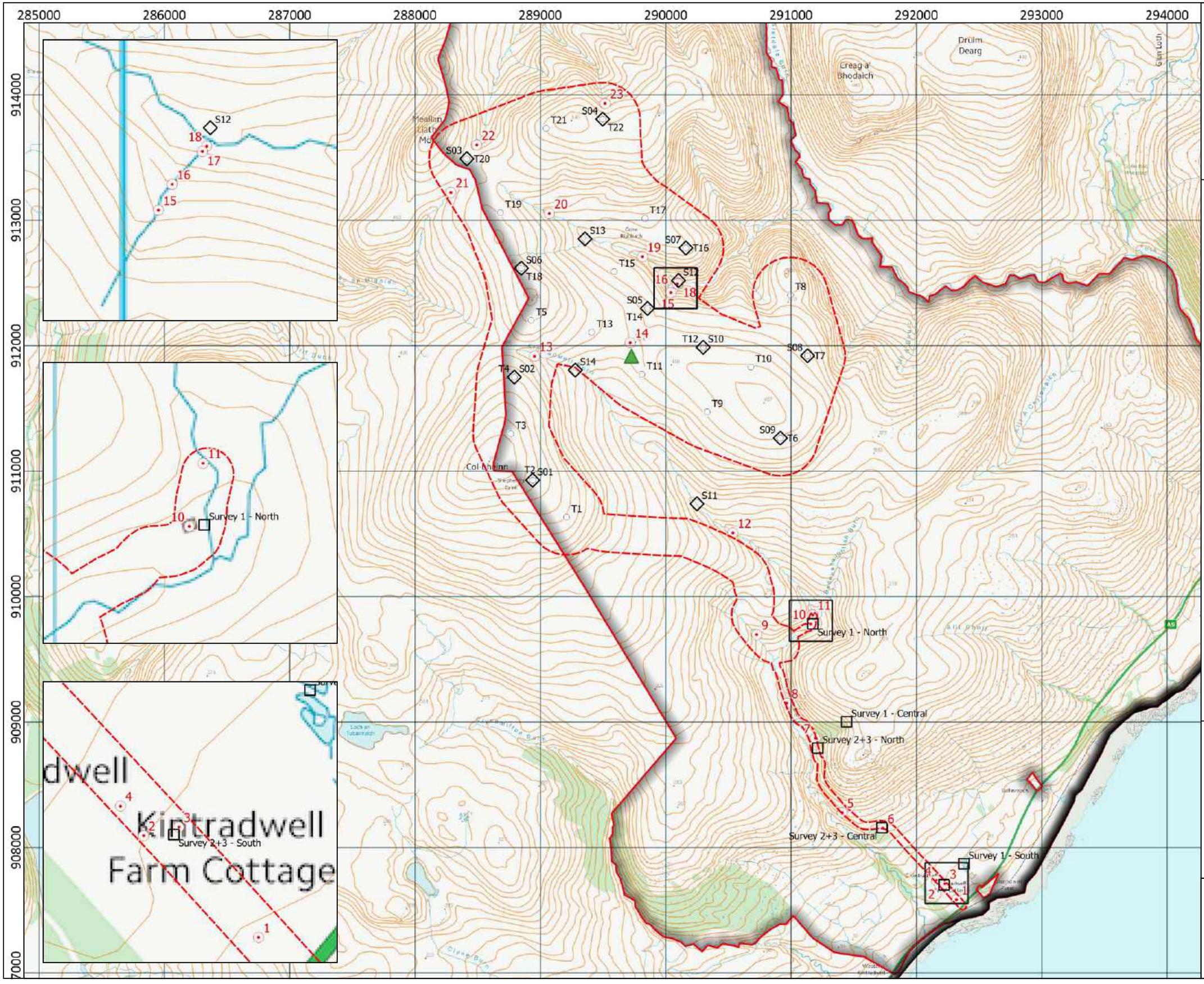

Legend

- Site Boundary
- Turbine Locations May 2019
- OS Contours (10m)
- Proposed Survey Area
- Turbine Envelope Statics
- Access Track Statics
- Target Notes
- Weather Station

TRACKS ecology

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Drawing number: 19/029/ITP/002
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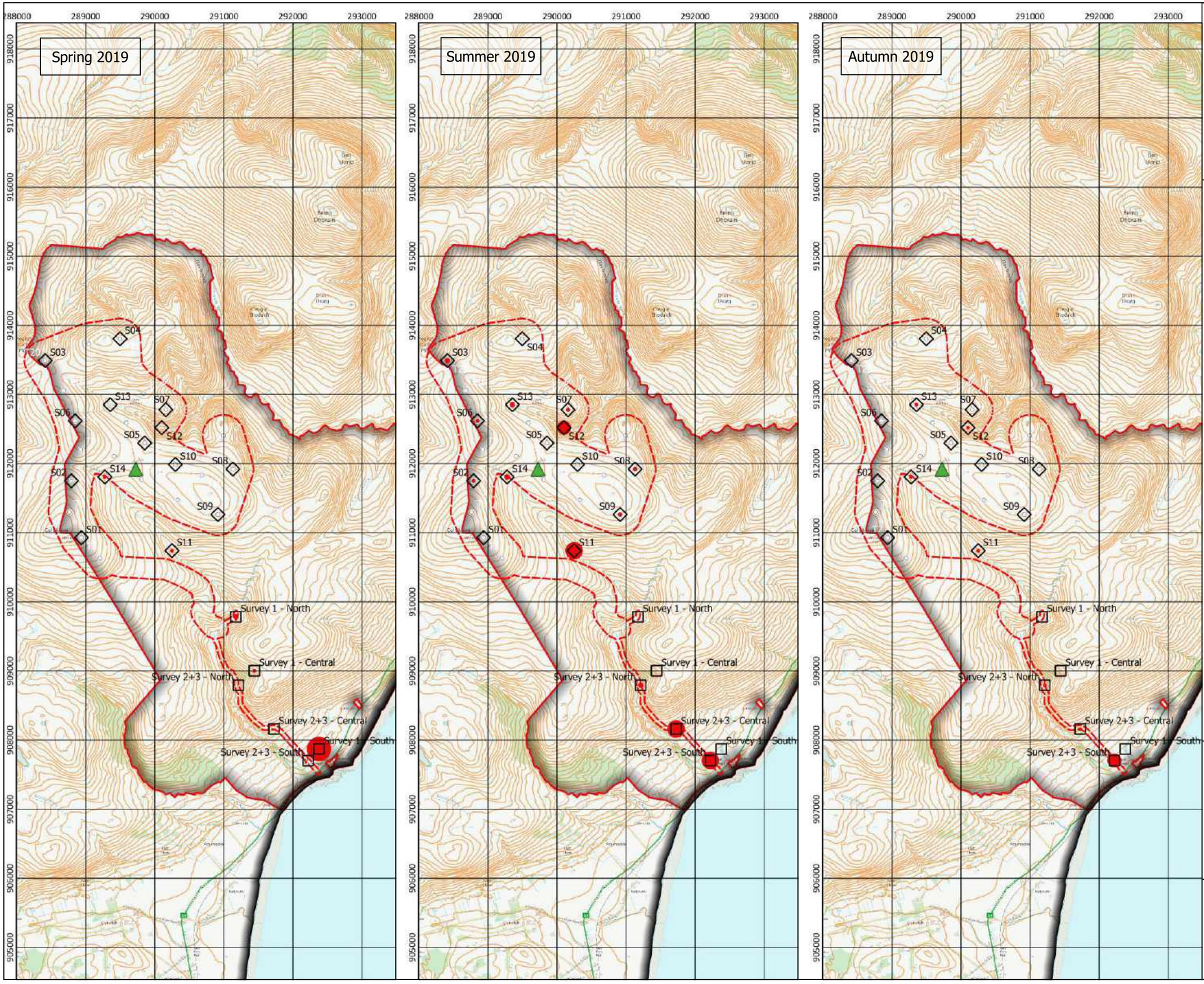

Kintradwell Wind Farm, Sutherland

Figure 3: Bat Activity Survey Results - Common Pipistrelle

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Legend

Proposed Access

- Site Boundary
- Survey Area
- Turbine Locations May 2019
- Turbine Envelope Statics
- Access Track Statics

Average bat passes per hour

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 55

TRACKS ecology

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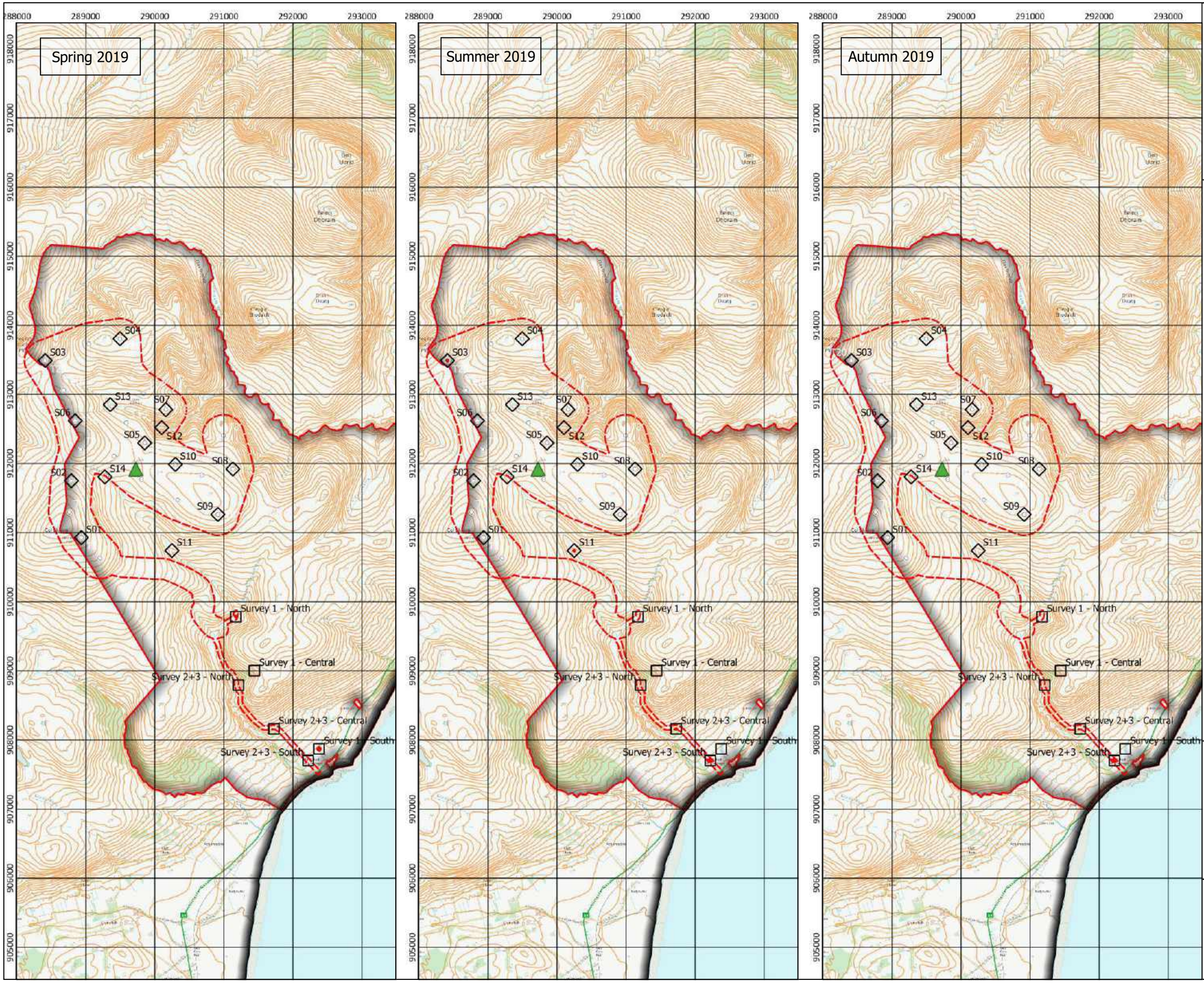

Kintradwell Wind Farm, Sutherland

Figure 4: Bat Activity Survey Results - Soprano Pipistrelle

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Legend

Proposed Access

- Site Boundary
- Survey Area
- Turbine Locations May 2019
- Turbine Envelope Statics
- Access Track Statics

Average bat passes per hour

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 55

TRACKS ecology

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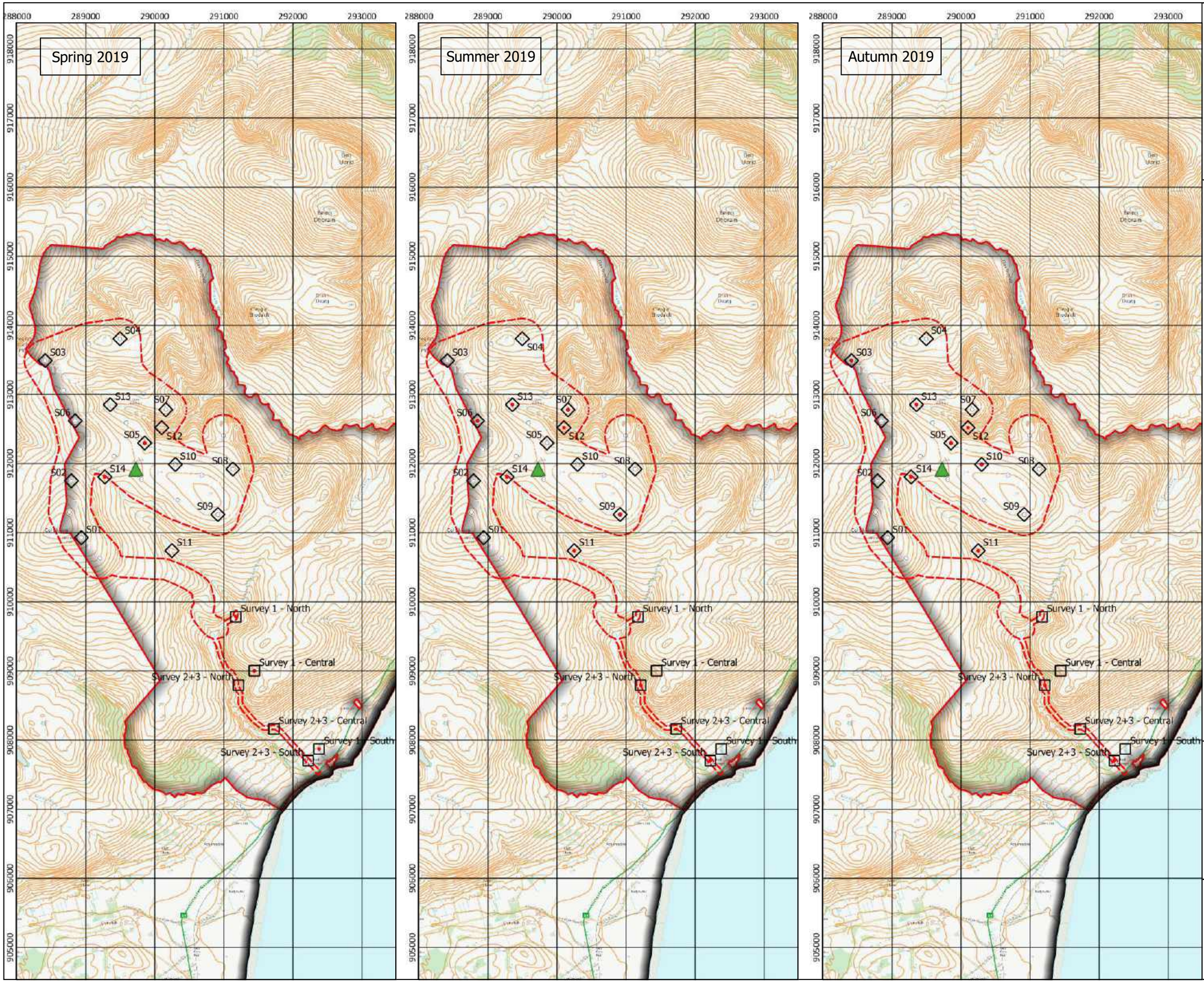

Kintradwell Wind Farm, Sutherland

Figure 5: Bat Activity Survey Results - Brown Long-eared Bat

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Legend

Proposed Access

- Site Boundary
- Survey Area
- Turbine Locations May 2019
- Turbine Envelope Statics
- Access Track Statics

Average bat passes per hour

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 55

TRACKS ecology

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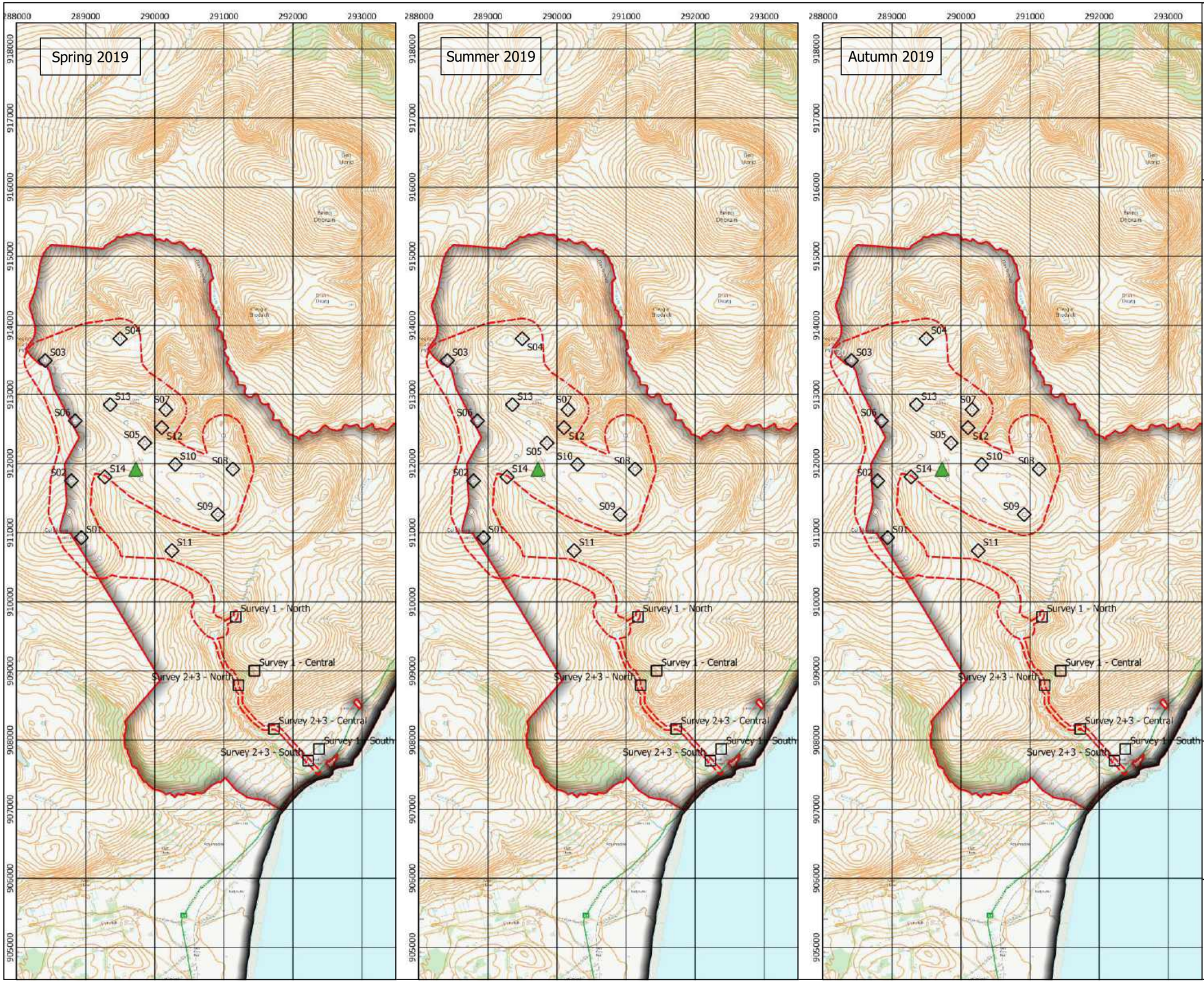

Kintradwell Wind Farm, Sutherland

Figure 6: Bat Activity Survey Results - Myotis sp.

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Legend

Proposed Access

- Site Boundary
- Survey Area
- Turbine Locations May 2019
- Turbine Envelope Statics
- Access Track Statics

Average bat passes per hour

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 55

TRACKS ecology

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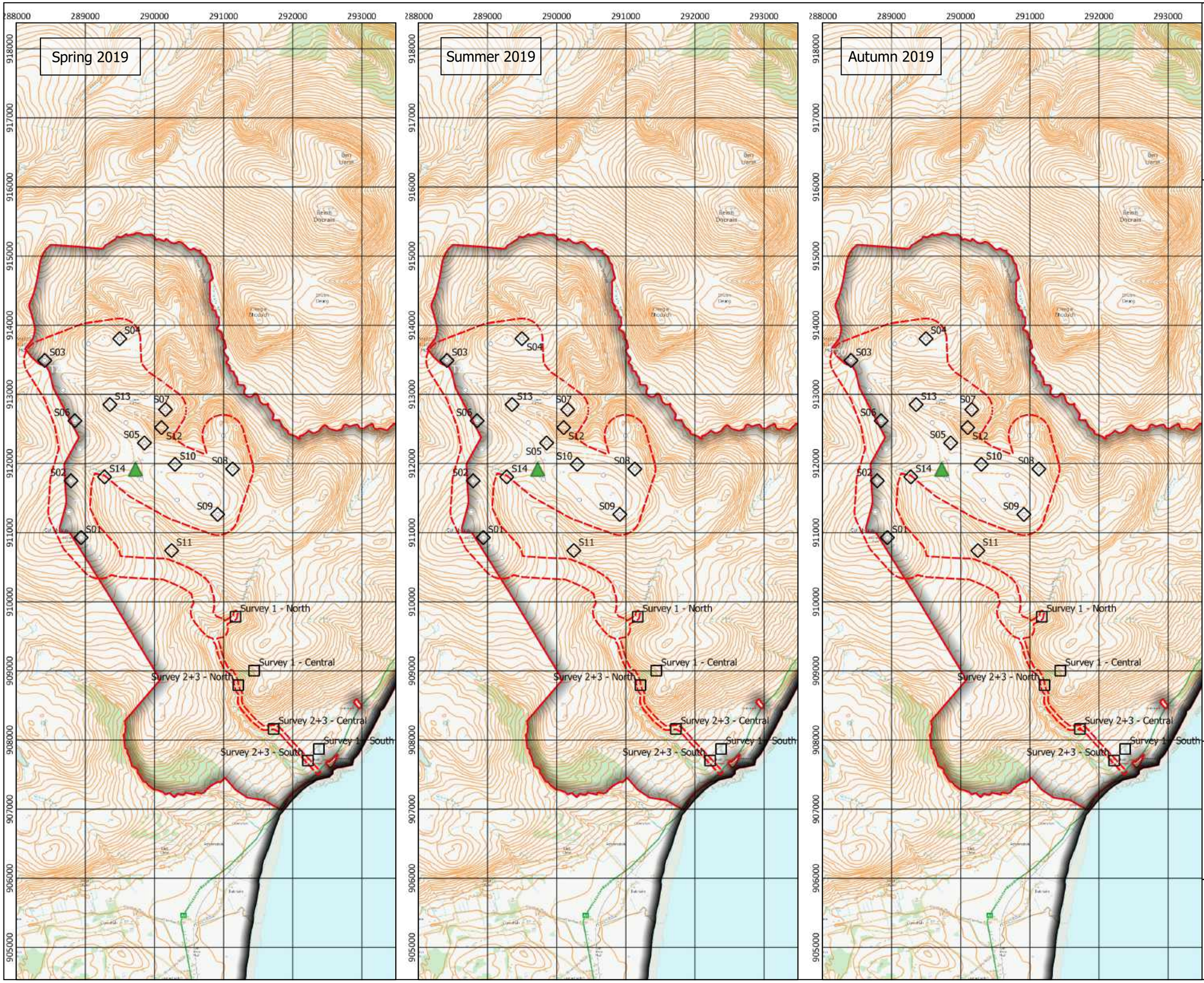

Kintradwell Wind Farm, Sutherland

Figure 7: Bat Activity Survey Results - Nathusius Pipistrelle

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Legend

Proposed Access

- Site Boundary
- Survey Area
- Turbine Locations May 2019
- Turbine Envelope Statics
- Access Track Statics

Average bat passes per hour

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 55

TRACKS ecology

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Kintradwell Wind Farm

Technical Appendix 8.5 – Electric Fish Survey Report

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Project/Proposal No:	GLA_1663
Version:	1.0
Date:	2020-11-10

Document Information

Project Name:	Kintradwell Wind Farm
Document Title:	Technical Appendix 8.5 – Electric Fish Survey Report
Client Name:	RES (Renewable Energy Systems Limited)
Client Contact:	John Appleton
Client Address:	Beaufort Court, Egg Farm Lane, Kings Langley, Hertfordshire, WD4 8LR
Document Status:	Final for Issue
Author:	Waterside Ecology
Reviewed:	R King
Approved:	R King
Date:	2020-11-10
Version:	1.0
Project/Proposal Number:	GLA_1663
ITPEnergised Office:	4th Floor, Centrum House, 108-114 Dundas Street, Edinburgh, EH3 5DQ

Revision History

Version	Date	Authored	Reviewed	Approved	Notes
1.0	2020-11-10	Waterside Ecology	R King	R King	Final for Issue

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Kintradwell Wind Farm:

Survey of fish habitats and populations

Commissioned Report to ITPEnergised

August 2020

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Kintradwell Wind Farm: fish habitats and populations

Commissioned Report to ITPEnergised, August 2020

Contractor: Waterside Ecology

SUMMARY

Background

This survey of fish habitats and populations was commissioned to inform the Environmental Impact Assessment report for the proposed Kintradwell Wind Farm in east Sutherland. The proposed wind farm would be constructed on hill ground to the north of Brora, and takes in the upper reaches of two catchments, the Kintradwell Burn and the Sletdale Burn, the latter being a tributary of the Loth Burn.

Methods

A qualitative walkover survey of stream habitats was carried out in July 2020. Photographs and target notes were taken, and the habitat was scored on its overall quality for salmonid (salmon and trout) fry and parr. Major obstacles were recorded. The habitat survey was followed by an electric fishing survey of suitable and representative habitats, also conducted in July 2020.

The habitat survey covered the following reaches:

- Kintradwell Burn from NC 921 073 to NC 887 120 (sea to headwaters).
- Sletdale Burn (lower) from NC 924 125 to NC 912 132.
- Sletdale Burn (upper) from NC 891 148 to NC 886 141.
- Allt a' Choire Riabhaich from NC 912 132 to NC 886 133.

Main findings

<u>Kintradwell Burn Catchment</u>

- No clearly impassable natural barriers were recorded along the course of Kintradwell Burn other than in the upper headwaters. This suggests that sea trout may have access at least as far upstream as a hydro intake, located approximately 3 km upstream of the NTL as measured along the channel.
- Much of Kintradwell Burn provides good quality habitat for trout and pockets of potential spawning habitat are widespread. Wet width in the lower reaches is approximately 3 m and the stream is clearly more suited to trout than to salmon. The stream is largely stable other than in the lower reaches and fish production potential was judged to be high.
- The upstream limit of potentially suitable habitat is where the channel becomes dry at NC 9013 1094.
- Electric fishing surveys indicated that the fish community of Kintradwell Burn comprises brown trout and European eels. No other species were seen or captured.
- Trout parr densities at all sites where fish were present were excellent by regional standards. Trout fry densities were excellent at the two lower sites, but poor further upstream. No fish were present at the most upstream site, which was located at NC 9018 1080, approximately 150 m downstream of the upper limit of potentially suitable habitat.
- Overall, the data confirm the results of a previous survey indicating that Kintradwell Burn is a highly productive trout stream. As there is access to the sea, the trout population may support a sea trout stock component.

- A proposed crossing point for the access track is located in a reach of good quality trout habitat. It is recommended that disruption to the streambed at this location should be minimised and that fish movement should not be impeded. A crossing in the headwaters is above the upstream limit of potentially productive habitat,

Loth Burn Catchment

- A waterfall at NC 9457 1076 (~ 0.5 km upstream of A9 road) marks the natural upstream limit for migratory salmonids and probably also for eels. Therefore migratory salmonids do not have access to the stream reaches around the proposed turbine array and associated track network via the Loth Burn.
- In its lower reaches (downstream of the Allt a' Choire Riabhaich confluence) Sletdale Burn has a wet width of 3 to 4 m. It is well suited to trout production. Electric fishing found excellent densities of trout fry and parr in this reach.
- Upstream of the Allt a' Choire Riabhaich confluence the Sletdale Burn appears well suited to trout production. The upper limit of suitable fish habitat is approximately at NC 886 137. Trout were present at two electric fishing sites in the upper reaches. No other fish species were recorded.
- Trout habitat quality in Allt a' Choire Riabhaich is variable, but almost the entire stream is suitable for trout production. The upstream limit of potentially suitable habitat for trout in Allt a' Choire Riabhaich is ~ NC 892 130, by which point some of the flow is beneath the turf and there is little or no bedload. Much of the channel further upstream was dry at the time of survey.
- Three sites on Allt a' Choire Riabhaich were surveyed by electric fishing. Fish were absent from the most upstream site, which was close to the upper limit of suitable habitat. Trout parr densities were excellent at the other two sites, but fry were found only at the most downstream site.
- Two proposed stream crossings were assessed, both in the upper drainage of Allt a' Choire Riabhaich. These are well upstream of the upper limit of suitable fish habitat, either in wet flush or amongst indistinct channels in eroded peat.

The findings are discussed in relation to the proposed development and a number of recommendations are made for mitigation.

1 Introduction

1.1. Proposed development

This survey of fish habitats and populations was commissioned to inform the Environmental Impact Assessment report for the proposed Kintradwell Wind Farm in east Sutherland. The proposed wind farm is anticipated to have 15 turbines and would be constructed on hill ground to the north of Brora, immediately to the east of the existing Gordonbush Wind Farm. The turbine layout extends over approximately 5 km² of open hill ground, and takes in the upper reaches of two catchments, the Kintradwell Burn and the Loth Burn. The Kintradwell Burn drains the site to the south, and the Sletdale Burn and its tributary the Allt a' Choire Riabhaich, both tributaries of the Loth Burn, drain the northern and eastern parts of the site. Access to the site would be from the A9 via a track running close to Kintradwell Burn.

1.2. Fish populations

1.2.1. Species presence

Some fish surveys have previously been carried out in both the Kintradwell Burn (Waterside Ecology 2010) and the Loth Burn (Waterside Ecology 2013). The surveys found that Kintradwell Burn was populated with trout and European eels. Trout densities in Kintradwell Burn were unusually high for the region, suggesting the burn is very productive. The Marine Scotland Science scoping response suggests that there may be an obstacle in the lower reaches, however the burn was walked during the current survey and no natural obstacle was found in the lower reaches; it therefore seems likely that the burn is accessible to migratory fish, and that the trout population may include a sea trout stock component.

The Loth Burn was found to support populations of Atlantic salmon, trout and European eels. A waterfall upstream of the A9 is impassable, so migratory species do not have access to Glen Sletdale or to the streams around the proposed wind farm infrastructure.

1.2.2. Conservation status

The Atlantic salmon is listed on Annexes IIa and Va of the EU Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (known as the Habitats Directive). Atlantic salmon receive protection, particularly from over-exploitation, under the Bern Convention (Appendix 3). Salmon in Scotland receive further protection from Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. This covers a number of regulatory areas, including legal methods of fishing and offences, close times and protection of juvenile and spawning salmon. The Atlantic salmon is listed vulnerable on the IUCN red list.

Due to recent declines, eels are of increasing conservation interest and are protected by European (EC No 1100/2007) and Scottish (Freshwater Fish Conservation (Prohibition on Fishing for Eels) (Scotland) Regulations 2008) legislation. The latter makes it illegal to take eels without a license from the Scottish Government. European eels are listed as critically endangered on the IUCN Red List.

Atlantic salmon, brown trout (including sea trout) and European eel are listed as priority species on the UK and Scottish Biodiversity Action Plan lists.

1.3. Habitat requirements

1.3.1. Salmon and trout

The physical habitat requirements of juvenile salmonids are reviewed by e.g. Crisp (1993), Hendry & Cragg-Hine (2003), Klemetsen *et al*. (2003), Summers *et al*. (1996) and Youngson & Hay (1996). Trout and salmon spawn in late autumn and early winter, depositing their eggs in redds excavated in gravel and pebble substrates. Eggs are often deposited in areas of accelerating flow, such as the tails of pools and glides, upstream from riffles. However, in upland streams eggs may be deposited in any areas of

gravel that can be physically moved. A good supply of oxygen is essential for eggs to develop and this is facilitated by a flow of water through the gravel. Clogging with fine sediment such as silt and fine sand reduces water flow resulting in egg mortality due to lack of oxygen. Egg survival is also affected by redd 'washouts' during winter spates – the direct, physical, scouring out of eggs from the gravel. Substrate stability, the dynamics of water flow and the weather all determine the extent of siltation and washouts.

After hatching the young fry remain in the gravel, absorbing nutrient from the remaining yolk sac. On emergence, usually between March and early May, the young fry disperse and set up territories which they defend aggressively. Salmon fry prefer fast flows (>30 cm/s) and favour areas with surface turbulence (riffle habitat). They require a rough bed of pebble, cobble and gravel. Trout fry prefer areas of relatively low velocity water near the streambed. Cover from stones, plants or debris is required and good cover is essential for maintaining high fry densities.

Salmon that have survived their first winter (parr) prefer deeper water than fry (typically 15-40 cm) and a coarser substrate of pebbles, cobbles and boulders. Trout parr generally favour areas of relatively low current speed where cover is available. Juvenile trout are often to be found in cover alongside the banks, in undercuts, among tree roots or in marginal vegetation. Cover remains important for adult trout and salmon particularly in smaller streams. In larger rivers and lochs this may be less important, as deep water provides refuge.

1.3.2. Eels

Eel habitat requirements have received less attention than those of salmonid fish. Tesch (1977) suggests that so long as temperature and oxygen requirements are met, there are few stretches of water that are not suitable for eels. The main requirement for eels is cover, as they are averse to light and require suitable refuges during daylight hours. Eels of different size show different substrate preferences. Larger eels require large hollows, crevices or weed beds whereas small eels are sometimes abundant in cobble substrates, where they can burrow between the stones. Tree stumps, roots and other large structures provide ideal cover for eels. Eel diet is diverse, but the majority of the diet consists of benthic species (Moriarty 1978; Kottelat & Freyhof 2007).

2 Survey needs

Generic guidance from Marine Scotland Science (MSS) in relation to fish data in Environmental Statements for wind developments (Marine Scotland Science 2015) states that:

> *In order that MSS- FL can assess the potential impact of developments the developer should provide information on all species and abundance of fish within the development area and on fisheries which depend on these.*

The above principle underpins current guidance (Marine Scotland Science 2018). In relation to proposed Kintradwell Wind Farm, the scoping response from Marine Scotland (letter from Dr Emily Bridcut, 28th April 2020) has requested:

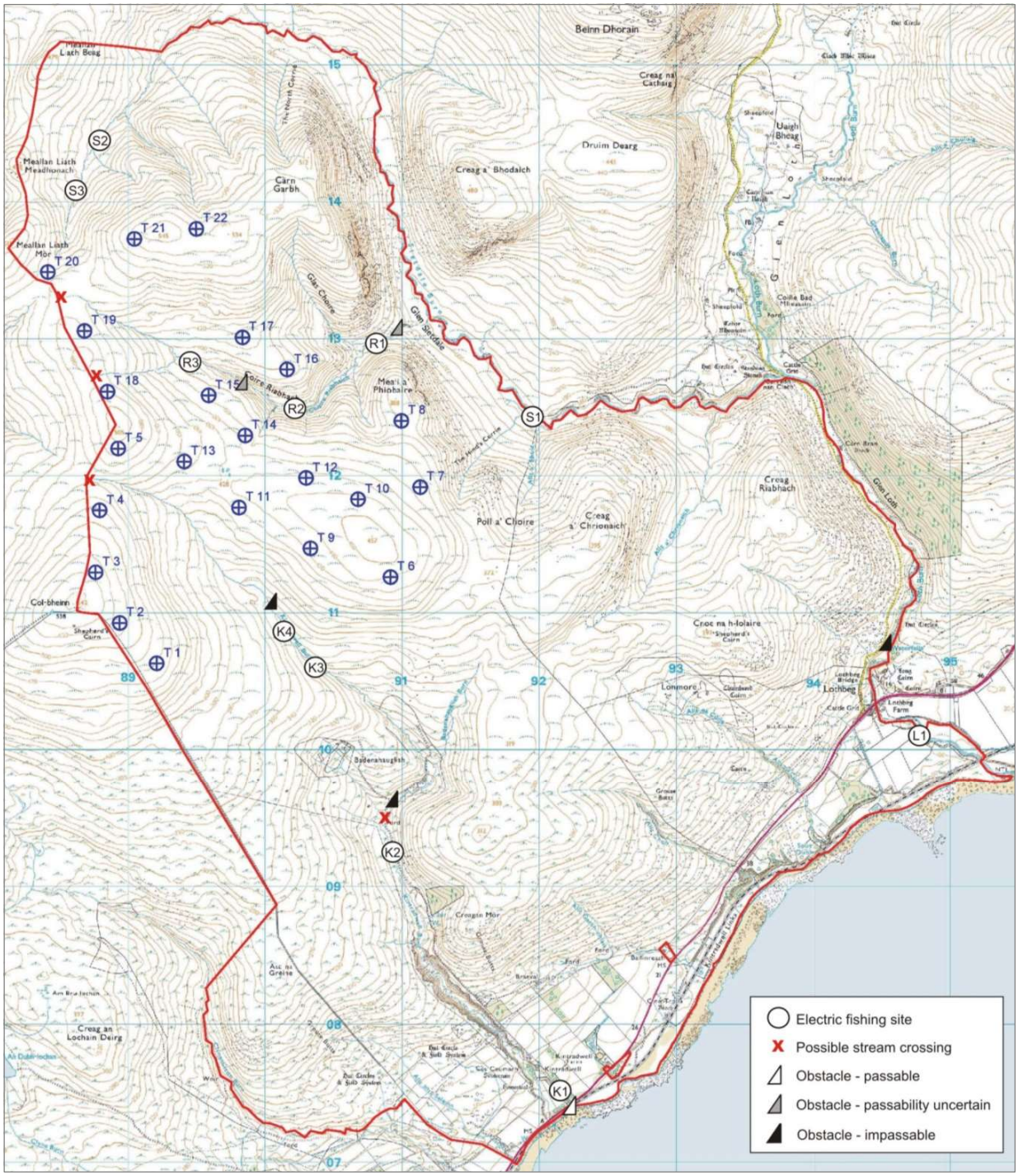
- Site characterisation surveys including electric fishing within and downstream of the site boundary;
- Consideration of cumulative impacts;
- That the developer should contact the relevant DSFB to seek advice on local fisheries.

3 Aims and objectives

Typical concerns potentially arising in relation to wind farm impacts on freshwater fish and other aquatic fauna include increased sediment transport, changes to habitat or invertebrate species, and obstruction to upstream and downstream migration e.g. at stream crossing locations. Since changes to water quality

can extend well downstream of their source, the current assessments included some stream reaches outside as well as within the proposed wind farm site.

Figure 1 Map of study area showing indicative layout of the proposed Kintradwell wind farm



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The overall aim of the study was to provide data on fish habitats and populations in streams within and immediately downstream of the proposed Kintradwell Wind Farm, particularly in those reaches that might potentially be affected by changes in water quality resulting from the wind farm development. These data were collected to guide the Environmental Impact Assessment report for the site. The primary target species were salmonids (salmon and trout). Specific objectives were to:

(i) Broadly identify the distribution and quality of fish habitats within and immediately downstream of the site;

(ii) Conduct electric fishing at a representative series of sites in order to characterise the fish communities in potentially impacted watercourses;

(iii) Carry out detailed assessment of proposed watercourse crossings, where these potentially impact directly on fish habitats.

4 Methods

4.1. Habitat survey

4.1.1. Survey dates and reaches

The habitat surveys of the Kintradwell Burn, Sletdale Burn and Allt a' Choire Riabhaich were carried out between 13th and 16th July 2020. Survey conditions were good with low to moderate flows and good light. Survey reaches are listed in Table 1.

Table 1 Stream habitat survey reaches

Catchment	Watercourse	Downstream	Upstream	Approx. length
Kintradwell	Kintradwell Burn	NC 921 073	NC 887 120	7.5 km
Loth	Sletdale Burn (lower)	NC 924 125	NC 912 132	2 km
Loth	Sletdale Burn (upper)	NC 891 148	NC 886 141	1 km
Loth	Allt a' Choire Riabhaich	NC 912 132	NC 886 133	3.5 km

4.1.2. Stream crossing assessments

Reaches with the potential to be directly impacted by the proposed development (in this case, stream crossings) were surveyed by quantitative walkover. Methods were based on protocols described by Hendry and Cragg-Hine (1997), Summers *et al*. (1996) and SEPA (2010a). These characterise in-stream habitats according to depth, substrate, flow and thus suitability for different age classes of salmonid fish (Table 2). Quantitative survey extended 50 m upstream and 100 m downstream of proposed crossing points. Data were collected on substrate composition, flow types and depths. Areas of suitable spawning substrate were recorded using the SFCC protocol (SFCC 2007). The location of individual patches was recorded with GPS and marked on the field maps. Other variables recorded in each survey section were: (i) up and downstream grid reference, (ii) wet width, (iii), stability of substrate and compaction of substrate. The availability of cover for fish alongside banks was recorded as this can be an important factor in determining trout density, particularly in habitats where cover on the streambed is sparse.

Table 2 Habitat categories used for walkover survey

Habitat category	Description
Fry habitat	For salmon, shallow fast flowing habitat with substrate of pebble and cobble. For trout, shallow slow flowing habitats with substrate of pebble and cobble.
Mixed juvenile habitat	Habitats with mixed depth and coarse substrates including cobble, boulder and pebble that provide cover for salmonid fry and parr. Depth typically 10 to 50 cm.
Glide	Low gradient channel with small substrates. Lacking cover for fish. Productive if instream macrophytes or bankside cover are present.
Deep pool	Over 1 m deep. Slow or eddying current. Suitable for adult salmonids if cover is present. If >1 m deep cover may be less important, as depth can provide refuge.
Bedrock	Sheet bedrock or compacted earth covering majority of streambed. No cover. Unproductive for fish.
Hardpan	Non-standard classification. Stream form is down-cut gully scoured to hard, immobile streambed. Usually in upper reaches of first order streams. Unproductive for fish.

Habitat category	Description
Peat channel	Non-standard classification. Simple incised channel through peat and earth with no hard substrate. Unproductive for fish.
Spawning	Ideally well oxygenated, stable & not compacted. Typically comprising gravel and pebble. Fines (sand & fine gravel <2 mm) less than 20%. Not silted.

4.1.3. Qualitative surveys

Away from stream crossings the walkover surveys comprised non-quantitative assessments of the distribution and quality of stream habitats. Qualitative surveys involved walking the streambanks and taking notes on the nature of stream habitats and their potential for fish production. Habitats were not mapped or quantified in reaches surveyed qualitatively. Significant obstacles were recorded mainly where these might determine the fish species present. Their likely passability for adult salmonids was assessed based on published guidance (SEPA 2010, SNIFFER 2010). The walkover sought to identify whether impassable barriers are present in the lower reaches on Kintradwell Burn, as this would determine its accessibility or otherwise for migratory sea trout (and potentially Atlantic salmon).

Photographs were taken of representative habitats in each stream. In addition, surveyors made subjective assessments of typical habitat quality for juvenile trout in each reach, based on published habitat requirements and many years' experience of electric fishing in streams throughout Scotland.

There are no recognised UK protocols for assessing habitat suitability for European eels. Eels have a very broad habitat niche and their main requirement other than a food source is cover. This may take the form of stones, roots or vegetation but eels also have the ability to bury themselves in soft streambeds. The presence of suitable climbing substrate for eels was considered during any obstacle assessments (see SNIFFER 2010).

4.2. Electric fishing survey

4.2.1. Field survey

Fish populations were surveyed by electric fishing between 13th and 16th July 2020. Surveys were conducted mainly using semi-quantitative methods as described by Scottish Fisheries Co-ordination Centre (SFCC 2014). A single electric fishing run was conducted at semi-quantitative survey sites. Two fully quantitative sites were surveyed: one on Kintradwell Burn and one on Loth Burn in order to provide an index of survey efficiency. One qualitative survey was carried out in the upper reaches of Kintradwell Burn and another in Sletdale Burn in order to identify the approximate upstream limit of trout distribution. Sites are listed in Table 3 below and are shown on Figure 1 above.

Table 3 Locations of electric fishing sites

Site code	Watercourse	NGR	Survey type
K1	Kintradwell Burn	NC 92063 07326	Semi-quantitative
K2	Kintradwell Burn	NC 90912 09341	Fully quantitative
K3	Kintradwell Burn	NC 90353 10611	Semi-quantitative
K4	Kintradwell Burn	NC 90185 10801	Qualitative
L1	Loth Burn	NC 94795 10099	Semi-quantitative
S1	Sletdale Burn	NC 91940 12435	Fully quantitative
S2	Sletdale Burn	NC 88793 14428	Semi-quantitative
S3	Sletdale Burn	NC 88630 14040	Qualitative
R1	Allt a Choire Riabhaich	NC 90835 12990	Semi-quantitative
R2	Allt a Choire Riabhaich	NC 90180 12489	Semi-quantitative
R3	Allt a Choire Riabhaich	NC 89501 12821	Semi-quantitative

All electric fishing sites covered the full stream width and incorporated a representative range of habitat types. Sites were surveyed using a single anode. Fish were captured in hand-held dip nets then placed

in bins of clean water where they were held until ready for processing. Fish were anaesthetised for handling and were identified to species. Salmonid fork length was measured to the nearest millimetre as was eel total length. All fish were allowed to recover fully in clean water before being released back into the survey reaches.

Habitat descriptions were made at fully- and semi-quantitative survey sites using the SFCC (2014) protocol.

4.2.2. Data analyses and presentation

All fish densities are expressed as fish per 100 square metres of wetted stream area (fish.100m^{-2}). Salmonid densities are presented separately for fish fry and parr. Throughout this report the term 'fry' is used for salmonid fish in their first year of life (i.e. fish aged 0+ years). The term 'parr' is used for juvenile salmonid fish aged 1 year or older.

The classification provided by Godfrey (2006) is used to describe fish abundance in a regional context. The classifications are based on large data sets held by Scottish Fisheries Co-ordination Centre (SFCC). The quintile ranges of salmon and trout densities (Appendix 8.1) allow for comparison of fishery performance against regional and national reference points. The classification system is based on semi-quantitative fishing i.e. density based on number of fish captured during a single electric fishing run through an undisturbed site. Different classifications are provided for stream of various widths.

5 Results

5.1. Kintradwell Burn

5.1.1. Obstacles to fish migration

Potential obstacles to fish migration are listed in Table 4 below. The most downstream of these is the bridge footing beneath the railway at the tidal limit. The stream flows beneath the bridge over a rough masonry footing. This is uneven and at the time of survey depth was between 5 and 10 cm. Current speed was moderate and the slope is gentle, and the footing itself appeared passable to sea trout. A jump of approximately 40 cm is required at the downstream end and there is no plunge pool. However, the strand line suggests it will inundate on a high spring tide, making the obstacle passable. A photograph is provided in Appendix 8.2.

The stream was walked from the railway upstream and no further significant obstacles were encountered until the intake weir at NC 9091 0955, some 3.5 km upstream of the tidal limit. There is no fish pass on the weir and it seems likely to be impassable based on the height of the weir face (0.9 m) and the shallow depth of the plunge pool beneath this (0.2 m). Hand-off flow is provided by an orifice in the weir face set at a height of approximately 0.5 m above the plunge pool, but this is not suitable for upstream fish passage.

A rock ramp at NC 9033 1064, approximately 2 km upstream of the weir, presents a substantial obstacle to trout. It is non-vertical and there is no deep plunge pool beneath. At the time of survey it was impassable but due to the complex shape of the rocks and ledges it is conceivable that ascent may be possible on elevated flows. The rock ramp is 0.4 km downstream of the absolute potential upstream migratory limit, which the dry channel NC 9013 1094. At the time of survey no surface flow was apparent upstream of this location.

The distribution of obstacles suggests that sea trout may have access at least as far upstream as the hydro intake, which is approximately 3.5 km upstream of the NTL as measured along the channel.

Table 4 Potential obstacles to fish migration, Kintradwell Burn

NGR	Type	Assessment	Comment
NC 9209 0729	Railway bridge footing	Passable	Rough bed with some depth variation. Depth at time of survey approximately 5 cm. 30 cm high step at downstream end seems likely to inundate on high spring tide. Passable on high tide and moderately elevated flow.
NC 9091 0955	Intake weir	Impassable	Two steps. Lower step height = 0.55 m with 20 cm deep pool below. Second step 0.9 m with 20 cm deep pool. Second step dry at weir crest. Hands-off flow provided via pipe through weir face.
NC 9033 1064	Waterfall/rock ramp	Uncertain	0.9 m high with no plunge pool. Non vertical. Complex rapid split by large boulders. Flows in spate difficult to predict.
NC 9013 1094	Dry channel	Impassable	Long section of dry channel. There is likely to be some flow below the ground but clearly impassable. No suitable habitat/wetted channel further upstream.

5.1.2. Salmonid habitats

The first 2.5 km of stream above the NTL largely runs through a steep-sided, V-shaped valley. The streambed and banks are rather unstable but despite this cover for salmonid fish and eels is good due to the preponderance of cobble and boulder substrates. The first 0.7 km of stream bank upstream of the NTL is heavily wooded and tree roots, undercuts and woody debris provide further cover. Electric fishing site K1 was placed in this reach. No extensive areas of spawning habitat were recorded in the lower burn but small pockets of suitable material are widespread and some of these appear quite stable. Overall, the reach has good potential for fish production. Wet width is typically 2 to 4 m.

The valley opens out at NC 911 086. From here to the bothy at NC 911 098 the stream channel is meandering and stable, with low grassy banks. Substrate is mainly of cobble, boulder and pebble. The boulder and larger cobbles are mossy, suggesting long term stability. Pockets of spawning habitat are widespread and habitat quality for trout appears excellent. Many fish were seen in this reach during the walkover survey and fish production potential is clearly high. Electric fishing site K2 is in this reach.

From the bothy to the rock ramp at NC 903 106 the stream is meandering. Parts of the channel are entrenched but while there are short reaches of bedrock the majority of habitats appear well suited to trout and eels. As in the reaches further downstream pockets of spawning calibre substrate were found to be widespread. Wet width is typically between 1.5 and 3 m. Flow types are varied, ranging from riffle glide sequences in the lower part of the reach near the bothy to a more step-pool type morphology with associated runs and pool further upstream. Electric fishing site K3 was placed in the steeper step-pool habitat towards the upstream end of this reach and straddled the rock ramp.

Upstream of the rock ramp habitat quality is rather poor. Stream width is 1 to 1.5 m and the step-pool habitat gives way to shallow, boulder and cobble-dominated run and glide with little spawning potential. At the time of survey the channel upstream of NC 901 109 was largely dry and clearly entirely unsuited to fish production. Electric fishing site K4 was located approximately 150 m downstream of the dry channel.

Photographs of the above reaches are provided in Appendix 8.3.

5.1.3. Fish populations

Trout and eels were recorded on the Kintradwell Burn but salmon were absent from samples.

Trout fry and parr were present at three out of four electric fishing sites, and eels at two out of four (Table 5); no fish were recorded at the topmost site (K4), which is likely to be upstream of the limit of trout distribution on the stream. Trout fry were plentiful at sites K1 and K2, and densities were classified as excellent by regional standards. Fry densities at site K3, the top site at which fish were recorded, were

classed as very poor. Parr were abundant and parr densities were classed as excellent at all three sites where fish were caught. Parr density at site K2 (37.1 fish per 100m²) was exceptionally high and exceeded the maximum in the regional classification reference data set (Appendix 8.1).

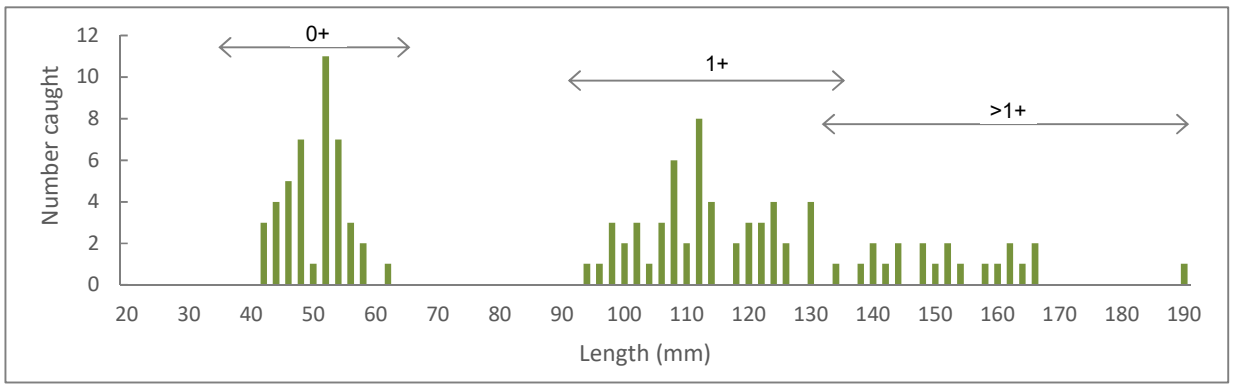
Eels were only caught in the two more downstream sites, and it is possible that eels are unable to pass the intake dam at NC 9091 0955.

Table 5 Electric fishing results, Kintradwell Burn

Site	Salmon density (fish. 100m^{-2})		Trout density (fish.100m^{-2})		Trout density class		Eels (n)
	Fry	Parr	Fry	Parr	Fry	Parr	
K1	0.0	0.0	17.0	16.0	Excellent	Excellent	3
K2	0.0	0.0	15.1	37.1	Excellent	Excellent	5
K3	0.0	0.0	1.5	7.7	Very Poor	Excellent	0
K4	0.0	0.0	0.0	0.0	-	-	0

The trout fry (0+) year class was well defined, ranging in length from to 41 mm to 61 mm, and showed no overlap with the 1+ year class (Figure 2). The 1+ year class ranged from 93 mm to 130 mm in length. Too few scales were taken from larger fish to identify how many older year classes were present. The largest specimen caught was 190 mm in length, at site K3, and is likely to be aged at least 3+.

Figure 2. Kintradwell Burn, trout size distribution and year classes



5.1.4. Stream crossings

Proposed stream crossings are listed in Table 6 below, with descriptions of fish habitats present and comments on potential impacts. The existing ford, which may be used as a crossing point, is in a section of good quality trout habitat approximately 150 m upstream of electric fishing site K2. Habitat at and immediately downstream of the ford is typical of the reach and appears well suited to trout fry and parr. Width is approximately 2.5 m and flow types are riffle run and glide. The streambed is stable and cover in boulder and cobble is plentiful. The meandering channel has some deeper scoured areas on bends providing depth refuge for larger trout. Small pockets (<0.2 m^2) of gravel, pebble and coarse sand are widespread (total estimated area approx 2 m^2) and provide some spawning opportunities for stream-dwelling trout. No larger areas of spawning habitat were recorded. The ford itself provides approximtely 0.5 m^2 of potential spawning habitat but this is only of moderate quality, lying in a rather thin layer over larger substrates.

The gradient increases upstream of the ford and the stream flows through a series of steps and pools. Habitat quality for trout appears good to excellent with plentiful instream cover. Undercut banks provide additional overhead cover. Small pockets of spawning habitat are present, totalling some 4 m^2. Further

detail of habitats up and downstream of the ford are provided in Appendix 8.4 and a photograph of the proposed crossing point is included in Appendix 8.3.

Table 6 Stream crossing assessments, summary, Kintradwell Burn

NGR	Description	Comment
NC 90874 09484	At existing ford. Stream is 2.5 m wet width. Habitat quality for fish immediately downstream and upstream is excellent. Pockets of spawning habitat are widespread in the reach.	Habitat at the ford is largely typical of the reach and is well suited to fish production. No critical habitats are present at the ford. As pockets of spawning habitat are present throughout the reaches up and downstream, works at this location are unlikely to pose a risk to fish populations so long as downstream impacts on water quality are avoided.
NC 88820 11968	Between T4 and T5. Near watershed. No discernible channel and entirely unsuited to fish production.	There is no risk to fish at the crossing location. Avoidance of peat erosion at this location will be the key issue, to avoid sedimentation of suitable habitats further downstream. Nearest productive and occupied fish habitat is > 1 km downstream so risk is minimal assuming suitable mitigation.

5.2. Loth Burn

5.2.1. Obstacles to fish migration

A waterfall at NC 9457 1076 (~ 0.5 km upstream of A9 road) marks the natural upstream limit for migratory salmonids and probably also for eels. The waterfall is located in a gorge with a long, deep pool immediately downstream. The sides of the gorge drop vertically into deep water and it is not possible to approach the waterfall from up or downstream by wading. The waterfall has two tiers, with a ledge between. The lower tier was estimated to be over 3 m high and the upper tier perhaps 4 m. There is no plunge pool between the two tiers.

Due to the presence of the waterfall, migratory salmonids do not have access to the stream reaches around the proposed turbine array and associated track network. Eels may also be blocked by the waterfall as climbing substrate is absent.

5.2.2. Salmonid habitats

5.2.2.1. Loth Burn

Downstream of the impassable waterfall Loth Burn has a typical wet width of 5 to 8 m. Current speed is moderate and flow types are varied with sections of run, riffle and pool. The stream appears to provide good to moderate quality juvenile salmonid habitat with substrates of boulder, cobble and gravel. Spawning habitats are present. The reaches that were inspected have been modified in places, and bank reinforcements and current deflectors were noted. The riverbanks are well vegetated with scrub, grasses and tall herbs. This reach is several km downstream of the proposed wind farm. A single electric fishing site, L1, was located in this reach in order to determine if migratory fish species are present. No inspections were made between the impassable waterfall and the confluence of Sletdale Burn and Loth Burn (NC 938 127).

5.2.2.2. Sletdale Burn

Sletdale Burn was inspected between its confluence with the Loth Burn and the Allt a Coire Riabhaich confluence (NC 912 131). In this reach Sletdale Burn has a wet width of 3 to 4 m. It has a moderate gradient and the streambed appears stable, with mossy boulders surrounded by smaller substrates. Spawning habitat suited to trout appears to be widespread and many trout were seen throughout the surveyed reach. Bed width is similar to wet width and the stable banks provide cover beneath undercuts and some draped vegetation. Electric fishing site S1 is in this reach, a short distance downstream of The Hind's Corrie.

The Sletdale Burn was walked from the confluence with Allt a Coire Riabhaich to NC 891 148. Habitat in the uppermost 1 km of the burn, close to the turbine array, was assessed. Formal habitat assessment was not carried out in the reaches downstream, but it was clear that the burn provides long reaches of good quality trout habitat, with a moderate gradient and varied flow types. In the headwater reach the wet width is approximately 1 m and is similar to bed width. The channel is incised in peat and substrates are a mix of bedrock, hardpan and short reaches of cobble and pebble. The stream appears suitable for trout but habitat quality is rather poor due to lack of cover and water depth. Small pockets of gravel may permit spawning to take place. The upper limit of suitable fish habitat is approximately NC 886 137. Further upstream the stream becomes a simple incised channel running partly below the peat, and carries no bedload. Electric fishing sites S2 and S3 were in this headwater reach.

5.2.2.3. Allt a' Choire Riabhaich

The lower 200 m of Allt a' Choire Riabhaich comprise riffles, runs and shallow pools. In this reach the stream appears rather unstable compared to Sletdale Burn and no spawning habitat was noted. Wet width is 1.5 to 2 m. At NC 911 131 the stream becomes much steeper, running over large boulders and small bedrock ledges for around 250 m (see Appendix 8.6 for photographs). The channel is partly entrenched between steep banks faces and morphology is largely step-pool and torrent. It is not clear whether upstream access is possible through this torrential reach, but no clearly impassable obstacles were recorded.

The gradient eases at NC 909 130 and the banks are lower, so the stream is less entrenched and scoured. The next 0.7 km of stream provides several long sections of good quality trout habitat interspersed with short sections of bedrock. Wet width is between 1.5 and 3 m. The stream banks are mainly stable and overhead cover is present in the form of undercut banks. Spawning opportunities are present and trout appeared to be widespread. Electric fishing site R1 is in this reach.

Upstream of NC 902 125 the banks are steep and the channel is partly entrenched. The proportion of bedrock increases compared with the reach further downstream and the streambed appears scoured. Fish habitat quality is poor in the bedrock reaches but moderate in the less entrenched reaches where some stable habitat is present among cobble, boulder and pebble. Spawning habitats are limited to small pockets of gravel and pebble at pool edges and alongside the banks in the slower flowing areas. Trout were seen in some of the pools. Electric fishing site R2 is in one of the better quality parts of this reach.

The bedrock reach ends at NC 895 128. The stream has a wet width of < 1 m. Flow types are mixed with runs and shallow pools. Spawning habitat is present but no fish were seen. Electric fishing site R3 is in this reach (no fish present). The upstream limit of potentially suitable habitat for trout in Allt a' Choire Riabhaich is ~ NC 892 130, by which point some of the flow is beneath the turf and there is little or no bedload. Much of the channel further upstream was dry at the time of survey.

5.2.3. Fish populations

Seven sites were surveyed on the Loth Burn catchment; one on Loth Burn itself downstream of the waterfall, three on Sletdale Burn, and three on Allt a' Choire Riabhaich. The Loth Burn catchment supports Atlantic salmon, brown trout and European eels, but salmon and eels were found only on the lower part of Loth Burn, downstream of the waterfall, at site L1 (Table 7). Juvenile trout were present at all sites with the exception of the most upstream site on Allt a' Choire Riabhaich (R3). This site is likely to be upstream of the limit of trout distribution in the stream.

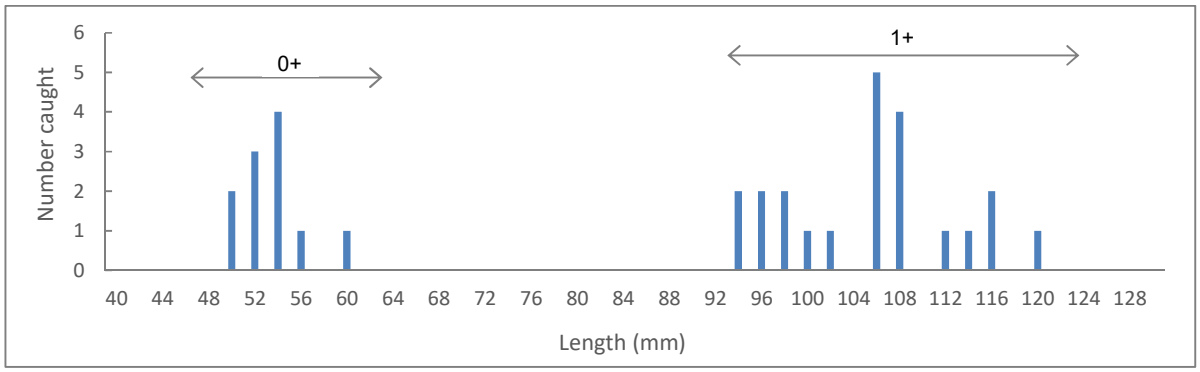
Salmon densities on the lower Loth Burn were classified as fair and excellent for fry and parr respectively, and trout densities were classed as good for fry and excellent for parr. The fact that salmon fry were outnumbered by parr by two to one suggests that 2019 may not have been a very good spawning year for salmon on Loth Burn, however given that only one site with salmon was surveyed it is not possible to draw any firm conclusions.

Table 7 Electric fishing results, Loth Burn catchment

Site	Salmon density (fish. 100m^{-2})		Trout density (fish.100m^{-2})		Trout density class		Eels (n)
	Fry	Parr	Fry	Parr	Fry	Parr	
L1	10.9	21.8	9.9	7.9	Good	Excellent	4
S1	0.0	0.0	15.2	10.4	Excellent	Excellent	0
S2	0.0	0.0	3.6	3.6	Poor	Fair	0
S3	0.0	0.0	Absent	Present	-	na	0
R1	0.0	0.0	4.6	16.5	Fair	Excellent	0
R2	0.0	0.0	0.0	23.1	-	Excellent	0
R3	0.0	0.0	0.0	0.0	-	-	0

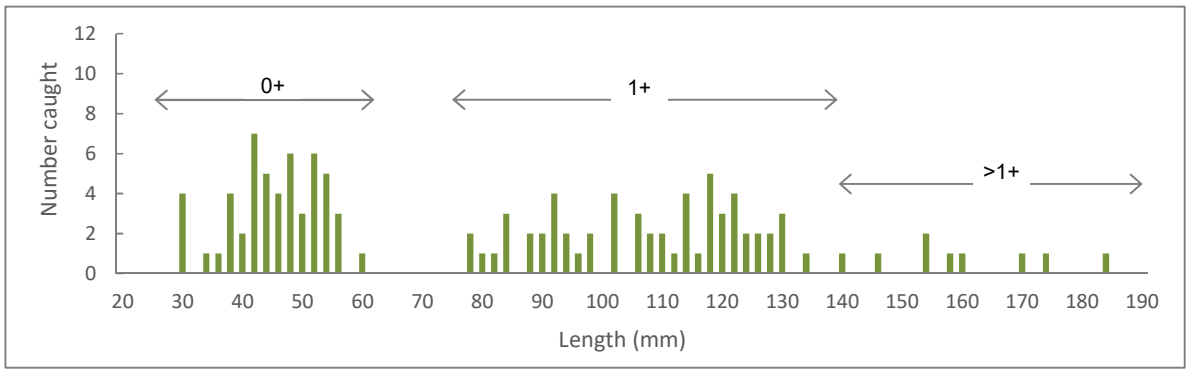
All salmon caught on Loth Burn were fry or 1+ parr, with ages confirmed by scale reading. The two age classes were very clearly defined (Figure 3). Fry ranged in size from 50 mm to 60 mm and 1+ parr from 94 mm to 119 mm.

Figure 3. Loth Burn, salmon size distribution and year classes



Trout densities in the inaccessible reaches of the Loth Burn system upstream of the waterfall were variable. Trout fry were present at excellent densities in the lowermost site on Sletdale burn, but further upstream towards the headwaters densities were much lower, classified as fair or poor. Fry were absent from the top site on Sletdale Burn and the two upper sites on Allt a' Choire Riabhaich. Trout parr were present at all three sites on Sletdale Burn; densities were classed as excellent at the lowest site (S1) and fair at the middle site (S2). Parr were present at the top site (S3) but as it was not possible to survey this reach quantitatively no density estimates are available. Parr densities were classed as excellent at both the lower (R1) and middle (R2) sites on Allt a' Choire Riabhaich, but they were not found at the top site (R3).

Figure 4. Loth Burn catchment, trout size distribution and year classes



Trout fry (0+ year class) fell into a clearly defined size range between 28 mm and 59 mm (Figure 4); however fry in the lower Loth Burn site (L1) ranged from 47 mm to 59 mm, whereas those in Allt a' Choire Riabhaich and at the topmost site at which they were present on Sletdale Burn (S2) were between 28 mm and 41 mm suggesting that growth rates are rather lower in the headwaters than in the lower part of the catchment. The 1+ year class ranged from 77 mm to 130 mm in length. Too few scales were taken from larger fish to identify how many older year classes were present, but several 2+ individuals were identified from scales, and the largest specimen caught (site S1) at 180 mm in length is likely to be aged at least 3+.

5.2.4. Stream crossings

Proposed stream crossings are listed in Table 8 below, with descriptions of fish habitats present and comments on potential impacts. Both crossing are very close to the watershed and the stream channels are indistinct. Both channels have long partially dry reaches downstream of the proposed crossing locations. Habitats at the crossings, and for several hundreds of meters downstream, are entirely unsuited to fish production.

Table 8 Stream crossing assessments

NGR	Description	Comment
NC 8866 1331	Between T19 and T17. At watershed. Dry. Channel indistinct. Eroded peat hags.	Entirely unsuitable. No suitable fish habitat for ~ 0.8 km downstream.
NC 8875 1272	Dry indistinct channel at watershed.	No suitable fish habitat at this location of for ~ 0.5 km downstream. This headwater channel is entirely unsuited to fish.

6 Interpretation and conclusions

6.1. Data quality

Water and light conditions for the habitat survey of both catchments were good, with sunshine and low water levels. Observations of habitat distribution and quality are therefore likely to be reliable.

Water levels and stream temperatures for electric fishing were suitable and the depletions attained at the two fully quantitative sites (Appendix 8.9) suggest that fishing was effective and that capture efficiency was good.

6.2. Kintradwell Burn

The current survey data are consistent with those from a previous survey of this watercourse (Waterside Ecology 2010), which demonstrated that it is an unusually productive trout stream, capable of supporting very high densities of trout parr and fry. Although Marine Scotland have suggested that the Kintradwell Burn is inaccessible to migratory sea trout this appears not to be the case, as the full walkover conducted during the current survey found no clearly impassable natural obstacles. As such, there may be a sea trout stock component among the trout population.

A number of the turbines associated with the proposed development would be located in the headwater reaches of Kintradwell Burn, but they would be sited well upstream of the main productive reaches. Potential impacts on trout resulting from construction of the turbines therefore relate primarily to possible downstream effects on water quality due e.g. to siltation, exposure of mineral soils resulting in leaching of metals, or spillage of pollutants. Such risks will have to be assessed and appropriate mitigation developed, if necessary, for their avoidance.

At the time of survey the proposed track route for access to the wind farm would cross Kintradwell Burn at the existing ford (NC 90874 09484), as described above. This location is in a reach of highly productive

trout habitat and parr densities just downstream at electric fishing site K2 were exceptional for north region. No particularly critical habitats were noted at the ford itself. While small pockets of potential spawning habitat are present at the ford (total ~ 0.5 m^2) such habitat is widespread elsewhere in the reach, with an additional 5.5 m^2 recorded in the 150 m of stream adjacent to the proposed crossing location and much more elsewhere. Any loss of spawning at the ford would therefore be negligible in terms of predicted impact. Given the quality of adjacent habitats it is however recommended that disruption of the streambed at the ford should be minimised, in order to avoid downstream effects on fish habitats and/or water quality. Furthermore, any new crossing should ensure that upstream and downstream access for trout and eels are unaffected.

6.3. Loth Burn

Loth Burn continues to support a small but apparently sustainable population of Atlantic salmon in its lower reaches, downstream of the waterfalls near the A9 road. Salmon were previously recorded in this reach by Waterside Ecology (2013) and the burn is known to support an occasional fishery for salmon when conditions are suitable. European eels are also present in the accessible reach as well as brown trout. It is likely that the latter includes a sea trout component. Salmon cannot ascend the waterfalls and the absence of eels at electric fishing sites upstream of them suggests the falls may also be impassable to this species. The only fish species present in samples at electric fishing site upstream of the waterfalls, in Sletdale burn and Allt a' Choire Riabhaich, was brown trout. Densities of trout were variable but excellent parr densities were present at one or more location in both streams, underscoring their productive potential. Trout distribution in both streams extends well into the headwater reaches, but stops short of the proposed track network due to the absence of suitable habitat.

The proposed layout would place several turbines in the upper catchments of Sletdale Burn and Allt a' Coire Riabhaich. In addition, turbine locations T6, T7 and T10 would drain towards the lower Sletdale Burn via The Hind's Corrie, just upstream of electric fishing site S1. As noted above, the track network does not impinge directly on productive or potentially suitable fish habitats. The potential impacts of the proposed development therefor relate to downstream effects on water quality and these will have to be considered and suitable mitigation developed.

7 References

Godfrey, J. D. 2006. Site condition monitoring of Atlantic salmon cSACs. Commissioned report to Scottish Natural Heritage, December 2006. Scottish Fisheries Co-ordination Centre, Pitlochry.

Marine Scotland Science. 2018. Generic Monitoring Programme for Monitoring Watercourses in relation to Onshore Wind Farm Developments. August 2018.

SFCC. 2014. Team Leader Electrofishing: manage electrofishing operations. Inverness & Barony Colleges. April 2014.

Waterside Ecology. 2010. Kintradwell Burn, Brora, Proposed Hydro Scheme, Fish Population Survey. Commissioned Report, October 2010.

Waterside Ecology. 2013. Loth Burn hydropower scheme: fish habitat and population assessments. Commissioned Report to Glen Hydro Ltd., August 2013.

8 Appendices

8.1. Salmonid density classification for North Region

	salmon 0+	salmon 1++	trout 0+	trout 1++
Percent zero density	24.0%	18.0%	12.0%	28.0%
Min	0.51	1.01	0.51	0.57
20th percentile	5.45	2.18	1.79	1.09
40th percentile	10.70	6.36	4.16	2.72
60th percentile	14.79	9.49	5.10	4.37
80th percentile	29.37	16.28	10.07	7.61
Max	67.36	27.66	98.49	14.73

Descriptive categories used in text

Density in regional classification	Description used in text
Min to 20th percentile	Very poor
20th to 40th percentile	Poor
40th to 60th percentile	Fair
60th to 80th percentile	Good
80th to 100th percentile	Excellent

The classification is based on large data sets held by SFCC. The quintile densities allow for comparison of fishery performance against regionally based reference points. Classifications are based on single run minimum densities.

8.2. Kintradwell Burn obstacles to migration,

	Kintradwell Burn Railway bridge NC 9209 0729 40 cm step at downstream end. Probably passable on a higher water level. Strand line suggests it will inundate on high spring tide. Appears passable.
	Kintradwell Burn Railway bridge NC 9209 0729 The streambed under the railway and road bridges is masonry. It is uneven. Depth at time of survey in low flow was 5 to 10 cm. Passable for sea trout or any slightly elevated flow.
	Kintradwell Burn Hydro intake NC 9091 0955 Two steps. Lower step height = 0.55 m with 20 cm deep pool below. Second step 0.9 m with 20 cm deep pool. Second step dry at weir crest. Hands-off flow provided via orifice through weir face.

	Kintradwell Burn Hydro intake NC 9091 0955 Orifice providing hands-off flow is immediately to the right of the net.
	Kintradwell Burn Cascade at NC 9033 1064 0.9 m high with no plunge pool. Non vertical. Complex rapid split by large boulders. Flows in spate difficult to predict.
	Kintradwell Burn Dry channel at NC 9013 1094 Continues upstream. Totally impassable and obviously unsuited to fish.

8.3. Kintradwell Burn fish habitats

	Kintradwell Burn NC 9173 0790 Approximately 600 m upstream of NTL Good cover but moderately unstable
	Kintradwell Burn from NC 9123 0852. Meanders in deep v-shaped valley.

	Kintradwell Burn at NC 9088 0940, upstream of proposed crossing. Stable juvenile trout habitat.
	Kintradwell Burn From footbridge near Badenahauglish, NC 9117 0986
	Kintradwell Burn at NC 9054 1054 Stable juvenile trout habitat.

	Kintradwell Burn at NC 9029 1068
	Kintradwell Burn NC 9013 1092
	Kintradwell Burn NC 9013 1094 Mainly dry channel

	Kintradwell Burn at NC 8998 1115 No over ground flow. Location is over 1 km downstream of the 'stream crossing' between T4 and T5

8.4. Stream survey data, Kintradwell Burn crossing (NC 90874 89425)

Section code	NGR		Instream habitat notes	Bankside notes
	Downstream	Upstream		
1	NC 90892 09315	NC 90874 89424	Substrate is mainly stable cobble and boulder. Depth 10 to 40 cm with good instream cover. Shallow edge habitats suited to trout fry. Widespread little pockets of potential spawning habitat where one or two small redds might be created but no substantial patches over 0.5 m^2. Good quality habitat for trout fry and parr. Top of section is ford.	Stable low banks with rough pasture and tall herbs on the bank top. Undercuts provide overhead cover.
2	NC 90874 89424	NC 90905 09548	Ford is shallow with approximately 0.5 m^2 of potential spawning habitat in several small pockets. Upstream of the ford is mixed juvenile trout habitat with boulder-dominated substrate. Some step-pool habitat at upstream end of the section. Pockets of little pebbles provide suitable substrate for spawning. Hydro intake at NC 90905 09548 (upstream end of section) may be impassable.	Stable banks with inset boulders and undercuts providing overhead cover.

Section code	Length (m)	% visible streambed	Width (m)		Substrate		Instream cover	Bankside cover (% of bank length)		Habitat quality for trout		Spawning habitat (m^2)
			Wet	Bank	Stability	Compaction		left	right	Fry	Parr	
1	140	100	2.5	2.7	Stable	Uncompacted	Good	10-25%	10-25%	Good	Good	2.0
2	130	100	2.5	2.6	Stable	Uncompacted	Good	10-25%	10-25%	Good	Good	4.0

8.5. Loth Burn catchment, obstacles to migration,

	Loth Burn Waterfall at NC 9457 1076 is impassable, so migratory salmonids do not have access to Sletdale Burn or Allt a' Choire Riabhaich. Probably impassable for eels due to lack of climbing substrate.
	Allt a' Choire Riabhaich NC 9107 1306 Steep entrenched reach with boulder strainers and cascades to 1 m high. Very complex. Passability uncertain.
	Allt a' Choire Riabhaich Sloping bedrock ramp at NC 8983 1268. Length 2.8 m height 1.6 m. Potentially impassable for trout.

8.6. Loth Burn catchment, fish habitats

	Sletdale Burn (lower) View from 9246 1259, approximately 200 m downstream from The Hind's Corrie
	Sletdale Burn (lower) NC 9152 1294 5 m wide stable juvenile habitat.
	Sletdale Burn (lower) NC 9143 1301 Spawning habitats 150 m downstream of Allt a' Coire Riabhaich confluence.

	Sletdale Burn (upper) NC 88801443 1.5 m wide channel. Mix of bedrock and juvenile trout habitat. Fish present.
	Sletdale Burn (upper) NC 8854 1381 Channel < 0.7 m wide. Incised. Depth ~ 5 cm. Very poor habitat. Trout present 200 m further downstream.
	Minor headwater channel draining T21 area NC 8857 1371 Width < 30 cm where flowing water present. Some wet flush. Unsuitable for fish.

	Allt a' Choire Riabhaich NC 9119 1311 50 m upstream of Sletdale Burn confluence
	Allt a' Choire Riabhaich NC 9029 1249 Patchy bedrock throughout this reach
	Allt a' Choire Riabhaich NC 8950 1282 1 m wide channel with pebble and gravel substrate. Appears well suited to trout fry but no fish present (close to electric fishing site R3.

	Allt a' Choire Riabhaich NC 8915 1301 Dry channel. Channel mainly dry with occasional pool of standing water.
	Allt a' Choire Riabhaich NC 8864 1325 This is looking downstream from site of proposed crossing at watershed between T19 and T20.
	West fork headwater. NC 8931 1282 Mix of wet flush and dry channel. Unsuited to fish. This little channel drains the watershed between T18 and T19.

8.7. Electric fishing sites

	Kintradwell Burn K1 NC 92063 07326
	Kintradwell Burn K2 NC 90912 09341
	Kintradwell Burn K3 NC 90353 10611

	Kintradwell Burn K4 NC 90185 10801 (fish absent)
	Loth Burn L1 NC 94795 10099
	Sletdale Burn S1 NC 91940 12435

	Sletdale Burn S2 NC 88793 14428
	Sletdale Burn S3 NC 88630 14040 (qualitative site – parts of stream too narrow to survey)
	Allt a' Coire Riabhaich R1 NC 90835 12990

	Allt a' Coire Riabhaich R2 NC 90180 12489
	Typical habitat at R3 NC 89501 12821 Due to small size of stream and entrenched channel no meaningful photograph of reach was possible.

8.8. Electric fishing survey site locations and survey event details.

Site	Watercourse	NGR	Length (m)	Width (m)	Area (m^2)	Voltage	Current (Amperes)	Effective fishing?	Level	Colour
K1	Kintradwell Burn	NC 92063 07326	35.5	2.8	100	250	0.3	Yes	low-mod	clear
K2	Kintradwell Burn	NC 90912 09341	33	2.6	86	200	0.3	Yes	low-mod	clear
K3	Kintradwell Burn	NC 90353 10611	94	2.2	207	200	0.3	Yes	low-mod	clear
K4	Kintradwell Burn	NC 90185 10801	150	na	Na	200	0.3	Yes	low-mod	clear
L1	Loth Burn	NC 94795 10099	14.5	7	101	250	0.3	Yes	low-mod	clear
S1	Sletdale Burn	NC 91940 12435	19	6.6	125	250	0.4	Yes	low-mod	clear
S2	Sletdale Burn	NC 88793 14428	63	1.8	111	250	0.2	Yes	low-mod	clear
S3	Sletdale Burn	NC 88630 14040	na	na	na	250	0.2	Yes	low-mod	clear
R1	Allt a Coire Riabhaich	NC 90835 12990	56	2.0	109	280	0.3	Yes	low-mod	clear
R2	Allt a Coire Riabhaich	NC 90180 12489	40	1.7	69	280	0.3	Yes	low-mod	clear
R3	Allt a Coire Riabhaich	NC 89501 12821	200	0.8	160	280	0.2	Yes	low-mod	clear

8.9. Depletion attained at fully quantitative electric fishing sites

Site	Area (m^2)	Number trout fry caught			Number trout parr caught			Total trout		
		run 1	run 2	run 3	run 1	run 2	run 3	run 1	run 2	run 3
K2	86	13	8	3	32	5	3	45	13	6
S1	125	19	11	3	13	4	5	32	15	8

Zippin density estimates with lower and upper 95% confidence limits:

Site K2. Trout fry density = 32.1 per 100 m^2 (95% CL = 24.0 to 35.8 per 100 m^2). Trout parr density = 47.0 per 100 m^2 (95% CL = 46.3 to 49.1 per 100 m^2)

Site S1. Trout fry density = 29.1 per 100 m^2 (95% CL = 26.5 to 34.2 per 100 m^2). Trout parr density = 21.5 per 100 m^2 (95% CL = 17.7 to 30.1 per 100 m^2)

8.10. Habitats at quantitative electric fishing sites

Site	**Depth in cm** (% of wetted area)						**Substrate** (% of wetted area)									**Flow types** (% of wetted area)							
	<10	*11-20*	*21-30*	*31-40*	*41-50*	*>50*	*HO*	*SI*	*SA*	*GR*	*PE*	*CO*	*BO*	*BE*	*OB*	*SM*	*DP*	*SP*	*DG*	*SG*	*RU*	*RI*	*TO*
K1	10	30	40	5	5	0	0	0	1	4	10	35	50	0	0	5	0	25	0	0	55	15	0
K2	25	45	30	0	0	0	0	0	1	4	15	30	50	0	0	5	0	0	0	35	55	5	0
K3	30	40	25	5	0	0	0	0	0	1	9	20	50	20	0	5	0	25	0	5	55	10	0
L1	30	45	20	5	0	0	0	0	0	5	15	25	55	0	0	5	0	0	0	10	75	10	0
S1	8	20	45	20	5	2	0	0	0	5	20	5	40	0	0	2	0	0	0	8	80	10	0
S2	20	25	25	15	10	5	0	0	0	5	20	20	5	50	0	10	5	10	0	30	40	5	0
R1	30	40	25	5	0	0	0	0	0	5	35	35	25	0	0	5	0	0	0	30	50	15	0
R2	10	25	35	15	10	5	0	0	0	5	15	25	25	30	0	0	10	10	5	10	40	25	0
R3	45	30	20	5	0	0	0	0	2	5	40	35	5	3	0	0	5	15	0	25	50	5	0

Site	**Left bank (% of bank length)**				**Right bank (% of bank length)**			
	Undercut	Draped	Bare	Marginal	Undercut	Draped	Bare	Marginal
K1	0	10	90	0	5	70	25	0
K2	10	0	90	0	15	0	85	0
K3	30	0	70	0	15	0	85	0
L1	0	0	100	0		15	85	0
S1	10	0	90	0	15	0	85	0
S2	10	0	90	0	10	0	90	0
R1	30	10	60	0	20	10	70	0
R2	30	10	60	0	10	10	80	0
R3	50	30	0	0	50	30	0	0

Substrates: HO = high organic (peat); SI = silt; SA = sand; GR = gravel; PE = pebble; CO = cobble; BO = boulder; BE = bedrock; OB = obscured.
Flow types: SM = shallow marginal; DP = deep pool; SP = shallow pool; DG = deep glide; SG = shallow glide; RU = run; RI = riffle; TO = torrent.

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Technical Appendix 8.6

Outline Habitat Management Plan

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Introduction

The proposed Kintradwell Wind Farm (the 'Proposed Development') is located on the east coast of Sutherland, North Highlands. The layout is shown on Figure 8.1 of Chapter 8 Ecology of the Environmental Impact Assessment Report (EIA Report). A Habitat Management Plan (HMP) is proposed to deliver enhancement measures to offset predicted (low) impacts on peatland habitats within the upper slopes of the site. This document forms an outline of the key principles of the approach to the HMP (termed the 'Outline HMP', or OHMP) and is presented as a document on which to form the basis of enhancement of the condition of the blanket bog and wet heath habitats that forms the majority of the vegetation within the array of the Proposed Development.

It should be noted that the EIA Report specifies a range of design mitigation measures that have been incorporated into the final layout and approach to construction that are to avoid or, where this is not practicable, reduce adverse effects on important ecological features. Anticipated impacts on mire habitats within the upper slopes of the site are considered to be low and not significant, although the quality of peat present appears to have been reduced over time through historical management and deer pressures. In the absence of any intervention, areas of bare peat, peat gullies and haggs are considered likely to experience further erosion through exposure, frost heave and desiccation following dewatering and lowering of the water table. This is considered likely to facilitate a further shift from wetter, peaty habitats towards dry heath habitats and appears to be already evident in some areas on the upper plateaus of the site.

The opportunity for enhancement measures to halt and, ultimately, reverse further erosion and reduction in the quality of habitats found within the higher altitudes of the site are presented in this OHMP. The proposed enhancement measures are also specified to achieve benefits for biodiversity, in accordance with planning policy requirements and good practice. Issues relating specifically to construction of the Proposed Development (e.g. preventing pollution of watercourses or disturbance of protected species) are not considered here but are instead summarised in Chapter 17 Schedule of Environmental Mitigation of the EIA Report.

Scope of this Document

This document should be read in conjunction with EIA Report Chapter 8 Ecology and Chapter 9 Ornithology which collectively consider a complete suite of ecological features, including habitats and species. It should also be read in conjunction with EIA Report Chapter 10 Geology, Hydrology and Hydrogeology which considers impacts on a range of features relevant to ecology, notably peat. In addition, EIA Technical Appendix 10.2 Outline PMP and Technical Appendix 2.1 Outline CEMP includes measures relevant to the OHMP, notably methods on how peat will be excavated and reinstated within the Proposed Development site. While the OHMP provides details of on-site areas targeted for peatland restoration, the objectives have been extended to provide provision for improvements for foraging golden eagle (*Aquila chrysaetos*) as well.

This OHMP is intended as an iterative document, which incorporates comments received during the Environmental Impact Assessment (EIA) consultation process, including scoping responses, and will be further refined as required following grant of consent for the Proposed Development and agreed by stakeholders, including The Highlands Council (THC) and Scottish Government Energy Consents Unit (ECU) in consultation with NatureScot (NS) (formerly Scottish Natural Heritage, SNH) and the Scottish Environment Protection Agency (SEPA), and based on the results of monitoring.

Priority Features for Management Action

As described in EIA Report Chapter 8 Ecology and Chapter 9 Ornithology, the application site for the Proposed Development supports a range of habitats and species of conservation importance. The features which form the priorities for the OHMP have been determined through consideration of the relative importance of each receptor and the extent to which they may be affected by the Proposed Development as set out in the EIA

Report. Taking the above into consideration, the aims and objectives of the OHMP relate to the following key features:

- blanket bog;
- wet heath; and
- golden eagle.

For the purposes of the OHMP, both blanket bog and wet heath have been combined into one peatland habitat type in terms of aims and objectives due to their association and similar requirements in terms of substrate and ground conditions.

Other features of importance identified in the EIA Report include otter (*Lutra lutra*), fish and birds, such as merlin (*Falco columbarius*) and golden plover (*Pluvialis apricaria*). However, it has been established through the EIA process that none of these are likely to be significantly affected by the Proposed Development in EIA terms, subject to the implementation of mitigation measures during the construction phase. Therefore, these features are not priorities for management action in the OHMP. However, several of these species are likely to benefit from the proposed habitat management measures, particularly merlin and golden plover.

Aims and Objectives

The relative importance of the key features and, more importantly, the extent to which they could be affected by the Proposed Development, have been used to determine some of the specific aims and objectives of the OHMP. In the absence of the measures proposed in this OHMP, the Proposed Development could have a minor although not significant adverse effect on blanket mire and wet heath.

The broad aims and objectives for each key feature are as follows:

Blanket bog and wet heath:

- Management and enhancement of blanket bog and wet heath habitat within the upper plateaus of the Proposed Development through use of excavated peat and bog management techniques (such as revegetating bare peat using reprofiling, geotextiles, dams and use of turves, etc.).

Golden eagle:

- Enhancement of areas of habitat previously subjected to muirburn and erosion/weathering pressures to increase foraging value to golden eagle through improving conditions for mammals, such as rabbit (*Oryctolagus cuniculus*) and mountain hare (*Lepus timidus*), and larger ground nesting birds such as red grouse (*Lagopus lagopus*).

Structure of this document

The OHMP is set out as follows:

- following explanation of the scope and aims of the OHMP in the present section, the next section sets out key elements of its implementation;
- the subsequent sections address the two key habitat features and the avian feature in turn – a summary programme for implementation of tasks and monitoring is provided as well as discussion of each; and
- the final section provides the document references used to compile this document.

Implementation

Roles and Responsibilities

The Applicant will be responsible for meeting the commitments made in the subsequent (detailed) HMP, which will be based on the objectives and principles set out in this OHMP. At this stage it is envisaged that these activities will be managed by contractors employed by the Applicant of the Proposed Development.

It is envisaged that the implementation of the final HMP will be a condition of the consent for the Proposed Development, following agreement of the (detailed) HMP post consent in consultation with appropriate consultees, notably NS, SEPA and THC.

Management actions and monitoring results will be reviewed periodically by an HMP Steering Group (HMP Group). The precise remit and structure of the HMP Group will be agreed post consent but at this stage it is considered that the following organisations are likely to be represented:

- the Applicant;
- NS;
- SEPA; and
- Royal Society for the Protection of Birds (RSPB).

Monitoring Objectives

This OHMP has been based on the guidance given by NS in their publication:

Planning for development: what to consider and include in Habitat Management Plans (SNH, 2016). This guidance states that the HMP should "*incorporate flexibility and be subject to periodic review. This will ensure that works/actions can be altered in response to monitoring results over time, evolving guidance or unexpected events. Any alterations would be subject to approval of the HMP steering group*."

In situations when habitat management activities are implemented in spite of uncertainties about their effects, monitoring is the process undertaken to measure and evaluate the effects of the management, and the results are used to inform future management decisions (Elzinga *et al*., 2001). This therefore requires periodic and appropriately timed monitoring to form an important part of the approach to the HMP in order to enable the success of the management tasks to be determined and to identify opportunities to further develop and/or improve enhancement measures and align with the HMP objectives.

Monitoring objectives are outlined for each conservation feature in the sections below. Each monitoring objective will be cost effective and 'SMART':

S – Specifically address the feature;

M – Measurable, i.e. quantified (for example, in terms of definitive numbers of individuals or proportionate growth of a population);

A – Achievable;

R – Relevant, and in compliance with, the overarching HMP aims (which encompass legal, policy and best practice requirements); and

T – Time-based to ensure that success rates or alternatively remedial actions can be ascertained.

Monitoring results will be systematically reported to the HMP Group on a pre-agreed schedule. Reporting of monitoring results and the review of management prescriptions will be undertaken by suitably qualified and experienced ecologists. The HMP Group will be responsible for reviewing the results of the monitoring studies and agreeing any changes in management prescriptions, if considered necessary.

Blanket Bog and Wet Heath

Objectives

The objectives are as follows:

1. To restore and manage localised areas of blanket bog and wet heath habitats that show signs of degradation and erosion surrounding the proposed array through local slope-reprofiling, seeding, damming and use of turves.
2. To restore blanket bog and wet heath habitats in the proposed borrow pit for the Proposed Development (through re-use of peat excavated for the development).

Time Frame

The management of the blanket bog and wet heath restoration area(s) will begin when construction works on the Proposed Development start. The management will then be ongoing for the life of the Proposed Development.

Background

Blanket Bog

As described in EIA Report Chapter 8 Ecology, a total of approximately 100.57ha of blanket bog is present within the study area as M17 *Trichophorum caespitosum-Eriophorum vaginatum* blanket mire (and associated sub-communities) in the National Vegetation Classification (NVC) (Rodwell, 1991 *et seq*.) or as the dominant component in a range of mosaics. The other NVC communities attributed to blanket bog habitat within the study area include M19 *Calluna vulgaris-Eriophorum vaginatum* blanket mire and M20 *Eriophorum vaginatum* blanket and raised mire (and associated sub-communities). M3 *Eriophorum angustifolium* bog pool community and M2 *Sphagnum cuspidatum/recurvum* bog pool community, *Sphagnum recurvum* sub-community are both present within the study area; of these EIA Report Chapter 8 predicts a direct loss of 0.01ha M3 community but this will in reality be avoided through the micrositing allowance under direction by a dedicated Ecological Clerk of Works (ECoW).

A total of approximately 2.27ha of blanket bog is expected to be permanently lost to the Proposed Development, while a further approximately 10.45ha may be subject to degradation totalling 12.72ha.

Wet Heath

Wet heath constitutes over 593ha of the total study area with all habitat loss as a result of the Proposed Development footprint situated within M15 *Scirpus cespitosus-Erica tetralix* wet heath community and associated sub-communities. The sub-communities recorded within the upper parts of the site and anticipated to be impacted upon by the Proposed Development include: M15a *Scirpus cespitosus-Erica tetralix* wet heath, *Carex panicea* sub-community, M15b *Scirpus cespitosus-Erica tetralix* wet heath, typical sub-community and M15d *Scirpus cespitosus-Erica tetralix* wet heath, *Vaccinium myrtillus* sub-community.

A total of approximately 5.7ha is anticipated to be permanently lost to the Proposed Development, with a further approximately 21.1ha potentially subject to further degradation.

Borrow pit

EIA Report Figure 1.2 shows the location of the borrow pit search area. As described in EIA Report Appendix 10.2 Peat Management Plan, the borrow pit search area covers approximately 5.4ha although only 32% (i.e 1.7ha) of this area is expected to be required for excavations. As described in EIA Report Appendix 10.2 Peat Management Plan, up to a total of 10,368m^3 of peat will be excavated from the borrow pit. However, peat will be reinstated

to a depth of 2m within the borrow pit, corresponding to 25,661m^3, of which 4,406m^3 would be acrotelmic peat and 21,254m^3 would be catotelmic peat[1].

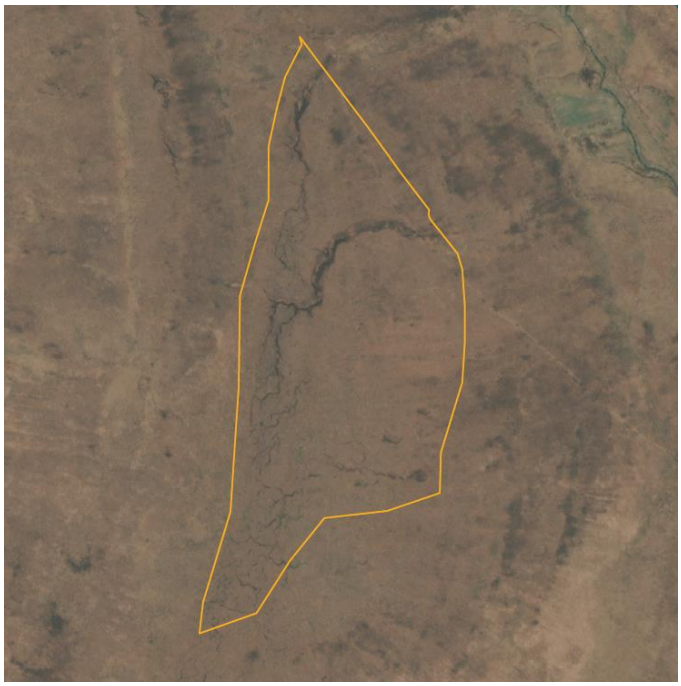
The borrow pit search area is currently vegetated with M19c *Calluna vulgaris-Eriophorum vaginatum* blanket mire, *Vaccinium vitis-idaea-Hylocomium splendens* sub-community along the upper half of the slope while the lower half is represented with M15b *Scirpus cespitosus-Erica tetralix* wet heath, typical sub-community.

Proposed HMP Areas

Locations with degraded peat have been identified within the upper parts of the site and within proximity to proposed infrastructure. The types of degradation vary, but most commonly occur as a result of overgrazing and poaching of the ground by wild deer populations, which has removed surface vegetation and left the peat surface vulnerable to further erosion, as well as historical muirburn practices which can cause long-term damage to peat forming bog-mosses (*Sphagnum* spp.). As described below, restoration management will focus on four of these areas in order to compensate for the loss or modification of blanket bog and wet heath within the site. The four areas, denoted Habitat Management Areas (HMAs) 1, 2, 3 and 4 are presented on Figure 8.6.1.

As part of the development of the detailed HMP, the HMAs will be further ground-truthed and specific details of the extent and grades of peat erosion will be categorised.

HMA 1: This area measures approximately 6.8ha and is located adjacent to the proposed access track route, on the eastern slope of the ridge to the southeast of Col-Bheinn. It is an area of deeper peat (some parts down to 3.5m) with approximately 4.43ha of the total area showing direct signs of erosion and fragmentation leading to early stages of washout forming gullies and bare peat "pans" in the crevices. This area is formed from M17a *Trichophorum cespitosum - Eriophorum vaginatum* blanket mire, *Drosera rotundifolia-Sphagnum* spp. sub-community, and M15b. The depth of the peat here varies from 3.5m to 0.5m. An aerial image of HMA 1 is shown on Plate A and the location is presented on Figure 8.6.1.



[1] *Peat can be separated into three main layers: Acrotelmic (the upper living layer), catotelmic (the middle to lower layer) and occasionally amorphous (lower layer) peat. Please see EIA Report Appendix 10.2 Peat Management Plan for a description of these layers. Distinct layers of amorphous peat were not observed on site, and catotelmic and amorphous peats are therefore treated as a single category.*

Plate A: HMA 1

HMA 2: The degraded section of HMA 2 is approximately 8.6ha in size and comprises a section of the south-facing slope to the west of the unnamed 457m high peak east-northeast of Col-Bheinn (i.e. to the south of Turbine 11 and Turbine 13). The peat in this area varies in depth from 0.5m to 2.4m deep, although in a small localised area it is as shallow as 0.2m. This area was noted during the peat probing survey as being severely eroded and forming peat hags as well as having eroded down to the visible mineral layer in some parts. The approximate area of eroded peat in HMA 2 is 6.38ha. This area is formed of M17b *Scirpus cespitosus-Eriophorum vaginatum* blanket mire, *Cladonia* spp. sub-community. An aerial image of HMA 2 is shown on Plate B and the location is presented on Figure 8.6.1.

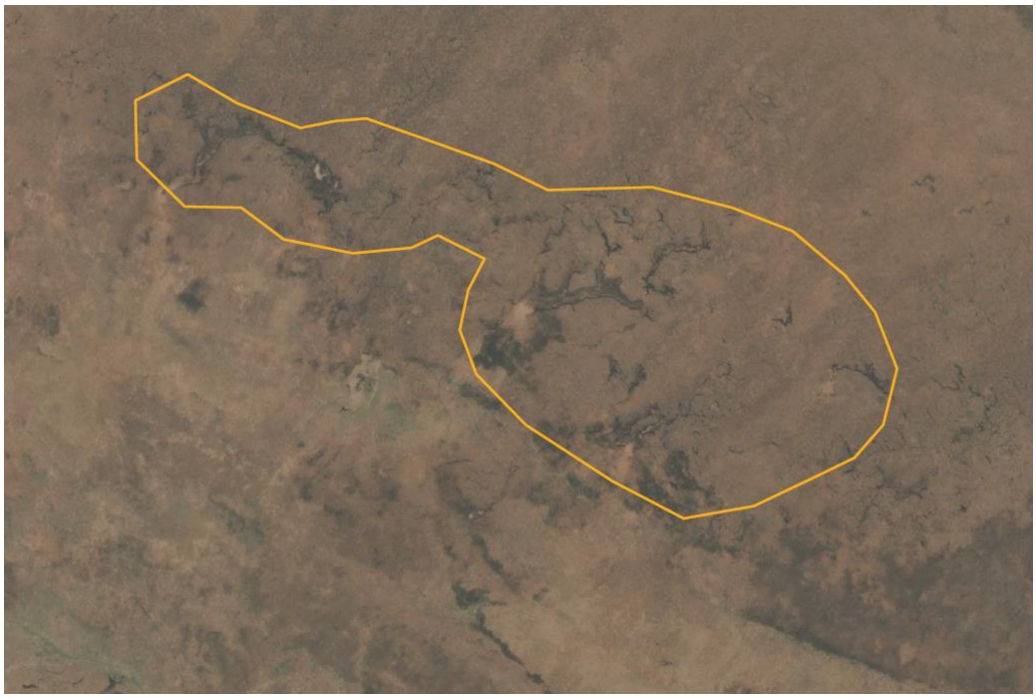


Plate B: HMA 2

HMA 3: The degraded section of HMA 3 is the largest and most degraded of all the proposed HMAs and covers approximately 30.6ha comprising peat which appears to have suffered localised high levels of grazing and poaching by deer and formed hags and bare peat pans and gullies. The area of fragmented and eroded peatland in HMA 3 is approximately 22.5ha. HMA 3 is located in the saddle between the peak of Meallan Liath Mòr (511m asl) and the ground to the west of Turbine 3, and northwest of Turbine 5, and lies on peat between 0.5m and 2.3m deep with very small localised areas of mineral layer at or near the surface. The vegetation communities in this area are formed mostly from M15b and M17a communities, but with some smaller areas of M15a and M19a Calluna *vulgaris-Eriophorum vaginatum* blanket mire, *Erica tetralix* sub-community. HMA 3 shows signs of severe hagging and deep gullies and bare, exposed peat that is clearly eroding and being washed downslope in to the Coire Riabhach and the Allt a' Choire Riabhach watercourse to the east and the Allt Leac an Nighidh watercourse flowing further west.

An aerial image of HMA 3 is shown on Plate C and the location is presented on Figure 8.6.1. Plates D and E show typical erosion within HMA 3.

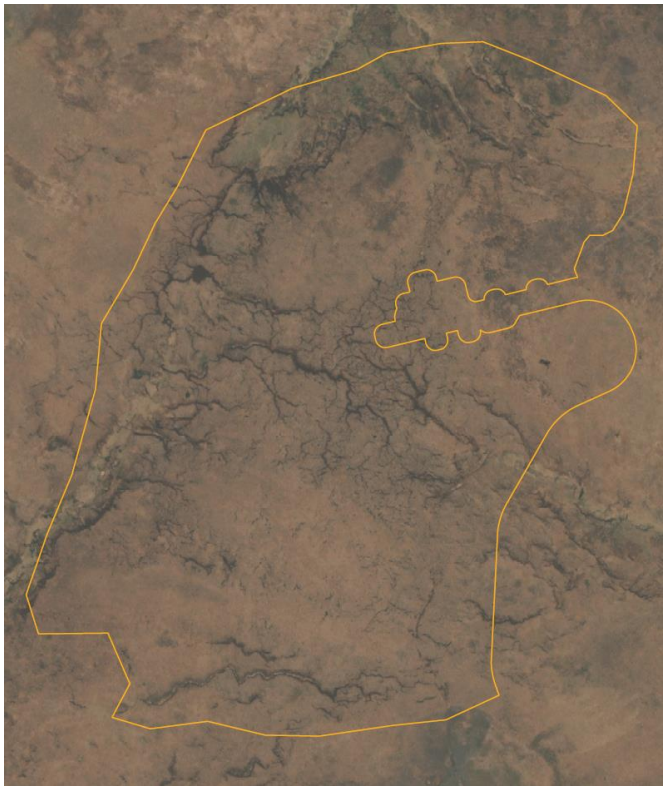


Plate C: HMA 3

Plate D: HM Area 3

Plate E: HMA 3

HMA 4: HMA 4 is located approximately 200m to the east of Turbine 1, covering 1.8ha and comprises peat of 0.8-1.8m in depth except in localised areas where erosion has scoured the peat layer to reveal the mineral substrate beneath. HMA 4 in its entirety is formed of eroded and fragmented peatland. HMA 4 is located in the saddle between the unnamed peaks of 545m asl and 536m asl, situated to the west of Càrn Garbh. The vegetation communities in this area are formed almost entirely from M15b community.

An aerial image of HMA 4 is shown on Plate F and the location is presented on Figure 8.6.1.

Plate F: HMA 4

Management Measures

Broad principles for the restoration management are provided below but will largely follow the IUCN guidelines as detailed in "*Conserving Bogs: The Management Handbook*" (Thom *et al.,* 2019). A detailed specification for the works, tailored to the specific conditions within individual management areas, will be agreed with the HMP Group following grant of the application for the Proposed Development.

The Proposed Development site is dominated by blanket bog and wet heath with a combined area of 884ha within the study area, or 290ha and 594ha per habitat, respectively. Apart from a permanent loss of approximately 2.27ha of blanket bog (and the potential modification of a further approximately 10.45ha), as well as the permanent loss of 5.7ha of wet heath (and the potential modification of a further 21.1ha), the blanket mire will be safeguarded during the operational life of the Proposed Development, with maintenance of the hydrology of the peatland being key to maintaining the structure and quality of the vegetation and for maintaining suitable conditions for peat forming species such as bog-mosses.

The Kintradwell Estate is a member of the East Sutherland Deer Management Group, forming one of the Eastern Sub-Group's estates, and as such confirms to agreed culling quotas of the herds of deer that freely roam the region. These quotas are formerly agreed between estates in order to allow each sporting estate to shoot specific numbers of deer in any given season. While there may be some scope to increase the Kintradwell Estate's quota by a few heads of deer per annum at the site level, it is considered that deer grazing will remain as a pressure within the landholding. Where practicable, though, it is expected that localised areas may be fenced off for several years in order to deter deer from causing damage to areas that have just undergone enhancements measures. Fence-marking may need to be considered in some areas in order to mitigate potential for collisions of ground-nesting birds, particularly red grouse (*Lagopus lagopus*). Such exclusion fencing will be removed once the worked areas are assessed as being established enough to withstand some limited pressures.

<u>Borrow pit restoration</u>

Acrotelmic and catotelmic peat excavated during construction of the Proposed Development will be used in the borrow pit restoration. As described in EIA Report Appendix 10.2 Peat Management Plan, all of the peat excavated for the Proposed Development will be re-used within the development site boundary. No peat will be taken off site. The borrow pit is a suitable receptor area for excavated peat as it comprises excavations surrounded by peatland which can be built up using excavated peat and reprofiling of the outer edges to achieve a topography which will look to mirror as far as practicable the surrounding peat landscape and tie into the hydrology of the surrounding peatland. This is predicted to result in active peat formation within the restored borrow pit.

As described in EIA Report Appendix 10.2 Peat Management Plan, excavated peat will be separated during the excavation and temporarily stored in separate areas, before being reinstated in the same order within the borrow pit. The following principles will be followed:

- Areas of peat within the footprint of any excavation will have the top layer of vegetation stripped off as turf prior to construction by an experienced specialist contractor. When excavating areas of peat, excavated turfs will be as intact as possible, which will typically be achieved by removing large turves up to 500mm.
- Excavated soils and turves will be handled so as to avoid cross contamination between distinct horizons and ensure reuse potential is maximised. Excavated peat will be stored in separate horizons. Specialist plant operators will be employed to undertake this work.
- Turves will be stored adjacent to the construction area in a way that ensures they remain moist and viable. Turves will be stored vegetation side up.

- Peat will be kept damp. The moisture content of stored/stockpiled peat will be monitored monthly and if it falls below 25% of that in surrounding, intact peat then it will be watered.
- Peat will be reinstated as soon as practicable following excavation.
- The amount of time any bare peat will be exposed will be minimised to preserve its integrity.
- The phasing of work will be carried out to minimise the total amount of exposed ground at any one time. By stripping turves and replacing as soon as possible after peat has been re-distributed there will be minimal areas of bare peat.
- Reinstatement will be done to a detailed plan, which will divide the borrow pit into smaller units.
- The height of the restored surface will match that of the adjacent peat.
- Any peat areas on steep ground or that remains partially bare will be covered using geotextile or a similar method to stop erosion.
- Any areas of bare peat, where vegetation is not re-growing, will be seeded with a seed mixture obtained from the existing habitat or commercial seeds of regional genetic provenance.
- The re-vegetated areas will be monitored.
- Low ground pressure diggers will be used for both excavation and reinstatement of the peat to minimise the risk of peat compression and damage to vegetation.
- Deer will need to be excluded during the establishment phase.

<u>Management Prescriptions within HMAs</u>

Enhancement of the four HMAs will focus on stabilising bare peat, including exposed hag faces, and stemming water flow from within the peat macrotope. This will be achieved through a variety of measures, which will be agreed with the HMP Group, but which are likely to including the following:

- Bare peat in flat or gently sloping (<35°) areas:
  - Use of geotextiles to stabilise the surface, where seeding is considered unlikely to achieve this on its own.
  - Seeding with blanket mire species of regional genetic provenance. The potential need for a nurse crop will be agreed with the HMP Group post consent.
  - Localised exclusion of deer through fencing until the habitat is considered to have recovered sufficiently to tolerate impacts from deer.
- Hags:
  - Re-profiling to reduce slopes to <35° using low ground pressure diggers, with excavated material placed at the bottom of the slope.
  - Seeding and/or surface stabilisation with geotextiles of bare peat surfaces similar to the approach for bare peat above.
  - Localised exclusion of deer through fencing until the habitat is considered to have recovered sufficiently to tolerate impacts from deer.
- Gullies and ditches:

- Use of dams (where appropriate) to block gullies and ditches where practicable (i.e. approaches taken are dependent on width and depth as well as the nature of the erosion, such as whether the mineral layer is exposed).
- Re-profiling to reduce slopes to <35° using low ground pressure diggers, with excavated material placed at the bottom of the slope.
- Seeding and/or surface stabilisation with geotextiles of bare peat surfaces similar to the approach for bare peat above.
- Localised exclusion of deer through fencing until the habitat is considered to have recovered sufficiently to tolerate impacts from deer.

Monitoring

The objective of the monitoring will be to determine the effectiveness of the management and assess the need to alter management prescriptions, e.g. mechanical control of undesirable species, such as tall rushes, stabilisation of still eroding areas with geotextiles, or the need for seeding to assist revegetation.

During the first five years of operation of the Proposed Development, vegetation monitoring will consist of simple, assessments, which will be undertaken on a regular basis. This will include recording the percentage cover of indicator species, such as *Sphagnum* mosses, from within fixed quadrats. This will provide information on the nature of change, including vegetation establishment and development, as well as any ongoing problems of erosion. This in turn will inform the prescribed management approach such that methods can be altered quickly, if necessary. After year five, the need for continued monitoring will be evaluated in consultation with the HMP Group and a subsequent monitoring schedule agreed accordingly.

Dipwells will be installed within the restored borrow pit, with a control in adjacent intact peatland. These will monitor the water table level annually within the first five years of the HMP, after which the need for continued monitoring will be evaluated and agreed with the HMP Group.

Golden Eagle Foraging

Aims

The broad aims for golden eagle are as follows:

1. To create improved conditions suitable for foraging golden eagle.

Target Areas

As reported in the EIA Report Chapter 9 Ornithology, golden eagles were active during the baseline surveys. In order to improve foraging conditions for golden eagle within the site boundary, two areas have been allocated to the south east of the Proposed Development array, named Golden Eagle (EA) HMA 1 and 2 (see Plate G and H, respectively, and Figure 8.6.1), where commitments from the landowner have been made to reduce muirburn practices in these locales. This is expected to allow more extensive and improved quality of vegetation to develop with an aim of supporting key golden eagle prey species (such as rabbit and mountain hare). Merlin are also likely to benefit from this additional foraging resource. The management prescriptions at these locations will continue throughout the operational lifetime of the Proposed Development in order to maintain suitable foraging habitat for golden eagle.

The two EA HMAs are located within the landownership and site boundary, although they are located outwith the NVC study area. EA HMA 1 is an area covering approximately 60.4ha and covers the upper parts of Creag a' Chrionaich and its north and north-eastern slopes. EA HMA 2 is located on the upper-most parts of Creag

Riabhach and its northern ridgeline. Both EA HMAs face north and eastwards towards the valleys of Glen Sletdale and Glen Loth.

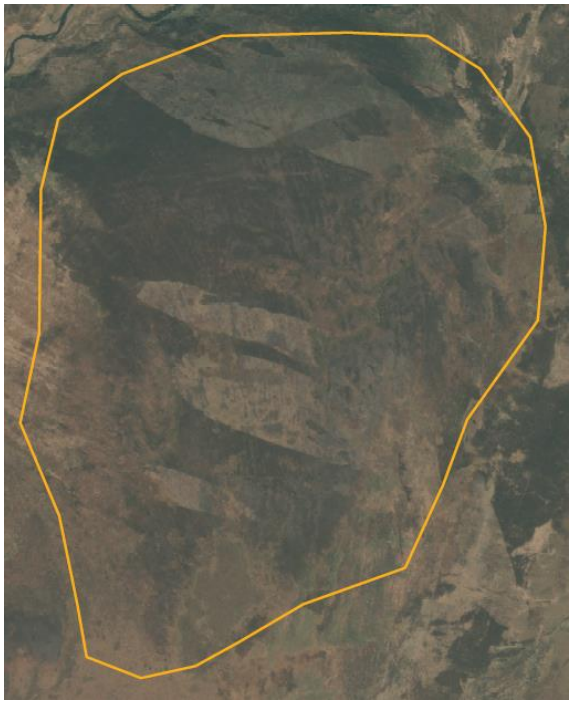


Plate G: EA HMA 1

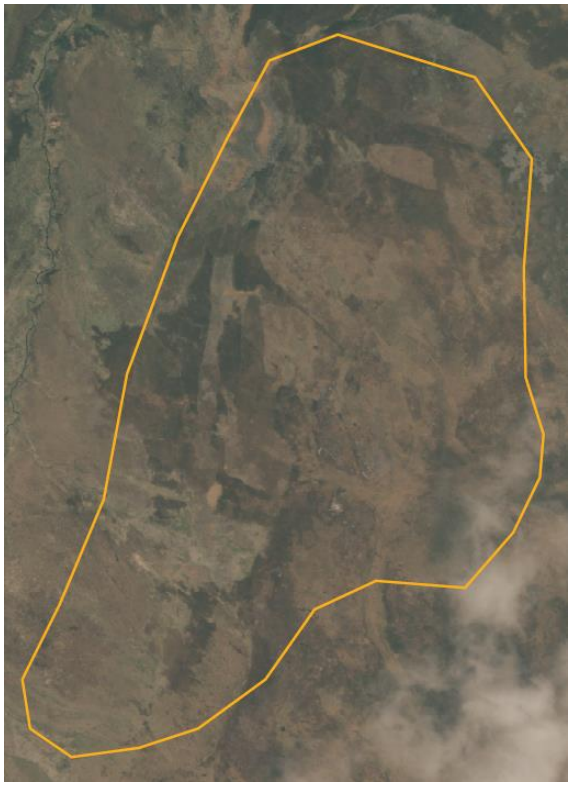


Plate H: EA HMA 2

Management Methodology

The two EA HMA areas have been subject to intensive muirburn in the past. The commitment by the estate to stop this practice in these areas is expected to facilitate a significant rate of recovery of the vegetation found

here. As the EA HMAs are located outside the NVC survey study area, the vegetation will be surveyed to NVC level as an assessment of the baseline conditions.

Monitoring Methodology

The objective of the monitoring will be to determine the effectiveness of leaving the vegetation within the two EA HMAs to re-establish and assess the need to alter management prescriptions, e.g. mechanical control of undesirable species, such as tall rushes, or the need for seeding to assist the revegetation process. It is worth noting that a separate, ornithological monitoring regime is proposed that targets both golden eagle and merlin during the breeding season (please see Chapter 9 Ornithology for more details).

During the first five years of operation of the Proposed Development, vegetation monitoring will consist of simple, assessments, which will be undertaken on a regular basis. This will include recording the percentage cover of indicator species, such as ericaceous species, from within a fixed number of quadrats within each EA HMA. This will provide information on the nature of change of the vegetation and its development over time, as well as any additional ongoing problems of erosion or degradation. This in turn will inform the prescribed management approach such that methods can be altered quickly, if necessary. After year five, the need for continued monitoring will be evaluated in consultation with the HMP Group and a subsequent monitoring schedule agreed accordingly.

The objective of the monitoring will be to determine the effectiveness of the management and assess the need to alter management prescriptions, e.g. the need to supplement with local provenance seed. All management measurements will be subject to reactive monitoring during the first five years of operation. In addition to the proposed ornithological monitoring (as detailed in Chapter 9 Ornithology), monitoring of the EA HMAs habitats will:

- Assess the development of heather vegetation through recording percentage cover and average canopy height; and
- Survey for evidence indicative of key golden eagle prey species.

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