Ref. No.	Mitigation Measure	Audit Result	Action Required
MM46	Measures will be in place to prevent the spread of invasive species during the proposed works. In addition, all necessary precautions will be taken to prevent the introduction of invasive species to the site from elsewhere. Best practice measures in relation to invasive species are described below: › All earthworks machinery and forestry machinery will be thoroughly pressure-washed prior to arrival on site and prior to their further use elsewhere. › Care will be taken not to disturb or cause the movement of invasive species fragments, either intentionally or accidentally. › Rhododendron will be pre-treated in the season prior to felling operations. › Any material that is imported onto any site will be verified by a suitably qualified ecologist to be free from any invasive species listed on the 'Third Schedule' of Regulations 49 & 50 of Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). This will be carried out by searching for rhizomes and plant material. The treatment and control of invasive alien species will follow guidelines issued by the National Roads Authority. The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads (NRA 2010).		
Air Quality and Dust			
MM47	In periods of extended dry weather, dust suppression may be necessary along haul roads and site roads to ensure dust does not cause a nuisance. If necessary, a water spreader will be used to dampen down haul roads to prevent the generation of dust where required. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff.		

Ref. No.	Mitigation Measure	Audit Result	Action Required
	› All plant and materials vehicles shall be stored in dedicated areas (on Site). › The agreed haul route roads adjacent to the Site will be regularly inspected for cleanliness and cleaned as necessary. › The Site access roads will be checked weekly for damage/potholes and repaired as necessary. › The transport of construction materials to the Site that have significant potential to cause dust, will be undertaken in tarpaulin or similar covered vehicles where necessary.		
MM48	› All construction and forestry vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise. › When stationary, delivery and on-site vehicles will be required to turn off engines. › Users of the Site will be required to ensure that all plant and vehicles are suitably maintained to ensure that emissions of engine generated pollutants are kept to a minimum.		
Noise			
MM49	› All plant and machinery used on the site will comply with E.U. and Irish legislation in relation to noise emissions. › Operation of plant: all construction operations will comply with guidelines set out in British Standard documents 'BS 5338: Code of Practice for Noise Control on Construction and Demolition Sites' and 'BS7228: Part 1: 1997: Noise & Vibration Control on Construction and Open Sites'. › The correct fitting and proper maintenance of silencers and/or enclosures, the avoidance of excessive and unnecessary revving of vehicle engines, and the parking of equipment in locations that avoid possible effects on noise-sensitive locations was employed.		
Traffic			

Ref. No.	Mitigation Measure	Audit Result	Action Required
MM50	› Resurfacing of the existing access with tarmacadam to tie into the existing R344 with a minimum radii of 13m provided and an access road width of 6m. › The introduction of STOP road markings and signs in accordance with Figure 7.35 of the Traffic Signs Manual (TSM). › "Agriculture (or Other) Machinery" warning signs are to be provided on both of the R344 approaches to the existing junction. › Clearance of a visibility triangle (3m at the junction tapering to 1m at a distance of 140m) of shrubs and bushes along the western side of the R344 in order to maximise visibility to the south of the junction. › Clearance of a short section of shrubs to the north of the junction in order to provide clear visibility to the north.		
Cultural Heritage			
MM51	A walk-over archaeological survey of the site should be carried out following the clear-felling of existing forestry stands. Any archaeological sites/features detected during the walk-over survey will be preserved in-situ (avoidance).		
	Operational Phase		
Land, Soils and Geology/Water			
MM52	› Vehicles used during the operational phase will be refuelled off site before entering the site; › No fuels will be stored on-site during the operational phase; and		

Ref. No.	Mitigation Measure	Audit Result	Action Required
	› Spill kits will be available in all site vehicles to deal with accidental spillages and breakdowns;		

6. MONITORING PROPOSALS

All monitoring proposals relating to the pre-commencement, construction and operational phases of the Proposed Project are set out in the relevant chapters of the Environmental Impact Assessment Report (EIAR).

This section of the Construction and Environment Management Plan groups together all of the monitoring proposals presented in the EIAR. The monitoring proposals are presented in Table 6-1 below.

By presenting the monitoring proposals in the format outlined, it is intended to provide an easy to audit list that can be reviewed and reported on during the future phases of the project. The tabular format in which the information is presented, can be further expanded upon during the course of future project phases to provide a reporting template for site compliance audits (Table 6-1).

Table 6-1 Monitoring Measures

Ref. No.	Survey / Monitoring Measure	Audit Result	Action Required
Pre-Commencement Phase			
MX2	Prior to commencement of works in sub-catchments across the site main drain inspections will be competed to ensure ditches and streams are free from debris and blockages that may impede drainage water discharge.		
MX3	Pre-commencement surveys will be undertaken prior to the initiation of works. The survey will include a thorough walkover survey to a 500m radius of all works areas, where access allows. If winter roosting or breeding activity of birds of high conservation concern is identified, the roost or nest site will be located and earmarked for monitoring at the beginning of the first winter or breeding season of the construction phase. If it is found to be active during the construction phase, no works shall be undertaken within a disturbance buffer (Forestry Commission Scotland, 2006; Ruddock and Whitfield, 2007) in line with industry best practise. No works shall be permitted within the buffer until it can be demonstrated that the roost/nest is no longer occupied.		
Construction Phase			
MX4	Archaeological walkover of site will be undertaken following felling of trees.		
MX6	Check dams will be inspected and maintained regularly to insure adequate performance. Maintenance checks will also ensure the centre elevation of the dam remains lower than the sides of the dam.		
MX7	A daily visual inspection of each settlement pond on the active site will be undertaken to identify when sediments are nearing capacity within the pond and sediment will be cleaned out as required. Settlement ponds will also be checked for anything else that might interfere with flow.		
MX8	Settlement ponds will be inspected weekly and following significant rainfall events i.e. after events of >25mm rainfall in any 24-hour period. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows. Inspection and maintenance of these structures during construction phase is critical to their functioning and purpose.		
MX9	All culverts will be inspected regularly to ensure they are not blocked by debris, vegetation or any other material that may impede conveyance.		

Ref. No.	Survey / Monitoring Measure	Audit Result	Action Required
MX10	The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat silt-laden water from the works areas, will be monitored continuously by the Environmental Manager. The Environmental Manager will respond to changing weather, ground or drainage conditions on site as the project proceeds, to ensure the effectiveness of the drainage system is maintained in so far as is possible.		
MX11	The plant used should be regularly inspected for leaks and fitness for purpose.		
MX12	Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended. Inspections will also be undertaken after tree felling.		
MX13	During the construction phase field testing and laboratory water analysis of a range of parameters with relevant regulatory limits and EQSs should be undertaken for each watercourse and specifically, following heavy rainfall events (*i.e.* weekly, monthly and event based). This will be completed in consultation with Inland Fisheries Ireland.		
MX15	Any requirement for construction works to run into the merlin breeding season following commencement will be subject to pre-construction bird surveys to confirm the presence/absence of breeding merlins.		
MX17	A Project Ecologist will be appointed. The responsibilities and duties of the Project Ecologist will include the following: › Undertake a pre-construction transect/walkover bird survey to ensure that significant effects on breeding birds will be avoided. Inform and educate on-site personnel of the ornithological and ecological sensitivities within the Proposed Project area. › Oversee management of ornithological, water quality protection and ecological issues during the construction period and advise on these issues as they arise. › Provide guidance to contractors to ensure legal compliance with respect to protected species onsite.		

Ref. No.	Survey / Monitoring Measure	Audit Result	Action Required
	Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress.		
Operational Phase			
MX18	Monthly sampling for laboratory analysis for a range of parameters adopted during pre-commencement and construction phases will continue for at least six months during the operational phase. The Project Hydrologist will monitor and advise on the results received from the testing laboratory.		

7. COMPLIANCE AND REVIEW

7.1 Site Inspections and Environmental Audits

Routine inspections of activities will be carried out on a daily and weekly basis by the Site Manager/ Environmental Manager or by a suitably qualified and competent person to ensure all controls are in place to prevent negative environmental impacts, due to the construction activities taking place.

Environmental inspections will ensure that the works are undertaken in compliance with this CEMP. Environmental site inspections will be carried out by suitably trained staff.

7.2 Environmental Compliance

The following definitions shall apply in relation to the classification of Environmental Occurrences during the infilling works:

Environmental Near Miss

An occurrence which if not controlled or due to its nature could lead to an Environmental Incident.

Environmental Incident

Any occurrence which has potential, due to its scale and nature, to migrate from source and have an environmental impact.

Environmental Non-Compliance

Non-fulfilment of a requirement includes any deviations from established procedures, programs and other arrangements related to the CEMP.

7.3 Corrective Action Procedure

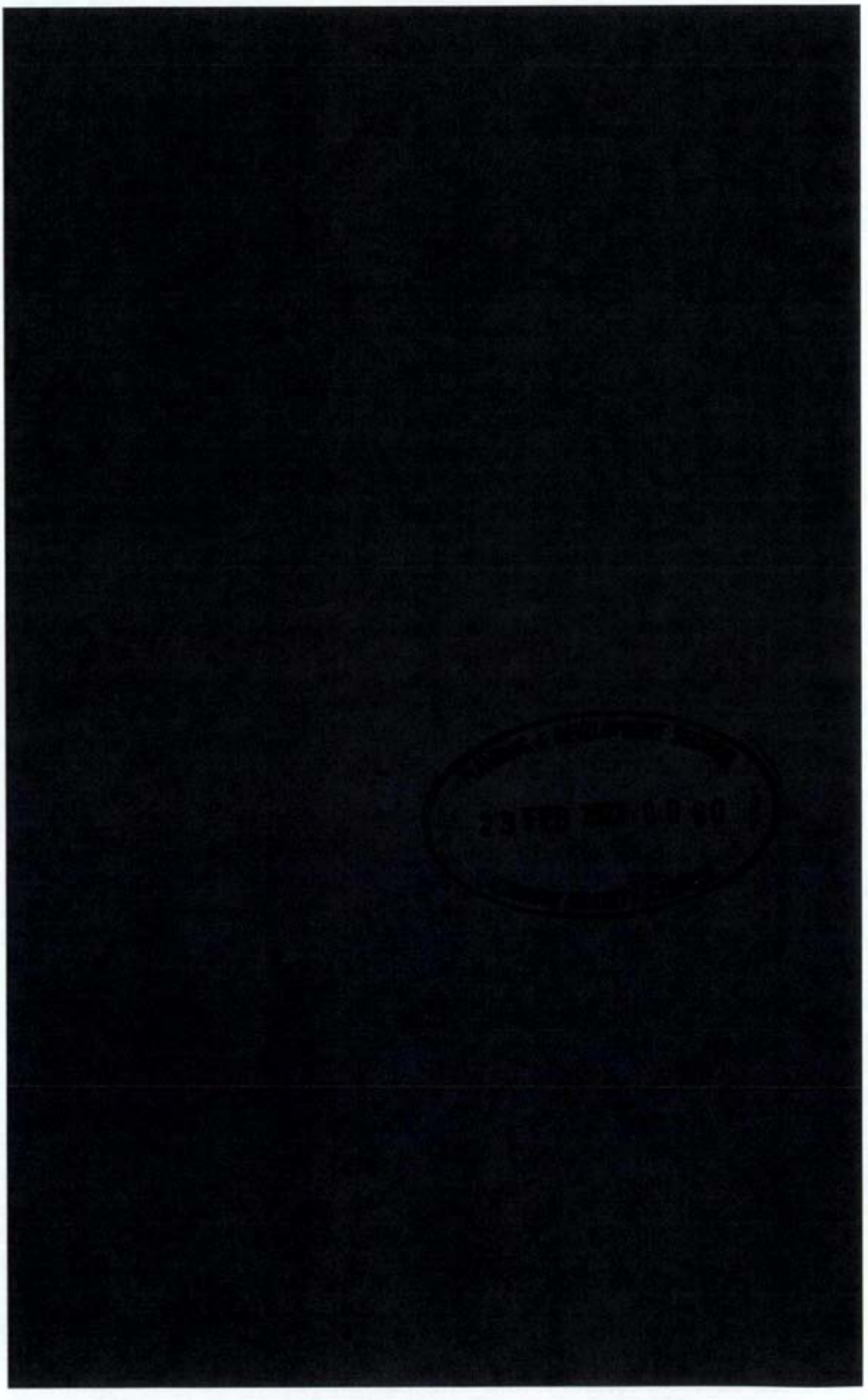
A corrective action is implemented to rectify an environmental issue on-site. Corrective actions will be implemented by the contractor, as advised by the Site Environmental Manager. Corrective actions may be required as a result of the following:

- Environmental Audits.
- Environmental Inspections and Reviews.
- Environmental Incidents; and,
- Environmental Complaints

A Corrective Action Notice will be used to communicate the details of the action required to the main contractor. A Corrective Action Notice is a form that describes the cause and effect of an environmental problem on site and the recommended corrective action that is required. The Corrective Action Notice, when completed, will include details of close out and follow up actions.

If an environmental problem occurs on site that requires immediate attention direct communications between the Contractor's foreman and the Site Environmental Manager will be conducted. This in turn will be communicated to all the site staff involved. A Corrective Action Notice will be completed at a later date.

MKO



APPENDIX 3

EIAR CHAPTER 8: HYDROLOGY AND HYDROGEOLOGY

8. HYDROLOGY AND HYDROGEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential effects of the proposed Derryclare Wild Western Peatlands Project on the hydrological and hydrogeological environment.

The project site at Derryclare lies to the west of Lough Inagh and Derryclare Lough in Connemara, Co. Galway. The project site lies to the north of the N59 which joins Galway in the east to Clifden in the west. The project site is owned by Coillte and was planted with coniferous forestry in the 1960s. The overall Coillte property at Derryclare is ~567ha ("the "project site", refer to **Figure 1-1**). Topography is highly variable within the project site, ranging from 10-180mOD (meters above Ordnance Datum). The site lies on the eastern slopes of Derryclare and Bencorr mountains with topography sloping steeply to the east towards Lough Inagh and Derryclare Lough.

The Derryclare Wild Western Peatlands Project (the "Proposed Project") aims to restore and rehabilitate ~281 hectares (ha) of Atlantic Bog and heathland that is currently planted with lodgepole pine and Sitka spruce forests and managed for commercial forestry. The Proposed Project will comprise of felling of the existing forestry plantations and a series of restoration works, including drain blocking and ground reprofiling designed to aid the restoration of the peatland at the project site. The Proposed Project also aims to convert ~62 ha. of coniferous forestry to native scrub woodland.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the project site;
- Identify likely significant effects of the Proposed Project on surface water and groundwater during construction, operational and decommissioning phases of the Proposed Project;
- Identify mitigation measures to avoid, reduce or offset significant negative effects;
- Assess significant residual effects; and,
- Assess cumulative effects of the Proposed Project and other local developments.

8.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice that delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience include upland hydrology and forestry and windfarm related drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types. We also specialise in the area of wetland hydrology, ecohydrology, an bog restoration.

This chapter of the EIAR was prepared by Michael Gill and Conor McGettigan.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and other developments in coniferous forestry plantations and bogs in Ireland. Michael has substantial experience in surface water

drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS for Oweninny WF, Cloncreen WF, Derrinlough WF, and Yellow River WF, and over 100 other forestry and wind farm-related projects. Michael also routinely provides hydrological/hydrogeological support and input to bog and wetland restoration projects.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with 3 years' experience in the environmental sector in Ireland. Conor holds an MSc in Applied Environmental Science and a BSc in Geology from University College Dublin. Conor has prepared the hydrology and hydrogeology chapter of EIARs for numerous projects including wind farms, grid connections and quarries. Conor has also been involved in several bog restoration projects including the restoration of Clonaslee Fen and the Liffey Head Bog.

8.1.3 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as summarised in Section 2.7 of Chapter 2 of the EIAR. Consultation responses relating to the water environment were received from the Geological Survey of Ireland, Department of Agriculture, Food and the Marine (response was related to forestry) and the Health Services Executive. Details of these scoping responses and actions taken to address them are outlined in Section 2.7.2 of this EIAR.

8.1.4 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU.

The following legislation has been complied with:

- Planning and Development Acts, 2000-2021;
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;
- S.I. No. 94/1997: European Communities (Natural Habitats) Regulations, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of 'daughter' Groundwater Directive (2006/118/EC);
- S.I. No. 684/2007: Waste Water Discharge (Authorisation) Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 249/1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (as amended by 2000/60/EC in 2007);
- S.I. No. 122/2014: European Union (Drinking Water) Regulations, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and WFD 2000/60/EC (the Water Framework Directive);

- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended;
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended; and,
- S.I. 191/2017, Forestry Regulations, Felling Licence, Department of Agriculture, Food and the Marine (DAFM).

8.1.5 Relevant Guidance

The Hydrology and Hydrogeology chapter of the EIAR is carried out in accordance with the guidance contained in the following:

- Environmental Protection Agency (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Environmental Protection Agency (2015): Draft - Advice Notes on Current Practice (in the preparation of Environmental Impact Statements);
- Environmental Protection Agency (2003) Advice Notes on Current Practice (in the preparation of Environmental Impact Statements);
- Environmental Protection Agency (2006): Environmental Management in the Extractive Industry;
- Institute of Geologists Ireland (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Forestry Commission (2004) Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Forestry Standards and Procedures Manual, Forest Service, Department of Agriculture, Food and the Marine (DAFM) (2015);
- Coillte (2009) Forest Operations & Water Protection Guidelines;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Water Courses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006); and,
- Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001.

8.2 Methodology

8.2.1 Desk Study

A desk study of the project site and the surrounding area was completed prior to the undertaking of field mapping and walkover assessments. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation of the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive "catchments.ie" Map Viewer (www.catchments.ie);

- Bedrock Geology 1:100,000 Scale Map Series, Sheet 10 (Geology of Connemara and South Mayo);Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- OPW Indicative Flood Maps (www.floodmaps.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

8.2.2 Baseline Monitoring and Site Investigations

A hydrological walkover survey, including detailed drainage mapping and baseline monitoring was undertaken by HES on 22nd and 23rd November 2022.

Field observations made by HES during the site surveys were supplemented by previous site investigations completed by RPS on July and August 2021 (RPS, 2021) and recent site investigations completed by FT in November and December 2022. The site investigations included the following:

- Site walkover surveys;
- Drainage mapping;
- HES completed field hydrochemistry at 14 no. locations on 22nd and 23rd November 2023;
- 43 no. peat probes (RPS, 2021),
- 73 no. peat probes (FT, 2022),
- 2 no. rounds of surface water sampling (10 no. samples) was completed by Coillte on 10th August 2022 and 24th October 2022,
- Installation of 29 no. piezometers (RPS, 2021); and,
- Measuring of groundwater levels in the installed piezometers on 2 no. occasions (RPS, 2021).

The combined geological dataset collated by HES, FT, MKO and RPS has been used in the preparation of this EIAR Chapter.

In summary, the combined HES and RPS site investigations used to define the baseline for the Water chapter of this EIAR includes the following:

- Walkover surveys and hydrological mapping of the project site and the surrounding areas were undertaken whereby water flow directions and drainage patterns were recorded;
- Completion of a preliminary flood risk assessment;
- Field hydrochemistry and laboratory analysis of surface water samples to determine baseline surface water quality;
- A total of 117 no. peat probe/investigation points were carried out by RPS (RPS, 2021 and FT, 2022) to determine the thickness and geomorphology of the peat at the project site; and,
- A geotechnical assessment of peat stability for the project site was completed by Fehily Timoney (FT, 2023).

8.2.3 Impact Assessment Methodology

The guideline criteria (EPA, 2022) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1 of this EIAR.

In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in **Table 8-1** for hydrology and **Table 8-2** for hydrogeology are used to assess the potential effect that the Proposed Project may have on them.

Table 8-1: Estimation of Importance of Hydrology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for a wide range of leisure activities.
High	Attribute has a high quality or value on a local scale	Salmon fishery locally important potable water source supplying >1000 homes. Quality Class B (Biotic Index Q3-4). Flood plain protecting between 5 and 50 residential or commercial properties from flooding.
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery. Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3). Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities. Local potable water source supplying <50 homes. Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

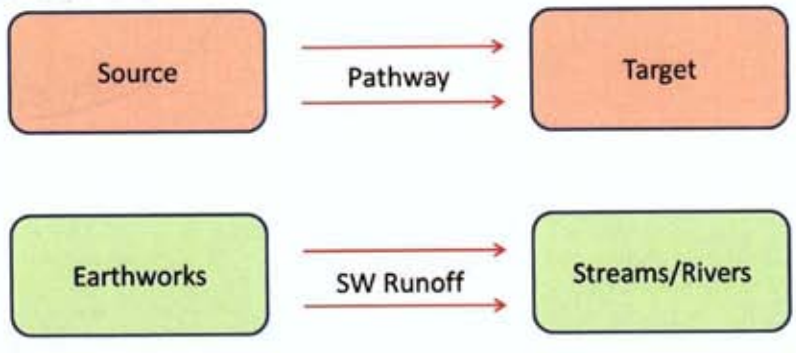
Table 8-2: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g. SAC or SPA status.
Very High	Attribute has a high quality or value on a	Regionally Important Aquifer with multiple wellfields.

Importance	Criteria	Typical Example
	regional or national scale	Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer. Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes.

8.2.4 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential effects on downstream environmental receptors (see below, bottom as an example) as a result of the Proposed Project.



Where potential effects are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003); and,
- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2022).

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Sections 9.4.2 to 9.4.4), a summary guide is presented below in Table 8-3, which defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction, operation and decommissioning activities which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

Table 8-3: Impact Assessment Process Steps

Step 1	› Identification and Description of Potential Impact Source › This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	› Pathway / Mechanism:	› The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation/movement or soil erosion are physical mechanisms by which potential impacts are generated.
Step 3	› Receptor:	› A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	› Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. In relation to this type of development, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by (engineering) design.
Step 6	› Post-Mitigation Residual Impact:	› Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	› Significance of Effects:	› Describes the likely significant post-mitigation effects of the identified potential impact source on the receiving environment.

8.2.5 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Hydrology and Hydrogeology Chapter of the EIAR.

8.3 Receiving Environment

8.3.1 Site Description and Topography

The Coillte property at Derryclare (the "project site") lies to the west of Lough Inagh and Derryclare Lough in Connemara, Co. Galway. The project site lies to the north of the N59 which joins Galway in the east to Clifden in the west.

The project site is owned by Coillte and was planted with Sitka Spruce and Lodgepole Pine in the 1960s. The overall Coillte landholding at Derryclare is ~567ha with the majority of the project site being dominated by coniferous forests (76%). The forestry plantations at Derryclare are of low to moderate productivity. Approximately 6% of the project site is unplanted, comprising of bog or wet heath habitats or is located along riparian buffer zones. An additional 18% of the forest cover has been felled or burnt and is reverting naturally wet heath or blanket bog.

The project site can be accessed from the R344, which branches off the N59 to the southeast of the project site and extends northwards travelling to the east of Derryclare Lough. A forestry track extends westwards from the R344 into the project site between Lough Inagh and Derryclare Lough. The project site is currently served by approximately 6.8km of forestry roads and tracks.

Topography of the project site is highly variable, ranging from 10-180mOD (meters above Ordnance Datum). The project site lies on the eastern slopes of Derryclare and Bencorr mountains with topography sloping steeply to the east towards Lough Inagh and Derryclare Lough. The western section of the project site contains the steepest gradients. Meanwhile, the eastern section of the project site, adjacent Lough Inagh and Derryclare Lough, is comparatively flatter.

Coillte have subdivided the Derryclare landholding into a total of 22 no. forestry harvest blocks. A total of 2 no. harvest blocks (GY27_HB0025 and GY27_HB0026) are not included in the Proposed Project. GY27_HB0025, located in the south and west of the project site is already natural bogland and does not require restoration. Meanwhile, GY27_HB0026 located towards the centre of the project site and along the western shores of Lough Inagh will be retained as commercial forestry. As part of the Proposed Projec the other 20 no. harvest blocks will be subject to felling (where felling has not already been completed) and the implementation of restoration measures.

A local topography map is included as **Figure 8-1** below.

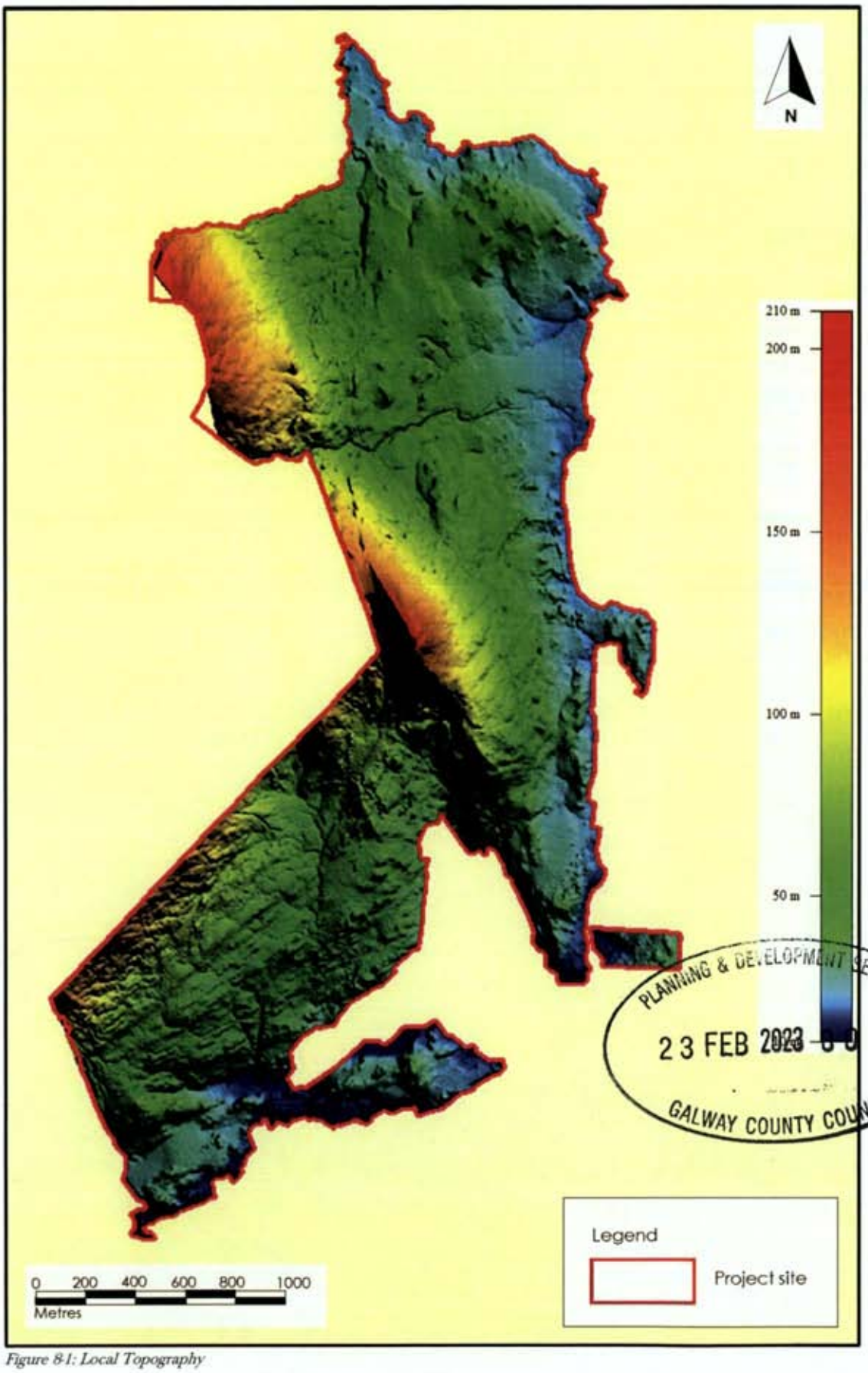


Figure 8-1: Local Topography

8.3.2 Water Balance

Long term rainfall and evaporation data were sourced from Met Éireann. The 30-year annual average rainfall recorded at the Ballynahinch rainfall station, located ~7km southwest of the project site is presented in **Table 8-4**. The standard annual average rainfall for the project site varies between 2056mm and 2285mm.

Table 8-4 Local average long-term rainfall data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Ballynahinch		75300		248600		27		1962		1985		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
117	86	94	92	92	83	64	89	95	136	140	123	1211

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Claremorris, approximately 54km northeast of the project site. The long-term average PE for this station is 408mm/yr. This value is used as the best estimate of the project site PE. Actual Evaporation (AE) at the project site is estimated as 387mm/yr (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the project site is calculated as follows:

$$\text{Effective rainfall (ER)} = \text{AAR} - \text{AE}$$

$$= 1211\text{mm/yr} - 387\text{mm/yr}$$

$$\text{ER} = 824\text{mm/yr}$$

Groundwater recharge coefficient estimates from the GSI (www.gsi.ie) vary across the project site from 4% where the project site is overlain by peat to 85% where bedrock outcrop is present. Due to the extensive coverage of blanket peat at the site, a recharge coefficient of 10% is taken for the project site. Based on this coefficient, an estimate of 82.4mm/year average annual recharge is given for the project site. This means that the hydrology of the project site is characterised by very high surface water runoff rates and very low groundwater recharge rates. Therefore, conservative annual recharge and runoff rates for the project site are estimated to be 82.4mm/yr and 741.6mm/yr respectively.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. A summary of various return periods and duration rainfall depths for the project site are presented in **Table 8-5**.

Table 8-5 Project site return period rainfall depths (mm)

	Return Period (Years)			
Storm Duration	1	5	30	100
5 mins	4.4	6.1	8.5	10.4
15 mins	7.3	10.0	14.0	17.1
30 mins	10.2	14.0	19.5	23.9
1 hour	14.2	19.5	27.1	33.3
6 hours	33.5	46.2	64.1	78.6
12 hours	46.7	64.4	89.5	109.7

Return Period (Years)				
Storm Duration	1	5	30	100
24 hours	65.2	89.8	124.8	153.0
2 days	83.3	110.6	148.1	177.3

8.3.3 Regional Hydrology

Regionally the project site is located in the Galway Bay North WFD catchment and Hydrometric area 31 of the Western River Basin District.

This catchment has a total area of 936km^2 and includes the area drained by all streams entering the tidal water between Nimmo's Pier and Syne Head, Co. Galway. The largest urban centre in the catchment is the western part of Galway city, with Bearna and Spiddle being the other main urban centres.

Locally, the project site is located within the Recess river sub-catchment (Recess_SC_010) and the Recess_020 WFD river sub-basin. In the vicinity of the project site, EPA mapping shows several watercourses (mountain streams) originating on the eastern slopes of Bencorr and Derryclare Mountains. In the north of the project site, these watercourses are unnamed and flow to the east from Bencor Mountain into Lough Inagh. To the south, the Derryclare stream (EPA Code: 31D10) flows to the east from Derryclare Mountain and discharges into Lough Inagh. Further south, 3 no. unnamed streams rise on the slopes of Derryclare mountain and flow to the southeast, discharging into Derryclare Lough. Derryclare Lough itself is also fed by the Tooreenacoona river (EPA Code: 31T01) which provides a hydrological connection between Lough Inagh in the north to Derryclare Lough in the south.

Downstream of Derryclare Lough, the Recess River (EPA Code: 31R01) crosses the N59 before discharging into Ballynahinch lake. Ballynahinch Lake is an east-west elongated lake which lies to the south of the Galway to Clifden Road. This lake is noted for salmon and sea-trout fishing. Downstream of Ballynahinch Lake, the Owenmore River flows to the south before it discharges into Roundstone Bay estuary. Further downstream the estuary discharges to the Betraghboy Bay coastal waterbody and the Aran Islands, Galway Bay, Connemara coastal waterbody.

A regional hydrology map is shown in **Figure 8-2**.

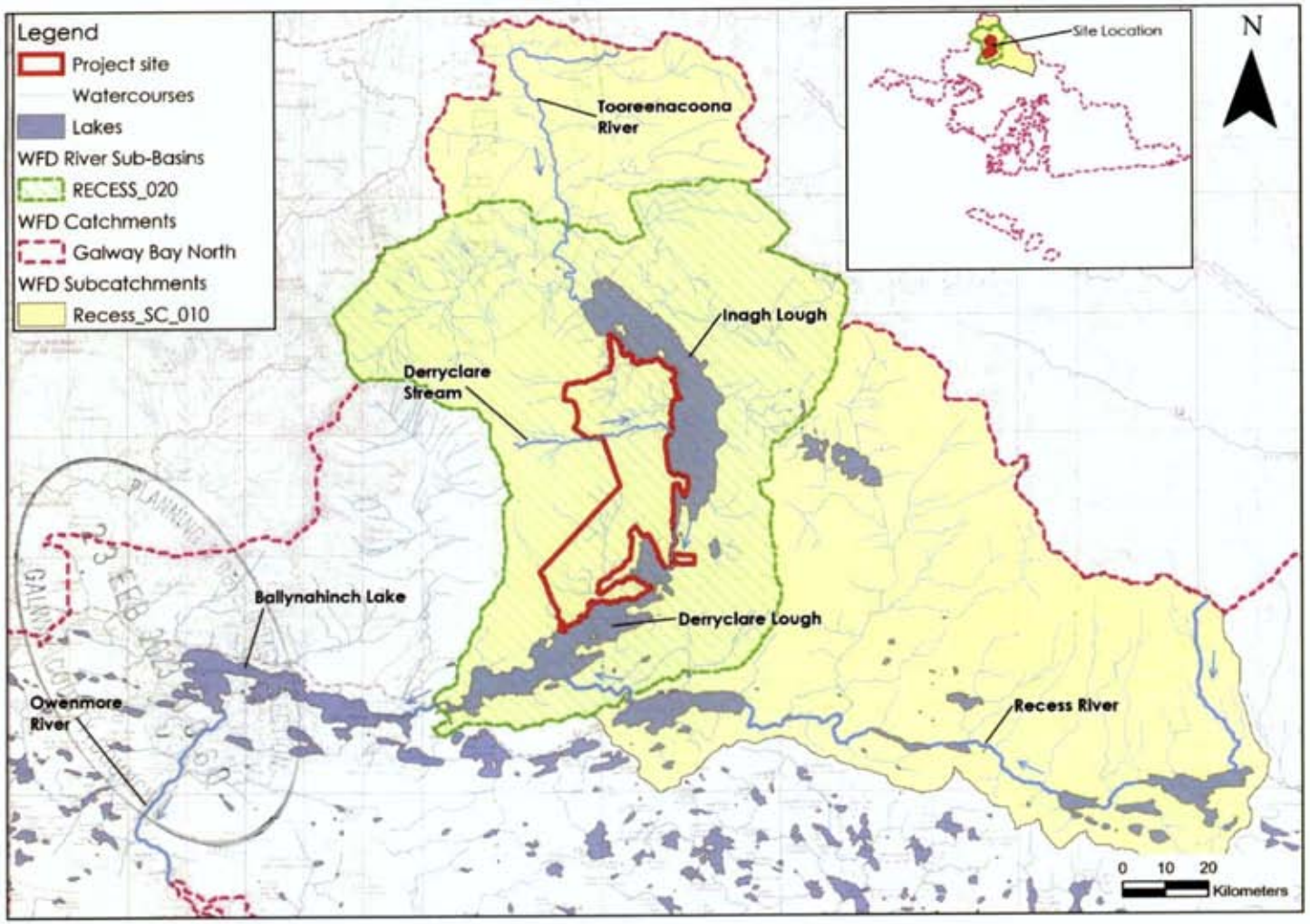


Figure 8-2: Regional Hydrology Map

Data on volumetric flow exceedance was acquired from the OPW gauging station (www.waterlevel.ie) at Derryclare. This station (Station Number: 31072) measures the outflow from Derryclare Lake to Ballynahinch Lake, with the 95%ile flow estimated to be 1.057m^3/day.

The EPA's HydroTool, available on www.catchments.ie, was also consulted in order to estimate natural flow volumes in the local area. The HydroTool dataset contains estimates of naturalised river flow duration percentiles. 2 no. nodes were consulted, one located upstream of Derryclare Lough on the Tooreenacoona River (Node: 31_1601) which has a total upstream catchment of 48km^2. A second node is located downstream of Derryclare Lough and upstream of Ballynahinch Lough (Node: 31_697) with a total upstream catchment of 112km^2.

Figure 8-3 below presents the estimated flow duration curves for each of the HydroTool Nodes described above. A 95%ile flow relates to the flow which will be exceeded within the river 95% of the time. For example, the 95%ile flow at Node 09_1601 is estimated to be 0.361m^3/s (361 L/s). This indicates that 95% of the time, the flow in the Tooreenacoona River at this location is estimated to be at or above 0.361m^3/s. Due to the increased catchment size, the 95%ile flow at Node 09_697, downstream of Derryclare Lough, is estimated to be 0.836m^3/s (836 L/s).

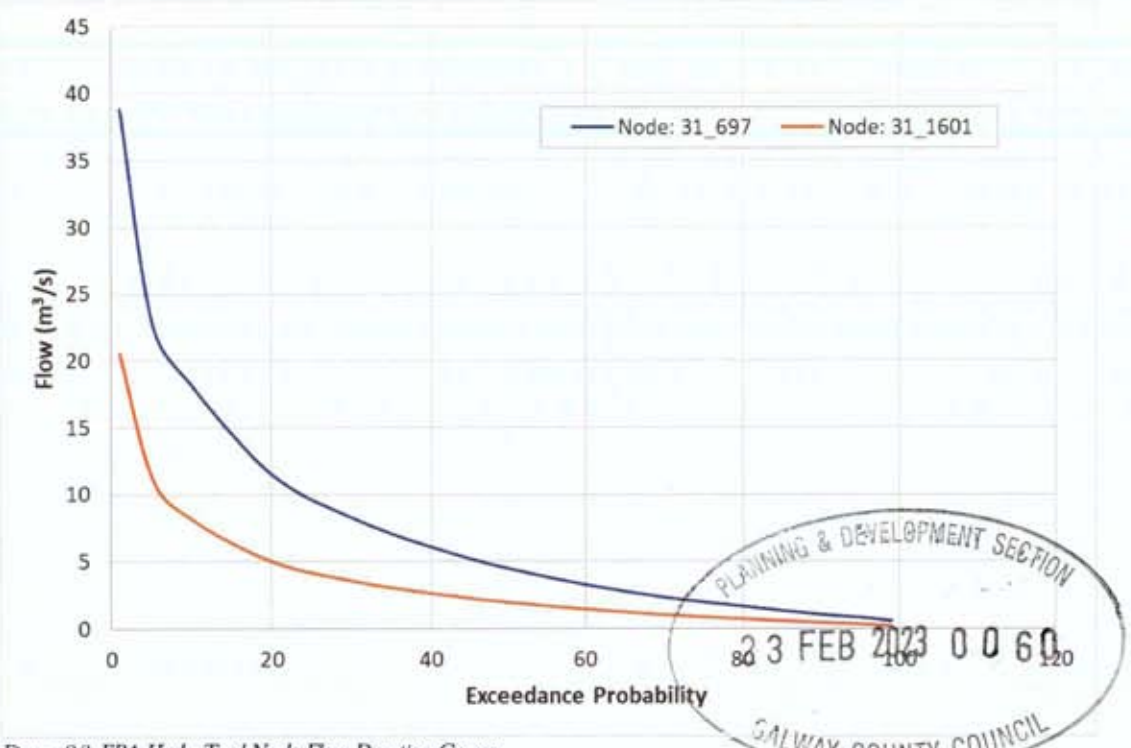


Figure 8-3: EPA HydroTool Node Flow Duration Curves

8.3.4 Project Site Drainage

The project site lies on the eastern slopes of Derryclare and Bencorr mountains and on the western shores of Lough Inagh in the north and Derryclare Lough in the south. The project site drains to these 2 no. lake waterbodies via several mountain streams which rise on the mountains to the west of the project site and flow to the east, through the project site.

The key drainage features of the project site were encountered during site walkover surveys. In the north of the project site, an unnamed mountain stream rises on the easter slopes of Bencorr Mountain and flows eastwards through the Corrabeg Valley. This watercourse runs along the northern site boundary and receives flow from several smaller unnamed EPA mapped watercourses which originate within the forestry plantation (**Figure 8-4**). This watercourse discharges into Lough Inagh immediately to the north

of the project site. Further south, the EPA named Derryclare River rises on the eastern slopes of Derryclare Mountain before flowing eastwards through the project site and discharging into Lough Inagh. Further south, 3 no. unnamed watercourses rise on the slopes of Derryclare Mountain and flow to the southeast, discharging into Derryclare Lough downstream of the project site. All natural watercourses encountered onsite were fast flowing, following surface topography and had incised channels into the peat deposits with some of the larger watercourses exposing bedrock outcrop.

An existing drainage map for the project site is shown within **Figure 8-5**. The drainage map was created using EPA/OSI mapped watercourses, aerial photography, field mapping and Lidar data. Lidar data allows detailed mapping on the topographic contours of the project site, thereby identifying all the linear drainage features at the project site that are greater than 150m in length. Based on this assessment the main drainage pathways at the project site are shown and the connectivity (i.e., pathways and outlet points) of these drains with the downstream EPA mapped streams/rivers can be clearly illustrated.

Surface water flow monitoring was completed at 12 no. locations within the project site. These data are presented in **Table 8-7** below. A large range of flow volumes were encountered during the walkover surveys with flows ranging from 2L/s for small drains and watercourses up to 2,000L/s for large mountain streams which drain the project site.

Within the project site there are also numerous manmade drains that are in place predominately to drain the forestry plantations. The current internal forestry drainage pattern is influenced by the topography, peat subsoils, layout of the forest plantation and by the existing road network. The forest plantations are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the project site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. As illustrated in **Figure 8-6** below, interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations. A schematic of a typical standard forestry drainage network and one which is representative of the project site drainage network is shown as **Figure 8-6**.

The forestry drains are the primary drainage routes towards the natural streams at the project site, but the flows in the higher elevated drains are generally very low or absent most of the time.

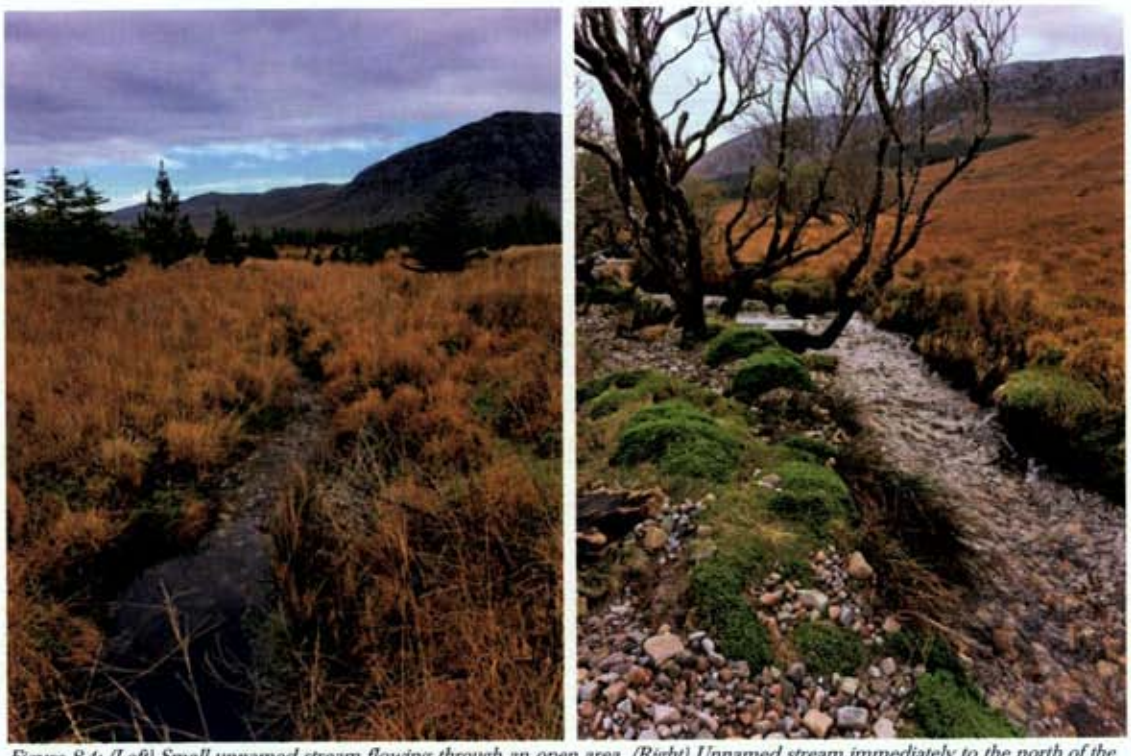


Figure 8-4: (Left) Small unnamed stream flowing through an open area. (Right) Unnamed stream immediately to the north of the project site which flows rapidly downslope and receives discharge from several watercourses which flow through the site.

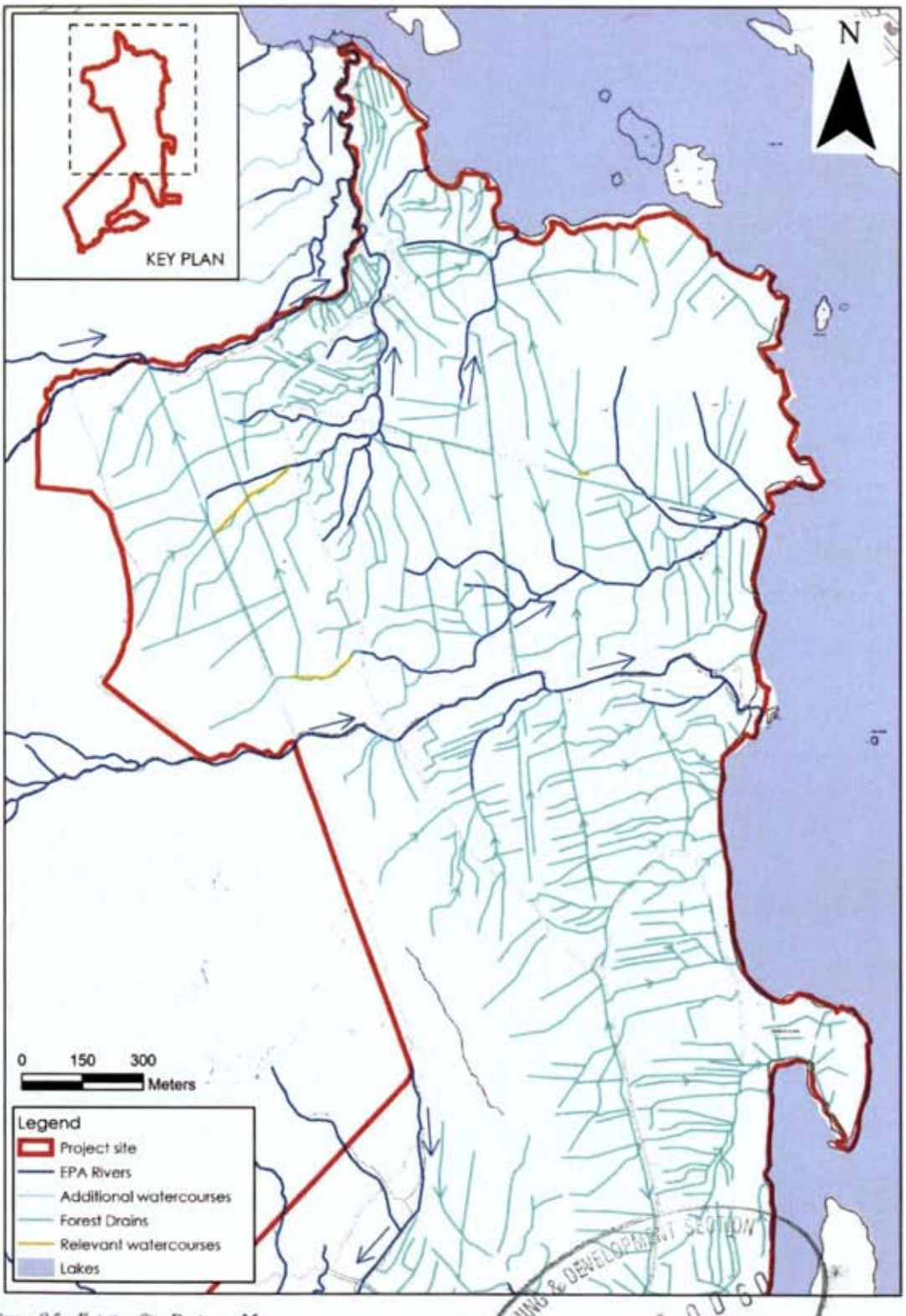


Figure 8-5a: Existing Site Drainage Map

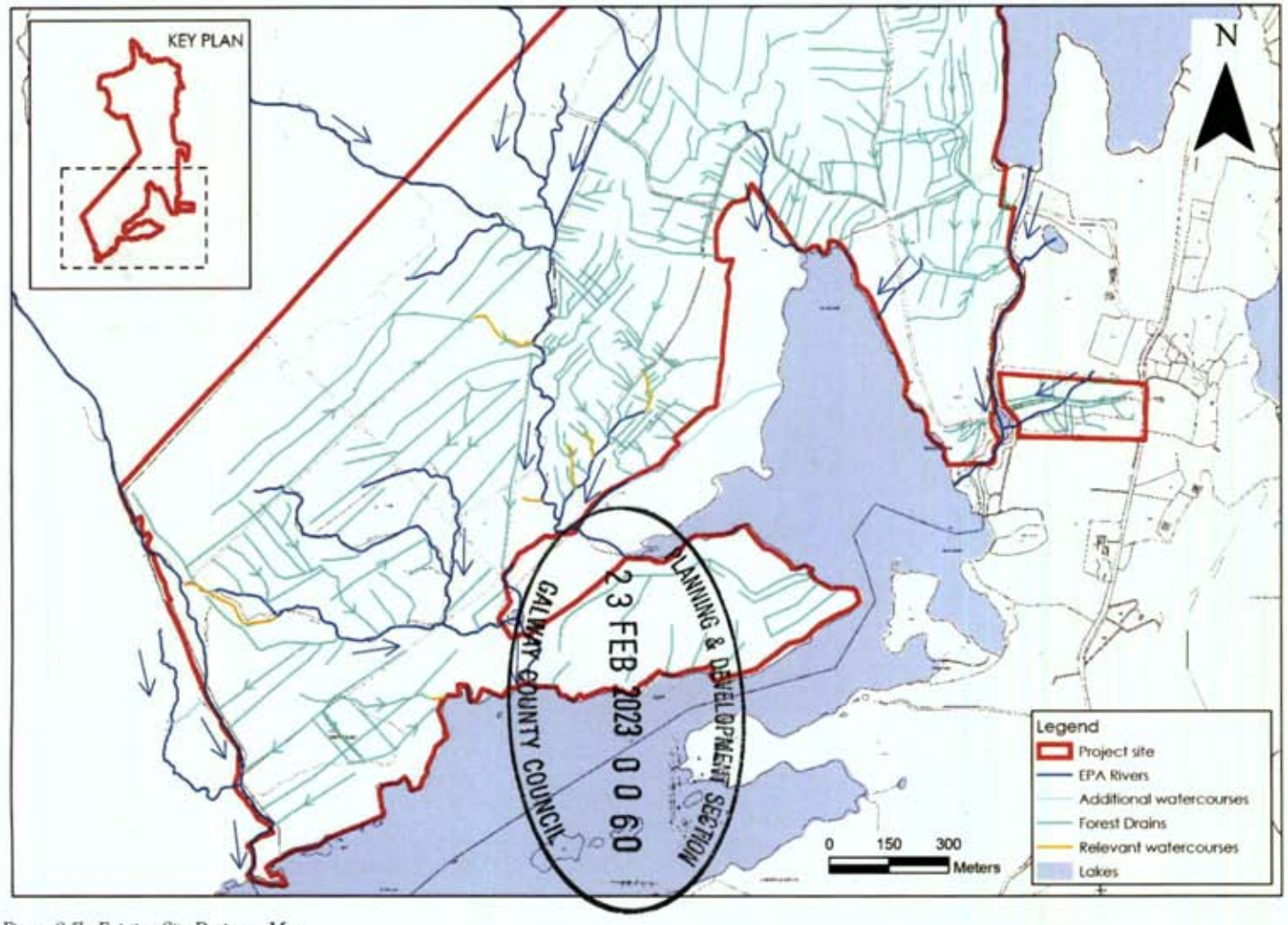


Figure 8 5b: Existing Site Drainage Map

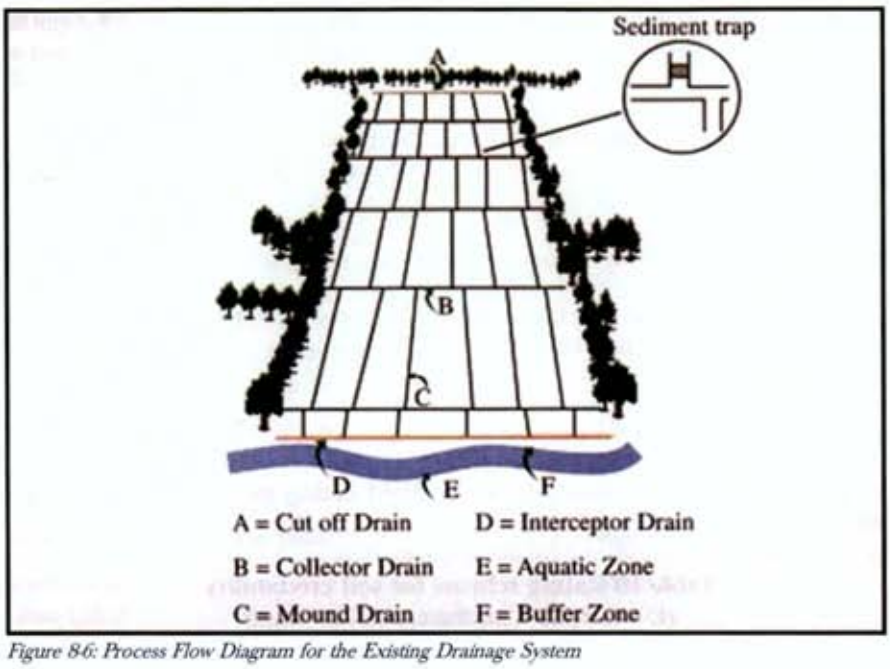


Figure 8-6: Process Flow Diagram for the Existing Drainage System

8.3.5 Flood Risk Assessment

A Flood Risk Assessment of the project site has been carried out by HES, the results of which are discussed below.

To identify those areas as being at risk of flooding, OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Flood Risk Assessment maps (www.cfram.ie), historical mapping (i.e. 6" and 25" base maps) and the GSI Groundwater Flood Maps (www.gsi.ie) were consulted.

The OPW National Flood Hazard Maps have no records of recurring or historic flood instances within the project site (**Figure 8-7**). Similarly, identifiable text on local available historical 6" or 25" mapping for the project site does not identify any lands that are "liable to flood".

The closest mapped recurring flood event to the project site (Flood ID: 1758) is located at Garroman, ~1.38km southeast of the project site, where an extensive low-lying area floods due to overflow of the Recess River and rising lake levels in Derryclare Lough. A recurring flood event (Flood ID: 1774) is also mapped between Derryclare and Ballynahinch Loughs.

The GSI Winter 2015/2016 Surface Water Flood Map shows surface water flood extents during the 2015/21016 flood event. This flood event is recognised as being the largest flood event on record in many areas. This flood map records surface water flooding at Lough Inagh and Derryclare Lough. However the flood extents do not significantly encroach upon the project site and are limited to the margins of the lakes.

No CFRAM mapping has been completed for the area of the project site.

The National Indicative Fluvial Flood Map for the Present Day Situation shows flooding along Lough Inagh and Derryclare Lough. However, the medium (1% AEP, 1 in 100yr) and low (0.1% AEP, 1 in 1,000yr) probability flood zones do not extend significant distances from the lakes. Flood modelling has also been completed to account for increased precipitation rates associated with climate change. The Mid-Range and High-End scenarios model potential flood zones associated with an increase in rainfall of 20% and 30% respectively. These modelled flood zones do not differ significantly from the Present Day

Scenario with flooding limited to the immediate vicinity of Lough Inagh and Derryclare Lough. No fluvial flood zones are mapped along the small mountain streams which drain the project site.

Furthermore, the project site is not mapped within any historic or modelled groundwater flood zones (www.gsi.ie).

The main risk of flooding across much of the project site is via pluvial flooding due to the low permeability peat soils and subsoils. The surface of the project site contains an extensive network of surface water drains which drain the existing forestry harvest blocks and discharge either directly into Lough Inagh or Derryclare Lough or into a nearby stream which in turn discharges into these lake waterbodies. This existing drainage network has reduced the risk of pluvial flooding across much of the project site. However, following periods of intense and prolonged rainfall events localised surface water ponding is still likely to occur in places.

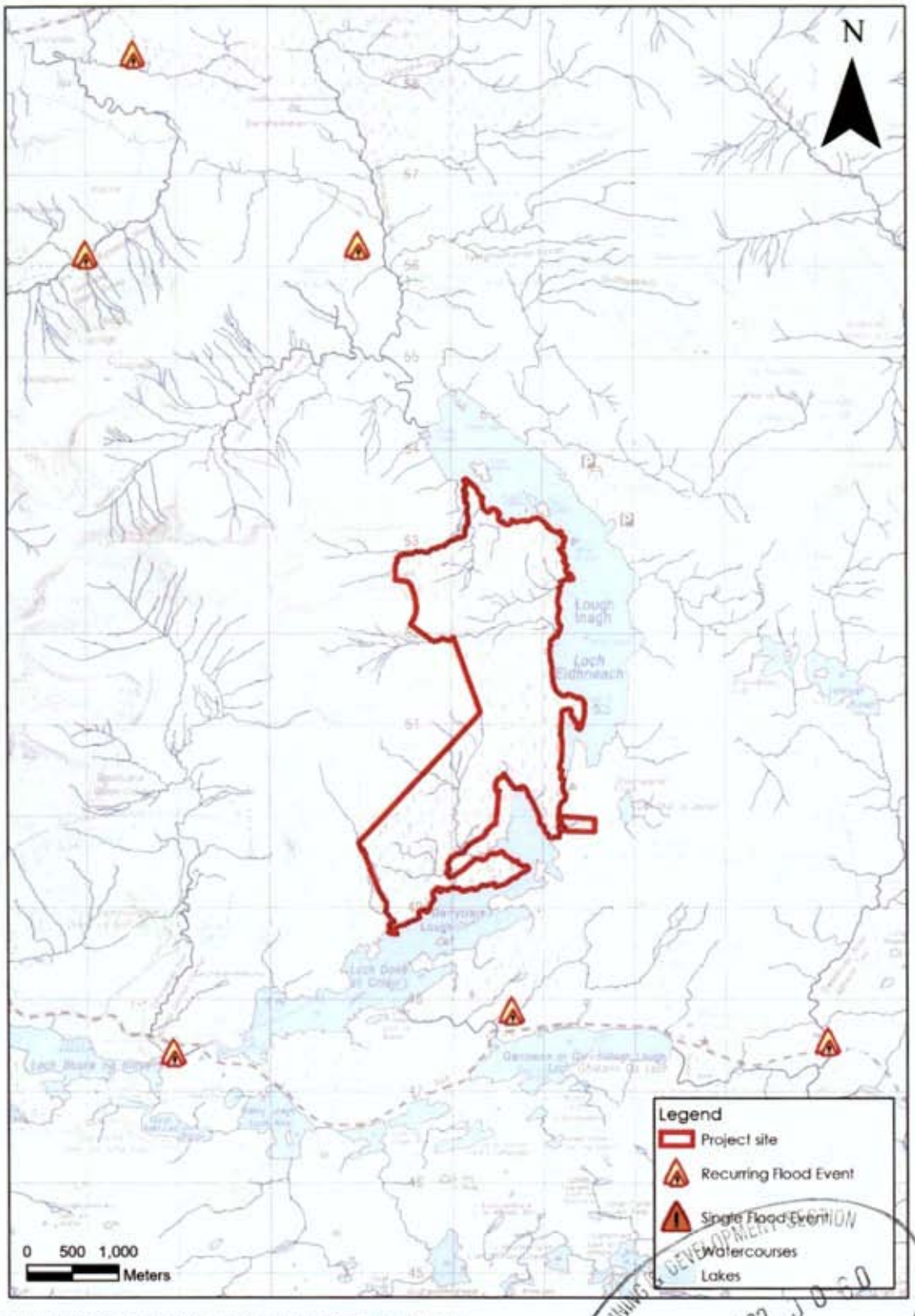


Figure 8-7: OPW National Flood Hazard Map (www.floodinfo.ie)

8.3.6 Surface Water Quality

Biological Q-rating data for EPA monitoring points downstream of the project site are shown in **Table 8-6** below. The Q-Rating is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from 0-1 (Poor) to 4-5 (Good/High).

No EPA Q-rating values are available for the streams draining the project site.

Upstream of Lough Inagh and upstream of the project site, the Tooreenacoona River achieved a Q-rating of Q4 (Good status) in 2021. There is only 1 no. EPA monitoring point located downstream of the project site. This monitoring point is located downstream of Ballynahinch lake. Here the Recess River achieved a Q-rating of Q4-5 (High status) at Cloonbeg Bridge in 2021.

Table 8-6: Latest EPA Water Quality Monitoring Q-Rating Values (2020)

River	Station ID	Easting	Northing	EPA Q-Rating Status
Tooreenacoona	RS31T010200	82445.8	255514	Q4
Recess	RS31R010700	75895.45	246570.53	Q4-5

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken at 14 no. locations during the site visit on 22nd and 23rd November 2023. The results are listed in **Table 8-7**. The monitoring locations were typically in small fast flowing mountain streams and are shown in **Figure 8-8** below.

Electrical conductivity (EC) values at the monitoring locations ranged between 64 and 117µS/cm, with an average conductivity value of 85.7µS/cm. Temperature ranges from 8.1 to 9.6°C while the % of dissolved oxygen saturation was recorded between 69 and 93%. The pH values were generally acidic, ranging between 4.2 and 6.9, with an average pH of 4.7. Slightly acidic pH values of surface waters would be typical of peatland environments due to the decomposition of peat

Table 8-7: Field Parameters - Summary of Surface Water Chemistry Measurements (22/11/2022 and 23/11/2022)

Location ID	Easting	Northing	Temp °C	DO (%)	SPC (µS/cm)	pH	Flow (L/s)
SW1	483274	753351	8.1	69.2	75.8	4.48	1.5
SW2 (Lough Inagh)	483338	753401	8.2	83.8	64	6.9	-
SW3	483137	753649	8.6	93.4	68.9	4.51	500
SW4	483036	752665	9.4	92.7	92.6	4.39	25
SW5	483166	752120	8.8	80	117.8	4.23	3
SW6	483459	752081	8.7	92.4	65	5.25	800
SW7	483908	752404	8.8	86.4	103.2	4.27	10
SW8	483584	750448	9.5	89.8	106.8	4.34	10
SW9 (Derryclare Lough)	483674	750291	8.3	78.5	85.3	4.39	-
SW10	483581	749983	9.0	83.4	100.9	6.59	10
SW11	483140	749603	8.4	92.8	70.4	4.45	2,000
SW12	482816	749658	8.8	90.8	78	4.54	6
SW13	482755	749579	9.6	92.5	87.6	4.28	6
SW14	482696	749378	8.8	91.5	84.3	4.37	8

Surface water samples were also taken at 5 no. locations for laboratory analysis on 2 no. occasions (10/08/2022 and 08/10/2022). Results of the laboratory analysis are shown alongside relevant water quality regulations in

Table 8-8 below. In addition, the European Communities Environmental Objectives (Surface Waters) Regulations (S.I. No. 272/2009) are shown in **Table 8-9**. The locations of these monitoring points are shown in **Figure 8-8** below.

Table 8-8: Surface water quality data (10/08/2022 and 24/10/2022)

Location ID	Suspended Solids (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l N)	Ammonia (mg/l)	Total Phosphorus (mg/l)
EQS	≤25([1])	≤ 0.035 to ≤0.025([2])	-	≤0.065 to ≤ 0.04([2])	-
P1	<2	<0.01 - 0.01	<0.51	0.02	<0.03
P2	<2	<0.01 - <0.01	<0.51	0.02	<0.03
P3	<2	<0.01 - 0.01	<0.51	0.03 – 0.06	<0.03
P4	<2	<0.01 - 0.01	<0.51	0.01 – 0.04	<0.03
P5	<2 – 5	<0.01 - 0.01	<0.51	0.03 – 0.04	<0.03

[1] *S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations*

Suspended solid concentrations ranged from <2 to 5mg/l. All suspended solids were below the S.I. 293/1988 threshold limit of 25 mg/L. Ammonia ranged between 0.01 to 0.06 mg/l, and were often above the threshold values for High (≤0.04 mg/L) and Good (≤0.065 mg/L) quality as set out in S.I. 272/2009. In relation to ammonia 9 of the 10 no. samples were found to be of "High" status. Nitrate was below the level of detection of the laboratory (<0.51mg/l N). For orthophosphate, all 10 no. samples were below the "High" status threshold of 0.025mg/l. Meanwhile, total phosphorus concentrations were below the level of detection of the laboratory in all 10 no. samples.

*Table 8-9: Chemical Conditions Supporting Biological Elements**

Parameter	Threshold Values (mg/L)
Ammonia-N	High status ≤ 0.04 (mean)
	Good status ≤0.065 (mean)
Orthophosphate	High status ≤0.025 (mean)
	Good status ≤0.035 (mean)
Total Phosphorus	High status 0.01 (mean)
	Good status ≤0.025 (mean)

*S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

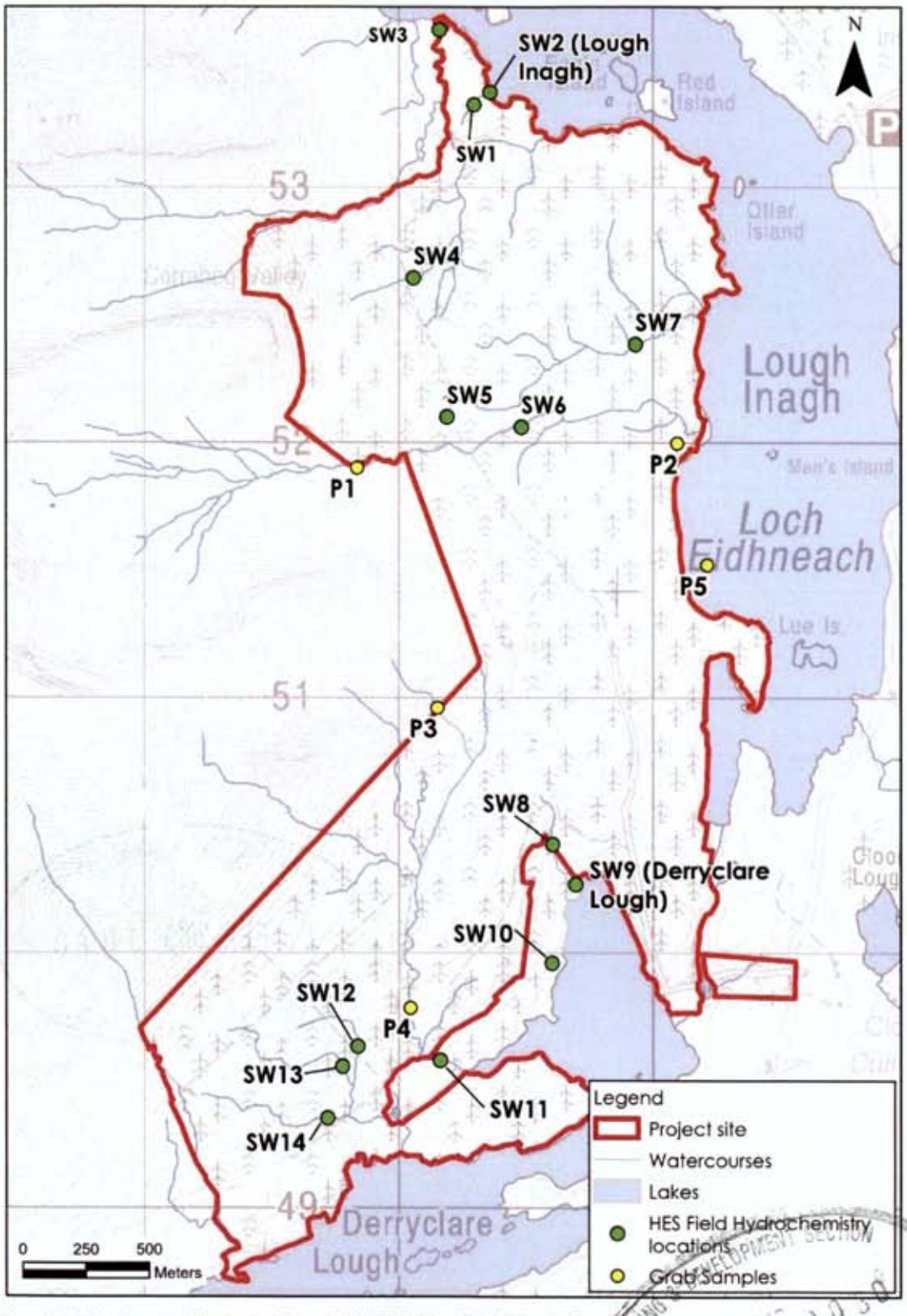


Figure 8-8: Hydrochemistry Monitoring Points (22-23/11/2022) and Grab Sample Locations

8.3.7 Regional Hydrogeology

The GSI map the bedrock underlying the project site to comprise predominantly of Precambrian Quartzites, Gneisses and Schists of the Streamstown Schist Formation, the Bennabeola Quartzite Formation and the Barnanoraun Schist Formation. Furthermore, Precambrian Marbles of the Lake Marbles Formation are mapped in a small area of the project site, along the western shores of Lough Inagh and again further south near Derryclare Lough. The GSI classify the bedrock geology underlying the project site as a Poor Aquifer – Bedrock which is Generally Unproductive except for Local Zones (Pl). A bedrock geology aquifer map is attached as **Figure 8-9**.

The project site is underlain largely by the Recess GWB (IE_WE_G_0011) which is characterized by poorly productive bedrock. The surface topography of this GWB is characterized by steep slopes and mountainous terrain which flattens towards the centre of the GWB. The GWB is comprised of Precambrian Quartzites, Gneisses and Schists which have undergone intense deformation, folding and faulting. These rocks are of low transmissivity, with most groundwater flow occurring in the uppermost part of the aquifer where the rocks are broken and weathered. Transmissivities may be higher in the vicinity of faults. Recharge occurs diffusely through the subsoils and rock outcrops, however recharge is limited by the presence of peat and the low permeability of the bedrock. Therefore, a high proportion of the available recharge discharges rapidly to nearby surface water streams. Flowpaths within this GWB are short (0-100m) with groundwater flows following surface topography, with the overall regional groundwater flow direction being to the south (GSI, 2004).

A small section in the northeast of the project site, along the western shores of Lough Inagh, is underlain by the Maamturks West Marbles GWB (IE_WE_G_0016) which is characterized by poorly productive bedrock. This GWB occupies a north-south trending valley between the Maamturks and the Twelve Pins, where the land surface is characterised by low-lying land and the surface water drainage pattern is towards Lough Inagh. This GWB is comprised of low transmissivity rocks, although there may be more productive zones in the vicinity of faults. Most of the groundwater flow will be concentrated in the uppermost weathered part of the aquifer. Groundwater recharge will be limited by the low permeability of subsoils and the underlying bedrock aquifer. Groundwater flowpaths will be short (~150m), with groundwater discharging to streams, springs and seeps. The overall groundwater flow direction is to the south (GSI, 2004).

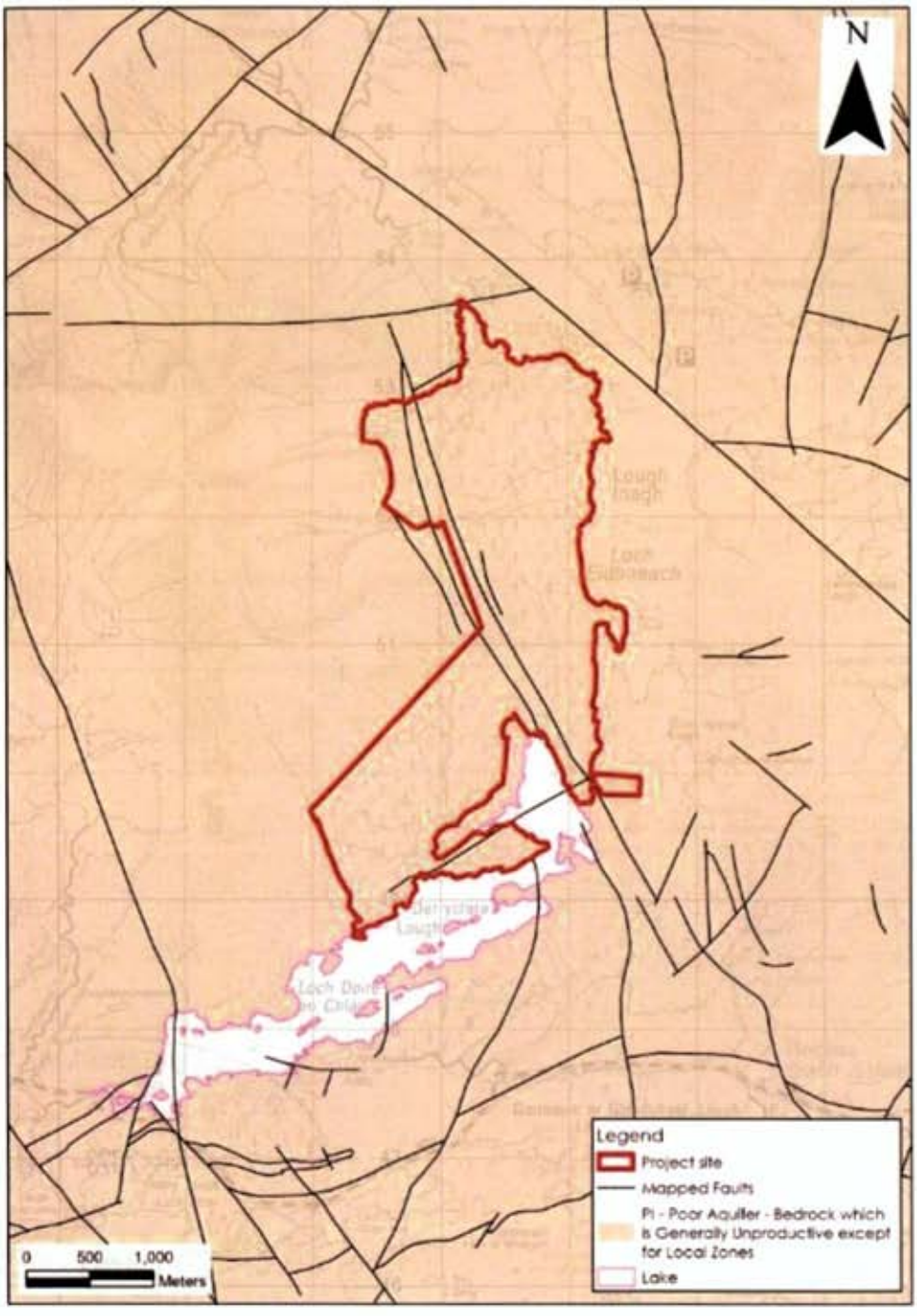


Figure 8.9: Bedrock Geology Aquifer Map

8.3.8 Project Site Hydrogeology

A shallow perched ground water table exists in the peat and is largely isolated from the underlying regional groundwater system (which occurs in the underlying bedrock).

In 2021, RPS installed a total of 43 no. shallow piezometers in the peat at Derryclare in order to record the elevation of the peat water table. These piezometers were dipped on 2 no. occasions in autumn 2021 (August and September) with the elevation of the peat water table ranging from 0 mbgl (metres below ground level) to 0.67mbgl.

Due to the extensive coverage of peat at the project site, combined with the low permeability of the bedrock aquifer and the sloping nature of the surface topography, groundwater recharge at the project site is limited and water is rapidly discharged to nearby forestry drains and natural streams.

8.3.9 Groundwater Vulnerability

The GSI Groundwater Vulnerability Map (www.gsi.ie) shows land areas where groundwater can be easily contaminated and where groundwater is well protected by the natural subsoil layers.

The groundwater vulnerability rating of the bedrock aquifer underlying project site ranges from "Moderate" to "Extreme-X". Moderate groundwater vulnerability is mapped in the northeast of the project site where blanket peat is mapped by the GSI. Here the coverage of subsoil peat protects the underlying aquifer. This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore surface water bodies, such as drains and streams, are more vulnerable to pollution than groundwater.

Further south, groundwater vulnerability is mapped as "Extreme-E" where the GSI map the presence of till derived from metamorphic rocks. Meanwhile, on the elevated ground in the west of the project site, groundwater vulnerability is mapped as "Extreme-X" where rock is close to or at the surface.

8.3.10 Groundwater Hydrochemistry

The GSI Characterisation Report for the Recess GWB (GSI, 2004) states that this GWB has a calcium-magnesium-bicarbonate signature. Alkalinity is reported to range from 32-180mg/l $CaCO_3$ with total hardness ranging between 82-336mg/l.

Whilst no hydrochemical data is available for the Maamturks West Marbles GWB, the national classification of Precambrian Marbles is that they are calcareous with a $CaHCO_3$ signature. Alkalinity of Precambrian Marbles ranges from 112-428mg/l $CaCO_3$ with conductivity ranging from 414-814µS/cm.

8.3.11 Water Framework Directive Water Body Status & Objectives

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The Third Cycle River Basin Management Plan (2022-2027) objectives include the following:

- Ensure full compliance with relevant EU legislation;
- Build on the achievements on the 2nd Cycle;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2027;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at restoring impacted waters and protecting waters from deterioration.

Our understanding of these objectives is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all.

Strict mitigation measures (refer to Section 8.5.2 and 8.5.3) in relation to maintaining a high quality of surface water runoff from the project site and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the project site will be at least maintained (see below for WFD water body status and objectives) regardless of their existing status.

8.3.12 Groundwater Body Status

Local Groundwater Body (GWB) and Surface water Body (SWB) status reports are available for download from (www.wfdireland.ie).

The Recess and Maamturks West Marbles GWBs achieved "Good" status in all 3 no. WFD cycles (2010-2015, 2013-2018 and 2016-2021) which is defined based on the quantitative status and chemical status of the GWB. These GWBs has been deemed to be "Not at risk" of failing to meet their WFD objectives. No significant pressures have been identified to be impacting on these GWBs (**Table 8-10**).

Table 8-10: WFD Groundwater Body Status

Groundwater body	Status 2010-2015	Status 2013-2018	Status 2016-2021	Risk Status 2013-2018	WFD Pressures
Recess	Good	Good	Good	Not at risk	-
Maamturks West Marbles	Good	Good	Good	Not at risk	

8.3.13 Surface Water Body Status

A summary of the WFD status and risk result of Surface Water Bodies (SWBs) in the vicinity and downstream of the project site are shown in **Table 8-11** below.

The project site is located in the Recess river sub-catchment and the Recess_020 river sub-basin. All river and stream waterbodies draining the project site form part of the WFD Recess_020 SWB which drains into Lough Inagh and Derryclare Lough.

All sections of the Recess River in the vicinity and downstream of the project site (Recess_020, Recess_030 and Recess_040) achieved "High" status in the latest WFD cycle (2016-2021). Meanwhile, Lough Inagh and Derryclare Lough immediately downstream of the project site have achieved "High" status in the last 2 no. WFD cycles. Further downstream Ballynahinch Lake achieved "High" status in all 3 no. WFD cycles.

In terms of transitional and coastal waterbodies downstream of the project site, Roundstone Bay, Bertraghboy Bay and the Aran Islands, Galway Bay and Connemara coastal waterbody all achieved "High" status in the last 2 no. WFD cycles.

No SWBs downstream of the project site have been deemed to be "at risk" of failing to meet their respective WFD objectives. A total of 7 no. SWBs are "not at risk" while the risk status for the Recess_040 river waterbody and the Aran Islands, Galway Bay and Connemara coastal waterbody is currently under review.

The 3rd Cycle Draft Galway Bay North Catchment Report states that morphological impacts remain the most prevalent issues in this catchment followed by excess nutrients and organic pollution. However, no significant pressures have been identified to be impacting on any of the SWBs in the vicinity or downstream of the project site.

It is worth noting that the Recess_040 river waterbody and Ballynahinch lake waterbody are listed as high ecological status waterbodies. Both of these SWBs achieved their target status in the latest WFD cycle.

Table 8-11: Summary WFD Information for Surface Water Bodies

SWB	Status 2010-2015	Status 2013-2018	Status 2016-2021	Risk Status 2013-2018	WFD Pressures
Recess_020	Unassigned	Good	High	Not at risk	-
Inagh	Unassigned	High	High	Not at risk	-
Derryclare	High	High	High	Not at risk	-
Recess_030	Unassigned	Good	High	Not at risk	-
Ballynahinch	High	High	High	Not at risk	-
Recess_040	High	Good	High	Under Review	-
Transitional Waterbodies					
Roundstone Bay	Unassigned	High	High	Not at risk	-
Coastal Waterbodies					
Bertraghboy Bay	Unassigned	High	High	Not at risk	-
Aran Islands, Galway Bay, Connemara	Unassigned	High	High	Under Review	-

8.3.14 Designated Sites and Habitats

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), candidate Special Areas of Conservation (SAC) and Special Protection Areas (SPAs).

The project site is surrounded on all sides by the Twelve Bens/Garraun Complex SAC and pNHA (Site Code: 002031). This is an extensive site situated in north-west Connemara and is dominated by mountainous terrain. The site has been designated as an SAC due to the occurrence of several habitats listed on Annex I of the E.U. Habitats directive including but not limited to oligotrophic water containing very few minerals, alpine and subalpine heaths, blanket bog and old oak woodlands. Furthermore several species listed in Annex II have been identified within the SAC including the freshwater pearl mussel, Atlantic salmon, otter and slender naiad. The project site is hydrologically connected with the Twelve Bens/Garraun Complex SAC and pNHA as all drainage from the project site discharges into Lough Inagh and Derryclare Lough which form part of the SAC/pNHA.

The Maumturk Mountains SAC and pNHA (Site Code: 002008) lies approximately 800m to the east of the project site on the eastern shores of Lough Inagh. The Maumturk Mountains are situated east of the Twelve Bens and west of the Maumtrasnas, between the Inagh Valley and the Leenaun/Maam road in Co. Galway. The site has been designated as an SAC due to the occurrence of several habitats/species

listed on Annex I/II of the E.U. Habitats Directive including but not limited to oligotrophic waters containing very few minerals, wet heath, blanket bogs, siliceous rocky slopes, Atlantic salmon and slender naiad. The project site is not hydrologically connected to the Maumturk Mountains SAC and pNHA as Lough Inagh and Derryclare Lough act as a hydrological buffer between the project site and the SAC/pNHA.

The Connemara Bog Complex SAC and pNHA (Site Code: 002034) is located ~2.2km to the south of the project site and is a large site encompassing much of the south Connemara lowlands. The SAC/pNHA is bounded to the north by the Galway to Clifden Road and stretches as far east as the Moycullen-Spiddal road. The SAC/pNHA supports a wide range of habitats, including extensive areas western blanket bog as well as areas of heath, fen, woodlands, lakes and river and coastal habitats. The site has been designated due to the occurrence of several habitats/species listed on Annex I/II of the E.U. Habitats Directive. The project site is hydrologically linked to the Connemara Bog Complex SAC via the Recess River.

The Connemara Bog Complex SPA (Site Code: 004181) is located ~2.3km southeast of the project site. This SPA consists of 3 no. separate areas and is characterized by areas of deep peat surrounded by heath-covered rock outcrops. The site is an SPE under the E.U. Birds Directive and is of special conservation interest for Cormorant, Merlin, Golden Plover and Common Gull. The Recess River acts as a hydrological barrier between the project site and this SPA.

A map of local designated sites is attached as **Figure 8-10** below.

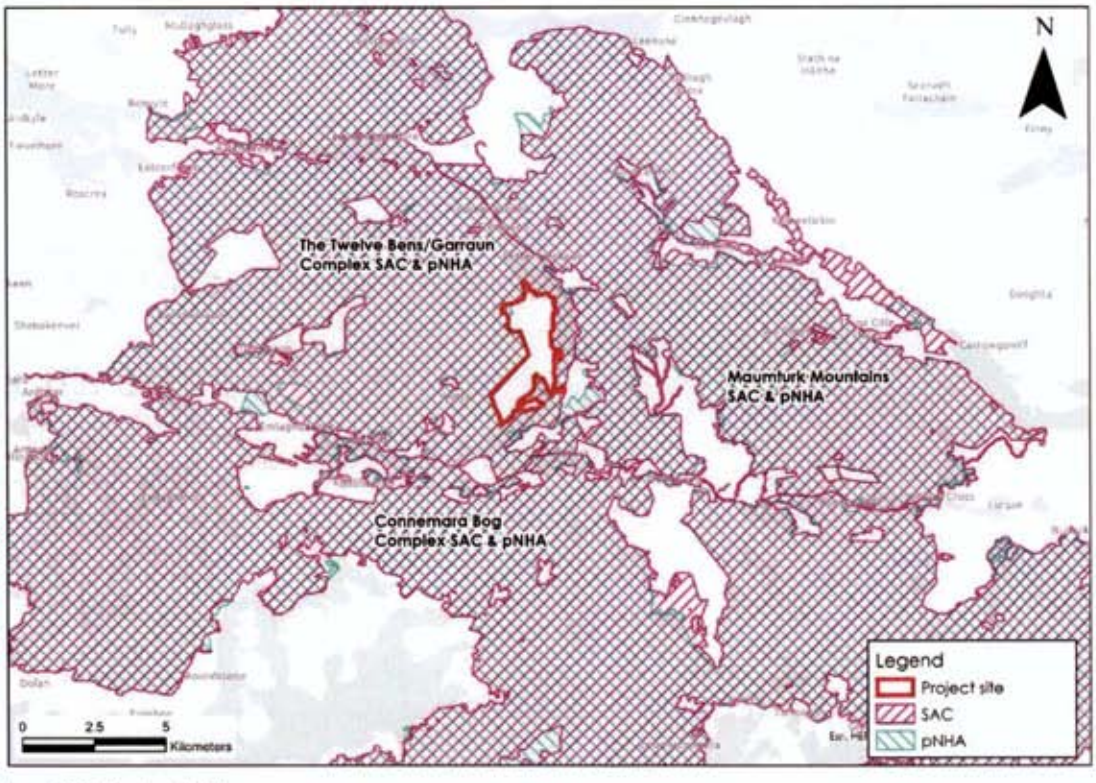


Figure 8-10: Designated Sites

8.3.15 Water Resources

There are no Group Water Schemes (GWS) or Public Water Schemes (PWS) located within the project site or in the surrounding lands.

The closest mapped water supply scheme is the Kilmain PWS located ~40km east of the project site. This PWS is located within the Cong-Robe GWB. No GWS or PWS are sourced from the Recess or Mamturks West Marbles GWBs.

A search of private well locations (wells with location accuracy of 1–100m were only sought) was undertaken using the GSI well database (www.gsi.ie). No wells are mapped within the project site or in the surrounding lands. The closest mapped well is located at Letterfrack, ~13km northwest of the project site. There are no mapped wells within the Recess or Mamturks West Marbles GWBs.

8.3.16 Receptor Sensitivity

Due to the nature of Proposed Project, being near surface construction activities (i.e., clearfelling and drain blocking), effects on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risks to groundwater at the project site would be from hydrocarbon spillage and leakages. These potential significant effects are assessed in Sections 8.5.2 and 8.5.3. Some of these are common potential effects on all construction and forestry sites. All potential contamination sources are to be carefully managed at the project site during the construction and operational phases of the Proposed Project and mitigation measures are proposed below to deal with these potential effects.

Based on the criteria set out in **Table 8-2** above, the Poor Aquifers underlying the project site can be classed as being of Low Importance. The primary risks to groundwater during construction activities are from hydrocarbon spillage and leakages from mobile plant serving and facilitating the clearfelling and restoration activities. The vast majority of the project site is covered in cutover peat which acts as a protective cover to the underlying bedrock aquifer. Furthermore, the low permeability of the bedrock aquifers means that any contaminants which may be accidentally released on-site are more likely to travel to nearby streams within surface runoff.

Local surface waters, including all streams draining the project site can be classed as being of Extremely High Importance due to their "High" WFD status. Furthermore downstream surface waterbodies including Lough Inagh, Derryclare Lough, Ballynahinch Lough are considered as being of Extremely High Importance due to their designation as a Special Area of Conservation. The primary potential contamination of surface watercourses is via elevated concentrations of suspended solids and nutrient enrichment.

Comprehensive surface water mitigation and controls are outlined below to ensure the protection of all downstream receiving waters (Recess river, Lough Inagh, Derryclare Lough and Ballynahinch Lough). Mitigation measures will ensure that surface runoff from the project site will be of a high quality and will therefore not effect the quality of downstream surface water bodies.

8.4 Characteristics of the Proposed Project

The Proposed Project comprises:

- The felling/removal of approximately 343 hectares of conifer plantation for the purposes of peatland restoration and the establishment of native woodland. The forestry will be (felled or mulched) removed in 20 no. harvest blocks spread out over a period of 5-7 years.
- Measures to restore and rehabilitate approximately 281 hectares of Atlantic blanket bog and heathland that is currently planted with lodgepole pine and Sitka spruce forests and managed for forestry.
- Conversion of 62 hectares of conifer forestry to native woodland.
- Main peatland restoration measures will include tree removal, drain blocking (manual and mechanical) and ground reprofiling.
- The control of existing invasive species on site and continued control during the restoration works to prevent their spread.
- Drain-blocking all existing artificial drainage and artificial land drains currently existing on site in order to restore the high water table which is necessary for blanket bog growth.
- Provision of silt traps at outflows to block the pathway to the Twelve Bens/Garraun Complex SAC.
- Installation of deer fencing to protect the proposed 62 hectares of native woodland.
- Provision of a Harvest Management Phasing Plan for the Proposed Project.
- Provision of new internal access road extending to 1.58km.
- Across the project site there will be 4 no. temporary water crossings.
- Provision of informational signage.
- Resurfacing of up to 8.23km of existing forestry roads.
- Resurfacing of the existing car park.
- Installation of water monitoring stations.
- Cutting of roadside trees to improve sightline visibility at site entrance.

The main characteristics of the Proposed Project that could affect the hydrological and hydrogeological environment are:

- Clear felling of the conifer plantation. Runoff from works areas has the potential to contain elevated concentrations of suspended solids and nutrients.
- Bog restoration measures including drain blocking and ground reprofiling. Runoff from works areas has the potential to contain elevated concentrations of suspended solids and nutrients.
- Construction of the site access tracks and upgrade of existing tracks will be completed primarily using floated techniques. Construction of these access tracks has the potential to effect surface water quality.
- Application of herbicide at the project site in order to control invasive species has the potential to affect water quality.

8.4.1 Proposed Drainage

No new site drainage system is proposed as part of the Proposed Project. Existing drains will be blocked as part of the restoration measures to be implemented at the project site.

During the construction phase of the Proposed Project the drainage of the project site will require additional management.

8.4.1.1 Drainage Management During Tree Felling

The existing site drainage system will be managed during felling works so as to attenuate run-off, guard against soil erosion and safeguard downstream water quality.

The details pertaining to the drainage management are described in Chapter 4. The following provides an outline of the drainage management arrangements:

- During felling operations silt traps will be installed at all outfalls of the existing forestry drains;
- The number, design and size of the traps will vary across the project site in order to ensure sufficient protection again sediment entrainment;
- There will be no direct discharge from any drains in the work areas into any surface watercourse;
- These silt traps will provide surface water attenuation, allowing for the settlement of suspended solids and preventing the entrainment of suspended solids in downstream surface watercourses;
- Other measures to protect surface water quality during felling operations include the use of brash mats, the movement of plant solely along predetermined off-road routes and the stacking of felled timbers in designated areas alongside site access roads.

Best practice and practical experience on other similar projects suggests that in addition to the above drainage management plans there are additional site based decisions and plans that can only be made in the field through interaction between the Site Construction Manager, the Project Hydrologist and the Project Geotechnical Engineers. In relation to decisions that are made on site it is important to stress that these will be implemented in line with the associated drainage controls and mitigation measures outlined above and to ensure protection of all watercourses. These details are included in the CEMP for the project (See Appendix 4-3).

8.4.1.2 Bog Restoration Techniques

The proposed bog restoration includes drain blocking and ground re-profiling. These restoration techniques are summarised below and described in full in Chapter 4.

Drain blocking will be achieved through the use of:

- Plastic dams: To be used in areas of the project site which are inaccessible by machinery and will be installed at 10-20m intervals on flat ground, with closer spacing on sloping ground. The installation methodology involves driving piles into the ground until they are ~30cm above the bank level.
- Peat dams: Will be installed using an excavator whereby consolidated peat will be taken from an in-ditch borrow pit upstream to create a dam. Peat dams will only be installed on relatively flat ground.
- Log dams: Used to block smaller ditches and will be installed using an excavator.

Meanwhile, surface smoothing and re-profiling are bog restoration techniques designed to reverse the effect of the ridge-furrow cultivation process. The techniques include:

- Reprofiling: Levelling off of the original plough furrow afforestation network using an excavator;
- Stump flipping: The root of a stump is pried off the bog surface using an excavator and turned upside down into the adjacent furrow. The plough ridges are then reprofiled by sliding the ridge material into the furrows with an excavator bucket; and,
- Cross-tracking: Involves an excavator tracking over the bog surface whereby the weight of the machine compresses the surface.

These restoration activities will disturb local peat deposits and increase the likelihood of erosion of peat and subsoils, increasing the potential for the entrainment of suspended solids in surface waters.

The main drainage management proposal during the restoration works is to first block the main collector artificial drains which are located nearest the natural watercourse followed by the strategic placement of silt traps to trap suspended solids in runoff from the work areas. The restoration works will then commence upslope at the highest point and work systematically downslope towards the natural watercourse.

8.5 Likely Significant Effects and Associated Mitigation Measures

8.5.1 Do-Nothing Scenario

If the Proposed Project were not to proceed the project site would continue to function as a coniferous forestry plantation. Currently felling operations are ongoing in some areas of the project site and, in the Do Nothing Scenario, such forestry operations would continue. The forestry operations would comprise felling and replanting of harvest blocks . We note that much of the project site is of low to moderate productivity. Nevertheless all operations at the project site would continue to conform with the current best practice Forest Service regulations, policies and guidance documents as well as Coillte and DAFM guidance documents, including replanting obligations even if commercial forestry is not continued in some harvest blocks.

If the Do Nothing Scenario was to occur the proposed restoration measures would not be implemented. In the case that the restoration plan is not implemented, it is likely that felled areas would be replanted with conifer species. If the restoration plan is not implemented the positive effects on the hydrological and hydrogeological environment at the project site would not be realised.

8.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

In relation to the Proposed Project the construction phase encompasses tree felling, habitat restoration and enhancement and all associated siteworks.

The likely significant effects of the construction phase of the Proposed Project, including construction works at the project site and mitigation measures that will be put in place to eliminate or minimise them are shown below and relate to the construction stage. It should be noted that the main potential effects on the hydrological and hydrogeological environment will occur during the construction stage.

8.5.2.1 Clear Felling of Coniferous Plantation

Tree felling is a major component of the proposed works at the project site. Initially the works will focus on harvest blocks where the existing pine and spruce have reached maturity and are starting to die off. However, over the course of 5-7 years a total of 343ha will be felled in 20 no. harvest blocks. The harvest plans and the associated drainage proposals are attached as Appendix 4-2 and provide individual plans for each of the harvest blocks to be felled at the project site. These plans are summarised in Section 8.4.1.1 above.

3 no. forms of felling will be implemented at the project site. Conventional machine felling is proposed over ~196ha, fell to waste is proposed over ~43ha while mulching is proposed over ~0.1ha. Please note that ~57.41ha have already been felled under existing forestry licences.

Potential effects during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking, compaction and skidding or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Entrainment of suspended sediment in watercourses due to vehicle tracking through watercourses;
- Damage to roads resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

These effects have the potential to affect the water quality and fish stocks of downstream water bodies. Potential effects on all watercourses downstream of the project site could be significant if not mitigated.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality in rivers and streams draining the project site and down-gradient waterbodies including Lough Inagh, Derryclare Lough, Ballynahinch Lough and the Recess River and associated dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, significant, indirect, temporary, likely effect on surface water quality and dependent aquatic ecosystems.

Proposed Mitigation Measures:

Forestry operations will conform to current best practice Forest Service regulations, policies and strategic guidance documents as well as Coillte and DAFM guidance documents, including the specific guidelines listed below, to ensure that felling, planting and other forestry operations result in minimal potential negative effects to the receiving environment.

- Forestry Standards Manual (Forest Service, 2017)
- Environmental Requirements for Afforestation (Forest Service, 2016a)
- Land Types for Afforestation (Forest Service, 2016b)
- Forest Protection Guidelines (Forest Service, 2002)
- Forest Operations and Water Protection Guidelines (Coillte, 2013)
- Forestry and Water Quality Guidelines (Forest Service, 2000b)
- Forestry and the Landscape Guidelines (Forest Service, 2000c)
- Forestry and Archaeology Guidelines (Forest Service, 2000d)
- Forest Biodiversity Guidelines (Forest Service, 2000e)
- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (DAFM, 2018)
- Coillte Planting Guideline SOP
- A Guide to Forest Tree Species Selection and Silviculture in Ireland (Horgan et al., 2003)
- Management Guidelines for Ireland's Native Woodlands. Jointly published by the National Parks & Wildlife Service (Cross and Collins, 2017)
- Native Woodland Scheme Framework (Forest Service, 2018)
- Code of Best Forest Practice (Forest Service, 2000)

Mitigation by Avoidance:

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in **Table 8-12**.

With moderate slopes existing across much of the project site, a 10m setback will be established along all aquatic zones. Furthermore, a 5m setback will be established along all relevant watercourses and water hotspots. Buffer zone widths will be increased at vulnerable hotspots where deemed necessary. This will ensure water quality is protected during the felling operations.

The setback distance from sensitive hydrological features means that adequate room is maintained for the proposed mitigation measures (discussed below) to be properly installed and operate effectively. The buffer/setback zone will:

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and the associated release of sediment;
- Avoid peat/soil disturbance and compaction within close proximity to surface watercourses;
- Avoid the entry of suspended sediment from works into watercourses; and,
- Avoid the entry of suspended sediment from the drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

Table 8-12: Recommended minimum buffer zone width

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10m	15m
Steep	(15 – 30%	15m	20m
Very Steep	(>30%)	20m	25m

In addition to the application of buffer/setback zones, the following supplementary mitigation measures will be employed during felling works:

Mitigation by Design:

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which are set out as follows:

- Machine combinations will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance. The harvester and the forwarder are designed specifically for the forest environment and are low ground pressure machines;
- All machinery will be operated by suitably qualified personnel;
- Checking and maintenance of roads and culverts will be on-going through any felling operations. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works;
- These machines will traverse the site along specified off-road routes (referred to as racks);
- The location of racks will be chosen to avoid wet and potentially sensitive areas;
- Brash mats will be placed on the racks to support the vehicles on soft ground, reducing peat and mineral soil disturbance and erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.

Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;

- Silt fences will be installed at the outfalls of existing drains downstream of felling areas. No direct discharge of such drains to watercourses will occur. Sediment traps and silt fences will be installed in advance of any felling works and will provide surface water settlement for runoff from work areas and will prevent sediment from entering downstream watercourses. Accumulated sediment will be carefully disposed of at pre-selected peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion it will be necessary to install double or triple sediment traps and increase buffer zone width. These measures will be reviewed on site during construction;
- Double silt fencing will also be put down slope of felling areas which are located in close proximity to streams and/or relevant watercourses;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded;
- Timber will be stacked in dry areas, and outside watercourse buffer zones. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water runoff;
- Refuelling or maintenance of machinery will not occur within 50m of an aquatic zone or within 20m of any other hydrological feature. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required; and,
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.

Silt Traps:

Silt traps will be strategically placed down-gradient of felling areas within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, thereby increase residence time and allow settling of silt in a controlled manner.

Pre-emptive Site Drainage Management :

The works programme for the felling operations will also take account of weather forecasts and predicted rainfall in particular. Operations will be suspended or scaled back if heavy rainfall is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily/weekly basis, as required, to allow site staff to direct proposed and planned construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Éireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Éireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,

- Consultancy Service: Met Éireann provide a 24-hour telephone consultancy service. The forecaster will provide an interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow planned works to be safely executed (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests any of the following is likely to occur:

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Timing of Site Felling Works:

Felling will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses.

Drain Inspection and Maintenance:

The following items shall be carried out during inspection pre-felling and after:

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches shall be identified. Ideally the pre-felling inspection shall be carried out during rainfall;
- Following tree felling all main drains shall be inspected to ensure that they are functioning;
- Extraction tracks near drains need to be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site will be unblocked; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

Surface Water Quality Monitoring:

It is proposed to complete continuous turbidity monitoring of surface watercourse downstream of the proposed work areas throughout the construction phase of the Proposed Project. This will be completed with the installation of automated water quality probes which will record turbidity and other hydrochemical parameters at regular intervals (typically every 15 minutes). These probes will be installed in natural watercourses downstream of work areas. The data will be processed and analysed at regular intervals and work will cease if elevated turbidity concentrations are recorded. In this event, all upstream silt traps and drainage routes will be inspected to identify the cause of the elevated turbidity levels. Work will not recommence until any issues have been resolved and the turbidity concentrations have returned to background concentrations.

In combination with the above, grab sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling should be conducted within 4 weeks of the felling activity, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling will

comprise as many sampling events as necessary to demonstrate that water quality has returned to pre-activity status (*i.e.* where an effect has been shown).

Criteria for the selection of water sampling points include the following:

- Avoid man-made ditches and drains, or watercourses that do not have year round flows, i.e. avoid ephemeral ditches, drains or watercourses;
- Select sampling points upstream and downstream of the forestry activities;
- It is advantageous if the upstream location is outside/above the forest in order to evaluate the effect of land-uses other than forestry;
- Where possible, downstream locations should be selected: one immediately below the forestry activity, the second at exit from the forest, and the third some distance from the second (this allows demonstration of no effect through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location); and,
- The above sampling strategy will be undertaken for all on-site sub-catchments streams where tree felling is proposed.

The final details defining this monitoring will be included in the Construction Stage CEMP which will be finalised in advance of any construction works. An outline version of the CEMP is included with the EIAR.

Residual Effects: Felling operations pose a risk to surface water quality in downstream receptors due to the release of suspended sediments and nutrient enrichment. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality and aquatic habitats.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on the surface water quality will occur.

8.5.2.2 Clear Felling and Nutrient Release to Surface Waters

Tree felling is a significant component of the proposed works at the project site. Over the course of 5-7 no. years a total of 343ha will be felled across 20 no. harvest blocks.

The afforestation of the project site in the 1960s would have required an initial one off application of a phosphate based fertiliser when the trees were replanted. Phosphate application was required at the project site due to the presence of peat soils which are strongly acidic and contain low levels of available nutrients. In these acidic soils, phosphorus is one of the major limiting factors of primary productivity and phosphate, typically in the form of rock phosphate, is applied when the trees are planted to ensure that the plantations have sufficient phosphorous for sustainable growth. Typically, only one application of the phosphate is required, as once the trees are growing phosphate recycles naturally and run-off is not an issue. Total phosphorus may increase in response to fertiliser applications but such increases are temporary and have no impact on downstream river ecological status (Wasif-Shah et al., 2021).

However, felling operations disrupt the forestry nutrient cycle and there is the potential for phosphorous to be released into downstream watercourses resulting in nutrient enrichment i.e. eutrophication.

Following clear felling there are 2 sources of phosphorus. Firstly, phosphorus is released from the forest floor and root system, due to needle decomposition and disruption to nutrient cycling by the trees (Asam et al,. 2014. Eur J. Forest. Res). The second source is the brash material that is left on site, as it degrades and leaches into adjoining watercourses (O'Driscoll et al., 2014. For. Ecol. Man.; Assam et al., 2014. Ecol. Eng). Meanwhile, phosphorus release to runoff waters due to the mechanical soil disturbance by extraction machinery has been shown to be minimal compared with the larger

contribution of the remaining clear felling residues in sites where brash mats and windrows have been applied (O'Driscoll et al. 2014. For Ecol. Man.).

Research on clear felling in upland blanket bog environments in Ireland and impacts on nearby receiving watercourses were undertaken by O'Driscoll et al. (2010). Increases in phosphorus levels in downstream nearby watercourses from baseline levels of 0.005mg/l (pre-felling) up to 0.183mg/l were noted within a couple of months after felling. The following year peak levels of 0.43mg/l were reported which is consistent with other studies (Nieminen, 2003 and Rodgers et al., 2010). The HYDROFOR project (2007) also reported that tree harvesting resulted in elevated episodic inputs of phosphorus to watercourses, typically occurring over ½ years or until the site revegetates. Once the site revegetates phosphorous is absorbed again and the leaching of phosphorus into the adjoining watercourses ceases.

The accepted critical threshold for total phosphorus is 62 µg/l (EPA, 2001). The EPA state that the "*limit values of 0.2mg/l for salmonid waters, expressed as PO4 (corresponding to 0.062mg/l as P) may be regarded as indicative in order to reduce eutrophication*". This threshold will be used for surface water streams within the project site.

Therefore, the proposed felling operations have the potential to release nutrients into nearby watercourses which will have a potential negative short term impact on downstream surface water quality.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality in rivers and streams draining the project site and downgradient waterbodies including Lough Inagh, Derryclare Lough, Ballynahinch Lough and the Recess River and associated water dependent aquatic ecosystems.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect on surface water quality and dependent aquatic ecosystems.

Proposed Mitigation Measures:

The most effective way to manage tree felling and the potential risks to water quality is to implement a strict and best practice mitigation system when carrying out the felling operations.

Best practise methods provided in the EIS related to water incorporated into the forestry management and water quality protection measures were derived from:

- Forestry Commission (2003) Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009) Forest Operations & Water Protection Guidelines;
- Coillte (2009) Methodology for Clear Felling Harvesting Operations;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford; and,
- Forest Service, (2000): Code of Best Forest Practice – Ireland. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

As stated above in Section 8.5.2.1, mitigation measures from best practice Forestry Service Guidelines along with the FPM requirements will be applied and will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses. These measures are set out above. The FPM presence also requires that the project site is independently assessed prior to work commencement.

The primary mitigation measures in relation to phosphorus are the implementation of aquatic buffer zones and the avoidance of large felling coupes in excess of 25ha in the same surface water sub-catchments. For harvest blocks that are larger than 25Ha (i.e. GY27_HB0012, GY27_HB0014, and

GY27_HB0021), those will be spilt into smaller harvest areas below the 25Ha threshold, and felling will be sequenced in order to minimise impacts.

Phosphorus is highly mobile and studies have shown that phosphorus is absorbed quickly by riparian buffer zones which are effective in mitigating against phosphorus runoff following felling (Finnegan et al., 2012 and O'Driscoll et al. 2014). It is well established forestry best practice to implement vegetative buffer zones adjacent to watercourses, allowing the vegetation in the buffer zone to absorb the phosphorous before it enters the watercourse. The full details regarding the implementation of buffer zones at the project site are provided in Section 9.5.2.1 above. In addition, post felling, the proposed bog restoration will create one large, vegetated buffer zone. The restoration of the project site will provide adequate onsite vegetation to absorb the remaining phosphorus.

Rodgers et al. (2010) found that harvesting appropriately sized coupes in a catchment at any one time can minimise nutrient concentrations in rivers. The majority of the proposed felling coupes in Derryclare are under 25ha and are spatially distributed across the project site's surface water catchments. There are 3 no. exceptions as noted above, and those harvest blocks (i.e. GY27_HB0012, GY27_HB0014, and GY27_HB0021) will be spilt into smaller harvest areas below the 25Ha threshold, and felling will be sequenced in order to minimise impacts. This will ensure that the phosphorus load is evenly spread out across the entire project site.

In addition, following felling operations, it is recommended that all felled trees and where possible, brash will be removed from the project site, especially adjacent to aquatic zones. Research has shown that phosphorus loss can be reduced significantly by carrying out brash removal (O'Driscoll et al. 2011, Rodgers et al., 2010 and Yanai et al. 1988).

Surface Water Quality (Phosphorus) Monitoring:

It is proposed to complete weekly and monthly phosphorus monitoring of surface watercourse downstream of the proposed work areas throughout the construction phase of the Proposed Project. The weekly monitoring will be completed using automatic samplers for collection of composite samples. These samples will be analysed on a rolling (weekly) basis and the results will be used to direct works away from specific watercourses if total P concentrations are observed to be increasing over time. Grab sampling will also be completed on a monthly basis. The monitoring will be used to ensure that the threshold of 62 µg/l Total P (EPA, 2001) for surface waters is not being exceeded. In addition, during the construction phase of the Proposed Project monthly grab samples will be taken from Lough Inagh and Derryclare Lough to ensure there is no upward trend in total P occurring, and to demonstrate that the Site Specific Conservation Objectives (SSCOs) for nutrients are maintained (i.e. annual average total phosphorus (TP) ≤10µg/l TP, average annual total ammonia concentration should be ≤0.040mg/l N, and annual 95th percentile for total ammonia should be ≤0.090mg/l N) (NPWS, 2017).

Impact Assessment:

The mitigation measures set out above will not completely prevent the release of nutrients to downstream watercourses. The release of phosphate into the environment is an unavoidable consequence of felling.

However, the works associated with the Proposed Project will involve similar forestry felling activities to those currently and historically being undertaken at the project site. These practices are used to keep the levels of total phosphorus below the accepted critical threshold of 62 µg/l (EPA, 2001). Therefore, the existing condition of the receiving waters will provide an indication as to the potential impacts which may result from the Proposed Project.

The WFD status of the receiving waterbodies has been consulted to determine the existing baseline environment. The Recess_020 river waterbody, which includes the streams directly draining the project site, achieved "High" status in the latest WFD cycle (2016-2021). This was an improvement on the

"Good" status which this waterbody achieved in the 2nd WFD cycle (2013-2018). The receiving lake waterbodies of Lough Inagh and Derryclare Lough also achieved "High" status in the latest WFD cycle. The overall status of surface waterbodies are based on both their qualitative and quantitative characteristics.

Furthermore, these SWBs have been deemed to be " not at risk" of failing to meet their respective WFD objectives. It is noted that Derryclare Lough is a high status objective waterbody and this waterbody has been deemed to be on track to meet this target by 2027 despite the ongoing forestry operations.

It is therefore concluded, based on the overall status and the risk status of the receiving waterbodies, that the existing forestry felling and associated activities have not resulted in any deterioration in the status of any downstream receptors. As the felling works associated with the Proposed Project do not represent a significant change to the current felling practice at the project site, there is no potential for the Proposed Project to result in any deterioration in the WFD status of the receiving waterbodies.

All of the managed forestry at the project site will ultimately be felled should the Proposed Project proceed or not. As such, there is no new risk of nutrient release to the downstream catchment associated with the Proposed Project.

However, the Proposed Project involves felling each of the 20 no. harvest blocks on only 1 no. occasion. Following felling, these harvest blocks will not be replanted and therefore will not be subject to further felling in the future. The Proposed Project only has the potential to release nutrients from the project site as a result of 1 no. felling round. Meanwhile, typical forestry activities involve a continuous cycle of felling and replanting. Therefore, in the Do Nothing Scenario there are potentially many future nutrient release events as each harvest block would likely be felled and replanted several times under the existing forestry licence, i.e. cumulative impact. The Proposed Project therefore will only result in 1 no. mitigated nutrient release event which will have a short-term temporary negative impact. If the Proposed Project were to proceed this short-term negative impact would be replaced by a long-term positive effect as there will be no additional felling at the project site, i.e. removing the cumulative impact.

Residual Effects: Felling operations pose a risk to surface water quality in downstream receptors due to nutrient enrichment. Best practice measures, including the implementation of riparian buffer zones and limiting of felling coupes to 25ha (and splitting larger harvest blocks (i.e. GY27_HB0012, GY27_HB0014, and GY27_HB0021) into areas <25ha), will help protect surface water quality throughout the construction phase however nutrient release is an unavoidable consequence of felling. The short-term residual effect is considered to be - negative, indirect, slight to moderate, likely effect on downstream water quality and aquatic habitats. As stated above, the Proposed Project only proposed 1 no. round of felling in comparison to the Do Nothing Scenario in which the project site would be felled and replanted several times. Therefore, the long-term residual effect is considered to be - positive, indirect, moderate, likely effect on downstream water quality and aquatic habitats.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on the surface water quality will occur.

8.5.2.3 Sediment Entrainment in Surface Waters Due to Bog Restoration Measures

It is proposed to restore ~281ha of commercial forestry to blanket bog and wet heath habitats. Following felling, bog restoration measures will be implemented in these harvest blocks. The main restoration measures proposed include drain blocking, surface smoothing and re-profiling.

Drain blocking will be achieved through the use of plastic dams, peat dams and log dams designed to raise the groundwater level in the surrounding peat soils.

- Plastic dams will be used in areas of the project site which are inaccessible by machinery and will be installed at 10-20m intervals on flat ground, with closer spacing on sloping ground. The installation methodology involves the driving piles into the ground until they are ~30cm above the bank level.
- Peat dams will be installed using an excavator whereby consolidated peat will be taken from an in-ditch borrow pit upstream to create a dam.
- Log dams will be used to block smaller ditches and will be installed using an excavator.

These drain blocking activities will disturb local peat deposits and increase the likelihood of erosion of peat and subsoils, increasing the potential for the entrainment of suspended solids in surface waters.

Surface smoothing and re-profiling are bog restoration techniques designed to reverse the effect of the ridge-furrow cultivation process. Ideally, where suitable the site should be reprofiled as this is a more effective restoration measure than drain blocking since it elevates the water table close to the bog surface more effectively. The techniques include reprofiling, stump flipping and cross-tracking.

- Reprofiling involves the levelling off of the original plough furrow forest establishment site preparation system using an excavator;
- Stump flipping is the process whereby the root of a stump is pried off the bog surface using an excavator and turned upside down into the adjacent furrow. The plough ridges are then reprofiled by sliding the ridge material into the furrows with an excavator bucket; and,
- Cross-tracking involves an excavator tracking over the bog surface whereby the weight of the machine compresses the surface.

These surface smoothing and re-profiling activities will disturb local peat deposits and also have the potential to result in the entrainment of suspended solids in surface waters.

Pathway: drainage and surface water discharge routes

Receptor: Rivers and streams draining the project site and down-gradient waterbodies including Lough Inagh, Derryclare Lough, Ballynahinch Lough and the Recess River and dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect.

Proposed Mitigation Measures:

All proposed bog restoration works at the project site will be in accordance with the best practice Forest Service regulation, policies and strategic guidance documents as well as Coillte and DAFM guidance documents to ensure minimal potential negative effects on the local hydrological environment.

Similar mitigation measures to those outlined in Section 8.5.2.1 will be implemented during the bog restoration works in order to protect downstream surface water quality: These measures include:

- Use of aquatic buffer zones, including 10m buffer to watercourses, and 5m buffer to relevant watercourses;
- All machinery operators will be experienced;
- The project site will be walked before a machine goes off-road;
- Bog mats will be used where the excavator is required to travel over wet ground;
- A low ground pressure excavator with wide tracks (1.9m or greater) will be used to reduce compaction of the peat and subsoils;
- Silt traps will be installed at the outfalls of existing forestry drains downstream of the work areas before any works commence. These traps will prevent sediment from entering downstream watercourses;
- Silt fences will be inspected and maintained for the duration of the works;

- Works will be suspended or scaled back prior to and following periods of heavy, intense and/or prolonged rainfall;
- During drain blocking the main collector drains nearest the natural watercourse will be blocked first and silt traps will be inserted as required. Then the operators shall begin work at the highest point and work systematically downslope towards the watercourse; and,
- All outlets of the collector and peripheral drains will be blocked.

Residual Effect Assessment: The potential for the release of suspended solids to watercourse receptors during bog restoration works is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short-term, unlikely effect on downstream water quality and aquatic habitats.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on the surface water quality will occur.

8.5.2.4 Potential effects from Vegetation Control Measures

Vegetation control and the control of invasive species will be completed in the autumn following clear felling and for a period of at least 5-7 no. years.

Invasive species such as Rhododendron will be removed using brush-cutters, chainsaw felling, stump treatment using herbicide ecoplugs/glyphospate-based herbicides. The use of herbicides in close proximity to watercourses has the potential to effect local and downstream surface water quality.

Pathway: Site drainage and surface water discharge routes.

Receptor: Surface water quality on down gradient surface waterbodies including Lough Inagh, Derryclare Lough, Ballynahinch Lough and the Recess River and associated dependent ecosystems.

Mitigation Measures:

The following mitigation measures are proposed:

- Any spraying or stump treatment shall only take place in dry weather;
- Any work near aquatic zones will be completed by an operator who has PA6 (AW) certification;
- Any work near aquatic zones must be completed using a product designated from aquatic use such as ecoplugs or bioactive roundup; and,
- Spraying will be undertaken during dry calm weather.

Likely Residual Effects: The application of herbicide in the early stages of the restoration works will only occur over a small area of the overall project site. Strict mitigation measures have been proposed in regard to the application of herbicide to ensure surface water quality is minimised. As such, we consider the residual effects of the proposed herbicide to be an imperceptible, negative, indirect, short-term effect on downstream surface water quality.

Significance of Effects: For the reasons outlined above and with the implementation of the mitigation measures, we consider that the proposed herbicide associated with the restoration works will not have a significant effect on downstream water quality.

8.5.2.5 Effects from Proposed Roads and Road/Carparking Upgrades

The Proposed Project will utilise 8.23km of the existing forestry road network at Derryclare. While some of the existing road network will require upgrading. No road widening works are proposed.

It is proposed to construct ~1.58km of new floating forest road extensions in order to access the forestry blocks in the north and south of the project site. The proposed new road extension in the north of the project site includes a total of 11 no. temporary watercourse crossings, 3 no. of which are located over an unnamed natural watercourse and 8 no. of which are located over man-made drains. Meanwhile, proposed new road extension in the south of the project site includes a total of 10 no. temporary watercourse crossings, 1 no. of which is located over an unnamed natural watercourse, and 9 no. of which are located over man-made drains.

The existing car parking at the project site entrance off the R344 will also be upgraded to provide a level and compacted car parking surface which will be able to accommodate up to 10 vehicles.

Effects associated with these construction activities have the potential to affect the water quality and fish stocks of downstream water bodies.

Pathway: Drainage and surface water discharge routes

Receptor: Rivers and streams draining the project site and down-gradient waterbodies including Lough Inagh, Derryclare Lough, Ballynahinch Lough and the Recess River and associated dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect.

Proposed Mitigation Measures:

Mitigation by Avoidance:

Potential water quality effects arising from proposed road construction have been minimised through the use of the existing on-site roads as part of the Proposed Project. Utilisation of the existing forestry road network reduces the amount of earthworks required for the Proposed Project and consequently minimises potential surface water quality effects.

Mitigation by Design:

Mitigation measures which will reduce the risk of entrainment of suspended solids during construction of the new floating road extensions and the upgrade of the existing site access road are set out as follows:

- All site access roads (existing and proposed) to be used as part of the Proposed Project will be capped with clean stone to minimize the risk of sediment runoff to surface waters;
- The upgrade of the existing road network will only be completed where necessary using local stone compatible with onsite geological materials;
- The proposed new roads will be designed as "Build On-Top Embankment Roads" in accordance with the COFORD (2004) Forest road Manual – Guidelines for the Design, Construction and Management of Forest Roads.
- These new proposed floating roads will minimize effects on peat hydrology and water quality as there is no requirement for excavation and/or spoil generation. The proposed roads will be created on the existing ground surface by adding crushed stone.

Residual Effect Assessment: Road construction and road upgrades have the potential to effect downstream surface water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of surface water contamination have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality and aquatic habitats.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on the surface water quality will occur.

8.5.2.6 Potential Release of Hydrocarbons During Construction Phase

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons can cause significant pollution risk to groundwater, surface water and associated aquatic ecosystems, and to terrestrial ecology. In addition, the accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbons have a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in the death of aquatic organisms.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Surface water quality in down-gradient waterbodies (1st and 2nd order streams draining the project site, Recess River, Lough Inagh, Derryclare Lough and Ballynahinch Lough) and groundwater quality in the peat bog.

Pre-Mitigation Potential Effect: Negative, indirect, slight, short term, likely effect on local groundwater quality in the peat bog. Indirect, negative, significant, short-term, unlikely effect to surface water quality.

Proposed Mitigation Measures:

- There will be no fuels or herbicides stored within 50m of an aquatic zone or within 20m of all other water features.
- All road-going vehicles will be refuelled off-site;
- On-site re-fuelling will be required for forestry and excavator machinery which will be based continuously at the project site;
- The on-site refuelling will be undertaken using a mobile double skinned bowser with spill kits kept on site for accidental leakages or spillages;
- The bowser will be refilled off-site and will be towed around the site by a 4x4 jeep;
- The 4x4 jeep will carry absorbent materials and pads in the event of accidental spillages;
- The fuel bowser will be parked on a level area on the construction compound when not in use;
- Only designated trained operatives will be authorised to refuel plant on-site;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;
- Fuels stored on-site will be minimised. All storage areas will be bunded appropriately for the duration of the construction phase. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency response plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (which is contained in Appendix 4.3).

Residual Effect: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual

effect is considered to be - Negative, imperceptible, indirect, temporary, unlikely effect on groundwater quality within the peat bog and surface water quality in down-gradient rivers (1st and 2nd order streams draining the project site, Recess River, Lough Inagh, Derryclare Lough and Ballynahinch Lough).

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on surface water or groundwater quality will occur.

8.5.2.7 Morphological Changes to Surface Watercourses

Diversion, culverting and bridge crossing of surface watercourses can result in morphological changes, changes to drainage patterns and alteration of aquatic habitats. Construction of structures over water courses has the potential to significantly interfere with water quality and flows during the construction phase.

The proposed new floating road extension in the north of the project site includes a total of 11 no. temporary watercourse crossings, 3 no. of which are located over an unnamed natural watercourse and 8 no. of which are located over man-made drains. Meanwhile, proposed new floating road extension in the south of the project site includes a total of 10 no. temporary watercourse crossings, 1 no. of which is located over an unnamed natural watercourse, and 9 no. of which are located over man-made drains.

Pathway: Site drainage network.

Receptor: Surface water flows, stream morphology and surface water quality.

Pre-mitigation Effect: Negative, direct, slight, long-term, unlikely effect on stream flows, stream morphology and surface water quality.

Mitigation Measures:

Mitigation by Avoidance:

Potential water quality effects arising from the requirement to cross the many unnamed watercourse within the project site have been minimised through the use of the existing on-site roads as part of the Proposed Project. Utilisation of the existing forestry road network has significantly reduced the amount of new proposed watercourse crossings required by the Proposed Project.

Mitigation by Design:

The following mitigation measures are proposed:

- All proposed crossings will comprise of standard log-bridge crossings which are typically used in normal forestry operations;
- Any guidance / mitigation measures proposed by the OPW or the Inland Fisheries Ireland will be incorporated into the design of the proposed crossings;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2016) guidance document "Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters", i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- During the stream crossing construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the

construction of the bog-bridge crossing. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas; and,

- All new river/stream crossings will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

Residual Effects: With the application of the best practice mitigation outlined above, and through compliance with the Section 50 consenting process, we consider the residual effect to be - Negative, imperceptible, direct, long-term, unlikely effect on stream flows, stream morphology and surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on stream morphology or stream water quality will occur at crossing locations.

8.5.2.8 Effect of Bog Restoration on Bog Hydrogeological Regime

The overall aim of the Proposed Project is to rehabilitate and restore much of the project site to blanket bog and wet heath habitats.

The current drainage system was designed to lower the local peat water table in order to facilitate forestry activities. This subdued peat water table does not support bog functioning and optimum bog or wet heath ecology. The drainage regime which currently exists on-site will be altered through a series of bog restoration measures to restore pre-forestry water table conditions where possible.

Restoration can be achieved through measures such as drain blocking and surface re-profiling which will encourage natural re-vegetation of the felled areas with typical blanket bog and wet heath communities. Drain blocking will help establish a more suitable hydrological/hydrogeological regime where the water table will be much closer to the surface than it is at present. Post restoration monitoring at other sites has shown that groundwater levels in rewetted bogs can recover relatively quickly *i.e.* within 2-5 years. Maps showing the existing forestry drains to be blocked as part of this project are shown in Appendix 4-5 of this EIAR.

The magnitude of this positive effect will vary across the project site, dependent on the local intensity of the restoration measures (drain blocking, reprofiling etc).

Pathways: Water volume and peat water level rise.

Receptors: Local peat bog hydrology/hydrogeology.

Mitigation Measures:

Proposed mitigation relating to water quality protection during restoration works are detailed in Section 8.5.2.3.

No other specific mitigation measures are required in relation to the proposed alteration of the existing bog hydrogeology as the proposed measures will have a positive effect on the bog hydrogeology.

All works completed during the restoration works will be done in accordance with 'best practice' procedures and the mitigation measures in relation to the protection of surface and groundwater quality are detailed elsewhere.

Likely Residual Effects: Following the implementation of the proposed bog restoration measures, the project site will likely be wetter, will retain more water, will recolonise with vegetation, and will eventually become a naturally functioning peatland. As such, we consider the residual effects of the restoration works to be moderate, positive, direct, long-term effect on local peat bog hydrology/hydrogeology.

Significance of Effects: For the reasons outlined above, we consider that the proposed restoration works will have a significant positive effect on local bog hydrogeology.

8.5.2.9 Potential Effects on Hydrologically Connected Designated Sites

While the project site is not located within any designated conservation site, direct hydrological connections exist between the project site and the Twelve Bens/Garraun Complex SAC and pNHA (Site Code: 002031). All watercourses draining the project site flow into Lough Inagh and Derryclare Lough which both form part of the Sac/pNHA. Further downstream the project site is also hydrologically connected to the Connemara Bog Complex SAC and pNHA (Site Code: 002034) via the Recess River. No hydrological connection exists between the project site and any other designated site.

Construction phase activities at the project site, including clear felling of the coniferous plantation, the implementation of the bog restoration measures and all associated siteworks have the potential to negatively affect downstream surface water quality. The surface water connections from the project site to Lough Inagh, Derryclare Lough and the Recess River could transfer poor quality surface water that may affect the Twelve Bens/Garraun Complex SAC/pNHA and the Connemara Bog Complex SAC/pNHA.

Pathway: Surface water flowpaths.

Receptor: Down-gradient water quality Lough Inagh and Derryclare Lough (Twelve Bens/Garraun Complex SAC/pNHA) and in the Recess River (Connemara Bog Complex SAC/pNHA).

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect on downstream designated sites (Twelve Bens/Garraun Complex SAC/pNHA) and in the Recess River (Connemara Bog Complex SAC/pNHA).

Mitigation Measures:

Detailed mitigation measures to protect surface water quality during felling operations are outlined in Section 8.5.2.1. Detailed mitigation measures to protect surface water quality during bog restoration measures are outlined in Section 8.5.2.3. Detailed mitigation measures for the control of hydrocarbons during construction works are outlined in Section 8.5.2.6. Implementation of these mitigation measures will ensure the protection of water quality in receiving waters.

Residual Effects: Construction activities at the project site pose a threat to designated sites hydrologically linked with the Proposed Project. Proven and effective measures to mitigate the risk of surface and groundwater contamination have been proposed which will break the pathway between the potential source and the downstream receptor. These mitigation measures will ensure that surface water runoff from the project site will be equivalent to baseline conditions and will therefore have no effect on the status or ecology of the protected species and habitats within the designated sites. The residual effect is considered to be Negative, imperceptible, indirect, short term, unlikely effect on downstream designated sites including the Twelve Bens/Garraun Complex SAC/pNHA and the Connemara Bog Complex SAC/pNHA.

Significance of Effects: For the reasons outlined above, no significant effects on any designated sites will occur.

8.5.2.10 Potential Effects on Surface and Groundwater WFD Status

The EU Water Framework Directive (2000/60/EC) requires that all member states protect and improve water quality in all waters, with the aim of achieving good status by 2027 at the latest. Any new development must ensure that this fundamental requirement of the Directive is not compromised.

The status of the groundwater and surface water bodies in the vicinity and downstream of the project site are described in Section 8.3.12 and 8.3.13 respectively.

In terms of surface waterbodies (SWBs), all sections of the Recess River in the vicinity and downstream of the project site (Recess_020, Recess_030 and Recess_040) achieved "High" status in the latest WFD cycle (2016-2021). Meanwhile, Lough Inagh and Derryclare Lough immediately downstream of the project site have achieved "High" status in the last 2 no. WFD cycles. Further downstream Ballynahinch Lake achieved "High" status in all 3 no. WFD cycles.

It has been determined that the Roundstone Bay transitional waterbody and the downstream coastal SWBs (Bertraghboy Bay and Aran Islands, Galway Bay and Connemara SWBs) have no potential to be affected by the Proposed Project due to their distal location from the project site, the large volume of water within these SWBs and the saline nature of the waters.

In terms of groundwater bodies (GWBs), The Recess and Maamturks West Marbles GWBs achieved "Good" status in all 3 no. WFD cycles (2010-2015, 2013-2018 and 2016-2021).

Potential effects on groundwater and surface water quality and quantity as a result of the Proposed Project has the potential to negatively affect the WFD status of ground and surface water bodies in the vicinity and downstream of the Proposed Project. The potential change in WFD status for waterbodies resulting from the Proposed Project, and in the absence of any mitigation measures, is summarised in **Table 8-13** below.

Our understanding of the WFD objectives is that water bodies, regardless of whether they have 'Poor' "Moderate" or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed in order to ensure there is no deterioration in the status of a waterbody.

Table 8-13: Summary of WFD Status Change in an Unmitigated Scenario (Construction Phase)

WFD Element	WFD Code	Current Status 2016-2021	Assessed Status – Unmitigated Scenario
Recess_020	IE_WE_31R010500	High	Good
Inagh	IE_WE_31_223	High	Good
Derryclare	IE_WE_31_227	High	Good
Recess_030	IE_WE_31R010600	High	High
Ballynahinch	IE_WE_31_228	High	High
Recess_040	IE_WE_31R010700	High	High
Recess GWB	IE_WE_G_0011	Good	Moderate
Maamturks West Marbles GWB	IE_WE_G_0016	Good	Moderate

Pathway(s): Surface water runoff and groundwater recharge

Receptor: The following surface waterbodies have been deemed to have the potential to be affected by the Proposed Project due to their location downstream of the project site: Recess_020, Lough Inagh and Derryclare Lough.

It has been determined that the Recess_030 and _040 and Ballynahinch lake SWBs have no potential to be affected by the Proposed Project due to their location downstream of Lough Inagh and Derryclare Loughs which contain a significant volume of water and act as a hydrological buffer. Meanwhile, the Roundstone Bay transitional waterbody and the downstream coastal SWBs (Bertraghboy Bay and Aran Islands, Galway Bay and Connemara SWBs) have no potential to be affected by the Proposed Project due to their distal location from the project site, the large volume of water within these SWBs and the saline nature of the waters.

In terms of groundwater bodies, the Recess GWB and the Maamturks west Marbles GWB have the potential to be affected by the Proposed Project due to their location directly underlying the project site.

Pre-Mitigation Potential Effect: Indirect, negative, moderate, short term, likely effect on the WFD status of downstream SWBs. Indirect, negative, imperceptible, short term, unlikely effect on the WFD status of the underlying GWBs.

Impact Assessment/Mitigation Measures:
Due to the hydrogeological regime at the project site, characterised by low groundwater recharge rates and high rates of surface water runoff, the SWBs in the vicinity and downstream of the Proposed Project are the most sensitive receptors. The GWBs will be less susceptible to effects from the Proposed Project.

Strict mitigation measures in relation to the protection of surface and groundwaters are outlined above in Section 8.5.2.1 to 8.5.2.6. The implementation of these mitigation measures during the construction phase of the Proposed Project will ensure the qualitative and quantitative status of the receiving surface waters will not be altered by the Proposed Project.

There will be no change in GWB or SWB status in the underlying GWBs or downstream SWBs resulting from the Proposed Project (refer to **Table 8-14**). There will be no change in quantitative (volume) or qualitative (chemical) status, and the downstream SWBs and the underlying GWB are protected from any potential deterioration from chemical pollution.

As such, the Proposed Project is compliant with the requirements of the Water Framework Directive (2000/60/EC).

Table 8-14: Summary WFD Status with the implementation of Mitigation Measures (Construction Phase)

WFD Element	WFD Code	Current Status 2016-2021	Assessed Status – Unmitigated Scenario
Recess_020	IE_WE_31R010500	High	High
Inagh	IE_WE_31_223	High	High
Derryclare	IE_WE_31_227	High	High
Recess_030	IE_WE_31R010600	High	High
Ballynahinch	IE_WE_31_228	High	High
Recess_040	IE_WE_31R010700	High	High
Recess GWB	IE_WE_G_0011	Good	Good
Maamturks West Marbles GWB	IE_WE_G_0016	Good	Good

Residual Effect: Due to the local hydrogeological regime at the project site, coupled with the implementation of the proposed mitigation measures for the protection of groundwater and downstream surface waters, we consider that there will be no residual effect on the WFD status of the underlying GWBs. While SWBs are more susceptible to pollution effects from the Proposed Project, with the implementation of the proposed mitigation measures we consider that there will be no residual effect on the WFD status of the downstream SWBs.

Significance of the Effect: With the implementation of the mitigation measures outlined above there will be no change in the GWB or SWB status in the underlying GWBs or downstream SWBs resulting from the Proposed Project. The Proposed Project will not result in the deterioration in the WFD status of any surface or groundwater body nor will it jeopardise the attainment of good status in the future.

8.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures

Very few potential direct effects are envisaged during the operational phase of the Proposed Project.

During the operational phase construction vehicles may be required to access the project site to allow suitably qualified personnel to complete the proposed monitoring of tree survival rates, water quality monitoring and invasive species management.

Due to the non-intrusive nature of the maintenance works during this phase of the Proposed Project, the potential effects on the hydrological and hydrogeological environment are limited to potential contamination from hydrocarbon spills and leaks as discussed in Section 8.5.3.1.

8.5.3.1 Site Vehicle/Plant Use

Plant and site vehicles used in site maintenance will be run on fuels and use hydraulic oils. Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to surface and groundwater quality and their water dependent ecosystems. The accumulation of

small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon is highly toxic to humans, and to all flora and fauna, and is persistent in the environment.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Surface water quality in downgradient rivers and Lough Inagh and Derryclare Lough, and groundwater quality in the peat bog.

Potential Pre-Mitigation Effect: Negative, indirect, slight, short term, likely effect on local groundwater quality in the peat bog. Indirect, negative, significant, short term, unlikely effect to surface water quality.

Proposed Mitigation Measures:

- Vehicles used during the operational phase will be refuelled off site before entering the project site;
- No fuels will be stored on-site during the operational phase; and
- Spill kits will be available in all site vehicles to deal with an accidental spillage and breakdowns; and,
- An emergency plan for the operational phase to deal with accidental spillages and breakdowns will be contained in the Environmental Management Plan.

Residual Effect: The use of hydrocarbons in plant and vehicles is a standard risk associated with all sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, temporary, unlikely effect on groundwater quality within the peat bog and surface water quality in down-gradient SWBs (Recess River, Lough Inagh and Derryclare Lough).

Significance of Effects: For the reasons outlined above, no likely significant effects will occur.

8.5.3.2 Potential Effects on Surface and Groundwater WFD Status

The potential effects on groundwater and surface water during the operational phase of the Proposed Project are much reduced in comparison to the construction phase described above in Section 8.5.2.10. Therefore, the potential for the operational phase of the Proposed Project to affect the WFD status of waterbodies in the vicinity and downstream of the project site is reduced compared to the construction phase (Section 8.5.2.10).

During the operational phase of the Proposed Project, all clearfelling and the implementation of all bog restoration measures will have been completed. During the operational phase some maintenance and/or monitoring works may be completed at the project site, however these would be of a very minor scale and would be very infrequent.

During the operational phase surface and groundwater and surface water quality will be at risk from the infrequent maintenance works (hydrocarbon spillages, wastewater disposal etc) which have the potential to affect the status of SWBs and GWBs.

The potential change in WFD status for waterbodies resulting from the operational phase Proposed Project, and in the absence of any mitigation measures, is summarised in **Table 8-15** below.

Table 8-15: Summary of WFD Status Change in an Unmitigated Scenario (Operational Phase).

WFD Element	WFD Code	Current Status 2016-2021	Assessed Status – Unmitigated Scenario
Recess_020	IE_WE_31R010500	High	Good
Inagh	IE_WE_31_223	High	Good
Derryclare	IE_WE_31_227	High	Good
Recess_030	IE_WE_31R010600	High	High
Ballynahinch	IE_WE_31_228	High	High
Recess_040	IE_WE_31R010700	High	High
Recess GWB	IE_WE_G_0011	Good	Moderate
Maamturks West Marbles GWB	IE_WE_G_0016	Good	Moderate

Pathway(s): Groundwater recharge and groundwater flow (downstream discharge of groundwater to surface waterbodies).

Receptor: The following surface waterbodies have been deemed to have the potential to be affected by the Proposed Project due to their location downstream of the project site: Recess_020, Lough Inagh and Derryclare Lough.

It has been determined that the Recess_030 and _040 and Ballynahinch lake SWBs have no potential to be affected by the Proposed Project due to their location downstream of Lough Inagh and Derryclare Loughs which contain a significant volume of water and acts as a hydrological buffer. Meanwhile, the Roundstone Bay transitional waterbody and the downstream coastal SWBs (Bertraghboy Bay and Aran Islands, Galway Bay and Connemara SWBs) have no potential to be impacted by the Proposed Project due to their distal location from the project site, the large volume of water within these SWBs and the saline nature of the waters.

In terms of ground waterbodies, the Recess GWB and the Maamturks west Marbles GWB have the potential to be affected by the Proposed Project due to their location directly underlying the project site.

Pre-Mitigation Potential Effect: : Indirect, negative, moderate, short term, likely effect on the WFD status of downstream SWBs. Indirect, negative, imperceptible, short term, unlikely effect on the WFD status of the underlying GWBs.

Impact Assessment/Mitigation Measures:

As outlined above, the potential for effects during the operational phase of the Proposed Project is reduced in comparison to the construction phase.

During the operational phase of the Proposed Project, the only plant which will be required on site will be maintenance/inspection vehicles (jeeps/vans/quads). These will be refuelled off site. Mitigation measures outlined for the protection of surface and groundwaters from hydrocarbon spillage will also be implemented during the operational phase. The implementation of these mitigation measures during

the operational phase will ensure the qualitative status of the receiving waters will not be altered by the Proposed Project.

There will be no change in GWB or SWB status in the underlying GWBs or downstream SWBs resulting from the Proposed Project (refer to **Table 8-16**). There will be no change in quantitative (volume) or qualitative (chemical) status, and the underlying GWBs are protected from any potential deterioration from chemical pollution.

As such, the Proposed Project is compliant with the requirements of the Water Framework Directive (2000/60/EC).

Table 8-16: Summary WFD Status with the implementation of Mitigation Measures (Operational Phase)

WFD Element	WFD Code	Current Status 2016-2021	Assessed Status – Unmitigated Scenario
Recess_020	IE_WE_31R010500	High	High
Inagh	IE_WE_31_223	High	High
Derryclare	IE_WE_31_227	High	High
Recess_030	IE_WE_31R010600	High	High
Ballynahinch	IE_WE_31_228	High	High
Recess_040	IE_WE_31R010700	High	High
Recess GWB	IE_WE_G_0011	Good	Good
Maamturks West Marbles GWB	IE_WE_G_0016	Good	Good

Residual Effect: Due to the minor and infrequent nature of works during the operational phase, coupled with the implementation of the proposed mitigation measures for the protection of groundwater and downstream surface waters, we consider that there will be no residual effect on the WFD status of SWBs downstream of the Proposed Project. Additionally, given the low rates of groundwater recharge at the project site, the minor and infrequent nature of the works during the operational phase, coupled with the proposed mitigation measures we consider that there will be no residual effect on the WFD status of the underlying GWB.

Significance of the Effect: With the implementation of the mitigation measures outlined above there will be no change in the GWB or SWB status in the underlying GWB or downstream SWBs resulting from the Proposed Project. The Proposed Project will not result in the deterioration in the WFD status of any surface or groundwater body nor will it jeopardise the attainment of good status in the future.

8.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

It is not intended that the proposed peatland restoration project will be reversed or removed as permanent planning permission is being sought for the change of land use from forestry to other habitat

types. Therefore, it is intended that the Proposed Project will be retained as permanent, and will not be decommissioned.

As such, no additional effects on the hydrological and hydrogeological environment can occur.

8.5.5 Assessment of Cumulative Effects

As stated above the restoration of the project site will not be reversed and the land use change will be permanent. Any potential cumulative hydrological and hydrogeological effects will result from other activities within the Recess River surface water catchment outside the project site. However, this is a largely rural catchment and there are no active IPC or discharge licences downstream of the project site.

Forestry activities will continue is 1 no; harvest block within the project site (GY27_HB0026). Typical downstream water quality issues arising from forestry activities include elevated concentrations of suspended solids and nutrient enrichment. However, the Proposed Project involves the restoration of much of the project site resulting in improved surface water quality and attenuation in the restored areas. This will improve local surface water quality in the vicinity of the project site in comparison to the existing baseline condition where forestry operations are ongoing across the entire project site.

8.5.6 Human Health

Due to the nature of the Proposed Project, combined with the mitigation measures designed to protect surface water and groundwater quality, the Proposed Project will pose no risk to human health and will likely result in the long-term improvement in local surface water quality.

8.5.7 Risk of Major Accidents and Disasters

The main risk of MADs at peatland sites is related to peat stability. However, there is no record of peat instability or historic peat slides at the project site. The Proposed Project does not involve any significant excavations and will therefore not increase the risk of peat failure at the project site.

Flooding can also result in downstream MADs. However, the rehabilitation and restoration of the project site will increase surface water retention/attenuation at the site through drain blocking, re-profiling and the restoration of the bog hydrogeological regime. This will reduce the risk of flooding downstream of the project site.

8.5.8 Monitoring

As part of the operational phase of the Proposed Project a surface water quality monitoring programme will be implemented.

This will include both chemical and biological water quality monitoring. The primary objective of this water quality monitoring will be to establish a baseline and then monitor the effect of the peatland restoration on water quality discharging from the project site. The chemical parameters to be included in the monitoring programme include pH, suspended solids, total phosphorous, total ammonia, COD and DOC. Initially, monitoring should be completed bi-annually and if, after two years, the key targets are being met then the requirement for further water quality monitoring programme will be reviewed.

It is also likely that some groundwater level monitoring will continue order to evaluate the success of the restoration plans. This shall include groundwater monitoring in the installed piezometers which will allow for the measurement of the peat groundwater table and assess the effect of the proposed restoration measures, such as drain blocking and re-profiling, which are designed to raise the local peat groundwater table.

8.5.9 Conclusion

The project site is located in the Coillte property at Derryclare, which lies to the west of Lough Inagh and Derryclare Lough in Connemara, Co. Galway. The overall Coillte landholding at Derryclare is ~567 hectares (ha). The project site was planted with Sitka Spruce and Lodgepole Pine in the 1960s. Currently the project site is dominated by coniferous forests which are of low to moderate productivity. The project site lies on the eastern slopes of Derryclare and Bencorr mountains with topography sloping steeply to the east. The western section of the project site contains the steepest gradients while the eastern section is comparatively flatter.

It is proposed to restore and rehabilitate ~281ha of Atlantic Bog and heathland that is currently planted and managed for commercial forestry. The Proposed Project will comprise of felling of the existing forestry plantations and a series of restoration works designed to aid the restoration of the peatland at Derryclare. The Proposed Project also aims to convert ~62 ha of coniferous forestry to native scrub woodland.

On a regional scale, the project site is located within the Galway Bay North catchment and Hydrometric area 31 of the Western River Basin District. More locally, the project site is located within the Recess river sub-catchment. The project site lies immediately to the west of the of Lough Inagh and Derryclare Lough and is drained by several mountain streams which dissect the project site and discharge into these lakes.

During each phase of the Proposed Project (construction and operation) a number of activities will take place at the project site which will have the potential to affect the hydrological regime or water quality at the project site or downstream. The main potential effects on the hydrological and hydrogeological environment will occur during the construction phase while very few potential direct effects are envisaged during the operational phase of the Proposed Project. These potential effects arise from sediment input and nutrient release during felling operations and the implementation of the proposed restoration measures. Potential effects may also arise from other pollutants such as hydrocarbons which will be present at the project site. These potential effects are similar to all sites which are managed for commercial forestry.

Surface water drainage measures, pollution control measures and other preventative measures have been incorporated into the project design to minimise significant negative effects on downstream water quality. Proven and effective measures to mitigate the risk of releases of sediment and nutrients in runoff have been proposed and will ensure that no significant effects will occur. Preventative pollution measures which also include fuel management have been incorporated into the Construction and Environmental Management Plan, which is presented in Appendix 4-3 of this EIAR.

Overall the Proposed Project presents no likely significant effects to surface water (quality or flows) and groundwater (quality or quantity) provided that the proposed mitigation measures are implemented.

No significant construction or operation phase cumulative effects on any surface or groundwater bodies will result from the proposed felling and restoration proposals at Derryclare.

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APPENDIX 4

2021 ECOLOGICAL REPORT

Ecological Report- Derryclare

Part 1: Habitat Survey

Prepared by Jackie Hunt and Louise Scally, ANIAR Ecology.

20th August, 2021

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1. Introduction

Habitat surveys were completed at Derryclare to inform the preparation of a habitat restoration plan. The objectives of the survey were as follows:

- to characterise the habitats present,
- to identify habitats, flora and fauna of conservation interest
- to assess the potential of habitats for restoration
- to map the location and extent of invasive species and lodgepole pine/sitka natural regeneration

The results from the habitat surveys form Part 1 of this report. The results from the ecological monitoring will be in Part 2. This report is provided along with associated shapefiles and attribute data, excel data and photographs.

2. Methodology

2.1 Field Survey

Walkover surveys were completed by Jackie Hunt and Louise Scally on the following dates:

- 15th to 18th June
- 7th and 16th July

The surveys aimed to sample as much of the site as possible in order to classify the habitats and consider their potential for restoration. Habitats were classified following Fossitt (2000). Additional data was collected on a standard recording form (Appendix I) regarding peat depth, features of modification owing to forestry (furrows, drains, brash), pressures and threats (grazing, invasives, non native conifer regen), slope, soil type and peat depth.

2.2 Data collation and mapping

Existing data was reviewed from the following sources:

- Coillte inventory data, sub and compt data
- Ordnance Survey Ireland's Geohive tool for old mapping and imagery.
- Geological Survey Ireland
- EPA
- Biodiversity Ireland
- NPWS data request

The data from the surveys was collated in excel (spreadsheet provided separately). Additional Coillte inventory data (plantation species, plant year, yield class, rotation, fell year) was also collated into the same excel spreadsheet, given the influence of these factors on existing habitat, restoration potential and management options.

Photographs were taken at each recording location (folders with photos provided separately).

Habitats were mapped in ArcGISpro and key data stored in attribute table (Shapefiles available separately).

2.3 Habitat assessment

2.3.1 Current habitats

The current habitats were assessed based on the plant communities present. Also considered was forestry cover (past and current), peat depth, topography and adjacent habitats.

Pressures such as rhododendron spread and regeneration were assessed, along with non native conifer regeneration and grazing.

Other consideration were the level of modification such as brash, stumps, dead stems, furrows, ridges and drains.

These factors were considered with regards to the describing current habitats and with regards to restoration potential, target habitat and actions to achieve targets.

2.3.2. Target habitats

Target habitats were assessed based on likely pre-afforestation habitats, the quality of current habitats and their restoration potential based on plant communities present and level of modification. Hydrology is a key factor in terms of restoration potential given that the site is dominated by peatland habitats and ecological restoration depends on the capacity of the site to re-wet. The hydrological assessment was provided by RPS Consultants.

3. Results

The Derryclare property covers 567Ha. The site was previously blanket bog and wet heath with outcropping rock, knolls and undulations and was planted in the 1960's with Sitka Spruce and Lodgepole Pine. Lands were planted throughout the 567 ha except for a small area of blanket bog (4.7Ha) which while drained presumably remained too wet to plant.

The Derryclare property is surrounded by mountains with wet heath, blanket bog and oligotrophic lakes (Derryclare Lough and Lough Inagh), these and other associated habitats are protected by the Twelve Bens/Garraun Complex Special Area of Conservation (002031). An area of old oak woodland is present on the shore of Derryclare Lough and lies directly adjacent to the Derryclare property. This is a Nature Reserve owned by NPWS and is part of the Twelve Bens/Garraun Complex SAC (Figure 1).

3.1 Existing data

There are several records for protected species which relate to the 10x10km square within which the property lies. This data was provided by NPWS (Rare and Protected Species request) in excel and shapefile.

The property lies directly adjacent to and surrounded by the Twelve Bens/Garrun Complex. This SAC is designated for a number of habitats and species of conservation interest (see below). Those shown in bold are "connected" to the Derryclare. This connection may be direct such as otter foraging in the rivers within the propery or indirect such as the rivers which flow through the property flow into Lough Inagh which as an oligotrophic lake.

Qualifying Interests:

- **Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) [3110]**
- **Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea [3130]**

- Alpine and Boreal heaths [4060]
- Blanket bogs (* if active bog) [7130]
- Depressions on peat substrates of the Rhynchosporion [7150]
- Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani) [8110]
- Calcareous rocky slopes with chasmophytic vegetation [8210]
- Siliceous rocky slopes with chasmophytic vegetation [8220]
- **Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]**
- **Margaritifera margaritifera (Freshwater Pearl Mussel) [1029]**
- **Salmo salar (Salmon) [1106]**
- **Lutra lutra (Otter) [1355]**
- **Najas flexilis (Slender Naiad) [1833]**

3.2 Current and target habitats

Given the size of the Derryclare property it is divided into three main areas (A, B, C), with a fourth area (Area D) to capture the outlying parts (Figure 1). The current and target habitats for each Area are mapped and described by below.

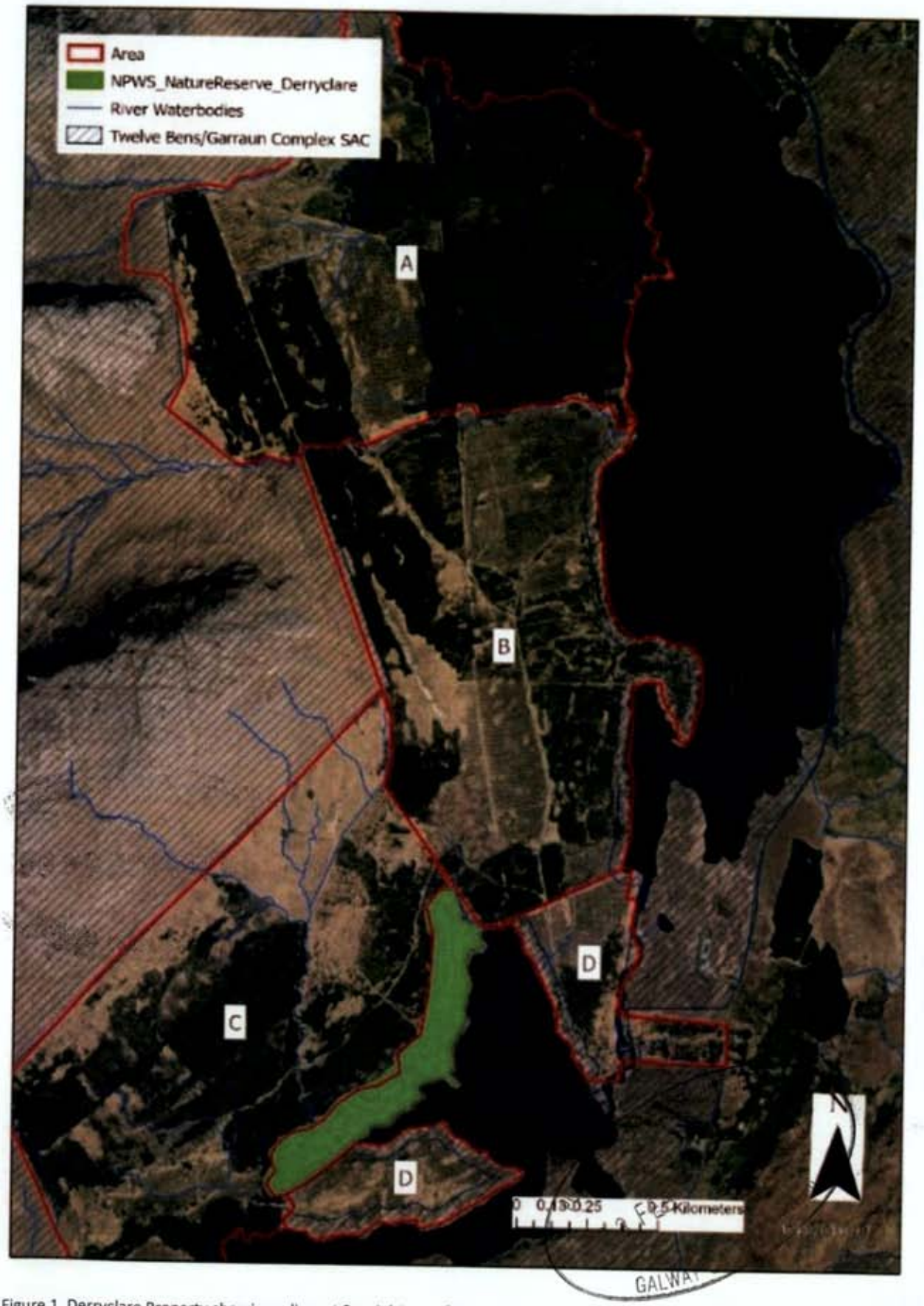


Figure 1. Derryclare Property showing adjacent Special Area of Conservation, Derrcylare Nature Reserve, Lough Inagh (northern) and Derryclare Loughs (southern) and watercourses.

Area A.

This northern part of the site begins in the west on the slopes of Binn an Choire (part of the Twelve Bens). The slopes are steep to moderate as they fall east before becoming gentle and flat as they reach the shore of Lough Inagh. Soils are blanket peat on the gentle to flat terrain, with peaty podzols on moderately to steeply sloping ground. There is an extensive network of eroding upland rivers and streams throughout

Current habitats

Overview

Peatland habitats have been modified by afforestation. Aside from conifer plantation, modification includes drains, ridges and furrows, brash, old stems and stumps. There is mosaic of plantation stages within this area. Parts were planted in the 1960's and have not yet been felled. Other parts have been felled, with no replant and other parts are second rotation forestry. Yield class in this area is generally low, being 10 or less and in places 0. Current habitats are shown in Figure 2 and described below.

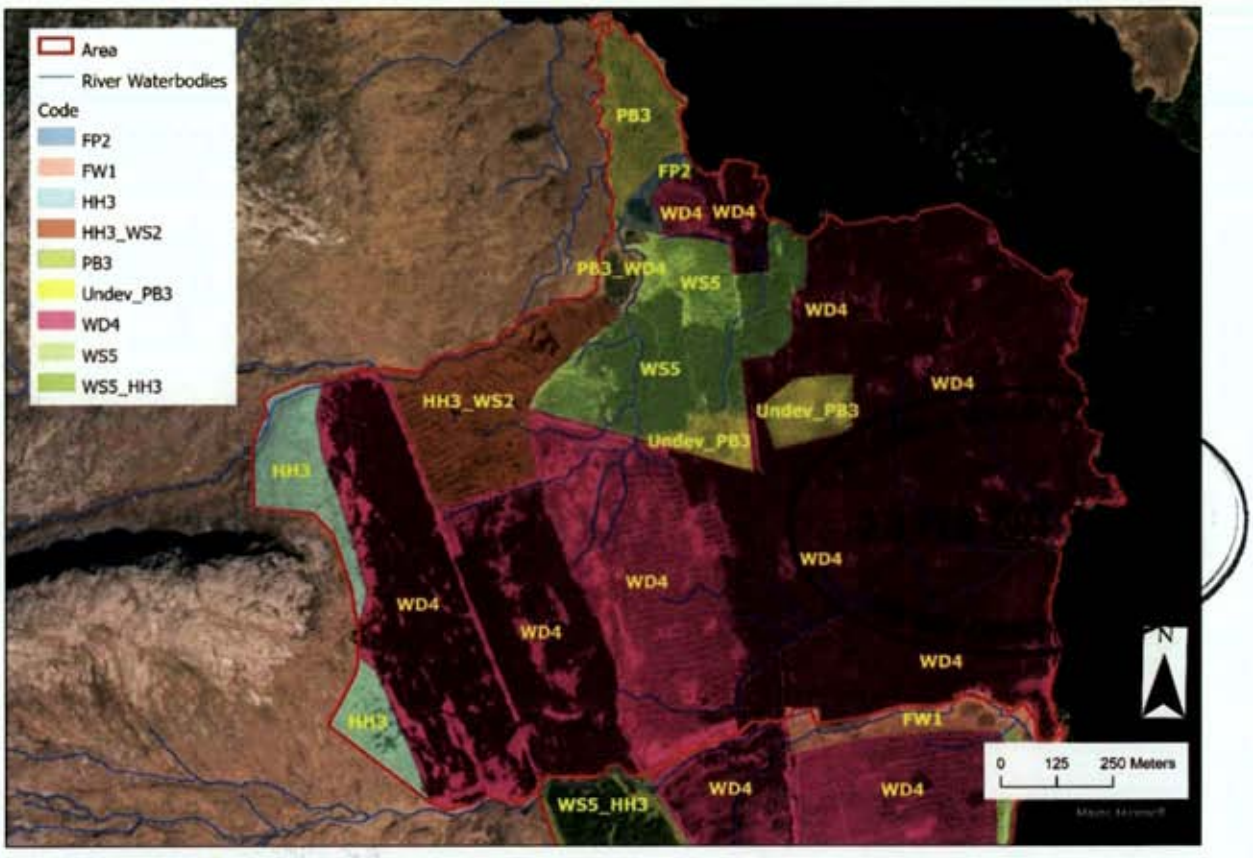


Figure 2. Current habitats in Area A.

Habitat descriptions

Non Calcareous Spring (FP2). Stream rises here with willow scrub and Sphagnum mosses. Conifers (SS/LP) also present.

Eroding/Upland River (FW1). A natural watercourse runs between areas A and B. Trees have been felled along the southern side of the watercourse. The watercourse has natural features with glide and riffle areas, natural steps and pools. The stream edge supports scattered willow, rowan and holly.

The northern side of the stream remain plantation dominated in the lower reaches, but has been cleared in places to leave regenerating wet heath.

Wet Heath (HH3). Unplanted wet heath is present in the upper steep slopes of this area. Scattered conifers (LP) are present, presumably self-seeded. *Calluna vulgaris* and *Molinia caerulea* are abundant. Other flora includes *Erica cinerea, Polygala serpyllifolia, Pontentilla erecta* and *Tricohporum cespitosum*. Sphagnum mosses are present but not abundant. There are patches of *Pteridium aquilinum*. The wet heath is grazed, with evidence of browsing and sheep paths.

Wet Heath and Immature Conifer plantation (HH3_WS2). Moderately sloping ground down to flat area with deeper peat (PB3_WS2). While this area is second rotation forestry deep heather is abundant (*Calluna vulgaris* and *Erica Cinerea*) along with *Molinia caerulea*. Other flora include: *Drosera rotundifolia, Potentilla erecta, Pedicularis sylvatica* and *Tricohporum cespitosum*. Spaghnum mosses are present and ferns in drier areas (*Blechnum spicant, Dryopteris dilatate*). There are scattered conifers (SS/LP) and some pockets of very low yield class first rotation forestry (undev). Deep furrows are present but are becoming sphagnum filled. Stems are stumps are becoming moss covered. Conifer regeneration is occasional.

Blanket bog (PB3). Small area of deep peat which slopes down to the lake. Clearfelled in 2009 with no replant. Blanket bog is regenerating with spaghnum hummocks and pools and grades to wet heath on sloping ground. Blanket bog flora includes sphagnum mosses, *Calluna vulgaris, Drosera rotundifolia, Erica cinerea, Potentilla erecta, Pedicularis sylvatica, Trichophorum germanicum, Rhynchospora alba, Molinia caerulea*. Flora of drier habitats is also present (associated with brash and dead stems) and includes *Rubus fruticosus, Galium saxatile* and *polytricum* mosses. There is some regeneration of native species (Rowan, Holly, Birch), though none beyond seedling stage. Conifer regeneration is occasional.

Failed conifers on blanket bog (Undev_PB3). Pockets of deep peat which were planted in 1963. The conifers have failed to grow beyond c. 5m and stems are thin. A small canopy is present where stems remain alive. The deep peat supports abundant sphagnum mosses including hummocks; and pools are present. The flora includes *Calluna vulgaris, Drosera rotundifolia, Erica cinerea, Potentilla erecta, Carex echinata* and *Molinia caerulea*. Rhododendron is present (small clumps and seedlings).

Conifer plantation (WD4). Much of this area is dominated by conifers planted in the 1960s' which have not yet been felled (LP/SS). One area of second rotation plantation is also present. The areas of conifer plantation are described below:

- **WD4 on deep peat.** 1960's plantation dominates the large area of deep peat on flat and gentle slopes next to Lough Inagh. The plantation varies in success with pockets of failed or undeveloped forestry and other areas with tall trees and good stems. The field layer reflects growth. Tall stems (c. 35m in places) and closed canopies dominate dry compact peat soils with furrows and mounds. Here, the field layer is dominated by pine needles and mosses ("dry" mosses). Spaghnum moss is limited to occasional wet pockets in furrows and *Molinia caerulea* to gaps in the canopy. Where the peat has retained moisture and the water table is higher tree growth is poor and the field layer retains elements of the former peatland community (*Molinia caerulea, sphagnum mosses*). Rhododendron was present but not widespread. This is largely closed canopy limiting growth of all flora with the exception of mosses, scattered *Dryopteris dilatate* and the odd *Hedera helix* seedling. Occasional native (Rowan, Birch) and conifer regen (SS).
- **WD4 on moderately to steeply sloping ground** is present above the access track where the peat depth is generally less than 50cm but with pockets of deeper peat. This habitat is dominated by

conifers with closed canopy and diminished field layer (pine needles with "dry mosses", polytrichum mosses). Furrows and drains are present along with pockets of windblow (many fallen stems). Some peatland community species persist and *Molinia caerulea* is present where light allows and sphagnum mosses in wet furrows. There are several unplanted pockets throughout (unplanted rocky knolls) and here the wet heath community remains with *Calluna vulgaris, Erica cinerea, Potentilla erecta, Trichophorum germanicum, Polygala serpyllifolia, Molinia caerulea* and sphagnum mosses. *Pteridium aquilinum* is present in the upper slopes were the canopy opens and it grades into unplanted wet heath.

- **Second rotation WD4** is present between the moderately to steep sloping higher ground and the largely flat expansive area of deep peat. Peat depths are more variable but reach over 1m in depth. This area was felled and replanted in 2011/12. Planted conifers have not yet created a canopy and elements of a peatland community (e.g. *Calluna vulgais, Molinia carulea*) remain. Either the first rotation forestry failed to create a closed canopy and a peatland community was retained or this community has recovered since felling in 2011/12. There is regeneration of conifers and Rhododendron is present especially along the roadside where it is regenerating.

Recently felled woodland (WS5). An area of deep peat (some shallower peats and riparian habitat also) that was planted in the 1960's and felled in 2017. The habitat is highly modified by brash, stumps and fallen stems which support plant communities of drier habitats (e.g. *Digitalis purpurea*, "dry mosses", polytrichum mosses) and disturbed wetlands (e.g. *Juncus effusus, Juncus squarrosus, Juncus bulbosus*). Deep drains and pools are also present which support abundant sphagnum mosses. Flora typical of peatland habitats is present with Calluna vulgaris, Erica cinerea, Potentilla erecta, *Carex echinata* , *Molinia caerulea* and *Cladonia* spp. There is regenerating conifers (SS, DL) and Rhodendron (Clumps and regeneration). A stream runs through this felled area.

Target Habitats

Target habitats have been considered based on plant communities present, peat depth, forest cover and history adjacent habitats and critically the hydrological assessment.

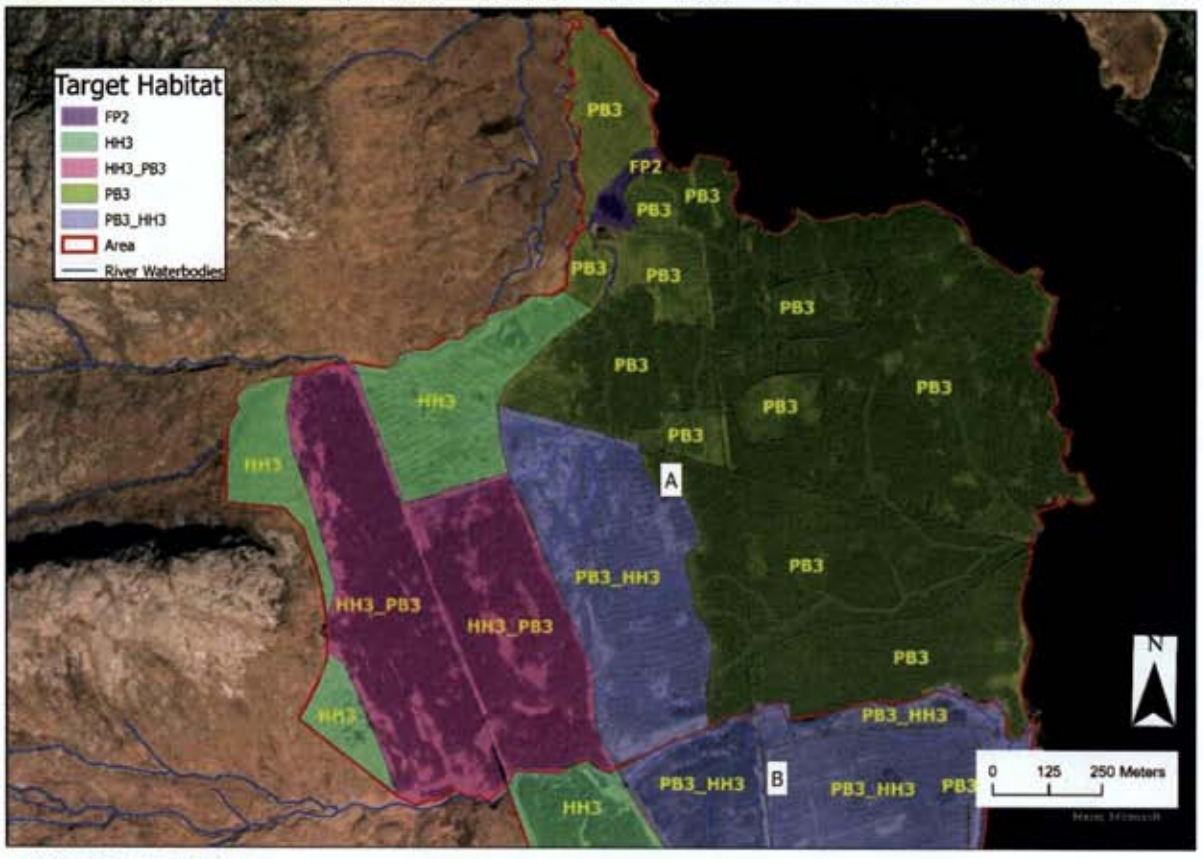
While the habitats in Area A have been modified by afforestation plant community's characteristic of peatland habitats remain. Closed canopy afforestation causing complete loss of field layer is present, however a mosaic of habitats with varying degrees of modification remains. This varies from closed canopy planation with lack of field layer to recovering wet heath in second rotation plantation and to open areas throughout planted areas which were not planted or where the trees failed. There are also areas which have been felled and where blanket bog recovery is underway or beginning, post afforestation.

A key factor in consideration of target habitats is the hydrological assessment. This assessment has found that with drain blocking and other actions re-wetting of the peatlands at Derryclare is possible. As such there is potential to restore the original blanket bog and wet heath which were present in this Area pre-afforestation. Actions will be required to mitigate on going afforestation impacts (conifer canopy, drains, furrows, brash/stems), impacts from restoration actions (e.g. sediment and nutrient release) and to mitigate future pressures on achieving target habitats (rhododendron spread, non native conifer regeneration, retained nutrient load, slow progress). However, with appropriate management and time there is restoration potential. This said it is possible that the target habitats will have to be modified if the post afforestation pressures and level of restoration action becomes unmanageable or no longer practical.

The target habitats for this Area are principally blanket bog and wet heath (Figure 3). In terms of achieving target habitats a number of "Management Scenarios" are described where the attributes of forest cover, history, yield class and slope have been considered. Areas with similar attributes were grouped under different scenarios (Figure 4). This exercise was carried out in order to assess the great variety of attributes over a large site. Pressures within each scenario area are described and proposed actions to achieve target habitats described (Table 1).

Figure 3. Target habitats for Area A (See table 1)

Table 1.Target habitats, pressures, actions and notes for various "scenarios" in Ar



ea A (See Figures 3&4).

Scenario	Target	Pressures	Actions
A 1st rotation, gentle (or flat) slope, **dead stand on PB3**	PB3	Rhododendron (clumps and regen). Conifer regeneration	Clear failed trees Block drains Remove and control rhododendron regeneration thereof. Remove and control conifer natural regeneration
Note: Very wet ground; water table has remained high in these small areas. Surrounded by plantation.			
B 1st rotation, gentle slope, **low or med YC on PB3** (small amount of 2nd rotation)	PB3	Wind blow in places (single, many) Rhododendron throughout (rare to occasional) Red deer present Conifer regeneration	Remove conifers Remove logs and brash during felling. Block drains Remove and control rhododendron regeneration thereof. Remove and control conifer natural regeneration
Note: Extensive area of deep peat, tall stems well grown in places. Watercourses throughout.			

Scenario	Target	Pressures	Actions
Threat of spread of rhododendron once area cleared as peat is very dry with no field layer (aside from mosses).			
D 1st rotation, **moderate slopes**, low and medium YC on HH3 (knolls, rock).	HH3_P B3	Windblow (many) Rhododendron occasional Deer present	Remove conifers Block drains Remove and control rhododendron regeneration thereof. Remove and control conifer natural regeneration.
Note: Erosion risk given slope. Wet heath field layer absent under some stands and invasion by Rhododendron is likely. Removal of brash and stems as much as possible. Access difficult.			
E 1st rotation, **steep slope**, low YC on HH3	HH3_P B3	Windblow (scattered) Rhododendron rare Sheep grazing	Remove conifers Control rhododendron regeneration. Control conifer natural regeneration. Control bracken Control grazing (sheep)
Note: As above, and slope is steeper.			
G 2nd rotation, **moderate slope** with low to high YC **on HH3**	HH3	Rhododendron rare Conifer regeneration Deer browsing	Remove conifers Control rhododendron regeneration. Control conifer natural regeneration Control grazing (deer)
Note: Wet heath habitat recovering from 1st rotation. Restoration already underway.			
I 2nd rotation, gentle slope, med YC **on PB3_HH3**	PB3_H H3	Rhododendron occasional	As above
Note:			
L **Felled** <12 yrs, no replant, gentle slope, **recovering PB3.**	PB3	Rhododendron frequent to occasional Conifer regeneration	Block drains Remove as much brash and felled stems as possible. Remove and control rhododendron regeneration thereof. Remove and control conifer natural regeneration.
Note:			
Q Unplanted, HH3	HH3	Bracken patches Sheep grazing	Control bracken Control grazing (sheep)
Note: Steep ground adjacent to open mountain.			
V Felled 2009, gentle slope, spring with willow and conifers	FP2	Conifers	Remove conifers Retain willow. Protect wetland.
Note: Nutrient enrichment of Spring waters			

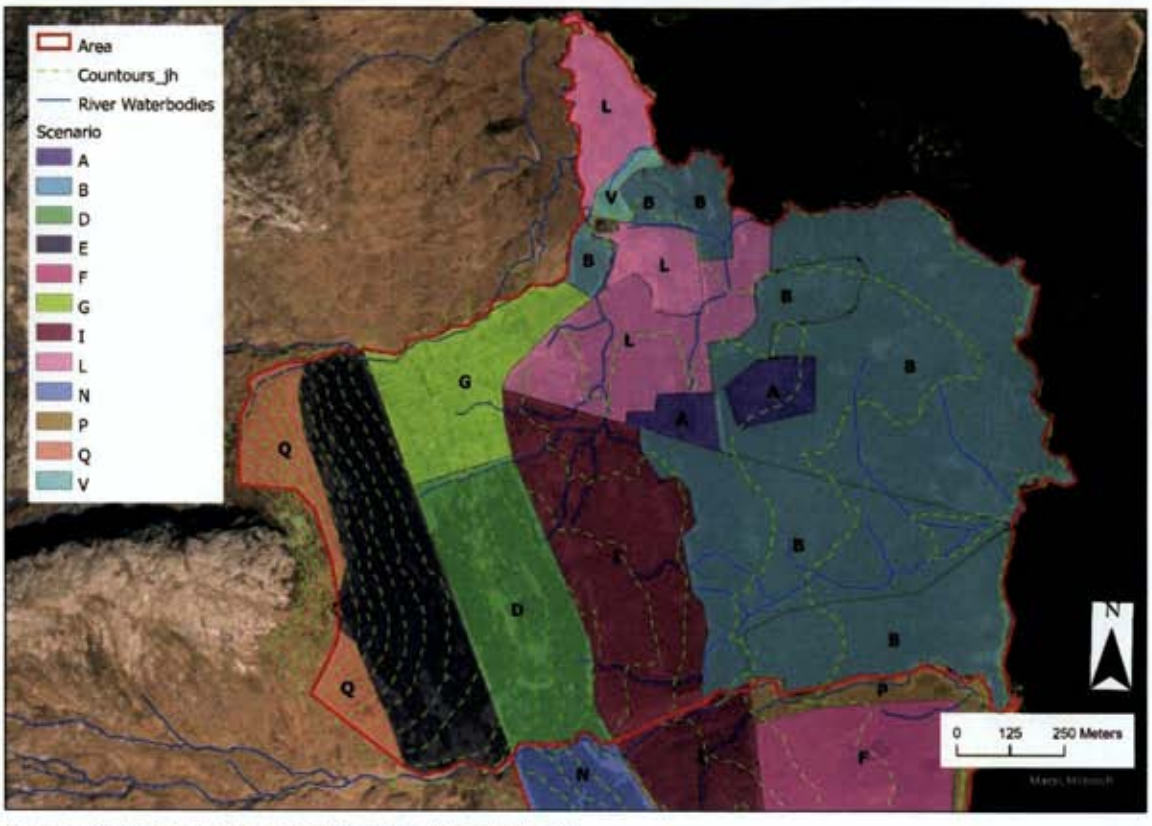


Figure 4. Management "scenarios" for Area A (See Table 1).

Area B.

This middle part of the site lies on the lower flanks of the mountain Doire an Chláir (peak of the oak wood of the plain) with a peak height of 677m and and includes a small rocky summit with a peak height of 190m. The land around this knoll slope steeply initially but then the slope become morerate and gentle at the shore of Lough Inagh. Between the mountain slope of Doire and Chláir and the smaller rocky summit there is an area of flat land which supports a basin of blanket peat. Peaty podzols dominate the steep and moderate slopes which also support some surface rock, most abundant on the rocky summit. As the moderate slopes grade into gentle slope blanket peats dominate down the shore of Lough Inagh. This area is bordered by a river to its north but the river network is less extensive than to the north (Area A) and south (Area B).

Current habitats

Overview

Existing habitats have been modified by afforestation. Modification includes planted conifers, drains, furrows and ridges, brash, old stems and old stumps. This Area is largely dominated by either second rotation plantation or recently felled 1st rotation on steeper ground which has not been replanted. There is an area of 1960's plantation on the slopes of summit 190m and another small pocket lower down and next to Derryclare Nature Reserve. Within the second rotation plantation yield class is generally medium to high (mostly YC 14, but 18 and 10 in places). Current habitats are shown in Figure 5 and described below.

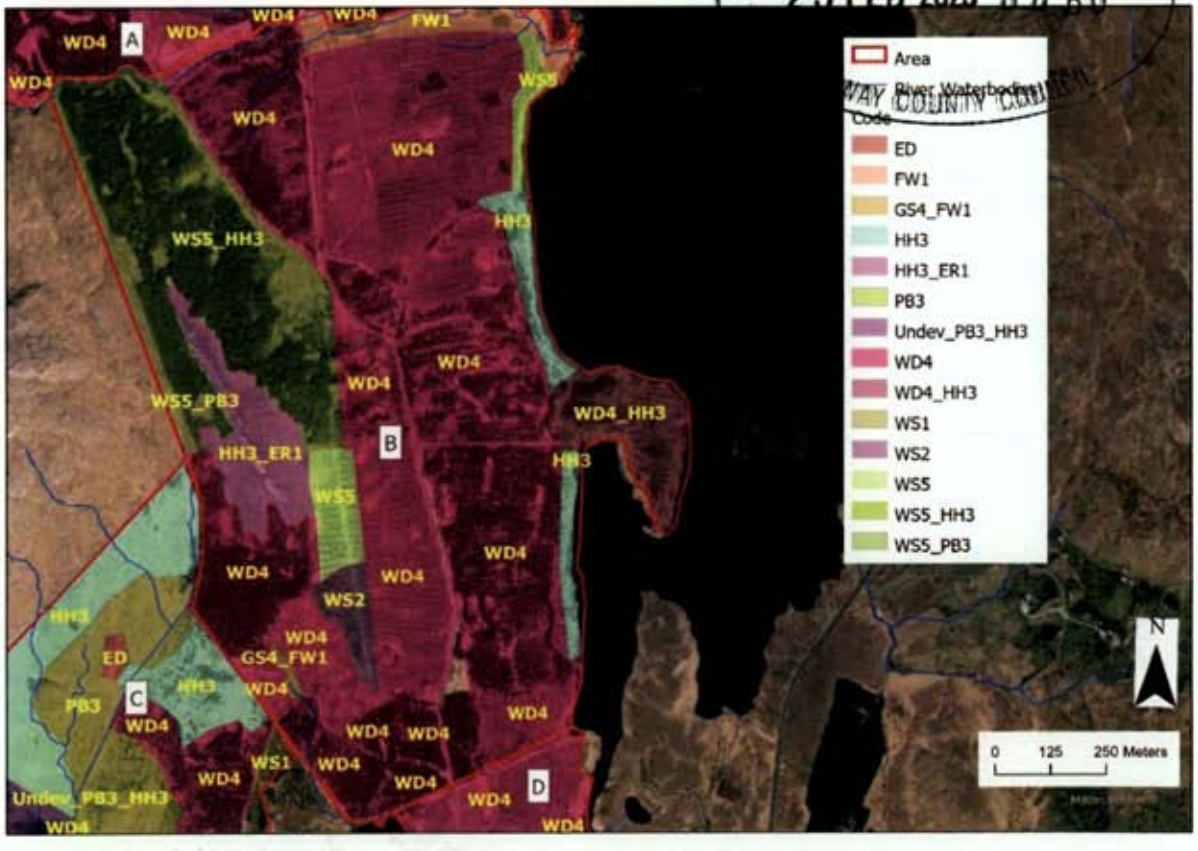


Figure 5. Current habitats in Area B

Eroding/Upland River (FW1) and Recently felled woodland (WS5)

The freshwater river is described in Area A. Beside this river on the southern bank and along the edge of Lough Inagh the plantation was felled in 2010 and not replanted. The peat depth is greater than a metre indicating blanket bog habitat. In places the riparian habitat is dominated by stumps and fallen and stems along which are providing habitat for regenerating conifers and rhododendron. Other parts are dominated by rushes (*Juncus* spp.). Stumps and fallen stems provide habitat for plant communities of drier habitats (e.g. (e.g. *Rubus fruticosus, Galium saxatile, Digitalis purpurea*, "dry mosses", polytrichum mosses). However, species typical of peatland habitat remain with *Calluna vulgaris, Pontentilla erecta* and *Molinia caerulea.* There is some naturally regenerating birch and willow. Conifer regeneration is abundant (SS) along. Rhodendron is occasional and is regenerating.

Wet grassland_Upland River (GS4_FW1) and Conifer Plantation (WD4)

Area of second rotation plantation in a small valley or dip with a stream. The flat ground either side of the stream is dominated by rushes (*Juncus* spp). The sloping ground is conifer plantation on wet heath. The conifer plantation is young (2015 planting) and there is no canopy allowing the wet heath to develop at present. The wet heath is modified by stumps, old stems and second rotation planting of conifers. However, the peatland community persists with sphagnum mosses, *Calluna vulgaris, Erica tetralix, Erica cinerea, Pontentilla erecta* and *Molinia caerulea.* There is natural regeneration of conifers and of Rhododendron.

Wet heath_Exposed Siliceous Rock (HH3_ER1)

Rocky summit with unplanted wet heath. This area was never planted and has not been modified by afforestation. Exposed rock is present, the peat depth is <50cm and a wet heath community is present. There is evidence of grazing (though not damaging) and of wind erosion (exposed peat faces). The wet heath flora includes: *Calluna vulgaris, Erica tetralix, Erica cinerea, Pontentilla erecta, Molinia caerulea, Narthecium ossifragum, Pedicularis sylvatica, Eriophorum vaginatum, Eriophorum angustifolium, Schoenus nigricans* and sphagnum mosses.

Conifer plantation (WD4)/ Wet heath (HH3), and Immature woodland (WS2)

Much of the eastern moderate and lower slopes of this site are dominated by second rotation conifer plantation of moderate to high yields. The plantation is not yet closed canopy (10/20 years old) but is dense in places, owing both to replanting and to natural regeneration. There are frequent open areas where the trees have failed, the land is rocky or wet and was not planted. The peat depth is generally greater than 1m. The peatland habitats have been modified by first and by second rotation planting. Elements of the peatland community remain especially in forest rides and in unplanted/failed area. Rushes are a feature and are dominant in places, perhaps influenced by nutrient enrichment but also a reflection of the wet and waterlogged soils. Species typical of peatlands persist and include: *Calluna vulgaris, Erica cinerea, Potentilla erecta, Carex echinata, Molinia caerulea* and sphagnum mosses. Brash, stems and stumps create drier habitat and support *Circaea lutetiana, Rubus fruticosus,* polytrichum mosses and "dry" mosses. There is natural regeneration of conifer and thododendron. Deer tracks, droppings and browsing were present.

One area of 1960's plantation is present on the southern slopes of the rocky summit. Peat depth is <50cm and the yield class is low (<10). The plantation canopy has closed and the field layer is very poor and crossed by furrows and drains. Windblow is present. The field layer is dominated by pine needles and "dry" mosses with rare pockets of spaghnum mosses in the bottom of furrows where

water remains and occasional *Molinia careulea*, ferns (*Dryopteris dilatate)* and willow in wet areas. Regeneration of native trees or conifer trees or was not recorded. Rhododendron was present and regenerating. The lower slope of this area is deep peat.

Recently felled woodland_Wet heath (WS5_HH3)

This is an area of steeply sloping ground where the first rotation crop (1960's) was felled in 2017. The habitat is dominated by brash, remnant conifer stems and stumps and peat depth is < 50cm. Piles of brash and large stumps remain in many places. The brash, stumps and stems create dry habitat above the water table and the plant community reflect with species such as *Circaea lutetiana, Rubus fruticosus, Agrostis* spp, polytrichum mosses and "dry" mosses. Other plants of disturbed ground are also present such as *Rumex* spp, *Juncus bulbosus* and *Juncus effusus*. Wet peatland remains and although modified by forestry (drains, furrows, ridges) typical species of wet heath habitats persist with *Calluna vulgaris, Potentilla erecta, Molinia caerulea* and sphagnum mosses. There are pockets of unplanted wet heath which are dominated by *Molinia caerulea*. Rhododendron is present.

Recently felled woodland_Blanket bog (WS5_PB3)

This is a pocket of deep peat which lies in a basin between the mountain side and the rocky knoll. The land is flat and was planted with neat rows of conifers. The conifers have been felled leaving neat rows of stumps with furrows, brash, felled stems and bare peat which provide habitat for species such as *Digitalis purpurea* and"dry" mosses; *Juncus effusus* is present in wetter areas. While the peatland flora is much diminished in extent and diversity pockets remain with *Calluna vulgaris, Erica tetralix, Narthecium ossigfragum, Potentilla erecta, Carex echinata, Trichophorum germanicum and Molinia caerulea*; sphagnum mosses are rare. Over the fence where the land was not planted and the blanket bog community remains (though will have suffered hydrologically). Rhododendron is present and regenerating.

Target Habitats

Target habitats have been considered based on plant communities present, peat depth, forest cover and history, adjacent habitats and critically the hydrological assessment.

While the habitats in Area B have been modified by afforestation (both first and second rotation) plant community's characteristic of peatland habitats remain.

A key factor in consideration of target habitats is the hydrological assessment. This assessment has found that with drain blocking and other actions re-wetting of the peatlands at Derryclare is possible. As such there is potential to restore the original blanket bog and wet heath which were present in this Area pre-afforestation. Actions will be required to mitigate on going afforestation impacts (conifer canopy, drains, furrows, brash/stems), impacts from restoration actions (e.g. sediment and nutrient release) and to mitigate future pressures on achieving target habitats (rhododendron spread, non native conifer regeneration, retained nutrient load, slow progress). However, with appropriate management and time there is restoration potential. This said it is possible that the target habitats will have to be modified if the post afforestation pressures and level of restoration action becomes unmanageable or no longer practical.

The target habitats for Area B are largely blanket bog and wet heath or a mosaic of these habitats to reflect peat depth (Figure 6). Native woodland is a further target habitat which has been selected for land adjacent to Derryclare Nature Reserve and for the slopes of the rocky summit (though this could also be HH3 target) and for connecting lands between. In terms of achieving target habitats a number of "Management Scenarios" are described where the attributes of forest cover, history, yield class and

slope have been considered. Areas with similar attributes were grouped under different scenarios (Figure 7). This exercise was carried out in order to assess the great variety of attributes over a large site. Pressures within each scenario area are described and proposed actions to achieve target habitats described (Table 2).

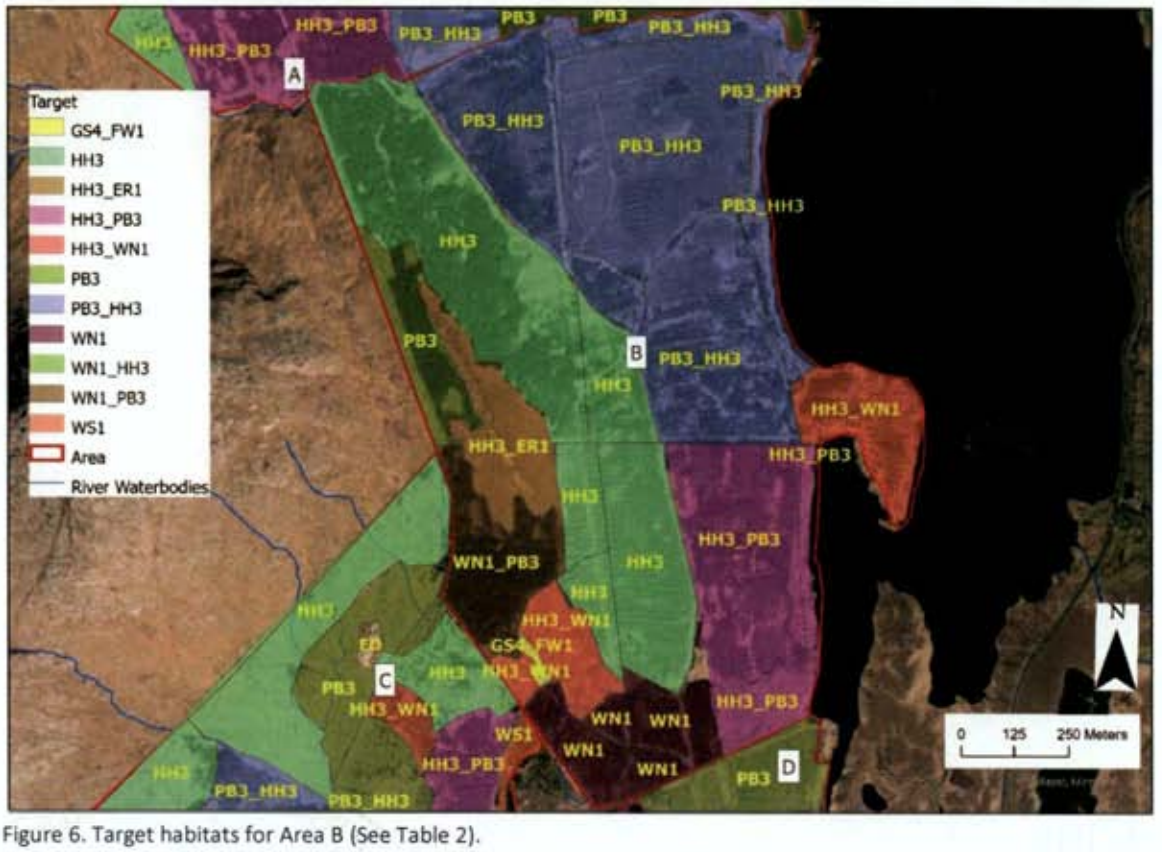


Figure 6. Target habitats for Area B (See Table 2).

Table 2. Target habitats, pressures, actions and notes for various "scenarios" in Area B (See Figures 6&7).

Scenario	Target	Pressures	Actions
C 1st rotation, gentle slope, knolls, low YC on HH3	WN1	Rhododendron rare Conifer (SS) regeneration rare. Grazing	Gradual conversion (natural regeneration and small coupe planting) to native woodland (CCF) with oak, birch, holly, rowan and Scots pine. Retain some conifers as future veterans and for squirrels. Remove and control rhododendron, rhododendron and conifer regeneration.
Note: Adjacent to Derryclare Nature Reserve.			
D 1st rotation, **moderate slopes**, low YC on HH3.	WN1_ PB3	Windblow (scattered) Rhododendron frequent	Remove conifers (CCF unlikely to work owing to windblow). Plant *as above*. Remove and control rhododendron regeneration thereof. Remove and control conifer natural regeneration.

Scenario	Target	Pressures	Actions
Note: Small area of PB3 on flat ground. Remove conifers, block drains and restore. Lies adjacent to larger area of recovering PB3. This area could also be restored to HH3 however it provides and corridor of native woodland from Derryclare Nature Reserve and potential for some conifer retention in view of squirrels.			
F 2nd rotation, gentle slope, med & high YC **on PB3_HH3**	HH3_PB3 mosaic	Rhododendron occasional to rare	Remove conifers Block drains. Control rhododendron regeneration. Control conifer natural regeneration.
Note: Medium to high YC suggests conversion to native woodland another option. However, peat depth is >1m and elements of peatland plant community remain. PB3 proposed as first priority. Pockets of HH3 may be suitable for birch (seed scattering).			
G 2nd rotation, **moderate slope** with low to high YC **on HH3**	HH3	Rhododendron rare Conifer regeneration Deer browsing	Remove conifers Control rhododendron regeneration. Control conifer natural regeneration Control grazing (deer)
Note:			
I 2nd rotation, moderate/gentle slope, med YC **on PB3_HH3**	PB3_HH3 mosaic	Rhododendron rare to occasional	Remove conifers Block drains. Control rhododendron regeneration. Control conifer natural regeneration.
Note: Similar to F.			
J 2nd rotation, moderate slope, high YC on HH3	WN1	Rhododendron rare Conifer regeneration	Gradual conversion (natural regeneration and small coupe planting) to native woodland (CCF) with oak, birch, holly, rowan and Scots pine. Retain some conifers as future veterans and for [illegible] Remove and control rhododendron, rhododendron and conifer regeneration.
Note: Contiguous to other WN1 area (C).			
L **Felled** <12 yrs, no replant, gentle slope, **recovering PB3.**	PB3	Rhododendron rare	Block drains Remove as much brash and felled stems as possible. Remove and control rhododendron regeneration thereof.
Note: Small area and highly modified by planting and felled, but contiguous to PB3 which was never planted (not Coillte owned) so benefits of restoration are greater (adjacent habitat will also be enhanced).			
N Felled, no replant, steep/gentle slope, recovering HH3	HH3	Rhododendron occasional to rare	Block drains Control rhododendron regeneration. Control conifer natural regeneration
Note: Felled HH3 on steep slope is recovering. It will take time. Useful example for other similar areas which are currently still under 1960's conifers.			
P Riparian, felled, no replant	HH3/ PB3/ GS4	Rhododendron rare Conifer regen abundant in places	Remove conifers and control regeneration Control rhododendron. Allow native trees to grow where naturally regenerating.
Note:			
Q Unplanted, HH3 and ER1	HH3_ER1	Grazing and erosion of peat	Control grazing (sheep)

Figure 7 Management Scenarios for Area B (See Table 2)

Area C

This southern part of the site also lies on the lower flanks of the mountain Doire an Chláir. The upper slopes of Area C are steep but the slope varies between moderate and gentle before reaching Loch an Doire an Chláir (Derryclare Lough). Between the Derryclare property and Derryclare Lough lies Derryclare Wood National Nature Reserve. Derryclare Wood is an Atlantic oak woodland with woodland cover since at least the 1830's. The geology of Derryclare Wood is complex with both Streamstown Schist formation and Lakes Marble Formation; the former supporting a more acidic vegetation community and the latter more calcareous. The Lake Marble Formation contrasts with the prevailing geology of the Derryclare propery which is Streamstown Schist formation. Soils within Area C are dominated by peaty podzols along with with peats and acid brown earths. There is an extensive network of rivers draining from Derryclare mountain, through Derryclare Property and into Derryclare Lough.

Current habitats

Overview

Existing habitats have been modified by afforestation. Modification includes planted conifers, drains, furrows and ridges/mounds, old stems, old stumps and windblow. Most of this Area is dominated by low yielding conifers and extensive areas of dead stand. The upper slopes are steep and unplanted. The lower slopes (mainly below forestry access track) include second rotation plantation. Part of the site was burned and was not replanted. There is a small area of Annex I quality blanket bog. Current habitats are shown in Figure 8 and described below.

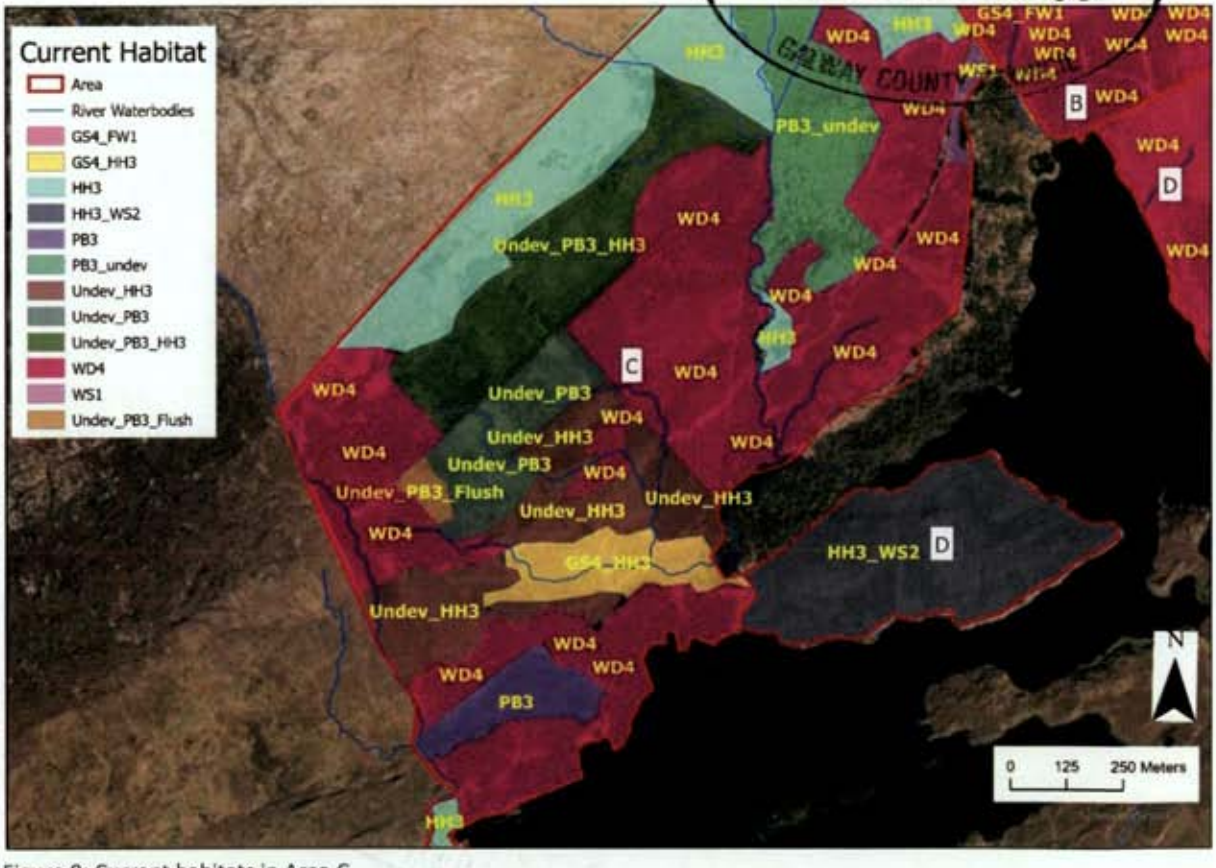


Figure 8: Current habitats in Area C

Habitat descriptions

Undeveloped Conifer plantation on blanket bog (Undev_PB3) and with flush (Undev_PB3_flush). This is a gently sloping area that was planted with conifers in the 1960's. The conifers have failed (YC 6 or less) and much of the tree cover is now standing dead. While there is no canopy the effects of afforestation persists with deep drains, furrows and ridges. However a peatland community persists with abundant *Molinia caerulea* along with *Calluna vulgaris, Erica tetralix, Potentilla erecta* and Sphagnum mosses. Flushing or lateral water movement is indicated with the presence of *Phragmites australis* in one area. Rhododendron is frequent and is regenerating. Deer browsing, tracks and droppings were present.

Conifer plantation (WD4). First and second rotation conifer plantation mainly on gentle slope with low or medium and high yield class (YC6-12-16) which has been planted on blanket bog and on blanket bog wet heath mosaic. There are some rocky knolls and bare rock, areas of deep peat and areas of shallower peat. Drains, furrows and ridges are present throughout. In places the canopy is closed and the peatland vegetation is absent or very poor, however there is generally variation in canopy cover reflecting a variety of factors such as peat depth, water table depth and presence of rocky knolls. Part of this habitat lies directly adjacent to Derryclare Nature Reserve and another part surrounds an area of Annex I quality blanket bog. This habitat includes windblow which is dense and extensive in places. Rhododendron is occasional to rare. There is considerable variation within this habitat type and it is described in four sections:

- Adjacent to Derryclare Wood and extending upslope (east side of river running through compt. 51217G). This area is dominated by second rotation conifers planted in the 1990's. Some birch, Japanese larch, ash and oak were also planted. The conifers are c. 5m and the canopy has not developed, however, in places growth is dense and there is not much light to the field layer. The field layer is generally poor under low light. Pine needles dominate along with occasional shade tolerant species such as *Hedera helix, Blechnum spicant* and *Dryopteris dilatata*. "Dry" mosses and less so sphagnum mosses are present. In wetter areas there is *Juncus effusus* and Willow (Salix spp.). Where light allows *Molinia caerulea* is present and there is some regeneration of native trees (birch, rowan, willow). There are areas with abundant sphagnum mosses including sphagnum hummocks, this is on the gently sloping ground above the road and not in an area of deeper peat below the road and directly adjacent to Derryclare Wood (where it might be expected).
- To the west side of the river running through compt. 51217G the conifer plantation is on deep peat. Some of trees are undeveloped or dead and lichen covered and the field layer is dominated by *Molinia caerulea* with abundant Spaghnum mosses in places. Wet areas of pooling water are present and may be a result of flows from constructed drains rather than naturally occurring. In some places, despite a similar peat depth, the canopy is closed and the field layer is dominated by pine needles. Up slope where the peat depth is more variable there is an extensive area of windblow with many fallen trees and tree root plates. This area has a very mixed plant community reflecting drier habitats created by old stumps and roots and by fallen trees and wet habitats in pools and drains created by the plantation and by fallen trees.
- At the southern upper edge of Area C the WD4 habitat lies on varying peat depth. It first rotation low yield class plantation. The trees are well grown in places, however there are areas of undev (higher slopes) and extensive areas of wind blow.
- At the southern lower edge of Area C the WD4 habitat lies on shallower peat soils with rocky knolls. A small part of the WD4 is on deep peat (adjacent to Annex I quality PB3).

Undeveloped conifers on wet heath, blanket bog or mosaic or both (Undev_HH3_PB3/PB3_undev). A large part of Area C is poor conifer cover (regen after burning) of undeveloped conifers on blanket bog or wet heath. While the peatland habitats have been modified by drains, furrows and mounds and there are dead stems (standing and fallen) the peatland community persists. The grass *Molinia caerulea* dominates along with a number of other species typical of blanket bog and wet heath. This habitat is extensive and varied with pockets of deeper peat and areas of shallower peat and surface rock over ground that is generally undulating with some gentle and moderate slopes. There is an extensive area of blanket bog with undeveloped conifers (likely natural generation after burning). This is an area of recovering blanket bog.

Blanket bog (PB3). An area of deep peat which lies within a naturally occurring "bowl" between rock "ridges" and supports Annex I quality blanket bog. Although drain lines are present and there is some forestry along its edge, the bog is quaking. While modified and with some negative indicator species, the blanket bog has species typical of the Annex I habitat types: Active blanket bog (7130) along with Depressions on peat substrates of the Rhynchosporion (7150).

Wet grassland and Wet heath (GS4_HH3). The floor of the stream valley is dominated by rushes (Juncus spp) along with *Molinia caerulea* and abundant conifer regeneration. Wet heath is present where the ground is sloping (north side of stream).

Scrub (WS1) Small pocket of scrub next to Derryclare Wood Nature Reserve.

Target Habitats

Target habitats have been considered based on plant communities present, peat depth, forest cover and history, adjacent habitats and critically the hydrological assessment.

While the habitats in Area C have been modified by afforestation there are large areas with undeveloped or low yielding conifers which have retained a wet heath and blanket bog community; albeit degraded. In some areas afforestation has been more successful and the field layer has been modified, however this is generally in a mosaic with other areas of poor or little conifer cover and "better" habitat. There is considerable potential for restoration to wet heath and blanket bog habitat. A priority for restoration in this area is the small area of Annex I blanket bog habitat. There is also potential for native woodland creation which will benefit Derryclare Nature Reserve and provide an more extensive and connected area of native woodland cover.

The target habitats for this Area are shown in Figure 9. In terms of achieving these targets a number of "Management Scenarios" are described where the attributes of forest cover, history, yield class and slope have been considered. Areas with similar attributes were grouped under different scenarios (Figure 10). This exercise was carried out in order to assess the great variety of attributes over a large site. Pressures within each scenario area are described and proposed actions to achieve target habitats described (Table 1).

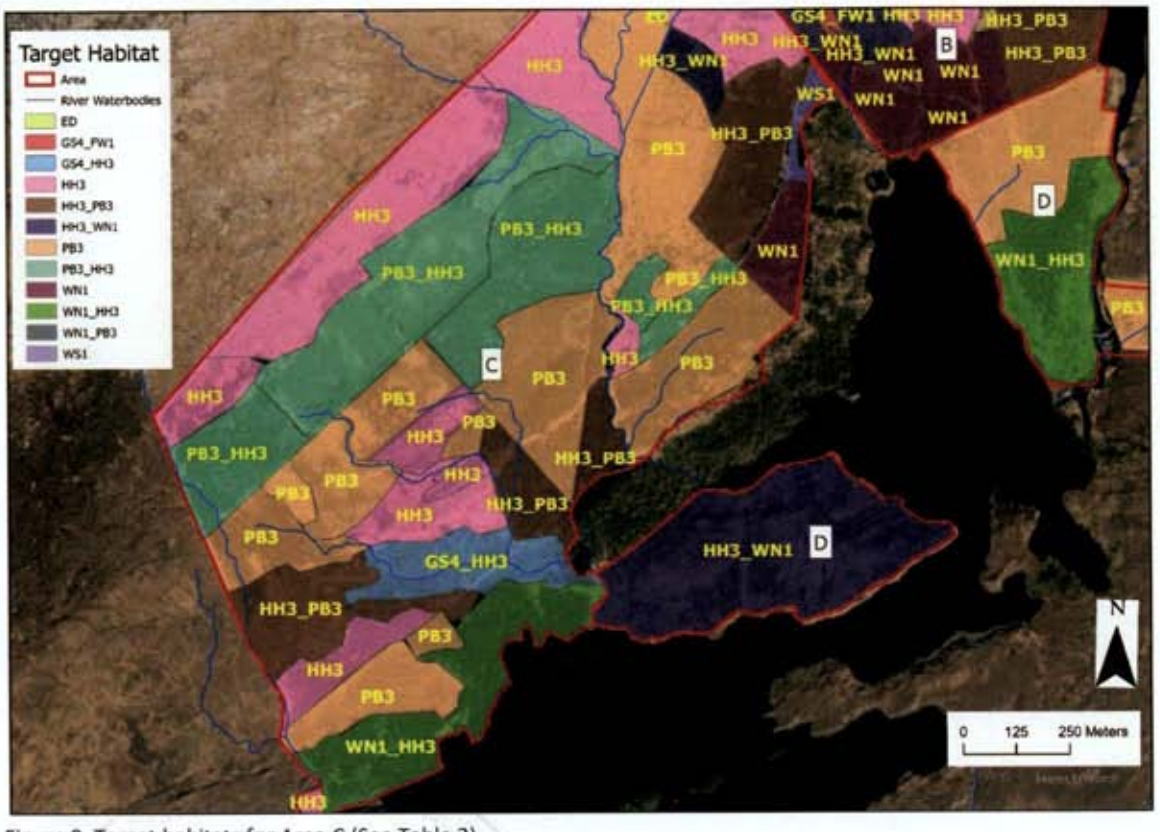


Figure 9. Target habitats for Area C (See Table 3).

Table 3. Target habitats, pressures, actions and notes for various "scenarios" in Area B (See Figures 9&10).

Scenario	Target	Pressures	Actions
A 1st rotation, gentle slope, deadstand on PB3	PB3	Rhododendron frequent Conifer (SS) regeneration occasional. Grazing (Deer)	Block drains Remove deadstand Remove and control conifer and rhododendron.
Note: Difficult terrain. Flush with *Phragmites australis* present.			
AA 1st rotation, gentle slope, low YC on PB3_HH3	PB3	Rhododendron frequent to occasional Conifer (SS) regeneration frequent. Windblow (many and scattered) Grazing (Deer)	Block drains Remove conifers Remove and control conifer and rhododendron.
Note: Large pockets of windblow creating very difficult terrain. Difficult access.			
B 1st rotation, **gentle slopes**, medium, low YC and dead stand on PB3.	PB3	Rhododendron rare to occasional Conifer regeneration rare Windblow (scattered)	Block drains Remove conifers Remove and control conifer and rhododendron.
Note: Deep peat with abundant Spaghnum mosses in places. Trees have largely failed, though some areas of closed canopy.			
C 1st rotation, **gentle slopes**,	HH3 HH3_	Rhododendron rare to frequent	Block drains Remove conifers

Scenario	Target	Pressures	Actions
medium, low, med, high YC HH3/PB3, rock likely.	PB3 WN1_ HH3	Conifer regeneration Conifer regen frequent Windblow (scattered)	Remove and control conifer and rhododendron. Where WNI is target, fell and replant with natives; retain some conifers as future veterans and for squirrels.
Note:			
F 2nd rotation, gentle slope, med YC **on PB3**	PB3	Rhododendron rare Conifer regeneration present	Remove conifers Block drains. Control rhododendron regeneration. Control conifer natural regeneration.
Note: Deep peat with 2nd rotation plantation. This lies next to Derryclare Wood. Restore to PB3 is possible, give depth of peat (3m).			
G 2nd rotation, **moderate/gentle slope** with med YC **on HH3**	HH3_ WN1 WN1	Rhododendron rare to frequent	Remove conifers Control rhododendron regeneration. Control conifer natural regeneration Control grazing (deer)
Note:			
I 2nd rotation, moderate/gentle slope, med YC **on PB3_HH3**	PB3_ HH3 mosaic	Rhododendron rare to frequent	Remove conifers Block drains. Control rhododendron regeneration. Control conifer natural regeneration.
Note: Similar to F.			
L **Felled** <12 yrs, no replant, gentle slope, **recovering PB3.**	PB3_ Undev	Rhododendron occasional Bracken Deer, sheep, cattle Conifer regeneration	Block drains Remove as much brash and fallen stems as possible. Remove and control rhododendron regeneration thereof.
Note:			
O Felled/burned, no replant, gentle/moderate slope, **recovering HH3**	HH3	Rhododendron abundant to frequent Windblow single trees Bracken Conifer undev and regen	Remove and control conifers and rhododendron Control bracken Block drains
Note:			
Q and E Unplanted HH3 and small areas of 1st rotation; all on steep slope.	HH3	Rhododendron rare Bracken	Remove and control conifers and rhododendron Control bracken
Note: Steepness of slope and remote access.			
R Unplanted PB3	PB3	Rhododendron rare Poaching and browsing (sheep, deer) Conifer regen rare	Remove conifers from along edge of "basin" and from nearby pocket of deep peat. Block drains Remove stock Remove conifer and rhodo regen.
Note: Annex I quality; priority for restoration			

Scenario	Target	Pressures	Actions
S Unplanted Scrub	Scrub	Rhododendron Conifer regen	Remove and control conifers and rhododendron Leave to natural regeneration and development
Note:			
U Felled riparian wet grassland and heath	GS4_H H3 or WN6	Prolific conifer regeneration	Remove conifers Plant with native riparian species to manage likely on going colonisation by conifers.
Note:			

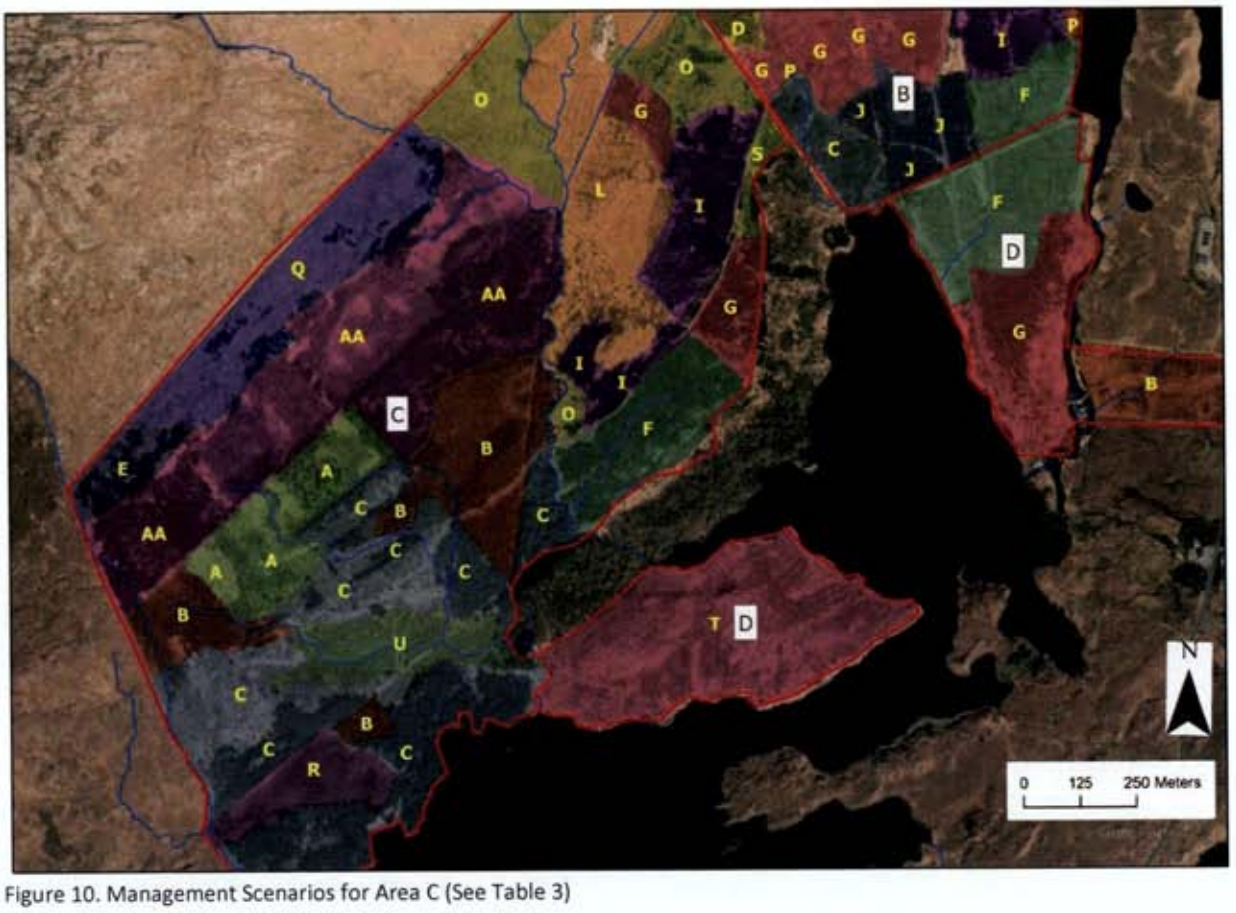


Figure 10. Management Scenarios for Area C (See Table 3)

Area D

This area covers a large peninsula which extends into Derryclare Lough and the land which separates Derryclare Lough and Lough Inagh.

Current habitats

Existing habitats are conifer plantation (WD4) and wet heath with immature native woodland (HH3_WS2) (Figure 11).

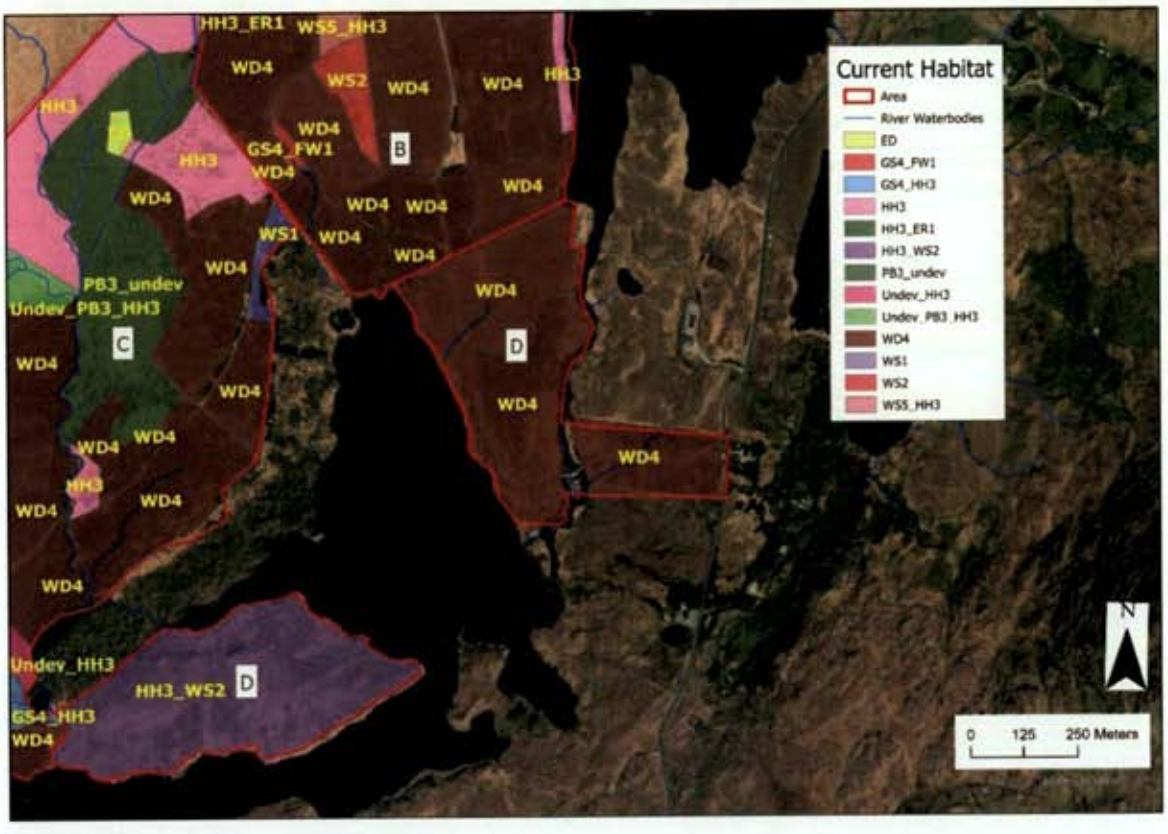


Figure 11. Current habitats in Area D

Target Habitats

Target habitats are wet heath with native woodland (oak, birch, holly, scots pine), blanket bog and wet heath. Habitats reflect peat depth and topography. Native woodland also provides for expansion of Derryclare Wood Nature Reserve. See Figure 12.

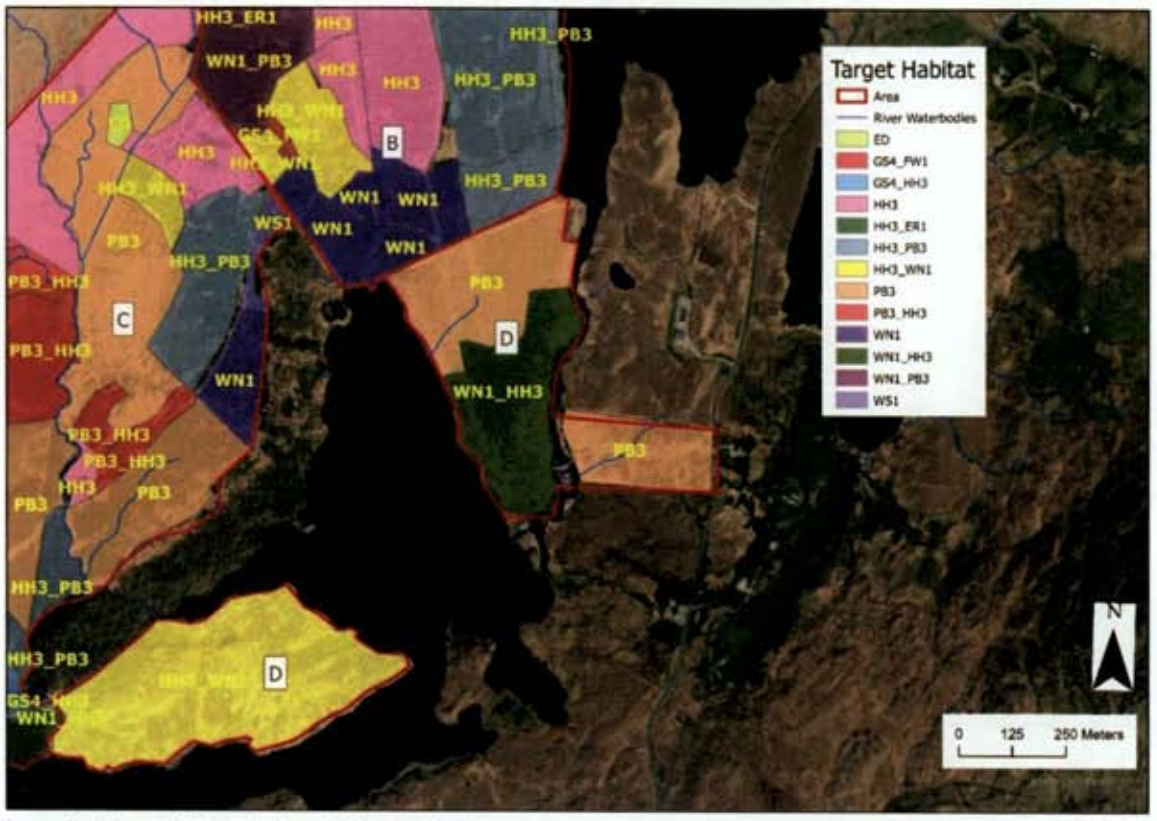


Figure 12. Target habitats in Area C (See Table 4)

Table 4. Target habitats, pressures, actions and notes for various "scenarios" in Area D (See Figures 12&13).

Scenario	Target	Pressures	Actions
B 2nd rotation, gentle slope med YC **on PB3**	PB3	Rhododendron rare	Remove conifers Block drains. Control rhododendron regeneration. Control conifer natural regeneration.
Note:			
F 2nd rotation, gentle slope, high YC **on PB3**	PB3	Rhododendron frequent	Remove conifers Block drains. Control rhododendron regeneration. Control conifer natural regeneration.
Note: Dense conifer growth on part of area; otherwise sparse.			
G Gentle slope, abundant regen or replant, rock, knoll, HH3	WN1_ HH3	Rhododendron rare Conifer regeneration	Remove conifers Control rhododendron regeneration. Control conifer natural regeneration
Note: The inventory says no replant, however conifer cover is high and seems unlikely to be natural regeneration?			
T 2nd rotation, native woodland replant, gentle slope, rock on HH3	HH3_ WN1	Rhododendron occasional Conifer regeneration Deer browsing	Control grazing
Note:			

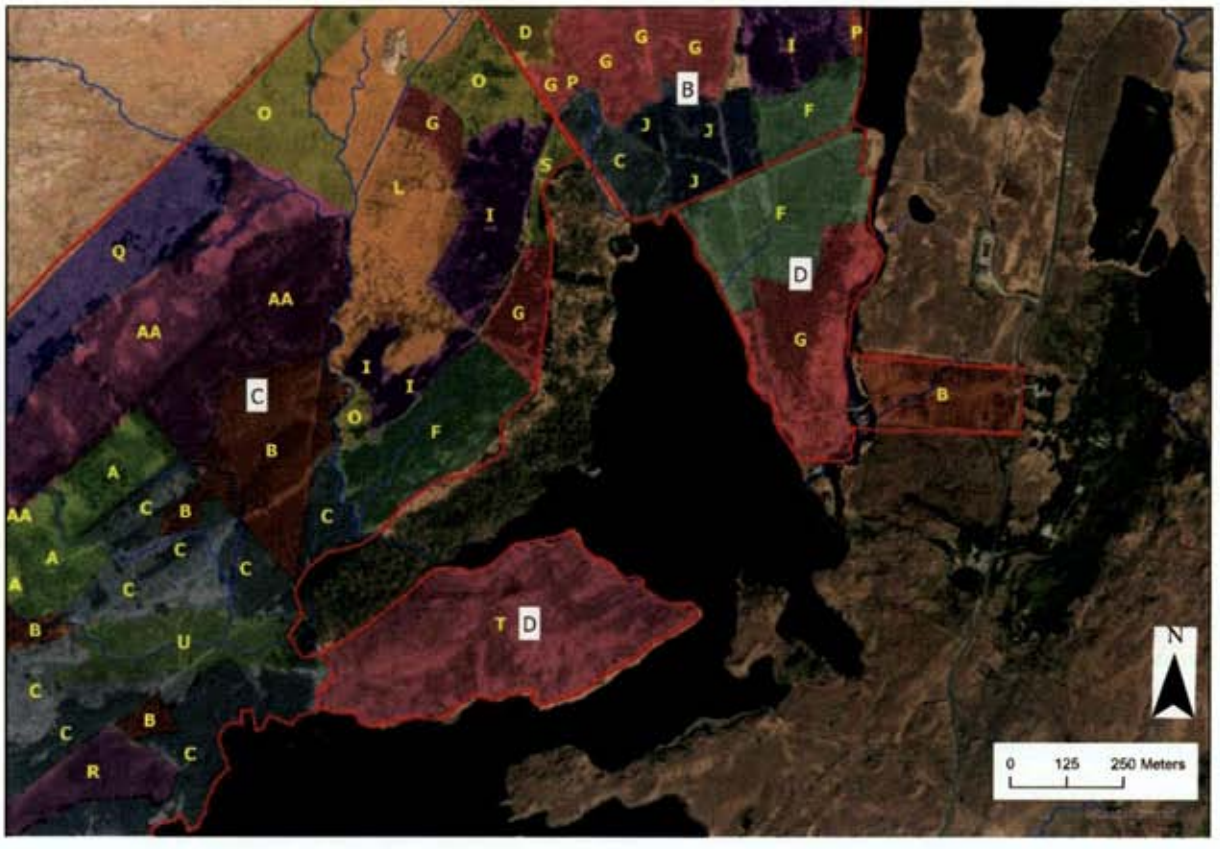


Figure 13. Management Scenarios for Area D (See table 4)

Appendix I: Recording form used during walkover survey.

Date		**Compt & sub no**	
Photo No./			
Indicative soil type			
Depth			
Topography			
Watercourses			
Fauna			
Habitat (Fossitt)			
Habitat status H-M-L (Current)			
Characterising spp			
Natural Features e.g. hummocks, flush, pools GPS location			
Modification features			
Impacts/pressures			
Target Habitat			

Appendix II: Definition of Terms

Windblow :

- Many - many trees down in pockets (large local effect; root plates, fallen dead)
- Scattered - single trees down in many places
- Single- the odd tree noted

Yield class (YC)

- YC 10 or less is considered to be LOW
- YC of 12-14 is considered to be MEDIUM
- YC of 16-20 is considered to be HIGH

Undev - is undeveloped plantation (YC of 4 or less)

Dead stand - is standing dead plantation

Rhododendron and cover and regeneration and conifer regeneration

Follows DAFOR descriptions below (BSBI.ie).

PRESENT used where Rhododendron is considered likely to be present but not sufficiently walked to rate following DAFOR as below:

D for Dominant: In practice you will rarely, if ever use this. To score **D**, a species would have to be the most common plant by far, in well over three quarters of the square. It is possible that in a square that is entirely conifer plantation, that Sitka spruce Picea sitchensis might score **D**; or in a square that is almost all occupied by highly improved grassland, perennial rye-grass Lolium perenne might sometimes score **D**, but even these two scenarios are unlikely most of the time. If you are not sure if something should score **D** or **A**, give it **A**.

A for Abundant: Only use **A** if the plant was really very common in many parts of the square. For most species this would mean that there were thousands of individual plants present. In most squares, few species will score as highly as **A** and in quite a few squares there will be no species that score that highly. If you are not sure if something should score **A** or **F**, give it **F**.

F for Frequent: Use **F** if you found the plant in several places in the square and there was usually more than just **A** few individuals in each of these places. You could also use **F** if the plant was only present in one part of the square but was very common in that part, with many individuals and covered **A** substantial area (e.g. between one eight and one quarter of the area of the whole square). If you are not sure if something should score **F** or **O**, give it **O**.

O for Occasional: Use **O** for species that occur in several places in the square, but whose populations are usually not very big. You would also use **O** for species that are very common in one bit of habitat within the square that occupied just a small area (e.g less than one eight of the area of the whole square). You will use **O** for many species in most squares. If you are not sure if something should score **O** or **R,** give it **R**.

R for Rare: Use **R** for any species that occur as a small number of individuals in the square. This small number of individuals may be located in one place in the square, or scattered over several different locations within the square. In many squares **R** is likely to be the score that most species get. If you are not sure if something should score **O** or **R,** give it **R**.

For those of you who are used to using the DAFOR scale, please stick to the basic 5 scores only and avoid entries like **O/F** (occasional to frequent) and particularly please avoid using the prefix '**L**' as in **LF** (locally frequent).

MKO