National Parks & Wildlife Service

Tóchar Midlands Wetland Restoration Scheme

Mannin

NFS site No.

109005

pNHA 000868

Fen Restoration Plan

July 2026

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National Parks and Wildlife Service

Fen Restoration Plan

Mannin - pNHA (000868)

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Executive Summary

Mannin is located approximately 3 km east of Borris-in-Ossory, Co. Laois and has been designated as a proposed Natural Heritage Area (pNHA) for the wetland habitats present within the site. These habitats include Annex I quality 7140 Transition mire, 7230 Alkaline fen, 7210 Cladium fen and 91E0 Alluvial forests. The site is dominated by rich fen which includes the Annex I quality 7230 Alkaline fen and patches of 7210 Cladium fen, with small areas of 7140 Transition mire. Other habitats include scrub, wet grassland, wet woodland, raised bog, and wet heath. These habitats are of significant ecological value and support biodiversity, improve water quality, store carbon, and contribute to flood mitigation.

The ecological condition of these habitats is variable across the site, with higher quality fen vegetation associated with wetter areas and evidence of localised degradation in relatively drier areas. The assessment identifies a number of key pressures affecting the hydrological functioning and ecological condition of fen habitats at the site. These pressures act primarily through alteration of water levels and vegetation structure, resulting in changes to species composition and habitat condition. The assessment primarily considers the following pressures, which may be affecting the hydrological function and favourable condition of the fen habitats:

- Drainage
- Scrub encroachment
- Abandonment of traditional grazing regimes (undergrazing)
- Poaching

Artificial drainage lowers local water tables and reduces groundwater influence, leading to drying of fen habitats and associated changes in vegetation composition. Reduced grazing pressure allows the development of rank vegetation and promotes scrub establishment, while trampling in wetter areas can result in localised poaching and damage to vegetation structure. These pressures have degraded the habitat quality and threaten the species and ecological functions the site supports.

Actions of the Fen Restoration Plan

The restoration plan for Mannin sets out a coordinated series of measures to address the key pressures affecting the site and to support the recovery of its wetland habitats.

The key action of this plan is a programme of hydrological monitoring to improve understanding of groundwater and surface water interactions to determine the role of the drainage network in controlling water levels within the fen.

The results of this monitoring programme will inform future hydrological restoration measures, including whether water level management is required. If hydrological restoration measures are progressed, scrub encroachment monitoring and, where necessary, targeted scrub removal would also help improve fen condition.

Vegetation management measures include targeted scrub monitoring and removal, where necessary, and the implementation of appropriate grazing management to address both undergrazing and localised poaching pressures. Grazing intensity will be informed by monitoring to ensure that vegetation structure is maintained without causing damage to sensitive wet areas.

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 measurable benefits for fen habitats and associated species at Mannin. Improved understanding of hydrological conditions will support the identification of appropriate management actions to maintain or restore suitable wet conditions across the site.

Targeted vegetation management will reduce scrub encroachment and control rank vegetation, helping to maintain open fen structure and support characteristic species assemblages. Collectively, these measures will enhance habitat condition and resilience, supporting the long-term conservation of Annex I fen habitats and associated biodiversity.

The monitoring data indicate that the highest quality fen vegetation occurs in the wettest areas of the site, confirming that hydrological conditions are the primary control on habitat condition at Mannin.

Habitat and Restoration Map

The Annex I habitats recorded during the 2022 NFS are 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 quality habitats mapped and recorded during the 2022 NFS surveys. Note the % refers to the % of the Annex I quality habitat present within the mapped polygon. See Table 9-1 for the full directory of habitat codes and names.

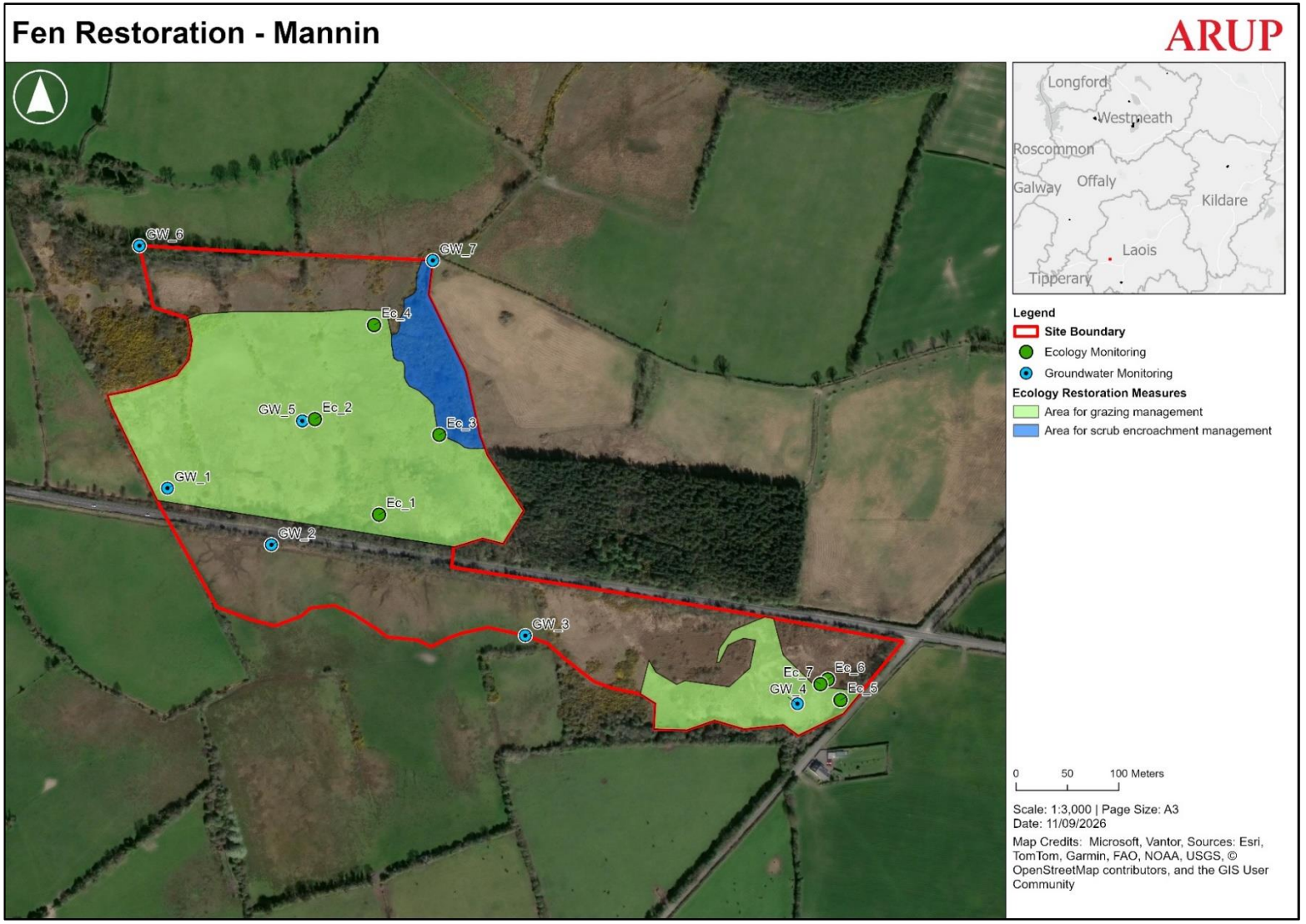


Figure 1-2 Proposed restoration measures for Mannin

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.

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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 and management of fen habitats within the Mannin proposed as a Natural Heritage Area (pNHA). The FRP focuses on habitats of Annex[1] I quality[2] including 7140 Transition mire and quaking bog (hereafter referred to as 7140 Transition mire), Annex I quality 7230 Alkaline fen, Annex I quality 7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (hereafter referred to as 7210 Cladium fen) and Annex I quality 91E0 Alluvial Woodland.

The site is recognised for the presence of habitats corresponding to the EU Annex I habitat types, although it is not designated as a Special Area of Conservation (SAC). Mannin (pNHA 000868) is located approximately 3 km east of Borris-in-Ossory, County Laois, and occurs on both sides of a regional road (R434). The pNHA covers a total area of approximately 16.80 ha and is dominated by a fen habitat with a range of associated peatland and wetland habitats also present (Brophy et al, in prep).

According to the National Fen Survey (NFS) carried out in 2022 (Brophy et al., In prep) the total estimated extent of Annex I quality habitats within Mannin comprises approximately 0.28 ha of 7140 Transition mire, 1.88 ha of 7210 Cladium fen, and 8.11 ha of 7230 Alkaline fen.

The primary objective of the restoration actions proposed as part of this FRP is to maintain or improve the quality of existing areas of fen or improve the hydrological conditions that will allow an expansion of the measurable area of fen thus impacting on the favourable condition of the fen. However, in some areas, it must be recognised that restoration to increase areas of existing fen will not be possible due to unsuitable hydrological conditions, and the objective may simply be to ensure no further deterioration. Restoration actions are also expected to provide benefits to other wetland habitats mapped within the site, as described in Section 4.

Proposed restoration measures include hydrological monitoring to improve understanding of site water dynamics, alongside potential hydrological interventions where appropriate. Vegetation management measures include targeted scrub removal to reduce encroachment pressure on fen habitats as well as grazing management to address both undergrazing and localised poaching pressures. These measures will act to improve vegetation structure and support the maintenance of characteristic fen species.

1.2 Wider benefits of fen restoration

Fens are vital habitats due to their rich biodiversity, supporting a wide array of flora and fauna, many of which are rare or endangered. They act as natural water filters, purifying water by trapping pollutants and sediments, thus enhancing water quality downstream.

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

[2] Annex I quality habitats are habitats which meet the ecological characteristics of Annex I habitat types but occur outside designated Special Areas of Conservation.

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 minimise 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 Special Areas of Conservation (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.

The restoration of fen habitat at Mannin pNHA is likely to lead to improved water quality. A fen habitat that is functioning well 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). The overall conservation status is assigned as Bad for 7140 Transition mire, 7230 Alkaline fen and 7210 Cladium fen in the Article 17 report.

Table 1-1: National pressures to fen habitats

Habitat	Importance	Pressure
7140 Transition mire	High	PA09 Burning for agriculture PA22 Drainage for use as agricultural land PL02 Drainage (mixed or unknown drivers) K02 Drainage K04 Modification of hydrological flow
	Medium	PA08 Extensive grazing or undergrazing by livestock L02 Natural succession resulting in species composition change
7230 Alkaline fen	High	PA07 Intensive grazing or overgrazing by livestock PA22 Drainage for use as agricultural land
	Medium	PA08 Extensive grazing or under grazing by livestock PL02 Drainage (mixed or unknown drivers) to surface or ground waters
	Low	PE01 Roads, paths, railroads and related infrastructure

Habitat	Importance	Pressure
7210 Cladium fen	High	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)
	Medium	PA08 Extensive grazing or undergrazing by livestock
	Low	PA07 Intensive grazing or overgrazing by livestock

1.4 Legislative Context

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

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

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

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 habitat types) and Annex II species under the EU Habitats Directive, while Special Protection Areas (SPAs) are designated for Annex I bird species and migratory birds under the Birds Directive. For SACs, site-specific conservation objectives (SSCOs) are defined for the Annex I habitats and Annex II species for which the site is selected.

Although Mannin is not designated as a SAC or SPA and therefore has no formal qualifying interests or SSCOs, the site supports habitats of Annex I quality[2]. In the absence of SSCOs, the published conservation objectives and condition attributes for Annex I fen habitats have been used as an appropriate and recognised reference framework to inform the identification of pressures, the development of restoration measures, and the assessment of restoration outcomes within this FRP.

This approach ensures that proposed actions are aligned with national conservation standards for fen habitats and are consistent with best practice restoration principles.

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 Mannin pNHA, and the pressures and threats reported for the fen habitats within the site.
- Section 3 outlines the findings from the land and water desktop and site monitoring surveys that were carried out to inform the development of this FRP.
- Section 4 outlines the findings from the ecological desktop and site monitoring surveys that were carried out to inform the development of this FRP.
- Section 5 provides a summary of the key pressures identified by this FRP report that are affecting fen condition.
- Section 6 outlines the key restoration measures proposed by this FRP.
- Section 7 outlines additional considerations to inform the development of the FRP.
- Section 8 outlines key players in the FRP, summarises restoration actions proposed, habitats that will benefit and further steps required to prepare for implementation.

Restoration actions proposed by this FRP assessment have been mapped in GIS format and delivered to NPWS in accordance with NPWS data standards. This includes detailed mapping of the key pressures addressed by this assessment, detailed mapping of proposed restoration actions, ecological survey results and referenced sensitivity areas. GIS Shapefiles which accompany this report include all relevant data on referenced species.

2 Site Overview

2.1 Mannin

Mannin is located 3 km east of Borris-in-Ossory, Co. Laois, extending on both sides of a regional road (R434) (Figure 2-1). The site occupies a lowland setting within a predominantly agricultural landscape characterised by improved pasture, with adjacent land uses including conifer forestry and areas of wet grassland.

The site is dominated by fen habitat, principally rich fen, including extensive areas of 7230 Alkaline fen. Patches of 7210 Cladium fen occur locally within the alkaline fen matrix, and small areas of 7140 Transition mire are also present. In addition, areas of non-Annex rich fen occur, some of which are rank in structure. Other habitats recorded within the site include scrub, wet grassland, wet woodland, raised bog and wet heath.

Management across much of the site is limited. Light cattle grazing occurs intermittently in the southwest of the site, while the field at the extreme south-west comprises predominantly mown and grazed wet grassland with a narrow fen margin along its wettest edge. Grazing is also evident in the northern part of the site, including encroachment into areas of 7230 Alkaline fen and 7210 Cladium fen. Drains are confined to the southwest of the site where the land is more actively farmed. A deep vegetated drain runs parallel to the road here.

Mannin is situated within the River Nore catchment and is primarily drained by tributaries of the Nore_060 River Waterbody, including the Mannin and Ballykeevan streams. For the purposes of the Water Framework Directive, the site lies within the Nore_SC_010 sub-catchment. Figure 2-1 outlines the location and extent of Mannin pNHA.

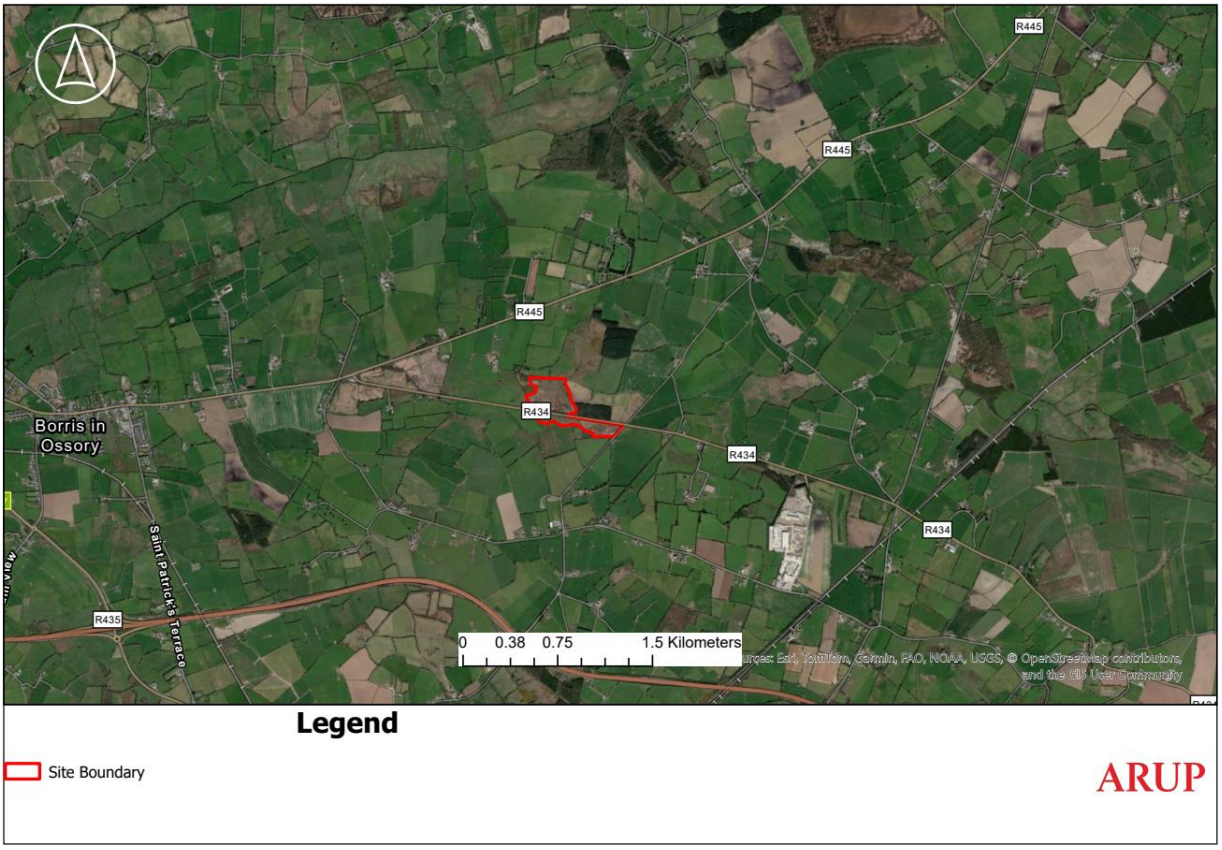


Figure 2-1: Site Location Map

2.1.1 Fen Condition Assessment

Mannin was surveyed as part of the NFS on 25 and 26 of July 2022 (Brophy et al., In prep). Fen habitats within Mannin pNHA retain areas of Annex I quality vegetation but show evidence of localised modification and degradation. The site supports a diverse assemblage of characteristic fen species, including brown mosses, charophytes and a range of positive indicator vascular plants, indicating the presence of base-rich, groundwater-influenced conditions across much of the site.

Drainage features recorded during the survey are fully vegetated, infilled or quaking, where historic drainage remains present. The presence of drains represents a potential pressure on fen condition, particularly in the southwestern part of the site.

Localised pressures affecting habitat condition include scrub encroachment (notably birch *Betula spp*., and gorse *Ulex europaeus*), uneven grazing pressure, and light trampling/poaching in places. Management divisions created by fencing may also contribute to variable vegetation structure across the 7230 Alkaline fen. Invasive species pressure is limited but present, with giant hogweed (*Heracleum mantegazzianum)* recorded within areas of alluvial woodland.

2.1.2 Site-specific conservation objectives

As Mannin is not a SAC, it does not have Site-Specific Conservation Objectives (SSCO). While the attributes and targets for Annex I habitats are site-specific and cannot be directly applied to Mannin, published conservation objectives and condition assessment attributes for Annex I fen habitats have been used as a reference framework to guide habitat management and inform measures aimed at improving the condition of the fen habitats towards favourable conservation status. This includes measures such as maintaining appropriate hydrological levels and quality or abundance of vegetation communities and appropriate physical structure relevant to Annex I quality habitats.

2.1.3 National Fen Survey (Brophy et al., In prep)

The NFS (Brophy et al., In prep) identified three primary pressures and threats across the Mannin site:

- Drainage
- Extensive grazing
- Mowing

The results of a field evaluation completed in 2026 and undertaken to inform the restoration planning process, are presented in Section 5 of this report.

The NFS recorded the site as being mostly unmanaged, with extensive cattle grazing occurring across parts of the site and a small amount of mowing noted in the southwestern area. No site-specific restoration or conservation measures were proposed within the NFS report, and overall baseline information to inform restoration planning was limited.

As part of the NFS condition assessment, 7210 Cladium fen was assessed as ‘Unfavourable-Inadequate’ with respect to structure and functions, while 7230 Alkaline fen was assessed as ‘Unfavourable-Bad’ for the same parameter. No condition assessment was recorded for 7140 Transition mire. These assessments indicate that restoration measures will be required to improve

habitat structure and function and to prevent further deterioration of the Annex I quality fen habitats present at the site.

3 Land and Water

3.1 Desktop Study

3.1.1 Meteorological Conditions

Understanding long-term meteorological patterns is key for informing effective fen restoration planning, particularly with respect to hydrological dynamics. To support this, historical precipitation data over the past 30 years from the closest Met Éireann weather station, Roscrea (New Road), has been reviewed to assess seasonal variability in rainfall at the site and surrounding areas (Met Eireann, 2025).

Two datasets have been visualised: (1) average monthly precipitation (mm), incorporating a 30-year period to show seasonal distribution patterns (Figure 3-1) and (2) total annual precipitation (mm) for each year within the 30-year record (Figure 3-1), to identify longitudinal trends. This information is important to assess water availability and to evaluate the feasibility and sustainability of restoration actions aimed at restoring or maintaining suitable hydrological conditions.

The 30-year monthly rainfall data indicate that rainfall is typically highest in late autumn and winter (with the greatest monthly averages in October, November and December), and lowest in spring (notably April). The rainfall data also indicates some variability around these averages, with monthly totals ranging from very low values to very high monthly totals exceeding 200 mm in the long-term record (Figure 3-1).

Total annual precipitation also varies between years, indicating inter-annual variability that is relevant when considering baseline hydrological conditions and the application of the restoration measures under both wetter and drier climate conditions (Figure 3-2).

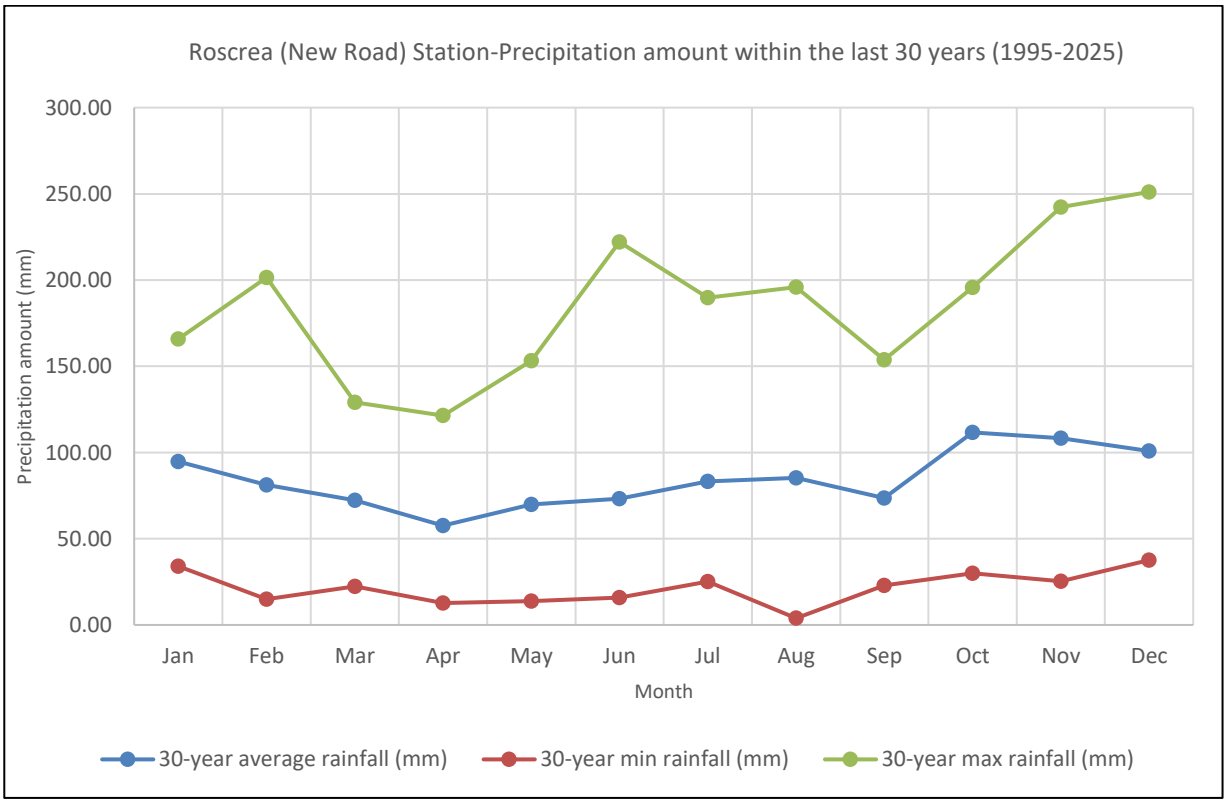


Figure 3-1: Roscrea (New Road) Station – Precipitation amount (mm) within the last 30 years (1995-2025)

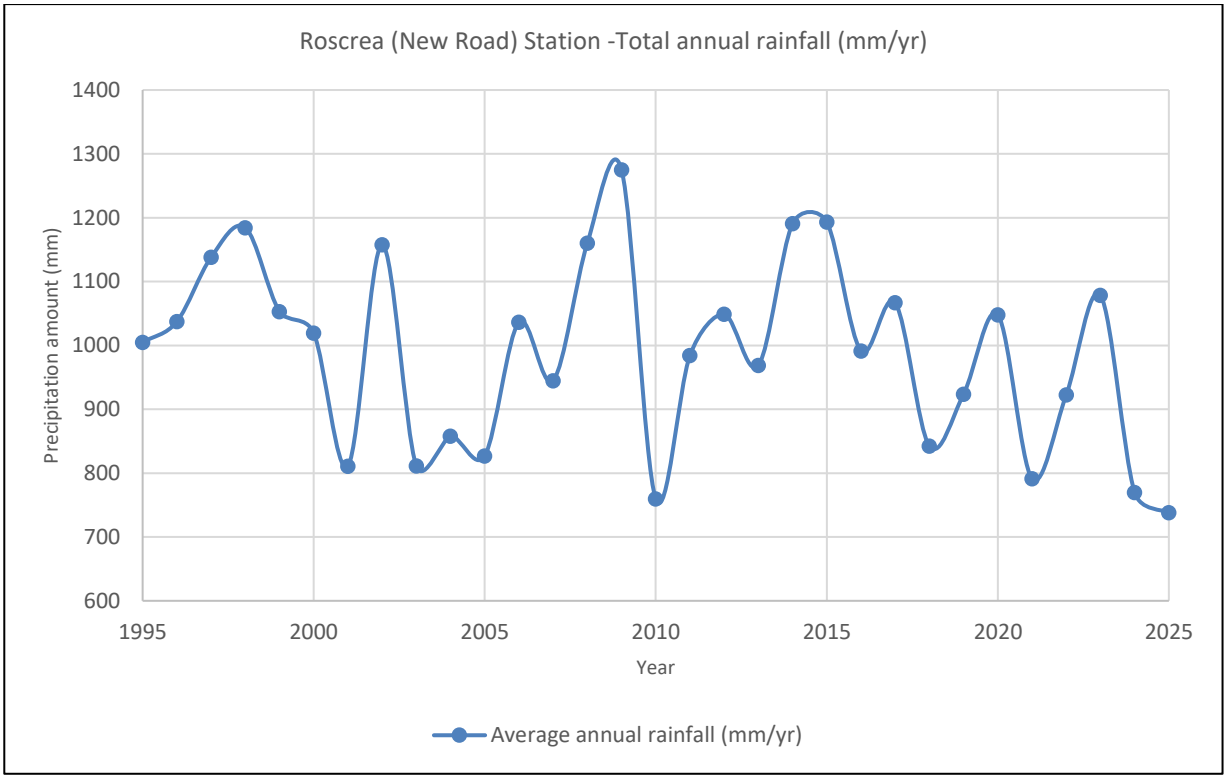


Figure 3-2: Roscrea (New Road) Station – Total annual rainfall (mm/yr)

3.1.2 Hydrogeological Setting

According to the Bedrock Geology 100K layer (GSI), the site is underlain by the Ballysteen Formation, characterised by dark muddy limestone and shale, as shown in Figure 3-3. Bedrock outcrops are located to the northwest and south/southeast of the site, at a distance of approximately 450 m and 400 m, respectively.

The area is underlain by a Locally Important bedrock aquifer which is moderately productive only in local zones (LI), as shown in Figure 3-4. Most of the flow in this type of aquifer is in the upper 15 m, in the zone that consists of weathered layer and connected fracture zone below. The site area is located within the Dinantian Lower Impure Limestone (DLIL) hydrostratigraphic rock unit.

The site is part of the Rathdowney groundwater body, is currently classified with a 'good' status and is assessed as not at risk of failing to meet its Water Framework Directive (WFD) objectives.

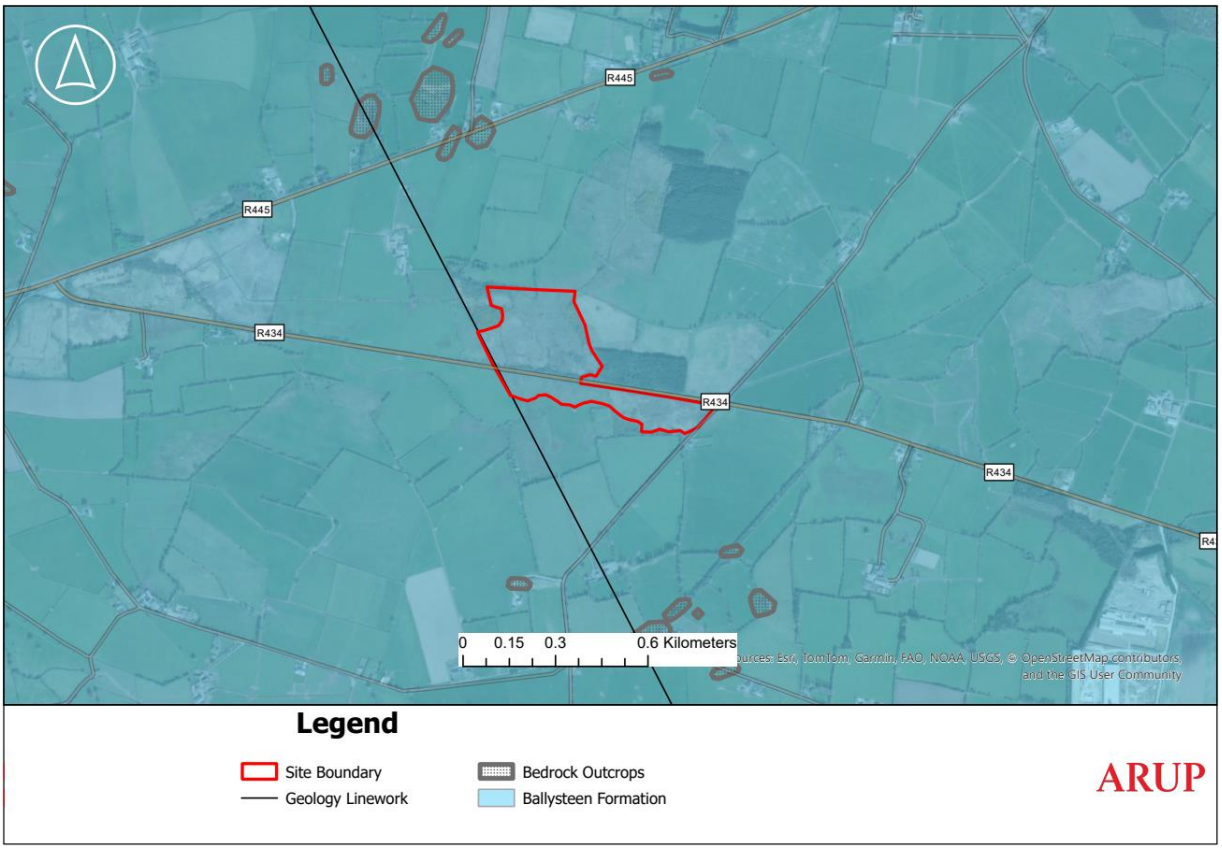


Figure 3-3: Bedrock Geology of Mannin

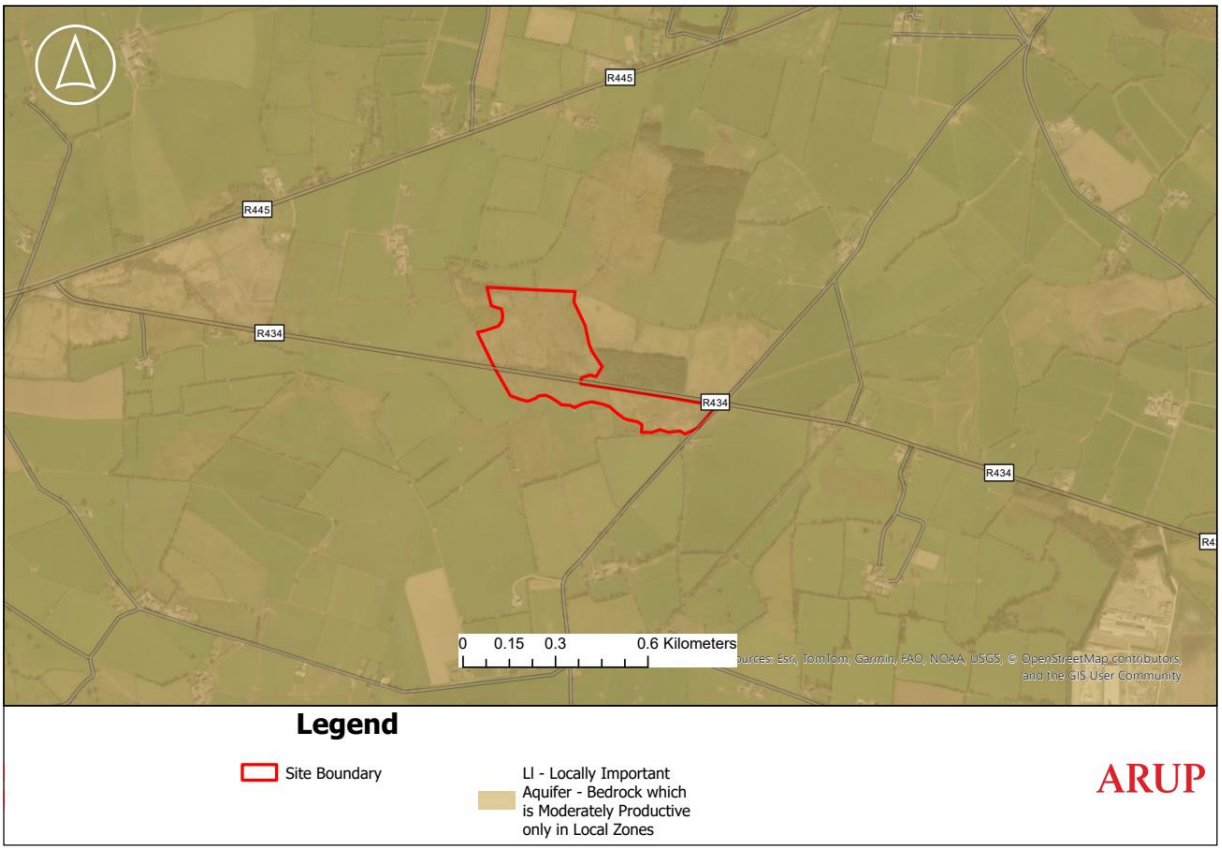


Figure 3-4: Aquifer classification and karst underlying Mannin

Quaternary sediments in the area comprise cut over raised peat. Till derived from limestones is identified in the surrounding areas. To the east of the site, there are gravels derived from limestones, along with lacustrine sediments. The gravel deposits predate the formation of the peat, having formed through glacial retreat, whereas the peat accumulated in the post-glacial, warmer climatic period. The subsoil type underlying the site is presented in Figure 3-5.

Soil type in Mannin observed during the NFS (Brophy et al., In prep) included peat with depths ranging from 16 cm to 146 cm. The Teagasc soils map notes that the soil within the site is mostly characterised by cut peat, with smaller areas of mineral poorly drained, shallow peaty poorly drained mineral and peaty poorly drained mineral soils.

Groundwater vulnerability within the site is moderate, with high groundwater vulnerability in the surrounding areas underlain by gravels and till. There is also an area of extreme vulnerability in the northwest and south of the site, where rocks are near or at surface. This pattern is reflected by the recharge rates, which are higher in gravels and till (151 to 200 mm/year) and lower in the peat (1 to 50 mm/year) (Figure 3-6).

The groundwater vulnerability for the site is presented in Figure 3-6 and the groundwater recharge is presented in Figure 3-7.

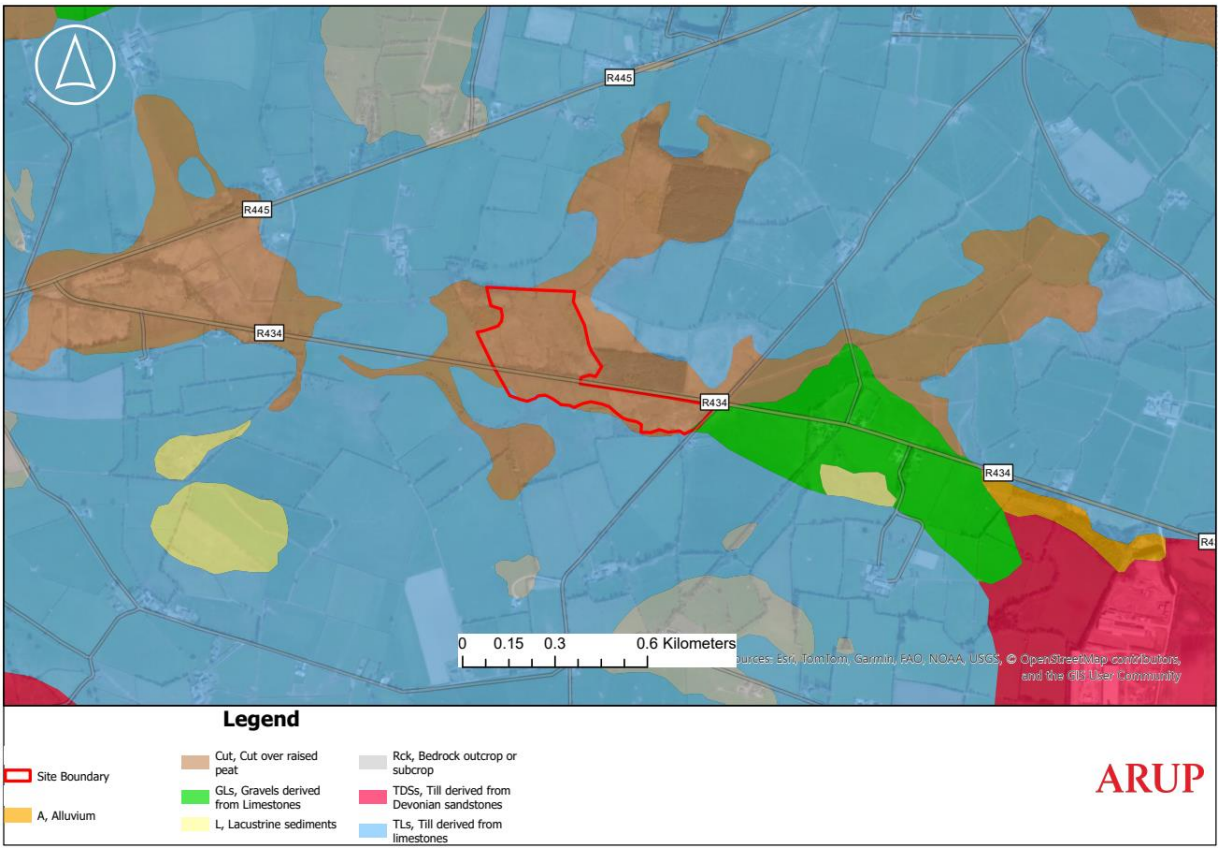


Figure 3-5: Subsoil type underlying Mannin (Source: GSI Quaternary map)

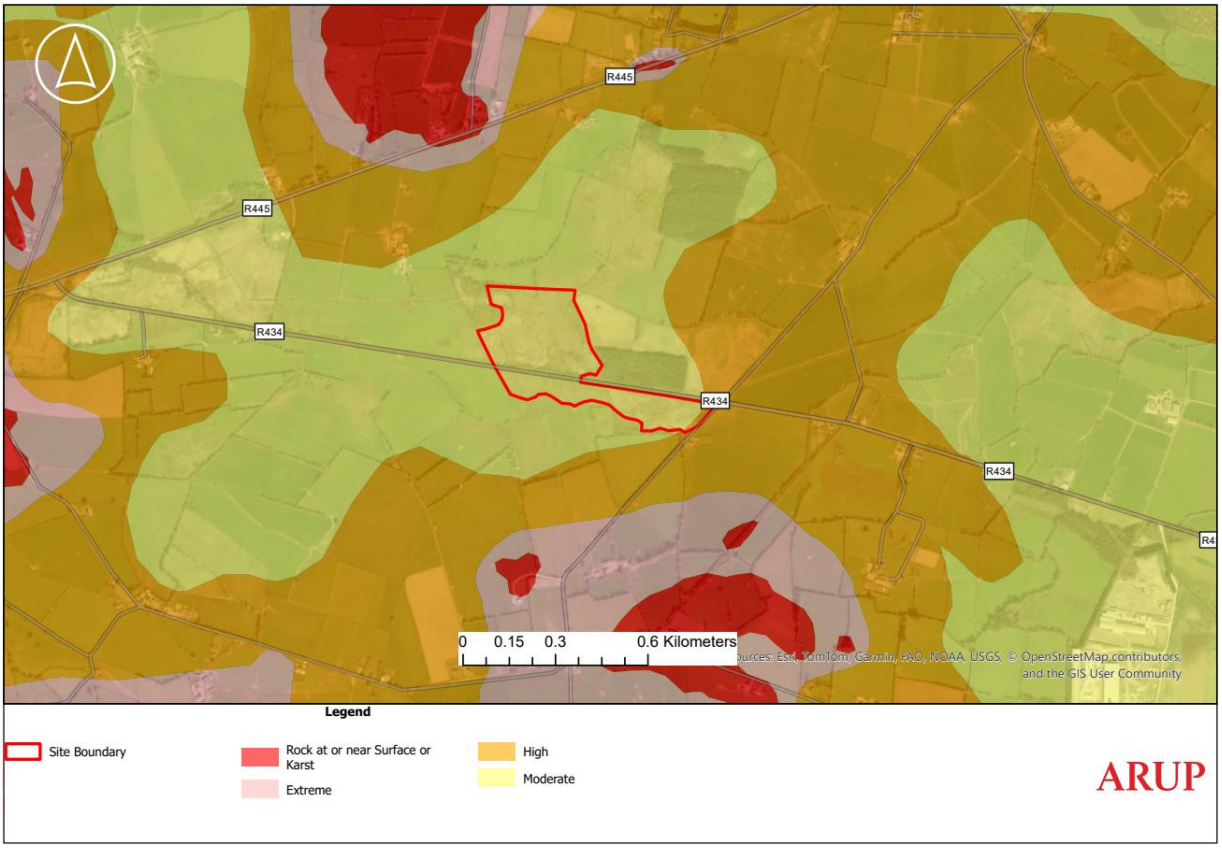


Figure 3-6: Groundwater vulnerability map for Mannin (Source: GSI)

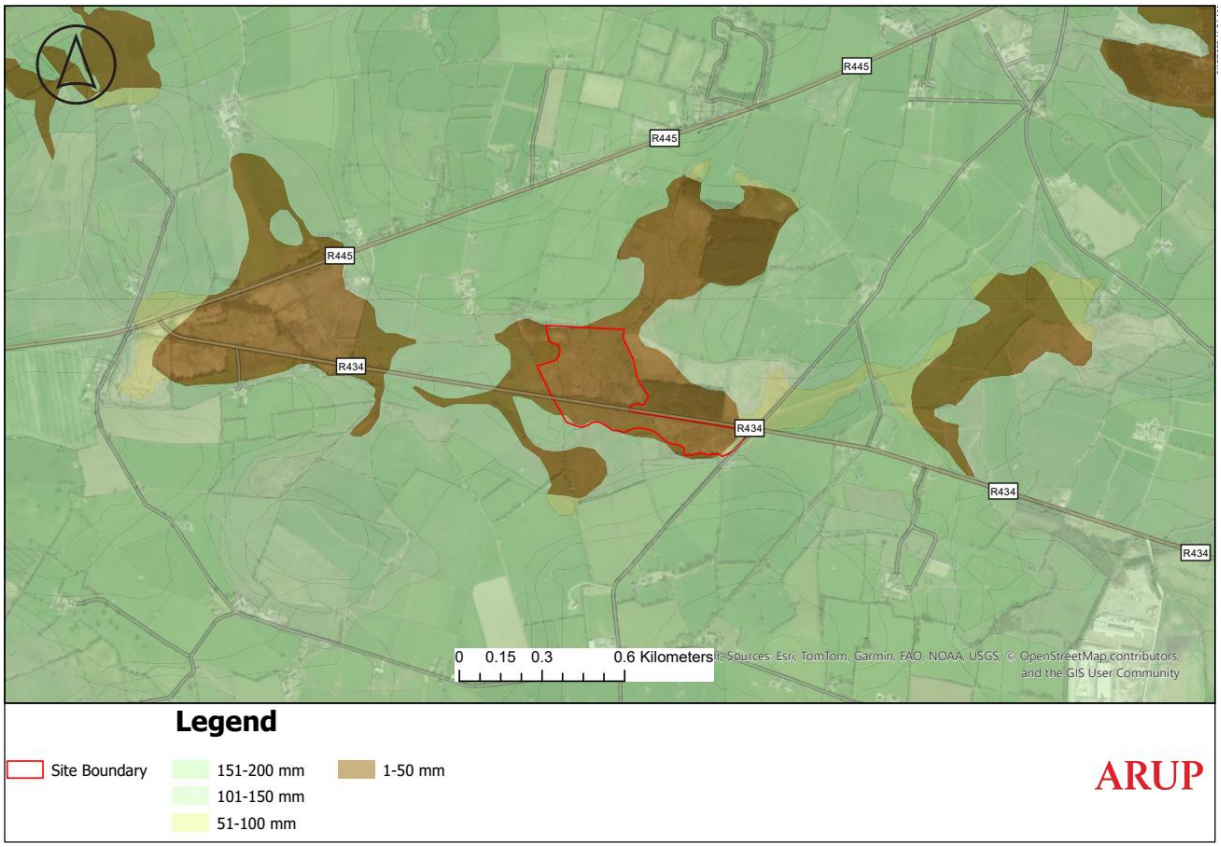


Figure 3-7: Groundwater recharge map for Mannin (Source: GSI)

3.1.3 Topographic and Surface Water Drainage

The site is located within the Nore WFD Catchment and the Nore_SC_010 WFD subcatchment (Figure 3-8).

This catchment covers the area drained by the River Nore and its tributaries flowing into tidal waters between its confluence with the River Barrow at Ringwood and the Barrow railway bridge at Drumdowney, Co. Kilkenny. The site drains towards the Nore_060 River Waterbody, via local streams including the Mannin and Ballykeevan. The WFD River waterbody is classed at 'good' WFD Status and 'not at risk' of not achieving its WFD objective.

The topography of the site is of a gentle slope decreasing from north to south and the altitude ranges from 114 mOD to 117 mOD. In addition, the area presents a relatively flat profile when viewed along the west-east direction. Beyond the site boundary, the landscape becomes notably elevated in the northwest and south. These areas show bedrock outcrops rising to approximately 160 mOD in the south and 130 mOD in the northwest.

Review of historical and current hydrological data suggests that drainage flows towards the north-west (Figure 3-9). Maps dating back to the late 1800s and early 1900s indicate the presence of two springs, located to the southeast and northwest of the site. This information is supported by the GSI mapping, which identifies two springs in the southeast: one for agricultural use only (2017NEW129) and other for domestic use only (2017NEW128). In addition, GIS mapping indicates a potential spring/well in the northwest area, however, no further information on this is available.

According to the National Fen Survey (NFS) carried out in 2022 (Brophy et al., In prep) there are several drains along the south and southwest boundaries where the land is more actively farmed. A deep vegetated drain runs parallel to the road in this area. There is also a mapped drain located to the northeast of the site, which may represent the water input for the site. Overall, the predominant direction of surface water flow across the site is towards the west and northwest, which discharge to Mannin stream and Ballykeevan stream and therefore to River Nore.

The surface water drainage is presented in Figure 3-10.

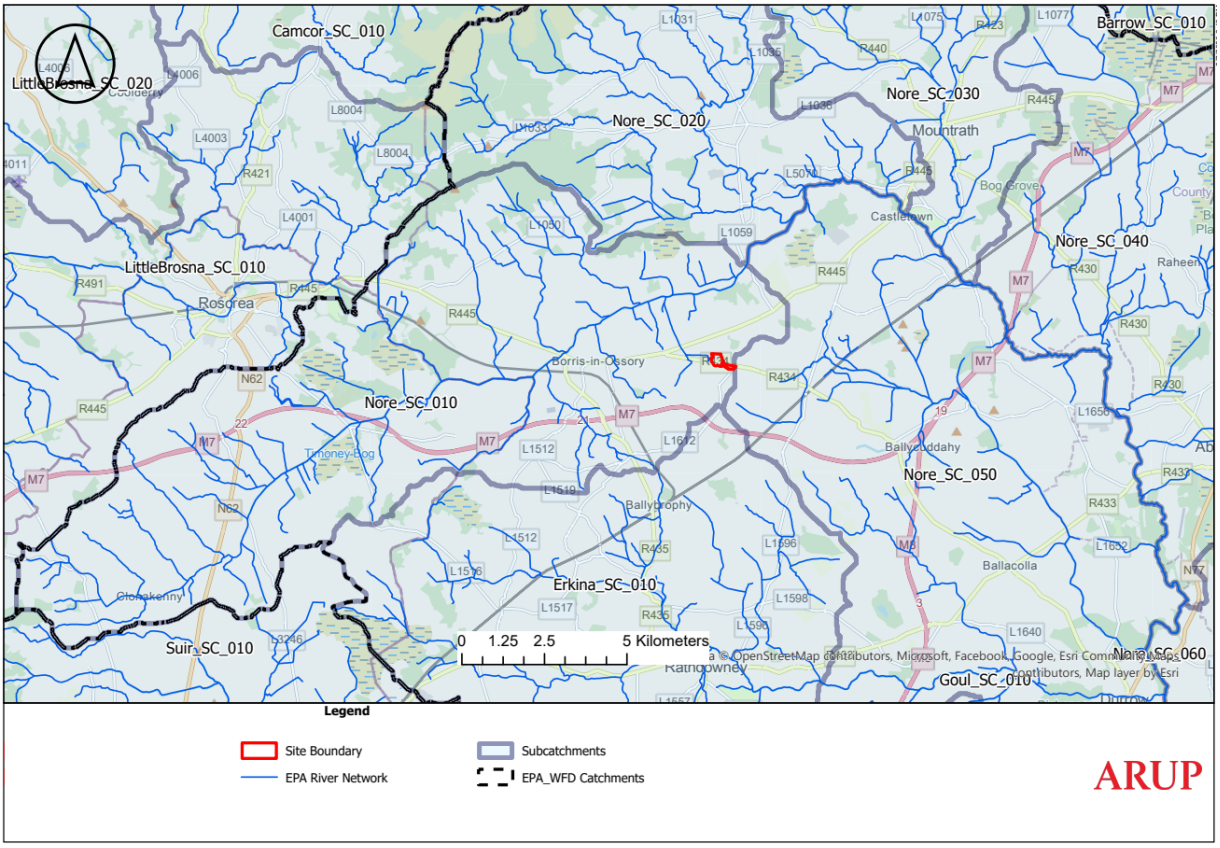


Figure 3-8: WFD Catchment and River sub-basin (EPA, 2025)

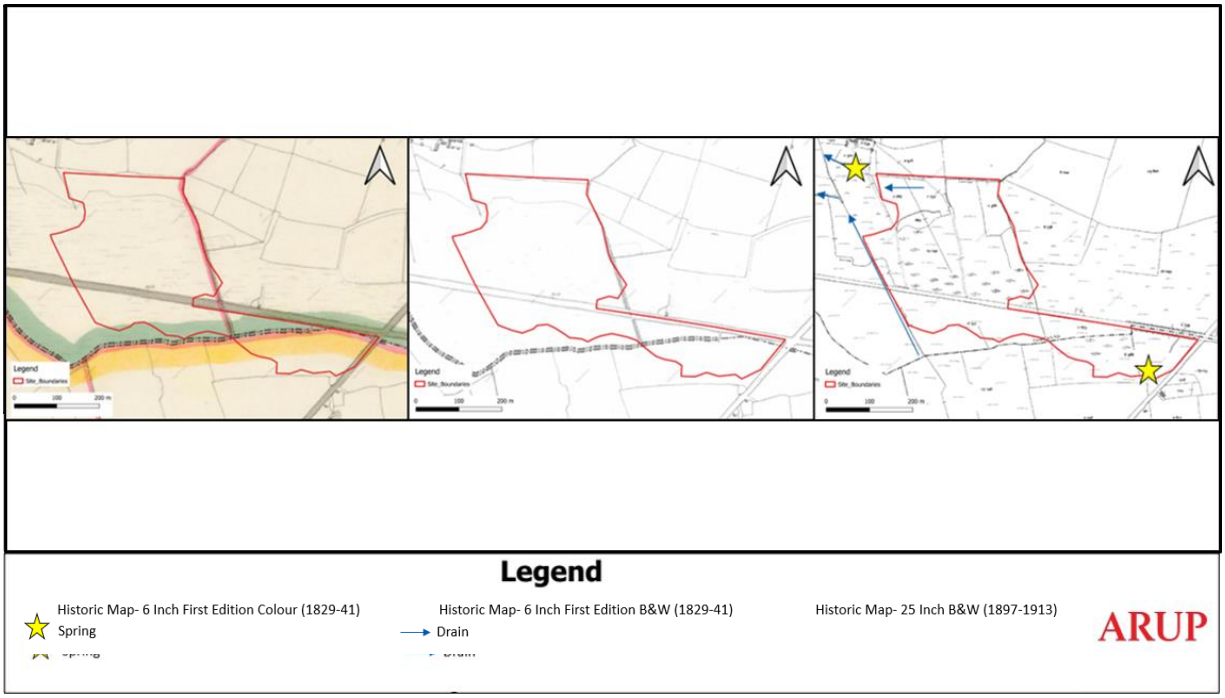


Figure 3-9: Historical water distribution and retention within wetland (Tailte Éireann Historical mapping)



Figure 3-10: Mapped drainage network of Mannin

The mapped Wetness Index classifies the site as temporarily wet, indicating periods of saturation and dryness over the period 2012 to 2018. This pattern suggests a mosaic of variable soil moisture conditions, supporting intermittent wetland characteristics across the site (Figure 3-11).

Total productivity mapping of Mannin follows the site's hydrogeological variation. Total productivity ranges from moderate, typically associated with semi-degraded peatlands habitats impacted by drainage and vegetation encroachment; to low, which is characteristic of relatively intact peatland. These areas exhibit nutrient-poor, water saturated soil and are dominated by Sphagnum mosses, indicating a functioning peatland system (Figure 3-12).

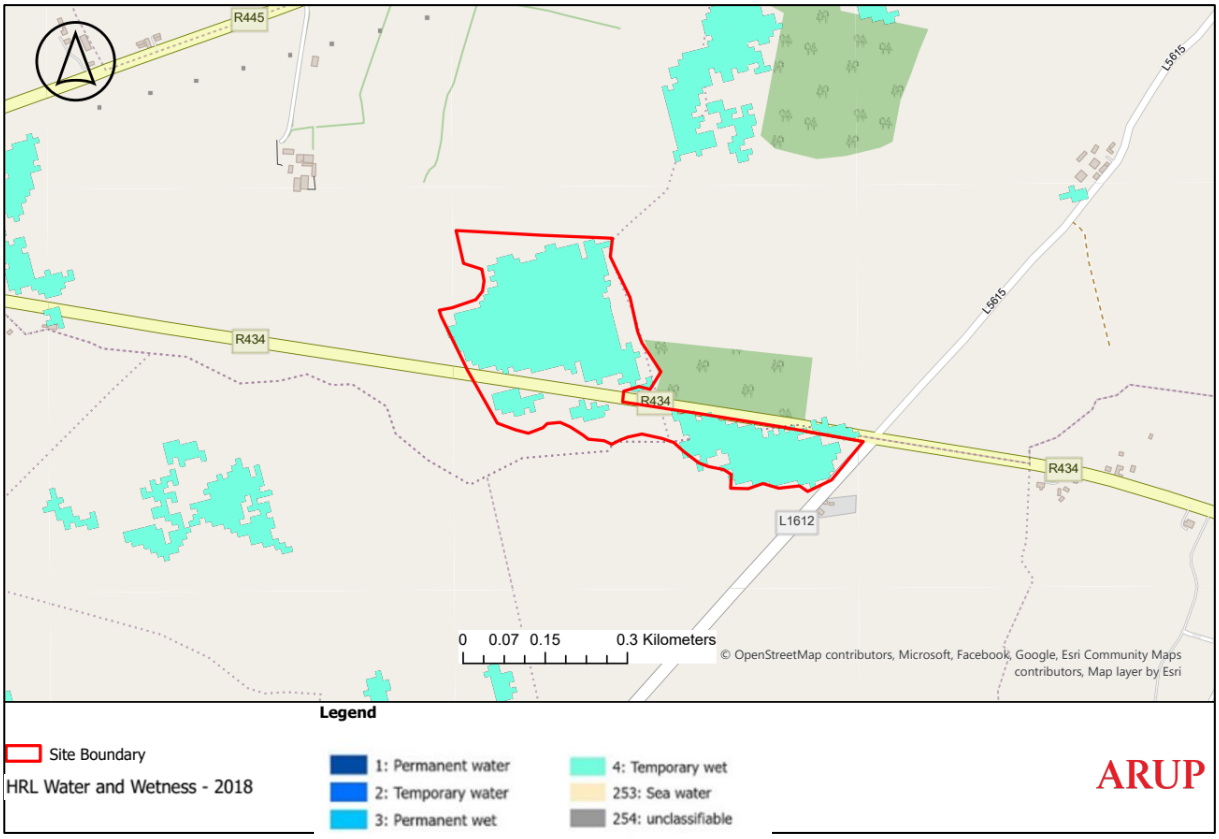


Figure 3-11: HRL Water and Wetness – 2018 of Mannin (Copernicus, 2025)

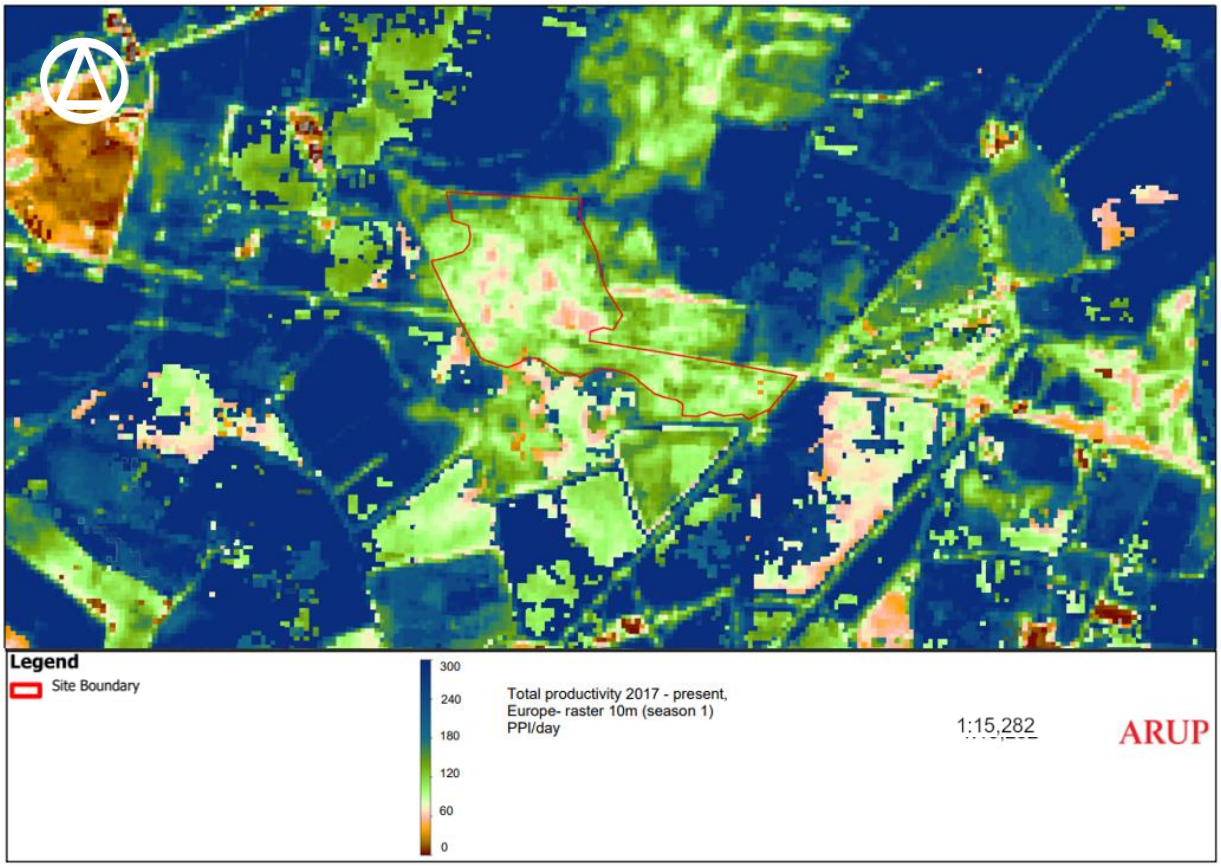


Figure 3-12: Total Productivity 2017 -present, Europe – raster 10m (season 1) of Mannin (Copernicus, 2025)

3.1.4 Land use Pressures and Water Quality

Pollution Impact Potential (PIP) maps (EPA 2025) show the highest risk areas in the landscape for losses of Nitrate and Phosphorus to waterbodies. The PIP models estimate the annual nutrient losses from agricultural land using spatial data on farm management, soil and hydrogeology.

High risk areas for phosphorus loss are generally characterised by soils with poor drainage and the presence of predominant overland flow pathways. Such conditions facilitate the movement of phosphorus from the land surface into nearby waterbodies. According to the maps, phosphorus delivering flow paths are notably high across the site, with distinct variations in risk ranking. Specifically, Rank 3 areas are identified to the north of the regional road, while Rank 1 areas are mapped to the south of the road, denoting higher risk. Additionally, potential preferential pathways have been identified to the north of the site which may provide a pathway towards the fen, highlighting specific locations that could be targeted for measures. Flow delivery paths and points for Phosphorus are presented in Figure 3-13.

Freely draining soils and significant groundwater pathways are recognised as high-risk zones for nitrate losses. Within the context of Mannin site and its surroundings, the overall risk of nitrate loss is generally assessed as low. However, to the south and the northwest of the site, there are areas that may represent a more vulnerable zone for nitrate loss. PIP maps for Phosphorus and Nitrate are presented in Figure 3-14 and Figure 3-15, respectively.



Figure 3-13: PIP- P - Flow delivery paths and points for Phosphorus (EPA, 2021)

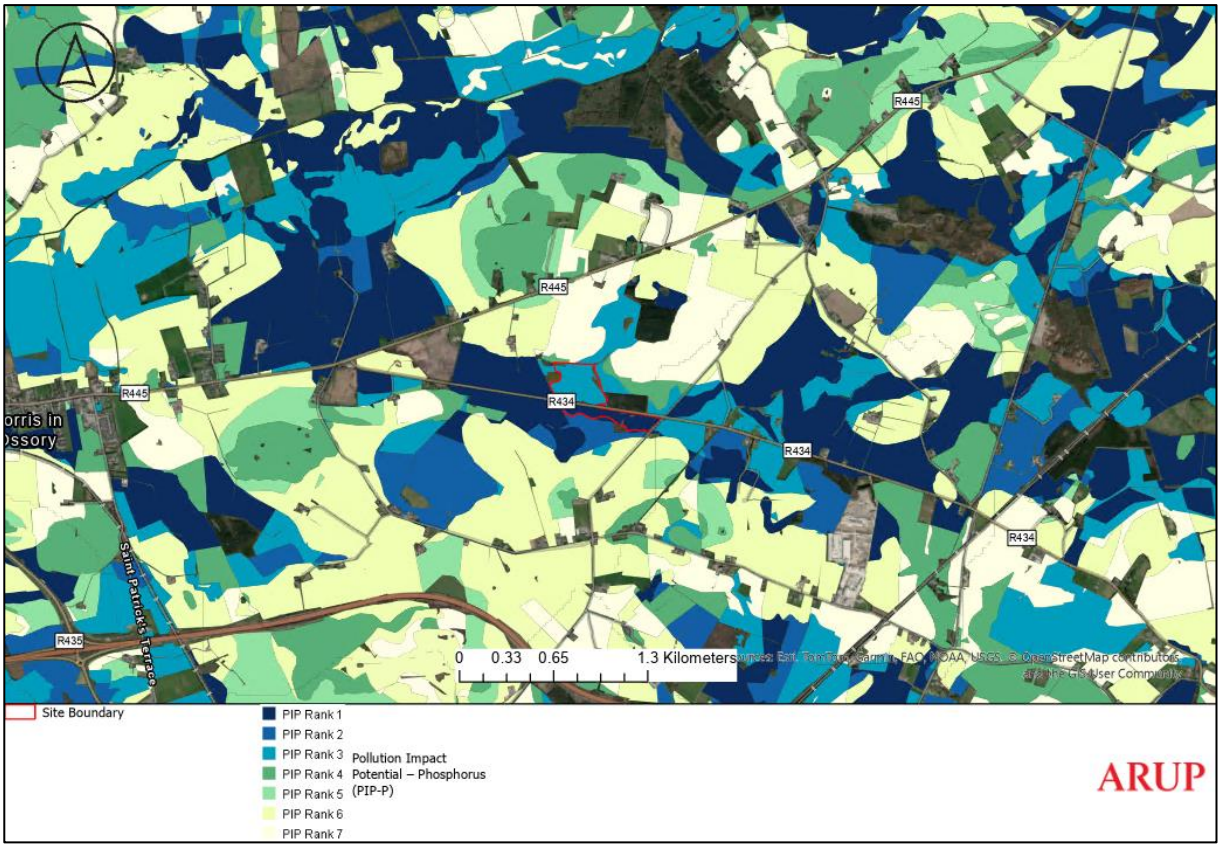


Figure 3-14: PIP maps (Phosphorus) of Mannin



Figure 3-15: PIP maps (Nitrate) of Mannin

Figure 3-16 and Figure 3-17 show the Digital Terrain Model (DTM) map and the site photogrammetry of Mannin pNHA, both generated from LiDAR imagery. The imagery indicates that the most pronounced drains are located in the southern part of the site, south of the main road, as well along the western boundary where the drains flow towards the Mannin River. The northeast drain, which appears to represent the water input to the fen, is most distinct in the northeast and becomes progressively less defined towards the south. This observation is consistent with field survey findings. Near the main road, the drain becomes difficult to identity in the LiDAR data. Similarly, the drain running parallel to the main road in the southern is less well-defined and cannot be clearly identified in some sections. Photogrammetry imagery provides additional evidence regarding the current condition of this feature. The drain shows a largely continuous vegetation cover, with little visible open water or exposed channel surface. The dense vegetation obscures the channel and contributes to the reduced definition of the feature on both photogrammetry and LiDAR datasets. This suggests that the drain may be inactive or seasonally functional, with vegetation establishment.

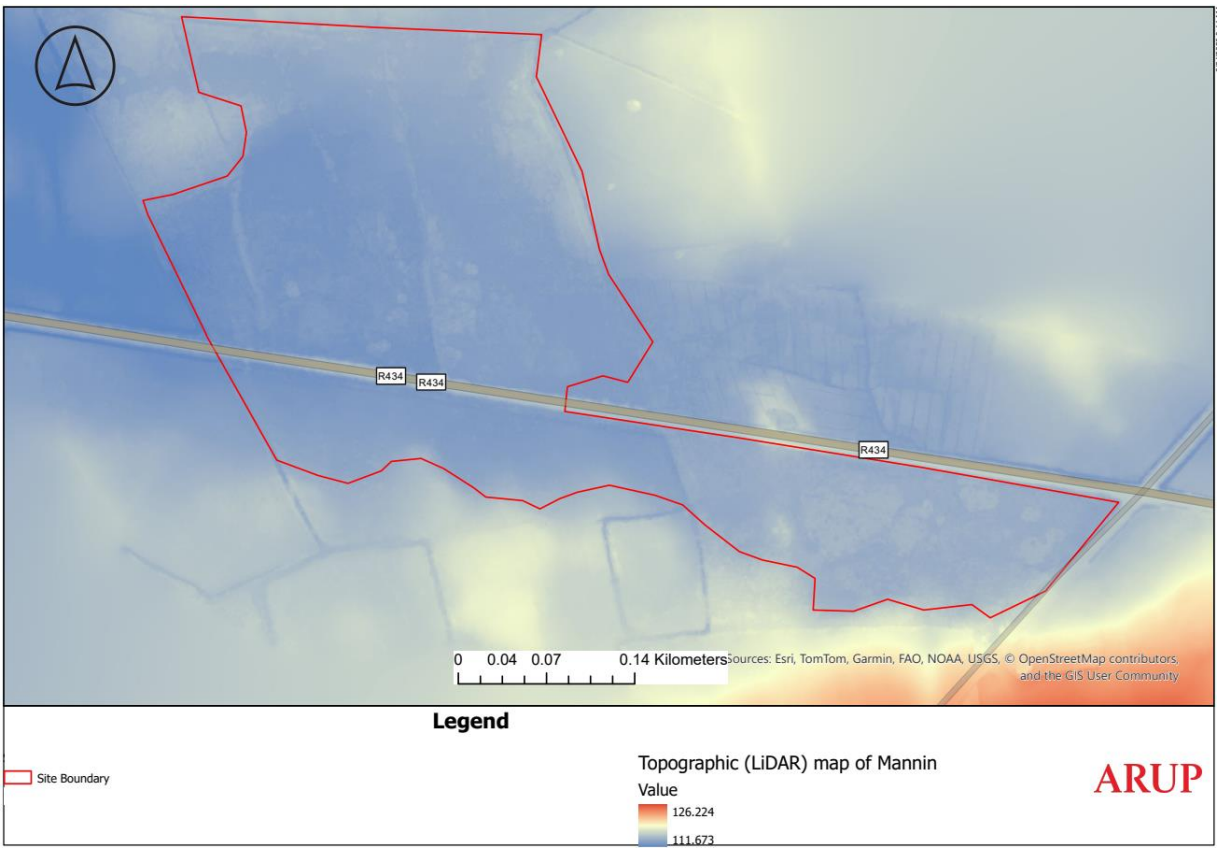


Figure 3-16: DTM Topographic (LiDAR) map of Mannin

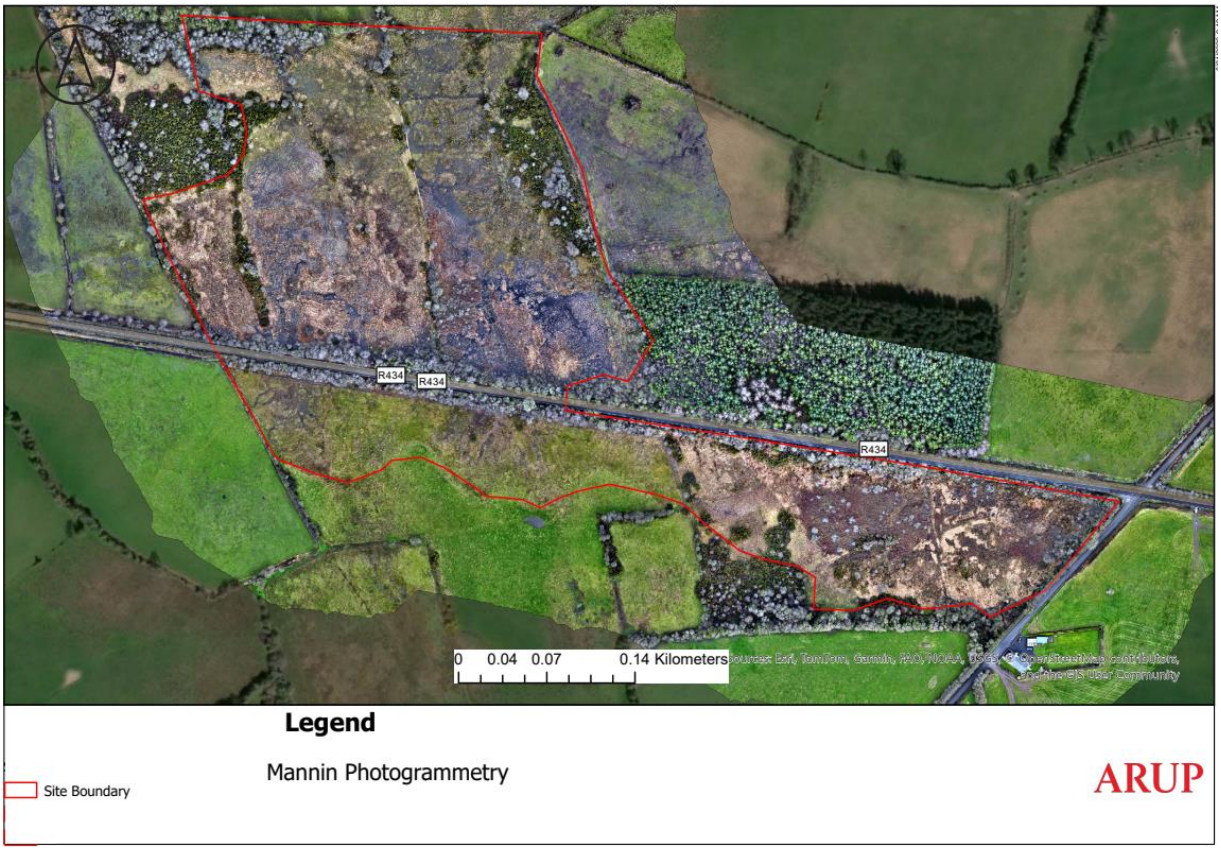


Figure 3-17: Site Photogrammetry map of Mannin

3.2 Field Survey: Monitoring Activities

Electrical conductivity (EC), pH, and peat depth data were recorded as part of the National Fen Survey (Brophy et al., In prep). EC ranged from 643 to 845 µS/cm and pH from 6.83 to 7.39. Peat depth was also recorded, and it ranged from 16 to 146 cm. However, the spatial location of these measurements was not provided.

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

Water quality data were collected from several areas within the site and its surroundings. Samples were obtained from the drains located in the northern area, as well as from the drains located along the southern and western boundaries. pH, EC, temperature, nitrate, and phosphate were recorded during the monitoring. Observations of water flow were made throughout the site's drainage network to further understand hydrological dynamics. Peat depths were measured at various locations across the site to assess substrate characteristics.

3.2.1 Peat Depth Probing and Ground Investigations

Peat depth probing was conducted throughout the site to assess substrate characteristics (Figure 3-18).

The first site visit, completed in February 2026, involved peat depth measurements at three locations in the southeast, southwest and northwest areas. The deepest peat depth measurement was recorded at 1.8 m in the southeast area. The shallowest peat depth measurement was registered at

0.05 m in the southwest area. During the June 2026 site visit, peat depth was measured along the drain running parallel to, and south of, the main road. Recorded depths were 0.5 m in the western and central sections, and 0.25 m in the eastern section.

The findings are consistent with those from previous National Fen Surveys (Brophy et al., In prep), which documented a peat depth ranging from 0.16 m to 1.46 m.

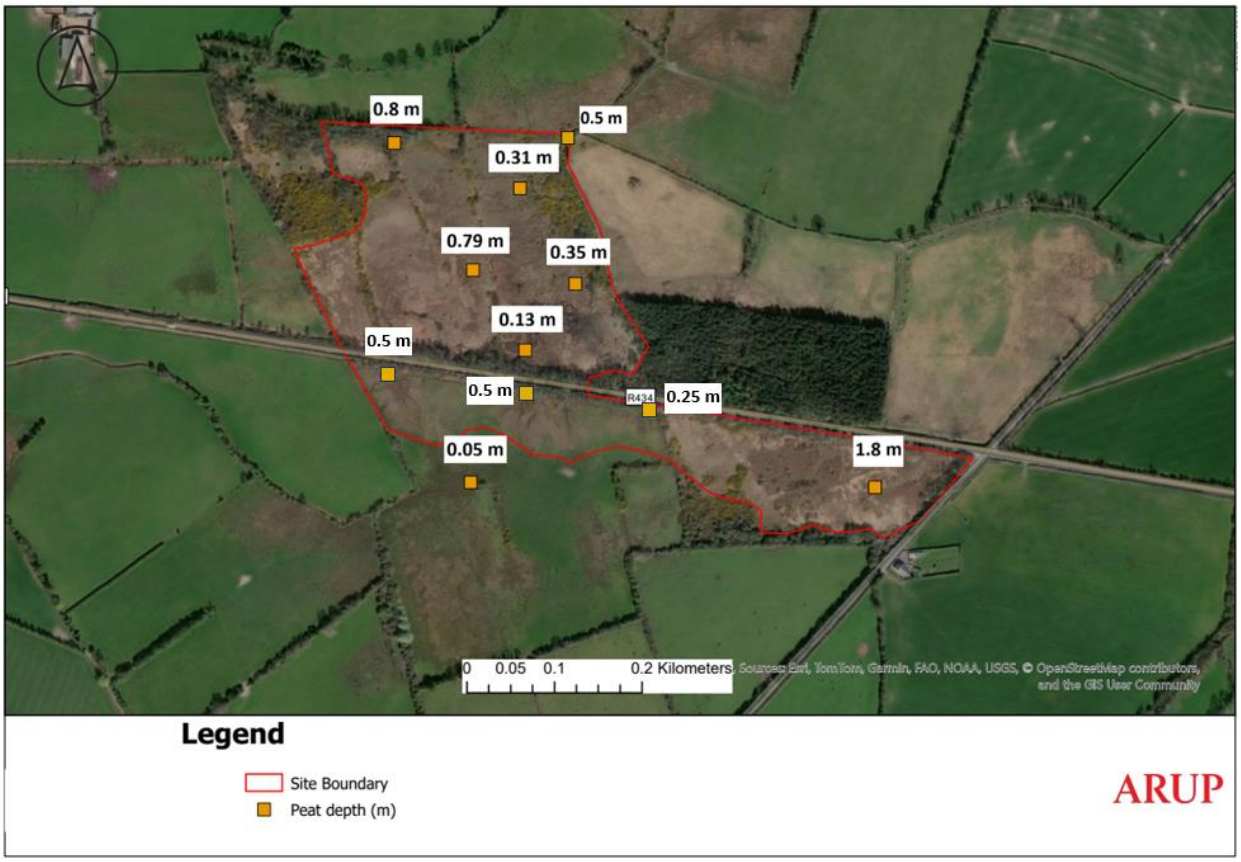


Figure 3-18: Baseline peat monitoring locations of Mannin

3.2.2 Surface Water Drainage

3.2.2.1 Drainage Network Description

According to the NFS carried out in 2022 (Brophy et al., In prep), most drains are confined to the southwest of the site where the land is more actively farmed. A deep vegetated drain which runs parallel to the road was also mapped in this area, with the road acting as a drainage barrier. Additionally, a drain was identified in the northeast of the site.

According to historical mapping (25 Inch B&W, 1897–1913) and GSI database, two springs are recorded in the southeast and northwest areas, which are used for agricultural (2017NEW129) and domestic (2017NEW128) (Figure 3-19).

Surface water conditions varied across the site, particularly with respect to flow regimes and drainage features. Information was collected in site visits completed in February, May and June 2026 and are presented in Figure 3-20.

In the north area of the site, a drain interpreted as the main water input feature was observed in the northeast. The drain was largely overgrown, with little to no obvious flow towards the south. The drain measures approximately 3 m in width and 1.5 m in depth. Further south, the drain becomes

extremely overgrown and shallow, allowing access across the channel by foot. Limited water was visible within the drain and was only apparent where vegetation had been compressed by walking.

In the northwest area of the site, a drain of approximately 5 m in width was observed, containing very shallow water with an estimated depth of 0.3 m and no visible flow. The area is characterised by ponded water and very muddy ground conditions. This location corresponds to the potential spring feature identified in the GIS mapping.

In the south area of the site, at southeast, a wet area consisting of a ponded feature was observed, although no obvious water flow was evident. Sedimentation was present at the bottom of the ponded area, and the feature was densely vegetated. This area corresponds to the location of a potential spring. The water depth recorded at this location was approximately 0.15 m.

Along the southern boundary of the site, several drains flowing generally from east to west were identified. These drains ranged between approximately 2.5 m and 4 m in width, with shallow water depths between 0.15 m and 0.2 m. In some locations, the flow direction was not evident and was interpreted based on the vegetation patterns observed. The drains become increasingly densely vegetated towards the western extent of the site. Fine sediments were also observed within the water.

The drain running parallel to the main road ranged from approximately 1 m to 2 m in width, becoming wider towards the east. Water depths were shallow, ranging between 0.25 m and 0.30 m. The drain was heavily vegetated, and no visible flow was observed due to dense foliage.

Some drains flowing from south to north and connecting with the westward-flowing drains were also observed. These features were shallow, with water depths ranging between 0.05m and 0.2m. The drains were poorly defined and heavily vegetated, making it difficult to determine channel width.

Along the western boundary of the site, a drain flowing northwards was observed. A large, ponded area was noted at the point where this drain intersects with one of the westwards flowing drains. The drain measures approximately 4 m in width, although the channel becomes poorly defined further north. The recorded water depth at this location was approximately 0.15 m.

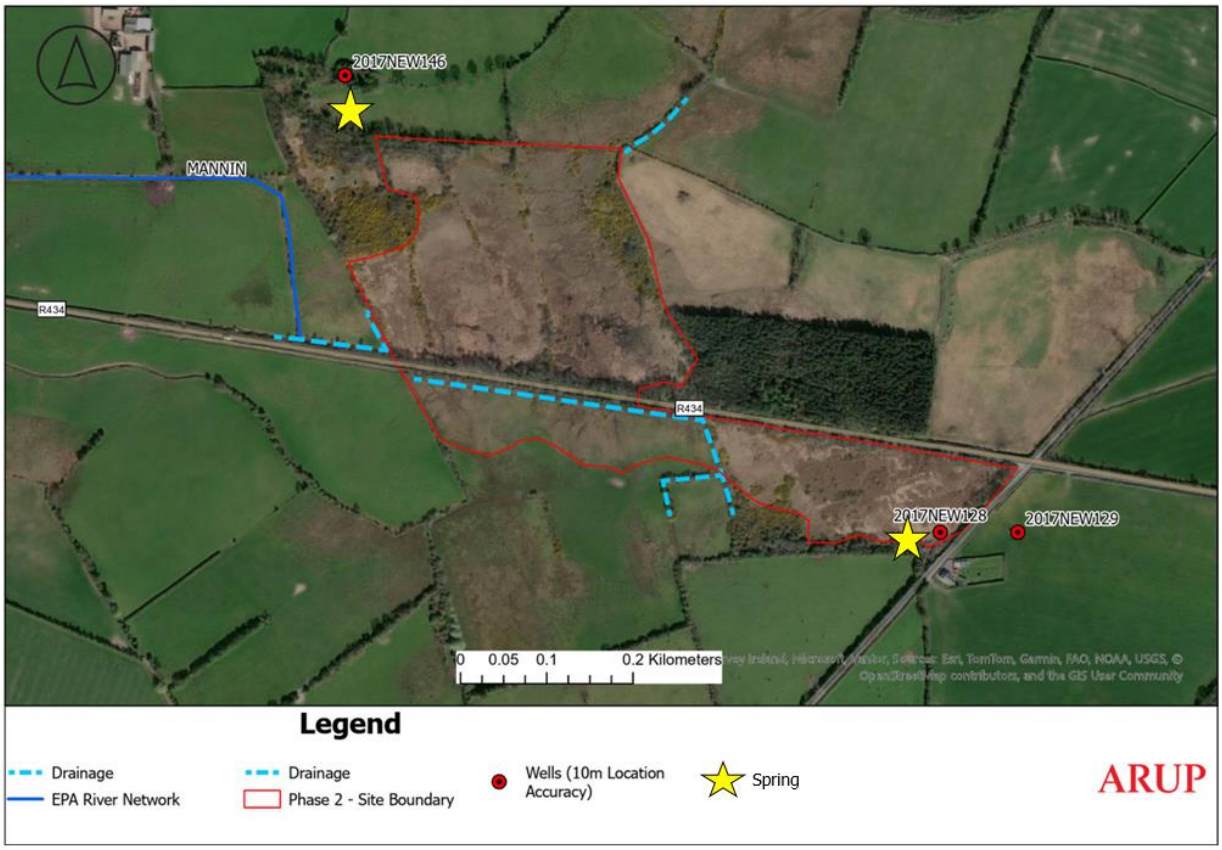


Figure 3-19: Spring locations. Sources: historical mapping (25 Inch B&W, 1897–1913), GSI.

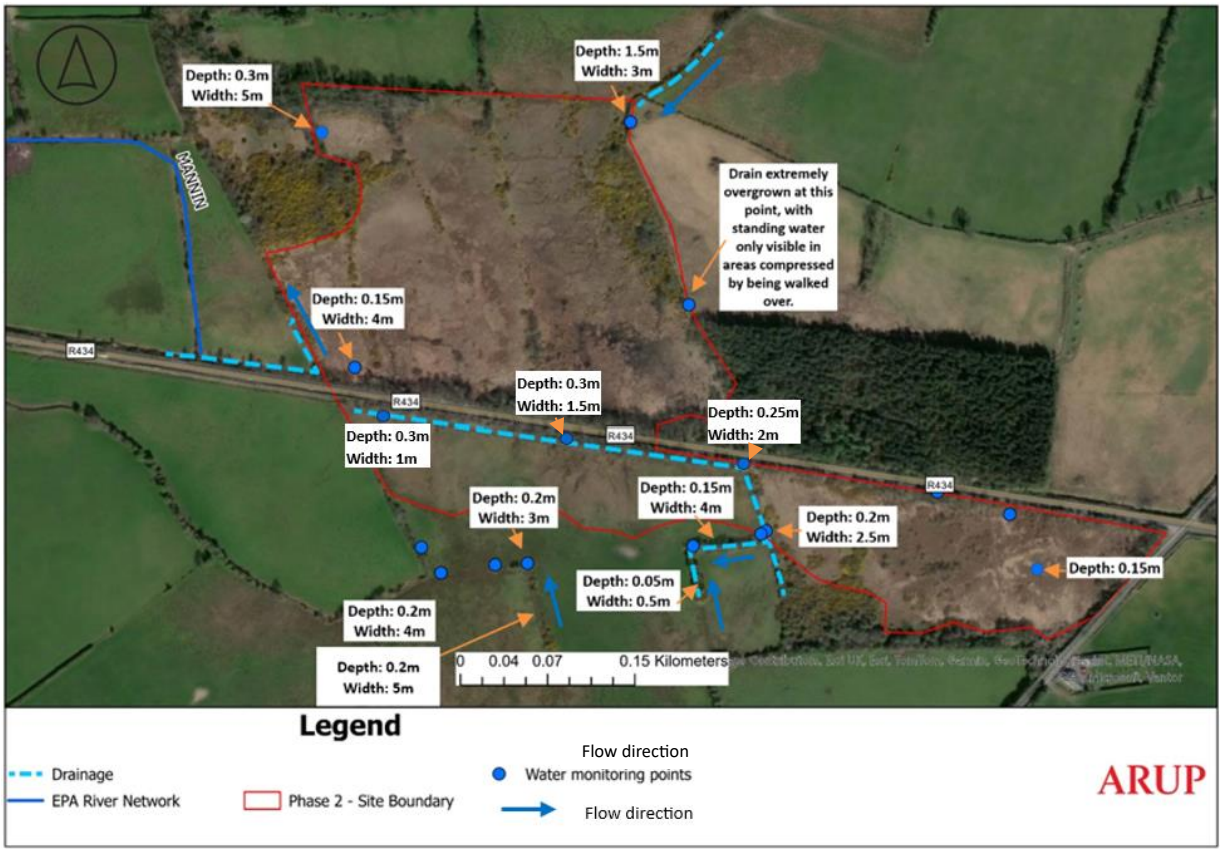


Figure 3-20: Drainage Network of Mannin

3.2.3 Water Quality

Water quality monitoring indicates spatial variation in nutrient concentrations across the Mannin site, with evidence of localised enrichment associated with sections of the drainage network and ponded areas.

Phosphate (PO_4) concentrations recorded across the site range from 0.08 mg/L to 2.01 mg/L. Most recorded values exceed the Water Framework Directive (WFD) good status environmental quality standard of 0.107 mg/L PO_4 (0.035 mg/L PO_4-P[3]).

The lowest phosphate concentration (0.08 mg/L) was recorded within the northern drain feature interpreted as the principal water input to the site, which was below the WFD threshold. Elevated phosphate concentrations were recorded within the southern drainage network, including 0.32 mg/L within the ponded feature in the southeast of the site, 0.34 mg/L and 0.28 mg/L within the southern and southwestern drains, respectively.

The highest phosphate concentrations were recorded in the drain running parallel to the main road in the southern part of the site, with values of 1.03 mg/L in the central section and 2.01 mg/L in the eastern section.

A phosphate concentration of 0.26 mg/L was also recorded within the drain along the western boundary of the site, while the northwest ponded feature recorded a concentration of 0.1 mg/L, marginally below the WFD threshold.

Overall, the results indicate elevated values concentrated primarily within the southern area (Figure 3-21).

Nitrate (NO_3-N) concentrations varied considerably across the site, ranging from 0.3 mg/L to 16.3 mg/L. Several recorded values exceed the indicative ecological threshold of 1.8 mg/L NO_3-N (8 mg/L (NO_3^-)) (EPA,2025b), above which impacts on ecological water quality may occur.

The highest nitrate concentration (16.3 mg/L) was recorded within a westward-flowing drain along the southern boundary. Elevated nitrate concentrations were also recorded within the southeast ponded feature (11.3 mg/L) and in the southwest (8.7 mg/L). Lower nitrate concentrations were recorded within the northwest ponded feature (0.3 mg/L), the western boundary drain (1.6 mg/L), and the drain feature located in the northeast (1.8 mg/L).

Overall, the results indicate spatial variability in nitrogen concentrations across the site, with elevated values concentrated primarily within sections of the southern drainage network and ponded wetland features (Figure 3-22).

[3] Government of Ireland, 2015. European Union Environmental Objectives (Surface Waters) Regulations 2009–2015. S.I. No. 272 of 2009, as amended.

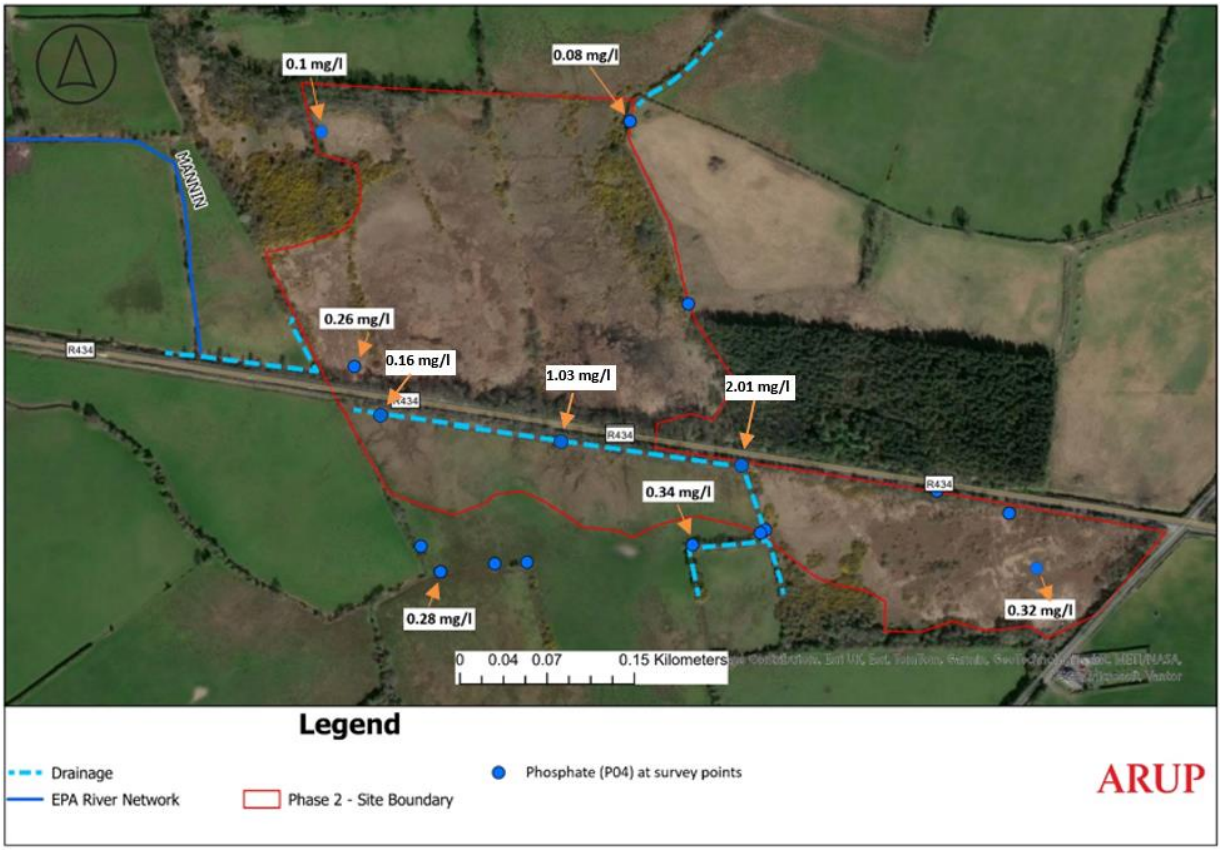


Figure 3-21: Phosphate (mg/L PO_4) at survey points in Mannin

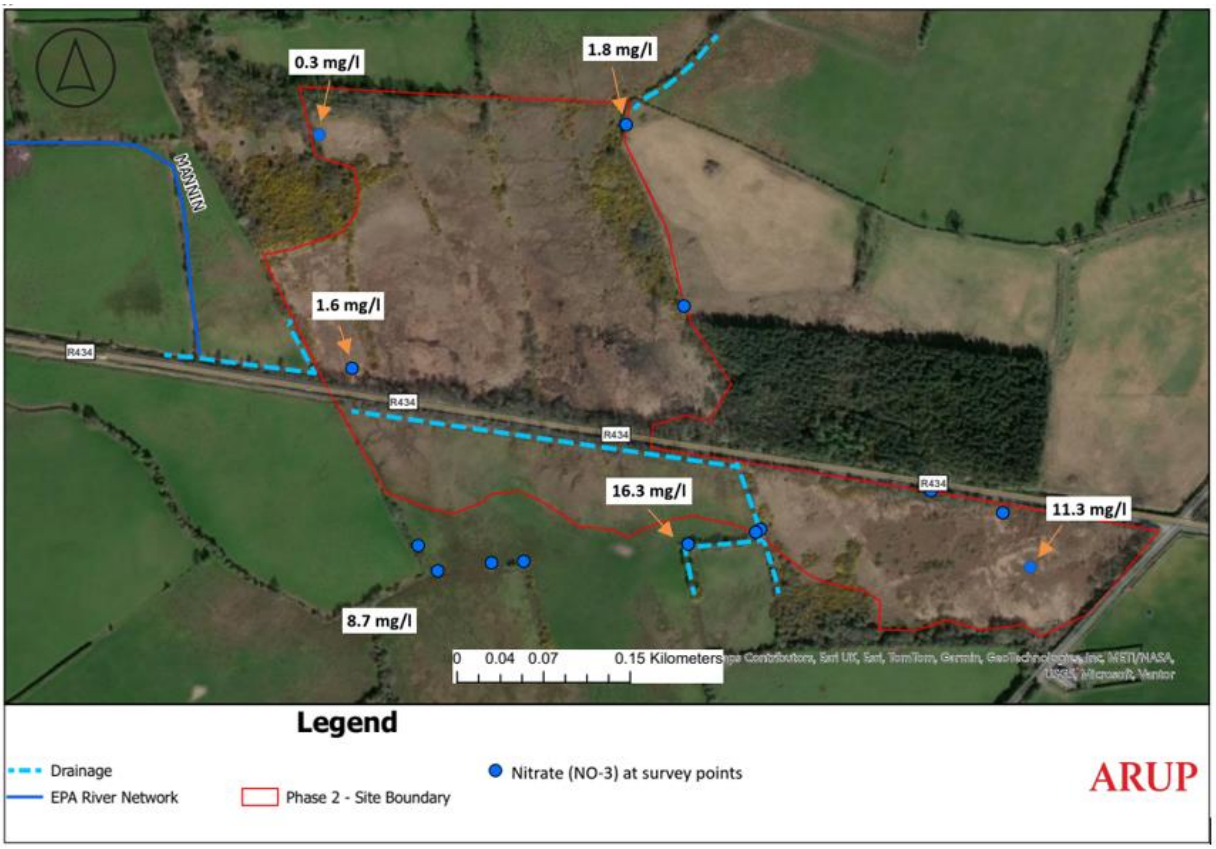


Figure 3-22: Nitrate (mg/L NO_3) at survey points in Mannin

The observed nutrient concentrations indicate localised nutrient enrichment within sections of the site. Elevated nitrate and phosphate concentrations are associated primarily with slow-flowing and ponded drainage features located in the south, suggesting limited flushing and potential nutrient accumulation. However, concentrations vary notably between monitoring locations, indicating differing hydrological conditions and potential variability in groundwater and surface water inputs across the site.

Measurements of pH and electrical conductivity (EC) provide further information into site hydrology and groundwater influence. Recorded pH values ranged from 6.6 to 7.87, indicating neutral to slightly alkaline conditions (Figure 3-23). Electrical conductivity values ranged from 465 µS/cm to 686 µS/cm, with the highest EC values corresponding to areas where elevated nutrient concentrations were also recorded, particularly within the southern drainage network. These EC values may indicate a contribution from mineral-rich groundwater inputs, although variability across the site suggests mixed surface water and groundwater influences (Figure 3-24).

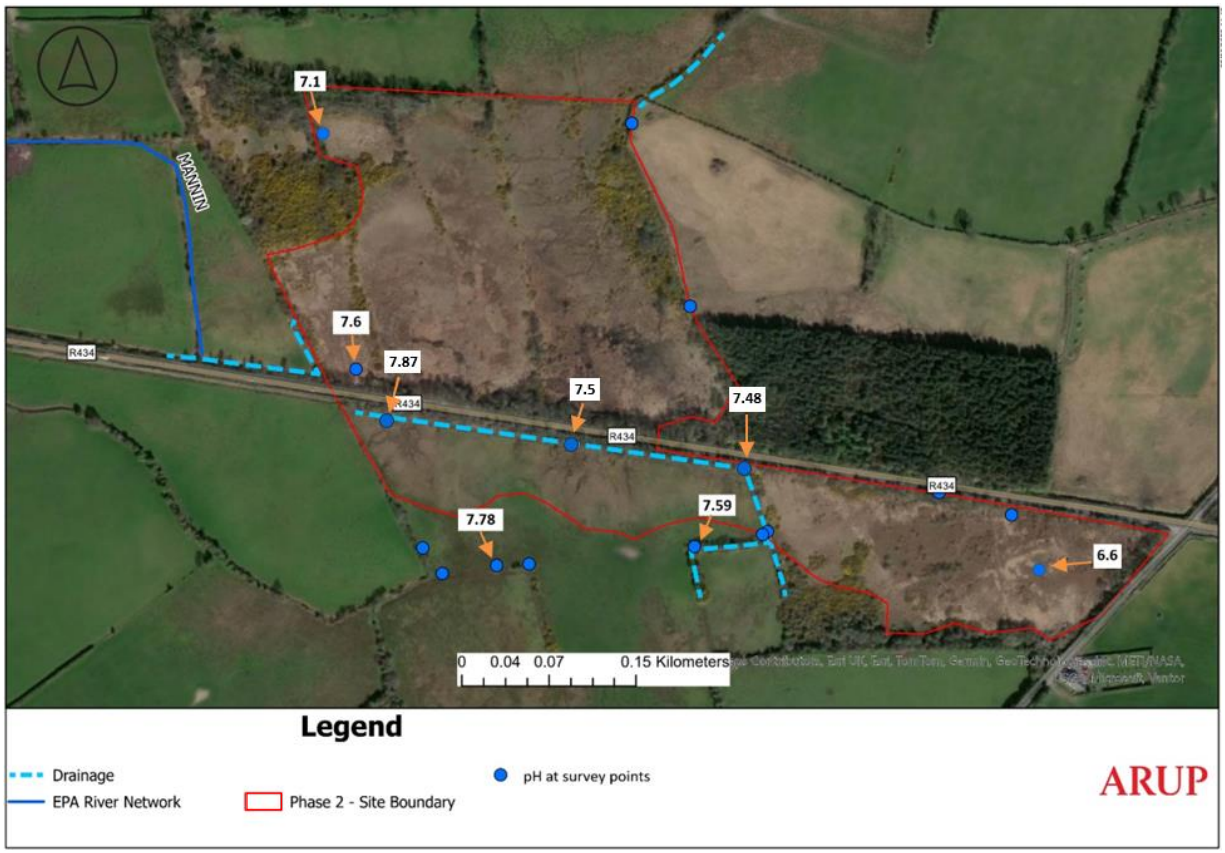


Figure 3-23: pH at survey points in Mannin

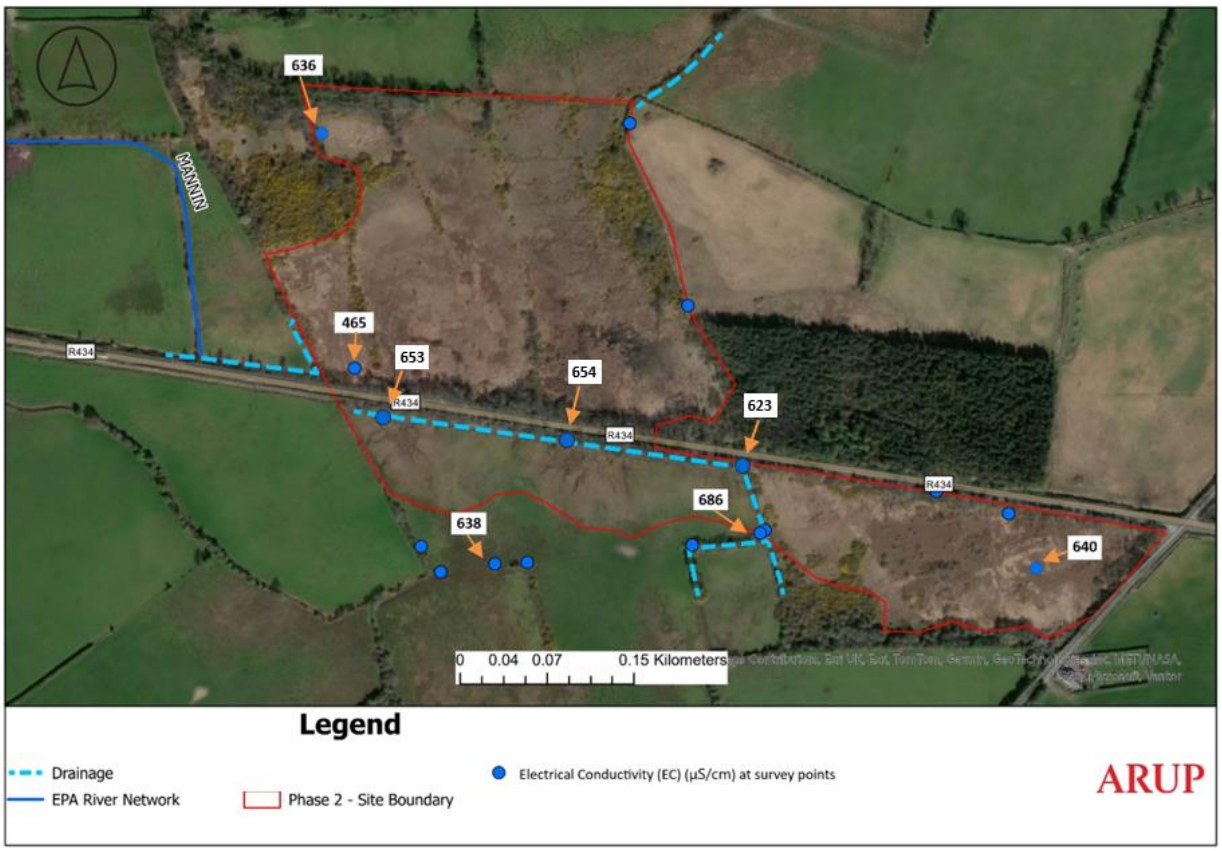


Figure 3-24: Electrical Conductivity (EC) (µS/cm) at survey points in Mannin

3.3 Conceptual Site Model

Under the WETMEC framework defined by Wheeler, Shaw & Tanner (2009), Mannin is primarily consistent with a WETMEC 9 groundwater-fed valley-bottom fen, occurring within a low-lying valley setting where groundwater inputs maintain a shallow-water table and support minerotrophic fen conditions. The historical springs located to the northwest and southeast of the site are associated with WETMEC 16: groundwater-flushed bottom. The areas of the site associated with historical and current drainage represent WETMEC 9b: part-drained groundwater bottom. The characteristics of the site are:

- Mannin is pNHA where the following Annex I quality habitats are identified: 7140 Transition mire, 7210 Cladium fen and 7230 Alkaline fen.
- The site occurs at elevations between approximately 114 and 117 mOD and is characterised by a generally flat to gently sloping topography, with elevation decreasing gradually from north to south. Along the west-east direction the site is relatively flat. Beyond the site boundary, elevated ground occurs to the northwest and south and southeast, at approximately 450 and 400 m, respectively, where bedrock outcrops rise to approximately 130 mOD in the northwest and 160 mOD in the south and southeast. These elevated areas likely function as groundwater recharge zones supplying groundwater to the fen system.
- The site is underlain the Ballysteen Formation, comprising dark muddy limestone and shale. Quaternary deposits within the site consist of cutover raised peat overlying limestone-derived till, with gravels present to the east. The gravel deposits likely provide permeable pathways facilitating shallow groundwater movement towards the site.

- Beneath the site lies a Locally Important Bedrock Aquifer which is moderately productive only in Local Zones (LI).
- Historical mapping and field observations suggest the presence of two groundwater discharge points (springs) associated with the site. Historical maps from the late nineteenth and early twentieth century identify springs to the southeast and northwest, while GSI mapping records springs used for agricultural and domestic abstraction in the southeast. Ponded wet areas were observed in both northwest and southeast sectors during the site visit, which likely represent the potential spring zones.
- Surface water flow across the site is interpreted to move predominantly to the west and northwest towards the Mannin stream. Several shallow, heavily vegetated drains occur throughout the site, particularly along the southern and southwestern boundaries. Drains generally flow east-west, with north-south drains linking into the wider drainage network. However, some drains exhibited little or no visible flow. The road bisecting the site acts as a hydrological barrier. Along the northern section, a drain interpreted as the potential principal water input feature was observed in the northeast, although little active flow to the south was visible.
- The southern section of the site supports the best-developed fen habitats, including Annex I alkaline fen and localised patches of Cladium fen vegetation. The electrical conductivity values (465–686 µS/cm) and neutral to slightly alkaline pH (6.6-7.8) indicate influence from calcium-rich groundwater, which supports the development of these fen habitats.
- High nitrates (16.3 mg/L) and phosphate (2.01 mg/L) levels are associated primarily within the drains located in the southern area.
- The Annex I quality vegetation, dominated by a diverse assemblage of characteristic fen species, including brown mosses, charophytes and a range of positive indicator vascular plants, is the expected ecological expression of a functioning WETMEC 9.

The CSM is presented in Figure 3-25.

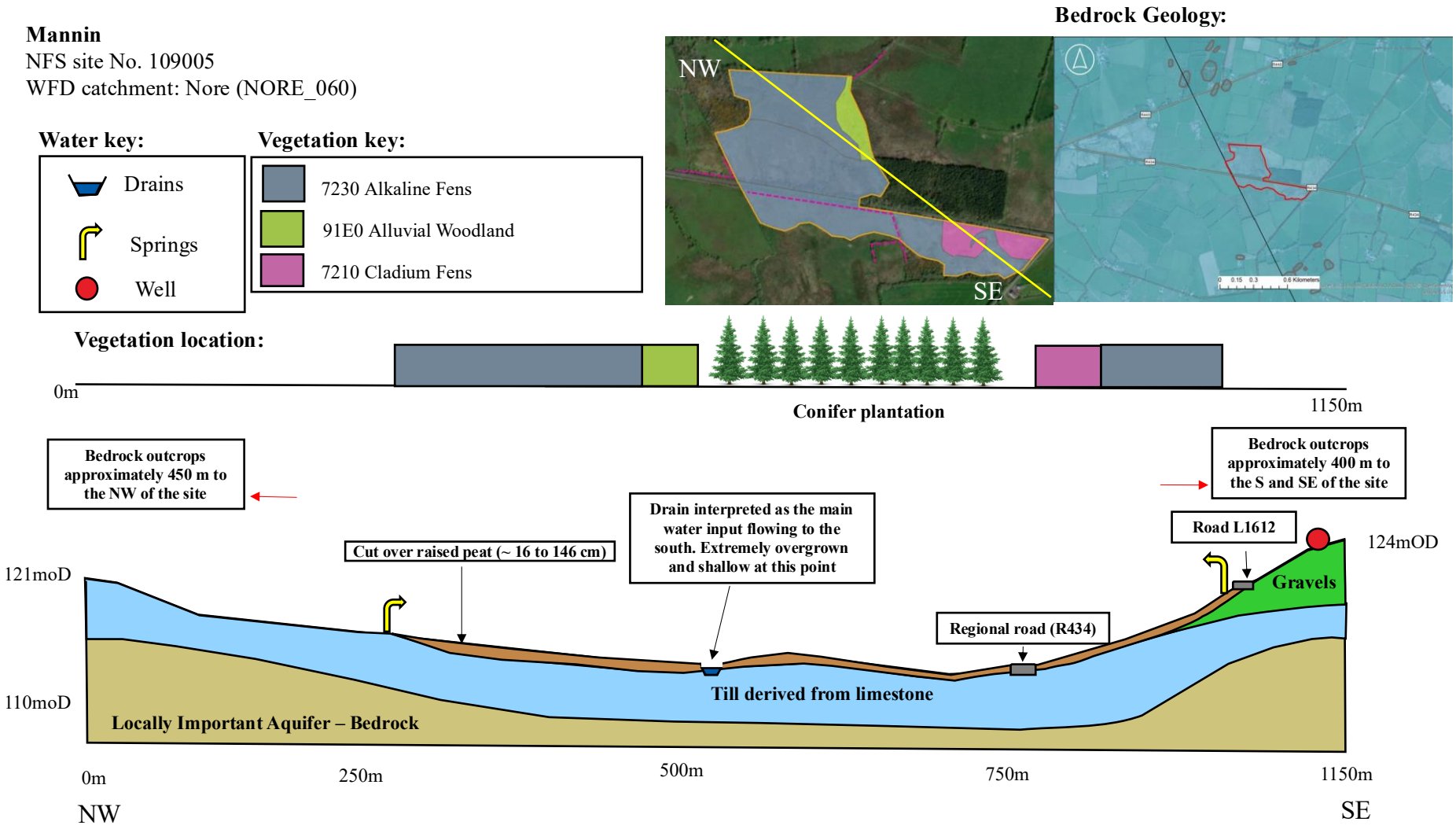


Figure 3-25: Conceptual Site Model (CSM) of Mannin

4 Ecology

4.1 Desk Study

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

- NPWS Article 17 habitats distribution datasets
- National Fen Survey (Brophy et al, in prep)
- Biodiversity Maps - National Biodiversity Data Centre (NBDC)
- Plant Atlas 2020 website - Botanical Society of Britain & Ireland (BSBI)

The desk study focused on the distribution and ecological characteristics of fen and associated wetland habitats, and on the presence of species of conservation interest recorded at or within the zone of influence of the site. For the NFS, 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 site supports a mosaic of fen and wetland habitats, with Annex I quality fen habitats forming the dominant ecological component. The fen system displays considerable structural and compositional variability, including transitions between 7230 Alkaline fen, 7210 Cladium fen and small areas of 7140 Transition mire, reflecting local variation in moisture regime, substrate and management intensity.

In addition to fen habitats, a range of associated wetland and peatland habitats occur within the site, contributing to overall ecological connectivity and habitat diversity.

4.1.1.1 Annex I Quality Habitats

The following Annex I quality habitats were identified during the NFS and form the principal ecological features of the site:

- **7230 Alkaline fen** (c. 8.11 ha) This is the dominant habitat type at Mannin pNHA. Vegetation is characterised by species-rich alkaline fen communities, including tussocky and quaking variants. Diagnostic and frequent species recorded include *Schoenus nigricans, Molinia caerulea, Carex nigra, Carex diandra, Carex rostrata, Carex paniculata, Succisa pratensis, Menyanthes trifoliata* and *Dactylorhiza fuchsii*. Brown mosses and charophytes occur locally, particularly in wetter and more quaking areas, indicating well-developed fen structure.
- **7210 Cladium fen** (c. 1.88 ha) This habitat occurs discrete patches within the wider fen system, principally within the eastern part of the site. Vegetation is characterised by stands of Cladium mariscus, often in mosaic with alkaline fen communities. Transitional zones between 7210 and 7230 habitats are evident, reflecting subtle gradients in water depth and nutrient availability. The limited spatial extent of 7210 Cladium fen indicates that this habitat is potentially vulnerable to change.
- **7140 Transition mire** (0.28ha) Transition mire is present in small, localised areas within the site. These areas support typical transition mire species including *Drosera rotundifolia, Molinia caerulea, Carex panicea, Carex echinata* and *Sphagnum subnitens*. The limited extent of this habitat reflects its occurrence as a component within the broader fen mosaic rather than as a distinct habitat unit.
- **91E0 Alluvial forests** – Annex I quality alluvial woodland occurs along the north-eastern boundary of the site, where wet woodland communities dominated by willow (*Salix* spp.) and birch (*Betula spp*.) are present.

It should be noted that habitat mapping derived from the NFS represents the dominant habitat type within each polygon. As such, individual polygons may comprise a mosaic of habitats, with Annex I quality communities forming part of a broader assemblage and requiring interpretation at sub-polygon scale.

4.1.1.2 Non-Annex/Fossitt habitats

A range of non-Annex I habitats were also recorded at the site and mapped using the Fossitt classification system (Fossitt, 2000). These habitats form part of the wider wetland mosaic and include wet grassland, wet heath, raised bog, scrub, wet woodland, and drains. The distribution of these habitats is summarised in Table 4-1.

Table 4-1: Fossitt habitats within Mannin pNHA

Habitat Type	Location	Notes
GS4 – Wet grassland	Located within the southern section of the site to the south of the road which bisects Mannin pNHA.	This area is dominated by 7230 Alkaline fen though the land is more intensively managed than elsewhere within the site. Cattle are grazed here.
HH3 – Wet heath	A small area within the northern area of the site.	Surrounded by 7230 Alkaline fen.
FW4 – Drainage Ditches	Limited to the southern area of the site within the field that is intensively managed/grazed.	There is a drain just outside of the site boundary to the north.
PB1 – Raised bog	Concentrated in the eastern area of the site but a small amount is also found in the centre and northern areas.	Surrounded in each area by 7230 Alkaline fen.
WS1 - Scrub	Present across most of site.	Absent from some land in the south and east.
WN6 – Wet willow-alder-ash woodland	Present in the northeast section of the site.	The majority of the WN6 habitat on site is a part of the wider area of 91E0 Alluvial forests.

4.1.2 Species

Species records for Mannin pNHA were reviewed to inform baseline ecological understanding of the site and to identify species of conservation relevance. Records were collated from the NFS, NBDC and BSBI datasets.

The review considered records from the past ten years where available, reflecting the most relevant timeframe for current species presence. Historical records of invasive species were also reviewed where there was no indication of subsequent eradication. Species information is used to support interpretation of habitat quality and to inform the identification of ecological sensitivities relevant to restoration planning.

4.1.2.1 Species Within the Site

The species within Table 4-2 below were identified using the NBDC interactive maps service, reviewing the NFS documentation and from the ecological walkover conducted in 2026. The species outlined below include a selection of notable records taken from the wider NBDC data search results, which can be found in their entirety in Appendix D.

Table 4-2: Species present within Mannin pNHA

Common Name	Latin name	Description	Most recent record
Bogbean	*Menyanthes trifoliata*	Characteristic species of fens and other base-rich wetland habitats.	2026
Bottle sedge	*Carex rostrata*	Common sedge of wet fen, flush and mire habitats.	2026
Carnation sedge	*Carex panicea*	Typical component of species-rich fen and wet grassland communities.	2026
Common cottongrass	*Eriophorum angustifolium*	Frequent species of wet peatland habitats including fens and transition mires.	2026
Common polypody	*Polypodium vulgare*	Widespread fern of woodland, scrub and rocky habitats.	2026
Devil's bit scabious	*Succisa pratensis*	Characteristic species of species-rich fen, wet grassland and mire habitats.	2026
Gorse	*Ulex europaeus*	Native scrub species occurring on dry and marginal habitats.	2026
Great fen sedge	*Cladium mariscus*	Diagnostic species of Annex I quality 7210 Cladium fen.	2026
Grey willow	*Salix cinerea*	Common wetland tree species of fen margins and wet woodland.	2026
Intermediate hookmoss	*Scorpidium cossonii*	Base-demanding bryophyte characteristic of rich fen and flush habitats.	2026
Jointed rush	*Juncus articulatus*	Frequent rush of wet grassland, fen and flush habitats.	2026
Lustrous bog moss	*Sphagnum subnitens*	Moss species associated with wet, mildly base-rich peatland habitats.	2026
Marsh horsetail	*Equisetum palustre*	Typical species of fens, marshes and wet grassland habitats.	2026
Marsh pennywort	*Hydrocotyle vulgaris*	Low-growing species of wet grassland and fen habitats.	2026
Meadowsweet	*Filipendula ulmaria*	Tall-herb species common in wet grassland, fen and marsh habitats.	2026
Purple moor-grass	*Molinia caerulea*	Widespread grass species of fens, wet heaths and bog margins.	2026
Small-fruited yellow-sedge	*Carex viridula*	Small sedge typical of calcareous fens and flushes.	2026
Soft rush	*Juncus effusus*	Common rush of wet grassland and disturbed wet habitats.	2026
Tormentil	*Potentilla erecta*	Widespread shrub of grassland, heath and wetland margins.	2026
Water horsetail	*Equisetum fluviatile*	Aquatic and semi-aquatic species of wet fens and shallow waterbodies.	2026

Common Name	Latin name	Description	Most recent record
Water mint	*Mentha aquatica*	Aromatic species of fens, marshes and wet grassland habitats.	2026
Yellow starry feathermoss	*Campylium stellatum*	Indicator bryophyte of base-rich fen and flush habitats.	2026
Black bog-rush	*Schoenus nigricans*	Diagnostic species of Annex I quality 7230 Alkaline fen.	2022
Common Frog	*Rana temporaria*	Widespread amphibian associated with wetlands and damp habitats.	2022
Common sedge	*Carex nigra*	Common sedge of fens, wet grasslands and flush habitats.	2022
Round-leaved sundew	*Drosera rotundifolia*	Carnivorous plant of wet peatland habitats including transition mires.	2022
Snipe	*Gallinago gallinago*	Widespread wetland bird associated with fens and wet grasslands.	2022
Small heath	*Coenonympha pamphilus*	Butterfly species of grassland and open habitats; listed as Near Threatened in Ireland.	2017

4.1.2.2 Species within the Zone of Influence

Table 4-3 outlines the functionally linked species recorded within the 2km distribution zone of influence around Mannin within the last ten years from NBDC. These records provide contextual information on species present in the wider landscape which may interact with, or be influenced by, habitats at Mannin pNHA. The full results of the NBDC data search are provided in Appendix E.

Table 4-3: Species records within the Zone of Influence of Mannin

Designation	Common Name	Latin Name
EU Birds Directive	Golden Plover	*Pluvialis apricaria*
Wildlife Acts	Kestrel	*Falco tinnunculus*
Wildlife Acts	Meadow Pipit	*Anthus pratensis*
Wildlife Acts	Swallow	*Hirundo rustica*
No legislative protection	Woodpigeon	*Columba palumbus*
Wildlife Acts	Yellowhammer	*Emberiza citrinella*
No legislative protection	Small Heath	*Coenonympha pamphilus*
Wildlife Acts	Hedgehog	*Erinaceus europaeus*

4.2 Field Survey

Following a comprehensive review of available desktop data, a targeted follow-up ecological survey was undertaken on the site on April 16th, 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.

The pressures identified above form the basis for the prioritisation presented in Section 5.2, where pressures are ranked and evaluated based on field validation and their relative influence on site condition.

4.2.1 Monitoring Points

To inform the restoration plan for Mannin, a targeted walkover survey was undertaken at a series of pre-identified monitoring locations. These locations were selected based on habitat distribution, ecological sensitivity and restoration potential, informed by the desk study and expert judgement. The walkover was designed to assess ecological condition at 7 pre-identified monitoring points (Monitoring Points 1-7), 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.

At each monitoring point, the surveys focused on:

- Target Notes: Qualitative observations at each monitoring point, capturing site condition, vegetation structure, hydrological features, and legacy management.
- Pressures and Threats Identification: Systematic recording of anthropogenic and natural pressures affecting each location.

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

- 7210 Cladium fen: Detected at monitoring points 2 and 6.
- 7230 Alkaline fen: Detected at monitoring points 1, 3, 4, 6, and 7.

4.2.2 Pressure & Threats

Field surveys were used to validate and spatially refine the pressures and threats previously identified through the desk study and NFS for Mannin (Section 2). Observations focused on how these pressures manifest on the ground and their distribution in relation to Annex I quality fen habitats, including 7140 Transition mire, 7210 Cladium fen and 7230 Alkaline fen.

4.2.2.1 7140 Transition mire

Historical Pressures

Due to the very limited extent of 7140 Transition mire at Mannin this habitat was not subject to a formal condition assessment as part of the NFS. However, based on its spatial context within the wider fen system, the habitat is inferred to be subject to the same overarching pressures identified for the site, particularly drainage-related modification and scrub encroachment.

- **Drainage** is present in the southern part of the site where land is more intensively managed for cattle grazing (see Sections 1.3 and 3). A drain located outside the northern site boundary may also be influencing local wetness conditions in the area containing the small (c. 5 × 5 m) patch of 7140 Transition mire**.**
- **Scrub encroachment** associated with natural succession is affecting wetter habitats across the site and is likely to influence the small areas of transition mire, particularly where local drying occurs

Current Observations

Recent walkover surveys identified the following:

- **Drainage** continues to influence the north most area of the site, which is noticeably drier than areas further south and includes the small patch of 7140 Transition mire.
- **Scrub encroachment**, primarily gorse, is evident in this area and is associated with changes in vegetation structure and composition.
- **Habitat vulnerability** is increased due to the very limited extent of 7140 Transition mire present at the site.

4.2.2.2 7210 Cladium fen

Historical Pressures

The NFS assessed the structure and functions of Annex I quality 7210 Cladium fen at Mannin as unfavourable–inadequate (see Section 2.1.3), with the following pressures identified:

- **Drainage** affecting areas of fen habitat, particularly within grazed land adjacent to fields supporting 7210 Cladium fen.
- **Poaching** recorded within eastern areas of the site where 7210 Cladium fen is present, likely related to grazing pressure.

Current Observations

Recent walkover surveys identified the following:

- **Drainage** continues to abstract water from areas of the site, contributing to shifts in vegetation structure in northern areas where 7210 Cladium fen occurs. Despite this, the drain running along the northern side of the road bisecting the site retains water locally (Section 3.3), which appears to benefit some patches of 7210 habitat.
- **Poaching** was recorded in the drier areas of the north of the site where cattle are grazed, though the extent of this was considered minor at the time of survey. Poaching is also likely to occur in the southern part of the site, where grazing pressure is greater.

4.2.2.3 7230 Alkaline fen

Historical Pressures

The NFS assessed the structure and functions of the Annex I quality 7230 Alkaline fen at Mannin as Unfavourable–Bad, with the following pressures identified:

- **Drainage** has altered wetness conditions across parts of the site, particularly in areas subject to agricultural management. Drainage features within and adjacent to the site have contributed to localised drying, influencing vegetation structure and facilitating shifts away from characteristic alkaline fen communities.
- **Scrub encroachment** associated with ongoing natural succession, has occurred in areas of reduced wetness. This has resulted in increased cover of woody species and a decline in the extent and continuity of open fen vegetation, particularly in marginal and drier areas of the site.
- **Rank vegetation** has developed in places where grazing pressure is absent or uneven, leading to reduced structural diversity and suppression of characteristic fen species within parts of the 7230 Alkaline fen.
- **Poaching** linked to grazing activity, has been recorded in areas of 7230 Alkaline fen, particularly where ground conditions allow livestock access. This has locally affected surface structure and vegetation composition.

Current Observations

Recent walkover surveys identified the following:

- **Drainage** occurs across the southern part of the site, where 7230 Alkaline fen are present within grazed land. A drain located outside the northern site boundary coincides with areas of 7230 habitat and is associated with localised drying effects
- **Scrub encroachment**, primarily gorse, continues to pressure the northmost areas of the site where ground conditions are significantly drier. Grazing pressure in these areas appears insufficient to control scrub development.
- **Poaching** was recorded within central and eastern areas of the site where 7230 Alkaline fen occur, though impacts were generally minor at the time of survey. Poaching is expected to occur in the southern areas where grazing is more intensive.

4.2.3 Additional Observations

As noted in Section 3.3, the drain running along the northern side of the road bisecting the site retains water locally due to the absence of a defined outflow. This results in the retention of standing water within adjacent fen habitats. While water levels in this area are expected to fluctuate seasonally, the feature represents a notable influence on local habitat condition.

- Areas of 7230 Alkaline fen adjacent to this drain are of notably higher quality than comparable areas elsewhere within the site.
- A graded decline in habitat condition is observed towards the northern site boundary, where ground conditions become progressively drier.
- This transition corresponds with progressively drier ground conditions that are more readily accessible to livestock. While the wettest areas supporting high-quality fen vegetation, including patches of 7210 Cladium fen, are generally less susceptible to grazing impacts, localised trampling and poaching can occur in drier fen areas and along habitat margins where livestock access is greater

This spatial pattern highlights the sensitivity of fen condition at Mannin pNHA to small-scale variations in wetness and land use. The monitoring data indicate that the highest quality fen vegetation is associated with wetter areas of the site. Monitoring point MP1, which is characterised by persistently high-water levels, supports a strong assemblage of positive indicator species typical of 7230 Alkaline fen. In contrast, monitoring points located in relatively drier areas show evidence of vegetation change, including increased Molinia caerulea cover and the presence of scrub species.

This pattern demonstrates that hydrological conditions are the primary control on vegetation composition and habitat condition at the site.

4.3 Site Conservation Priority Matrix for Mannin pNHA

The restoration measures proposed (Table 4-4) for the Annex I quality habitats of 7230 Alkaline fen, 7210 Cladium fen, and 7140 Transition mire are expected to deliver broader ecological benefits beyond their target habitat types. If these measures are successfully implemented and sustained, they may positively influence associated features such as European priority species, nationally important species, and locally significant habitats and species. In such cases, the additional restoration interventions outlined for these other features may become unnecessary or only partially required. However, to validate and understand the extent of these mutual benefits, ongoing post-restoration monitoring will be essential. This will ensure that improvements are not limited to Annex I quality alone but extend to the wider ecological network within and around the site.

Table 4-4 Site Conservation Priority Matrix for Mannin pNHA

Level	Feature Type	Feature Name	Extent/Population	Pressure/threat	Restoration Measure on-site	Restoration Measure off-site
1	Annex I quality habitat	7140 Transition mire	0.28 ha	Drainage Scrub Encroachment	Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage)
		7210 Cladium fen	1.88 ha	Drainage Poaching	Grazing management Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage)
		7230 Alkaline fen	8.11 ha	Poaching Drainage Scrub Encroachment	Grazing management Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage)
2	pNHA Habitat	HH3 – Wet heath	See Appendix B	Drainage Scrub Encroachment	Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage)
		PB1 – Raised bog	See Appendix B	Drainage Scrub Encroachment	Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage)

Level	Feature Type	Feature Name	Extent/Population	Pressure/threat	Restoration Measure on-site	Restoration Measure off-site
		WN6 – Wet willow-alder-ash woodland	See Appendix B	Drainage Scrub Encroachment	Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage)
3	European priority species	Common frog	See Table 4-2 and Table 4-3	Habitat degradation via scrub encroachment	Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage)
4	Nationally important species	See Table 4-2 and Table 4-3	See Table 4-2 and Table 4-3	Habitat degradation via scrub encroachment	Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage
5	Habitats and species of local interest	GS4 – Wet grassland	See Appendix B	Drainage Scrub encroachment	Vegetation monitoring Scrub removal (where necessary) Hydrological monitoring	Buffer zone management (Management of scrub encroachment and drainage

4.4 Impact Assessment Notes

Restoration actions proposed for Mannin aim to improve the ecological condition of sensitive wetland and fen habitats, particularly regarding the Annex I quality 91E0 Alluvial forests, 7140 Transition mire , 7210 Cladium fen, and 7230 Alkaline fen on-site. These actions are designed to support favourable conservation status and enhance habitat resilience. However, potential impacts, both direct and indirect, must be carefully assessed to ensure compliance with Article 6(3) of the Habitats Directive.

The restoration measures proposed for Mannin are directly connected to the management of Mannin pNHA and are inherently connected with maintaining the favourable conservation status of the site's primary features of note; the wetland habitats present within the site.

Potential Impacts

- **Habitat loss** – low risk - Restoration actions (i.e. scrub removal) are designed to enhance existing habitats rather than remove them. However, minor loss of degraded habitat may occur during scrub clearance.
- **Habitat degradation –** moderate risk - Potential degradation could occur if restoration measures are poorly implemented or monitored. This could occur where scrub removal without follow-up could lead to erosion or colonisation by invasive species or access to the site for continued ecological and hydrological monitoring is undertaken without due care.
- **Species disturbance** – very low risk – where required works will be appropriately timed to minimise risk of disturbance, with supervision by an Ecological Clerk of Works where necessary.
- **Accidental pollution release** – very low risk - No chemical inputs are proposed. However, machinery use (if any) could pose a risk of fuel/oil leaks. This is mitigated by avoiding machinery in sensitive areas and using hand tools where possible.
- **Introduction and/or spread of invasive non-native species** – moderate risk - Restoration activities (e.g. soil disturbance, water movement) could facilitate dispersal of invasive species. Monitoring and biosecurity protocols will be embedded into the site plan to avoid such risks

4.5 Good Practice Recommendations

Several good practice measures are recommended based on the requirement for compliance with legislation but also the occurrence of sensitive receptors and possible pathways for negative effects during preparation for or implementation of restoration actions. These are summarised in Table 4-5 below and should be taken as generally applicable in the planning of FRP.

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

Table 4-5: Good Practice Recommendations

Receptor	Measure
Ground nesting birds	No vegetation clearance or activity which might contravene Section 40 of the wildlife act (consolidated) should be undertaken.

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

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

The conservation status assessment results for Mannin pNHA is summarised in Table 5-1. The NFS did not assign conservation status categories for Area, Future Prospects or Overall Conservation Status for this site following surveys in 2022. Baseline condition is therefore derived from the 2026 walkover surveys and the field-based assessment presented in Section 4.

Table 5-1: Conservation Status Assessment for Mannin pNHA

OVERALL CONSERVATION STATUS ASSESSMENT				
Annex I habitat	**Area**	**Structure & functions**	**Future prospects**	**Overall Conservation Status**
7140	Not recorded	Not recorded	Not recorded	Not recorded
7210	Not recorded	Unfavourable-inadequate	Not recorded	Not recorded
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 1.1.

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 flora and fauna pressures identified during field surveys are described in detail in Section 4.2. These include scrub encroachment, drainage-related hydrological modification, and variable grazing pressure across the site. This section focuses on the evaluation and prioritisation of these pressures based on field validation and their influence on habitat condition.

Scrub encroachment is considered a key pressure affecting Annex I habitats, in particular 7230 Alkaline fen. Its extent across the site and its influence on vegetation structure and hydrological functioning indicate that it represents a primary driver of ecological change, with the potential to alter species composition and promote succession toward scrub and woodland habitats if unmanaged.

Grazing pressure is observed to be spatially variable, with both undergrazing and localised overgrazing identified during field surveys. While grazing has an important role in maintaining open fen conditions, its current variability results in uneven vegetation structure and contributes to both localised disturbance and areas of rank vegetation. As such, grazing is considered a moderate but important management pressure.

Invasive species are present but limited in extent and are therefore considered a secondary pressure. However, their localised impacts on vegetation composition warrant monitoring and targeted management to prevent further spread.

The flora and fauna pressures are presented in Figure 5-1.



Figure 5-1: Flora & Fauna Pressures mapped within Mannin

5.2.2 Fen Hydrology Pressures

The following hydrological pressures were identified within Mannin site:

Drainage has been identified as a historical pressure on the site, particularly influencing the northern section, which is observed to be comparatively drier than the southern section. However, based on current site investigations and available data, it is not yet possible to confirm the extent to which drainage is actively influencing the hydrological regime and affecting the development of fen habitats. Further monitoring and assessment are therefore required to determine whether drainage is a significant control on site, and whether it should be retained as an ongoing pressure to be considered within the restoration measures and future proposed actions.

The key hydrological features requiring further investigation include:

- The drain located in the northeast, which appears to act as the main water input, flowing southwards into the site.
- The drain along the western boundary, which likely represents a primary outflow drain and may facilitate water loss from the system.
- The southern drain running parallel to the main road, which may influence local water levels.
- The southeast and northwest areas, where potential springs have been identified and may contribute to localised groundwater inputs.
- Lowering and fluctuations of water levels:
- Most of the visited drains or areas with water accumulation have shown very shallow water depth. Water movement is consistently very slow, indicating low hydraulic gradients across the fen. There is currently insufficient information to determine how water levels fluctuate over time or what is driving these changes. Further monitoring is required to understand seasonal variation, the influence of drainage, and the role of groundwater inputs.

Adjacent land use that may influence site hydrology:

- In particular, farmland activities in the southern area may be affecting the water balance through changes in runoff, drainage and potentially altering hydrological connectivity with the fen.

5.2.3 Fen Nutrient Pressures

The following nutrient pressures were identified within Mannin site:

- Nutrient enrichment identified particularly within the southern section area likely due to internal nutrient enrichment linked to hydrological change and vegetation composition/structure and to adjacent agricultural activities. Higher nutrient concentrations ranging between 8.7 and 16.3 mg/L were encountered within the southern section.

These conditions have the potential to alter vegetation composition and impact the low-nutrient, calcium-rich conditions required to maintain favourable alkaline fen habitat and associated qualifying species.

6 Restoration Measures

6.1 Introduction

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

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

Each of the factors was considered based on a combination of desktop analysis combined with site-specific field surveys to select the most appropriate restoration technique to address each pressure considered by the FRP. The restoration measures proposed are outlined in Section 6.2 to Section 6.3, with detailed mapping of proposed measures illustrated in the maps provided in Appendix B.

6.2 Hydrology Measures

6.2.1 On-site Fen Hydrology Measures

At this stage, no direct interventions (e.g. drain blocking) are proposed. Monitoring will be undertaken to assess hydrological conditions across the site and to determine the role of the drainage network in controlling the water levels and consequently affecting the fen habitat development.

A hydrological monitoring network will be established to assess site conditions. Monitoring will include the installation of a total of seven piezometers and standpipes at selected locations (Figure 6-1). These locations include water inflow (northeast), water inflow (southwest), wet areas, corresponding to historical and GSI mapped springs (northwest and southeast), one point within the centre of the northern area, and two other additional points within the drain parallel to the regional road bisecting the site (R434).

Information collected will include depth to water table, pH, EC, temperature, nitrate, and phosphate.

Supporting datasets will include rainfall and evapotranspiration data obtained from nearby monitoring stations.

The monitoring results will be used to inform any future hydrological restoration measures, including the potential requirement for drain blocking or water level management.

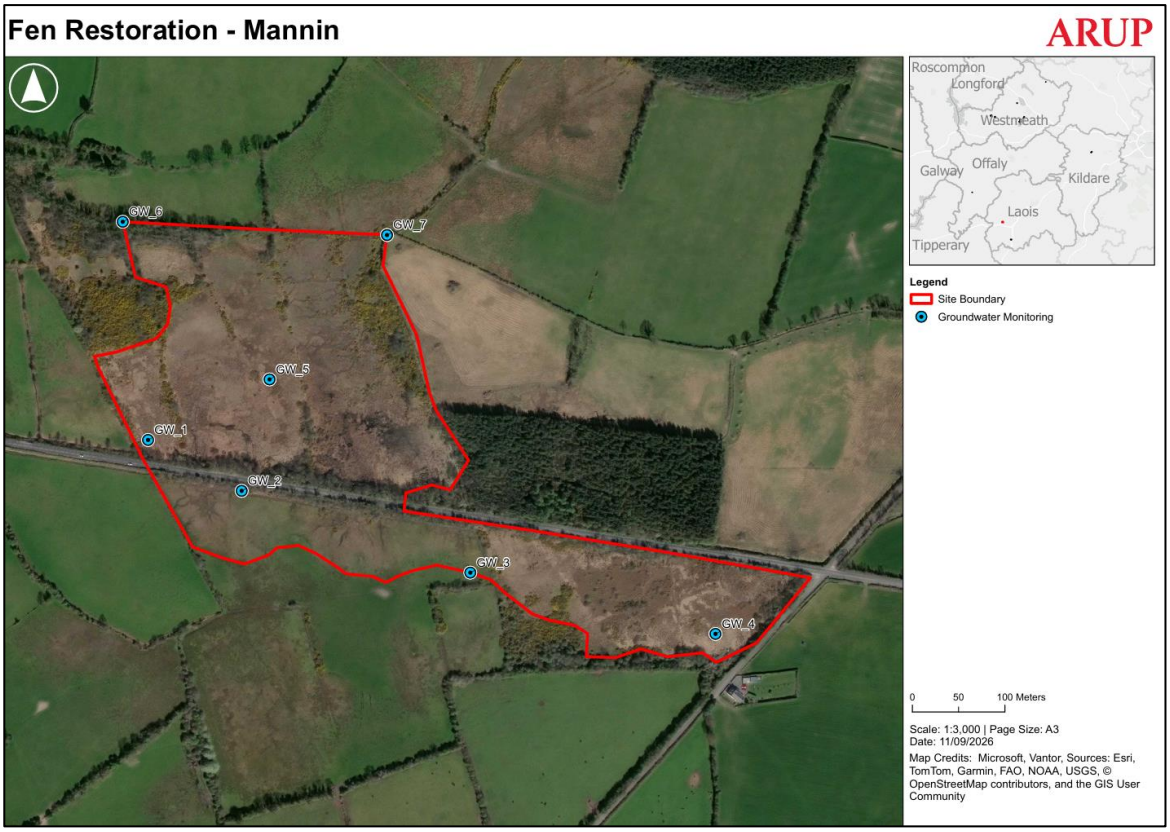


Figure 6-1: Proposed hydrological monitoring for Mannin

6.2.2 Off-site Hydrology Measures

Engagement with adjacent landowners will be undertaken to avoid the introduction of new drainage works or the deepening of existing drains where hydrological connectivity to Mannin Fen may be affected. In particular, landowner engagement will be important to avoid future farming activities within the southern section of Mannin site, where this may be affecting the water balance and potentially altering hydrological connectivity with the fen.

6.3 Nutrient Measures

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

6.3.1 On-site Nutrient Measures

On-site nutrient measures will focus on the monitoring of water quality to improve understanding of nutrient dynamics within the site and to assess the effectiveness of any future off-site measures.

Water quality monitoring will include nitrate, phosphate, electrical conductivity (EC), pH and temperature.

Monitoring locations will include the piezometers installation in seven areas across the site where the objectives are to:

- Identify spatial and temporal trends in nutrient concentrations;
- Improve understanding of nutrient sources and pathways (surface water vs groundwater).

The results of monitoring will be used to determine whether further interventions are required and to guide the selection of appropriate nutrient management measures, if need.

6.3.2 Off-site Nutrient Measures

Elevated nutrient concentrations are likely indicative of inputs from the surrounding agricultural, which are probably promoting nutrient enrichment via both surface and groundwater pathways.

Catchment-scale measures should target both phosphorus and nitrogen pathways based on observed spatial patterns. Measures should include source control through nutrient management planning, pathway interception to reduce nutrient transport.

6.4 Vegetation Measures

6.4.1 On-site Vegetation Measures

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

- Vegetation Monitoring
- Scrub removal
- Grazing management

Table 6-1: On Site Vegetation Measures proposed for Mannin pNHA.

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 rate, if any, of succession and/or general scrub encroachment which in turn informs the need for further works outside the Tóchar fen restoration programme such as scrub removal and conservation grazing. Due to the nature of the site being so wet, it is recommended that consistent monitoring of both vegetation and hydrology (through piezometers) is undertaken to provide a suitable baseline of information which can then inform further measures.	Tóchar & NPWS (post-Tóchar)
2	Scrub removal	Scrub removal will be carried out as shown below in Figure 6-2 in areas where fen habitat is pressured by encroachment. Due to the sensitivity of the site, this should be manual clearance. The area for clearance should be marked in the field by an ecologist prior to operations. It is important to note that areas of Annex quality 91E0 Alluvial forests in the	Tóchar & NPWS (post-Tóchar)

Priority	Measure	Description	Responsibility
		northeastern area of the site should be retained and not targeted for scrub/tree removal. It is important to note that small stands of willow forms part of the transition mire community and so the aim is to control areas of willow scrub where present within 7140 Transition Mire habitat on site rather than eliminate it. Any additional scrub clearance beyond that outlined will be reviewed following the ecological monitoring. It is expected that after this clearance and following the implementation of appropriately managed grazing that scrub at Mannin pNHA will be effectively controlled so as to prevent it from pressuring fen habitats.	
3	Grazing management	Grazing management will be implemented as a low-intensity, adaptive measure across the site to support the maintenance of fen vegetation structure. Due to the sensitivity of fen habitats to both overgrazing and undergrazing, stocking density, timing and spatial distribution of grazing will be carefully controlled. In wetter areas supporting high-quality fen vegetation, grazing pressure will be reduced or excluded where necessary to prevent trampling and poaching of the peat surface and associated vegetation. In contrast, light grazing may be encouraged in relatively drier areas where appropriate, to control the development of rank vegetation and prevent further establishment of scrub. It is expected that appropriate grazing management will contribute to maintaining open fen structure, limiting the expansion of Molinia caerulea and scrub, and preventing further degradation of fen habitats at Mannin pNHA.	Tóchar & NPWS (post-Tóchar)

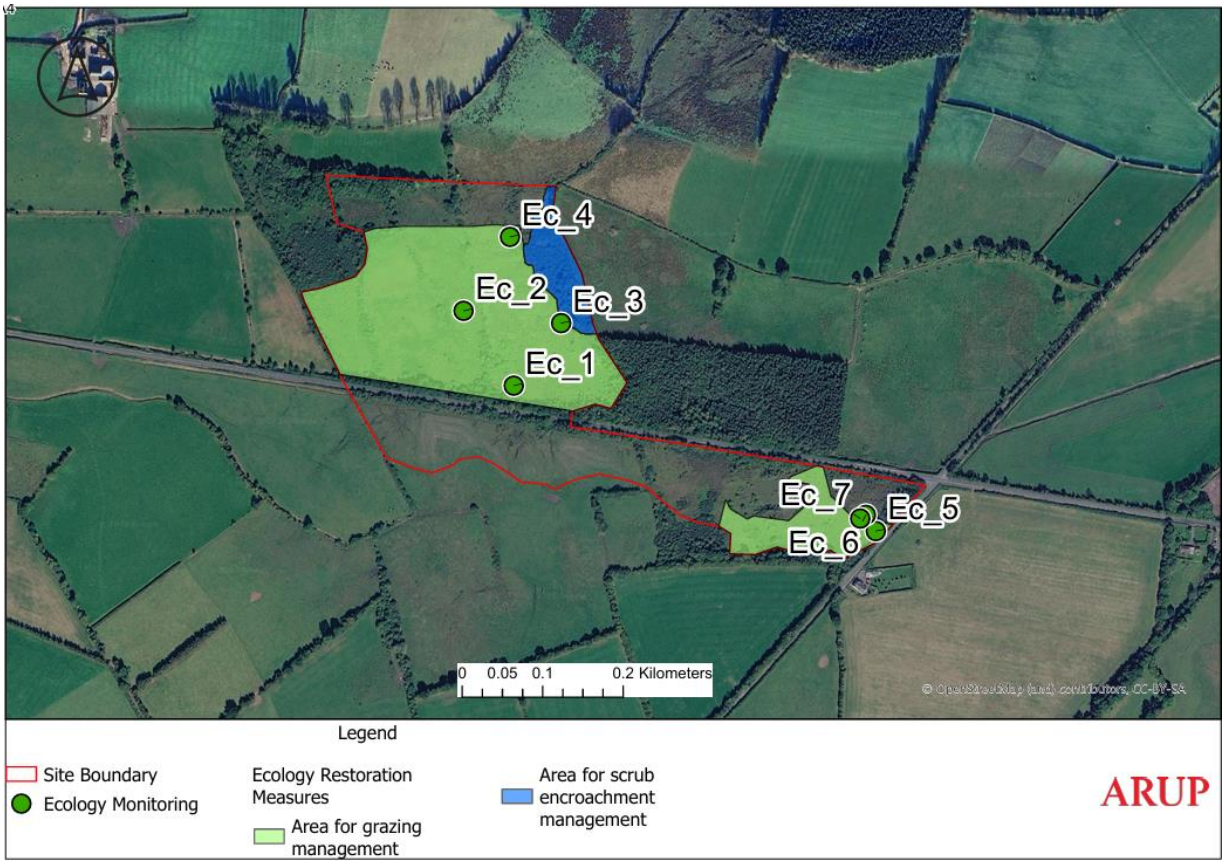


Figure 6-2: Proposed vegetation management measures and monitoring for Mannin pNHA

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 purpose of the schemes was to improve land for agriculture, to ensure that the three-year 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.

The Mannin site and its associated drainage network are not located within an OPW Arterial Drainage Scheme (ADS) or Drainage District (DD).[4]

The preliminary drainage management plan for Mannin is presented in Appendix C.

7.2 Peat Stability Assessment

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

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

The 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

[4] https://www.floodinfo.ie/map/drainage_map/

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 Mannin is presented in Figure 7-1.

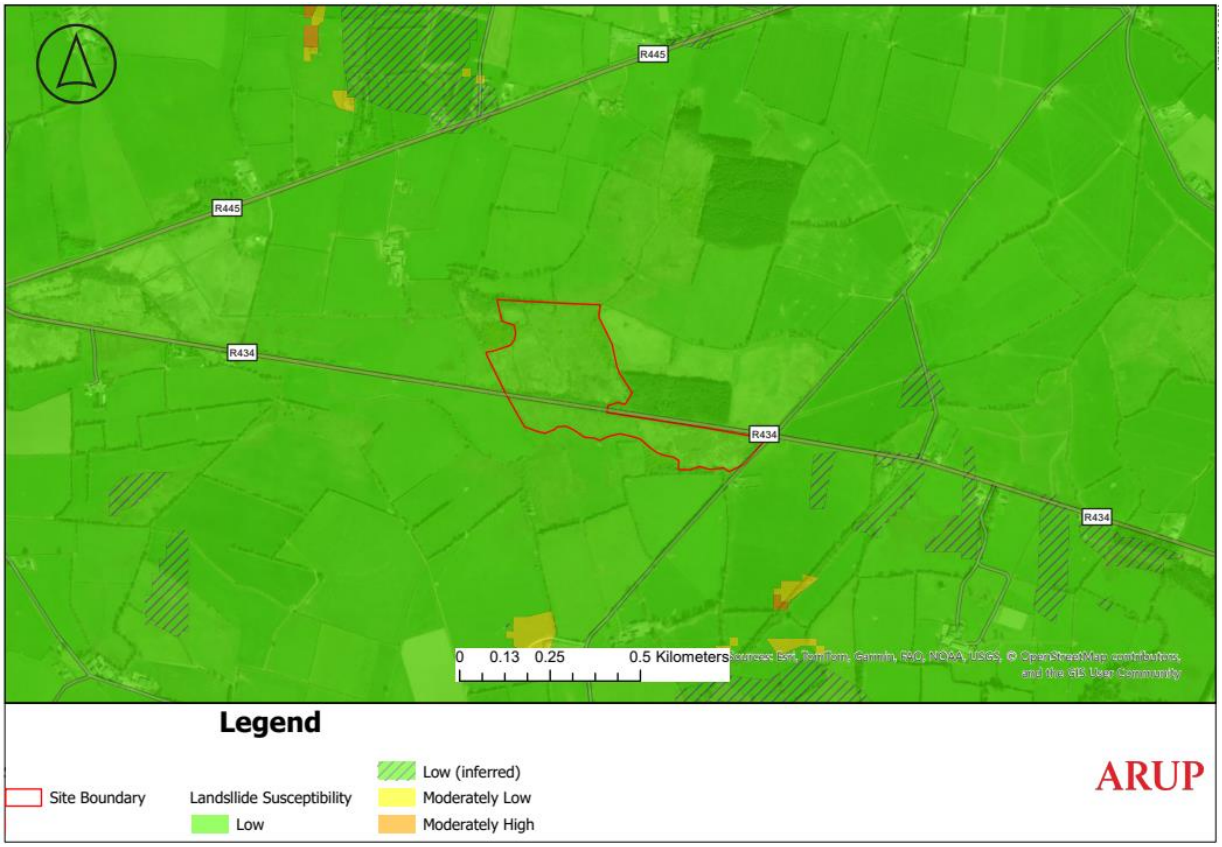


Figure 7-1: Geological Survey of Ireland Landslide Susceptibility mapping for Mannin

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 review indicates that there are no recorded archaeological sites within the site.

However, one recorded monument, shown in Figure 7-2, is located within the surrounding area, approximately 135 m from the north of the site, which is identified as LA022-004 (Enclosure located in Ballytarsna).

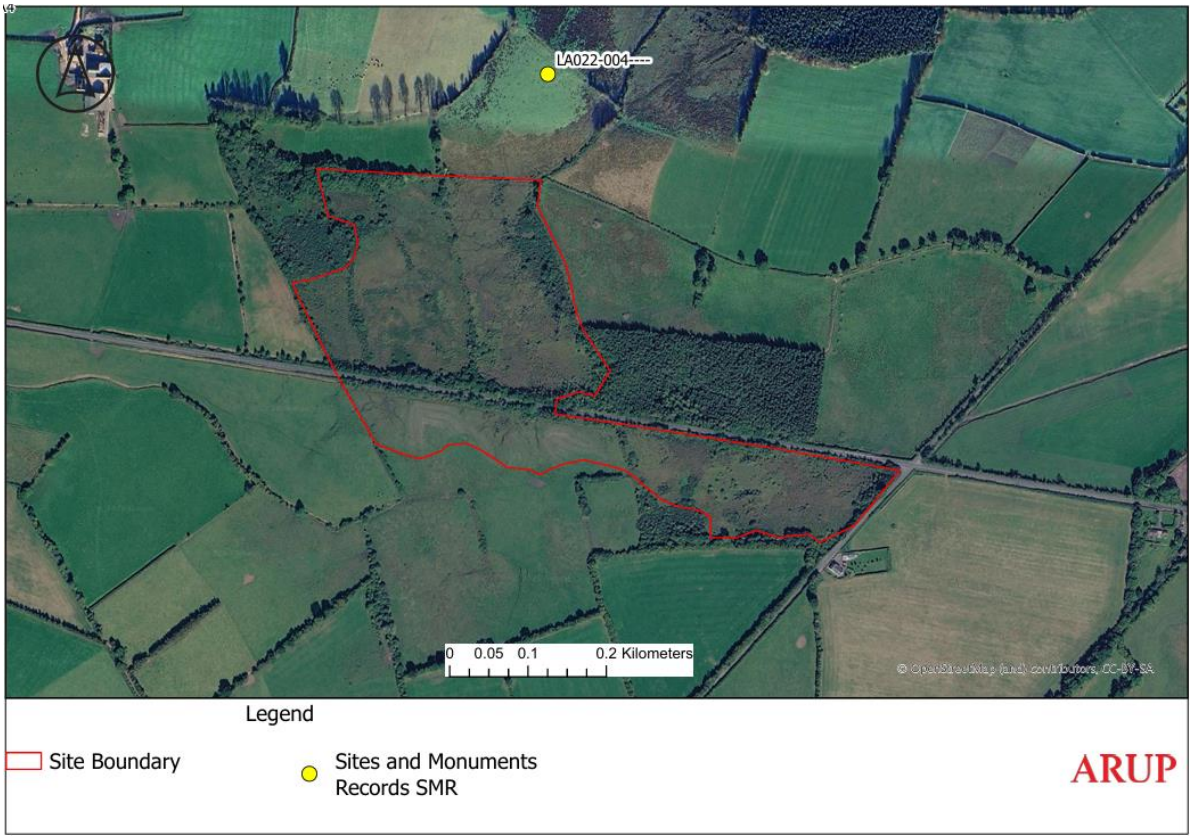


Figure 7-2: Archaeological Sites for Mannin (NMS, 2025)

8 Summary of Fen Restoration Plan Actions

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

Table 8-1: Role players in fen restoration plan

Measures	Stakeholder	Description
On-site	Landowners	Mannin is under ownership by private individuals.
Off-site	Landowners & farmers	Engagement for uptake of catchment measures.
	NMS	Consultation regarding the enclosure situated north of the site.
Capacity building	NPWS	NPWS engaging in community education and events

This section provides the summary of the Fen Restoration Plan Actions for Mannin Fen pNHA (Table 8-2).

Table 8-2: Implementation plan for Mannin Fen pNHA Fen Restoration

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
1	**Required preliminary actions**							
1.1	**Screening for Appropriate Assessment report.**							
	Although the site is not designated as a SAC, the potential for indirect effects on European sites within the wider hydrological catchment cannot be excluded. Therefore, a screening for AA will be undertaken to determine whether the proposed restoration measures are likely to result in significant effects on any European sites.	Sitewide	Screening report	Pre-restoration	NPWS			NPWS
1.2	**Drainage management plan**							
	Consultation with Co. Laois on the drainage management plan is required to ensure compliance with legislation and local authority objectives.	Sitewide	Drainage management plan	Pre-restoration	NPWS	Laois County Council	Arup	Within Tóchar project scope
1.3	**Archaeological assessment**							
	Consultation with Co. Laois on the archaeology is required to ensure compliance with legislation and local authority objectives.	Sitewide	Archaeological assessment report	Pre-restoration	NPWS	Laois County Council	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

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
2.2	**Implementation of Mitigation Measures**							
	Ecological Impact Assessment Considerations – identification of necessary mitigation measures. Such measures may include, but are not limited to, the use of hand machinery to avoid impact on sensitive habitats	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.3	**Breeding Bird Considerations**							
	Prior to restoration works, where any restoration measures are identified to have the potential to interfere with breeding birds e.g. scrub removal, these works shall occur outside the breeding bird season (1 March – 31 August inclusive).	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.4	**Good Practice Recommendations and CEMP**							
	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**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Installation of Piezometers Targeted hydrological monitoring, including the installation of piezometers, is required to improve understanding of groundwater-surface interaction and to support the interpretation of groundwater pathways. It will allow to establish the baseline hydrological conditions to determine the water management measures.	Northeast, southern and western areas	Site installation records	Restoration in 2027	NPWS to facilitate		Arup/ Contractor	Within Tóchar project scope
3.2	**Vegetation measures**							
	Vegetation monitoring	Sitewide	Monitoring surveys	Long-term	NPWS	Laois County Council		Within Tóchar project scope
	Removal of scrub (young willow) via hand tools (chainsaw), and implementation of an appropriate grazing regime that will control scrub levels appropriately within the site,	Sitewide	Site records / habitat surveys	Restoration 2026	NPWS	Laois County Council	Arup/Contractor	Within Tóchar project scope
	Implementation of a grazing management plan to reduce poaching and control scrub levels within the site, preventing re-encroachment of scrub after manual clearance.	Sitewide	Monitoring surveys	Long-term	NPWS	Laois County Council		Within Tóchar project scope
4	**Off-Site Restoration measures**							
4.1	**Hydrology measures**							
	Landowner engagement is required due to the farmland activities in the southern area that may be affecting the water balance of the site.	Surrounding farms	Landowner awareness	Long-term	NPWS, LAWPRO, Farming for Water EIP		Landowners	Catchment measures to be funded through Farming for Water EIP/other similar
4.2	**Nutrient measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Investigate nutrient sources and pathways, monitor water quality, and implement targeted catchment-scale measures where external nutrient inputs are shown to affect the fen.	Surrounding landowners	Uptake of measures by landowners	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	Northeast, southern and western areas	Water level	Long term	NPWS to facilitate access	Laois County Council		Within Tóchar project scope
5.2	**Nutrient monitoring**							
	Ongoing monitoring of habitats, drainage channels and piezometers for water quality parameters is proposed within the northern and southern sections of the site.	Various locations within the site	Nutrients (Nitrate and phosphate), electrical conductivity and pH	Long term	NPWS to facilitate	Laois County Council		Within Tóchar project scope
5.3	**Vegetation monitoring**							
	Habitat condition assessments will be included to track restoration progress.	Sitewide	Habitat condition	Long-term	NPWS	Laois County Council		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 fen

Restoration measures will focus on maintaining suitable ecological conditions through continued vegetation and hydrological monitoring and the control of scrub encroachment. Targeted manual scrub removal, combined with appropriate grazing management and monitoring, will reduce localised vegetation pressures such as scrub establishment, *Molinia caerulea* expansion and poaching. These measures will help maintain the structure and function of 7230 Alkaline fen habitats, supporting characteristic species assemblages and reducing the risk of succession to scrub or rank vegetation.

7210 Cladium fen

The proposed measures will support the protection of this localised and structurally sensitive habitat. Vegetation and hydrological monitoring will provide a baseline to track changes in habitat condition and inform any future management requirements. Appropriate grazing management and the avoidance of localised damage (e.g. trampling) will help maintain the integrity of the *Cladium mariscus*-dominated vegetation. These measures will support the maintenance of Annex I habitat condition and reduce the risk of structural degradation or succession.

7140 Transition mire

Restoration measures will support the maintenance of the open and wet conditions required for this habitat through continued monitoring and targeted vegetation management. Vegetation monitoring will allow early detection of scrub encroachment and changes in species composition, while hydrological monitoring will provide an understanding of water level dynamics. Targeted manual scrub clearance in areas where encroachment threatens transition mire habitat will reduce the risk of succession, supporting the persistence of characteristic species and overall habitat stability.

91E0 Alluvial forests /WN6 Wet willow-alder-ash woodland

Restoration measures will retain these woodland communities where present, recognising their ecological function within the wider site. Woodland areas will not be targeted for removal unless locally encroaching into sensitive fen habitats. This approach ensures that wet woodland continues to provide buffering and filtration functions without adversely affecting fen habitats.

Non-Annex Habitats

Non-Annex I habitats within the site (e.g. scrub, wet grassland and woodland) are expected to benefit indirectly from the restoration of hydrological and ecological processes targeted at Annex I habitats. These habitats will respond positively to increased water levels, reduced nutrient inputs, and appropriate vegetation management, and therefore do not require site-specific restoration measures.

8.2 Species Benefiting from Implementation of Restoration Actions

The proposed restoration measures will benefit plant and animal species associated with fen and wetland habitats by maintaining suitable hydrological and vegetation conditions. The preservation of open fen structure and the control of scrub and rank vegetation will support characteristic fen species, including sedges, brown mosses and other positive indicator species associated with Annex I quality habitats.

Improving and maintaining vegetation structure through targeted scrub management and appropriate grazing will also benefit invertebrates, birds and other fauna reliant on open wetland habitats. Continued monitoring will ensure that habitat conditions remain suitable for these species and will

allow for adaptive management if changes are detected. Collectively, these measures will support ecosystem function and the long-term viability of species associated with Mannin pNHA.

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Appendix A – Non-Technical Summary

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary			
Site Name	Mannin	**NFS site no.**	*109005*
County	Laois	**Designation**	pNHA 000868
Fen habitats present (area)	7140 Transition mire and quaking bog (0.28 ha), 7230 Alkaline fen (8.11 ha), 7210 Calcareous fens with Cladium mariscus (1.88 ha)	**Species of note**	*Common snipe*

Site Description

Mannin (pNHA 000868) is located approximately 3 km east of Borris-in-Ossory, County Laois, and occurs on both sides of a regional road (R434). The site is recognised for the presence of habitats corresponding to the EU Annex I habitat types, although it is not designated as a SAC. The pNHA covers a total area of approximately 16.80 ha and is dominated by a fen habitat with a range of associated peatland and wetland habitats also present.

Conceptual Site Model (CSM)

Under the WETMEC framework, Mannin is primarily a groundwater-fed valley-bottom fen, with historical springs in the northwest and southeast contributing to its hydrology. The site supports important Annex I habitats, including Transition Mire, Cladium Fen and Alkaline Fen.

Mannin has a gentle north-to-south slope ranging between 114 and 117 mOD, with higher levels to the northwest and south, likely providing groundwater recharge to the fen. The site is underlain by limestone and shale bedrock, overlain by peat, till and local gravel deposits that help facilitate groundwater movement. Historical records and field surveys indicate groundwater discharge areas in both the northwest and southeast of the site.

Surface water generally flows west and northwest towards the Mannin Stream through a network of shallow drains, although some drains show little active flow and a road crossing the site acts as a hydrological barrier. The southern part of the site contains the best-developed fen habitats, including Alkaline fen and localised Cladium fen, supported by calcium-rich groundwater. Elevated nitrate and phosphate concentrations were recorded in some southern drains. The diverse fen vegetation, including characteristic mosses, charophytes and fen plant species, is consistent with the expected ecological condition of a functioning groundwater-fed fen system.

Key Pressures	
Hydrology Pressures	Historical drainage is influencing the northern section, but its effect on the hydrological regime and fen habitat development cannot yet be confirmed.
Nutrient Pressures	Nutrient enrichment is evident in the southern section, likely linked to hydrological change, vegetation composition and structure, and adjacent agricultural activities.
Ecology Pressures	Scrub encroachment, drainage-related hydrological modification, and variable grazing pressure across the site.

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary	
Objective of Restoration Plan	
The primary objective of the restoration actions proposed as part of this FRP is to maintain or improve the quality of existing areas of fen or improve the hydrological conditions that will allow an expansion of the measurable area of fen thus impacting on the favourable condition of the fen. However, in some areas, it must be recognised that restoration to increase areas of existing fen will not be possible due to unsuitable hydrological conditions, and the objective may simply be to ensure no further deterioration.	
Restoration Measures	
Hydrology Measures	**On-Site Measures:** Hydrological monitoring **Off-Site Measures**: Avoid creating new drainage channels
Nutrient Measures	**On-Site Measures:** Water quality monitoring **Off-Site Measures:** Catchment measures should target phosphorus and nitrogen through nutrient management and flow interception
Ecology Measures	**On-Site Measures:** Vegetation monitoring, Scrub removal, Grazing management
Monitoring	
Hydrology Monitoring	Hydrological monitoring will be undertaken to assess water conditions across the site and evaluate the influence of the drainage network on water levels and fen habitat development.
Nutrient Monitoring	Monitoring of water quality to improve understanding of nutrient dynamics within the site and to assess the effectiveness of any future off-site measures.
Ecology Monitoring	The monitoring programme will use points that align with existing NFS locations to track changes in plant species composition, helping identify ecological succession and scrub encroachment. The results will guide any future management measures, such as scrub clearance or conservation grazing. Because the site is very wet, regular monitoring of both vegetation and hydrology, including piezometer measurements, is recommended to establish a reliable baseline and inform future restoration actions.
More information	
Fen Restoration Plan Report Tóchar website: https://www.tocharwetlands.ie/fen-restoration/	



Figure 3: Site Habitat Map

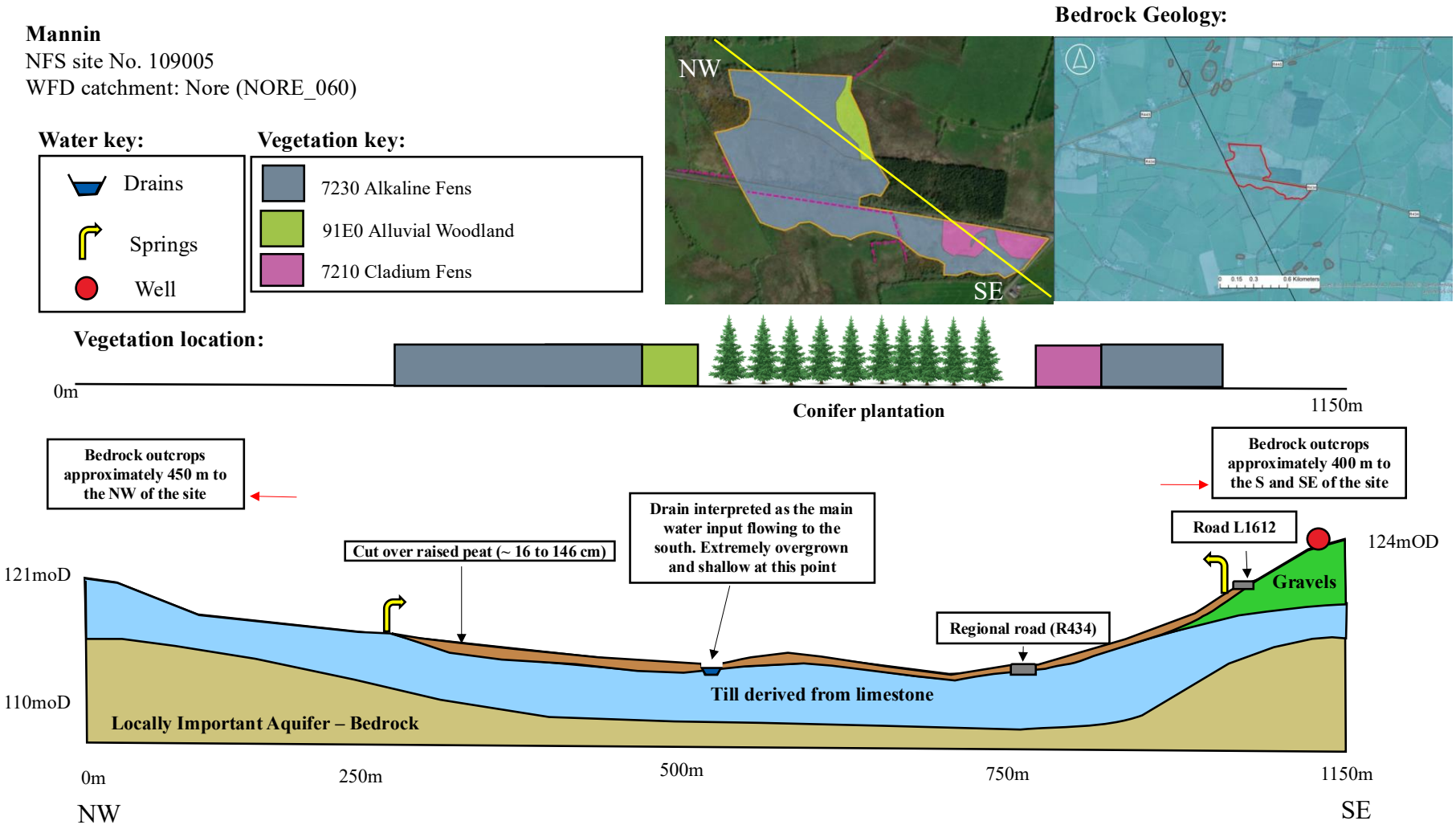


Figure 4: Conceptual Site Model

Appendix B – Ecological Survey Maps



Figure 9-5 Habitats identified during the 2022 NFS Survey and classified according to Fossitt Habitat Classification. Please refer to Appendix B for the full directory of habitat codes and names.

Table 9-1 Annex I habitat codes 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
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 fen	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

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
8310	Caves	PB4	Cutover bog
8330	Sea caves	PB5	Eroding blanket bog
91A0	Old oak woodland	PF1	Rich fen and flush
91D0	Bog woodland	PF2	Poor fen and flush
91E0	Alluvial woodland	PF3	Transition mire and quaking bog
91J0	Yew woodland	WN1	Oak-birch-holly woodland
		WN2	Oak-ash-hazel woodland
		WN3	Yew woodland
		WN4	Wet pedunculate oak-ash woodland
		WN5	Riparian woodland
		WN6	Wet willow-alder-ash woodland
		WN7	Bog woodland
		WD1	(Mixed) broadleaved woodland
		WD2	Mixed broadleaved/conifer woodland
		WD3	(Mixed) conifer woodland
		WD4	Conifer plantation
		WD5	Scattered trees and parkland
		WS1	Scrub
		WS2	Immature woodland
		WS3	Ornamental/non-native shrub
		WS4	Short rotation coppice
		WS5	Recently-felled woodland
		WL1	Hedgerows
		WL2	Treelines
		ER1	Exposed siliceous rock
		ER2	Exposed calcareous rock
		ER3	Siliceous scree and loose rock
		ER4	Calcareous scree and loose rock
		EU1	Non-marine caves
		EU2	Artificial underground habitats
		ED1	Exposed sand, gravel or till

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
		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

Appendix C – Restoration measures and monitoring

Table C-1: Long-term monitoring points for fen restoration at Mannin pNHA

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				
GW_5				
GW_6				
GW_7				
Ec_1	Ecological	Monitoring within areas of 7230 Alkaline fen and 7210 Cladium fen	Long-term	Seasonal for year 1 Every 3 years for year 2-5
Ec_2				
Ec_3				
Ec_4				
Ec_5				
Ec_6				
Ec_7				

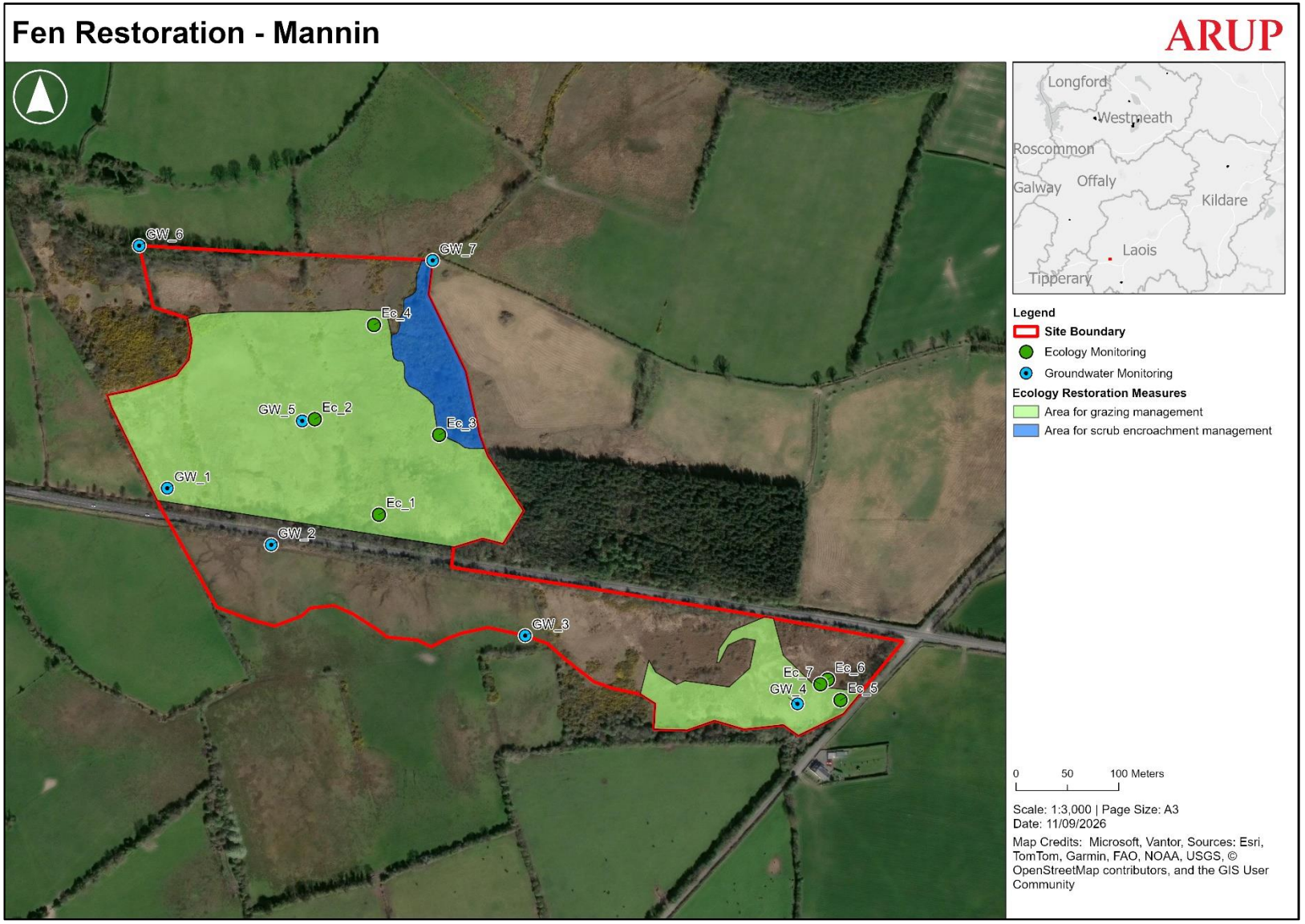


Figure 9-6 Proposed restoration measures and monitoring for Mannin

Appendix D – Drainage Management Plan

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan			
Site name	Mannin		
County	Laois	NFS site No.	109005
Catchment overview:			
The catchment is drained by the River Nore and its tributaries and flows towards the Nore_060 River Waterbody via local streams, including the Mannin and Ballykeevan. The Nore_060 waterbody has Good WFD Status and is not at risk of failing to achieve its WFD objective. The site has a gentle north-to-south slope, with ground levels ranging from 114 to 117 mOD and a generally flat west-east profile. Surrounding land rises in the northwest and south, where bedrock outcrops reach approximately 130 mOD and 160 mOD, respectively.			
WFD catchment	Nore	WFD Sub-catchment	Nore_SC_010
Drainage Area	None	Drainage District	None
Responsible authority	N/A	Maintenance date	N/A
Surrounding landowners	Landowners and farmers. Mannin is under ownership by private individuals		
Wetland drainage			
Historical and current hydrological data indicate that drainage generally flows towards the northwest. Historic mapping and GSI records identify springs to the southeast and northwest of the site, including two springs in the southeast used for agricultural and domestic purposes. Drains are present along the south, southwest, west and northeast of the site, with the northeastern drain potentially providing water input. Overall, surface water flow discharges to the Mannin and Ballykeevan streams and ultimately to the River Nore.			
Surface water inflow	Norther eastern drain	Surface water outflow	Mannin Stream
Groundwater inflow	Springs		
Internal drains	One drain through the site, south of the road (R434)	Perimeter drains	One to the northeast, one to the west and some to the south
On site hydrology measures			
On-site measure 1	Hydrological monitoring	Role player	NPWS/Surrounding landowners
Off-site hydrology measures			
Off-site measure 1	Avoid creating new drainage channels	Role player	NPWS/Surrounding landowners

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan					
On-site nutrient measures					
On-site measure 1	Water quality monitoring		Role player		NPWS/Surrounding landowners
Off-site nutrient measures					
Off-site measure 1	Catchment measures should target phosphorus and nitrogen through nutrient management and flow interception.		Role player		NPWS/Surrounding landowners
Proposed Water Monitoring:					
Indicator	Water level/ Water quality	Location	Various locations across site	Role players	NPWS/ Surrounding landowners
Hydrological monitoring will be undertaken to assess water conditions across the site and evaluate the influence of the drainage network on water levels and fen habitat development. A network of seven piezometers will be installed at key locations, including inflow areas, wet areas associated with mapped springs, the northern part of the site, and the drain alongside the R434. Monitoring will record groundwater levels and water quality parameters, including pH, EC, temperature, nitrate, and phosphate, supplemented by rainfall and evapotranspiration data from nearby stations. The results will provide a baseline understanding of site hydrology and inform any future restoration measures, such as water level management or drain blocking.					

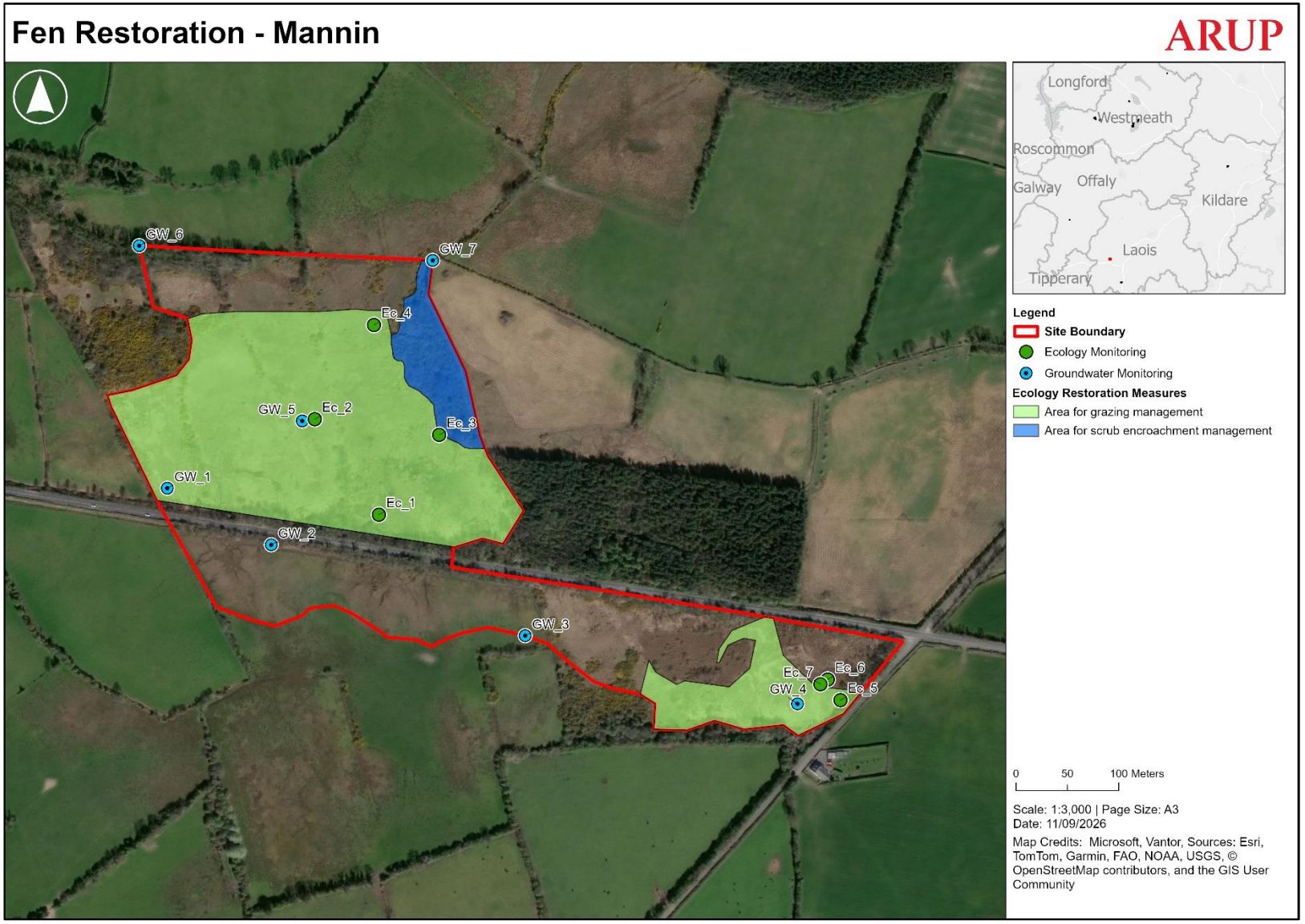


Figure 1: Hydrology measures and monitoring at Mannin

Appendix E – NBDC Data Search Results for Species Within the Site

Table E.1: NBDC Data Search Results for Species Within the Site

Species group	Species name	Record count	Date of last record
Insect - butterfly	Green-veined White (*Pieris napi*)	1	13/05/2017
Insect - butterfly	Meadow Brown (*Maniola jurtina*)	1	21/06/2017
Insect - butterfly	Ringlet (*Aphantopus hyperantus*)	1	21/06/2017
Insect - butterfly	Small Heath (*Coenonympha pamphilus*)	1	21/06/2017
Insect - moth	Narrow-bordered Bee Hawk-moth (*Hemaris tityus*)	1	13/05/2017

Appendix F – NBDC Data Search Results for Species Within the Zone of Influence

Table F.1: NBDC Data Search Results for Species Within the Zone of Influence

Species group	Species name	Record count	Date of last record
Bird	Buzzard (*Buteo buteo*)	1	22/04/2020
Bird	Collared Dove (*Streptopelia decaocto*)	1	23/11/2020
Bird	Golden Plover (*Pluvialis apricaria*)	1	22/11/2021
Bird	Kestrel (*Falco tinnunculus*)	2	30/11/2020
Bird	Magpie (*Pica pica*)	1	22/05/2016
Bird	Meadow Pipit (*Anthus pratensis*)	2	01/04/2016
Bird	Rook (*Corvus frugilegus*)	1	29/08/2017
Bird	Swallow (*Hirundo rustica*)	1	29/08/2017
Bird	Woodpigeon (*Columba palumbus*)	1	29/08/2017
Bird	Yellowhammer (*Emberiza citrinella*)	6	12/06/2022
Flowering plant	Bluebell (*Hyacinthoides non-scripta*)	1	02/04/2019
Flowering plant	Lesser Celandine (*Ficaria verna*)	1	02/04/2019
Flowering plant	Lords-and-Ladies (*Arum maculatum*)	1	02/04/2019
Flowering plant	Primrose (*Primula vulgaris*)	1	05/05/2019
Insect - butterfly	Common Blue (*Polyommatus icarus*)	1	24/08/2019
Insect - butterfly	Green-veined White (*Pieris napi*)	2	24/08/2019
Insect - butterfly	Meadow Brown (*Maniola jurtina*)	1	21/06/2017
Insect - butterfly	Red Admiral (*Vanessa atalanta*)	1	24/08/2019
Insect - butterfly	Ringlet (*Aphantopus hyperantus*)	2	07/07/2017
Insect - butterfly	Small Heath (*Coenonympha pamphilus*)	1	21/06/2017
Insect - butterfly	Small Tortoiseshell (*Aglais urticae*)	1	24/08/2019
Insect - butterfly	Small White (*Pieris rapae*)	1	24/08/2019
Insect - moth	Narrow-bordered Bee Hawk-moth (*Hemaris tityus*)	1	13/05/2017
Terrestrial mammal	Hedgehog (*Erinaceus europaeus*)	4	05/10/2020