National Parks & Wildlife Service

Tóchar Midlands Wetland Restoration Scheme

Ballynafagh Lake SAC

NFS site No. 1002

SAC 001387

Fen Restoration Plan

May 2026

Tóchar
Athchóiriú Bogach Lár na Tíre
Midlands Wetland Restoration

ARUP

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An tSeirbhís Páirceanna Náisiúnta agus Fiadhúlra
National Parks and Wildlife Service

Fen Restoration Plan

Ballynafagh Lake SAC (001387)

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Arup

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Executive Summary

Ballynafagh Lake SAC is located approximately 2 km north-west of Prosperous in County Kildare and has been designated as a Special Area of Conservation (SAC) for the presence of 7230 Alkaline fens, 1016 Desmoulin's whorl snail (*Vertigo moulinsiana*), and 1065 Marsh fritillary (*Euphydryas aurinia*) - all of which are listed under Annex I and II of the EU Habitats Directive. Additionally 7140 Transition mires and two 7220 Petrifying spring habitats have been recorded on site. Ballynafagh Lake is a shallow alkaline lake with emergent and submerged vegetation, surrounded by alkaline fen, wet woodland, grassland, heath, and cutover bog. The site is important for rare molluscs and insects and supports a variety of breeding and wintering birds. Fishing is the main land use, and the lake has developed natural vegetation of conservation importance.

The site is an artificial lake that was created to supply water to the Grand Canal and historically functioned as a managed reservoir controlled by a sluice structure at the lake outflow. While the feeder canal is now disused, historic drainage infrastructure continues to influence water levels within the lake and surrounding fen habitats. Desktop analysis and satellite imagery indicate intermittent drying of the lake margins and adjacent fen areas. These hydrological changes are likely to have implications for the extent and condition of alkaline fen habitats and for groundwater-dependent qualifying species within the site, including Desmoulin’s whorl snail.

This assessment of Fen Restoration Plan has been developed to set out proposals for the restoration of 7230 Alkaline fens habitat to contribute to the achievement of site-specific conservation objectives (SSCOs) for the SAC and the favourable conservation condition of fen habitat. In parallel, the conservation objectives (SSCOs) include the maintenance of the favourable conditions of Desmoulin's whorl snail and marsh fritillary, acknowledging their ecological significance and vulnerability within the landscape.

This is a site-level plan that will be subject to refinement prior to implementation of restoration actions in each subsite. The assessment primarily considers the following pressures that may be impacting on the hydrological function and/or favourable condition of the fen habitat:

- Drainage
- Scrub encroachment and rank vegetation
- Changes to water quality, e.g. nutrient enrichment
- Invasive species e.g. purple pitcher plants

The site is publicly accessible, and the extent to which restoration measures can be implemented will depend on the scope for managing recreational use.

This assessment was developed using a desktop assessment of previous studies of Ballynafagh Lake SAC commissioned by NPWS including the surveys carried out in 2022 as part of the National Fen Survey (Brophy et al., 2022). Detailed aerial imagery and topographic datasets

were then used to map all drainage features within the site. Hydrological and ecological field surveys were undertaken to collect additional information to validate the findings from desktop assessment and inform the selection of suitable restoration actions, considering the conditions found on site and possible constraints.

Drainage features, water quality and ecology were assessed, and a recommendation made for suitable restoration actions. A prioritisation exercise has been completed to identify restoration measures that should be targeted first in progressing the implementation of these restoration requirements. Consultation with stakeholders, and further site investigations, will be the next key steps required to refine this assessment prior to proceeding to the implementation phase(s). The key measures proposed by this assessment are

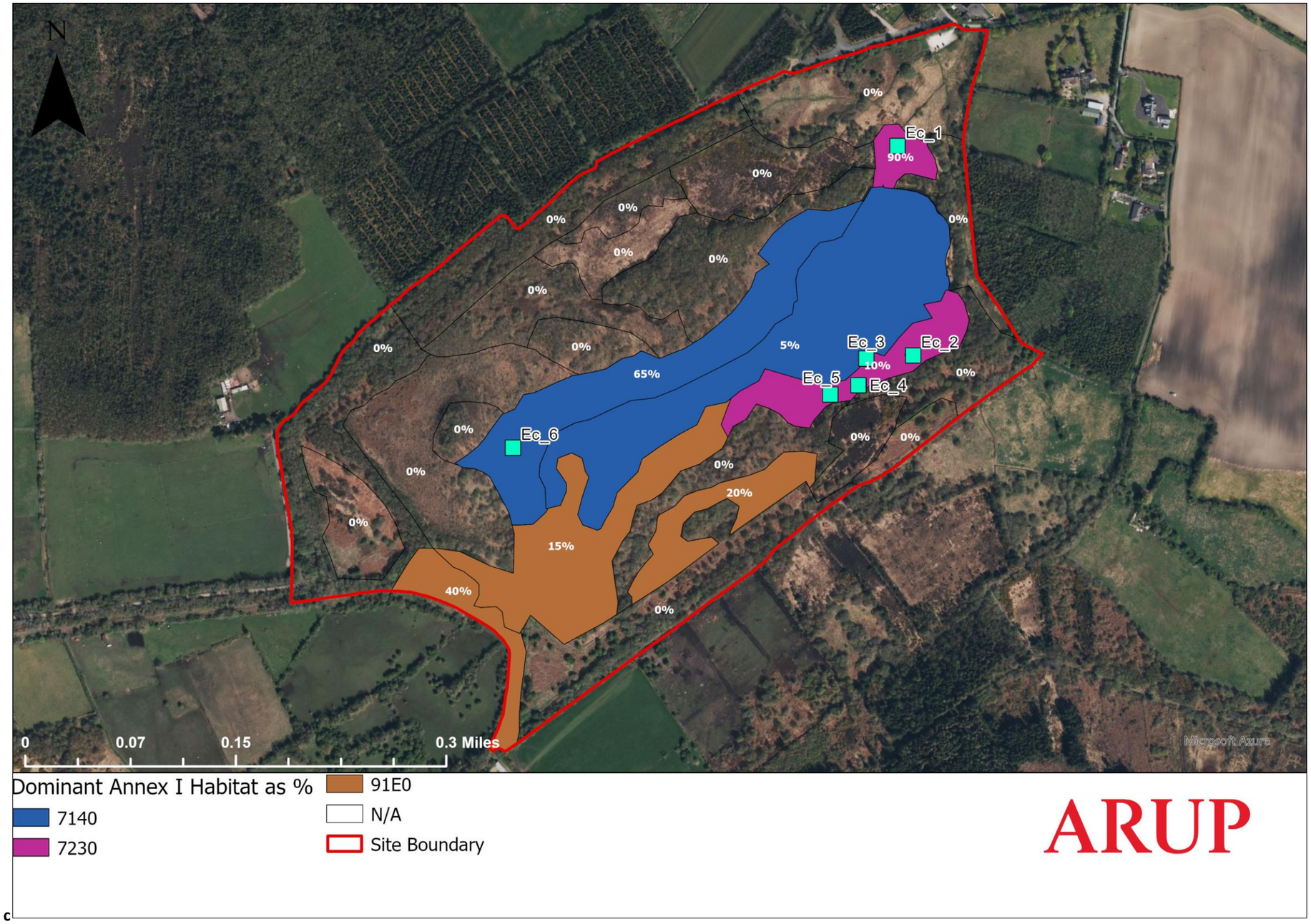
On-site Measures:

- Water quality monitoring: to maintain low nutrient, calcium-rich conditions in the fen.
- Outlet reinstatement: phased approach to outlet reinstatement will help raise the water levels within the fen.
- Ground investigations are proposed to address two data gaps:
    - to characterise structure and integrity of the perimeter berm in particular in areas where this has been eroded and may be a drainage pathway
    - a geophysical investigation along the northern boundary to determine the soil profile and identify potential groundwater pathways and monitoring targets.
- Peat reprofiling (extent of which is subject to monitoring results and geotechnical investigations): to reduce drawdown and enhance water retention.
- Flow-blocking measures (subject to monitoring results): to attenuate and redistribute flows, helping to raise the water levels in the fen.
- Molinia management: cut and removal of arisings.
- Bracken management: rolling/cutting/brashing of bracken along the boundary of the site to maintain fen habitat communities.
- Removal of waste and litter throughout the site: to prevent pollution.
- Cut over bog reprofiling: dependent on hydrological monitoring.
- Scrub monitoring and potential removal: target removal of younger saplings to maintain the community and reduce scrub encroachment following hydrological monitoring.

Off-site Measures:

- Restoration of groundwater hydrology: engagement with landowners for the best practice regarding land management to reduce fertilizer use and improve nutrients entering the site from surrounding lands. Regularly test pH and nutrient levels in the

surface and groundwater. Water quality monitoring done along with observing the catchment measures such as nutrients entering the fen from surrounding land.



c

Figure 1-1: Annex I and Annex I quality habitats recorded and mapped as part of the 2022 NFS. Note the % value indicates the % cover of the dominant Annex I and Annex I quality habitat recorded in the polygon

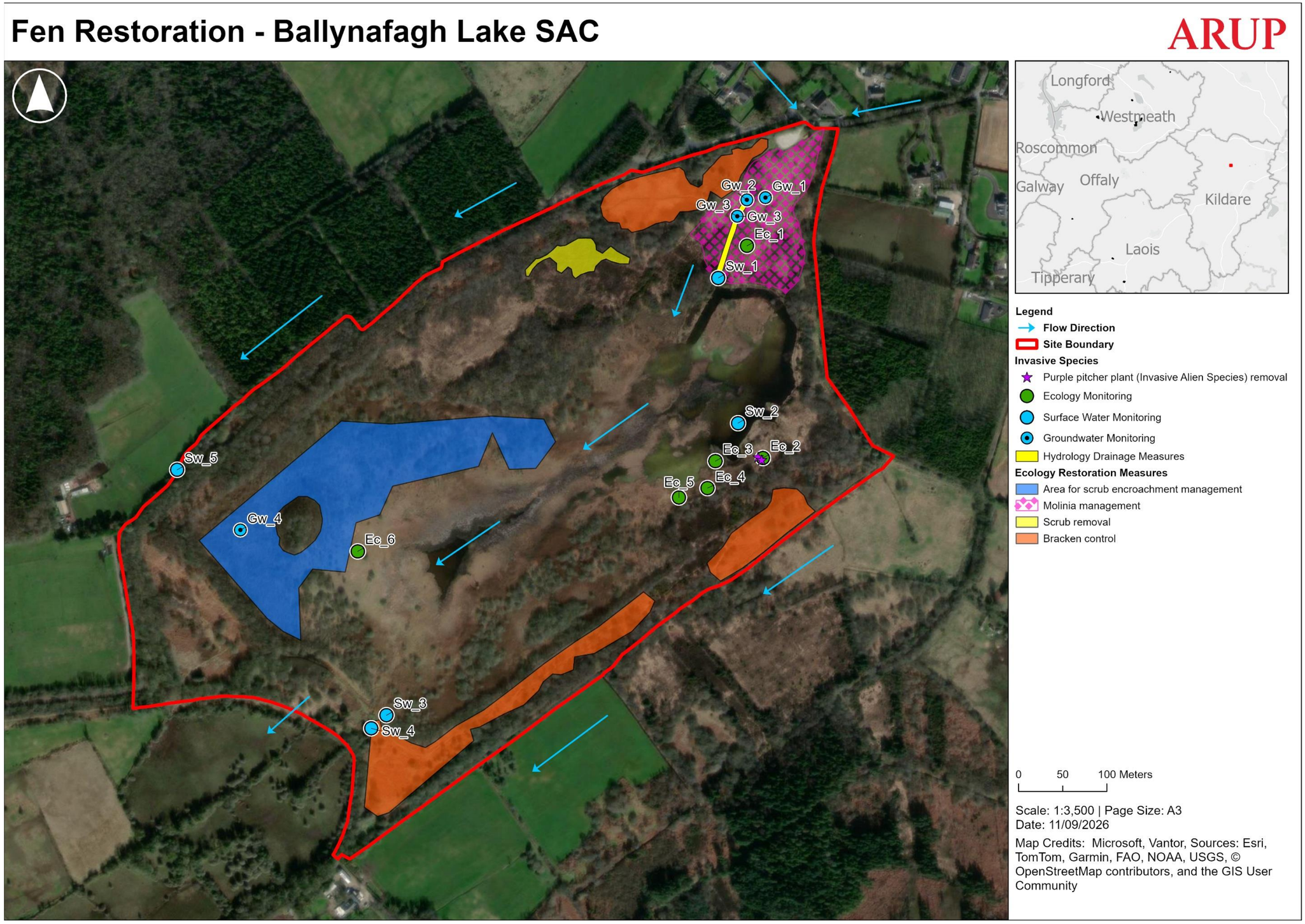


Figure 1 2: Restoration and monitoring map

Acknowledgements

This Restoration Action Plan was prepared following consultation with a broad range of groups and individuals involved in peatland restoration, local residents and stakeholders through several workshops.

The Blackwood Feeder Baseline Study, issued in 2006 by White Young Green in association with Natura Environmental Consultants, was used as a key reference for this fen restoration plan. The study provided a detailed understanding of the hydrological and ecological environments of Blackwood Feeder and Ballynafagh Lake. The authors also acknowledge Kildare County Council for making these earlier reports available, which informed and supported the development of this plan.

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Tóchar Wetlands is a wetlands restoration project, co-funded by the Government of Ireland and the European Union through the EU Just Transition Fund Programme. It is managed by the National Parks and Wildlife Service, of the Department of Housing, Local Government and Heritage.

1 Introduction

1.1 Purpose of this Fen Restoration Plan

This Fen Restoration Plan (FRP) report has been developed by Arup on behalf of National Parks and Wildlife Service (NPWS) to set out proposals for restoration of fen habitat.

Ballynafagh Lake Special Areas of Conservation (SAC) (site code: 001387) is located approximately 2 km north-west of Prosperous in County Kildare. The SAC covers a total area of 45.49ha and is dominated by fen habitat, although several other associated peatland habitats are also present (Brophy et al., 2022). The qualifying features of the SAC are Annex I habitat 7230 Alkaline fen and the Annex II species 1016 Desmoulin's whorl snail *Vertigo moulinsiana* and 1065 marsh fritillary *Euphydryas aurinia*. The site also supports the following Annex I quality wetland habitats: 7140 Transition mires and quaking bog (hereafter referred to as 7140 Transition mires) and 7220 Petrifying springs with tufa formation (*Cratoneurion*) (7220 Petrifying springs). These habitats are referred to as Annex I quality, meaning it conforms to the Annex I habitat description, but is not a designated feature of the SAC.

According to the National Fen Survey (NFS) carried out in 2022 (Brophy et al., 2022), the total extent of 7140 Transition mires and 7230 Alkaline fens at Ballynafagh Lake SAC are 2.16ha and 0.59ha respectively. According to the Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs 2025 report the extent of 7220 Petrifying springs habitat within the site is 0.024ha (Denyer et al, 2025). The population of Desmoulin's whorl snail in Ballynafagh Lake is spread across four polygons, namely the lake itself, adjacent wetland to the southwest and two stretches of the Blackwood Feeder.

The conservation value of Ballynafagh Lake SAC is closely linked to its hydrological regime. The Blackwood Feeder Baseline Study (Hayes, 2006) concluded that many qualifying features are dependent on a stable, calcium-rich groundwater supply and that even minor changes in inflow/outflow balance can drive habitat succession and changes in wetland extent. This FRP therefore focuses on understanding and protecting the groundwater-dependent hydrological function of the lake-fen system and on managing pressures that accelerate drying and scrub encroachment.

The main aim of the restoration actions proposed as part of this assessment is to maintain or improve the quality of existing areas of fen or improve the hydrological conditions that will allow an expansion of the measurable area of fen thus supporting the site-species conservation objectives (SSCOs) of the site. However, in some areas, it must be recognised that restoration to increase areas of existing fen will not be possible due to unsuitable hydrological conditions, and the objective may simply be to ensure no further deterioration.

Although the focus of the restoration plan is on fen habitat and associated SSCOs, it is anticipated that restoration actions will also benefit other wetland habitats, including 91E0 Alluvial forest and 91D0 Bog woodland which were mapped at Ballynafagh Lake SAC during the

NFS (Brophy et al., 2022). Restoration actions to raise the water table of fen will improve the hydrology of adjacent waterbodies. The implementation of the actions proposed within this FRP report may also provide wider improvements to biodiversity, reduce carbon emissions and potentially improve water quality; all of which may be demonstrable under eventual post implementation monitoring.

1.2 Wider benefits of peatland restoration

Fens are vital habitats due to their rich biodiversity, supporting a wide array of flora and fauna, many of which are rare or endangered. They act as natural water filters, purifying water by trapping pollutants and sediments, thus enhancing water quality downstream. Additionally, fens store significant amounts of carbon in their peat soils, contributing to climate change mitigation by reducing atmospheric carbon dioxide levels. Their ability to absorb and gradually release water helps regulate water flow and minimize flood risks. Beyond their ecological importance, fens hold cultural, historical, and recreational value, offering opportunities for education, research, and outdoor activities. Although some fens in Ireland are not protected as SACs or Natural Heritage Areas (NHAs), they remain crucial for biodiversity and climate resilience.

Peatland drainage and extraction transform a natural peatland which acts as a modest carbon sink into a carbon source (Waddington & McNeil, 2002; Alm *et al*. 2007; Wilson *et al*. 2015). The EPA- funded Carbon Restore Project (Wilson *et al*. 2012) found that rewetting of drained peatlands can lead to restoration of functional peatland, such as the return of typical plant and animal species, which in turn may lead to the restoration of peat-formation and the C-sink function.

It is expected that areas within Ballynafagh Lake SAC may become a carbon sink following implementation of the FRP measures which may result in revegetation of bare peat areas and improvement in hydrology via drain blocking and raising of the lake levels.

The restoration of fen habitat at Ballynafagh Lake SAC is likely to lead to improved water quality. Well- functioning fen habitat reduces the risk of dissolved organic carbon passing into water courses and has been shown to attenuate the speed at which water moves downstream, promoting nutrient uptake and aiding in flood mitigation.

1.3 Key pressures on Fens

The overarching (National) key pressures and threats to Annex I fen habitats and Annex II species Desmoulin's whorl snail and marsh fritillary, have been identified in the latest Status of EU Protected Habitats and Species in Ireland (Article 17 report) (NPWS 2025) in Table 1-1. The overall conservation status is assigned as: Bad for 7140 Transition mires, Inadequate for 7220 Petrifying springs, Bad for 7230 Alkaline fens, Inadequate for Desmoulin's whorl snail and Favourable for marsh fritillary in the Article 17 report.

Table 1-1: National pressures to fen habitats

Habitat	Importance	Pressure
7140 Transition mires	High	PA09 Burning for agriculture PA13 Application of natural or synthetic fertilisers on agricultural land PA22 Drainage for use as agricultural land PF02 Construction of modification (e.g. of housing and settlements) in existing built-up areas PL02 Drainage (mixed or unknown drivers)
	Medium	PA08 Extensive grazing or undergrazing by livestock PA17 Agricultural activities generating pollution to surface or ground waters (including marine) PB24 Drainage for forestry PE01 Roads, paths, railroads and related infrastructure PI03 Problematic native species
	Low	PA01 Conversion into agricultural land (excluding drainage and burning) PA02 Conversion from one type of agricultural land use to another (excluding drainage and burning) PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming) PA07 Intensive grazing or overgrazing by livestock PA21 Active abstraction of water for agriculture PB01 Conversion to forest from other land uses, or afforestation (excluding drainage) PB26 Other forestry activities, excluding those relating to agro forestry PC05 Peat extraction PF06 Deposition and treatment of waste/rubbish from built-up areas PI02 Other invasive alien species (other than species of Union concern)

Habitat	Importance	Pressure
7220 Petrifying springs	Medium	PK01 Mixed source pollution to surface and ground waters (limnic and terrestrial) PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming) PA17 Agricultural activities generating pollution to surface or ground waters (including marine) PA07 Intensive grazing or overgrazing by livestock PL05 Modification of hydrological flow (mixed or unknown drivers) PF01 Conversion from other land uses to built-up areas PI03 Problematic native species PA25 Agriculture activities not referred to above PE05 Land, water and air transport activities generating pollution to surface or ground waters PL01 Abstraction from groundwater, surface water or mixed water (mixed or unknown drivers) PF07 Residential and commercial activities and structures generating pollution to surface or ground waters
	Low	PI02 Other invasive species (other than species of Union concern) PM05 Avalanches, landslides and collapse of terrain PF05 Sports, tourism and leisure activities PL02 Drainage (Mixed or unknown drivers) PF06 Deposition and treatment of waste/rubbish from built-up areas
7230 Alkaline fens	High	PA07 Intensive grazing or overgrazing by livestock PA22 Drainage for use as agricultural land PA23 Physical alteration of water bodies (including dams, channels, etc.)
	Medium	PA01 Conversion into agricultural land (excluding drainage and burning) PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming) PA08 Extensive grazing or under grazing by livestock PB24 Drainage for forestry PC06 Dumping/depositing of inert and dredged materials from terrestrial and marine extraction PF06 Deposition and treatment of waste/rubbish from built-up areas PI02 Other invasive alien species (other than species of Union concern) PL02 Drainage (mixed or unknown drivers) to surface or ground waters
	Low	PF05 Sports, tourism and leisure activities PI03 Problematic native species

Habitat	Importance	Pressure
		PE09 Land, water and air transport activities not referred to above PE01 Roads, paths, railroads and related infrastructure PC05 Peat extraction PA17 Agricultural activities generating pollution to surface or ground waters (including marine) PA20 Livestock farming generating pollution PB19 Forestry activities generating pollution to surface or ground waters (including marine) PB26 Other forestry activities, excluding those relating to agro-forestry
Desmoulin's whorl snail	High	PA07 Intensive grazing or overgrazing by livestock PL02 Drainage (mixed or unknown drivers) PL05 Modification of hydrological flow (mixed or unknown drivers) PM07 Natural processes without direct or indirect influence from human activities or climate change
	Low	PH08 Other human intrusions and disturbance not mentioned above
Marsh fritillary	Medium	PA01 Conversion into agricultural land (excluding drainage and burning) PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming) PA08 Extensive grazing or undergrazing by livestock PB01 Conversion to forest from other land uses, or afforestation (excluding drainage)

1.4 Legislative Context

There is a comprehensive system of legislation, both domestic and international, which aims to protect biodiversity at a landscape, habitat and species level in Ireland. This legislation exists within, and independently of, the planning process.

In Ireland, the most important pieces of legislation underpinning biodiversity and conservation are:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, hereafter referred to as the Habitats Directive.
- European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011), as amended, hereafter referred to as the Birds and Habitats Regulations.
- Regulation (EU) 2024/1991 of the European Parliament and of the Council of June 2024 on nature restoration and amending Regulation (EU) 2022/869.

- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, hereafter referred to as the Birds Directive.
- Wildlife Acts 1976 to 2017, hereafter referred to as the Wildlife Acts; and
- Flora (Protection) Order, 2015 (S.I. No. 356 of 2015).

According to the EU Habitats Directive (92/43/EEC) and the EU Birds Directive (79/409/EEC), Member States are required to establish a Natura 2000 network of sites of highest biodiversity importance for rare and threatened habitats and species across the EU. In Ireland, the Natura 2000 network of European sites includes SACs and Special Protection Areas (SPAs).

The EU Nature Restoration Regulation aims to restore damaged ecosystems and improve biodiversity with particular focus on capturing and storing carbon and reducing the impact of natural disasters. Specific targets include improving and re-establishing biodiverse habitats on a large scale and bringing back species populations by improving and enlarging their habitats. EU countries are required to submit National Restoration Plans to the European Commission showing how they will deliver on the targets and monitor their progress. Member States are required to implement restoration measures for specific habitats and species, including marine ecosystems, forests, wetlands, and pollinators.

SACs are selected for the conservation of Annex I habitats (including priority types which are in danger of disappearance) and Annex II species (other than birds). SPAs are selected for the conservation of Annex I birds and all migratory birds and their habitats. The Annex habitats and species, for which each site is selected, are the qualifying interests (QI) of the SAC and special conservation interest (SCI). Conservation objectives for the site are defined for these qualifying interests.

Ireland is required to manage water resources in an integrated way under the Water Framework Directive (WFD, 2000/60/EC) and the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003). Member States are required to submit River Basin Management Plans to the European Commission showing how they will protect and improve the water environment. Restoring surface and groundwater bodies to the equivalent of ‘good status’ or better and to protect water from any further deterioration requires collaboration at a local and national level. Implementing the WFD supports the achievement of site-specific conservation objectives for fen habitats, contributing to their favourable conservation status.

1.5 Outline of this FRP document

- Section 2 of this FRP report outlines details of Ballynafagh Lake SAC and the conservation objectives for 7230 Alkaline fen habitat.
- Section 3 outlines the findings from the land and water desktop and site monitoring surveys that were carried out to inform the development of these FRP.

- Section 4 outlines the findings from the ecological desktop and site monitoring surveys that were carried out to inform the development of these FRP.
- Section 5 provides a summary of the key pressures identified by this FRP report that are impacting on fen.
- Section 6 outlines the key restoration measures proposed by this FRP.
- Section 7 outlines additional considerations to inform the development of the FRP.
- Section 8 outlines key players in the FRP, summarises restoration actions proposed, habitats that will benefit and further steps required to prepare for implementation.

Restoration actions proposed by this FRP assessment have been mapped in GIS format and delivered to NPWS in accordance with NPWS data standards. This includes detailed mapping of the key pressures addressed by this assessment, detailed mapping of proposed restoration actions, ecological survey results and referenced sensitivity areas. Regarding maps presented, and following consultation with NPWS, due to the sensitivity of many of the species recorded or referenced, species names have been omitted from Map legends. This is to ensure no confidential or highly sensitive locations are revealed which might result in negative impacts. GIS Shapefiles which accompany this report include all relevant data on referenced species.

2 Site Overview

2.1 Ballynafagh Lake SAC

Ballynafagh Lake SAC is situated roughly 2 km north-west of Prosperous in County Kildare. The site is a SAC for the 7230 Alkaline fens, 1016 Desmoulin's whorl snail and 1065 Marsh fritillary as listed on Annex I/II of the E.U Habitats Directive. Additionally, 7140 Transition mires habitat is also present on most of the northern part of the site and western side of the lake, with abundant round-leaved wintergreen (*Pyrola rotundifolia)*. Ballynafagh Lake is shallow, peat-based artificial lake dug in former raised bog to supply water to the Grand Canal. The feeder canal is disused and the lake is infilling, with some areas suffering from severe scrub encroachment. On the southern side of the lake is mostly reedswamp, while to the south-east alkaline fen is present. Further from the lake are disturbed former raised bog, mapped as cutover, and willow dominated wet woodland with some alder. The edge of the site comprises dry birch woodland and dense bracken stands on bog peat (Brophy et al., 2022).

The lake is strongly influenced by calcareous groundwater inputs (Hayes, 2006) and has been subject to significant historical hydrological modification associated with its function as a canal reservoir, including construction of embankments, a managed outflow sluice and the Blackwood Feeder canal. Although the feeder was drained and decommissioned in the mid-twentieth century, these historic modifications continue to influence present-day hydrological conditions through interactions between groundwater supply, surface water pathways and long-term ecological change and drying trends across the lake and fen system.

Altitude at the site ranges from 81m to 85.5m, with further detailed topographical information found in Section 3.1.3. Figure 2.1-1 outlines the location and extent of Ballynafagh Lake SAC.

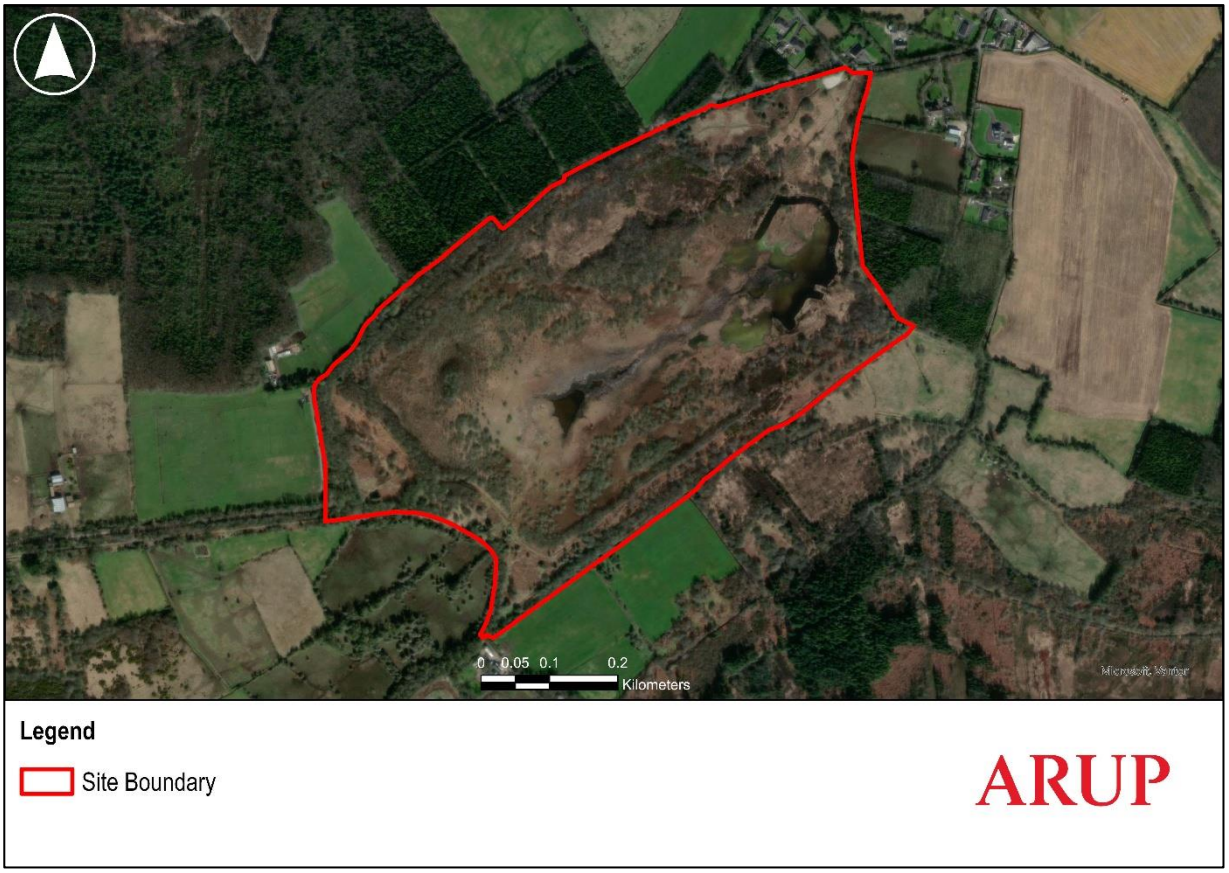


Figure 2.1-1: Site Location Map

The site synopsis (NPWS, 2021) for Ballynafagh Lake SAC notes that submerged plants in the area include starworts (*Callitriche spp.*) and lesser bladderwort (*Utricularia minor*), with common duckweed (*Lemna minor*) and the liverwort *Riccocarpus natans* occurring on the surface.

The SAC is located within the Barrow Catchment and is primarily drained by tributaries of the Slate River. For the purposes of the Water Framework Directive, most of the SAC is located within the Slate_SC_010 sub-catchment.

2.1.1 Fen Condition Assessment

Ballynafagh Lake SAC was surveyed as part of the NFS (Brophy et al, 2022) on the 26th of July 2022 and again as part of the 2025 Petrifying springs monitoring report (Denyer, 2025) on the 22nd of August 2023. During these surveys, the negative pressures outlined in Table 2-1 were identified.

Table 2-1: Assessment of impacts of pressures on 7140 Transition mires, 7220 Petrifying springs and 7230 Alkaline fen at Ballynafagh Lake SAC

Pressure Code	Pressure [sub-category]	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming). Impacting 7220 Petrifying spring habitat within the site.	Negative
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial). Impacting 7220 Petrifying spring habitat within the site.	Negative
L02	Natural succession to scrub and bracken was recorded within the site. This was considered to be impacting 7140 Transition mires, 7220 Petrifying spring, and 7230 Alkaline fen habitats within the site.	Negative
A26	Agricultural activities generating diffuse pollution to surface or groundwaters. Elevated nitrate and phosphate levels were noted during the 2023 Petrifying springs survey.	Negative
K02	Drainage. Drains are concentrated around the site borders and are considered to be impacting 7140 Transition mires, 7220 Petrifying spring, and 7230 Alkaline fen within the site.	Negative

The results of a field evaluation (2026) of the above pressures to inform the restoration planning process is detailed in Section 5 of this report.

The structure and functions of the Annex I habitat was recorded:

- 7140 Transition mires: Unfavourable-Bad
- 7230 Alkaline fens: Unfavourable-Bad

2.1.2 Site-specific conservation objectives

Detailed SSCOs aim to define the conditions necessary to maintain or achieve the favourable conservation condition of a habitat or species at site level. The maintenance of habitats and

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

SSCO has been set for Ballynafagh Lake SAC for 7230 Alkaline fens, using attributes and targets based on parameters set out in the Habitats Directive. The aim of this SSCO is to 'Maintain the favourable conservation condition of this habitat: Maintain or restore natural groundwater and surface water regimes; Maintain calcium-rich, low-nutrient water conditions'. The attributes and targets for 7230 Alkaline fens, along with how the FRP will contribute to achieving set targets, are set out in Table 2-2. This document does not present the full suite of attributes, targets, and measures for the Annex I habitats. The selection provided in Table 2-2 reflects a conscious decision to focus on those with clear, direct benefits from the FRP measures. While these are listed below, it is anticipated that the remaining attributes, targets, and measures will also experience positive outcomes as restoration measures are implemented.

Table 2-2: Attributes and Targets for 7230 Alkaline fens (NPWS, 2021)

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribution to achieving target?
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Yes	Yes. FRP actions will contribute to the increase of 7230 area.
Habitat distribution	Occurrence	No decline, subject to natural processes	Yes	Yes. FRP actions will not result in a decline in distribution of fen habitat within the SAC. In fact, it will contribute to the increase of 7230 distribution.
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	Yes	Yes. FRP actions will address nutrient input from surrounding land which will assist in the restoration of more natural nutrient conditions.

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribution to achieving target?
Ecosystem function: hydrology – groundwater levels	Water levels (centimeters); duration of levels; hydraulic gradients	Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Yes	Yes. FRP actions include weir installation which will improve hydrology of fen habitat
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	Yes	Yes. FRP actions include weir installation which will improve hydrology of fen habitat
Ecosystem function: water quality	Water chemistry measures	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitats	Yes	Yes. FRP actions will include the engagement with landowners for best practice regarding land management to reduce nutrients entering wetland. Water quality monitoring will be carried out within the site. FRP actions will alter hydrological conditions (such as drainage blockage) and nutrient uptake which in turn will assist in restoration of more natural water pH and nutrient status.
Vegetation composition: brown mosses	Percentage cover at a representative number of 2m x 2m monitoring	Maintain adequate cover of typical brown moss species	Yes	The restoration measures seek to have a positive impact on the vegetation structure and composition of 7230 Alkaline fens. Subsequently, all attributes should see a favourable shift towards their respective targets.
Vegetation composition: typical vascular plants	Percentage cover at a representative number of 2m x 2m monitoring stops	Maintain adequate cover of typical vascular plant species	Yes	

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribution to achieving target?
Vegetation composition: native negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of native negative indicator species at insignificant levels	Yes	
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%	Yes	
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	Yes	

3 Land and Water

3.1 Desktop Study

3.1.1 Meteorological Conditions

Understanding long-term meteorological patterns is key for informing effective fen restoration planning, particularly with respect to hydrological dynamics. To support this, historical precipitation data over the past 30 years from the closest Met Éireann weather station, Straffan (Turnings) (approximately 11 km southeast of the site), has been reviewed to assess seasonal variability in rainfall at the site and surrounding areas (Met Éireann, 2026) (Table 3-1).

At this station, both monthly and daily rainfall data are available for the period 1996–2025. Mean monthly rainfall ranged from a minimum of 49.79 mm in April to a maximum of 86.66 mm in October. The highest daily rainfall total recorded was 46.7 mm on 24 October 2011. Over the same period, the months with the highest mean number of days with rainfall ≥0.2 mm and ≥1.0 mm were November (18.33 days) and October (13.27 days), respectively.

Table 3-1: Straffan (Turnings) weather station long term averages (1996-2025) - (Met Éireann, 2026)

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean monthly total	65.17	58.59	51.57	49.79	57.33	66.97	64.42	76.67	68.27	86.66	82.49	79.14	1996-2025
Greatest daily total	32.6	28.9	28.2	27.9	37	26.6	52.4	45.3	44.3	46.7	68	29.8	1996-2025
Mean num. of days with >= 0.2mm	15.80	15.13	14.37	14.47	14.87	14.23	15.86	16.60	14.20	17.70	18.33	17.97	1996-2025
Mean num. of days with >= 1.0mm	11.23	10.50	10.07	9.93	11.07	10.10	11.53	11.63	9.87	13.27	12.17	12.40	1996-2025

Additionally, two datasets have been visualised in Figure 3.1-1: (1) average monthly precipitation (mm), incorporating a 30-year period to show seasonal distribution patterns and (2) total annual precipitation (mm) for each year within the 30-year record, to identify longitudinal trends. This information is important to assess water availability and to evaluate

the feasibility and sustainability of restoration actions aimed at restoring or maintaining suitable hydrological conditions.

The average monthly rainfall is highest in the winter months (October to January) and lowest in the beginning of spring (March and April). Minimum rainfall has the lowest amount of rainfall from April to June, while the maximum monthly rainfall shows a notable increase in winter (Figure 3.1-1).

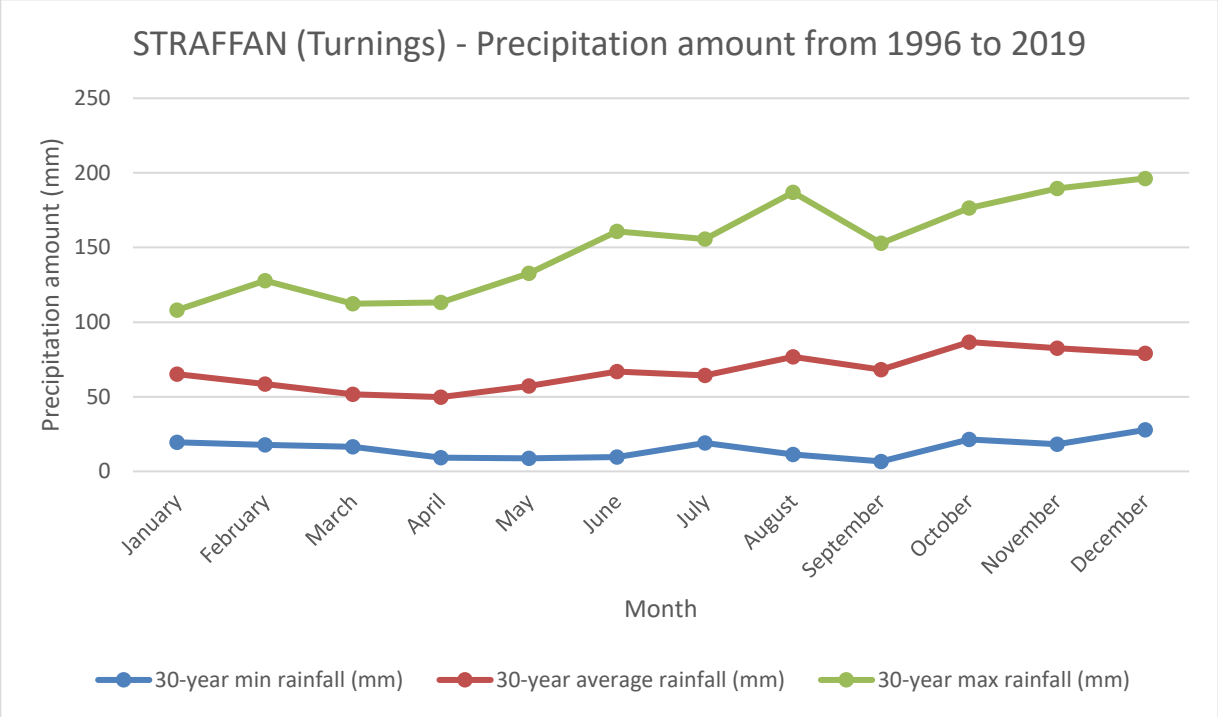


Figure 3.1-1: STRAFFAN (Turnings) weather Station – Total annual precipitation from 1996 to 2019 (Met Éireann, 2026)

3.1.2 Hydrogeological Setting

The hydrogeological information gathered for the Ballynafagh Lake SAC was extracted from the Geological Survey Ireland (GSI) website. The site is underlain by Waulsortian Limestones (characterised by pale grey lime mudstone) and Boston Hill Formation (nodular and muddy limestone, typically interbedded with shale), as shown in Figure 3.1-2. These are typically capable of transmitting groundwater through fractures and solution features, supporting groundwater dependent wetland systems.

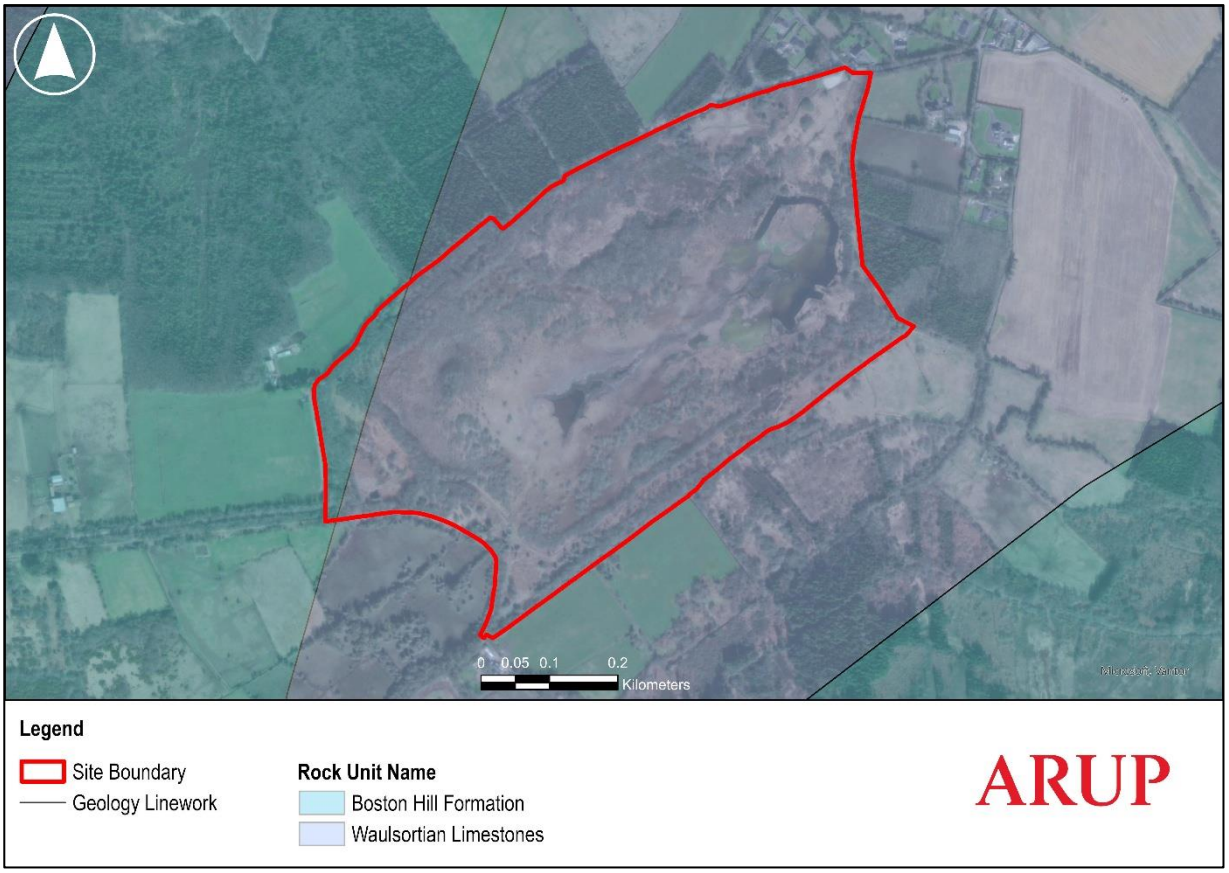


Figure 3.1-2: Bedrock Geology of Ballynafagh Lake SAC (GSI Bedrock Geology Map, 2025)

The area is underlain by a Locally Important Aquifer moderately productive only in local zones (Ll). Most of the flow in this type of aquifer is in the upper 15 m, in the zone that consists of a weathered layer and connected fracture zone below. Bedrock aquifer faultlines are observed 350m southeast of the site and 600 m north of the site (Figure 3.1-3), which may locally influence groundwater movement and permeability within the surrounding bedrock.

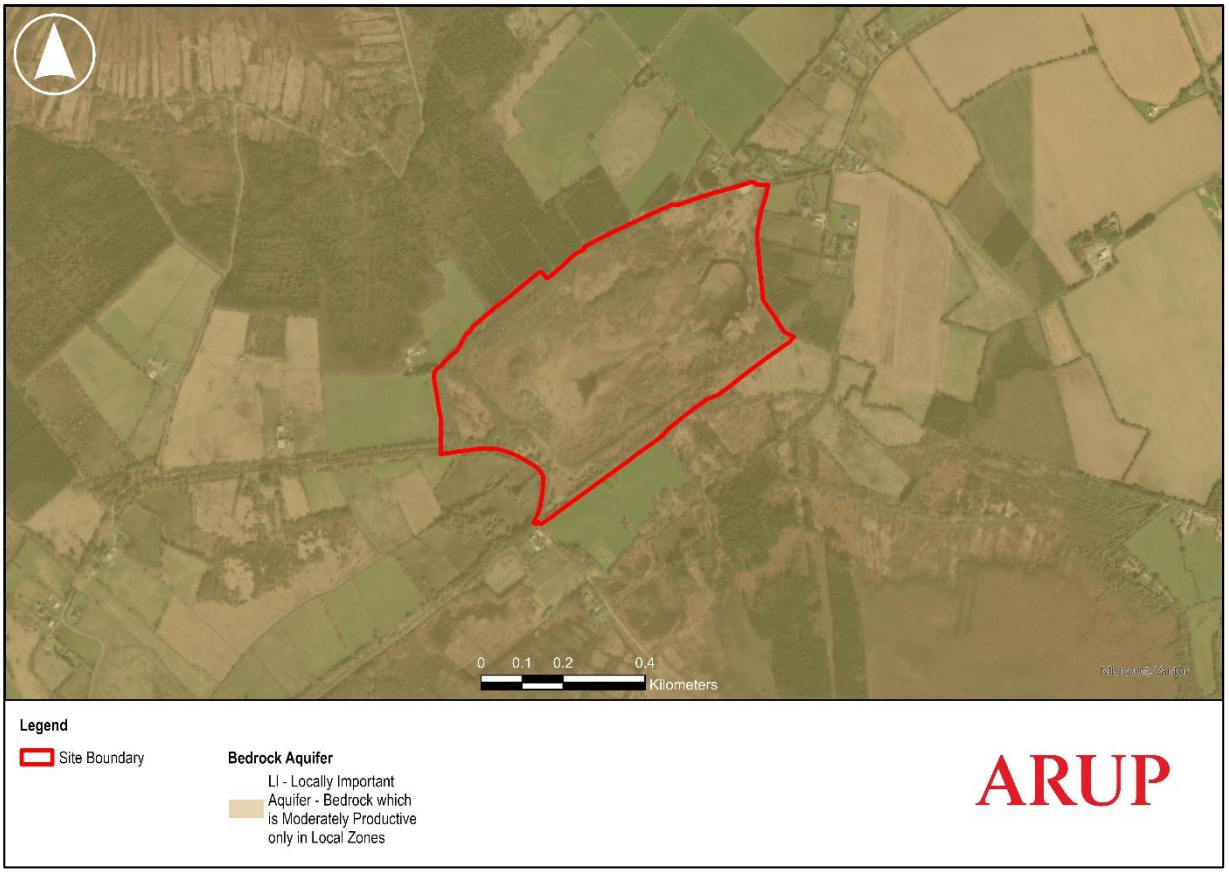


Figure 3.1-3: Aquifer classification underlying Ballynafagh Lake SAC (GSI Bedrock Aquifer map, 2026)

The quaternary sediments in the area comprise cut over raised peat and Fen Peat. Till derived from limestones is present in the surrounding areas, directly adjacent to the site in the northeast and 1.2 km southwest of the site (Figure 3.1-4). These deposits influence recharge rates, groundwater storage, and discharge patterns across the site.

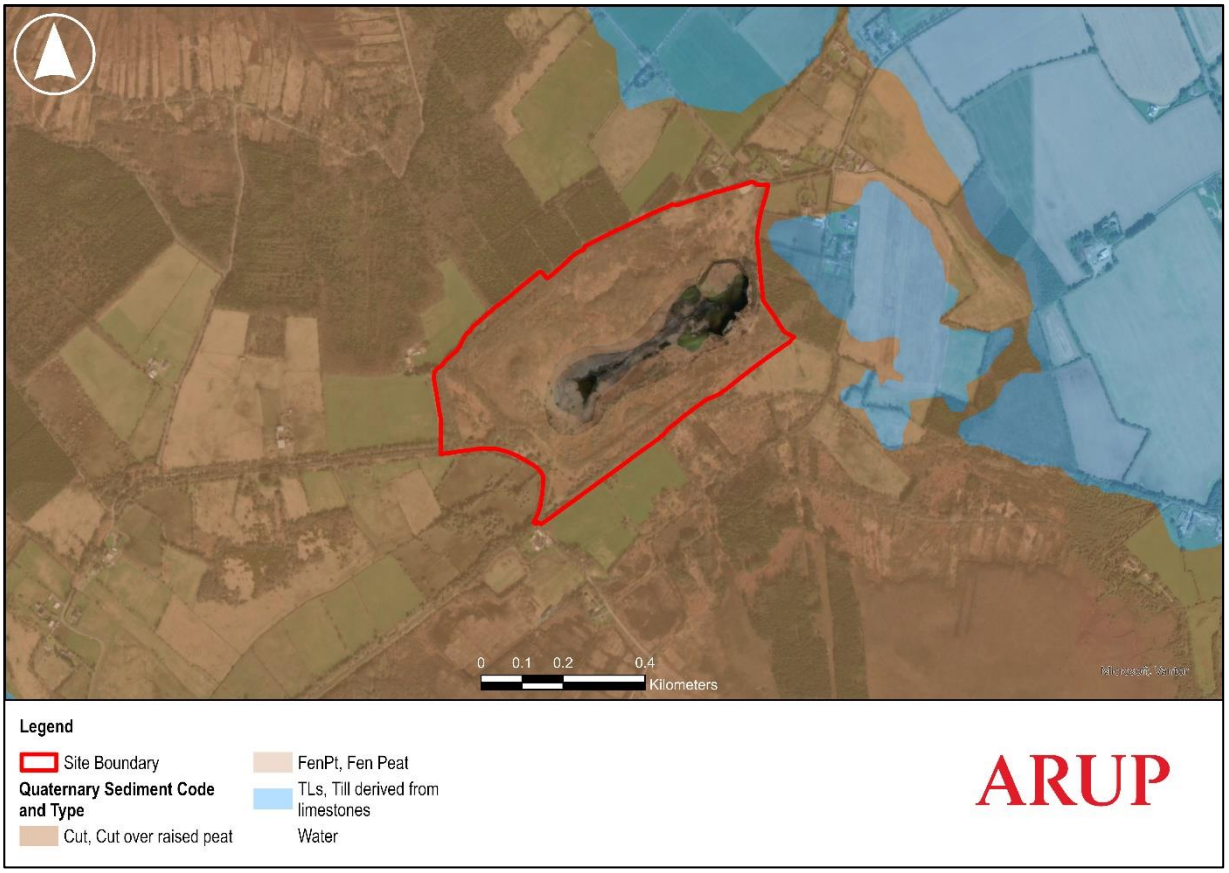


Figure 3.1-4: Sub-soil type underlying Ballynafagh Lake SAC (Source: GSI Quaternary map, 2025)

The groundwater vulnerability within the site is mostly low (suggesting low susceptibility to diffuse groundwater contamination), with moderate vulnerability in small sections of the site to the northeast and southwest (Figure 3.1-5).

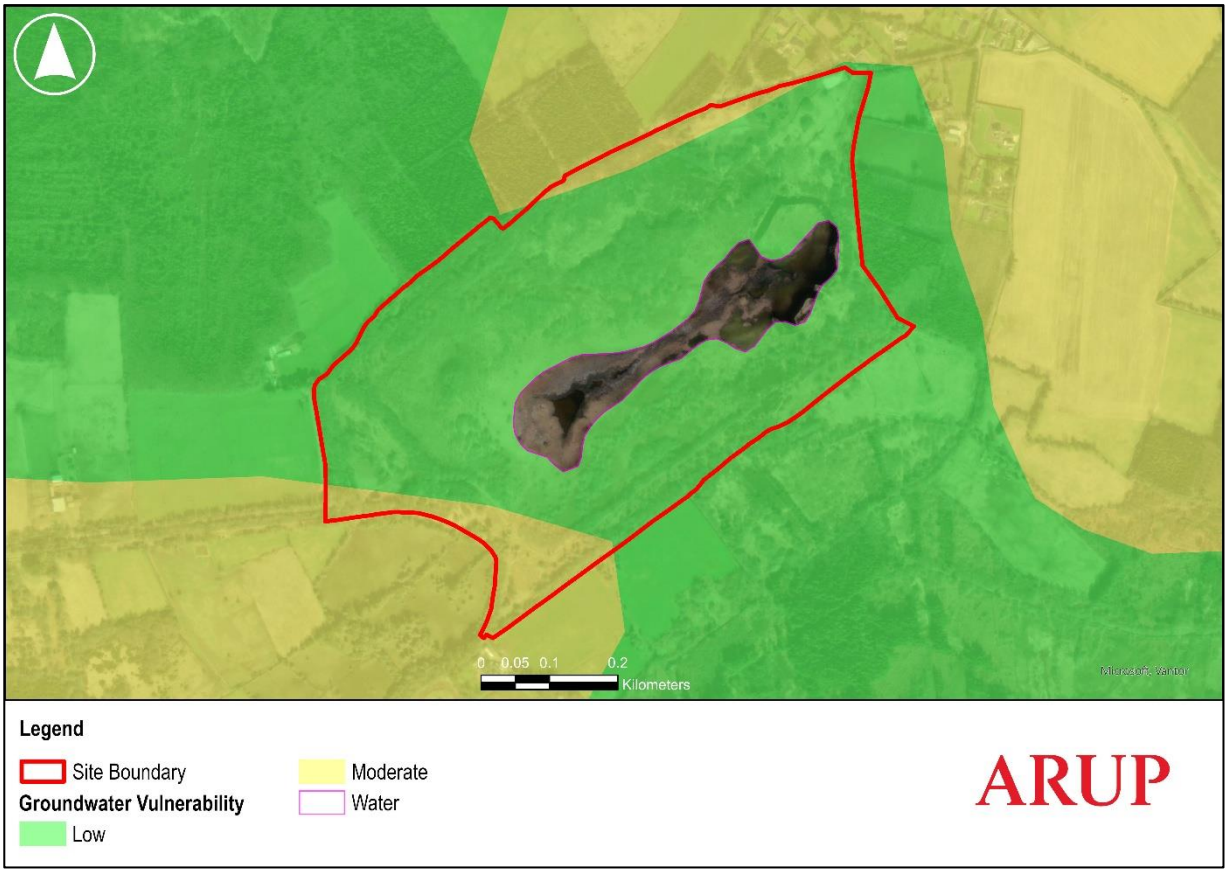


Figure 3.1-5: Groundwater vulnerability map for Ballynafagh Lake SAC (GSI Groundwater vulnerability map,2026)

3.1.3 Topographic and Surface Water Drainage

Ballynafagh Lake SAC occupies a shallow topographic depression within a predominantly raised bog and agricultural landscape. The site is located within the 14: Barrow WFD Catchment and the Slate_SC_010 WFD sub catchment (Figure 3.1-6). The WFD River waterbody is classed at poor WFD Status and at risk of not achieving its WFD objectives stablished by WFD Cycle 2 (EPA, 2019). The general water flow direction in the area is from northeast to southwest.

Ballynafagh Lake is located high in the sub catchment with a relatively small upstream contributing area. Four groundwater springs are visible on historic mapping, three of which are located along the northeastern boundary of the site, with a fourth located approximately 350 m southeast of the site (Figure 3.1-7). The fourth spring is located outside the study boundary within privately held land, and as a result wasn't surveyed during site visits. Its influence on the site is unconfirmed. The Blackwood Feeder Baseline Study (Hayes, 2006) notes that surface water inflow is low and concludes that groundwater is likely the principal source sustaining lake levels. However, a drain entering the site from the north-eastern boundary contributes surface water under certain flow conditions and may include inflow originating from the aforementioned spring located east of the site.

The sluice structure at the lake outflow to the Blackwood Feeder has been reported to be damaged, ending the former active management of the lake levels. Drainage channels along site boundaries provide the main surface water outflow, with water ultimately discharging toward the Slate River to the south-west, and onwards through the River Barrow system.

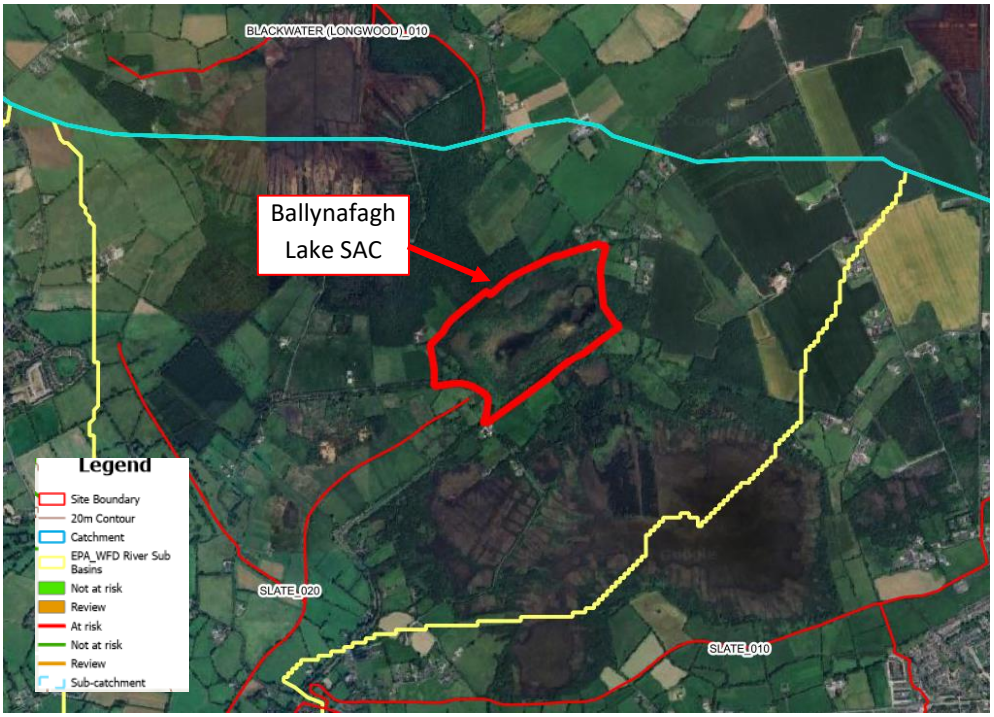


Figure 3.1-6: WFD Catchment and River sub-basin (EPA, 2025)

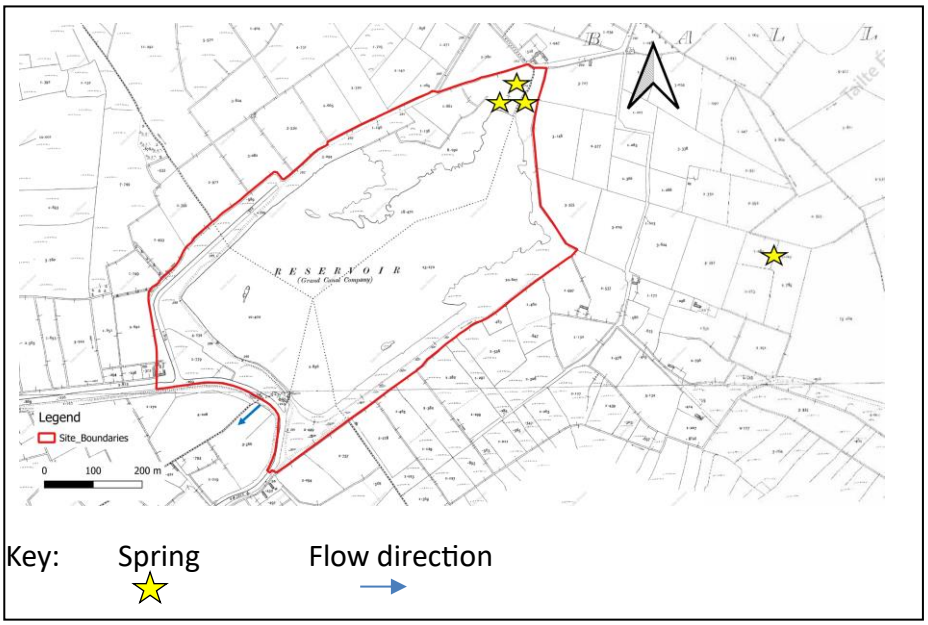


Figure 3.1-7: Historical water distribution and retention within wetland (Tailte Éireann Historical mapping, 2025)

The mapped Wetness Index[1] classifies the site as partially temporarily wet, indicating alternating periods of saturation and dryness over the period of 2012 to 2018. The site is also partially classified as permanently wet (closer to the lake centre) with an area of permanent water southwest of the site. This pattern suggests a mosaic of variable soil moisture conditions and seasonally fluctuating water levels, supporting intermittent wetland characteristics across the site (Figure 3.1-8).

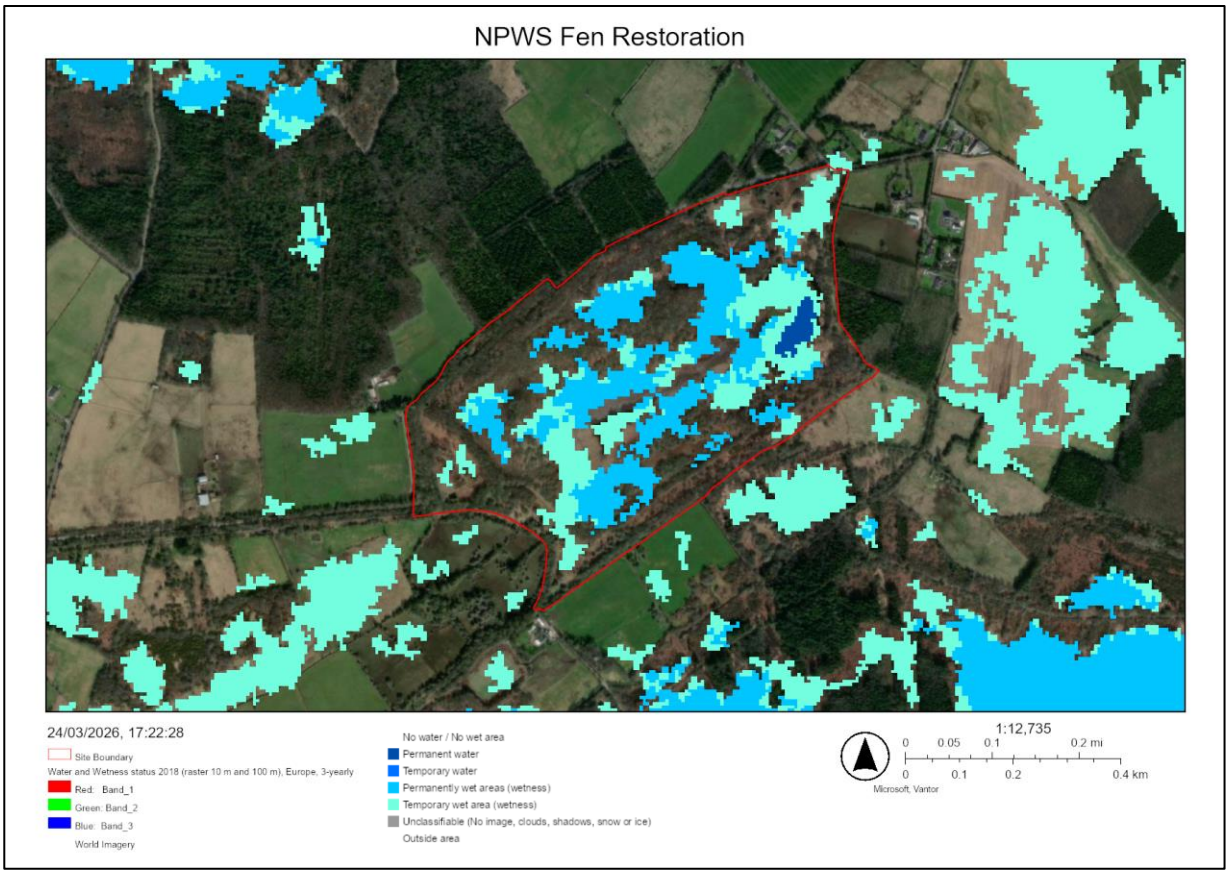


Figure 3.1-8: High Resolution Layer (HRL) Water and Wetness – 2018 (Copernicus, 2025)

Total productivity mapping of Ballynafagh Lake further illustrates the site's hydrological variation. Most of the area is classified as having moderate productivity, typically associated with peatland habitats that have experienced some hydrological modification, including drainage influences and vegetation succession. The area along the western boundary of the site shows higher productivity, suggestive of more intensive modification, potentially related to artificial drainage, agricultural influence, or increased cover of grasses, shrubs, or trees. In contrast, localised areas of low productivity are evident within the site, which is characteristic of relatively intact peatland processes and sustained waterlogging (Figure 3.1-9).

[1] Dataset available at 10m resolution indicating the occurrence of water and wet surfaces over the period from 2012 to 2018 (Copernicus, 2025).

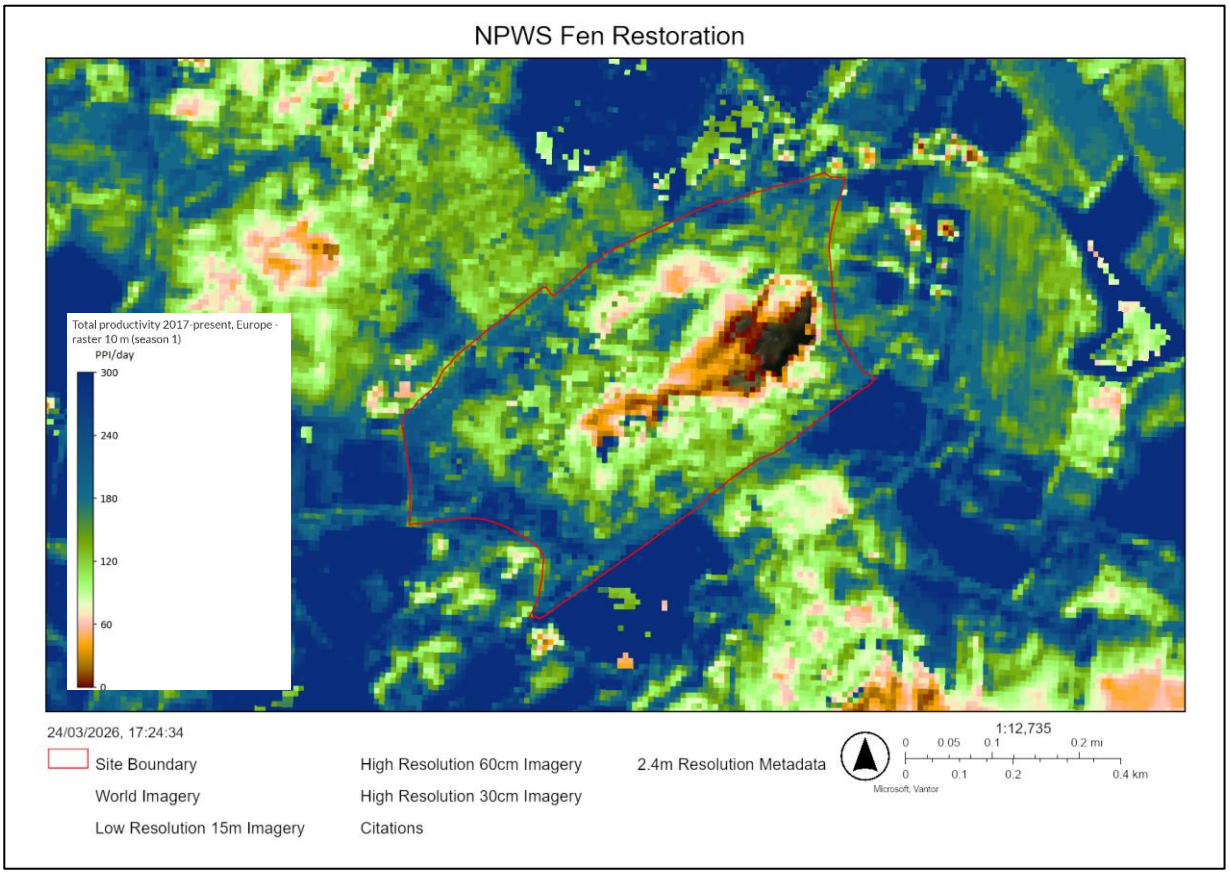


Figure 3.1-9: Total Productivity 2017 -present, Europe – raster 10m (season 1) of Ballynafagh Lake SAC (Copernicus, 2025)

Figure 3.1-10 and Figure 3.1-11 show the Digital Terrain Model (DTM) map and the site photogrammetry of Ballynafagh Lake SAC, both generated from LiDAR imagery. The images indicate two sets of boundary drains surrounding the site: smaller drains located adjacent to the lake, and larger drains positioned approximately 20 m from the site boundary. In the northeast of the site, a surface drain adjacent to the groundwater springs deepens as it flows southwest towards the lake. In addition, a large drain exits the site at the western boundary, conveying outflow from the system.

Topographically, the site slopes at approximately 5% from north to south along the northern portion of the site, and around 10% from south to north along the southern portion of the site. A large, shallow central depression extends for approximately 386 m, of which around 200 m consists of the lake surface. The lake itself is shallow, with a measured depth of approximately 0.5 m at its southwestern edge in May 2026.

From west to east, the site initially rises at a slope of approximately 5% along the western boundary, continuing up to a berm with approximately 5 m width.

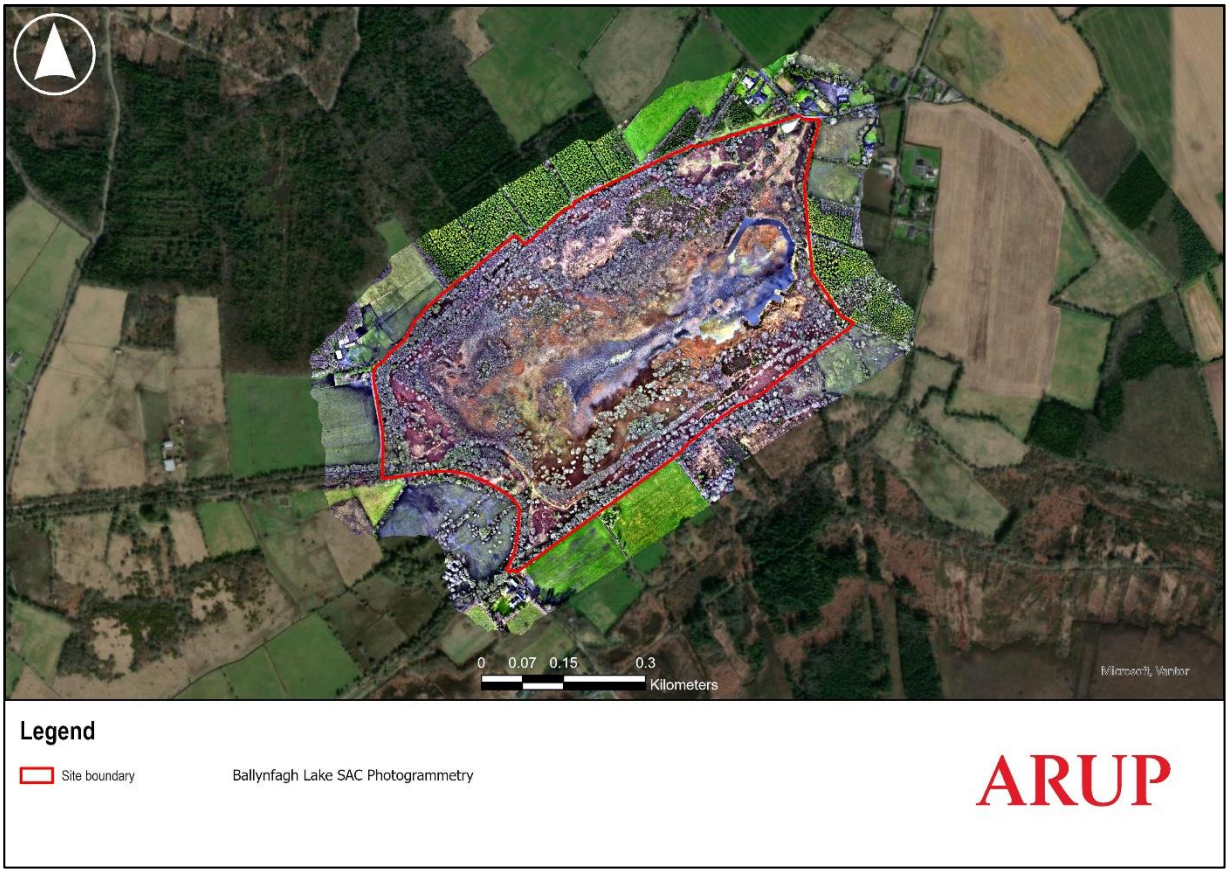


Figure 3.1-10: Site Photogrammetry map of Ballynafagh Lake SAC

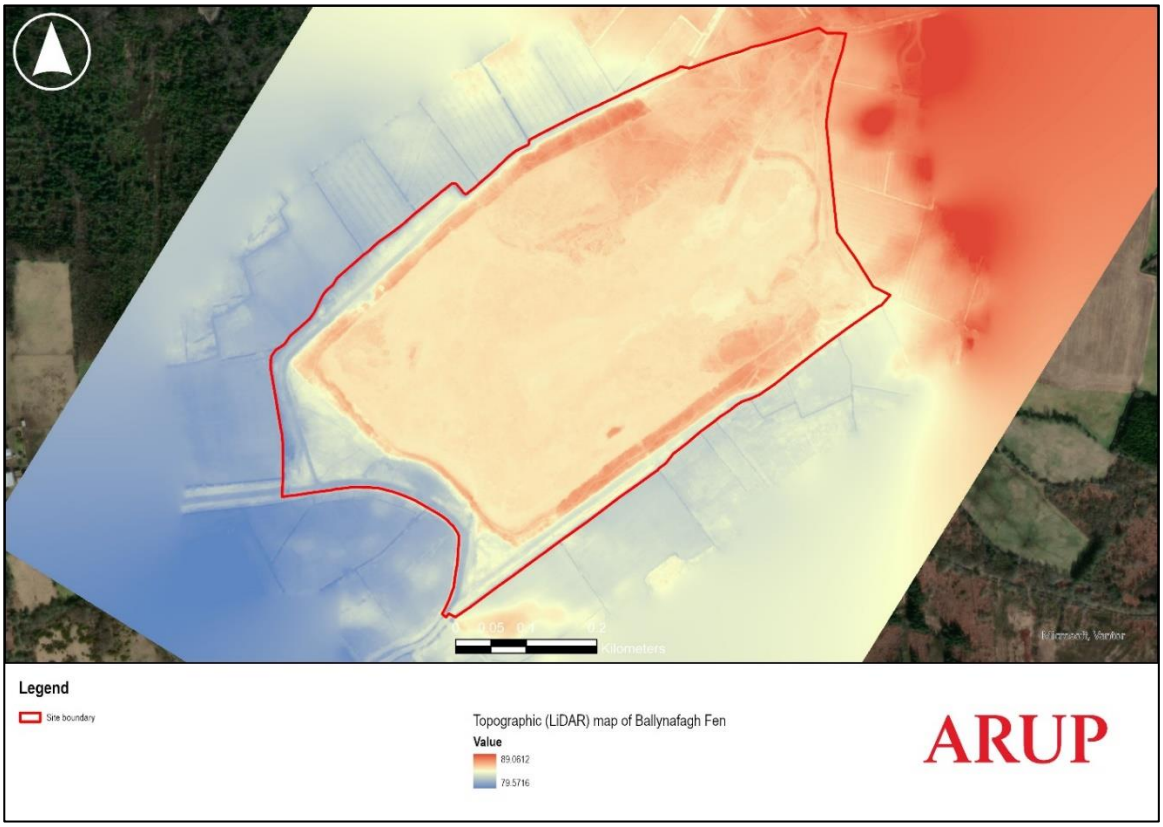


Figure 3.1-11: DTM Topographic (LiDAR) map of Ballynafagh Lake SAC

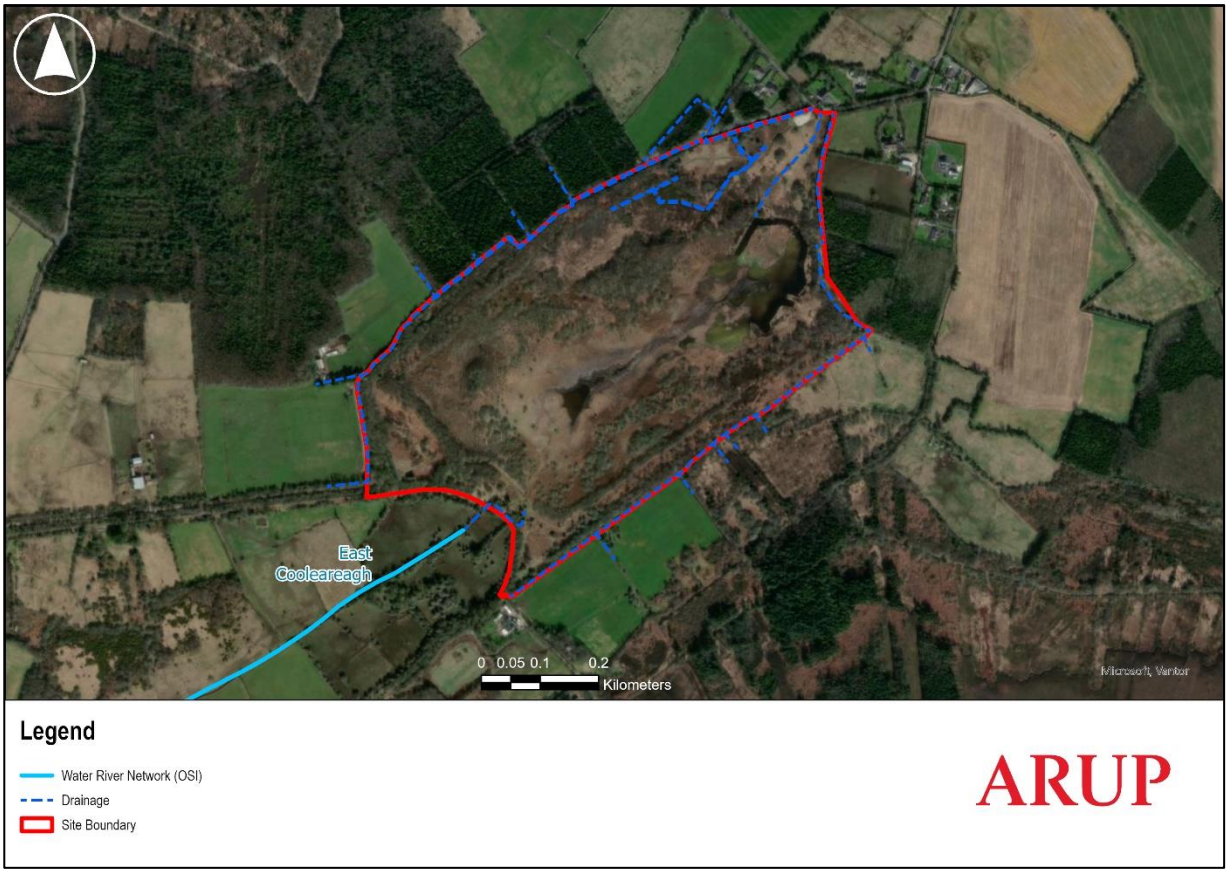


Figure 3.1-12 Mapped drainage network of Ballynafagh Lake SAC

3.1.4 Land use Pressures and Water Quality

Pollution Impact Potential (PIP) maps (EPA 2025) show the highest risk areas in the landscape for losses of Nitrate and Phosphorus to waterbodies. The PIP models estimate the annual nutrient losses from agricultural land using spatial data on farm management, soil and hydrogeology. This information is relevant to the SSCO attribute “Water quality – Nutrients” and informs assessment against the SSCO target to maintain nutrient levels and support favourable conservation condition.

PIP mapping indicates that the risk of nitrate loss is generally low within the immediate vicinity of the lake. Very low and low risk nitrate classes are present near surface within a 500 m radius of the SAC, indicating a low vulnerability to nitrate leaching in the immediate catchment of the lake to the soil layer (Figure 3.1-13). The susceptibility of nitrate loss in the subsurface layer, connected to groundwater, is low within a 500 m radius of the SAC (Figure 3.1-14).

In contrast, phosphorus PIP mapping identifies areas of elevated phosphorus risk in close proximity to the SAC boundary, typically associated with poorly draining soils and dominant overland flow pathways (Figure 3.1-15).

The flow delivery pathway mapping shown in Figure 3.1-15 indicates that phosphorus flow delivery paths within the site range from medium to high risk, with several high risk runoff pathways to the east and north of the site. While the pathways to the north of the site are likely intercepted by the boundary drain, pathways from the east represent potential routes for nutrient enrichment of lake and fen waters, particularly during high rainfall events.

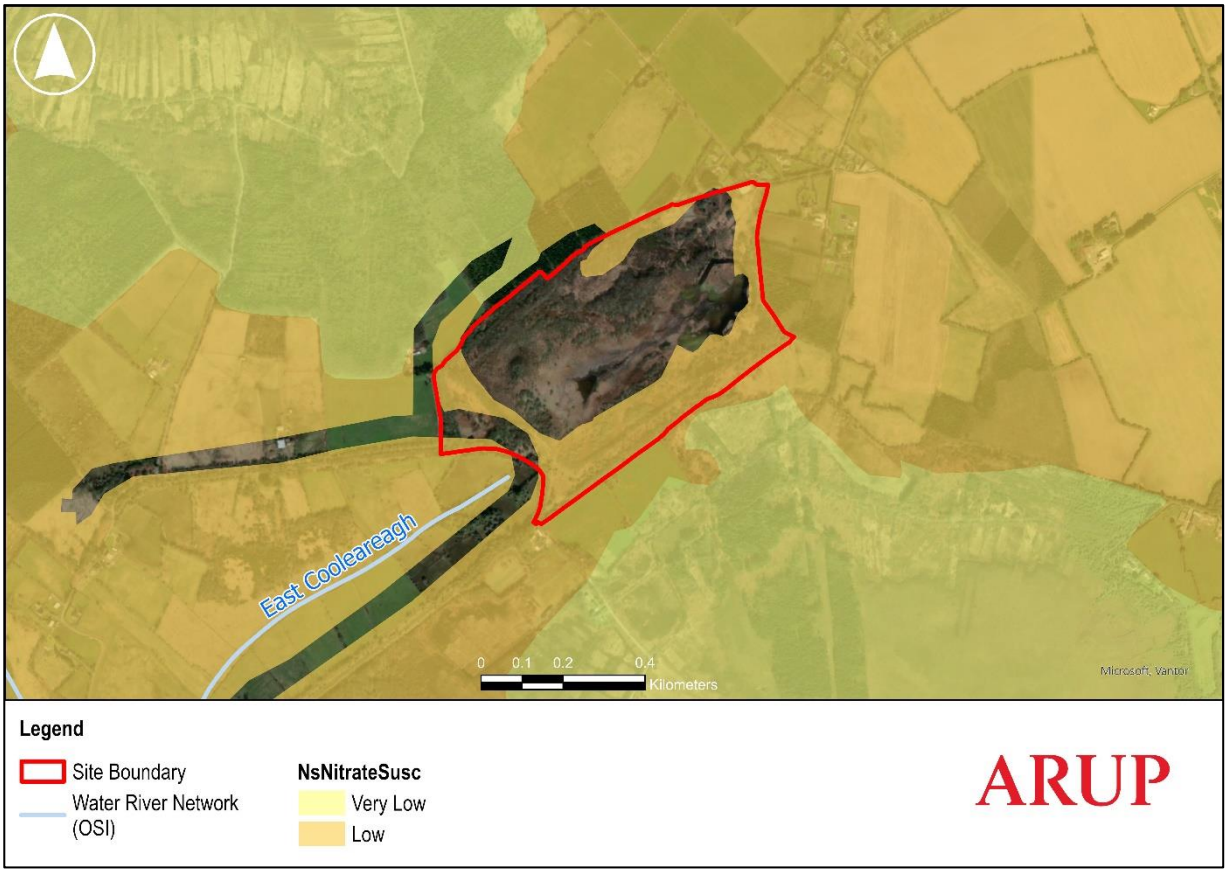


Figure 3.1-13: PIP maps (Nitrate – near surface) of Ballynafagh Lake SAC (EPA, 2021)

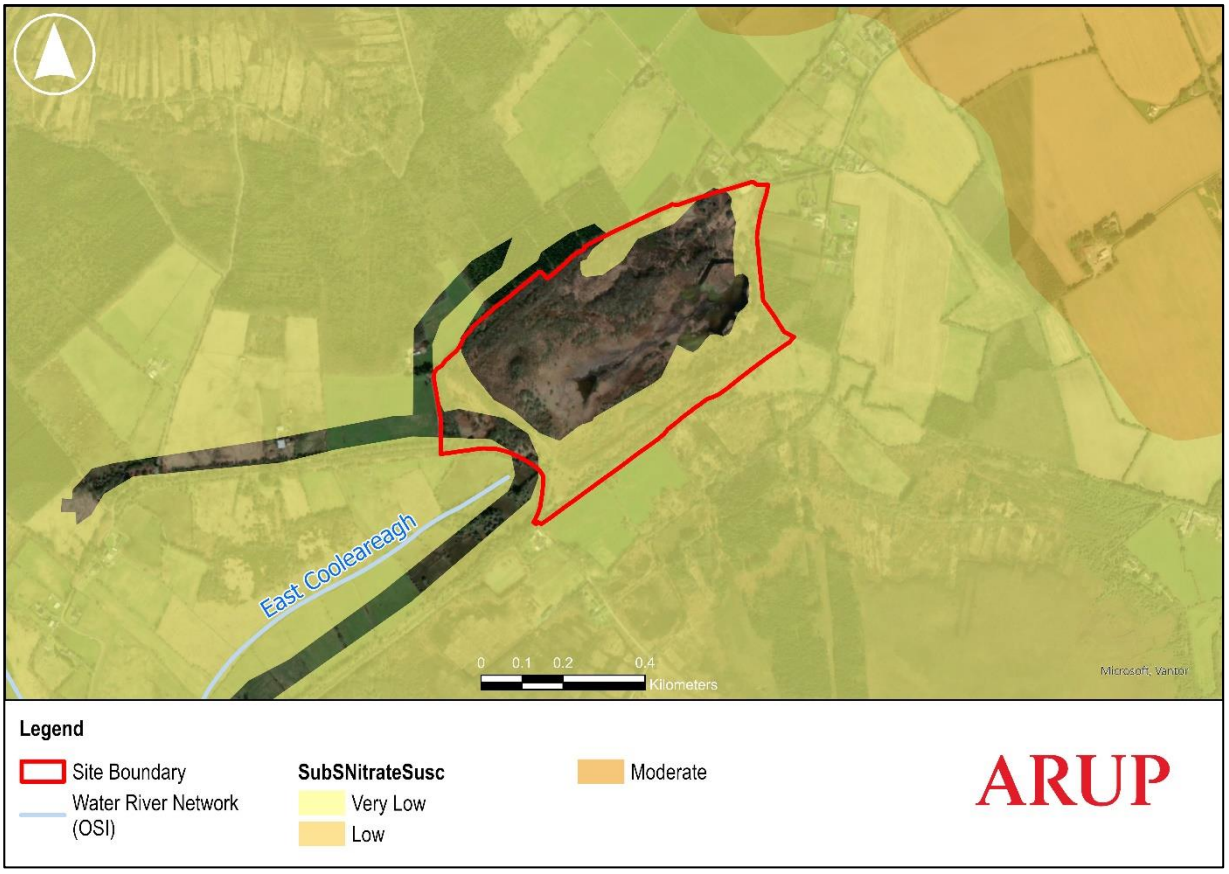


Figure 3.1-14: PIP maps (Nitrate – sub surface) of Ballynafagh Lake SAC (EPA, 2021)

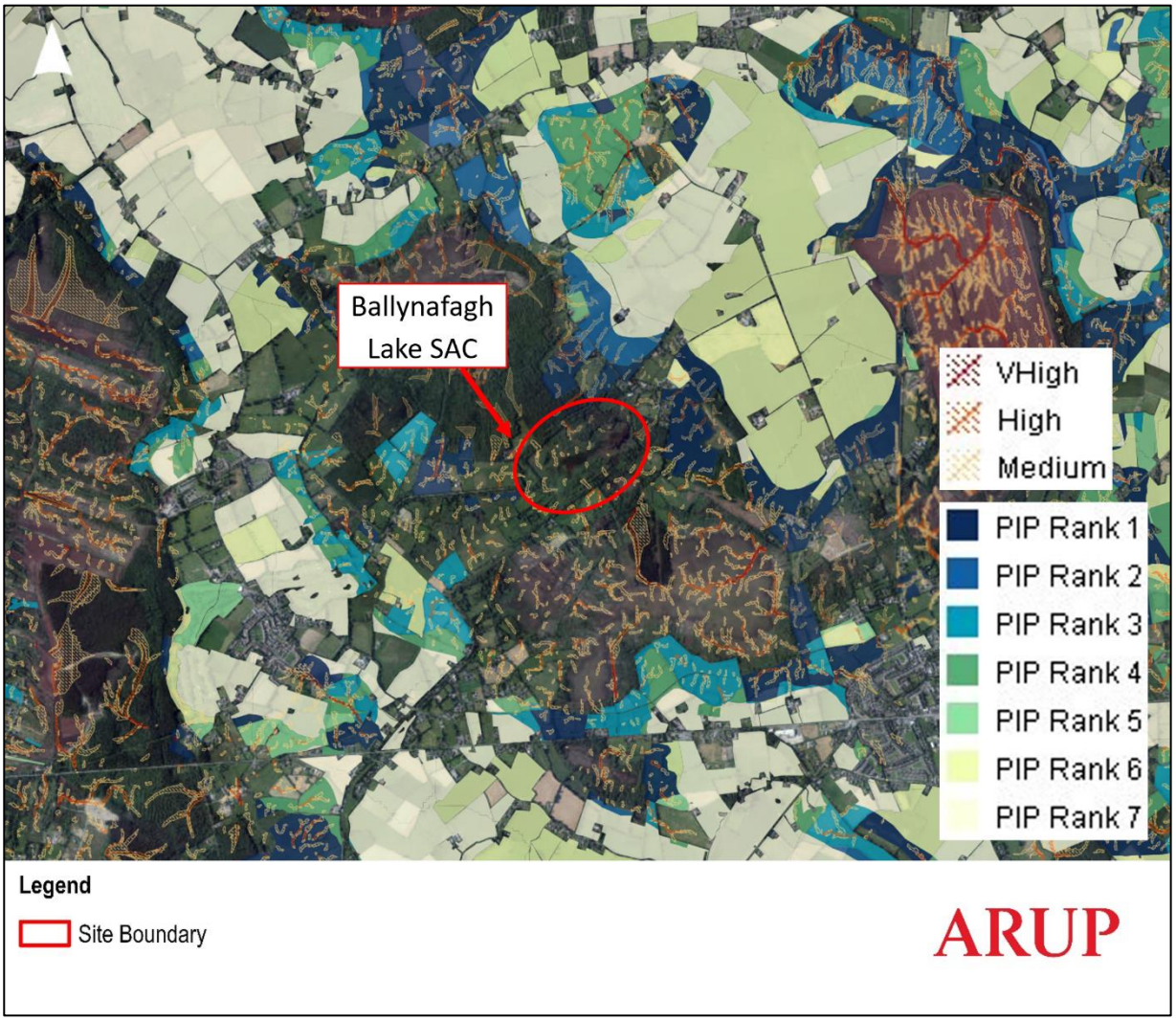


Figure 3.1-15: PIP maps + Flow delivery paths and points (Phosphorus) of Ballynafagh Lake SAC (EPA, 2021)

3.2 Field Survey

As part of the 2022 NFS, water sampling was undertaken to measure electrical conductivity (EC), pH and peat depth. Recorded EC values ranged from 246 to 950 µS/cm, pH values ranged from 4.66 to 8.16 and peat depths where between 307 to 310 cm (Brophy et al., 2022).

Site monitoring was undertaken in February and May 2026, focusing on developing the understanding of the water regime, pressures and implementation of restoration measures within the habitat. The site monitoring included peat depth probing, water quality monitoring and observations of water flow in the drainage network, such as water level and width.

For water quality monitoring, the parameters recorded included electrical conductivity (EC), pH, temperature, phosphate and nitrate.

The 20 monitoring locations for Ballynafagh Lake are shown in Figure 3.2-1, including areas within the fen habitat, adjacent to the springs, and at the inflow and outflow points of the lake.

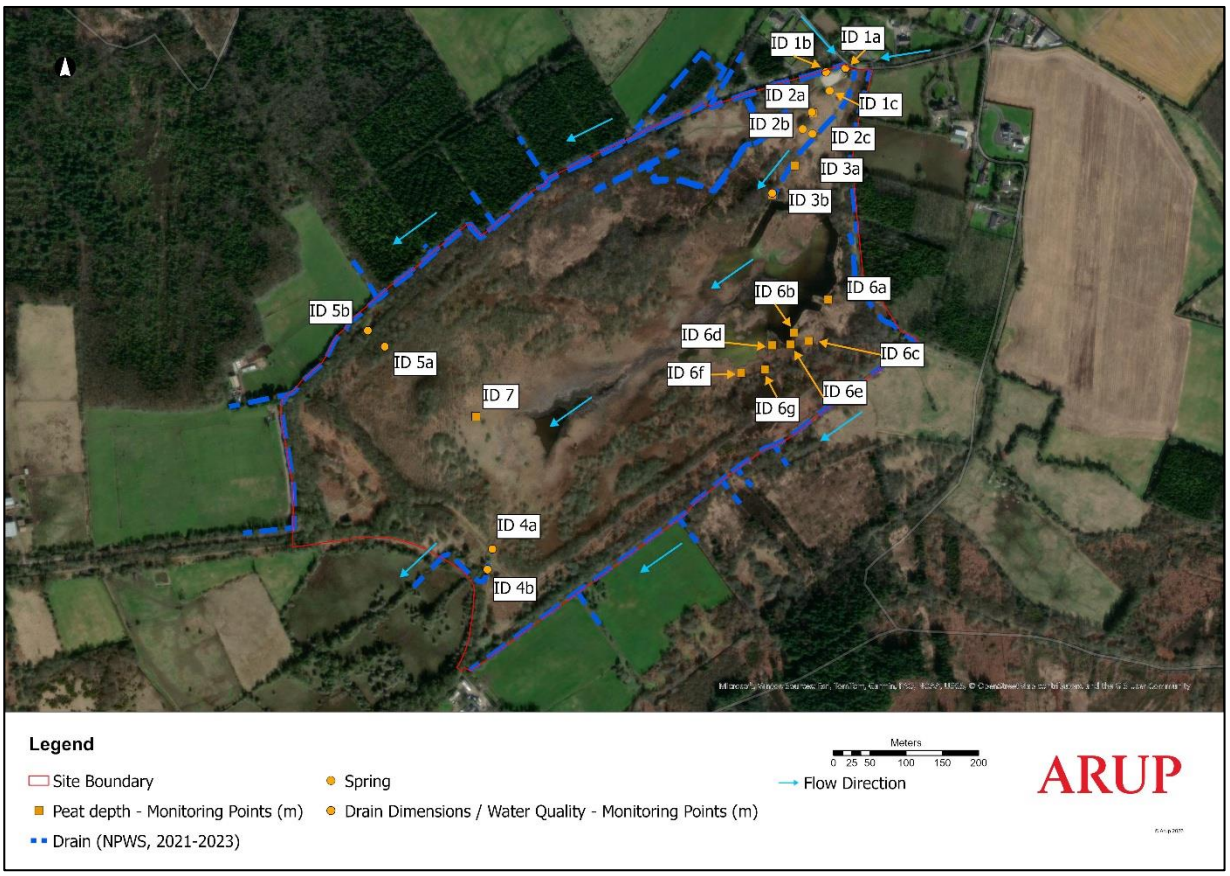


Figure 3.2-1: Baseline monitoring locations of Ballynafagh Lake SAC

3.2.1 Peat Depth Probing and Ground Investigations

Peat depth measurements indicated a depth of 2.05 m in the vicinity of the springs (Points 2a, 2b and 2c) (Figure 3.2-2). Further probing adjacent to the lake's edge produced measurements ranging between 2.14 to greater than 3.5 m (Points 3a to 6g).

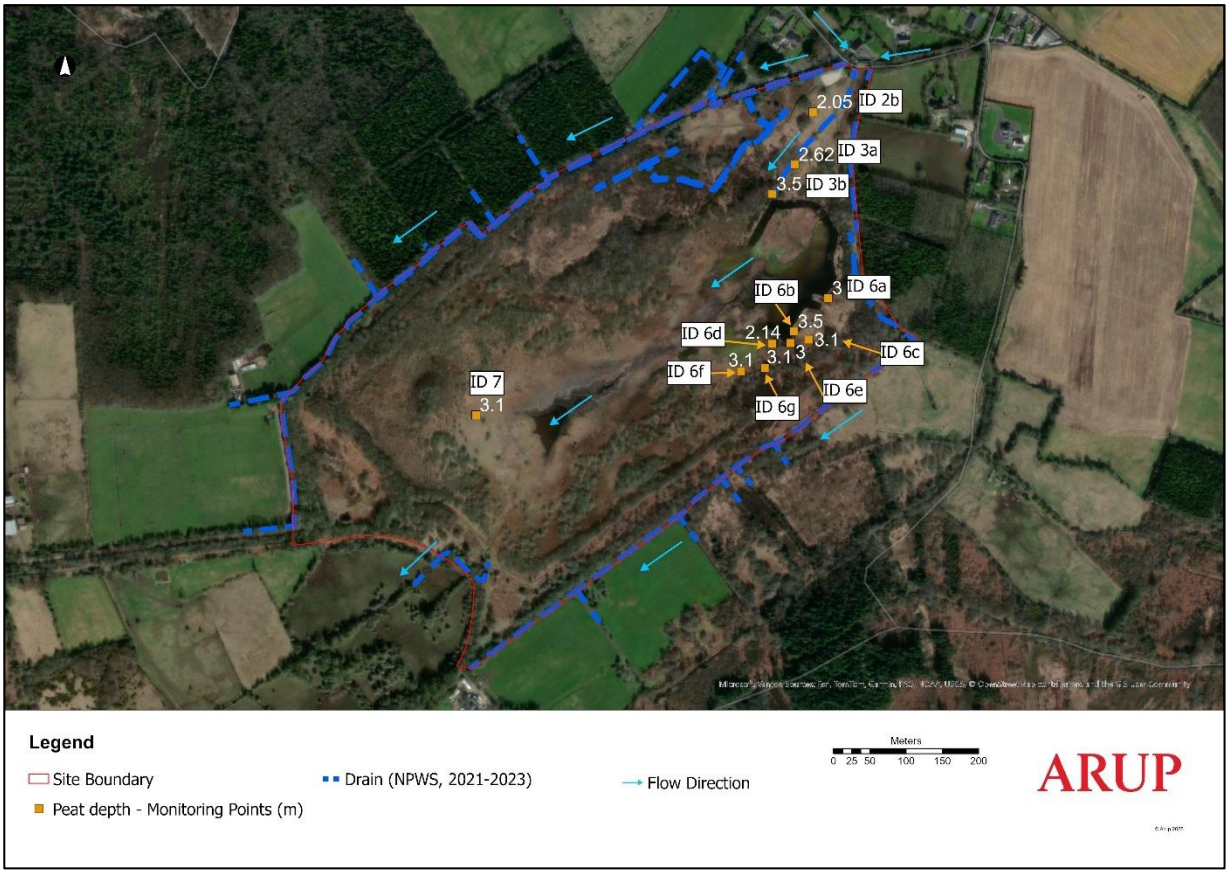


Figure 3.2-2: Baseline peat depth monitoring locations of Ballynafagh Lake SAC

3.2.2 Groundwater Levels and Springs

During site visits, three petrifying springs were observed to the northeast of Ballynafagh Lake. These locations were characterised by persistently wet conditions and visible tufa deposition. No measurements of spring discharge rates were undertaken as part of the field survey, and the hydrogeological source areas feeding individual springs could not be determined from site observations alone.

3.2.3 Surface Water levels

There are two EPA water level gauges inside Ballynafagh Lake SAC, namely Ballynafagh (Stream) and Ballynafagh Lake O/L (Lake Outlet) (Figure 3.2-3). Water levels were recorded in these gauges from 2007 to 2019. During this period, the levels in Ballynafagh (Stream) generally varied from 84.50 to 84.75 m, although this stream only contributes surface water inflow into the lake under certain conditions. For Ballynafagh Lake O/L (Lake Outlet), the levels varied from 82.18 to 82.42 m (Figure 3.2-4).

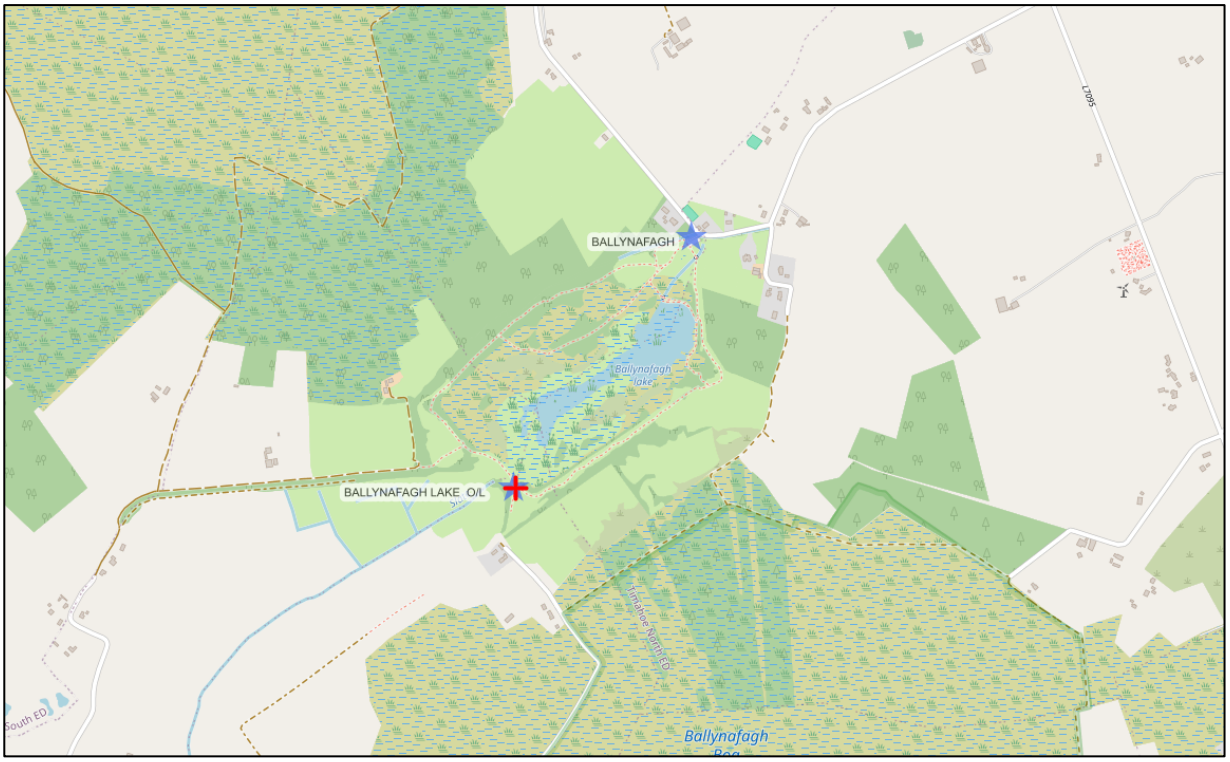


Figure 3.2-3: Location of EPA water level gauges in the vicinity of Ballynafagh Lake SAC (EPA,2026)

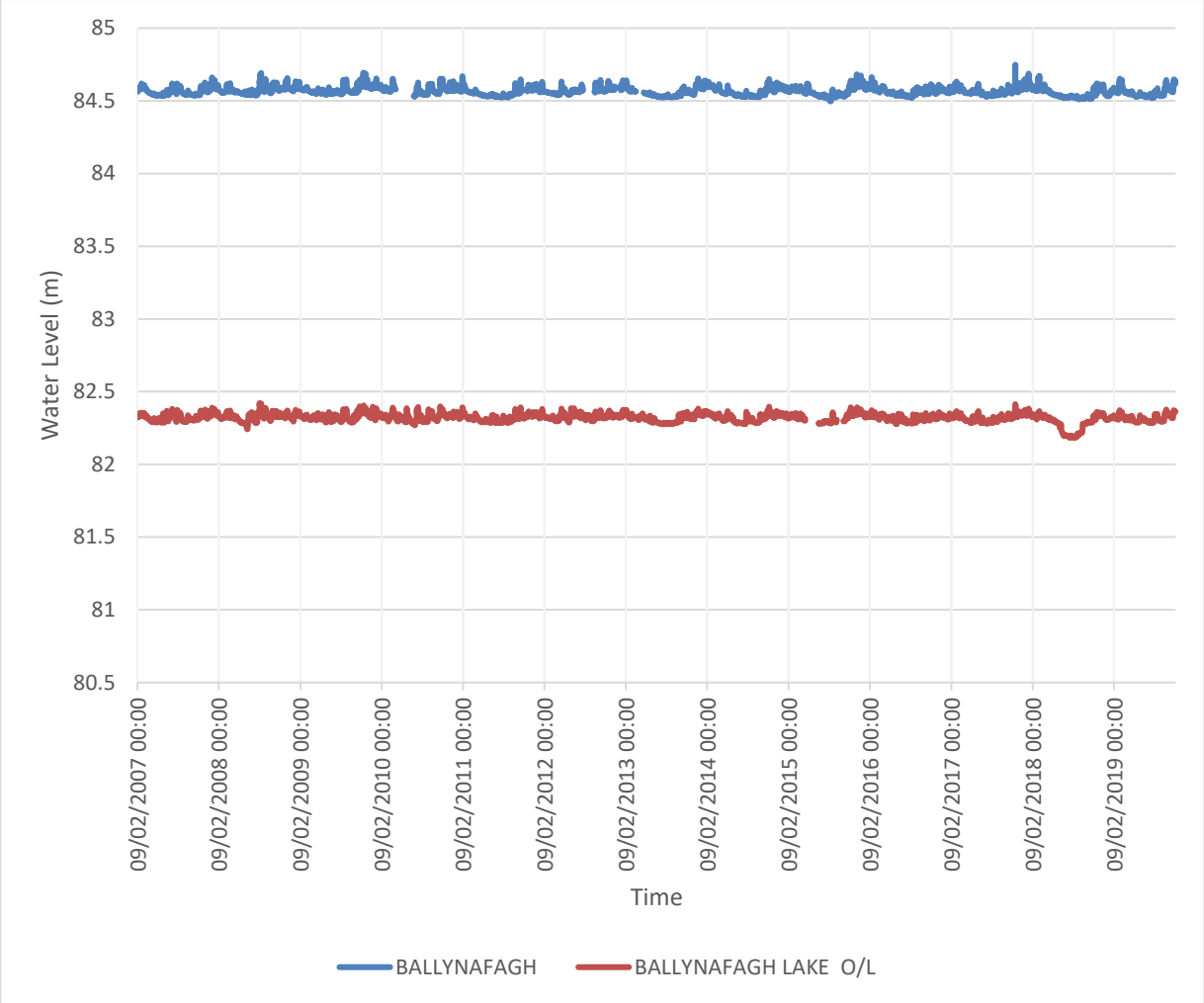


Figure 3.2-4: Water levels from 2007 to 2019 at EPA gauges in the vicinity of Ballynafagh Lake SAC (EPA,2026)

The main flow paths are through the site from northeast to southwest towards the lake and around the perimeter of the site. The numbered locations of these points are shown in Figure 3.2-1 above, while their dimensions are shown in Figure 3.2-5 below. The first points surveyed in the northeastern boundary of the site had a depth of approximately 0.15 m and a width ranging from 1.2 (Point 1a) to 2 m (Point 1b) from the site boundary to the southwestern limit of the parking. Three springs were identified to the northeast of the site (Points 2a–2c). Two of these springs (Points 2a and 2b) exhibited very shallow water depths of approximately 0.05–0.10 m. The third spring (Point 2c), located further to the southeast, had a greater depth of approximately 0.7 m, with a preferential flow path conveying spring water towards the lake (Figure 3.2-5).

Further southwest, the main drain conveying inflows to the lake (Point 3) flowed in a south□westerly direction and had an approximate depth of 0.5 m and a width of 1.5 m. The water was observed to be yellowish in colour, and the rectangular drain supported dense vegetation on both the bed and water surface (Figure 3.2-5).

At the lake outflow culvert, two survey points were recorded: one upstream (Point 4a) and one downstream (Point 4b), both flowing south‑westwards. Upstream of the culvert, the drain was approximately 0.1 m deep and 1.2 m wide, with dense vegetation that limited accessibility and made width estimation difficult. Downstream of the culvert, the drain was approximately 0.3 m deep and 1.2 m wide, with extensive vegetation on the bed and clear yellowish water. A concrete structure immediately downstream of the culvert functions as a weir (Figure 3.2-5).

The final survey points were located along the north‑western boundary of the site, where water was observed seeping through a raised berm. Two shallow pools (Points 5a and 5b), each approximately 0.1 m deep, were connected by a narrow stream approximately 0.15 m wide. The pools were muddy along the margins but clearer in the centre. Further to the northwest, a large perimeter drain approximately 6 m wide was recorded at Point 5b (Figure 3.2-5).

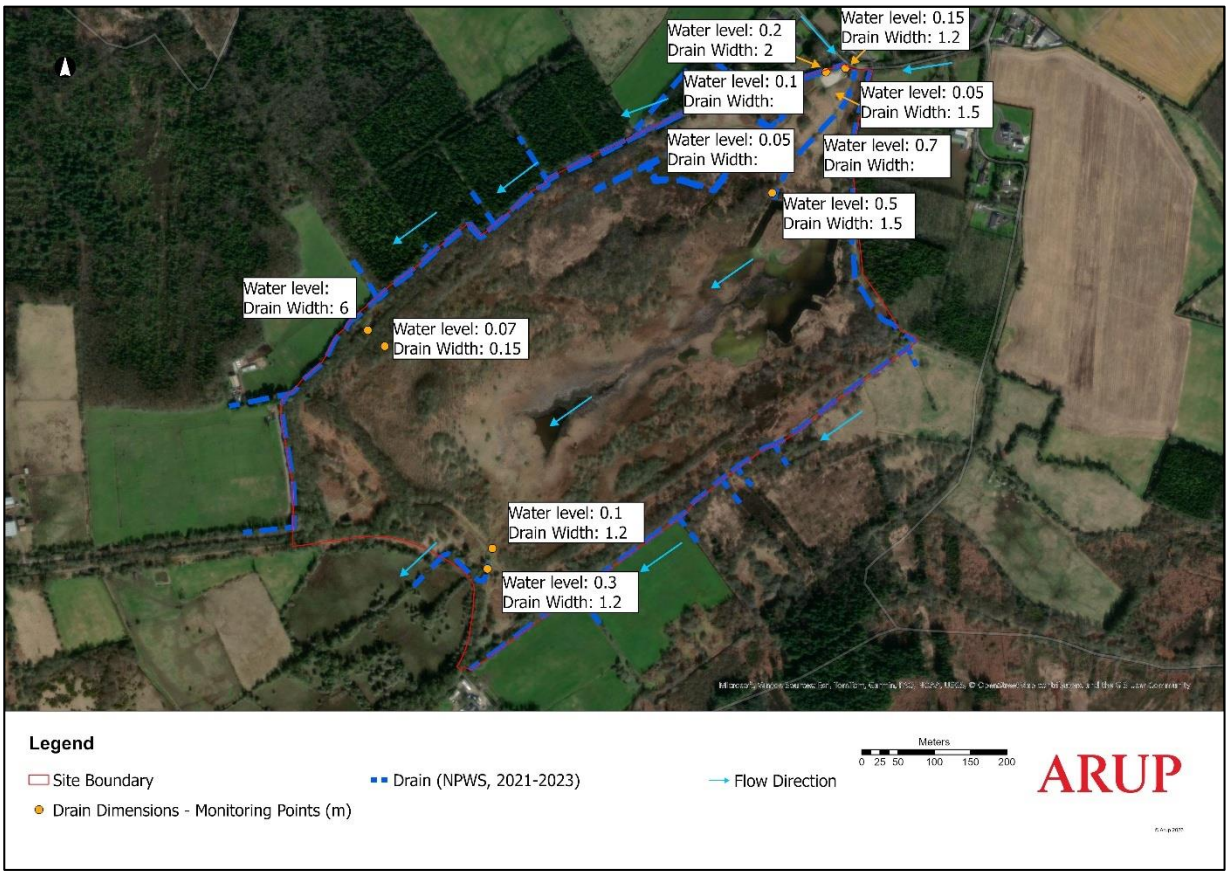


Figure 3.2-5: Baseline ground and surface water monitoring locations of Ballynafagh Lake SAC

3.2.4 Water Quality

Water quality in Ballynafagh Lake was measured at points 1b, 2a, 2c, 3b, 4a, 4b, 5a and 6e, as seen in Figure 3.2-6 and Figure 3.2-7 below. Sampling locations include both groundwater-fed springs (e.g. Points 2a, 2b and 2c) and surface water flows (e.g. perimeter drains and at the lake inflow and outflow points) and therefore reflect a combination of groundwater and surface water chemistry within the system. Results of this monitoring indicates pronounced spatial

variability in nutrient concentrations across Ballynafagh Lake, with evidence of elevated nutrient inputs along key inflow pathways to the lake.

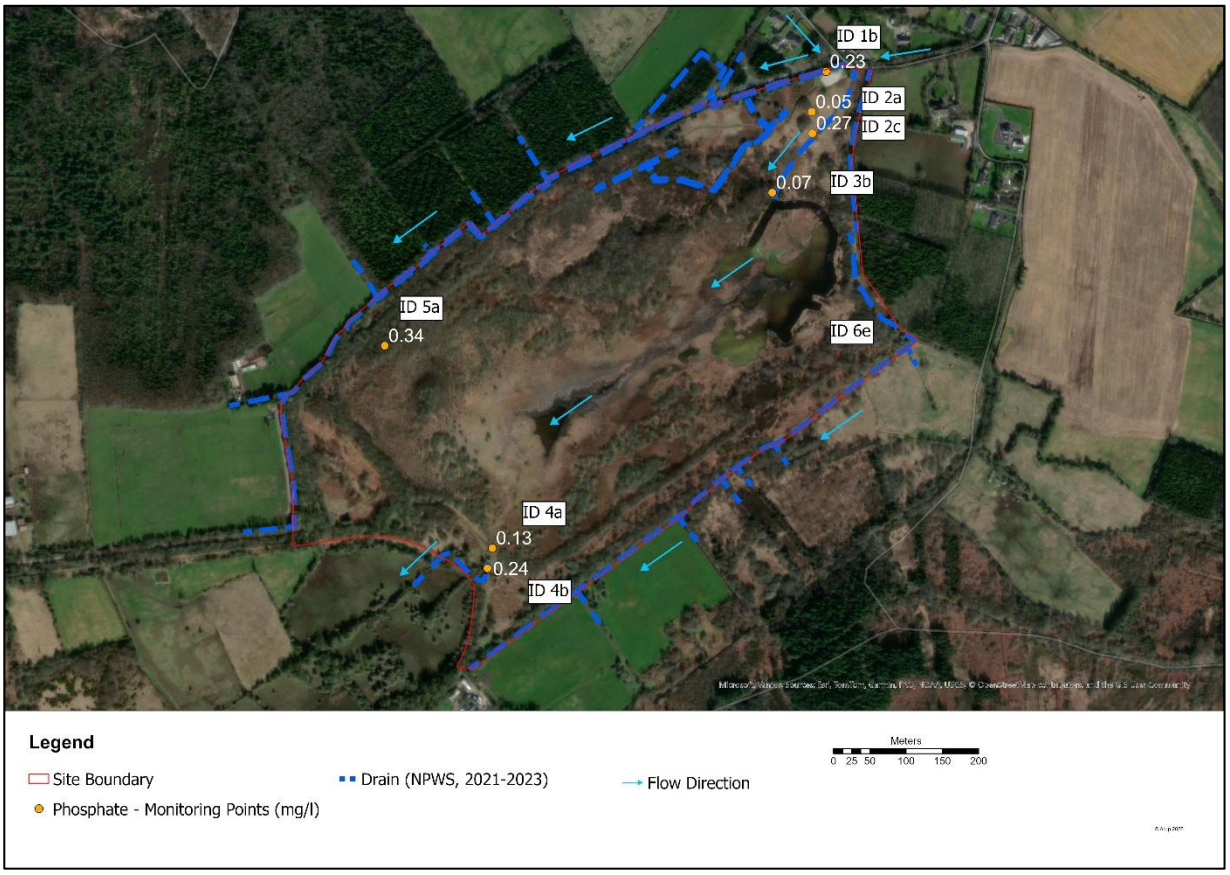


Figure 3.2-6 Phosphate concentrations across Ballynafagh Lake SAC

Phosphate concentrations (PO_4) varied along the site from 0.05 mg/L at the northern spring (Point 2a) to 0.34 mg/L at the northwestern extent of the site (Point 5a). All recorded surface water concentrations exceeded the WFD Good Status environmental quality standard for Phosphate of 0.035 mg/L PO_4–P [2].

[2] S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009

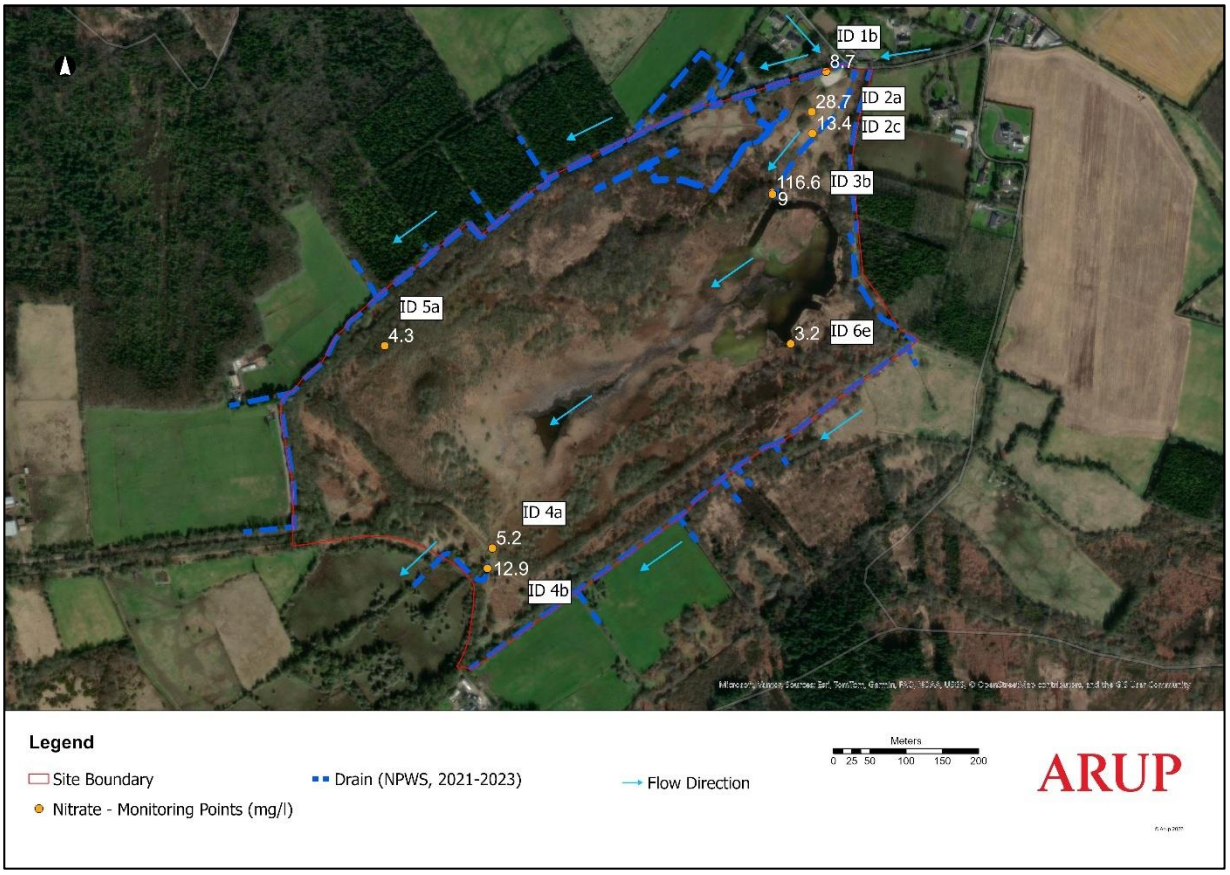


Figure 3.2-7: Nitrate concentrations across Ballynafagh Lake SAC

Nitrate (NO_3^-N) concentrations were generally elevated across the site. The lowest concentration was recorded at the edge of the lake in May 2026 (3.2 mg/L NO_3-N at Point 6e), while the highest concentration was measured in February 2026 in the main drain discharging to the lake (Point 3b), where concentrations reached 116.6 mg/L NO_3-N. It should be noted that a second sample was taken at point 3b in May 2026 with a value of 9mg/L NO_3-N, indicating that the February measurement may have been influenced by a temporary upstream input or surge in nutrient loading. The values across the site exceed typical ecological thresholds associated with groundwater-dependent fen systems (approximately 1.8 mg/L NO_3-N (Wheeler et al., 2009)), and in some cases also exceed the EU Groundwater Directive threshold of 50 mg/L NO_3^- (equivalent to approximately 11.3 mg/L NO_3-N) (European Commission, 2006). These results indicate a strong spatial variability in nitrate inputs, with particularly elevated levels associated with the main groundwater-fed surface inflows to the lake indicating pathways of nitrate enrichment.

The Blackwood Feeder Baseline Study (BFBS) included baseline water quality sampling for a range of parameters taken at three locations over July to September 2005 (Hayes, 2006). A comparison of pH, conductivity and nitrate levels from 2005 and recent sampling results are presented in Table 3-2, while Figure 3.2-8 to Figure 3.2-10 demonstrate these recent field survey results spatially. Generally, the pH values recorded during the recent site visit were

comparable with those reported in 2005. Electrical conductivity values recorded in the BFBS were higher than those measured during the 2026 survey, particularly in the stream entering the lake. Water temperatures recorded during the 2026 sampling were similar to those reported in the BFBS at the springs, although higher temperatures were recorded at the stream entering the lake.

Table 3-2: Comparison of water quality parameters between Blackwood Feeder Baseline Study and 2026 site visits

Parameters	BFBS (Hayes, 2006)				Recent site monitoring		
	GW Spring (21/07/05)	GW Spring (15/11/05)	Stream entering the lake (21/07/05)	Stream entering the lake (15/11/05)	GW Spring 2a (24/02/26)	GW Spring 2c (24/02/26)	Stream entering the lake (Point 3) (24/02/26)
pH	7.21	7.25	6.7	5.8	7.11	7.67	-
Conductivity (µS/cm)	898	818	816	809	771	304	641
Temperature (ºC)	11	9.9	7.49	7.55	10.5	9.5	9.8

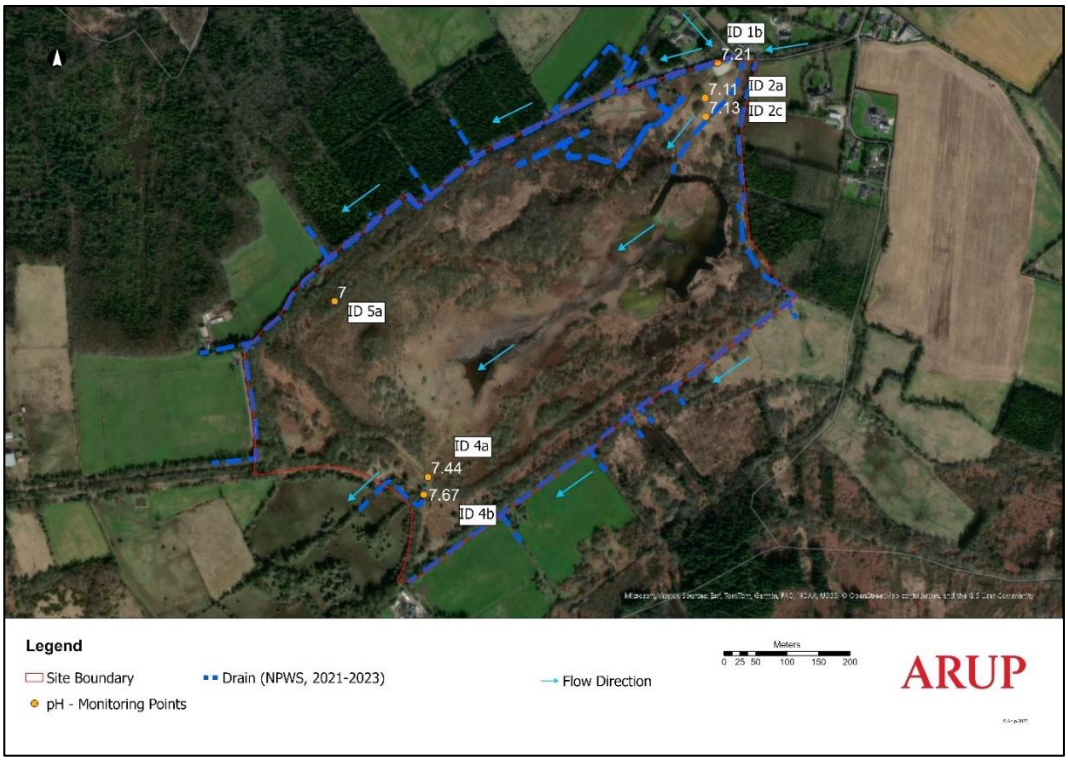


Figure 3.2-8: pH levels across Ballynafagh Lake SAC

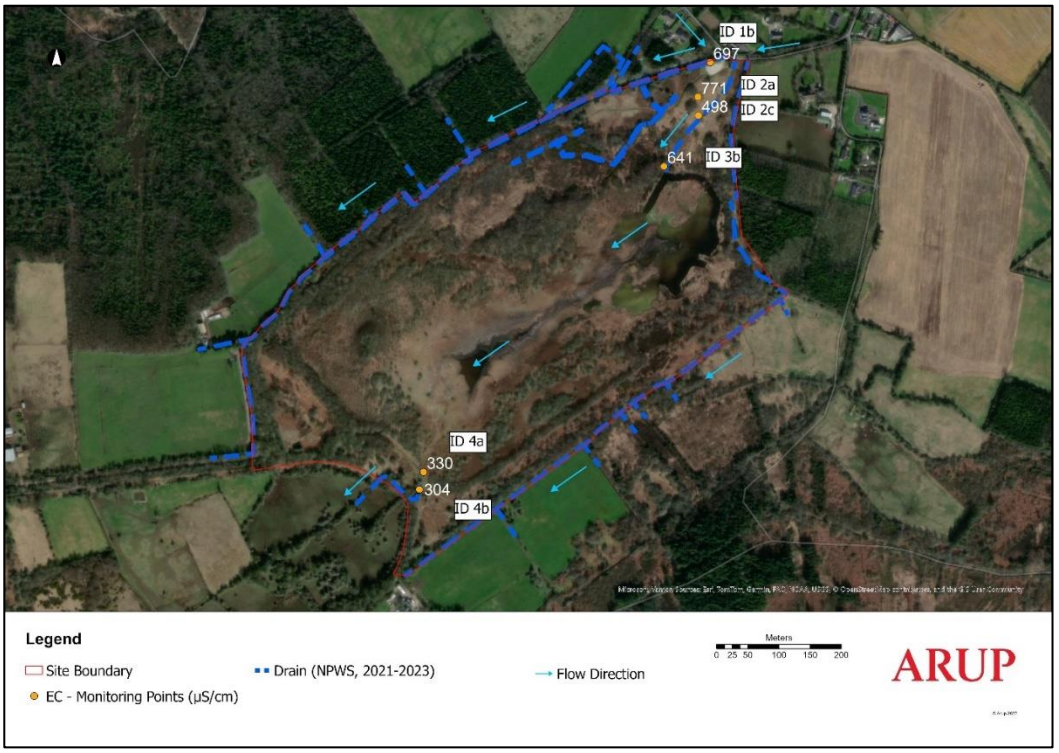


Figure 3.2-9: Conductivity levels across Ballynafagh Lake SAC

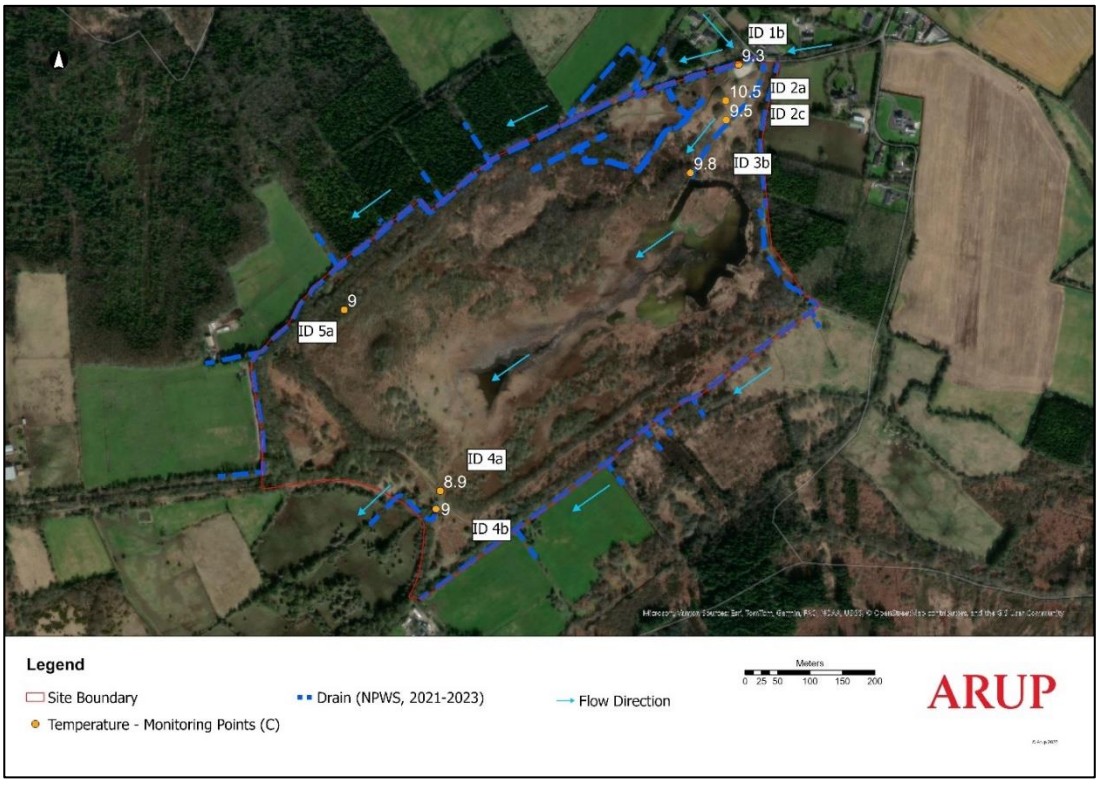


Figure 3.2-10: Temperature across Ballynafagh Lake SAC

Overall, the water quality results indicate nutrient enrichment within Ballynafagh Lake, particularly with respect to phosphate and nitrate inputs via groundwater-fed surface inflows into the lake. These water quality results are relevant to the site-specific conservation objectives for Ballynafagh Lake, particularly those relating to the maintenance of appropriate nutrient conditions. As fens are typically nutrient-poor systems with respect to nitrogen and phosphorus, the recorded concentrations indicate enrichment that could impede the achievement of the conservation targets. In addition, phosphate concentrations exceed thresholds associated with WFD Good Status, while recorded nitrate concentrations are elevated to levels that may pose a risk to ecological condition, surpassing limits outlined by both ecological thresholds and the EU Groundwater Directive.

3.3 Conceptual Site Model

Ballynafagh Lake SAC is a minerotrophic and groundwater influenced system and is characterised as a combination of open water transition and groundwater-fed fen systems under the WETMEC framework. Based on its hydrological setting, peat characteristics and the presence of Annex I 7230 Alkaline fen and 7220 Petrifying springs habitat, the site is characterised as WETMEC 13 (Open Water Transition) associated with the areas of transition mire habitat, while the drained centre of the site can be categorised as WETMEC 9b (Groundwater-Fed Bottoms, Part-Drained) (Wheeler et al. 2009) .

These classifications reflect the dominant hydrological setting and water-supply mechanisms across the site; however, elements of these systems are also hydrologically modified by historic drainage and lake-level management, which is addressed through the pressures and restoration measures set out later in this plan. This is of particular importance as stable water levels are required to maintain WETMEC 13 conditions, and hence care must be taken to avoid rapid or excessive fluctuations in water level which may destabilise the quaking mats.

The characteristics of the site are:

- The topography of the site is generally flat. Slightly elevated ground and associated gravel deposits occur along the northern boundary of the SAC and influence groundwater discharge patterns.
- A 1100 m northeast–southwest cross section through the Ballynafagh SAC indicates up to 3 m of cut-over peat overlying low-permeability limestone-derived till, estimated to be approximately 10 m thick based on groundwater vulnerability mapping. Beneath this, the site is underlain by a locally important aquifer with bedrock of generally moderate productivity, increasing locally where groundwater vulnerability shifts from low to moderate (Figure 3.3-1). Additionally, there are faultlines northwest and southeast of the site (GSI, 2025) that may locally influence groundwater movement.

- The principal surface water feature within the site is Ballynafagh Lake, which occupies much of the SAC and functions as the central hydraulic feature of the system. Surface water inflow is limited, although a drain entering the site from the north-eastern boundary contributes surface water under certain flow conditions. Drainage channels along site boundaries provide the main surface water outflow, with water ultimately discharging toward the Slate River to the south-west.
- Springs associated with the gravels along the northern boundary provide recharge into the fen site and play a key role in sustaining site hydrology and associated Annex I habitats and species. These areas are characterised by visible tufa deposition and support base□rich fen vegetation, indicating calcium□rich groundwater inputs. Based on the contrast in permeability between the gravel deposits and the surrounding peat, groundwater is interpreted to emerge at the ground surface where permeable deposits interface with lower□permeability peat, forming springs and seepages.
- These groundwater inputs maintain the minerotrophic conditions required for Annex I alkaline fen and petrifying spring habitats and support classification of much of the fen system as groundwater□fed (WETMEC 9b), with marginal areas of quaking bog associated with the lake-fen interface being classified as WETMEC 13.
- Hydrological modifications at Ballynafagh Lake relates primarily to its historic function as a managed canal reservoir. Decommissioning of the feeder system and deterioration of control structures have altered this managed regime. While groundwater springs continue to provide localised inputs to the system, the lake has experienced a drying trend and fluctuations in lake extent and marginal wetness.
- The site's hydrological characteristics result from the combination of groundwater discharge, limited surface water inflow and historical drainage modification. These elements have influenced habitat development and the spatial distribution of springs and seepages over recent decades. Ballynafagh Lake is classified as a predominantly soligenous fen system, with lateral water movement entering via groundwater springs and minor surface inflows, and draining toward the Slate River under typical conditions, resulting in a generally through flowing hydrological regime.

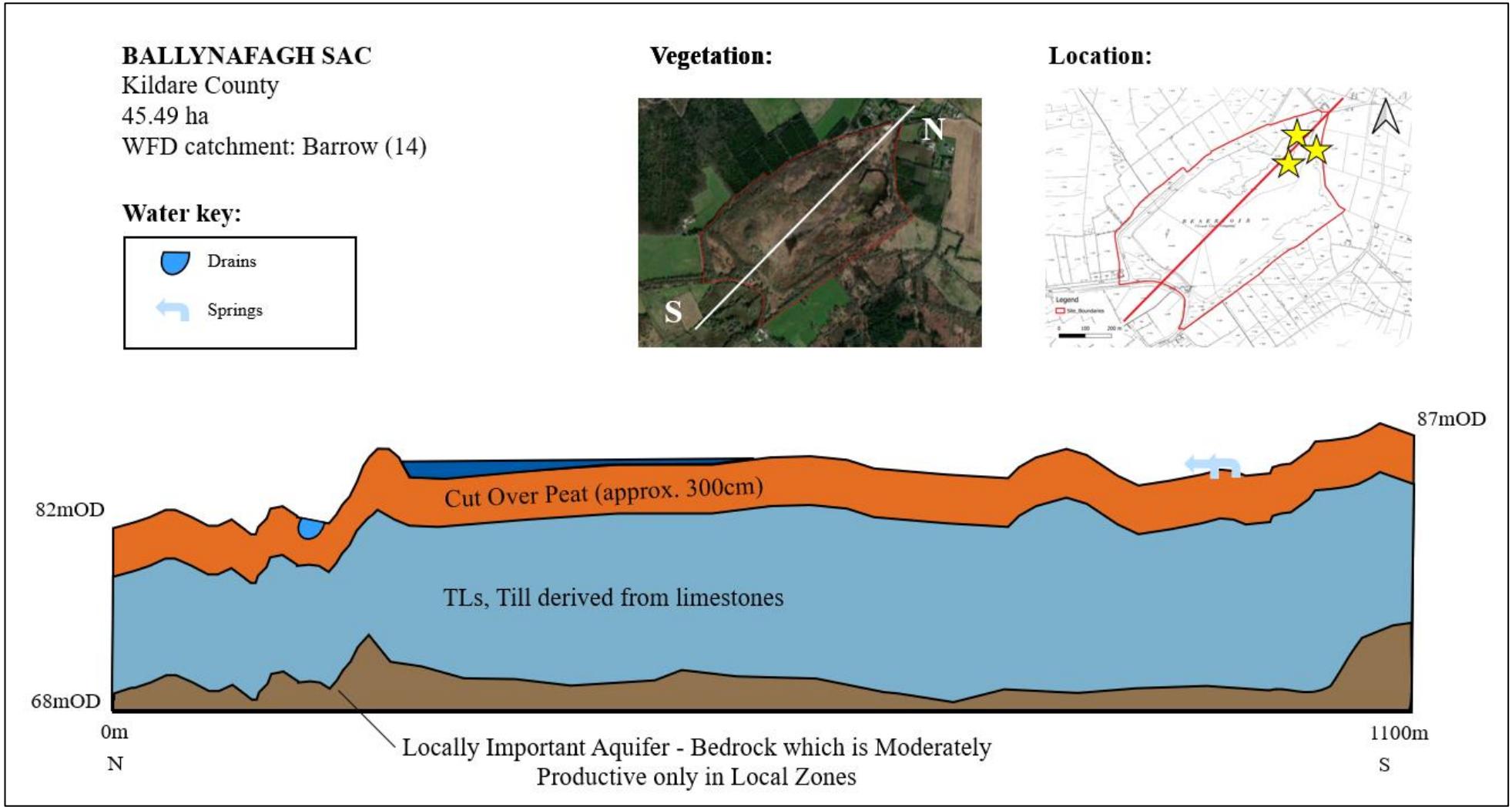


Figure 3.3-1: Conceptual Site Model of Ballynafagh Lake SAC

4 Ecology

4.1 Desk Study

A review of available desktop information on the ecological baseline for Ballynafagh Lake SAC was reviewed from the below information sources:

- NPWS Protected Sites – Special Areas of Conservation – Ballynafagh Lake SAC;
- NPWS Article 17 habitats distribution datasets;
- National Fen Survey (Brophy et al., in prep);
- Biodiversity Maps - National Biodiversity Data Centre (NBDC);
- World Imagery Wayback - ArcGIS;
- Plant Atlas 2020 website - Botanical Society of Britain & Ireland (BSBI);
- Monitoring of Sites and Habitat for Three Annex II Species of Whorl Snail (Vertigo) - (Maria P. Long and John T. Brophy);
- Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs, 2025 – Irish Wildlife Manuals 160.

The NFS was commissioned to develop and test a standardised methodology for assessing the conservation status of fen habitats across Ireland. As part of this study, Ballynafagh Lake SAC was selected as one of the sites for field survey. The site was surveyed in July 2022, with a focus on Annex I wetland and fen habitats. The survey methodology included:

- Detailed vegetation assessments using quadrats to record species composition and structure.
- Hydrological observations such as water levels and flow.
- Documentation of disturbance indicators including drainage, grazing, and invasive species.

GPS mapping and photographic records were also used to support habitat boundary delineation and condition assessment. While the primary emphasis was on habitat quality, vascular plants and bryophytes were recorded as part of the vegetation surveys, contributing to an understanding of species diversity and habitat integrity at the site.

4.1.1 Habitats

The NFS revealed that the site comprises of a mosaic of Annex I 7230 Alkaline fens with Annex I quality 7140 Transition mires, 7220 Petrifying springs, and 91E0 Alluvial forests as well as reed and large sedge swamps, wet grassland, scrub, wet willow-alder-ash woodland, bog woodland, cutover bog, dense bracken, and buildings and artificial surfaces. Drains largely occur around the borders of the site.

4.1.1.1 Annex I Habitats

The following Annex I and Annex I quality habitat was identified and mapped:

- **7230 Alkaline fens** covering approximately 0.59ha. Located across the site in two areas, this Annex I habitat is represented by typical species including *Schoenus nigricans*.
- **7140 Transition mires** covering approximately 2.16ha. This Annex I quality habitat is spread across the centre of the site, with a large population of *Pyrola rotundifolia* recorded.
- **7220 Petrifying springs** – covering approximately 0.024ha. This Annex I quality habitat is present in the form of two flush springs.
- **91E0 Alluvial forests** - located in three areas in the south of the site.

It should be noted that the resulting mapping of Annex I and Annex I quality habitats from the NFS survey requires suitable interrogation and interpretation as to the extent of these habitats within each polygon i.e. Annex I habitat mapping is represented by the habitat that has the highest percentage attributed to the polygon. Therefore, polygons could be a mosaic or only support a small percentage of Annex I habitat within the overall polygon area and thus must be interpreted appropriately.

4.1.1.2 Non-Annex/Fossitt habitats

Non-Annex I fen and other habitats were also recorded, with mapping based on Fossitt classification (Fossitt, 2000). Habitats recorded are detailed in Table 4-1 and Figure B-1, Appendix B.

Table 4-1: Habitat types and locations at Ballynafagh Lake SAC

Habitat Type	Location	Notes
BL3 – Buildings and artificial surfaces	Present in the north of the site.	Minimal coverage., not the dominant habitat in this area.

Habitat Type	Location	Notes
FW4 – Drainage ditches	Along the borders of the side, with a network of drains also present in the north of the site.	Drains run through a range of habitats.
GS4 – Wet grassland	Largely present within the east of the site.	Not a dominant habitat where it is present within the site.
FS1 – Reed swamp	Present in the south and centre of the site.	91E0 Alluvial forests present in this area.
HD1 – Dense bracken	Present in areas in the north and east of the site.	Dominant habitat in these areas.
PB4 – Cutover bog	Present in areas in the north and east of the site.	Dominant habitat in these areas,
WS1 - Scrub	Present in areas in the north, south and centre of the site.	Dominant habitat in these areas, present elsewhere across the site at a reduced density.
WN6 – Wet willow-alder-ash woodland	Present in areas in the north, northeast and centre of the site.	Dominant habitat in these areas but present elsewhere within the site at a reduced density.
WN7 – Bog woodland	Present within outer areas of the site in the north, east, south, and west.	Dominant habitat in these areas but present elsewhere within the site at a reduced density.

4.1.2 Species

The following subsections outline the presence of species recorded at or within the zone of influence of Ballynafagh Lake SAC. This includes protected species listed under relevant legislation and conservation frameworks such as the EU Habitats and Birds Directives (Annex I, II, IV, and V), the Irish Red Lists, and the Wildlife Acts (including species protected under the Flora Protection Order. Where available, maps of recorded sightings will be provided to support spatial understanding of species distribution. Records are limited to those from the past ten years, reflecting the most plausible timeframe for continued presence and ecological relevance to the site - excepting where invasive species have been historically recorded and there has been no indication since of their elimination.

4.1.2.1 Species Within the Site

The species within Table 4-2 were identified using the NBDC interactive maps service, reviewing the NFS documentation and from the ecological walkover conducted in 2026.

Table 4-2: Notable species records within Ballynafagh Lake SAC

Common Name	Latin name	Description	Most recent record
Black bog-rush	*Schoenus nigricans*	A sedge species that grows in calcareous and base-rich fens, it is associated with 7230 Alkaline fens .	2022
Round-leaved wintergreen	*Pyrola rotundifolia*	A near threatened species of native Irish plant.	2022
Marsh marigold	*Caltha palustris*	A native Irish plant species associated with wetland habitats.	2026
Wild angelica	*Angelica sylvestris*	A native Irish plant species often found in wetland habitats.	2026
Common marsh bedstraw	*Galium palustre*	A native Irish plant species associated with wetland habitats.	2026
Common cottongrass	*Eriophorum angustifolium*	A native Irish plant species associated with wetland habitats.	2026
Marsh horsetail	*Equisetum palustre*	A native Irish plant species associated with wetland habitats.	2026
Water horsetail	*Equisetum fluviatile*	A native Irish plant species associated with wetland habitats.	2026
Blunt-flowered rush	*Juncus subnodulosus*	A native Irish plant species associated with wetland habitats.	2026
Jointed rush	*Juncus articulatus*	A native Irish plant species associated with wetland habitats.	2026
Water mint	*Mentha aquatica*	A native Irish plant species associated with wetland habitats.	2026
Tormentil	*Potentila etecta*	A native Irish plant species often found in wetland habitats.	2026
Marsh arrowgrass	*Triglochin palustre*	A native Irish plant species associated with wetland habitats.	2026
Devil's bit scabious	*Succisa pratensis*	A native Irish plant species associated with wetland habitats.	2026

Common Name	Latin name	Description	Most recent record
Ragged robin	*Silene flos-cuculis*	A native Irish plant species associated with wetland habitats.	2026
Lesser spearwort	*Ranunculus flammula*	A native Irish plant species associated with wetland habitats.	2026
Lesser tussock-sedge	*Carex diandra*	A native Irish plant species associated with wetland habitats.	2026
Small-fruited yellow-sedge	*Carex viridula*	A native Irish plant species associated with wetland habitats.	2026
Bottle sedge	*Carex rostrata*	A native Irish plant species associated with fen and wetland habitats.	2026
Carnation sedge	*Carex panicea*	A native Irish plant species associated with fen and wetland habitats.	2026
Grey willow	*Salix cinerea*	A native Irish tree species associated with wetland habitats. Forms part of the 7140 Transition mires community but can become a pressure on fen habitats through encroachment.	2026
Yellow starry feathermoss	*Campylium stellatum*	A base-demanding species of moss typically found in rich fen and flush habitats.	2026
Hooked scorpion-moss	*Scorpidium scorpioides*	A base-demanding species of moss typically found in rich fen and flush habitats.	2026
Twisted bog-moss	*Sphagnum contortum*	A base-demanding species of moss typically found in rich fen and flush habitats.	2026
Desmoulin's whorl snail	*Vertigo moulinsiana*	A small Annex II species of snail found in wetlands.	2022-2024
Little grebe	*Tachybaptus ruficollis*	A small widespread bird across waterbodies in Ireland. Largely piscivorous.	2022
Mute swan	*Cygnus olor*	A large widespread bird across waterbodies in Ireland	2021

Common Name	Latin name	Description	Most recent record
Otter	*Lutra lutra*	A semi-aquatic Annex II species of Irish mustelid.	2022

4.1.2.2 Species within the Zone of Influence

Table 4-3 outlines the functionally linked species recorded within the 2 km distribution zone of influence around Ballynafagh Lake SAC within the last ten years from the NBDC, NFS, and from the ecological walkovers undertaken.

Table 4-3: Species records within the Zone of Influence of Ballynafagh Lake SAC

Legislative Protection	Common Name	Latin Name
EU Habitats Directive	Common Frog	*Rana temporaria*
EU Habitats Directive	Smooth Newt	*Lissotriton vulgaris*
EU Birds Directive	Coot	*Fulica atra*
EU Birds Directive	Curlew	*Numenius arquata*
Wildlife Acts	Goldcrest	*Regulus regulus*
EU Birds Directive	Golden Plover	*Pluvialis apricaria*
Wildlife Acts	Greenfinch	*Chloris chloris*
No legislative protection	Herring Gull	*Larus argentatus*
No legislative protection	House Sparrow	*Passer domesticus*
Wildlife Acts	Kestrel	*Falco tinnunculus*
EU Birds Directive	Kingfisher	*Alcedo atthis*
EU Birds Directive	Lapwing	*Vanellus vanellus*
Wildlife Acts	Linnet	*Linaria cannabina*
Wildlife Acts	Little Grebe	*Tachybaptus ruficollis*
EU Birds Directive	Mallard	*Anas platyrhynchos*
Wildlife Acts	Meadow Pipit	*Anthus pratensis*
Wildlife Acts	Mistle Thrush	*Turdus viscivorus*
Wildlife Acts	Mute Swan	*Cygnus olor*
EU Birds Directive	Redshank	*Tringa totanus*
Wildlife Acts	Redwing	*Turdus iliacus*
Wildlife Acts	Robin	*Erithacus rubecula*
EU Birds Directive	Rock Dove	*Columba livia*
Wildlife Acts	Sand Martin	*Riparia riparia*
Wildlife Acts	Skylark	*Alauda arvensis*
EU Birds Directive	Snipe	*Gallinago gallinago*
Wildlife Acts	Sparrowhawk	*Accipiter nisus*
No legislative protection	Starling	*Sturnus vulgaris*
Wildlife Acts	Stonechat	*Saxicola rubicola*
Wildlife Acts	Swallow	*Hirundo rustica*
Wildlife Acts	Swift	*Apus apus*
No legislative protection	Water Rail	*Rallus aquaticus*

Legislative Protection	Common Name	Latin Name
Wildlife Acts	Willow Warbler	*Phylloscopus trochilus*
Wildlife Acts	Yellowhammer	*Emberiza citrinella*
No legislative protection	Butterfly-bush	*Buddleja davidii*
No legislative protection	Round-leaved Wintergreen	*Pyrola rotundifolia*
No legislative protection	Sycamore	*Acer pseudoplatanus*
No legislative protection	Dingy Skipper	*Erynnis tages*
No legislative protection	Large Heath	*Coenonympha tullia*
EU Habitats Directive	Marsh Fritillary	*Euphydryas aurinia*
No legislative protection	Small Heath	*Coenonympha pamphilus*
No legislative protection	Red-tailed Bumblebee	*Bombus lapidarius*
No legislative protection	Dark Tussock	*Dicallomera fascelina*
No legislative protection	Suspected moth	*Parastichtis suspecta*
No legislative protection	Fringed Heartwort	*Ricciocarpos natans*
EU Habitats Directive	Blunt-leaved Bog-moss	*Sphagnum palustre*
EU Habitats Directive	Compact Bog-moss	*Sphagnum compactum*
Wildlife Acts	Common Lizard	*Zootoca vivipara*
Wildlife Acts	Hedgehog	*Erinaceus europaeus*
Wildlife Acts	Irish Hare	*Lepus timidus subsp. hibernicus*
Wildlife Acts	Pine Marten	*Martes martes*
Wildlife Acts	Pygmy Shrew	*Sorex minutus*

4.2 Field Survey

Following a comprehensive review of available desktop data, a targeted follow-up ecological survey was undertaken on the site on 1 April 2026. The field survey concentrated on key areas highlighted during the desk-based assessment, specifically those with potential for restoration activities. These locations were investigated in detail to verify and further assess ecological conditions and parameters, ensuring that any recommended restoration measures would be both appropriate and effective in the identified zones.

Two survey forms were created to collect data relevant to:

- Monitoring data; and
- Pressures and threats.

4.2.1 Monitoring Points

To inform the restoration plan for Ballynafagh Lake SAC, a targeted walkover survey was undertaken. This was a focused assessment designed to gather site-specific data at pre-identified locations. The walkover was designed to assess ecological condition at six pre-identified monitoring points (Monitoring Points 1-6), selected based on hydrological features, habitat potential, and restoration feasibility. The locations were determined through expert

discussion and review of baseline data and will serve as fixed monitoring stations post-restoration. A map of survey points is provided in Appendix B.

These monitoring points now serve a dual purpose:

- Baseline characterisation of current site conditions.
- Long-term monitoring stations to assess ecological change following restoration.

The surveys focused on three key components:

- Monitoring points: Presence and absence of positive and negative indicators of fen habitat.
- Target Notes: Qualitative observations at each monitoring point, capturing site condition, vegetation structure, hydrological features, and legacy management.
- Pressures and Threats Identification: Systematic recording of anthropogenic and natural pressures affecting each location.

The surveys confirmed the presence of several fen habitat types, notably the Annex I quality habitats of:

- 7140 Transition mires: Present at monitoring points 3 and 6.
- 7230 Alkaline fens: Present at monitoring points 1, 2, 4, and 5.

4.2.2 Pressure & Threats

This section outlines the historical and current pressures and threats affecting fen habitats at Ballynafagh Lake SAC, with emphasis on the Annex I habitat of 7230 Alkaline fen and the Annex I quality habitats of 7140 Transition mire and 7220 Petrifying springs. Litter from human activity has been noted across the site.

4.2.2.1 7230 Alkaline fens

4.2.2.1.1 Historical Pressures

The NFS determined that the structure and functions of the Annex quality Alkaline fen habitat at Ballynafagh Lake SAC was unfavourable – bad, with negative pressures likely relating to drainage and problematic native species (scrub encroachment).

- **Scrub encroachment** is noted as a pressure across the site and is likely contributing to the unfavourable structure and function of the 7230 Alkaline fen habitat within the site.
- **Drainage** is similarly impacting the wider site and is likely contributing to the unfavourable structure and function of the 7230 Alkaline fen habitat within the site.

4.2.2.1.2 Current Observations

Recent walkover surveys identified the following:

- **Scrub encroachment** continues to be present across the site and it is considered likely that this pressure is contributing to the unfavourable structure and function of the 7230 Alkaline fens habitat within the site.
- **Drainage** continues to be a persistent pressure across the site, and it is considered to be contributing to the unfavourable structure and functions of the 7230 Alkaline fens habitat within the site

4.2.2.2 7140 Transition mire

4.2.2.2.1 Historical Pressures

The NFS determined that the structure and functions of 7140 Transition mire habitat at Ballynafagh Lake SAC was unfavourable – bad, with negative pressure relating to scrub encroachment.

- **Scrub encroachment** was noted as arising from ongoing natural succession in the site, leading to shifts in species composition and a decline in characteristic fen species. This is particularly impacting Annex quality 7140 Transition mire within the site.

4.2.2.2.2 Current Observations

Recent walkover surveys identified the following:

- **Scrub encroachment** continues to pressure 7140 Transition mires habitat within the site and was noted as severe in areas.

4.2.2.3 7220 Petrifying springs

4.2.2.3.1 Historical Pressures

The Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs 2025 Report determined that the overall status of the Annex I quality Petrifying springs habitat at Ballynafagh Lake SAC was unfavourable – bad, with negative pressures relating to problematic native species (rank vegetation and scrub encroachment), drainage, and eutrophication.

- **Rank vegetation** has arisen within petrifying spring habitat which has altered the vegetation community within these areas - this is potentially due to reduced water levels caused by drainage.
- **Eutrophication** – Elevated nitrate and phosphate levels were detected within the petrifying springs habitat, potentially contributing to the alteration of vegetation community within petrifying springs habitat. This is likely due to excess nutrient

inputs from lands adjacent to the site, which may be entering the site via groundwater inflows.

- **Scrub encroachment** is altering the vegetation community within the petrifying springs habitat, potentially facilitated by ongoing drainage across the site.
- **Drainage** across the site, particularly along the site boundaries, may be contributing to the alteration of the petrifying springs vegetation community – including through the facilitation of scrub encroachment into these areas.

4.2.2.3.2 Current Observations

Recent walkover surveys identified the following:

- **Rank Vegetation** was noted to be surrounding a drain containing brown mosses associated with 7220 Petrifying springs. It is considered likely that the ongoing drainage across the site continues to facilitate rank vegetation in 7220 Petrifying springs habitats.
- **Eutrophication** continues to be present across the site with abundant presence of algae noted in areas of shallow water within the fen. Section 3.2.4 discusses the continued presence of elevated nutrient levels within the water across the site.
- **Drainage** continues to be a persistent pressure across the site, and it is considered to be contributing to the alteration of the 7220 Petrifying springs vegetation community at Ballynafagh Lake SAC.

4.2.3 Additional Observations

The walkover survey identified the presence of the purple pitcher plant *(Sarracenia purpurea)*. This species is an alien invasive species that can outcompete native peatland flora species. As such it is suggested that this invasive species is removed from the site, as described in Section 6.4.1.

4.3 Site Conservation Priority Matrix for Ballynafagh Lake SAC

The restoration actions proposed (Table 4-4) for the Annex I 7230 Alkaline fens and Annex I quality 7220 Petrifying springs and 7140 Transition mires habitats are expected to deliver broader ecological benefits beyond their target habitat types. If these measures are successfully implemented and sustained, they may positively influence associated features such as European priority species, nationally important species, and locally significant habitats and species. In such cases, the additional restoration interventions outlined for these other features may become unnecessary or only partially required. However, to validate and understand the extent of these mutual benefits, ongoing post-restoration monitoring will be

essential. This will ensure that improvements are not limited to Annex I quality habitat alone but will also extend to the wider ecological network within and around the site.

Table 4-4: Site Conservation Priority Matrix for Ballynafagh Lake SAC

Level	Feature Type	Feature Name	Extent/Population	Pressure/threat	Restoration Measure on-site	Restoration Measure off-site
1	Annex I SAC Habitat	7230 Alkaline fens	0.59ha	Rank vegetation Drainage	Vegetation monitoring Molinia management Potential flow blocking measures and hydrological monitoring Removal of dumped litter material	Buffer zone management (Management of drainage and nutrient input)
1	Annex I quality habitat	7220 Petrifying springs	0.024ha	Rank vegetation Drainage Eutrophication	Vegetation monitoring Molinia management Potential flow blocking measures and hydrological monitoring Removal of dumped litter material	Buffer zone management (Management of drainage and nutrient input)
		7140 Transition mires	2.16ha	Scrub encroachment	Vegetation monitoring Scrub management/removal (where necessary)	Buffer zone management (Management of drainage and nutrient input)
		91E0 Alluvial forests	Not assessed as part of NFS	None identified – part of the wider hydrological monitoring to inform future measures		
	Annex II SAC Species	Marsh fritillary *(Euphydryas aurinia)*	See Table 4-3	Scrub encroachment	Vegetation monitoring	

Level	Feature Type	Feature Name	Extent/Population	Pressure/threat	Restoration Measure on-site	Restoration Measure off-site
		Desmoulin's whorl snail *(Vertigo moulinsiana)*	See Table 4-2	Drainage Eutrophication	Scrub and vegetation management/removal (where necessary) Potential flow blocking measures and hydrological monitoring Removal of dumped litter material	Buffer zone management (Management of drainage and nutrient input)
3	European priority species	Common frog	See Table 4-3 and Table 4-2	Scrub encroachment Drainage Eutrophication	Vegetation monitoring Scrub and vegetation management/removal (where necessary) including bracken management on site boundary Potential flow blocking measures and hydrological monitoring Removal of dumped litter material	Buffer zone management (Management of drainage and nutrient input)
		Otter *(Lutra lutra)*				
4	Nationally important species	See Table 4-2 and Table 4-3	See Table 4-2 and Table 4-3			
5	Habitats and species of local interest	GS4 – Wet grassland	See Table 4-1			
		FS1 – Reed swamp				
		PB4 – Cutover bog				
		WN6 – Wet willow-alder-ash woodland				
		WN7 – Bog woodland				

4.4 Impact Assessment Notes

Restoration actions proposed for Ballynafagh Lake SAC aim to improve the ecological condition of sensitive fen habitats, particularly Annex I 7230 Alkaline fens and the Annex I quality habitats of 7220 Petrifying springs, 7140 Transition mires and 91E0 Alluvial forests present on site. These actions are designed to support favourable conservation status and enhance habitat resilience. However, potential impacts—both direct and indirect—must be carefully assessed to ensure compliance with Article 6(3) of the Habitats Directive.

The restoration measures proposed for Ballynafagh Lake SAC are directly connected to the management of the SAC and inherently connected with maintaining the favourable conservation status of the site's qualifying interests: 7230 Alkaline fens, marsh fritillary, and Desmoulin's whorl snail.

Potential Impacts

- **Habitat loss** – low risk - Restoration actions (i.e. Molinia management and potential flow blocking measures pending monitoring results) is designed to enhance existing habitats rather than remove them. Whilst temporary disturbance will likely occur, it is not anticipated that this would result in habitat loss.
- **Habitat degradation –** moderate risk - Potential degradation could occur if restoration measures are poorly implemented or monitored. This could occur where continued ecological and hydrological monitoring is undertaken without due care.
- **Species disturbance** – very low risk – It is not expected that the proposed restoration actions will result in any significant disturbance to species. Works will be timed appropriately so as to avoid disturbing breeding or wintering bird species within the site and these works will be carried out appropriately so as to avoid disturbing the SAC's QI species e.g. marsh fritillary and Desmoulin's whorl snail.
- **Accidental pollution release** – very low risk - No chemical inputs are proposed. However, machinery use (if any) could pose a risk of fuel/oil leaks. This is mitigated by avoiding machinery in sensitive areas and using hand tools where possible.
- **Introduction and/or spread of invasive non-native species** – moderate risk - Restoration activities (e.g. soil disturbance, water movement) could facilitate dispersal of invasive species. Monitoring and biosecurity protocols will be embedded into the site plan to avoid such risks.

4.5 Good Practice Recommendations

Several good practice measures are recommended based on the requirement for compliance with legislation but also the occurrence of sensitive receptors and possible pathways for

negative effects during preparation for or implementation of restoration actions. These are summarised in Table 4-5 below and should be taken as generally applicable in the planning of FRP.

Consultation with relevant NPWS staff should be undertaken prior to implementation to obtain more recent or up to date information on the locations of sensitive receptors, and buffers revised accordingly. Any further requirements outlined by NPWS at pre implementation stage should also be adhered to.

Table 4-5: Good Practice Recommendations

Receptor	Measure
Ground nesting birds	No vegetation clearance or activity which might contravene Section 40 of the wildlife act (consolidated) should be undertaken.
Invasive Alien Species	All vehicles should undergo steam cleaning before site entry. Identified buffers on IAS should be avoided during site preparation and restoration implementation. This includes the location of the purple pitcher plant which should be highlighted to contractors if its removal has not been undertaken prior to any works.
Protection of European Sites	Any required mitigation measures to avoid potentially adverse effects on European Sites should be incorporated into an Environmental Management Plan or Checklist of Environmental Commitments. Implementation should be overseen by a suitably qualified ecologist.
Protection of Sensitive Habitats	High sensitivity habitats should be protected from long term damage by the use of low-pressure vehicles. Extensive repeated tracking over fen habitat or any other identified priority habitat should be avoided. The storage locations of any materials should avoid high & medium sensitivity habitats.

5 Key Pressures – Field Validation and Evaluation

The FRP considers pressures on Ballynafagh Lake SAC through an initial desktop assessment of existing information on the site (including previous NPWS commissioned surveys), assessment of land, water and topographic data and aerial imagery, followed by field surveys to characterise and confirm key pressures mapped through desktop assessment. Consultation with NPWS Regional Staff was also undertaken, including a visit with the Conservation Ranger for the area to inform identification of pressures.

The NFS undertook a site evaluation and ranking which determined the conservation value of the site. This evaluation considered 15 criteria as outlined which included naturalness, non-recreatability, potential value, typicality, educational value, size, diversity, fen value, rarity of species, rarity of habitats, viability, recorded history, management needs, intrinsic appeal and expert opinion. These criteria then informed the conservation status assessment (structure & functions) which are detailed in Section 2.1.1.

5.1 Field surveys of key pressures

Following completion of desktop mapping of key pressure, field surveys were carried out by personnel to verify the findings of the desktop assessment and characterise conditions of the pressures to inform selection of appropriate restoration actions required. The site surveys are discussed in Sections 3.2 and 4.2. These surveys aimed to capture information on the land and water environment such as drainage features, peat depth and water quality and the ecology.

As part of the ecology monitoring surveys, pressures and threats associated with the monitoring point were recorded. A summary is provided within Section 5.2.

5.2 Key Pressures

An overview of the key pressures identified on site, following desktop review and site visits are summarised in this section.

5.2.1 Flora and Fauna Pressures

The following pressures are listed in order of their intensity and impact on the ecological receptors of Ballynafagh Lake SAC. These were determined from the review of historical information and gathered from observations made along the monitoring points carried out as part of this project (Figure 5.2-1).

- Drainage – recorded as a threat to Annex I 7230 Alkaline fens and Annex I quality 7140 Transition mires and 7220 Petrifying springs, this pressure is leading to shifts in species composition and a decline in characteristic fen community vegetation. This pressure is currently impacting the above Annex I and Annex I quality habitats alongside the site's

QI species (Desmoulin's whorl snail and marsh fritillary), other protected species and non-annex I habitats on site including cutover bog. It is expected that active management of Ballynafagh Lake's water levels alongside the wider hydrological restoration methods described in this report will alleviate this pressure.

- Scrub encroachment – the spread of scrub into fen habitat threatens the future prospects of Annex I 7230 Alkaline fens habitat and Annex I quality 7220 Petrifying springs and 7140 Transition mires habitats within the site. This encroachment is considered a pressure on the site's QI species and other protected species and non-Annex I habitats within the site. It is expected that a return to active management of the water levels within the site will remediate this issue alongside manual removal of scrub in designated areas within the site.
- Rank vegetation – Water abstraction arising from drainage within the site has facilitated scrub encroachment across the site alongside the development of bracken and rank vegetation including purple moor-grass. This ongoing pressure is leading to shifts in species composition and a decline in characteristic 7140 Transition mires, 7220 Petrifying springs, and 7230 Alkaline fens vegetation. The reintroduction of grazing is not currently proposed within the FRP, given the nature of the site as a public recreation area. Instead, the measures identified to remediate water abstraction and to control/remove scrub, bracken and rank vegetation including dense purple moor-grass swards are expected to resolve this pressure.
- Nutrient enrichment/Eutrophication – arising from adjacent agricultural activities which generate diffuse pollution to surface and/or ground waters – evidence of this is recorded within areas of 7220 Petrifying springs in the form of elevated nutrient levels. The pressure of rank vegetation within this Annex I quality habitat may be influenced by this elevated nutrient level. These impacts lead to shifts in species composition and a decline in characteristic 7220 Petrifying springs vegetation.

All identified pressures and threats have been fully considered within the FRP to guide appropriate remediation. The proposed suite of restoration measures, encompassing both hydrological and vegetation interventions, is designed to maintain and improve the condition of Annex I and Annex I quality habitats present within Ballynafagh Lake SAC, while delivering co-benefits to associated non-Annex habitats and protected species. The prioritisation of pressures (scrub encroachment, molinia and bracken management, nutrient enrichment and drainage) was informed by a review of historical data (including the NFS) and detailed observations recorded at monitoring points during this project. These measures, supported by ongoing vegetation and hydrological monitoring, will ensure that habitat structure and function are preserved, threats are addressed promptly, and the ecological integrity of the site is safeguarded into the future.

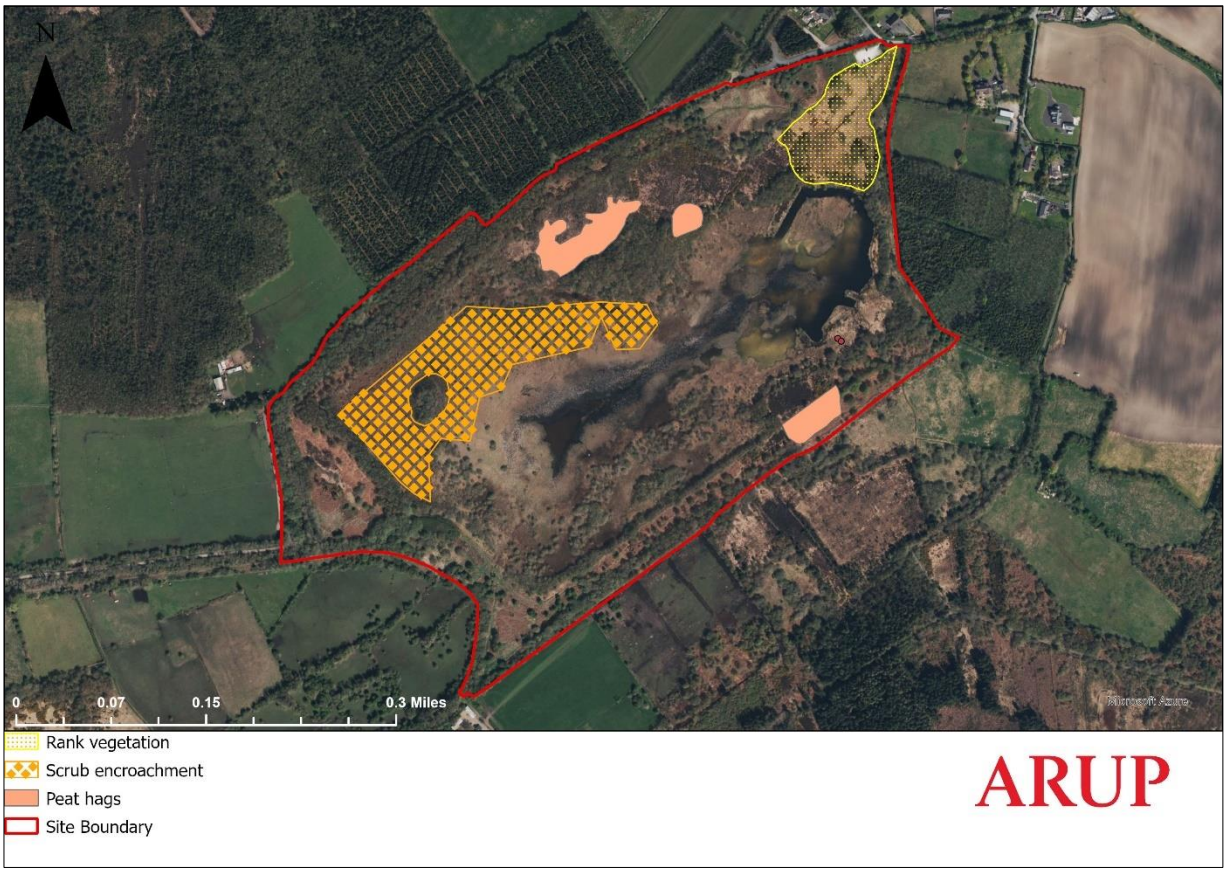


Figure 5.2-1: Pressures and threats recorded as present at Ballynafagh Lake. Pressures and threats were compiled from the desktop review and 2026 ecological walkover

5.2.2 Fen Hydrology Pressures

Fen hydrology within Ballynafagh Lake SAC has been significantly influenced by historical and ongoing modification of natural water level controls due to its role as a canal feeder reservoir. Intermittent drying of lake margins and adjacent fen areas suggesting a shift away from historically wetter conditions.

5.2.3 Fen Nutrient Pressures

Nutrient pressures within Ballynafagh Lake SAC are primarily associated with diffuse inputs from the surrounding catchment and localised surface water inflows. Water quality monitoring indicates elevated nitrogen and phosphorus concentrations in parts of the site, with higher values recorded near inflow areas and adjacent to boundary drains. Although Pollution Impact Potential mapping suggests relatively low nutrient export risk in the immediate catchment, field data indicate that groundwater and surface water pathways may still act as vectors for nutrient enrichment. These conditions have the potential to alter vegetation composition and impact the low-nutrient, calcium-rich conditions required to maintain favourable alkaline fen habitat and associated qualifying species.

6 Restoration Measures

6.1 Introduction

The restoration actions proposed by the FRP will help to maintain or improve the quality of existing areas of fens and improve the conditions that will allow an expansion of the area of fen. In some areas it must be recognised that restoration to fen habitat will not be possible, and the objective may simply be to improve the habitat condition.

Selection of the most appropriate restoration action depends on a range of factors including peat depth, hydrological conditions (flow rates, existing and expected flow paths after restoration), substrate type, existing ecological conditions, potential ecological constraints and practicality of access for machinery.

Each of the factors was considered based on a combination of desktop analysis combined with site-specific field surveys to select the most appropriate restoration technique to address each pressure considered by the FRP. The restoration measures proposed are outlined in Section 6.4 to Section 6.3, with detailed mapping of proposed measures illustrated in the maps provided in Appendix C.

6.2 Hydrology Measures

6.2.1 On-site Fen Hydrology Measures

On-site hydrology measures aim to reinstate active management of the lake water levels to support groundwater dependent fen habitats. These measures will be implemented in a phased and monitored manner to ensure improved understanding of the groundwater-surface water interactions while avoiding adverse flooding impacts.

A key component in restoring active water-level management is by monitoring and, where appropriate, reinstating the existing lake outflow infrastructure. Continuous monitoring at the outflow will be achieved through the installation of a stilling well and vented logger at the existing standpipe. This will allow continuous measurement of the lake outflow levels and provide insight into the lake's response to rainfall events and any associated inundation risks. The sluice gate located in the southwestern boundary of the site will be inspected, and, subject to the monitoring results, reinstated to enable regulation of the lake outfall level. This will follow a phased approach:

- Phase 1: Targeted scrub clearance to enable inspection of the outfall area (Figure 6.2-1) and installation outflow monitoring infrastructure.
- Phase 2: Inspection of the outfall structure in conjunction with the contractor to determine the most appropriate approach for improvement or reinstatement.
- Phase 3: Preparation and implementation of a follow-on specification for any required reinstatement works, informed by available monitoring data.



Figure 6.2-1: Scrub to be remove upstream of the outfall structure at Ballynafagh Lake SAC

Given the potential industrial heritage value of the existing sluice gate, Phase 2 will include an assessment of the structure's condition, significance and suitability for continued use. Where feasible, retention and repair of the existing structure will be prioritised over replacement. Any required interventions will be informed by a proportionate heritage assessment and balanced against the functional requirements of restoring water-level management at the site.

The lake water levels will also be monitored within Ballynafagh Lake through installation of a GPS-levelled staff gauge along with continuous waterlevel loggers. Monitoring data will be used to characterise seasonal variability and will be used in combination with LiDAR to define appropriate target operating levels.

Levels will be set to maintain conditions favourable to fen systems, including the relatively stable water levels required for WETMEC 13, while avoiding rapid or excessive fluctuations that could destabilise quaking mats and associated vegetation. These levels will also account for ecological requirements, including those of QI species Desmoulin's whorl snail, which require persistently humid and saturated conditions whilst avoiding prolonged deep inundation. Accordingly, any proposed water level increases must be implemented with appropriate marginal topographic design to avoid adverse impact on existing habitat. The reinstated outlet should incorporate adjustable control features (weirs) to allow water levels to be managed

dynamically in response to monitoring results, ensuring that suitable hydrological conditions can be maintained over time.

To assess sediment accumulation, lake depth surveys will be taken every two to three years and compared with data from studies undertaken in 2005 as part of the Blackwood Feeder Baseline Study (Hayes, 2006).

Restoration measures are also planned in areas adjacent to the groundwater springs in the northeast of the site. Loggers will be reinstalled on existing monitoring boreholes to assess groundwater upwelling rates and improve understanding of groundwater influence within the SAC. An additional groundwater monitoring borehole will be installed along the preferential flow path which currently conveys spring water into the lake, to determine whether additional springs may be present and to assess the hydraulic gradient driving spring flow. Based on the results of this monitoring, flow-blocking measures may be introduced to reduce preferential drainage into the lake and provide more consistently wet conditions for the 7230 Alkaline fen habitat. These measures may include placement of limestone cobbles or the installation of shallow plastic weirs.

If flow-blocking interventions are to be installed, these will also follow a phased approach, with initial vegetation clearance to enable inspection of the flow path combined with peat probing to confirm depth of peat. LiDAR analysis will then be used to determine suitable locations for the installation of any weirs or cobbles. In addition to promoting lateral wetting of fen habitats, these measures will encourage diffuse spreading of nutrient rich water, increasing uptake by fen vegetation and reducing direct delivery into the lake via existing efficient drainage pathways.

In areas along the northwestern margin of Ballynafagh Lake where seepage is occurring through gaps in the peat berm, localised peat reprofiling is to be undertaken. Additional reprofiling may also be required to prevent any potential subsurface water loss from the lake. To determine whether lake water is being drawn down via the northern perimeter drain, surface water monitoring along the perimeter drain and groundwater monitoring within adjacent areas 7140 Transition mire to the west of the lake will be implemented. In parallel, geotechnical investigations will be undertaken along the length of the berm to characterise the subsurface profile and assess the integrity of the peat berm, including whether localised drawdown effects or preferential flow pathways are present.

By comparing lake levels, groundwater levels, and drain water levels over time, it will be possible to assess whether a hydraulic gradient exists that promotes seepage from the lake into the drainage network. The combined findings of the monitoring and geotechnical investigations will inform whether restoration works are required, and if so, whether these should consist of targeted peat reprofiling or the installation of low-impact plastic piling to improve the integrity of the existing berm.

Similarly, in areas to the north and south of the lake where cutover bog habitat is present, restoration involving peat bank reprofiling or the installation of low-impact plastic piling to reduce erosion and enhance water retention within the peat is proposed, preventing further deterioration and facilitating the recovery of cutover bog habitat.

Equipment

Installation of hydrological monitoring equipment and associated restoration measures will be undertaken using manual equipment where possible. Hand tools will be used for scrub clearance where necessary. Temporary access platforms or boards shall be used where required to reduce trampling of vegetation.

Where peat reprofiling is required, works will be undertaken using low ground pressure machinery, with access and methods designed to minimise disturbance to sensitive habitats. If plastic piling is to be used, the installation of these piles will be manual using manual post-driving tools such as a fencing maul, with timber battens used to protect the tops of piles during installation (50 mm x 150 mm).

Infrastructure Maintenance

All hydrological infrastructure will be subject to a structured inspection and maintenance regime to ensure continued functionality and to avoid unintended hydrological impacts within the SAC.

Following reinstatement or improvement of the lake outfall monitoring and control infrastructure, an initial inspection will be undertaken approximately one month after works are completed. This inspection will confirm that the monitoring equipment is securely installed and functioning correctly, that the outfall structure remains unobstructed, and that any reinstated outfall control is operating as intended. Monitoring data will be reviewed alongside site observations to assess whether lake water levels are responding appropriately to rainfall events and whether any unintended bypass flow is occurring around the outfall structure. Subsequent inspections will be undertaken on a seasonal basis to check for sediment accumulation, vegetation blockage or structural deterioration with maintenance carried out as required.

An initial inspection of any installed flow control measures (noting that installation is subject to the results of the monitoring data) will be carried out approximately one month after installation. This will assess whether limestone cobbles or plastic weirs are functioning as intended to attenuate and redistribute flow within the preferential flow path, and whether they remain stable in situ. The inspection will also check for signs of bypassing, erosion, scour, or unintended concentration of flow around the structures. Ongoing seasonal inspections will confirm whether the measures continue to function effectively and that vegetation reestablishment supports the attenuation and spreading of flow.

If plastic piling is installed (subject to the results of hydrological monitoring and geotechnical ground investigations), an initial one□month check will be undertaken to assess the functioning of the piling. This will include confirming that water is being held back as intended, that piles are driven in firmly, that links between sheets remain secure, and that no sheets are cracked or damaged. Off□cuts and construction materials will be checked to ensure they have been removed from site. This inspection will form the initial hydrology check for the intervention. Continued seasonal monitoring will then be undertaken to determine whether water is bypassing the piling via the sides or beneath the structure and to identify any significant leakage requiring remedial action.

Monitoring progress

Annual groundwater, surface water and lake level monitoring will be undertaken through a network of piezometers and standpipes at key locations within the site (as described above) to inform the need for interventions, including peat reprofiling and flow blocking measures, and to assess changes in water levels resulting from both outlet control reinstatement and any implemented restoration measures. Continuous level loggers will be used to monitor changes in water levels.

6.2.2 Off-site Hydrology Measures

Engagement with adjacent landowners will be undertaken to avoid the introduction of new drainage works or the deepening of existing drains where hydrological connectivity to Ballynafagh Lake and associated fen habitats is confirmed. In particular, the boundary drain along the northwestern edge of the fen will be considered subject to the results of onsite hydrological monitoring and geotechnical investigations, which will be used to determine whether the drain is hydrologically connected to the lake and fen system. Only where evidence demonstrates a hydrological connection or drawdown effect will engagement focus on restricting drainage activities at this location.

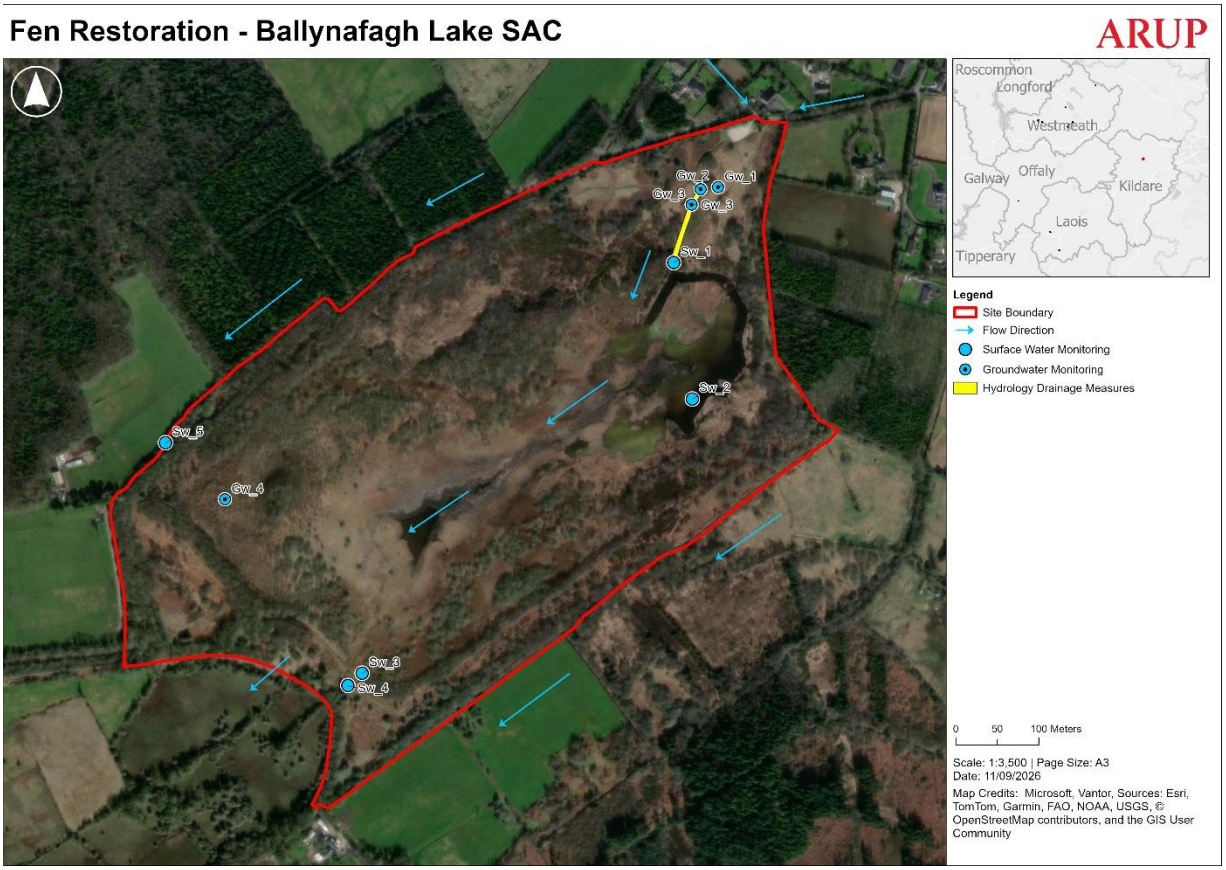


Figure 6.2-2: Proposed hydrological management and monitoring for Ballynafagh Lake SAC

6.3 Nutrient Measures

The primary aim of the nutrient measures is to maintain appropriate water quality, particularly nutrient levels, to support the natural structure and functioning of the habitats. For water quality the target is to maintain, or where necessary restore, appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of fen habitat.

6.3.1 On-site Nutrient Measures

Continued water quality monitoring will be undertaken at the springs, within the lake and surface water inputs (see Appendix C for proposed locations). The water quality monitoring includes measuring nutrients (nitrate and phosphate), electrical conductivity and pH.

If water monitoring results indicate that flow-blocking measures are to be installed in the existing preferential flow path from the springs to the lake, this hydrological measure will contribute to on-site nutrient management by spreading spring flows across fen habitats, encouraging nutrient uptake and reducing efficient drainage pathways that currently deliver nutrient-rich water directly to the lake.

6.3.2 Off-site Nutrient Measures

Water quality monitoring and Pollution Impact Potential (PIP) mapping indicate that nutrient enrichment poses a risk at Ballynafagh Lake. While the potential installation of flow-blocking measures aim to reduce direct nutrient delivery to the lake, off-site nutrient measures may also be required to reduce the nutrient inputs at source and along hydrological pathways before they reach the SAC. Engagement with landowners in the immediate catchment is therefore recommended, with priority given to lands identified as high or moderate risk in the EPA PIP mapping, particularly where flow pathways are shown to connect directly to the lake or associated spring systems.

Agricultural measures outlined under the Farming for Water EIP[3] or novel approaches under NPWS Farm Plans[4] are categorised depending on if they address the source, pathway or receptor. Suitable measures for Ballynafagh Lake may include:

- **Source control measures:**
    - Farmer Training Course for farmers in the fen catchments.
- Nutrient Management Plan to support optimal slurry application and nutrient uptake, avoiding overapplication within the groundwater and surface water catchments.
- Nitrogen Surplus Plan to identify and reduce excess nitrogen loads where elevated nitrate concentrations are indicated.
- **Pathway interception measures:**
- Linear Riparian Buffer Zones (grassland), particularly adjacent to high□ranking phosphorus PIP areas, to intercept runoff and reduce phosphate delivery to surface waters.

6.4 Vegetation Measures

[3] The "Farming for Water" project provides funding to help farmers implement 43 measures designed to protect water quality by reducing pollution from nitrates, phosphorus, sediment, and pesticides. The project is a major initiative to reduce pollution from farming practices in Ireland and ensure that the country's rivers and other waterbodies are kept clean and healthy for the future and that we meet our obligations under the Water Framework Directive. Suggestion – make this smaller font so it can all fit on one page

[4] The NPWS Farm Plan Scheme trials novel approaches to farming for the environment, to safeguard particular sites, habitats and species, and to work towards meeting conservation measures required under the EU Birds and Habitats Directives. Role players are the NPWS through the Agri-Ecology Unit, the regional staff of the NPWS and the farm participant.

6.4.1 On-site Vegetation Measures

Proposed measures to address vegetation succession, invasive species and scrub encroachment include the following on-site measures which are described in order of priority in Table 6-1, Figure 6.4-1 and Figure 1-2.

Table 6-1: On Site Vegetation Measures proposed for Ballynafagh Lake SAC

Priority	Measure	Description	Responsibility
1	Vegetation monitoring	Monitoring points have been proposed which overlap with (where suitable) the existing NFS points. The purpose of these points is to monitor species composition within the habitat. This serves to monitor any vegetation change and inform future restoration measures (Figure 6.4-1).	Tóchar & NPWS (post-Tóchar)
2	Mowing of dense purple moor-grass (*Molinia caerula)* sward and removal of arisings	To initiate the transition from a dense purple moor-grass sward towards a fen habitat in the north-eastern area of the site, the existing dense *Molinia* cover will be cut back to reduce above-ground biomass and limit competitive dominance. This can help open the sward structure and create conditions for less competitive fen species to establish. Following mowing, the arisings will be removed. This action would serve two purposes: removing the dense thatch layer to prevent smothering of germinating fen species and removal of nutrient inputs from dead mass. It is recommended that this takes place before any potential flow-blocking measures that may be installed following groundwater monitoring results. Management of the *Molinia* sward, i.e. its removal, could help kick-start the transition by reducing its dominance, before water levels rise due to any potential flow-blocking measures. Doing this first may give fen species a better chance by lowering competition ahead of wetter conditions. Mowing and scarifying could weaken *Molinia*, create a more varied structure, and open space for fen plants to spread. If monitoring indicates that flow-blocking measures should not be implemented, this *Molinia* sward may require more frequent mowing in the absence of a raised water table in	Tóchar

Priority	Measure	Description	Responsibility
		that particular area of the site. This will be reassessed following the hydrological monitoring. Approximate area for mowing and scarifying is defined in.	
3	Purple pitcher plant removal (*Sarracenia purpurea*)	The removal of this species across the site is proposed to prevent this species outcompeting native fen flora. This invasive species can be dug out and removed by hand. Due to the sensitivity of the site, this is the preferred measure. The area for clearance should be marked in the field by an ecologist prior to operations. Approximate area for scrub clearance is defined in Appendix C.	Tóchar & NPWS (post-Tóchar)
4	Bracken management	Bracken management in the form of cutting/rolling/brashing is recommended to prevent further encroachment onto fen habitats. Planting trees can also be explored as an option to control bracken in the longer term, specifically on the boundary of the site where fen habitat is not located. Species may include *Betula pubescens, Quercus robur, Taxus baccata, Crataegus* monogynya and *Sorbus aucuparia*. Due to the sensitivity of the site, this should be done manually. The area for clearance should be marked in the field by an ecologist prior to operations. Approximate area for scrub clearance is defined in Appendix C.	Tóchar & NPWS (post-Tóchar)
5	Removal of dumped litter material	Litter removal should be undertaken manually where possible due to the sensitivity of the site. This will contribute to the long-term health of the vegetation community within the site.	Tóchar
6	Scrub removal [informed by hydrological monitoring]	Following hydrological monitoring, an assessment of what hydrological interventions (if any) will be made. Should measures be identified that raise the existing water table, it is recommended that scrub removal is undertaken concurrently. This will ensure that scrub removal is effective in the long term. The purpose of the scrub removal within the 7140 Transition mires area is to control the levels rather than eliminate as small stands of scrub form part of the	NPWS (post-Tóchar)

Priority	Measure	Description	Responsibility
		transition mire community. Furthermore, areas of Annex I quality 91E0 Alluvial forests would not be targeted for scrub/tree removal. Approximate area for scrub removal based on current surveys and historical data is defined in Appendix C but should be updated following the monitoring surveys to reflect the updated areas.	
7	Cutover bog reprofiling [informed by hydrological monitoring and geotechnical investigations]	As detailed in Section 6.2.1, following hydrological monitoring and geotechnical investigation, an assessment of the feasibility of additional bank reprofiling will be made.	NPWS (post-Tóchar)

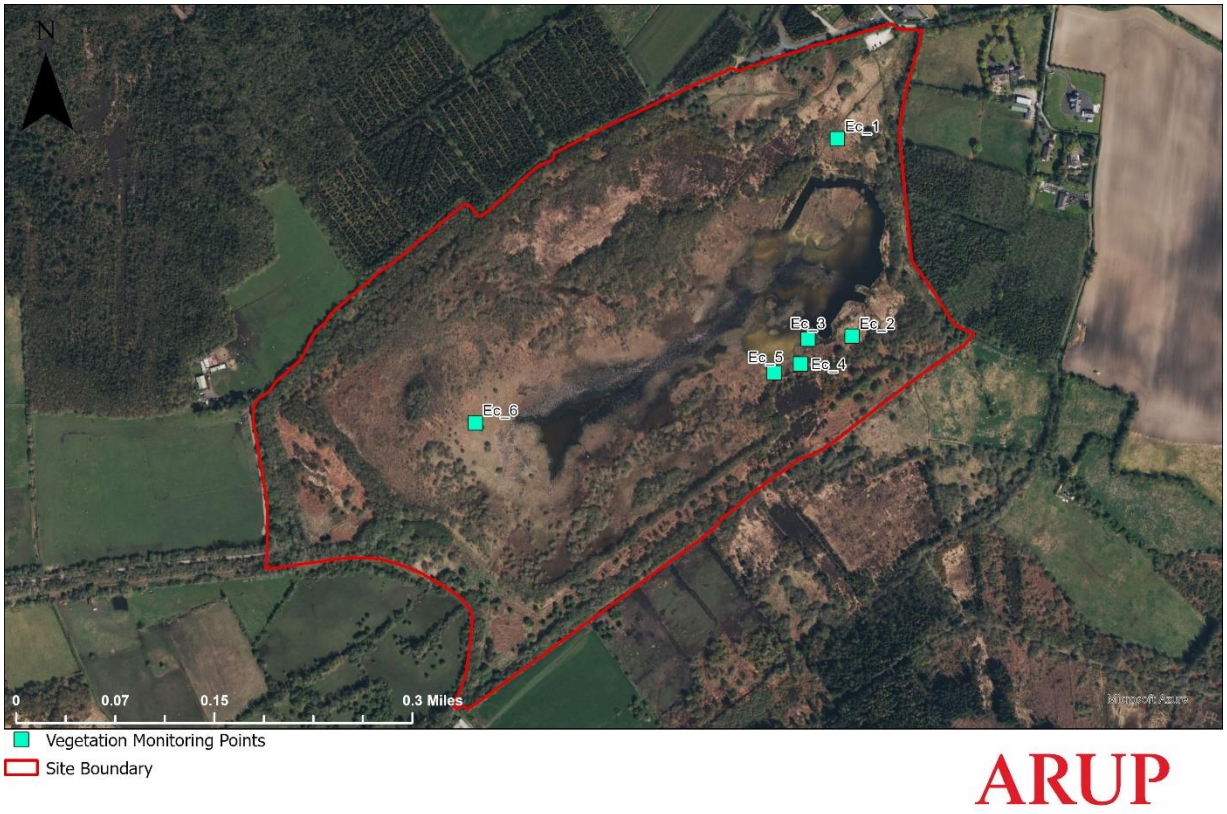


Figure 6.4-1: Proposed monitoring points for Ballynafagh Lake SAC

7 Additional Considerations

7.1 Drainage Management Plan

Drainage Districts were designated by the Commissioners of Public Works to improve land for agriculture and to mitigate flooding. Channels and lakes were deepened and widened, weirs removed, embankments constructed, bridges replaced or modified and various other work was carried out. Local authorities are charged with responsibility to maintain Drainage Districts. The Arterial Drainage Act, 1945 contains a number of provisions for the management of Drainage Districts in Part III and Part VIII of the act.

The Ballynafagh Lake SAC is part of a Drainage District managed by Kildare County Council. Consultation is required with Kildare County Council on the maintenance and function of the channel, and the impact of future drainage plans on the fen and the impact of the proposed restoration measures on the objectives of the drainage district.

The preliminary drainage management plan for Ballynafagh Lake SAC is presented in Appendix C.

7.2 Peat Stability Assessment

Restoration activities have the potential to introduce additional risk of peat stability issues. The combination of additional loading (e.g. machinery required for peat reprofiling works) and a higher water table has the potential to increase risk. At present, no specific guidance is available in Ireland detailing how peat stability risks should be managed in restoration projects.

Undertaking geotechnical assessments along the peat berm is recommended as part of this FRP. However, a preliminary peat stability analysis has already been undertaken to inform the level of assessment required prior to the implementation of restoration actions. This includes a review of the landslide susceptibility map and historic landslide events produced by the Geological Survey of Ireland (GSI). The GSI landslide susceptibility map provides a preliminary indication of the susceptibility of a landslide based on several contributing factors, including where previous landslides have occurred and what caused them (slope, soil type and the impact of the flow of water in an area).

The GSI landslide susceptibility map for Ballynafagh Lake SAC shows that within a 2 km radius from the site the landslide susceptibility is low (Figure 7.2-1).



Figure 7.2-1: Geological Survey of Ireland Landslide Susceptibility mapping for Ballynafagh Lake SAC

7.3 Archaeology

The site includes the Ballynafagh Lake pNHA (site code 001387). The locations of proposed restoration measures and access routes were reviewed against the Archaeological Survey of Ireland datasets. No Recorded Monuments (or associated buffer zones) were identified within the footprint of the proposed works, access routes or associated work buffer areas. Accordingly, no additional archaeological constraints are anticipated in relation to the implementation of the proposed restoration measures, and a dedicated archaeological constraints map has not been included.

It should be noted that a total of six Sites and Monuments Record (SMR) entries occur within 1 km of Ballynafagh Lake (Figure 7.3-1), namely:

- KD00318 – cropmarks of a probable ringfort site (KD013-003001) with traces of a field system apparently both radiating off and encircling it.
- KD00319 – cropmarks of two curving, parallel fosses, running northeast to southwest.
- KD01746 – historic graveyard associated with an early ecclesiastical enclosure, containing predominantly 18th–20th century burials. It surrounds both a 19th-

century church and the remains of an earlier medieval church, reflecting long-term religious use of the site.

- KD01744 – a large, likely early medieval ecclesiastical enclosure that originally enclosed the church and graveyard complex. The enclosing boundary has been removed, and no visible surface remains survive today, but historic mapping indicates a substantial circular religious enclosure.
- KD01747 – a Church of Ireland church built in 1831 with funding from the Board of First Fruits. Following storm damage in the 1980s, the roof was removed, and the structure now survives as a roofless ruin within the graveyard.
- KD01745 – remains of a medieval parish church dedicated to the Blessed Virgin Mary, with references dating back to at least the 18th century. Only a short section of the north wall survives within the graveyard, representing the remnants of the earlier church serving the parish.



Figure 7.3-1: Archaeological Sites for Ballynafagh Lake SAC (NMS, 2025)

8 Summary of Fen Restoration Plan Actions

Prior to proceeding with the implementation of the restoration measures outlined in the FRP, consultation with key stakeholders with an interest in the site is essential (Table 8-1). While this FRP identifies the key pressures and actions to be implemented, consultation with landowners and stakeholders may identify the need to amend or alter restoration actions. There may also be opportunities to provide additional benefits to the wider community. Consultation with local NPWS staff will be crucial to informing implementation planning.

Table 8-1: Role players in fen restoration plan

Measures	Stakeholder	Description
On-site	Kildare County Council	The entirety of Ballynafagh Lake SAC is under the ownership of Kildare County Council
Off-site	Kildare County Council	Management of Drainage District
	Landowners & farmers	Engagement for uptake of catchment measures.
Capacity building	NPWS	NPWS engaging in community education and events

This section provides the summary of the FRP Actions for Ballynafagh Lake SAC (Table 8-2).

Table 8-2: Implementation plan for Ballynafagh Lake SAC Fen Restoration

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
1	**Required preliminary actions**							
1.1	**Screening for Appropriate Assessment report.**							
	This report must outline all restoration measures that shall be undertaken as part of the project at Ballynafagh Lake SAC. The Screening for AA must conclude whether a likely significant effect is anticipated to arise from the implementation of the project.	Sitewide	Screening report	Pre-restoration	NPWS			Within Tóchar project scope
1.2	**Drainage management plan**							
	Consultation with Kildare County Council on the drainage management plan is required to ensure compliance with legislation and local authority objectives.	Sitewide	Drainage management plan	Pre-restoration	NPWS	Kildare Co. Co	Arup	Within Tóchar project scope
1.3	**Archaeological assessment**							
	Consultation with Kildare County Council on the archaeology is required to ensure compliance with legislation and local authority objectives.	Sitewide	Archaeological assessment report	Pre-restoration	NPWS	Kildare Co. Co	Arup	Within Tóchar project scope
2	**Enabling Works**							
2.1	**Pre-restoration Works Surveys**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Pre-site walkover with Ecologist/Ecological Clerk of Works (ECoW) to ensure proposed measures are appropriate and whether alterations are required. Surveys should also include identifying habitats for the QI species Desmoulin's whorl snail and marsh fritillary, which are within the areas for restoration measures. Where QI species habitats overlap with areas for restoration, appropriate mitigation e.g. seasonal constraints, or rationale for implementing measures resulting in a positive outcome, will be identified.	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.2	**Implementation of Mitigation Measures**							
	Ecological Impact Assessment Considerations – identification of necessary mitigation measures. Such measures may include, but are not limited to, the utilisation of hand machinery to avoid impact on sensitive habitats	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.3	**Breeding Bird Considerations**							
	Prior to restoration works, where any restoration measures are identified to have the potential to interfere with breeding birds e.g. scrub removal, these works shall occur outside the breeding bird season (1 March – 31 August inclusive).	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.4	**Good Practice Recommendations and CEMP**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Good Practice Recommendations – Includes, but not limited to, avoidance of sensitive ecological receptors, pollution prevention procedures, biosecurity measures etc. The preparation and provision of a Construction Environmental Management Plan (CEMP).	Sitewide	ECoW report	Pre-restoration			Arup / Contractor	Within Tóchar project scope
3	**On-Site Restoration measures**							
3.1	**Hydrology measures**							
	Active water management restoration Continuous monitoring of the lake outflow will be undertaken via a stilling well and vented logger installed at the existing standpipe. The sluice gate along the southwestern site boundary will be inspected and, subject to monitoring results, reinstated to allow regulation of the lake outfall level. Target lake levels will be defined using LiDAR data alongside a GPS□levelled staff gauge and continuous water□level loggers installed within the lake.	Sitewide	Site installation records	Restoration in 2026	NPWS	Kildare County Council	Arup / Contractor	Within Tóchar project scope
	Installation of flow-blocking measures (pending monitoring results) Install limestone cobbles or plastic piling to attenuate and spread spring flows laterally across adjacent fen habitats.	Northeastern corner of the site	Dependent on the hydrological monitoring results	Appropriate season following hydro monitoring	NPWS	Kildare County Council	Arup / Contractor	Within Tóchar project scope

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Peat berm seepage assessment and restoration Surface water, groundwater, and geotechnical investigations will assess seepage from the lake and the integrity of the northwestern peat berm. Localised peat reprofiling will be undertaken in existing gaps in the berm. Where monitoring indicates water loss via preferential pathways, additional targeted peat reprofiling or low□impact plastic piling may be implemented to reduce seepage and improve berm stability.	Northwestern peat berm	Dependent on the hydrological monitoring results and geotechnical investigations	Appropriate season following hydro monitoring	NPWS	Kildare County Council	Arup / Contractor	Within Tóchar project scope
	Cut over bog reprofiling Following hydrological monitoring, the cutover bog on the north and south of the lake may be reprofiled to reduce erosion and enhance water retention	North and south of the lake	Dependent on the hydrological monitoring results	Appropriate season following hydro monitoring	NPWS	Kildare County Council		Within Tóchar project scope
3.2	**Nutrient measures**							
	Installation of flow-blocking measures (pending monitoring results) The flow-blocking measures that may implemented as part of the hydrological measures will contribute to on□site nutrient management by spreading spring flows across fen habitats.	Northeastern corner of the site	Site installation records	Restoration in 2026	NPWS	Kildare County Council	Arup / Contractor	Within Tóchar project scope
3.3	**Vegetation measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Proposed measures to address vegetation succession, invasive species and bracken include: removal of purple pitcher plant via hand tools, mowing and removal of arisings of purple moor-grass and bracken management (rolling/cutting/brashing)	Measures to be undertaken in specified areas	Site records / habitat surveys	Restoration 2026	NPWS	Kildare County Council	Arup/Contractor	Within Tóchar project scope
	Removal of dumped litter material will contribute to the long-term health of the vegetation community within the site and should be carried out manually wherever possible	Sitewide	Site records / habitat surveys	Restoration 2026	NPWS	Kildare County Council	Arup/Contractor	Within Tóchar project scope
	Scrub removal - this should be undertaken following the results of the hydrological monitoring as scrub removal and an increase in the water table would be the most effective measure to prevent encroachment	Dependent on the proposed hydrological measures. Scrub removal should be in areas of the site where the water table will rise	Updated monitoring and a pre-start check with an ecologist to identify the optimal area and extent of scrub removal required	Seasonal removal of vegetation to avoid bird nesting season	NPWS working with landowner	Kildare Country Council		Within Tóchar project scope
4	**Off-Site Restoration measures**							
4.1	**Hydrology measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Engage with adjacent landowners to avoid new drainage works or deepening of existing drains where hydrological connectivity to the lake system is confirmed. Targeted engagement will be informed by site□specific hydrological monitoring along the northern perimeter drain, with restrictions focused only where a demonstrable drawdown effect is identified.	Surrounding landowners	Uptake of measures by landowners / farmers	Long-term	NPWS, LAWPRO, Farming for Water EIP		Landowners	Catchment measures to be funded through Farming for Water EIP / other similar
4.2	**Nutrient measures**							
	Catchment nutrient management Targeted nutrient control measures should be implemented across the catchment to address both phosphate and nitrogen pathways. Measures may include engagement on best□practice nutrient management, avoidance of drainage works that enhance nutrient delivery pathways, and targeted interception of surface or shallow subsurface flows where monitoring identifies risks to fen or lake water quality.	Surrounding landowners	Uptake of measures by landowners / farmers	Long-term	NPWS, LAWPRO, Farming for Water EIP		Landowners	Catchment measures to be funded through Farming for Water EIP / other similar
5	**Monitoring progress**							
5.1	**Hydrology monitoring**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Groundwater, surface water and lake level monitoring will be undertaken through a network of piezometers and standpipes at key locations within the site (as described above) to inform the need for interventions, including peat reprofiling and flow□blocking measures, and to assess changes in water levels resulting from both outlet control reinstatement and any implemented restoration measures. Continuous level loggers will be used to monitor changes in water levels.	Various locations across site	Water level	Long-term	NPWS	Kildare County Council		Within Tóchar project scope
	Implementation of sediment accumulation surveys Undertake lake depth surveys every two to three years and compared with data from studies undertaken in 2005 as part of the Blackwood Feeder Baseline Study (Hayes, 2006).	Sitewide	Sediment levels	Long-term	NPWS	Kildare County Council	Arup / Contractor	NPWS
5.2	**Nutrient monitoring**							
	Ongoing monitoring of habitats, drainage channels and springs for water quality parameters is proposed within the fen.	Various locations within the site	Nutrients (Nitrate and phosphate), electrical conductivity and pH	Long-term	NPWS	Kildare County Council		Within Tóchar project scope
5.3	**Vegetation monitoring**							
	Habitat condition assessments will be included to track restoration progress.	Sitewide	Habitat condition	Long-term	NPWS	Kildare County Council		Within Tóchar project scope

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
6	**Capacity building and training**							
	Public meeting: To engage stakeholders on developments and results from the restoration measures.			Long-term	NPWS	Kildare County Council		NPWS
	Farmer training: Training such as that provided by the Farming for Water EIP will provide farmers with knowledge of alternative and habitat sensitive measures			Long-term	NPWS/ Farming for Water EIP / LAWPRO / Teagasc			Farming for Water EIP / other similar

8.1 Habitats Benefiting from Implementation of Restoration Actions

- **7230 Alkaline fens**

Restoration measures will focus on maintaining hydrological balance and controlling nutrient inputs. Initial Molinia management as well as regular monitoring of vegetation and water levels will ensure that 7230 Alkaline fen communities remain stable and resilient to pressures such as eutrophication and atmospheric deposition while engagement with landowners (outside the immediate remit) will further mitigate diffuse pollution risks. Together, these measures will protect the fen's structure and function, preventing succession and supporting its long-term conservation value.

- **7220 Petrifying springs**

Restoration measures will address the pressures of drainage, rank vegetation, and nutrient enrichment all of which threaten species composition and habitat structure. Vegetation and hydrological monitoring will provide a baseline to track changes and inform timely interventions. Controlling water levels and intra-site nutrient inputs while engaging with adjacent landowners on external nutrient input will protect the spring's species community, preventing succession and maintaining their Annex I quality.

- **7140 Transition mires**

The proposed restoration measures will maintain the open, wet conditions that are fundamental to this habitat's ecological integrity. Vegetation monitoring will allow early detection of scrub encroachment and species shifts, while hydrological monitoring ensures that water levels remain suitable for the delicate mire system. Following hydrological monitoring, proposed targeted manual scrub clearance will prevent succession to woodland. These actions collectively support the persistence of characteristic species, ensuring long-term habitat stability.

- **91E0 Alluvial forests**

Restoration actions will respect the ecological role of wet woodland by retaining these communities while controlling scrub expansion elsewhere. This ensures woodland continues to provide filtration and hydrological buffering functions without compromising fen integrity.

- **WN7 – Bog woodland**

Bog woodland areas will be retained as part of the site's natural mosaic. Scrub clearance will avoid these zones, preserve their ecological function and maintain habitat diversity within the SAC.

- **GS4 – Wet grassland**

Wet grassland areas will be retained as part of the site's natural mosaic. Restoration actions will preserve their ecological functions without compromising fen integrity and maintain habitat diversity within the SAC.

- **PB4 - Cutover bog**

Restoration actions will respect the potential for the rehabilitation of this habitat within the SAC without compromising fen integrity. Following hydrological monitoring, reprofiling of cut over bog banks may be proposed to reduce erosion and enhance water quality.

- **WL2 – Treelines**

Retention of treelines along site boundaries will maintain structural diversity within the landscape

8.2 Species Benefiting from Implementation of Restoration Actions

The proposed restoration measures will benefit both of the SAC's QI species – Desmoulin's whorl snail and marsh fritillary as well as the site's population of round-leaved wintergreen and otter by halting ongoing habitat degradation across the SAC for these species. Together, the proposed restoration efforts offer mutual benefits for broader fen ecosystem function and the long-term viability of Ballynafagh Lake SAC's QI species.

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Appendix A – Non-Technical Summary

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary			
Site Name	Ballynafagh Lake	**NFS site no.**	106002
County	Kildare	**Designations**	SAC 001387
Fen habitats present (area)	7230 Alkaline fens (0.59 ha) and 7140 Transition mires (2.16 ha)	**Species of note**	Desmoulin's Whorl Snail (*Vertigo moulinsiana*) and Marsh Fritillary (*Euphydryas aurinia*)

Site Description

Ballynafagh Lake is situated roughly 2 km north-west of Prosperous in County Kildare and includes the Ballynafagh Lake Special Area of Conservation (SAC) for the presence of 7230 Alkaline fens and Desmoulin's Whorl Snail *(Vertigo moulinsiana) and* Marsh Fritillary *(Euphydryas aurinia),* all of which are listed under Annex I and II of the E.U. Habitats Directive. The 7230 Alkaline fen habitats are primarily located on the southeastern side of the site, while 7220 Petrifying springs with tufa deposits are predominantly present in the northeastern section. Additionally, areas of 7140 Transition mires habitats are also present on the northern section of the site. Figure 1 presents the habitats mapped within the site as per the National Fens Survey.

Conceptual Site Model (CSM)

The landscape of Ballynafagh Lake is generally flat with slightly elevated ground and associated gravel deposits occur along the northern boundary of the SAC and influence groundwater discharge patterns. The site is fed mostly by groundwater sources, with limited surface water inflow. Springs associated with the gravels along the northern boundary provide recharge into the fen site, contributing to the site's hydrology and supporting Annex I habitats and species. The principal surface water feature within the site is Ballynafagh Lake, which occupies much of the SAC and functions as the central hydraulic feature of the system. A drain entering the site from the northeastern boundary contributes surface water under certain flow conditions. Drainage channels along site boundaries provide the main surface water outflow, with water ultimately discharging toward the Slate River to the southwest. The CSM is presented in Figure 2.

Key Pressures

Hydrology Pressures	Artificial drainage and historic reservoir controls affecting lake levels and fen wetness
Nutrient Pressures	Mixed sources of pollution to surface and groundwaters leading to nutrient enrichment. Elevated nitrate concentrations in the northeastern part of the site where the springs are located potentially indicate nutrient input from the adjacent farmland. High public use (walkers, fishing) causing bank trampling, litter, and disturbance, while off-lead dogs may also introduce nutrient pressures.

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary	
Ecology Pressures	Succession and vegetation change alongside scrub encroachment due to drainage modification is resulting in shifting fen vegetation patterns and promoting growth of non-fen species (e.g. grasses). Excess nutrients within the water table may also be contributing to shifts in the vegetation community. Dumped litter has been recorded within the site which negatively impacts the long-term health of the vegetation community.
Objective of Restoration Plan	
The objective of the Ballynafagh Lake Fen Restoration Plan is to maintain or improve the quality of existing areas of fens and improve the conditions that will allow an expansion of the area of fen. In some areas it must be recognised that restoration to fen habitat will not be possible or preferable, and the objective is to improve the habitat condition.	
Restoration Measures	
Hydrology Measures	**On-Site Measures:** Water level management through phased reinstatement of outflow structure and (pending evidence of drawdown effects), peat reprofiling or plastic piling to prevent flow seepage through the berms in the boundary of the site. Redistribution of spring flows via shallow gravity fed distribution trenches. **Off-Site Measures:** If drawdown effects are determined to be present, engagement with neighbouring landowners will be undertaken to avoid the introduction of new drainage works or the deepening of existing drains, particularly the boundary drain on the north-western edge of the fen.
Nutrient Measures	**On-Site Measures:** Redistribution of spring flows via shallow gravity fed distribution trenches encouraging nutrient uptake. **Off-Site Measures:** Engagement with landowners in the immediate catchment is therefore recommended, with priority given to lands identified as high or moderate risk in the EPA PIP mapping, particularly where flow pathways are shown to connect directly to the lake or associated spring systems.
Ecology Measures	**On-Site Measures:** Vegetation management including scrub removal, mowing and scarifying of *Molinia caerulea*, removal of invasive plant species (Purple pitcher plant), and bracken management. Dumped litter material within the site is also to be removed.
Monitoring Progress	

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary	
Hydrology Monitoring	Groundwater, surface water and lake level monitoring within the fen as well as rainfall and evaporation monitoring.
Nutrient Monitoring	Ongoing monitoring of habitats, drainage channels and springs for water quality parameters within the fen
Ecology Monitoring	Habitat condition assessments to track restoration progress.
More information	
Fen Restoration Plan Report Tóchar website: https://www.tocharwetlands.ie/fen-restoration/	

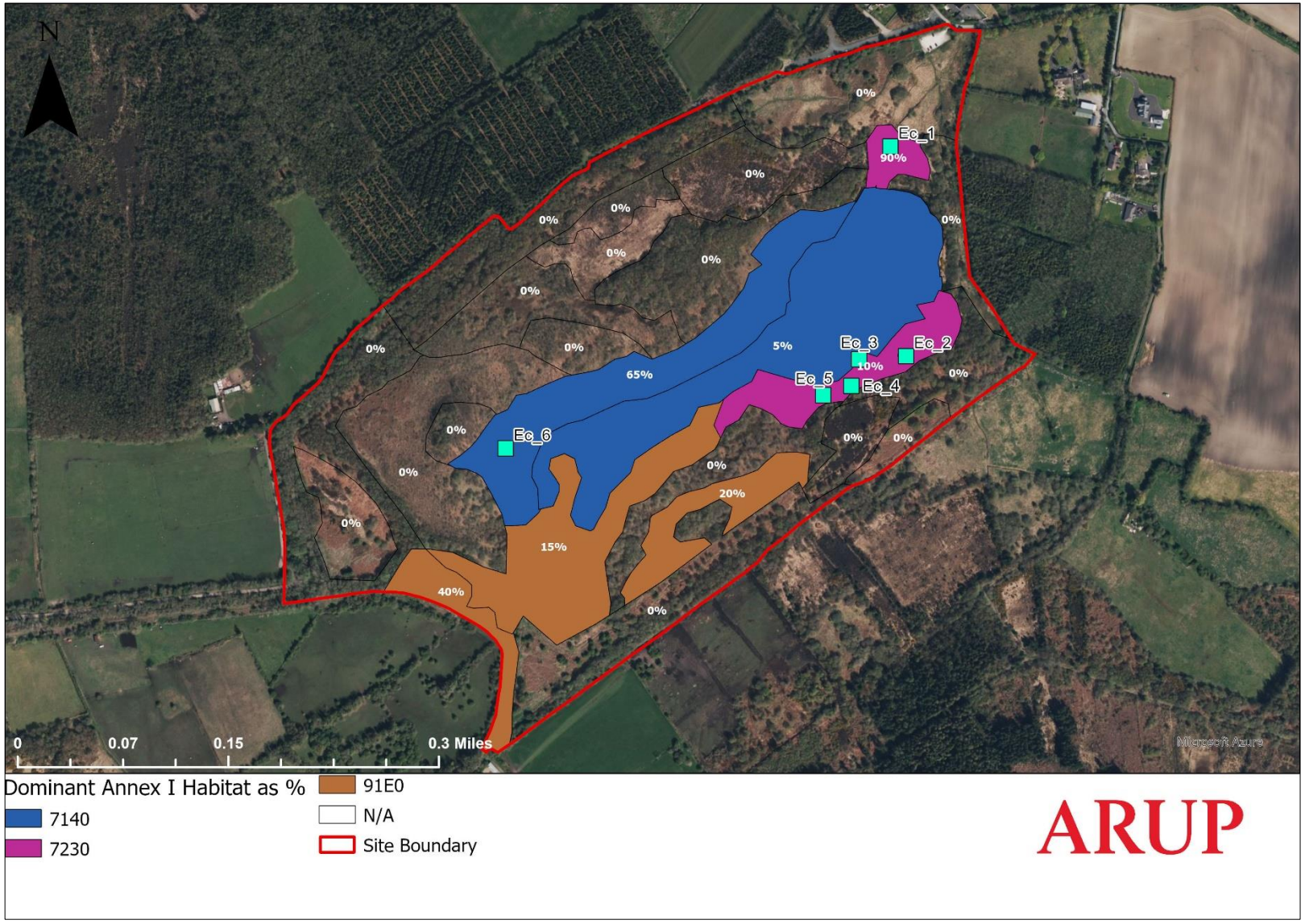


Figure 1: Site Habitat Map

BALLYNAFAGH SAC
Kildare County
45.49 ha
WFD catchment: Barrow (14)

Water key:

Drains

Springs

Vegetation:



Location:



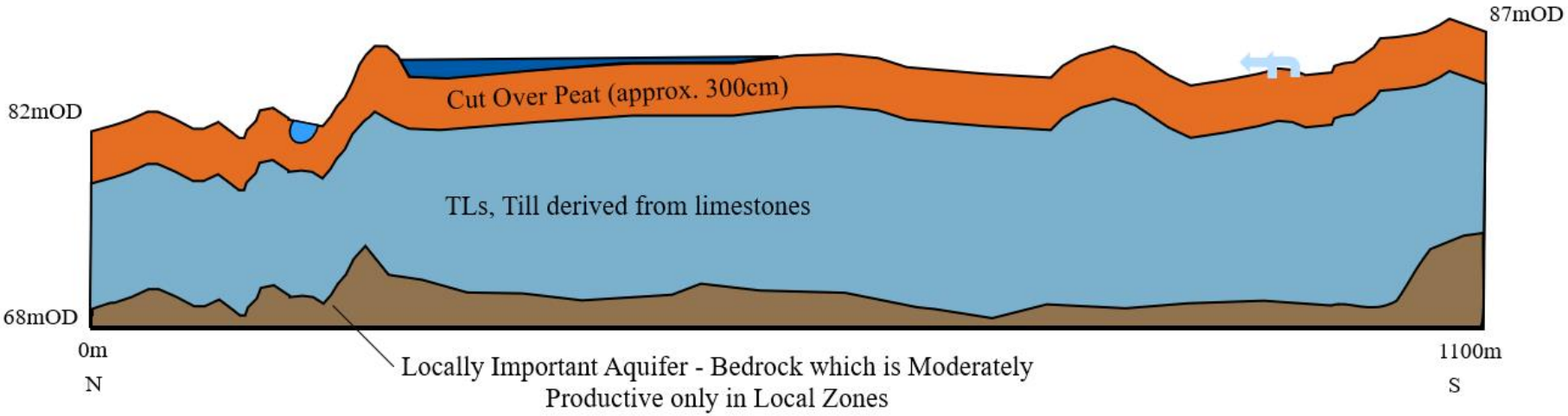


Figure 2: Conceptual Site Model

Appendix B – Ecological Survey Maps

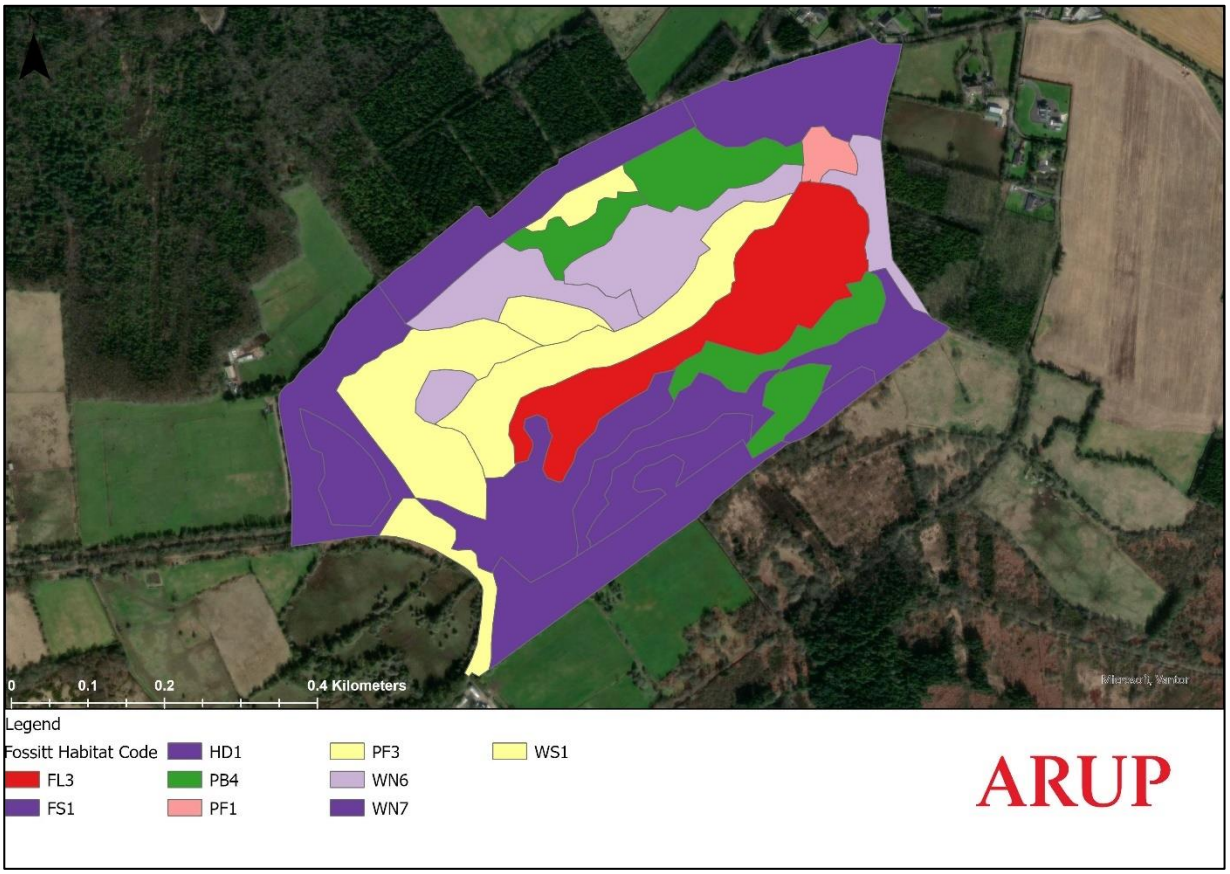


Figure B-1: Habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification System

Table B-1:Annex I and Fossit Habitat types at Ballynafagh Lake SAC

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
3110	Oligotrophic Isoetid lake habitat	FL1	Dystrophic lakes
3130	Slender Naiad-type lakes	FL2	Acid oligotrophic lakes
3140	Hard-water lakes	FL3	Limestone/marl lakes
3150	Rich pondweed lake habitat	FL4	Mesotrophic lakes
3160	Acid oligotrophic lakes	FL5	Eutrophic lakes
3180	Turloughs	FL6	Turloughs
3260	Vegetation of flowing waters	FL7	Reservoirs
3270	Chenopodion rubri	FL8	Other artificial lakes and ponds
4010	Wet heaths	FW1	Eroding/upland rivers
4030	Dry heaths	FW2	Depositing/lowland rivers
4060	Alpine and subalpine heath	FW3	Canals
5130	Juniper scrub	FW4	Drainage ditches
6130	Calaminarian grasslands	FP1	Calcareous springs

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
6210	Orchid-rich calcareous grassland	FP2	Non-calcareous springs
6230	Species-rich Nardus grassland	FS1	Reed and large sedge swamps
6410	Molinia meadows	FS2	Tall-herb swamps
6430	Hydrophilous tall-herb swamp	GA1	Improved agricultural grassland
6510	Hay meadows	GA2	Amenity grassland (improved)
7110	Raised bog (active)	GS1	Dry calcareous and neutral grassland
7120	Degraded raised bogs	GS2	Dry meadows and grassy verges
7130	Blanket bog (active)	GS3	Dry-humid acid grassland
7140	Transition mires	GS4	Wet grassland
7150	Rhynchosporion depressions	GM1	Marsh
7210	Cladium fens	HH1	Dry siliceous heath
7220	Petrifying springs	HH2	Dry calcareous heath
7230	Alkaline fens	HH3	Wet heath
8110	Siliceous scree	HH4	Montane heath
8120	Calcareous scree	HD1	Dense bracken
8210	Calcareous rocky slopes	PB1	Raised bog
8220	Siliceous rocky slopes	PB2	Upland blanket bog
8240	Limestone pavement	PB3	Lowland blanket bog
8310	Caves	PB4	Cutover bog
8330	Sea caves	PB5	Eroding blanket bog
91A0	Old oak woodland	PF1	Rich fen and flush
91D0	Bog woodland	PF2	Poor fen and flush
91E0	Alluvial woodland	PF3	Transition mire and quaking bog
91J0	Yew woodland	WN1	Oak-birch-holly woodland
		WN2	Oak-ash-hazel woodland
		WN3	Yew woodland
		WN4	Wet pedunculate oak-ash woodland
		WN5	Riparian woodland
		WN6	Wet willow-alder-ash woodland
		WN7	Bog woodland
		WD1	(Mixed) broadleaved woodland
		WD2	Mixed broadleaved/conifer woodland
		WD3	(Mixed) conifer woodland
		WD4	Conifer plantation

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
		WD5	Scattered trees and parkland
		WS1	Scrub
		WS2	Immature woodland
		WS3	Ornamental/non-native shrub
		WS4	Short rotation coppice
		WS5	Recently-felled woodland
		WL1	Hedgerows
		WL2	Treelines
		ER1	Exposed siliceous rock
		ER2	Exposed calcareous rock
		ER3	Siliceous scree and loose rock
		ER4	Calcareous scree and loose rock
		EU1	Non-marine caves
		EU2	Artificial underground habitats
		ED1	Exposed sand, gravel or till
		ED2	Spoil and bare ground
		ED3	Recolonising bare ground
		ED4	Active quarries and mines
		ED5	Refuse and other waste
		BC1	Arable crops
		BC2	Horticultural land
		BC3	Tilled land
		BC4	Flower beds and borders
		BL1	Stone walls and other stonework
		BL2	Earth banks
		BL3	Buildings and artificial surfaces



Figure B.1: Distribution of Desmoulin's whorl snail within and adjacent to Ballynafagh Lake SAC using NBDC data viewer



Figure B.2: Distribution of marsh fritillary within and adjacent to Ballynafagh Lake SAC using NBDC data viewer

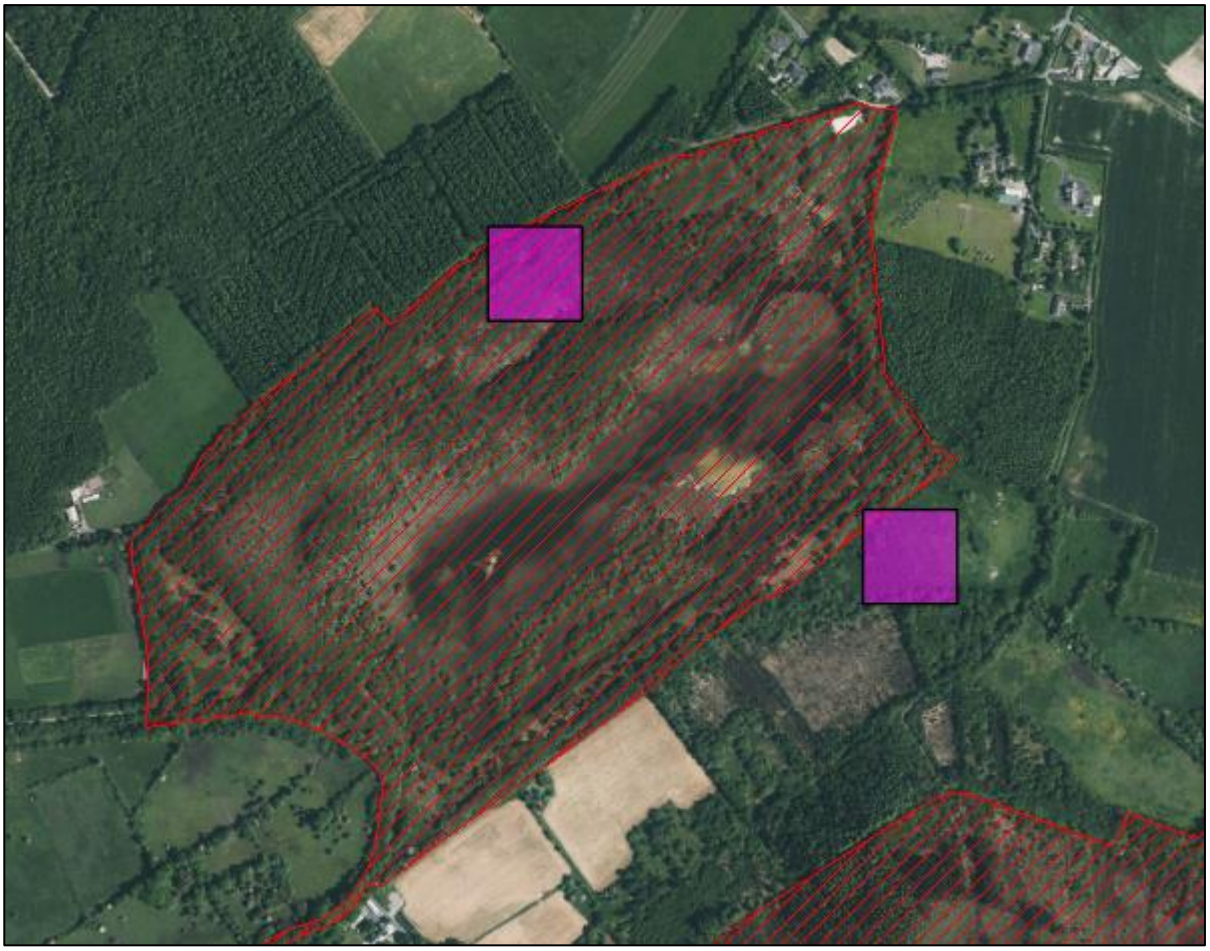


Figure B.3: Distribution of otter within and adjacent to Ballynafagh Lake SAC using NBDC data viewer



Figure B.4: Distribution of common frog within and adjacent to Ballynafagh Lake SAC using NBDC data viewer

Appendix C – Restoration and Monitoring Map

Table C-1: Long-term monitoring points for fen restoration at Ballynafagh Lake

Point	Measure	Objective	Timeframe	Frequency of monitoring	Monitoring indicator
Gw_1	Hydrological	Monitoring groundwater levels and quality	Long-term	One data logger Seasonal[5] for year 1 Annual for year 2-5	Groundwater level
Gw_2					Groundwater level
Gw_3					Groundwater level
Gw_4					Groundwater level
Sw_1		Monitoring of surface water levels and quality	Long-term	Seasonal for year 1 Annual for year 2-5	Water level and quality in main drain entering flow path
Sw_2					Water level and quality at Ballynafagh Lake
Sw_3					Water level and quality at main outlet - upstream of the culvert
Sw_4					Water level and quality at main outlet - downstream of the culvert
Sw_5					Water level and quality at northern drain surrounding the site
Ec_1	Ecological	Monitoring within the 7230 Alkaline fens, 7140 Transition mires and 7220 Petrifying springs	Long-term	Seasonal for year 1 Every 3 years for year 2-5	Ecological monitoring
Ec_2					
Ec_3					
Ec_4					
Ec_5					
Ec_6					

[5] Seasonal: every quarter to represent a hydrological year

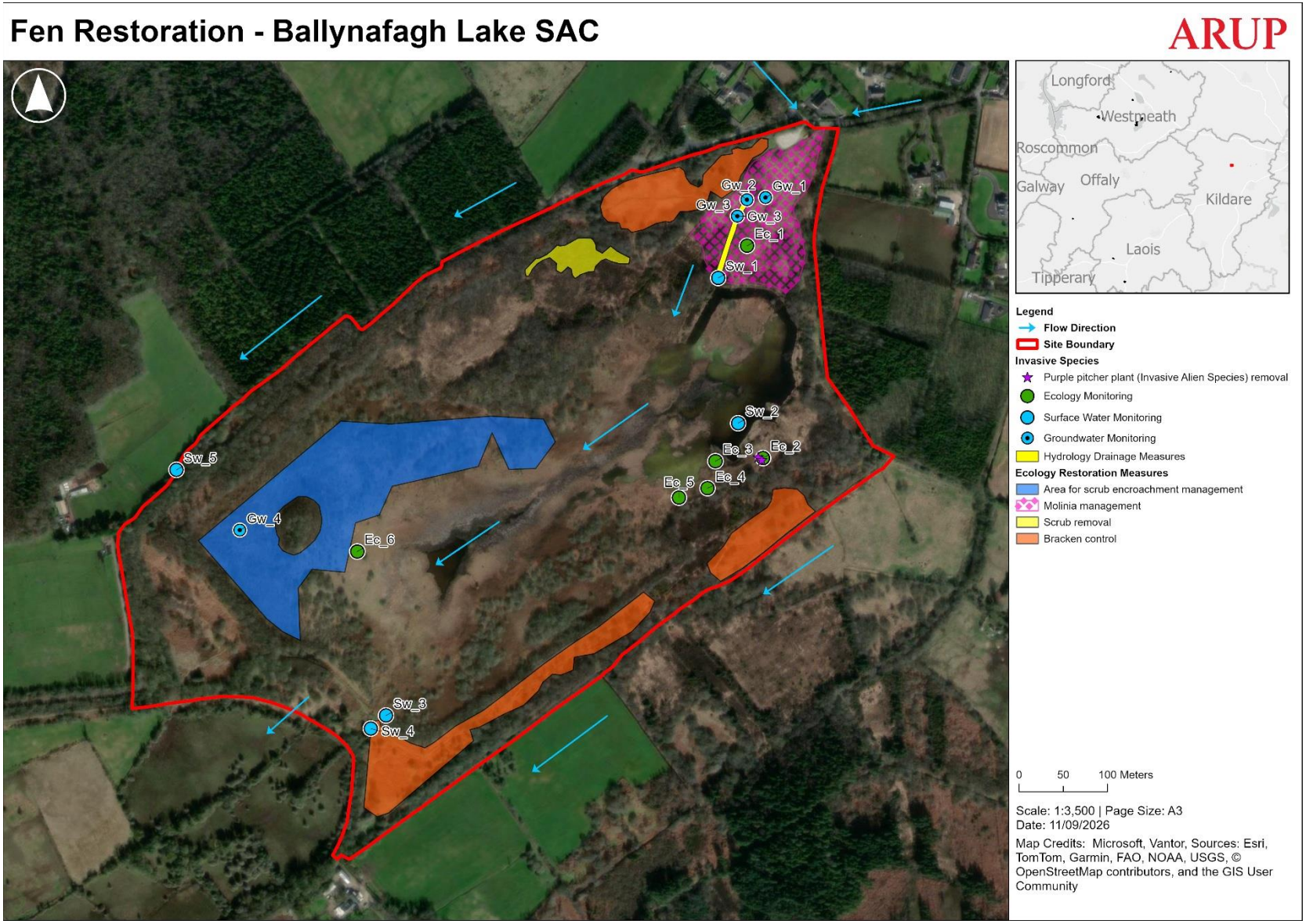


Figure C.5: Restoration and Monitoring points at Ballynafagh Lake SAC

Appendix D - Drainage Management Plan

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan			
Site name	Ballynafagh Lake		
County	Kildare	NFS site No.	106002
Catchment overview:			
Altitude at the site ranges from 83 m to 93 m. The topography of the site is generally flat. Slightly elevated ground and associated gravel deposits occur along the northern boundary of the SAC and influence groundwater discharge patterns.			
WFD catchment	14 - Barrow	WFD Sub-catchment	Slate_SC_010
Drainage Area	None	Drainage District	Yes
Responsible authority	Kildare County Council	Maintenance date	TBD
Surrounding landowners	Landowners		
Wetland drainage			
Ballynafagh Lake is located high within the sub-catchment, with a relatively small upstream contributing area, and is sustained primarily by groundwater inputs. Four groundwater springs are identified on historic mapping, with three located within the northeast of the site and one located approximately 350 m to the southeast. Groundwater inputs from the three springs within the site boundary are captured by surface drainage features and conveyed into the lake. Surface water inputs are generally limited, although a drain entering from the northeastern boundary provides inflow under certain conditions, and may also convey water from the spring located to the east of the site. Historically, lake levels were actively managed via a sluice structure at the outflow to the Blackwood Feeder, which conveyed water toward the Grand Canal. The feeder was drained and decommissioned in the 1950s, and the outflow control structure is now understood to be damaged, meaning that lake levels are no longer actively managed. Drainage channels along the site boundaries provide the main surface water outflow, with water discharging toward the Slate River to the southwest and onwards through the River Barrow system.			
Surface water inflow	Roadside drainage to the northeast of the site (under certain flow conditions)	Surface water outflow	Slate River
Groundwater inflow	Springs in the northeast of the site		
Internal drains	One internal drain in the northeast of the site	Perimeter drains	Surrounding the entire perimeter
On site hydrology measures			
On-site measure 1	Restoration of active water level management restoration	Role player	NPWS, Kildare County Council
Continuous monitoring of the lake outflow will be undertaken via a stilling well and vented logger installed at the existing standpipe. The sluice gate along the southwestern site boundary will be inspected and, subject to monitoring results, reinstated to allow regulation of the lake outfall level. Target lake levels will be defined using LiDAR data alongside a GPS-levelled staff gauge and continuous water-level loggers installed within the lake. These will be actively managed using adjustable outlet controls (weirs) to ensure optimum levels are maintained for both the fen and QI species Desmoulin's whorl snail habitats.			
On-site measure 2	Localised peat reprofiling	Role player	NPWS, Kildare County Council

In areas where the berm is visibly compromised (e.g. gaps in the berm), localised reprofiling will be undertaken to restore the berm and prevent water loss.			
On-site measure 3	Peat reprofiling or plastic piling to reduce lake seepage	Role player	NPWS, Kildare County Council
If monitoring indicates lake water is being drawn down via the northern perimeter drain, additional peat reprofiling or the installation of low-impact plastic piling will be undertaken to improve the integrity of the existing berm and reduce seepage.			
On-site measure 4	Potential flow-blocking measures	Role player	NPWS, Kildare County Council
Subject to monitoring results, flow-blocking measures (limestone cobbles or low impact plastic piling) may be installed within the preferential flow path from the springs in the northeast of the site to the lake. Implementation will include vegetation clearance and peat probing, with LiDAR analysis used to identify appropriate locations for intervention.			
Off-site hydrology measures			
Off-site measure 1	Avoid deepening boundary drains	Role player	NPWS/Surrounding landowners
Engage with adjacent landowners to avoid new drainage works or deepening of existing drains where hydrological connectivity to the lake system is confirmed. Targeted engagement will be informed by site-specific hydrological monitoring along the northern perimeter drain, with restrictions focused only where a demonstrable drawdown effect is identified.			
Proposed Water Monitoring:			

Indicator	Water level	Location	Various locations across site	Role players	NPWS/ Kildare County Council
Groundwater, surface water and lake level monitoring will be undertaken through a network of piezometers and standpipes at key locations within the site to monitor changes to water levels as a result of the installation of the flow distribution trenches and any reinstatement of the outlet control structure. Level loggers will be used to monitor changes in water levels.					
Indicator	Sediment level	Location	Within lake	Role players	NPWS/ Kildare County Council
Undertake lake depth surveys every two to three years and compared with data from studies undertaken in 2005 as part of the Blackwood Feeder Baseline Study (Hayes, 2006).					

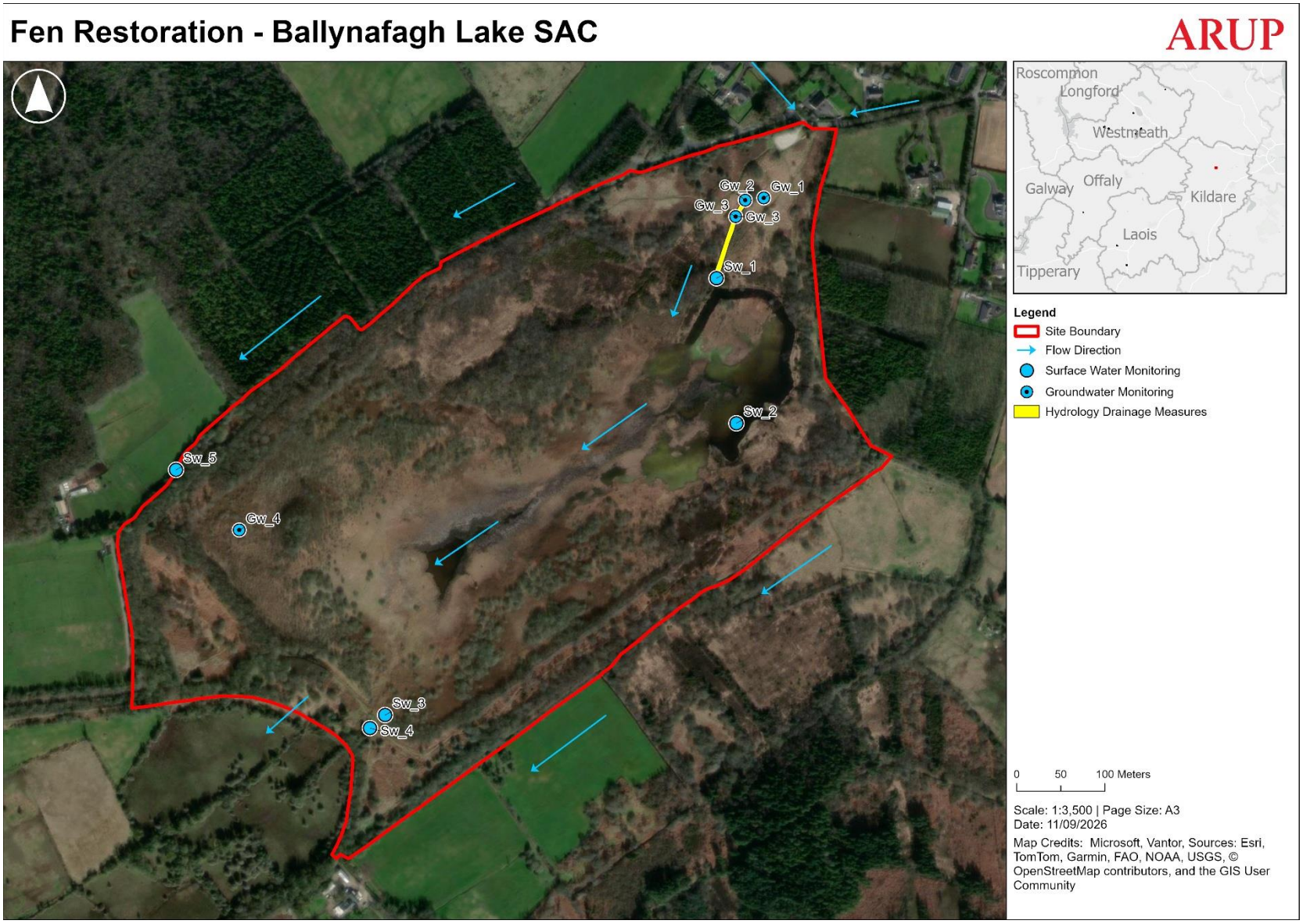


Figure 1: Mapped drainage network at Ballynafagh Lake