National Parks & Wildlife Service

Tóchar Midlands Wetland Restoration Scheme

Monroe Fen

NFS site

No. 104006

Fen Restoration Plan

September2026

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ARUP

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NPWS An tSeirbhís Páirceanna Náisiúnta agus Fiadhúlra National Parks and Wildlife Service

Fen Restoration Plan

Monroe Fen (Westmeath)

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Executive Summary

Monroe Fen is located 7.2 km northwest of Mullingar in Co. Westmeath and is formed in a valley basin.

The site is not designated either nationally or internationally, however has been recorded to support Annex I quality 7230 Alkaline fens and 6430 Hydrophilous tall-herb swamp.

This Fen Restoration Plan has been developed to set out proposals for the restoration of 7230 Alkaline fens and associated wetland habitats.

This site-level plan will be refined prior to implementing the restoration actions at each subsite. The assessment primarily considers the following pressures, which may be affecting the hydrological function and favourable condition of the fen habitat:

- Drainage works that have altered natural water levels;
- Nutrient enrichment from adjacent agricultural activities; and
- Inappropriate grazing regimes.

The Fen Restoration Plan was developed using a desktop assessment of previous studies of Monroe Fen commissioned by National Parks & Wildlife Service, which includes surveys carried out in 2022 as part of the National Fen Survey and the Wetlands of County Westmeath[1]. Detailed aerial imagery and topographic datasets were used to identify drainage features. Hydrological and ecological field surveys were undertaken to collect additional information and validate the findings from desktop assessment, supporting the proposed restoration actions.

Actions of the Fen Restoration Plan

The Fen Restoration Plan sets out a coordinated series of measures to address the key pressures affecting the site and to support the recovery of its wetland habitats. These measures include:

- Drainage management;
- Creation of buffer strips;
- Vegetation management; and
- Landowner engagement.

Drainage management will include drain blocking in a few locations 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. This measure should be implemented only after the water quality

[1] NPWS (2022) Conservation Objectives: Monroe fen (Westmeath). National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht

monitoring and the implementation of the vegetation buffer zones, to assure that this has been effectively worked.

The creation of buffer strips on certain sections of the site boundary aims to reduce nutrient inputs from adjacent land.

Vegetation management includes conservation grazing targeted within the southern area of the site where suitable access is available for livestock. Additionally, scrub encroachment management is included within the southeastern areas of the site to reduce scrub.

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.

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.

Benefits of the Fen Restoration Plan

The restoration plan is expected to deliver significant benefits for a range of habitats and species at Monroe Fen.

Conservation grazing, buffer strips, vegetation and hydrological monitoring will all contribute to favourable condition of the 7230 Alkaline fens, 6430 Hydrophilous tall-herb swamp and other wetland habitats. The grazing will open up the sward preventing certain vegetation to dominate and encourage an increase in diversity. The buffer strips will improve water quality reducing eutrophication within the site from surrounding landscape and hydrological monitoring will inform a water quality programme.

Community Engagement with local landowners to promote restoration within the fen will reduce nutrient input from runoff from adjacent farmland and improve ecological resilience.

Overall, these restoration actions will enhance habitat quality and resilience, supporting both biodiversity and favourable condition of fen and wetland habitats.

Habitat and Restoration Map

The habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification system is presented in Figure 1-1: .

The Restoration and Monitoring Map including both hydrological and ecological measures is presented in Figure 1-2.

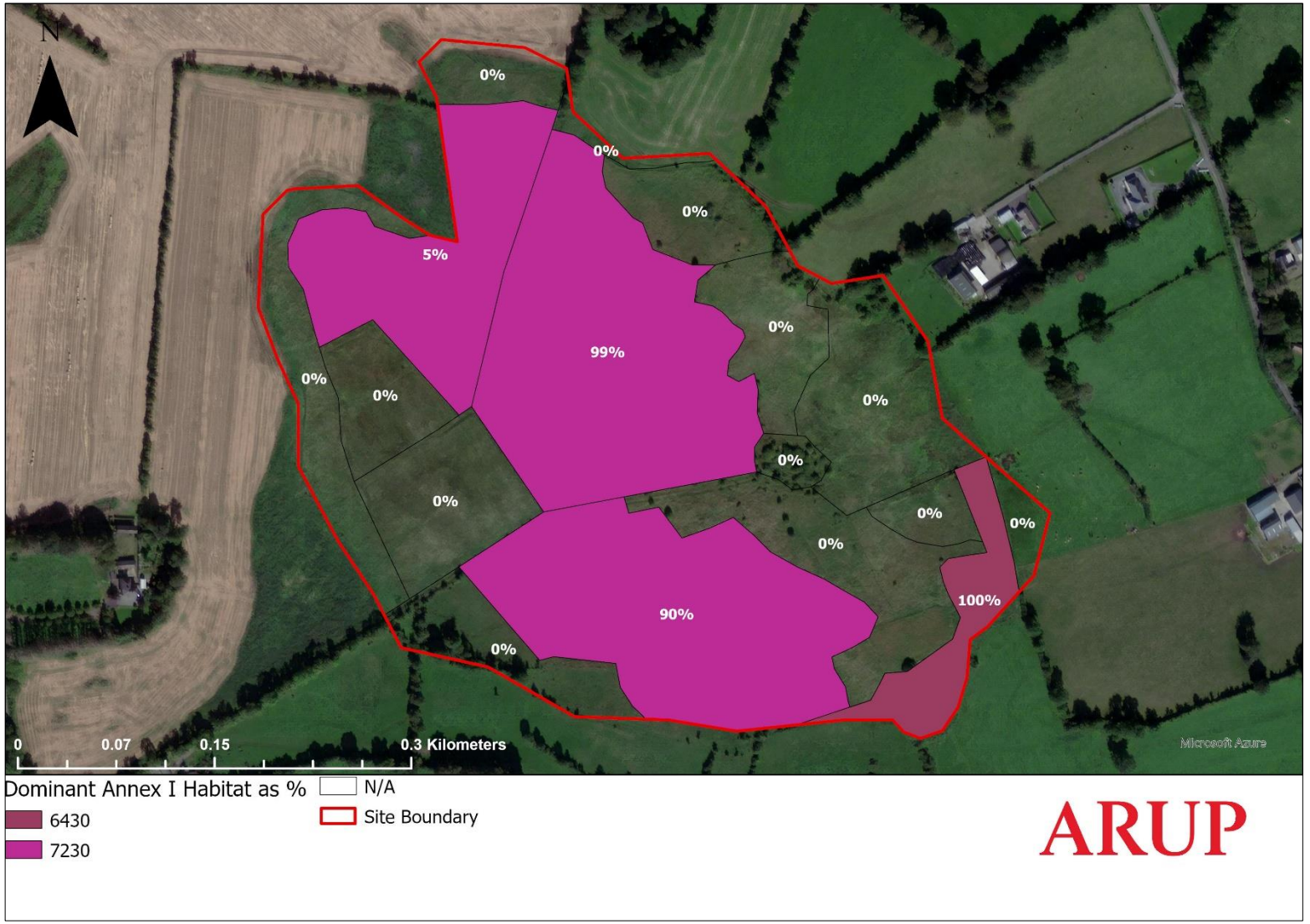


Figure 1-1: Annex I and Annex I quality habitats recorded and mapped as part of the 2022 NFS. Note the % value indicates the % cover of the dominant Annex I and Annex I quality habitat recorded in the polygon

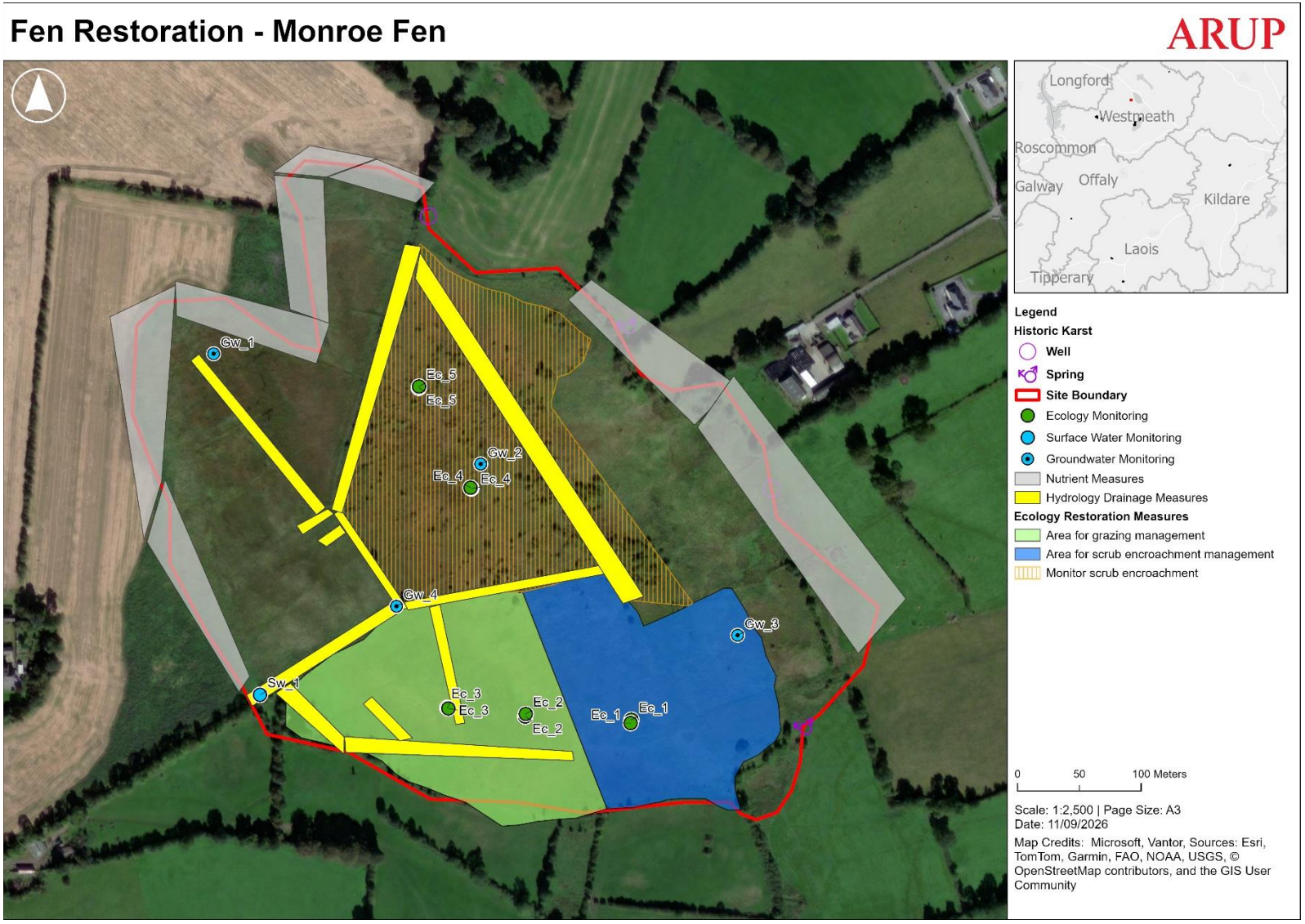


Figure 1-2: Restoration map of Monroe fen

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, The FENCES Project team and the Tóchar Wetlands Project Team, including Shirley Clerkin (Project Manager), Monica Byrne (Project Administrator), Hazel Daly (Community Engagement Officer), and Emily Nolan (Community Engagement Officer).

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

1 Introduction

1.1 Purpose of this Fen Restoration Plan

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

Annex I habitats are those formally listed under Annex I of the EU Habitats Directive and are recognised as qualifying features of a designated site, meaning they have legal protection and must be assessed and managed to meet site-specific conservation objectives. Monroe Fen is not a designated site (either nationally or internationally) but supports Annex I habitat. It is referred to here as Annex I quality, meaning it conforms to the Annex I habitat description, but is not a designated Special Area of Conservation (SAC).

The following Annex I quality habitats were recorded within the site: 7230 Alkaline fens and 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (hereafter referred to as 6430 Hydrophilous tall-herb swamp).

Monroe Fen is located approximately 7.2 km north-west of Mullingar in Co. Westmeath. The site covers a total area of 20.21 ha and is dominated by fen habitat although several other associated peatland habitats are also present (Brophy et al., In prep). According to the National Fen Surveys carried out in 2022 (Brophy et al., In prep) the total extent of 7230 Alkaline fens at Monroe Fen is 7.22 ha.

The main aim of the restoration actions proposed as part of this assessment is to maintain and improve the quality of existing areas of the fen habitat, to enhance 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 restorations 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.

The implementation of the actions proposed within this FRP report may also provide wider improvements to biodiversity, reduce carbon emissions and potentially improve water quality all of which may be demonstrable under eventual post implementation monitoring.

1.2 Wider benefits of peatland restoration

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

SACs or Natural Heritage Areas (NHAs), they remain crucial for biodiversity and climate resilience.

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

It is expected that areas within Monroe Fen will become a reduced carbon source/part carbon sink following implementation of the FRP, which will result in the improvement in hydrology.

The restoration of fen habitat at Monroe fen may contribute to improved water quality in downstream waterbodies. 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 reducing flood risk.

1.3 Key pressures on Fens

The overarching (National) key pressures and threats to Annex I fen habitats 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 7230 Alkaline fens in the Article 17 report.

Table 1–1: National pressures to fen habitats

Habitat	Importance	Pressure
7230 Alkaline fens	High	PA07 Intensive grazing or overgrazing by livestock PA22 Drainage for use as agricultural land PA23 Physical alteration of water bodies (including dams, channels, etc.)
	Medium	PA01 Conversion into agricultural land (excluding drainage and burning) PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming) PL02 Drainage (mixed or unknown drivers) to surface or ground waters
	Low	PC05 Peat extraction PA17 Agricultural activities generating pollution to surface or ground waters (including marine) PA20 Livestock farming generating pollution

1.4 Legislative Context

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

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

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, hereafter referred to as the Habitats Directive.
- European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011), as amended, hereafter referred to as the Birds and Habitats Regulations.
- Regulation (EU) 2024/1991 of the European Parliament and of the Council of June 2024 on nature restoration and amending Regulation (EU) 2022/869.
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, hereafter referred to as the Birds Directive.
- Wildlife Acts 1976 to 2017, hereafter referred to as the Wildlife Acts; and
- Flora (Protection) Order, 2015 (S.I. No. 356 of 2015).

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

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

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

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

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

1.5 Outline of this FRP document

- Section 2 of this FRP report outlines details of Monroe Fen and the pressures and threats reported 7230 Alkaline fens and 6430 Hydrophilous tall-herb swamp.
- 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. This is to ensure no confidential or highly sensitive locations are revealed which might result in negative impacts. GIS Shapefiles which accompany this report include all relevant data on referenced species.

2 Site Overview

2.1 Monroe fen

Monroe fen is located 7.2 km north-west of Mullingar in Co. Westmeath and is not designated as SAC/SPA/pNHA, however as outlined in Section 1.1, it supports Annex I quality habitat. The site is bounded by agricultural land, as shown in Figure 2-1. Historical maps indicate that the area is associated with wet vegetation and shows a drain from northeast to southwest. There are also two springs and two wells located along the eastern border of the site.

The site sits in a depression at an elevation of 100 mOD and is surrounded by areas of higher elevation, up to 169 mOD, with the exception of the surface water discharge point to the west, where the elevation is at 100 mOD. The terrain within the site boundary is relatively flat ranging from 94 mOD to 96 mOD.

Monroe Fen has been selected for the presence of Annex I quality fen habitats. The site is located within the 26F Upper Shannon_Catchment and the River Inny_080 is observed to the west of the site and is flowing towards Lough Iron, located north of the site. For the purposes of the Water Framework Directive most of the site is located within the Inny [Shannon] SC_040 sub-catchment.

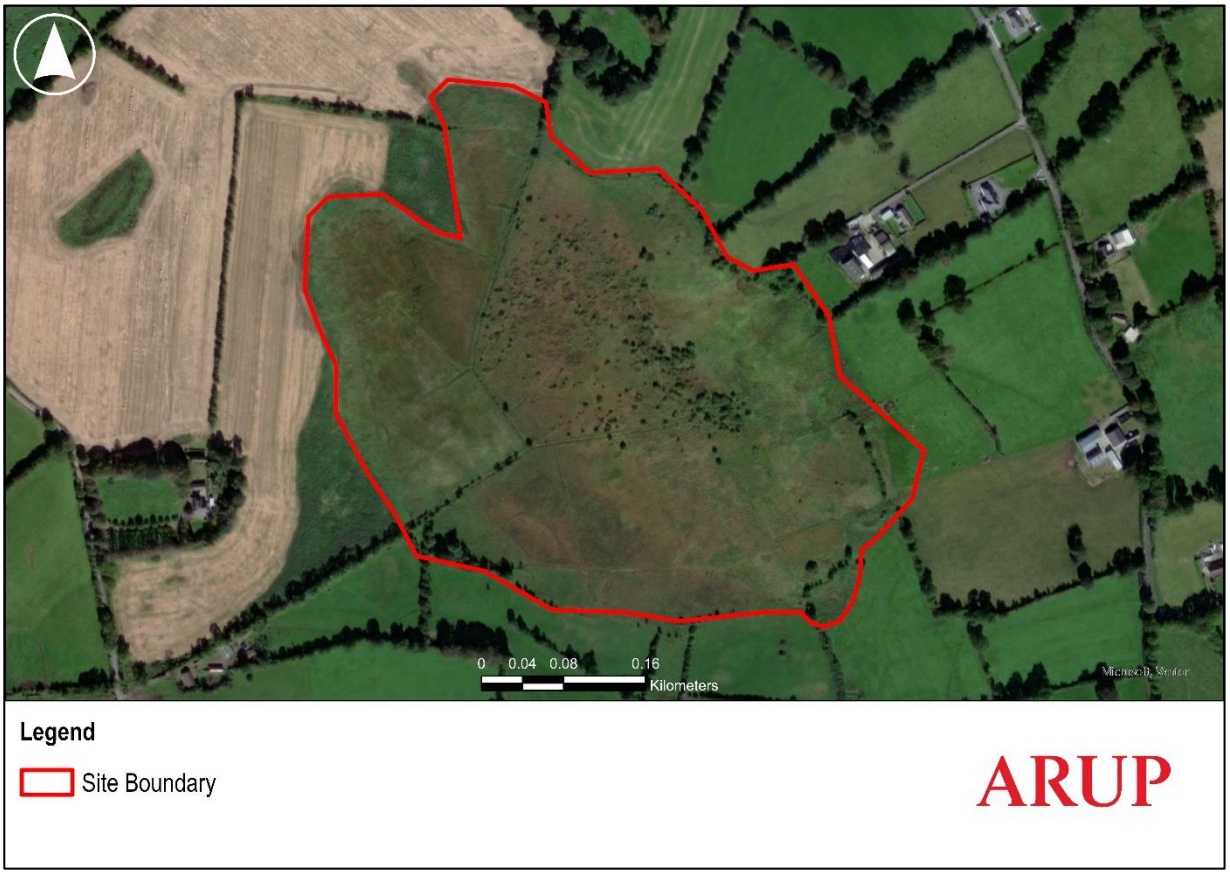


Figure 2-1: Site Location Map

2.2 Fen Condition Assessment

Monroe Fen was surveyed as part of the National Fen Survey (NFS) on 8th August 2022 (Brophy et al., In prep). During the NFS the following pressures were recorded:

- Under grazed and unmanaged areas of fen.
- Nutrient enrichment from agricultural runoff.
- Drainage – two deep drains divide the site into three sections.

The Structure & functions of the following Annex I quality habitat was recorded:

- 7230 Alkaline fens: Unfavourable-Bad.

2.3 Site-Specific Conservation Objectives

As Monroe Fen is not an SAC, it does not have Site-Specific Conservation Objectives (SSCO). Attributes and targets for Annex I habitats vary and are specific to each site, therefore whilst they cannot be directly applied to Monroe Fen, general conservation objectives can be applied as a basis to inform favourable conservation status of the fen habitats. This includes measures such as maintaining appropriate hydrological levels and quality or abundance of vegetation communities and appropriate physical structure relevant to Annex I habitats.

3 Land and water

3.1 Desktop Study

3.1.1 Meteorological Conditions

Understanding meteorological patterns is essential for restoration planning. To evaluate seasonal rainfall variability at the site and surrounding areas, historical precipitation data from the nearest weather station at Mullingar (Met Éireann) covering the past 30 years have been compiled.

Two datasets were visualised: (1) average yearly precipitation (mm), revealing long-term rainfall trends over a 30-year span (Figure 3-1) and (2) average monthly precipitation, illustrating seasonal distribution patterns across the same period (Figure 3-2). This data is essential for assessing the feasibility and sustainability of restoration efforts focused on maintaining suitable hydrological conditions.

Yearly maximum rainfall fluctuates significantly more than average or minimum values (Figure 3-1). In particular, maximum precipitation surged to nearly 280 mm around 2015. Both average and minimum rainfall vary slightly but remain relatively consistent throughout the 30 years.

Average monthly rainfall peaks during winter (October to January) and is lowest in late spring (April and May) (Figure 3-2). Minimum values follow a similar trend, while maximum monthly rainfall distinctly rises in winter.

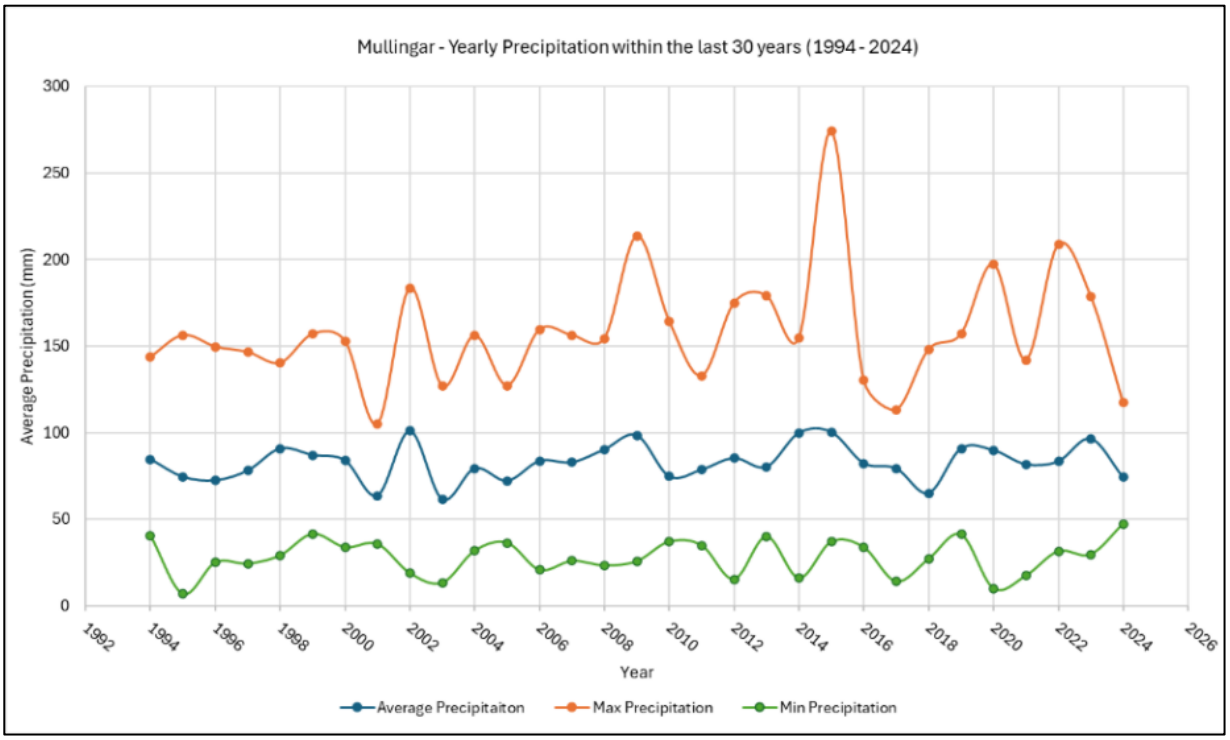


Figure 3-1 Mullingar weather station - average, maximum, and minimum yearly precipitation from 1994-2024.

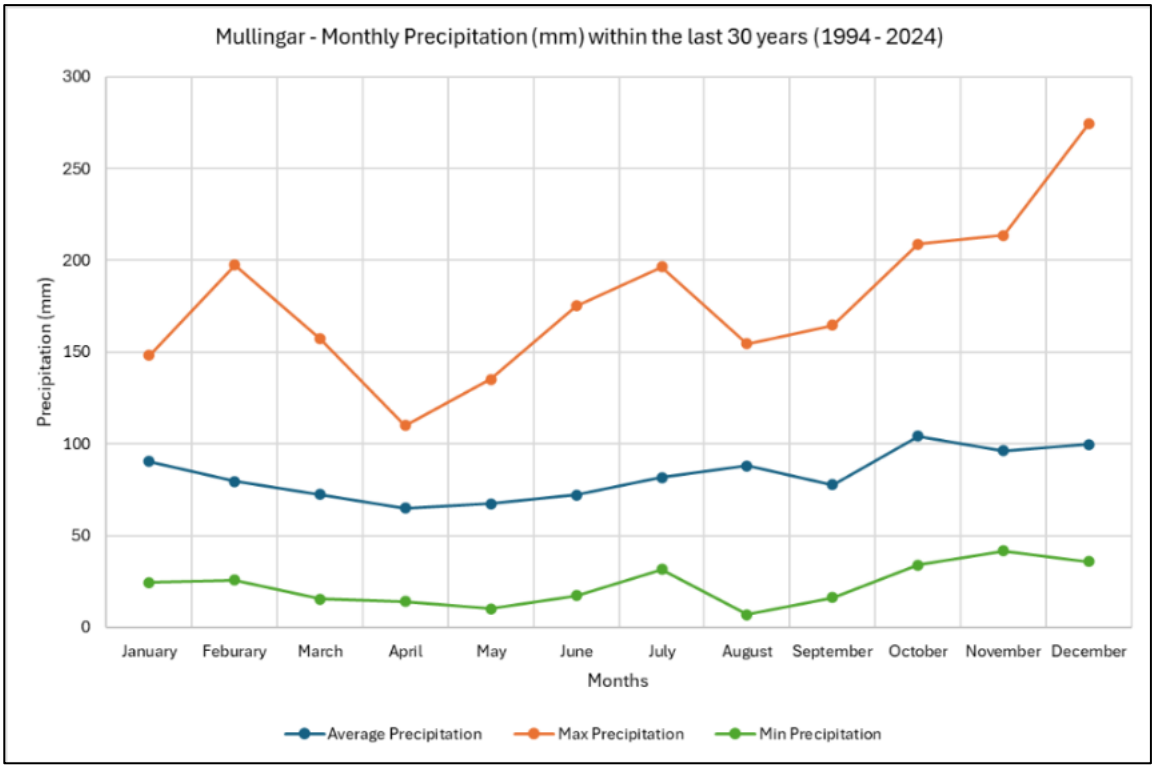


Figure 3-2: Mullingar weather station - average, maximum, and minimum monthly precipitation between 1994 and 2024

3.1.2 Hydrogeological Setting

The area is underlain by the Lucan formation, characterised mainly by dark grey coloured limestones interbedded with shaly limestones and shales. The bedrock geology of Monroe site is presented in Figure 3-3.

The site is underlain by a Locally Important Bedrock Aquifer which is moderately productive only in local zones (LI). There is a Locally Important Karstified Aquifer located to the northeast of the site. The aquifer classification underlying the site is presented in Figure 3-4.

Quaternary sediments comprise Fen Peat (FenPt), with cut over raised peat present within the land surrounding the site. Surrounding the site comprises till derived from limestone and bedrock outcrop. Eskers and lacustrine sediments are also present in the region. The subsoil map is shown in Figure 3-5.

Groundwater vulnerability within the site is high. At northeast of the site there is an area where the vulnerability is extreme due to the presence of rock at or near the surface. This is illustrated in Figure 3-6.

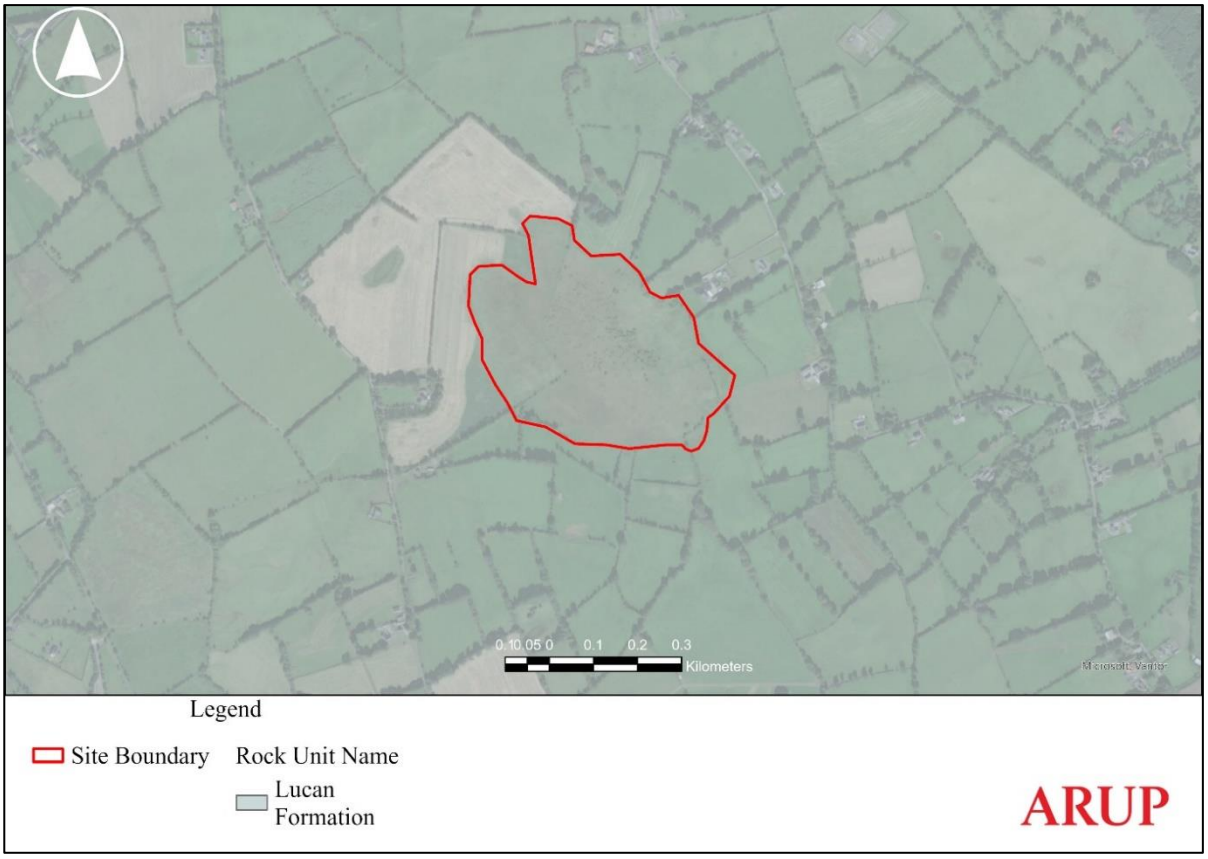


Figure 3-3: Bedrock Geology of Monroe Fen



Figure 3-4: Aquifer classification and karst underlying Monroe Fen



Figure 3-5: Sub-soil type underlying Monroe Fen (Source: GSI Quaternary map)

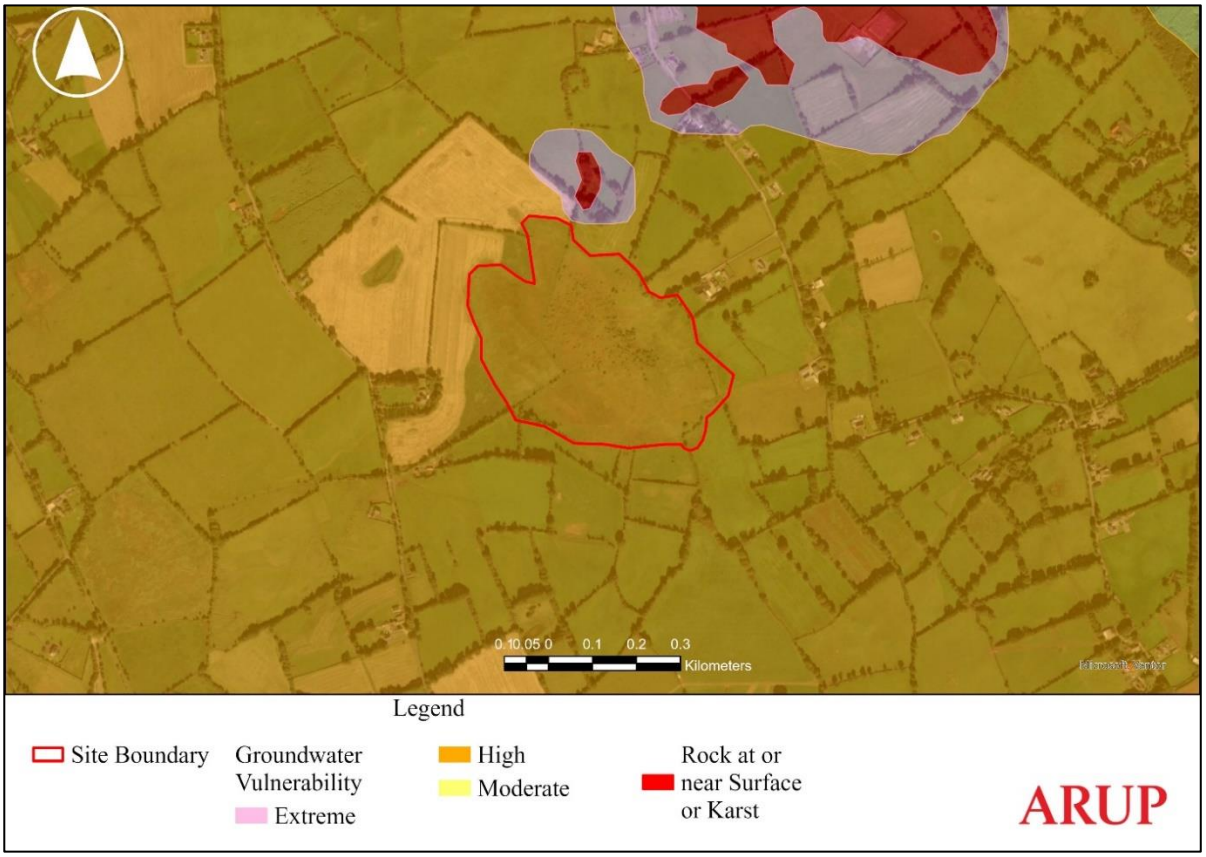


Figure 3-6: Groundwater vulnerability map for Monroe Fen (Source: GSI)

3.1.3 Topographic and Surface Water Drainage

The site is located within the 26F Upper Shannon WFD Catchment and the Inny [Shannon]_SC_040 WFD sub catchment (Figure 3-7). The River Inny discharges from the western part of the Monroe fen to Lough Iron located north of the site. The Inny_080 waterbody is 'Good' WFD Status and 'not at risk' of not achieving its WFD objective.

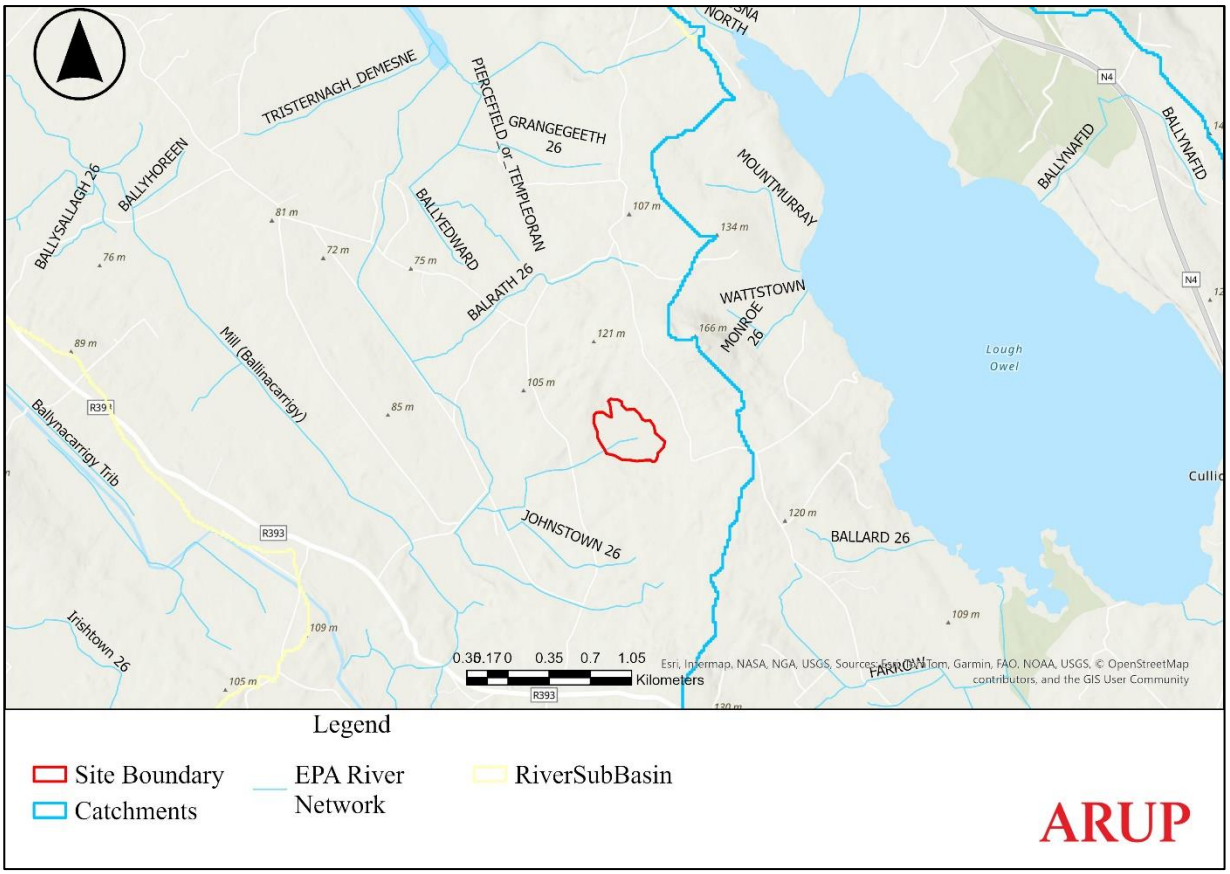


Figure 3-7: WFD Catchment and River sub-basin (EPA, 2025)

The topography of the site is mainly flat and is at approximately 100 mOD, surrounded by areas of higher elevation, up to 169 mOD, except for the surface water discharge point to the southwest. Several drains are identified throughout the site. Wetland vegetation covers the site with two springs and two wells present along the eastern boundary of the site. This is shown on the historic maps presented in Figure 3-8.

The mapped Wetness Index classifies the majority of the site as being temporary wet. There is no wetness class identified to the east, close to the site boundary. The Wetness Index map is shown in Figure 3-9.

Total Productivity mapping of Monroe fen illustrates that majority of the site is highly productive which indicates degraded or drained peatlands. This could be the result of colonization by grasses herbs and trees, drainage or agricultural land use. The Total Productivity map is shown in Figure 3-10.

Digital Terrain Model (DTM) map and the site photogrammetry were both generated from LiDAR images of Monroe Fem and are presented in Figure 3-11 and Figure 3-12 . These images show that the most notable water features are the water inflow entering the site in the northeast and flowing to the southwest, representing the water outflow of the site and ultimately discharging to River Inny.

The drainage network mapped by previous surveys is presented in Figure 3-12.

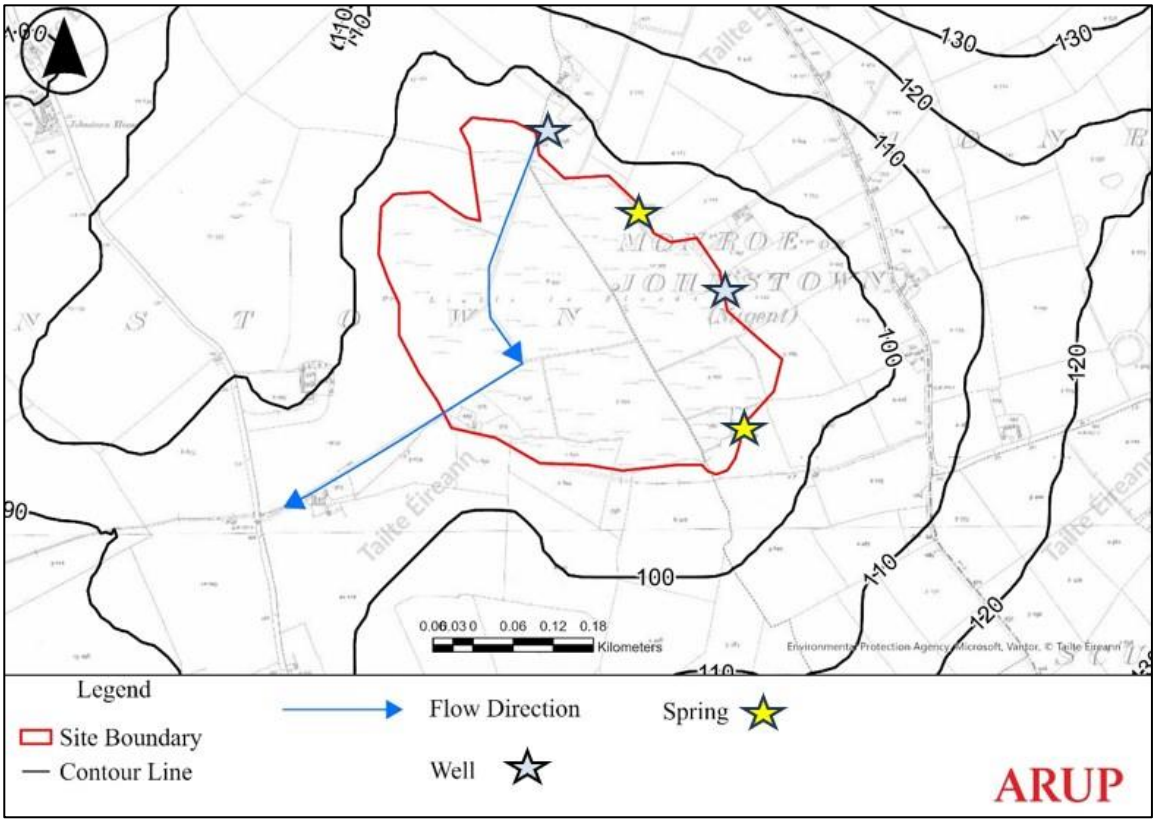


Figure 3-8: Historical water distribution and retention within Monroe fen (Tailte Éireann Historical mapping)



Figure 3-9: HRL Water and Wetness - 2018 of Monroe fen (Copernicus, 2025)

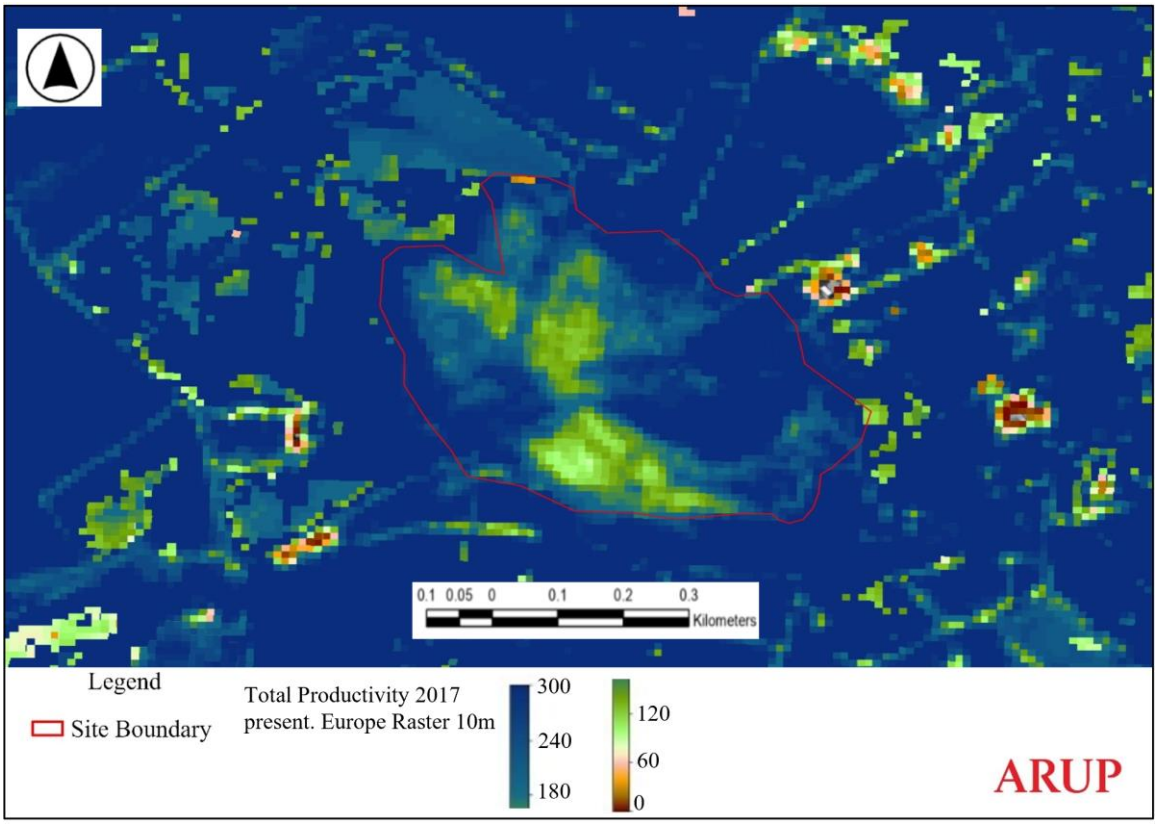


Figure 3-10: Total Productivity 2017 - present, Europe - raster 10m (season 1) of Monroe fen (Copernicus, 2025)

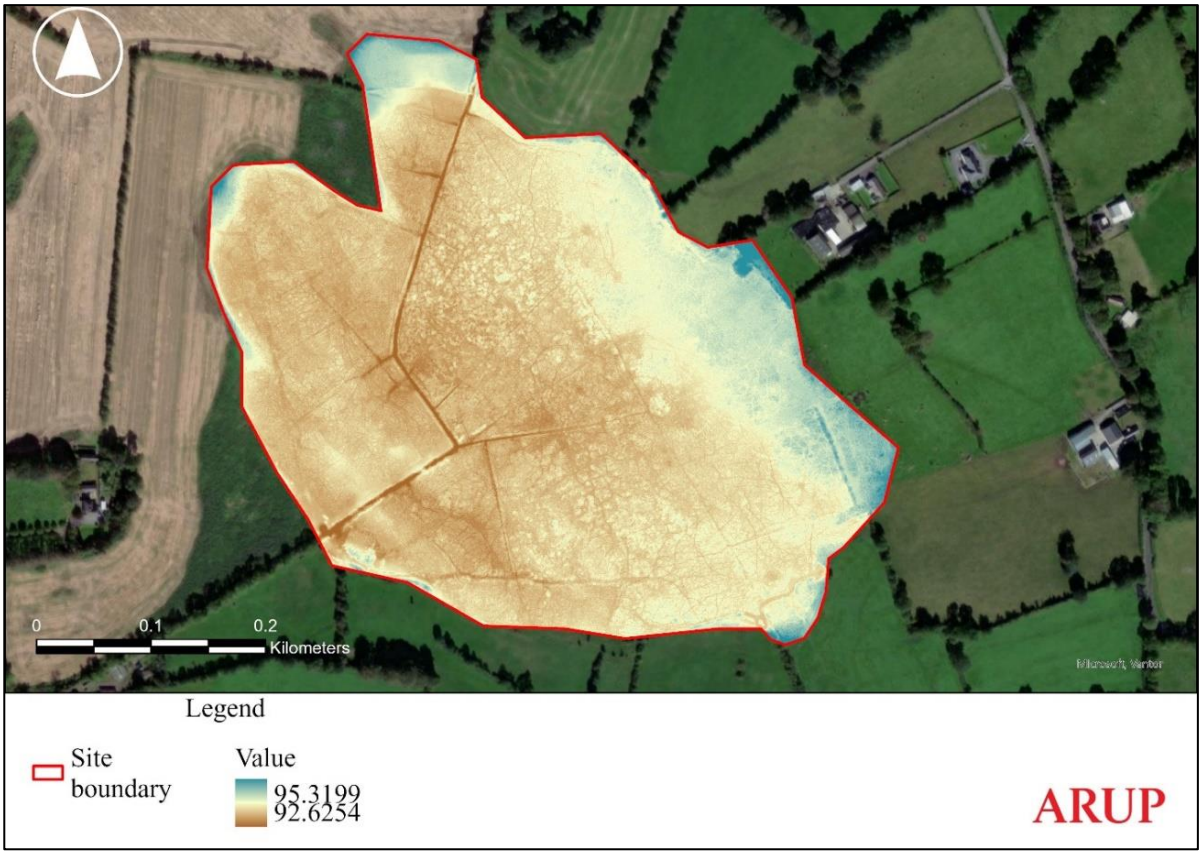


Figure 3-11: Topographic (LiDAR) map of Monroe fen



Figure 3-12 Site Photogrammetry map of Island Fen SAC

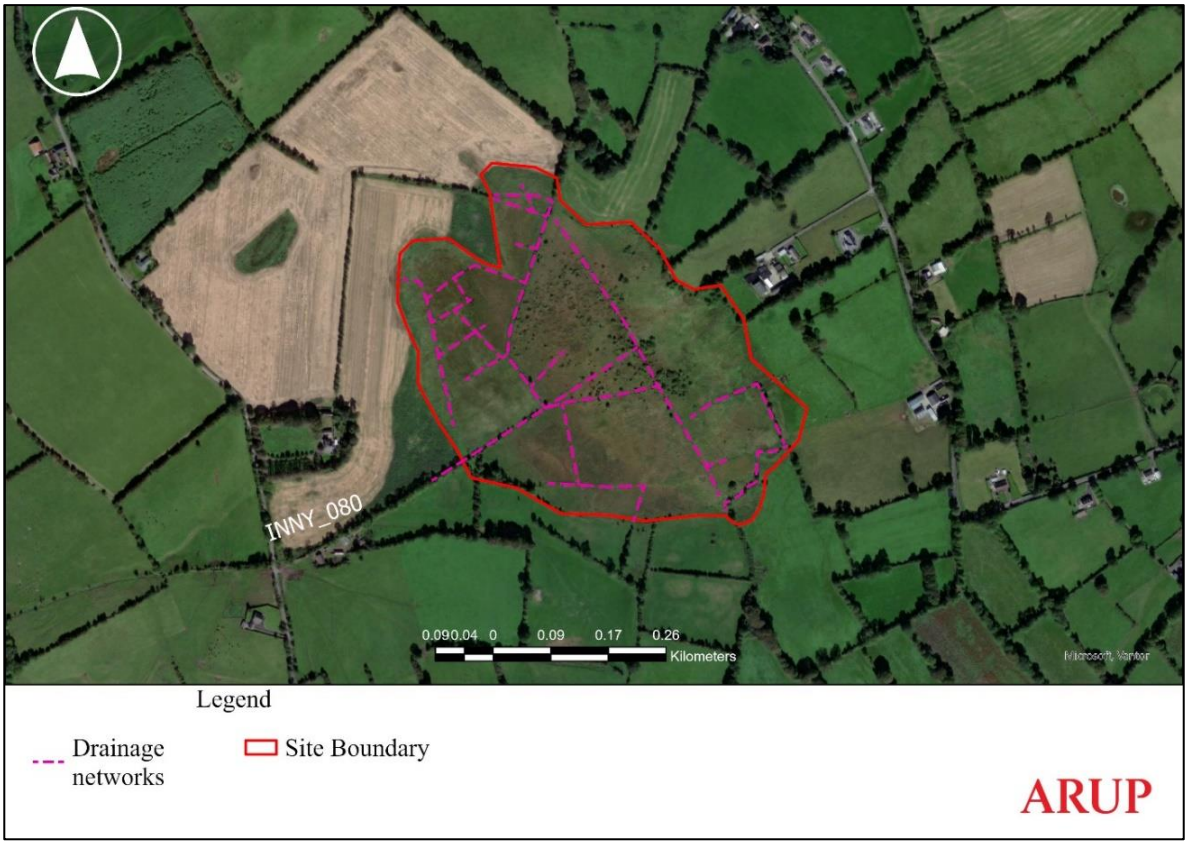


Figure 3-13: Mapped drainage network of Monroe fen

3.1.4 Land use Pressures and Water Quality

Pollution Impact Potential (PIP) maps (EPA,2025) show where nutrient losses are most likely to impact waterbodies. The PIP maps estimate the annual nutrient losses from the agricultural land using spatial data from farm management, soils and hydrogeology. PIP maps for Nitrogen and Phosphorus are presented in Figure 3-14, igure 3-15 and Figure 3-16.

High risk areas for phosphorous loss typically have poorly draining soils and dominant overland flow pathways. The maps indicate that phosphorus delivery flow paths and range from medium to high risk throughout the site. The highest risk area of phosphorus runoff is to the eastern side of the site where, according to the historical maps, the springs and wells are located. According to the NFS (Brophy et al., In prep), the eastern area features floating and quaking vegetation characteristic of transition mire, however, wet grassland species dominate due to nutrient enrichment from agricultural run-off.

The high-risk areas for nitrate (Rank 1, 2 or 3) are typically due to the presence of freely draining soils and groundwater pathways. There is a high risk for nitrate to the northwest area adjacent to the site, where agricultural land is identified.



Figure 3-14: Pollution Impact Potential - Sub surface Nitrate (PIP-N) at Monroe fen (EPA,2025)

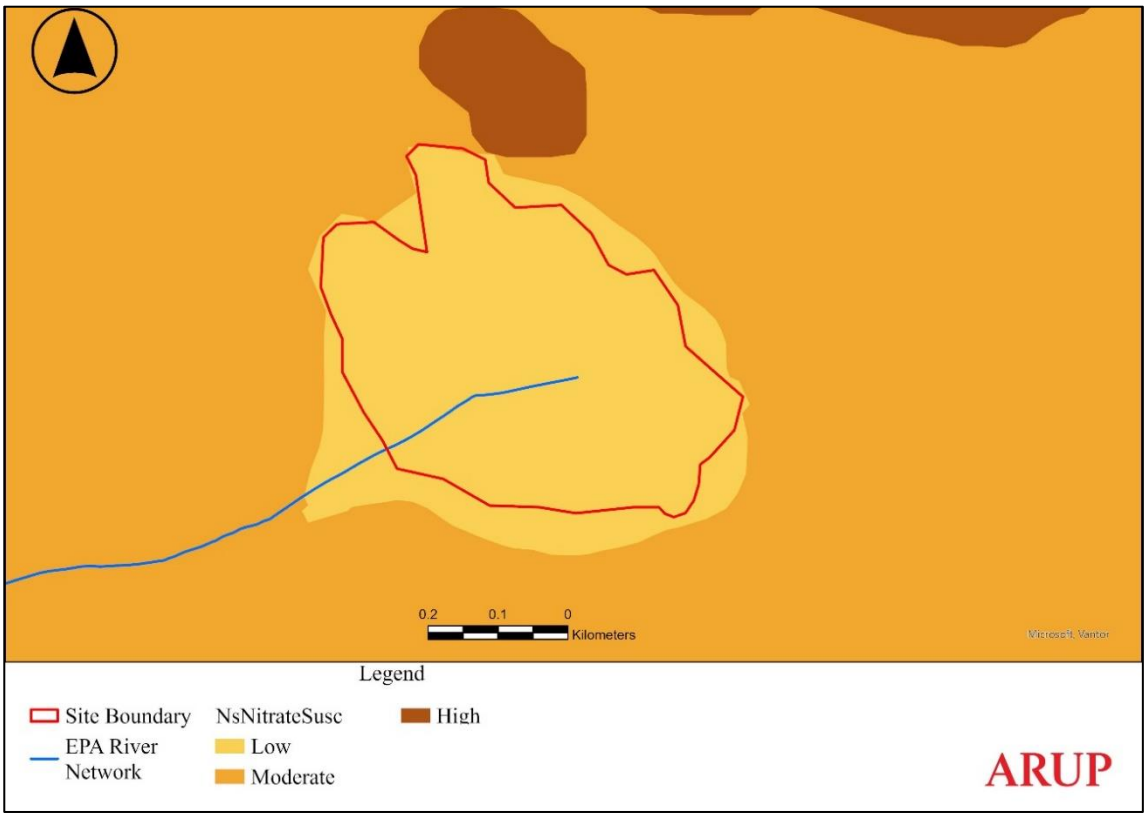


Figure 3-15: Pollution Impact Potential – Near surface Nitrate (PIP- N) at Monroe fen (EPA, 2025)

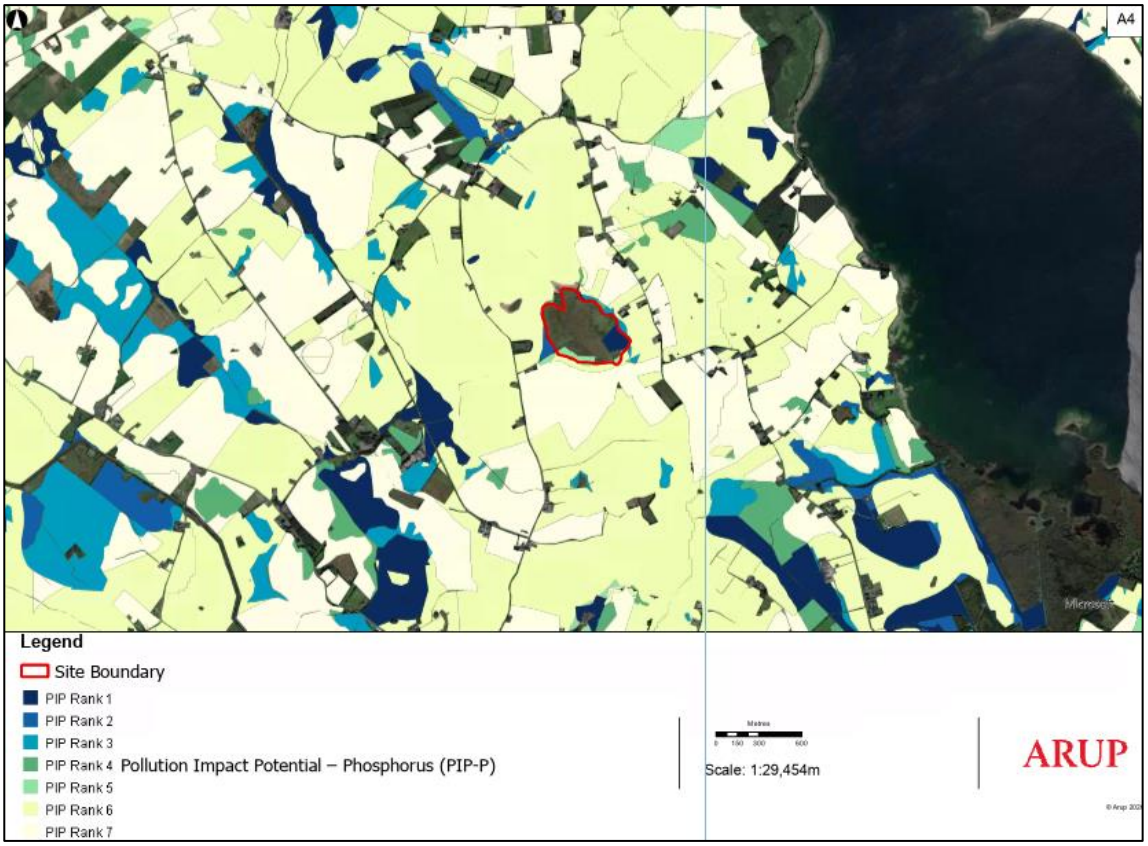


Figure 3-16: Potential Impact Potential – Phosphorous (EPA, 2021)

3.2 Field Survey

Electrical Conductivity (EC), pH and peat depth data were recorded as part of the NFS undertaken on the 8th of August 2022 (Brophy et al., In Prep). The water sampling location was not specified, but the recorded EC and pH at the site were 710 µS/cm and 7.5, respectively. Peat depth locations were also not provided, but it ranged from 2.03 m to 3.10 m.

Site monitoring was undertaken in March 2026, focusing on developing the understanding of the water regime, pressures and implementation of restoration measures within the habitat. The site monitoring included peat depth probing, water quality and water level measurements. The monitoring location are presented in Figure 3-17.

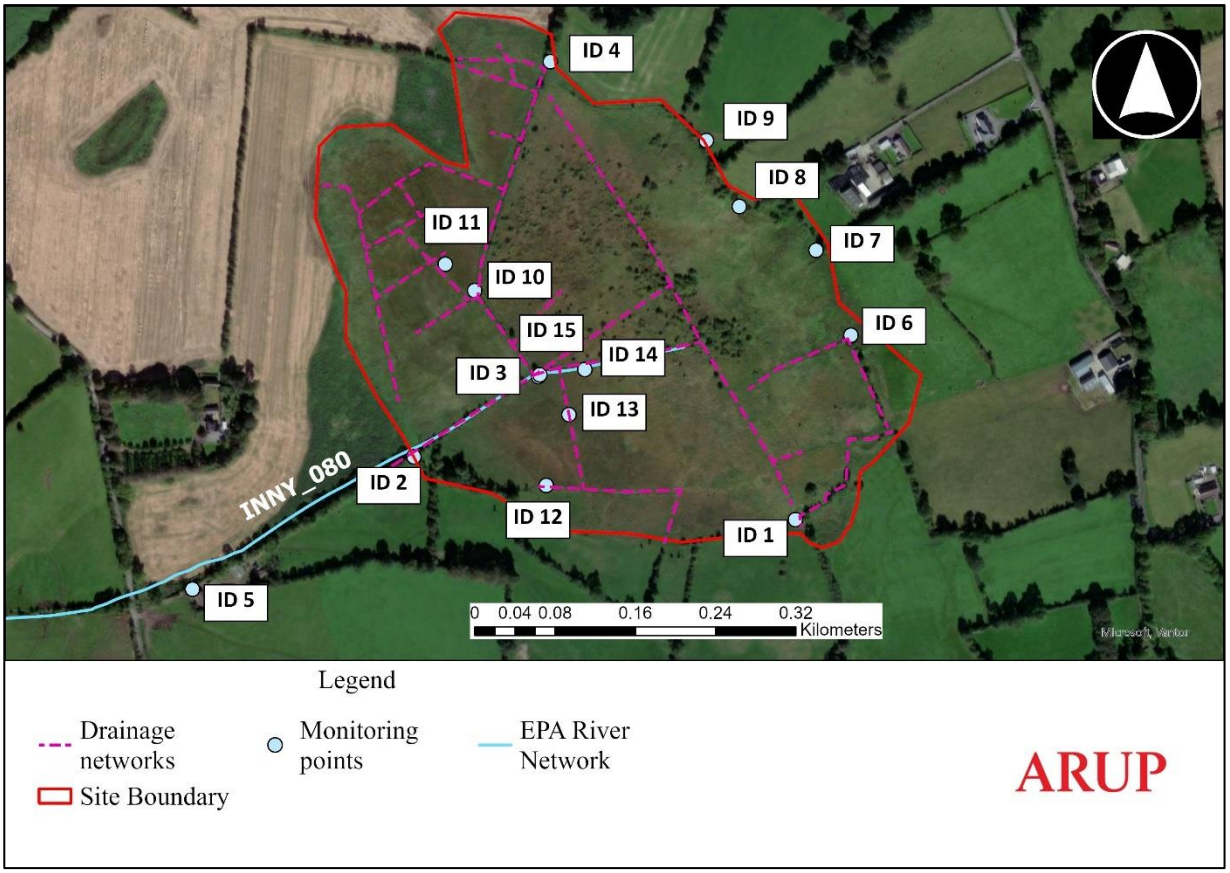


Figure 3-17: Baseline monitoring locations at Monroe fen

3.2.1 Peat Depth

Peat depth probing was conducted throughout the site to assess substrate characteristics (**Figure 3-18**). It showed a variability in peat accumulation, that ranges from 1.0 m to 3.1 m in the northern area, which is deeper than the peat surrounding the main drain, where it ranges from 0.5 m to 1.5 m. Peat deposition increases toward the centre of the site and become progressively shallower toward the edge, in the eastern section. This pattern reflects the site's position within a valley basin, where the surrounding land lies at a higher elevation.

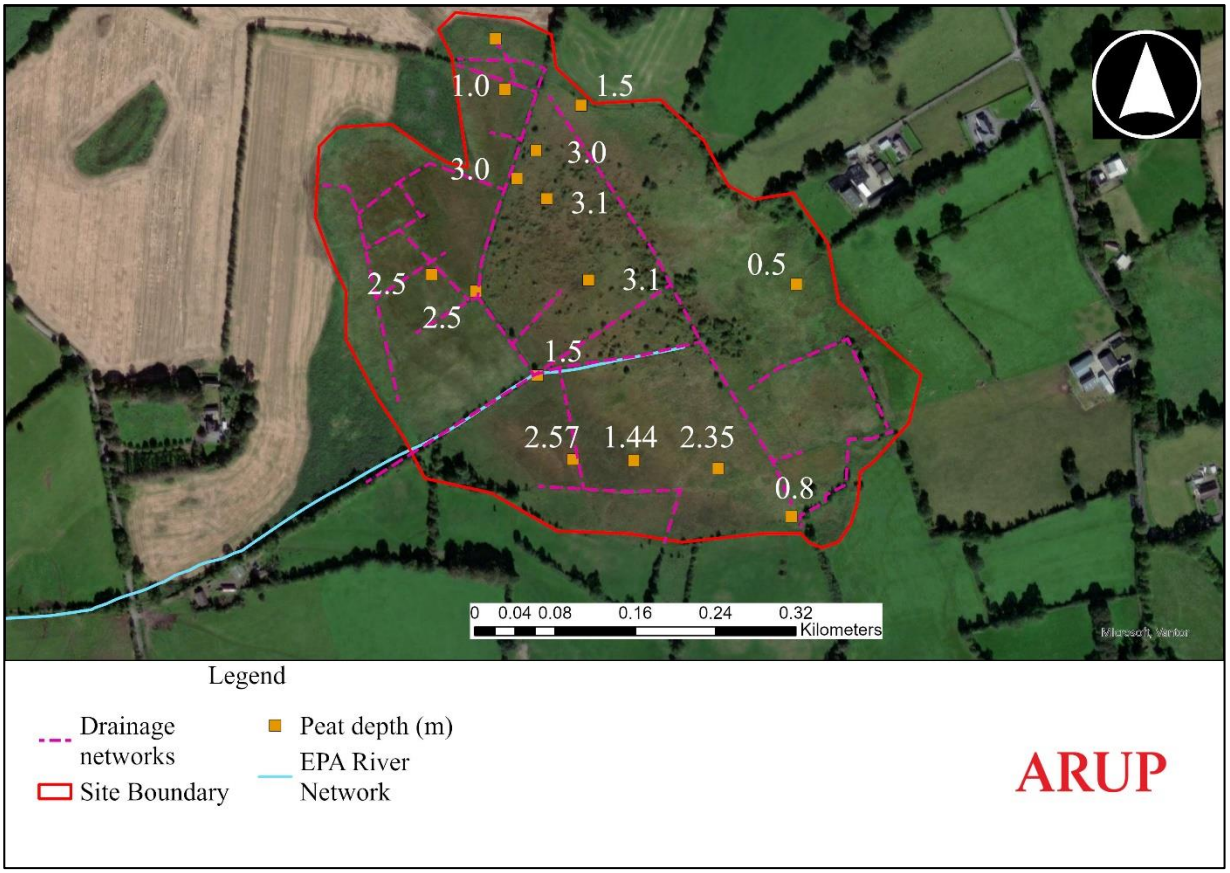


Figure 3-18: Peat depth (m) locations at Monroe Fen

3.2.2 Groundwater Levels and Springs

According to the historical maps two wells and two springs were identified along the eastern boundary of the site. During the site visits in March 2026, these locations were visited, but no installations (wells or springs) were encountered. However, these locations were heavily vegetated and displayed unstable, waterbed-like ground conditions when traversed. No standing water was visible due to the dense vegetation cover, although, aquatic plants were observed. Historical wells and spring locations are presented in Figure 3-8.

3.2.3 Surface Water levels

Surface water conditions showed different conditions across the site. The outflow drain located in the western section, which discharges to the River Inny, was observed flowing to the southwest, conveying water out of the fen. The drain is approximately 2 m wide, and the water level measurements ranges from 0.15 to 0.2 m. Cattle regularly cross this drain to move between adjacent fields.

A drainage channel at the north (ID 4) converges with this outflow drain near the central area of the site. This drain is approximately 2 m wide and 1m in depth. The width of the drain narrows to 0.75 m towards the north. The drain running from the north to the south exhibited minimal flow in its southern section, where water is moving southwards. No water flow was observed in the northern section of the drain. Drains in the southwestern section displayed no

flow and were infilled with vegetation. Water level monitoring locations are presented in Figure 3-19.

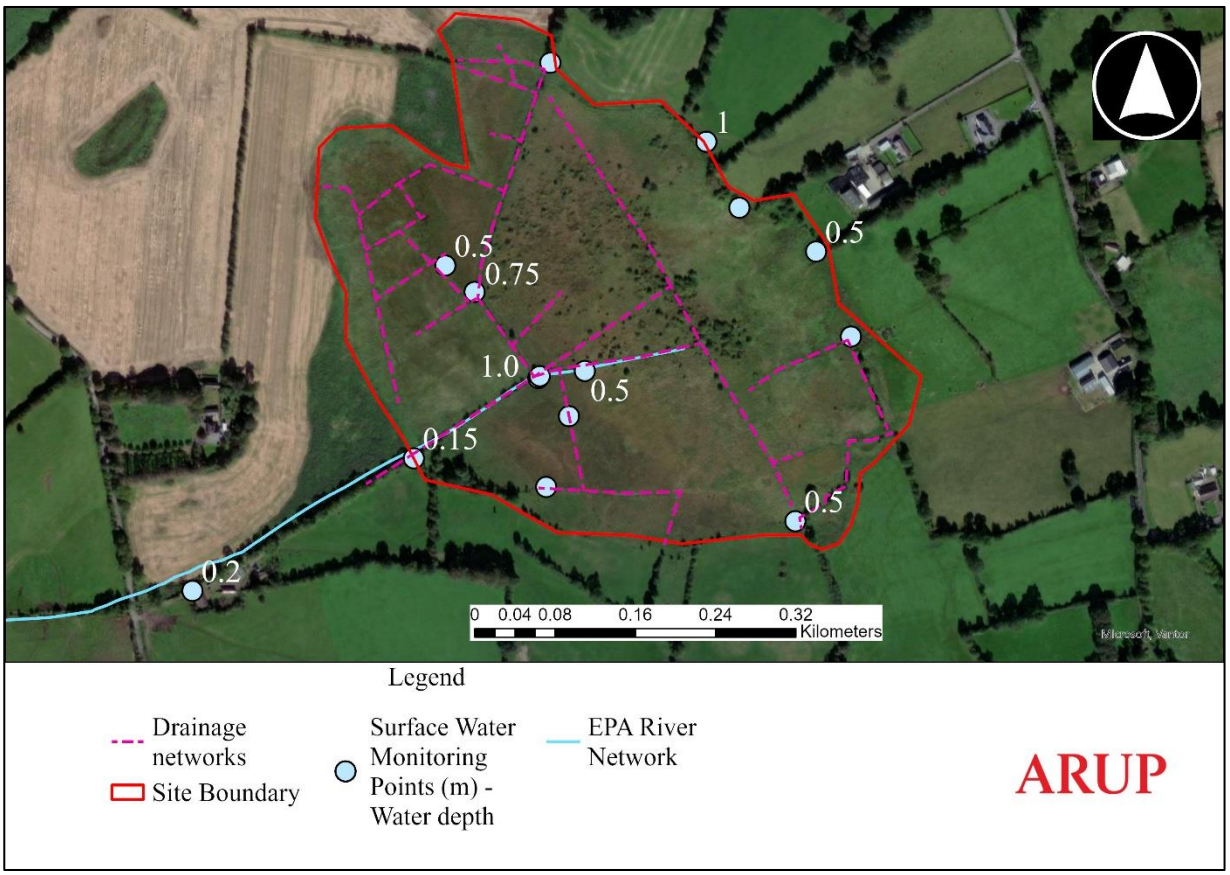


Figure 3-19: Water level (m) monitoring within Monroe Fen

3.2.4 Water Quality

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

Phosphate (PO_4^{3-}) concentrations are variable across the site, with some measurements exceeding the WFD good status environmental quality standard of 0.107 mg/l PO_4^{3-} (0.035 mg/l PO_4^{3-}), while others remain below this level. Phosphate concentrations in the western area, were generally high (ID 2, 3 &5), ranging from 0.21-1.18mg/l PO_4^{3-}. No phosphate concentrations were found along the northwest to southwest drain (ID 1), were it was registered as 0.0 mg/l. Along the eastern boundary, in the surrounding area of historical wells and springs, phosphate concentrations exceeded the WFD standards and were at 1.14 mg/l and 1.74 mg/l (ID 7 & 9) (Figure 3-20).

Nitrate concentrations (NO_3^-) is also variable across the site, with some measurements exceeding the regulatory European groundwater threshold of 50mg/l $N0_3$-N (Directive 2006/118/EC). Although there is no regulatory surface water threshold for nitrate, concentrations of greater than 8 mg/l NO_3^- may impact the ecological health of rivers (EPA, 2025b). Nitrate concentrations in the western area (ID 2) showed extremely high nitrate

concentrations of 105.5 mg/l, with other measurements in the area (ID 3) showing concentrations of 0.0 and 3.9 mg/l. Extremely high concentrations, of 121.4 mg/l, were measured in the northwestern area (ID 11). The northern area of the site, (ID 4), showed a concentration of 27.3 mg/l. The southern part of the site (ID 1) showed a concentration of 1.8 mg/l. Along the eastern boundary, in the surrounding area of historical wells and springs, nitrate concentrations didn't exceed the threshold and were registered at 5.40 mg/l and 8.20 mg/l (ID 7 & 9) (Figure 3-21).

These water quality results are directly relevant to conservation measures for Monroe Fen, particularly those concerning the maintenance of appropriate nutrient conditions. As fens are naturally nutrient-poor systems with respect to nitrogen and phosphorus, the recorded concentrations suggest potential nutrient enrichment, specifically in the eastern area, that may influence the achievement of the conservation targets. Additionally, several phosphate and nitrate measurements exceeded the thresholds typically associated with Water Framework Directive (WFD) good or high ecological status.

EC and pH were measured during field site visits. pH values ranged from 6.77 in the eastern part of the site (ID 7) to 7.65 in the southern part of the site (ID3) (Figure 3-22). EC values ranged from 523 µS/cm in the northwestern part of the site (ID 10) to 797 µS/cm in the northern part of the site (ID 4) (Figure 3-23).

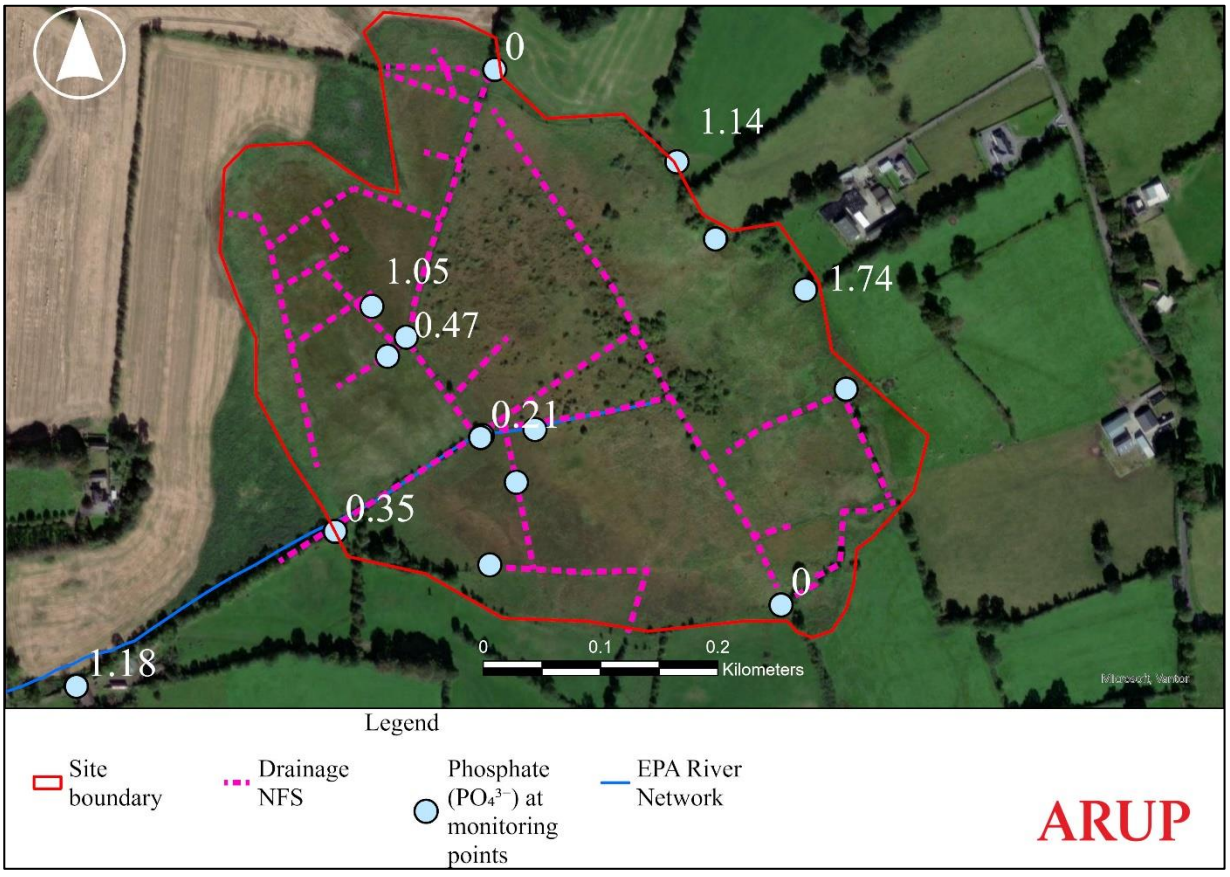


Figure 3-20: Phosphate (PO_4^{3-}) at monitoring points in locations in Monroe Fen.



Figure 3-21: Nitrate (mg/l NO_3^-) at monitoring points in Monroe Fen

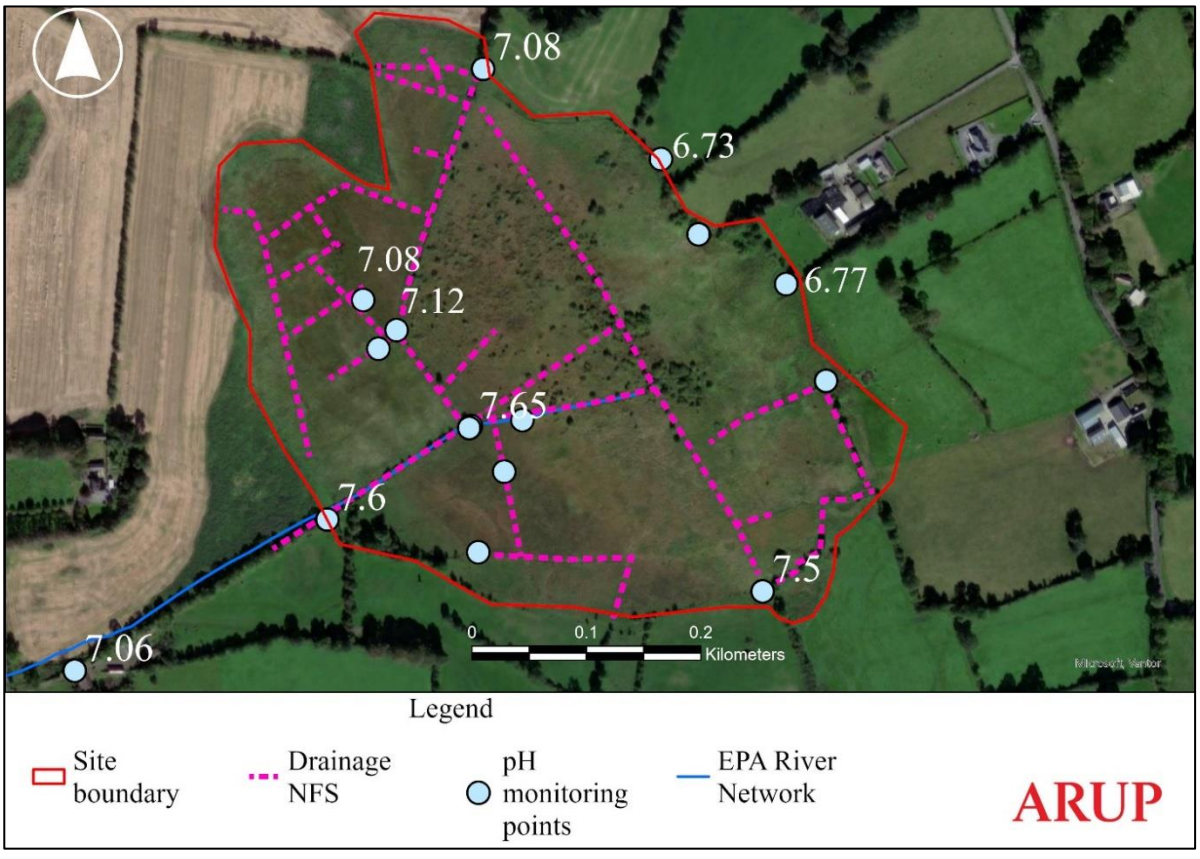


Figure 3-22: pH at monitoring points in Monroe Fen



Figure 3-23: Electrical Conductivity (EC) (µS/cm) at monitoring points in Monroe Fen

3.3 Conceptual Site Model

Monroe Fen corresponds to a Groundwater-Fed Bottom under the WETMEC classification (Wheeler, Shaw & Tanner, 2009): a fen developed in a valley basin and sustained primarily by groundwater discharge from the surrounding higher ground, with through-flow to a surface outfall. In its current modified state, the site presents as WETMEC 9b (Part-Drained Groundwater Bottom); the restoration target is the wetter regime characteristic of WETMEC 9a (Wet Groundwater Bottom).

The classification is supported by the following information:

- The topographic setting is a flat valley basin at approximately 100 mOD set within ground rising to 169 mOD, with peat thickness greatest centrally (3.1 m) and thinning towards the margins.
- The underlying geology is characterised by the Lucan Formation, which is formed mainly by grey coloured limestones interbedded with shaly limestone and shales. Within the site boundary, quaternary sediments comprised Fen Peat (FenPt) are registered. Surrounding the area, Till derived from limestone are observed. Eskers and Lacustrine sediments are also registered within the region.
- The site is underlain by a Locally Important Bedrock Aquifer (Ll), which is moderately productive only in local zones.

- The water flow direction is towards the west, discharging to Lough Iron. Historical mapping shows the main drain flowing towards the west from the centre of the site. Additional drains are located throughout the site, particularly in the northwestern and northeastern parts of the site. All drains in the northern area are flowing towards the main drain, which therefore flows to the west, connecting to the River Inny.
- The base-rich hydrochemistry (pH 6.8 to 7.7; EC 520 to 800 µS/cm) confirms substantial groundwater contribution to the water balance and rules out an ombrogenous classification. High nitrates levels were registered on the northwestern area and might be related to adjacent agricultural activities. Values were also high in the main drain outflow that discharges to River Inny.
- The Annex I 7230 Alkaline fen vegetation, dominated by *Schoenus nigricans* and *Juncus subnodulosus*, is the expected ecological expression of a functioning WETMEC 9.
- The historically mapped springs and wells along the eastern boundary represent localised groundwater discharge points with the functional characteristics of WETMEC 16 (Groundwater-Flushed Bottom) embedded within the broader basin system.

Monroe fen
County Westmeath
WFD catchment: 26F Upper Shannon
WETMEC 9b

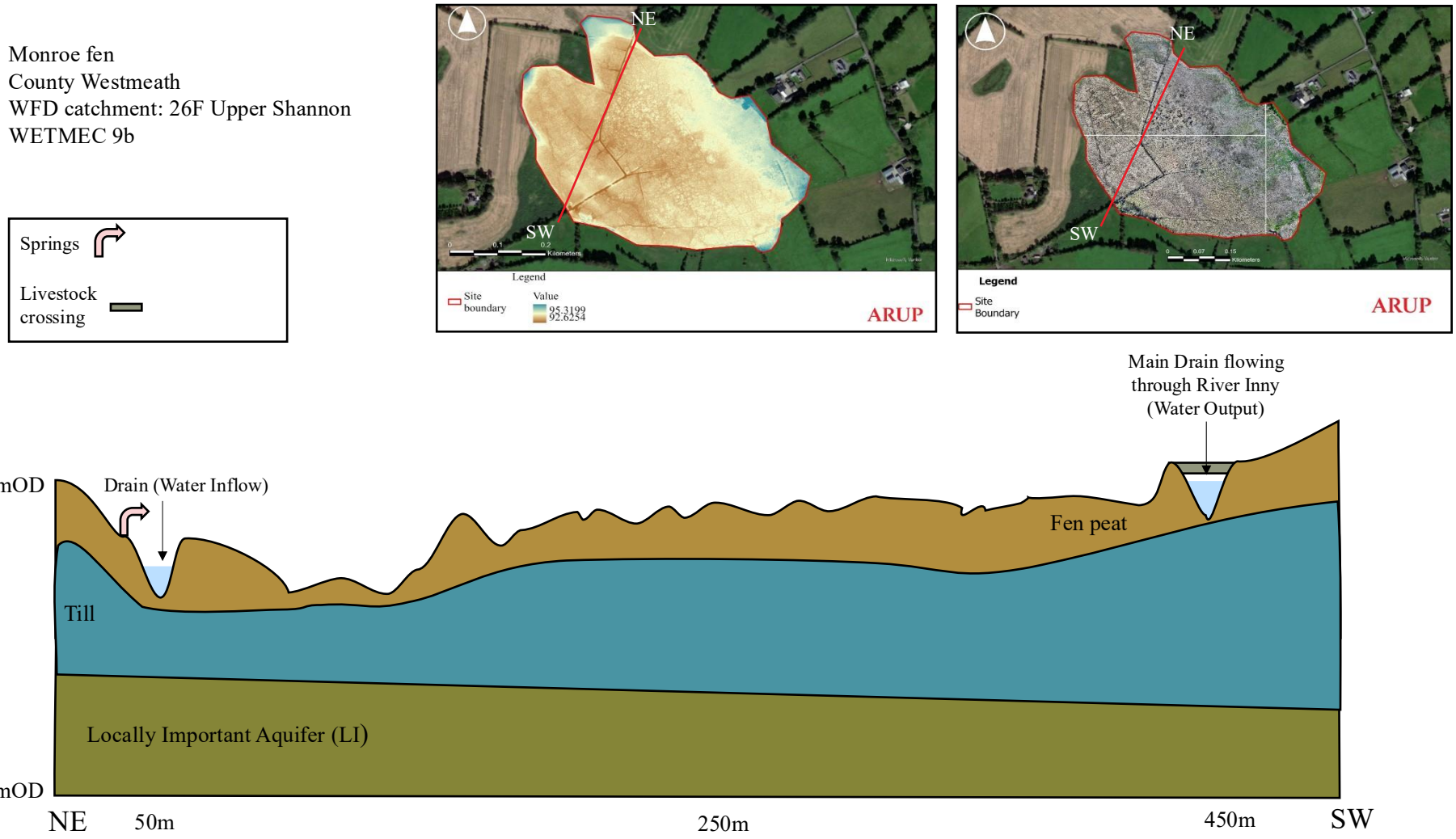


Figure 3-24: Conceptual Site Model of Monroe Fen

4 Ecology

4.1 Desk Study

A review of available desktop information on the ecological baseline for Monroe Fen was reviewed from the below information sources:

- National Fen Survey 2021-25: Final Report. Irish Wildlife Manuals, National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland (Brophy et al, In prep).
- The Wetlands of County Westmeath (Smith 2026);
- Biodiversity Maps - National Biodiversity Data Centre (NBDC); and
- Plant Atlas 2020 website - Botanical Society of Britain & Ireland (BSBI).

The NFS was commissioned to develop and test a standardised methodology for assessing the conservation status of fen habitats across Ireland. As part of this study, Monroe Fen was selected as one of the sites for field survey. The survey methodology included:

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

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

4.1.1 Habitats

The NFS at Monroe Fen revealed that the site is dominated by alkaline fen with some former transition mire in the east of the site which supports floating and quaking vegetation. However, this is dominated by species of wet grassland.

The site is divided into three sections by deep drains.

4.1.1.1 Annex I Habitats

The following Annex I quality habitat was identified and mapped:

- 7230 Alkaline fens - covering approximately 7.22 ha of the site. The 7230 Alkaline fens is found through the central plane of the site. Two types of 7230 Alkaline fens were recorded on site: one with dominant black bog-rush *Schoenus nigricans* and the other having blunt flowered rush *Juncus subnoulosus* as the most dominant.

- 6430 Hydrophilous tall-herb swamp – recorded in the southeast of the site.

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

4.1.1.2 Non-Annex/Fossitt habitats

Non-Annex I fen and other habitats were also recorded, with mapping based on Fossitt[3] (2000) classification (Table 4-4–1).

Table 4-4–1: Fossitt habitats recorded within Monroe Fen

Habitat Type	Location	Notes
PF1 - Rich Fen and Flush	Within the central plane of the site	Predominant habitat within the site, located centrally
PF3 - Transition mire and quaking bog	Located in the East of the fen	Located in the eastern border of the site
FS2 – Tall-herb swamps	Within the northwest, northeast and south	There are three distinct areas of tall-herb swamps across the fen, found on the outer edge of the site
WN6 - Wet willow-alder-ash woodland	Located east of the central plane of the site	A small patch surrounded by PF1 and PF3
GA1 - Improved agricultural grassland	Located in the southeast of the site	A small patch of improved grassland surrounded by FS2 located on the southeast border of the site
GS4 – Wet grassland	Located to the west and southwest of the site	From the target notes this area is a species-rich purple moor-grass *Molinia caerulea* grassland which is described as rank with frequent devil's bit scabious *Succica pratensis*, meadowsweet *Filipendula ulmaria* and fragrant orchid *Gymnadenia* sp. present. This grassland is surrounded by FS2 with abundant meadowsweet.

4.1.2 Species

The following subsections outline the presence of species recorded at or within the zone of influence of Monroe Fen. 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. Records are limited to those from the past ten years, reflecting the most plausible timeframe for continued presence and ecological relevance to the site - excepting where

invasive species have been historically recorded and there has been no indication since of their elimination.

4.1.2.1 Species Within the Site

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

Table 4-4–2: Species records within Monroe Fen

Common Name	Latin Name	Description	Most recent record
Black Bog-rush	*Schoenus nigricans*	Grows on calcareous and base-rich fens, in marshes, bogs and lake margins.	2026
Fibrous Tussock-sedge	*Carex appropinquata*	Limited distribution, confined to a small number of base-rich fen and mire sites	2020
Hen harrier	*Circus cyaneus*	Protected under Wildlife Acts and Annex I under the EU Birds Directive. Considered Amber under Bird of Conservation Concern	2022
Common frog	*Rana temporaria*	Protected under Wildlife Acts and Annex V; breeds in wetland habitats including transition mires.	2020

4.1.2.2 Species within the Zone of Influence

Table 4 outlines the functionally linked species recorded within the 2 km distribution zone of influence around Monroe Fen. Records from the last ten years from NBDC were reviewed, however no records returned. Subsequently records detailed in Table 4 are the latest records from 2015.

Table 4-4–3: Species records within the Zone of Influence of Monroe Fen

Legislative Protection	Common Name	Latin Name
No legal protection	No widely used common name – last record 2015	*Agrypnia obsoleta*

No legal protection	No widely used common name – last record 2015	*Agrypnia varia*
No legal protection	No widely used common name – last record 2015	*Limnephilus vittatus*
No legal protection	Longhorn caddisfly– last record 2015	*Mystacides azurea*
No legal protection	Great caddisfly – last record 2015	*Phryganea grandis*
No legal protection	No widely used common name– last record 2015	*Polycentropus flavomaculatus*
No legal protection	No widely used common name – last record 2015	*Tinodes waeneri*

4.2 Field Survey

Following a comprehensive review of available desktop data, a targeted follow-up ecological survey was undertaken in April and August in 2026. 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.

Two survey forms were created to collect data relevant to:

- Monitoring data; and
- Pressures and threats.

4.2.1 Monitoring Points

To inform the restoration plan for Monroe Fen, 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.
- Long-term monitoring stations to assess ecological change following restoration.

The surveys focused on these key components:

- Monitoring points: Presence and absence of positive and negative indicators of fen habitat.
- Target notes: Any qualitative observations capturing for example site condition, vegetation structure, hydrological features, and legacy management.
- Pressures and Threats Identification: Systematic recording of anthropogenic and natural pressures affecting each location.

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

- 7230 Alkaline fens: Recorded at monitoring points 1-4 and 8,9.

4.2.2 Pressure & Threats

This section outlines the historical and current pressures and threats affecting Monroe Fen, with emphasis on the Annex I quality habitats.

4.2.2.1 7230 Alkaline fens

Historical Pressures

The NFS determined that the Structure & functions of 7230 Alkaline fens was Unfavourable-Bad. The following pressures were recorded:

- **Under grazed and unmanaged** areas of fen.
- **Drainage** by two deep drains across the site.

Additionally, the Wetlands of County Westmeath (Smith, 2026) recorded the following pressures:

- **Historical cattle poaching** occurred some years ago. The lack of brown moss cover in the southern section and lower species-richness than the eastern section suggest it has been overgrazed in the past and still recovering. Furthermore, this section of the fen is significantly drier.

Current Observations

The 2026 walkover surveys identified the following:

- Southern section of the fen is overgrown, but wet underfoot. Rush species dominance increases to the east with a gradual transition to better quality fen to the west. The rush dominance is due to historical reclamation efforts in the southeast of the site which was spread with cow manure.
- The southern section of fen has several 7230 Alkaline fen indicators, but at a low cover.

4.2.3 Additional Observations

The NFS and Wetlands of county Westmeath recorded transition mire on the east of the site which was likely degraded as a result of eutrophication from adjacent land use.

The 2026 walkover surveys identified the following:

- The drain in the south of the site precludes sheep access to the north and potential grazing.
- The central part of the fen has been unmanaged, however due to the habitat (quaking areas), it is not suitable for grazing. The areas of scrub would likely become naturally controlled if drains were blocked.

4.3 Site Conservation Priority Matrix for Monroe Fen

The restoration actions proposed (Table 4) for the fen habitat of Monroe Fen 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 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 fen habitats alone but extend to the wider ecological network within and around the site.

Table 4-4–4: Site Conservation Priority Matrix for Monroe Fen

Level	Feature Type	Feature Name	Extent/ Population	Pressure/Threat affecting it	Restoration Measure On-Site	Restoration Measure Off- Site
1	NHA Habitat – Annex I quality and non-Annex habitat	7230 Alkaline fens	7.22	Undergrazing	Grazing at southern end	N/A
		6430 Hydrophilous tall-herb swamp	Not specified in NFS	Previous attempts at reclamation have resulted in increased nutrients and vegetation assemblage change	Vegetation management – cut and removal of arisings	
		Rich fen and flush (PF1) and Tall-herb swamps (FS2)	Not specified in NFS	Eutrophication from adjacent landuse	Buffer strip	
3	Nationally important species	See Table 4-4–2 and Table 4	See Table 4-4–2 and Table 4	Undergrazing	Grazing at southern end	N/A
4	Habitats and species of local interest	See Table 4-4–2 and Table 4	See Table 4-4–2 and Table 4	Undergrazing	Grazing at southern end	N/A

4.4 Impact Assessment Notes

4.5 Good Practice Recommendations

Several good practice measures are recommended based on the requirement for compliance with legislation but also the occurrence of sensitive receptors and possible pathways for negative effects during preparation for or implementation of restoration actions. These are summarised in Table 4-1 below and should be taken as generally applicable in the planning of FRP.

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

Table 4–5: Good Practice Recommendations

Receptor	Measure
Ground nesting birds	No vegetation clearance or activity which might contravene Section 40 of the wildlife act (consolidated) should be undertaken.
Invasive Alien Species	All vehicles should undergo stream cleaning before site entry. Identified buffers on IAS should be avoided during site preparation and restoration implementation. Consideration should be given to confirmatory survey to identify the latest *Rhododendron* infestation extent 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 Monroe fen through an initial desktop assessment of existing information on the site (including previous NPWS commissioned surveys), assessment of land, water and topographic data and aerial imagery, followed by field surveys to characterise and confirm key pressures mapped through desktop assessment. Consultation with NPWS Regional Staff was also undertaken, including a visit with the Conservation Ranger for the area to inform identification of pressures.

The National Fen Survey undertook a site evaluation and ranking which determined the conservation value of the site. This evaluation considered 15 criteria as outlined which included naturalness, non-recreatability, potential value, typicality, educational value, size, diversity, fen value, rarity of species, rarity of habitats, viability, recorded history, management needs, intrinsic appeal and expert opinion. These criteria then informed the overall conservation status assessment was applied based.

The conservation status assessment results for Monroe fen relating to 7230 Alkaline fens is summarised in Table 5–1.

Table 5–1: Conservation Status Assessment [complete based on NFS results for the site]

OVERALL CONSERVATION STATUS ASSESSMENT				
Annex I habitat	**Area**	**Structure & functions**	**Future prospects**	**Overall Conservation Status**
7230	Not recorded	Unfavourable-Bad	Not recorded	Not recorded

5.1 Field surveys of key pressures

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

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

5.2 Key Pressures

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

5.2.1 Flora and Fauna Pressures

The following pressures are listed in order of their intensity and impact on the ecological receptors of Monroe fen (Figure 5-1). These were determined from the review of historical information (NFS and The Wetlands of County Westmeath) and gathered from observations made along the monitoring points carried out as part of this project.

- Undergrazing;
- Drainage; and
- Eutrophication/nutrient enrichment (both current and historic).

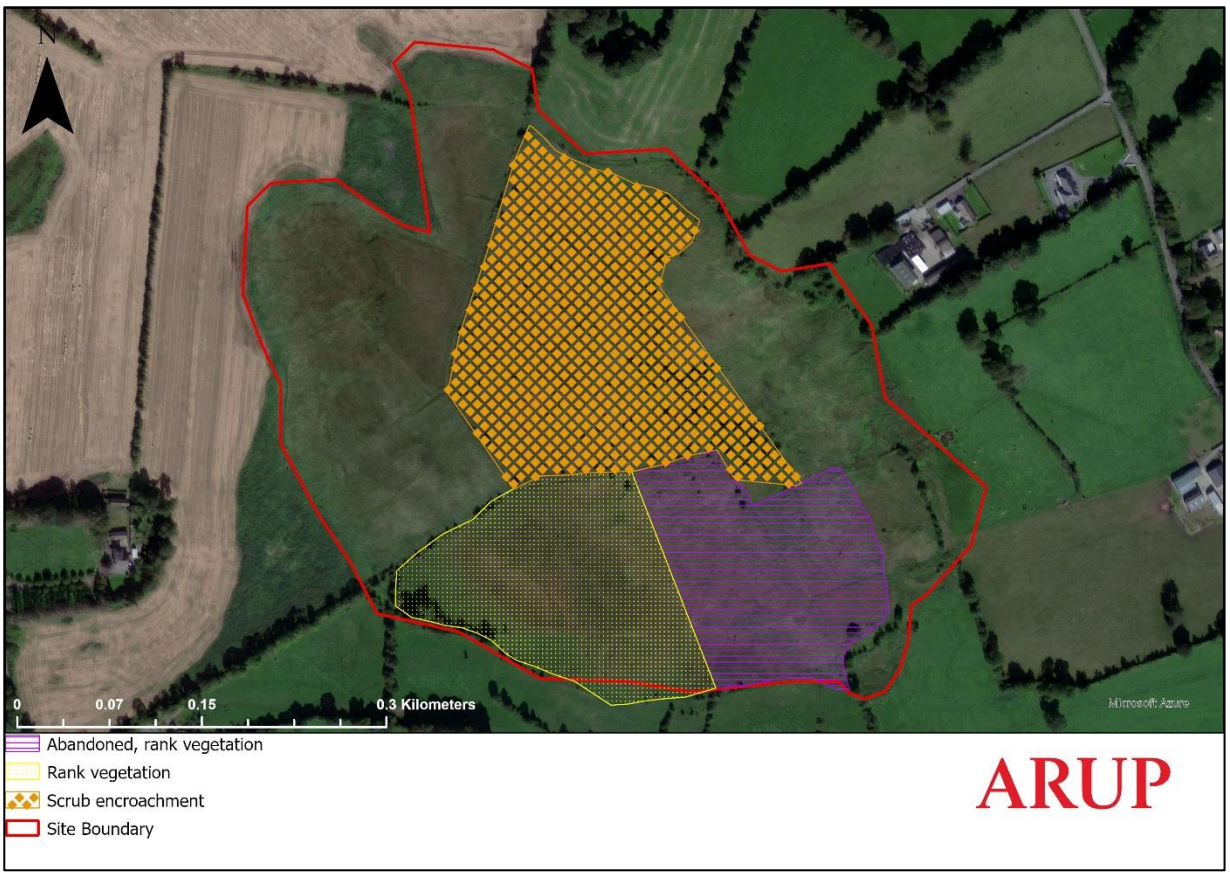


Figure 5-1: Flora & Fauna Pressures mapped within Monroe Fen.

5.2.2 Fen Hydrology Pressures

The following hydrological pressures were identified within Monroe Fen (Westmeath):

- Drainage has been identified as a pressure affecting fen hydrology across the site. In combination to the topography configuration where the area is in a valley basin, it can be affecting the natural conditions of the fen habitat. Where drains occur within the habitat and show localised effects, they have been flagged as a pressure requiring further assessment. Key features include:
    - Monroe Fen has numerous drains that are all connected to the main drain in the western part of the site, and which is therefore flowing towards River Inny.

- The drain located to the northwestern part of the site represents an important feature of water inflow, which may also be related to nutrient enrichment from the adjacent fields. This flows towards the main drain, in the western area.
- This outflow drain in the western area of the site was previously excavated and reduced the fen water levels. Extending towards the northeastern section of the site, the drain continues to lower groundwater levels and is likely affecting the distribution and ecological quality of the habitat.

5.2.3 Fen Nutrient Pressures

According to the NFS (Brophy et al., In prep), no nutrient pressures were identified for the site. However, during the site visits, evidence of nutrient enrichment was registered.

Diffuse pollution from adjacent agricultural activities presents nutrient pressure on the fen habitat. Land use in the surrounding areas, specifically in the northwest, is contributing to nutrient enrichment and eutrophication primarily through overflow pathway and groundwater pathways.

The highest nitrate levels where registered within the northwest drain that flows towards the main drain, and within this main drain in the outflow point, located in the western site boundary. While phosphate concentrations are higher in the western part of the site and in the eastern boundary, within a wetter area that is correspondent to historical wells and springs.

6 Restoration Measures

6.1 Introduction

The restoration actions proposed by the FRP will help to maintain or improve the quality of existing areas of fens and improve the conditions that will allow an expansion of the fen area. 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 6.3 to section 6.4, with detailed mapping of proposed measures illustrated in the maps provided in Appendix B.

6.2 Nutrient Measures

6.2.1 On-site Nutrient Measures

On-site nutrient management involves water quality monitoring to evaluate how well off-site nutrient interventions are working and to identify any modifications in the site natural conditions.

High nitrate levels were identified within the northwest drains and the main drain discharging to the River Inny. The elevated concentrations are likely associated with runoff from adjacent agricultural lands, with Monroe Fen potentially acting as a discharge zone.

To confirm whether water quality in this area is being impacted by surrounding land use, additional monitoring should be undertaken. Laboratory water quality analysis should be completed over three separate sampling rounds, with a two-month interval between each round. The monitoring programme should include analysis of the following parameters:

- Nitrate (NO_3^-)
- Nitrite (NO_2^-)
- Phosphate (PO_4^{3-})
- Ammonia (NH_3)
- Total Dissolved Solids (TDS)

Piezometers are proposed to be installed across the site, in selected locations. The main areas of focus are along the southeastern, northwestern and central area, where high nitrate and phosphate levels were recorded. Additionally, a piezometer will be installed along the main drain to determine the relationship between surface water and groundwater.

The piezometers located within the main drain and the piezometer at the northwest area, the water monitoring should incorporate the five listed parameters above (Nitrate, Nitrite, Phosphate, Ammonia and TDS), as well the other standard analysis of EC and pH.

The remaining two piezometers on the eastern and central area should be monitored only by the following parameters:

- Nitrate (NO_3^-)
- Phosphate (PO_4^{3-})
- pH
- EC

Water quality measurements should inform both the development and implementation of response strategies whenever nutrient levels consistently fall outside established limits. The main objectives are:

- Assess nutrient concentrations across the site
- Identify spatial and temporal trends in nutrient concentrations
- Improve understanding of nutrient sources and pathways (surface water and groundwater)
- Assess the relationship between hydrology and nutrient enrichment

Livestock crossing the main drain along the western site boundary, contribute for the damage of the bank, causing soil erosion and nutrient enrichment. Nitrate levels registered at this location are of 104 mg/l (NO_3^-), which is above the groundwater threshold. A well-designed livestock crossing will be implemented to reduce the erosion of soil and improve the water quality, as well as making it safer for animals and people to cross. Details of this livestock cross construction should be following the below:

- Identify a suitable crossing place – the banks must not be too steep, and the water course (drain) should be straight (i.e. not on a curve). The crossing point must be convenient for cattle.
- Use layers of stone and gravel to construct a hard surface across the drain.
- The upstream side of the crossing should be constructed with a maximum slope of 4:1 (horizontal to vertical).

- The main crossing should have a maximum slope from upstream to downstream of 10:1.
- The height of the crossing should be as low as practical.
- Dig the bed of the channel out (if it is soft) and lay a sheet of filter cloth or geotextile material to stabilise the bed.
- Add layers of different sizes of rock and a final layer of gravel. This should then be compacted.
- Bury the upstream end about 1m into the bed.
- Lay the rock bank all the way up the embankment, to prevent the soft embankment from being scoured away during floods.
- The bed of the crossing should not be too high and the drain must flow freely over the crossing.
- Fence should be installed at both sides of the crossing to keep livestock at this location.

To effectively manage nutrient levels throughout the broader catchment, targeted control strategies addressing both phosphorus and nitrogen pathways are recommended. PIP mapping and field water quality data indicate that vegetation buffer zones on the northwestern and eastern boundary could mitigate runoff risks by intercepting and retaining nutrients transported via surface and subsurface channels from adjacent areas.

High phosphate levels in nearby farmland warrant coir logs to be installed along the site's eastern boundary. High nitrate levels in nearby farmlands warrants a 3D buffer layer along the northwestern boundary. Pollutant deposition in buffer zones depends on the texture and composition of eroded soil, with coarse particles being retained more effectively than fine ones.

The proposed water quality monitoring points and buffer zones at the northwestern and eastern zones for Monroe Fen are shown in Annex C (

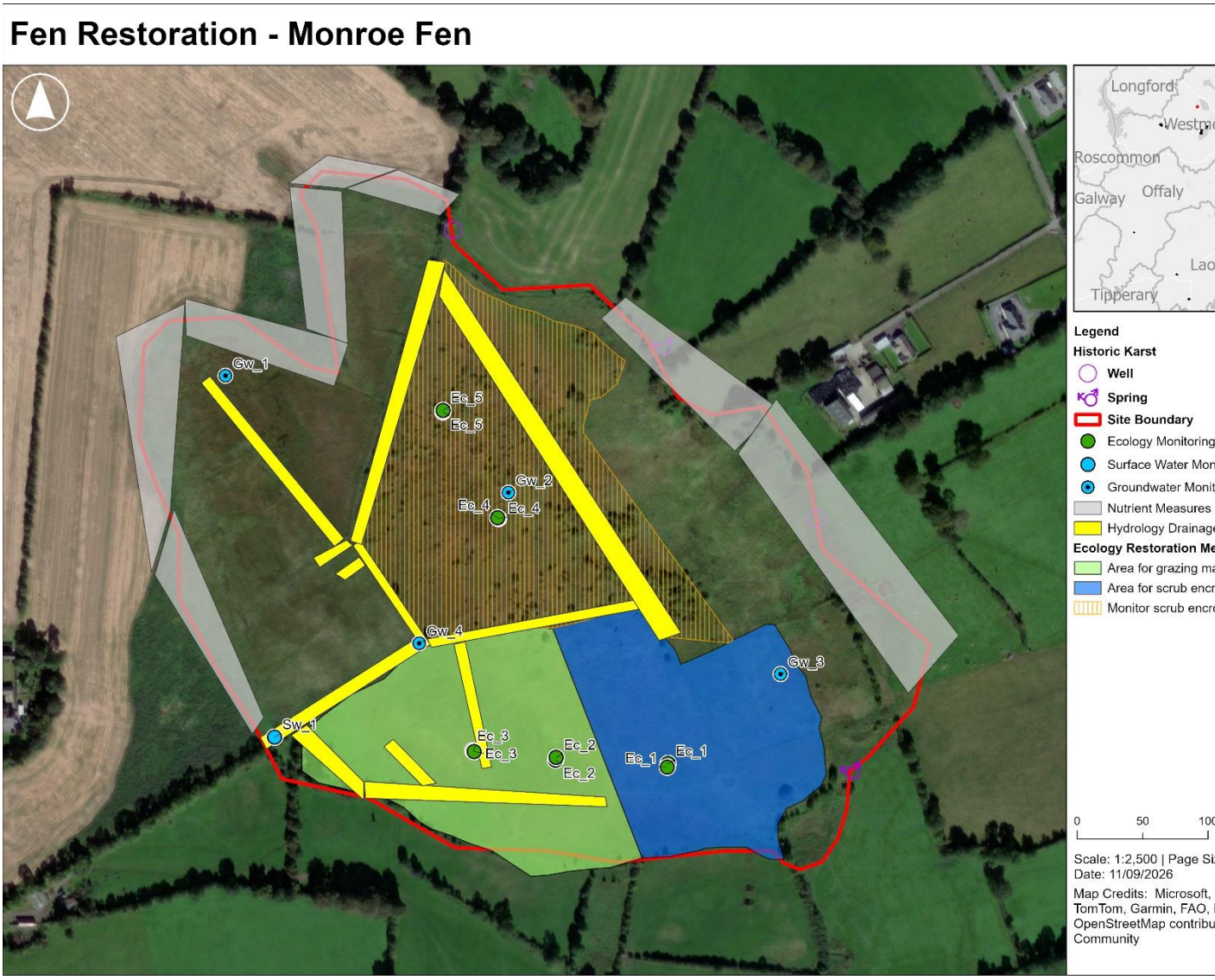


Figure 9-2: Restoration measures and monitoring for Monroe fen

). These measures should be implemented prior to any hydrological restoration measures.

6.2.2 Off-site Nutrient Measures

Agricultural 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 Monroe Fen may include:

Source control measures:

- **M2 Farmer Training.** Course for farmers in the fen catchment.
- **M3 Nutrient Management Plan**. This plan helps farmers apply slurry efficiently, optimise nutrient uptake, and prevent excessive nutrient use.
- **M4 Nitrogen Surplus.** Nutrient accounting can be used on dairy farms to manage excess nitrate in groundwater catchments.

- **M5. Multi-species swards**. This measure decreases the requirement for fertiliser application and is advised for regions designated as PIP N 1-4, including the area's located to the northwest and eastern of the site boundary.

Pathway interception measures:

- **M15 Spatially Targeted Buffer Zones**: Buffers will vary in shape and size, based on flow pathways and catchment area. These zones will intercept and retain water and pollutants from nearby fields via surface and subsurface routes.
- **M19 Management of Critical Source Areas**: CSAs are parts of farmland with strong connectivity to the drainage network where surface runoff accumulates, increasing the risk of sediment and nutrient losses to rivers and streams. These areas are typically low-lying and should be identified using EPA PIP maps, alongside consideration of field slope and local drainage conditions.
- **M23 Watercourse Crossing/Bridges:** Animal and farm vehicle crossings can introduce sediment and pollutants into rivers, especially when part of a farm road. Replacing these with properly designed bridges will have a positive impact on the river.

Receptor measures:

- **M38 Vegetated bunded drain**. Slowing the outflow stream in wet conditions may improve sediment deposition and boost nutrient attenuation.

6.3 Hydrology Measures

6.3.1 On-site Fen Hydrology Measures

There is evidence that modifications to the drainage network are negatively affecting the site. The outflow drain located in the western section, which discharges to the River Inny and is recognised as the main drain, may be altering the hydrological regime within the site and adversely impacting the fen habitat.

Drain blocking is proposed in a few locations at Monroe Fen: along the drain flowing from northeast to southwest, the outflow drain flowing to the west, in other four drains (at northwest, southwest, centre and east of the site), and minor drains connected to those. This measure will raise the water levels and provide a positive benefit to the fen habitat.

A hydrological monitoring programme will be implemented, including the installation of surface and groundwater monitoring. Piezometers and standpipes will be installed in selected locations to incorporate a site-wide monitoring network. This information, along the water quality analysis and the vegetation buffer zone, will highlight if blocking the main drain is the best solution and could lead to a positive impact on the fen habitat.

The water level monitoring in the River Inny is operated by the OPW at an existing gauging station and the data is available publicly. This data can be compared with the water level

measurements from the proposed piezometers to assess the direction of groundwater flow within the site.

The proposed hydrological management measure and monitoring is shown in Annex C (

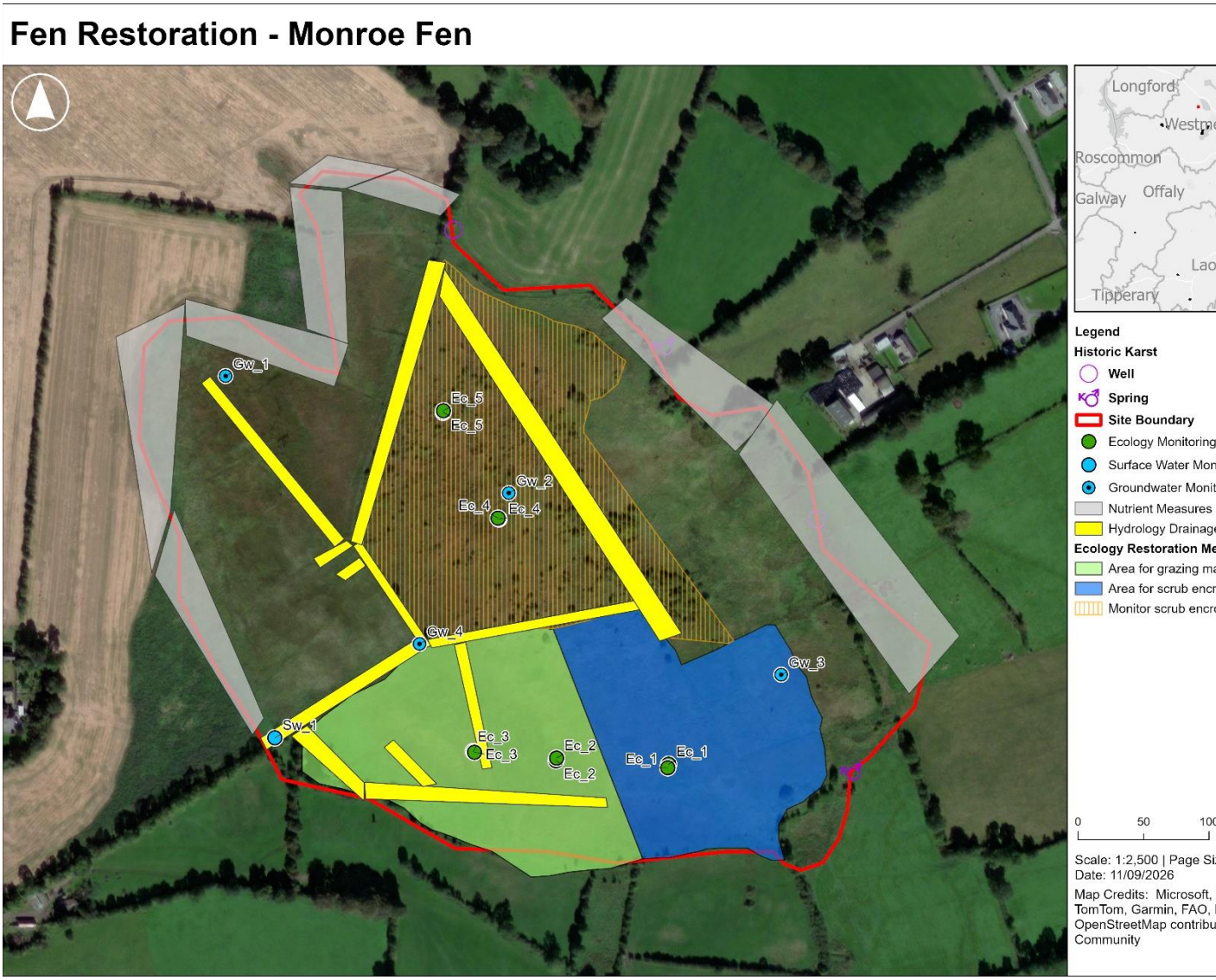


Figure 9-2: Restoration measures and monitoring for Monroe fen

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6.3.2 Off-site Hydrology Measures

The hydrology of Monroe Fen is influenced by groundwater recharge and subsurface flow, particularly from the northern region. No new drainage channels should be excavated within those lands that are hydrologically connected to Monroe Fen. Engagement with adjacent landowners will be required to maintain natural infiltration processes and to prevent drainage works that could alter recharge or flow pathways.

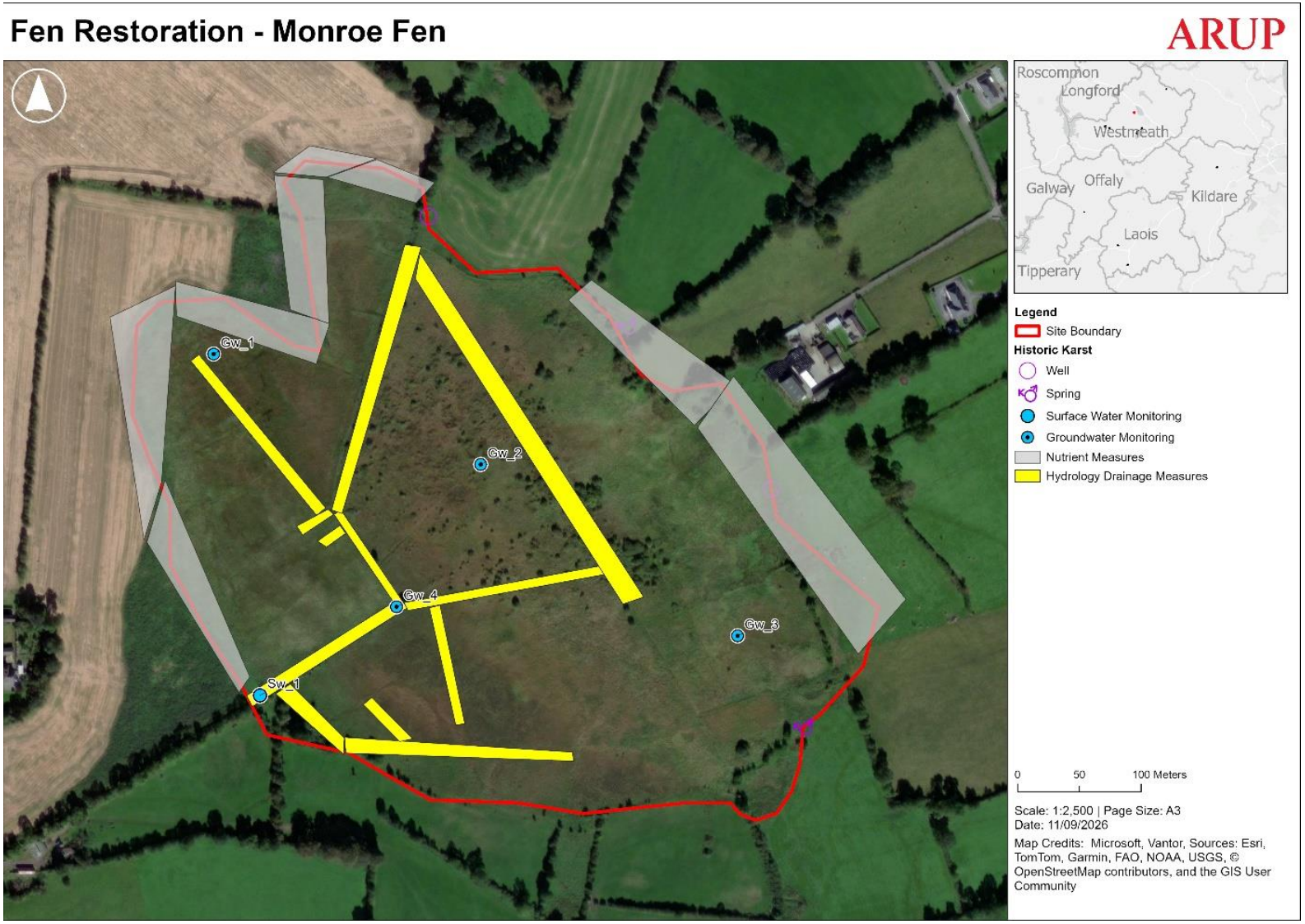


Figure 6-1: Proposed hydrological management measures and monitoring

6.4 Vegetation Measures

6.4.1 On-site Vegetation Measures

On-site vegetation measures are detailed in Table 6-6–1 and Figure 6-2.

Table 6-6–1: On-site vegetation measures

Priority	Measure	Description	Responsibility
1	Vegetation monitoring	Monitoring points have been proposed which overlap with (where suitable) the existing NFS points. The purpose of these points is to monitor species composition within the habitat. This serves to monitor the effectiveness of proposed restoration measures.	Tóchar & NPWS (post-Tóchar)
2	Conservation grazing	Using appropriate livestock breeds for conservation grazing of the 7230 Alkaline fens at the southern end of the site where access for livestock is suitable e.g. Droimeann, Irish moiled, Dexter or Kerry cattle. The objective of the grazing is to open up the sward. Seasonal grazing should be undertaken in late summer/early autumn. Regular monitoring will be undertaken to ensure the stocking density and objectives of vegetation management are met.	Tóchar & NPWS (post-Tóchar)
3	Mechanical cut and arisings removal	The area of rich fen and flush (PF1) and tall-herb swamp (FS2) in the southeast of the site that has been historically reclaimed. It is too wet for livestock to safely graze the area. To reduce soil fertility, a mechanical cut and arisings removal could be explored, dependent on safely accessing the site with appropriate machinery. Future monitoring of vegetation will report back on the effectiveness of this measure and whether additional cuts may be necessary.	Tóchar & NPWS (post-Tóchar)

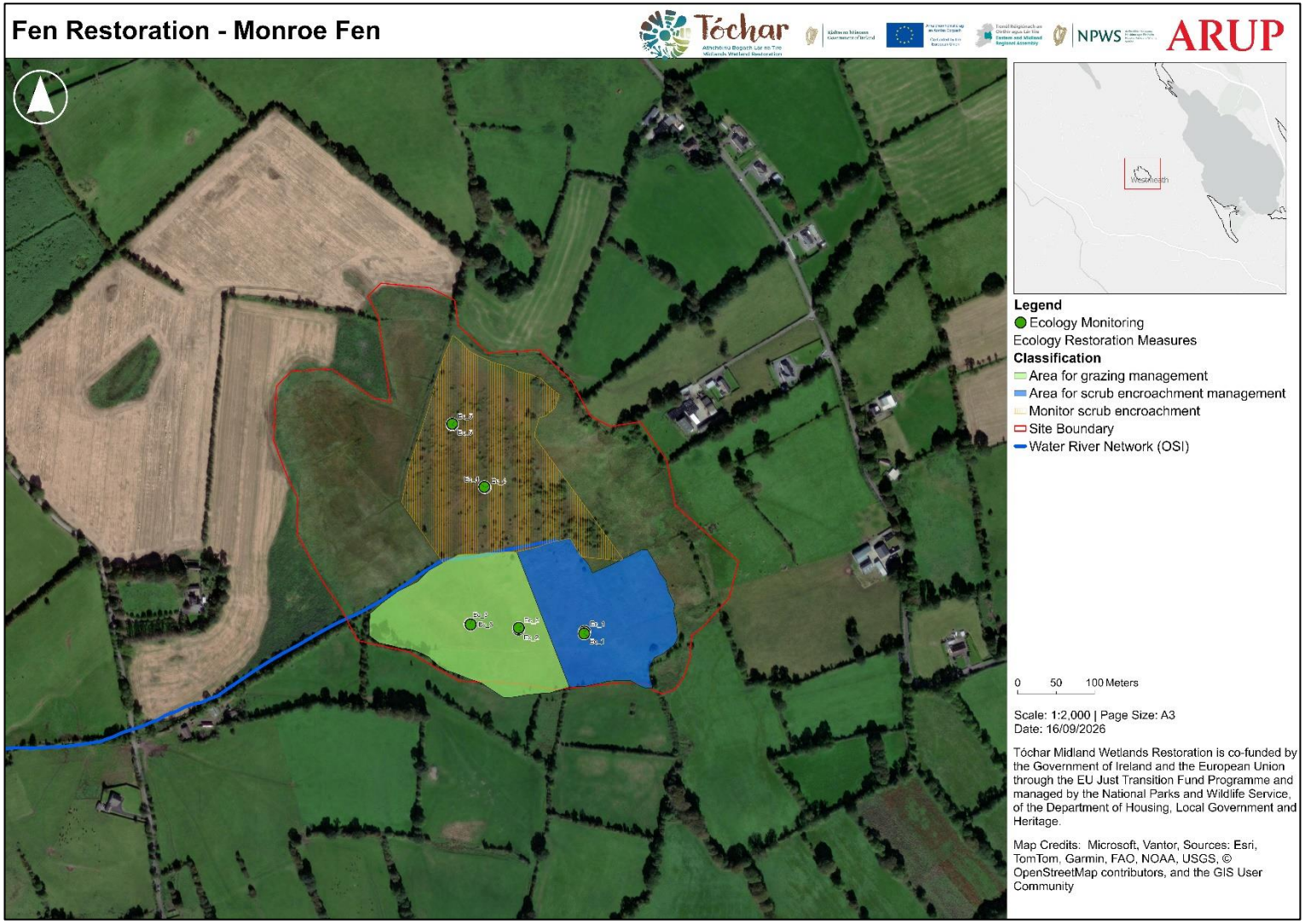


Figure 6-2: Proposed ecological management measures and monitoring

7 Additional Considerations

7.1 Drainage Management Plan

Arterial Drainage Schemes were carried out under the Arterial Drainage Act, 1945 to improve land for agriculture and to mitigate flooding. Rivers, lakes weirs and bridges were modified to enhance conveyance, embankments were built to control the movement of flood water and various other work was carried out under Part II of the Arterial Drainage Act, 1945.

The than the 3 – year purpose of the schemes was to improve land for agriculture, to ensure flood was retained in bank this was achieved by lowering water levels during the growing season to reduce waterlogging on the land beside watercourses known as callows. Flood protection in the benefiting lands was increased as a result of the Arterial Drainage Schemes.

The Brosna (Westmeath, Offaly and Laois) was the first scheme, which commenced in 1947. The last schemes were completed in the 1990s. Arterial Drainage schemes cover approximately 20% of the country, typically the flattest areas. The OPW is required to maintain Arterial Drainage schemes under sections 37 and 38 of the Arterial Drainage Act, 1945. The Act was amended on a number of occasions, e.g. to transpose EU Regulations and Directives such as the EIA, SEA, and Habitats Directives and the Aarhus Convention.

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.

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 proposed approach to peat stability is a tiered approach that aims to filter out low risk sites that can proceed with limited ground investigation, followed by more complex sites that

require a more detailed quantitative assessment. Where risks cannot be excluded following these steps it may be necessary to progress to more detailed geotechnical studies.

The GSI landslide susceptibility map for Monroe Fen is presented in Figure 7-1.

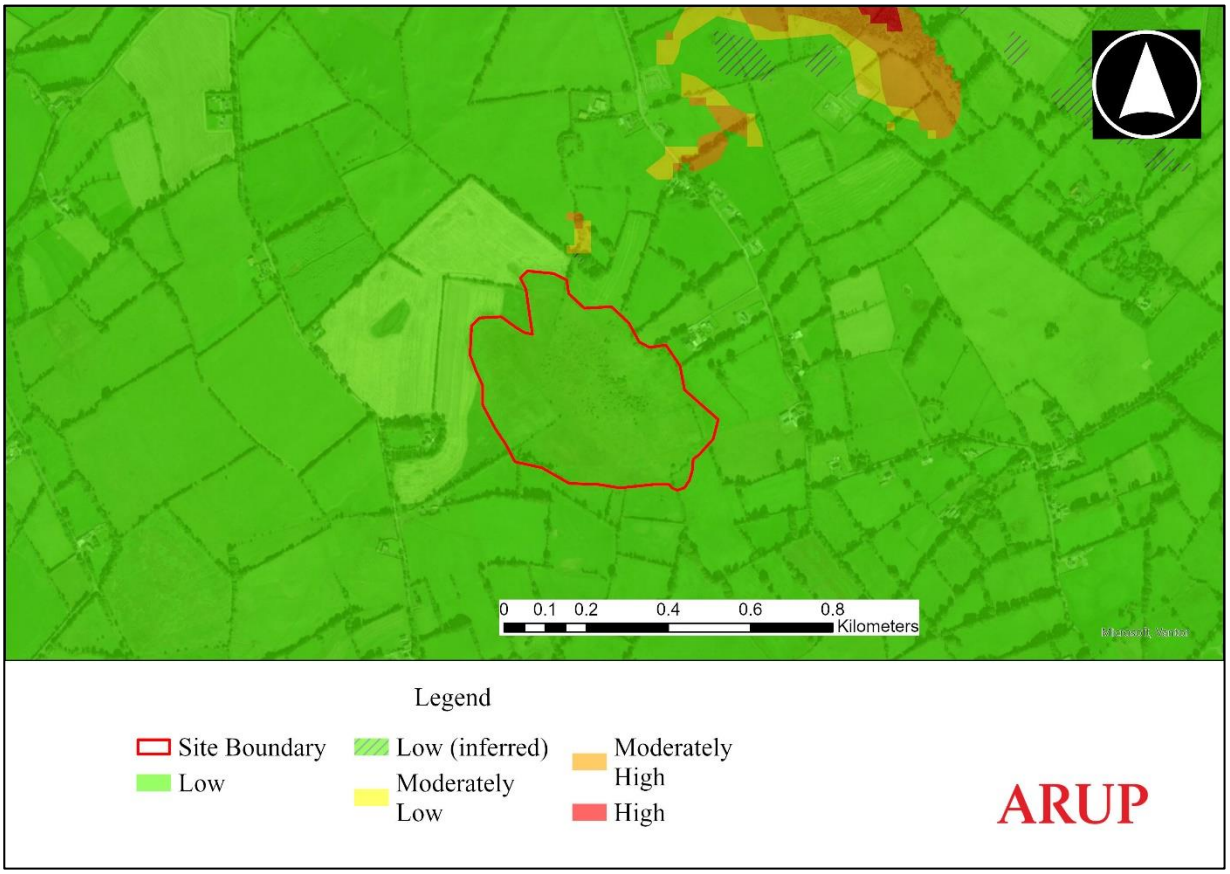


Figure 7-1: Geological Survey of Ireland Landslide Susceptibility mapping for Monroe Fen

7.3 Archaeology

A desktop constraint assessment was conducted using the National Monuments Service (NMS) Historic Environment Viewer to evaluate the site boundary and immediate surrounding buffer zones against the statutory Record of Monuments and Places (RMP) and the Sites and Monuments Record (SMR).

- The assessment confirmed that no recorded archaeological monuments, protected heritage assets, or statutory Zones of Notification occur within, or in close proximity to, the proposed restoration area. Consequently, the requirements of the National Monuments Acts are not considered applicable to the proposed works.
- Specifically:
  - Section 12 Notification is not required, as no works are proposed within or adjacent to a site recorded in the Record of Monuments and Places (RMP).
  - Section 14 Consent/Licensing is not required, as the project will not affect a designated National Monument or any site subject to a Preservation Order.

Although no recorded archaeological features have been identified, the waterlogged and anaerobic conditions characteristic of fen environments can present a high potential for the preservation of previously undiscovered organic archaeological remains, such as wooden trackways, artefacts, and paleoenvironmental deposits.

To ensure compliance with best practice and the objectives of the National Monuments Acts, a standard Chance Finds Procedure will be implemented throughout the restoration works. In the unlikely event that previously unrecorded archaeological remains or artefacts are encountered during excavation, drain blocking, rewetting, or other ground disturbance activities, all works within the immediate vicinity of the discovery will cease. The National Monuments Service and the National Museum of Ireland will be notified within the statutory 72-hour reporting period, and any further actions will be undertaken in accordance with their recommendations.

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	Landowners	Parts of Monroe are under Commonage ownership by private individuals
Off-site	Landowners & farmers	Engagement for uptake of catchment measures.
Capacity building	NPWS	NPWS engaging in community education and events

This section provides the summary of the Fen Restoration Plan Actions for Monroe fen (Table 8–2).

Table 8–2: Implementation plan for Monroe Fen Restoration

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
1	**Required preliminary actions**							
1.1	**Drainage management plan**							
	Consultation with Westmeath Co. Co on the drainage management plan is required to ensure compliance with legislation and local authority objectives.	Sitewide	Drainage management plan	Pre-restoration	NPWS		Arup	Within Tóchar project scope
1.2	**Archaeological assessment**							
	Consultation with NMS on the archaeology is required to ensure compliance with legislation and local authority objectives.	Sitewide	Archaeological assessment report	Pre-restoration	NPWS	Co. Co	Arup	Within Tóchar project scope
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	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.2	**Implementation of Mitigation Measures**							
	Ecological Impact Assessment Considerations – identification of necessary mitigation measures. Such measures may include, but are not limited to, choosing appropriate machinery for the intended purpose.	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
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. vegetation cutting, these works shall occur outside the breeding bird season (1 March – 31 August inclusive).	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.4	**Good Practice Recommendations and CEMP**							
	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 Piezometers & Drain Blocking Piezometers will be used to monitor groundwater levels and support the interpretation of groundwater flow pathways. Drain blocking is proposed in several drains at Monroe Fen, including the main drain flowing from northeast to southwest.	Sitewide	Site installations Records	Restoration in 2027	NPWS to facilitate		Arup/ Contractor	Within Tóchar project scope
3.2	**Nutrient measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Riparian buffer for northwestern and eastern areas							
3.3	**Vegetation measures**							
	Conservation grazing	7230 Alkaline fen south of the site	Regular monitoring of vegetation to review the stocking density and suitability of grazers	Seasonal grazing regime	NPWS working with landowner	Landowner to the south of the site		NPWS Farm Plan Scheme
	Proposed measures to address high soil fertility in PF1 and FS2 habitat in the southeast of the site: Mowing and removal of arisings within the demarcated areas	Southeast side of the site within PF1/FS2 habitat	Review of vegetation annually to understand impact of mowing and whether additional cuts are recommended	Late summer	NPWS working with landowner	Landowner to the southeast of the site	Arup/Contractor	Within Tóchar project scope
4	**Off-Site Restoration measures**							
4.1	**Hydrology measures**							
	Landowners should be made aware about excavation and livestock access impacts to prevent drainage on nearby land that could disrupt the fen's water balance.	Surrounding farms	Landowner awareness	Long-term		Westmeath Co.Co		Westmeath Co.Co
4.2	**Nutrient measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Catchment nutrient management. Targeted nutrient management strategies should be implemented throughout the catchment to address both phosphate and nitrogen pathways. Recommended measures include source controls such as Farmer Training Courses within the fen catchment, Nutrient Management Plans, and Nitrogen Surplus monitoring; pathway interception initiatives like Linear Riparian Buffer Zones in grassland areas; and receptor interventions such as installation of vegetated bunded drains.	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**							
	Monitoring groundwater and surface water at key site locations using piezometers and standpipes.	Southeastern, centre and northwestern area	Water level	Long term	NPWS to facilitate access			NPWS
5.2	**Nutrient monitoring**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Water quality in fen habitats, drainage channels, and springs will be monitored regularly.	Allocated locations across Monroe Fen	Nitrate, phosphorous, EC, Temperature, pH at some locations and Nitrate, Nitrite, Phosphate, Ammonia and Total Dissolved Solids (TDS)	Long term	NPWS to facilitate site access			NPWS
5.3	**Vegetation monitoring**							
	Vegetation monitoring will be undertaken using detailed relevés to document habitat composition, cover, and structural characteristics within representative plots. The surveys will also record any pressures or threats, including scrub encroachment, invasive species, or changes to hydrological conditions. These surveys will guide any restoration actions if changes are detected.	Sitewide	Site records/habitat surveys	Long term	NPWS to facilitate site access	Westmeath Co.Co		Within Tóchar project scope
6	**Capacity building and training**							
	Public meeting: To engage stakeholders on developments and results from the restoration measures.			Long-term	NPWS			NPWS

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	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**

  Conservation grazing, buffer strips and vegetation monitoring will all contribute to favourable condition of the 7230 Alkaline fens. The grazing will open up the sward preventing certain vegetation to dominate and encourage an increase in diversity. The buffer strips will improve water quality reducing eutrophication within the site from surrounding landscape.

- **6430 Hydrophilous tall-herb swamp**

  This habitat is located in the southern area, where the phosphorous levels are very high. The buffer strips will improve water quality reducing eutrophication within the site from surrounding landscape.

- **PF1 Rich fen and flush/ FS2 Tall-herb swamp**

  This habitat covers areas of 7230 Alkaline fens, but also includes the area proposed for mechanical cutting and arisings removal. The later seeks to reduce soil fertility which will reduce the dominance of certain vegetation e.g. rushes.

- **FS2 Tall herb swamps**

  This habitat border's areas of high nutrient enrichment from nearby farmland. The buffer strips will improve water quality reducing eutrophication within the site from surrounding landscape. Piezometers and a water quality programme will also be installed and monitor nutrient input.

- **PF3 Transition mire and quaking bog**

  This habitat to the east of the site was degraded, likely as a result of eutrophication. The buffer strips will improve water quality reducing eutrophication within the site from surrounding landscape.

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Appendix A – Non-Technical Summary

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary			
Site Name	Monroe Fen	**NFS site no.**	*104006*
County	Westmeath	**Designation**	*None*
Fen habitats present (area)	7230 Alkaline fen	**Species of note**	Carex appropinquata, Salix pentandra

Site Description

Monroe Fen is located approximately 7.2 km northwest of Mullingar in County Westmeath within a valley basin. Although the site is not designated nationally or internationally, surveys have confirmed the presence of important wetland habitats, including 7230 Alkaline fens and 6430 Hydrophilous tall-herb swamp habitats. The site occupies a topographic depression at an elevation of approximately 100 mOD and is surrounded by higher ground reaching elevations of up to 169 mOD. The exception is the western boundary, where the site's surface water discharge point is also located at approximately 100 mOD. The terrain within the site boundary is relatively flat, with ground levels ranging from approximately 94 mOD to 96 mOD.

Conceptual Site Model (CSM)

Monroe Fen is a groundwater-fed wetland situated within a low-lying basin surrounded by higher ground, where deep peat deposits and underlying limestone geology help maintain, the hydrological conditions required for fen development. Groundwater is the principal water source to the site, supplying the mineral-rich conditions necessary to sustain the extensive alkaline fen habitat, which is of European conservation importance and is dominated by species such as black bog-rush (Schoenus nigricans) and blunt-flowered rush (Juncus subnodulosus). Water moves generally westwards through the site towards the River Inny and ultimately Lough Iron, while a network of drains, particularly within the northern areas, influences local hydrological conditions. Springs and groundwater seepages along the eastern boundary provide an additional and important source of water, helping to maintain the ecological integrity and biodiversity of the fen. Although groundwater quality is generally supportive of alkaline fen habitats, elevated nitrate concentrations in parts of the site indicate some influence from surrounding agricultural activities. Overall, the geology, hydrology and ecology of Monroe Fen are strongly interconnected, with groundwater playing a critical role in sustaining the site's habitats and ecological function.

Key Pressures

Hydrology Pressures	Drainage, where two deep drains divide the site into three sections.
Nutrient Pressures	Nutrient enrichment from agricultural runoff in the eastern and northwestern area
Ecology Pressures	Under grazed and unmanaged areas of fen.

Objective of Restoration Plan

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary	
The restoration plan is expected to improve water quality, restore natural wetland hydrological conditions, enhance biodiversity, and strengthen the long-term ecological resilience of Monroe Fen. Collectively, these measures will support the conservation and recovery of fen habitats and enhance the site's long-term environmental value.	
Restoration Measures	
Hydrology Measures	**On-Site Measures**: Managing drainage through the installation of drain blocking at a few locations across the site to help restore natural water levels. **Off-Site Measures:** Engagement with landowners to prevent new drains being excavated
Nutrient Measures	**On-Site Measures:** Establishing vegetation buffer strips along the eastern and northwestern boundary to reduce nutrient runoff from surrounding farmland **Off-Site Measures:** Agricultural 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.
Ecology Measures	**On-Site Measures:** Introducing appropriate conservation grazing and vegetation management to improve habitat diversity.
Monitoring	
Hydrology Monitoring	Groundwater and surface water monitoring within the fen as well as rainfall and evaporation monitoring.
Nutrient Monitoring	Ongoing monitoring of groundwater and surface water for water quality parameters within the fen
Ecology Monitoring	Habitat condition assessments to monitor the rate, if any, of succession and/or general scrub encroachment which in turn will inform the need for further works
More information	
Fen Restoration Plan Report	

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary
Tóchar website: https://www.tocharwetlands.ie/fen-restoration/

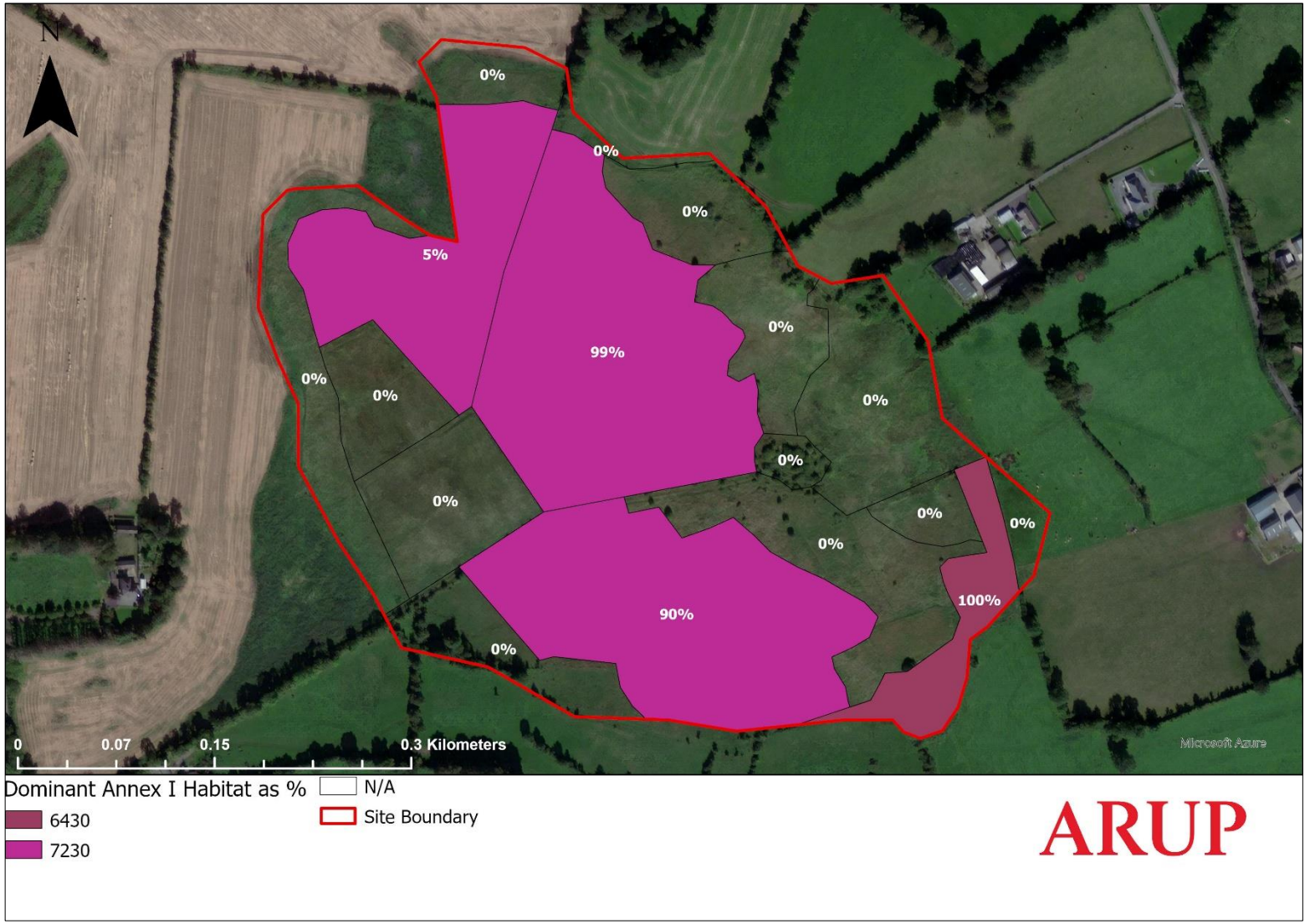


Figure 1: Site Habitat Map

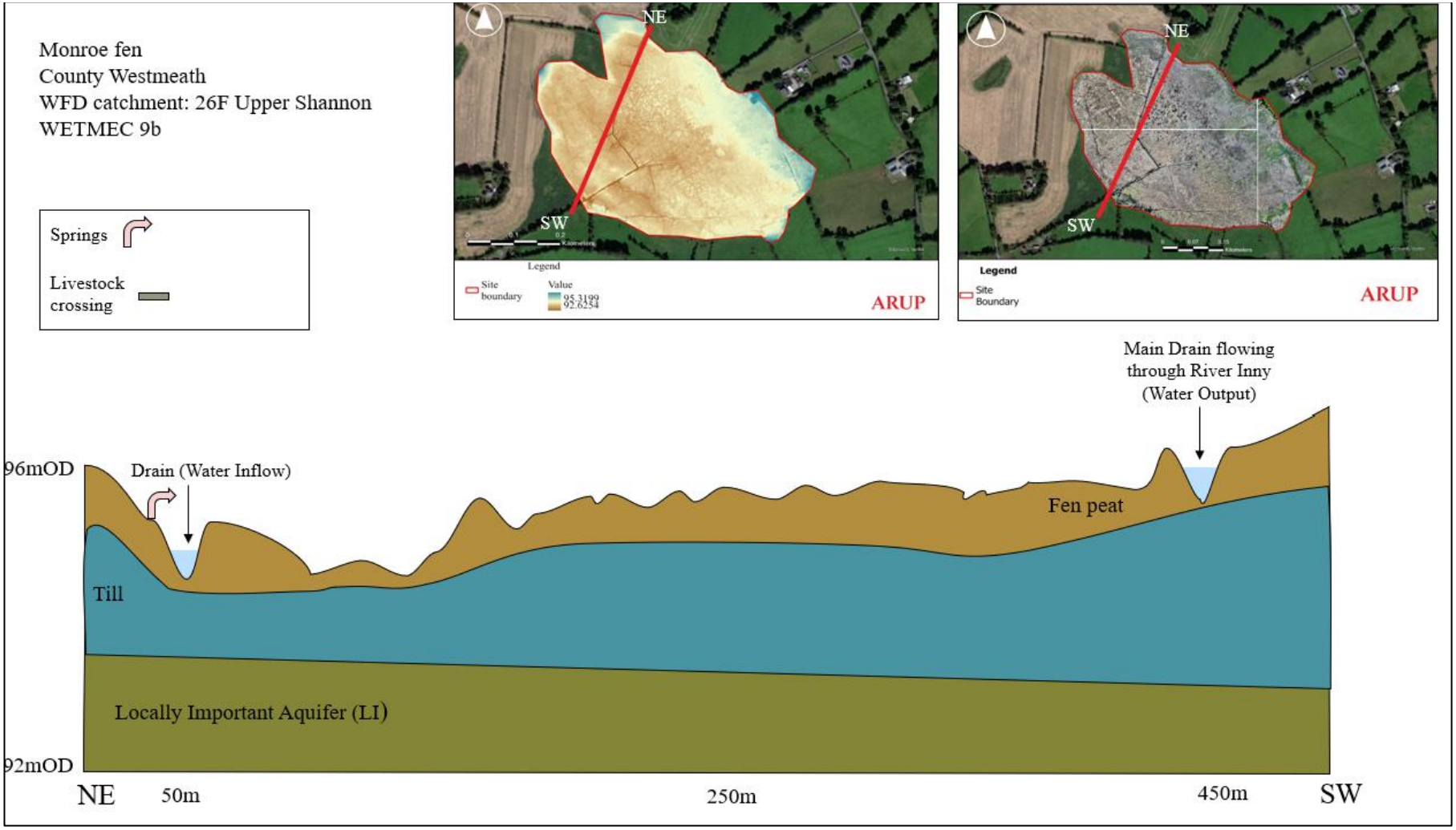


Figure 2: Conceptual Site Model

Appendix B – Ecological Survey Maps

Table 9–1: Annex I habitat and Fossitt habitat code directory

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
3110	Oligotrophic Isoetid lake habitat	FL1	Dystrophic lakes
3130	Slender Naiad-type lakes	FL2	Acid oligotrophic lakes
3140	Hard-water lakes	FL3	Limestone/marl lakes
3150	Rich pondweed lake habitat	FL4	Mesotrophic lakes
3160	Acid oligotrophic lakes	FL5	Eutrophic lakes
3180	Turloughs	FL6	Turloughs
3260	Vegetation of flowing waters	FL7	Reservoirs
3270	Chenopodion rubri	FL8	Other artificial lakes and ponds
4010	Wet heaths	FW1	Eroding/upland rivers
4030	Dry heaths	FW2	Depositing/lowland rivers
4060	Alpine and subalpine heath	FW3	Canals
5130	Juniper scrub	FW4	Drainage ditches
6130	Calaminarian grasslands	FP1	Calcareous springs
6210	Orchid-rich calcareous grassland	FP2	Non-calcareous springs
6230	Species-rich Nardus grassland	FS1	Reed and large sedge swamps
6410	Molinia meadows	FS2	Tall-herb swamps
6430	Hydrophilous tall-herb swamp	GA1	Improved agricultural grassland

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
6510	Hay meadows	GA2	Amenity grassland (improved)
7110	Raised bog (active)	GS1	Dry calcareous and neutral grassland
7120	Degraded raised bogs	GS2	Dry meadows and grassy verges
7130	Blanket bog (active)	GS3	Dry-humid acid grassland
7140	Transition mires	GS4	Wet grassland
7150	Rhynchosporion depressions	GM1	Marsh
7210	Cladium fens	HH1	Dry siliceous heath
7220	Petrifying springs	HH2	Dry calcareous heath
7230	Alkaline fens	HH3	Wet heath
8110	Siliceous scree	HH4	Montane heath
8120	Calcareous scree	HD1	Dense bracken
8210	Calcareous rocky slopes	PB1	Raised bog
8220	Siliceous rocky slopes	PB2	Upland blanket bog
8240	Limestone pavement	PB3	Lowland blanket bog
8310	Caves	PB4	Cutover bog
8330	Sea caves	PB5	Eroding blanket bog
91A0	Old oak woodland	PF1	Rich fen and flush
91D0	Bog woodland	PF2	Poor fen and flush
91E0	Alluvial woodland	PF3	Transition mire and quaking bog
91J0	Yew woodland	WN1	Oak-birch-holly woodland
		WN2	Oak-ash-hazel woodland
		WN3	Yew woodland

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
		WN4	Wet pedunculate oak-ash woodland
		WN5	Riparian woodland
		WN6	Wet willow-alder-ash woodland
		WN7	Bog woodland
		WD1	(Mixed) broadleaved woodland
		WD2	Mixed broadleaved/conifer woodland
		WD3	(Mixed) conifer woodland
		WD4	Conifer plantation
		WD5	Scattered trees and parkland
		WS1	Scrub
		WS2	Immature woodland
		WS3	Ornamental/non-native shrub
		WS4	Short rotation coppice
		WS5	Recently-felled woodland
		WL1	Hedgerows
		WL2	Treelines
		ER1	Exposed siliceous rock
		ER2	Exposed calcareous rock
		ER3	Siliceous scree and loose rock
		ER4	Calcareous scree and loose rock
		EU1	Non-marine caves

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
		EU2	Artificial underground habitats
		ED1	Exposed sand, gravel or till
		ED2	Spoil and bare ground
		ED3	Recolonising bare ground
		ED4	Active quarries and mines
		ED5	Refuse and other waste
		BC1	Arable crops
		BC2	Horticultural land
		BC3	Tilled land
		BC4	Flower beds and borders
		BL1	Stone walls and other stonework
		BL2	Earth banks
		BL3	Buildings and artificial surfaces

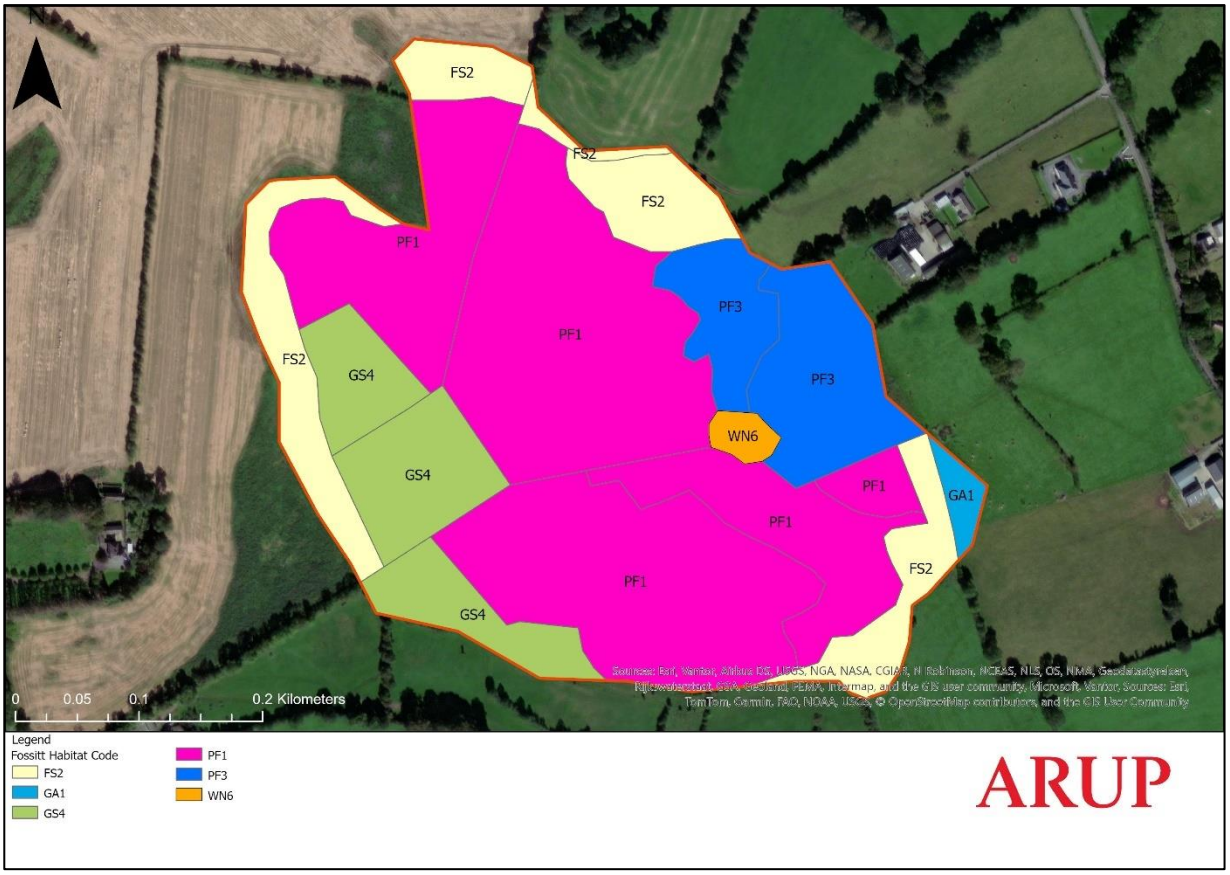


Figure 9-1: Habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification System

Appendix C – Restoration and Monitoring Map

Point	Measure	Objective	Timeframe	Frequency of monitoring
Gw_1	Hydrological	Groundwater levels and quality monitoring	Long-term	Quarterly for year 1 Annual for year 2-5
Gw_2				
Gw_3				
Gw_4				
Sw_1		Surface water level and quality monitoring	Long-term	Quarterly for year 1 Annual for year 2-5
N/A		Vegetation Buffer Strip	Long Term	Seasonal for year 1 Every 3 years for year 2-5
Ec_1	Ecological	Monitoring within areas of 7230 Alkaline fens	Long-term	Seasonal for year 1 Every 3 years for year 2-5
Ec_2				
Ec_3				
Ec_4				
Ec_5				

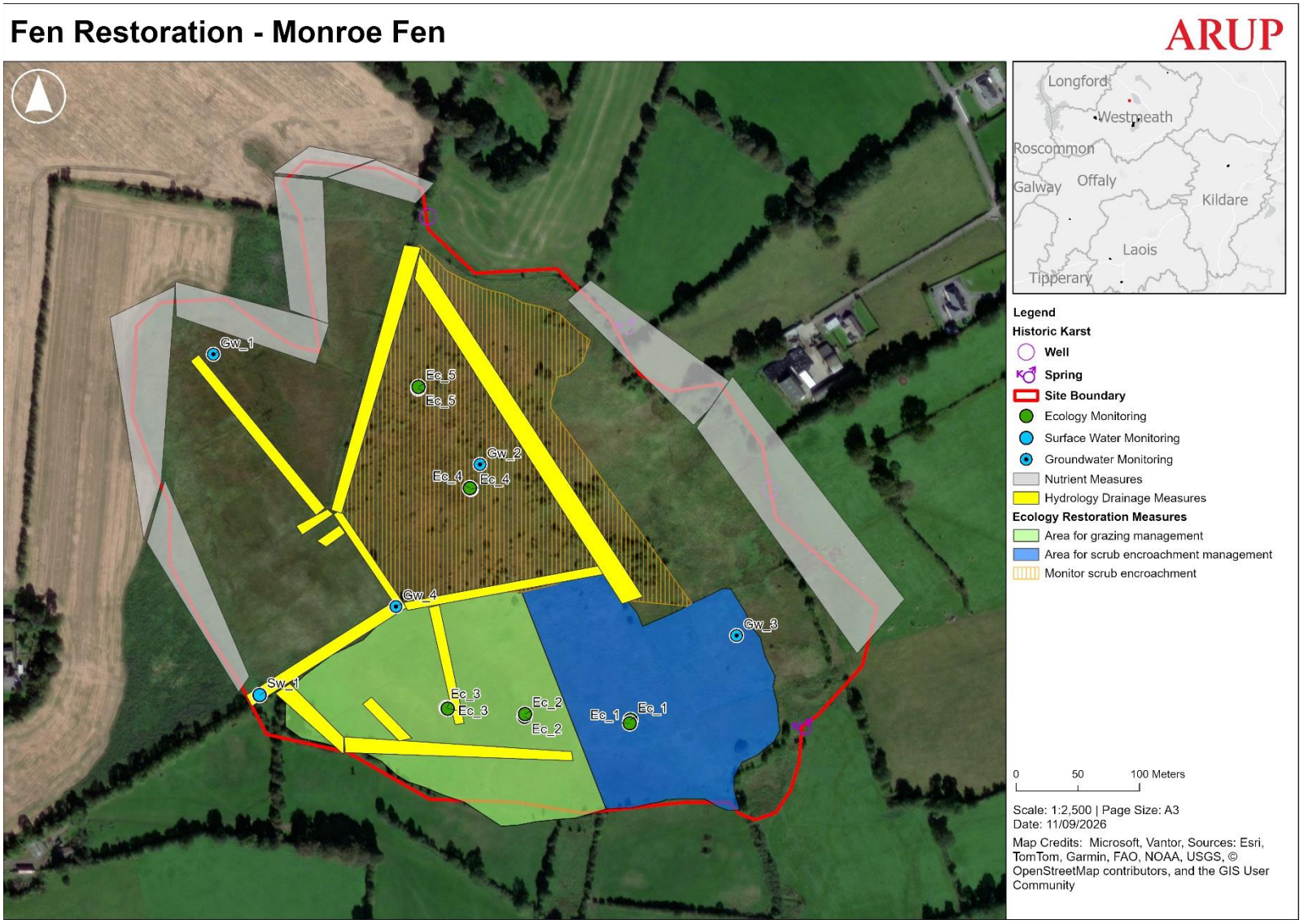


Figure 9-2: Restoration measures and monitoring for Monroe fen

Appendix D – Drainage Management Plan

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan			
Site name	Monroe Fen		
County	Westmeath	NFS site No.	104006
Catchment overview:			
The site sits in a depression at an elevation of 100 mOD and is surrounded by areas of higher elevation, up to 169 mOD, except for the surface water discharge point to the west, where the elevation is at 100 mOD. The terrain within the site boundary is relatively flat ranging from 94 mOD to 96 mOD. The site is located within the 26F Upper Shannon Catchment and the River Inny_080 is observed to the west of the site and is flowing towards Lough Iron, located north of the site.			
WFD catchment	26F Upper Catchment	WFD Sub-catchment	Inny [Shannon]_SC_040
Drainage Area	No	Drainage District	None
Responsible authority	Westmeath County Council	Maintenance date	TBD
Surrounding landowners	Landowners and Mooland Farm Limited		
Wetland drainage			
Historical maps indicate that the area is associated with wet vegetation and shows a drain from northeast to southwest. There are also two springs and two wells located along the eastern border of the site. Currently the main drain cross the site and flows to southwest discharging at River Inny. There are other multiple drains within this site, especially to the northwest.			
Surface water inflow	Drain flowing from north	Surface water outflow	The western drain shows active flow towards the west/southwest with connects to the River Inny_080.
Groundwater inflow	Groundwater input through springs on the eastern boundary.		
Internal drains	One drain located in the northern area of the site which connects to the outflow drain located in the west.	Perimeter drains	None
On site hydrology measures			
On-site measure	Drain Blocking at multiple areas across the site Hydrological Monitoring	Role player	NPWS
Off-site hydrology measures			

<table>
<tr><th colspan="6">NPWS Tóchar Midlands Wetland Restoration Scheme
Fen Restoration Plan: Drainage Management Plan</th></tr>
<tr><td>Off-site measure</td><td colspan="2">Avoid creating new drainage channels</td><td>Role player</td><td colspan="2">NPWS</td></tr>
<tr><td colspan="6">Off-site nutrient measures</td></tr>
<tr><td>On-site measure</td><td colspan="2">Vegetation buffer in the northwestern area</td><td>Role player</td><td colspan="2">NPWS</td></tr>
<tr><td colspan="6">Water Monitoring</td></tr>
<tr><td colspan="6">Groundwater and surface water monitoring in a network of piezometers at selected locations within the site to monitor changes to water to establish if onsite measures area required such as drain blocking.</td></tr>
<tr><td>Indicator</td><td>Water level</td><td>Location</td><td>Various locations across site</td><td>Role players</td><td>NPWS</td></tr>
<tr><td colspan="6">A hydrological monitoring programme will be implemented, including the installation of piezometers. The network will include four piezometers located across the eastern, southeastern and northwestern area to observe the water level within the site and the water quality.

Surface water monitoring will form part of the monitoring programme and will be undertaken at locations along the outflow drain. The monitoring data will be used to assess changes in drain water levels and evaluate the effectiveness of the proposed drain-blocking measures in raising water levels within the site.

Rainfall and evaporation monitoring is proposed using the nearby Met Eireann weather station at Mullingar.</td></tr>
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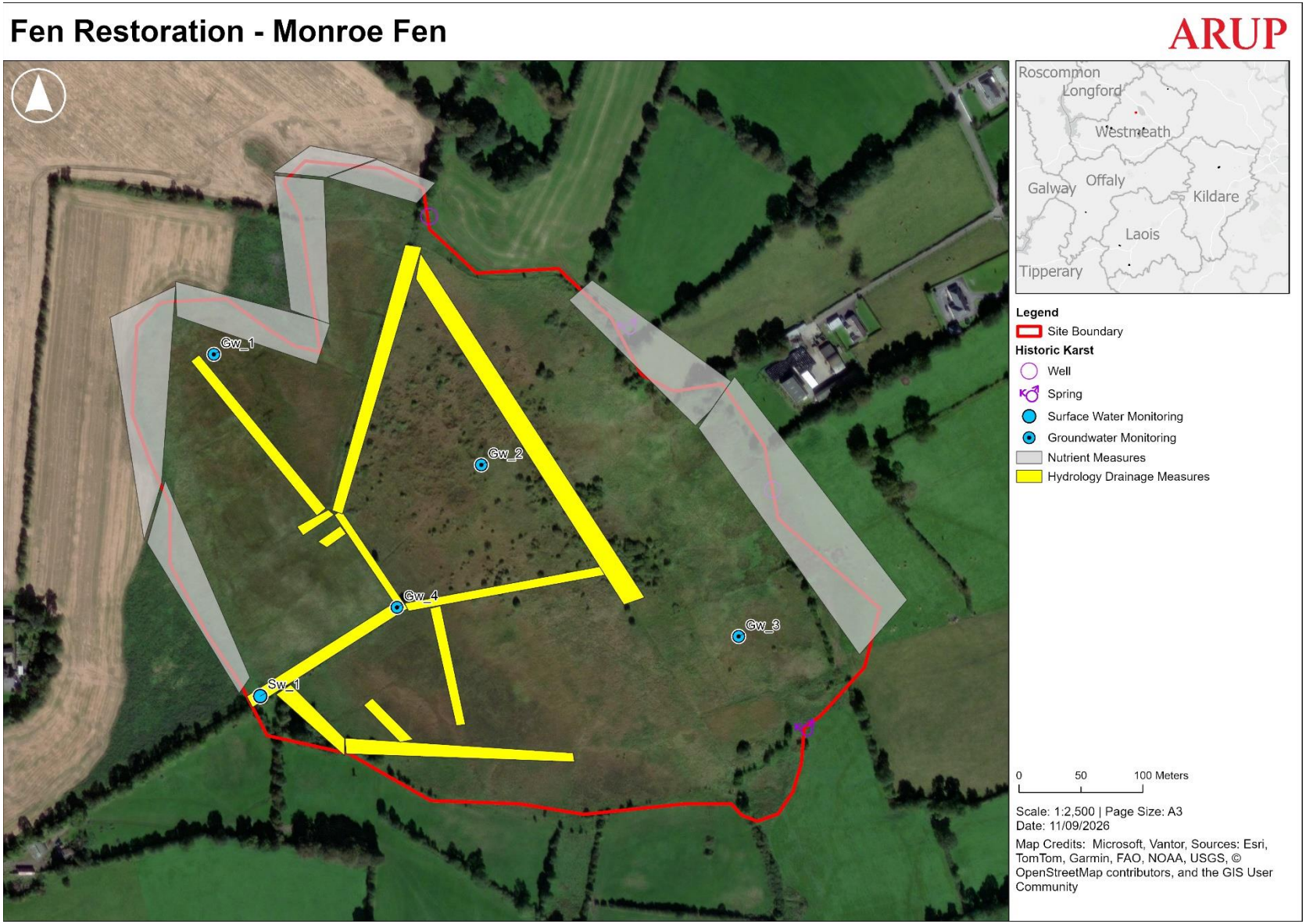


Figure 1: Hydrology measures and monitoring at Monroe fen