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Conservation Objectives Series

Pollardstown Fen SAC 000396

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

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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***

000396	Pollardstown Fen SAC
1013	Geyer's Whorl Snail *Vertigo geyeri*
1014	Narrow-mouthed Whorl Snail *Vertigo angustior*
1016	Desmoulin's Whorl Snail *Vertigo moulinsiana*
7210	Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae*
7220	Petrifying springs with tufa formation (Cratoneurion)*
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 :	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 :	2011
Title :	Monitoring and condition assessment of populations of *Vertigo geyeri*, *Vertigo angustior* and *Vertigo moulinsiana* in Ireland
Author :	Moorkens, E.; Killeen, I.
Series :	Irish Wildlife Manuals, No. 55
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 :	Conservation status assessment for petrifying springs
Author :	Lyons, M.D.; Kelly, D.L.
Series :	Unpublished report to NPWS
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 Lists series, NPWS
Year :	2019
Title :	Monitoring of sites and habitat for three Annex II species of whorl snail (*Vertigo*)
Author :	Long, M.P.; Brophy, J.T.
Series :	Irish Wildlife Manuals, No. 104
Year :	2019
Title :	Monitoring of sites and habitat for three Annex II species of whorl snail (*Vertigo*). Appendix IV. *Vertigo angustior* site reports
Author :	Brophy, J.T.; Long, M.P.
Series :	Irish Wildlife Manuals, No. 104
Year :	2019
Title :	Monitoring of sites and habitat for three Annex II species of whorl snail (*Vertigo*). Appendix V. *Vertigo geyeri* site reports
Author :	Brophy, J.T.; Long, M.P.
Series :	Irish Wildlife Manuals, No. 104

Year :	2019
Title :	Monitoring of sites and habitat for three Annex II species of whorl snail (*Vertigo*). Appendix VI *Vertigo moulinsiana* site reports
Author :	Brophy, J.T.; Long, M.P.
Series :	Irish Wildlife Manuals, No. 104
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 :	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 :	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
Year :	in prep.
Title :	Agricultural Atmospheric Ammonia: Identification & Assessment of Potential Impacts
Author :	Kelleghan, D.B.; Fogarty, M.; Welchman, S.; Cummins, T.; Curran, T.P.
Series :	Irish Wildlife Manuals

Other References

Year :	1981
Title :	Pollardstown Fen: hydrogeological assessment of the effects of drainage on the water supply to the Grand Canal
Author :	Daly, D.
Series :	Geological Survey of Ireland report
Year :	1988
Title :	*Platycheirus amplus*: an insect new to Ireland not previously recorded from Europe (Diptera: Syrphidae)
Author :	Speight, M.C.D.; Vockeroth, J.R.
Series :	Irish Naturalists' Journal, 22(12): 518-521
Year :	1991
Title :	A preliminary survey of the Lepidoptera of Pollardstown Fen, Co. Kildare, including a record of *Cosmopterix lienigiella* (Lieng and Zeller 1939) (Cosmopterigidae), a species new to Ireland
Author :	Bond, K.G.M.
Series :	Bulletin Irish Biogeographical Society, 14: 24-47
Year :	1992
Title :	*Panimerus goodi* sp.n. from Ireland, with a description of other members of the *maynei* complex (Diptera: Psychodidae)
Author :	Vaillant, F.; Withers, P.
Series :	Irish Naturalists' Journal, 24: 27-28
Year :	2002
Title :	Thirty-nine species of Diptera new to Ireland, including a species of Psychodidae new to the British Isles
Author :	Withers, P.
Series :	Dipterists Digest, 9: 113-119

Year :	2008
Title :	Eco-hydrology of Pollardstown Fen, Co. Kildare, Ireland
Author :	Kuczyńska, A.
Series :	Unpublished Ph.D. Thesis, Trinity College Dublin
Year :	2008
Title :	Ecohydrological Interpretive Report
Author :	White Young Green Ltd.
Series :	Report for Kildare County Council
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 :	Determining seepage flows and water chemistry of petrifying springs
Author :	Mitchel, N.
Series :	Unpublished M.Sc. thesis, Newcastle University, UK
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 :	2018
Title :	Irish Vegetation Classification: Technical Progress Report No. 4
Author :	Perrin, P.
Series :	Report submitted to National Biodiversity Data Centre

Spatial data sources

Year :	Digitised 2020
Title :	Kuczyńska (2008) Eco-hydrology of Pollardstown Fen, Co. Kildare, Ireland
GIS Operations :	Paper map scanned and georectified. Habitats as outlined on map digitised. Centroids derived from 7220 polygons. Dataset clipped to the SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	7210, 7220, 7230 (map 2)
Year :	2016
Title :	Point file associated with Lyons (2015)
GIS Operations :	Dataset created from spatial references; clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	7220 (map 2)
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 :	1013, 1014, 1016 (map 3)

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 Pollardstown Fen 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	Pollardstown Fen, which is the largest spring-fed fen in Ireland, contains an excellent example of the Annex I priority habitat Calcareous fens *Cladium mariscus* and species of the Caricion davallianae*. The area of *Cladium* fen in Pollardstown Fen SAC has been calculated as 47.97ha based on a 2002 Pollardstown Fen habitat map by Kuczyńska (2008). The habitat occurs predominantly in the centre and lowest sections of the SAC, with some smaller examples elsewhere. Gradations from *Cladium* fen to alkaline fen (Annex I habitat code 7230) and other habitats are found throughout the SAC. See also O'Neill et al. (in prep.)
Habitat distribution	Occurrence	No decline, subject to natural processes	Distribution based on Kuczyńska (2008). See map 2
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. However, nitrogen deposition is noted as being relevant to this habitat in O'Neill et al. (in prep.). See also Kelleghan et al. (in prep.). White Young Green (2008) reported an increase in fertility index within sections of the SAC. The reasons for this increase may be from management (litter build up through lack of grazing and subsequent release of nitrogen from decaying vegetation) or from oxidation of the peat during the period when the fen was drier (leading to release of nitrogen from organic matter normally held in wet peat). 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. Layers of calcareous marl have been detected within the peat at Pollardstown Fen SAC, reflecting the occasional inundation by calcium-rich water during its formation. The peat-dominated deposits reach 6m at their deepest point
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). Pollardstown Fen is fed by c.40 springs from one of the three Curragh aquifer catchments. The springs are mainly at the margins of the fen along distinct seepage areas and the associated habitats are the most sensitive to changes in water levels and quality. The stability of water levels are dependent upon the amount of seepage delivered into the peat which is controlled by the hydraulic head in the underlying gravel (Kuczyńska, 2008). Regional abstraction of groundwater may affect levels in the fen. White Young Green (2008) reported evidence that the periphery of the fen has been drying since 1979. A possible cause is a slow reduction in water supplied from the aquifer as a result of an increase in abstraction elsewhere, although no evidence for this has been found in the hydrological studies

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	At Pollardstown Fen, water flows from the springs into an extensive network of ditches and drainage channels, which in turn lead into two canal feeder drains. There is also a small stream which enters the SAC from the south-east and another stream which arises west of the partially cleared forest plantation and flows north-west towards the Barrow (NPWS internal files). Daly (1981) estimated that approximately 25,000m3 per day was discharging through the Milltown feeder from the fen. Approximately 92% of the discharge from the fen emanates from the southern part of the catchment, while the remaining 8% is sourced from the smaller northern portion of the catchment, at the spring at the public entrance to the fen, and via direct precipitation (Mitchel, 2014). Drainage, either within or surrounding the fen habitat, can result in the drawdown of the fen groundwater table. Drainage activity 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. Water supply should also be relatively calcium-rich. Fens are generally poor in nitrogen and phosphorus, with the latter tending to be the limiting nutrient under natural conditions. The springs feeding Pollardstown Fen are derived from a continuous supply of calcium-rich water from the Curragh aquifer and from limestone bedrock to the north. The lowest sections of Pollardstown fen also receive water supply for the Grand Canal via the feeder channels. Intensive management of farmland surrounding the fen could potentially cause an increase in nutrients to the fen
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 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: 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 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.). 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
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.). See also the conservation objective for the priority Annex I habitat Petrifying springs with tufa formation (Cratoneurion) (habitat code 7220) in this volume
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 (see Nelson et al., 2019, 2021). Of particular note in the SAC is *Tomentypnum nitens*, a relict boreal moss species classified as Vulnerable (VU) in Ireland (Lockhart et al., 2012). The Annex II species *Vertigo geyeri, V. angustior* (listed as VU in Byrne et al., 2009) and *V. moulinsiana* (Endangered; Byrne et al., 2009) have been reported in the SAC, all with differing habitat requirements (Moorkens and Killeen, 2011; Long and Brophy, 2019; see the conservation objectives for 1013, 1014 and 1016). Marsh Fritillary (*Euphydryas aurinia*), also listed on Annex II and VU in Regan et al. (2010), has been recorded regularly in the SAC. A number of other internationally important invertebrates have also been recorded, including the rare hoverfly *Platycherius amplus*, discovered in 1988 (Speight and Vockeroth, 1988), and the moth *Cosmopterix lienigiella* (Bond, 1991)
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	Damp pastures occur on wet mineral soils and partly-drained peats on the fen margins in the SAC. These are reasonably species-rich, with particularly good displays of orchids in some areas. Small areas of habitat equivalent to Transition mires and quaking bogs (Annex I habitat code 7140) have been also reported within the SAC (White Young Green, 2008). 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

7220 Petrifying springs with tufa formation (Cratoneurion)*

To restore the favourable conservation condition of Petrifying springs with tufa formation (Cratoneurion)* in Pollardstown Fen 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	Pollardstown Fen SAC is the largest spring-fed fen in Ireland and contains an excellent example of calcareous springs, some of which are tufa-forming and conform to the Annex I priority habitat. An area of 0.44ha (4,400m²) of 7220* was recorded by Kuczyńska (2008), while Lyons (2015) recorded 800m² at 3 sites, distinct from those recorded by Kuczyńska. The entire extent of the habitat has not been mapped. White Young Green (2008) also identified 50 different tufa formations with/without springs and the associated bryophytes (of the Cratoneurion commutati community, Koch, 1928). They stated that there appeared to have been some changes in the tufa spring habitat between 2002 and 2008 but stated they were hard to quantify. This is arguably the most dynamic habitat on the fen and likely to be significantly impacted by any reduction in water supply. Tufa sites may also decrease naturally due to natural blockages of upwelling springs. See also the conservation objectives for 7210* and 7230
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 2	See map 2 for the point locations of the habitat based on Kuczyńska (2008) and Lyons (2015) (at sub-sites PS004a, PS004d and PS004f). It is important to note that further unmapped springs are present in the SAC. Within the SAC, tufa springs are located typically around the perimeter of the fen along distinct seepage areas. White Young Green (2008) noted a decrease in saturated tufa spring species, and their replacement by species that tolerate drier conditions in the south-west of the SAC. The cause was attributed to the combination of reduced recharge due to consecutive drought summers, possible additional lowering of water levels due to dewatering at the Kildare bypass cutting, and changes in grazing management. The consequences of the hydrological impact (groundwater lowering) was that spring emergence and the associated habitat and species have moved downslope from areas where they were protected from flooding to lower areas where they are more vulnerable to flooding incidents
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 seepages (Lyons and Kelly, 2013). In karst areas, water tends to flow away rapidly over bare rock surfaces, even on fairly flat ground (Lyons and Kelly, 2013). Water flow should not be altered anthropogenically (Lyons and Kelly, 2016). In this SAC, water abstraction via the Milltown Feeder to the Grand Canal has the potential to negatively affect the spring communities (Lyons, 2015)

Physical structure: tufa formations	Seepage rate to the spring and groundwater quality (saturated calcium carbonate, pH, temperature and alkalinity conditions)	Maintain appropriate levels of tufa formation	Petrifying springs are springs that typically form small calcareous or 'tufa' deposits. On contact with the atmosphere at the spring head, carbon dioxide is lost from calcium saturated water to the atmosphere or is depleted by the photosynthetic activities of plants. This results in the precipitation of a calcium carbonate marl or tufa. Seepage flow rates, as low as 1mm/day in parts of Pollardstown, are crucial for the development of tufa. Tufa does not form within all springs in the SAC. Two types of tufa formation are found in Pollardstown fen: a) Perched springline mounds, or Spring heads, which require a hydrostatic head to facilitate the formation of tufa via capillary action in cushions of the moss *Palustriella commutata* and b) Paludal deposits, or Tufa-forming seepage, in low relief areas mixed with *Chara* marls and a rich malacofauna (Lyons and Kelly, 2013; Mitchel, 2014)
Ecosystem function: water quality - nitrate level	mg/l	Maintain/restore nitrate levels to less than 10mg/l	Attribute and target based on Lyons and Kelly (2016). The springs at Pollardstown Fen receive a continuous supply of calcium-rich water from the Curragh aquifer and from limestone bedrock to the north. Intensive management of farmland surrounding the fen has the potential to cause an increase in nutrient supply. Nitrate levels of <0.07mg/l were recorded at the sub-sites PS004a and PS004f; however, a nitrate level of 19.02mg/l was recorded at PS004d by Lyons (2015), thus failing the attribute target
Ecosystem function: water quality - phosphate level	µg/l	Maintain/restore phosphate levels to less than 15µg/l	Attribute and target based on Lyons and Kelly (2016). Phosphate levels of 9µg/l and 7µg/l were recorded at the sub-sites PS004a and PS004f respectively; however, a phosphate level of 20µg/l was recorded at PS004d by Lyons (2015), thus failing the attribute target
Vegetation composition: community diversity	Variety of vegetation communities	Maintain/restore variety of vegetation communities, subject to natural processes	Lyons and Kelly (2016) describe eight plant communities of petrifying springs in Ireland based on relevé data. In this SAC, the main community recorded at the sub-sit PS004a by Lyons (2015) was *Schoenus nigricans* springs, and the main community at both PS004d and PS004f was *Carex lepidocarpa* small sedge springs, with the additional community *Palustriella commutata-Agrostis stolonifera* springheads also occurring at PS004d. Further information on the vegetation communities associated with this habitat is presented in Lyons and Kelly (2016)
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	Attribute and target based on Lyons and Kelly (2016), where lists of positive and high quality indicator species are presented. Lyons (2015) recorded 17 positive indicator species at PS004a, 10 at PS004d and 16 at PS004f which included the species *Carex lepidocarpa, Carex panicea, Schoenus nigricans, Festuca rubra, Epipactis palustris, Galium uliginosum, Pedicularis palustris, Chara vulgaris* and the bryophytes *Aneura pinguis, Bryum pseudotriquetrum, Campylium stellatum, Palustriella commutata, P. falcata, Scorpidium cossonii* and the high quality indicator moss species *Tomentypnum nitens*, which is classified as Vulnerable in Ireland (Lockhart et al., 2012)

Vegetation composition: negative indicator species	Cover (DAFOR scale)	Potentially negative indicator species should not be Dominant or Abundant; woody species should be absent in unwooded springs; invasive species should be absent	Based on Lyons and Kelly (2016), where 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/algae species are present, and if at least two are Frequent, or at least one is Abundant, then the habitat fails for this attribute. The potentially negative herbaecous species *Eupatorium cannabinum* and *Phragmites australis* were recorded as Occasional at all three sub-sites surveyed by Lyons (2015) and the potentially negative bryophyte *Cratoneuron filicinum* was also recorded as Occasional at PS004d; the potentially negative woody species *Fraxinus excelsior* was recorded at PS004a and PS004d, and *Salix cinerea* at PS004d and PS004f, all of which are unwooded springs
Vegetation composition: algal cover	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of algae less than 2%	Algal cover is indicative of nutrient enrichment from multiple sources (McBride et al., 2011)
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). The field layer height recorded by Lyons (2015) at PS004d and PS004f was above 50cm, and a lack of grazing was recorded as a negative impact at both sub-sites. At PS004a, the vegetation exceeded 50cm in parts, but it had an open structure and the attribute was allowed to pass on expert judgement (Lyons, 2015). Scrub encroachment and accumulating leaf litter, suggesting a reduction or cessation of grazing, was also noted by Lyons (2015)
Physical structure: trampling/dung	Cover (DAFOR scale)	Cover should not be Dominant or Abundant	Attribute and target based on Lyons and Kelly (2016)
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	The Vulnerable (Lockhart et al., 2012) moss *Tomentypnum nitens* occurs in the habitat in the SAC (Lyons, 2015; O'Neill et al., in prep.). The Annex II snails *Vertigo geyeri, V. angustior* (VU in Byrne et al., 2009) and *V. moulinsiana* (Endangered) occur in the SAC (Moorkens and Killeen, 2011; Long and Brophy, 2019; see conservation objectives for 1013, 1014 and 1016). White Young Green (2008) identified 2 species of moth flies (Diptera, Psychodidae): *Pericoma calcilega* and *Pericoma decipiens*, both very rare in Ireland with distribution restricted to tufa springs as they have developed special adaptations for living in a calcite depositing habitat. Withers (2002) lists Diptera from tufa springs in the SAC, including the moth fly (Psychodidae) *Sycorax feuerborni* at its only known Irish site. The moth fly *Panimerus goodi* was described new to science by Vaillant and Withers (1992). This remains the only known site for the species

7230 Alkaline fens

To restore the favourable conservation condition of Alkaline fens in Pollardstown Fen 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	Pollardstown Fen, which is the largest spring-fed fen in Ireland, contains an excellent example of the Annex I habitat Alkaline fens. The area of alkaline fen in Pollardstown Fen SAC has been calculated as 39.64ha based on a 2002 Pollardstown Fen habitat map by Kuczyńska (2008). The habitat has been reported to occur predominantly along the edges of the SAC, where the seepage areas are located, and to the south of the SAC. Gradations from alkaline fen to the priority habitat *Cladium* fen (Annex I habitat code 7210) and Transition mire and quaking bogs (7140), are found across the SAC. See also O'Neill et al. (in prep.)
Habitat distribution	Occurrence	No decline, subject to natural processes	Distribution based on Kuczyńska (2008). See map 2
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 O'Neill et al. (in prep.). See also Kelleghan et al. (in prep.) and Bobbink and Hettelingh (2011). White Young Green (2008) reported an increase in fertility index within sections of the SAC. The reasons for this may be from management (litter build up through lack of grazing and subsequent release of nitrogen from decaying vegetation) or from oxidation of the peat during the period when it was drier (leading to release of nitrogen from organic matter normally held in wet peat). Increased nutrients can lead to changes in plant and invertebrate species through competition and subsequent structural changes to micro-habitat. These nutrients favour growth of grasses rather than forbes 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. There are layers of calcareous marls in the peat at Pollardstown Fen SAC, reflecting the occasional inundation by calcium-rich water. The peat-dominated deposits reach 6m at their deepest point
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). Pollardstown Fen is fed by c.40 springs from one of the three Curragh aquifer catchments. The springs are mainly at the margins of the fen along distinct seepage areas and the associated habitats are the most sensitive to changes in water levels and quality. The stability of water levels are dependent upon the amount of seepage delivered into the peat which is controlled by the hydraulic head in the underlying gravel (Kuczyńska, 2008). Regional abstraction of groundwater may affect levels in the fen. White Young Green (2008) reported evidence that the periphery of the fen has been drying since 1979. A possible cause is a slow reduction in water supplied from the aquifer as a result of an increase in abstraction elsewhere, although no evidence for this has been found in the hydrological studies

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	At Pollardstown Fen, water runs from the springs into an extensive network of ditches and drainage channels, which in turn lead into two canal feeder drains. There is also a small stream which enters the SAC from the south-east and a further stream which arises west of the partially cleared forest plantation and flows north-west towards the Barrow (NPWS internal files). Daly (1981) estimated that approximately 25,000m3 per day was discharging through the Milltown feeder from the fen. Approximately 92% of the discharge from the fen emanates from the southern part of the catchment, while the remaining 8% is sourced from the smaller northern portion of the catchment, at the spring at the public entrance to the fen, and direct precipitation (Mitchel, 2014). Drainage, either within or surrounding the fen habitat, can result in the drawdown of the fen groundwater table. Drainage activity 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. Water supply should be also relatively calcium-rich. Fens are generally poor in nitrogen and phosphorus, with the latter tending to be the limiting nutrient under natural conditions. The springs feeding Pollardstown Fen provide a continuous supply of calcium-rich water from the Curragh aquifer and from limestone bedrock to the north. The lowest sections of Pollardstown Fen also receive water supply for the Grand Canal via the feeder channels. Intensive management of farmland surrounding the fen could cause an increase in nutrients supply
Vegetation composition: community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	Kuczyńska (2008) reported a wide range of alkaline fen vegetation types, with *Schoenus nigricans-Juncus subnodulosus* fen the most common one. The following were also reported: *Juncus subnodulosus-Carex disticha* fen meadow, *Juncus subnodulosus-Phragmites*-dominated wet fen, *Molinia caerulea* fen meadow with *Cirsium dissectum* and Small sedge-rich fen meadow. Information on the vegetation communities associated with alkaline fens within the sections surveyed in the SAC in 2020 is provided by 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 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 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.). Typical species recorded in the habitat in the SAC include *Juncus subnodulosus, Carex panicea, Eriophorum latifolium* and the high-quality indicator *Dactylorhiza traunsteinerioides* (NPWS internal files). A progressive increase in *Juncus subnodulosus* which has expanded into areas formerly dominated by small sedges, has been reported in the centre of the fen as a result of the blocking of the culvert under the Canal Feeder in 1983. White Young Green (2008) reported an increase in density of tall species (e.g. *Molinia caerulea, Cladium mariscus, Carex acutiformis, Carex disticha, Schoenus nigricans* and *Juncus subnodulosus*), as well as a decline in species diversity, and more acid-loving species such as *Calluna vulgaris* and the moss *Hylocomium splendens*

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. Nevertheless, lack of grazing and the shading of the moss layer by tall rush and grass vegetation can also render the habitat less favourable for *Vertigo geyeri*. On the other hand, increased light conditions as a result of active management can favour species such as *Palustriella commutata, Triglochin palustris* and the alga *Chara* sp. (White Young Green, 2008)
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
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.). See also the conservation objective for the priority Annex I habitat Petrifying springs with tufa formation (Cratoneurion) (habitat code 7220) in this volume
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 (see Nelson et al., 2019, 2021). The Near Threatened fly orchid (*Ophrys insectifera*) (Wyse Jackson et al., 2016) and the Vulnerable moss *Tomentypnum nitens* (Lockhart et al., 2012) have been recorded in Pollardstown Fen (O'Neill et al. in prep.). The Annex II listed species *Vertigo geyeri, V. angustior* (VU; Byrne et al., 2009) and *V. moulinsiana* (Endangered; Byrne et al., 2009) have been reported in the SAC (Moorkens and Killeen, 2011; Long and Brophy, 2019; see the conservation objectives for 1013, 1014 and 1016). Marsh Fritillary (*Euphydryas aurinia*), also listed on Annex II and VU in Regan et al. (2010), has been recorded regularly in the SAC. Several other internationally important invertebrates have also been recorded, including the rare hoverfly *Platycherius amplus* (Speight and Vockeroth, 1988) and the moth *Cosmopterix lienigiella* (Bond, 1991)

Transitional areas between fen and adjacent habitats	Hectares; distribution	Restore adequate transitional areas to support/protect the alkaline fen habitat and the services it provides	Damp pastures occur on wet mineral soils and partly-drained peats on the fen margins. These are reasonable species-rich, with particularly good displays of orchids in some areas. Transition mires and quaking bogs (7140) have been also reported in the SAC (White Young Green, 2008). 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

1013 Geyer's Whorl Snail *Vertigo geyeri*

To maintain the favourable conservation condition of Geyer's Whorl Snail (*Vertigo geyeri*) in Pollardstown Fen SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Number of occupied 1km squares	No decline, subject to natural processes. There is one known site for this species in the SAC within the 1km grid squares N7615, N7616, N7715, and N7716	Geyer's whorl snail (*Vertigo geyeri*) has been recorded in four 1km squares that overlap Pollardstown Fen SAC: N7615, N7616, N7715, and N7716. See map 3. See details for the site Pollardstown Fen (site code VgCAM22) in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019)
Occurrence in suitable habitat	Percentage positive records in a representative number of samples	No decline, subject to natural processes. A baseline figure of 50% positive samples is set	Adult or sub-adult snails should be present in 50% of samples taken at appropriate intensity using the methodology described in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019). This target is derived from Moorkens and Killeen (2011). Optimal and suboptimal habitat is defined in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019)
Habitat area	Hectares	Area of suitable habitat stable or increasing, subject to natural processes; no less than 2ha of at least suboptimal habitat, with at least 50% in optimal condition	There should be at least 2ha of habitat in suboptimal and optimal condition on the site, with at least 50% in optimal condition. This attribute should be assessed according to the definitions and methodology in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019), where optimal and suboptimal habitat is defined. In the last survey in 2014, no habitat in optimal condition was found (Long and Brophy, 2019; Brophy and Long, 2019)
Habitat quality	Number of patches	No decline, subject to natural processes	There should be habitat in at least suboptimal condition in all occupied patches on the site. The definition of optimal and suboptimal habitat is given in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019)
Habitat quality: soil wetness	Soil wetness criteria	No decline, subject to natural processes	Soil wetness requirements for Geyer's whorl snail (*Vertigo geyeri*) are given in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019). This attribute should be assessed across the site and along the transects using the methodology described in Moorkens and Killeen (2011), Brophy and Long (2019) and Long and Brophy (2019)

1014 Narrow-mouthed Whorl Snail *Vertigo angustior*

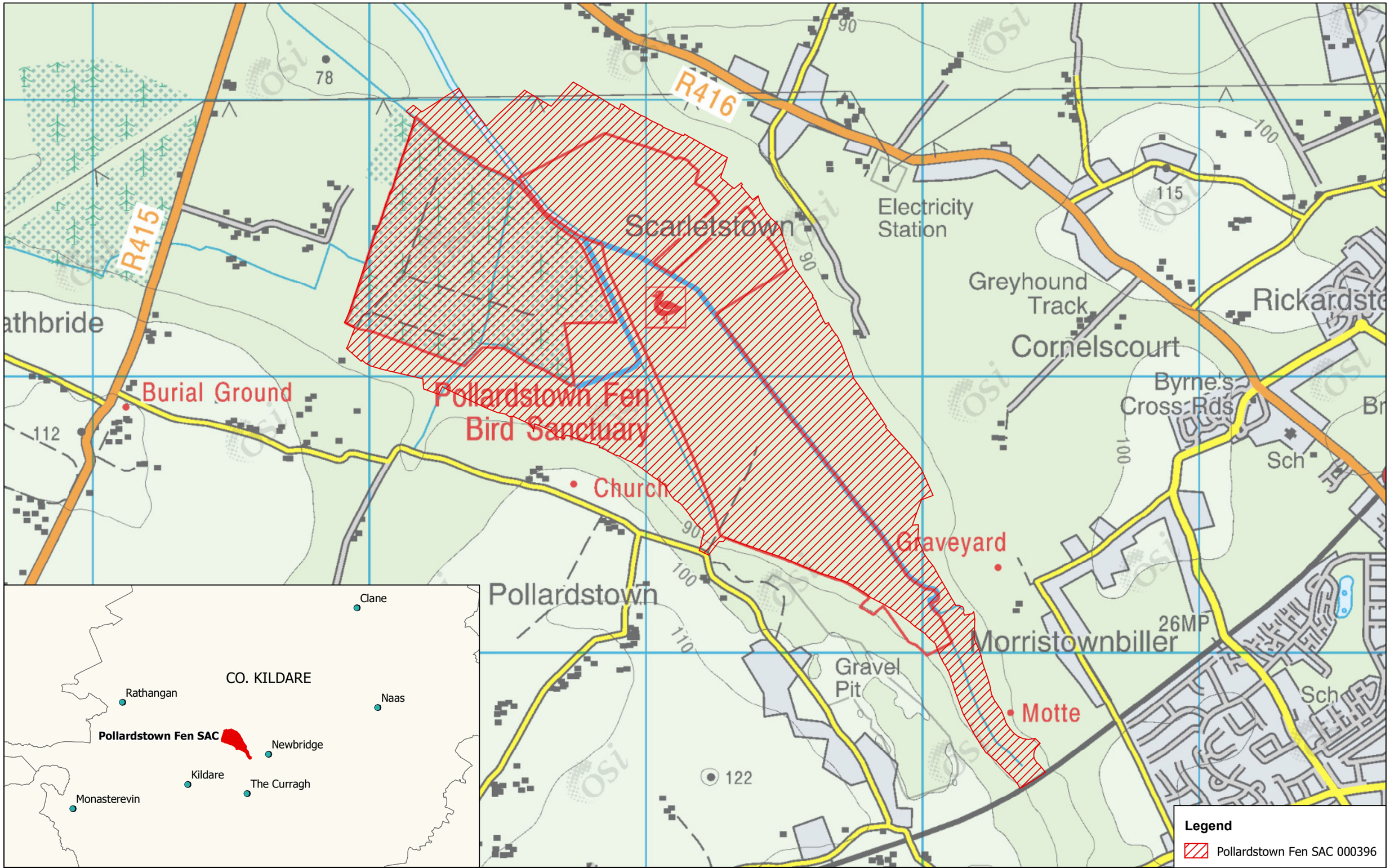
To restore the favourable conservation condition of Narrow-mouthed Whorl Snail (*Vertigo angustior*) in Pollardstown Fen SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Number of occupied 1km squares	No decline, subject to natural processes. There is one known site for this species in the SAC within the 1km grid squares N7615 and N7715	Narrow-mouthed whorl snail (*Vertigo angustior*) has been recorded in two 1km squares that overlap Pollardstown Fen SAC: N7615 and N7715. See map 3. See details for the site Pollardstown Fen (site code VaCAM13) in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019)
Occurrence in suitable habitat	Percentage positive records in a representative number of samples	No decline, subject to natural processes. A baseline figure of 50% positive samples is set	Adult or sub-adult snails should be present in at least 50% of a representative number of samples using the methodology given in Moorkens and Killeen (2011), Brophy and Long (2019) and Long and Brophy (2019). Optimal and suboptimal habitat is defined in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019)
Habitat area	Hectares	Area of suitable habitat stable or increasing, subject to natural processes; no less than 2ha of optimal habitat	There should be at least 2ha of habitat in optimal condition on the site. This attribute should be assessed according to the definitions and methodology in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019), where optimal and suboptimal habitat is defined. In the last survey in 2014, no habitat in optimal condition was found (Long and Brophy, 2019; Brophy and Long, 2019)
Habitat quality: soil wetness	Soil wetness criteria	No decline, subject to natural processes	Soil wetness should be assessed using the methodology and definitions in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019)

1016 Desmoulin's Whorl Snail *Vertigo moulinsiana*

To maintain the favourable conservation condition of Desmoulin's Whorl Snail (*Vertigo moulinsiana*) in Pollardstown Fen SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Number of occupied 1km squares	No decline, subject to natural processes. There is one known site for this species in the SAC within the 1km grid squares N7615, N7616, N7715 and N7716	There are records of Desmoulin's whorl snail (*Vertigo moulinsiana*) from four 1km squares that overlap Pollardstown Fen SAC: N7615, N7616, N7715 and N7716. See map 3. See details for the site Pollardstown Fen (site code VmCAM18) in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019)
Occurrence in suitable habitat	Percentage positive records in a representative number of samples	No decline, subject to natural processes. A baseline figure of 75% positive samples is set	Desmoulin's whorl snail (*Vertigo moulinsiana*) should be present in at least 75% of samples taken across the site in suitable habitat. Sampling should be done at an appropriate scale within patches and across the site according to the definitions and methodology in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019), where Class I and Class II habitat is defined
Density within habitat	Number of individuals per sample	No decline, subject to natural processes; at least 50% of samples should have at least 20 individuals	There should be at least 20 individuals in at least 50% of samples taken across the site in suitable habitat. Sampling should be done at an appropriate scale within patches and across the site according to the definitions and methodology in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019), where Class I and Class II habitat is defined
Habitat area	Hectares	Area of suitable habitat stable or increasing, subject to natural processes; no less than 10ha of at least suboptimal habitat	The baseline figure for the amount of habitat in at least suboptimal condition for this site is 10ha. Optimal and suboptimal habitat is defined in Moorkens and Killeen (2011), Brophy and Long (2019) and Long and Brophy (2019)
Habitat quality	Percentage of samples classified as suitable habitat	No decline, subject to natural processes	Over 80% of sample locations should be assessed as at least Class II. Sampling should be done at an appropriate scale within patches and across the site according to the definitions and methodology in Moorkens and Killeen (2011), Long and Brophy (2019) and Brophy and Long (2019), where Class I and Class II habitat is defined
Habitat quality: soil wetness	Soil wetness criteria	No decline, subject to natural processes	80% of sample points should be classified as in soil wetness Class 3-5, with appropriate scale of sampling across the site and within habitat patches. This attribute should be assessed according to the definitions and methodology in Moorkens and Killeen (2011), Brophy and Long (2019) and Long and Brophy (2019), where soil wetness classes are defined



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MAP 1:
POLLARDSTOWN FEN SAC
CONSERVATION OBJECTIVES
SAC DESIGNATION

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

SITE CODE:
SAC 000396; version 3.02
CO. KILDARE

0 125 250 500 Metres

N

Date: November 2021

Lyons (2015) site ref: PS004d

Kuczynska (2008)

Lyons (2015) site ref: PS004f

Lyons (2015) site ref: PS004a

Kuczynska (2008)

Kuczynska (2008)

Ordnance Survey Ireland

Legend

- 7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
- 7220 *Petrifying springs with tufa formation (*Cratoneurion*)
- 7230 Alkaline fens
- Pollardstown Fen SAC 000396

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MAP 2:
POLLARDSTOWN FEN SAC
CONSERVATION OBJECTIVES
FEN HABITATS

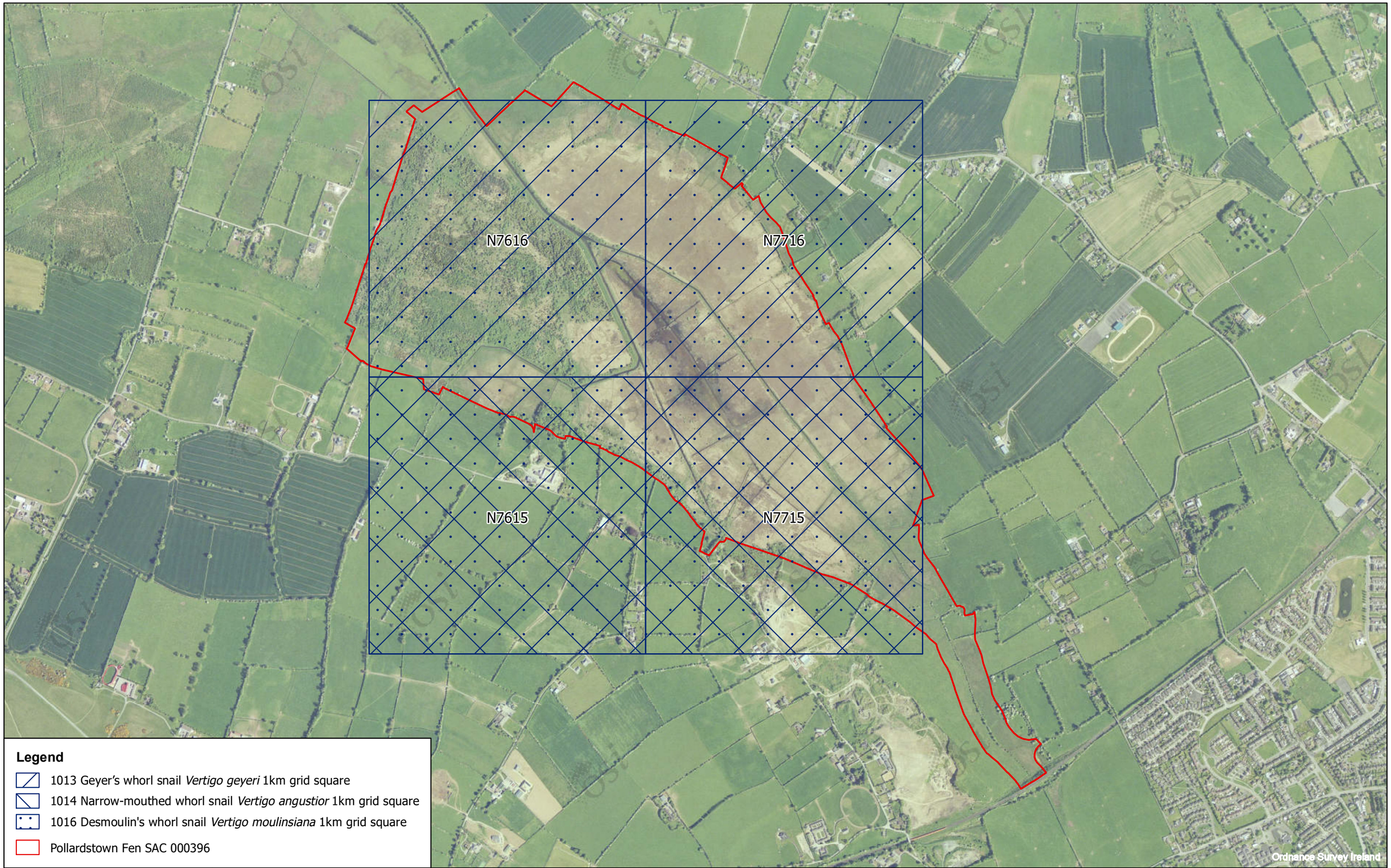
Map to be read in conjunction with the NPWS Conservation Objectives Document

SITE CODE:
SAC 000396; version 3.02
CO. KILDARE

0 100 200 400 Metres

N

Date: January 2022



Legend

- 1013 Geyer's whorl snail *Vertigo geyeri* 1km grid square
- 1014 Narrow-mouthed whorl snail *Vertigo angustior* 1km grid square
- 1016 Desmoulin's whorl snail *Vertigo moulinsiana* 1km grid square
- Pollardstown Fen SAC 000396

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MAP 3:
POLLARDSTOWN FEN SAC
CONSERVATION OBJECTIVES
VERTIGO SPECIES

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

SITE CODE:
SAC 000396; version 3.02
CO. KILDARE

0 125 250 500 Metres

N

Date: November 2021