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Conservation Objectives Series

Kilroosky Lough Cluster SAC 001786

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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***

001786	Kilroosky Lough Cluster SAC
1092	White-clawed Crayfish *Austropotamobius pallipes*
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
7210	Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae*
7230	Alkaline fens

Supporting documents, relevant reports & publications

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

NPWS Documents

Year :	1983
Title :	Pre-drainage survey, Finn/Lacky River catchment, Cos Monaghan and Cavan
Author :	Douglas, C.; Lockhart, N.
Series :	Unpublished report
Year :	1984
Title :	Revisions to the lists of areas of scientific interest in County Monaghan
Author :	Ni Lamhna, E.
Series :	Unpublished Report
Year :	2007
Title :	Monaghan Fen Survey 2007 Volume I: Main Report
Author :	Foss, P.; Crushell, P.
Series :	Unpublished report to NPWS and Monaghan County Council
Year :	2009
Title :	Monitoring of white-clawed crayfish *Austropotamobius pallipes* in Irish lakes in 2007
Author :	O'Connor, W.; Hayes, G.; O'Keeffe, C.; Lynn, D.
Series :	Irish Wildlife Manuals, No. 37
Year :	2009
Title :	Ireland Red List No. 2: Non-marine molluscs
Author :	Byrne, A.; Moorkens, E.A.; Anderson, R.; Killeen, I.J.; Regan, E.C.
Series :	Ireland Red List series, NPWS
Year :	2010
Title :	Ireland Red List No. 4: Butterflies
Author :	Regan, E.C.; Nelson, B.; Aldwell, B.; Bertrand, C.; Bond, K.; Harding, J.; Nash, D.; Nixon, D.; Wilson, C.J.
Series :	Ireland Red List series, NPWS
Year :	2010
Title :	A technical manual for monitoring white-clawed crayfish (*Austropotamobius pallipes*) in Irish lakes
Author :	Reynolds, J.; O'Connor, W.; O'Keeffe, C.; Lynn, D.
Series :	Irish Wildlife Manuals, No.45
Year :	2012
Title :	Ireland Red List No. 8: Bryophytes
Author :	Lockhart, N.; Hodgetts, N.; Holyoak, D.
Series :	Ireland Red List series, NPWS
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 :	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 Lists series, 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 :	Checklists Protected and Threatened Species in Ireland 2019
Author :	Nelson, B.; Cummins, S.; Fay, L.; Jeffrey, R.; Kelly, S.; Kingston, N.; Lockhart, N.; Marnell, F.; Tierney, D.; Wyse Jackson, M.
Series :	Irish Wildlife Manuals, No. 116
Year :	2020
Title :	Marl Lake (Habitat 3140) Survey and Assessment Methods Manual
Author :	Roden, C.; Murphy, P.; Ryan, J.; Doddy, P.
Series :	Irish Wildlife Manuals, No. 125
Year :	2020
Title :	Benthic vegetation in Irish marl lakes: monitoring habitat 3140 condition 2011 to 2018
Author :	Roden, C.; Murphy, P.; Ryan, J.
Series :	Irish Wildlife Manuals, No. 124
Year :	2020
Title :	Benthic vegetation in Irish marl lakes: monitoring habitat 3140 condition 2011 to 2018. Appendix III, Site Reports
Author :	Roden, C.; Murphy, P.; Ryan, J.
Series :	Irish Wildlife Manuals, No. 124
Year :	2021
Title :	Checklists Protected and Threatened Species in Ireland. Version 2.1. 3 December 2021
Author :	Nelson, B.; Cummins, S.; Fay, L.; Jeffrey, R.; Kelly, S.; Kingston, N.; Lockhart, N.; Marnell, F.; Tierney, D.; Wyse Jackson, M.
Series :	Irish Wildlife Manuals, No. 116
Year :	2021
Title :	White-clawed Crayfish *Austropotamobius pallipes* survey in designated SACs in 2017
Author :	Gammell, M.; McFarlane, A.; Brady, D.; O'Brien, J.; Mirimin, L.; Graham, C.; Lally, H.; Minto, C.; O'Connor, I.
Series :	Irish Wildlife Manuals, No. 131
Year :	in prep.
Title :	Scoping study and pilot survey of fens
Author :	O'Neill, F.H.; Perrin, P.M.; Denyer, J.; Martin, J.R.; Daly, O.H.; Brophy, J.T.
Series :	Irish Wildlife Manuals

Other References

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

Year :	1987
Title :	A method for evaluating wetlands - a case study on the Finn river catchment, County Monaghan, Ireland
Author :	Lockhart, N.D.
Series :	Irish Geography, 20: 75-81
Year :	1992
Title :	The Northern Ireland Lakes Survey
Author :	Wolfe-Murphy, S.A.; Lawrie, E.W.; Smith, S.J.; Gibson, C.E.
Series :	Report to Countryside and Wildlife Branch, Department of the Environment for Northern Ireland
Year :	2009
Title :	The marl lakes of the British Isles
Author :	Pentecost, A.
Series :	Freshwater Reviews, 2(1): 167-197
Year :	2011
Title :	Review and revision of empirical critical loads and dose-response relationships. Proceedings of an expert workshop, Noordwijkerhout, 23-25 June 2010
Author :	Bobbink, R.; Hettelingh, J.P.
Series :	RIVM report 680359002, Coordination Centre for Effects, National Institute for Public Health and the Environment (RIVM)
Year :	2011
Title :	The Fen Management Handbook
Author :	McBride, A.; Diack, I.; Droy, N.; Hamill, B.; Jones, P.; Schutten, J.; Skinner, A.; Street, M. (eds.)
Series :	Scottish Natural Heritage, Perth
Year :	2014
Title :	Tellus Investigation of Wetland Ecology and Geochemistry (TIWEG) Final Report
Author :	Flynn, R.; McKernan, R.; O'Leary, Á.; Rolston, A.; McCarthy, V.
Series :	Tellus Border report
Year :	2014
Title :	Tellus Border Wetland Project: an ecohydrological investigation of wetlands in the border region of Ireland
Author :	McCarthy, V.; Rolston, A.
Series :	Tellus Border report
Year :	2015
Title :	Magheraveely Marl Loughs SAC Conservation Objectives. V2
Author :	McKeown, R.
Series :	Department of Agriculture, Environment and Rural Affairs, Northern Ireland
Year :	2016
Title :	A narrative for conserving freshwater and wetland habitats in England
Author :	Mainstone, C.; Hall, R.; Diack, I.
Series :	Natural England Research Reports Number 064
Year :	2018
Title :	Irish Vegetation Classification: Technical Progress Report No. 4
Author :	Perrin, P.
Series :	Report submitted to National Biodiversity Data Centre
Year :	2019
Title :	Crayfish (*Austropotamobius pallipes*) surveys in the Magheraveely/Kilroosky Lake Custer SAC 2019
Author :	CANN (Collaborative Action for the Natura Network)
Series :	Unpublished report for EU INTERREG project CANN

Year :	2020
Title :	Magheraveely Marl Lakes - Kilroosky Lough Cluster. Macrophytes and Water Chemistry Trends. Confidential draft
Author :	Stewart, N.F.; McElarney, Y.R
Series :	Internal CANN project report
Year :	2020
Title :	White-clawed crayfish (*Austropotamobius pallipes*) stock assessment on the 'Horseshoe lake' (Kilroosky Lough ASSI)
Author :	CANN (Collaborative Action for the Natura Network)
Series :	Unpublished report for EU INTERREG project CANN
Year :	2021
Title :	White-clawed crayfish (*Austropotamobius pallipes*) stock assessment on the 'Horseshoe lake' (Kilroosky Lough ASSI). June 2021
Author :	CANN (Collaborative Action for the Natura Network)
Series :	Unpublished report for EU INTERREG project CANN
Year :	2021
Title :	White-clawed crayfish (*Austropotamobius pallipes*) stock assessment on the 'Horseshoe Lake' (Kilroosky Lough ASSI). August 2021
Author :	CANN (Collaborative Action for the Natura Network)
Series :	Unpublished report for EU INTERREG project CANN
Year :	2021
Title :	White-clawed crayfish (*Austropotamobius pallipes*) stock assessment on the 'Dummy's Lough' (Kilroosky Lough Cluster SAC). August/September 2021
Author :	CANN (Collaborative Action for the Natura Network)
Series :	Unpublished report for EU INTERREG project CANN
Year :	2021
Title :	Kilroosky Lough Cluster SAC CANN Habitat Mapping Report
Author :	AFBI (Agri-Food and BioSciences Institute)
Series :	Unpublished report for EU INTERREG project CANN

Spatial data sources

Year :	2021
Title :	OSi Prime 2 water polygon file
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 :	3140 (map 2)
Year :	2021
Title :	Kilroosky Lough Cluster SAC CANN Habitat Mapping Report
GIS Operations :	Dataset clipped to SAC boundary; QIs selected; Expert opinion used as necessary to resolve any issues arising
Used For :	7210, 7230 (map 3)
Year :	2021
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 :	1092 (map 4)

3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.

To restore the favourable conservation condition of Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. in Kilroosky Lough Cluster 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	Habitat 3140 occurs in a series of small marl lakes, Summerhill, Burdautien, Kilroosky and Dummy's Loughs. All are cross-border and most are protected in Northern Ireland in Magheraveely Marl Loughs SAC. The lakes in the SAC were assessed as in bad conservation condition and habitat 3140 was in bad, deteriorating conservation status across Ireland in the two reporting periods, 2007-2018 (NPWS, 2013, 2019). CANN project survey work showed charophyte abundance had significantly declined in the four lakes in 2018, with plants restricted to areas adjacent to calcareous fen or open patches in swamp (Stewart and McElarney, 2020). The lake surface area is the simplest measure of extent and should be stable or increasing. It may also be possible to estimate the area of the vegetation zones that typify the habitat. For further information on all attributes see Roden et al. (2020) and O Connor (2015). See Pentecost (2009) and Roden et al. (2020) for an overview of Irish and British marl lakes
Habitat distribution	Occurrence	No decline, subject to natural processes	In the SAC, habitat 3140 is found in Summerhill, Burdautien, Kilroosky and Dummy's Loughs, a series of small, cross-border, inter-drumlin, kettle-hole, marl lakes, on predominantly limestone substrate, fed by lime-rich water. See map 2. It may have formerly occurred in Ramages Lough, which was altered by drainage and some infilling. The lakes are protected in Kilroosky Lough Cluster SAC in Ireland and in Magheraveely Marl Loughs SAC (UK0016621) (and as ASSIs) in Northern Ireland; however, the boundaries of the SACs in the two jurisdictions do not match exactly. Habitat 3140 was surveyed in Summerhill in 2012 (Roden et al., 2020) and in all four lakes in 2018 for the CANN project. Other surveys have included (Wolfe-Murphy et al., 1992; McCarthy and Rolston, 2014; Lockhart, 1987; Ní Lamhna, 1984; Douglas and Lockhart, 1983). Further data may also be available from NIEA (condition monitoring) and, for Summerhill Lough, from the EPA (Water Framework Directive monitoring)
Vegetation composition: typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution; restore condition and extent of typical charophyte species	While charophyte diversity had not decreased in 2018, charophytes were restricted in distribution and had low abundance, and higher plants dominated the flora (Stewart and McElarney, 2020). Roden et al. (2020) found no charophytes on the 2012 Summerhill transect. The following typical charophytes have been recorded: Summerhill: *Chara aculeolata, C. contraria* var. *contraria, C. globularis, C. hispida, C. rudis, C. vulgaris*; Burdautien: *C. aculeolata, C. curta, C. hispida, C. virgata, C. vulgaris*; Kilroosky: *C. aculeolata, C. contraria* var. *contraria, C. globularis, C. hispida, C. rudis, C. virgata, C. vulgaris, Nitella flexilis* agg.; Dummy's: *C. aculeolata, C. contraria* vars *contraria* and *hispidula, C. hispida*. Habitat 3140 typical species include cyanobacteria, algae, higher plants and water beetles (see NPWS, 2013, 2019 and O Connor, 2015). Roden et al. (2020) list species present in marl lakes in good condition

Vegetation composition: characteristic zonation	Occurrence	Restore characteristic charophyte and crust zones	Charophytes had declined significantly in all four lakes in 2018 and were confined to areas protected from the main water body, adjacent to calcareous fen, frequently in open patches within swamp (Stewart and McElarney, 2020). The 2012 Summerhill transect had no characteristic zones (Roden et al., 2020). Charophyte zones were extensive in Kilroosky until at least 2006, but declined significantly by 2014 and were restricted to the north-eastern shore in 2018. Higher plants dominated the lakes in 2018, particularly bands of floating-leaved species *Nuphar lutea, Nymphaea alba, Potamogeton natans*, and a variety of submerged species had expanded (e.g. *Utricularia vulgaris* agg. at Kilroosky). Marl lakes in good condition have four or more characteristic zones, see Roden et al. (2020). Small kettle-hole lakes may show some natural variation from this zonation, including more frequent, but not dominant, submerged vascular plants
Vegetation distribution: maximum depth	Metres	Restore maximum depth of vegetation (euphotic depth), subject to natural processes	Maximum depth of vegetation was 1.5m in Summerhill in 2012; however, no charophytes occurred on the transect (Roden et al., 2020). Charophytes appeared to be restricted to shallow water in 2018 (Stewart and McElarney, 2020). The target for maximum depth of vegetation colonisation (euphotic depth) in marl lakes is >7m (Roden et al., 2020). Euphotic depth is considered to be a key measure of the structure and functions of marl lake vegetation and has been found to exceed 10m in some Irish marl lakes (Roden et al., 2020)
Hydrological regime: water level fluctuations	Metres	Restore appropriate hydrological regime necessary to support the habitat	The lakes in the SAC are largely fed by springs (McCarthy and Rolston, 2014). At Kilroosky, a sluice installed following unauthorised deepening of the outflow to lower the water level was subsequently by-passed (McKeown, 2015). Excavation of the outflow from Burdautien lowered the lake water level in 2018. Fluctuations in lake water level can be amplified by activities such as abstraction and drainage. In undisturbed marl lakes, fluctuations follow predictable seasonal trends and relationships exist with the vegetation zones (Roden et al., 2020). In summer, >90% of the crust zone should be covered and water level should never be lower than the top of the *Chara curta* zone; in winter, all zones should be submerged (Roden et al., 2020). Groundwater normally exerts a strong influence on the hydrology of marl lakes. Increased water level fluctuations can increase wave action, up-root vegetation, increase turbidity, alter the substratum and lead to nutrient release from sediment
Lake substratum quality	Various	Maintain/restore appropriate substratum type, extent and chemistry to support the vegetation	Highly variable surface sediment composition was recorded at Kilroosky (McCarthy and Rolston, 2014). Increased accumulation of nutrients and organic matter in the lake sediments in the SAC may contribute to eutrophication and the observed bad condition of the habitat. In general, marl lakes are dominated by limestone bedrock, calcareous silt and sand, and loose stones (Roden et al., 2020). Deposited peat may indicate excessive sediment inputs and sediment can accumulate phosphorus and release it into the water column (Roden et al., 2020). Further research into acceptable sediment phosphorus concentrations and other aspects of substratum quality in marl lakes would be beneficial

pH and Alkalinity	pH units, mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes	Average alkalinity was 130mg/l at Kilroosky (McCarthy and Rolston, 2014). The Environmental Protection Agency (EPA) reported alkalinity of 201 and 196mg/l in Summerhill in 2010-12 and 2013-15, respectively. The lower alkalinity boundary for the habitat may lie between 80 and 100mg/l; however, alkalinity is far higher in most Irish marl lakes, exceeding 200mg/l in some cases (Roden et al., 2020). Acidification is not considered a threat to habitat 3140, but eutrophication can lead to at least temporary increases in pH to toxic levels (>9/9.5 pH units). Maximum pH should be <9.0 pH units, in line with the surface water standards (The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019). Further study of the sediment pH, alkalinity and cation concentration may assist in understanding of nutrient cycling
Nutrients	mg/l P; mg/l N	Restore the concentration of nutrients in the water column to sufficiently low levels to support the habitat and its typical species	The EPA reported moderate total phosphorus (TP) status and average concentration of 0.030mg/l in Summerhill in 2010-12, but high TP status in 2013-15. Episodes of elevated TP concentrations have also been reported at Kilroosky since 2012 (Flynn et al., 2014; McCarthy and Rolston, 2014; NIEA/DAERA data). Maxima of 0.04mg/l and 0.08mg/l TP were recorded in Kilroosky and Burdautien respectively (Stewart and McElarney, 2020). Roden et al. (2020) found that most marl lakes in good condition have TP ≤0.01mg/l; this is the target for good condition although vegetation attributes determine the overall conservation condition (Roden et al., 2020). ≤0.01mg/l TP is equivalent to oligotrophic (OECD, 1982) and WFD High Status (The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019). WFD high status targets for total ammonia (annual average ≤0.04mg/l N and annual 95th percentile ≤0.09mg/l N) may also be appropriate. Summerhill had high ammonia status 2012-2015
Water colour	mg/l PtCo	Restore appropriate water colour to support the habitat	Water colour in Summerhill was 46mg/l PtCo in 2012 (Roden et al., 2020). Roden et al. (2020) found that water colour (dissolved light-absorbing compounds) is negatively correlated with euphotic depth, charophyte species richness and cover, and positively correlated with vascular plant cover in marl lakes. Roden et al. (2020) set good condition at <15mg/l PtCo; however, the highest conservation value marl lakes in Ireland have very clear waters with colour of <5mg/l PtCo. Roden et al. (2020) also set a TP×Colour Index with a target of <0.1 for good. Increased colour decreases light penetration and reduces the area of macrophyte habitat, particularly at the lower euphotic depths. The primary source of increased colour in Ireland is peatland disturbance, e.g. through overgrazing, afforestation
Dissolved organic carbon (DOC)	mg/l	Maintain/restore appropriate organic carbon levels to support the habitat	Dissolved organic carbon (DOC) in the water column is linked to water colour. It can provide a substrate (food source) for heterotrophic organisms, which can impact directly (e.g. shading) and indirectly (e.g. nutrient release) on the characteristic lake communities. Damage and degradation of peatland, e.g. through afforestation or turf-cutting, leading to decomposition of peat is likely to be the predominant source of dissolved and particulate organic carbon in Ireland. The very high colour recorded in Summerhill Lough in 2012 may have indicated high DOC from catchment sources

Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate unit	Maintain/restore 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
Transparency	Metres	Restore appropriate Secchi transparency. There should be no decline in Secchi depth/transparency	High colour was recorded in Summerhill in 2012 (Roden et al., 2020) and high chlorophyll concentration in Kilroosky in 2012-2013 (McCarthy and Rolston, 2014), both frequently associated with reduced transparency. Transparency relates to light penetration and, hence, to the depth of colonisation of vegetation. Roden et al. (2020) advised it is preferable to measure euphotic depth directly by observation, but noted that a decreasing trend in Secchi depth indicates declining water quality. Transparency can be affected by phytoplankton blooms, water colour and turbidity. Secchi depth in marl lakes in good condition is generally >6m. The OECD fixed boundary system set transparency targets for oligotrophic lakes of ≥6m annual mean Secchi disk depth and ≥3m annual minimum Secchi disk depth
Attached algal biomass	Algal cover	Maintain/restore trace/absent attached algal biomass (<5% cover)	Locally frequent filamentous algae were recorded at Dummy's Lough in 2018 (Stewart and McElarney, 2020). Filamentous algae have increased at Kilroosky. Nutrient enrichment can favour epiphytic and epipelic algae that can out-compete the submerged vegetation. Roden et al. (2020) noted that occasional blooms of filamentous algae occur in marl lakes in the absence of excess nutrients, especially species of the orders Zygnematales or Oedogoniales, but that drifting masses of *Cladophora* species may indicate a decline in water quality. In general, the cover abundance of attached algae in marl lakes (3140) should be trace/absent (<5% cover)
Fringing habitat: area and condition	Hectares	Restore the area and condition of fringing habitats necessary to support the natural structure and functioning of habitat 3140	*Cladium* and alkaline fens fringe lakes in the SAC (see the conservation objectives for habitats 7210* and 7230 in this volume). Grazing to maintain open, species-rich fen and prevent further encroachment and dominance by dense swamp and woodland is essential for the survival of charophytes in the SAC. Wet woodland and scrub, swamp, species-rich marsh and wet grassland also occur around the lakes. The Near Threatened (Wyse Jackson et al., 2016) *Pyrola rotundifolia* subsp. *rotundifolia* occurs at Kilroosky, as does *Epipactis palustris*, and *Prunus padus* in woodland at Summerhill (Lockhart, 1987; NPWS internal files). Fringing habitats along lakes intergrade with and support the structure and functions of the lake habitat. Equally, fringing wetland habitats are dependent on the lake, particularly its water levels, and support invertebrate and plant communities and species of high diversity and conservation concern. See also Mainstone et al. (2016)

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

To restore the favourable conservation condition of Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae* in Kilroosky Lough Cluster 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	As part of the CANN (Collaborative Action for the Natura Network) cross-border environment project, Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae* within Kilroosky Lough Cluster SAC was mapped with an area of 0.47ha (AFBI, 2021). See map 3. The habitat in the SAC had previously been surveyed by Foss and Crushell (2007) as part of the Monaghan Fen Survey 2007. See also the conservation objective for Alkaline fens (Annex I habitat code 7230) in this volume
Habitat distribution	Occurrence	No decline, subject to natural processes	Distribution based on mapping from the CANN project (AFBI, 2021). See map 3. *Cladium* fen occurs in an area on the south-east shore of Kilroosky Lough and on the north/north-east side of Summerhill Lough in the SAC
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil pH and nutrient status within natural ranges	Relevant nutrients and their natural ranges are yet to be defined for fen habitats. Increased nutrients can lead to changes in plant and invertebrate species through competition and subsequent structural changes to micro-habitats. These nutrients favour growth of grasses rather than forbs and mosses and leads to a higher and denser sward
Ecosystem function: peat formation	Percentage cover of peat-forming vegetation and water table levels	Maintain active peat formation, where appropriate	In order for peat to form, water levels need to be slightly below or above the soil surface for c.90% of the time
Ecosystem function: hydrology - groundwater levels	Water levels (centimetres); duration of levels; hydraulic gradients; water supply	Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Fen habitats require high groundwater levels (i.e. water levels at or above the ground surface) for a large proportion of the calendar year (i.e. duration of mean groundwater level). Fen groundwater levels are controlled by regional groundwater levels in the contributing catchment area (which sustain the hydraulic gradients of the fen groundwater table). Regional abstraction of groundwater may affect fen groundwater levels
Ecosystem function: hydrology - surface water flow	Drain density and form	Maintain, or where necessary restore, as close as possible to natural or semi-natural, drainage conditions	Drainage, either within or surrounding the fen habitat, can result in the drawdown of the groundwater table. The depth, geometry and density of drainage (hydromorphology) will indicate the scale and impact on fen hydrology. Drainage can result in loss of characteristic species and transition to drier habitats. Drying out of the habitat at Kilroosky Lough has been noted (AFBI, 2021)
Ecosystem function: water quality	Various	Maintain, or where necessary restore, appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	Fens receive natural levels of nutrients (e.g. iron, magnesium and calcium) from water sources. However, they are generally poor in nitrogen and phosphorus, with the latter tending to be the limiting nutrient under natural conditions. Water supply should be also relatively calcium-rich. See Foss and Crushell (2007) for details of hydrochemical analysis undertaken in the SAC
Vegetation composition: cover of *Cladium mariscus*	Percentage cover at a representative number monitoring stops	Cover of *Cladium mariscus* at least 25%	Attribute and target based on O'Neill et al. (in prep.)
Vegetation composition: typical vascular plants	Percentage cover at a representative number of monitoring stops	Maintain adequate cover of typical vascular plant species	For lists of typical vascular plant species, including high quality indicators, see O'Neill et al. (in prep.)

Vegetation composition: native negative indicator species	Percentage cover at a representative number of monitoring stops	Cover of native negative indicator species at insignificant levels	Negative indicators include species not characteristic of the habitat and species indicative of undesirable activities such as overgrazing, undergrazing, nutrient enrichment, agricultural improvement or impacts on hydrology. Native negative indicators may include *Anthoxanthum odoratum, Epilobium hirsutum, Holcus lanatus, Juncus effusus, Phragmites australis, Ranunculus repens* and *Typha latifolia*. See O'Neill et al. (in prep.)
Vegetation composition: non-native species	Percentage cover at a representative number of monitoring stops	Cover of non-native species less than 1%	Attribute and target based on O'Neill et al. (in prep.). Non-native species can be invasive and have deleterious effects on native vegetation. A low target is set as non-native species can spread rapidly and are most easily dealt with when still at lower abundances
Vegetation composition: trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of scattered native trees and shrubs less than 10%	Attribute and target based on O'Neill et al. (in prep.). Scrub and trees will tend to invade if fen conditions become drier. Scattered alder (*Alnus glutinosa*) has been noted in the habitat around Summerhill Lough (AFBI, 2021)
Vegetation composition: algal cover	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of algae less than 2%	Attribute and target based on O'Neill et al. (in prep.). Algal cover is indicative of nutrient enrichment from multiple sources (McBride et al., 2011)
Vegetation structure: vegetation height	Percentage cover at a representative number of monitoring stops	At least 10% of live shoots more than 1m high	Attribute and target based on O'Neill et al. (in prep.)
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of disturbed bare ground not more than 10%	Attribute and target based on O'Neill et al. (in prep.). Disturbed bare ground and the loss of characteristic species may result from excessive grazing. Disturbance can include hoof marks, wallows, vehicle and machinery tracks. Excessive disturbance can result in loss of characteristic species and presage erosion for peatlands. At Summerhill Lough, trampling causing worn paths through fen areas to fishing platforms, where further trampling occurs, has been reported (Foss and Crushell, 2007)
Physical structure: tufa formations	Percentage cover in local vicinity of a representative number of monitoring stops	Disturbed proportion of vegetation cover where tufa is present is less than 1%	Attribute and target based on O'Neill et al. (in prep.)
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat; maintain features of local distinctiveness, subject to natural processes	This includes species on the Flora (Protection) Order, 2015 and/or Red Lists (Byrne et al., 2009; Regan et al., 2010; Lockhart et al., 2012; Wyse Jackson et al., 2016, etc.; see Nelson et al., 2019, 2021)
Transitional areas between fen and adjacent habitats	Hectares; distribution	Maintain/restore adequate transitional areas to support/protect the *Cladium* fen habitat and the services it provides	In many cases, fens transition to other wetland habitats. It is important that the transitional areas between *Cladium* fen and other habitats are maintained in as natural condition as possible in order to protect the functioning of the fen

7230 Alkaline fens

To restore the favourable conservation condition of Alkaline fens in Kilroosky Lough Cluster 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	As part of the CANN (Collaborative Action for the Natura Network) cross-border environment project, Alkaline fens within Kilroosky Lough Cluster SAC was mapped with an area of 0.22ha (AFBI, 2021). See map 3. The habitat in the SAC had previously been surveyed by Foss and Crushell (2007) as part of the Monaghan Fen Survey 2007. See also the conservation objective for *Cladium* fens (priority Annex I habitat code 7210) in this volume
Habitat distribution	Occurrence	No decline, subject to natural processes	Distribution based on mapping from the CANN project (AFBI, 2021). See map 3. Alkaline fen occurs on the eastern side of Kilroosky Lough and south-west of Dummy's Lough
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil pH and nutrient status within natural ranges	Relevant nutrients and their natural ranges are yet to be defined. However, nitrogen deposition is noted as being relevant to this habitat in NPWS (2013). See also Bobbink and Hettelingh (2011). Increased nutrients can lead to changes in plant and invertebrate species through competition and subsequent structural changes to micro-habitats. These nutrients favour growth of grasses rather than forbs and mosses and leads to a higher and denser sward
Ecosystem function: peat formation	Percentage cover of peat-forming vegetation and water table levels	Maintain active peat formation, where appropriate	In order for peat to form, water levels need to be slightly below or above the soil surface for c.90% of the time
Ecosystem function: hydrology - groundwater levels	Water levels (centimetres); duration of levels; hydraulic gradients; water supply	Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Fen habitats require high groundwater levels (i.e. water levels at or above the ground surface) for a large proportion of the calendar year (i.e. duration of mean groundwater level). Fen groundwater levels are controlled by regional groundwater levels in the contributing catchment area (which sustain the hydraulic gradients of the fen groundwater table). Regional abstraction of groundwater may affect fen groundwater levels
Ecosystem function: hydrology - surface water flow	Drain density and form	Maintain, or where necessary restore, as close as possible to natural or semi-natural, drainage conditions	Drainage, either within or surrounding the fen habitat, can result in the drawdown of the groundwater table. The depth, geometry and density of drainage (hydromorphology) will indicate the scale and impact on fen hydrology. Drainage can result in loss of characteristic species and transition to drier habitats
Ecosystem function: water quality	Various	Maintain, or where necessary restore, appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	Fens receive natural levels of nutrients (e.g. iron, magnesium and calcium) from water sources. However, they are generally poor in nitrogen and phosphorus, with the latter tending to be the limiting nutrient under natural conditions. Water supply should be also relatively calcium-rich. See Foss and Crushell (2007) for details of hydrochemistry analysis undertaken in the SAC. Some enrichment has been noted in the habitat at Dummy's Lough (AFBI, 2021)
Vegetation composition: community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	The entire diversity of alkaline fen vegetation communities present in the SAC is currently unknown. Information on the vegetation communities associated with alkaline fens is provided in O'Neill et al. (in prep.). See also the Irish Vegetation Classification (Perrin, 2018; www.biodiversityireland.ie/projects/ivc-classification-explorer/)

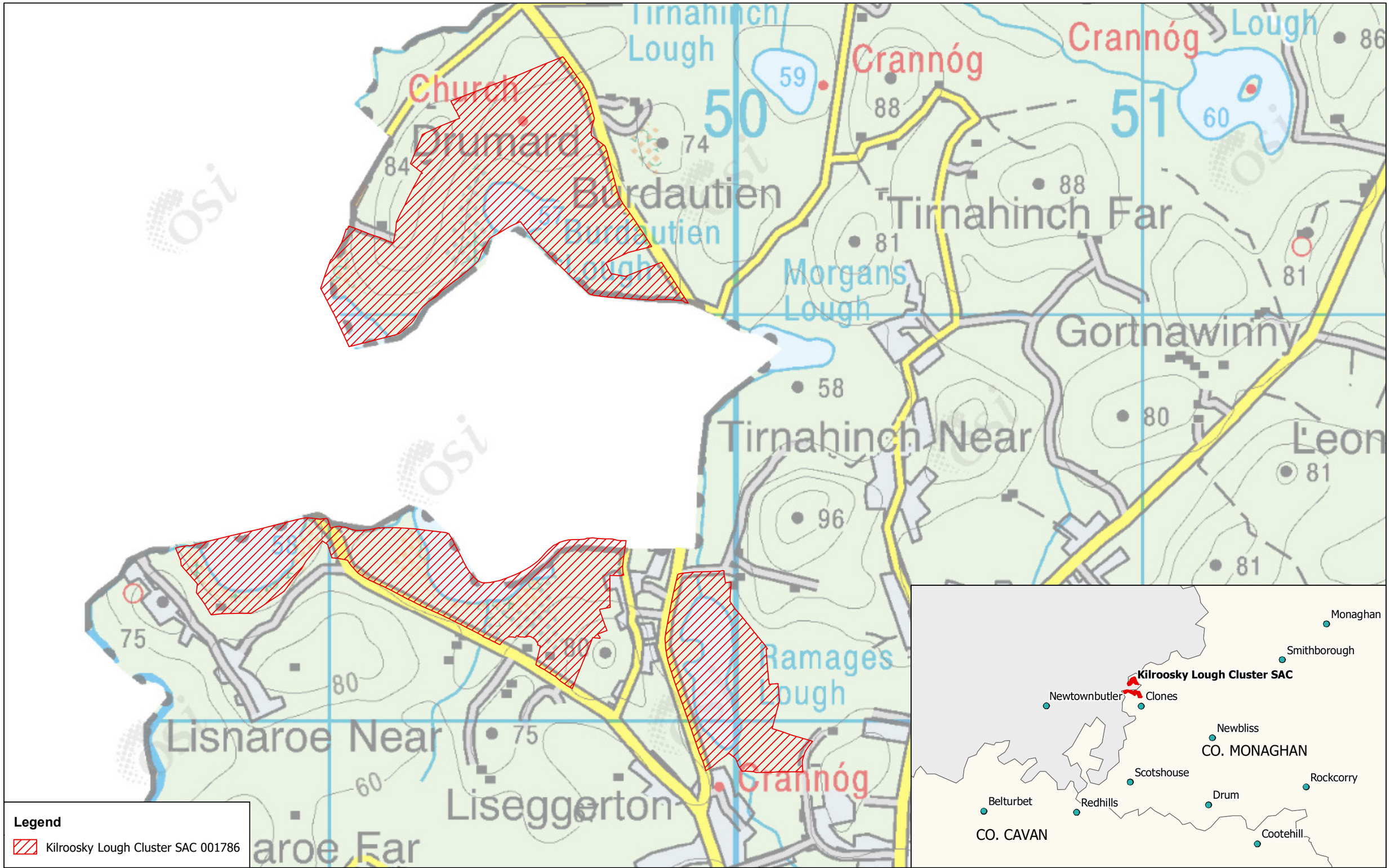
Vegetation composition: typical brown mosses	Percentage cover at a representative number of monitoring stops	Maintain adequate cover of typical brown moss species	For lists of typical bryophyte species for alkaline fen, including high quality indicator species, see O'Neill et al. (in prep.)
Vegetation composition: typical vascular plants	Percentage cover at a representative number of monitoring stops	Maintain adequate cover of typical vascular plant species	For lists of typical vascular plant species for the different vegetation communities, including high quality indicators. see O'Neill et al. (in prep.)
Vegetation composition: native negative indicator species	Percentage cover at a representative number of monitoring stops	Cover of native negative indicator species at insignificant levels	Negative indicators include species not characteristic of the habitat and species indicative of undesirable activities such as overgrazing, undergrazing, nutrient enrichment, agricultural improvement or impacts on hydrology. Native negative indicators may include *Anthoxanthum odoratum, Epilobium hirsutum, Holcus lanatus, Juncus effusus, Phragmites australis* and *Ranunculus repens*. See O'Neill et al. (in prep.)
Vegetation composition: non-native species	Percentage cover at a representative number of monitoring stops	Cover of non-native species less than 1%	Attribute and target based on O'Neill et al. (in prep.). Non-native species can be invasive and have deleterious effects on native vegetation. A low target is set as non-native species can spread rapidly and are most easily dealt with when still at lower abundances
Vegetation composition: native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of scattered native trees and shrubs less than 10%	Attribute and target based on O'Neill et al. (in prep.). Scrub and trees will tend to invade if fen conditions become drier
Vegetation composition: algal cover	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of algae less than 2%	Attribute and target based on O'Neill et al. (in prep.). Algal cover is indicative of nutrient enrichment from multiple sources (McBride et al., 2011)
Vegetation structure: vegetation height	Percentage cover at a representative number of monitoring stops	At least 50% of the live leaves/flowering shoots are more than either 5cm or 15cm above ground surface depending on community type	Attribute and target based on O'Neill et al. (in prep.). While grazing may be appropriate in this habitat, excessive grazing can reduce the ability of plant species to regenerate reproductively and maintain species diversity, especially if flowering shoots are cropped during the growing season
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of disturbed bare ground not more than 10%	Attribute and target based on O'Neill et al. (in prep.). While grazing may be appropriate in this habitat, excessive areas of disturbed bare ground may develop due to unsuitable grazing regimes. Disturbance can include hoof marks, wallows, human footprints, vehicle and machinery tracks. Excessive disturbance can result in loss of characteristic species and presage erosion for peatlands. In this SAC, heavy grazing by cattle has been reported in the habitat at Kilroosky Lough (AFBI, 2021)
Physical structure: tufa formations	Percentage cover in local vicinity of a representative number of monitoring stops	Disturbed proportion of vegetation cover where tufa is present is less than 1%	Attribute and target based on O'Neill et al. (in prep.)
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat; maintain features of local distinctiveness, subject to natural processes	This includes species on the Flora (Protection) Order, 2015 and/or Red Lists (Byrne et al., 2009; Regan et al., 2010; Lockhart et al., 2012; Wyse Jackson et al., 2016, etc.; see Nelson et al., 2019, 2021). The Near Threatened round-leaved wintergreen (*Pyrola rotundifolia* subsp. *rotundifolia*) (Wyse Jackson et al., 2016) has been recorded from the wetland habitats around the shore of Kilroosky Lough in the SAC (NPWS internal files), but cannot be specifically assigned to this habitat in the SAC
Transitional areas between fen and adjacent habitats	Hectares; distribution	Maintain/restore adequate transitional areas to support/protect the alkaline fen habitat and the services it provides	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

1092 White-clawed Crayfish *Austropotamobius pallipes*

To maintain the favourable conservation condition of White-clawed Crayfish (*Austropotamobius pallipes*) in Kilroosky Lough Cluster SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Number of occupied 1km squares	No reduction from baseline. See map 4	White-clawed crayfish (*Austropotamobius pallipes*) has been reported from the four lakes in the SAC within the 1km grid squares H4827, H4927 and H4928. Most of the records come from Kilroosky Lough, but it is also been reported in each of the other three lakes in the SAC - Burdautien, Dummy's and Summerhill. The species is well-recorded from Kilroosky and it supports the largest population. Dummy's Lough also appears to have a resident population. In 2017, the species was found in Kilroosky Lough, but not Summerhill (Gammell et al., 2021); Dummy's and Burdautien were not surveyed. All four lakes were surveyed by the CANN (Collaborative Action for the Natura Network) project during 2019-2021 and many were found in both Kilroosky and Dummy's Lough, but only a single individual in Burdautien Lough and none in Summerhill Lough (CANN, 2019, 2020, 2021). The status of white-clawed crayfish in these two lakes remains unclear, but would appear not to be significant
Population structure: recruitment	Percentage occurrence of juveniles and females with eggs	Juveniles and females with eggs in at least 50% of positive samples taken at appropriate time and methodology	See Reynolds et al. (2010) for further details. Gammell et al. (2021) found high numbers of juveniles in Kilroosky Lough in 2017
Population size	Catch per unit effort (CPUE)	No reduction from baseline of 1.0 for Kilroosky Lough; no reduction in baseline of 0.5 for Dummy's Lough	Various catch per unit effort (CPUE) figures for Kilroosky Lough are given in O'Connor et al. (2009), Gammell et al. (2021) and CANN (2019, 2020, 2021). The figures vary according to the methodology used, but a CPUE figure of 1 is taken as an appropriate baseline for Kilroosky Lough. The CANN project (CANN 2019, 2021) sampled the white-clawed crayfish population in Dummy's Lough and calculated CPUE figures. Based on this, a CPUE of 0.5 is considered the baseline for Dummy's Lough. These figures may be refined with more detailed assessment of the stocks in both lakes. Each baseline CPUE figure applies to sampling using crayfish traps, sweep netting or night time searches. Hand searching at each site is considered ineffective due to the nature of the shoreline
Negative indicator species	Occurrence	No non-indigenous crayfish species	Non-indigenous crayfish species (NICS) are identified as a major direct threat to the white-clawed crayfish and as a disease vector, in particular crayfish plague (*Aphanomyces astaci*), which is fatal to white-clawed crayfish. The possession, import and intentional release of five species of invasive alien crayfish is banned by Statutory Instrument No. 354/2018
Disease	Occurrence	No instances of disease	Crayfish plague, caused by the water-borne mould *Aphanomyces astaci*, is identified as major threat to the species in Ireland. Instances of crayfish plague have occurred in Ireland since 2015 causing local extinctions. There have been no confirmed or suspected outbreaks in this SAC

Water quality	Water chemistry measures	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	Water quality status of Summerhill Lough is monitored by the Environmental Protection Agency (EPA) and has been consistently assessed as moderate. There is no regular monitoring of Dummy's, Burdautien or Kilroosky Loughs. White-clawed crayfish is not considered very sensitive of water quality but the species is intolerant of low pH and poorest water quality, and lack of calcareous influence. There should be no decline in the water quality as defined by the targets for the Annex I lake habitat Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (habitat code 3140), as these are more stringent than white-clawed crayfish requires. See the conservation objective for 3140 in this volume for further details
Habitat quality: heterogeneity	Occurrence of positive habitat features	No decline from the baseline	White-clawed crayfish need high habitat heterogeneity. Larger crayfish must have stones to hide under, or an earthen bank in which to burrow. Hatchlings shelter in vegetation, gravel and among fine tree roots. Smaller crayfish are typically found among weed and debris in shallow water. Larger juveniles in particular may also be found among cobbles and detritus such as leaf litter. These conditions and habitat features must be available on the whole length of occupied habitat. Gammell et al. (2021) scored the habitat heterogeneity and, following this methodology, a baseline score of 0.5 is set



Legend

Kilroosky Lough Cluster SAC 001786

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MAP 1:
KILROOSKY LOUGH CLUSTER SAC
CONSERVATION OBJECTIVES
SAC DESIGNATION

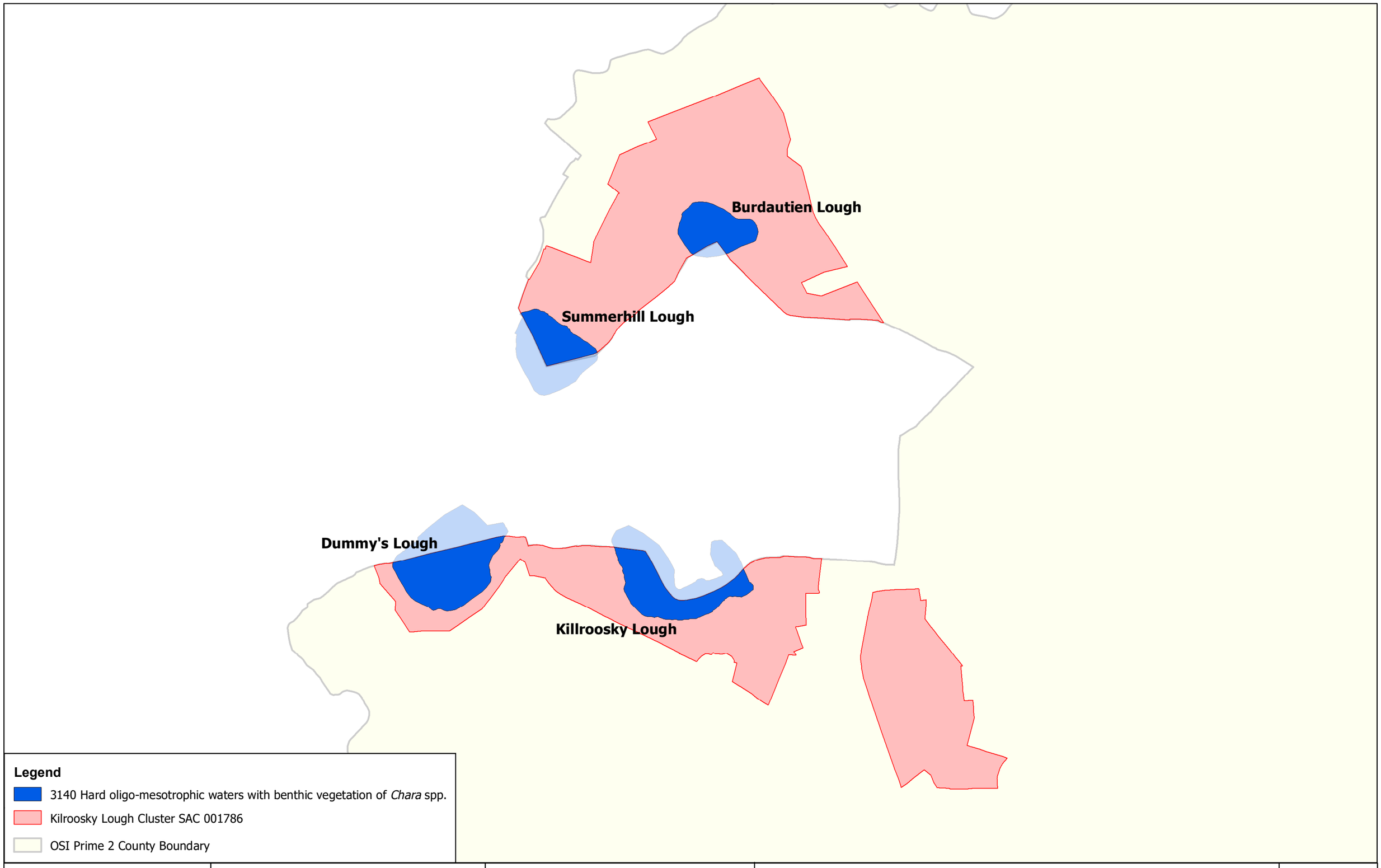
Map to be read in conjunction with the NPWS Conservation Objectives Document

SITE CODE:
SAC 001786; version 3.02.
CO. MONAGHAN

0 0.1 0.2 0.4 Kilometres

N

Date: October 2021



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Department of Housing, Local Government and Heritage

MAP 2:
KILROOSKY LOUGH CLUSTER SAC
CONSERVATION OBJECTIVES
INDICATIVE LAKE HABITATS

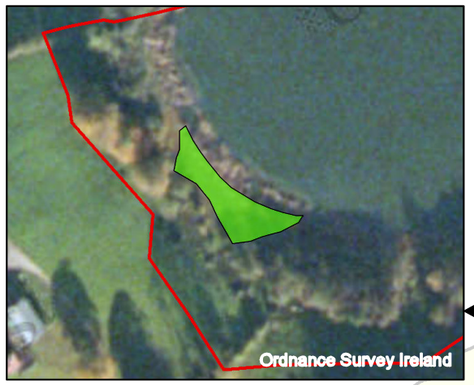
Map to be read in conjunction with the NPWS Conservation Objectives Document

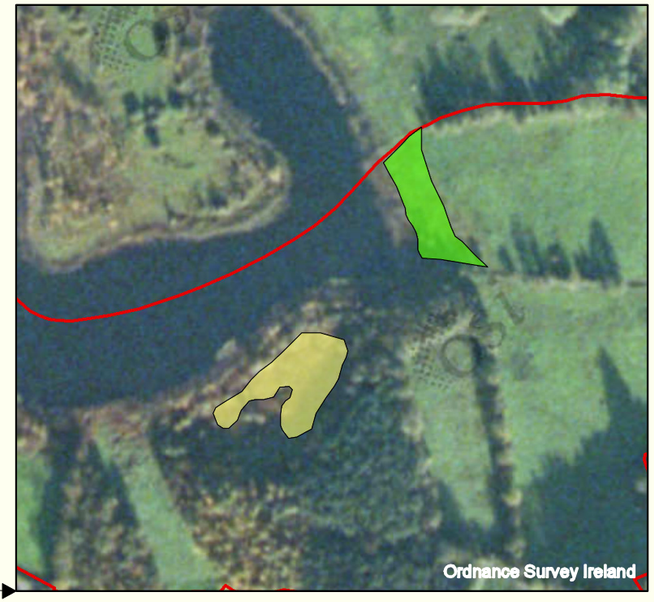
SITE CODE:
SAC 001786; version 3.02.
CO. MONAGHAN

0 0.1 0.2 0.4 Kilometres

N

Date: October 2021





Legend

- 7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
- 7230 Alkaline fens
- Kilroosky Lough Cluster SAC 001786
- OSI Prime 2 County Boundary

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MAP 3:
KILROOSKY LOUGH CLUSTER SAC
CONSERVATION OBJECTIVES
FEN HABITATS

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

SITE CODE:
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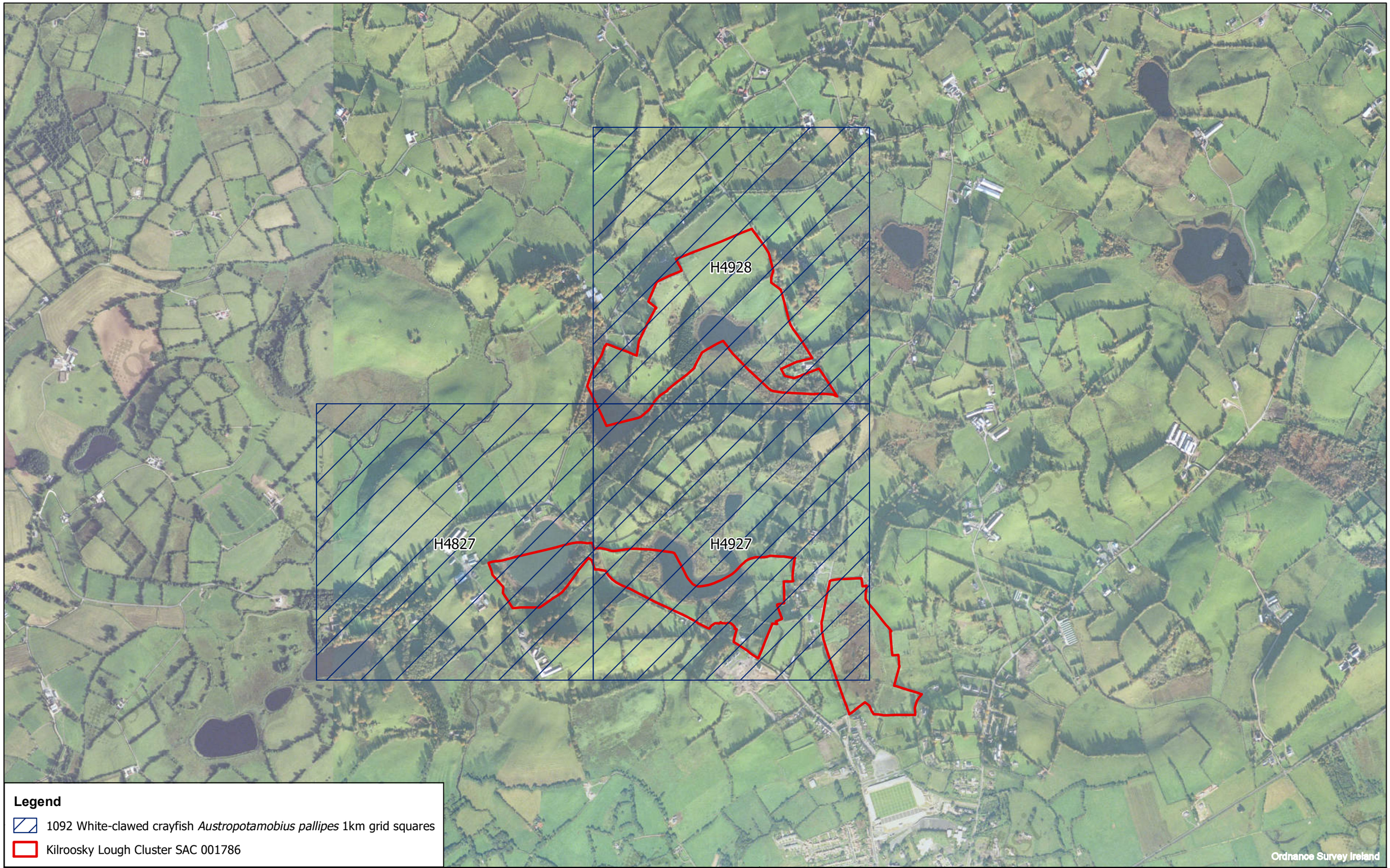
CO. MONAGHAN

0 0.1 0.2 0.4 Kilometres

N

Date: October 2021



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MAP 4:
KILROOSKY LOUGH CLUSTER SAC
CONSERVATION OBJECTIVES
WHITE-CLAWED CRAYFISH

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

SITE CODE:
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0 0.125 0.25 0.5 Kilometres

N

Date: October 2021