

# Appendix 3 Habitat Survey Reports

**EIAR – Volume 3**

**Knockanarragh Wind Farm**

SLR Project No.: 501.V00727.00008

25/01/2024

## Fossitt Habitat Types and Photos

The following Fossitt habitat types were recorded during habitat surveys. Note that any other habitats recorded during Annex I habitat surveys are described in the Annex I habitat report that has been appended here (PF3 transition mire and quaking bog, PB4 recolonising cutover bog and WN6 wet willow-alder-ash woodland). The same is also true for any aquatic habitats, which are described in Technical Appendix 5.4 (aquatic survey results).

### A.1.1 BC4 flower beds and other borders

BC4 flower beds and other borders were recorded along the Cable Corridor. No picture of this artificial habitat is available.

### A.1.2 BL1 stone walls and other stoneworks

BL1 stone walls and other stoneworks habitat was predominantly found as walls and ruins within the Main Wind Farm Site, plus as walls along the Cable Corridor and at the TDR nodes. Species included: creeping buttercup *Ranunculus repens*, ivy *Hedera helix*, lichens, polypody fern *Polypodium vulgare* and ivy-leaved toadflax *Cymbalaria muralis*.



Photo 1: BL1 stone walls and other stoneworks

### A.1.3 BL3 buildings and other artificial surfaces

BL3 buildings and other artificial surfaces habitat consists of roads and buildings both within the Main Wind Farm Site and along the Cable Corridor and at TDR nodes.



**Photo 2: BL3 buildings and other artificial surfaces**

#### **A.1.4 ED2 bare ground**

ED2 bare ground consisted of bare soil in GA1 fields within the Main Wind Farm Site where livestock had eroded any vegetation.



**Photo 3: ED2 bare ground**

### **A.1.5 ED3 recolonising bare ground**

ED3 recolonising bare ground was found within the Main Wind Farm Site. Species recorded included bramble *Rubus fruticosus* agg., cocksfoot grass *Dactylis glomerata*, coltsfoot *Tussilago farfara*, common hogweed *Heracleum sphondylium*, common spotted orchid *Dactylorhiza maculata*, black medick *Medicago lupulina*, creeping buttercup, crested dogstail grass *Cynosurus cristatus*, *Epilobium* spp., false oat grass *Arrhenatherum elatius*, field horsetail *Equisetum arvense*, field forget me not *Myosotis arvensis*, glaucous sedge *Carex flacca*, rough hawkbit *Leontodon hispidus*, marsh thistle *Cirsium palustre*, mullein *Verbascum thapsus*, perennial rye grass *Lolium perenne*, pineapple weed *Matricaria discoidea*, *Plantago* spp., ragwort *Senecio jacobea*, red clover *Trifolium pratense*, selfheal *Prunella vulgaris*, sweet vernal grass *Anthoxanthum odoratum*, wild strawberry *Fragaria vesca* and Yorkshire fog *Holcus lanatus*.



**Photo 4: ED3 recolonising bare ground**

#### **A.1.6 ED3 recolonising bare ground x WS1 scrub x WS3 ornamental/non-native shrub**

ED3 recolonising bare ground x WS1 scrub x WS3 ornamental/non-native shrub mosaic was found adjacent to the Cable Corridor, consisting of a dumping ground with large patches of Japanese knotweed *Fallopia japonica*. Species for the recolonising bare ground and scrub component of the mosaic are like the single component habitat types described here.

#### **A.1.7 FL5 eutrophic lake**

An FL5 eutrophic lake (pond) was found within the Main Wind Farm Site. Species recorded included common bur reed *Sparganium erectum*, water purslane *Lythrum portula*, flag iris *Iris pseudacorus*, duckweed *Lemna* spp., soft rush *Juncus effusus* and pondweeds *Potamogeton pectinatus*.



**Photo 5: FL5 eutrophic lake**

#### **A.1.8 FL8 other artificial lakes and ponds**

These consisted of artificial ponds within the Northern Cluster that were created via human activities. They were generally species-poor but willow saplings had started grow on the edges.



**Photo 6: FL8 other artificial lakes and ponds**

### **A.1.9 FW1 eroding/upland rivers**

FW1 eroding/upland rivers are described in the aquatic ecology report.

### **A.1.10 FW2 depositing/lowland rivers**

FW2 lowland/depositing rivers included the River Stonyford. Species recorded included common hogweed, duckweed, harts tongue fern *Asplenium scolopendrium*, flag iris, ivy, pondweed, watercress *Nasturtium officinale* and lesser water parsnip *Berula erecta*.



**Photo 7: FW2 depositing/lowland rivers**

#### **A.1.11 FW4 drainage ditches**

FW4 drainage ditches were found within the Main Wind Farm Site and substation, plus along the Cable Corridor and TDR. Species consisted of common reed *Phragmites australis*, hairy willowherb *Epilobium hirsutum*, pondweeds, water parsnip, water starwort *Callitriche stagnalis* and Yorkshire fog.



**Photo 8: FW4 drainage ditches**

#### **A.1.12 GA1 improved agricultural grassland**

GA1 improved agricultural grassland was found within the Main Wind Farm Site and at the substation. Species included: creeping buttercup, dandelion *Taraxacum* spp., dock, mouse ear, rye grass and white clover.



**Photo 9: GA1 improved agricultural grassland**

#### **A.1.13 GA1 improved agricultural grassland x ED2 spoil and bare ground**

GA1 improved agricultural grassland x ED2 spoil and bare ground mosaic was recorded in the Main Wind Farm Site. Species recorded were the same as the two constituent habitat types.

#### **A.1.14 GA2 amenity grassland**

GA2 amenity grassland was recorded along the Cable Corridor as part of domestic lawns. Species recorded included *Poa* species and broadleaved herbs. No photo is given for this highly-modified habitat type.

#### **A.1.15 GS1 dry and calcareous grassland**

GS1 dry and calcareous grassland was found in the Southern Cluster along an esker. This habitat was grazed by sheep. Species included meadow thistle, *Agrostis* grass spp, lesser birdsfoot trefoil, sweet vernal grass, cocksfoot, selfheal, germander speedwell, red clover, dog violet, yarrow, tormentil, bull thistle, red bartsia and purging flax.



**Photo 10: GS1 dry and calcareous grassland**

#### **A.1.16 GS2 dry meadows and grassy verges**

GS2 dry meadows and grassy verges were found predominantly along Cable Corridor and at TDR nodes. Species included bindweed, brambles, cocksfoot grass, common birdsfoot trefoil, common comfrey, common hogweed, creeping buttercup, *Epilobium* species, false brome, false oat grass, hawkbit, lesser knapweed, meadowsweet, meadow vetchling, red clover, rosebay willowherb, sow thistle, yellow rattle and Yorkshire fog grass.



**Photo 11: GS2 dry meadows and grassy verges**

#### **A.1.17 GS4 wet grassland**

There are occasional GS4 wet grassland depressions throughout the Southern Cluster dominated by soft rush and glaucous sedge, with other areas containing abundant

silverweed *Potentilla anserina*, canary grass *Phalaris arundinacea*, and the occasional purple loose strife *Lythrum salicaria*, meadowsweet *Filipendula ulmaria*, yellow iris and bush vetch *Vicia sepium*.



**Photo 12: GS4 wet grassland**

#### **A.1.18 WD1 (mixed) broadleaved woodland**

WD1 (mixed broadleaved) habitat was recorded as a variety of types including ash *Faxinus excelsior* plantation plus other areas of Possible Ancient Woodland (PAW) type within the Main Wind Farm Site.

Trees included: ash, beech *Fagus sylvatica*, hawthorn *Crataegus monogyna*, hazel *Corylus avellana*, silver fir *Abies alba* and sycamore *Acer pseudoplatanus*. The understory consisted of: birdsfoot trefoil *Lotus corniculatus*, bluebell *Hyacinthoides non-scriptus*, bramble, bugle *Ajuga reptans*, cocksfoot grass, creeping buttercup, germander speedwell *Veronica chamaedrys*, greater stitchwort *Stellaria holostea*, hawthorn saplings, ivy, nettles *Urtica dioica*, primrose *Primula vulgaris*, rosebay willowherb *Epilobium angustifolium*, Yorkshire fog grass, wood sedge *Carex sylvatica* and wood sorrel *Oxalis acetosella*.



**Photo 13: WD1 (mixed) broadleaved woodland**

#### **A.1.19 WD4 conifer plantation**

WD4 conifer plantation was recorded within the Main Wind Farm Site. Species recorded included predominantly Sitka spruce *Picea sitchensis* with a few cypress *Cupressus* spp. trees. The understory species consisted of the occasional bluebell, stitchwort and sweet woodruff *Galium odoratum*.



**Photo 14: WD4 conifer plantation**

#### **A.1.20 WD5 scattered trees and parkland**

WD5 scattered trees and parkland habitat type was found in the Southern Cluster. Tree species included: ash, copper beech *Fagus sylvatica f. purpurea*, hawthorn, large-leaved lime *Tilia platyphyllos*, Monterey cypress *Cupressus macrocarpa* and sycamore. The trees were very mature, c. 30 m tall with 1-1.5 m diameter.



**Photo 15: WD5 scattered trees and parkland**

#### **A.1.21 WL1 hedgerows**

WL1 hedgerows were recorded within the Main Wind Farm Site, substation, along the Cable Corridor and at TDR nodes. Species recorded included bramble, blackthorn *Prunus spinosa*, common hogweed, cleavers *Galium aparine*, creeping buttercup, dogrose *Rosa canina*, elder *Sambucus nigra*, hawthorn, hazel, herb robert *Geranium robertianum*, ivy and rosebay willowherb.



**Photo 16: WL1 hedgerows**

#### **A.1.22 WL1 hedgerows x FW4 drainage ditches**

WL1 hedgerows x FW4 drainage ditch mosaics were recorded within the Main Wind Farm Site. Species present were similar to those for each individual habitat type.

#### **A.1.23 WL2 treelines**

WL2 treelines were recorded within the Main Wind Farm Site, substation, along the Cable Corridor and at TDR nodes. Species recorded included ash, beech, blackthorn, elder, grey willow *Salix cinerea*, hawthorn, horse chestnut *Aesculus hippocastanum* and sycamore.



**Photo 17: WL2 treelines**

#### **A.1.24 WL1 hedgerows x WL2 treeline**

WL1 hedgerows x WL2 treeline mosaic was present along the Cable Corridor and within the Main Wind Farm Site. Species consisted of those of each individual habitat type.

#### **A.1.25 WN2 oak-ash-hazel woodland**

WN2 oak-ash-hazel woodland was found in the Southern Cluster in some areas previously mapped as PAW. In addition to the tree species consisting of ash, beech, cherry *Prunus avium*, hazel, holly *Ilex aquifolium* and pedunculate oak *Quercus robur*, the understory consisted of bluebell, bramble, dog violet *Viola riviniana*, false brome *Brachypodium sylvaticum*, enchanter's nightshade *Circaea lutetiana*, germander speedwell, honeysuckle, ivy *Lonicera periclymenon*, lords and ladies *Arum maculatum*, wood avens *Geum urbanum*, wood sanicle *Sanicula europaea*, wood sorrel, barren strawberry *Potentilla sterilis* and wood violet *Viola odorata*.



**Photo 18: WN2 oak-ash-hazel woodland**

#### **A.1.26 WN7 bog woodland**

WN7 bog woodland was found to the western edge of the Southern Cluster and in an area of the Northern Cluster. The Southern Cluster type is described here, with the Northern Cluster type described in the Annex I habitat report.

The Southern Cluster type mainly consisted of silver birch *Betula pendula*. Undergrowth consisted of honeysuckle and brambles. Feather moss *Eurhynchium praelongium*, ivy, broad buckler fern *Dryopteris dilatata* and enchanter's nightshade were abundant. Bracken *Pteridium aquilinum* was also present.

This was in an area previously mapped as Annex I fen, so it is likely that this fen was colonised by birch.



**Photo 19: WN7 bog woodland**

#### **A.1.27 WS1 scrub**

WS1 scrub habitat type was found in the Main Wind Farm Site in fields where fallen trees had become dominated by brambles and rosebay willowherb, with nettles also abundant.



**Photo 20: WS1 scrub**

#### **A.1.28 WS2 immature woodland**

WS2 immature woodland is found mainly alongside the Cable Corridor, comprising of osier willow *Salix viminalis* plantation (likely short rotation coppice).



**Photo 21: WS2 immature woodland**

## **Possible Ancient Woodland Condition Assessment**

The methodology for assessing AW condition was in accordance with Perrin and Daly (2010)<sup>1</sup>.

Briefly, this involved assigning a DOMIN scale score per tree species within a 10 x 10 m relevé. The aim was to sample 30 trees per relevé, focusing on trees >7 cm diameter at breast height. Ground cover was also included to assess condition.

Three relevés were chosen to sample the three main PAW blocks, with details provided below.

The presence of any indicator species was then assessed against Perrin and Daly (2010) and assigned to AW groups, if possible.

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<sup>1</sup> Perrin, P.M. & Daly, O.H. (2010) A provisional inventory of ancient and long-established woodland in Ireland. Irish Wildlife Manuals, No. 46. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

### A.1.29 Relevé 1

This relevé was located at WGS 84 coordinates -7.05216,53.63991 (see **Photo 1**).



**Photo 22: Relevé 1**

A list of species recorded at this relevé is shown below in **Table A-1**. Indicator species recorded in AW are shown below in italics.

Only hazel and bluebell indicator species were recorded, which are species most frequently recorded in the *Fraxinus excelsior* – *Hedera helix* AW type woodland (there are 15 potential indicator species for this AW type). In general, very few AW indicator species were recorded.

**Table A-1: Species Composition Relevé 1**

Species	DOMIN	Mean diameter (cm)	Mean height (m)
<b>Trees</b>			
Ash	4	70	30
Beech	5	85	25
<i>Hazel</i>	6	71	20
Hawthorn	2	1	15
Holly	1	80	25
<b>Groundcover</b>			
<i>Bluebell</i>	3	N/A	N/A
Bramble	4	N/A	N/A
Enchanter's nightshade	5	N/A	N/A
Feather moss	7	N/A	N/A
Honeysuckle	4	N/A	N/A
Ivy	8	N/A	N/A
Primrose	2	N/A	N/A
Broad buckler fern	3	N/A	N/A

### A.1.30 Relevé 2

This relevé was located at WGS 84 coordinates 7.04997,53.64292 (see **Photo 2**).



**Photo Error!** No text of specified style in document.**23: Relevé 2**

A list of species recorded at this relevé is shown below in **Table A-2**. Indicator species recorded in AW are shown below in italics.

Only hazel and bluebell indicator species were recorded, which are species most frequently recorded in the *Fraxinus excelsior* – *Hedera helix* AW type woodland (there are 15 potential indicator species for this AW type). In general, very few AW indicator species were recorded.

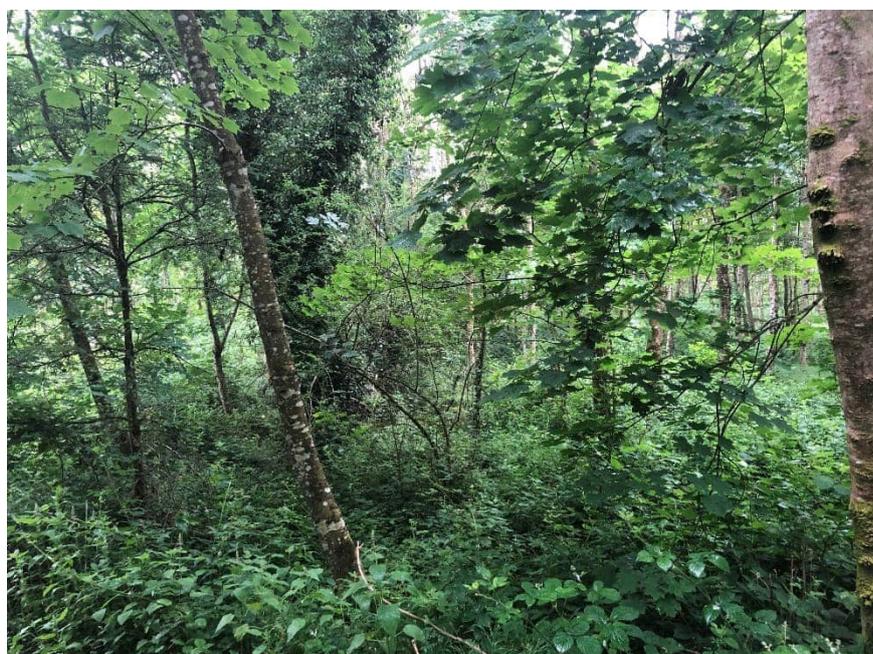
**Table A-2: Species Composition Relevé 2**

Species	DOMIN	Mean diameter (cm)	Mean height (m)
<b>Trees</b>			
Beech	2	100	20
Elder	2	10	2
<i>Hazel</i>	5	60	5
Hawthorn	2	5	8
Sitka spruce	7	10	10
<b>Groundcover</b>			
Ash saplings	5	N/A	N/A
<i>Bluebell</i>	4	N/A	N/A

Species	DOMIN	Mean diameter (cm)	Mean height (m)
Enchanter's nightshade	4	N/A	N/A
Harts tongue fern	2	N/A	N/A
Hawthorn saplings	2	N/A	N/A
Herb robert	2	N/A	N/A
Holly saplings	4	N/A	N/A
Ivy	4	N/A	N/A
Primrose	2	N/A	N/A
Soft shield fern	2	N/A	N/A
Sycamore saplings	2	N/A	N/A
Wood violet	4	N/A	N/A

### A.1.31 Relevé 3

This relevé was located at WGS 84 coordinates -7.05867,53.63529 (see **Photo 3**).



**Photo 24: Relevé 3**

A list of species recorded at this relevé is shown below in **Table A-3**. Indicator species recorded in PAW are shown below in italics.

Only barren strawberry and wood sorrel indicator species were recorded, which are species most frequently recorded in the *Fraxinus excelsior* – *Hedera helix* and *Quercus petraea* – *Luzula sylvatica* AW type woodlands, respectively (there are 15 and nine potential indicator species for these AW types, respectively). In general, very few indicator AW species were recorded.

**Table A-3: Species Composition Relevé 3**

Species	DOMIN	Mean diameter (cm)	Mean height (m)
<b>Trees</b>			

Species	DOMIN	Mean diameter (cm)	Mean height (m)
Ash	6	70	18
Beech	9	150	25
Hawthorn	4	33	15
<b>Groundcover</b>			
<i>Barren strawberry</i>	5	N/A	N/A
Bramble	40	N/A	N/A
Common nipplewort	4	N/A	N/A
False brome	6	N/A	N/A
Germander speedwell	7	N/A	N/A
Herb robert	4	N/A	N/A
Male fern	4	N/A	N/A
Primrose	4	N/A	N/A
Wood sanicle	4	N/A	N/A
<i>Wood sorrel</i>	7	N/A	N/A

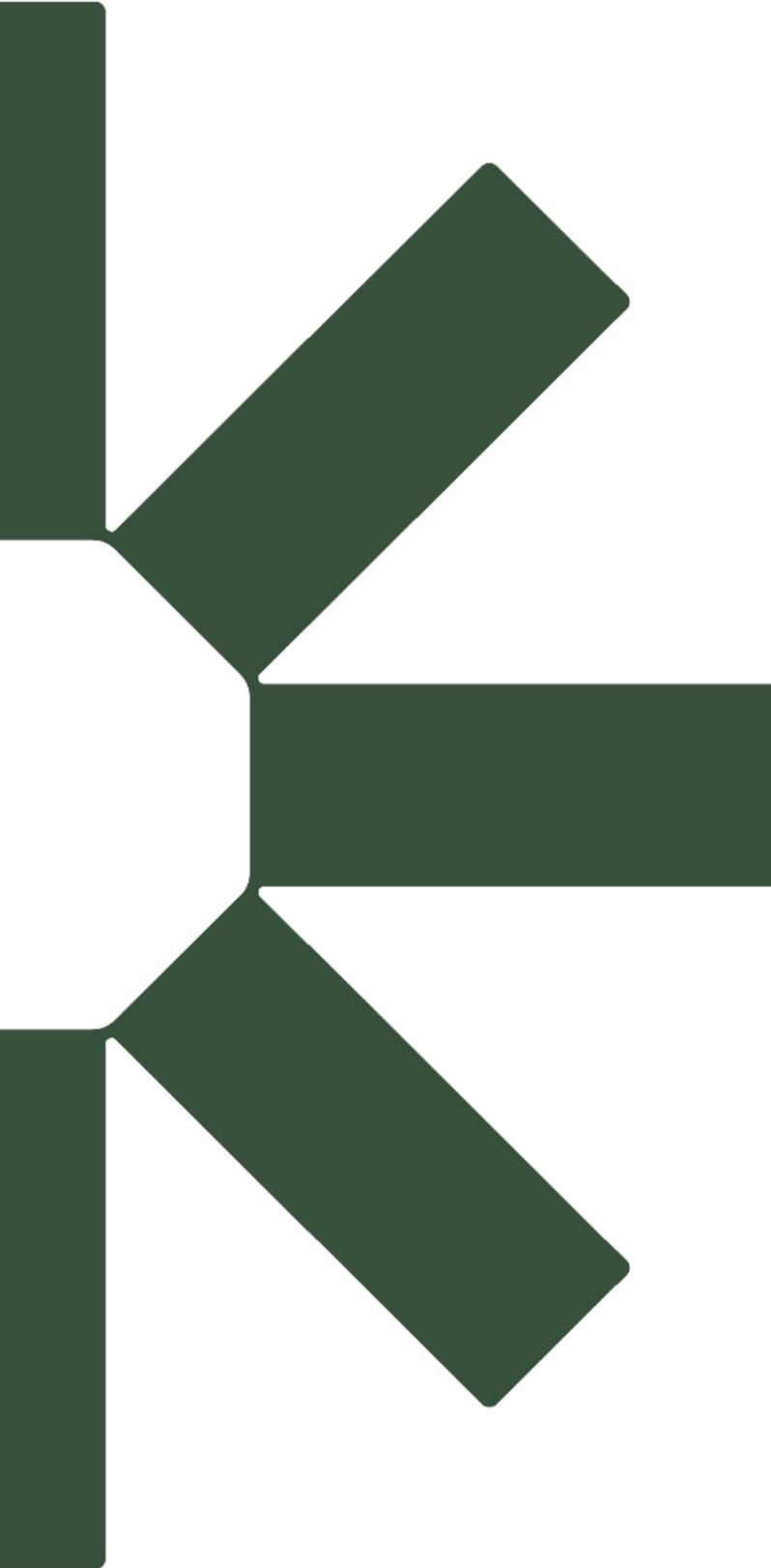
## List of Habitats at Each TDR Node

Habitats are described for each TDR Node where there are any proposed works that could affect habitats, either directly or via the spread of invasive and non-native species. Habitats are not listed where the proposed works only consist of removal of street furniture or any other similarly low-impact works. This should be read in conjunction with Technical Appendix 14.1.

Node	Relevant Works	Habitats	Invasive and Non-Native Plants
1: N4/N52 Delvin Road Roundabout	Trimming of trees / hedges Temporary removal of traffic signs Temporary surface for overrun on roundabout	GA2 amenity grassland in centre of roundabout and along verges WL2 treelines either side of road Other habitats artificial	Treelines consist of cherry laurel <i>Prunus laurocerasus</i> , so may need to be trimmed or could be spread during removal of traffic signs
2: Along N52 Delvin Road	Trimming of hedges and overgrowth to wall	WL1 hedgerows GA2 amenity grassland for trimmed verge BL1 stone walls and other stoneworks Other habitats artificial	There is some winter heliotrope <i>Petasites fragrans</i> on eastern verge but seems to be outside of development footprint
3: Along N52 Main Street, Delvin	Trimming of trees to boundary	WD5 scattered trees and parklands	There is some cherry laurel that

Node	Relevant Works	Habitats	Invasive and Non-Native Plants
		BL1 stone walls and other stoneworks GA2 amenity grassland Other habitats artificial	might require trimming
4: N52 Clonmellon Road North of Delvin Along N52	Trimming of trees on verge as necessary	WD5 scattered trees and parklands GA2 amenity grassland BC4 flower beds and other borders Other habitats artificial	None
5: N52 Bend at Robinstown Little	Temporary removal of two traffic signs	GS2 dry meadows and grassy verges WL1 hedgerows Other habitats artificial	Snowberry <i>Symphoricarpos alba</i> present near eastern entrance to Rosmead House but appears to be outside of development footprint
6: N52 Bend by Robinstown Little Junction	Trimming of trees	GS2 dry meadows and grassy verges WL2 treelines WL1 hedgerows Other habitats artificial	None
7: N52 Access for Wind Farm Site	Hedges within visibility splay to be trimmed Trimming of trees	GS2 dry meadows and grassy verges WL2 treelines WL1 hedgerows Other habitats artificial	None
8: Bend Along N52 Clonmellon Road	Trimming of hedges as necessary	GS2 dry meadows and grassy verges WL2 treelines WL1 hedgerows Other habitats artificial	None
9: Bend Along N52 Clonmellon Road	Trimming of trees as necessary on the outside of the bend (or tie back)	GS2 dry meadows and grassy verges WL2 treelines WL1 hedgerows	Rockspray cotoneaster <i>Cotoneaster horizontalis</i> in WL2 hedgerow on

Node	Relevant Works	Habitats	Invasive and Non-Native Plants
	Trimming of hedgerow on inside of bend  Raising of tree canopy	Other habitats artificial	outside of bend (should not be trimmed)  Some cherry laurel within a garden but should be outside of development footprint
10: Along L5542 Road	Raising of tree canopy  Trees and hedges to be trimmed as necessary	GS2 dry meadows and grassy verges  WL2 treelines  WL1 hedgerows  Other habitats artificial	None
11: L5542 Site Access South	Existing road widened	GS2 dry meadows and grassy verges  WL2 treelines  WL1 hedgerows  Other habitats artificial	Snowberry and cherry laurel within lane to south but should be outside of the development footprint
12: L5542 Bend	Gaps to be created in hedge  Existing road widened  New roadway access to field	GS2 dry meadows and grassy verges  Single trees  WL1 hedgerows  Other habitats artificial	None
13: Site Access North	Trees and hedgerows trimmed or removed if necessary  Corrugated shed to be demolished and re-built to suit new access  Existing road to be widened	GS2 dry meadows and grassy verges  WL2 treelines  WL1 hedgerows  Other habitats artificial	None



Making Sustainability Happen

## Knockanarragh Proposed Wind Farm

### Fen Habitats Survey



November 2022

*Photograph taken looking towards Newtown Lough with alkaline fen vegetation in the foreground, and Cladium fen vegetation adjacent to lough.*

## Summary

- Three Annex I fen habitat types were recorded including: H7140 Transition mires and quaking bog, H7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*, and H7230 Alkaline fen.
- Fen habitats are fragmented and localised within the proposed site boundary.
- Fen habitats at Newtown Lough are vulnerable to loss in extent, drainage, changes in hydrology, grazing pressures and nutrient enrichment.
- Fen habitats to the north west of the proposed site are isolated to cutover sections of a larger fen peat mass.
- Consideration of the conservation and restoration potential and habitat connectivity of component peatland habitat types across the proposed site is recommended given the Annex I habitat presence, especially in relation to qualifying interest features of the River Boyne and River Blackwater SAC.

## Introduction

A botanical survey was carried out week beginning 11th July, 2022 within the proposed Knockanarragh Wind Farm site, west of Clonmellon village, County Westmeath; approximate Irish Grid reference: N 63093 67934. Sharon Spratt, independent plant ecologist was contracted by SLR Consulting Limited to report on the presence of fen habitats within the optioned lands at the proposed wind farm development site. This report builds upon an interim field note submitted to SLR Consulting Ltd. in August 2022. This report provides an overview of fen habitat, including any Annex I habitats recorded within the proposed site, in order to guide planning.

Areas were highlighted by SLR Consulting Ltd. as potential areas for Annex I fen habitat types, representing a subset of the entire proposed wind farm site. The survey area was located across the townland of Newtown, with elevation generally under 100m<sup>1</sup>. An area to the west and south of Newtown Lough within the proposed site boundary is located within the River Boyne and River Blackwater Special Area of Conservation (SAC) – site code: IE0002299<sup>2</sup>. Alkaline Fen (H7230) is a qualifying interest feature for the SAC<sup>3</sup>.

Land-use within the survey area includes a quarry, pasture (used for sheep, cattle and horse grazing), and with coniferous forestry to the southern end of the site boundary (outside survey area for fen). A range of semi-natural habitats occur within the survey area.

## Statement of Authority

The assessment was carried out by Sharon Spratt, BSc (Hons), PhD, an independent ecologist and botanist. Sharon has 14 years' post-graduate experience with specialisms in habitat mapping, botanical surveys, and conservation management. She is knowledgeable in the identification of vegetation communities and habitats across the island of Ireland. Project types include, for example, habitat mapping and vegetation monitoring on windfarms, biodiversity checklists and preliminary ecological appraisals of small-scale developments, Phase 1/Fossitt and NVC/IVC level mapping/assessment, and detailed botanical/mapping surveys of Annex I habitats. She has been a field ecologist for the National Fen Survey of Ireland for the past two years. Sharon is an associate member of the Chartered Institute of Ecology and Environmental Management (CIEEM), a full member of the Institution of Environmental Sciences (IES), and a county recorder with the Botanical Society of Britain and Ireland (BSBI).

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<sup>1</sup> [Elevation Finder Online Tool](#) (last accessed 16.11.22)

<sup>2</sup> [EPA MapViewer](#) (last accessed: 16.11.22)

<sup>3</sup> [River Boyne and River Blackwater SAC documents](#) (last accessed: 16.11.22)

## Methodology

The fen habitat survey was carried out week beginning 11<sup>th</sup> July, 2022. Areas were highlighted by SLR Consulting Ltd. as potential areas for the presence of Annex I fen habitat types (Appendix 1). Weather conditions during the survey were favourable, with warm and sunny spells.

A walkover survey was completed, with fen habitats identified to Fossitt level three<sup>4</sup> and Annex I<sup>5</sup>. Other Annex I habitats or areas of conservation value encountered within these highlighted areas, and elsewhere within the site boundary were also noted. A full Fossitt habitat map of the entire proposed site was completed separately by SLR Consulting Ltd.

Mapping was carried out in the field using existing aerial photography, with areas of fen habitat subsequently digitised using Quantum GIS software (QGIS)<sup>6</sup>. Additional aerial imagery was captured across the survey area using a DGI drone. Areas of habitat/land parcels were mapped as polygons, with singular features or features of note/target notes mapped as points.

A representative number of relevés were recorded within Annex I fen habitats to describe the vegetation in greater detail and to understand the habitat condition. Relevé number was selected based upon estimated size of total fen habitat present. Perrin *et al.*, (2014) provide guidance on the number of relevés appropriate to area of habitat (ha)<sup>7</sup>. This was amended to account for the lowland context and scale of fen habitats in question<sup>8</sup>. Placement of relevés within each fen habitat type were selected to capture as best as possible, the variation in: a) vegetation communities observed across the fen habitat type/area, and b) condition within the fen habitat type.

The relevé dataset was analysed using ERICA (Engine for Relevés to Irish Communities Assignment)<sup>9</sup> to assign each to the Irish Vegetation Classification (IVC). ERICA is a web-based application used to analyse vegetation relevé data, with the resulting output a classification of each relevé according to the Irish Vegetation Classification, i.e. it assigns relevés to vegetation communities.

Full details of mapping rationale are included in Appendix 2.

### Survey Limitations

- The fen habitat survey was restricted to those areas advised by SLR Consulting Ltd. in line with the proposed site boundary and to avoid areas which could not be accessed/traversed due to lack of landowner permissions.
- Fen habitat was generally limited in extent and scattered across the survey area. Mapping should be considered approximate, due to the narrow linear nature or small pockets of fen habitat observed.
- Aside from relevé data recording, species recorded as part of this survey are incidental and a comprehensive/specialised species survey was not the objective of this fen habitat survey.

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<sup>4</sup> Fossitt, J. A. (2000) *A Guide to Habitats in Ireland*. The Heritage Council

<sup>5</sup> [European Commission \(2003\) Interpretation Manual of European Union Habitats. Euro 28. European Commission DG Environment.](#) (last accessed: 16.11.22)

<sup>6</sup> [QGIS software](#) (last accessed: 18.11.22)

<sup>7</sup> [Perrin et al., \(2014\) - Irish Wildlife Manual No. 79.](#) (last accessed: 18.11.22)

<sup>8</sup> Pers. comm. as part of the National Fen Survey of Ireland (2022), which is currently underway. Reports currently in preparation.

<sup>9</sup> [ERICA Irish Vegetation Classification Tool](#) (last accessed: 18.11.22)

## Results and Discussion

### Existing Fen Data

Alkaline fen (H7130) is a qualifying interest feature for the River Boyne and River Blackwater SAC, with H7230 noted around Newtown Lough<sup>10</sup>. National data for both Alkaline fen (H7230) and Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (H7210) are held by National Parks and Wildlife Service (NPWS) as part of reporting procedures to the European Union on Annex I habitats. Appendix 3 shows the location of known H7230 and H7210 habitat within the Knockanarragh proposed site boundary and in the surrounding area. In the latest, and third Article 17 report, Alkaline fen (H7230) was reported to be in favourable condition for the River Boyne and River Blackwater SAC<sup>11</sup>.

The Map of Irish Wetlands was a mapping project that aimed to amalgamate numerous datasets on wetland habitats across Ireland<sup>12</sup>. A data point for Newtown Lough demonstrates the presence of alkaline fen, transition mire, calcareous springs, and *Cladium* fen, as well as lake, scrub, reed swamp and tall herb swamp. The site is described as: “small fen area on edge of lake, with good species variety. *Schoenus* abundant on hummocks. *Cladium* in places”. Further, this map indicates fen peat sediment in this area, and further west (Appendix 4). This area of fen peat sediment overlaps part of the proposed site boundary.

### Definitions of Fen

Foss and Crushell (2008) provide a comprehensive overview of fen habitat classifications for Ireland<sup>13</sup>. Four Annex I habitat types are recognised in Ireland under the EU Habitats Directive, including:

- H7140 Transition mires and quaking bogs
- H7210 \*Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
- H7220 \* Petrifying springs with tufa formation (Cratoneurion)
- H7230 Alkaline fen.

Table 1 provides Fossitt habitat classification correspondences for each of these Annex I habitat types where appropriate. The 2019 Article 17 overall status and trend of each Annex I fen habitat type is also included. All Annex I fen habitat is classified as unfavourable within Ireland. Appendix 5 contains text from the Interpretation of European Union Habitats<sup>14</sup> on Annex I fen habitat types in Ireland. Appendix 6 contains text from A Guide to Habitats in Ireland<sup>15</sup>.

Fens exist as complexes of habitat types. Other commonly occurring Fossitt habitats may include: FP1 calcareous springs, FP2 non-calcareous springs, reed and large sedge swamps (FS1), tall-herb swamps (FS2), marsh (GM1), wet grassland (GS4), wet heath (HH3), raised bog (PB1), lowland blanket bog (PB2), upland blanket bog (PB3), woodland, in particular wet willow-alder-ash woodland (WN6), and turloughs (FL6). Some of these have Annex I correspondences.

<sup>10</sup> [River Boyne and River Blackwater Site Synopsis](#) (last accessed: 16.11.22)

<sup>11</sup> [River Boyne and River Blackwater Conservation Objectives](#) (last accessed: 16.11.22)

<sup>12</sup> [Map of Irish Wetlands](#) (last accessed: 16.11.22)

<sup>13</sup> The National Fen Survey of Ireland is currently underway, following on from the ‘Guidelines for a National Fen Survey of Ireland Survey Manual’ (Foss and Crushell, 2008). Reports are currently in preparation, so any refinement on Irish fen definitions is not taken into account within this report.

<sup>14</sup> [Interpretation Manual of EU Habitats \(2013\)](#) (last accessed: 16.11.22)

<sup>15</sup> [Fossitt \(2000\) A Guide to Habitats in Ireland](#) (last accessed: 16.11.22)

Table 1. Fen habitat types recorded in Ireland according to Fossitt habitat classification and Annex I habitats  
\*denotes priority habitat<sup>16</sup>.

Fossitt habitat type	Annex I habitat type	Overall Status and Trend within Ireland (2019 Article 17 reporting) <sup>17</sup>
PF3 transition mire and quaking bog	H7140 Transition mires and quaking bogs	Unfavourable-Bad (stable)
PF1 rich fen and flush	H7210 *Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	Unfavourable-Inadequate (stable)
PF1 rich fen and flush	H7220 * Petrifying springs with tufa formation (Cratoneurion)	Unfavourable-Inadequate (declining)
PF1 rich fen and flush	H7230 Alkaline fen	Unfavourable-Bad (declining)
PF2 poor fen and flush	n/a	n/a

The Irish Vegetation Classification is a recent and developing classification system<sup>18</sup>. It aims to provide a comprehensive national vegetation classification which can be used to aid identification of Annex I habitats, and facilitate monitoring of vegetation change, amongst other uses.

Fens, mires and springs form one division within the hierarchical classification<sup>19</sup>. The four fens and mires groupings are further divided into 16 individual communities.

### ***Vegetation Communities and Annex I habitats***

Eight relevés were recorded across the fen vegetation located at Newtown Lough and in an area to the north west of the proposed site (Appendix 7). Photographs for each relevé are presented in Appendix 8. Species richness ranged from 5 species within the H7210 equivalent relevé to 19 species within both a H7140 and a H7230 equivalent relevé. Ground conditions were variable, with some quaking and wet in the north-western section, to firm and dry, and firm and wet surrounding Newtown Lough. Bare soil was not observed in any of the relevés, and evidence of livestock poaching or grazing was not recorded. There was a small number of sheep, one horse and a herd of feral goats grazing extensively across much of this north and western section of the proposed site (Figure 1). Much of the fen vegetation is fenced off from grazing cattle at Newtown Lough, with livestock poaching high outside this fence (Figure 2). A full species list for the site survey is presented in Appendix 9, with relevé raw data presented in Appendix 10.

<sup>16</sup> i.e. habitat types in danger of disappearance and whose natural range mainly falls within the territory of the EU.

<sup>17</sup> [NPWS \(2019\). The Status of EU Protected Habitats and Species in Ireland.](#)

<sup>18</sup> [Perrin, P., Fitzpatrick, U., and Lynn, D. \(2018\). The Irish Vegetation Classification - an overview of concepts, structure and tools. \*inpractice\*. 102. pp: 14-19.](#) (last accessed: 18.11.22)

<sup>19</sup> [Irish Vegetation Classification Explorer](#) (last accessed: 18.11.22)

Figure 1. Feral goats grazing in north west of proposed site.



Figure 2. View looking from edge of fen vegetation adjacent to Newtown Lough landwards, with livestock poaching evident in wet grassland vegetation.



A total of five IVC communities were assigned to the eight relevés (Table 2). Percentage “goodness of fit” ranged from 32.3% for relevé 8 to 100% for relevé 6. Within the ERICA programme each relevé is assigned to the vegetation community it most closely fits, or which has the “maximum membership value”, presented as a percentage within the output (Appendix 11). Further, the output categorises each relevé to one of three categories; assigned, unassigned and transitional (Appendix 12). Relevés 1 to 7 had IVC types which were assigned, with relevé 8 having a transitional IVC type.

Seven relevés were assigned to vegetation communities within the ‘fens and mires’ division, with one relevé assigned to the ‘freshwater’ division. Table 3 lists the Fossitt and Annex I classification correspondences for these assigned IVC communities. H7140 Transition mire and quaking bog, H7210 *Cladium* fens, H7230 Alkaline fens, and H6410 *Molinia* meadows are the Annex I habitat equivalents. The vegetation communities and Annex I habitats are discussed further in subsequent sections when describing fen vegetation according to location within the proposed site. Appendix 13 provides IVC community summaries for the classified relevés.

Table 2. IVC resulting vegetation communities from ERICA software.

Relevé	Code	Community	Group	Division
1	FE2D	<i>Carex rostrata - Menyanthes trifoliata</i>	<i>Menyanthes trifoliata – Potentilla palustris</i>	Fens and mires
2	FE2F	<i>Menyanthes trifoliata - Calliergonella cuspidata</i>	<i>Menyanthes trifoliata – Potentilla palustris</i>	Fens and mires
3	FE2F	<i>Menyanthes trifoliata - Calliergonella cuspidata</i>	<i>Menyanthes trifoliata – Potentilla palustris</i>	Fens and mires
4	FE1C	<i>Carex panicea - Carex viridula</i>	<i>Schoenus nigricans – Corynephorus diactyloides</i>	Fens and mires
5	FE2F	<i>Menyanthes trifoliata - Calliergonella cuspidata</i>	<i>Menyanthes trifoliata – Potentilla palustris</i>	Fens and mires
6	FW3H	<i>Cladium mariscus – Phragmites australis</i>	<i>Phragmites australis – Cladium mariscus</i>	Freshwater
7	FE1B	<i>Schoenus nigricans - Succisa pratensis</i>	<i>Schoenus nigricans – Corynephorus diactyloides</i>	Fens and mires
8	FE1B	<i>Schoenus nigricans - Succisa pratensis</i>	<i>Schoenus nigricans – Corynephorus diactyloides</i>	Fens and mires

Table 3. Fossitt and Annex I correspondences for IVC assigned communities.

Relevé	Community	Fossitt	Annex I
1	<i>Carex rostrata - Menyanthes trifoliata</i>	FS1 reed and large sedge swamp / PF3 transition mire and quaking bog	H7140 Transition mire and quaking bog
2	<i>Menyanthes trifoliata - Calliergonella cuspidata</i>	FS1 reed and large sedge swamp / PF1 rich fen and flush / PF3 transition mire and quaking bog	H7140 Transition mire and quaking bog / H7230 Alkaline fens
3	<i>Menyanthes trifoliata - Calliergonella cuspidata</i>	FS1 reed and large sedge swamp / PF1 rich fen and flush / PF3 transition mire and quaking bog	H7140 Transition mire and quaking bog / H7230 Alkaline fens
4	<i>Carex panicea - Carex viridula</i>	PF1 rich fen and flush / PF2 poor fen and flush	H7230 Alkaline fens
5	<i>Menyanthes trifoliata - Calliergonella cuspidata</i>	FS1 reed and large sedge swamp / PF1 rich fen and flush / PF3 transition mire and quaking bog	H7140 Transition mire and quaking bog / H7230 Alkaline fens
6	<i>Cladium mariscus – Phragmites australis</i>	FS1 reed and large sedge swamp	H7210 <i>Cladium</i> fens
7	<i>Schoenus nigricans - Succisa pratensis</i>	PF1 rich fen and flush	H6410 <i>Molinia</i> meadows / H7230 Alkaline fens
8	<i>Schoenus nigricans - Succisa pratensis</i>	GS4 wet grassland	H6410 <i>Molinia</i> meadows / H7230 Alkaline fens

### *Fen habitats at Newtown Lough*

A narrow band of both Calcareous fens with *Cladium mariscus* and species of the *Caricion davalliana* (H7210) and Alkaline fens (H7230) occurs on the fringe of Newtown Lough, within the proposed site boundary. Small areas of H7140 Transition mires and quaking bogs also occurs scattered throughout this band of fen vegetation, and mostly towards the north of this area. Figure 3 is an example of this narrow band of vegetation. The area is estimated to be c. 0.4ha. The H7210 and H7230 Annex I fen habitat on the fringe of Newtown Lough is narrow in extent. It was difficult to map accurately the area located within the proposed site boundary, with some of the H7210 habitat located outside the proposed site boundary. The presence of this Annex I fen habitat within and adjacent to the proposed site boundary should be considered as one management/conservation unit.

*Figure 3. Aerial image showing narrow band of Alkaline fen and Cladium fen on the edge of Newtown Lough.*



Relevé 5 is representative of the H7140 vegetation adjacent to this area of Newtown Lough. It was classified as FE2F *Menyanthes trifoliata* - *Calliergonella cuspidata* fen and mire. This vegetation community can correspond to both H7140 and H7230 vegetation. It is generally accepted that the presence of the 'brown mosses' group of species is required to classify a habitat as H7230. The absence of brown mosses within this relevé indicates H7140. Additionally, FE2F has affinity with FS1 reed and large sedge swamp, and indeed much of this sparse H7140 vegetation type was located adjacent to FS1 habitat around Newtown Lough (Figure 4). This relevé serves to demonstrate the transitional nature of fen habitats more generally, and in particular around Newtown Lough.

Figure 4. Image shows FS1 reed and large sedge swamp with sparse H7140 equivalent vegetation.



The relevé which represents Annex I *Cladium* fen (relevé 6) was classified as FW3H *Cladium mariscus* – *Phragmites australis* freshwater habitat. The vegetation demonstrated a *Cladium mariscus* dominated version of this habitat type (Figure 5). The FW3H synopsis states that where these denser stands occur adjacent to other fen habitat types, they are considered as H7210 quality within Ireland<sup>20</sup>. This differentiates this *Cladium* fen (Annex quality) from *Cladium* swamp (non-Annex quality) for example.

Figure 5. Great fen-sedge *Cladium mariscus* on edge of Newtown Lough.



Two relevés represent Annex I Alkaline fen (relevés 7 and 8). These were classified as FE1B *Schoenus nigricans* – *Succisa pratensis* fen and mire habitat. The relevés were of medium species diversity typical of this black bog-rush *Schoenus nigricans* rich fen habitat. These two relevés demonstrate the uneven distribution and abundance of the brown moss species across this narrow band of H7230 vegetation. Relevé 7 had a 45% cover

<sup>20</sup> This is an accepted definition of H7210 quality habitat (pers. comm. as part of the National Fen Survey of Ireland, 2022).

of brown moss species, namely *Ctenidium moluscum*, compared with only 0.3% of *Campyllum stellatum* within relevé 8.

A number of factors are highlighted which may be impacting upon the quality and extent of Annex I fen vegetation at Newtown Lough. Scattered scrub (birch and willow) was observed throughout the Annex I fen vegetation at Newtown Lough (Figure 6).

Figure 6. Image shows scattered scrub throughout Annex I fen habitat at Newtown Lough.



As noted previously, the Annex I fen habitat is separated from the adjacent grazed grassland with an electric fence. Fencing has been placed in order to facilitate cattle drinking access to the lough. This access 'pool' on the lough fringe can be seen in Figure 7<sup>21</sup> and Figure 8. It is located just north of the proposed site boundary.

Figure 7. Aerial image shows cattle access to lough and fencing separating Annex I habitat.



<sup>21</sup> Fence line in this area can be seen more clearly in photograph .jpg when zooming in and via MP4 footage.

Figure 8. Cattle drinking access point to Newtown Lough.



Green algae were observed within the H7210 and H7230 habitats at Newtown Lough, as well as within drains outside the proposed site boundary (Figure 9). A full list of target note summaries is provided in Appendix 14. Appendix 15 contains an associated map of target notes.

Figure 9. Green algae observed within drain outside proposed site boundary feeding into Newtown Lough.



The vegetation adjacent to the Annex I fringe of fen habitat at Newtown Lough grades from GS4 wet grassland through to drier GS1 neutral grassland upslope (westerly direction from lough). As stated previously, this grassland is heavily poached (Figure 2 above and can be seen clearly on aerial footage). There is a natural gradient present between the H7230 fen and GS4 wet grassland, which has been artificially altered/shortened somewhat by the presence of the electric fence, and subsequent contrast in management. Given the location of the boundary of known/previous H7230 habitat at Newtown Lough (Appendix 3), and the presence of some calcareous indicators outside this fence line, the extent of the H7230 habitat may have been greater in the past. Further, there are some indicators of H6410 *Molinia* meadows within the GS4 wet grassland adjacent to the band of H7230 fen vegetation, and to the lough side of the fence line. This includes areas rich in orchids (Figure

10). Some areas of the wet grassland outside of the fence line were less diverse (Figure 11). Relevés 7 and 8 were assigned the IVC FE1B *Schoenus nigricans* - *Succisa pratensis*, which as well as having affinity with H7230 Alkaline fen, also has affinity with H6410 *Molinia* meadows. Consideration should be given to degraded H6410 *Molinia* meadow being present within this transitional area. Grazing and associated livestock poaching are likely to be contributing to the condition of this transitional habitat zone.

Considering the narrow band of Annex I fen (H7230, H7210 with limited H7140) on the fringe of Newtown Lough and the transitional nature of these habitats, buffer zones are important in protecting these fragile wetland habitats from further degradation and loss in extent. Consideration should be given to ensuring that any activities take into account appropriate buffer zoning to include any potential degraded H7230 and H6410 habitats outside the current fence line.

The following text is cited from the attribute related to transitional areas of the SAC conservation objectives, "In many cases, fens transition to other wetland habitats. It is important that the transitional areas between fens and other habitats are maintained in as natural condition as possible in order to protect the functioning of the fen"<sup>22</sup>.

A habitat map of fen vegetation habitats of interest within the proposed site boundary is provided in Appendix 16.

Figure 10. Orchid-rich area transitional between H7230 vegetation and GS4 vegetation.



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<sup>22</sup> NPWS (2021) Conservation Objectives: River Boyne and River Blackwater SAC 002299. Version 1. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage.

Figure 11. GS4 wet grassland adjacent to fence line at H7230 boundary.



### ***Wet woodland at Newtown Lough***

Wet woodland is a commonly occurring companion habitat type within the wider fen complex of habitats. Some of the woodland to the south west of Newtown Lough (Irish Grid ref: N 63733 67720) is located within the proposed site boundary. This woodland was classified as WN6 wet willow-alder-ash woodland according to the Fossitt classification (Figure 12). This vegetation of this woodland shows some affinity with the Annex I habitat type: H91E0 \* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)<sup>23</sup>. This area is estimated to be c. 0.5 ha. Some cutover was identified within this woodland (Figure 13). Given location adjacent to the lough shore and fen habitat complex, this is considered a fen peat source. H91E0 is listed as a qualifying interest feature of the River Boyne and River Blackwater SAC. Chalara ash dieback was observed in woodland at Newtown Lough.

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<sup>23</sup> Both WN6 according to the Fossitt classification and H91E0 according to Annex I definitions are complex habitat types with many vegetation communities.

*Figure 12. WN6 wet woodland to south west of Newtown Lough.*



*Figure 13. Image shows cutover within wet woodland to south west of Newtown Lough.*



### ***Fen Habitats to north west***

An area to the north west of the site (estimated at c. 1.8 ha)<sup>24</sup> was classified as containing PF3 transition mire and quaking bog (Appendix 14), equating to Annex I habitat type H7140 Transition mires and quaking bogs. The fen vegetation is confined to cutover areas within the wider habitat type (Figure 14). Figure 15 was captured via drone survey, and shows various cutover sections containing fen vegetation. These areas of cutover containing fen vegetation were approximately 2m x 1.5m.

*Figure 14. Example cutover vegetation in north west of proposed site.*



*Figure 15. Aerial image showing cutover plots within north west of site, containing H7140 fen vegetation (highlighted in yellow circle).*



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<sup>24</sup> Areas are indicative and to include the general area where fen vegetation is present.

Two of the relevés were classified through the IVC as FE2F *Menyanthes trifoliata* - *Calliargonella cuspidata* fen and mire, one relevé was classified as FE2D *Carex rostrata* - *Menyanthes trifoliata* fen and mire, and one relevé was classified as FE1C *Carex panicea* - *Carex viridula* fen and mire.

The relevé classified as FE2D corresponds to H7140 Transition mire and quaking bog and is described as being a relatively species poor vegetation community. The dominant species here were; bottle sedge *Carex rostrata*, bogbean *Menyanthes trifoliata*, and marsh cinquefoil *Comarum palustre*.

Relevé 4, classified as FE1C corresponds to H7230 Alkaline fen, however its fit with this IVC community was only 53.8%, although it was categorised as “assigned”. A small percentage of the brown mosses, *Scorpidum cossonii* at 5% and *Campyllum stellatum* at 1% were present, indicating somewhat base-rich conditions. The vascular composition does not closely resemble the synopsis for this vegetation community. Although one of the constant species, purple moor-grass *Molinia caerulea* is present (35%), the other dominant vascular species, bogbean *Menyanthes trifoliata* (45%) is not a characteristic species of this otherwise upland vegetation community.

Relevés 2 and 3 were classified as FE2F which corresponds to both H7140 Transition mire and quaking bog and H7230 Alkaline fen. As described previously, the presence of brown moss species is more indicative of Alkaline fen. 10% *Campyllum stellatum* was recorded within relevé 2, again indicating somewhat base-rich conditions.

It can be difficult to separate H7140 from H7230 especially in vegetation communities like FE2F *Menyanthes trifoliata* - *Calliargonella cuspidata*. Overall, the fen vegetation within these isolated pockets to the north west of the site generally correspond to PF3 transition mires and quaking bog according to the Fossitt classification. This vegetation generally corresponds to H7140 Transition mire and quaking bog, albeit with some base-rich influence.

### **Other fen habitats to north west**

The vegetation in the wider area of where the fen vegetation occurs was dominated by *Molinia caerulea* and most closely relates to both GS4 wet grassland and PB4 cutover bog according to the Fossitt classification. It most closely relates to the IVC grassland community, GL1C *Molinia caerulea* – *Succisa pratensis*. This vegetation community has affinity with Annex I habitat type H6410 *Molinia* meadows<sup>25</sup>. Some Annex I indicator species were present within the wider areas including: devil’s-bit scabious *Succisa pratensis*, flea sedge *Carex pulicaris*, glaucous sedge *Carex flacca*, and tormentil *Potentilla erecta* for example. The area is extensively grazed, with purple moor-grass dominance. This grades into more neutral semi-improved grassland types outside of those general areas highlighted as containing some fen habitat (Appendix 14).

Further east from the area with fen vegetation in cutover (Figure 16) was a similar area of PF3 transition mires and quaking bogs within cutover. The extent of Annex I H7140 fen habitat is comparatively less here (Figure 17). In addition to similar wider vegetation dominated by purple moor-grass, a small area of ling heather *Calluna vulgaris* dominated vegetation occurs in this area (Figure 17 and Figure 18). Although no relevés were placed in this area, the vegetation could generally be described as corresponding to IVC type HE4E *Molinia caerulea* – *Calluna vulgaris* – *Erica tetralix* heath. This vegetation community has Annex I affinities with H4011 Northern Atlantic wet heaths with *Erica tetralix* and H7120 Degraded raised bogs capable of natural regeneration in this lowland context. This entire area is approximately 1.3ha.

Downy birch *Betula pubescens* is encroaching within these areas, and beginning to form woodland.

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<sup>25</sup> Not assigned through ERICA. Ecological best judgement when looking at IVC type synopses in conjunction with field notes.

*Figure 16. Fen vegetation within more wooded area.*



*Figure 17. Aerial image showing wooded area with H7140 fen vegetation in cutover and limited area containing ling heather (highlighted in yellow circle).*



Figure 18. Area with ericoids and purple moor-grass.



These two areas which contain fen habitat within cutover to the north west of the site are vulnerable to continued pressures of scrub encroachment/loss of habitat through succession to woodland. The current conservation value, and future potential restoration value of fen habitat and other associated peatland habitat types (*Molinia* meadows, wet woodland and heathland/degraded bog) in this area should be considered as a whole.

Some of the denser areas of woodland towards the north west of the site show affinities with 91EO Annex I woodland<sup>26</sup>.

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<sup>26</sup> Not surveyed in detail.

### ***Round-leaved wintergreen (Pyrola rotundifolia)***

Round-leaved wintergreen *Pyrola rotundifolia* is a Red Data List species in Ireland<sup>27</sup>. The site synopsis for the River Boyne and River Blackwater SAC notes its occurrence around Newtown Lough. Historical records for *P. rotundifolia* are for the eastern side of Newtown Lough<sup>28</sup>, outside the survey area and proposed site boundary/optioned land. The species was first discovered in 1972<sup>29</sup> (Breen, 1973)<sup>30</sup>.

*P. rotundifolia* was not observed during the survey at Newtown Lough, nor elsewhere in the survey area. No other rare or protected plant species were recording during the survey.

### ***Other species***

A number of coincidental faunal species were observed during the survey.

Meadow brown butterfly *Maniola jurtina* and ringlet butterfly *Aphantopus hyperantus* were observed on the wing within the vicinity of the relevés recorded to the north-west of the site. Devil's-bit scabious *Succisa pratensis* was abundant within this area, therefore the potential for marsh fritillary butterfly *Euphydryas aurinia* should be considered (potentially similarly within wet grassland transitional zone at Newtown Lough).

Common red soldier beetles *Rhagonycha fulva* were observed at Newtown Lough.

A lapwing *Vanellus vanellus* was also observed in fields to the east of the quarry.

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<sup>27</sup> [Curtis and McGough \(1988\)- The Irish Red Data List Book 1- Vascular Plants](#) (last accessed: 16.11.22)

<sup>28</sup> Location provided by SLR Consulting Ltd. resulting from a NPWS data request.

<sup>29</sup> Cross, J. R. (1986) The Distribution and Status of *Pyrola rotundifolia* L. in Ireland. *Irish Naturalists Journal*. Vol. 22, No. 1. pp. 16-20.

<sup>30</sup> Breen, C. (1973) Report of BSBI field meeting, L. Shesk, Co. Meath, 29<sup>th</sup> July, 1972. *Watsonia*, 9: pp 424.

## Ecological Recommendations

The following recommendations are made in relation to fen, and associated habitats at Knockanarragh proposed wind farm site:

- There is a narrow band of Annex I fen habitat on the fringe of Newtown Lough, within the proposed site boundary. This includes: H7230, H7210 and limited H7140. Fens are usually transitional in nature with adjacent wetland habitats. In the case of Newtown Lough, this includes wet grassland (GS4), and wet woodland (WN6).

Consideration should be given to ensuring that any activities take into account the use of appropriate buffer zones (to include any potential degraded H7230 and degraded H6140 habitat outside the current livestock exclusion fence) in order to protect these fragile wetland habitats from further degradation and loss in extent <sup>31</sup>.

The narrow band of fen vegetation at Newtown Lough should be considered as one management unit, regardless of whether it lies within the proposed site boundary or not.

- Small, isolated fragments of fen habitat, largely relating to H7140 Transition mire and quaking bog occur to the north west of the proposed site. These are vulnerable to continued pressures of habitat loss and degradation through scrub encroachment/loss of habitat to successional woodland, and associated hydrological changes.

The current conservation value, and future potential restoration value of fen habitat, and other associated peatland habitat types (namely *Molinia* meadows, wet woodland and heathland/degraded bog) within this area should be considered as a whole.

- Annex I fen habitats are considered for their habitat and botanical conservation value within this report. Their presence within the proposed site, necessitates consideration of the potential fauna they may support, including Annex II species, and species of national conservation importance.
- The hydrology of fen habitats is of paramount importance to their ecological functioning. Fen peat substrate has been indicated within the vicinity of the fen habitats within the proposed site boundary (and outside this boundary).

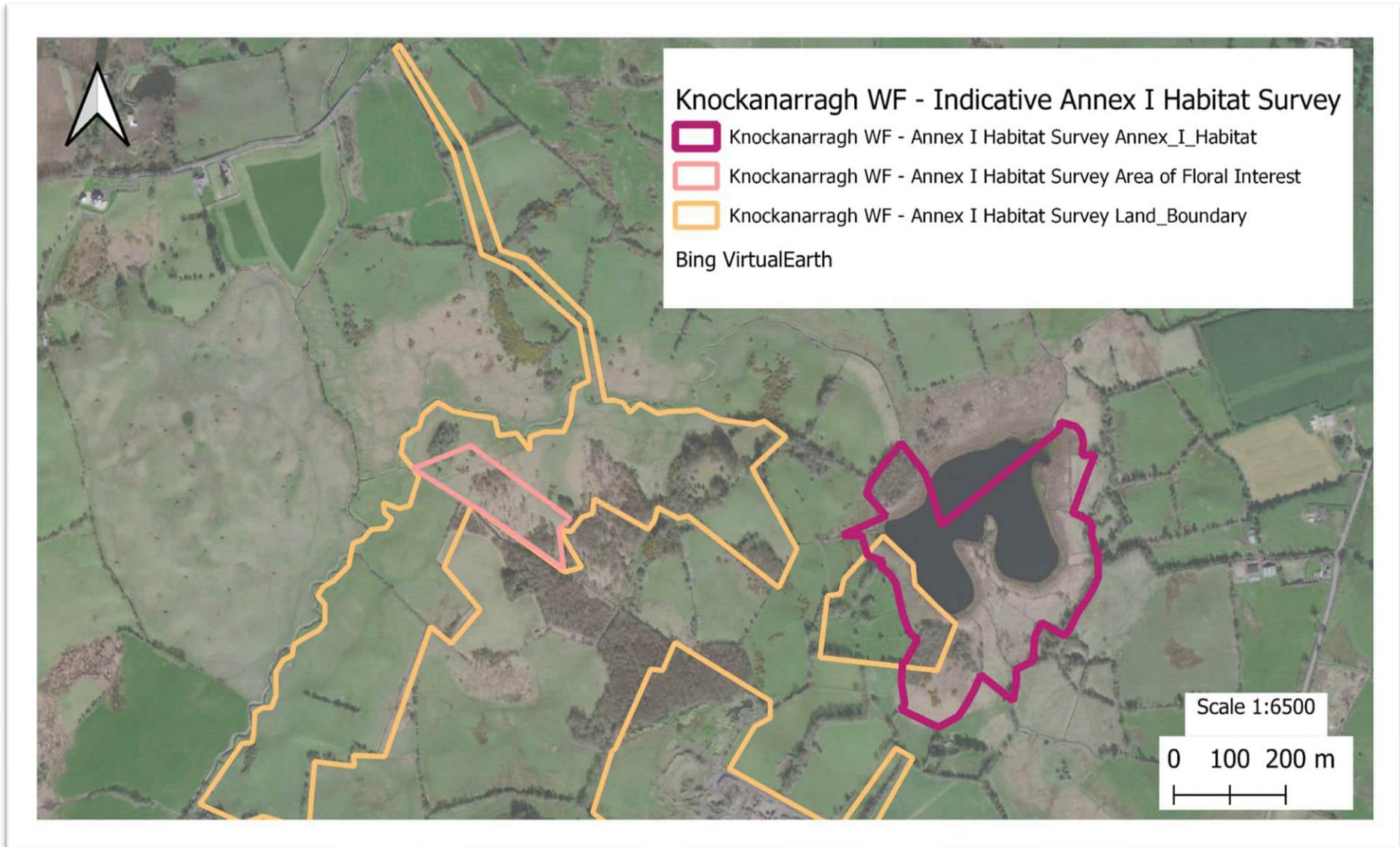
Consideration should be given to understanding the hydrological regime of the fen habitats within the proposed site, and any potential impacts of proposed activities, in order to avoid further degradation and loss of habitat<sup>32</sup>.

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<sup>31</sup> The following text is cited from the attribute related to transitional areas of the SAC conservation objectives, "In many cases, fens transition to other wetland habitats. It is important that the transitional areas between fens and other habitats are maintained in as natural condition as possible in order to protect the functioning of the fen"<sup>31</sup>.

<sup>32</sup> This extends to the hydrological links and potential consequences of changes to the hydrology on the adjacent fen/wetland habitats in the neighbouring SAC.

**Appendix One** – Map showing indicative areas of potential Fossitt/Annex I fen habitat.



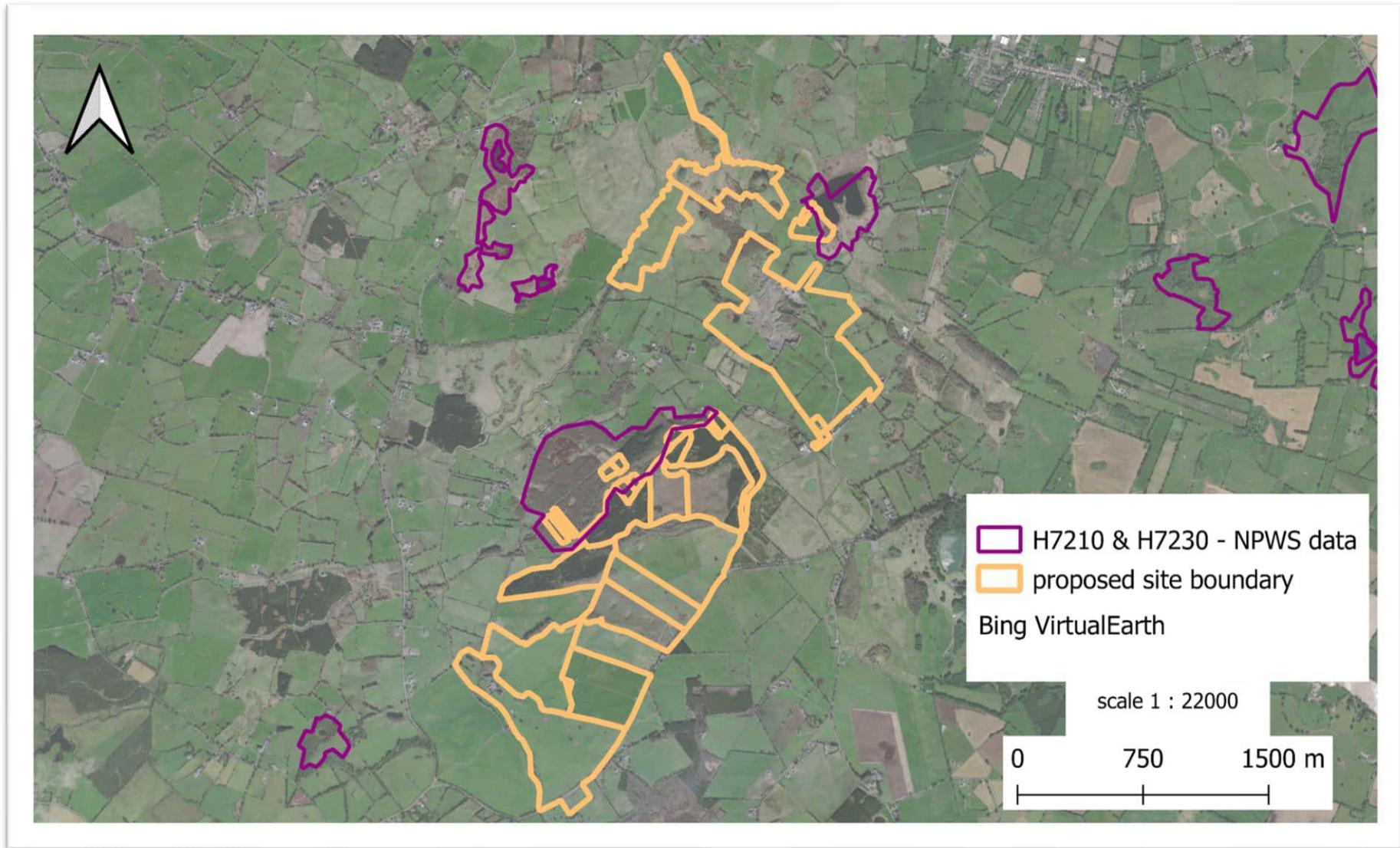
## Appendix Two – notes related to mapping.

- A minimum mapping area of 400m<sup>2</sup> has been applied for polygons<sup>33</sup>. Areas of habitat below this threshold are target noted and can be viewed in the points layer.
- The point layer includes additional detail on habitats and other features of interest.
- A natural occurrence of fen habitats/peatland, is a gradation between adjacent habitat types, therefore polygon boundaries should be considered a guide and not absolute.
- Boundaries of polygons have followed natural boundaries as shown on aerial imagery where appropriate, i.e. field boundaries, roads, water courses etc. Exceptions to this is where the site boundary bisects a natural habitat feature/land-parcel boundary.
- GPS accuracy generally to 4m, therefore locations of point data are still approximate.
- A suite of aerial imagery and other maps were used for digitising through the QuickMapServices Plugin for QGIS.
- The coordinate reference system used for digitising was TM65/Irish National Grid (EPSG: 22990).
- Symbology for Fossitt and Annex I habitat types followed guidance within Smith *et al.*, (2011).

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<sup>33</sup> [Best Practice Guidance for Habitat Survey and Mapping](#) (last accessed: 16.11.22)

**Appendix Three** – NPWS dataset on Alkaline fen (H7230) and Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (H7210)<sup>34</sup>.



<sup>34</sup> Shapefiles provided by SLR Consulting Ltd.

Appendix Four – Map of Irish Wetlands – screenshot from web viewer showing area in the vicinity of Newtown Lough.



**Appendix Five** – Text from Interpretation Manual of European Union Habitats on Annex I fen habitat types in Ireland.

### **7140 Transition mires and quaking bogs**

PAL.CLASS.: 54.5

**1)** Peat-forming communities developed at the surface of oligotrophic to mesotrophic waters, with characteristics intermediate between soligenous and ombrogenous types. They present a large and diverse range of plant communities. In large peaty systems, the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium-sized or small sedges, associated with sphagnum or brown mosses. They are generally accompanied by aquatic and amphibious communities. In the Boreal region this habitat type includes minerotrophic fens that are not part of a larger mire complex, open swamps and small fens in the transition zone between water (lakes, ponds) and mineral soil.

These mires and bogs belong to the Scheuchzerietalia palustris order (oligotrophic floating carpets among others) and to the Caricetalia fuscae order (quaking communities). Oligotrophic water-land interfaces with *Carex rostrata* are included.

**2)** Plants: *Eriophorum gracile*, *Carex chordorrhiza*, *Carex lasiocarpa*, *Carex diandra*, *Carex rostrata*, *Carex limosa*, *Scheuchzeria palustris*, *Hammarbya paludosa*, *Liparis loeselii*, *Rhynchospora alba*, *R. fusca*, *Menyanthes trifoliata*, *Epilobium palustre*, *Pedicularis palustris*, *Sphagnum* sp. (*S. papillosum*, *S. angustifolium*, *S. subsecundum*, *S. fimbriatum*, *S. riparium*, *S. cuspidatum*, *Calliergon giganteum*, *Drepanocladus revolvens*, *Scorpidium scorpioides*, *Campylium stellatum*, *Aneura pinguis*.

**3)** Corresponding categories: United Kingdom classification: "M4 - *Carex rostrata*-*Sphagnum recurvum* mire", "M5 - *Carex rostrata*- *Sphagnum squarrosum* mire", "M8 - *Carex rostrata* *Sphagnum warnstofii* mire", "M9 *Carex rostrata*-*Calliergon cuspidatum/giganteum*", "S27 -*Carex rostrata* - *Potentilla palustris* fen".

### **7210 \*Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae***

PAL.CLASS.: 53.3

**1)** *Cladium mariscus* beds of the emergent-plant zones of lakes, fallow lands or succession stage of extensively farmed wet meadows in contact with the vegetation of the *Caricion davallianae* or other Phragmition species [*Cladietum marisci* (Allorge 1922) Zobrist 1935].

**2)** Plants: *Cladium mariscus*, *Kosteletzkia pentacarpos*.

**3)** Corresponding categories: United Kingdom classification: "S2 *Cladietum marisci*", "S24 *Peucedano* – *Phragmitetum australis*", "S25 *Phragmites australis* - *Eupatorium cannabinum* fen", "M9 *Carex rostrata**Calliergon* spp. mire", "M13 *Schoenus nigricans* - *Juncus subnodulosus* mire", "M14 *Schoenus nigricans* - *Narthecium ossifragum* mire", "M24 *Molinia caerulea* – *Cirsium dissectum* fen meadow", "SD 14 *Salix repens* - *Campylium stellatum* dune slack" and "SD15 *Salix repens* - *Calliergon cuspidatum* dune slack".

**4)** In contact with calcareous fens (7230), but also with acid fens, extensive wet meadows, other reed beds and tall sedge communities.

### **7220 \* Petrifying springs with tufa formation (*Cratoneurion*)**

PAL.CLASS.: 54.12

**1)** Hard water springs with active formation of travertine or tufa. These formations are found in such diverse environments as forests or open countryside. They are generally small (point or linear formations) and dominated by bryophytes (*Cratoneurion commutati*).

**2)** Plants: *Arabis soyeri*, *Cochlearia pyrenaica* (in sites with heavy metals), *Pinguicula*

*vulgaris*, *Saxifraga aizoides*. Mosses: *Catoscopium nigrum*, *Cratoneuron commutatum*, *C. commutatum* var. *falcatum*, *C. filicinum*, *Eucladium verticillatum*, *Gymnostomum recurvirostrum*. In the Boreal region also *Carex appropinquata*, *Epilobium davuricum*, *Juncus triglumis*, *Drepanocladus vernicosus*, *Philonotis calcarea*, *Scorpidium revolvens*, *S. cossoni*, *Cratoneuron decipiens*, *Bryum pseudotriquetrum*.

**3)** Corresponding categories: United Kingdom classification: "M37 *Cratoneuron commutatum* - *Festuca rubra* spring community" and "M38 *Cratoneuron commutatum*-*Carex nigra* spring community".

**4)** Can form complexes with transition mires, fens, chasmophytic communities of cold and humid environments and heaths and calcareous grassland (*Festuco-Brometalia*). In order to preserve this habitat of very limited expanse in the field, it is essential to preserve its surroundings and the whole hydrological system concerned.

### **7230 Alkaline fens**

PAL.CLASS.: 54.2

**1)** Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. Peat formation, when it occurs, is infra-aquatic. Calciphile small sedges and other Cyperaceae usually dominate the mire communities, which belong to the *Caricion davallianae*, characterised by a usually prominent "brown moss" carpet formed by *Campylium stellatum*, *Drepanocladus intermedius*, *D. revolvens*, *Cratoneuron commutatum*, *Acrocladium cuspidatum*, *Ctenidium molluscum*, *Fissidens adianthoides*, *Bryum pseudotriquetrum* and others, a grasslike growth of *Schoenus nigricans*, *S. ferrugineus*, *Eriophorum latifolium*, *Carex davalliana*, *C. flava*, *C. lepidocarpa*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus*, *Scirpus cespitosus*, *Eleocharis quinqueflora*, and a very rich herbaceous flora including *Tofieldia calyculata*, *Dactylorhiza incarnata*, *D. traunsteineri*, *D. traunsteinerioides*, *D. russowii*, *D. majalis* ssp. *brevifolia*, *D. cruenta*, *Liparis loeselii*, *Herminium monorchis*, *Epipactis palustris*, *Pinguicula vulgaris*, *Pedicularis sceptrum - carolinum*, *Primula farinose*, *Swertia perennis*. Wet grasslands (*Molinietalia caerulaea*, e.g. *Juncetum subnodulosi* & *Cirsietum rivularis*, 37), tall sedge beds (*Magnocaricion*, 53.2), reed formations (*Phragmition*, 53.1), fen sedge beds (*Cladietum mariscae*, 53.3), may form part of the fen system, with communities related to transition mires (54.5, 54.6) and amphibious or aquatic vegetation (22.3, 22.4) or spring communities (54.1) developing in depressions. The sub-units below, which can, alone or in combination, and together with codes selected from the categories just mentioned, describe the composition of the fen, are understood to include the mire communities *sensu stricto* (*Caricion davallianae*), their transition to the Molinion, and assemblages that, although they may be phytosociologically referable to alkaline Molinion associations, contain a large representation of the *Caricion davallianae* species listed, in addition to being integrated in the fen system; this somewhat parallels the definition of an integrated class *Molinio - Caricetalia davallianae* in Rameau et al., 1989. Outside of rich fen systems, fen communities can occur as small areas in dune slack systems (16.3), in transition mires (54.5), in wet grasslands (37), on tufa cones (54.121) and in a few other situations. The codes below can be used, in conjunction with the relevant principal code, to signal their presence. Rich fens are exceptionally endowed with spectacular, specialised, strictly restricted species. They are among the habitats that have undergone the most serious decline. They are essentially extinct in several regions and gravely endangered in most.

**2)** Plants: *Schoenus nigricans*, *S. ferrugineus*, *Carex* spp., *Eriophorum latifolium*, *Cinclidium stygium*, *Tomentypnum nitens*.

## Appendix Six – Fen habitat text from Fossett (2000) *A Guide to Habitats in Ireland*.

### Rich fen and flush PF1

Rich fens and flushes are fed by groundwater or flowing surface waters that are at least mildly base-rich or calcareous, and are usually found over areas of limestone bedrock. The substratum is waterlogged peat (except in the case of some flushes) and this usually has a high mineral content. Vegetation is typically dominated by Black Bog-rush (*Schoenus nigricans*) and/or small to medium sedges such as *Carex viridula*, *C. nigra*, *C. dioica* and *C. panicea*. Other prominent components of the vegetation include rushes, particularly Blunt-flowered Rush (*Juncus subnodulosus*), Purple Moor-grass (*Molinia caerulea*), Marsh Pennywort (*Hydrocotyle vulgaris*), Lesser Spearwort (*Ranunculus flammula*), Water Mint (*Mentha aquatica*), Common Marsh-bedstraw (*Galium palustre*), Grass-of-parnassus (*Parnassia palustris*), Common Butterwort (*Pinguicula vulgaris*) and Devil's-bit Scabious (*Succisa pratensis*). Rich fen and flush can be important for orchids such as *Epipactis palustris* and *Dactylorhiza* spp. A well-developed moss layer with *Campylium stellatum*, *Scorpidium scorpioides* and *Drepanocladus revolvens* is also characteristic. The tops of Black Bog-rush (*Schoenus nigricans*) tussocks are relatively dry and may support plants such as heathers (*Calluna vulgaris*, *Erica tetralix*), Tormentil (*Potentilla erecta*), Bog-myrtle (*Myrica gale*) and Bog Asphodel (*Narthecium ossifragum*). Rich fens and flushes may have some patchy cover of Common Reed (*Phragmites australis*), Bulrush (*Typha latifolia*), or tussock-forming species such as Great Fen-sedge (*Cladium mariscus*) and Greater Tussock-sedge (*Carex paniculata*). If large areas are dominated by species-poor or monodominant stands of tall herbaceous plants, they should be considered under **reed and large sedge swamps - FS1**. Fens may contain patches of scrub or woodland, or bodies of open water with aquatics such as Bogbean (*Menyanthes trifoliata*). If the surface is quaking and very wet, and the vegetation comprises some species that may also be found in acid bogs, consider the category **transition mire and quaking bog - PF3**. *Links with Annex I*: This category corresponds to two annexed habitats, 'alkaline fens (7230)' and '\*calcareous fens with *Cladium mariscus* and species of the Caricion davallianae (7210)'. The latter is a priority habitat that describes stands of species-rich alkaline fen vegetation in which Great Fen-sedge (*Cladium mariscus*) is dominant.

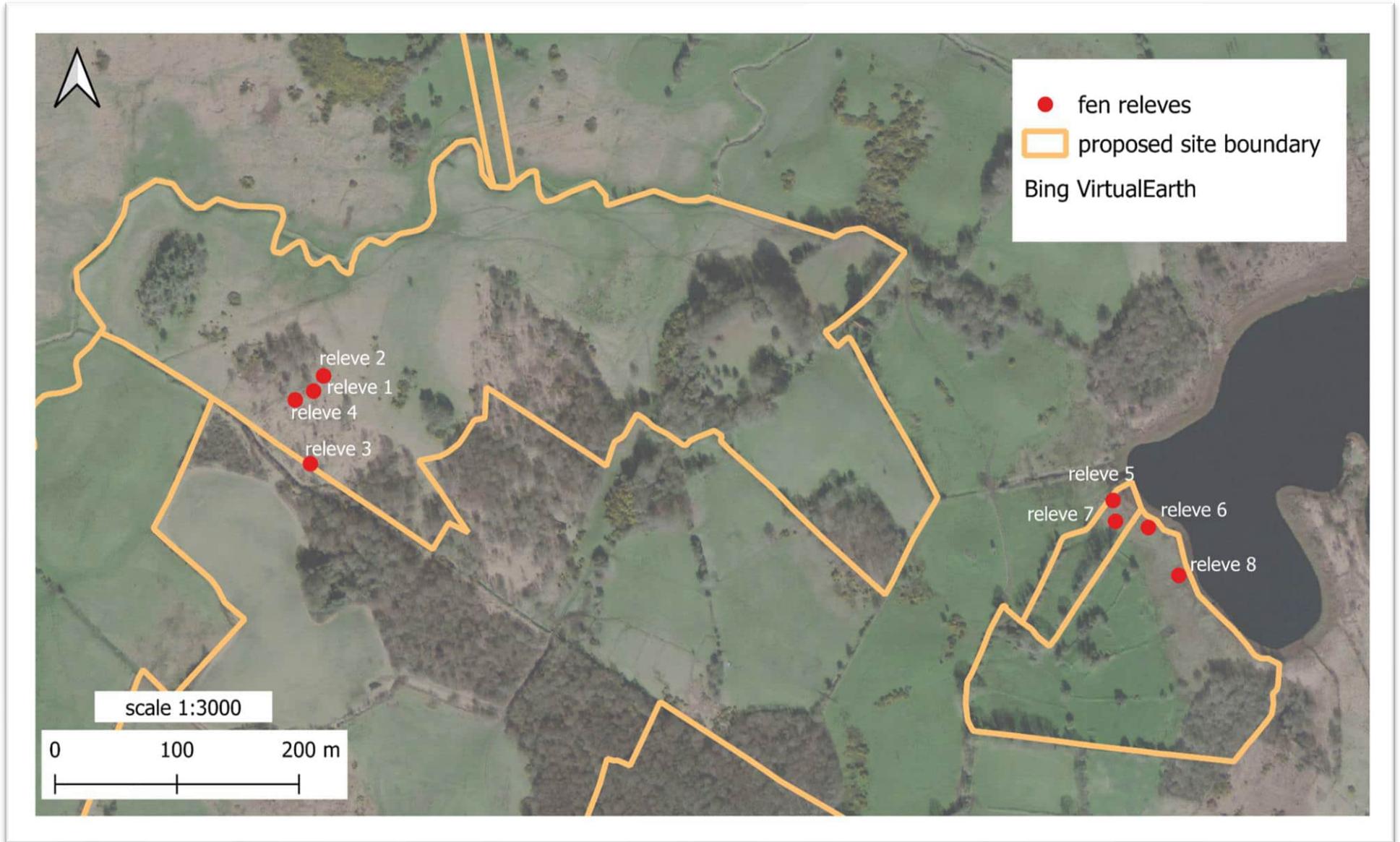
### Poor fen and flush PF2

This category includes peat-forming fens and flushes that are fed by groundwater or flowing surface waters that are acid. Flushes that are acidic but not peat-forming should also be considered here. In most cases the substratum is acid peat which has a higher nutrient status than that of ombrotrophic bogs. The vegetation of poor fens and flushes is typically dominated by sedges (particularly *Carex rostrata*, *C. nigra*, *C. curta*, *C. lasiocarpa* and *C. echinata*) and/or rushes (*Juncus effusus*, *J. articulatus*, *J. acutiflorus*). Other common components include Common Cottongrass (*Eriophorum angustifolium*), Velvet Bent (*Agrostis canina*), Purple Moor-grass (*Molinia caerulea*), Yorkshire-fog (*Holcus lanatus*) and broadleaved herbs such as Marsh Violet (*Viola palustris*), Bogbean (*Menyanthes trifoliata*), Heath Bedstraw (*Galium saxatile*), Tormentil (*Potentilla erecta*) and Marsh Cinquefoil (*Potentilla palustris*). There may be some limited cover of dwarf shrubs. Extensive carpets of mosses including, in particular, *Sphagnum palustre*, *S. recurvum*, *S. auriculatum*, *Calliergon stramineum* and *Polytrichum commune*, are characteristic. Although poor fen and flush is not listed in Annex I of the Habitats Directive, it is very limited in extent in Ireland and should be regarded as being of special conservation importance (C. Ó Críodáin, pers. comm.).

### Transition mire and quaking bog PF3

Transition mires and quaking bogs are extremely wet peat-forming systems with characteristics that are intermediate between poor and rich fens. For this reason, they are considered as a separate habitat but they may occur within, or on the fringes of other peat-forming systems. Transition mires and quaking bogs are usually associated with the wettest parts of a bog or fen and can be found in wet hollows, infilling depressions, or at the transition to areas of open water. Vegetation frequently forms a floating mat or surface scraw over saturated, spongy or quaking peat. Standing water may occur in pools or along seepage zones. The vegetation typically comprises species that are characteristic of bog, fen and open water habitats. Small to medium sedges, mainly *Carex* spp. (particularly *Carex diandra*, *C. lasiocarpa*, *C. limosa* and *C. viridula*), usually dominate and may occur together with White Beak-sedge (*Rhynchospora alba*), cottongrasses (*Eriophorum angustifolium*, and the much rarer *E. gracile*), Creeping Bent (*Agrostis stolonifera*), Purple Moor-grass (*Molinia caerulea*), and a range of broadleaved wetland herbs such as Bogbean (*Menyanthes trifoliata*), Marsh Pennywort (*Hydrocotyle vulgaris*), Lesser Spearwort (*Ranunculus flammula*), Marsh Cinquefoil (*Potentilla palustris*) and Marsh Lousewort (*Pedicularis palustris*). Extensive moss cover is characteristic; *Sphagnum* spp., *Calliergon* spp. and *Scorpidium scorpioides* are usually abundant. *Links with Annex I*: Corresponds to the annexed habitat, 'transition mires and quaking bogs (7140)'.

**Appendix Seven** – Map showing location of the eight relevés across identified fen vegetation.



**Appendix 8: Relevé photographs.**

**Relevé 1**



**Relevé 2**



**Relevé 3**



Relevé 4



Relevé 5



Relevé 6



Relevé 7



Relevé 8



**Appendix 9:** Full site survey species list.

*Agrostis capillaris*  
*Agrostis stolonifera*  
*Alopecurus geniculatus*  
*Aneura pinguis*  
*Angelica sylvestris*  
*Anthoxanthum odoratum*  
*Azolla filiculoides*  
*Calliergon cordifolium*  
*Betula pubescens*  
*Briza media*  
*Caltha palustris*  
*Campyllum stellatum*  
*Carex diandra*  
*Carex elata*  
*Carex flacca*  
*Carex lepidocarpa*  
*Cirsium palustre*  
*Carex flacca*  
*Carex panicea*  
*Carex pulicaris*  
*Carex nigra*  
*Carex rostrata*  
*Cardamine pratensis*  
*Centaurea nigra*  
*Chara* spp.  
*Cladium mariscus*  
*Climacium dendroides*  
*Comarum palustre*  
*Crataegus monogyna*  
*Ctenidium moluscum*  
*Cynosurus cristatus*  
*Dactylis glomerata*  
*Dactylorhiza incarnata*  
*Dactylorhiza maculata*  
*Epilobium palustre*  
*Equisetum fluviatile*  
*Eriophorum angustifolium*  
*Festuca rubra*  
*Filipendula ulmaria*  
*Fraxinus excelsior*  
*Galium palustre*  
*Galium saxatile*  
*Galium verum*  
*Geranium robertianum*  
*Glyceria* spp.  
*Gymnadenia conopsea*  
*Hedera helix*  
*Hippuris vulgaris*  
*Holcus lanatus*  
*Hydrocharis morsus-ranae*

*Hydrocotyle vulgaris*  
*Hypericum pulchrum*  
*Hypochaeris radicata*  
*Iris pseudacorus*  
*Juncus articulatus*  
*Juncus effusus*  
*Linum catharticum*  
*Luzula multiflora*  
*Lythrum salicaria*  
*Mentha aquatica*  
*Menyanthes trifoliata*  
*Molinia caerulea*  
*Parnassia palustris*  
*Phalaris arundinacea*  
*Phragmites australis*  
*Plantago lanceolata*  
*Potamogeton* spp.  
*Potentilla erecta*  
*Ranunculus flammula*  
*Ranunculus repens*  
*Rubus fruticosus* agg.  
*Rhynchospora squarrosa*  
*Salix cinerea*  
*Sambucus nigra*  
*Schoenoplectus lacustris*  
*Schoenus nigricans*  
*Silene flos-cuculi*  
*Sparganium erectum*  
*Succisa pratensis*  
*Trifolium repens*  
*Typha latifolia*  
*Ulex europaeus*  
*Vaccinium myrtillus*  
*Valeriana officinalis*  
*Vicia cracca*

Appendix 10: Relevé raw data.

	relevé							
	1	2	3	4	5	6	7	8
<b>target fossitt habitat type</b>	PF3	PF3	PF3	PF3	PF3	PF1	PF1	PF1
<b>target Annex I habitat type</b>	H7140	H7140	H7140	H7140	H7140	H7210	H7230	H7230
<b>photo ID</b>	1a, 1b	2a, 2b	3a, 3b	4a, 4b	5a, 5b	6a, 6b	7a, 7b	8a, 8b
<b>% cover open water</b>	20	0	0	0	0	3	0	0
<b>% cover bare soil</b>	0	0	0	0	0	0	0	0
<b>average vegetation height (cm)</b>	60	55	60	45	70	150	30	45
<b>% cover of sedges</b>	55	50	85	60	5	95	80	87
<b>% cover of grasses</b>	0	55	10	35	20	25	70	65
<b>% cover of herbs</b>	100	40	100	45	40	5	40	35
<b>% cover of bryophytes</b>	5	80	30	45	70	0	80	70
<b>% cover of rushes</b>	0	1	0	0	5	0	3	0
<b>% cover of shrubs</b>	0	10	0	3	0	0	1	0.5
<b>ground type</b>	quaking & wet	quaking & dry	dry (non-quaking)	dry (non-quaking)	dry	frim & wet	dry	dry
<b>total no. of species</b>	7	19	13	9	16	5	19	15
<b>notes</b>	typical Care rost-Coma palu quaking transi- tion mire vege- tation type	representative of a more species diverse vegeta- tion community, with grasses be- coming dominant in sward	typical carex-Coma palu rich drier transition mire	Care pani-Care lepi-Meny trif drier transition mire	to rep- resent transi- tion mire habitat adja- cent lough	typical spe- cies-poor Cladium fen	Scho nigr typical spe- cies-di- verse sward	Scho nigr typical spe- cies-di- verse sward

	percentage cover							
<i>Agrostis stolonifera</i>	-	-	-	-	20	-	-	10
<i>Aneura pinguis</i>	-	-	-	-	-	-	-	0.3
<i>Angelica sylvestris</i>	-	-	-	-	-	-	-	0.3
<i>Anthoxanthum odoratum</i>	-	20	-	-	-	-	0.3	-
<i>Betula pubescens</i>	-	7	-	-	-	-	-	0.5
<i>Brachythecium</i> spp.	-	-	0.5	-	-	-	-	-
<i>Briza media</i>	-	-	-	-	-	-	35	7
<i>Calliargon cordifolium</i>	-	-	0.5	-	50	-	-	-
<i>Callierigonella cuspidata</i>	3	80	20	40	20	-	35	70
<i>Caltha palustris</i>	-	-	-	-	0.3	-	-	-
<i>Campyllum stellatum</i>	1	-	10	1	-	-	-	0.3
<i>Cardamine pratensis</i>	-	0.5	-	-	-	-	-	0.1
<i>Carex diandra</i>	-	5	60	-	50	-	-	-
<i>Carex elata</i>	-	-	-	-	25	-	-	5
<i>Carex flacca</i>	-	-	-	-	-	-	20	-
<i>Carex nigra</i>	5	-	1	-	-	-	-	-
<i>Carex lepidocarpa</i>	-	-	-	10	-	-	-	20
<i>Carex panicea</i>	-	15	20	50	-	-	45	30
<i>Carex rostrata</i>	50	30	3	-	10	-	-	-
<i>Cirsium palustre</i>	-	-	-	-	-	-	1	1
<i>Cladium mariscus</i>	-	-	-	-	-	95	-	15
<i>Comarum palustre</i>	60	25	50	-	3	-	-	-
<i>Ctenidium moluscum</i>	-	-	-	-	-	-	45	-
<i>Dactylorhiza maculata</i>	-	0.3	-	-	-	-	-	-
<i>Epilobium palustre</i>	-	-	-	-	7	-	-	-
<i>Equisetum fluviatile</i>	-	0.1	-	-	-	-	0.1	-
<i>Eriophorum angustifolium</i>	-	-	-	-	-	-	-	7
<i>Filipendula ulmaria</i>	-	-	7	-	1	-	0.1	-
<i>Galium palustre</i>	1	10	3	-	5	3	-	0.5

<i>Gymnadenia conopsea</i>	-	-	-	-	-	-	0.5	-
<i>Holcus lanatus</i>	-	20	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	10
<i>Juncus articulatus</i>	-	1	-	-	5	-	3	-
<i>Linum catharticum</i>	-	-	-	-	-	-	1	-
<i>Luzula multiflora</i>	-	0.7	-	-	-	-	-	0.5
<i>Lythrum salicaria</i>	-	-	7	0.3	1	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	7	1	-	3
<i>Menyanthes trifoliata</i>	45	-	-	45	15	-	-	3
<i>Molinia caerulea</i>	-	15	10	35	-	-	35	40
<i>Parnassia palustris</i>	-	-	-	-	-	-	-	3
<i>Pedicularis palustris</i>	-	-	-	-	-	-	-	7
<i>Phragmites australis</i>	-	-	-	-	0.7	25	1	7
<i>Potentilla erecta</i>	-	0.3	-	-	-	-	0.5	-
<i>Rhynchospora alba</i>	-	0.5	-	-	-	-	-	-
<i>Salix cinerea</i>	-	3	-	3	-	-	1	-
<i>Schoenus nigricans</i>	-	-	-	-	-	-	25	10
<i>Scorpidium cossonii</i>	-	-	-	5	-	-	-	-
<i>Silene flos-cuculii</i>	-	-	-	-	-	1	-	-
<i>Succisa pratensis</i>	-	5	-	-	-	-	35	10
<i>Trifolium pratense</i>	-	-	-	-	-	-	0.1	-

**Appendix 11:** ERICA output for eight fen relevés recorded.

	Code	Community	Group	Division	Max	Type	Link
plot1	FE2D	Carex rostrata - Menyanthes trifoliata	Menyanthes trifoliata - Potentilla pa...	Fens an...	98.0	Assigned	Web
plot2	FE2F	Menyanthes trifoliata - Calliergonell...	Menyanthes trifoliata - Potentilla pa...	Fens an...	68.1	Assigned	Web
plot3	FE2F	Menyanthes trifoliata - Calliergonell...	Menyanthes trifoliata - Potentilla pa...	Fens an...	81.8	Assigned	Web
plot4	FE1C	Carex panicea - Carex viridula	Schoenus nigricans - Campyllum stellatum	Fens an...	53.8	Assigned	Web
plot5	FE2F	Menyanthes trifoliata - Calliergonell...	Menyanthes trifoliata - Potentilla pa...	Fens an...	98.4	Assigned	Web
plot6	FW3H	Cladium mariscus - Phragmites australis	Phragmites australis - Cladium mariscus	Freshwater	100.0	Assigned	Web
plot7	FE1B	Schoenus nigricans - Succisa pratensis	Schoenus nigricans - Campyllum stellatum	Fens an...	94.4	Assigned	Web
plot8	FE1B	Schoenus nigricans - Succisa pratensis	Schoenus nigricans - Campyllum stellatum	Fens an...	32.3	Transitional	Web

**Appendix 12:** Plot type assignment according to fuzzy membership resulting from noise clustering analysis performed in ERICA programme when assigning relevés to the Irish Vegetation Classification<sup>35</sup>.

**Table 1.** Categorising types of plots using fuzzy membership results from noise clustering analysis (after Wisser & De Cáceres 2013).

Plot type	Definition
Assigned	The plot has membership $\geq 0.5$ for one of the vegetation communities and therefore relates to the core definition of that vegetation community.
Unassigned	The plot has membership $\geq 0.5$ for the noise class and is poorly represented by the current classification scheme.
Transitional	The plot has membership $< 0.5$ for all vegetation communities and for the noise class. It falls within the scope of the current classification scheme but does not relate to the core definition of any of the vegetation communities.

<sup>35</sup> Perrin, P., Fitzpatrick, U., and Lynn, D. (2018). The Irish Vegetation Classification - an overview of concepts, structure and tools. *inpractice*. 102. pp: 14-19. (last accessed: 18.11.22)

**Appendix 13:** Irish Vegetation Classification community summaries assigned the eight fen relevés recorded.




**Irish Vegetation Classification (IVC)**

[www.biodiversityireland.ie/ivc](http://www.biodiversityireland.ie/ivc)

**Community Synopsis**



An Roinn Tithíochta,  
Rialtais Aisriúil agus Oidhreachta  
Department of Housing,  
Local Government and Heritage

<b>Scientific name</b>	<i>Carex rostrata</i> – <i>Menyanthes trifoliata</i> mire
<b>Common name</b>	Bottle Sedge – Bogbean mire
<b>Community code</b>	FE2D

**Vegetation**  
*Carex rostrata* is the principal species of this mire community with the only other constants being *Equisetum fluviatile*, *Menyanthes trifoliata* and *Galium palustre*. There is frequently some growth of *Agrostis stolonifera* and the forbs *Mentha aquatica*, *Cardamine pratensis*, *Ranunculus flammula* and *Potentilla palustris*. Less often, one may discover some *Hydrocotyle vulgaris* or *Juncus articulatus*. Bryophyte cover is only occasional and rather uninspiring, being chiefly composed of *Calliergonella cuspidata*.

**Ecology**  
 This is a wetland community of nutrient-poor, slightly acidic situations, typically occurring as part of lowland fens and bogs, or along lake margins.

**Sub-communities**  
 No sub-communities are currently described.

**Similar communities**  
*Carex rostrata* also dominates in the FW3C *Carex rostrata* swamp, but that is a far less diverse community in which *Menyanthes trifoliata*, *Mentha aquatica* and *Potentilla palustris* are scarce. *Carex rostrata* may also occur in the FE2E *Menyanthes trifoliata* – *Sphagnum recurvum* agg. mire, but that differs clearly in the abundant cover of *Sphagnum*.

**Records and distribution**

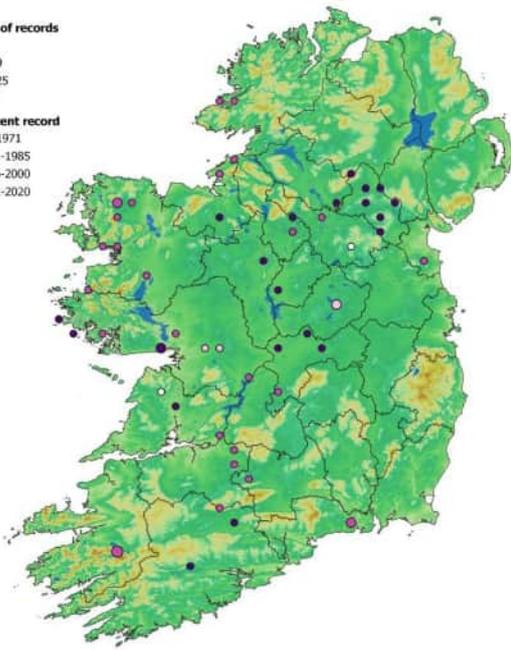
<i>Number of records (all)</i>	
Clearly assigned:	76
Transitional:	33
<b>Total:</b>	<b>109</b>
<i>Number of records (mapped)</i>	
2001-2020:	28
1986-2000:	59
1971-1985:	18
Pre-1971:	2
<b>Total:</b>	<b>107</b>
<i>Number of hectads (by most recent time period)</i>	
2001-2020:	21
1986-2000:	25
1971-1985:	3
Pre-1971:	2
<b>Total:</b>	<b>51</b>
<i>Number of hectads (records in each time period)</i>	
2001-2020:	21
1986-2000:	26
1971-1985:	9
Pre-1971:	2

**Number of records**

- 1-3
- 4-10
- 11-25
- 26+

**Most recent record**

- pre-1971
- 1971-1985
- 1986-2000
- 2001-2020



Synoptic table (n = 67)					
Species	Frequency (from I-V)	Cover min (med) max	Species	Frequency (from I-V)	Cover min (med) max
<i>Carex rostrata</i>	V	4-(7)-9	<i>Filipendula ulmaria</i>	I	2-(3)-8
<i>Equisetum fluviatile</i>	V	2-(5)-9	<i>Calliergon giganteum</i>	I	2-(3)-8
<i>Menyanthes trifoliata</i>	IV	2-(7)-9	<i>Juncus acutiflorus</i>	I	2-(5)-7
<i>Galium palustre</i>	IV	1-(3)-8	<i>Lotus pedunculatus</i>	I	2-(5)-8
<i>Mentha aquatica</i>	III	1-(3)-7	<i>Hypericum elodes</i>	I	2-(5)-8
<i>Potentilla palustris</i>	III	2-(5)-8	<i>Juncus effusus</i>	I	2-(3)-8
<i>Agrostis stolonifera</i>	III	1-(4)-8	<i>Phragmites australis</i>	I	2-(3)-8
<i>Cardamine pratensis</i>	III	+(3)-5	<i>Anthoxanthum odoratum</i>	I	2-(3)-5
<i>Ranunculus flammula</i>	III	2-(3)-5	<i>Typha latifolia</i>	I	+(3)-6
<i>Calliergonella cuspidata</i>	II	1-(5)-9	<i>Veronica scutellata</i>	I	+(2)-3
<i>Hydrocotyle vulgaris</i>	II	2-(3)-8	<i>Eleocharis palustris</i>	I	+(4)-5
<i>Epilobium palustre</i>	II	2-(3)-5	<i>Potamogeton polygonifolius</i>	I	2-(2)-3
<i>Caltha palustris</i>	II	1-(3)-5	<i>Salix cinerea</i>	I	2-(2)-4
<i>Holcus lanatus</i>	II	2-(3)-8	<i>Sparganium erectum</i>	I	3-(5)-7
<i>Juncus articulatus</i>	II	1-(3)-8	<i>Iris pseudacorus</i>	I	2-(3)-5
<i>Carex nigra</i>	II	2-(5)-7	<i>Lemna trisulca</i>	I	2-(3)-6
<i>Eriophorum angustifolium</i>	II	2-(3)-5	<i>Molinia caerulea</i>	I	2-(2)-5
<i>Angelica sylvestris</i>	II	2-(3)-7	<i>Myosotis laxa</i>	I	1-(2)-5
<i>Lemna minor</i>	I	1-(3)-8	<i>Ranunculus lingua</i>	I	2-(4)-5
<i>Succisa pratensis</i>	I	2-(5)-8	<i>Rhytidadelphus squarrosus</i>	I	2-(4)-9

**Affinities**

GHI: FS1 Reed and large sedge swamp / PF3 Transition mire and quaking bog

ZM: IA Alnetea glutinosae Br.-Bl. et Tx. ex Westhoff et al. 1946 (50.7%) / PA Scheuchzerio palustris-Caricetea fuscae Tx. 1937 (29.9%)

EUNIS: D2.332 Basicline bottle sedge quaking mires / D5.2141 Bottle sedge beds

NVC: S27a *Carex rostrata*-*Potentilla palustris* tall-herb fen *Carex rostrata*-*Equisetum fluviatile* sub-community (74.6%)

Annex I: 7140 Transition mires

**Proxy environmental data**

Light: 7.6 Reaction: 5.1 Wetness: 9.1 Fertility: 3.3 Salinity: 0.1

**Conservation value**

Examples of this community may correspond with EU HD Annex I habitat 7140 Transition mires. Desmoulin's whorl snail (*Vertigo moulinsiana*), an EU HD Annex II species, has been recorded from this community at several sites. Species diversity is rather poor (species/4 m<sup>2</sup> = 15.8, n = 36).

**Management**

Typically, this is an unmanaged community. The main threats include drainage, reclamation, ground water pollution and peat extraction.

**Key references**

Foss, P., Crushell, P. (2007) Monaghan Fen Survey 2007. Volume I: Main report. (unpublished). Monaghan County Council/National Parks and Wildlife Service.

O'Criodain, C. (1988) Parvocaricetea in Ireland (Ph.D. thesis). University College Dublin.

**Synopsis version:** V2.0

**Synopsis date:** April 2021

**Synopsis author(s):** P.M. Perrin



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**Irish Vegetation Classification (IVC)**  
[www.biodiversityireland.ie/ivc](http://www.biodiversityireland.ie/ivc)  
**Community Synopsis**



An Roinn Tithíochta,  
Rialtais Áitiúil agus Oidhreachta  
Department of Housing,  
Local Government and Heritage

<b>Scientific name</b>	<i>Menyanthes trifoliata</i> – <i>Calliergonella cuspidata</i> mire
<b>Common name</b>	Bogbean – Pointed Spear-moss mire
<b>Community code</b>	FE2F

**Vegetation**  
 In this quite diverse mire community, *Menyanthes trifoliata* is usually found growing vigorously through a dense layer of *Calliergonella cuspidata*. The remaining constant species do not provide too much cover on average, these being *Galium palustre*, *Equisetum fluviatile*, *Potentilla palustris*, *Agrostis stolonifera*, *Mentha aquatica* and *Carex diandra*. Frequently, these are accompanied by *Hydrocotyle vulgaris*, *Cardamine pratensis*, *Angelica sylvestris* or *Caltha palustris*. *Phragmites australis* and *Carex rostrata* are also frequent and sometimes dominate. Other bryophytes are infrequently present. Occasionally, there is some cover *Calliergon giganteum* and less often some presence of the 'brown mosses' *Campylium stellatum* and *Bryum pseudotriquetrum*.

**Ecology**  
 This is a wetland community of slightly nutrient-poor, mildly acidic situations, often occurring as part of lowland fens.

**Sub-communities**  
 No sub-communities are currently described.

**Similar communities**  
 The abundance of *Calliergonella cuspidata* will help separate FE2F from other communities in this group. An abundance of *Calliergonella cuspidata* is also encountered in the FE3D *Carex nigra* – *Calliergonella cuspidata* fen. In that community, however, *Menyanthes trifoliata*, *Equisetum fluviatile* and *Potentilla palustris* are scarce.

**Records and distribution**

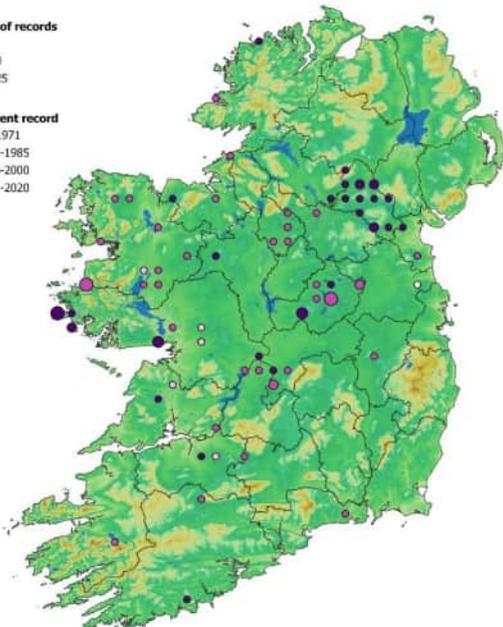
<i>Number of records (all)</i>	
Clearly assigned:	198
Transitional:	45
Total:	243
<i>Number of records (mapped)</i>	
2001-2020:	89
1986-2000:	84
1971-1985:	65
Pre-1971:	1
Total:	239
<i>Number of hectads (by most recent time period)</i>	
2001-2020:	27
1986-2000:	33
1971-1985:	5
Pre-1971:	1
Total:	66
<i>Number of hectads (records in each time period)</i>	
2001-2020:	27
1986-2000:	35
1971-1985:	14
Pre-1971:	1

**Number of records**

- 1-3
- 4-10
- 11-25
- 26+

**Most recent record**

- pre-1971
- 1971-1985
- 1986-2000
- 2001-2020



Synoptic table (n = 173)					
Species	Frequency (from I-V)	Cover min (med) max	Species	Frequency (from I-V)	Cover min (med) max
<i>Calliergonella cuspidata</i>	V	3-(8)-10	<i>Calliergon giganteum</i>	II	2-(5)-9
<i>Menyanthes trifoliata</i>	V	2-(6)-9	<i>Succisa pratensis</i>	II	+(3)-8
<i>Galium palustre</i>	V	1-(3)-8	<i>Carex viridula</i>	II	2-(5)-8
<i>Equisetum fluviatile</i>	IV	1-(3)-7	<i>Lychnis flos-cuculi</i>	II	+(3)-7
<i>Potentilla palustris</i>	IV	+(3)-8	<i>Carex panicea</i>	II	2-(3)-7
<i>Carex diandra</i>	IV	2-(5)-9	<i>Molinia caerulea</i>	II	2-(5)-7
<i>Agrostis stolonifera</i>	IV	1-(3)-8	<i>Equisetum palustre</i>	I	2-(3)-7
<i>Mentha aquatica</i>	IV	+(3)-8	<i>Carex lasiocarpa</i>	I	1-(5)-9
<i>Hydrocotyle vulgaris</i>	III	2-(3)-9	<i>Iris pseudacorus</i>	I	+(2)-5
<i>Cardamine pratensis</i>	III	+(2)-5	<i>Salix cinerea</i>	I	+(2)-6
<i>Angelica sylvestris</i>	III	+(2)-5	<i>Eriophorum angustifolium</i>	I	1-(3)-7
<i>Epilobium palustre</i>	III	+(3)-5	<i>Campylium stellatum</i>	I	1-(5)-8
<i>Phragmites australis</i>	III	2-(3)-10	<i>Pedicularis palustris</i>	I	1-(2)-7
<i>Caltha palustris</i>	III	+(2)-5	<i>Bryum pseudotriquetrum</i>	I	+(3)-5
<i>Carex rostrata</i>	III	+(3)-9	<i>Lythrum salicaria</i>	I	+(2)-4
<i>Holcus lanatus</i>	III	+(3)-5	<i>Anthoxanthum odoratum</i>	I	2-(3)-7
<i>Juncus articulatus</i>	II	2-(3)-7	<i>Typha latifolia</i>	I	+(2)-5
<i>Ranunculus flammula</i>	II	+(3)-7	<i>Carex disticha</i>	I	+(3)-7
<i>Filipendula ulmaria</i>	II	+(3)-7	<i>Juncus subnodulosus</i>	I	+(5)-9
<i>Carex nigra</i>	II	+(3)-9	<i>Plagiomnium rostratum</i>	I	2-(4)-8

**Affinities**

GHI: FS1 Reed and large sedge swamp / PF1 Rich fen and flush / PF3 Transition mires and quaking bogs

ZM: IA Alnetea glutinosae Br.-Bl. et Tx. ex Westhoff et al. 1946 (78.0%) / PA Scheuchzerio palustris-Caricetea fuscae Tx. 1937 (21.4%)

EUNIS: D2.32 Carex diandra quaking mires / D2.391 Boreo-nemoral bog bean and marsh cinquefoil rafts

NVC: S27a *Carex rostrata-Potentilla palustris* tall-herb fen *Carex rostrata-Equisetum fluviatile* sub-community (66.0%), but also M9b *Carex rostrata-Calliergon cuspidatum/giganteum* mire *Carex diandra-Calliergon giganteum* sub-community (63.9%)

Annex I: 7140 Transition mires / 7230 Alkaline fens

**Proxy environmental data**

Light: 7.4 Reaction: 5.7 Wetness: 8.4 Fertility: 3.5 Salinity: 0.1

**Conservation value**

Examples of this quite diverse community with 'brown mosses' may correspond with EU HD Annex I habitat 7230 Alkaline fens. Where the habitat is quaking habitat 7140 Transition mires should be considered. It is a community of medium species richness (species/4 m<sup>2</sup> = 20.3, n = 113).

**Management**

Typically, this is an unmanaged community. The main threats include drainage, reclamation, ground water pollution and peat extraction.

**Key references**

Foss, P., Crushell, P. (2007) Monaghan Fen Survey 2007. Volume I: Main report. (unpublished). Monaghan County Council/National Parks and Wildlife Service.

O'Criodain, C. (1988) Parvocaricetea in Ireland (Ph.D. thesis). University College Dublin.

van Groenendael, J., Hochstenbach, S.M.H., van Mansfeld, M., Roozen, A.J.M., Westhoff, V. (1982) The influence of the sea on the vegetation of lakes in southwest Connemara. *Journal of Life Sciences - Royal Dublin Society* 3, 221-242.

**Synopsis version:** V2.0

**Synopsis date:** April 2021

**Synopsis author(s):** P.M. Perrin

**Irish Vegetation Classification (IVC)**  
[www.biodiversityireland.ie/ivc](http://www.biodiversityireland.ie/ivc)  
**Community Synopsis**

An Roinn Tíbhíochta,  
 Rialtais Aitiúil agus Oidhreachta  
 Department of Housing,  
 Local Government and Heritage

<b>Scientific name</b>	<i>Carex panicea</i> – <i>Carex viridula</i> fen
<b>Common name</b>	Carnation Sedge – Yellow Sedge fen
<b>Community code</b>	FE1C

**Vegetation**  
 This variable community brings together a range of small-sedge dominated vegetation types. The main sedges are *Carex viridula* and *Carex panicea*, which are constant and the combination of their glaucous and bright green sedge leaves is an indicator of this habitat. These are frequently accompanied by *Carex echinata* and occasionally by *Carex nigra*, *Carex hostiana*, *Carex pulicaris* or *Carex dioica*. Other constants are *Molinia caerulea*, *Anagallis tenella*, *Juncus bulbosus* and *Ranunculus flammula*. Frequent vascular plants are *Eleocharis multicaulis*, *Eriophorum angustifolium*, *Succisa pratensis*, *Potentilla erecta*, *Juncus articulatus* and *Potamogeton polygonifolius*. Occasionally, the conspicuous pale-leaved rosettes of *Pinguicula vulgaris* will be seen. There is often, but not always, a 'brown moss' presence in the bryophyte layer, most often in the shape of *Campyllum stellatum*, and somewhat less often in the guise of *Aneura pinguis*, *Drepanocladus cossonii/revolvens*, *Scorpidium scorpioides*, *Fissidens adianthoides* or *Bryum pseudotriquetrum*. *Sphagnum subsecundum* agg. is occasionally present and may be abundant.

**Ecology**  
 This community usually occurs in the uplands on grassy or heathy slopes where there is strong flushing over nutrient-poor thin peats or mineral soils, but variants also occur in the lowlands in association with other fen types.

**Sub-communities**  
 No sub-communities have been described for this community.

**Similar communities**  
 From the other communities in this group, community FE1C differs principally in that *Schoenus nigricans* is scarce here.

**Records and distribution**

<i>Number of records (all)</i>	
Clearly assigned:	195
Transitional:	60
Total:	255
<i>Number of records (mapped)</i>	
2001-2020:	59
1986-2000:	114
1971-1985:	50
Pre-1971:	13
Total:	236
<i>Number of hectads (by most recent time period)</i>	
2001-2020:	33
1986-2000:	24
1971-1985:	10
Pre-1971:	1
Total:	68
<i>Number of hectads (records in each time period)</i>	
2001-2020:	33
1986-2000:	31
1971-1985:	16
Pre-1971:	7

**Number of records**

- 1-3
- 4-10
- 11-25
- 26+

**Most recent record**

- pre-1971
- 1971-1985
- 1986-2000
- 2001-2020

Synoptic table (n = 174)					
Species	Frequency (from I-V)	Cover min (med) max	Species	Frequency (from I-V)	Cover min (med) max
<i>Carex viridula</i>	V	2-(4)-9	<i>Drosera rotundifolia</i>	II	+(2)-3
<i>Carex panicea</i>	V	2-(5)-8	<i>Hydrocotyle vulgaris</i>	II	1-(3)-7
<i>Anagallis tenella</i>	V	1-(3)-8	<i>Sphagnum subsecundum</i> agg.	II	1-(3)-9
<i>Molinia caerulea</i>	V	2-(4)-8	<i>Carex pulicaris</i>	II	+(3)-5
<i>Juncus bulbosus</i>	IV	+(3)-8	<i>Eleocharis quinqueflora</i>	II	2-(5)-8
<i>Ranunculus flammula</i>	IV	+(3)-7	<i>Carex dioica</i>	II	1-(3)-5
<i>Carex echinata</i>	III	+(3)-8	<i>Prunella vulgaris</i>	II	+(2)-7
<i>Eleocharis multicaulis</i>	III	1-(5)-8	<i>Myrica gale</i>	II	2-(3)-5
<i>Campyllum stellatum</i>	III	+(3)-8	<i>Scorpidium scorpioides</i>	II	+(3)-9
<i>Eriophorum angustifolium</i>	III	+(3)-7	<i>Nardus stricta</i>	II	2-(3)-5
<i>Potentilla erecta</i>	III	+(2)-5	<i>Erica tetralix</i>	II	+(2)-7
<i>Succisa pratensis</i>	III	+(3)-6	<i>Pinguicula vulgaris</i>	II	1-(2)-3
<i>Potamogeton polygonifolius</i>	III	2-(5)-8	<i>Anthoxanthum odoratum</i>	II	1-(2)-7
<i>Juncus articulatus</i>	III	+(3)-7	<i>Fissidens adianthoides</i>	II	+(2)-6
<i>Calliergonella cuspidata</i>	II	1-(3)-7	<i>Rhytidiadelphus squarrosus</i>	II	+(2)-4
<i>Carex nigra</i>	II	+(3)-8	<i>Bryum pseudotriquetrum</i>	I	+(2)-5
<i>Aneura pinguis</i>	II	+(2)-3	<i>Hypericum elodes</i>	I	1-(4)-8
<i>Drepanocladus cossonii/revolvens</i>	II	1-(4)-9	<i>Bellis perennis</i>	I	1-(3)-5
<i>Carex hostiana</i>	II	2-(3)-7	<i>Pedicularis palustris</i>	I	1-(2)-5
<i>Narthecium ossifragum</i>	II	+(3)-5	<i>Schoenus nigricans</i>	I	1-(3)-5

**Affinities**  
GHI: PF1 Rich fen and flush / PF2 Poor fen and flush  
ZM: PA Scheuchzerio palustris-Caricetea fuscae Tx. 1937 (90.2%)  
EUNIS: D4.151 British dioecious-yellow sedge fens  
NVC: M10a *Carex dioica-Pinguicula vulgaris* mire *Carex demissa-Juncus bulbosus/kochii* sub-community (60.3%)  
Annex I: 7230 Alkaline fens

**Proxy environmental data**  
Light: 7.7 Reaction: 4.6 Wetness: 8.5 Fertility: 2.2 Salinity: 0.0

**Conservation value**  
This is species-rich community (species/4 m<sup>2</sup> = 25.1, n = 106). Examples which support 'brown mosses' correspond with EU HD Annex I habitat 7230 Alkaline fens.

**Management**  
Flushes in the uplands are in areas usually managed by extensive sheep grazing, which may impact on this community. Stands in the lowlands are vulnerable to drainage, infilling, reclamation and eutrophication.

**Key references**  
Bleasdale, A. (1995) The vegetation and ecology of the Connemara uplands, with particular reference to sheep grazing. (Ph.D. thesis). National University of Ireland Galway.  
O'Criodain, C. (1988) Parvocaricetea in Ireland (Ph.D. thesis). University College Dublin.  
van Groenendael, J., Hochstenbach, S.M.H., van Mansfeld, M., Roozen, A.J.M., Westhoff, V. (1982) The influence of the sea on the vegetation of lakes in southwest Connemara. *Journal of Life Sciences - Royal Dublin Society* 3, 221-242.

**Synopsis version:** V2.0

**Synopsis date:** April 2021

**Synopsis author(s):** P.M. Perrin




## Irish Vegetation Classification (IVC)

[www.biodiversityireland.ie/ivc](http://www.biodiversityireland.ie/ivc)

### Community Synopsis



An Roinn Tithíochta,  
Riailais Aitiúil agus Oidhreachta  
Department of Housing,  
Local Government and Heritage

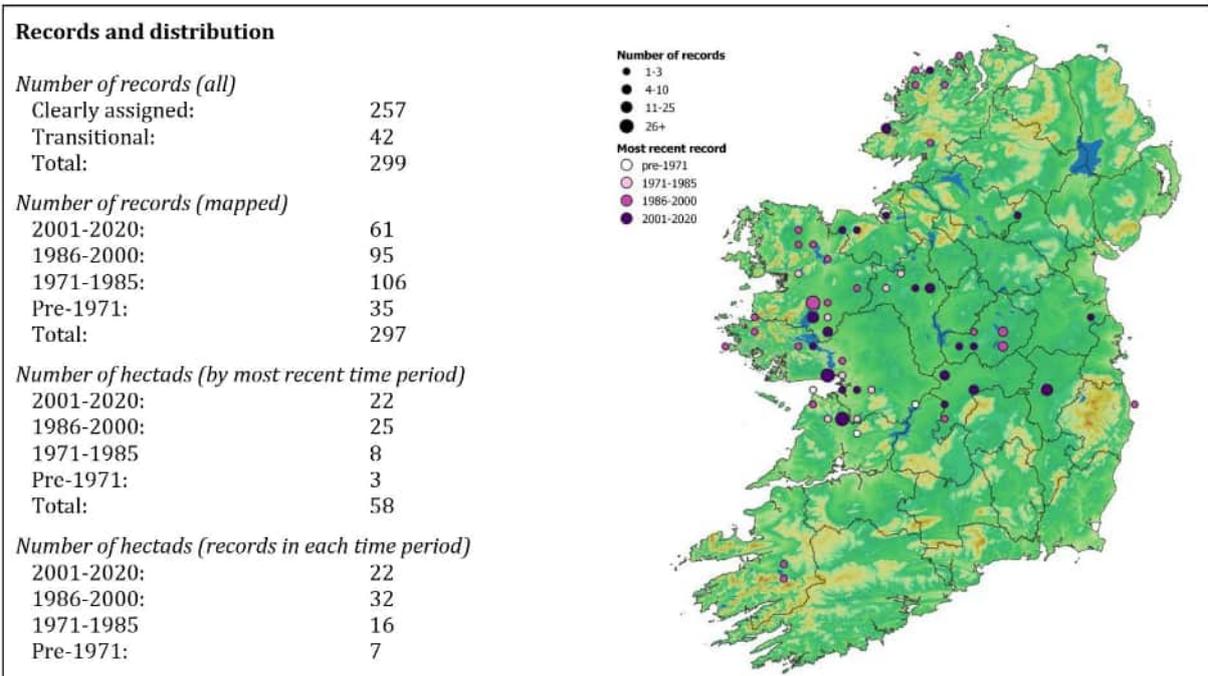
<b>Scientific name</b>	<i>Schoenus nigricans</i> – <i>Succisa pratensis</i> fen
<b>Common name</b>	Black Bog-rush – Devil’s-bit Scabious fen
<b>Community code</b>	FE1B

**Vegetation**  
 This a tussocky fen community dominated *Schoenus nigricans* and *Molinia caerulea*. Other constant species in the field layer are *Succisa pratensis*, *Carex panicea* and *Potentilla erecta*, whilst *Cirsium dissectum* and *Carex flacca* are frequently found. There is usually a notable ‘brown moss’ bryophyte layer in which *Campyllum stellatum* is the mainstay and *Ctenidium molluscum* is frequent, while, occasionally, one will find *Fissidens adianthoides* or the sickle-leaved *Drepanocladus cossonii/revolvens*, and less often *Scorpidium scorpioides*. *Calliergonella cuspidata* is also occasional.

**Ecology**  
 This community occurs in wet fens and flushes on mildly basic, nutrient-poor peats.

**Sub-communities**  
 No sub-communities are described.

**Similar communities**  
 The most closely related community is the FE1A *Schoenus nigricans* – *Campyllum stellatum* fen. Both communities contain *Schoenus*, *Molinia* and a suite of ‘brown mosses’. FE1A, however, contains many species of ombrotrophic bogs including *Eriophorum angustifolium*, *Menyanthes trifoliata*, *Myrica gale*, *Potamogeton polygonifolius*, *Erica tetralix*, *Drosera* spp. and *Narthecium ossifragum*, which are absent from the more meadow-like FE1B. The HE4C *Molinia caerulea* – *Schoenus nigricans* – *Calluna vulgaris* peatland and the BG2D *Erica tetralix* – *Schoenus nigricans* bog both share with the present community the feature of tussocky *Schoenus* and *Molinia* vegetation, but the FE1B community clearly differs from them in the absence of *Calluna vulgaris* and *Sphagnum* spp. The *Molinia* grasslands of group GL1, in which *Cirsium dissectum* is also found, lack both *Schoenus* and brown mosses.



Synoptic table (n = 232)					
Species	Frequency (from I-V)	Cover min (med) max	Species	Frequency (from I-V)	Cover min (med) max
<i>Schoenus nigricans</i>	V	2-(7)-10	<i>Selaginella selaginoides</i>	II	+(2)-3
<i>Molinia caerulea</i>	V	1-(5)-8	<i>Linum catharticum</i>	II	+(2)-3
<i>Succisa pratensis</i>	IV	1-(3)-7	<i>Lotus corniculatus</i>	II	+(2)-5
<i>Campylopus stellatus</i>	IV	+(3)-8	<i>Prunella vulgaris</i>	II	+(2)-5
<i>Carex panicea</i>	IV	1-(3)-8	<i>Carex hostiana</i>	II	1-(3)-6
<i>Potentilla erecta</i>	IV	+(3)-5	<i>Hydrocotyle vulgaris</i>	I	+(2)-7
<i>Cirsium dissectum</i>	III	+(3)-8	<i>Angelica sylvestris</i>	I	+(2)-5
<i>Carex flacca</i>	III	1-(3)-7	<i>Filipendula ulmaria</i>	I	+(2)-5
<i>Ctenidium molluscum</i>	III	1-(3)-7	<i>Galium boreale</i>	I	2-(2)-5
<i>Mentha aquatica</i>	II	+(2)-5	<i>Festuca rubra</i>	I	1-(3)-5
<i>Agrostis stolonifera</i>	II	1-(2)-5	<i>Ranunculus flammula</i>	I	+(2)-5
<i>Calliergonella cuspidata</i>	II	1-(3)-9	<i>Scorpidium scorpioides</i>	I	1-(2)-8
<i>Carex viridula</i>	II	1-(3)-6	<i>Dactylorhiza incarnata</i>	I	1-(2)-3
<i>Parnassia palustris</i>	II	+(2)-5	<i>Sesleria caerulea</i>	I	1-(2)-5
<i>Pinguicula vulgaris</i>	II	+(2)-5	<i>Briza media</i>	I	+(3)-5
<i>Euphrasia officinalis</i> agg.	II	1-(2)-5	<i>Carex pulicaris</i>	I	+(3)-5
<i>Fissidens adianthoides</i>	II	+(2)-5	<i>Centaurea nigra</i>	I	1-(2)-5
<i>Phragmites australis</i>	II	2-(2)-5	<i>Leontodon autumnalis</i>	I	+(2)-5
<i>Anagallis tenella</i>	II	+(2)-5	<i>Polygala vulgaris</i>	I	+(2)-3
<i>Drepanocladus cossonii/revolvens</i>	II	1-(3)-8	<i>Juncus subnodulosus</i>	I	1-(4)-8

**Affinities**

GHI: PF1 Rich fen and flush

ZM: PA Scheuchzerio palustris-Caricetea fuscae Tx. 1937 (47.4%) / CM Molinio-Arrhenatheretea Tx. 1937 (47.0%)

EUNIS: D4.111 Hiberno-Britannic black bogrush fens

NVC: M10a *Carex dioica*-*Pinguicula vulgaris* mire *Carex demissa*-*Juncus bulbosus/kochii* sub-community (46.7%), but also, M13 *Schoenus nigricans*-*Juncus subnodulosus* mire (45.1%)

Annex I: 6410 *Molinia* meadows / 7230 Alkaline fens

**Proxy environmental data**

Light: 7.6 Reaction: 5.8 Wetness: 7.7 Fertility: 2.3 Salinity: 0.1

**Conservation value**

Examples of this community with high cover of *Schoenus nigricans*, *Carex* spp. and brown mosses should correspond with the EU HD Annex I habitat 7230 Alkaline fens. Examples with *Cirsium dissectum* or *Dactylorhiza incarnata* may correspond with the fen variant of habitat 6410 *Molinia* meadows. Geyer's whorl snail (*Vertigo geyeri*), an EU HD Annex II species, has been recorded from this community at several sites. It is a community of medium species richness (species/4 m<sup>2</sup> = 20.8, n = 117).

**Management**

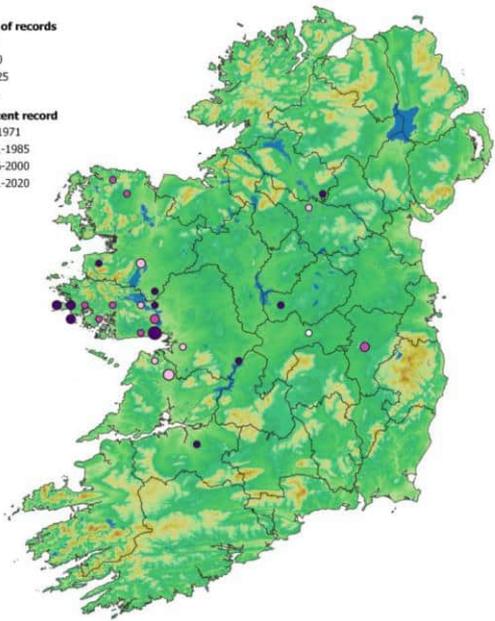
These stands are typically unmanaged but may be grazed by livestock. The main threats are from peat extraction, infilling, drainage, reclamation and eutrophication.

**Key references**

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O'Criodain, C. (1988) Parvocaricetea in Ireland (Ph.D. thesis). University College Dublin.

**Synopsis version:** V2.0      **Synopsis date:** April 2021      **Synopsis author(s):** P.M. Perrin

  <b>Irish Vegetation Classification (IVC)</b> <a href="http://www.biodiversityireland.ie/ivc">www.biodiversityireland.ie/ivc</a> <b>Community Synopsis</b>		 An Roinn Tithíochta, Rialtais Aitiúil agus Oidhreachta Department of Housing, Local Government and Heritage																																										
<b>Scientific name</b>	<i>Cladium mariscus</i> – <i>Phragmites australis</i> swamp																																											
<b>Common name</b>	Great Fen-sedge – Common Reed swamp																																											
<b>Community code</b>	FW3H																																											
<p><b>Vegetation</b>            This community comprises typically rather species-poor, dense stands of <i>Cladium mariscus</i>. <i>Phragmites australis</i> is also a constant species here but is usually clearly subordinate to <i>Cladium</i>. No other species is frequent, but careful searching between the saw-toothed leaves may occasionally reveal some plants of <i>Equisetum fluviatile</i>, <i>Menyanthes trifoliata</i> or <i>Mentha aquatica</i>. Infrequently, tussocks of <i>Molinia caerulea</i> and <i>Schoenus nigricans</i> may occur. There is usually very little in the way of a bryophyte layer.</p> <p><b>Ecology</b>            These stands occur in rather nutrient-poor but strongly alkaline conditions, in a variety of habitats, including lake margins, fens and flushed areas of bog.</p> <p><b>Sub-communities</b>            No sub-communities are currently described.</p> <p><b>Similar communities</b>            This is a distinct community which should be easily recognised.</p>																																												
<p><b>Records and distribution</b></p> <table border="0"> <tr> <td colspan="2"><i>Number of records (all)</i></td> </tr> <tr> <td>Clearly assigned:</td> <td>127</td> </tr> <tr> <td>Transitional:</td> <td>6</td> </tr> <tr> <td>Total:</td> <td>133</td> </tr> <tr> <td colspan="2"><i>Number of records (mapped)</i></td> </tr> <tr> <td>2001-2020:</td> <td>53</td> </tr> <tr> <td>1986-2000:</td> <td>26</td> </tr> <tr> <td>1971-1985:</td> <td>31</td> </tr> <tr> <td>Pre-1971:</td> <td>20</td> </tr> <tr> <td>Total:</td> <td>130</td> </tr> <tr> <td colspan="2"><i>Number of hectads (by most recent time period)</i></td> </tr> <tr> <td>2001-2020:</td> <td>11</td> </tr> <tr> <td>1986-2000:</td> <td>8</td> </tr> <tr> <td>1971-1985:</td> <td>6</td> </tr> <tr> <td>Pre-1971:</td> <td>1</td> </tr> <tr> <td>Total:</td> <td>26</td> </tr> <tr> <td colspan="2"><i>Number of hectads (records in each time period)</i></td> </tr> <tr> <td>2001-2020:</td> <td>11</td> </tr> <tr> <td>1986-2000:</td> <td>11</td> </tr> <tr> <td>1971-1985:</td> <td>12</td> </tr> <tr> <td>Pre-1971:</td> <td>5</td> </tr> </table> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p><b>Number of records</b></p> <ul style="list-style-type: none"> <li>● 1-3</li> <li>● 4-10</li> <li>● 11-25</li> <li>● 26+</li> </ul> <p><b>Most recent record</b></p> <ul style="list-style-type: none"> <li>○ pre-1971</li> <li>○ 1971-1985</li> <li>○ 1986-2000</li> <li>○ 2001-2020</li> </ul> </div>  </div>			<i>Number of records (all)</i>		Clearly assigned:	127	Transitional:	6	Total:	133	<i>Number of records (mapped)</i>		2001-2020:	53	1986-2000:	26	1971-1985:	31	Pre-1971:	20	Total:	130	<i>Number of hectads (by most recent time period)</i>		2001-2020:	11	1986-2000:	8	1971-1985:	6	Pre-1971:	1	Total:	26	<i>Number of hectads (records in each time period)</i>		2001-2020:	11	1986-2000:	11	1971-1985:	12	Pre-1971:	5
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Synopsis table (n = 117)					
Species	Frequency (from I-V)	Cover min (med) max	Species	Frequency (from I-V)	Cover min (med) max
<i>Cladium mariscus</i>	V	5-(9)-10	<i>Carex viridula</i>	I	1-(2)-4
<i>Phragmites australis</i>	V	1-(3)-8	<i>Nymphaea alba</i>	I	2-(3)-7
<i>Equisetum fluviatile</i>	II	+(3)-7	<i>Utricularia intermedia</i>	I	2-(3)-5
<i>Menyanthes trifoliata</i>	II	1-(3)-5	<i>Utricularia minor</i>	I	1-(2)-5
<i>Mentha aquatica</i>	II	+(2)-5	<i>Valeriana officinalis</i>	I	+(1)-3
<i>Galium palustre</i>	I	+(2)-4	<i>Eleocharis multicaulis</i>	I	1-(3)-5
<i>Schoenus nigricans</i>	I	2-(3)-7	<i>Eriocaulon aquaticum</i>	I	3-(3)-7
<i>Molinia caerulea</i>	I	+(3)-8	<i>Kindbergia praelonga</i>	I	1-(2)-4
<i>Potentilla palustris</i>	I	+(2)-4	<i>Lycopus europaeus</i>	I	2-(2)-4
<i>Carex lasiocarpa</i>	I	1-(3)-5	<i>Cardamine pratensis</i>	I	2-(2)-3
<i>Ilydrocotyle vulgaris</i>	I	+(3)-5	<i>Carex disticha</i>	I	1-(3)-3
<i>Juncus subnodulosus</i>	I	2-(3)-3	<i>Carex elata</i>	I	1-(4)-5
<i>Lysimachia vulgaris</i>	I	1-(3)-7	<i>Carex rostrata</i>	I	1-(2)-5
<i>Agrostis stolonifera</i>	I	1-(2)-5	<i>Scorpidium scorpioides</i>	I	2-(2)-5
<i>Lythrum salicaria</i>	I	+(2)-7	<i>Typha latifolia</i>	I	1-(1)-4
<i>Myrica gale</i>	I	2-(3)-5	<i>Epilobium palustre</i>	I	+(2)-3
<i>Ranunculus flammula</i>	I	1-(2)-3	<i>Lemna trisulca</i>	I	1-(3)-5
<i>Calliergonella cuspidata</i>	I	+(2)-5	<i>Salix cinerea</i>	I	+(2)-8
<i>Angelica sylvestris</i>	I	1-(2)-3	<i>Sparganium erectum</i>	I	2-(3)-4
<i>Filipendula ulmaria</i>	I	1-(2)-7	<i>Succisa pratensis</i>	I	2-(2)-3

**Affinities**  
 GIII: FS1 Reed and large sedge swamps  
 ZM: OD Phragmito-Magnocaricetea Klika in Klika et Novák 1941 (93.2%)  
 EUNIS: C3.28 Riparian *Cladium mariscus* beds / D5.24 Fen *Cladium mariscus* beds  
 NVC: S2 *Cladium mariscus* swamp (68.3%)  
 Annex I: 7210 *Cladium fens*\*

**Proxy environmental data**  
 Light: 7.8 Reaction: 7.4 Wetness: 9.8 Fertility: 4.0 Salinity: 0.2

**Conservation value**  
 Open, diverse stands of *Cladium mariscus* swamp and denser stands occurring adjacent to other types of fen, fen-meadow or tall-herb swamps, correspond in Ireland with the priority EU HD Annex I habitat 7210 *Cladium fen*\*. Low diversity, closed stands occurring in isolation are not deemed to correspond. Species/4 m<sup>2</sup> = 7.0, n = 73.

**Management**  
 These stands are typically unmanaged. The main threats are from peat extraction, infilling, drainage and reclamation.

**Key references**  
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 Mooney, E. (1991) A phytosociological and palaeoecological study of the wetlands of the Lower Corrib Basin, Co. Galway, Ireland. (Ph.D. thesis). National University of Ireland Galway.

**Synopsis version:** V2.0

**Synopsis date:** April 2021

**Synopsis author(s):** P.M. Perrin

**Appendix 14:** Summary of target notes.

**TN 1:** drain approximately 2m wide. too deep to pass. green algae present. infilling with *Care rostr*, *Coma palu*.

**TN2:** drain with *Care rostr*, *Chara spp.*, *Meny trif*, *Hipp vulg*, *Pota spp.*, green algae and *Hydr mors*.



**TN3:** area of FS3 on edge of woodland- viewed from across drain.



**TN4:** approximate boundary between H7230 and grazed grassland.

**TN5:** approximate location of *Dactylorhiza incarnata*.

**TN6:** cattle drinking access with GS4, bare soil, open water, and *Clad mari* with FS1 to edges, *Scho lacu* in water.

**TN7:** cattle drinking access- open water with limited Annex I habitat adjacent- likely impacted by access point - *Hydrocharis morsus-ranae* floating in water.



**TN8:** boundary between H7210 and H7230.

**TN9:** boundary between H7210 and H7230.

**TN10:** boundary between fen and grassland.

**TN11:** boundary between GS4 and drier grassland.

**TN12:** Lapwing observed in vicinity.

**TN13:** Area of generally more neutral and semi-improved grassland.



**TN14:** Charophytes present within pond. Water abstraction associated with quarry (assumed).



**TN15:** Grassland surrounding quarry with abundant orchids (GS1 calcareous grassland).



**TN16:** *Azolla filiculoides* present within pond.



Appendix 15: Map showing target note locations.



**Appendix 16:** Habitat map in relation to fen habitats at Knockanarragh proposed wind farm site.



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Smith, G.F. and Crowley, W. (2020) The habitats of cutover raised bog. *Irish Wildlife Manuals*, No. 128. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

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# Technical Note: Annex I potential habitat survey – Knockanarragh

Knockanarragh Proposed Wind Farm

604841 R01 (01)

NOVEMBER 2023

**RSK**



# RSK GENERAL NOTES

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**Project No:** 604841

**Title:** Technical Note: Annex I potential habitat survey - Knockanarragh

**Client:** SLR Consulting

**Date:** November 2023

**Office:** RSK Ireland (Belfast)

**Status:** Issue

<b>Author</b>	<u>Sharon Spratt</u>	<b>Technical &amp; quality reviewer</b>	<u>Mark Lang</u>
Signature		Signature	
Date:	<u>29 November 2023</u>	Date:	<u>08 November 2023</u>

**Project manager** Sharon Spratt

Signature 

Date: 19 October 2023

Revision control sheet		
Revision ref.	Date	Reason for revision
(00)	20 November 2023	n.a (first issue)
(01)	29 November 2023	Clarification on Annex I potential impacts within conclusions.

RSK Ireland (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK.

## EXECUTIVE SUMMARY

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- This technical note reports on the potential for Annex I habitats within additional lands at Knockanarragh Proposed Wind Farm, Co. Westmeath.
- A habitat survey, carried out in September 2023, identified areas of 7140 transition mires and quaking bogs habitat within cutover trenches, as part of a mosaic of other non-Annex habitat types.
- Non-Annex wet grassland was mapped to the northern section of the survey area. To the southern section of the survey area, the non-Annex habitats of wet grassland, wet woodland, and cutover bog were recorded.
- Annex and non-Annex habitats across this survey area were present on fen peat substrates, and should be considered as higher conservation value than adjacent habitat within the site boundary.
- It is recommended that any development occurs outside of these areas to: a) minimise the potential impacts on Annex I fen habitat, and b) maintain the ecological integrity of the mosaic of fen peat habitats in the local area.

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# 1.0 INTRODUCTION

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## 1.1 Purpose of this technical note

- 1.1.1 RSK Ireland was commissioned by SLR Consulting to provide an assessment of the potential for Annex I habitats at Knockanarragh proposed wind farm site, Co. Westmeath.
- 1.1.2 This technical note presents the findings of a walkover survey of additional optional lands at the proposed wind farm site.

## 1.2 Project Background

- 1.2.1 Knockanarragh proposed wind farm site is located west of Clonmellon village, Co. Westmeath; approximate Irish Grid reference: N 63093 67934. The site contains a range of semi-natural habitats with predominantly quarrying and pasture (sheep, cattle and horses) land-uses.
- 1.2.2 To guide planning, baseline habitat mapping was completed by SLR Consulting. This resulted in the identification of fen habitats within the site boundary, and requirement for an Annex I fen habitat survey of the site. Sharon Spratt (independent plant ecologist at the time of the 2022 survey, and author of this report) was commissioned by SLR Consulting to report on the presence of fen habitats, and potential for Annex I habitats.
- 1.2.3 Three Annex I fen habitat types were recorded during the 2022 survey including; H7140 transition mires and quaking bogs, H7210 calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*, and H7230 alkaline fen (Appendix A).
- 1.2.4 Additional optional lands at the proposed site were identified, and with the potential for Annex I habitats being present. The findings of a walkover survey are presented in this technical note, and should be read as an addendum to the previous Annex I fen habitats report for the site (Spratt, 2022).
- 1.2.5 A map showing the 2022 and 2023 site boundaries, and survey areas is provided in Appendix C.

### **1.3 Statement of authority**

Sharon Spratt is a senior ecologist with RSK Ireland Ltd. Sharon is an associate member of CIEEM and a botanical recorder for BSBI. She holds a B.Sc (Hons) in environmental science and a Ph.D in plant community ecology from Ulster University. Sharon has approximately 15 years' post-graduate experience in the ecological consulting, research, conservation and government sectors. She has widescale experience in undertaking habitat and botanical surveys and assessing wider ecological impacts. She is knowledgeable in the identification of vegetation communities and habitats across the island of Ireland.

Technical and quality review has been carried out by Mark Lang, a Chartered ecologist (CEcol) and Chartered Environmentalist (CEnv). Mark is a fellow of CIEEM and a field botanist with 30 years' experience.

## 2.0 METHODS

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### 2.1 Overview

- 2.1.1 A walkover survey of additional optional lands at Knockanarragh proposed wind farm site, Co. Westmeath was conducted on 20 September 2023. An assessment of habitats was carried out to establish whether any Annex I habitats were present.

### 2.2 Desktop Review

- 2.2.1 A desktop review was conducted and included the following:
- Previous associated ecological / botanical reports,
  - Habitats / vegetation specific literature,
  - Best practice guidance, and;
  - GIS shapefiles.

### 2.3 Walkover Survey and Reporting

- 2.3.1 A habitat survey was carried out on 20 September 2023. Target survey areas were highlighted by SLR Consulting via email correspondence. The walkover survey was completed, with habitats in the survey areas identified according to the Fossitt habitat classification (Fossitt, 2000) and Annex I habitats (European Commission, 2007). Digital mapping was completed using GIS.
- 2.3.2 A small number relevés were recorded, only to aid in the identification and description of vegetation communities, as part of Annex I habitat classification, and numbers were not designed to be representative of hectarage of habitat (Perrin *et al.*, 2014). ERICA (Engine for Relevés to Irish Communities Assignment) was used to classify any relevés to an Irish Vegetation Classification (IVC) type (NBDC, 2023). Relevant literature, including IVC type definitions were used to assist in describing the vegetation recorded (NBDC, 2023).

### 2.4 Limitations

- 2.4.1 The habitat survey was carried out during September 2023. April through September is considered the optimum survey window for the majority of habitats (Smith *et al.*, 2011). The majority of species could be easily identified in the field, with some requiring vegetative identification, i.e., grasses and sedges.
- 2.4.2 The habitat survey was restricted to those areas advised by SLR Consulting, in line with the proposed additional optional lands.
- 2.4.3 Mapping should be considered approximate, due to the transitional state of habitats within the survey area.

- 2.4.4 Aside from relevé data recording, used to describe vegetation, species recorded as part of this survey are incidental and a comprehensive / specialised species survey was not the objective of this habitat survey.

## 3.0 RESULTS & DISCUSSION

---

### 3.1 Overview

- 3.1.1 Three habitat areas were mapped following a walkover survey of additional optioned lands at Knockanarragh proposed wind farm. Habitat areas 1 and 2 are newly surveyed areas, and habitat area 3 was partially surveyed during 2022. Findings and discussion for these three habitat areas are presented below.

### 3.2 Habitat Area 1

- 3.2.1 Habitat area 1 is located north of the original site boundary (Appendix C). This area was recorded as GS4 wet grassland, with the following typical species composition: *Juncus effusus* soft rush – LA, *Agrostis stolonifera* (creeping bent) – A, *Molinia caerulea* (purple moor-grass) – A, *Rhynchospora squarrosus* – A, *Thuidium tamariscinum* – A, *Agrostis capillaris* (common bent) – F, *Anthoxanthum odoratum* (sweet vernal-grass) – F, *Festuca rubra* (red fescue) – F, *Holcus lanatus* (Yorkshire-fog) – F, *Potentilla anserina* (silverweed) – LF, *Potentilla erecta* (tormentil) – F, *Pseudoscleropodium purum* – F, *Rumex acetosa* (common sorrel) – F, and *Galium palustre* (marsh bedstraw) – O. Figure 1 and Figure 2 provide representation of vegetation in the area.
- 3.2.2 This vegetation community aligns most closely with Irish Vegetation Classification GL1D *Molinia caerulea* – *Potentilla erecta* – *Agrostis stolonifera* grassland. This lowland grassland type, common across basin peats and peaty gleys is typically species-poor compared to other rush pasture communities. Some of the more species diverse examples of this community, with *Cirsium dissectum* (meadow thistle) present in the sward, and with less purple-moor grass corresponds with Annex I H6410 *Molinia* meadow on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*).
- 3.2.3 The grassland of habitat area 1 does not correspond to Annex I H6410 (Appendix C).



**Figure 1. GS4 wet grassland (habitat area 1).**



**Figure 2. GS4 wet grassland habitat with prominent *Molinia caerulea* tussocks.**

### 3.3 Habitat Area 2

- 3.3.1 Habitat area 2 was located south of the original site boundary, in the northern section of the proposed site (Appendix C). This woodland area was dominated by *Betula pubescens* (downy birch) and *Salix cinerea* (grey willow) (Figure 3). *Rubus fruticosus* agg. (bramble) was frequent in the shrub layer, with *Vaccinium myrtillus* (bilberry) a rare occurrence. *Crataegus monogyna* (hawthorn) and *Ulex europaeus* (European gorse) were occasional, with *Fraxinus excelsior* (ash) and *Sorbus aucuparia* (rowan) rare. The ground layer had abundant *Molinia caerulea* (purple moor-grass), *Agrostis stolonifera* (creeping bent), locally frequent *Filipendula ulmaria* (meadowsweet), frequent *Thuidium tamariscinum*, with occasional *Dryopteris dilatata* (broad-buckler fern), *Ilex aquifolium* (holly), and *Rhytidiadelphus triquetrus*. According to the Fossitt classification of habitats, this woodland corresponded to both WN6 wet willow-alder-ash woodland and WN7 bog woodland.
- 3.3.2 The vegetation of this area most closely corresponds to IVC type WL4E *Betula pubescens* – *Salix cinerea* woodland. This is a lowland woodland vegetation community, commonly associated with smaller degraded bogs (NBDC, 2023). This woodland IVC type has affinities with both Annex I habitat 91D0 bog woodland\* and 91E0 alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)\*.
- 3.3.3 Sphagnum birch woods are the only sub-type to be recognised as 91D0 bog woodland\* in Ireland (Cross and Lynn, 2013). Article 17 assessment of Annex I woodland in Ireland classifies 91D0 as woodland dominated by a *Betula pubescens* canopy with a sphagnum cover of greater than 25% (Daly *et al.*, 2023).
- 3.3.4 Some examples of WL4E are considered to correspond to Annex I H91D0 bog woodland (Daly *et al.*, 2023) however the absence of sphagnum species means that this habitat type does not correspond to 91D0 bog woodland.
- 3.3.5 According to the IVC, 91E0 alluvial forests are primarily associated with the WL3 *Alnus glutinosa-Filipendula ulmaria* group (Daly *et al.*, 2023). Additionally, the dominance of birch, alongside purple moor-grass within this woodland habitat, places it within the WL4 *Betula pubescens-Molinia caerulea* group. This habitat type does not correspond to 91E0 alluvial forest.
- 3.3.6 The woodland was considered to be establishing on degraded basin peat, and extends from habitat area 2 into habitat area 3 (see discussion below).
- 3.3.7 There were some cutover sections within the woodland with PF3 transition mire and quaking bog habitat (Figure 4. PF3 transition mire and quaking bog vegetation in cutover sections throughout woodland.). Some cutover sections were unvegetated (Figure 5). These are similar to those cutover sections mapped in the vicinity (north and west) during 2022 (Spratt, 2022). Similar to vegetation mapped previously, this habitat type corresponds to Annex I habitat 7140 transition mires and quaking bogs.



**Figure 3. WN7 bog woodland.**



**Figure 4. PF3 transition mire and quaking bog vegetation in cutover sections throughout woodland.**



**Figure 5. Unvegetated cutover peat substrate within woodland.**

- 3.3.8 An opening in the canopy can be clearly viewed on aerial photography. This area can be described as GS4 wet grassland (Figure 6. GS4 wet grassland within opening in woodland canopy.). Purple moor-grass and *Succisa pratensis* (devils-bit scabious) were abundant, *Carex panicea* (carnation sedge), meadowsweet and tormentil were frequent, with *Angelica sylvestris* (wild angelica) occasional. In terms of IVC, this grassland most closely aligns with a more species-rich version of GL1D *Molinia caerulea* – *Potentilla erecta* – *Agrostis stolonifera* grassland and less species diverse version of GL1C *Molinia caerulea*–*Succisa pratensis* grassland. This area has potential as marsh fritillary butterfly *Euphydryas aurinia* habitat.
- 3.3.9 There were some cutover sections within this grassland area with PF3 transition mire and quaking bog (Figure 7 and Figure 8). These are similar to those cutover sections mapped in the vicinity (north and west) during 2022 (Spratt, 2022). Similar to vegetation mapped previously, this corresponds to Annex I habitat 7140 transition mires and quaking bogs.



**Figure 6. GS4 wet grassland within opening in woodland canopy.**



**Figure 7. PF3 fen vegetation in cutover sections within opening in woodland canopy.**



**Figure 8. PF3 fen vegetation in cutover within opening in woodland canopy.**

- 3.3.10 The woodland transitions to GS4 wet grassland towards the north-western boundary.
- 3.3.11 Peat soils in this habitat area were generally around 50 – >100 cm, with shallower soils to the eastern end of the woodland (Figure 9).



**Figure 9. Woodland to east with shallower soils.**

### 3.4 Habitat Area 3

- 3.4.1 Habitat area 3 (Appendix C) was mapped as part of the 2022 survey of fen habitats on the site (Appendix A). A limited number of cutover sections occurred in this area, with PF3 transition mire and quaking bog vegetation recorded. The surrounding vegetation largely corresponded to PB4 cutover bog.
- 3.4.2 As part of the walkover survey, two relevés were placed in this area to aid in further defining the vegetation present, and to assess the likelihood of Annex I presence within the cutover bog habitat (Appendix C).



**Figure 10. Bog vegetation in vicinity of relevé 1.**

- 3.4.3 Relevé 1 was assigned to IVC type HE3F *Calluna vulgaris*–*Eriophorum vaginatum* bog, with an affinity of 52.24% (Table 1). This vegetation community corresponds to PB2 upland blanket bog habitat. The second highest affinity was with BG2E *Calluna vulgaris*–*Eriophorum* spp. bog, at 43.33%. This vegetation community corresponds to PB1 raised bog.
- 3.4.4 Relevé 2 (Figure 11) was assigned to IVC type BG2C *Erica tetralix*–*Molinia caerulea*–*Cladonia portentosa* bog, with an affinity of 66.31%. The second highest affinity, with only 20.22% was type HE2D *Calluna vulgaris*–*Molinia caerulea*–*Erica cinerea* heath. Both these IVC types are heathland vegetation communities. Peat depths across this area were >1 m, indicating bog in this lowland context (Fossitt, 2000). Smith and Crowley (2020) state that, “Only where a habitat is underlain by shallow peat and good indicators of heath present, such as *Carex binervis*, *Galium saxatile* and *Juncus squarrosus*, should heath habitats be considered for cutover bog.
- 3.4.5 According to the Map of Irish Wetlands (Foss and Crushell, 2019), the area within habitat area 3 is classified as fen peat sediment (also includes habitat areas 1 and 2). Smith and Crowley (2020) acknowledged that there was a general lack of cutover bog data used to develop the current IVC. This coupled with the fen peat

substrate, provides some explanation as to why these two relevés do not fit well within the vegetation classification when used to describe bog habitats present in this area.

- 3.4.6 The cutover bog habitat does not correspond to Annex I habitats. It should however be considered of high conservation value in the local context, and in relation to the mosaic of fen peat habitats present in this part of the site.

**Table 1. Irish Vegetation Classification assigned to relevés in habitat area 3.**

Relevé	IVC type	Affinity (%)	Fossitt type	Annex I type
1	HE3F <i>Calluna vulgaris</i> – <i>Eriophorum vaginatum</i> bog	52.24	PB2 upland blanket bog	H7130 blanket bogs (active)*
	BG2E <i>Calluna vulgaris</i> – <i>Eriophorum</i> spp. bog	43.33	PB1 raised bog	H7110 raised bog (active)*
2	BG2C <i>Erica tetralix</i> – <i>Molinia caerulea</i> – <i>Cladonia portentosa</i> bog	66.31	HH3 wet heath	H4010 wet heath
	HE2D <i>Calluna vulgaris</i> – <i>Molinia caerulea</i> – <i>Erica cinerea</i> heath	20.22	HH3 wet heath	H4010 wet heath



**Figure 11. Bog vegetation in vicinity of relevé 2.**

- 3.4.7 There was a transition towards GS4 wet grassland towards the north-western boundary of habitat area 3 (Figure 12).



**Figure 12. Transition to GS4 wet grassland habitat to north-western boundary.**

### 3.5 Other Records

- 3.5.1 A frog *Rana temporaria* and two small tortoiseshell *Aglais urticae* butterflies were observed within the wet grassland habitat (habitat area 1).
- 3.5.2 Feral goats were observed at approximate Irish grid reference: N 63065 67916. There was evidence of grazing throughout the woodland in this vicinity, including mammal tracks through the vegetation, with birch and hawthorn browsed down to approximately 30-50 cm in height (Figure 13). This area is also open to livestock, including sheep and horses. A dead goat was also recorded within the large drain to the south (N 63061 67843).
- 3.5.3 A fox *Vulpes vulpes* was observed resting up towards the edge of the woodland, at approximate Irish grid reference: N 63101 67899.
- 3.5.4 Evidence of snipe *Gallinago gallinago* was observed further into the woodland, (Figure 14), at approximate Irish grid reference: N 63141 67830.

**Figure 13. Evidence of browsing throughout woodland habitat.**



**Figure 14. Snipe feather found within wet grassland habitat (habitat area 2).**



## 4.0 CONCLUSIONS

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- 4.1.1 Fen peat substrates were present across habitat areas 1, 2 and 3, influencing wet grassland, wet woodland and fen habitats present.
- 4.1.2 *Habitat Area 1:* GS4 wet grassland was recorded within this habitat area. This habitat type does not correspond to any Annex I habitat.
- 4.1.3 *Habitat Area 2:* Non-Annex habitats present within this area included: WN6 wet willow-alder-ash woodland / WN7 bog woodland, and GS4 wet grassland. PF3 transition mire and quaking bog within this habitat area (confined to cutover areas) corresponds to Annex I habitat 7140 transition mires and quaking bogs.
- 4.1.4 *Habitat Area 3:* Non-Annex habitat present within this area included: WN6 wet willow-alder-ash woodland / WN7 bog woodland, GS4 wet grassland, and PB4 cutover bog. PF3 transition mire and quaking bog within this habitat area (confined to cutover areas) corresponds to Annex I habitat 7140 transition mires and quaking bogs.
- 4.1.5 As discovered previously during the 2022 survey, PF3 transition mire and quaking bog habitat is restricted to small cutover trenches throughout habitat areas 2 and 3. This vegetation equates to Annex I habitat 7140 transition mires and quaking bogs. These cutover trenches should be avoided as part of development to prevent any loss of Annex I habitat.
- 4.1.6 Following the field survey, the proposed development is not thought to affect any cutover trenches with Annex I habitat 7140 transition mires and quaking bogs in habitat areas 2 and 3 (Appendix D).
- 4.1.7 Although woodland present within habitat areas 2 and 3 were considered not to correspond to Annex I woodland habitats, this type of establishing wet woodland on peat substrate is considered to be of high ecological value. This wet woodland habitat, along with associated habitats such as wet grassland, fen and degraded bog forms a mosaic of habitats and habitat connectivity within the local area.
- 4.1.8 PB4 cutover bog habitat, as related to fen peat substrates, was recorded within habitat area 3. Although it does not correspond to Annex I habitat, it should be considered as high conservation value in the local context, and in relation to the mosaic of fen peat habitats present in this part of the site.
- 4.1.9 It is recommended that any development occurs as far east within habitat areas 2 and 3 as possible (and preferably east and north of existing fence line) to minimise the potential impacts on Annex I habitat, and to maintain the ecological integrity of this fen peat habitat mosaic.
- 4.1.10 The current conservation value and future potential restoration value of this fen peat habitat mosaic should be considered as a whole and in relation to habitat connectivity for species such as the marsh fritillary butterfly.

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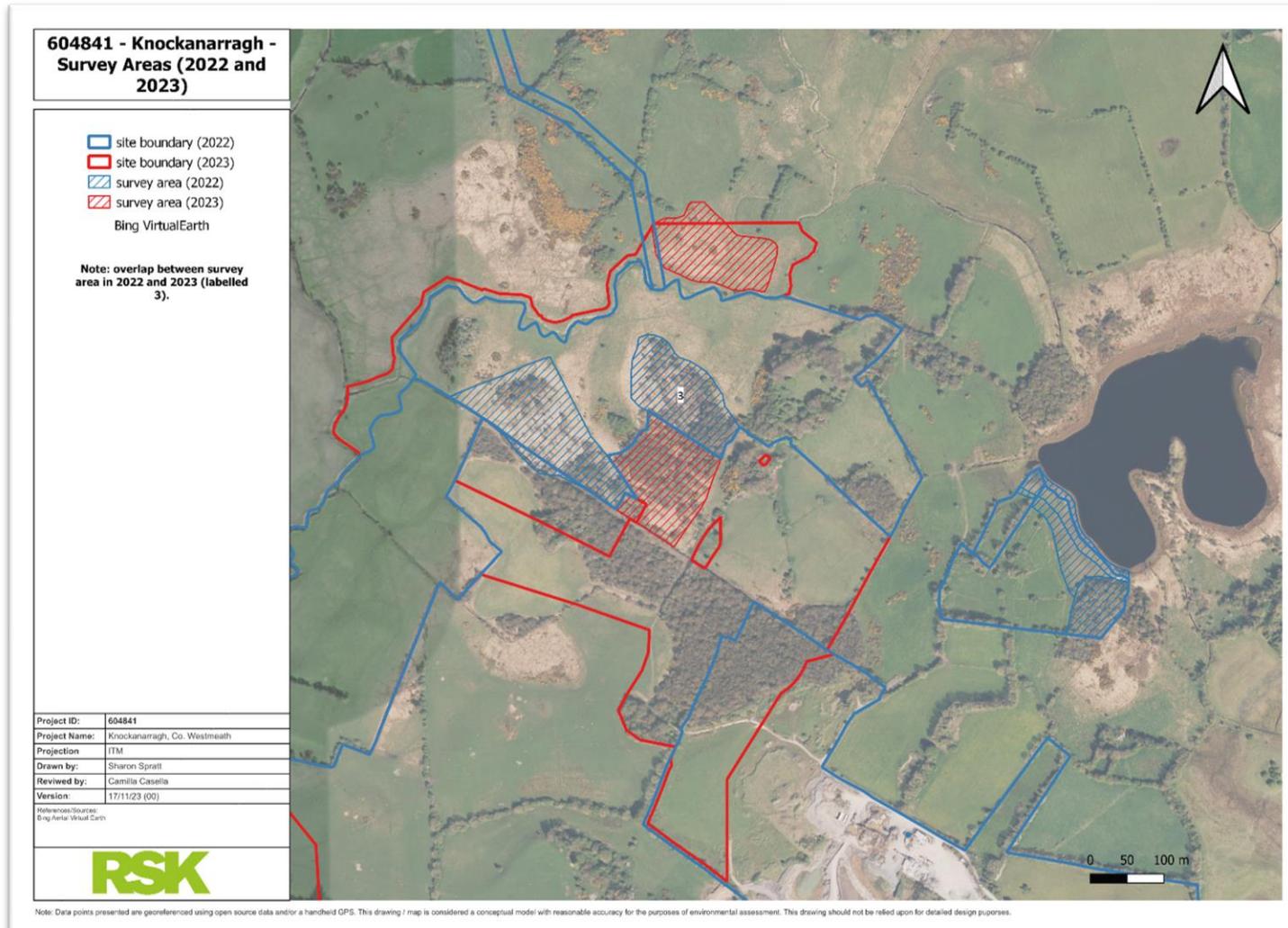
## 6.0 APPENDICES

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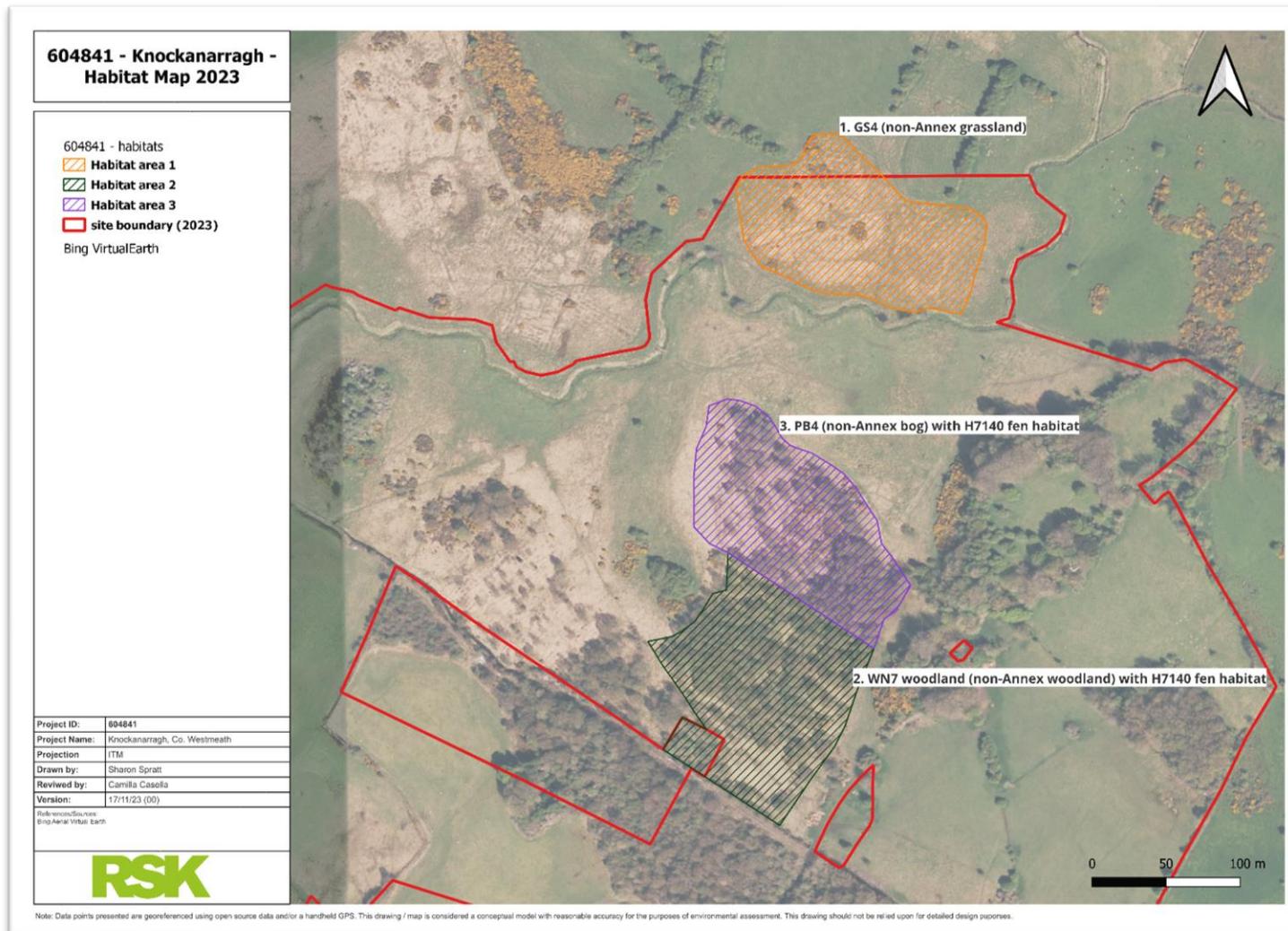
# APPENDIX A: Habitat Map 2022 (Spratt, 2022)



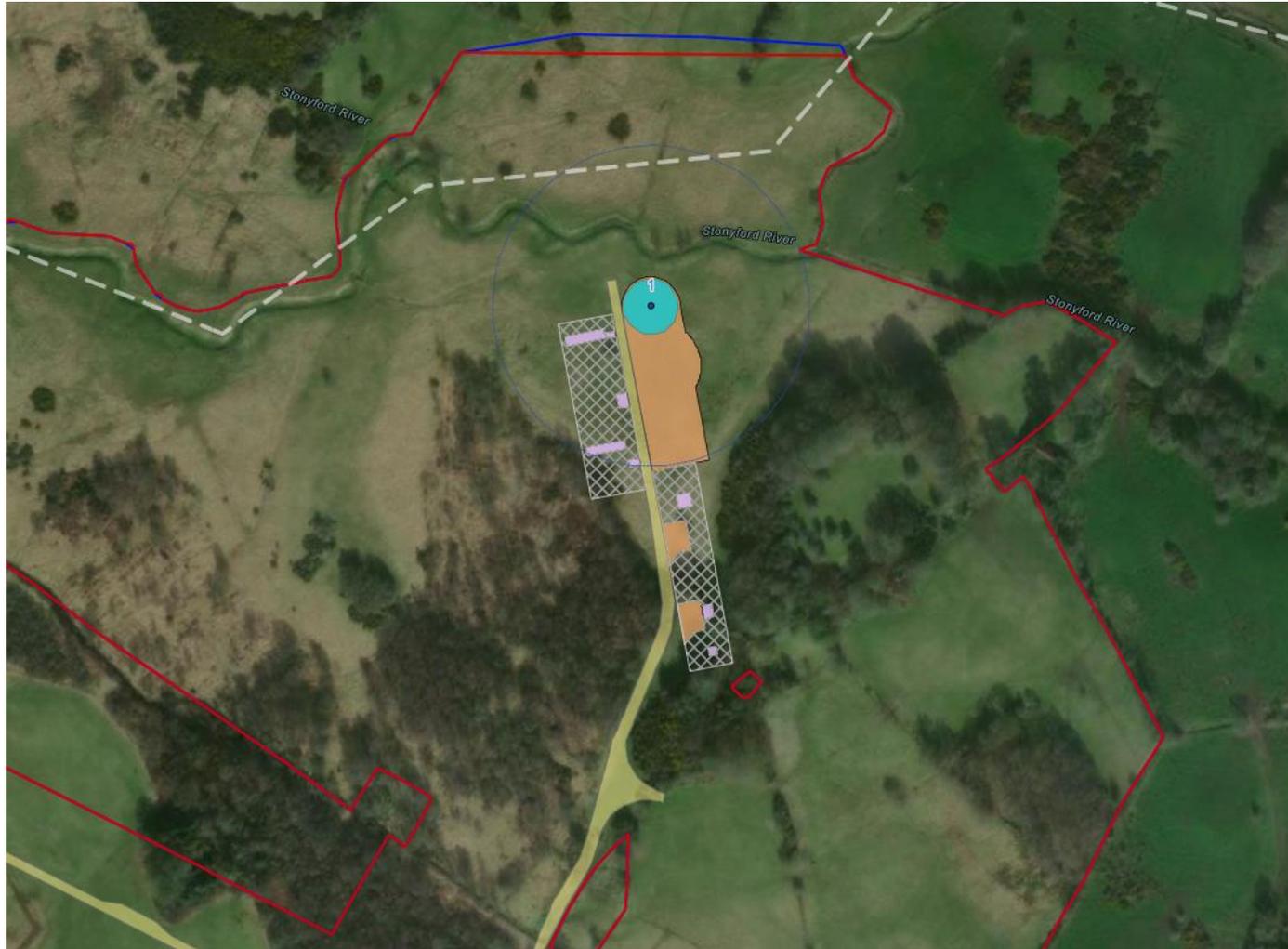
## APPENDIX B: Site boundaries and survey areas (2022 and 2023)

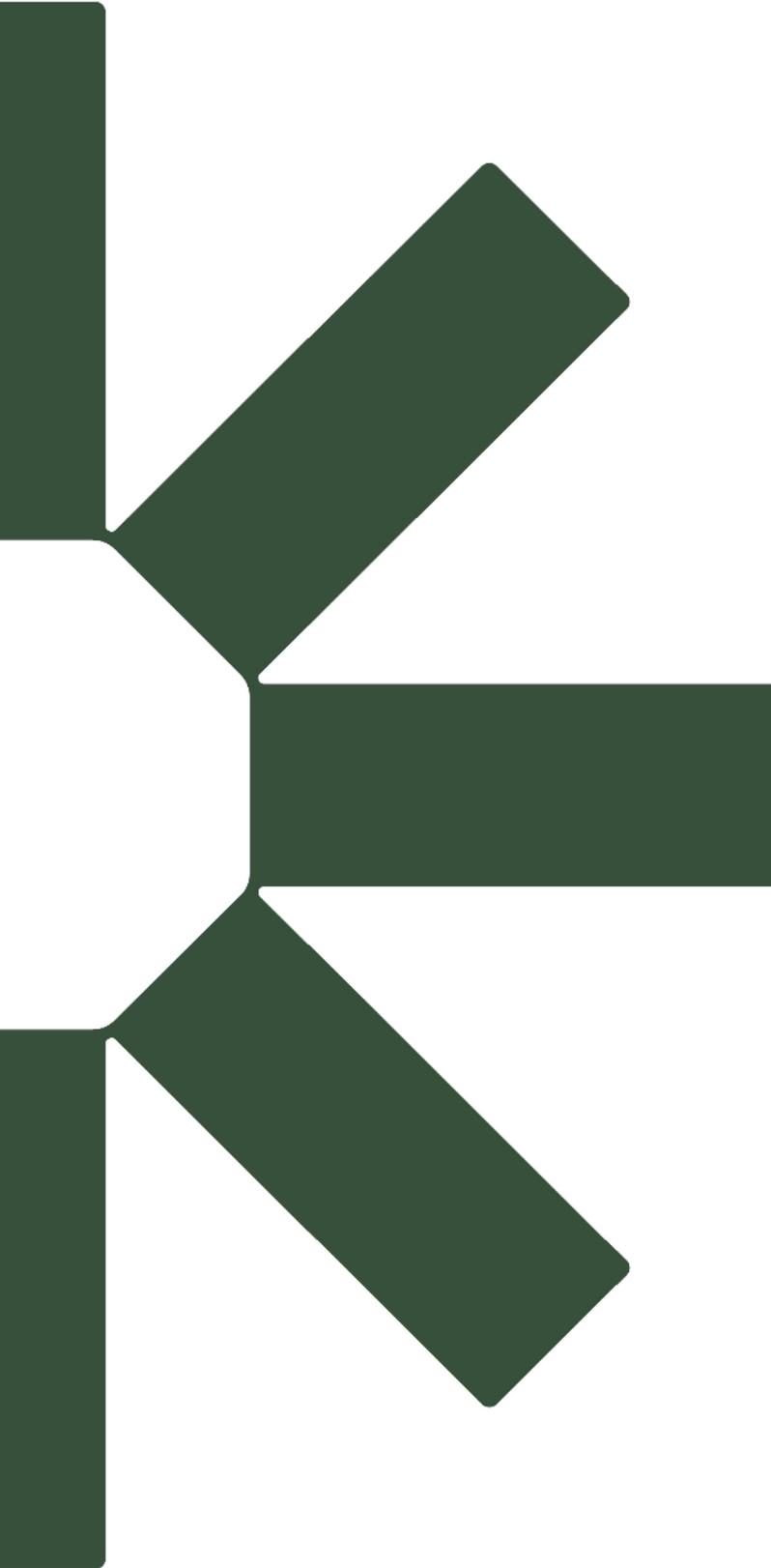


## APPENDIX C: Habitat Map 2023



**APPENDIX D: Screenshot provided by SLR Consulting via email correspondence (20 November 2023) showing proposed development adjacent to habitat areas 2 and 3.**





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