

National Parks and Wildlife Service

Conservation Objectives Series

Lough Eske and Ardnamona Wood SAC 000163



**An Roinn Cultúir,
Oidhreacht agus Gaeltachta**
Department of Culture,
Heritage and the Gaeltacht

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Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

* indicates a priority habitat under the Habitats Directive

000163	Lough Eske and Ardnamona Wood SAC
1029	Freshwater Pearl Mussel <i>Margaritifera margaritifera</i>
1106	Salmon <i>Salmo salar</i>
3110	Oligotrophic waters containing very few minerals of sandy plains (<i>Littorelletalia uniflorae</i>)
7220	Petrifying springs with tufa formation (Cratoneurion)*
6985	Killarney Fern <i>Vandenboschia speciosa</i>
91A0	Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles

Supporting documents, relevant reports & publications

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

NPWS Documents

Year :	1973
Title :	A Report on Areas of Biological and Geological Interest in County Donegal
Author :	Young, R.
Series :	Unpublished report
Year :	2007
Title :	Monitoring Populations of the Freshwater Pearl Mussel, <i>Margaritifera margaritifera</i> . 2006 Baseline Survey of the River Eske, County Donegal
Author :	Moorkens, E.
Series :	Unpublished report to NPWS
Year :	2008
Title :	National survey of native woodlands 2003-2008
Author :	Perrin, P.M.; Martin, J.; Barron, S.; O'Neill, F.H.; McNutt, K.E.; Delaney, A.
Series :	Unpublished report to NPWS
Year :	2009
Title :	NS II Freshwater pearl mussel sub-basin management plans: fisheries survey. Stage 1 report
Author :	Paul Johnston Associates
Series :	Unpublished report to NPWS
Year :	2009
Title :	NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the Freshwater Pearl Mussel in the Eske
Author :	Moorkens, E.A.
Series :	Unpublished report to NPWS
Year :	2009
Title :	NS2 Freshwater Pearl Mussel Sub-Basin Management Plans. Phytobenthos monitoring of the Eske Catchment, Co. Donegal. (NWIRBD). June 2009
Author :	Ní Chatháin, B.
Series :	Unpublished report to NPWS
Year :	2009
Title :	NS II Freshwater Pearl Mussel Sub-basin Management Plans: Report on Biological Monitoring of Surface Water Quality in Eske Catchment, Co. Donegal
Author :	Williams, L.
Series :	Unpublished report to NPWS
Year :	2010
Title :	A provisional inventory of ancient and long-established woodland in Ireland
Author :	Perrin, P.M.; Daly, O.H.
Series :	Irish Wildlife Manuals, No. 46
Year :	2010
Title :	Second Draft Eske Freshwater Pearl Mussel Sub-basin Management Plan (2009-2015). March 2010
Author :	NPWS
Series :	Unpublished document to the Department of the Environment, Heritage and Local Government
Year :	2013
Title :	Conservation status assessment for petrifying springs
Author :	Lyons, M.D.; Kelly, D.L.
Series :	Unpublished report to NPWS

Year :	2013
Title :	Results of a monitoring survey of old sessile oak woods and alluvial forests
Author :	O'Neill, F.H.; Barron, S.J.
Series :	Irish Wildlife Manuals, No. 71
Year :	2013
Title :	The status of EU protected habitats and species in Ireland. Volume 2. Habitats assessments
Author :	NPWS
Series :	Conservation assessments
Year :	2015
Title :	Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site-specific conservation objectives and Article 17 reporting
Author :	O Connor, Á.
Series :	Unpublished document by NPWS
Year :	2015
Title :	Monitoring methods for the Killarney fern (<i>Trichomanes speciosum</i> Willd.) in Ireland
Author :	Ní Dhúill, E.; Smyth, N.; Waldren, S.; Lynn, D.
Series :	Irish Wildlife Manuals, No. 82
Year :	2016
Title :	Monitoring guidelines for the assessment of petrifying springs in Ireland
Author :	Lyons, M.D.; Kelly, D.L.
Series :	Irish Wildlife Manuals, No. 94
Year :	2016
Title :	Ireland Red List No. 10: Vascular Plants
Author :	Wyse Jackson, M.; FitzPatrick, Ú.; Cole, E.; Jebb, M.; McFerran, D.; Sheehy Skeffington, M.; Wright, M.
Series :	Ireland Red List Series, NPWS
Year :	2017
Title :	Survey and Condition Assessment of the population of the freshwater mussel <i>Margaritifera margaritifera</i> in the River Eske, County Donegal. 2014-2016
Author :	Moorkens, E.
Series :	Unpublished report to NPWS
Year :	2019
Title :	The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments
Author :	NPWS
Series :	Conservation assessments
Year :	2019
Title :	The Status of EU Protected Habitats and Species in Ireland. Volume 3: Species Assessments
Author :	NPWS
Series :	Conservation assessments
Year :	in prep.
Title :	The monitoring and assessment of four EU Habitats Directive Annex I woodland habitats
Author :	Daly, O.H.; O'Neill, F.H.; Barron, S.J.
Series :	Irish Wildlife Manuals
Year :	in prep.
Title :	A study of the mixed <i>Najas flexilis</i> lake habitat (3130), 2015-2018
Author :	Roden, C.; Murphy, P.; Ryan, J.
Series :	Unpublished report to NPWS

Year : in prep.
Title : Monitoring and assessment of Killarney Fern (*Vandenboschia speciosa* (Willd.) Kunkel) in Ireland, 2015-2018
Author : Ní Dhúill, E.; O'Neill, F.H.; Hodd, R.
Series : Irish Wildlife Manuals

Other References

Year : 1898
Title : The Flora of the County Donegal
Author : Hart, H.C.
Series : Sealy Bryers and Walker, Dublin. David Nutt, 270 & 271 Strand W.C., London

Year : 1982
Title : Eutrophication of waters. Monitoring assessment and control
Author : OECD
Series : OECD, Paris

Year : 1996
Title : The distribution and ecology of the freshwater pearl mussel, *Margaritifera margaritifera* L. 1758, in County Donegal, Ireland and implications for its conservation
Author : Beasley, C.R.
Series : Unpublished Ph.D. thesis, The Queen's University of Belfast

Year : 2000
Title : Colour in Irish lakes
Author : Free, G.; Allott, N.; Mills, P.; Kennelly, C.; Day, S.
Series : Verhandlungen Internationale Vereinigung für theoretische und angewandte Limnologie, 27: 2620-2623

Year : 2001
Title : Aquatic plants in Britain and Ireland
Author : Preston, C.D.; Croft, J.M.
Series : Harley Books, Colchester

Year : 2002
Title : Reversing the habitat fragmentation of British woodlands
Author : Peterken, G.
Series : WWF-UK, London

Year : 2002
Title : Deterioration of Atlantic soft water macrophyte communities by acidification, eutrophication and alkalinisation
Author : Arts, G.H.P.
Series : Aquatic Botany, 73: 373-393

Year : 2006
Title : The status of host fish populations and fish species richness in European freshwater pearl mussel (*Margaritifera margaritifera*) streams
Author : Geist, J.; Porkka, M.; Kuehn, R.
Series : Aquatic Conservation: Marine and Freshwater Ecosystems, 16: 251-266

Year : 2006
Title : A reference-based typology and ecological assessment system for Irish lakes. Preliminary investigations. Final report. Project 2000-FS-1-M1 Ecological assessment of lakes pilot study to establish monitoring methodologies EU (WFD)
Author : Free, G.; Little, R.; Tierney, D.; Donnelly, K.; Coroni, R.
Series : Environmental Protection Agency, Wexford

Year :	2009
Title :	The identification, characterization and conservation value of isoetid lakes in Ireland
Author :	Free, G.; Bowman, J.; McGarrigle, M.; Little, R.; Coroni, R.; Donnelly, K.; Tierney, D.; Trodd, W.
Series :	Aquatic Conservation: Marine and Freshwater Ecosystems, 19(3): 264-273
Year :	2009
Title :	A survey of the <i>Margaritifera margaritifera</i> (L.) population in a section of the Eske River at Clardrumnaghan Bridge (Thrushbank), County Donegal
Author :	Ross, E.
Series :	Unpublished report for Donegal County Council
Year :	2010
Title :	Water Quality in Ireland 2007-2009
Author :	McGarrigle, M.; Lucey, J.; Ó Cinnéide, M.
Series :	Environmental Protection Agency, Wexford
Year :	2014
Title :	Assessing near-bed velocity in a recruiting population of the endangered freshwater pearl mussel (<i>Margaritifera margaritifera</i>) in Ireland
Author :	Moorkens, E.; Killeen, I.
Series :	Aquatic Conservation: Marine and Freshwater Ecosystems, 24(6): 853-862
Year :	2015
Title :	Water Quality in Ireland 2010-2012
Author :	Bradley, C.; Byrne, C.; Craig, M.; Free, G.; Gallagher, T.; Kennedy, B.; Little, R.; Lucey, J.; Mannix, A.; McCreesh, P.; McDermott, G.; McGarrigle, M.; Ní Longphuirt, S.; O'Boyle, S.; Plant, C.; Tierney, D.; Trodd, W.; Webster, P.; Wilkes, R.; Wynne, C.
Series :	Environmental Protection Agency, Wexford
Year :	2015
Title :	The flora and conservation status of petrifying springs in Ireland
Author :	Lyons, M.D.
Series :	Unpublished Ph.D. thesis, Trinity College Dublin
Year :	2016
Title :	Irish Vegetation Classification: Technical Progress Report No. 2
Author :	Perrin, P.
Series :	Report submitted to National Biodiversity Data Centre
Year :	2017
Title :	Water Quality in Ireland 2010-2015
Author :	Fanning, A.; Craig, M.; Webster, P.; Bradley, C.; Tierney, D.; Wilkes, R.; Mannix, A.; Treacy, P.; Kelly, F.; Geoghegan, R.; Kent, T.; Mageean, M.
Series :	Environmental Protection Agency, Wexford
Year :	2019
Title :	The Status of Irish Salmon Stocks in 2018 with Catch Advice for 2019
Author :	Technical Expert Group on Salmon (TEGOS)
Series :	Report of the Technical Expert Group on Salmon (TEGOS) to Inland Fisheries Ireland (IFI)

Spatial data sources

Year :	2008
Title :	OSi 1:5000 IG vector dataset
GIS Operations :	WaterPolygons feature class clipped to the SAC boundary. Expert opinion used to identify Annex I habitat and to resolve any issues arising
Used For :	3110 (map 2)
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Year :	Derived 2019
Title :	Internal NPWS files
GIS Operations :	Dataset created from spatial reference contained in files
Used For :	7220 (map 3)
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Year :	Revision 2010
Title :	National Survey of Native Woodlands 2003-2008. Version 1
GIS Operations :	QI selected; clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	91A0 (map 4)
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Year :	2019
Title :	NPWS rare and threatened species database
GIS Operations :	Dataset created from spatial references in database records. Expert opinion used as necessary to resolve any issues arising
Used For :	1029 (map 5)
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Year :	Revision 2012
Title :	Margaritifera Sensitive Areas data
GIS Operations :	Relevant catchment boundary identified. Expert opinion used as necessary to resolve any issues arising
Used For :	1029 (map 5)
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Conservation Objectives for : Lough Eske and Ardnamona Wood SAC [000163]

3110 Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)

To restore the favourable conservation condition of Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) in Lough Eske and Ardnamona Wood SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Lake habitat 3110 occurs in Lough Eske (see map 2) in Lough Eske and Ardnamona Wood SAC. Habitat 3130 is also considered to occur in the lake. Sources for aquatic plant records for the lakes in the SAC include NPWS internal files and N.F. Stewart and C.D. Preston records made for Preston and Croft (2001). It was briefly surveyed as part of an on-going study of slender naiad (<i>Najas flexilis</i>) lakes (Roden et al., in prep.). Lough Eske is on the Water Framework Directive (WFD) monitoring programme and regular macrophyte surveys are conducted by the Environmental Protection Agency (EPA). Two measures of extent should be used: 1. the area of the lake itself and 2. the extent of the vegetation communities/zones that typify the habitat. Further information relating to all attributes is provided in the lake habitats supporting document for the purposes of site-specific conservation objectives and Article 17 reporting (O Connor, 2015)
Habitat distribution	Occurrence	No decline, subject to natural processes	As noted above, lake habitat 3110 occurs in Lough Eske in the SAC. See map 2
Vegetation composition: typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution	See NPWS (2013, 2019) and O Connor (2015) for lists of typical plant species. In 1990 N.F. Stewart and C.D. Preston recorded: SW Bay- <i>Equisetum fluviatile</i> , <i>Isoetes</i> sp., <i>Juncus bulbosus</i> , <i>Littorella uniflora</i> , <i>Lobelia dortmanna</i> , <i>Mentha aquatica</i> , <i>Myriophyllum alterniflorum</i> , <i>Nymphaea alba</i> , <i>Phalaris arundinacea</i> , <i>Potamogeton berchtoldii</i> , <i>P. natans</i> , <i>P. x nitens</i> , <i>Ranunculus flammula</i> , <i>Chara virgata</i> , <i>Nitella flexilis</i> ; Harvey's Point- <i>Osmunda regalis</i> , <i>Alisma plantago-aquatica</i> , <i>Baldellia ranunculoides</i> , <i>Caltha palustris</i> , <i>Carex rostrata</i> , <i>Cladium mariscus</i> , <i>Comarum palustre</i> , <i>Eleocharis multicaulis</i> , <i>Eleogiton fluitans</i> , <i>Juncus bulbosus</i> , <i>Littorella uniflora</i> , <i>Lobelia dortmanna</i> , <i>Lythrum salicaria</i> , <i>Mentha aquatica</i> , <i>Myriophyllum alterniflorum</i> , <i>Nymphaea alba</i> , <i>Phragmites australis</i> , <i>Potamogeton natans</i> , <i>Utricularia intermedia</i> agg., <i>Chara virgata</i> , <i>Nitella flexilis</i> . Roden et al. (in prep.) recorded 28 species such as <i>I. echinospora</i> , <i>P. praelongus</i> , <i>P. perfoliatus</i>
Vegetation composition: characteristic zonation	Occurrence	All characteristic zones should be present, correctly distributed and in good condition	Further work is necessary to describe the characteristic zonation and other spatial patterns in lake habitat 3110 (see O Connor, 2015). Roden et al. (in prep.) noted simple vegetation structure in Lough Eske: a <i>Littorella-Lobelia</i> shore zone with patches of <i>Phragmites</i> , <i>Schoenoplectus</i> and <i>Equisetum fluviatile</i> in sheltered bays; below 1m to the base of the euphotic zone, <i>Isoetes lacustris</i> is dominant; occasional plants of <i>Potamogeton berchtoldii</i> and <i>Nitella translucens</i> occur down to 3m. The absence of a <i>Nitella</i> -dominated zone below the <i>Isoetes</i> band may indicate declining conservation condition (Roden et al., in prep.) and habitat 3130 was categorised as Poor in Lough Eske for 2013-2018 (NPWS, 2019). Additional information on vegetation zonation in the SAC may be available from EPA surveys and other sources

Vegetation distribution: maximum depth	Metres	Maintain maximum depth of vegetation, subject to natural processes	The maximum depth of vegetation is likely to be specific to the lake shoreline in question. Roden et al. (in prep.) recorded a maximum vegetation depth of 3m. Further work is necessary to develop indicative targets for lake habitat 3110. Maximum depth should be large in 3110 lakes; however, pressures such as eutrophication, overgrazing, forestry and peat-cutting can lead to reduced vegetation depth
Hydrological regime: water level fluctuations	Metres	Maintain appropriate hydrological regime necessary to support the habitat	Fluctuations in lake water level are typical in Ireland, but can be amplified by activities such as abstraction, drainage and overgrazing. Increased water level fluctuations can increase wave action, up-root vegetation, increase turbidity, alter the substratum and lead to release of nutrients from the sediment. The hydrological regime of the lakes must be maintained so that the area, distribution and depth of the lake habitat and its constituent/characteristic vegetation zones and communities are not reduced
Lake substratum quality	Various	Maintain appropriate substratum type, extent and chemistry to support the vegetation	Research is required to further characterise the substratum types (particle size and origin) and substratum quality (notably pH, calcium, iron and nutrient concentrations) favoured by each of the five Annex I lake habitats in Ireland. It is likely that lake habitat 3110 is associated with a range of nutrient-poor substrates, from stones, cobble and gravel, through sands, silt, clay and peat. Substratum particle size is likely to vary with depth and along the shoreline within a single lake. Roden et al. (in prep.) recorded sand, cobbles, silt and rock in Lough Eske. Additional data on lake substrata in the SAC may be available from EPA surveys and other sources
Water quality: transparency	Metres	Maintain/restore appropriate Secchi transparency. There should be no decline in Secchi depth/transparency	Transparency relates to light penetration and, hence, to the depth of colonisation of vegetation. It can be affected by phytoplankton blooms, water colour and turbidity. Specific targets have yet to be established for lake habitat 3110 (O Connor, 2015). Habitat 3110 is associated with very clear water. The OECD fixed boundary system set transparency targets for oligotrophic lakes of $\geq 6\text{m}$ annual mean Secchi disk depth, and $\geq 3\text{m}$ annual minimum Secchi disk depth (OECD, 1982). Free et al. (2009) found high isoetid abundance in lakes with Secchi depths of more than 3m. In this SAC, Free et al. (2006) recorded a Secchi depth of 3.7m in Lough Eske. Roden et al. (in prep.) recorded a Secchi depth of 2.7m
Water quality: nutrients	$\mu\text{g/l P}$; mg/l N	Maintain/restore the concentration of nutrients in the water column to sufficiently low levels to support the habitat and its typical species	As a nutrient-poor habitat, oligotrophic and WFD 'high' status targets apply. Where a lake has nutrient concentrations that are lower than these targets, there should be no decline within class, i.e. no upward trend in nutrient concentrations. For lake habitat 3110, annual average total phosphorus (TP) concentration should be $\leq 10\mu\text{g/l TP}$, average annual total ammonia concentration should be $\leq 0.040\text{mg/l N}$ and annual 95th percentile for total ammonia should be $\leq 0.090\text{mg/l N}$. See also The European Communities Environmental Objectives (Surface Waters) Regulations 2009. Lough Eske passed the TP target in 2010-12 and 2012-15 (high status) (Bradley et al., 2015; Fanning et al., 2017), but failed in 2007-09 (good status) (McGarrigle et al., 2010)

Water quality: phytoplankton biomass	µg/l chlorophyll <i>a</i>	Maintain appropriate water quality to support the habitat, including high chlorophyll <i>a</i> status	Oligotrophic and WFD 'high' status targets apply to lake habitat 3110. Where a lake has a chlorophyll <i>a</i> concentration that is lower than this target, there should be no decline within class, i.e. no upward trend in phytoplankton biomass. The average growing season (March-October) chlorophyll <i>a</i> concentration must be <5.8µg/l. The annual average chlorophyll <i>a</i> concentration should be <2.5µg/l and the annual peak chlorophyll <i>a</i> concentration should be ≤8.0µg/l. See also The European Communities Environmental Objectives (Surface Waters) Regulations 2009. Lough Eske passed the target (high status) in 2007-09, 2010-12 and 2013-15 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017)
Water quality: phytoplankton composition	EPA phytoplankton composition metric	Maintain appropriate water quality to support the habitat, including high phytoplankton composition status	The EPA has developed a phytoplankton composition metric for nutrient enrichment of Irish lakes. As for other water quality indicators, lake habitat 3110 requires WFD high status
Water quality: attached algal biomass	Algal cover	Maintain trace/absent attached algal biomass (<5% cover)	Nutrient enrichment can favour epiphytic and epipelagic algae that can out-compete the submerged vegetation. The cover abundance of attached algae in lake habitat 3110 should, therefore, be trace/absent (<5% cover)
Water quality: macrophyte status	EPA macrophyte metric (The Free Index)	Restore high macrophyte status	Nutrient enrichment can favour more competitive submerged macrophyte species that out-compete the typical and characteristic species for the lake habitat. The EPA monitors macrophyte status for WFD purposes using the 'Free Index'. The target for lake habitat 3110 is high status or an Ecological Quality Ratio (EQR) for lake macrophytes of ≥0.90, as defined in Schedule Five of the European Communities Environmental Objectives (Surface Waters) Regulations 2009. Lough Eske failed the target, having good macrophyte status in 2007-09 and 2010-12 (McGarrigle et al., 2010; Bradley et al., 2015) and moderate status in 2013-15 (Fanning et al., 2017)
Acidification status	pH units; mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes	Acidification can impact on species abundance and composition in soft water lake habitats. In Europe, acidification of isoetid lakes can lead to loss of isoetids and dominance by submerged bog mosses (<i>Sphagnum</i> spp.) and bulbous rush (<i>Juncus bulbosus</i>) (Arts, 2002). The specific requirements of lake habitat 3110, in terms of water and sediment pH, alkalinity and cation concentration, have not been determined. For lakes with habitat 3110, and adopting a precautionary approach based on Arts (2002), minimum pH should not be <5.5 pH units. Maximum pH should be <9.0 pH units, in line with the surface water standards established for soft waters (where water hardness is ≤100mg/l calcium carbonate). See Schedule Five of the European Communities Environmental Objectives (Surface Waters) Regulations 2009. Lough Eske passed the WFD metric in 2007-09, 2010-12 and 2013-15 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017)

Water colour	mg/l PtCo	Maintain/restore appropriate water colour to support the habitat	Increased water colour and turbidity decrease light penetration and can reduce the area of available habitat for lake macrophytes, particularly at the lower euphotic depths. The primary source of increased water colour in Ireland is disturbance to peatland. No habitat-specific or national standards for water colour currently exist. Studies have shown median colour concentrations in Irish lakes of 38mg/l PtCo (Free et al., 2000) and 33mg/l PtCo (Free et al., 2006). It is likely that the water colour in all Irish lake habitats would naturally be <50mg/l PtCo. Water colour can be very low (<20mg/l PtCo or even <10mg/l PtCo) in lakes with habitat 3110, where the peatland in the lake's catchment is intact. In this SAC, Free et al. (2006) reported colour of 27mg/l PtCo in Lough Eske
Dissolved organic carbon (DOC)	mg/l	Maintain appropriate organic carbon levels to support the habitat	Dissolved (and particulate) organic carbon (OC) in the water column is linked to water colour and acidification (organic acids). Increasing DOC in water has been documented across the Northern Hemisphere, including afforested peatland catchments in Ireland. Damage and degradation of peatland, leading to decomposition of peat is likely to be the predominant source of OC in Ireland. OC in water promotes decomposition by fungi and bacteria that, in turn, releases dissolved nutrients. The increased biomass of decomposers can also impact directly on the characteristic lake communities through shading, competition, etc.
Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate unit	Maintain appropriate turbidity to support the habitat	Turbidity can significantly affect the quantity and quality of light reaching rooted and attached vegetation and can, therefore, impact on lake habitats. The settlement of higher loads of inorganic or organic material on lake vegetation communities may also have impacts on sensitive, delicate species. Turbidity can increase as a result of re-suspension of material within the lake, higher loads entering the lake, or eutrophication. Turbidity measurement and interpretation is challenging. As a result, it is likely to be difficult to set habitat-specific targets for turbidity in lakes
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of lake habitat 3110	Most lake shorelines have fringing habitats of reedswamp, other swamp, fen, marsh or wet woodland that intergrade with and support the structure and functions of the lake habitat. In Lough Eske and Ardnamona Wood SAC, fringing habitats may include freshwater marsh, poor fen, flush, blanket bog, wet and dry heath, and a variety of native woodland and grassland types. Fringing habitats are dependent on the lake, particularly its water levels, and support wetland communities and species of conservation concern. Many of the fringing wetland habitats support higher invertebrate and plant species richness than the lake habitats themselves. Whorled caraway (<i>Carum verticillatum</i>) is known from the margins of Lough Eske (Hart, 1898; Young, 1973). There is also a record for six-stamened waterwort (<i>Elatine hexandra</i>) in Hart (1898). Both species are Near Threatened in Ireland (Wyse Jackson et al., 2016)

Conservation Objectives for : Lough Eske and Ardnamona Wood SAC [000163]

7220 Petrifying springs with tufa formation (Cratoneurion)

To maintain the favourable conservation condition of Petrifying springs with tufa formation (Cratoneurion)* in Lough Eske and Ardnamona Wood SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Square metres	Area stable or increasing, subject to natural processes	The habitat Petrifying springs with tufa formation (Cratoneurion)* has not been surveyed in detail in Lough Eske and Ardnamona Wood SAC and thus the exact total area of the qualifying priority habitat in the SAC is currently unknown. The habitat is known to occur along the north side of the valley of the Lowerymore River in the SAC, notably at White Goat's Island, where it occurs in semi-open terrain within woodland in an area of the river where waterfalls occur. A second area of petrifying springs with tufa formation was also recorded a short distance further downstream on the same river (NPWS internal files). It is important to note that further areas of the habitat may be present within the SAC
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 3 for point location at White Goat's Island	Point distribution (see map 3) is based on NPWS internal files. Note that further areas of the habitat may be present within the SAC. Lyons and Kelly (2016) describe eight plant communities of Irish petrifying springs based on relevé data. It is not currently known which communities occur in the habitat in Lough Eske and Ardnamona Wood SAC. Further information on the vegetation communities associated with this habitat is presented in Lyons and Kelly (2016)
Hydrological regime: height of water table; water flow	Metres; metres per second	Maintain appropriate hydrological regimes	Petrifying springs rely on permanent irrigation, usually from upwelling groundwater sources or seepage sources (Lyons and Kelly, 2013). Water flow should not be altered anthropogenically. See Lyons and Kelly (2016) for further details on this attribute
Water quality - nitrate level	mg/l	No increase from baseline nitrate level and less than 10mg/l	Target based on data from McGarrigle et al. (2010). See Lyons and Kelly (2016) for further details on this attribute
Water quality - phosphate level	µg/l	No increase from baseline phosphate level and less than 15µg/l	Based on data from Lyons (2015). See Lyons and Kelly (2016) for further details on this attribute
Vegetation composition: positive indicator species	Number per spring	At least three positive/high quality indicator species as listed in Lyons and Kelly (2016) and no loss from baseline number	Based on Lyons and Kelly (2016), where the lists of positive and high quality indicator species are presented. A good diversity of bryophytes have been recorded in the habitat at White Goat's Island, including the positive indicator bryophyte species <i>Palustriella commutata</i> , <i>Eucladium verticillatum</i> and <i>Pellia endiviifolia</i> . Other species recorded include remote sedge (<i>Carex remota</i>), herb-robert (<i>Geranium robertianum</i>), yellow pimpernel (<i>Lysimachia nemorum</i>) and the bryophytes <i>Conocephalum conicum</i> , <i>Eurhynchium striatum</i> and <i>Plagiomnium undulatum</i> (NPWS internal files)
Vegetation composition: negative indicator species	Cover (DAFOR scale)	Potentially negative indicator species should not be Dominant or Abundant; potentially negative woody species should be absent in unwooded springs; invasive species should be absent	Based on Lyons and Kelly (2016), where the lists of potentially negative herbaceous, bryophyte, algal and woody species are presented. See Lyons and Kelly (2016) also for details on potentially invasive species. If two or more potentially negative bryophyte/alga species are present, and if at least two are Frequent, or at least one is Abundant, then the habitat fails for this attribute. See Lyons and Kelly (2016) for further details. The potentially negative bryophyte species <i>Cratoneuron filicinum</i> has been recorded in the habitat in the SAC (NPWS internal files), but at an unknown level of cover

Vegetation structure: sward height	Centimetres	Field layer height between 10cm and 50cm (except for bryophyte-dominated ground <10cm)	Attribute and target based on Lyons and Kelly (2016)
Physical structure: trampling/dung	Cover (DAFOR scale)	Cover should not be Dominant or Abundant	Attribute and target based on Lyons and Kelly (2016)

Conservation Objectives for : Lough Eske and Ardnamona Wood SAC [000163]

91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

To maintain the favourable conservation condition of Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles in Lough Eske and Ardnamona Wood SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles is present at Ardnamona Wood in Lough Eske and Ardnamona Wood SAC. Ardnamona Wood is state-owned and protected as a Nature Reserve. As part of the National Survey of Native Woodlands (NSNW), the sub-site Ardnamona Wood (NSNW site code 1427) was surveyed by Perrin et al. (2008). Map 4 shows the surveyed woodland (52.9ha) within the SAC. The surveyed area contains a mosaic of woodland habitats, comprising c.80% 91A0 woodland habitat. Ardnamona Wood (site code 1427) was also included in national monitoring surveys (O'Neill and Barron, 2013; Daly et al., in prep.) and is considered to contain an excellent example of the extreme oceanic variant of 91A0 woodland habitat. It is important to note that further unsurveyed areas may be present within the SAC
Habitat distribution	Occurrence	No decline, subject to natural processes. The surveyed woodland area is shown on map 4	Distribution based on Perrin et al. (2008) and Daly et al. (in prep.). It is important to note that further unsurveyed areas may be present within the SAC
Woodland size	Hectares	Area stable or increasing. Where topographically possible, "large" woods at least 25ha in size and "small" woods at least 3ha in size	The target areas for individual woodlands aim to reduce habitat fragmentation and benefit those species requiring 'deep' woodland conditions (Peterken, 2002). In some cases, topographical constraints may restrict expansion
Woodland structure: cover and height	Percentage; metres; centimetres	Total canopy cover at least 30%; median canopy height at least 11m; native shrub layer cover 10-75%; native herb/dwarf shrub layer cover at least 20% and height at least 20cm; bryophyte cover at least 4%	The target aims for a diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi-mature trees and shrubs; and well-developed herb layer and ground layer. Assessment criteria are described in Daly et al. (in prep.) and O'Neill and Barron (2013)
Woodland structure: community diversity and extent	Hectares	Maintain diversity and extent of community types	Described in Perrin et al. (2008). See also the Irish Vegetation Classification (Perrin, 2016; www.biodiversityireland.ie/projects/national-vegetation-database/irish-vegetation-classification)
Woodland structure: natural regeneration	Seedling: sapling: pole ratio	Seedlings, saplings and pole age-classes of target species for 91A0 woodlands and other native tree species occur in adequate proportions to ensure survival of woodland canopy	The target species for 91A0 are sessile oak (<i>Quercus petraea</i>) and the hybrid oak <i>Quercus x rosacea</i> . Assessment criteria are described in Daly et al. (in prep.) and O'Neill and Barron (2013)
Woodland structure: dead wood	Number per hectare	At least 19 stems/ha of dead wood of at least 20cm diameter	Dead wood is a valuable resource and an integral part of a healthy, functioning woodland ecosystem. Dead wood comprises old senescent trees, standing dead trees, fallen dead wood (including large branches) and rotten stumps of any species. Assessment criteria are described in Daly et al. (in prep.) and O'Neill and Barron (2013)
Woodland structure: veteran trees	Number per hectare	No decline	Veteran trees are important habitats for bryophytes, lichens, saproxylic organisms and some bird species. Their retention is important to ensure continuity of habitats/niches and propagule sources

Woodland structure: indicators of local distinctiveness	Occurrence	No decline	Includes ancient or long-established woodlands (Perrin and Daly, 2010), archaeological and geological features as well as red listed and other rare or localised species. Perrin and Daly (2010) list Ardnamona Wood (NSNW site code 1427) as 'possible ancient woodland'. Ardnamona Wood has been noted as being particularly species-rich. Notably, the rare lichen tree lungwort (<i>Lobaria pulmonaria</i>) has been recorded in the old oak woodland in the SAC (NPWS internal files). The Flora (Protection) Order, 2015 (FPO) listed and Vulnerable narrow-leaved helleborine (<i>Cephalanthera longifolia</i>) (Wyse Jackson et al., 2016) has also been recorded (NPWS internal files). The Annex II and FPO listed species Killarney fern (<i>Vandenboschia speciosa</i>) also occurs in the habitat in the SAC. See the conservation objective for Killarney fern (species code 6985) in this volume
Woodland structure: indicators of overgrazing	Occurrence	All four indicators of overgrazing absent	There are four indicators of overgrazing within 91A0: topiary effect on shrubs and young trees; browse line on mature trees; abundant dung; and severe recent bark stripping (Daly et al., in prep.; O'Neill and Barron, 2013)
Vegetation composition: native tree cover	Percentage	No decline. Native tree cover at least 90% of canopy; target species cover at least 50% of canopy	The target species for 91A0 are sessile oak (<i>Quercus petraea</i>) and the hybrid oak <i>Quercus x rosacea</i> (Daly et al., in prep.; O'Neill and Barron, 2013). Species present reported in Perrin et al. (2008)
Vegetation composition: typical species	Occurrence	At least 1 target species for 91A0 woodlands present; at least 6 positive indicator species for 91A0 woodlands present	A variety of typical native species should be present, depending on woodland type. The target species for 91A0 are sessile oak (<i>Quercus petraea</i>) and the hybrid oak <i>Quercus x rosacea</i> . Positive indicator species for 91A0 are listed in Daly et al. (in prep.) and O'Neill and Barron (2013). Species present reported in Perrin et al. (2008). See also Young (1973)
Vegetation composition: negative indicator species	Occurrence	Negative indicator species cover not greater than 10%; regeneration of negative indicator species absent	Negative indicator species (i.e. any non-native species, including herbaceous species such as montbretia (<i>Crocsmia x crocosmiiflora</i>)) should be absent or under control. In general, the following are the most common non-native invasive species in 91A0 woodlands: beech (<i>Fagus sylvatica</i>), sycamore (<i>Acer pseudoplatanus</i>) and rhododendron (<i>Rhododendron ponticum</i>). Rhododendron has previously been removed from parts of the woodland (Perrin et al., 2008; NPWS internal files)

Conservation Objectives for : Lough Eske and Ardnamona Wood SAC [000163]

1029 Freshwater Pearl Mussel *Margaritifera margaritifera*

To restore the favourable conservation condition of Freshwater Pearl Mussel (*Margaritifera margaritifera*) in Lough Eske and Ardnamona Wood SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Kilometres	Maintain/restore distribution at 6.08km. See map 5	The conservation objective applies to the Eske freshwater pearl mussel (<i>Margaritifera margaritifera</i>) population. The distribution and abundance of the species in the Eske was mapped in 2006 as part of full, baseline monitoring (Moorkens, 2007). Mussels are distributed throughout the River Eske from Lough Eske to the estuary. Mussels also occurred in Lough Eske in 1994 (Moorkens, 2007). Mussels are abundant in two stretches: from Drumnacarry to the Limestone Brook confluence, and from below the N56 to the Drummenny confluence. Significant mussel kills were recorded in the abundant stretch downstream of the N56 in 2014 and 2016 (Moorkens, 2017). The target is for the species to be sufficiently widespread to maintain itself on a long-term basis as a viable component of the Eske system. See NPWS (2010) for further information
Population size	Number of adult mussels	Restore population to at least 200,000 adult mussels	Moorkens (2007) estimated the Eske population as at least 200,000. Beasley (1996) counted 10,962 mussels at 5 sites along the Eske, with significant within-site variation in mussel density. In 2006, mussel density of up to 240/m ² was recorded, while maximum density in transects was 77/m ² (Moorkens, 2007). Moorkens (2017) found 24% of quadrats were occupied, average density was 1.8/m ² and highest density was 19/m ² . Habitat is below carrying capacity throughout. Pearl fishing was documented in the past (Beasley, 1996). Moorkens (2007) recorded a significant decline in population between 1994 and 2006. Further losses were noted in 2009 (Moorkens, 2009). Further significant declines were recorded in 2014-2016 (Moorkens, 2017). NPWS (2019) estimated that the population may have declined to as little as 45,000. The target is for the species to be sufficiently abundant to maintain itself on a long-term basis as a viable component of the Eske system
Population structure: recruitment	Percentage per size class	Restore to at least 20% of population no more than 65mm in length; and at least 5% of population no more than 30mm in length	Mussels ≤65mm are 'young mussels' and found buried in the substratum or beneath adult mussels. Mussels ≤30mm are 'juvenile mussels' and always buried in the substratum. See the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 and I.S. EN 16859:2017. The Eske is an ageing population. Beasley (1996) found some mussels of 25-30mm. The smallest mussel was 7mm in 1994, but 67mm in 2006 when the Eske failed both targets (Moorkens, 2007). It failed both targets again in 2009 (no mussels under 75mm) (Moorkens, 2009; NPWS, 2010). Ross (2009) found 4 young mussels: 0% and 0.17% ≤30mm and 1.5% and 0.5% ≤65mm in quadrats and translocation, respectively. No young/juvenile mussels were observed in 2014-16 (Moorkens, 2017). The Eske population is unsustainable owing to lack of survival of juvenile mussels. The target is for sufficient juvenile recruitment to allow the species to maintain itself on a long-term basis as a viable component of the Eske system

Population structure: adult mortality	Percentage	No more than 5% decline from previous number of live adults counted; dead shells less than 1% of the adult population and scattered in distribution	5% is considered the cut-off between the combined errors associated with natural fluctuations and sampling methods and evidence of true population decline. 1% dead shells is indicative of natural losses. The Eske failed both targets in 2014-16 with recent severe decline in live adults and many dead and moribund mussels; 200m estimated in 2006 to have 50,000-75,000 had declined to <6,000 in 2016 (Moorkens, 2017). The Eske also failed both targets in 2009, with some decline in adult numbers since 2006 and excessive dead shells (Moorkens, 2009; NPWS, 2010). The baseline survey also reported a decline in adult numbers between 1994 and 2006 (Moorkens, 2007). The Eske population is unsustainable owing to lack of survival of juvenile mussels and elevated adult mortality. The target is for sufficient survival of adults to allow the species to maintain itself on a long-term basis as a viable component of the Eske system
Suitable habitat: extent	Kilometres	Restore suitable habitat in more than 6.08km in the Eske system (see map 5) and any additional stretches necessary for salmonid spawning	The extent of the freshwater pearl mussel habitat in the Eske River is from Lough Eske to the estuary (Moorkens, 2007, 2009, 2017; NPWS, 2010). The species was also known to occur in Lough Eske near the river's outflow (Moorkens, 2007). The mussel habitat is severely impacted by nutrient-enrichment and sedimentation. Disturbance to the natural hydrological regime, morphological changes and toxic pollution also appear to be significant factors. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Eske system
Suitable habitat: condition	Kilometres	Restore condition of suitable habitat	The species' habitat is a combination of 1) the area of habitat adult and juvenile mussels can occupy; 2) the area of spawning and nursery habitats host fish can occupy. Fish nursery habitat typically overlaps with mussel habitat. Fish spawning habitat is generally adjacent to mussel habitat, but may lie upstream of the generalised mussel distribution. Only spawning areas that can regularly contribute juvenile fish to areas occupied by adult mussels should be considered. Mussel and fish spawning/nursery habitat availability is determined by flow and substratum conditions, and is highly sensitive to hydromorphological, sedimentation and nutrient enrichment pressures from throughout the catchment (map 5). See I.S. EN 16859:2017. Mussel habitat is widespread in the Eske but cannot support sufficient juvenile survival. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Eske system
Water quality: macroinvertebrate and phytobenthos (diatoms)	Ecological quality ratio (EQR)	Restore water quality - macroinvertebrates: EQR greater than 0.90 (Q4-5 or Q5); phytobenthos: EQR greater than 0.93	The EQR targets correspond to high ecological status for these two Water Framework Directive biological quality elements. They represent high water quality with very low nutrient concentrations (oligotrophic conditions). Reaching these targets does not however guarantee achieving the targets for the other attributes. In 2009, the habitat in the Eske system failed the macroinvertebrate target, but passed the diatom target; however, confidence in the diatom result was low owing to early sampling (Ní Chatháin, 2009; Williams, 2009; NPWS, 2010). See also The European Communities Environmental Objectives (Surface Waters) Regulations 2009. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Eske system

Substratum quality: filamentous algae (macroalgae); macrophytes (rooted higher plants)	Percentage	Restore substratum quality- filamentous algae: absent or trace (less than 5%); macrophytes: absent or trace (less than 5%)	Macroalgae and, particularly, macrophytes have increased in the Eske since the 1990s (Moorkens, 2007). In 2014-16, it passed the algal target and failed the macrophyte target, having dense <i>Ranunculus</i> growths (Moorkens, 2017). Both targets failed in 2009, macrophyte cover was up to 100% in unshaded mussel habitat and filamentous algae widespread (Moorkens, 2009; Ní Chatháin, 2009; Williams, 2009; NPWS, 2010). Both were also widespread and abundant in 2006, obscuring mussels (Moorkens, 2007). Abundant decaying organic matter/floc has been noted in mussel habitat, with death of in-stream macroalgae/macrophytes the most likely source. Sufficient recruitment of juvenile mussels is being prevented by the poor condition of the river substratum. Algal/macrophyte growths may also be contributing to elevated adult mortality. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Eske system
Substratum quality: sediment	Occurrence	Restore substratum quality- stable cobble and gravel substrate with very little fine material; no artificially elevated levels of fine sediment	The Eske failed the target in 2014-16 and for the Sub-basin Management Plan (NPWS, 2010; Moorkens, 2017). In 2014, Moorkens (pers. comm.) noted very high turbidity throughout the river, downstream of Thrushbank Bridge. Silt infiltration was recorded in 70% of quadrats (Moorkens, 2017). Heavy sedimentation was noted in some mussel habitat in 2009 (Moorkens, 2009; NPWS, 2010). Williams (2009) noted sedimentation in glides and a significant silt plume during kicks at 2 sites on the Eske. Sedimentation of the mussel habitat has provided a rooting medium for macrophytes in the Eske. Sufficient survival of juvenile mussels is being prevented by the poor condition of the river substratum. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Eske system
Substratum quality: oxygen availability	Redox potential	Restore to no more than 20% decline from water column to 5cm depth in substrate	Differences in redox potential between the water column and the substrate correlate with differences in oxygen levels. Juvenile mussels require full oxygenation while buried in gravel. In suitable habitat, there should be very little loss of redox potential between the water column and underlying gravels. See I.S. EN 16859:2017. The Eske failed the redox target in 2014-16 and 2009. In 2014-16, average redox potential was 22% and only 41% of measurements had redox of 20% or less (Moorkens, 2017). In 2009, the average loss was 30.7%, indicating a severe decline of oxygen in the substratum (Moorkens, 2009; NPWS, 2010). Severe redox declines were also measured in 2006 (Moorkens, 2007). The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Eske system

Hydrological regime: flow variability	Metres per second	Restore appropriate hydrological regime	<p>The availability of suitable mussel habitat is largely determined by flow (also catchment geology). To restore the habitat for the species, flow variability over the annual cycle must be such that: 1) high flows can wash fine sediments from the substratum; 2) high flows are not artificially increased so as to cause excessive scour of mussel habitat; 3) low flows do not exacerbate the deposition of fine sediments or growth of algae/macrophytes; 4) low flows do not cause stress to mussels in terms of exposure, water temperatures, food availability or aspects of the reproductive cycle; see Moorkens and Killeen (2014) and I.S. EN 16859:2017.</p> <p>Groundwater inflow to the substratum contributes to water-cycling. Catchment drainage, resulting in hydrological regime change, may be contributing to the decline of the species in the Eske. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Eske system</p>
Host fish	Number	Maintain sufficient juvenile salmonids to host glochidial larvae	<p>Salmonid fish are host to the larval stage of the freshwater pearl mussel and, thus, are essential to completion of the life cycle. 0+ and 1+ fish are typically used, both because of habitat overlaps and the development of immunity with age in fish. Fish presence is sufficient, as higher fish density and biomass is indicative of enriched conditions in mussel rivers. Geist et al. (2006) found that higher densities of host fish coincided with eutrophication, poor substrate quality for mussels and a lack of mussel recruitment, while significantly lower densities and biomass of host fish were associated with high juvenile mussel numbers. Fish movements must be such that 0+ fish remain in the mussel habitat until their 1+ summer. No fish stocking should occur within the mussel habitat, nor any works that may change the salmonid balance or residency time. In May 2009, glochidia were found on salmon but not on trout in the Eske (Johnston, 2009; NPWS, 2010)</p>
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the population	<p>Semi-natural and natural riparian habitats, including those along lake fringes, even where they do not form part of a natural floodplain, are an integral part of the structure and functioning of river systems. Open wetlands, e.g. wet heath and blanket bog, are particularly critical to the hydrological regime of mussel rivers. Fringing habitats aid in the settlement of fine suspended material, protect banks from erosion, contribute to nutrient cycling, and to the aquatic food web (e.g. allochthonous matter from poor fens/flushes), and provide habitat (refuge and resources) for life-stages of fish, birds and aquatic invertebrates. Equally, fringing habitats are dependent on rivers/lakes, particularly their water levels, and support wetland communities and species of conservation concern. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Eske system. See the conservation objective for 3110</p>

Conservation Objectives for : Lough Eske and Ardnamona Wood SAC [000163]

1106 Salmon *Salmo salar*

To restore the favourable conservation condition of Atlantic Salmon (*Salmo salar*) in Lough Eske and Ardnamona Wood SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution: extent of anadromy	Percentage of river accessible	100% of river channels down to second order accessible from estuary	Artificial barriers block salmon's upstream migration, thereby limiting species to lower stretches and restricting access to spawning areas
Adult spawning fish	Number	Conservation limit (CL) for each system consistently exceeded	A conservation limit (CL) is defined by the North Atlantic Salmon Conservation Organisation (NASCO) as "the spawning stock level that produces long-term average maximum sustainable yield as derived from the adult to adult stock and recruitment relationship". The target is based on the Technical Expert Group on Salmon's (TEGOS) annual model output of CL attainment levels. See Technical Expert Group on Salmon (2019) for further details. Stock estimates are either derived from direct counts of adults (rod catch, fish counter) or indirectly by fry abundance counts. The fish counter on the River Eske is used as the source of adult salmon run estimates. The Eske is currently below CL, meeting 56% of CL
Salmon fry abundance	Number of fry/5 minutes electrofishing	Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 minutes sampling	Target is threshold value for rivers currently exceeding their conservation limit (CL)
Out-migrating smolt abundance	Number	No significant decline	Smolt abundance can be negatively affected by a number of impacts such as estuarine pollution, predation and sea lice (<i>Lepeophtheirus salmonis</i>)
Number and distribution of redds	Number and occurrence	No decline in number and distribution of spawning redds due to anthropogenic causes	Salmon spawn in clean gravels
Water quality	EPA Q value	At least Q4 at all sites sampled by EPA	Q values based on triennial water quality surveys carried out by the Environmental Protection Agency (EPA)

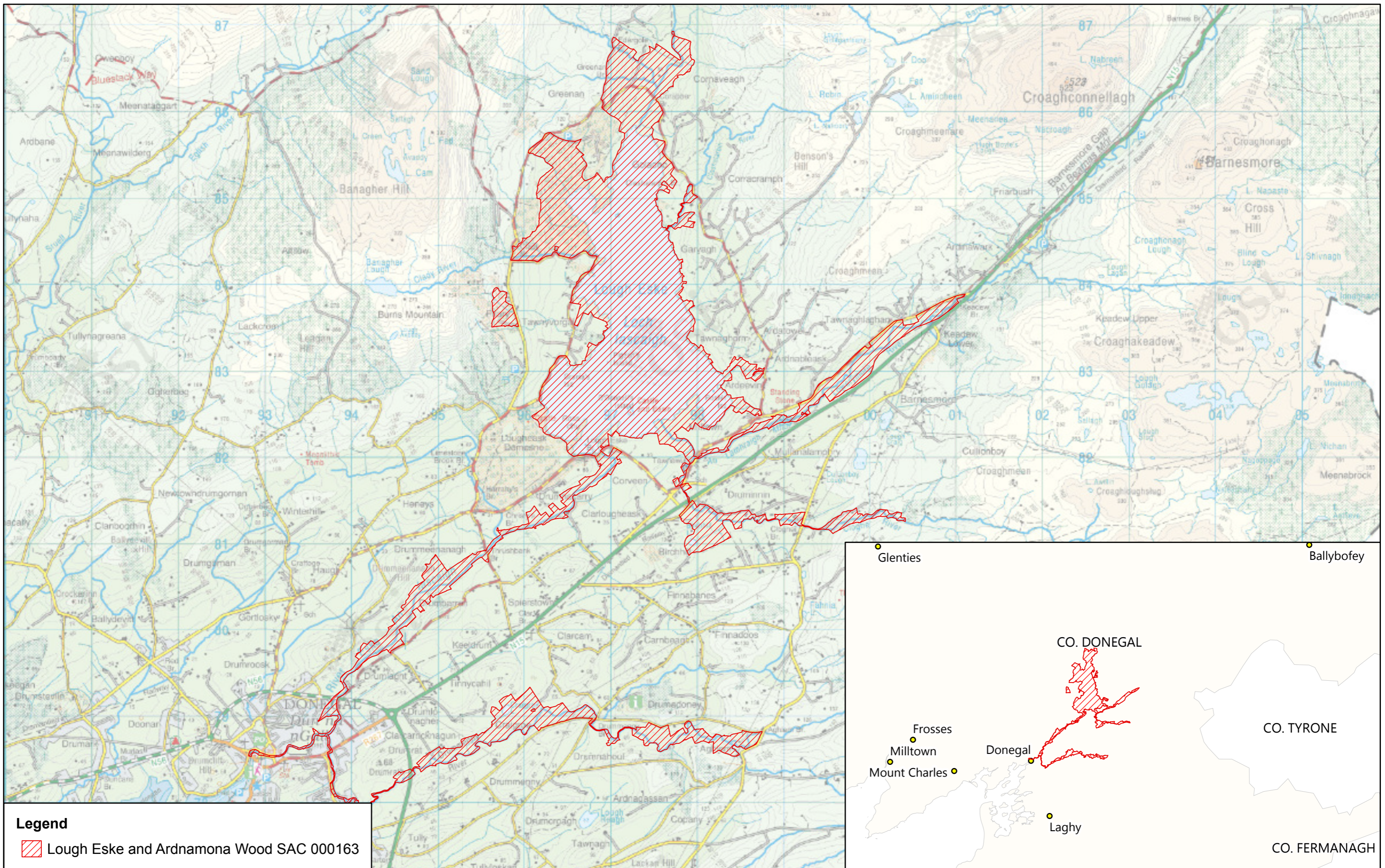
Conservation Objectives for : Lough Eske and Ardnamona Wood SAC [000163]


6985 Killarney Fern *Vandenboschia speciosa*

To maintain the favourable conservation condition of Killarney Fern (*Vandenboschia speciosa*) in Lough Eske and Ardnamona Wood SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Occurrence	No loss in geographical spread of populations, subject to natural processes	The population of Killarney fern (<i>Vandenboschia speciosa</i> [formerly <i>Trichomanes speciosum</i> ; species code 1421]) is currently known from locations in Lough Eske and Ardnamona Wood SAC within hectad G98. Exact locations are not mapped here on account of the threat posed by illegal collecting. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Number of populations	Number	No decline, subject to natural processes	One population of the species has been recorded in the SAC since 1960. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Number of colonies	Number	No decline, subject to natural processes	Six colonies of the species have been recorded in the population in the SAC since 1960, five in 2016 and one in 1993. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Population: life-cycle stage	Type (sporophyte or gametophyte)	Maintain life-cycle stage composition of populations, subject to natural processes	One of the six colonies recorded since 1960 is composed of sporophytes (frond stage) with co-existing gametophytes (filamentous stage) and five are composed of gametophytes only. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Population size: area of occupancy	Square metres	No decline, subject to natural processes	Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Population size: living sporophyte fronds	Number	No decline, subject to natural processes	Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Population structure: young and unfurling fronds	Occurrence	Young (not fully expanded) and/or unfurling (crozier) fronds present in populations previously observed to have these, subject to natural processes	Young and/or unfurling fronds have been recorded from Lough Eske and Ardnamona Wood SAC. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Population structure: fertile fronds	Occurrence	Fertile fronds present in populations previously observed to have these, subject to natural processes	Fertile fronds have not been recorded from the SAC. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Population structure: juvenile sporophyte fronds emerging from gametophytes	Number	No decline, subject to natural processes	Juvenile sporophyte fronds emerging from gametophytes have not been recorded from the SAC. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Habitat extent	Hectares	No loss of suitable habitat, subject to natural processes	The species grows in deeply shaded, humid situations - dripping caves, overhangs and crevices on cliffs, rocky slopes, by waterfalls, in stream ravines and gullies, on rock or soil banks in woodlands and, occasionally, under fallen trees and on the floor of damp woodlands. Whilst also occurring in these habitats, the gametophyte stage can grow in drier areas that do not suit the sporophyte. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files

Hydrological conditions: wet/damp microhabitats	Occurrence	Maintain hydrological conditions at the locations of known populations - visible water source, with dripping or seeping water present and/or substrate wet/damp to touch, subject to natural processes	Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Hydrological conditions: relative humidity	Percentage	Maintain relative humidity levels at known colonies at not less than 80%, subject to natural processes	Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Hydrological conditions: desiccated fronds	Number	No increase, subject to natural processes	Presence of desiccated sporophyte fronds and gametophyte mats is indicative of unsuitable conditions. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Light levels: shading	Shade index score	At least 4 for woodland sporophyte-only and mixed colonies; at least 5 for open upland sporophyte-only and mixed colonies; at least 6 for gametophyte-only colonies, subject to natural processes	Shade Index: 4. Moderate shade, e.g. light-medium deciduous canopy with sun flecks. 5. Permanently shaded from direct sunlight but otherwise open to sky. 6. Deep woodland (e.g. coniferous or in ravine) shade, no sun flecks. 7. Perpetual deep shade, e.g. cave entrance, beneath boulder. The species occurs in moderate to deep shade in woodland in Lough Eske and Ardnamona Wood SAC. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Woodland canopy cover	Percentage	No loss of woodland canopy at, or in the vicinity of, the locations of known populations and canopy cover here maintained at more than 33%, subject to natural processes	Woodland management at or near to locations of known populations of the species must take account of its habitat requirements, particularly with regard to maintenance of sufficient canopy cover. The species occurs in woodland in Lough Eske and Ardnamona Wood SAC. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files
Invasive species	Occurrence	Maintain absence of invasive non-native and vigorous native plant species at the locations of known populations or, if present, maintain vegetation cover of these at less than 10%, taking into account the habitat requirements of <i>V. speciosa</i>	In order to avoid negative impacts on the Killarney fern (<i>Vandenboschia speciosa</i>), its habitat requirements (site hydrology, relative humidity, canopy cover, shading levels, etc.) must be taken into account in locations that are subject to or proposed for management actions to control invasive non-native and/or vigorous native plant species. Based on Ní Dhúill et al. (2015, in prep.), NPWS (2019) and NPWS internal files



Legend
 Lough Eske and Ardnamona Wood SAC 000163



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**MAP 1:
 LOUGH ESKE AND ARDNAMONA WOODSAC
 CONSERVATION OBJECTIVES
 SAC DESIGNATION**

Map to be read in conjunction with the NPWS Conservation Objectives Document.

**SITE CODE:
 SAC 000163; version 3.01. CO. DONEGAL**

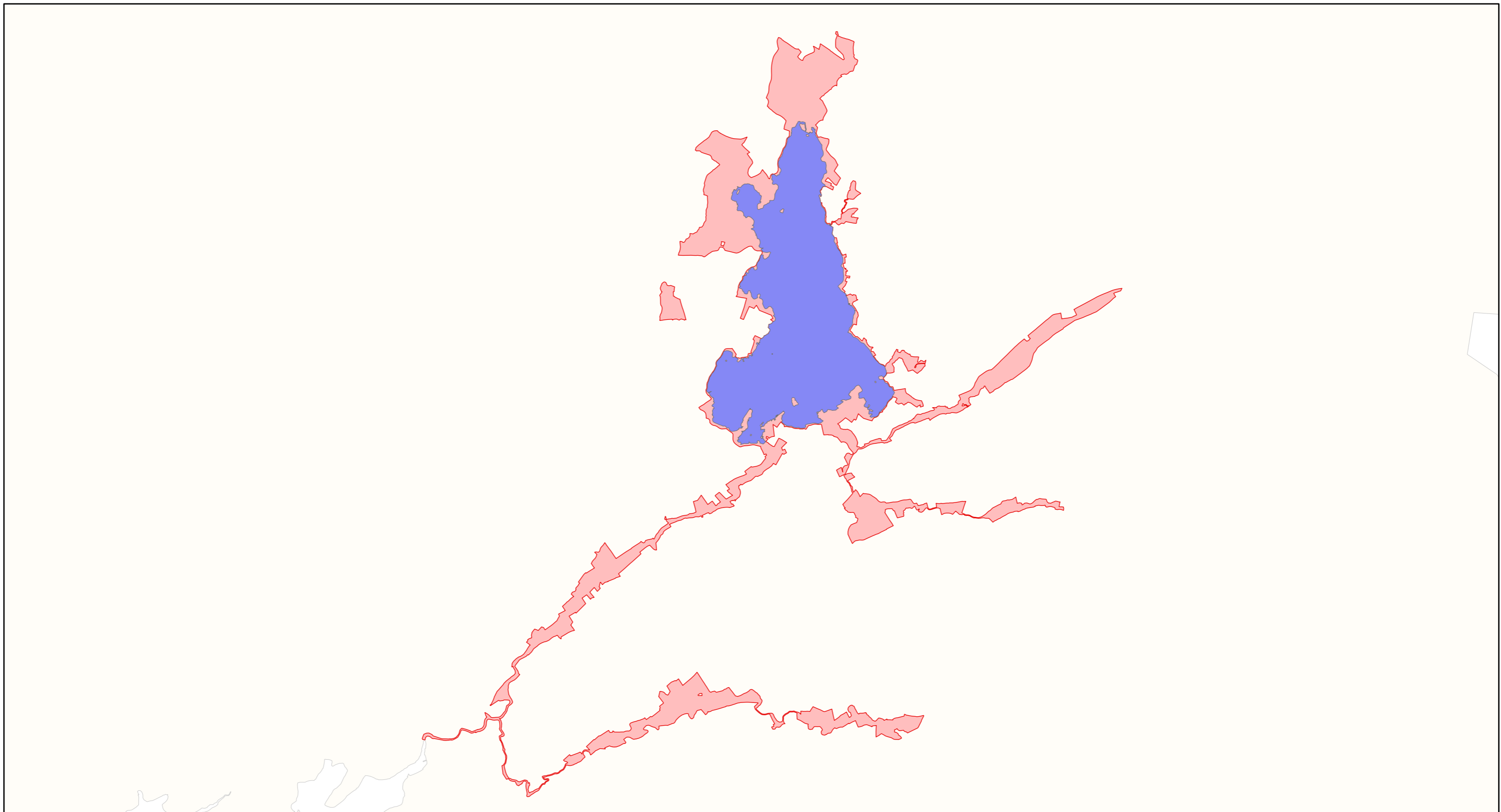


The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision.
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Níl sna teorainneacha ar na léarscáileanna ach nod garshuíomhach ginearálta. Féadfar athbheithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Suirbhéarachta Ordonáis na hÉireann Ceadúnas Uimh EN 0059216. © Suirbhéarachta Ordonáis na hÉireann Rialtas na hÉireann

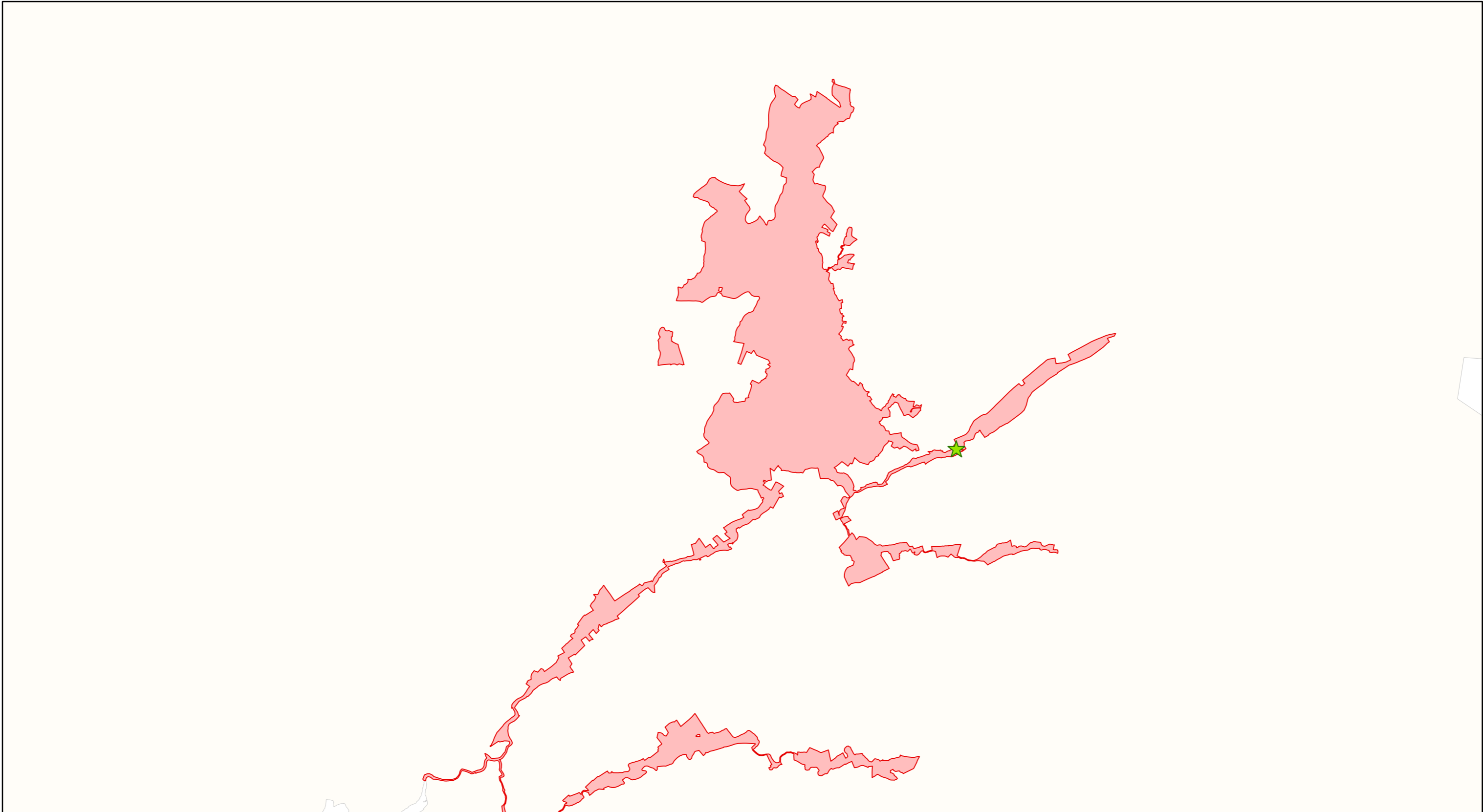


**Map Version 1
 Date: May 2019**



Legend

- 3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)
- OSi Discovery Series County Boundary
- Lough Eske and Ardnamona Wood SAC 000163



Legend

- Lough Eske and Ardnamona Wood SAC 000163
- OSi Discovery Series County Boundary
- 7220 Petrifying springs with tufa formation (*Cratoneurion*)

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**MAP 3:
LOUGH ESKE AND ARDNAMONA WOOD SAC
CONSERVATION OBJECTIVES
PETRIFYING SPRINGS**

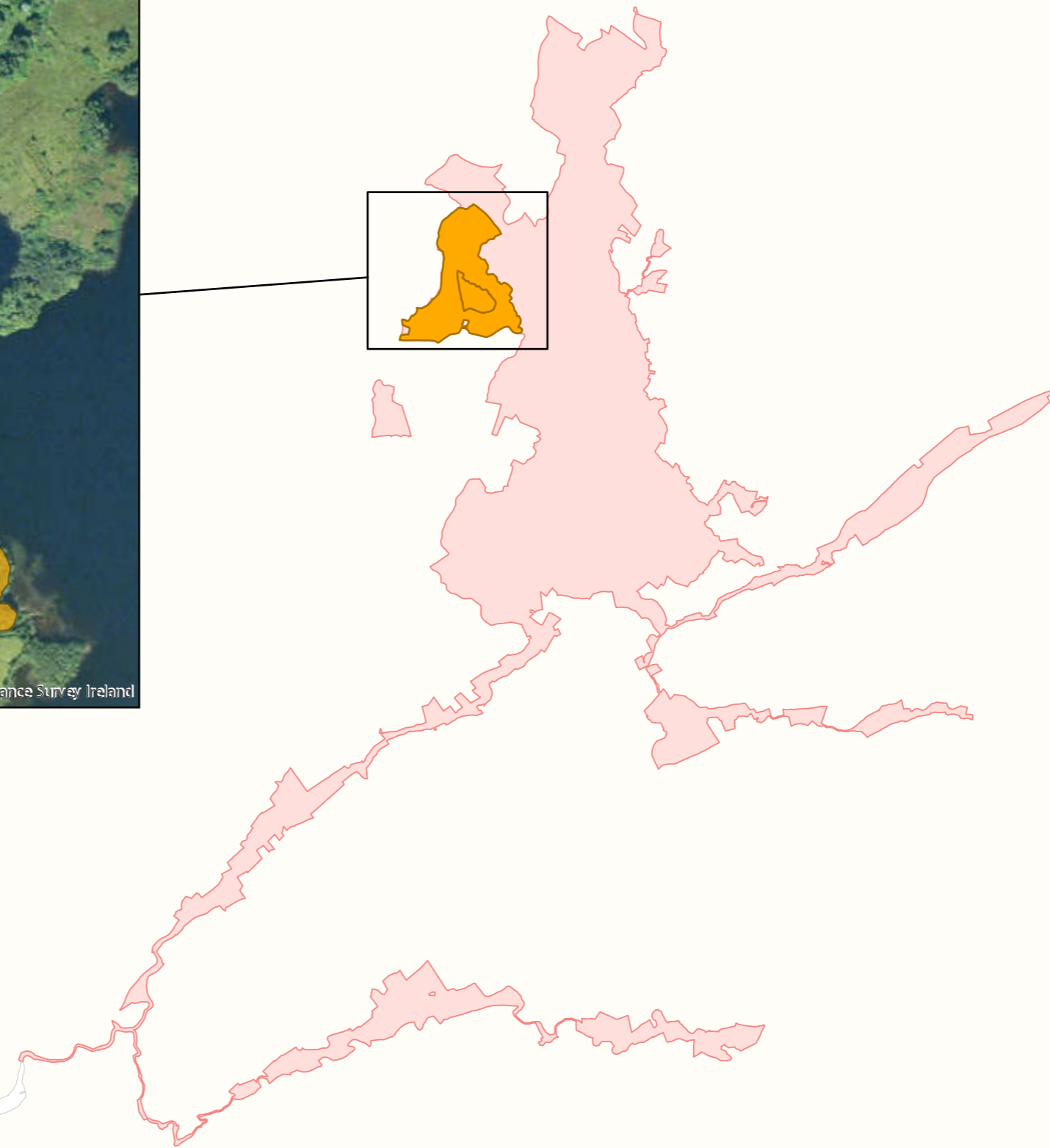
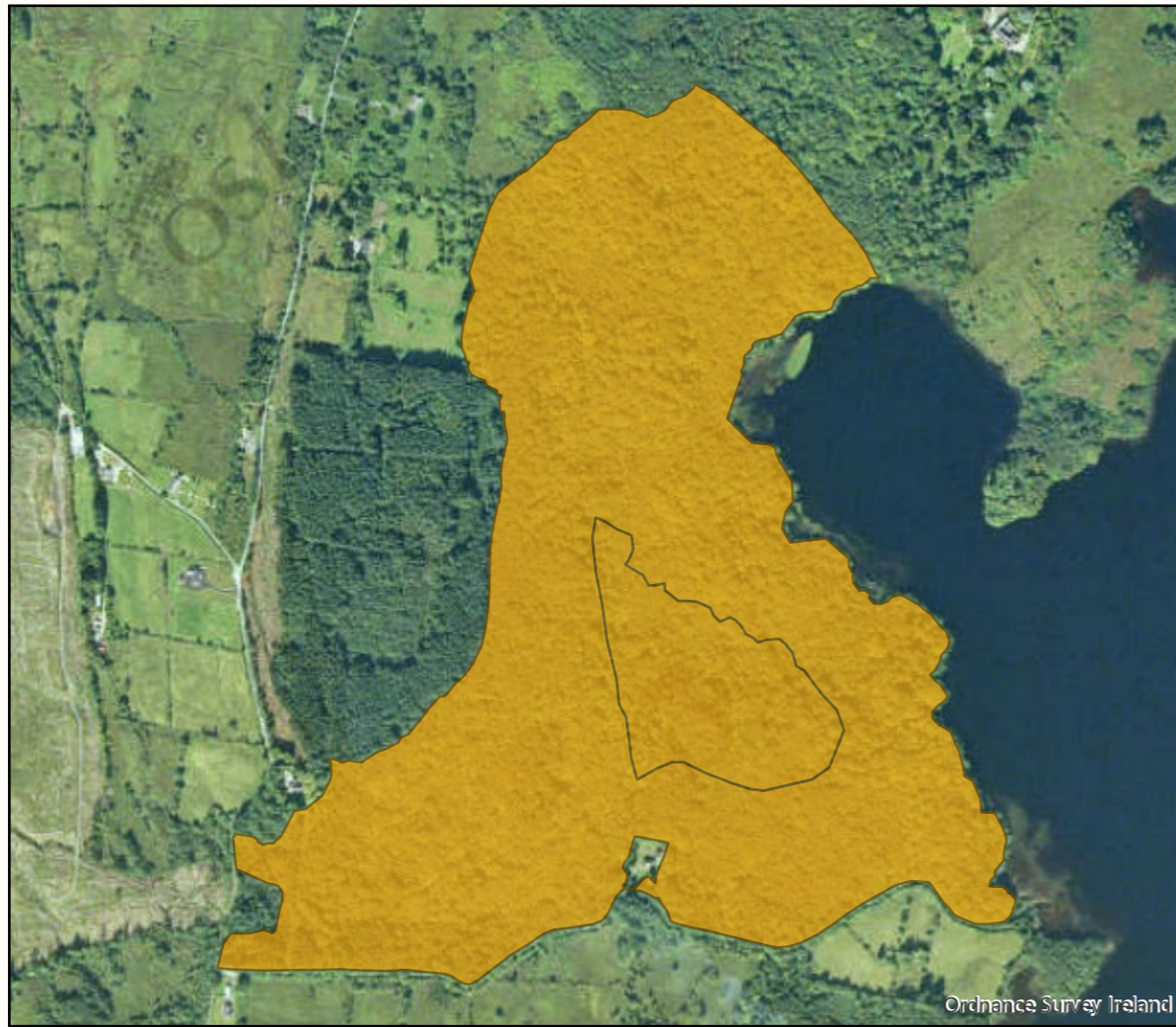
Map to be read in conjunction with the NPWS Conservation Objectives Document.

**SITE CODE:
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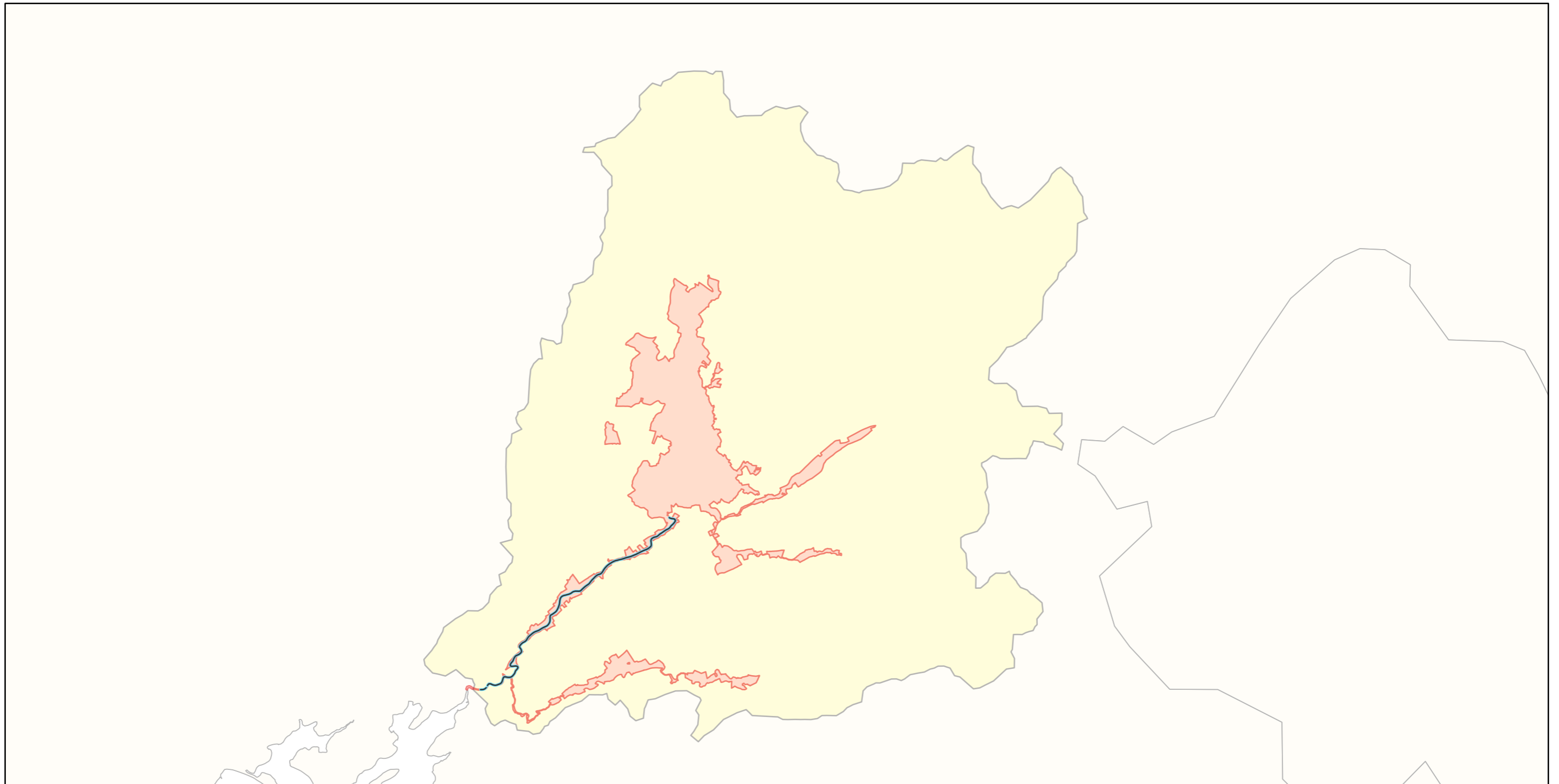
Níl sna teorainneacha ar na léarscáileanna ach nod garshuíomhach ginearálta. Féadfar athbheithnithe a déanamh ar theorainneacha na gceantar comharthaíthe. Suirbhéarachta Ordonáis na hÉireann Ceadúnas Uimh EN 0059216. © Suirbhéarachta Ordonáis na hÉireann Rialtas na hÉireann

**Map Version 1
Date: May 2019**



Legend

- Lough Eske and Ardnamona Wood SAC 000163
- OSi Discovery Series County Boundary
- 91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles



Legend

- Lough Eske and Ardnamona Wood SAC 000163
- 1029 Freshwater Pearl Mussel - *Margaritifera margaritifera* Suitable habitat target
- 1029 Freshwater Pearl Mussel - *Margaritifera margaritifera* Distribution target
- 1029 Freshwater Pearl Mussel - *Margaritifera margaritifera* Catchment
- OSi Discovery Series County Boundaries