

National Parks & Wildlife Service
Tóchar Midlands Wetland Restoration Scheme

Lough Owel
PFS Site No. 1005
SAC 000688
Fen Restoration Plan

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ARUP



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An tSeirbhís Páircenna
Náisiúnta agus Fiadhúlra
National Parks and Wildlife
Service

Fen Restoration Plan
Fin Lough (Offaly) SAC (000576)

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Executive Summary

Fin Lough, situated in County Offaly, is a designated Special Area of Conservation (SAC) due to its rare wetland habitats, primarily Alkaline fens, Transition mires and quaking bogs and the presence of the protected Geyer's Whorl Snail (*Vertigo geyeri*). These habitats and species are of significant ecological value, supporting biodiversity, improving water quality, storing carbon, and contributing to flood mitigation.

The ecological integrity of Fin Lough has been impacted by several factors:

- Drainage works that have altered natural water levels,
- Nutrient enrichment from adjacent agricultural activities,
- Ineffective grazing regimes (both overgrazing and absence of grazing),
- Encroachment by scrub and invasive species.

These pressures have resulted in a decline in habitat quality and threaten the species and ecological functions the site supports.

Actions of the Fen Restoration Plan

The restoration plan for Fin Lough sets out a coordinated series of measures to address the key pressures affecting the site and to support the recovery of its unique wetland habitats. Central to the plan is the management of water levels through the installation of an adjustable weir on the main internal drainage channel. This intervention is designed to restore and stabilise the wet conditions that are essential for the persistence of fen habitats. The effectiveness of these hydrological measures will be tracked through ongoing monitoring of both groundwater and surface water across the site.

Vegetation management is another core component of the plan. Dense grass, particularly *Molinia caerulea*, will be mown and the soil scarified to reduce its dominance and encourage the return of fen- specialist plant species. In addition, selective removal of scrub, such as birch and hawthorn, will be carried out using low-impact methods to prevent further encroachment into open fen areas. The potential for introducing light, conservation-focused grazing could be implemented outside the Tóchar programme, with the aim of maintaining an open habitat structure and promoting greater plant diversity.

To address nutrient and pollution pressures, the plan emphasises collaboration with local landowners and farmers through established programmes and incentives. This includes efforts to reduce nutrient runoff from surrounding agricultural land, as well as the provision of alternative livestock watering solutions to prevent direct access to the fen. Regular water quality assessments will be conducted to monitor nutrient levels and inform adaptive management of the site.

Finally, the plan recognises the importance of stakeholder engagement and compliance. Active engagement with landowners, statutory bodies, and other local stakeholders will help ensure that restoration actions are practical, widely supported, and compliant with relevant legislation. The plan also includes measures to protect archaeological features and to assess and manage any risks to peat stability, thereby safeguarding both the cultural heritage and the physical integrity of the site.

Benefits of the Fen Restoration Plan

The restoration plan is expected to deliver significant benefits for a range of habitats and species at Fin Lough. For Alkaline fens, weir installation will raise the water table, creating wetter conditions that favour fen plants and reduce the dominance of coarse grasses such as *Molinia caerulea*. Cutting and scarifying dense *Molinia* will further support fen expansion and help restore natural drainage.

Transition mires and quaking bogs will benefit from weir installation, *Molinia* removal, scrub clearance, and the potential for conservation grazing beyond the scope of the programme. These actions aim to restore the wet, unstable conditions needed by species such as *Sphagnum* mosses, while preventing further drainage and nutrient input will help avoid habitat decline.

Rich fen and flush areas will be improved through controlled grazing, potentially as conservation grazing beyond the programme, and removal of *Molinia* litter, keeping vegetation open and species rich. Potential conservation grazing in the future could contribute to maintaining the structure and integrity of these habitats.

Reed and large sedge swamps will be supported by maintaining high water levels and managing vegetation to preserve habitat diversity, while wet heath areas may require the potential for conservation grazing beyond the programme, following mowing and drain blocking, to prevent *Molinia* dominance. Wet woodland patches will benefit from efforts to maintain wet conditions and monitor drainage.

Although the main works are outside the known range of the rare snail *Vertigo geyeri*, improved water levels could create more suitable conditions for this species to spread. Additional measures such as the potential for conservation grazing beyond the programme and scrub control will help maintain the open structure and microhabitats important for its survival.

Overall, these restoration actions will enhance habitat quality and resilience, supporting both biodiversity and the site's long-term conservation objectives.

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.

Thanks to the members of the SAR Directorate, NPWS Regional Staff, Ecological Assessment Unit (EAU), Ecological Guidance and Advisory Unit (EGAU), Wildlife Enforcement and Nature Protection Directorate, Conservations Measures Unit, Conservation Planning Unit and the Tóchar Wetlands Project Team.

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 Annex¹ I 7230 Alkaline fens habitats within the site which contributes to favourable conservation condition of the fen habitat and the achievement of SAC site-specific conservation objective (SSCO) targets. Much of the site is also part of the Fin Lough Special Area of Conservation (SAC) (site code: 000576), which covers a total area of 77.20 ha and is dominated by fen habitat although several other associated peatland habitats are also present (O'Neill, et al., 2023). The qualifying features of the SAC are Annex I habitat and the Annex II species *Vertigo geyeri* (1013 Geyer's Whorl Snail). Some areas of 7140 Transition mires and quaking bog (hereafter referred to as 7140 Transition mires habitat) are also present, albeit it is not a qualifying feature of the SAC. According to the Scoping Study and Pilot Survey of Fens carried out in 2023 (O'Neill, et al., 2023), the total extent of 7230 Alkaline fens and 7140 Transition mires within Fin Lough (Offaly) SAC has been estimated at 1.44 ha and 13.82 ha, respectively. The population of *Vertigo geyeri* is associated with *7220 Petrifying springs with tufa formation, located in the northern part of the site.

The main aims of the FRP are to maintain or improve the quality of existing areas of fen and improve the hydrological conditions that will allow an expansion of the measurable area of fen thus impacting on the favourable condition of the fen. 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 FRP is on fen habitat and associated SSCOs, it is anticipated that restoration actions will also benefit other wetland habitats mapped within the Fin Lough (Offaly) site during previous National Fen Surveys (Section 4.1.1.2). These wetland habitats include the Fossitt² habitat types of FL3 Lakes and ponds, HH3 Wet heath, FS1 Reed and large sedge swamps, FS2 Tall herb swamp, FW3C/G Open water and swamp mosaics, PB4 Cutover bog, PF1 Rich fen and flush, WN6/WN7 Wet woodland types (O'Neill, et al., 2023).

Restoration actions to raise the water table of a fen will improve the hydrology of adjacent wetlands and fen habitats. The implementation of the actions proposed within this FRP report

¹ Each habitat and species type protected under the EU Habitats Directive (Council Directive 92/43/EEC of 21 May 1992) is given a unique numeric code so that all Member States use the same reference in legislation, reporting and monitoring. Each habitat and species code is an index in the Annex lists with codes grouped by habitat family.

² Fossitt habitats refer to the classification system outlined in A Guide to Habitats in Ireland by J.A. Fossitt (2000). It provides a standardised framework for habitat identification and mapping in Ireland, grouping habitats into hierarchical levels based on vegetation, landform, and ecological characteristics.

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.

While full-scale hydrological restoration aimed at re-establishing the site's former lake would offer potential ecological gains for aquatic species and waterfowl, this would result in the loss of existing fen areas. Therefore, restoration will be carefully targeted to deliver hydrological and ecological improvements while restoring, expanding and maintaining the extent and quality of existing fen habitat, ensuring a balanced approach that supports favourable conservation outcomes across priority habitats and species.

1.2 Wider benefits of fen 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 notable 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 many fens in Ireland are not protected as SACs or Natural Heritage Areas (NHAs), they can play an important part 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. 2015) 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 functions.

The restoration of fen habitat can 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 thereby also reducing flood risk.

1.3 Key Pressures on Fens

The overarching (National) key pressures and threats to Annex I fen habitats and Annex II species *Vertigo geyeri*, 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, 7230 Alkaline fens and 1013 *Vertigo geyeri* 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) B01 Conversion to forest from other land uses, or afforestation J01 Mixed source pollution to surface and ground waters K02 Drainage K04 Modification of hydrological flow
	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 K01 Abstraction from groundwater, surface water or mixed water L02 Natural succession resulting in species composition change C05 Peat extraction
	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 agroforestry 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)
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.) J01 Mixed source pollution to surface and ground waters

Habitat	Importance	Pressure
	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 N02 Droughts and decrease in precipitation due to climate change N03 Increases or changes in precipitation due to climate change
	Low	PF05 Sports, tourism and leisure activities PI03 Problematic native species 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
<i>Vertigo geyeri</i>	High	PA08 Extensive grazing or under grazing by livestock PA22 Drainage for use as agricultural land PL05 Modification of hydrological flow (mixed or unknown drivers)

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.
- Regulation (EU) 2024/1991 of the European Parliament and of the Council of June 2024 on nature restoration and amending Regulation (EU) 2022/869.
- 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.
- 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), each Member State is required to establish a number of protected sites of the highest biodiversity importance for rare and threatened habitats and species across the EU. In Ireland, the sites belonging to the Natura 2000 network of European sites includes Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

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 interests (SCI) of the SPA. Conservation objectives for the site are defined for these qualifying interests.

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 increasing 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.

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 improving their conservation status.

1.4 Outline of this FRP document

- Section 2 of this FRP report outlines details of Fin Lough (Offaly) and the conservation objectives for 7140/7230 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 (see Appendix D for details of GIS layers provided). 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. GIS Shapefiles which accompany this report include all relevant data on referenced species.

2 Site Overview

2.1 *Fin Lough (Offaly)*

Fin Lough (Offaly) is located 7 km north-east of Shannonbridge in Co. Offaly. The site is bounded by the Clonfinlough esker ridge to the north, agricultural land to the east and the Blackwater Bog to the south and west which is largely cut over. Historical maps from the mid-1800s show that Fin Lough was a shallow lake but by the 1940s the open water body was notably reduced. The Glebe River located to the east of the site acts as an inflow into Fin Lough and the Gowlan River located to the southeast of the site provides an outflow. The area of open water has decreased due to drainage activities carried out for peat cutting in the adjacent Blackwater Bog.

The site is a SAC for the presence of 7230 Alkaline fens and 1013 *Vertigo geyeri* (Geyer's Whorl Snail), as listed on Annex I/II of the E.U. Habitats Directive. The 7230 Alkaline fen habitat is found on the eastern side of the site. Petrifying springs are located to the north of the site which provide suitable conditions for the *Vertigo geyeri* species. Additionally, 7140 Transition mires habitat is also present on the eastern side of the site.

shows the location and extent of Fin Lough (Offaly).

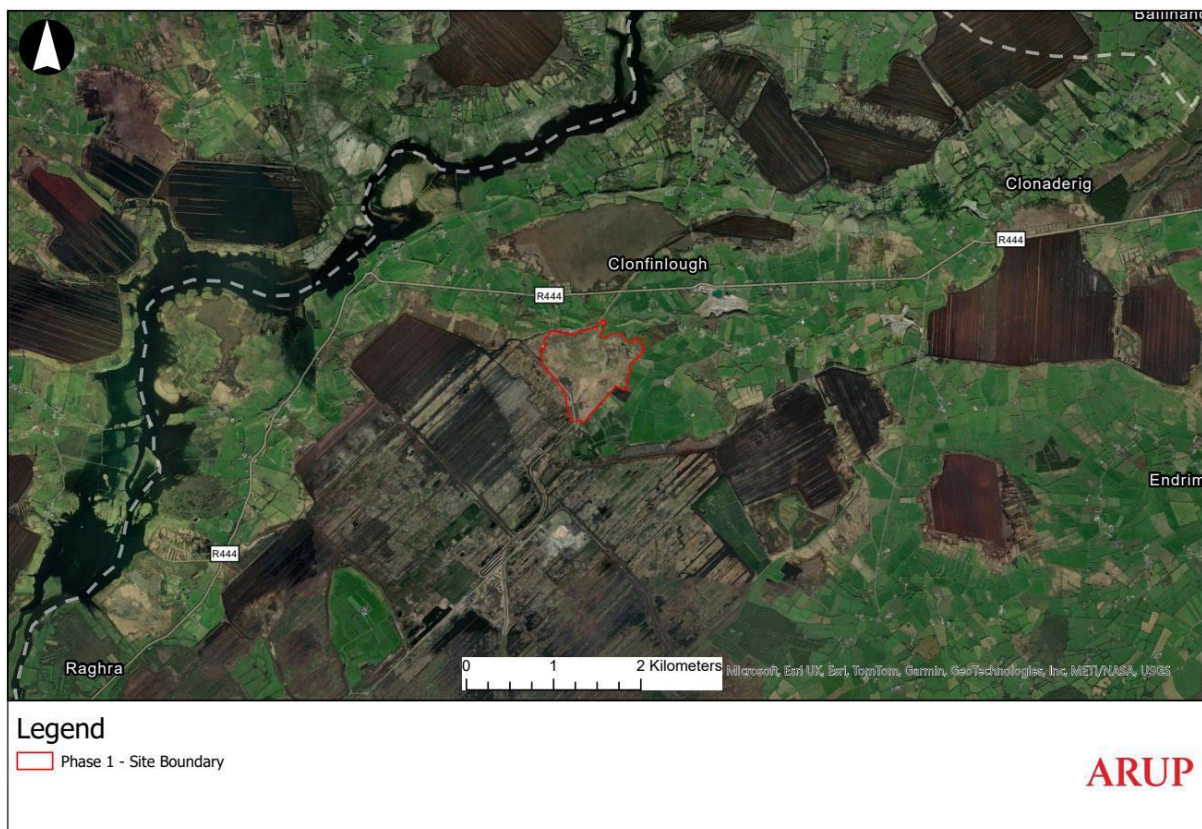


Figure 2-1: Site location map

The site synopsis for Fin Lough (Offaly) SAC notes that the site is a shallow limestone lake surrounded by a complex of wetlands habitats (NPWS, 2019). The lake and its surrounding wetland communities are arranged in distinct zones reflecting wetness and substrate. They include open water, reed swamp, tall sedge, alkaline fen, fen-bog transition, swamp woodland and bog. The transition from calcium-rich lake to reedbed, to fen, to bog is relatively intact in some areas, which is exceptional for this part of the country.

2.2 Fen Condition Assessment

As detailed in Table 2-1 the following four pressures have been reported across the site in the Scoping Study and Pilot Survey of Fens (O'Neill et al., 2023):

- A09 Intensive grazing or overgrazing by livestock
- L02 Natural succession resulting in species composition change
- A26 Agricultural activities generating diffuse pollution to surface or ground waters
- K02 Drainage

Table 2-1: Assessment of impacts of pressures on 7140 Transition mires/7230 Alkaline fen Fen at Fin Lough (Offaly) (O'Neill et al., 2023)

Pressure Code	Pressure [sub-category]	Influence
A09	Overgrazing by livestock was noted as a problem at Fin Lough in the area of 7230 habitat recorded at the edge of the site.	Negative
L02	Natural succession mainly to scrub or woodland was recorded at Fin Lough. It varied in the extent to which it affected the 7140 Annex I habitat, ranging from 1-5%.	Negative
A26	Agricultural activities generating diffuse pollution to surface or groundwaters. Algal deposition was noted indicating pollution. However, the intensity was low, impacting less than 1% of the site	Negative
K02	Drainage. Newly dug ditch was noted with the potential to remove water from the site.	Negative

The results of a field evaluation (2025) of the above pressures to inform the restoration planning process is detailed in Section 5 of this report.

Fin Lough (Offaly) was surveyed as part of the Scoping Study and Pilot Survey of Fens between the 15th and 17th of June 2020 (O'Neill, et al., 2023). The overall conservation status of 7140 Transition mires and 7230 Alkaline fens were assessed as Unfavourable – Bad and Unfavourable – Inadequate, respectively. The results of the conservation status assessment of habitats carried out as part of the Scoping Study and Pilot Survey of Fens at Fin Lough (Offaly) is summarised in Table 2-2.

Table 2-2: Conservation Status Assessment of 7140/7230 Fen (O'Neill, et al., 2023)

Annex I habitat	Area	Overall Status	Rationale
7140 Transition mires	Favourable	Unfavourable-Bad	Agricultural activities are generating diffuse pollution to surface or groundwater. Site vulnerable to runoff from surrounding green fields, some signs along edge of the site.
7230 Alkaline fens	Favourable	Unfavourable-Inadequate	Not addressed/ included in the NFS

2.3 SAC 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.

A conservation objective has been set for Fin Lough SAC for 7230 Alkaline fens, using attributes and targets based on parameters set out in the Habitats Directive. The conservation objective is 'to maintain the favourable conservation condition of Alkaline fens in Fin Lough (Offaly) SAC'.

The attributes and targets for 7230 Alkaline fens, along with how the FRP will contribute to achieving set targets, are set out in Table 2-3.

The restoration actions outlined by this restoration plan aim to contribute towards achieving these targets.

Table 2-3: Attributes and Targets for 7230 Alkaline Fens (NPWS, 2019)

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribute to achieving target?
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. They should 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.
Ecosystem function: peat formation	Percentage cover of peat-forming vegetation and water table levels	Maintain active peat formation, where appropriate	Yes	Yes. Improvement in the hydrology of fen habitat will improve conditions for peat formation.
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 -	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

Fin Lough (Offaly) Fen Restoration Plan

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribute to achieving target?
surface water flow				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 via Glebe River and from surrounding lands. Water quality monitoring will be carried out within the site.
Community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	Yes	The restoration measures seek to have a positive impact on the vegetation structure and composition of Alkaline fens 7230. Subsequently, all attributes should see a favourable shift towards their respective targets.
Vegetation composition: brown mosses	Percentage cover at a representative number of 2m x 2m monitoring	Maintain adequate cover of typical brown moss species	Yes	
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	
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: non-native species	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of non-native species less than 1%	Yes	

Fin Lough (Offaly) Fen Restoration Plan

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribute to achieving target?
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 composition: soft rush and common reed cover	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of soft rush (<i>Juncus effusus</i>) and common reed (<i>Phragmites australis</i>) less than 10%	Yes	
Vegetation structure: litter	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of litter not more than 25%	Yes	
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of disturbed bare ground not more than 10%	Yes	
Physical structure: tufa formations	Percentage cover in local vicinity of a representative number of monitoring stops	Disturbed proportion of vegetation cover where tufa is present is less than 1%	Indirectly	Areas of tufa are not the target of restoration measures and monitoring. However, measures to improve the condition of fen habitats may indirectly positively affect vegetation in these areas.

3 Land and Water

3.1 Desk 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, Athlone O.P.W, have been reviewed to assess seasonal variability in rainfall at the site and surrounding areas (Met Éireann, 2025).

Two datasets have been visualised: (1) average monthly precipitation (mm), incorporating a 30-year period to show seasonal distribution patterns (Figure 3-1) and (2) total annual precipitation (mm) for each year within the 30-year record (Figure 3-1), 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 late spring (April and May). Minimum rainfall follows a similar pattern, while the maximum monthly rainfall shows a notable increase in winter (Figure 3-1).

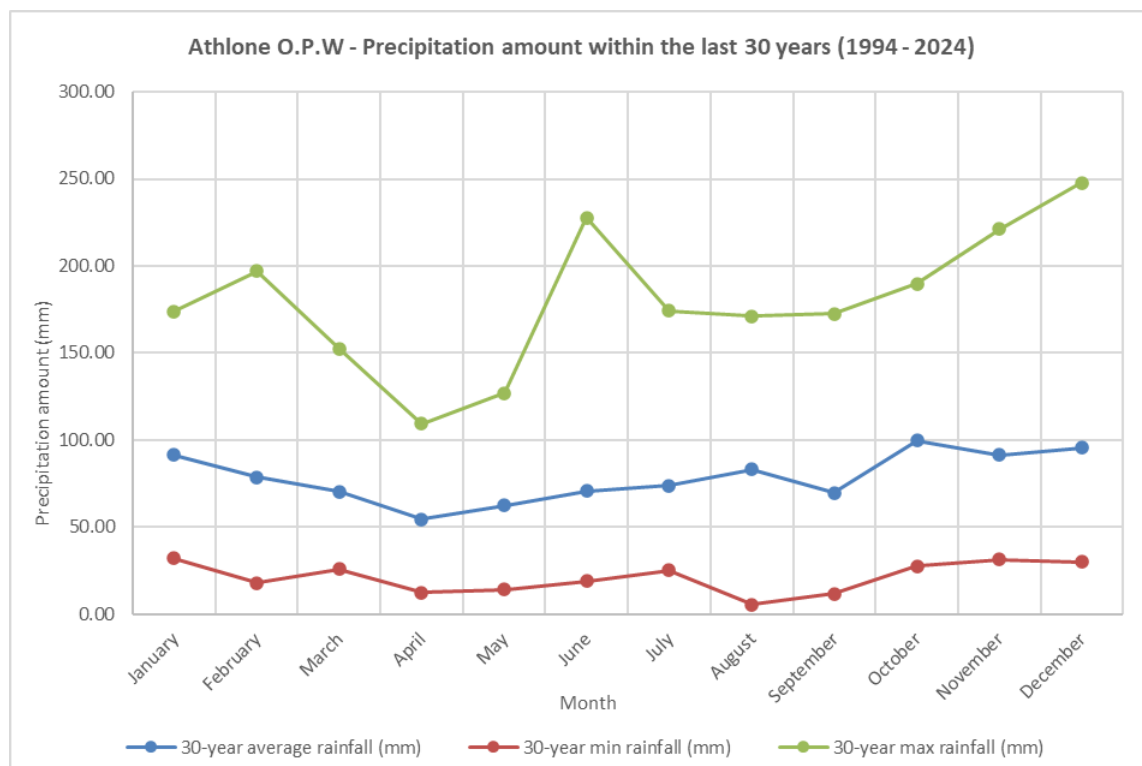


Figure 3-1: Athlone O.P.W weather Station – Total annual precipitation within the last 30 years (1994-2024)

3.1.2 Hydrogeological Setting

The west of the site is underlain by the Ballysteen Formation, characterised by dark muddy limestone and shale. The eastern part of the site is underlain by the Navan Beds formation which is characterised by dark limestone, mudstone and sandstone. The bedrock geology of the site is presented in

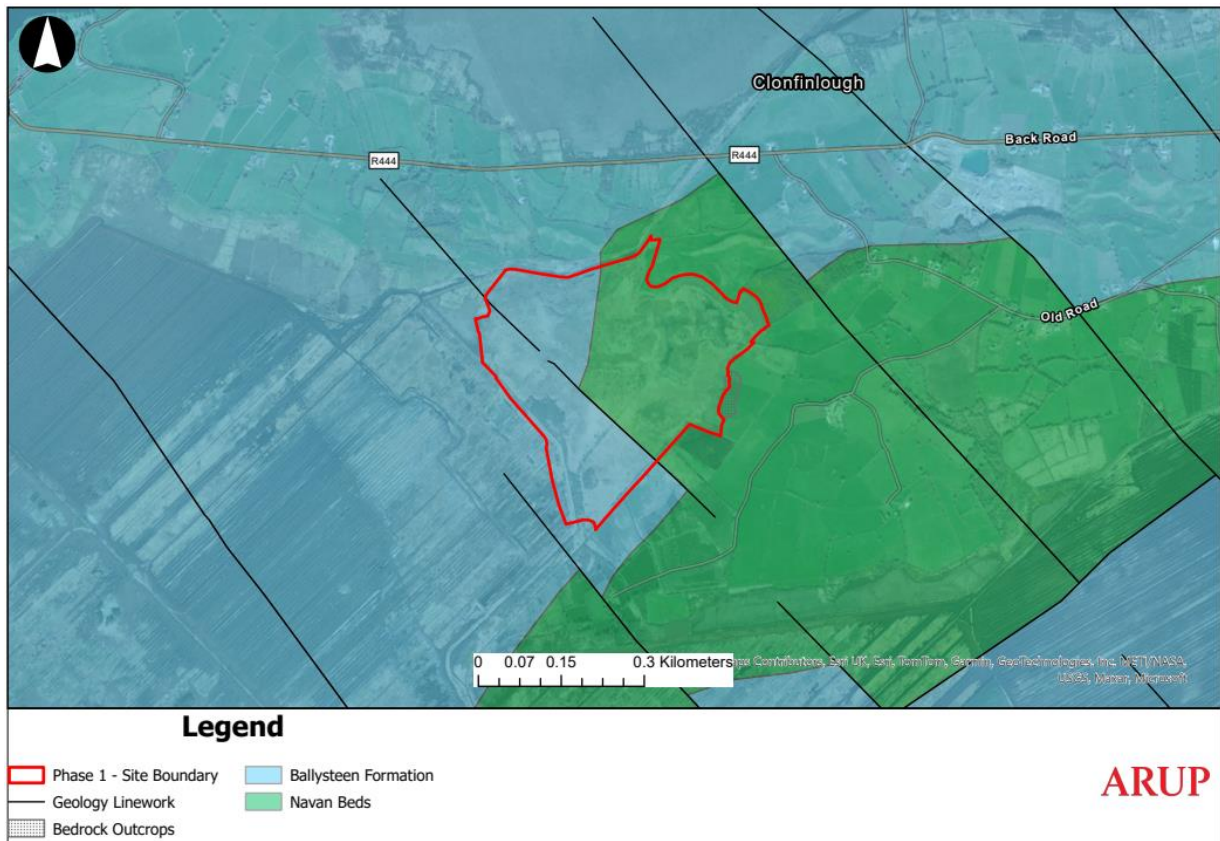


Figure 3-2.

Figure 3-2: Bedrock Geology of Fin Lough (Offaly) (GSI, 2025)

The area is underlain by a Locally Important bedrock aquifer which is moderately productive only in local zones (LI). Most of the flow in this type of aquifer is in the upper 15m, in the zone that consists of a weathered layer and connected fracture zone below. A locally Important gravel aquifer (Lg) is located north of the site and will provide some groundwater storage. The aquifer classification underlying the site is presented in Figure 3-3.

The Fin Lough groundwater body, GWDTE-Fin Lough Fen, which underlies the site is at 'good' status and 'not at risk' of not achieving its WFD objectives (EPA, 2024).

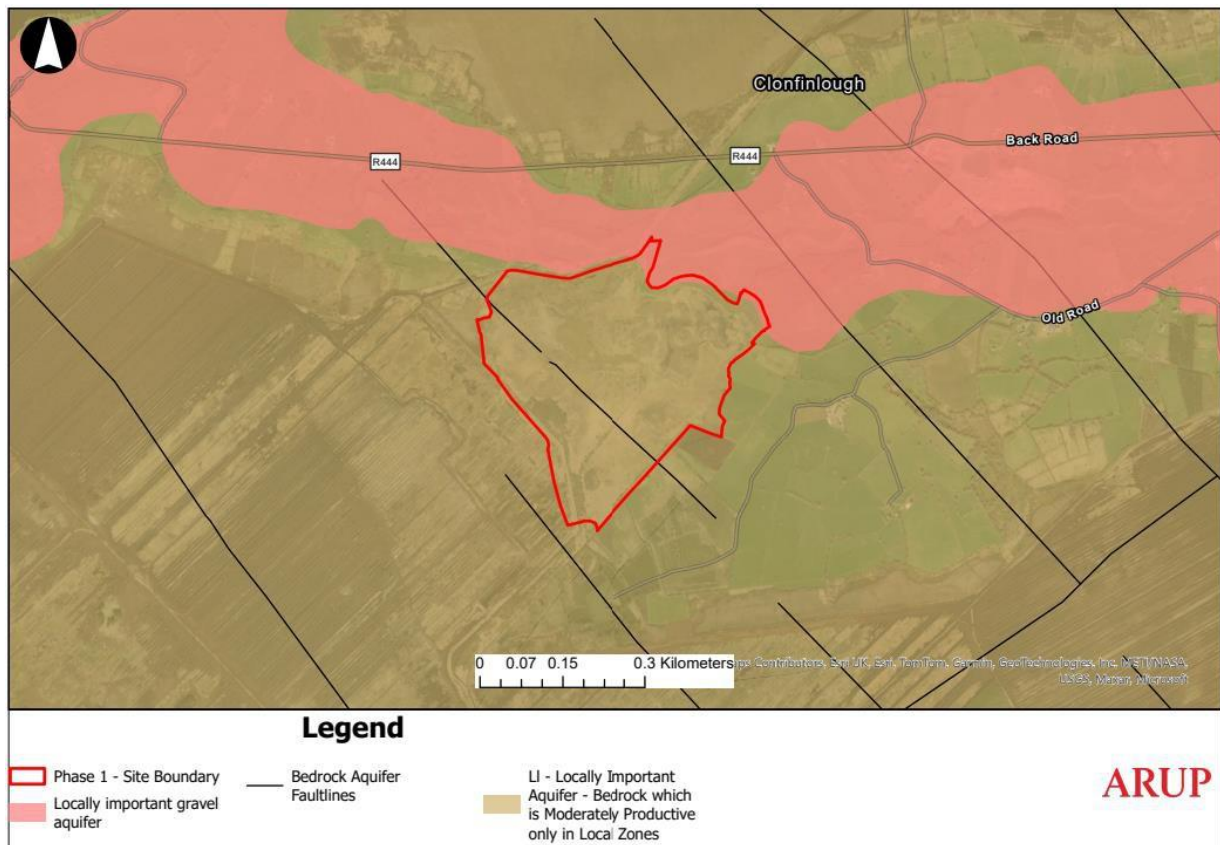


Figure 3-3: Aquifer classification at Fin Lough (Offaly) (GSI, 2025)

Quaternary sediments within the site boundary comprise fen peat, with cut over raised peat present in the surrounding area. To the north of the site, there are gravels derived from limestones, along with bands of eskers and lacustrine sediments, while till derived from limestone is located to the south and east. The gravel deposits predate the peat, having formed through glacial retreat, whereas the peat accumulated in the post-glacial, warmer climatic period. The subsoil type underlying the site is presented in Figure 3-4.

Soil type in Fin Lough observed during the Scoping Study and Pilot Survey of Fens (O'Neill et al., 2023) included peat with depths ranging from 7cm to more than 310cm. The Teagasc soils map notes that soil types within the site are mostly cut peat and fen peat with smaller areas in the site's northern and eastern fringes of shallow poorly drained mineral soil.

Groundwater vulnerability ranges from low in peat-covered areas to high in areas underlain by gravel, with an area of extreme vulnerability in the east where rock is near or at surface or karst is present. This pattern is reflected by the recharge rates, which are higher in gravels (400 to 450 mm/year), and lower in the peat (1 to 50mm/year). The groundwater vulnerability for the site is presented in Figure 3-5.

Fin Lough (Offaly) Fen Restoration Plan

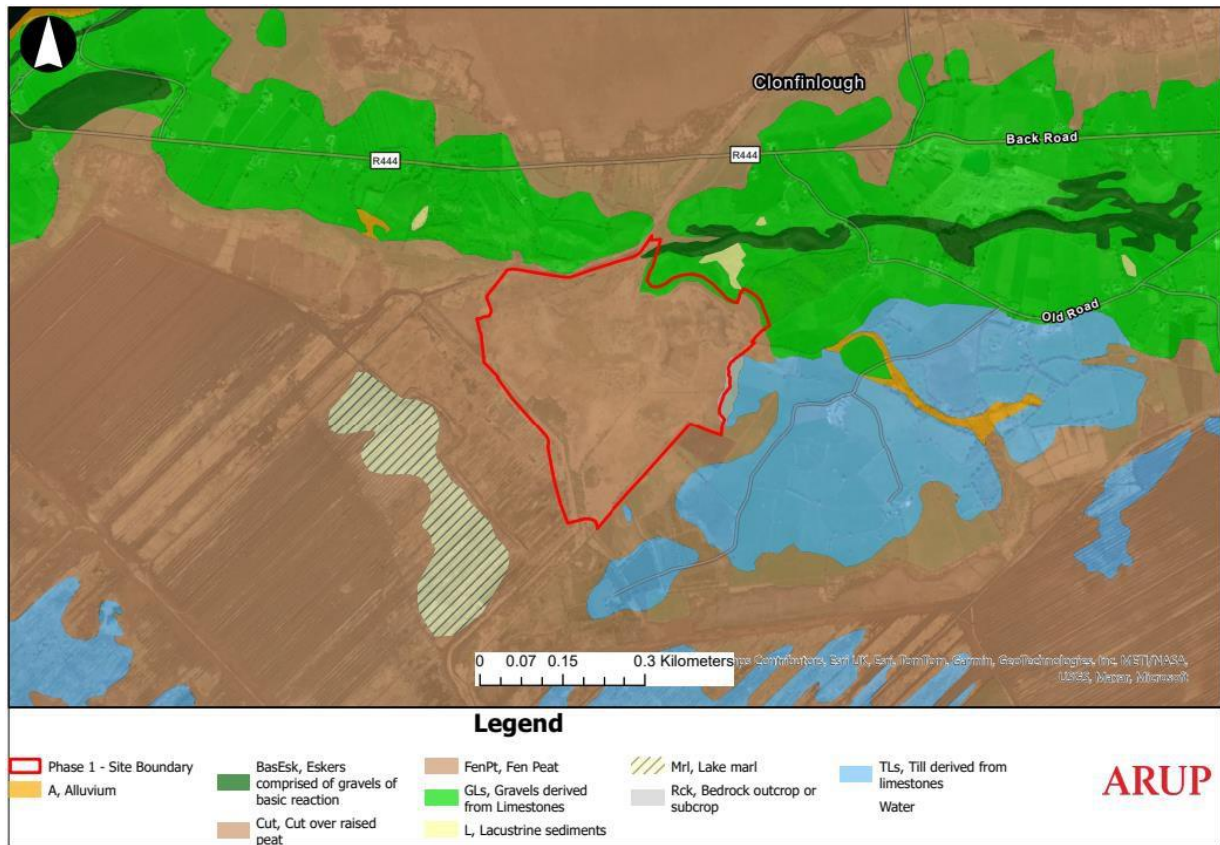


Figure 3-4: Subsoil type underlying Fin Lough (Offaly) (GSI 2025)

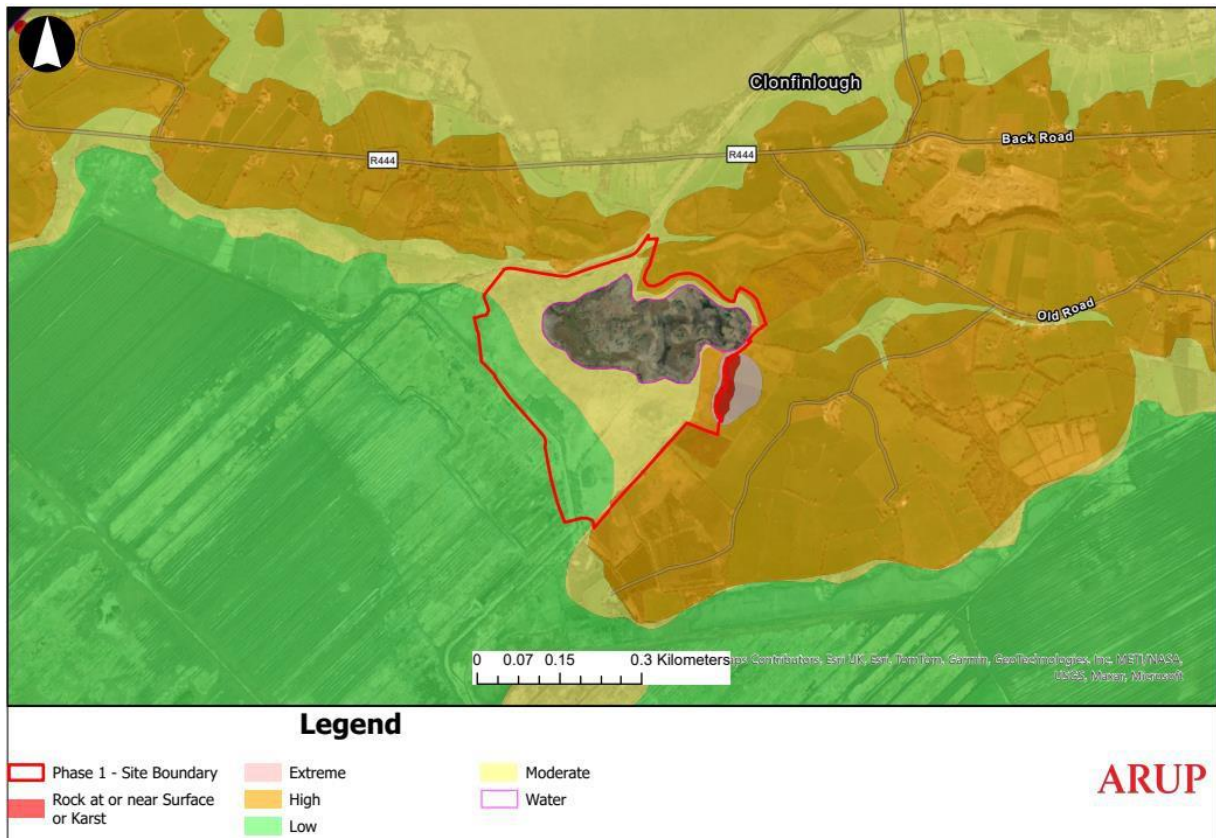


Figure 3-5: Groundwater vulnerability map for Fin Lough (Offaly) (GSI 2025)

3.1.3 Topography and Surface Water Drainage

The site is located within the Lower Shannon Catchment 25B and the WFD sub catchment: Shannon [Lower] SC_030) (Figure 3-6). The lower Shannon catchments drain towards the Shannon Estuary. The WFD River Sub-Basin: Blackwater (ShannonBridge)_020 drains the site to the south-west towards River Shannon (Figure 3.6). The Blackwater (ShannonBridge)_020 WFD River waterbody is classed at 'moderate' WFD Status and 'at risk' of not achieving its WFD objective (EPA, 2024).

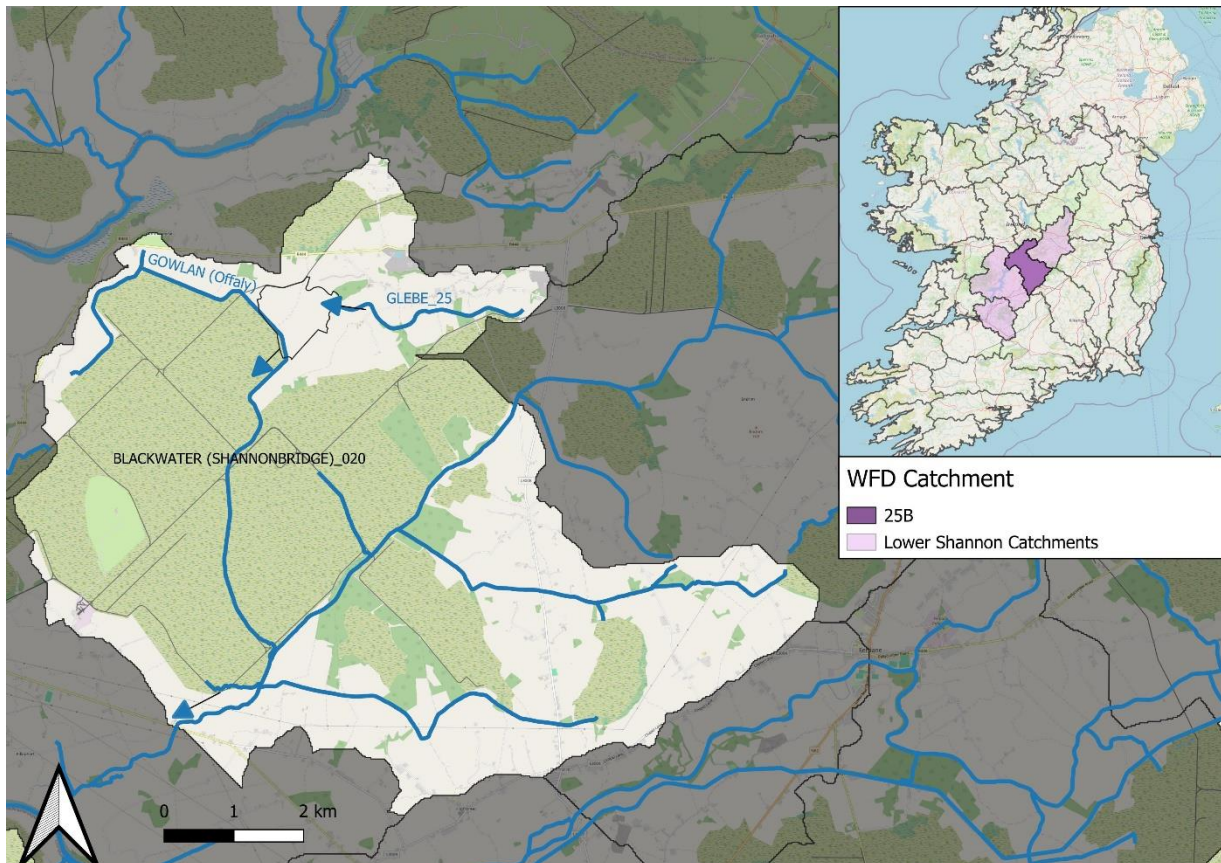


Figure 3-6: WFD Catchment and River sub-basin (EPA, 2025). Arrows indicate the direction of flow.

The site is positioned at approximately 40m OD and is relatively flat. Higher ground is located to the north along an esker ridge. The area to the west and south of the site is very flat where the Blackwater Bog has been historically excavated for peat.

An assessment of historical and current hydrological data indicates that the water regime of Fin Lough (Offaly) has changed over time, primarily due to drainage for peat extraction activities. Historical maps from the early-1800s show an open water body with the site boundary, with a drain passing through the centre of the site. By the 1940s, the lake area had reduced significantly. While the northern part of the site still comprised an open water body the southern portion had become vegetated. Historical water distribution and retention within wetland is shown in Figure 3-7.

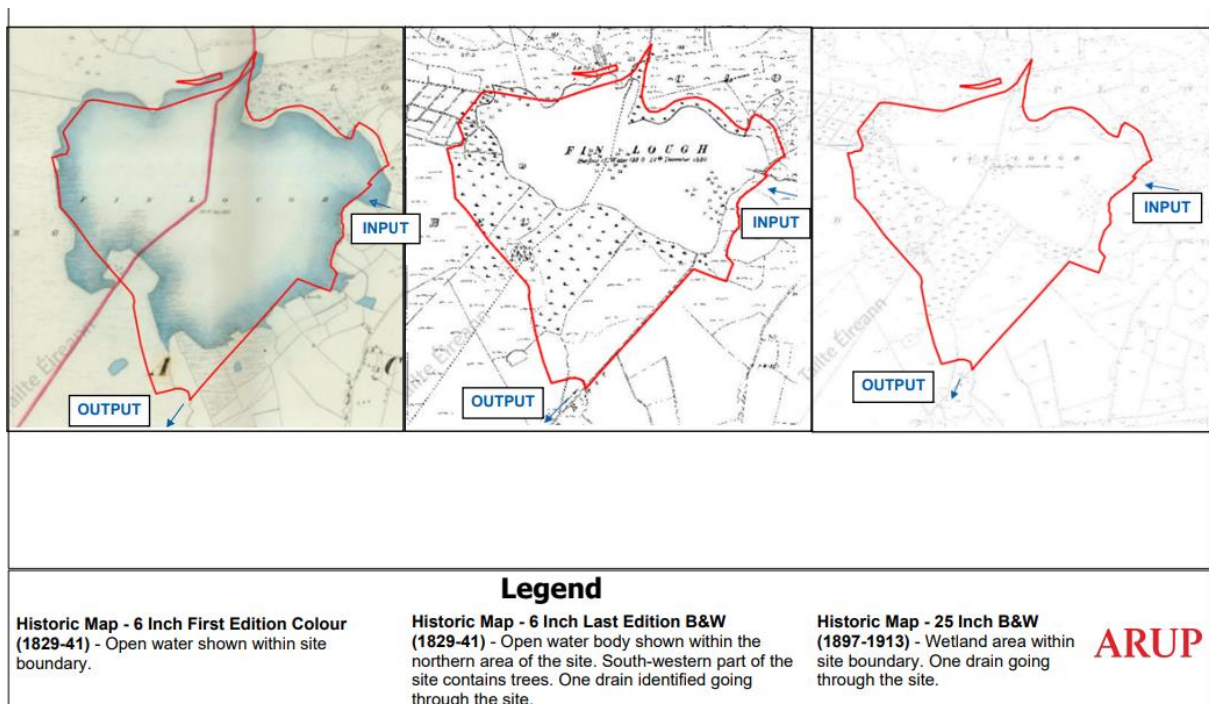


Figure 3-7: Historical water distribution and retention within wetland (Tailte Éireann Historical mapping)

Springs located at the northern boundary of the site, feed the surface water drainage system with groundwater discharge. Over the last 50 years, the spring emergence points have shifted southward. This change is likely associated with a historical lowering of lake levels. The reduction in lake level, probably associated with drainage excavations, may have resulted in the spring emergence moving to lower elevations further south. Historically, these springs might have emerged higher on the esker slope when water levels were higher.

The mapped Wetness Index³ classifies the site as temporarily wet, indicating alternating periods of saturation and dryness over the period of 2012 to 2018. This pattern suggests a mosaic of variable soil moisture conditions, supporting intermittent wetland characteristics across the site (Figure 3-8). Total productivity mapping of Fin Lough further illustrates the site's hydrological variation. Most of the area is classified as having moderate productivity, typically associated with semi-degraded peatlands habitats impacted by drainage and vegetation encroachment. In contrast, the northeast section of the site shows low productivity, which is characteristic of relatively intact peatland. These areas exhibit nutrient-poor, water-saturated soils and are dominated by *Sphagnum* mosses, indicating a functioning peatland system (Figure 3-9).

³ Dataset available at 10m resolution indicating the occurrence of water and wet surfaces over the period from 2012 to 2018 (Copernicus, 2025).

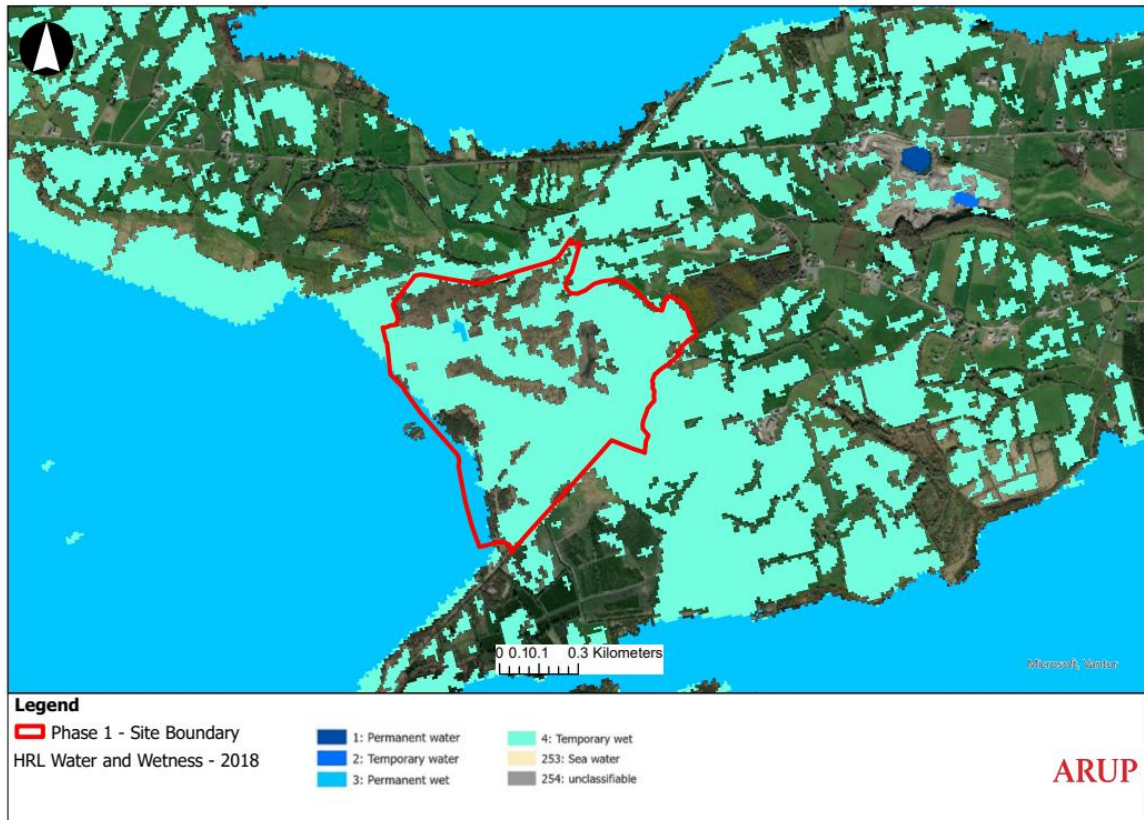


Figure 3-8: High Resolution Layer (HRL) Water and Wetness – 2018 (Copernicus, 2025)

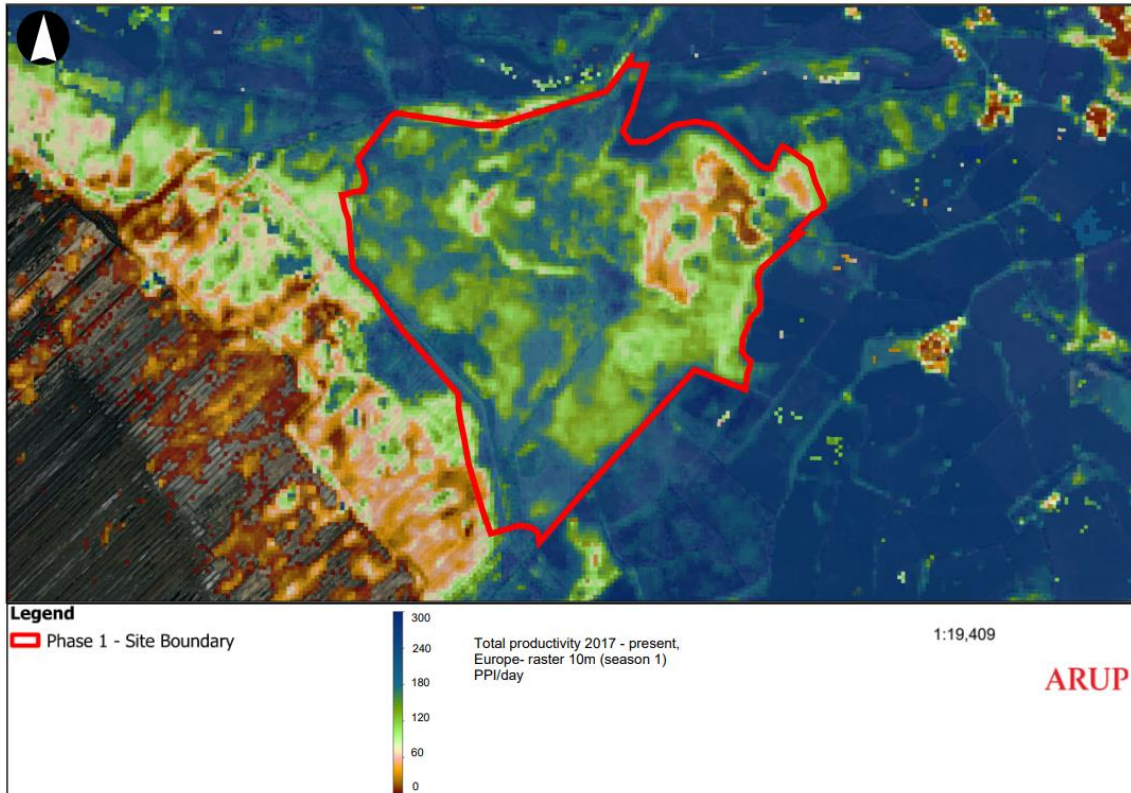
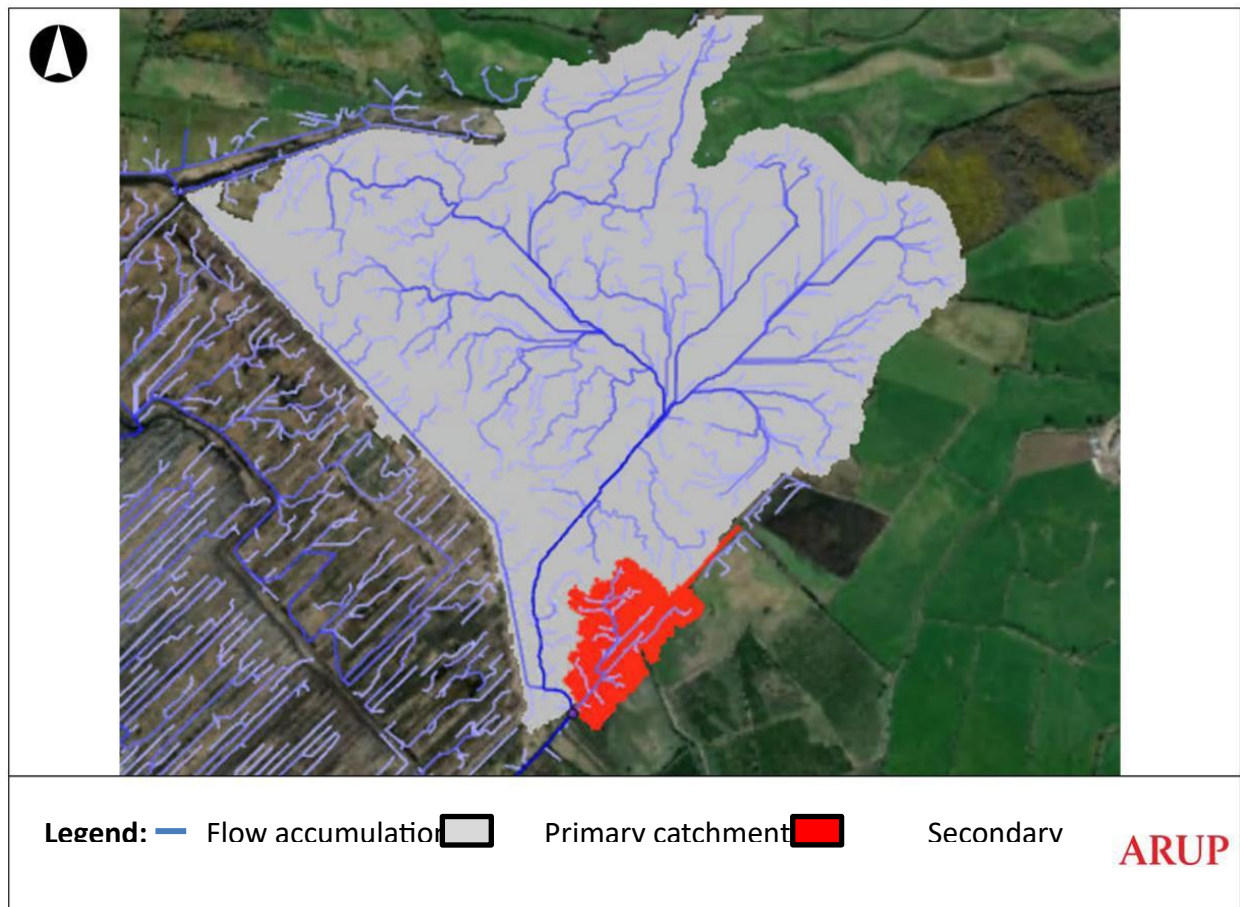


Figure 3-9: Total Productivity 2017 -present, Europe – raster 10m (season 1) (Copernicus, 2025)

The Glebe River located east of the site, acts as the main surface water inflow to Fin Lough, with the outflow directed southward towards the Gowlan River. The Gowlan River runs along the southwestern boundary of the site and flows to the south. There are two types of drainage systems present in and around the site: arterial drainage, involving deep excavations along the Gowlan River, managed by Offaly County Council under the Arterial Drainage Act of 1945; and peat drainage, completed by Bord na Móna (BnM) as part of peat extraction, which is particularly extensive across Blackwater Bog, located to the west of the Gowlan River.

The dominant drainage feature within the site is a channel that runs through the central area and directs water flow southwards, reflecting the underlying north-south topographic gradient, historical lake drainage patterns, alignment with former outflow routes, and the esker-fed groundwater discharge toward the centre of the site. In contrast, the Gowlan River and a channel which extends along the southeastern boundary of the site have limited connectivity to the internal drainage system due to low gradients, peat permeability and their separation from the groundwater input zones.

Flow accumulation for the site was assessed using high resolution LiDAR. Stream networks were identified by applying a threshold for cells with high flow (i.e. cells with more than 100 flow accumulated) (Figure 3-10). This also helped to identify surface flow areas which were isolated from the main catchment. The final drainage map for the site includes the wider drainage system as well as the internal drainage system (Figure 3-11).



loss is generally low across the south and west of the site. In contrast, the northeast area, underlain by gravels, may represent a more vulnerable zone for nitrate loss. PIP maps for Phosphorus and Nitrate are presented in Figure 3-13 and Figure 3-14 respectively.

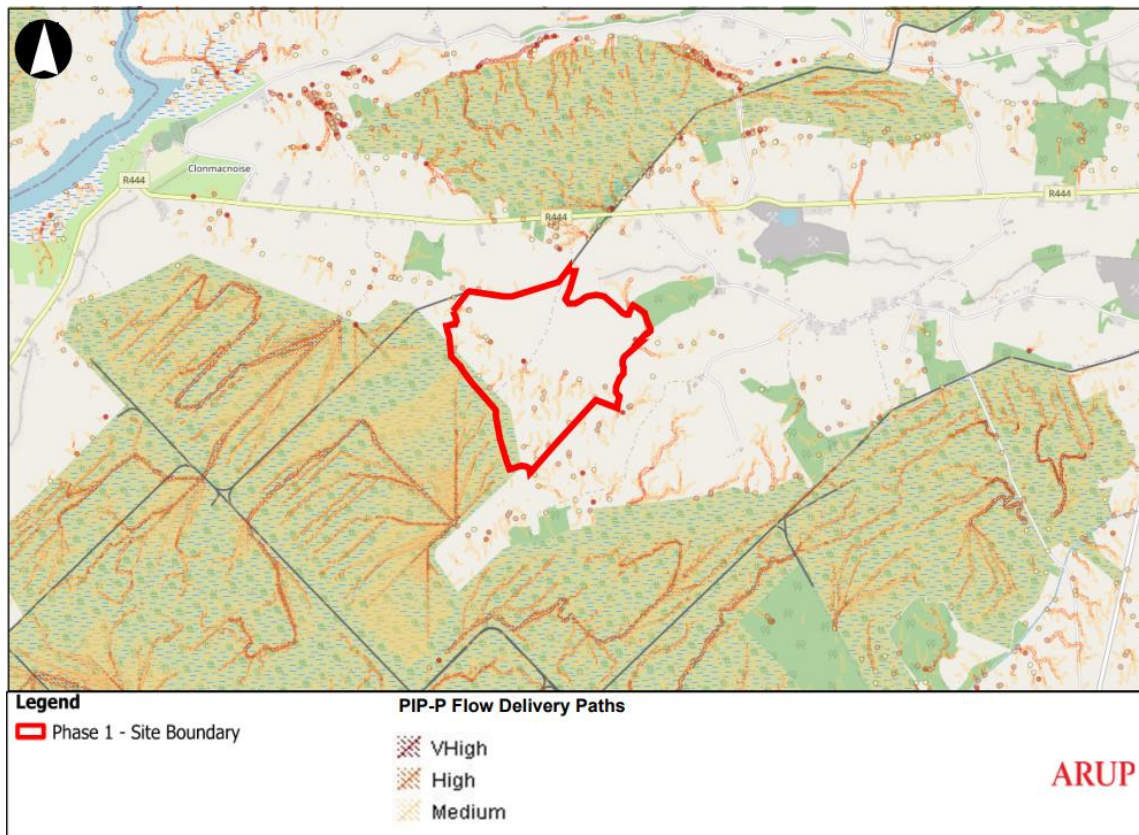


Figure 3-12: PIP- P - Flow delivery paths and points for Phosphorus (EPA, 2025)

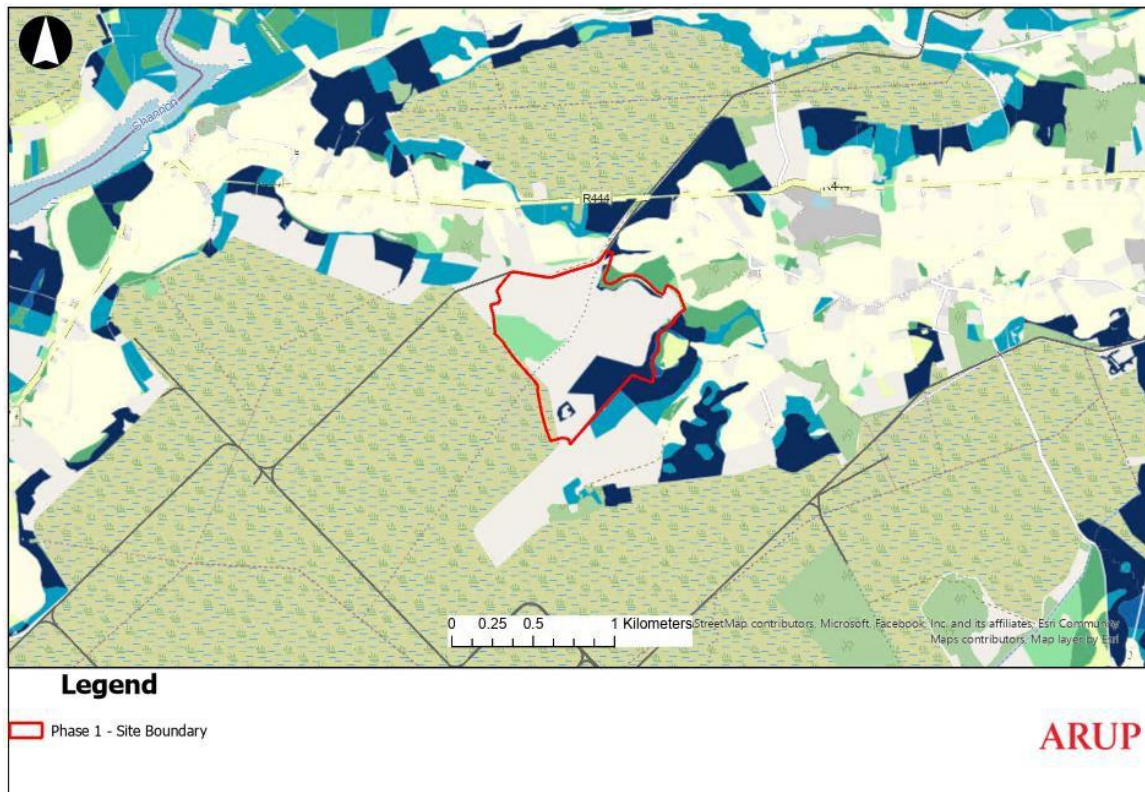


Figure 3-13: Pollution Impact Potential – Phosphorus (PIP-P) at Fin Lough (Offaly) (EPA, 2025)

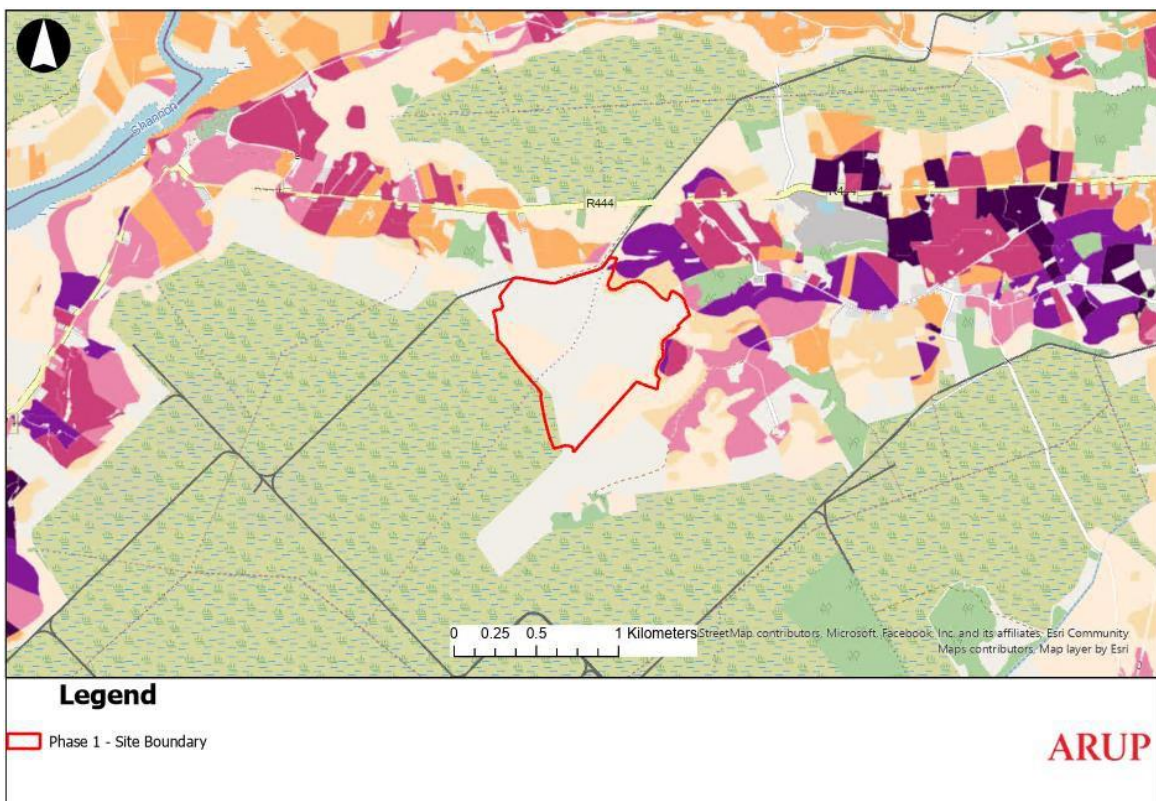


Figure 3-14: Pollution Impact Potential – Nitrate (PIP-N) at Fin Lough (Offaly) (EPA, 2025)

3.2 Field Survey

Electrical Conductivity and peat depth data were recorded as part of the Scoping Study and Pilot Survey of Fens undertaken between 15 and 17 June 2020 (O'Neill et al., 2023). EC values ranged from 452 to 689 $\mu\text{S}/\text{cm}$ in the north-east of the site, with the highest values recorded in the extreme north, close to spring locations and adjacent to the site boundary. pH values recorded in the east-northeast of the site ranged from 6.83 to 7.63, with the lowest values occurring close to the Glebe River and the highest values recorded in the extreme north-east of the site. Peat depth across the site ranged from 7 cm to more than 310 cm; however, the spatial locations of peat depth measurements were not provided.

Site monitoring was undertaken in July and August 2025, focusing on developing an understanding of the water regime, pressures and implementation of restoration measures within the site. The site monitoring included peat depth probing, water quality monitoring, groundwater level monitoring in piezometers and observations of water flow in the drainage network.

Water quality data were collected across multiple areas within and around the site, including fens, transition mires, tufa springs, and associated watercourses. The parameters recorded included pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), nitrate, and phosphate. Groundwater levels were monitored in selected piezometers, and peat depths were probed to assess substrate characteristics.

Field survey Monitoring locations are presented in Figure 3-15.

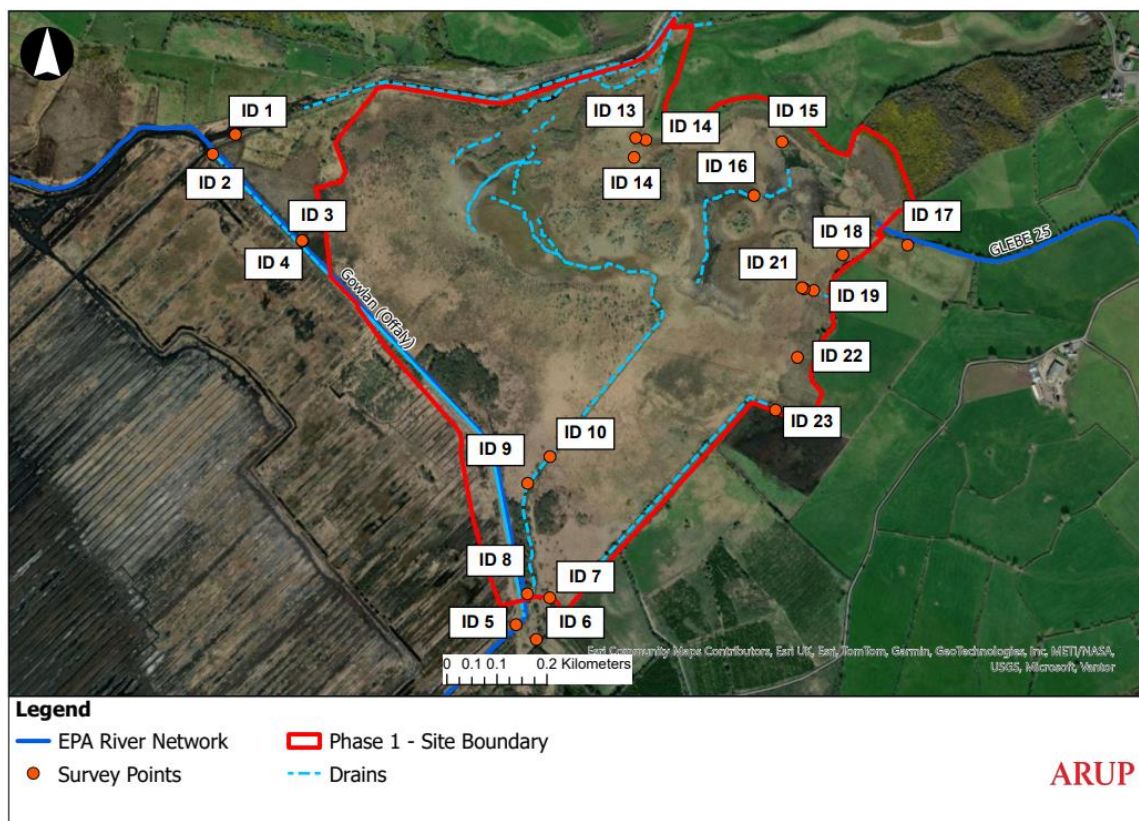


Figure 3-15: Baseline monitoring locations at Fin Lough (Offaly)

3.2.1 Peat Depth Probing

Peat depth probing across the site showed spatial variability in peat accumulation. Peat depths are relatively deep in the western and southern parts of the site consistently exceeding 2m. In contrast, peat depths in the north and northeast are more variable, ranging between 0.25m and 0.33m to 3 metres or greater in depth. Peat depths during the site surveys are shown in Figure 3-16.

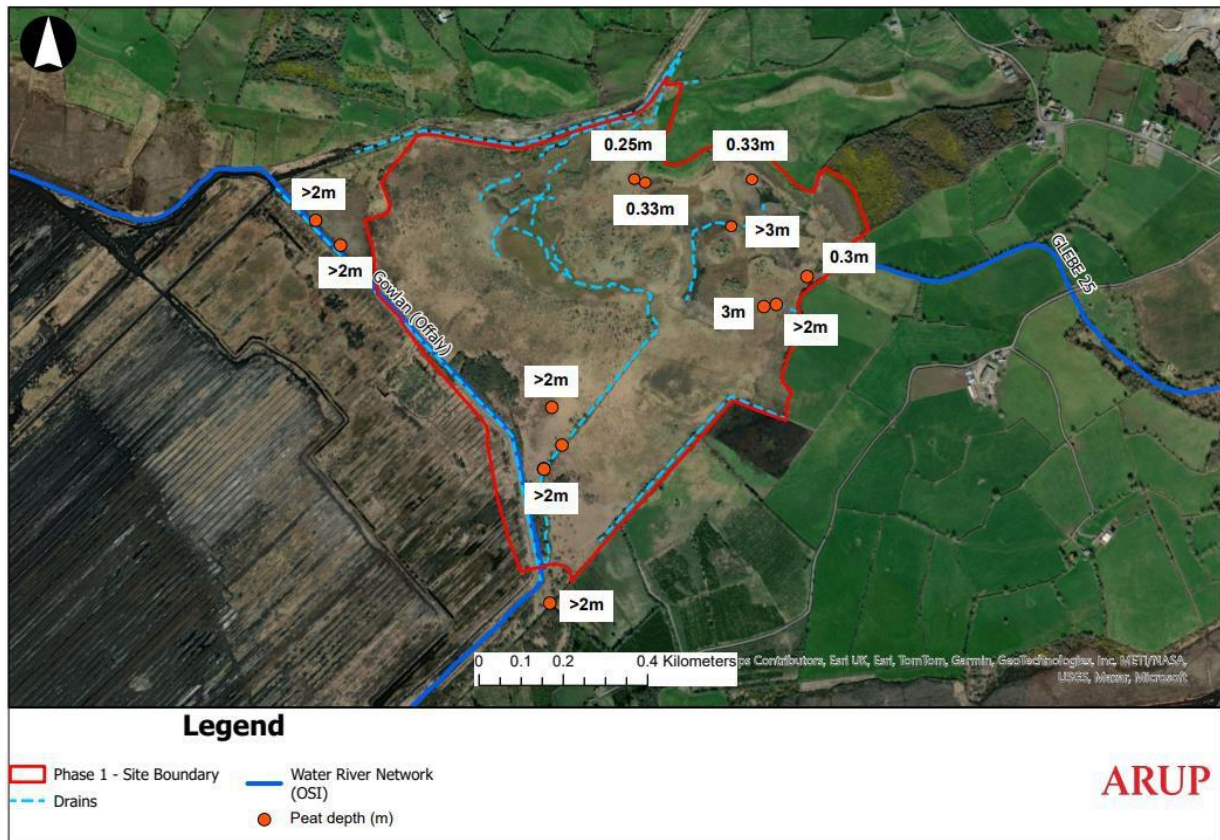


Figure 3-16: Peat depth (m) at Fin Lough (Offaly)

3.2.2 Groundwater Levels

Groundwater levels were assessed in the piezometers and springs present at the site. In the western part of the site, piezometer readings from Bord na Móna installations indicated variable conditions. Piezometer T1-P6 (ID3) recorded a water table at 1.07 m below top of casing, while T1-P9 (ID4) was recorded as dry. A spring was identified in the northern area of the site where tufa was evident, and the peat was shallow (0.25m) (ID23). Another spring feature with associated tufa deposition was observed in the northeast area ID 15.

3.2.3 Surface Water Drainage

Surface water conditions varied across the site during the site visits, particularly in relation to flow regimes and drainage types. In the west, the Gowlan River showed minimal flow and a light tan colour, indicative of low discharge and the presence of organic matter content (ID2).

Downstream of the confluence with the main channel from Fin Lough the Gowlan River flow was slow-moving in a southern direction (ID5).

The Glebe River had little surface flow and was highly vegetated. The Glebe was accessed by livestock. The fen itself was not directly accessible to cattle.

3.2.4 Water Quality

Water quality monitoring shows spatial variation in nutrient concentrations across the site, with potential sources of enrichment particularly evident in areas adjacent to agricultural activity and livestock presence.

Measured phosphate concentrations (PO₄) across the site vary, with some measurements exceeding the WFD good status environmental quality standard of 0.107 mg/l PO₄ (0.035 mg/l PO₄-P⁴), while others remain below this level. Phosphate concentrations in the northern and northeastern areas, associated with the tufa springs, were generally low, ranging from below the detection limit to 0.09 mg/l PO₄ (Figure 3-17). Higher phosphate concentrations were evident in the eastern part of the site ranging from 0.12-2.45 mg/l PO₄. This area lies adjacent to agricultural land used by livestock. This spatial pattern also aligns with areas identified as being at risk in the EPA PIP maps for phosphorous (Figure 3-13).

Nitrate (NO₃-N) across the site remain below the regulatory groundwater threshold of 8.5 mg/l NO₃-N (37.5 mg/l NO₃⁴). Although there is no regulatory surface water threshold for nitrate, mean nitrate concentrations of greater than 1.8 mg/l NO₃-N (8 mg/l NO₃) may impact the ecological health of rivers (EPA, 2025b). Nitrate concentrations in the northern area near the springs range from 2.2-8.5 mg/l NO₃-N, showing some nutrient enrichment from the farmland to the north of the site (Figure 3-18). Nitrate concentrations in the main internal channel and the Gowlan river ranged from 3.7-5.2 mg/l NO₃-N suggesting limited nutrient removal in the surface water channels within site. Further water quality monitoring is required across the site to establish trends.

These water quality results are relevant to the site-specific conservation objectives for Fin Lough, 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, some phosphate and nitrate values exceed those associated with WFD good/high ecological status. Inputs from the surrounding areas, including both wet and dry

⁴ S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009

nitrogen deposition in the form of ammonia and ammonium, may also contribute to nutrient enrichment in fens (Scottish Natural Heritage, 2011).

Electrical conductivity (EC) and pH were measured during field site visits. pH values ranged from 6.78 in the northern part of the site to 7.71 in the eastern area, also recorded within the Glebe River (Figure 3-19). EC values ranged from 483 $\mu\text{S}/\text{cm}$ in the western part of the site to 693 $\mu\text{S}/\text{cm}$ in the eastern part of the site at a monitoring point on the Glebe River (Figure 3-20).

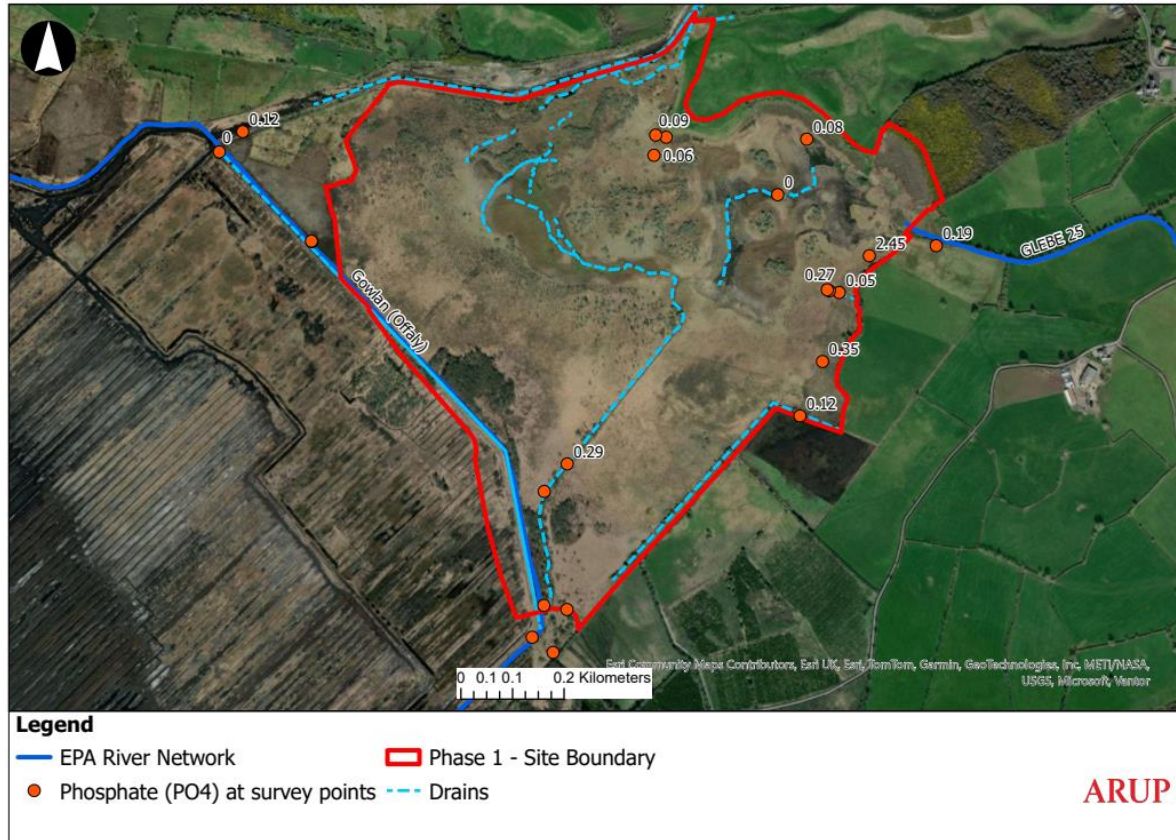


Figure 3-17: Phosphate (PO₄) at survey points in Fin Lough (Offaly)

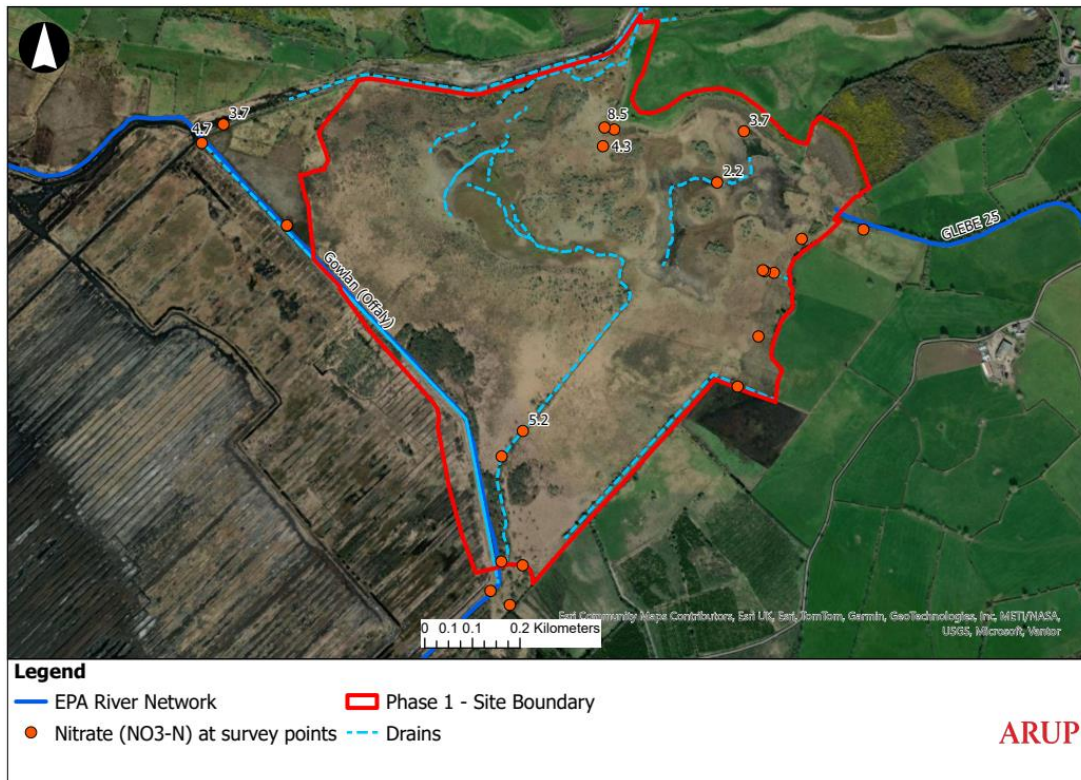


Figure 3-18: Nitrate (mg/l NO₃) at survey points in Fin Lough (Offaly)

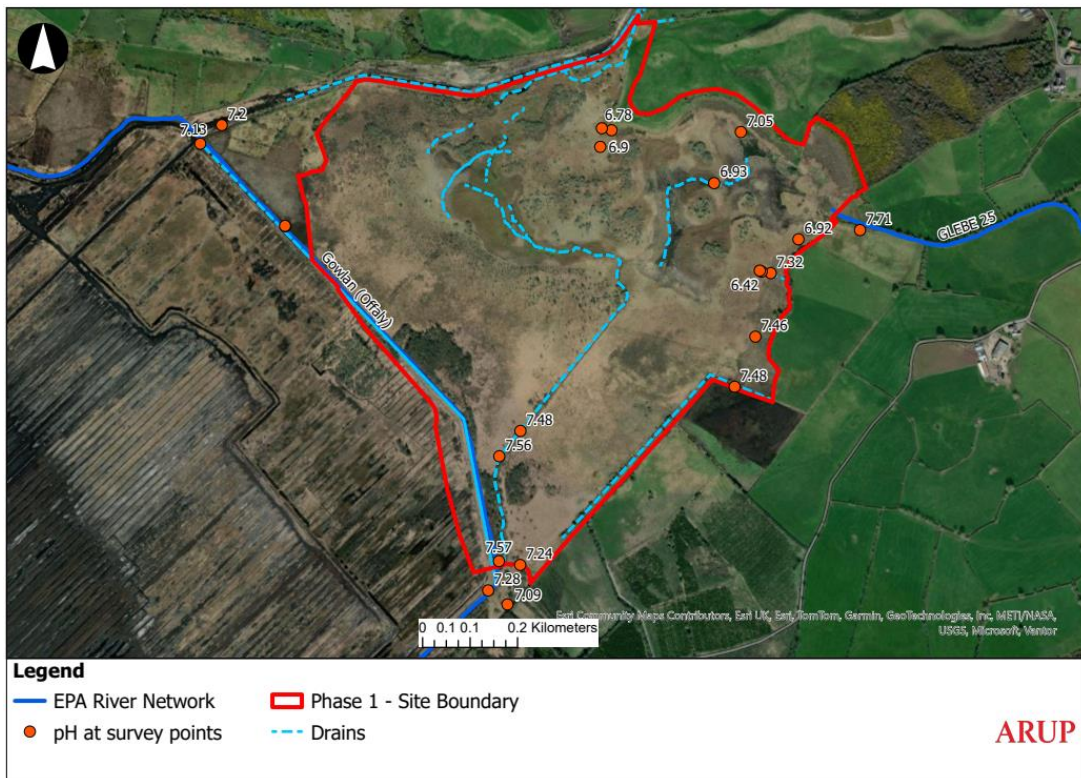


Figure 3-19: pH at survey points in Fin Lough (Offaly)

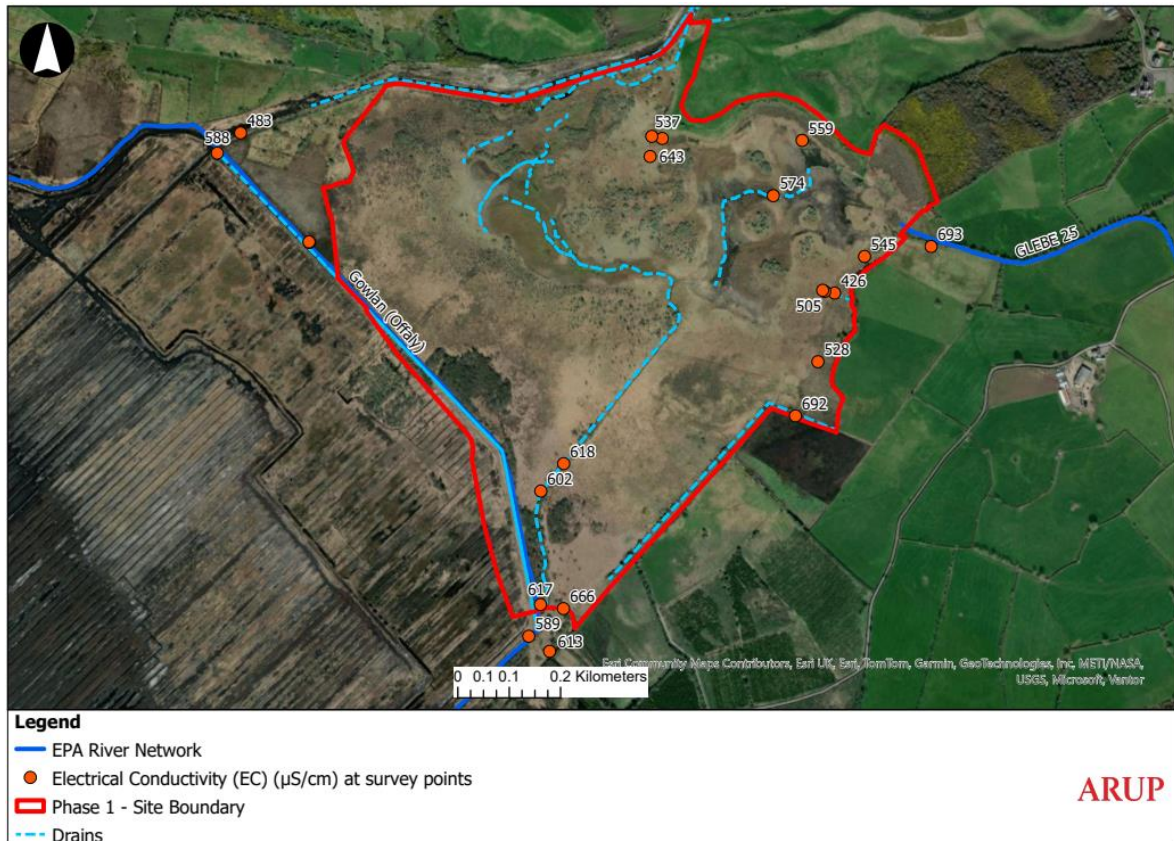


Figure 3-20: Electrical Conductivity (EC) ($\mu\text{S}/\text{cm}$) at survey points in Fin Lough (Offaly)

3.3 Conceptual Site Model

Fin Lough (Offaly) is classed as mainly having being Seepage basin/bottom (centre) (WETMEC 13b: Seepage percolation quag) with some Ombrogenous bog (WETMEC 3) to the west (O'Neill et al., 2023; Weeler et al., 2009). The characteristics of the site are:

- The topography of the site is notably flat, with elevated ground located to the north along an esker which extends in an east-west direction.
- Geologically, the western area of the site is underlain by the Ballysteen Formation, which comprises dark muddy limestone and shale. The eastern area is underlain by the Navan Beds Formation, consisting of dark limestone, mudstone, and sandstone. Within the site boundary, quaternary sediments are primarily fen peat, whereas the surrounding landscape features cut-over raised peat. Gravel deposits are located to the north, while till derived from limestone is present to the south and east.
- The site is underlain by a Locally Important Aquifer – Bedrock that is Moderately productive only in Local Zones (LI). To the north, a Locally Important Gravel Aquifer (Lg) which provides groundwater storage.

- The Gowlan River flows along the western boundary of the site. The Glebe River provides surface water inflow into the site from the east but once in the site the channel is not clearly defined and the flow floods out. A minor channel is located along the southeast boundary; however, this is a minor channel and has limited influence on site drainage. The main surface water feature within the site is a channel which runs through the centre of the site and provides the main drainage outflow for the site. This channel discharges into the Gowlan River in the southeast of the site.
- Springs associated with the gravels along the northern boundary provide recharge into the fen site. These springs, which have evidence of tufa formation, contribute to the site's hydrology and support Annex I habitats and species. Groundwater feeding the springs originates in the esker and gravel deposits. Rainfall infiltrates these gravels, and as groundwater moves laterally through the permeable material, it emerges at the margins of the gravel deposits where it meets lower permeability peat. This contrast in permeability forces groundwater to surface, resulting in springs and seeps. Local variation in peat thickness may also influence spring location, with emergence more likely where the peat is thinner.
- Hydrological modifications to the site occurred through the excavation of drainage features. However, as the site remains relatively wet and peat extraction has not occurred on the site this indicates that drainage may not have been entirely effective due to the persistent groundwater input.
- The site's hydrological characteristics results from the combination of groundwater discharge, surface water inflow and drainage modification. These elements have influenced habitat development and the spatial distribution of springs and seepages over recent decades. Fin Lough is a soligenous fen as water movement is predominantly lateral entering through the inflows from the springs and Glebe River and draining towards the Gowlan River, therefore providing a continuous through flow of water.

The CSM is presented in Figure 3-21.

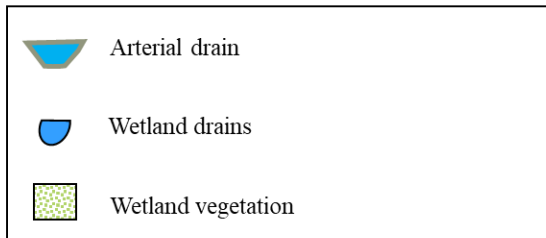
Fin Lough

Offaly County

25B Lower Shannon

Seepage percolation quag (WETMEC: 13b) & Ombrogenous bog (WETMEC 3)

Key:



Cross section:



Water input/output:

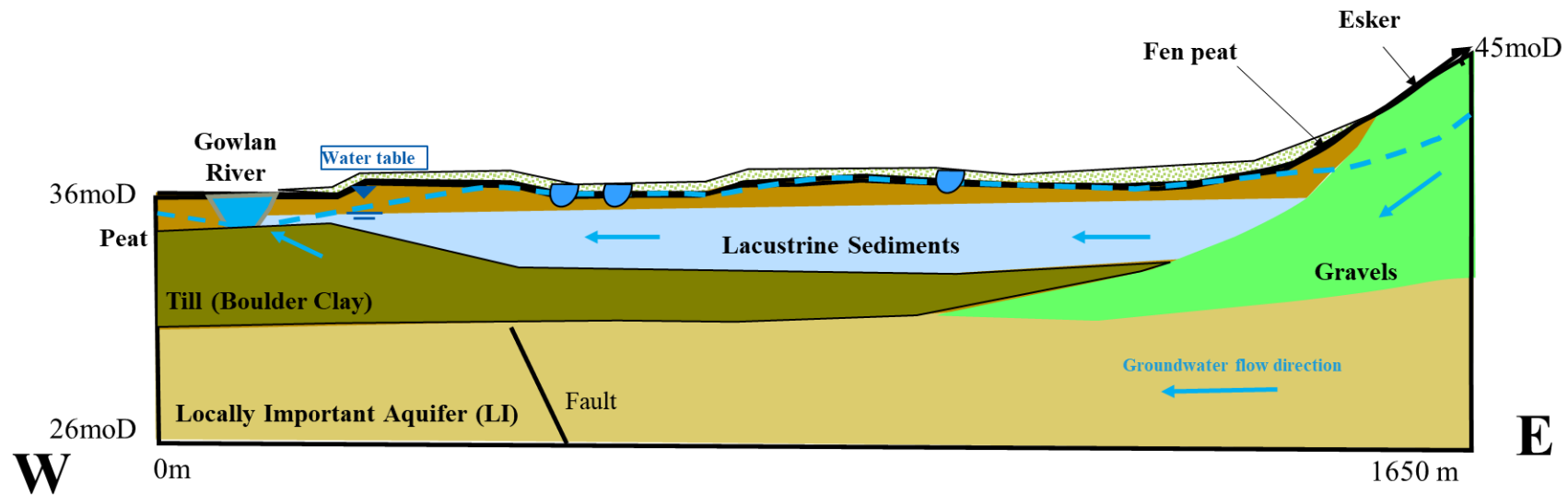
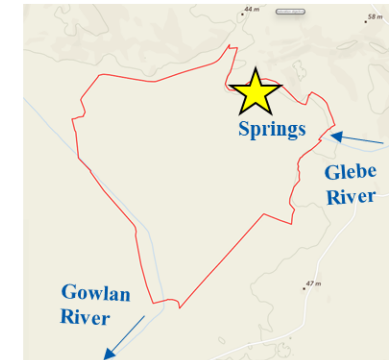


Figure 3-21: Conceptual Site Model of Fin Lough (Offaly)

4 Ecology

4.1 Desk Study

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

- NPWS Protected Sites – Special Areas of Conservation – Fin Lough (Offaly) SAC⁵;
- NPWS Article 17 habitats distribution datasets;
- Scoping Study and Pilot Survey of Fens (O’Neill, et al. (2023));
- Biodiversity Maps - National Biodiversity Data Centre (NBDC); and
- Plant Atlas 2020 website - Botanical Society of Britain & Ireland (BSBI).

In addition to the desktop sources outlined above, supplementary ecological baseline information relevant to this FRP was provided by Bord na Móna. While this material contributed to informing the overall understanding of site conditions, its content is not directly replicated within the current report.

The ‘Scoping Study and Pilot Survey of Fens’ (O’Neill, et al., 2023) was commissioned to develop and test a standardised methodology for assessing the conservation status of fen habitats across Ireland. As part of this study, Fin Lough SAC in County Offaly was selected as one of the pilot sites for field survey. The site was surveyed in June 2020, with a focus on Annex I fen habitats, specifically 7230 Alkaline fens and 7140 Transition mires. 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

⁵ NPWS (2019) Conservation Objectives: Fin Lough (Offaly) SAC 000576. Version 1. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht.

The Scoping Study and Pilot Survey of Fens at Fin Lough SAC comprised a mosaic of fen, reed beds, wet heath, and wet woodland, with notable hydrological variation due to calcareous springs in the east and drainage features in the centre and west. The habitats summarised below for the Annex and non-Annex habitats are based on the findings of the Scoping Study and Pilot Survey (see Appendix B for the habitat maps). Two habitat classification systems were used: Annex I codes (EU Habitats Directive) for legally protected habitats and Fossitt codes (Irish habitat classification) for broader ecological context. Annex I habitats are distinguished by their conservation importance and presence of indicator species such as *Schoenus nigricans* and *Carex davalliana*, which signal high-quality fen conditions.

It should be noted that, beyond the high-quality fen areas, there are more extensive and degraded fen zones across the site, where pressures have led to transitions towards wet heath or scrub.

4.1.1.1 Annex Habitats

The following Annex I habitats (O'Neill, 2023) were identified and mapped as part of the Scoping Study and Pilot Survey:

- **7140 Transition mires** – covering 13.82 ha. Found predominantly in the eastern part of the site, often associated with reed beds and springs. Key species include *Calliergonella cuspidata*, *Carex diandra*, *C. lasiocarpa*, *C. rostrata*, and *Menyanthes trifoliata*. Despite its extent, the condition assessment indicates unfavourable-bad status for structure and functions, future prospects, and overall condition. This is likely due to hydrological disturbance (e.g. newly dug drains), nutrient enrichment (algal cover), and localised overgrazing.
- **7230 Alkaline fens** – covering 1.44 ha. Also concentrated in the east, with species such as *Schoenus nigricans*, *Molinia caerulea*, *Carex dioica*, *C. demissa*, *Scorpidium cossonii*, *Ctenidium molluscum*, and *Campyllum stellatum*. The condition is assessed as unfavourable-inadequate, with concerns around hydrological modification and scrub encroachment. However, its floristic composition remains relatively intact.

Several 'Annex-quality' habitat parcels for both 7140 Transition mires and 7230 Alkaline fens were recorded during the site survey.

4.1.1.2 Non-Annex I/Fossitt habitats

Non-Annex fen and other habitats were also recorded, with mapping based on Fossitt (2000) classification. These include:

- FL3 – Lakes and ponds
- FS1 – Reed and large sedge swamp
- FS2 – Tall herb swamp

- FW3C/G – Open water and swamp mosaics
- GS1 – Dry calcareous and neutral grassland
- HH3 – Wet heath
- PB4 – Cutover bog
- PF1 – Rich fen and flush (some areas heavily grazed)
- WN6/WN7 – Wet woodland types
- WS1 – Scrub

These habitats were distributed across the site, with wet woodland and reed swamp particularly prevalent in the western and central areas.

- **PF1 Rich fen and flush**

Found in several areas, including heavily grazed zones along the eastern boundary of the site. Within this mosaic, a subset of these habitats qualifies as Annex I fen, while other areas fall under Fossitt classifications but could be targeted for measures to expand fen extent (e.g., scrub removal). Some patches contain *Schoenus nigricans* and *Ctenidium molluscum*, though they lack brown mosses typically associated with high-quality fen. One area was noted as overgrazed and currently non-Annex I (eastern section of the site).

- **FS1 Reed and large sedge swamp**

Widespread across the site, often fringing fen habitats. Species include *Phragmites australis*, *Equisetum fluviatile*, *Carex rostrata*, and *Menyanthes trifoliata*. Some areas also support *Cladium mariscus* and *Typha sp.*

- **FW3C/G Open water and swamp mosaics**

Present in wetter zones, particularly where drains and ditches intersect with fen habitats.

- **HH3 Wet heath**

Dominant in the western part of the site, with *Myrica gale*, *Molinia caerulea*, and *Calluna vulgaris*.

- **WN6/WN7 Wet woodland**

Sparse canopy woodland with grassy PF1 field layers, contributing to habitat heterogeneity.

- **GS1 Dry calcareous and neutral grassland, WS1 Scrub, and PB4 Cutover bog**

These habitats occur in smaller patches and transitional zones, adding to the site's structural complexity.

There is a diverse mix of habitats across the site, creating a mosaic that supports a wide range of plants and animals, particularly birds and invertebrates. This diversity has partly arisen through drying out and lack of management in some areas, leading to the development of grassland, scrub, and woodland where fen conditions have been altered. Some areas are also impacted by drainage, nutrient enrichment, and grazing pressure.

Several categories of the Irish Vegetation Classification (IVC) were recorded on site during the Pilot Survey, primarily within fen and transition mire habitats. The IVC is a system for classifying plant communities in Ireland based on species composition and ecological characteristics, providing a finer-scale understanding of vegetation structure than habitat-level classifications. These records help to identify community types within Annex I and Fossitt habitats and inform conservation measures

- FE1B - *Schoenus nigricans* – *Succisa pratensis* fen / Black Bog-rush – Devil's-bit Scabious fen.
- FE1C - *Carex panicea* – *Carex viridula* fen / Carnation Sedge – Yellow Sedge fen
- FE2C - *Carex lasiocarpa* – *Menyanthes trifoliata* mire / Slender Sedge – Bogbean mire
- FE2F - *Menyanthes trifoliata* – *Sphagnum recurvum* agg. Mire / Bogbean – Flat-topped Bog- moss mire
- FW3C - *Carex rostrata* swamp / Bottle Sedge swamp

4.1.2 Species

The following subsections outline the presence of species recorded at or within the zone of influence⁶ of the Fin Lough site. 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 from the National Biodiversity Data Centre have been 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

⁶ The area within which a project or activity may cause direct, indirect, or cumulative ecological effects on species, habitats, or environmental receptors. It typically extends beyond the site boundary to include zones affected by factors such as hydrology, noise, light, nutrient run-off, or species movement, as determined through impact assessment.

4.1.2.1 Qualifying Interest

Species – *Vertigo geyeri*

1013 *Vertigo geyeri* is highly specialised and occupies saturated, calcareous, groundwater-fed flushes, often limited to small patches within broader fen macrohabitats. Within these zones, the snail resides in the decaying root zones of small calcareous sedges, especially *Carex viridula* ssp. *brachyrrhyncha*, and is associated with fen mosses such as *Drepanocladus revolvens* and *Campylium stellatum*. The presence of tufa-forming springs is a strong indicator of optimal habitat.

Fin Lough SAC is designated for the presence of 1013 *Vertigo geyeri*. Historical records from the National Biodiversity Data Centre (NBDC) indicate the presence of the species in the northern and eastern parts of the site, with the most recent confirmed record dating to 2005. The 2011 national monitoring report (Moorkens, 2011) assessed the population, habitat, and future prospects of 1013 *Vertigo geyeri* at Fin Lough SAC as favourable, with an optimal habitat area of 0.19 ha and suboptimal habitat of 0.21 ha. The species was associated with petrifying springs containing traces of tufa, particularly in the northern section of the site.

Key ecological conditions include:

- Constant hydrogeological conditions, with water tables within 5 cm of the surface for most of the year.
- Micro-topographical variation, such as tussocks of *Schoenus nigricans*, which provide refugia during meteorological extremes.
- Open habitat structure, maintained by wetness and/or light grazing, to prevent succession by shade-tolerant plants and competitive snail species.

Unsuitable habitat for 1013 *Vertigo geyeri* is characterised by excessive dryness, acidification, or shading due to scrub encroachment or lack of grazing.

4.1.2.2 Species within the site

A review of species records from NBDC showed that limited site records exist, with a sole record of Rigid bog-moss (*Sphagnum teres*) recorded in the last ten years (2018). The species is protected under the Habitats Directive and on a national level is listed as 'Near Threatened' under the IUCN Conservation Status. The species is associated with base rich environment including PF1 Rich fen and flush and PF3 Transition mire and quaking bog, both of which are present on site. The record is from the northern section of the site, overlapping with PB4 Cutover bog and PF1 Rich fen and flush (refer to Appendix B).

4.1.2.3 Species within the Zone of Influence

Table 4-1 details species recorded within the 1km distribution zone of influence around Fin Lough SAC within the last ten years from NBDC.

Table 4-1: Species records within the Zone of Influence of Fin Lough SAC

Legislative Protection	Common name	Latin name
Birds Directive	Hen harrier	<i>Circus cyaneus</i>
Habitats Directive	Kneiff's hook-moss	<i>Hamatocaulis vernicosus</i>
Flora Protection Order	Green-winged orchid	<i>Anacamptis morio</i>
	Lesser water-plantain	<i>Baldellia ranunculoides</i>
	Narrow-leaved marsh orchid	<i>Dactylorhiza traunsteinerioides</i>
	Lesser butterfly orchid	<i>Platanthera bifolia</i>
Irish Red List	Hen harrier	<i>Circus cyaneus</i>
No legislative protection	Dingy skipper	<i>Erynnis tages</i>
	Grayling	<i>Hipparchia semele</i>
	Common spotted orchid	<i>Dactylorhiza fuchsii</i>
	Marsh helleborine	<i>Epipactis palustris</i>
	Fragrant orchids	<i>Gymnadenia conopsea</i>
	Chalk fragrant orchid	<i>Gymnadenia conopsea</i> var. <i>densiflora</i>

Further to this, information provided from Bord na Mona has found that the species listed below are recorded within a 2km radius of Fin Lough SAC. In line with best conservation practice and to safeguard these sensitive and protected species, the precise locations of their occurrences are intentionally omitted from this report. This approach helps minimise the risk of disturbance or harm to vulnerable populations, while still ensuring that ecological assessments and management actions remain robust and effective.

- Hen harrier;
- Marsh harrier (*Circus aeruginous*);
- *Vertigo* sp.;
- Whooper swan (*Cygnus cygnus*);
- Breeding waders' assemblage; and
- Common crane (*Grus grus*).

4.2 *Field Survey*

Following a comprehensive review of available desktop data, a targeted follow-up ecological survey was undertaken on the site in August 2025. The field surveys 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.

Three 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 Fin Lough, 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 nine pre-identified monitoring points (Monitoring Points 1–9), 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; and
- Long-term monitoring stations to assess ecological change following restoration.

The surveys focused on two key components:

- Target Notes: Qualitative observations at each monitoring point, capturing site condition, vegetation structure, hydrological features, and legacy management; and
- 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:

- 7230 Alkaline fens: Active groundwater-fed processes were observed at Monitoring Point 3, including paludal tufa deposition and base-rich vegetation;
- 7140 Transition mires: Monitoring Point 5 includes a substantial boundary drain extending into mapped transition mire, now infilled and non-functional; and

- Neutral and Base rich Non-Annex Fen: Indicating a strong base-rich fen character across the site.

The walkover confirmed the following site conditions:

- Saturated Conditions: Quaking ground stability and presence of fen peat and tufa.
- Base-Rich Hydrology: High pH (9.99) and conductivity (999 $\mu\text{S}/\text{cm}$).
- Dense Vegetation Structure: High cover across all layers, indicating succession and potential management needs.
- Habitat Classification: Presence of alkaline fen, circumneutral fen, and base rich non- Annex fen; absence of transition mire and poor acidic fen

4.2.2 Pressure & Threats

This section outlines the historical and current pressures and threats affecting fen habitats at Fin Lough, with emphasis on Annex I habitats 7230 Alkaline fens and 7140 Transition mires. The analysis draws on baseline data from the Scoping Study and Pilot Survey of Fens (O'Neill et al., 2023) and recent ecological walkovers.

4.2.2.1 Alkaline Fens [7230]

Historical Pressures

The Scoping Study and Pilot Survey of Fens (O'Neill et al., 2023) identified two key pressures historically affecting alkaline fens at the site:

- Intensive grazing or overgrazing by livestock, which can lead to soil compaction, nutrient enrichment, and loss of sensitive fen species.
- Natural succession, particularly the encroachment of scrub and rank grasses, resulting in shifts in species composition and a decline in open fen conditions

Current Observations

Recent walkover surveys confirm that these pressures remain relevant, albeit in altered forms:

- Grazing absence is now the dominant issue. While overgrazing is no longer evident, the lack of any grazing has allowed *Molinia caerulea* to proliferate, forming dense litter layers that suppress fen-specialist flora. This organic accumulation is consistently noted across multiple plots and is flagged as a barrier to successful restoration.
- Scrub encroachment is occurring in areas where grazing has ceased, with *Betula pubescens* (birch), *Crataegus* (hawthorn), and *Prunus spinosa* (blackthorn) establishing in drier zones. This is particularly evident in areas adjacent to drainage features or where fencing has excluded livestock.

- Hydrological features such as scattered seeps and paludal tufa deposition were recorded in alkaline fen zones, indicating that some groundwater-fed processes remain active. These features are ecologically significant and should be protected during restoration works.
- Drainage impacts are ongoing, with both historical and newer channels influencing water movement. While some drains are infilled and vegetated, their legacy effects on site hydrology persist.

4.2.2.2 7140 Transition Mires

Historical Pressures

The Scoping Study and Pilot Fen Survey identified the following pressures affecting transition mires:

- Diffuse agricultural pollution, particularly from surrounding improved grasslands, which can lead to eutrophication and species loss.
- Drainage, both historical and ongoing, which lowers water tables and disrupts mire hydrology.
- Natural succession, leading to shifts in species composition and a decline in characteristic mire vegetation.

Current Observations

Walkover surveys confirm that these pressures continue to shape the condition of transition mire habitats

- Boundary drainage remains a prominent feature, with the Gowlan River measuring approximately 5 metres wide and over 2 metres deep. Although largely infilled and non- functional, its presence indicates significant past hydrological modification. Vegetation within the drain includes *Glyceria maxima*, *Phragmites australis*, and *Salix cinerea*, suggesting a shift towards more mesotrophic conditions.
- Vegetation succession is evident, with degraded fen areas dominated by tussocky *Molinia caerulea* and *Agrostis stolonifera*. These species indicate drying and reduced habitat quality.
- Organic accumulation is again a key issue, with *Molinia caerulea* litter suppressing regeneration and contributing to a loss of structural diversity.
- Nutrient inputs from adjacent land are not currently recorded as active pressures, but the site remains vulnerable due to its landscape context.

4.2.2.3 General Site Observations

The broader fen habitat mosaic at Fin Lough, encompassing both alkaline and transition mire types, is subject to a range of pressures that reflect both historical land use and current ecological dynamics. These pressures are not isolated to specific plots but are evident across the site and have implications for restoration feasibility and long-term habitat resilience.

- **Grazing absence and succession** - Across the site, the absence of active grazing is a consistent theme. While some areas show signs of past management—such as electric fencing and relic grazing infrastructure—there is no evidence of current livestock activity. This lack of disturbance has led to the proliferation of scrub species, particularly *Betula pubescens* (birch), *Crataegus* (hawthorn), and *Prunus spinosa* (blackthorn), which are encroaching on open fen areas. The encroachment is most pronounced in areas where drainage has reduced soil moisture, allowing woody species to establish.
- The **absence of grazing** also contributes to the accumulation of *Molinia caerulea* litter, which is recorded as a significant barrier to recolonisation by fen-specialist flora. This build-up of organic material suppresses germination and light availability, potentially shifting the habitat trajectory away from open fen towards more rank grassland or scrub-dominated systems. Several plots explicitly note that *Molinia caerulea* litter may hinder restoration success unless actively managed.
- **Hydrological modification** - Drainage remains one of the most pervasive pressures across Fin Lough habitats. Drains have altered the site's hydrological regime, reducing water retention and disrupting the natural water table dynamics essential for fen habitat maintenance (refer to Section 3). The presence of paludal tufa deposition in alkaline fen zones suggests that some hydrological processes remain intact, but they may be vulnerable to further modification.

4.2.2.4 Additional Observations

A number of supplementary observations were recorded during the site walkovers that provide further ecological context and insight into site condition.

- **Vegetation structure and cover** - The monitoring points recorded dense cover of negative indicator species *Molinia caerulea*. Combined with other grass and rush species recorded on site (*Holcus lanatus*, *Juncus effusus* and *Agrostis stolonifera*), this can contribute to a dense structure which may indicate advanced succession and result in reduced light availability. This environment could then influence species composition and restoration outcomes
- **Vegetation recovery in historic drainage channels** - At Monitoring Point 2 (EC_2, Appendix C) an older drainage channel was observed to be naturally infilling with fen vegetation, including *Carex spp.*, *Menyanthes trifoliata*, and *Calliergon*

giganteum. This suggests passive hydrological recovery and colonisation by fen indicator species as well as a potential abandonment of land management.

- **Legacy management** - Monitoring Point 6 (EC_6, Appendix C) identified a linear feature interpreted as an electric fence line. The vegetation structure differed markedly on either side, with frequent birch regeneration to the north and none to the south. This may reflect historical grazing patterns highlighting how the past management still influences the current vegetation distribution.

4.2.2.5 Site Conservation Priority Matrix for Fin Lough SAC

The restoration actions proposed (Table 4-2) for the SAC habitats of Fin Lough SAC (7230 Alkaline fens and 7140 Transition mires) 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 SAC habitats alone but extend to the wider ecological network within and around the site.

Table 4-2: Site Conservation Priority Matrix for Fin Lough SAC

Level	Feature Type	Feature Name	Extent/ Population	Pressure/Threat	Restoration Measure On-Site	Restoration Measure Off- Site
1	SAC Habitat	7230 Alkaline fens	1.44ha	Hydrological disturbance (drains), nutrient enrichment	Drain blocking, <i>Molinia</i> litter management (potential removal through mowing and scarifying. Potential for grazing reintroduction for long-term management)	Buffer zone management to reduce nutrient input
		7140 Transition mires	13.82ha	Scrub encroachment, lack of grazing, hydrological modification	Scrub clearance, reintroduction of light grazing, protect groundwater seeps	Landscape-scale hydrological restoration planning
	SAC Species	<i>Vertigo geyeri</i>	1.08ha ⁷	Hydrological disturbance (drains), nutrient enrichment, scrub encroachment, vegetation succession ⁸	Drain blocking	Buffer zone management to reduce nutrient input

⁷ According to Moorkens (2011) the total habitat area for *Vertigo geyeri* at Fin Lough SAC, including both optimal, sub-optimal and unsuitable habitat is 1.08ha

⁸ As part of the Tóchar restoration programme, species specific surveys for *Vertigo geyeri* were not undertaken. The pressures and threats to the species were drawn from the Monitoring and Condition Assessment of the populations of *V geyeri* (Moorkens, 2011) and compared with the pressures recorded against habitats on site.

Fin Lough (Offaly) Fen Restoration Plan

Level	Feature Type	Feature Name	Extent/ Population	Pressure/Threat	Restoration Measure On-Site	Restoration Measure Off- Site
2	European Priority Species	<i>Sphagnum teres</i> (Rigid bog-moss)	1 record (2018)	Habitat degradation, hydrological change	Habitat restoration of PF1/PF3 zones, maintain base-rich conditions	Prevent off-site drainage impacts
3	Nationally important species	Hen harrier (<i>Circus cyaneus</i>)	Recorded in Zol	Habitat fragmentation, disturbance	Maintain open fen and wet heath mosaics, minimise human disturbance	Protect surrounding foraging habitats
		Kneiff's hook-moss (<i>Hamatocaulis vernicosus</i>)	Recorded in Zol	Hydrological instability, succession	Maintain wet fen conditions, control scrub	Monitor hydrology in adjacent land
		Green-winged orchid (<i>Anacamptis morio</i>)	Recorded in Zol	Scrub encroachment, nutrient input	Maintain open grassland/fen mosaics	Reduce fertiliser use in surrounding areas
4	Habitats and species of local interest	PF1 Rich fen and flush	Several patches	<i>Molinia</i> dominance, overgrazing,	<i>Molinia</i> litter removal through mowing and scarifying, scrub removal, controlled grazing,	Engage with adjacent landowners on grazing regimes
		FS1 Reed and large sedge swamp	Widespread	Drainage, succession	Maintain hydrology, manage reed expansion	Prevent further drainage from surrounding land
		HH3 Wet heath	Dominant in west	Succession, lack of grazing	Manage <i>Molinia</i> through mowing and scarifying.	Landscape-scale grazing coordination

Fin Lough (Offaly) Fen Restoration Plan

Level	Feature Type	Feature Name	Extent/ Population	Pressure/Threat	Restoration Measure On-Site	Restoration Measure Off- Site
		WN6/WN7 Wet	Patchy	Succession, drainage	Retain mosaic structure, monitor hydrology	Prevent off-site drainage impacts

4.3 Impact Assessment Notes

Restoration actions proposed for Fin Lough SAC aim to improve the ecological condition of sensitive fen habitats, particularly Annex I habitats 7140 Transition mires and 7230 Alkaline fens. 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 Fin Lough are directly connected to the management of the SAC and inherently connected with maintaining the favourable conservation status of the 7230 Alkaline fen, and 1013 *Vertigo geyeri*.

Potential Impacts

- **Habitat loss** – low risk - Restoration actions (e.g. drain blocking, scrub removal, *Molinia* management) are designed to enhance and expand existing habitats rather than remove them. However, minor loss of degraded habitat may occur during scrub clearance. Where these are required, targeted removal/placement will be mapped to ensure minimal areas are impacted.
- **Habitat fragmentation** – low risk – temporarily, the removal of dense *Molinia* sward via mowing and scarifying may fragment pockets of habitats. However, pre-mowing surveys can determine areas to be avoided e.g. pockets of fen mosaic.
- **Habitat degradation** — moderate risk - Potential degradation could occur if restoration measures are poorly implemented or monitored. This could occur where scrub removal without follow-up could lead to erosion or colonisation by invasive species or where weir installation may alter hydrology in unintended ways if not based on robust baseline data. Monitoring protocols will be embedded into the site plan to monitor change following implementation of the restoration measures.
- **Species disturbance** –low risk – There is potential risk for species disturbance to 1013 *Vertigo geyeri* where scrub removal, mowing and scarifying occurs within their habitat range. However, this will be managed by carrying out pre-mowing and pre-scrub clearance surveys to map important areas for the species. These areas will be avoided for scrub clearance, mowing and scarifying. Fin Lough SAC is located approximately 0.34km from Mongan Bog SPA, which is designated for the Greenland White-fronted Goose (*Anser albifrons flavirostris*). Where proposed restoration works overlap with the overwintering period of the Greenland White-fronted Goose, there is the potential that minor disturbance impacts could arise from the operation of machinery and the movement of personnel. However, given there are no species records for the Greenland White-fronted Goose presented on site at Fin Lough SAC, this risk is considered very low. There are species records for Whooper Swan, Golden Plover, Lapwing and Wigeon for nearby Blackwater bog,

immediately adjacent to Fin Lough. These species are SCIs of the Shannon Callows SPA. The risk of disturbance to these species from the operation of machinery is likely to be very low risk.

- **Accidental pollution release** – very low risk - No chemical inputs are proposed. However, machinery use could pose a risk of fuel/oil leaks. This is mitigated by avoiding machinery in sensitive areas and using hand tools where possible. Furthermore, measures such as refuelling will be undertaken within designated areas of hardstanding outside of the SAC where any potential spill can be managed with a spill kit and avoid accidental release of pollutants into the ground.
- **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.

Fin Lough Ecological Impact Assessment Considerations

- **Vegetation Management**
 - Monitoring of Vegetation: Fixed-point quadrat monitoring to assess effectiveness and inform adaptive management.
 - Mowing and Scarifying: Mowing of *Molinia* followed by scarifying to break up the thatch using double wheeled tractors and equipment (mower & scarifier). This will enable fen species e.g. *Schoenus* to recolonise.
 - Scrub Removal: Removal of scrub in the northern region of Fin Lough SAC. Monitored and removed where excessive using hand tools or low-impact machinery.
- **Hydrology Management**
 - Drain Blocking: Prioritised based on baseline hydrological data; peat dams or plastic piling used.
 - Hydrochemistry Monitoring: Regular testing of nutrients in surface and groundwater.
- **Land/Soil Management**
 - Catchment Measures: Engagement with landowners to reduce nutrient input via Glebe River and surrounding lands.

4.4 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 4-3 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 4-3: 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 stream cleaning before site entry. The appointed Ecological Clerk of Work will identify appropriate IAS buffers (where applicable) and these should be avoided during site preparation and restoration implementation. Consideration should be given to confirmatory survey to identify the latest <i>Rhododendron</i> infestation along with ecological oversight regarding works proximal to larger infestations.
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 Fin Lough (Offaly) 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.

The Scoping Study and Pilot Survey of Fens (O'Neill, et al., 2023) 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 were subsequently used to guide the overall assessment of conservation status.

The conservation status assessment results for Fin Lough (Offaly) is summarised in Table 5-1.

Table 5-1: Conservation Status Assessment [based on PFS results for the site]

	OVERALL CONSERVATION STATUS ASSESSMENT				
Annex I habitat	Area (ha)	Structure & functions	Future prospects	Rationale	Overall Conservation Status
Alkaline fens [7230]	1.44	Unfavourable-Inadequate	Unfavourable-Inadequate	Some issue with overgrazing but no other major problems	Unfavourable-Inadequate
Transition mires [7140]	13.82	Unfavourable-Bad	Unfavourable-Bad	Unfavourable structure and functions (not enough positive species, high cover of negative species)	Unfavourable-Bad

5.1 Field Surveys of Key Pressures

Following completion of desktop mapping of key pressures, 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 Hydrology Pressures

The following hydrological pressures were identified within Fin Lough (Offaly):

- **Drainage** has been identified as a pressure affecting fen hydrology across the site. Where drains occur within the habitats and show localised effects, they have been flagged as pressures requiring targeted action. The main area of concern in relation to drainage are:
 - The main channel traversing the centre of Fin Lough, which discharges into the Gowlan River which was dug to lower water levels within the site. Although the persistent discharge from the springs suggests that the drainage efforts have had limited effectiveness in fully dewatering the site, this drain is a modification of the natural hydrogeological environment and is likely to be impacting the distribution and quality of fen habitats within the site.
 - Relatively newly dug pit features located to the east of the site, constructed for livestock watering
- **Dredging works carried out along the Gowlan River.** Field observations confirm that the active modification of the Gowlan River, which is an arterial drain, is ongoing as evidenced by marl deposits placed along the riverbank.
- **Modification of natural hydrological flows:** Changes in groundwater discharge patterns, including a southward shift of the springs discharging into the northeast of the fen are likely due to the historical drainage interventions and the associated lowering of lake levels. These changes have influenced both the spatial distribution and ecological function of spring-fed areas.

5.2.2 Nutrient Pressures

The following nutrient pressures were identified within Fin Lough (Offaly):

- **Diffuse pollution from agricultural activities** presents nutrient pressure on the fen habitat. Land use in the surrounding catchment is contributing to nutrient enrichment through both surface and groundwater pathways. The site exhibits

evidence of nutrient enrichment, with excess nitrogen and phosphate concentrations identified across the area. Likely sources include intensive grassland farming, one-off housing developments, and intensive farm shed units. Phosphate levels (0.12–2.45 mg/L PO₄) were highest in the eastern part of the site adjacent to agricultural land with livestock access to dug water pits. Elevated nitrate concentrations in the northern part of the site where the springs are located indicate nutrient input from the adjacent farmland.

5.2.3 *Flora and Fauna Pressures*

The following pressures are listed in order of their intensity and impact on the ecological receptors of Fin Lough SAC. These were determined from the review of historical information (Scoping Study and Pilot Survey) and gathered from observations made along the Monitoring points carried out as part of this project.

- **Drainage** – evident by both historical drains and actively managed drains. Drainage features alter water tables and disrupt flow, shifting fen vegetation patterns and promoting grass dominance. While some drains are infilled with vegetation, the influence upon the on-site hydrology remains (see Figure 5-1 for drains).
- **Absence of appropriate grazing management** – Rank grasses and scrub are replacing the open fen vegetation, leading to a shift in habitat structure and species composition. A lack of appropriate grazing management has led to the dominance of *Molinia* and dense litter, suppressing fen specific flora, hindering the regeneration of the open fen habitat (see Figure 5-1 for dense *Molinia*).
- **Scrub encroachment** – evident by birch *Betula pubescens* regeneration at various points throughout the site. Smaller stands of hawthorn, blackthorn and gorse all exist on site (see Figure 5-1 for areas to be targeted for scrub removal).
- **Succession & vegetation change** – The dense cover of negative indicator species (*Molinia*, *Holcus*, *Agrostis* and *Juncus*) reduces light availability and inhibits the ability for favourable fen vegetation to grow (see Figure 5-1 for dense *Molinia*).

Historical pressures, which were not evidenced during site walkover in 2025 are outlined below. It is important to note that whilst these pressures were not observed during site walkover, it does not necessarily mean they are not present and as such should be considered as potentially current.

- **Pollution** – runoff from agriculture was noted from adjacent fields to the north and east of the site boundary (O'Neill, et al., 2023). Additional nutrients to the wetland habitats of fen and mire gives rise to eutrophic conditions, which may shift species composition and result in a decline in characteristic fen and mire vegetation.

- **Overgrazing** – intensive grazing, or overgrazing by livestock can lead to soil compaction, nutrient enrichment and the loss of valuable fen species.

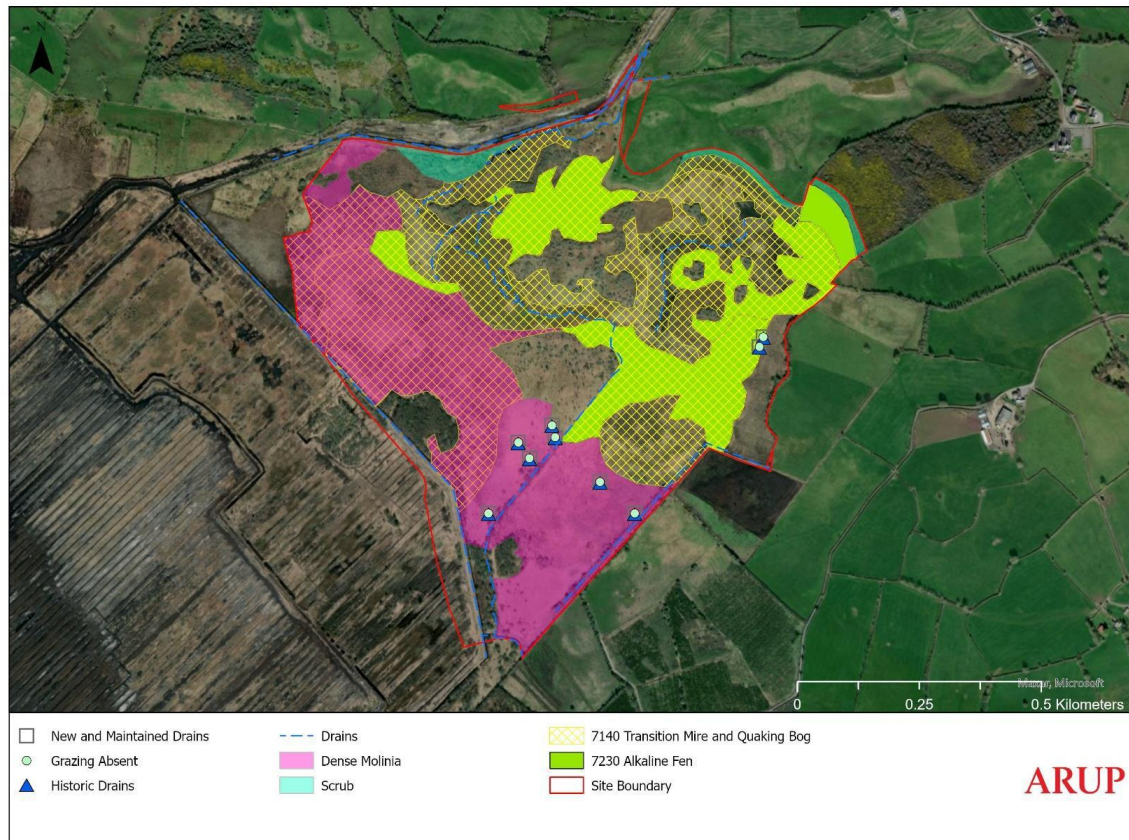


Figure 5-1: Flora & Fauna Pressures mapped within Fin Lough (Offaly) SAC

6 Restoration Measures

6.1 Introduction

The restoration actions proposed by the Fen Restoration Plan 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 6.2 to Section 6.3, with detailed mapping of proposed measures illustrated in the table and map provided in Appendix C.

6.2 Hydrology Measures

6.2.1 On-site Hydrology Measures

A flow accumulation analysis using high resolution LiDAR data was used to identify drains affecting surface and groundwater movement. This guided the selection of dam locations, with the objective of restoring and maintaining appropriate water levels within the fen habitat.

The land surface elevation of 37.7mOD was identified as an appropriate water level for the fen habitat through an analysis of the longitudinal profile of the central drain. This land surface elevation reflects the historical lake morphology of the site and extends over much of the fen habitat. Figure 6-1 shows the area which will be inundated if the water is raised to 37.7mOD. The area of inundation is primarily in the proximity of Alkaline fen [7140] and non-fen/7140 providing more consistent wet conditions for these habitats. Raising the water level to 38mOD will likely inundate a significant area of the fen habitat and critically the area in which *Vertigo geyeri* are present which would be counter to the objectives of the fen restoration plan (Figure 6-2).

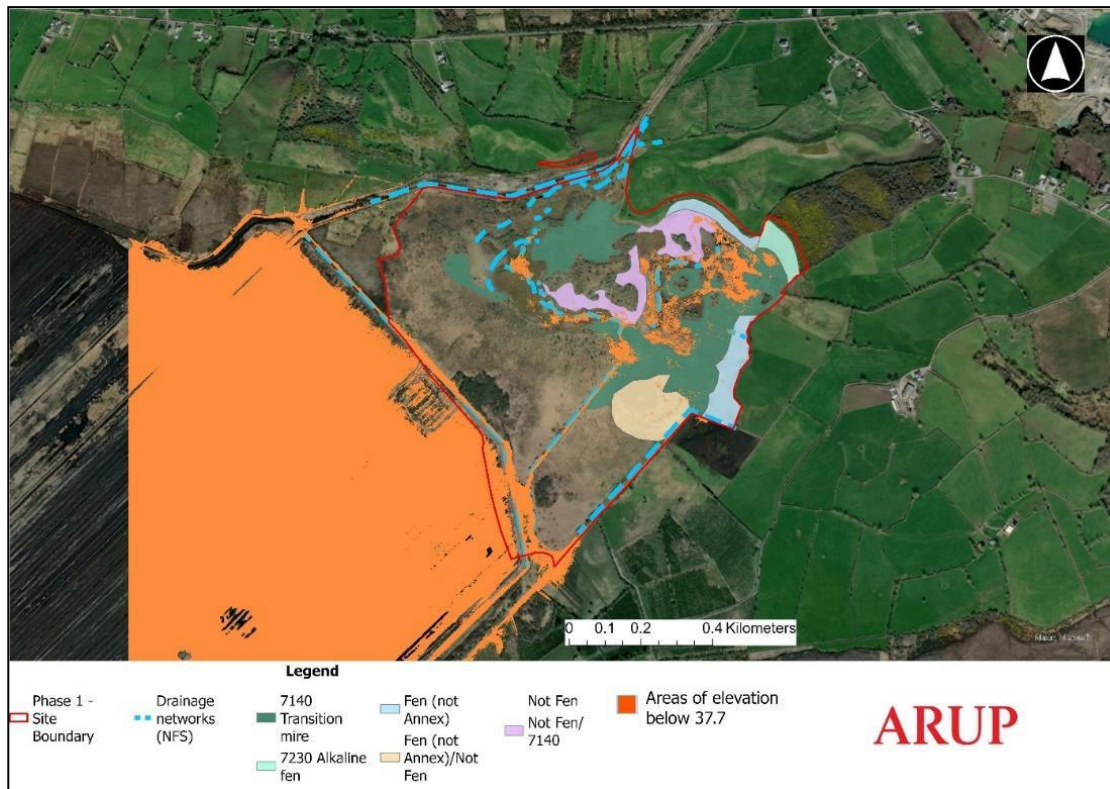


Figure 6-1: Areas of elevation below 37.7mOD

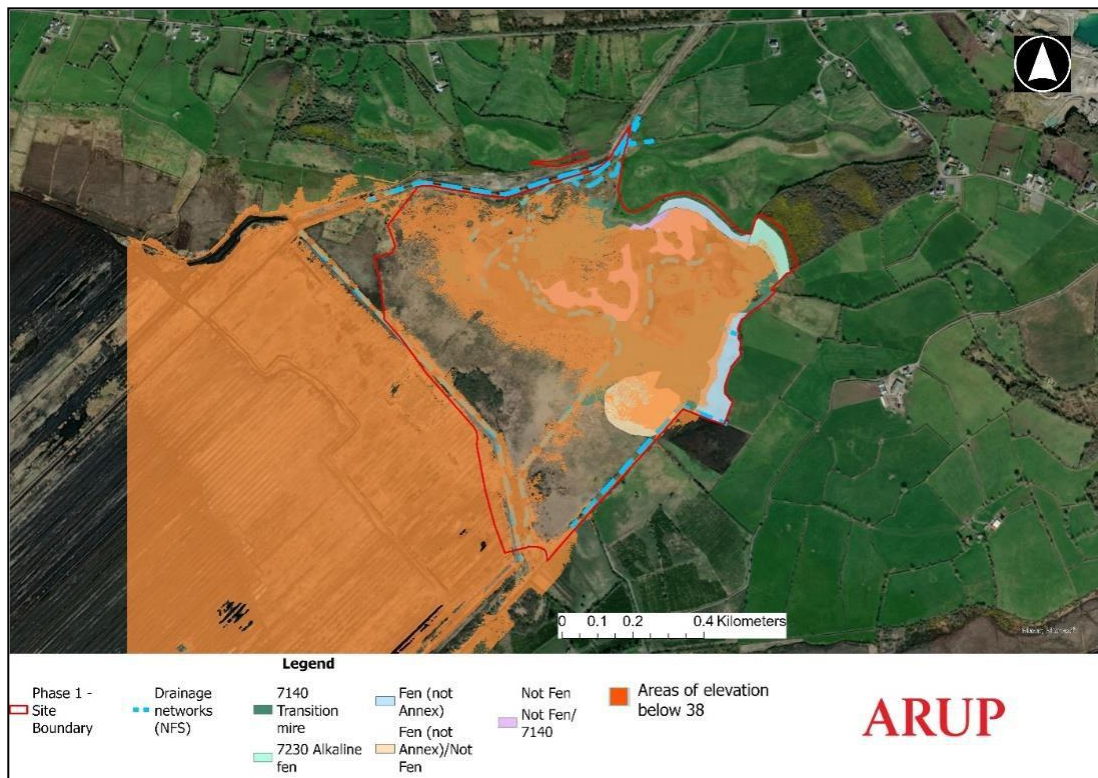


Figure 6-2: Areas of elevation below 38mOD

As the main channel running through the centre of the site provides the greatest influence on water level within the fen habitat (See Figure 3-10) it has been targeted for water level management. The central drain will be blocked using plastic piling to slow water loss. Dam spacing on gentle slopes require up to 15m to 20m spacing (NatureScot, 2019; Convention on Wetlands, 2021). The total quantity of plastic piling required will be approximately twice the cross-section area of the drain (Figure 6-3).

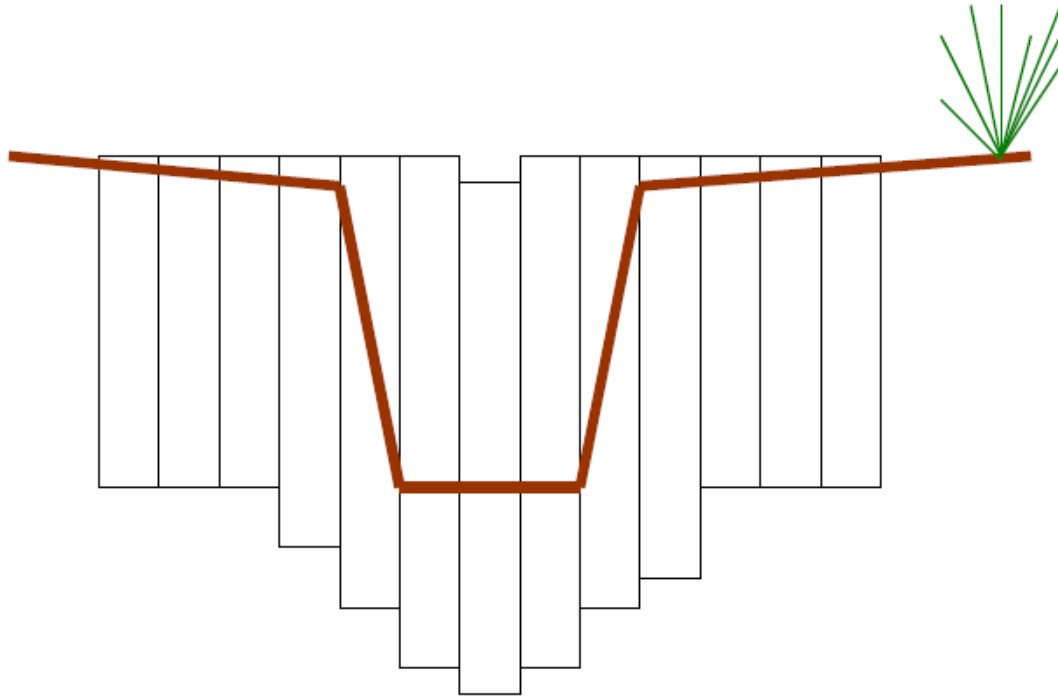


Figure 6-3: Example of a cross-section of a drain with piling inserted (NatureScot, 2019)

To allow for access for the restoration measure the blocking will start at the highest part of the peatland and work towards the southern discharge point. The distance between blocks should be kept to a minimum to allow for retention of water and to decrease the velocity and the water level difference at each dam.

As the depth of peat is more than 4m at the proposed locations, piling will provide a good seal. Piling should be driven into at least 75cm of solid peat (NatureScot, 2019). The plastic dams should extend into the banks of the drain, with the width of extension equalling the width of the drain (i.e. up to 2m). To stop overcutting of the dam, branches or appropriate vegetation material can be placed in the flow. The final plastic dam may need reinforcement where water pressure is greatest. Reinforcement takes the form of timber or metal piles such as road barriers (Figure 6-4). In general, timber reinforcement is adequate. Reinforcement usually entails the use of timber immediately behind the dam with diagonal timbers linked to the ditch bank. Reinforcement is reserved for the end of a large dam run and usually on the last two dams at the lower end. Support consists of timber immediately behind the dam and fixed to the ground by stops at either end. This is used where the dam face exposed to water is greater than 2 metres. The purpose of the support is to reduce bowing of the dam structure.

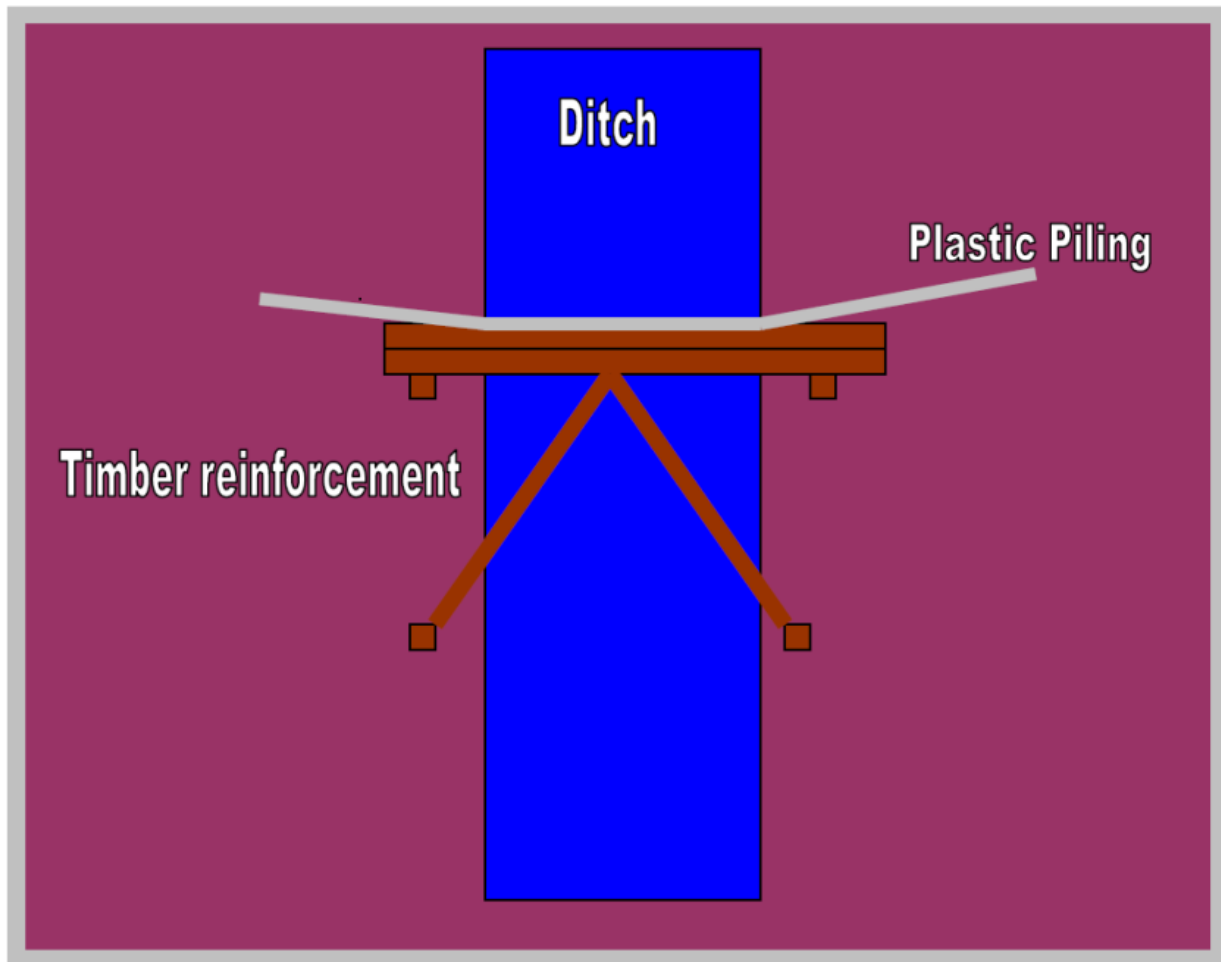


Figure 6-4: Example of timber reinforcement (NatureScot, 2019)

The plastic piling dams will act as a good terminal dam at the end of the fen. Once the water level has been managed then further hydrological measures within the site can be considered using peat dams (i.e. for drains that are less than 1.5m wide).

Equipment

Installation will be manual and require sheet piles, a sharp spade for cutting through the vegetation, fencing mesh to knock the pile in, a timber batten to protect top of pile (piece of 50mm x 150mm) and a platform to allow easier access and to reduce trampling of vegetation.

Infrastructure Maintenance

There needs to be an initial one month check on the functioning of the plastic piling dams. The one month check will include checking whether water is being held back, are piles driven in firmly, are off-cuts cleaned up from site, is the sheet cracked or shattered, and are links between sheets adrift. This is considered the initial hydrology check.

Infrastructure monitoring to assess the functioning of the plastic piling dams will need to continue seasonally. These checks are to ensure the overflow is not blocked with floating material and to check whether the dams are holding water. There will also need to be a check

on whether the water is going around sides of the dam or underneath and whether there are any major leaks.

Monitoring progress

Annual groundwater, surface water and lake level monitoring will be 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 plastic dams along the main drain. Level loggers will be used to monitor changes in water levels.

Annual rainfall and evaporation monitoring using nearby stations, and habitat condition assessments (refer to 6.4) will be included to track restoration progress.

The locations for measures and monitoring are presented in Appendix C.

6.2.2 Off-site Fen Hydrology Measures

6.2.2.1 Avoid creating new drainage channels adjacent to fen

Livestock drinking water provision in adjacent lands appears to be modifying the groundwater in the immediate vicinity. Engagement with the landowner to relocate drinking water provision and block any excavations is recommended

Engagement is required with landowners around the site, particularly those whose lands are hydrologically connected to Fin Lough via drains or surface flow. The landowners should be made aware of the impact of excavation and livestock access to the fen to ensure that no drainage measures take place on adjacent lands which could interfere with the site's water balance.

Where existing pits have been constructed for livestock water supply, alternative solutions such as pasture pumps or water troughs located in suitable locations should be discussed with the landowner.

Monitoring Progress

Progress will be monitored against indicators for increased awareness by landowners about alternative livestock water supply.

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.

6.3.1 On-site Nutrient Measures

6.3.1.1 Water Quality Monitoring

On-site nutrient measures include the monitoring of water quality within the site to assess the effectiveness of proposed off-site nutrient measures and identify any changes in water quality within the site which may require a modification of measures.

Monitoring of habitats, drainage channels and springs for water quality parameters including nutrients (nitrate and phosphate), electrical conductivity and pH is proposed. Locations are to include the Glebe River, springs in the northern part of fen, fen lake water, main fen channel upstream of the proposed dams and the Gowlan River upstream and downstream of the confluence with the main fen channel (Appendix C).

6.3.2 Off-site Nutrient Measures

6.3.2.1 Agricultural Nutrient Management

Livestock drinking water points present a potential source of nutrients to the fen. Measures outlined in the Farming for Water EIP⁹ or novel approaches under NPWS Farm Plans¹⁰ which may provide an alternative water supply to the excavated pits include:

- **Alternative water supply, water troughs, piping and fittings.** Alternative water supplies for livestock include pasture pumps and solar powered pumps with water troughs. Consultation with the farmer will be required to establish a suitable location for the water supply.
- **Bovine, Ovine exclusion from waterbodies.** Access to the existing pits constructed for water supply for livestock should be prevented with a permanent fence.

6.3.2.2 Catchment Nutrient Management

Targeted nutrient control measures should be implemented across the catchment to address both phosphate and nitrogen pathways. PIP maps and field water quality data suggest that Phosphorus runoff is an issue around the Glebe River and the ditches located in the east and

⁹ 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.

¹⁰ 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.

southeast of the site. Therefore, measures to address phosphate runoff should consider the Glebe River catchment and overland flow pathways on the eastern boundary of the site.

Nitrate is a greater concern in the northeastern area where the ground conditions are characterised by freely draining soils. Nitrate is likely to enter the fen through groundwater pathways, primarily via the gravel aquifer to the north and northeast of the site which provides flow to the springs along the northeastern boundary. Measures proposed to address excess nitrate entering the habitat should focus on the groundwater catchment providing flow to the northeast of the site.

Measures outlined under the Farming for Water EIP or novel approaches under NPWS Farm Plans are categorised depending on if they address the source, pathway or receptor. Suitable measures for Fin Lough may include:

- Source control measures (Farming for Water EIP, 2023):
 - **Farmer Training Course for farmers** in the fen catchment.
 - **Nutrient Management Plan.** Such a plan will enable farmers in the catchment to achieve optimum slurry application and nutrient update and avoid overapplication of nutrients.
 - **Nitrogen Surplus.** A nutrient accounting approach is applicable to dairy farms and may be appropriate to address excess nitrate in the habitat's groundwater catchment.
- Pathway interception measures (Farming for Water EIP, 2023):
 - **Linear Riparian Buffer Zones: Grassland.** A linear riparian buffer zone is an uncultivated area located adjacent to streams. It helps intercept sediment and nutrients that have been mobilised from soil surfaces. Riparian buffers effectively intercept and retain water and pollutants transported from adjacent fields through surface pathways. They also enhance terrestrial habitats and provide various services that benefit wildlife.
 - This measure may be appropriate along the Glebe River, particularly on the eastern boundary of the site to prevent phosphate runoff. Depending on the option chosen this can extend for 4.5 to 7.5m from the Glebe River (i.e. riparian buffer zone) (Farming for Water EIP, 2023). Grassland buffer zones are to be fenced off.
- Receptor measures (Farming for Water EIP, 2023):
 - **Bovine, Ovine exclusion from waterbodies.** Although direct livestock access to the Glebe River has not been identified in the areas visited as part of the site

visits, this measure may be appropriate further upstream in the Glebe River if areas of encroachment from livestock on the Glebe River are identified.

- **Vegetated bunded drain.** Nutrients and sediment can be attenuated along this pathway by slowing the flow within a drain. Vegetated Bunded Drains help maximise the retention of sediments and nutrients, while also creating opportunities for water infiltration into the soil.
- This measure may be applicable to the Glebe River which is currently seasonally active and is highly vegetated. Implementing the measure at the entrance to the fen site will enhance the attenuation of nutrients and slow the flow during wet periods. As this action is within a managed drain, there will need to be consultation with relevant Offaly County Council about reducing maintenance and allowing vegetation and sediment to deposit.

6.4 Vegetation Measures

6.4.1 On-site Vegetation Measures

- Proposed measures to address vegetation succession and scrub encroachment include the following on-site measures which are described in order of priority in

Table 6-1:

- Carry out mowing and scarifying of dense *Molinia* sward.
- Carry out scrub clearance in the northern section of the site (Figure 5-1) and in locations adjacent to monitoring points following ecological monitoring post drain blocking (Appendix C **Error! Reference source not found.**).
- Implement conservation grazing measures on site following ecological monitoring post drain blocking.

Table 6-1: On Site Vegetation Measures proposed for Fin Lough (Offaly)

Priority	Measure	Description	Responsibility
1	<i>Molinia</i> mowing and scarifying	To initiate the transition from a dense <i>Molinia caerulea</i> sward towards a fen habitat, the existing dense <i>Molinia</i> cover could 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, scarifying the ground can remove the accumulated thatch and disturb the soil surface. This action would serve two purposes: removing the dense thatch layer to prevent smothering of germinating fen species and breaking up the soil surface to provide suitable microsites for	Tóchar

Priority	Measure	Description	Responsibility
		colonisation by fen specialists, including <i>Schoenus nigricans</i>, which is already present. It is recommended that this takes place before drain blocking. Management of the <i>Molinia</i> sward, i.e. its removal, could help kick-start the transition by reducing its dominance, before water levels rise as a result of weir installation (priority 2 below). Doing this first may give fen species a better chance by lowering competition ahead of wetter conditions. Mowing and scarifying could weaken <i>Molinia</i>, create a more varied structure, and open space for fen plants to spread.	
2	Plastic piling installation	Locations for plastic piling installation have been identified through the review of LiDAR data and the pressures affecting the vegetation composition on site. Appropriately placed plastic piling installation measures will increase the overall water table to a defined area. This increase is anticipated to deter the growth of grass species including <i>Molinia</i> and <i>Agrostis</i> in addition to the scrub encroachment by birch, hawthorn and blackthorn. This is anticipated to encourage the growth of fen and mire vegetation species.	Tóchar
3	Scrub removal	Scrub removal may be necessary following on-going monitoring of the ecological condition of habitats on site, post drain blocking. It may be necessary to carry out the removal of some unfavourable species such as the birch regeneration or the dense stands of <i>Molinia</i> via mechanical or hand-tool means. Ecological monitoring results will inform the most suitable method and type.	Tóchar & NPWS (post-Tóchar)

Priority	Measure	Description	Responsibility
4	Conservation grazing	The ecological monitoring, post-weir installation, will determine whether light grazing is necessary on-site. For habitat areas where weir installation has not occurred, these may not experience a shift in hydrological condition that combats the succession of grass species. As such light conservation grazing by cattle breeds suitable for wetland habitats (e.g. Kerry Blue, Irish Moiled or Belted Galloway) would be most suitable. Species choice should be made following review of the ecological monitoring data and following consultation with Department of Agriculture, Food and The Marine (DAFM) or Teagasc officials.	NPWS Agri-Ecology unit Outside the Tóchar fen restoration programme

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 Gowlan River is part of a Drainage District managed by Offaly County Council. Consultation is required with Offaly County Council on the maintenance and function of the Gowlan River 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 Fin Lough 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. when excavators are used) 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 detailed geotechnical assessments is beyond the scope of the FRP. However, preliminary peat stability analysis was 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 Fin Lough is presented in Figure 8-1. This highlights that there are no known historical landslides within the site, and the site is mostly classified as at low risk of landslide susceptibility. A pocket of moderately low landslide susceptibility is

located on the northeastern boundary of the site, however no restoration measures which require vehicle access or excavation are located in this area.



Figure 7-1: Geological Survey of Ireland Landslide Susceptibility mapping for Fin Lough (Offaly)

7.3 Archaeology

A Crannóg and a Causeway are located in the west of the site. Both the crannóg and causeway have been described as being situated at the centre of Fin Lough Lake and contains a recently excavated Late Bronze Age lakeside settlement. Numerous archaeological sites including a linear earthwork feature, Ballaun stone, crannog, habitation site, ringfort, enclosures, barrows and rock art are also located in adjacent lands (Figure 8-2). There is no proposed intrusive on-site or off-site works in the vicinity of the archaeological sites.

However, consultation with the Offaly County Council archaeologist or National Monuments Service is advised to ensure the archaeological sites are not compromised.

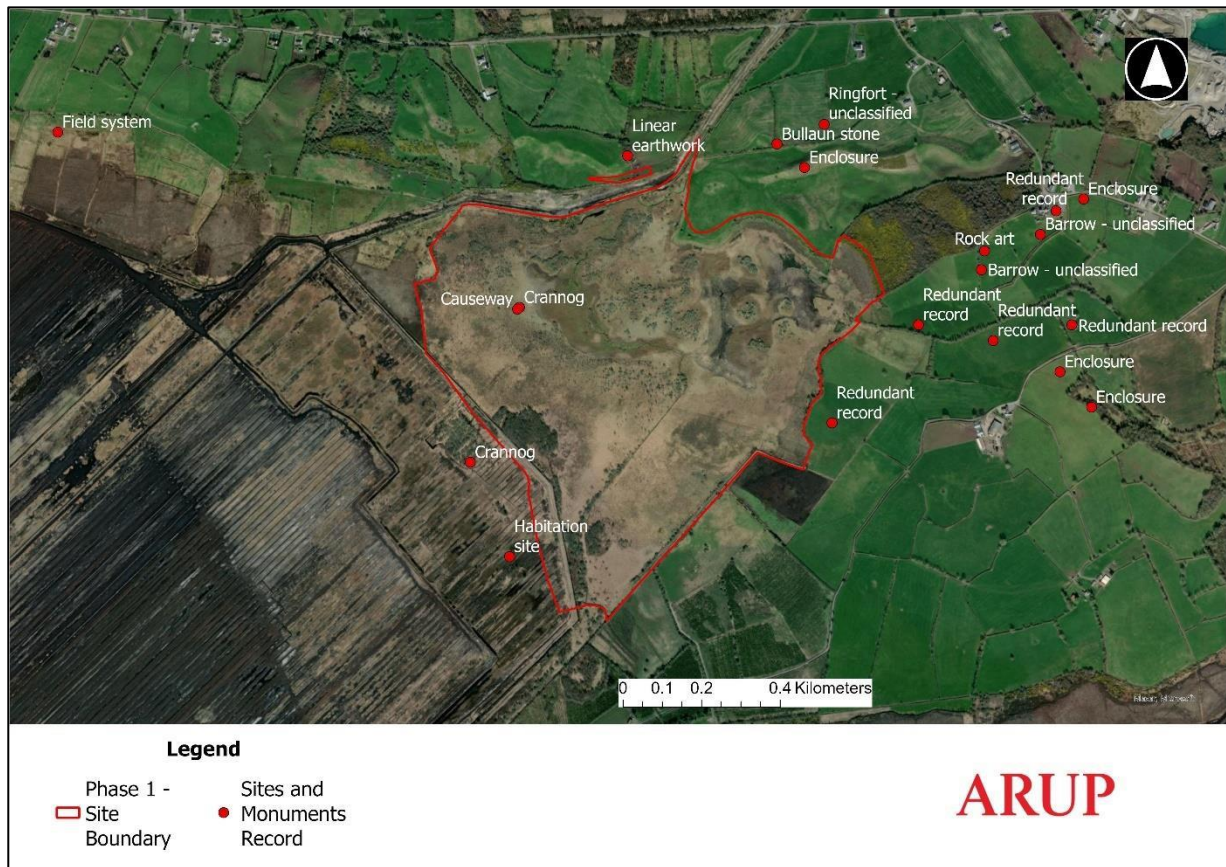


Figure 7-2: Archaeological Sites at Fin Lough (NMS, 2025)

8 Summary of Fen Restoration Plan Actions

Prior to proceeding with the implementation of the restoration measures outlined in the FRP, consultation with landowners and 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	Bord na Móna	Landowner of Fin Lough
	Landowners	Parts of Fin Lough are under Commonage ownership by private individuals
	ESB	Electricity lines within site.
	National Monument Services / County Council	Archaeology
Off-site	Bord na Móna	Landowner of adjacent land (Blackwater Bog) where bog restoration measures are in place
	Offaly County Council	Management of Gowlan River Drainage District
	LAWPRO	Blackwater (Shannonbridge) not a priority for LAWPRO targeted measures.
	Landowners & farmers	Engagement for uptake of catchment measures.
Capacity building	NPWS	NPWS engaging in community education and events
	LAWPRO	LAWPRO team engages with farmers through Farming for Water EIP.

This section provides the summary of the Fen Restoration Plan Actions for Fin Lough (Offaly) (Table 8-2).

Table 8-2: Implementation plan for Fin Lough (Offaly) 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 Fin Lough 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			NPWS
1.2	Drainage management plan							
	Consultation with Offaly 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	Offaly Co. Co	Arup	Within Tóchar project scope
1.3	Archaeological assessment							
	Consultation with Offaly County Council on the archaeology is required to ensure compliance with legislation and local authority objectives.	Sitewide	Archaeological assessment report	Pre-restoration	NPWS	Offaly Co. Co	Arup	Within Tóchar project scope

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
2	Enabling Works							
2.1	Pre-restoration Works Surveys							
	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 <i>Vertigo geyeri</i> which are within the areas for restoration measures. Where <i>Vertigo geyeri</i> habitats overlap with areas for restoration, alternative measures will be discussed with the project team.	Sitewide	ECoW report	Pre-restoration	NPWS		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

Fin Lough (Offaly) Fen Restoration Plan

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
2.4	Good Practice Recommendations and CEMP							
	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							
	Installation of plastic piling dam's along main channel The drain will be blocked using plastic piling, designed to slow water loss. The spatial distribution of the dam locations has been designed to limit the difference in water level upstream and downstream of the dam to 15-20cm in line best practice.	Main central drain	Site installation records	Restoration in 2026	NPWS/ Bord na Móna to facilitate site access		Arup / Contractor	Within Tóchar project scope
3.2	Vegetation measures							

Fin Lough (Offaly) Fen Restoration Plan

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Proposed measures to address vegetation succession and scrub encroachment include: 1. Mowing and scarifying of <i>Molinia</i> sward; 2. Removal of scrub (gorse, birch etc.,) via hand tools (chainsaw); 3. Carrying out scrub clearance following ecological monitoring post drain blocking; and Implementing conservation grazing measures on site following ecological monitoring post drain blocking.	Sitewide	Site records / habitat surveys	Restoration 2026	NPWS/ Bord na Móna to facilitate site access		Arup / Contractor	
4 Off-Site Restoration measures								
4.1 Hydrology measures								
	Avoid creating new pits or ditches The landowners should be made aware of the impact of excavation and livestock access to the fen to ensure that no drainage measures take place on adjacent lands which could interfere with the site's water balance. Where existing pits have be constructed for livestock water supply, alternative solutions such as pasture pumps or water troughs located in suitable locations should be discussed with the landowner.	Surrounding farms	Landowner awareness	Long-term	NPWS		Surrounding landowners	Farming for Water EIP / other similar

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Limit further dredging and modification of Gowlan River Engagement with Offaly County Council on future management of the channel is proposed in order to ensure further potential modification of the channel do not present a risk to the fen habitat.	Gowlan River	Maintenance of Gowlan River	Long-term		Offaly Co. Co.		Offaly Co. Co.
4.2	Nutrient measures							
	Alternative livestock water supply options Livestock drinking water access present a potential source of nutrients to the fen. Measures outlined under the Farming for Water EIP which may provide an alternative water supply to excavations include: Alternative water supply, water troughs, piping and fittings. Alternative water supplies for livestock include pasture pumps and solar powered pumps with water troughs. Consultation with the farmer will be required to establish a suitable location for the water supply. Bovine, Ovine exclusion from waterbodies. Access to the existing pits constructed for water supply for livestock should be prevented with a permanent fence.	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

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Catchment nutrient management Targeted nutrient control measures should be implemented across the catchment to address both phosphate and nitrogen pathways. Measures may include source control measures (Farmer Training Course for farmers in the fen catchment; Nutrient Management Plan; Nitrogen Surplus); pathway interception measures (Linear Riparian Buffer Zones: Grassland) and receptor measures (Bovine, Ovine exclusion from waterbodies; Vegetated bunded drain).	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							
	Groundwater, surface water and lake level monitoring in 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 dams along the main drain. Level loggers will be used to monitor changes in water levels.	Various locations across site	Water level	Long-term	NPWS/ Bord na Móna to facilitate site access			NPWS
	Rainfall and evaporation monitoring using site-specific or nearby stations.	Sitewide	Rainfall and evaporation levels	Long-term	NPWS/ Bord na Móna to facilitate site access			NPWS
5.2	Nutrient monitoring							

Fin Lough (Offaly) Fen Restoration Plan

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	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/ Bord na Móna to facilitate site access			NPWS
5.3	Vegetation monitoring							
	Habitat condition assessments will be included to track restoration progress.	Sitewide	Habitat condition	Long-term	NPWS/ Bord na Móna to facilitate site access			NPWS
6	Capacity building and training							
	Public meeting: To engage stakeholders on developments and results from the restoration measures.			Long-term	NPWS			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**

Drain blocking measures adjacent to the habitat are anticipated to increase the water table within the surrounding area, promoting conditions that favour the growth of fen species and limiting the dominance of unfavourable species such as *Molinia caerulea*. The removal of dense *Molinia* sward (through mowing and scarifying) from areas adjacent to 7230 Alkaline fens can encourage the expansion of the 7230 habitat. This, in combination with hydrological intervention, supports the achievement of targets outlined in the Conservation Objectives for Alkaline Fen at Fin Lough SAC, specifically the objective to “maintain or where necessary restore, as close as possible to natural or semi-natural drainage conditions.”

Drainage within or surrounding the fen habitat can result in the drawdown of the groundwater table, leading to loss of characteristic species and transition to drier habitats. By implementing drain blocking, the project contributes to maintaining the favourable conservation status of alkaline fens.

- **7140 Transition mires and quaking bogs**

Restoration measures including drain blocking, *Molinia* removal, scrub clearance and conservation grazing are designed to reverse succession and hydrological modification. These actions aim to restore the unstable, waterlogged conditions characteristic of this habitat, supporting species such as *Sphagnum* mosses and *Menyanthes trifoliata*. Preventing further drainage and nutrient input is critical to avoid eutrophication and degradation of this sensitive habitat. Hydrological and ecological monitoring will complement on-site efforts, aligning with conservation objectives to maintain ecosystem function and hydrology.

- **PF1 Rich fen and flush**

Controlled grazing and *Molinia* litter removal should reduce the dominance of coarse grasses and promote species-rich fen vegetation. These peat-forming wetlands benefit from mineral-rich water and support calcareous flora.

Restoration actions aim to maintain open structure and prevent transition to drier states. Engagement with adjacent landowners on grazing regimes supports long-term habitat resilience.

- **FS1 Reed and large sedge swamp**

Restoration measures focus on maintaining hydrology and managing vegetation succession and loss of habitat diversity. These swamps, dominated by *Phragmites australis* and *Carex* species, are widespread across the site and play a key role in buffering adjacent fen habitats. Preventing further drainage from surrounding land

in addition to dam installation within the site is essential to sustain wet conditions and ecological function.

- **HH3 Wet heath**

Following *Molinia* mowing/scarifying, weir installation and monitoring, it may be necessary to reintroduce light conservation grazing to control grass species such as *Molinia*. This would counteract succession and maintain open heath structure around areas of HH3 wet heath. Dominated by *Myrica gale* and *Calluna vulgaris*, this habitat supports transitional zones between fen and upland areas.

Conservation grazing coordination ensures consistent management across habitat mosaics.

- **WN6/WN7 Wet woodland**

Restoration actions include retaining mosaic structure and monitoring hydrology and ecological condition to prevent further drainage impacts. These patchy woodlands contribute to habitat heterogeneity and support transitional zones between fen and woodland. Maintaining wet conditions is vital to preserve the ecological integrity of these areas.

8.2 Species Benefiting from Implementation of Restoration Actions

Although the proposed dam installation measures are located outside the historically recorded habitat for *Vertigo geyeri* (primarily in the north-eastern portion of Fin Lough SAC (grid square N0329)), these hydrological interventions are expected to enhance the overall site water table stability. By restoring more natural groundwater-fed conditions across the SAC, the Tóchar project may increase the extent and connectivity of suitable microhabitats, thereby facilitating the potential redistribution and colonisation of *Vertigo geyeri* beyond its currently known range. This aligns with the conservation objective to ensure that the area of suitable habitat remains stable or increases, with a minimum of 0.7 ha of at least suboptimal habitat maintained (Moorkens and Kileen, 2011). Improved hydrology supports the snail's stringent requirements for saturated, calcareous flushes and moss-sedge root zones, particularly those associated with *Carex viridula* and *Campylium stellatum*.

Furthermore, outside the scope of the Tóchar programme, complementary measures such as light conservation grazing, buffer zone nutrient management, and scrub clearance can help maintain the open vegetation structure and micro-topographical variation critical for *Vertigo geyeri* habitat quality. These actions contribute to the conservation targets for vegetation structure and height, ensuring no decline in habitat quality and supporting the snail's persistence through natural processes.

Together, these restoration efforts offer mutual benefits for broader fen ecosystem function and the long-term viability of *Vertigo geyeri* within Fin Lough SAC.

9 References

Alm, J., Shurpali, N. J., Minkinen, K., Aro, L., & others. (2007). Emission factors and their uncertainty for the exchange of CO₂, CH₄ and N₂O in Finnish managed peatlands. *Boreal Environment Research*, 12(2), 191–204

CIEEM (2021). Good Practice Guidance for Habitats and Species. Version 3 May 2021. Chartered Institute of Ecology and Environmental Management

Convention on Wetlands (2021). Global guidelines for peatland rewetting and restoration. Ramsar Technical Report No. 11. Gland, Switzerland: Secretariat of the Convention on Wetlands.

Copernicus (2025) Land Monitoring Service Data Viewer. Available: <https://land.copernicus.eu/en/map-viewer> (Accessed September 2025)

Environmental Protection Agency (EPA) (2024) Cycle 3 HA 25B Lower Shannon Catchment Report.

EPA (2025a) EPA Maps. Available: <https://gis.epa.ie/EPAMaps/> (Accessed September 2025)

EPA (2025b) Water quality monitoring report on nitrogen and phosphorus concentrations in Irish waters 2024.

Farming for Water EIP. (2025). *Measures Information Booklet*. Available at: <https://farmingforwater.ie/app/uploads/2025/01/Measures-Booklet-Single-sheet.pdf>

Fossitt, J.A. (2000). A guide to habitats in Ireland. The Heritage Council, Kilkenny.

Geological Survey Ireland (2025) Data and Maps. Available at: <https://gsi.ie/en-ie/data-and-maps/pages/default.aspx> (Accessed September 2025).

Met Eireann (2025) Athlone O.P.W. Rainfall Data. Available at: <https://data.gov.ie/dataset/athlone-opw-rainfall-data> (accessed September 2025)

Moorkens, E.A. & Killeen, I.J. (2011) Monitoring and Condition Assessment of Populations of *Vertigo geyeri*, *Vertigo angustior* and *Vertigo moulinsiana* in Ireland. Irish Wildlife Manuals, No. 55. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin, Ireland.

Moorkens, E.A. (2011) *Monitoring and condition assessment of populations of Vertigo geyeri, Vertigo angustior and Vertigo moulinsiana in Ireland, 2011*. Irish Wildlife Manuals, No. 55. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

National Parks and Wildlife Service NPWS (2025). The Status of EU Protected Habitats and Species in Ireland. Volume 1: Summary Overview. Unpublished NPWS report. Available at: chrome-

NatureScot (2024). Peatland ACTION – Technical Compendium: Peatland Restoration and Management Guidance. NatureScot, Inverness.

NPWS (2019) Conservation Objectives: Fin Lough (Offaly) SAC 000576. Version 1. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht

O'Neill, F.H., Perrin, P.M., Denyer, J., Martin, J.R., Brophy, J.T. & Daly, O.H. (2023) Scoping study and pilot survey of fens. Irish Wildlife Manuals, No. 143. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Scottish Natural Heritage. 2011. The Fen Management Handbook. Editors A. McBride, I. Diack, N. Droy, B. Hamill, P. Jones, J. Schutten, A. Skinner, and M. Street. Scottish Natural Heritage, Perth.

Waddington, J. M., & McNeil, P. (2002). Peat oxidation in an abandoned vacuum extracted peatland. Canadian Journal of Soil Science, 82(3), 279–286. <https://doi.org/10.4141/S01-043>

Weeler, B.D., Shaw, S. and Tanner, K. 2009. Wetland functional mechanisms: a synopsis of WETMECs. SC030232/SR2. Environment Agency, Bristol.

Wilson, D., Dixon, S. D., Artz, R. R. E., Smith, T. E. L., Evans, C. D., Owen, H. J. F., Archer, E., & Renou-Wilson, F. (2015). Derivation of greenhouse gas emission factors for peatlands managed for extraction in the Republic of Ireland and the United Kingdom. Biogeosciences, 12(18), 5291–5308. <https://doi.org/10.5194/bg-12-5291-2015>

Appendix A – Non-Technical Summary

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary			
Site Name	Fin Lough (Offaly)	NFS site no.	1003
County	Offaly	Designations	SAC 000576
Fen habitats present (area)	7230 Alkaline fens (1.44 ha) and 7140 Transition mires (13.82 ha)	Species of note	Geyer's Whorl Snail (<i>Vertigo geyeri</i>)
Site Description			
Fin Lough (Offaly) is located approximately 7 km north-east of Shannonbridge in Co. Offaly and includes the Fin Lough Special Area of Conservation (SAC) for the presence of 7230 Alkaline fens and <i>Vertigo geyeri</i> species (Geyer's Whorl Snail), both listed under Annex I and II of the E.U. Habitats Directive. The 7230 Alkaline fen habitats are primarily located on the eastern side of the site, while petrifying springs with tufa deposits in the northern section provide suitable conditions for <i>Vertigo geyeri</i>. Additionally, areas of 7140 Transition mires habitats are also present on the eastern side of the site. Figure 1 presents the habitats mapped within the site			
Conceptual Site Model (CSM)			
As a former lake, the landscape of Fin Lough is relatively flat with elevated ground to the north associated with a band of gravel deposit known as an esker. Fin Lough is fed by both groundwater and surface water sources. The Glebe River provides the main surface water inflow into the site from the east but once in the site the channel is not clearly defined and the flow disburges. Groundwater emerges at springs located in the north of the site where gravel deposits meet the lower permeability peat associated with the fen habitat. The main surface water feature within the site is a channel which runs through the centre of the site and provides the main drainage outflow for the site. This channel discharges into the Gowlan River in the southeast of the site. The CSM is presented in Figure 2.			
Key Pressures			
Hydrology Pressures	Drainage – modification of the main channel within Fin Lough, relatively newly agricultural drainage features and dredging works in the Gowlan River.		
Nutrient Pressures	Diffuse pollution leading to nutrient enrichment. Phosphate concentrations were highest in the eastern part of the site adjacent to agricultural land. Elevated nitrate concentrations in the northern part of the site where the springs are located indicate nutrient input from the adjacent farmland.		
Ecology Pressures	Drainage modification, scrub encroachment, succession and vegetation change, the absence of appropriate grazing management, are resulting in shifting fen vegetation patterns and promoting growth of non-fen species (e.g. grasses). Excess nutrients from agricultural runoff and overgrazing can also change species and lead to a loss of fen species.		

**NPWS Tóchar Midlands Wetland Restoration Scheme
Fen Restoration Plan Non-Technical Summary**

Objective of Restoration Plan

The objective of the Fin Lough 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.

While full-scale hydrological restoration aimed at re-establishing the site's former lake would offer potential ecological gains for aquatic species and waterfowl, this would result in the loss of existing fen areas.

Restoration Measures

Hydrology Measures	On-Site Measures: Water level management through partial drain blocking of the main channel. Off-Site Measures: Avoid the creation of new agricultural drains and exploration of alternative water supply for existing water supply for livestock. Limit further dredging and modification of the Gowlan River.
Nutrient Measures	Off-Site Measures: Exploration of alternative water supply for existing water supply for livestock and employ catchment nutrient management measures.
Ecology Measures	On-Site Measures: Cutting and thinning areas of molinia, removing scrub (gorse, birch etc.) using hand tools and potentially implement conservation grazing following monitoring by cattle breeds suitable for wetland habitat e.g. Kerry Blue, Irish Moiled or Belted Galloway.

Monitoring Progress

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 ([provide url](#))

Tóchar website: <https://www.tocharwetlands.ie/fen-restoration/>

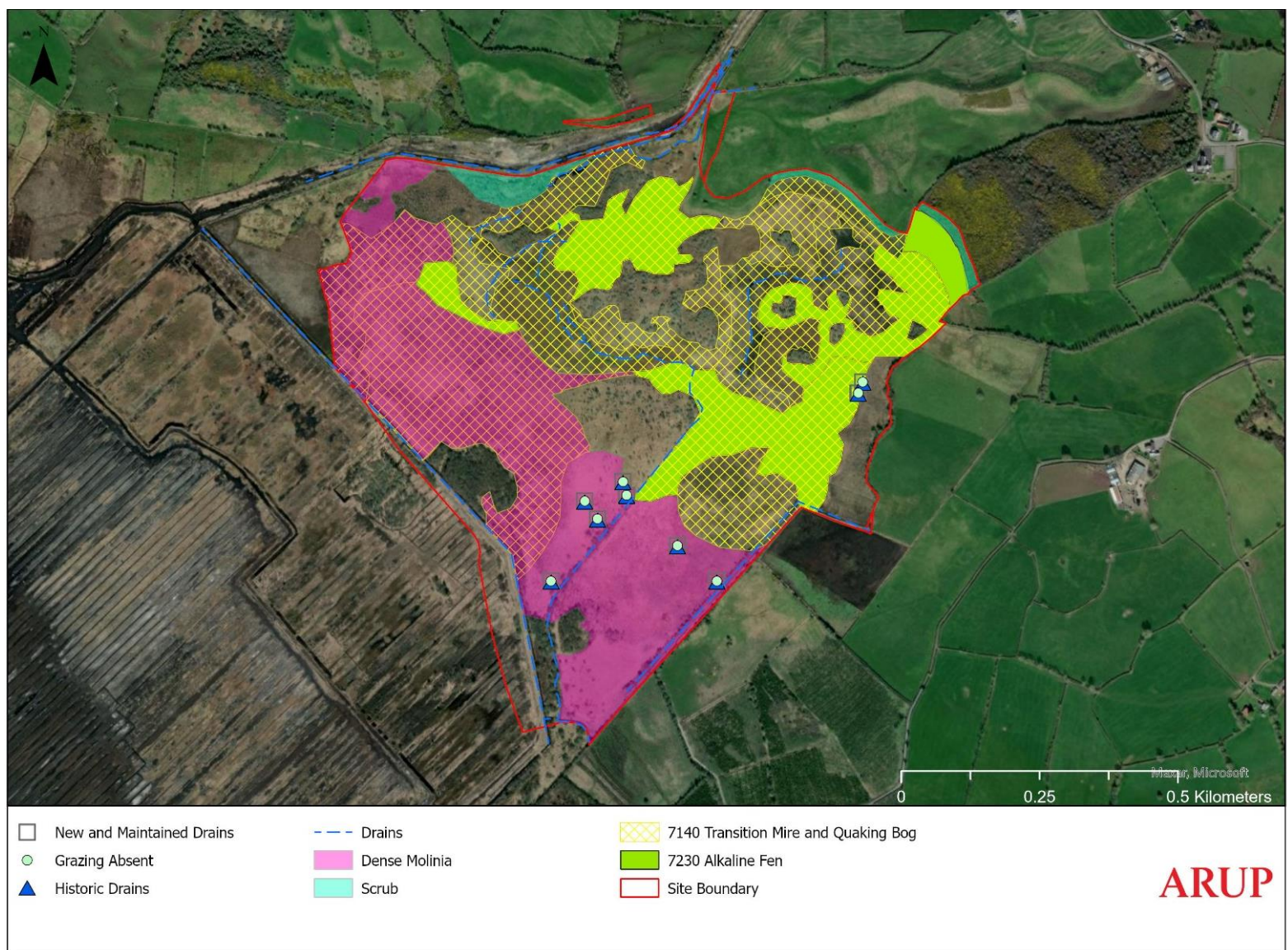


Figure 1: Site Habitat Map

Fin Lough

Offaly County

25B Lower Shannon

Seepage percolation quag (WETMEC: 13b) & Ombrogenous bog (WETMEC 3)

Key:

	Arterial drain
	Wetland drains
	Wetland vegetation

Cross section:

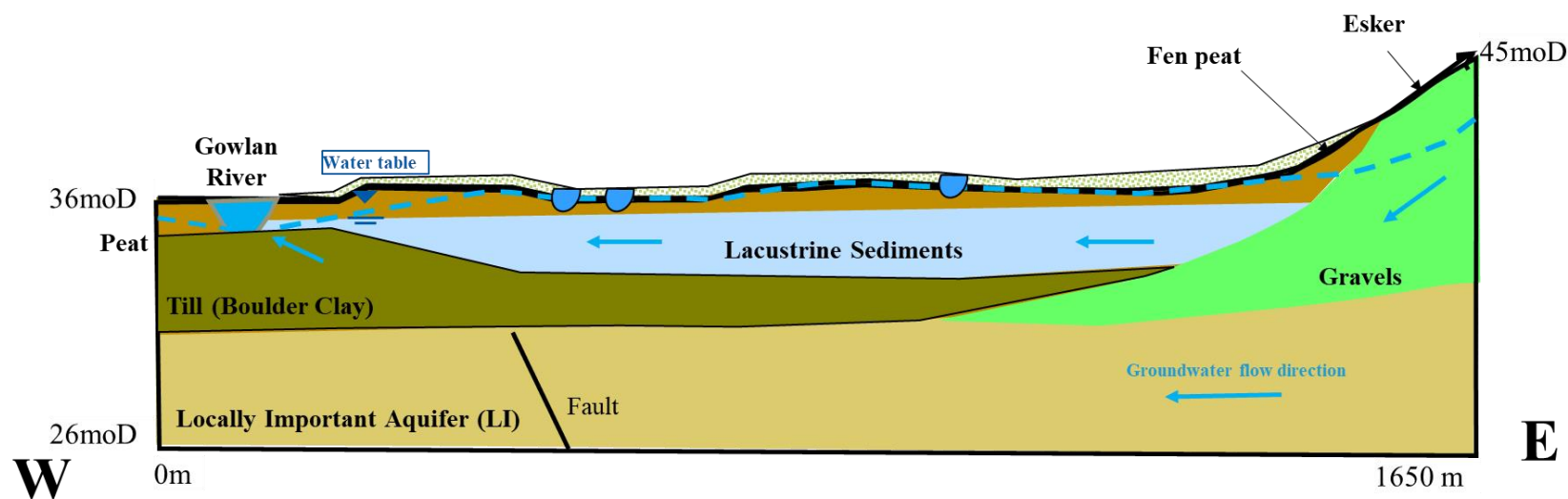
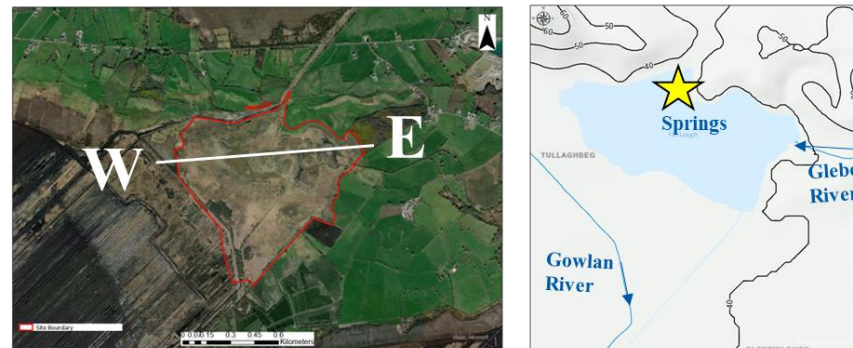


Figure 2: Conceptual Site Model

Appendix B – Ecological Survey Maps

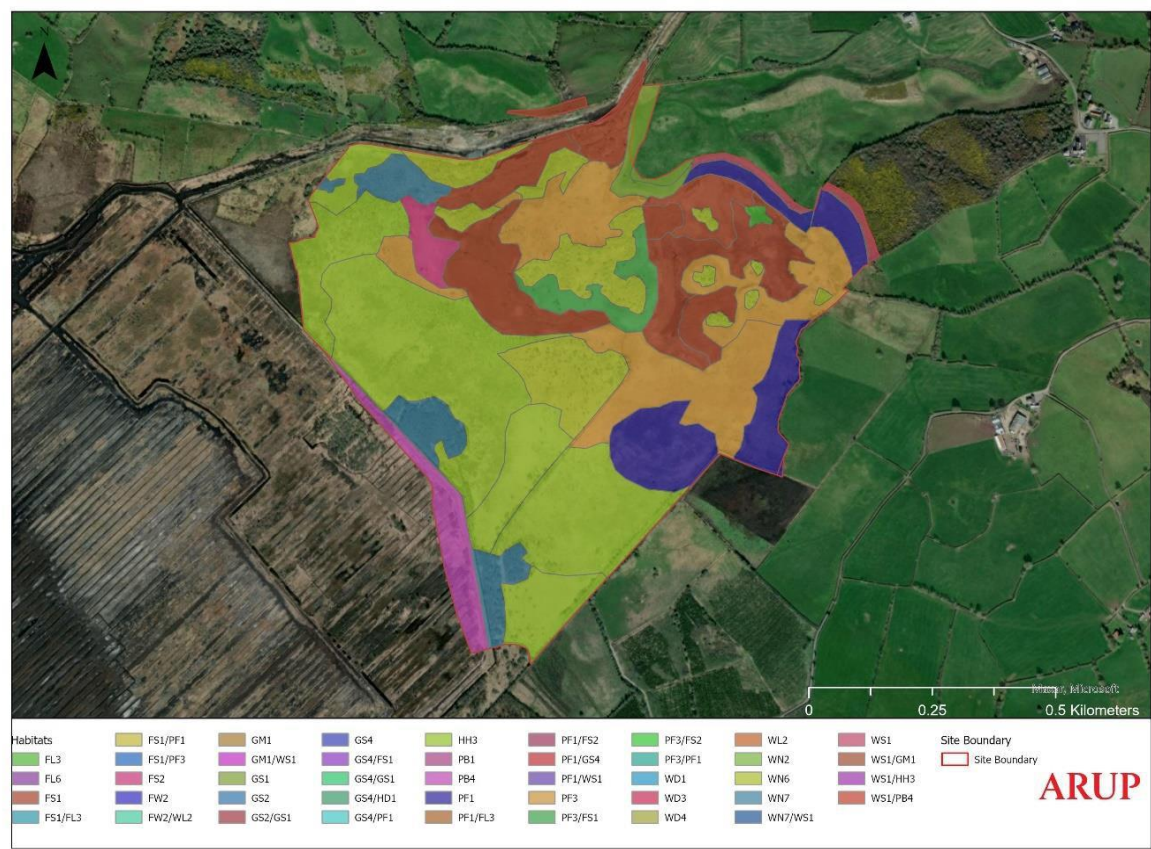


Figure B-1: Fossit habitat types at Fin Lough (Offaly)



Figure B-2: Approximate location of *Sphagnum teres* record.

Appendix C – Restoration and Monitoring Map

Table C1: Long-term monitoring points for fen restoration at Fin Lough

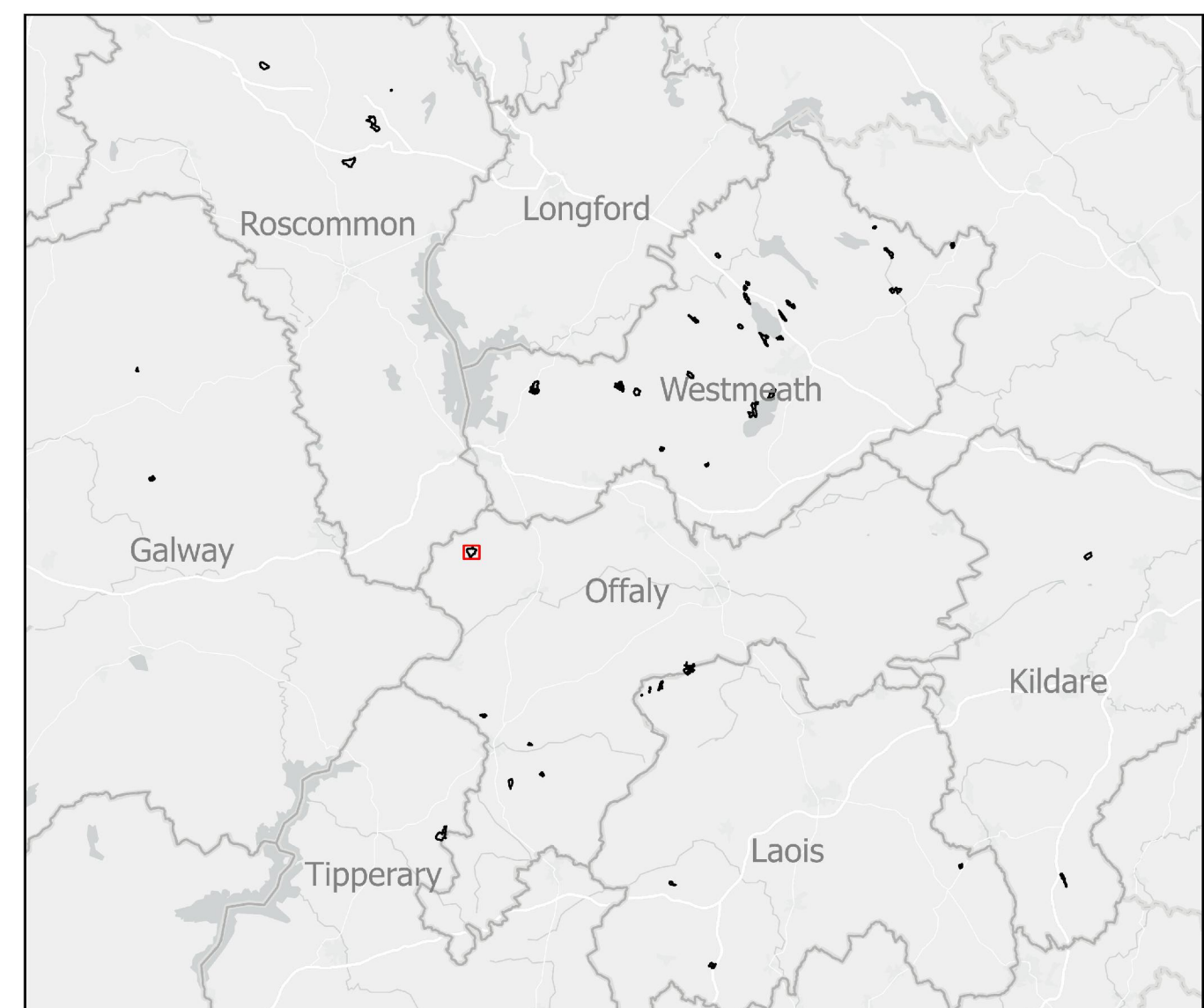
Point	Measure	Objective	Timeframe	Frequency of monitoring	Monitoring indicator
Gw_1	Hydrological	Monitoring groundwater levels and quality	Long-term	One data logger	Groundwater level
Gw_2				Seasonal ¹¹ for year 1	Groundwater level
Gw_3					Groundwater level
Gw_4				Annual for year 2-5	Groundwater level
Sw_1		Monitoring of surface water levels and quality	Long-term	Seasonal for year 1 Annual for year 2-5	Water level and quality at open water
Sw_2					Water level and quality at Glebe River
Sw_3					Water level and quality at main drain
Sw_4					Water level and quality at main drain near restoration
Sw_5					Water level and quality at Gowlan River
Ec_1	Ecological	Monitoring along main hydrological measure near central drain	Long-term	Seasonal for year 1 Every 3 years for year 2-5	Ecological monitoring
Ec_2					Ecological monitoring
Ec_3					Ecological monitoring
Ec_4					Ecological monitoring
Ec_5					Ecological monitoring

¹¹ Seasonal: quarterly to represent a hydrological year

Fin Lough Fen Restoration Plan

Point	Measure	Objective	Timeframe	Frequency of monitoring	Monitoring indicator
Ec_6					Ecological monitoring
Ec_7					Ecological monitoring
Ec_8		Monitoring near agricultural drains	Short-term	Seasonal for year 1	Ecological monitoring
Ec_9				Every 3 years for year 2-5	Ecological monitoring

Fen Restoration - Fin Lough (Offaly) - Phase 1



- Legend**
- Site Boundary
 - Drains
 - Water River Network (OSI)
 - Land Parcels
- Monitoring**
- Ecology monitoring
 - Groundwater monitoring
 - Surfacewater monitoring
- Restoration**
- Agricultural drain
 - Plastic piling
 - Area for scrub encroachment management
 - Molinia management

0 50 100 Meters

Scale: 1:3,000 | Page Size: A3
Date: 22/04/2026

Map Credits: Microsoft, Vantor, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Appendix D – Drainage Management Plan

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan			
Site name	Fin Lough (Offaly)		
County	Offaly	NFS site No.	1003
Catchment overview:			
The site is positioned at approximately 40 mOD and is relatively flat. Higher ground is located to the north along an esker ridge. The area to the west and south of the site is very flat where the Blackwater Bog has been historically excavated for peat.			
WFD catchment	25B- Lower Shannon	WFD Sub-catchment	Shannon [Lower]_SC_030
Drainage Area	None	Drainage District	Yes
Responsible authority	Offaly County Council	Maintenance date	TBD
Surrounding landowners	Bord na Móna, landowners		
Wetland drainage			
An assessment of historical and current hydrological data indicates that the water regime of Fin Lough (Offaly) has changed over time, primarily due to drainage for peat extraction activities. Historical maps from the early-1800s show an open water body with the site boundary, with a drain passing through the centre of the site. By the 1940s, the lake area had reduced significantly. While the northern part of the site still comprises an open water body the southern portion has become vegetated. Springs located at the northern boundary of the site, feed the system with groundwater discharge. Over the last 50 years, the spring emergence points have shifted southward. This change is likely associated with a historical lowering of lake levels. The reduction in lake level, probably associated with drainage excavations, may have resulted in the spring emergence moving to lower elevations further south. Historically, these springs might have emerged higher on the esker slope when water levels were higher. The Glebe River located east of the site, acts as the main surface water inflow to Fin Lough, with the outflow directed southward towards the Gowlan River. The Gowlan River, which runs along the southwestern boundary of the site flows to the south.			
Surface water inflow	Glebe River	Surface water outflow	Gowlan River
Groundwater inflow	Springs		
Internal drains	One drain through site	Perimeter drains	One to the west and one east
On site hydrology measures			
On-site measure 1	Drain blocking	Role player	NPWS/ Bord na Móna to facilitate site access
A water level of 37.7mOD was identified as a suitable minimum water level for much of the fen habitat. The area of inundation is primarily in the proximity of annex fen habitat providing more consistent wet conditions for these habitats. As the main channel running through the centre of the site provides the greatest influence on water level within the fen habitat it has been targeted for this water level management measure. The drain will be blocked using plastic piling, designed to slow water loss. The spatial distribution of the dam locations has been designed to limit the difference in water level upstream and downstream of the dam to 15 to 20m in line with best practice. Following installation there will need to be follow up monitoring of performance of the measure after one month. Following this seasonal monitoring will be conducted by the NPWS.			

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan					
Off-site hydrology measures					
Off-site measure 1	Avoid creating new pits or ditches		Role player	NPWS/Surrounding landowners	
Landowners should be made aware of the impact agricultural drains close to the fen to ensure that no drainage measures take place on adjacent lands which could interfere with the site's water balance. Where existing livestock access exists, alternative solutions such as pasture pumps or water troughs located in suitable locations should be discussed with the landowner.					
Off-site measure 2	Limit further dredging and modifications of Gowlan River		Role players	Offaly County Council/NPWS	
Engagement with Offaly County Council on future management of the channel is proposed in order to ensure further potential modification of the channel do not present a risk to the fen habitat.					
Proposed Water Monitoring:					
Groundwater, surface water and lake level monitoring in 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 dams along the main drain. Level loggers will be used to monitor changes in water levels.					
Indicator	Water level	Location	Various locations across site	Role players	NPWS/ Bord na Móna to facilitate site access
Rainfall and evaporation monitoring using site-specific or nearby stations.					

Table 1: Long-term monitoring points for fen restoration at Fin Lough

Point	Measure	Objective	Timeframe	Frequency of monitoring	Monitoring indicator
Gw_1	Hydrological	Monitoring groundwater levels and quality	Long-term	One data logger Seasonal ¹ 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 at open water
Sw_2					Water level and quality at Glebe River
Sw_3					Water level and quality at main drain

¹ Seasonal: every quarter to represent a hydrological year

Point	Measure	Objective	Timeframe	Frequency of monitoring	Monitoring indicator
Sw_4					Water level and quality at main drain near restoration
Sw_5					Water level and quality at Gowlan River
Ec_1	Ecological	Monitoring along main hydrological measure near central drain	Long-term	Seasonal for year 1 Every 3 years for year 2-5	Ecological monitoring
Ec_2					Ecological monitoring
Ec_3					Ecological monitoring
Ec_4					Ecological monitoring
Ec_5					Ecological monitoring
Ec_6					Ecological monitoring
Ec_7					Ecological monitoring
Ec_8		Monitoring near agricultural drains	Short-term	Seasonal for year 1 Every 3 years for year 2-5	Ecological monitoring
Ec_9					Ecological monitoring

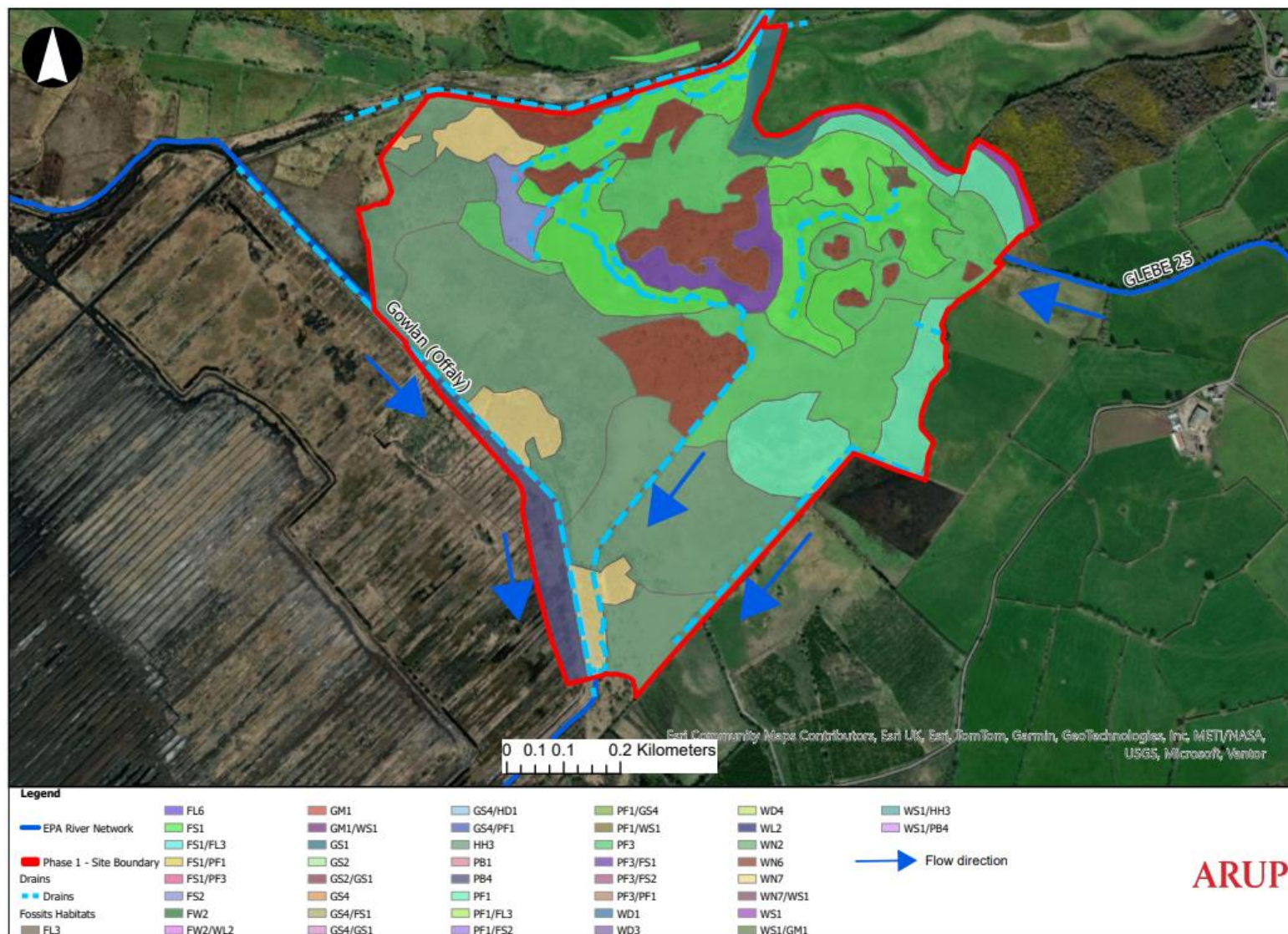


Figure 1: Mapped drainage network at Fin Lough (Offaly)