APPENDIX 6

Chapter 8 - Hydrology & Hydrogeology

8. HYDROLOGY AND HYDROGEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO Ireland (MKO) to provide a description and assessment of the residual direct and indirect actual and potential effects of the peat extraction activities and all ancillary works at Ballivor, Carranstown, Bracklin, Lisclogher and Lisclogher West bogs (the "Application Site") on the water aspects (hydrology and hydrogeology) of the receiving environment, from 1988 to the present day. This chapter will also assess the potential impacts of the proposed rehabilitation plans for the Application Site following the cessation of peat extraction activities and all ancillary works in 2020. The Application Site is located within the Ballivor Bog Group and is situated between the towns of Raharney and Delvin, Co. Westmeath and Ballivor, Co. Meath.

As stated in Chapter 4, July 1988 is the baseline environment as this is the date by which the EIA (Directive 85/337/EEC) Directive was required to be transposed into Irish Law. There is no legal requirement to complete a rEIAR on any of the activities occurring at the Application Site prior to the required transposition of the EIA Directive. Nevertheless, for completion, we provide a brief overview of the activities occurring at the Application Site from 1948 and the onset of site preparation works up to July 1988. The baseline hydrological and hydrogeological environment in the year 1988 is then described in detail along with a description of the description of activities from 1988 to the cessation of peat extraction activities and all ancillary works in June of 2020, the management of the Application Site since June 2020 and the activities intended to be carried out at the Application Site into the future.

This chapter presents:

- An assessment of impacts of the peat extraction activities and all ancillary works on the hydrological and hydrogeological environment;
- The baseline sensitivity of the receiving hydrological and hydrogeological environment has been assessed based on the baseline site conditions present in 1988;
- The impacts of the receiving hydrological and hydrogeological environment which have been assessed over 3 no. phases of the life cycle of the development. These phases include the Peat Extraction Phase (1988 – 2020), the Current Phase (2020 – present day) and the Remedial Phase, as described in Chapter 4;
- The control and monitoring measures that were implemented during the Peat Extraction Phase from July 1988 to June 2020;
- The control and monitoring measures that were implemented during the Current Phase from June 2020 to the present day;
- The proposed mitigation measures associated with the proposed Cutaway Bog Decommissioning and Rehabilitation Plans (Remedial Phase); and,
- The residual effects along with the cumulative effects from the proposed Ballivor Wind Farm development and other projects in the vicinity of the Application Site.

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 bog hydrology and windfarm drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types.

This chapter of the rEIAR 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 geological, hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. For example, Michael has worked on the EIARs for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 120 other wind farm related projects across the country. Michael has also worked on rEIARs for Cleanrath WF, 41 no. Bord na Móna bogs, and also for a number of quarry sites.

Conor McGettigan (BSc, MSc) is an Environmental Scientist, holding an M.Sc. in Applied Environmental Science (2020) from University College Dublin, graduating with a First-Class Honours degree. Conor has also completed a B.Sc. in Geology (2016) from University College Dublin (First Class Honours). Conor has completed numerous land, soils and geology chapters for several developments on peatlands. Conor has also completed geological and hydrological studies on sensitive peatlands sites, including Clonaslee Bog, the Liffey Head Project, and Keerglen WF and Kilsallagh WF.

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 Chapter 2 of the rEIAR. Details of these scoping responses pertaining to hydrology and hydrogeology are listed below and outlined in Chapter 2 of this rEIAR.

Inland Fisheries

A scoping request was issued to Inland Fisheries on the 2nd of December 2021 and again on the 14th February 2024. At the time of writing this chapter in July 2024, no response has been received.

Uisce Eireann

A scoping request was issued to Uisce Eireann (formerly known as Irish Water) on the 2nd of December 2021 and again on the 14th February 2024. An acknowledgement of the request was issued on in December 2021 and a response was received on the 20th of March 2024. Further detail on scoping is provided in Chapter 2 Section 2.6 of this rEIAR, and a copy of the response is provided in Appendix 2-1.

Uisce Éireann highlight key considerations for Water Services in Environmental Impact Assessments (EIAs). These include measures to protect Drinking Water Sources, waste sampling for backfilling materials, mitigations for negative impacts on water sources, assessments of impacts on nearby reservoirs and water services capacity, and considerations for connecting to Uisce Éireann networks. Developers are advised to identify infrastructure needs, assess potential impacts on water sources and catchments, and propose mitigation strategies to ensure zero risk to Uisce Éireann drinking water sources. These guidelines aim to safeguard water resources and infrastructure during development projects.

Waterways Ireland

A scoping request was issued to Waterways Ireland was issued on the 2nd of December 2021 and again on the 14th February 2024.

A response was received on the 15th February 2024 confirming that the Application Site is not within any Zone of Influence of their waterways and therefore they will not be commenting.

Geological Survey of Ireland

A scoping request was sent to the Geological Survey of Ireland (GSI) on the 2nd of December 2021 and again on the 14th February 2024. A response was received on the 21st of December 2021 and on the 28th of February 2024 which comprised the following:

- List of relevant available datasets;
- Recommend referring to GSI Groundwater and Geothermal Unit run GW Climate project which is a groundwater monitoring and modelling project that aims to investigate the impact of climate change on groundwater in Ireland. This is a follow on from a previous project (GWFlood); and,
- Requested copy of reports detailing any site investigations carried out.

Environmental Protection Agency (EPA)

A scoping request was sent to the GSI on the 2nd of December 2021 and again on the 14th February 2024. A response was received on the 21st of January 2022 and on the 27th of March 2024 which comprised the following:

The Agency is of the opinion that the scope and level of detail to be included in the remedial environmental impact assessment report should as a minimum:

a) address the matters raised in the responses received from relevant bodies;
b) have regard to the rehabilitation plan(s) required under Condition 10 of Licence Reg No. P0501 for any relevant bog areas;
c) consideration should be given to inclusion of any relevant bog areas in an enhanced rehabilitation scheme, e.g., under the Peatlands Climate Action Scheme (PCAS).
d) have regard to relevant water quality monitoring data. Any gaps in water quality data for receiving waters should be filled by a sampling programme over an appropriately representative period of time.

8.1.4 Relevant Legislation

The rEIAR 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 requirements of the following legislation are complied with:

- Planning and Development Acts, 2000 (as amended);
- 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;
- 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. 722/2003 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; and,
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.

8.1.5 Relevant Guidance

The Hydrology and Hydrogeology chapter of the rEIAR 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 (September 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;
- Environmental Protection Agency (2002) Guidelines on the Information to be Contained in Environmental Impact Statements;
- 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;
- Wind Farm Development Guidelines for Planning Authorities (2006);
- 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);
- Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017).

8.2 Methodology

8.2.1 Desk Study

A desk study of the Application Site and the surrounding area was completed to collect all relevant hydrological and hydrogeological data for the Application Site and the surrounding 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), including all relevant River Basin Management Plans (RBMPs);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 13 (Geology of Meath); 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 Monitoring and Site Investigation Data

HES completed site inspections, walkover surveys, drainage mapping, and baseline monitoring/sampling at the Application Site as part of this remedial Environmental Impact Assessment and to inform the proposed Ballivor Wind Farm planning application. In summary, site investigations conducted by HES included the following:

- A total of 199 no. peat probe depths/investigations points were carried out by HES (456 no. peat probes in a combined HES, Fehily Timoney, and MKO) in Ballivor, Carranstown, Bracklin and Lisclogher Bogs. No peat probing investigations were conducted in Lisclogher West as no peat extraction activities or ancillary works occurred in this bog and was not included in the proposed Ballivor Wind Farm planning application;
- Logging of subsoil exposures across the Application Site where mineral soils and peat profiles are exposed;
- Walkover surveys and hydrological mapping of the Application Site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) and surface water flow measurements were taken to determine the origin and nature of surface water flows surrounding the Application Site during 3 no. monitoring rounds (21st April, 28th October 2021 and 19th January 2022); and,
- A total of 52 no. surface water samples were taken to determine the baseline water quality of the primary surface waters originating from the proposed development site during the 3 no. monitoring rounds.

Site-specific data obtained by HES was supplemented with recent and historic site-specific data supplied by Bord na Móna (the Applicant). These included Lidar data of the Application Site, a peat depth database and water quality monitoring from 2000 to 2023 in compliance with the IPC Licence requirements.

8.2.3 Impact Assessment Methodology

The guideline criteria (EPA, May 2022) require that the baseline environment is described in terms of the context, character, significance and sensitivity of the existing environment. 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 rEIAR.

In addition to the above methodology, the importance of the water environment receptors was assessed on completion of the desk study and site investigations. Levels of importance which are defined in Table 8-1 and Table 8-2 for the hydrological and hydrogeological environments are used to assess the effects that peat extraction activities and all ancillary works may have had on them.

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

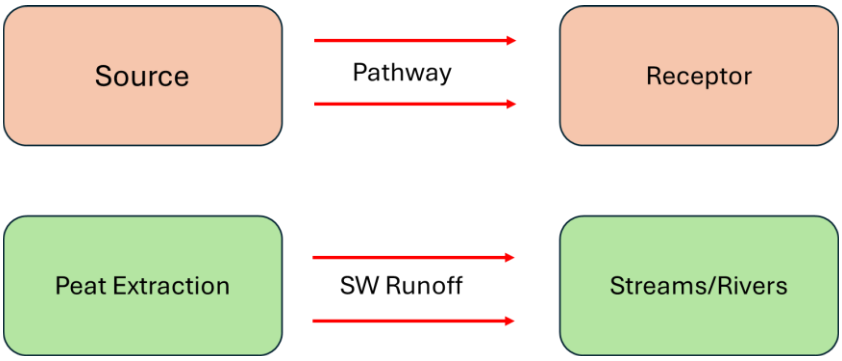
Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the 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 regional or national scale	Regionally Important Aquifer with multiple wellfields. 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 a 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-receptor model (see below, top) was applied to assess the potential effects on downstream environmental receptors (see below, bottom as an example, earthworks = peat extraction) as a result of the peat extraction activities and all ancillary works.



The descriptors used in this impact assessment are those set out in the EPA (2022) glossary of effects as shown in Chapter 1 of this rEIAR. The description process clearly and consistently identifies the key aspects of any impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

8.3 Site Landuse History Summary

The Application Site comprises five bogs located at the Westmeath-Meath County border. The bogs include Ballivor, Carranstown, Bracklin, Lisclogher and Lisclogher West bogs. The Application Site comprises an area of 2,421 hectares (ha) within which bog drainage works began in 1948 followed by the commencement of peat extraction activities and all ancillary works from 1954 to 2020. The Application Site is located 2.5 km south-southeast of Delvin, 3.7km east of Raharney and 2.2km west of Ballivor Village. The Application Site location is shown on **Figure 1-1 and Figure 1-2**. The landcover within the Application Site comprises a mix of bare cutaway peat, re-vegetated peat, degraded blanket bog, scrub, low woodland, remnants of high bog and a very small area of conifer plantation. Today, the site topography today ranges between 86 m above ordnance datum (m AOD) at its highest point to 69m AOD at its lowest point. For a full details of the Application Site description and location please see Chapter 4: Description of Development.

8.3.1.1 Site Topography

The topography of the Application Site has changed through time due to the historic peat extraction activities and all ancillary works. As discussed in Chapter 7: Land Soils and Geology the topography of the site was estimated to range between 72 and 89mOD prior to the onset of any peat extraction activities and all ancillary works or associated site preparation works (*i.e.* drainage and acrotelm removal). The topography has subsequently been lowered at each of the bogs due to drainage related subsidence and in the historic peat extraction activities and all ancillary works areas due to the removal of peat. Full details of the topography of the Application Site are presented in Section 7.3.2 of this rEIAR.

8.3.1.2 Historic Landuse Changes

The primary land-use change associated with the peat extraction activities and all ancillary works process occurs during the initial drainage of the bog in advance of peat extraction activities and all ancillary works. Constructed drainage ditches drain the upper surface of the bog by lowering the local peat water table. At this time at the Application Site, ancillary features were also constructed including railway lines, machine passes, canteens, work sites, welfare facilities, mobile fuel tanks, fixed fuel tanks and peat loading facilities. After the site was drained, vegetation was removed from the bog surface, leaving only bare peat fields between the drains. During the Peat Extraction Phase, only minimal landuse change occurred which predominantly related to minor annual topographic changes caused by ongoing peat extraction activities and all ancillary works. While the peat extraction activities and all ancillary works was ongoing it was not possible to rehabilitate the underlying peatland.

Land and landuse changes were investigated from 1988 to the present day. A full description of landuse changes across the Application Site is described in Chapter 7 Section 7.3.3. The primary change to land during the peat extraction activities and all ancillary works process occurred during the initial site drainage and the removal of vegetation in preparation for the peat extraction activities and all ancillary works operations. The timing of drainage and initiation of peat extraction activities and all ancillary works varies across the Application Site. Ballivor Bog was the first bog to be drained between 1948 and 1953 and would have experienced a relatively abrupt change in land cover from this date to the beginning of commercial peat extraction activities and all ancillary works in 1953.

By 1988, Ballivor, Bracklin, Lisclogher (main bog area) and Carranstown bogs had all been drained. At this time some peat extraction activities and all ancillary works had already begun in some areas of the Application Site including Ballivor, the western portion of Carranstown, the main area of Bracklin, the southern portion of Bracklin West and Lisclogher bogs. Elsewhere vegetation remained in the northern section of Bracklin Bog and the eastern section of Carranstown Bog in 1988 despite drainage ditches having already been inserted. In contrast to the other bogs, Lisclogher West remained as a raised bog up until 1973, when drainage works were initiated. Peat was never extracted from Lisclogher West, therefore, any significant changes to land and landcover would have occurred when the bog was drained between 1973 and 1995. Drainage works also commenced in the eastern section of Carranstown Bog in between 1974 and 1987, with peat extraction activities and all ancillary works beginning at some date preceding 1995.

Peat extraction activities and all ancillary works were formally ceased at the Application Site by the Applicant in June 2020. This will allow the former bare peat production fields to revegetate, however, this will likely take some time and measures to aid the site rehabilitation are outlined in the Applicant's Cutaway Bog Decommissioning and Rehabilitation Plans (Appendix 4-2).

8.3.1.3 Existing Site Description and Topography

Currently, the Application Site is covered in a mosaic of peatland habitats reflecting the contrasting timescales and intensities of peat extraction activities and all ancillary works undertaken across the site. Those areas from which peat was most recently extracted such as Ballivor, Bracklin West and Carranstown are covered by bare peat fields. Other areas in the site which have not been subject to peat extraction activities and all ancillary works for some time such as Bracklin and Lisclogher have already experienced significant natural recolonisation. Peat was never extracted from Lisclogher West and as a result retains many of its natural raised bog features, although it is partially drained.

In terms of hydrology, all bog units within the Application Site have been drained or partially drained to facilitate peat extraction activities and all ancillary works or intended peat extraction activities. This drainage has lowered the local water table in the peat and provided preferential pathways for surface water to leave the site via the manmade drainage system. Even Lisclogher West, from which peat was never extracted, is degraded with vegetated dry peat fields and deep drainage channels which were constructed between 1973 and 1995.

The following paragraphs describe each of the individual bogs comprising the Application Site. The general topography of the 5 bogs is illustrated in Plate 8-1.

Ballivor Bog has a total area of 638ha and had a peat extraction activity and all ancillary works area of 473ha which was subject to peat extraction activities and all ancillary works until June 2020. The topography within the bog ranges from 70 - 79mOD. Ballivor Bog is currently drained by a series of northwest-southeast orientated drains spaced at approximately 15m intervals. 2 no. production centres are located in the north of Ballivor Bog from which a railway extending southwards into the bog interior. The Applicant's current habitat map for Ballivor Bog (2024) (refer to Ballivor Bog 2024 Draft Decommissioning and Rehabilitation Plan included in Appendix 4-2) shows that the northeast of the bog is characterized by areas of bare peat. The lack of vegetation in this area indicates that this area was the most recent area of Ballivor Bog from which peat was being extracted. Meanwhile, areas in the west and south of Ballivor Bog contain a mosaic of heath, heath and scrub and pioneer open cutaway habitats. The presence of vegetation indicates that peat extraction activities and all ancillary works has not occurred recently in these areas. Ballivor Bog is fringed by cutaway and cutover bog in the northeast and remnant bog with some areas of birch woodland in the southwest.

Carranstown Bog has a total area of 304ha and a peat extraction activity and all ancillary works area of 80ha which was subject to peat extraction activities and all ancillary works until June 2020. A total of 117 hectares were drained but not subject to peat extraction activities and all ancillary works. The topography within the bog ranges from 68 - 75mOD. The bog is currently drained by a series of northwest-southeast orientated drains. A railway line dissects the site from the R156 in the south in a north-westerly direction. The Applicant's current habitat map for Carranstown Bog (2022) (refer to Carranstown 2022 Cutaway Bog Decommissioning and Rehabilitation Plan included in Appendix 4-2) shows that much of the interior of the bog comprises of bare peat fields. Note that approximately three quarters of the bog was in milled peat extraction up to June 2020. Meanwhile, to the east and west there are areas of heath, heath and scrub and woodland.

Bracklin Bog has a total area of 772ha and a peat extraction activity and all ancillary works area of 351ha which was subject to peat extraction activities and all ancillary works until 2003. Recent peat extraction activities and all ancillary works was concentrated in a small section in the west of the bog, referred to as Bracklin West. The topography within the bog ranges from 71 - 86mOD. The bog is drained by a series of northeast-southwest orientated drains. The bog is served by a railway line which extends to the north and west across Bracklin Bog. The Applicant's current habitat map for Bracklin (2024) (refer to Bracklin Bog 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan included in Appendix 4-2) shows that much of the main bog area currently comprises of a mosaic of heath, scrub, woodland and pioneer open cutaway habitats. Bracklin West currently comprises of bare peat fields, indicative of the recent peat extraction activities and all ancillary works activities in this area of the site. Meanwhile, the south of Bracklin Bog contains some areas of birch woodland with areas of remnant high bog recorded in the north of Bracklin Bog.

Lisclogher Bog has a total area of 479ha and sod peat extraction activities was underway across 378 hectares of the bog. While third party peat extraction activities and all ancillary works was ongoing in the northeast of the bog until 2020, milled peat extraction activities and all ancillary works had ceased there in March 2003. Lisclogher is drained by a series of east-west orientated drains. The topography within the bog ranges from 69 - 76mOD. The Applicant's Lisclogher East 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan states that the drainage system is beginning to break down with many drains becoming blocked and filling with water. A railway line extends from Bracklin Bog to the south into the interior of Lisclogher Bog. The Applicant's current habitat map for Lisclogher Bog (2024) (refer to Lisclogher Bog Cutaway Bog Decommissioning and Rehabilitation Plans included in Appendix 4-2) shows that much of the interior of the bog is comprised of a mosaic of pioneer open cutaway habitats, scrubland, and heath habitats. Some fingers of bare peat extend from the railway line to the east and west.

Lisclogher West has a total area of 228ha. Drainage infrastructure was installed in Lisclogher West Bog during 1988 and subsequent years across an area of approximately 22ha, as deduced from available aerial imagery. Lisclogher West was never subject to peat extraction activities and all ancillary works. The topography within the bog ranges from 77 - 82mOD. The existing remnant high bog is relatively dry due to the presence of a series of northwest-southeast orientated drains. No railway line of production centres are present within Lisclogher West. The Applicant's current habitat map for Lisclogher West (refer to Lisclogher West 2023 Cutaway Bog Decommissioning and Rehabilitation Plan included in Appendix 4-2) shows that majority of the site is classified as containing bog habitats, fringed to the north and south by woodland.

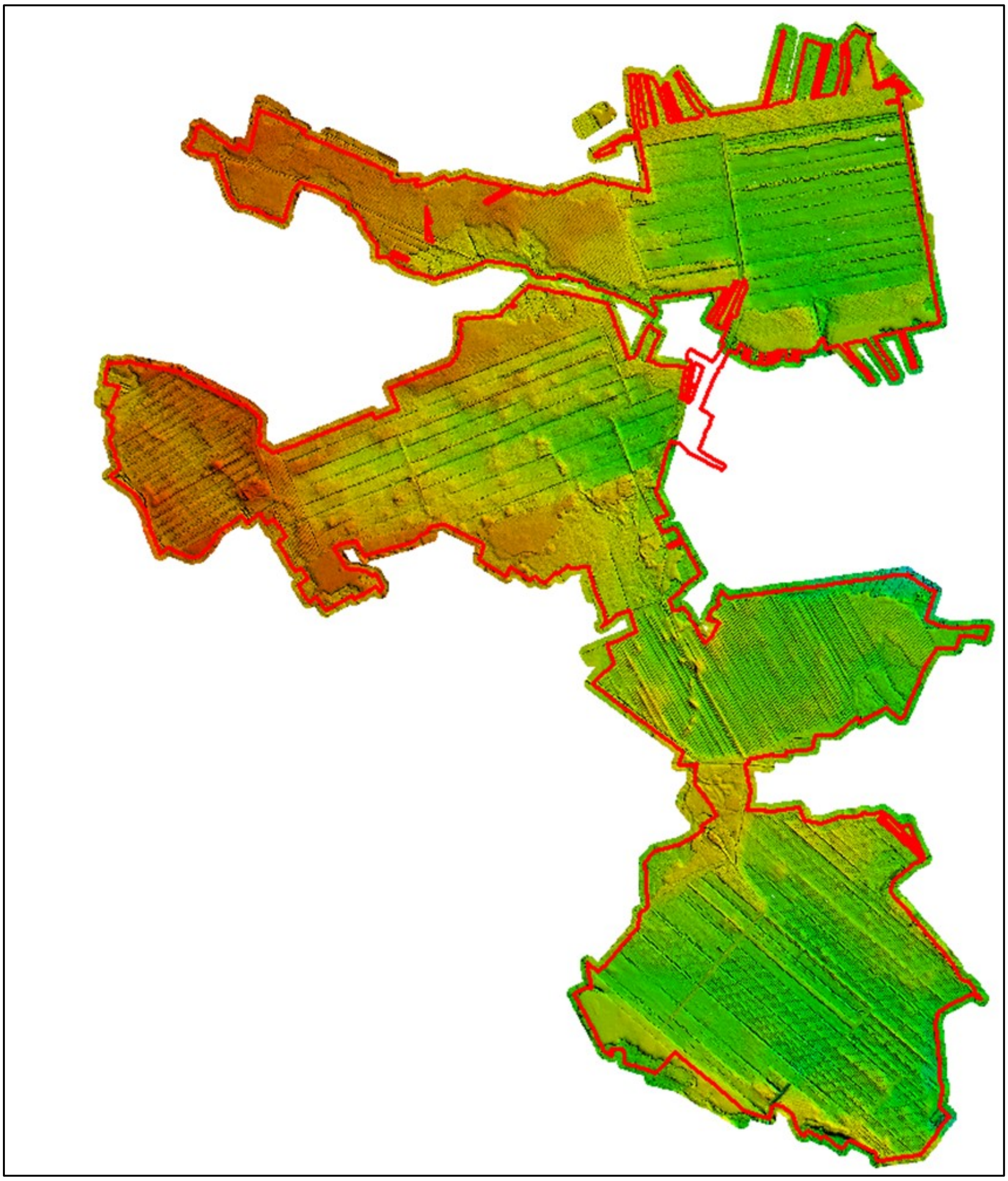


Plate 8-1 Topography across the Application Site

8.4 Establishing the 1988 Baseline Environment

8.4.1 Water Balance

Long term rainfall and evaporation data were sourced from Met Éireann. The 30-year annual average rainfall recorded at the Ballivor rainfall station, located ~4.5km east of the Application Site are presented in **Table 8-3**.

Table 8-3 Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Ballivor		268500		254200		68		1943		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
86	61	65	55	62	58	54	76	75	83	80	85	839

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Mullingar, approximately 17km west of the Application Site. The long-term average PE for this station is 445mm/yr. This value is used as the best estimate of the site PE. Actual Evaporation (AE) at the Application Site is estimated as 423mm/yr (which is 0.95 × PE).

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

Effective rainfall (ER) = AAR – AE

= 839 mm/yr – 423mm/yr

ER = 416mm/yr

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie) an estimate of 17mm/year average annual recharge is given for basin peat in this area (recharge coefficient of ~4%). This means that the hydrology of the Application 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 Application Site are estimated to be 17mm/yr and 399mm/yr respectively.

This water balance is unlikely to have changed significantly from the predevelopment period to the present day. Raised peat bogs are an excellent store of water. Pre-development when the storage capacity of the peat is reached surface water runoff will occur whereby rainwater would have moved slowly across the bog before discharging to fens and other wetland habitats at the bog margin. In the present day, however, drainage channels act as preferential flowpaths which allow surface water to leave the site. These channels generally have a low gradient and the on-site drainage systems have some inherent storage and attenuation, and likely release runoff water at slightly higher rates than that of predevelopment times.

8.4.2 Regional and Local Hydrology

Regionally the Application Site is located in the Boyne surface water catchment within Hydrometric Area 7 of the Eastern River Basin District.

The Boyne catchment has a total area of 2,694km^2 and includes all areas drained by the River Boyne. The source of the Boyne is at Trinity Well, located to the southeast of Carbury, Co. Kildare and approximately 18km southeast of the Application Site. The Boyne flows west from the Trinity Well, turning north at Edenderry, passing through the raised bog landscape of north Kildare, after which it is joined by the Yellow River. The Boyne then continues to flow to the northeast and the town of Trim, flowing approximately 5km east of Ballivor Bog. In the vicinity of the site, the main tributaries which discharge into the Boyne include the Deel (Raharney) and the Stonyford rivers. Further downstream, the Athboy River confluences with the Boyne before the Boyne flows to the east through the town of Trim. The Boyne then flows towards Navan after which it continues eastwards before becoming tidal to the west of the M1 motorway. The Boyne estuary flows through Drogheda and out to the Irish Sea between Haven and Mornington Point. A regional hydrology map is shown in Figure 8-1.

On a more local scale, the majority of the Application Site is located in the River Boyne sub-catchment (Boyne_SC_050) with much of Ballivor Bog and a small section in the southwest of Bracklin Bog located in the Boyne_040 sub-catchment. Additionally, a small area in the northwest of Bracklin Bog is located in the River Deel sub-catchment (Deel[Raharney]_SC_010).

Within the Deel[Raharney]_SC_010, the River Deel (EPA Code: 07D01) flows to the southeast approximately 1km west of Bracklin Bog. The River Deel flows to the southeast entering the Boyne_040 sub-catchment to the south of Raharney before reaching its confluence with the River Boyne (EPA Code: 07B04) approximately 4.5km south of Ballivor village. As stated above much of the site is located in the Boyne_060 sub-catchment, with the Stonyford River (EPA Code: 07S02) flowing to the southeast approximately 700m east of Lisclogher Bog. The Stonyford River discharges into the Boyne approximately 7km east of Ballivor Bog. A local hydrology map is shown in Figure 8-2.

An error has been observed in the EPA blueline watercourse mapping database in Lisclogher Bog. The EPA map a small watercourse, referred to as the Cartenstown stream, to flow to the southeast across Lisclogher Bog as shown in Figure 8-3. However, site walkover surveys and drainage mapping have shown that this watercourse does not exist on-site. The true drainage regime and flow directions in this area of the Application Site are shown on Figure 8-4. This drainage map has been produced following walkover surveys and drainage mapping of Lisclogher Bog. The on-site inspections were supplemented with the analysis of lidar data. The lidar data does not indicate the presence of any channel that may be associated with a surface watercourse. Indeed there are several topographic highs located along the cross-section meaning that it would be impossible for surface water to flow unimpeded from Point A to D. This lidar analysis supports the on-site observations and drainage mapping meaning that there is a local error in the EPA watercourse mapping in Lisclogher Bog. Such small local errors are infrequent in EPA mapping; however, they do exist where manmade drainage has been imposed upon natural drainage regime. The local hydrology map includes the corrections to the drainage on and around Lisclogher bog.

Table 8-4 summarises the location and receiving waterbodies of each of the 5 no. bogs which comprise the Ballivor Bog Group in accordance with the Water Framework Directive (WFD) waterbody classifications.

Table 8-4: WFD Catchments, sub-catchments and river-basins and receiving waterbodies of the Ballivor Bog Group

Bog Name	Catchment	Sub-catchment	River Sub-basin
Ballivor	River Boyne	West of the bog is located in Boyne_SC_040	Deel(Raharney)_060
		East of the bog is located in Boyne_SC_050	Boyne_060
Carranstown	River Boyne	Boyne_SC_050	South of the bog is located in Boyne_060
			North of the bog is located in Stonyford_040
Bracklin	River Boyne	East and centre of the bog are located in Boyne_SC_050	East and centre of the bog is located in Stonyford_040
		Small area in southwest of the bog is located in Boyne_SC_040	Small area in the southwest of the bog is located in Deel(Raharney)_060
		Northwest of the bog is located in Deel[Raharney]_SC_010	Small area in the west of the bog is located in Deel(Raharney)_040
			Small area in the northwest of the bog is located in Deel(Raharney)_030
Lisclogher	River Boyne	Boyne_SC_050	Stonyford_040
			Small area in the north of the bog is located in Stonyford_030
			Stonyford_020 EPA mapping and WFD river-sub basins are incorrectly mapped at Lisclogher Bog and some of the site drains to the northwest into the Stonyford_020 SWB.
Lisclogher West	River Boyne	Boyne_SC_050	Located in Stonyford_040

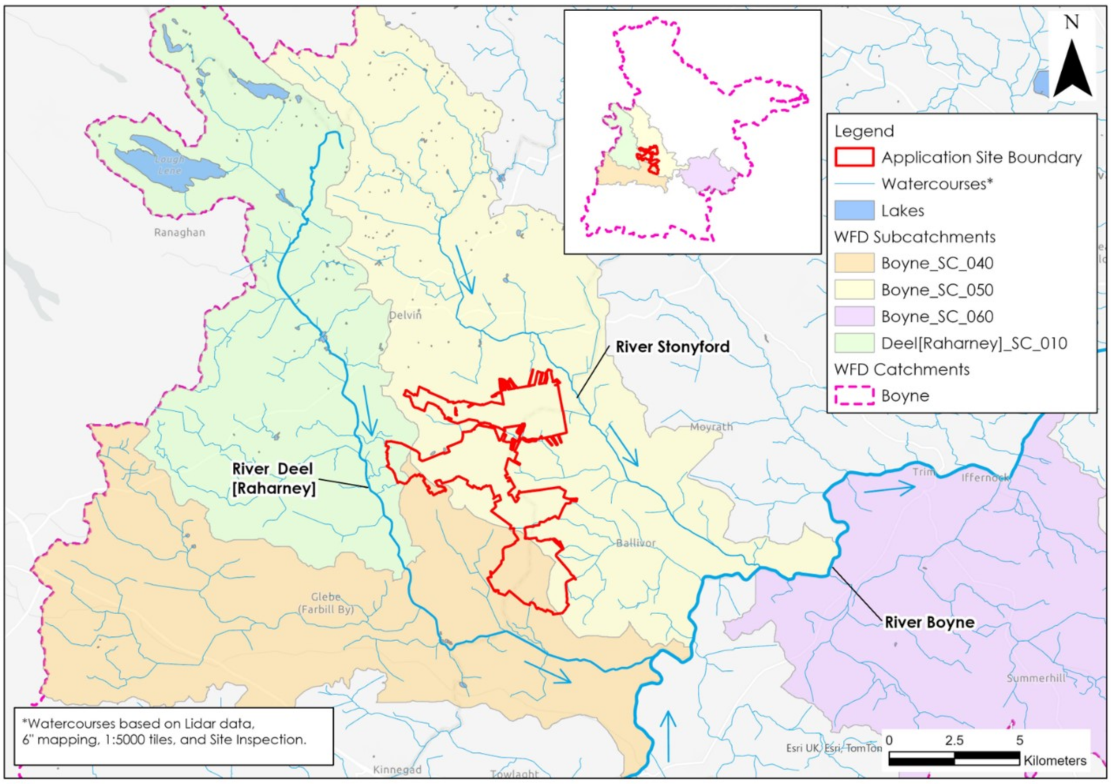


Figure 8-1: Regional Hydrology Map

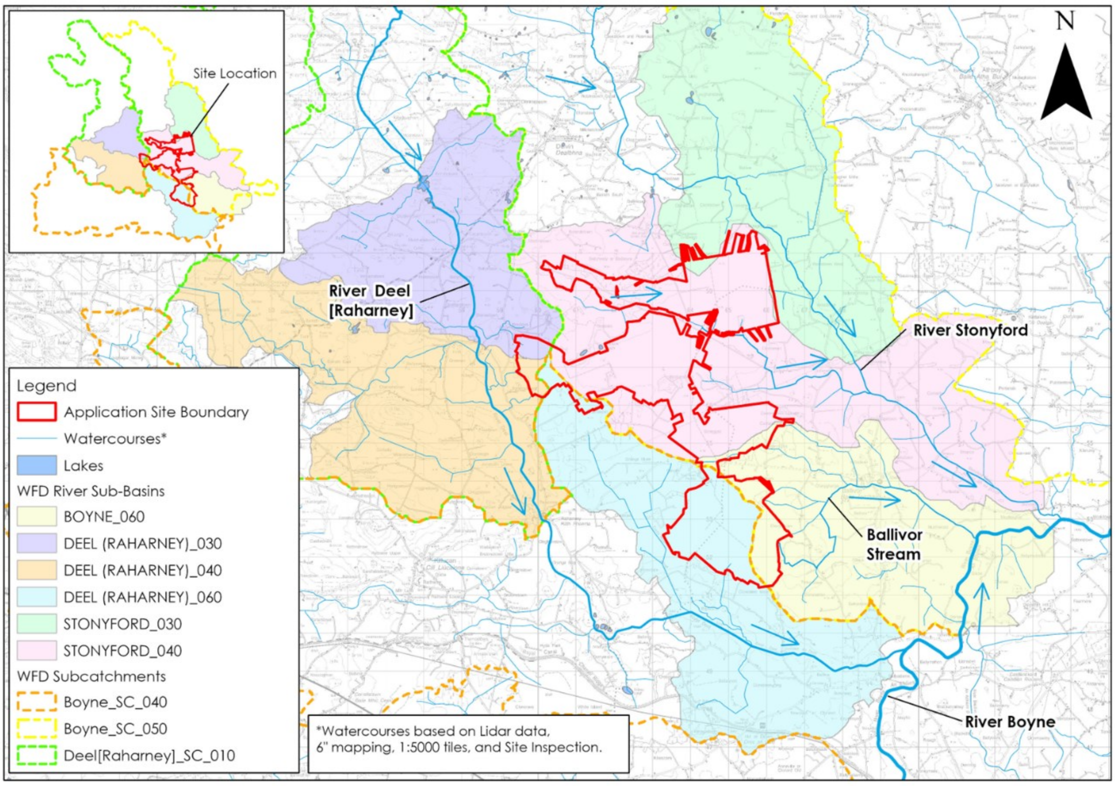


Figure 8-2: Local Hydrology Map

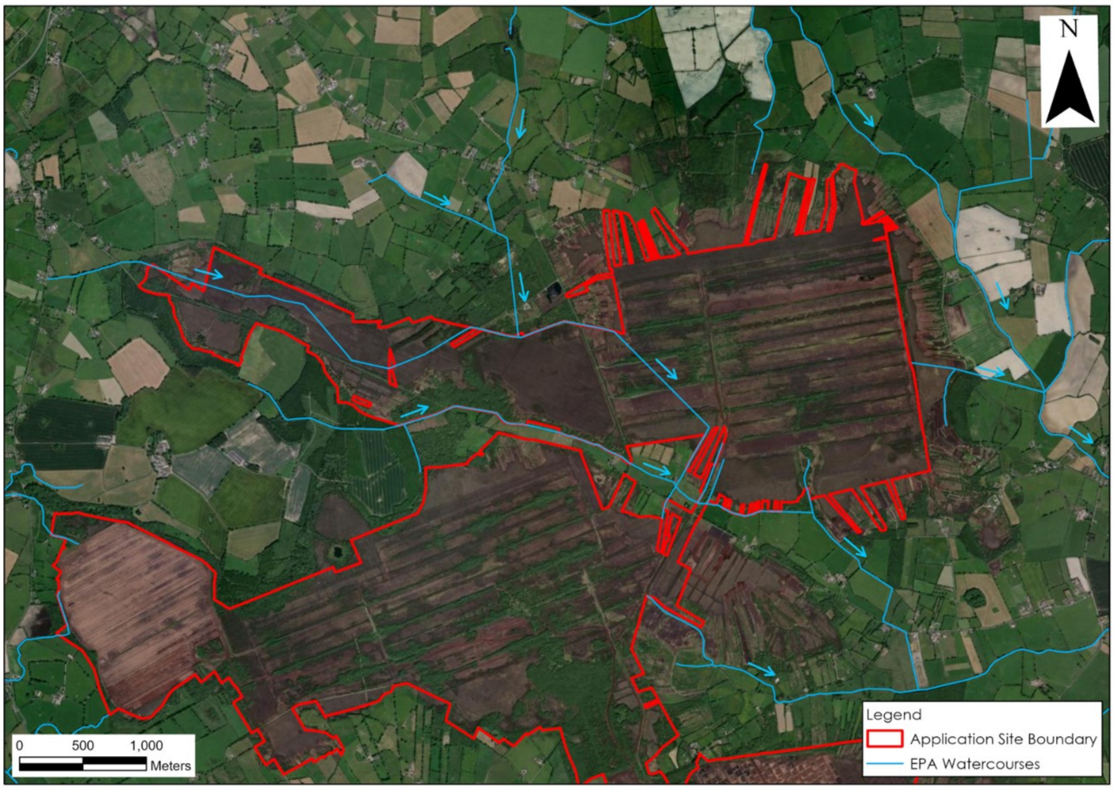


Figure 8-3: EPA Watercourse Mapping in Lisclogher Bog

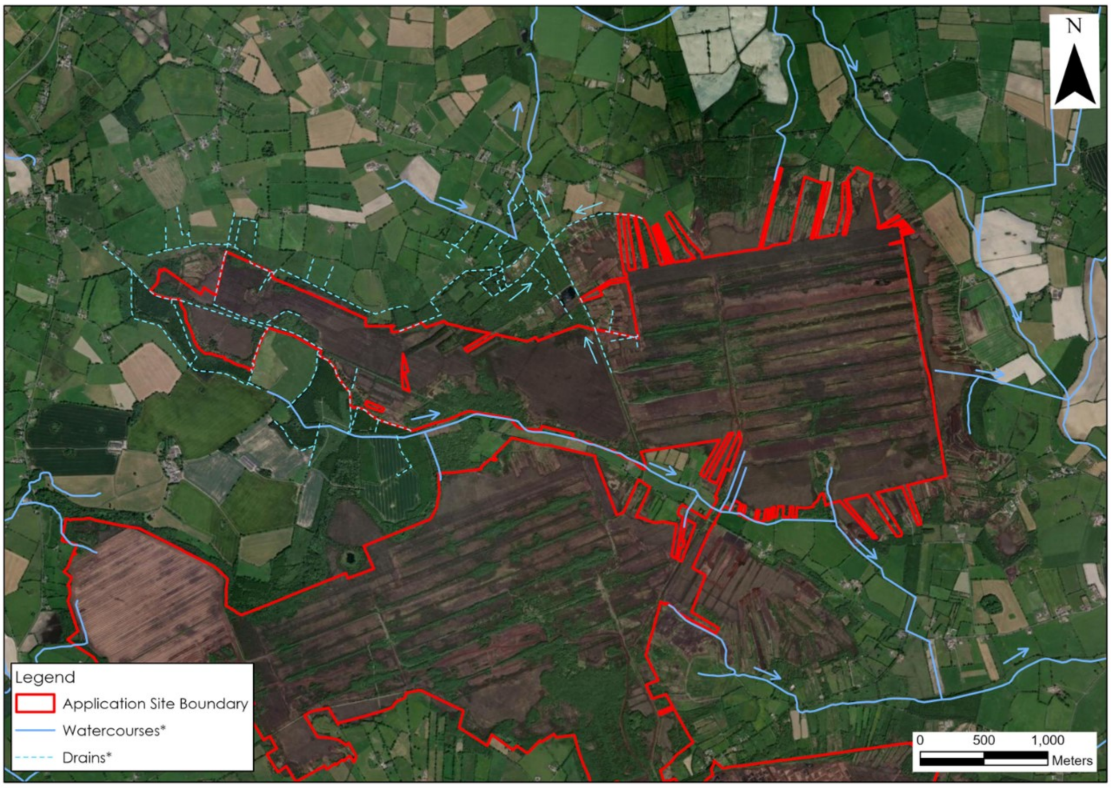


Figure 8-4: True Drainage of Lisclogher Bog Based on Site Walkovers and Lidar Data

Data on volumetric flow exceedance was acquired from OPW gauging stations (www.waterlevel.ie) within various river channels within the River Boyne catchment. The data was acquired for the main channels within the catchment, as well as in smaller tributaries of those rivers, such as the Ballivor River near Ballivor Bog. These data from the OPW include observed flows and are displayed as exceedance flows. A 95%ile flow relates to the flow which will be exceeded within the river 95% of the time *i.e.* a 95%ile flow of 1 m^3/s would indicate that 95% of the time, the flow in that river is at or above 1 m^3/s.

These data were plotted for the Boyne catchment and are displayed graphically as Figure 8-5. At some gauging stations, only 50% and 95% exceedance flows are available. The graph is annotated with zones that relate to the scale of the river flows within the overall channel.

Data from Ballivor River provides an example of flow volumes in small streams and bog outfalls within the Boyne catchment. Flows in the Ballivor River range from 0.01 – 0.1m^3/s. These flow volumes would be typical of the small streams located in the vicinity of the Application Site. Further downstream, the flow volumes increase in larger rivers such as the Deel and Stonyford rivers. For example, the 50%ile flow in the Deel River at Raharney is ~4m^3/s. Flow volumes increase further in the main Boyne River further downstream of the Application Site. For example the 50%ile flow in the River Boyne downstream of the site at Trim is ~24m^3/s.

This data highlights the variable flow volumes in river waterbodies located in the vicinity and downstream of the Application Site. Flow volumes increase progressively from small stream scale flows (0.01 – 0.1m^3/s) in the vicinity of the site, to river basin scale flows (~0.5 – 2.5m^3/s) and sub-catchment scale flows (10 - 100m^3/s) furthern downstream. Therefore the waterbodies in the vicinity of the site, with smaller flow volumes, would have had the greatest potential to be impacted by historic peat extraction activities. The potential for effects decreases progressively downstream due to the dilution effect associated with increasing flow volumes and larger upstream catchment areas.

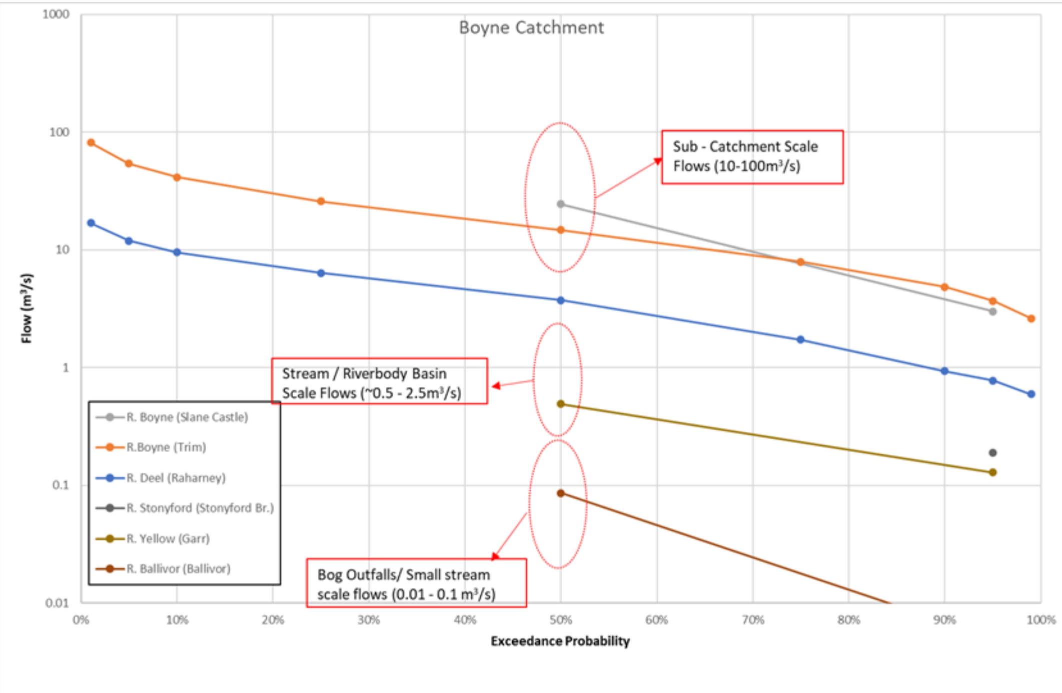


Figure 8-5: Flow Duration curves (full and partial) for rivers within the Boyne Catchment

8.4.3 Site Drainage

8.4.3.1 Pre – 1988 Bog Drainage

Table 8-5 summarises the bog areas, years of drainage and the year that peat extraction activities and all ancillary works first began in all 5 no. bogs comprising the Ballivor Bog Group.

Drainage ditches to drain the upper surface of the bogs by lowering the local water table were inserted in Lisclogher, Carranstown, Bracklin and Ballivor bogs at different stages.

The timing of initial bog drainage varies across the Application Site. Ballivor Bog was the first bog to be drained between 1948 and 1953. Clearance and drainage work commenced at Bracklin in 1952. The northern portion of Bracklin West was drained but not cleared prior to 1988. Lisclogher was drained and peat was being extracted 1960. Carranstown Bog was drained between 1974 and 1987 with only the western portion subject to peat extraction activities and all ancillary works prior to 1988. Meanwhile, drainage works were undertaken at Lisclogher West between 1973 and 1995, however no peat extraction activities or ancillary works has occurred in this bog.

Table 8-5: Peat Extraction Areas, Year of first drainage and Year of first extraction within the Ballivor Bog Group.

Bog Name	Bog Area (Ha)	Site Preparation Works including drainage insertion (Year)	First Extraction (Year)
Ballivor	638	1948 – 1953	1953
Carranstown	304	West: 1974 – 1987 –East: Drainage between 1974 – 1987, clearance postdating 1989 - 1995	West: Prior to 1988 (western side) East: Prior to 1995
Bracklin	772	Main Bracklin Bog Area: 1952 – 1958 Bracklin west: drained prior to 1988, vegetation clearance in southern portion only by 1988	Main Bracklin Bog Area: 1959 Between 1989 and 1995 at northern portion of Bracklin West By 1988 in southern portion of Bracklin West
Lisclogher	479	1955-1959	1960
Lisclogher West	228	1973-1995	No Extraction

<u>Drainage Design</u>

The drainage design comprised the insertion of parallel surface water drains, created by machine excavators, at intervals of 15m. Vegetation was then stripped from the bog between these drains to form the peat production fields. The drains were first opened by towing a plough cutting 50cm deep by turning the sod over and as a result, the surface water was removed. After one year the drains were deepened and the spoil removed. This step was repeated for a period of 5-7 years until a stable drain approx. 1.5m deep was established. The fields were then chambered to facilitate rainwater run-off and prevent standing water on the production fields. The drains generally fall towards the headland which is located at both ends of each production field. This headland allows for the plant such as harrowers, millers or ridgers to turn from one field into the next field. The open drains are generally piped across the end of each production field to facilitate peat extraction activities and all ancillary works plant and machinery to travel from field to field. The drainage network continues by either open channel or pipe to a silt pond or ponds prior to discharging from the Applicant's site to a local watercourse. The

Application Site was primarily drained via gravity however 2 no. pumps were located at the margins of Ballivor Bog.

Silt Ponds

Following the establishment of the Applicant's silt committee in the 1970s (included as Appendix 4-6 of this rEIAR) it was concluded that surveys should be carried out at the Application Site to select silt pond locations. Silt ponds are utilised to trap sediment and prevent elevated levels of suspended sediment arising in effluent from drained peatlands. At this time, it was agreed that silt ponds should be included in the development plans for any new areas of bog from which peat was extracted. The first silt ponds were constructed at the Application Site in 1983/1984, with these ponds being designed with an upper limit of 100mg/l of silt runoff (determined by an An Bord Pleanála (the Board) decision regarding effluent at Littleton Bog (refer to Appendix 4-8). The design of silt ponds is detailed in Section 4.3.5.9, with silt ponds typically being 8m in width, 1.5m deep and of variable length. In some locations, baffles have been installed within the ponds to reduce the energy in the flow and elongate the pond thereby increasing residence time and aiding settlement. The inlet and outlet pipes at the silt ponds control the flow velocity, with velocity within the silt pond being less than 0.1m/s. Silt ponds are cleaned twice a year and are all located hydraulically upgradient of discharge/outfall points.

8.4.3.2 1988 Baseline Bog Drainage

By 1988 (and the transposition of the EIA Directives into Irish Law), manmade drainage ditches existed across much the Application Site. In essence, the major changes from a hydrological perspective occurred within these bogs during their initial drainage, prior to 1988. Consequently, no major hydrological changes would have occurred following the initial drainage apart from minor alteration of drainage ditches as peat extraction activities and all ancillary works progressed.

Inspection of satellite imagery and annual reports reveal that Ballivor Bog was undergoing sod and milled peat extraction by 1988. The associated drainage to facilitate peat extraction activities and all ancillary works was already in situ, with field drains predominantly in a northwest-southeast orientation. The bog included 7 no. artificial silt ponds, and 7 no. surface water emission points which remain *insitu* today and two pumps were in operation at this time.

By 1988, the majority of peat extraction activities and all ancillary works had ceased at Bracklin Bog except for Bracklin West which continued to undergo milled peat extraction in the southern portion only. Drainage was already inserted by this time. The bog included 6 no. artificial silt ponds, and 5 no. surface water emission points which remain *insitu* today. Bracklin and Bracklin West were drained by gravity and there was no requirement for pumps.

Aerial imagery indicates that drainage and extraction for milled peat was underway in the western portion of Carranstown Bog in 1988. By this time, the eastern portion of Carranstown was drained but had not been cleared. This section of the bog included 5 no. artificial silt ponds, and 4 no. surface water emission points which remain *insitu* today.

By 1988, the centre of Lisclogher Bog had been drained and sod peat extraction was underway. No silt ponds or surface water emission locations were present at this time (the Applicant's records indicate that 6 no. silt ponds were in place before 1999). The Applicant's records also indicate that a pump was being used at Lisclogher bog. This pump was decommissioned ~20 years ago. The installation of main drainage in small areas of Lisclogher West commenced in 1973, as evidenced by aerial imagery. Aerial imagery from 1988 indicated that drainage installation was ongoing by 1988 and no extraction was taking place Table 8-6 below.

Table 8-6: 1988 Baseline Drainage

Bog Name	Drainage Status	No. Silt Ponds	No. Surface Water Discharge Locations	No. Pumps
Ballivor	Drainage already inserted	7	7	2
Carranstown	Drainage already inserted in Carranstown West No drainage in Carranstown East	5	4	-
Bracklin	Drainage inserted	6 in Bracklin West	5	-
Lisclogher	Drainage inserted	1	1	1
Lisclogher West	Drainage partially inserted	N/A	N/A	N/A

8.4.3.3 Peat Extraction Phase Drainage (July 1988 – June 2020)

By 1988, drainage had already been inserted at Ballivor, Bracklin, Lisclogher, Lisclogher West and Carranstown Bog. By 1995 all bogs within the Application Site had been drained.

Drainage of the bogs including silt pond locations and drainage outfalls are detailed in full in Section 8.4.3.4 below.

<u>Silt Ponds</u>

Several changes to the on-site bog drainage system occurred during this phase of the development. These changes were predominantly associated with silt ponds and attempts to reduce the concentrations of suspended sediment being discharged from the bog drainage systems to local surface watercourses. Upgrades to silt ponds were undertaken at the Application Site in the 1990s following the Harkins Internal Bord na Móna Report (1990) which highlighted the issue of elevated suspended sediment concentrations in discharge from the bog drainage network. The report revealed that a total of ~50m^3 of sludge per hectare of bog was being discharged to nearby surface watercourses every year (refer to Chapter 4). Following this, the silt ponds were designed to cater for the settling of sufficient amounts of silt providing the ponds were de-sludged at least twice per annum. A second pond was installed adjacent to the first to facilitate desludging (i.e., used as a backup when the first pond reached silt storage capacity and underwent desludging). During the Peat Extraction Phase a total of 25 no. silt ponds were installed across the 5 bogs to reduce the flow rate of drainage waters thereby allowing peat particles within the surface water to run-off and settle.

Since 2000, the bog drainage network has been operating in accordance with an Integrated Pollution Control licence (Reg. P0501-01), with all drainage water from bog units in the licensed area discharged via an appropriately designed silt pond treatment arrangement. The silt ponds serving operation bogs have been sized in accordance with a condition in the existing Integrated Pollution Control Licence (P0501-01) which states:

> *'Within three years of date of grant of this licence all existing silt ponds serving operational bogs shall achieve the following minimum performance criteria (flood periods excepted):*
>
> *Maximum flow velocity < 10 cms-1*

Silt design capacity of lagoons, minimum 50m³ per nett ha of bog serviced'

Silt ponds were generally designed and constructed with a width of 8 metres, however, in some cases, silt ponds are up to 12 metres in width. Silt ponds of 12m width are only provided in areas where access is available to both sides of the silt ponds for cleaning. The length of the silt pond will vary depending on the capacity required (i.e. proportional to the area of catchment being drained). In some locations, baffles have been installed within the ponds to reduce the energy in the flow and elongate the pond thereby increasing residence time and aiding settlement. Silt ponds are generally excavated to a depth of 1.5 metres below the pipe invert level, however in some locations, due to restricted space, the silt pond depth is greater than this. Low-velocity flow through the silt pond is generally controlled by inlet and outlet pipes at the silt ponds or upstream of the silt pond. These pipes control the velocity of the flow into and out of the silt ponds so that the velocity within the silt pond itself is less than 0.1 m/sec. The silt ponds are usually cleaned twice a year and are all located hydraulically upgradient of discharge/outfall points. A surface water outflow map which formed part of the EPA application recorded a total of 25 no. silt ponds across the Application Site (7 no. silt ponds in Ballivor, 6 no. silt ponds in both Bracklin and Lisclogher West, 5 no. ponds in Carranstown and 1 no. pond in Lisclogher Bog).

8.4.3.4 Decommissioning and Rehabilitation Phase Drainage (June 2020 – Present Day)

Detailed hydrological audit of flow paths from each bog to its eventual discharge point at the regional catchment scale was conducted for the 5 no. bogs. The flow paths have been traced using the River Waterbodies classification as outlined by the WFD. The flowpaths for as shown as Figure 8-6 to Figure 8-10 below. These flowpaths were also in operation during the Peat-Extraction Phase described above.

Drainage from the Ballivor Bog discharges through 6 no. outfalls (SW35, SW38, SW39, SW40, SW41 and SW41A) (refer to BNM-ECO-02-SP01: Sampling Points included in the Cutaway Bog Decommissioning and Rehabilitation Plan for Ballivor Bog, see Appendix 4-2). In the southwest of Ballivor Bog, SW41A discharges to Clondalee_More stream which in turn discharges to the Deel[Raharney] River. These waterbodies are mapped within the Deel(Raharney)_060 river waterbody. Further downstream, the Deel River discharges into the Boyne_050 river waterbody. The SW35, SW38 and SW39 outfalls, located in the northeast of the bog, discharge to several unnamed drains/streams, which then discharge to the Ballivor River. In the southeast of the bog outfalls SW40 and SW41 discarge to the Derryconor stream, which then discharges to the Ballivor River. The Ballivor River is mapped within the Boyne_060 river waterbody. The Ballivor River then reaches a confluence with the River Boyne (Boyne_060). The River Boyne then continues through segments Boyne_070 to Boyne_180 before becoming tidal in the Boyne Estuary to the west of Drogheda.

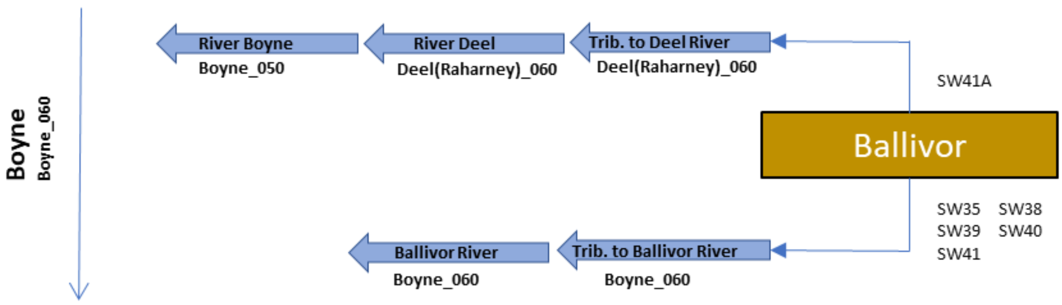


Figure 8-6: Hydrological Flow Path for Ballivor Bog

Drainage from the Carranstown Bog discharges via 4 no. outfalls (SW31, SW32, SW33 and SW34) (refer to BNM-DR-23-20-13: General Drainage Map included in the Cutaway Bog Decommissioning and Rehabilitation Plan for Carranstown Bog). In the west, SW31 discharges to the Grange More stream which in turn discharges to the Craddanstown stream before discharging into the

Deel[Raharney] River to the southwest of Ballivor Bog. These waterbodies are mapped within the Deel(Raharney)_060 river waterbody. The Deel River discharges into the Boyne_050 river waterbody. In the southeast of the bog, the SW33 ans S34 discharge to the Killaconnigan stream, which in turn discharges to the Ballivor River southwest of Ballivor village. Here the Ballivor River is mapped within the Boyne_060 river waterbody. In the northeast, SW32 outfalls to the Craddanstown Little stream which discharges into the Cartenstown stream and eventually the Stonyford River to the east of the bog. These waterbodies are mapped within the Stonyford_040 river waterbody. Further downstream the Stonyford River reaches a confluence with the River Boyne (Boyne_070). The River Boyne then continues through segments Boyne_080 to Boyne_180 before becoming tidal in the Boyne Estuary to the west of Drogheda.

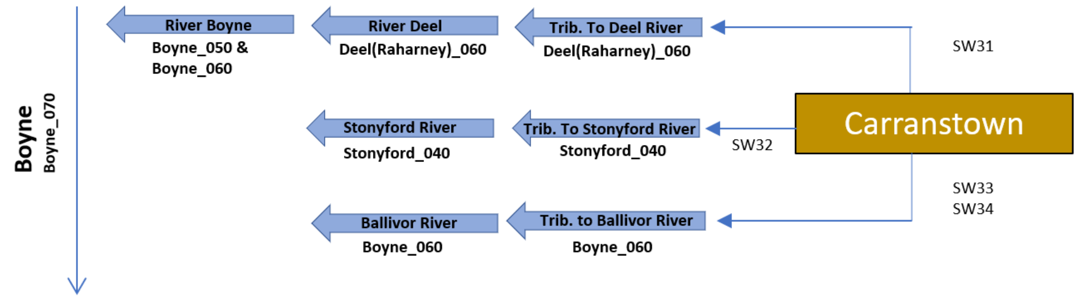


Figure 8-7: Hydrological Flow Path for Carranstown Bog

Drainage from the Bracklin Bog discharges via 5 no. outfalls (SW26, SW27, SW28, SW29 and SW30), with all outfalls being located in Bracklin West (refer to BNM-ECO-03-02: Strcutures and Sampling Map included in the Cutaway Bog Decommissioning and Rehabilitation Plan for Bracklin Bog). SW28, SW29 and SW30 discharge to the Greenan stream and the Ballynaskeagh stream respectively before discharging into the Deel River. These waterbodies are mapped in the Deel(Raharney)_030 river waterbody. The Deel River continues through segments Deel(Raharney)_040 and Deel(Raharney)_050. SW26 and SW27 outfall to the Craddanstown stream which forms part of the Deel(Raharney)_060 river waterbody. The Deel River discharges into the Boyne_050 river waterbody. The River Boyne then continues through segments Boyne_060 to Boyne_180 before becoming tidal in the Boyne Estuary to the west of Drogheda.

A small lake waterbody, referred to as Bracklin Lough is located to the north of Bracklin Bog and is visible in Figure 8-13.

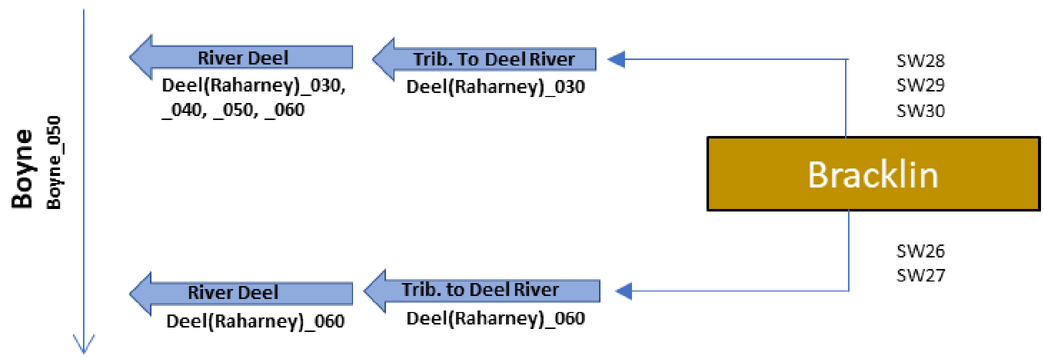


Figure 8-8: Hydrological Flow Path for Bracklin Bog

Beyond areas of third-party peat extraction activities and all ancillary works in the northeast (which ceased in 2020), Lisclogher Bog has not been subject to peat extraction activities and all ancillary works since the 2003 and has become overgrown with the Applicants Cutaway Bog Decommissioning and Rehabilitation Plan for Lisclogher East Bog (2022) stating that the drainage system is beginning to break down with many drains becoming blocked and filling with water. Drainage from Lisclogher Bog discharges via 1 no. outfall (SW25) located in the northeast of the bog (refer to BNM-ECO-01-SP01: Sampling Points Map included in the 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan for Lisclogher Bog, see Appendix 4-2). SW25 discharges to an unnamed stream which in turn discharges to the Stonyford River. These waterbodies are mapped in the Stonyford_030 river waterbody. The Stonyford River continues through the Stonyford_040 waterbody before discharging into the Boyne_070 waterbody.

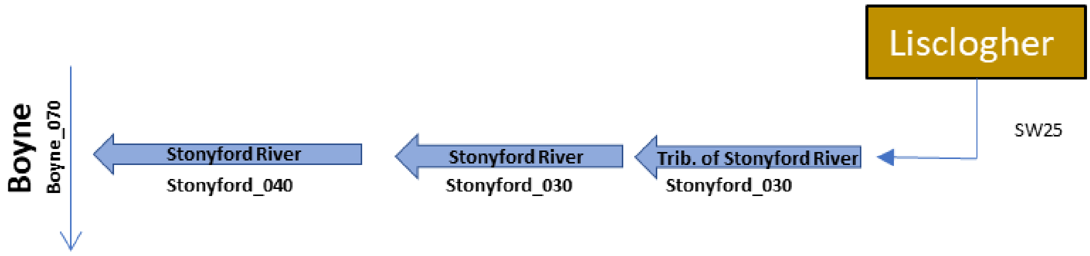


Figure 8-9: Hydrological Flow Path for Lisclogher Bog

While Lisclogher West was never subject to peat extraction activities and all ancillary works, ditches and drains were constructed between 1973 and 1995. Drainage from Lisclogher West discharges via 6 no. outfalls (SW19 – SW24) located along the southern boundary of the bog (refer to BNM-ECO-04-SP01: Sampling Points Map included in the 2023 Cutaway Bog Decommissioning and Rehabilitation Plan for Lisclogher West, see Appendix 4-2). These outfalls discharge to the Bolandstown stream which in turn discharges to the Cartenstown stream and then the Stonyford River. These waterbodies are mapped in the Stonyford_040 river waterbody. The Stonyford River discharges into the Boyne_070 waterbody approximately 5km southeast of the Ballivor village.

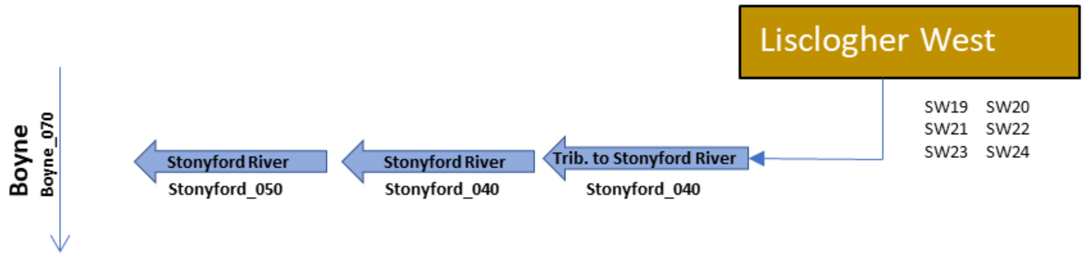


Figure 8-10: Hydrological Flow Path for Lisclogher West

The flowpaths outlined above were used in the assessment of any impacts between the surface water hydrological regime and the bog hydrogeological regime for both the Peat Extraction Phase and the Remedial Phase. It is assumed that due to the very high surface water runoff rates and very low groundwater recharge rates at the site there is a connection between the near surface groundwater at the bogs, which likely discharges to surface waterbodies.

During the Remedial Phase, the drainage system at the Ballivor bogs continued in accordance with IPC Licence conditions.

Drainage maps for each of the bogs are shown in Figure 8-11 to Figure 8-16 and include the locations of silt ponds.

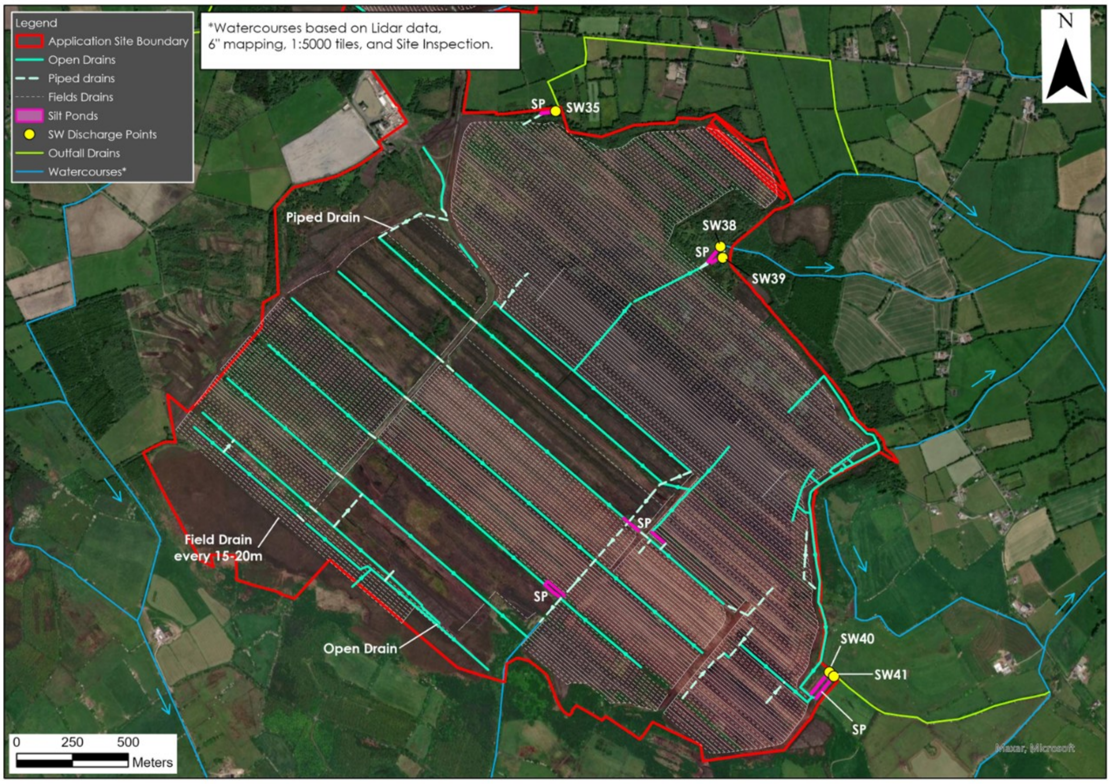


Figure 8-11: Internal Drainage Map - Ballivor Bog

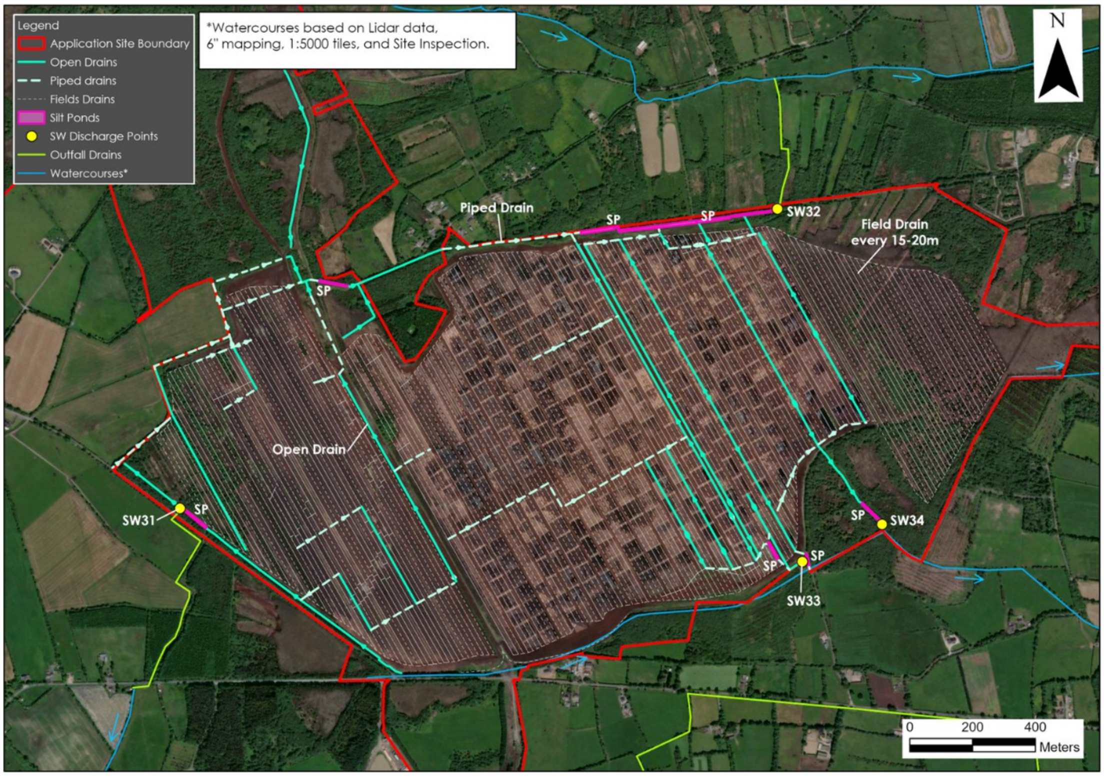


Figure 8-12: Internal Drainage Map - Carranstown Bog

Figure 8-13: Internal Drainage Map - Bracklin Bog

Figure 8-14: Internal Drainage Map – Bracklin West

Figure 8-15: Internal Drainage Map – Lisclogher Bog

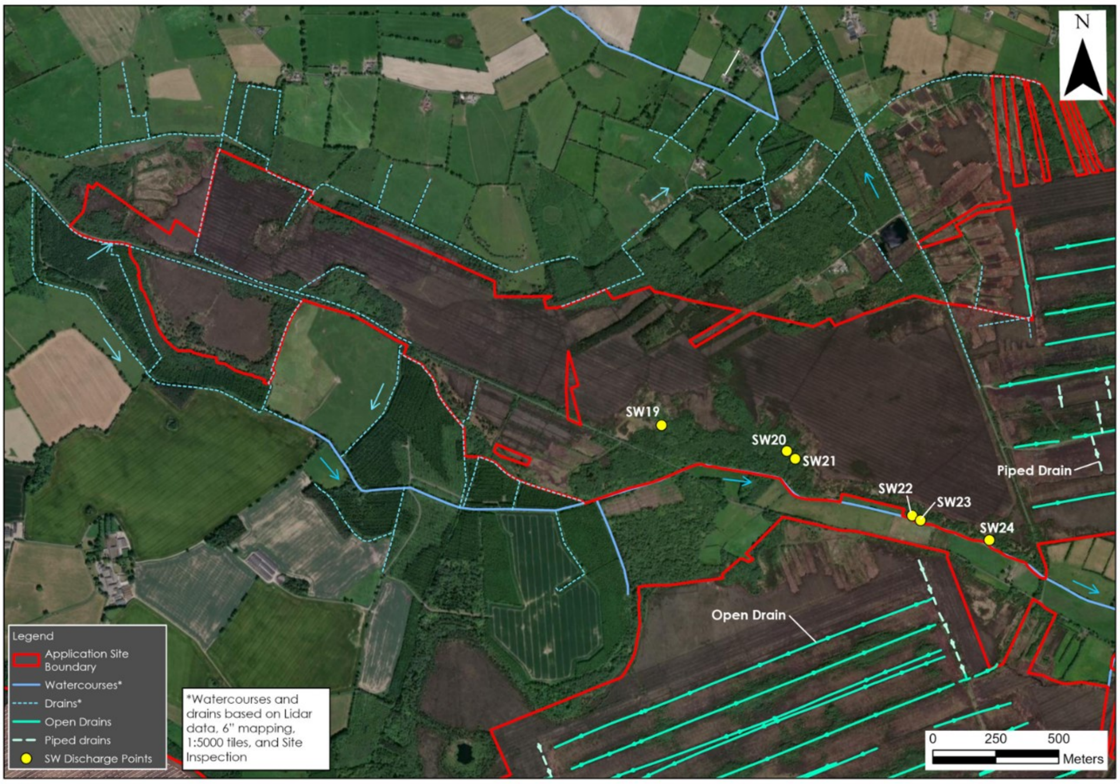


Figure 8-16: Internal Drainage Map – Lisclogher West Bog

8.4.4 Flood Risk Assessment

This section presents an overview of the flood risk assessment undertaken for the Ballivor Bog Group. The full flood risk assessment report is provided in **Appendix 8-1**.

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

No recurring flood incidents or instances of historical flooding were identified within the Application Site in historic OS maps or in OPW flood maps. Identifiable map text on local available historical 6" or 25" mapping for the Application Site does not identify any lands that are "liable to flood".

The Application Site is found to lie outside of the OPW's indicative river and coastal flood zones. In addition, the GSI Groundwater Flood mapping does not record any groundwater flood zones with the Application Site.

The Local Authority Strategic Flood Risk Assessment (SFRA) mapping indicates that areas in the northwest of Lisclogher Bog are vulnerable to fluvial flooding. However, site walkover surveys have revealed an error in the EPA map of local rivers. The EPA map (www.epa.ie) shows the Cartenstown stream to flow from Lisclogher West to the southeast, crossing Lisclogher Bog. Site walkovers have revealed that this section of the river does not exist, with Lisclogher West draining to the north. Such small (local) errors are infrequent in EPA mapping; however, they do exist especially where manmade drainage has been imposed upon natural drainage regimes. This error casts doubt on the validity of the SFRA flood zones in this area as the flood zones assume the presence of a surface watercourse.

CFRAM mapping includes modelled flood levels for the 10-year and 100-year flood events. These levels, modelled near Ballivor village, range from 64.19 – 65.34m OD and are well above the current outfall pipe elevations at the Application Site. Therefore, the risk of fluvial flooding along the Ballivor River, located to the east of the Application Site, backing up into the site drainage network is very low.

The main risk of flooding across much of the Application Site is via pluvial flooding due to the low permeability peat soils and subsoils. The surface of the cutover bog contains an extensive network of peat drains with surface water outflows from the bogs. This existing drainage network has reduced the risk of pluvial flooding across much of the site. However, following periods of intense and prolonged rainfall events localised surface water ponding is still likely to occur in places.

Based on existing topography there is significant storage within each of the bog basins to alleviate any flood risk associated with pluvial flooding. This storge of rainwater after rainfall events will not generate any additional offsite flood risk.

8.4.5 Surface Water Quality

8.4.5.1 EPA Biological Q-Rating Monitoring

The Biological 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).

8.4.5.1.1 *Pre-1988 EPA Q-Ratings*

EPA Q-rating monitoring (i.e. biological monitoring data) of river waterbodies began in the early 1970s. Historic Q-data is available from 1971 to 1986 for the Deel (Raharney), Stonyford and Boyne Rivers in the vicinity and downstream of the Application Site. Table 8-7 shows that the historic Q-values ranged from Q3 ('Poor' Status) to Q5 ('High' Status) during this time period.

Table 8-7: EPA Q-Rating Status (Pre-1988)

River	Station ID	Location	EPA Q-Rating (Years)	Q-Value Status Range	
Deel (Raharney)*	RS07D010100	Bridge upstream Cummer Bridge	3.5 (1982 - 1985)	Moderate	
Deel (Raharney)	RS07D010200	Cummer Bridge	4-5 - 5 (1971-1985)	High	
Deel (Raharney)	RS07D010300	Raharney Bridge	4-5 – 5 (1976 - 1985)	High	
Deel (Raharney)	RS07D010400	Inan Bridge	4-5 - 5 (1971 - 1985)	High	
Deel (Raharney)	RS07D010600	Bridge upstream of Boyne River confluence	4 - 5 (1971 - 1985)	Good (1978)	High (1985)
Boyne	RS07B040800	Inchamore Bridge	3 – 4-5 (1974 - 1986)	Poor (1974)	High (1986)
Boyne	RS07B040900	Scariff Bridge	3.5 - 5 (1974 - 1986)	Moderate (1974)	High (1986)
Stonyford	RS07S020100	Bridge upstream of Rathkenna Bridge	4 (1981 - 1985)	Good	
Stonyford	RS07S020200	Earl's Bridge	4 – 4.5 (1976 - 1985)	High (1976)	Good (1985)
Stonyford	RS07S020300	Shanco Bridge	4 (1981 - 1985)	Good	
Stonyford	RS07S020400	Stonyford Bridge	4 – 4.5 (1976 - 1985)	Good (1985)	High (1976)
Boyne	RS07B041000	Derrinydaly Bridge	4 - 5 (1974 – 1986)	Good (1979)	High (1986)

8.4.5.1.2 1988 Baseline EPA Q-Ratings

No Biological Q-rating data is available for 1988 due to the fact that no EPA monitoring was completed during this calendar year. However, EPA Q-rating monitoring was completed on the Deel (Raharney), Stonyford and Boyne rivers in the vicinity and downstream of the Application Site in 1985 and 1986.

This historic data, listed in Table 8-8, shows that the Deel (Raharney), Stonyford and Boyne rivers downstream of the Application Site were of 'Good' or 'High' Q-value status in 1988. Meanwhile upstream of the Application Site, the Deel(Raharney) River achieved 'Moderate' status upstream of Cummer Bridge (Station Code: RS07D010100). However, all 5 no. monitoring stations downstream of the Application Site on the Deel (Raharney) River achieved 'High' Q-value status (Station Code: RS07D010200 – RS07D010600). To the east and downstream of the Application Site the Stonyford

River was of 'Good' status (Station Code: RS07S020100 - RS07S020400). The Boyne River achieved 'Good' Q-value status downstream of its confluence with the Deel (Raharney) river (Station Code: RS07B040800) and 'High' Q-rating status downstream of its confluence with the Stonyford River (Station Code: RS07B041000).

Table 8-8: Baseline (1988) Q-ratings

River	Station ID	Location	EPA Q-Rating (Year)	Q-Value Status
Deel (Raharney)*	RS07D010100	Bridge upstream Cummer Bridge (upstream of Application Site)	3.5 (1985)	Moderate
Deel (Raharney)	RS07D010200	Cummer Bridge	4-5 (1985)	High
Deel (Raharney)	RS07D010300	Raharney Bridge	4-5 (1985)	High
Deel (Raharney)	RS07D010400	Inan Bridge	5 (1985)	High
Deel (Raharney)	RS07D010500	Clondalee Bridge	4-5 (1985)	High
Deel (Raharney)	RS07D010600	Bridge upstream of Boyne River confluence	4-5 (1985)	High
Boyne	RS07B040800	Inchamore Bridge	4-5 (1986)	High
Boyne	RS07B040900	Scariff Bridge	5 (1986)	High
Stonyford	RS07S020100	Bridge upstream of Rathkenna Bridge	4 (1985)	Good
Stonyford	RS07S020200	Earl's Bridge	4 (1985)	Good
Stonyford	RS07S020300	Shanco Bridge	4 (1985)	Good
Stonyford	RS07S020400	Stonyford Bridge	4 (1985)	Good
Boyne	RS07B041000	Derrinydaly Bridge	5 (1986)	High

8.4.5.1.3 EPA Q-Ratings during Peat Extraction Phase (1988-2020)

EPA Q-rating monitoring has been completed at several dates and at multiple locations on the Deel (Raharney), Stonyford and Boyne rivers in the vicinity and downstream of the Application Site between 1988 and 2020.

Historic Q-values for the Deel(Raharney) River are shown in Table 8-9 and Figure 8-17. The Deel (Raharney) River receives drainage from Bracklin and Ballivor bogs as outlined above. Of the monitoring locations situated downstream of the Application Site, 'High' status was not achieved after 1990. The Deel (Raharney) River achieved 'High' status downstream of the Application Site and upstream of its confluecne with the River Boyne in 1990 (Station Code: RS07D010600). The lowest Q-value assigned to the Deel(Raharney) River downstream of the Application Site occurred at Raharney Bridge in 2003 when it achieved 'Poor' status (Station Code: RS07D010300). Generally however the Q-ratings downstream of the Application Site have fluctauted between 'Moderate' and 'Good' Q status during the Peat Extraction Phase.

For comparison the Q-ratings of the Deel (Raharney) River upstream of the Application Site have also been investigated. While the Deel (Raharney) River achieved 'High' status in 1997 near Mabestown (Station Code: RS07D010070), no significant disparities exist between the recorded Q-values at these monitoring stations and those in the vicinity and downstream of the site.

Table 8-9: Summary of Q-Ratings on the Deel(Raharney) River during the Peat Extraction Phase (1988 – 2020)

Station ID	Location Description	Easting	Northing	Available Data	EPA Q-Rating Range
RS07D010070	Bridge west of Mabestown (upstream of site)	255870	265493	1990 - 2020	3.5 – 4.5
RS07D010090	Bridge upstream of Lough Analla (upstream of site)	256495	262448	1990 – 2003	3 - 4
RS07D010100	Bridge upstream of Cummer Bridge (upstream of site)	257915.83	260230.25	1985 - 1990	3.5 – 4.5
RS07D010200	Cummer Bridge	258458	257621	1985 – 2020	3.5 – 4
RS07D010300	Raharney Bridge	260085	253021	1985 - 2020	3.5 – 4
RS07D010400	Inan Brodge	263452	250407	1985 - 2020	3.5 – 4
RS07D010600	Bridge upstream of confluence with Boyne River	269031	249313	1985 - 2020	3.5 - 4

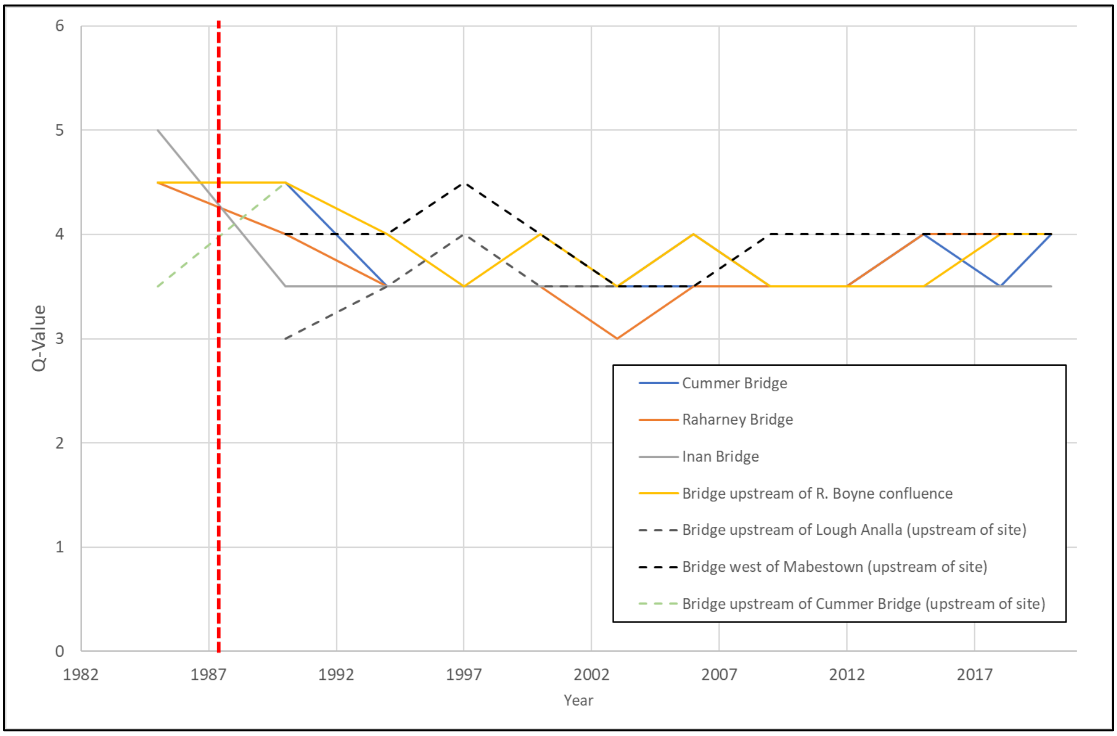


Figure 8-17: Biological Q-Rating Changes on the Deel (Raharney) River during the Peat Extraction Phase (1988 – 2020)

Historic Q-values for the Stonyford River are shown in Table 8-10 and Figure 8-18. The Stonyford River recieves discharge from Lisclogher, Lisclogher West, Bracklin and Carranstown bogs. Of the monitoring locations situated downstream of the Application Site, 'High' status was not achieved at any date duting the Peat Extraction Phase. The lowest Q-value assigned to the Stonyford River downstream of the site at Stonyford Bridge (Station Code: RS07S020075) and at a bridge near Rathkenna (Station Code: RS07S020100) which both achieved 'Poor' status in 2020. Generally however the Q-ratings downstream of the Application Site have fluctauted between 'Moderate' and 'Good' Q status during the Peat Extraction Phase.

For comparison the Q-ratings on the Stonyford River upstream of the Application Site have also been investigated. The Q-ratings at these upstream locations are comparable to those located downstream of the Application Site and no significant disparities exist.

Table 8-10: Summary of Q-Ratings on the Stonyford River during the Peat Extraction Phase (1988 – 2020)

Station ID	Location Description	Easting	Northing	Available Data	EPA Q-Rating Range
RS07S020065	Bridge near Ballinlough (upstream of Application Site)	262027	264264	2000 - 2020	3.5 – 4
RS07S020070	Bridge near Clonmaskill (upstream of Application Site)	262103	262562	1990 - 1997	3.5
RS07S020075	Stonestown Bridge (upstream of	263805	261681	2000 - 2020	3 – 4

Station ID	Location Description	Easting	Northing	Available Data	EPA Q-Rating Range
	Application Site)				
RS07S020100	Upstream of Rathkenna Bridge	268303	257165	1981 - 1985	4
RS07S020090	Upstream of Rathkenna Bridge	267684	258139	1990 - 2003	3.5 – 4
RS07S020080	Lisclogher Bridge	265568	261131	1990 - 1997	3.5 – 4
RS07S020400	Stonyford Bridge	273148	253252	1990 - 2020	3.5 – 4.5
RS07S020300	Shanco Bridge	270561	254707	1990 - 2003	4
RS07S020200	Earl's Bridge	269403	256080	1990	4

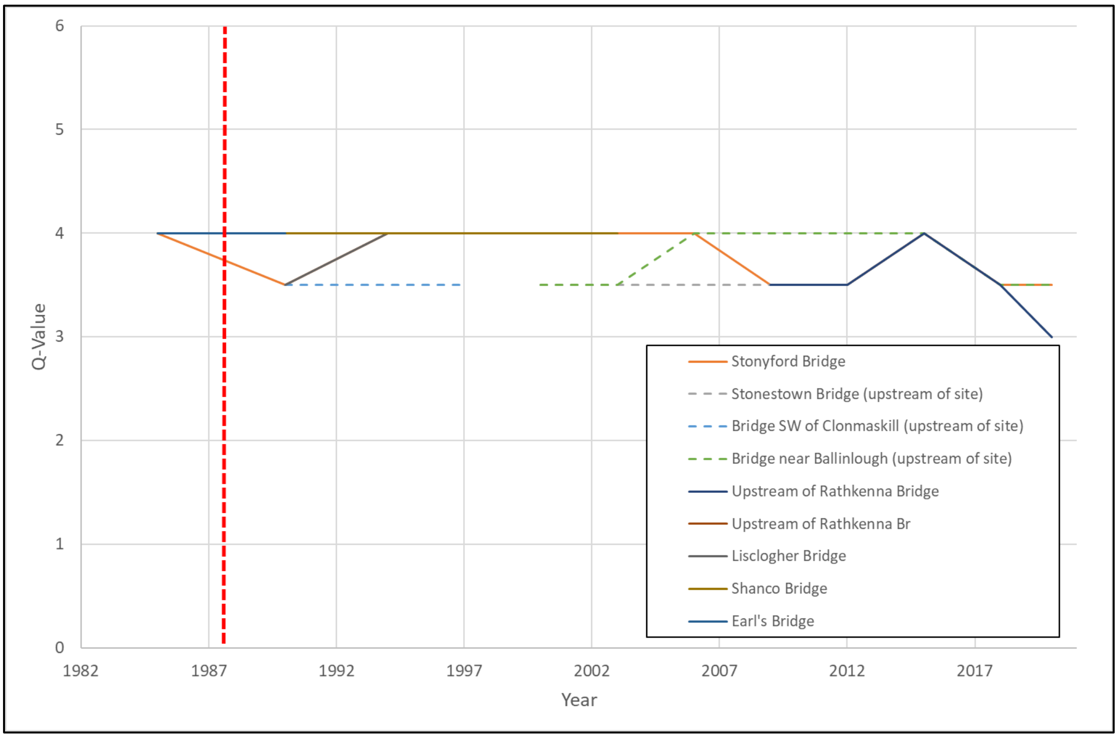


Figure 8-18: Biological Q-Rating Changes on the Stonyford River during the Peat Extraction Phase (1988 – 2020)

Historic Q-values for the River Boyne are shown in Table 8-11 and on Figure 8-19. The Boyne River recieves discharge from Carranstown and Ballivor Bogs and from the remainder of the site via the Deel (Raharney) and Stonyford Rivers. Of the monitoring locations situated downstream of the Application Site, 'High' status was achieved on 2 no. occasions at Inchamore Bridge (Station Code: RS07B040800). The lowest Q-rating status assigned to the Boyne River during the Peat Extraction Phase was 'Moderate' status. Generally the Q-ratings downstream of the Application Site have fluctuated between 'Moderate' and 'Good' Q status during this phase of the Project.

For comparison the Q-ratings of the Boyne River at Ashfield Bridge (Station Code: RS07B040600), located upstream of the confluence of the Boyne and Deel (Raharney) rivers have also been investigated. The Boyne at Ashfield achieved 'Poor' status on 2 no. occasions during this time period and did not achieved 'Good' status at any time post dating 1994.

Table 8-11: Summary of Q-Ratings on the Boyne River during the Peat Extraction Phase (1988 – 2020)

Station ID	Location Description	Easting	Northing	Available Data	EPA Q-Rating Range
RS07B040600	Ashfield Bridge	268466	244868	1990 - 2020	3 – 3.5
RS07B040800	Inchamore Bridge	271093	249913	1990 - 2020	3.5 – 4.5
RS07B040900	Scariff Bridge	273392	252679	1990 - 2020	3.5 - 5
RS07B041000	Derrinydaly Bridge	276679	253937	1990 - 2020	3.5 – 5
RS07B041100	Downstream of Athboy confluence	278039	256559	1990 - 2020	3.5 - 4

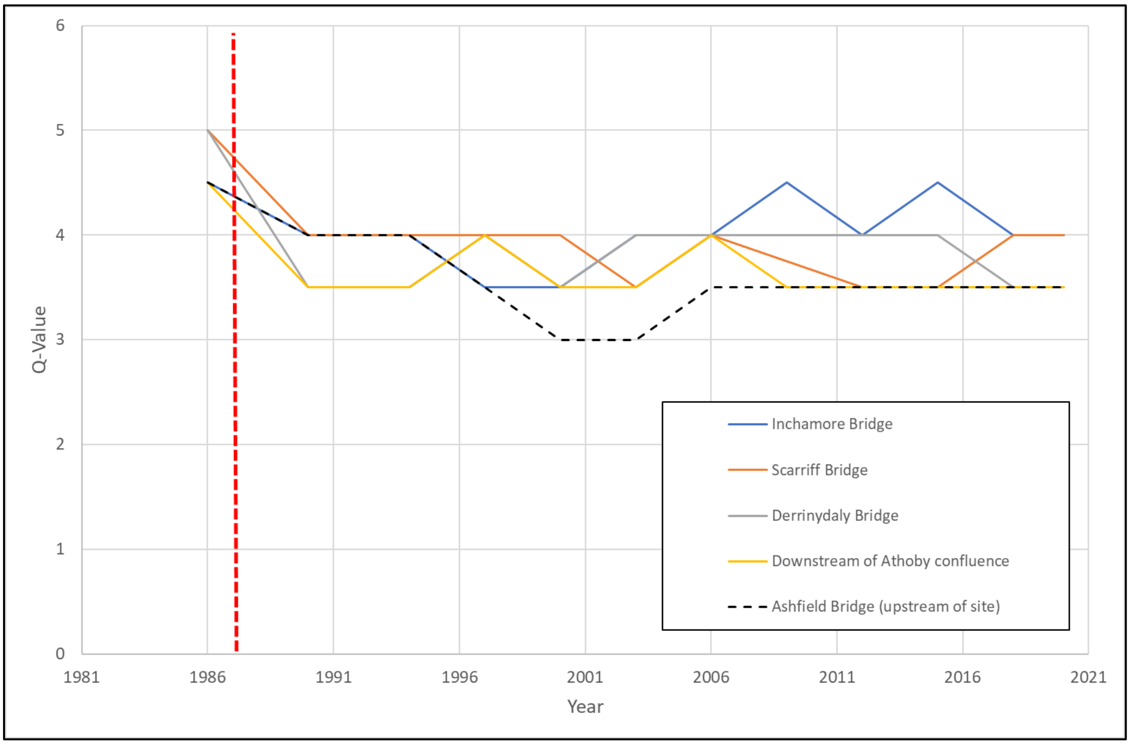


Figure 8-19: Biological Q-Rating Changes on the Boyne River during the Peat Extraction Phase (1988 – 2020)

8.4.5.1.4 EPA Q-Ratings During Current Phase (June 2020 – Present Day)

No available EPA Biological Q-rating monitoring data postdates 2020. The most recent Q-rating data for the Deel (Raharney), Stonyford and Boyne rivers is presented in Table 8-12 below. This data shows that the Q-status of the Deel (Raharney), Stonyford and Boyne rivers downstream of the Application Site ranges from 'Poor' to 'Good' status.

A total of 4 no. EPA monitoring points are available for 2020 along the Deel (Raharney) River to the west and downstream of the Application Site. Here the Deel (Raharney) River achieved a Q4 rating *i.e.* 'Good' status, at 3 no. locations (Station Codes: RS07D010200, RS07D010300 and RS07D010600) and a Q3-4 rating i.e. 'Moderate' status, at 1 no EPA monitoring location (Station Code: RS07D010400). Meanwhile to the east and downstream of the Application Site, the Stonyford River achieved 'Poor' status at 1 no. monitoring location (Station Code: RS07S020100) and 'Moderate' status further downstream (Station Code: RS07S020400). The Boyne River achieved 'Good' Q-value status downstream of its confluence with the Deel (Raharney) river (Station Code: RS07B040800 and RS07B040900) and 'Moderate' Q-rating status downstream of its confluence with the Stonyford River (Station Code: RS07B041000).

A map of EPA monitoring locations for the most recent round of monitoring is shown as Figure 8-20.

Table 8-12: Most Recent (2020) Q-ratings

River	Station ID	Location	EPA Q-Rating (Year)	Q-Value Status
Deel (Raharney)	RS07D010200	Cummer Bridge	4 (2020)	Good
Deel (Raharney)	RS07D010300	Raharney Bridge	4 (2020)	Good
Deel (Raharney)	RS07D010400	Inan Bridge	3-4 (2020)	Moderate
Deel (Raharney)	RS07D010600	Bridge upstream of Boyne River confluence	4 (2020)	Good
Boyne	RS07B040800	Inchamore Bridge	4 (2020)	Good
Boyne	RS07B040900	Scariff Bridge	4 (2020)	Good
Stonyford*	RS07S020075	Stonestown Bridge	3 (2020)	Poor
Stonyford	RS07S020100	Bridge upstream of Rathkenna Bridge	3 (2020)	Poor
Stonyford	RS07S020400	Stonyford Bridge	3-4 (2020)	Moderate
Boyne	RS07B041000	Derrinydaly Bridge	3-4 (2020)	Moderate

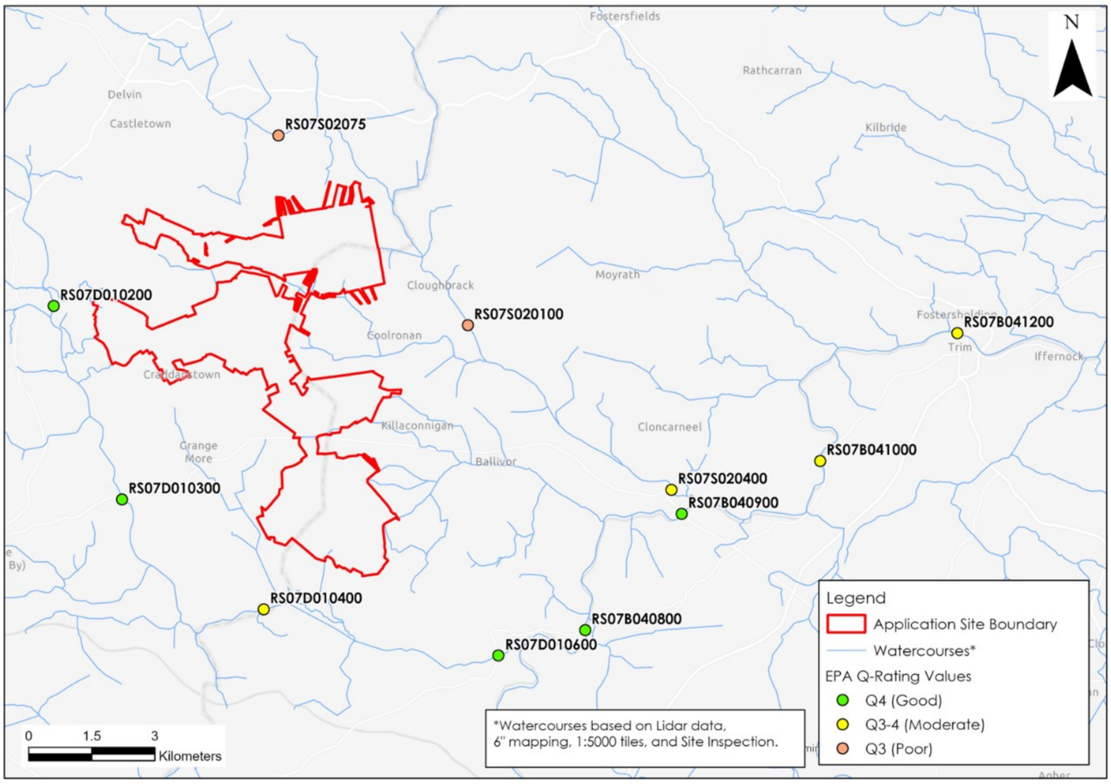


Figure 8-20: EPA Monitoring Locations

8.4.5.2 Bord na Móna Monitoring

8.4.5.2.1 *Pre - 2000*

Before the implementation of the IPC Licence requirements and associated monitoring discussed in Section 8.4.5.2.2 below, limited monitoring of surface water quality and emissions was completed at the Application Site by the Applicant.

However as discussed in Chapter 4, Section 4.7.1.1, several control measures designed to protect surface water quality were in place prior the IPC Licence. These measures related to the storage and maintenance of vehicles, refuelling procedures, the maintenance of internal drains, pumps and waste management. However, no records of surface water quality monitoring exist from this time period.

Silt ponds were constructed at the Ballivor Bogs in the mid-1980s, with no effluent control measures present before this date. These silt ponds were constructed with an upper limit of 100mg/l of suspended sediment.

8.4.5.2.2 *IPC Licence Monitoring (2000-Present)*

The Applicant has been conducting monitoring of emissions to water from the Application Site drainage system from 2000 to the present as set out in IPC Licence P0501-01 which came into effect in 2000.

Stormwater (i.e., rainwater run-off from roof and non-process areas such as carparks) derived on-site is released into a local waterbody following basic treatment. The IPC licence requires that stormwater (from roof and non-process areas such as carparks) is managed to ensure that no pollutants are released into the receiving environment. Where run-off comprises of only roof water it is directed directly to a drain. Runoff from other areas such as carparks is passed through a hydrocarbon interceptor before discharge. The waterbodies which are listed as receiving stormwater run-off at this site are the Boyne and Stonyford rivers. Discharges (from roof and non-process areas such as carparks) are inspected and sampled on a monthly basis. The primary treatment criteria used to define adequate treatment of stormwater is COD mg/l. Monthly sampling was completed with results being generally well below the COD trigger levels. Occasionally elevated concentrations occurred when machinery had been washed down immediately prior to sampling and subsequent results returned to satisfactory levels.

The EPA licence has also required that wastewater at the Application Site be managed to ensure no pollution results when wastewaters were discharged into local surface waterbodies. Two types of wastewaters were produced at the Application Site: Process wastewater from the activities associated directly with peat harvesting operations and sanitary wastewater from toilets and canteens. All process wastewater from peat extraction activities and all ancillary works areas is treated via a silt pond drainage system which has been inspected and maintained in accordance with Condition 6 of the IPC Licence. Treated wastewater is released into the Deel(Raharney), Stonyford and Boyne Rivers. IPC Licence requirements comprise of quarterly grab samples on a select number of silt pond outlets.

Across the 5-no. bog comprising the Ballivor Bog Group a total of 244 grab samples (between 14/09/2000 and 01/12/2022) have been taken and analysed for COD, pH, Ammonia, Total Phosphorous, Suspended Solids, Total Solids and Colour. The emission limit values are 35mg/l suspended solids, 2.78mg/l total ammonia, and 100mg/l COD.

As shown in Figure 8-21, no exceedances of Ammonia (I/PV (parameter value) for A3 water is 4 mg/L) have been recorded across the Application Site. The lowest mean concentration of ammonia (0.47mg/l) was recorded in the outfalls from Ballivor Bog, while the greatest mean concentration (0.97mg/l) was recorded in outfalls from Bracklin Bog. The I/PV for A3 waters is 4mg/l and all sampling results are below this value. A total of 10 no. exceedances have been recorded above the IPC Licence trigger limit of 2.78mg/l, with 9 of these exceedances coming from outfalls from Lisclogher Bog and 1 from an outfall from Carranstown Bog. These were recorded at outfall SW31 (2.8mg/l) from Carranstown Bog in Q2 2018, and at outfall SW33 (2.8mg/l) from Carranstown Bog in Q2 2018; on 8 no. occasions at outfall SW25 from Lisclogher Bog: Q2 2014 (2.8mg/l), Q2 2015 (3.4mg/l), Q1 2018 (2.9mg/l), Q4 2019 (3.49mg/l), 2 no. occasions in Q2 2021 (2.98 – 3.15mg/l) and 2 no. occasions in Q4 2021 (2.94 – 3.38mg/l); on 1 no. occasions at outfall SW22 from Lisclogher Bog: Q2 2015 (3.4mg/l). However, it is not unusual for surface water emanating from peatlands to contain slightly elevated ammonia concentrations.

As shown in Figure 8-22, 6 no exceedances of the IPC limit for Suspended Solids have been recorded in outfalls from the Application Site. The concentrations of suspended solids typically ranged from 5-10mg/l. A total of 6 no. exceedances are reported for the period from 2000-2021 which comprised a total of 335 no. samples. These exceedances occurred at SW31 outfall from Carranstown Bog (56mg/l) in Q2 2006, at SW32 outfall from Carranstown Bog (56mg/l) in Q2 2006 and at outfall SW30 from Bracklin Bog (37mg/l) in Q4 2007. In addition, 3 no. exceedances were recorded in outfalls from Ballivor Bog in 2021 (37, 37 and 56mg/l) However as seen below, these exceedances are outliers with 75% of all data being less than or equal to 16mg/l in each bog. The mean concentration of suspended solids recorded in the outfalls from individual bog units ranges from 6.1mg/l in Bracklin to 8.3mg/l in Carranstown.

As shown in Figure 8-23, 75 no. exceedances of COD have been recorded in outfalls from the Application Site. The mean concentration of COD from each individual bog unit lies below the IPC Limit of 100mg/l. The mean concentration of COD at Ballivor, Bracklin, Carranstown and Lisclogher Bog was 89mg/l, 75mg/l, 92mg/l and 75mg/l respectively. The greatest concentrations of 440mg/l were recorded in outfall SW29 and SW30 from Bracklin Bog in Q3 2020. Reduced flow and increased temperature can influence COD concentrations.

Other parameters recorded during the sampling included Total Phosphorous and pH. Total phosphorous remained relatively stable across the 20-year monitoring period and across all bogs with concentrations ranging from 0.05 - 0.65mg/l. pH values were generally within the recommended 6 – 9 range, however, 5 no. pH recordings from outfalls in Lisclogher Bog were below the lower pH limit of

6. It is not uncommon to record low pH concentrations from peat bogs. In general, however, pH values emanating from peat extraction activities and all ancillary works areas remain relatively constant and in line with background levels.

Quarterly flow monitoring was completed at 2 no. outfall locations in Bracklin and Carranstown bogs from 2004 to 2012. Flows ranged from 0-65.7l/sec with the greatest flows observed in Q1 and Q4 responding to increased volumes of precipitation during the winter months.

With regard to the most recent AER report from 2023, all samples were compliant with respect to suspended solids and ammonia. Meanwhile, the trigger level for COD was breached on 7 no. occasions. The Aer states that there was no obvious reason for breaching these trigger levels, other than naturally occurring background concentrations of COD. All exceedances were reported to the EPA.

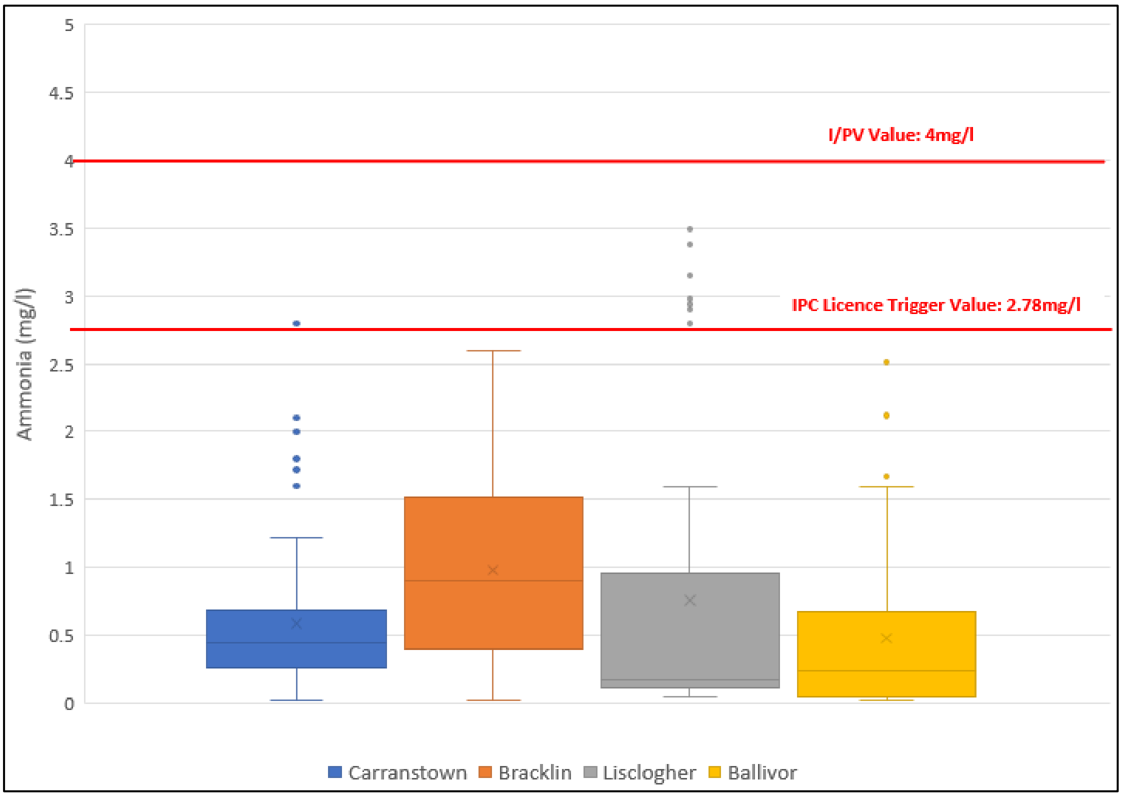


Figure 8-21: Bord na Móna Ammonia Monitoring (2000-2021)

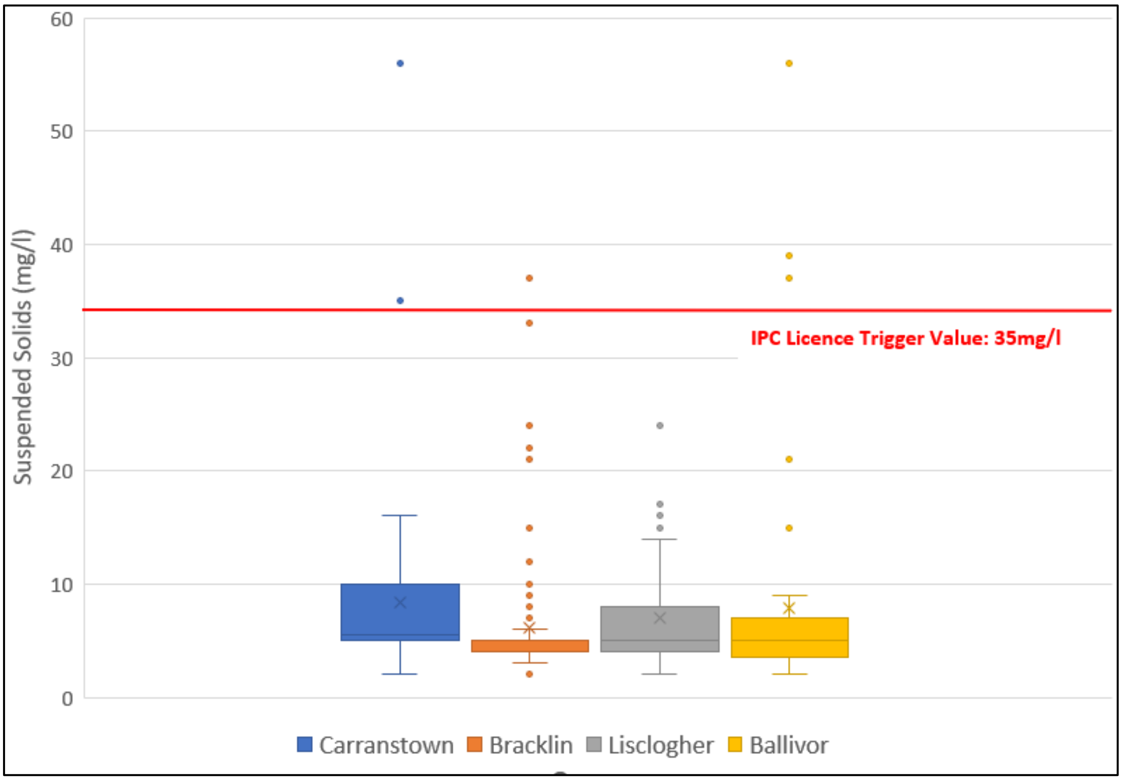


Figure 8-22: Bord na Móna Suspended Solids Monitoring (2000-2022)

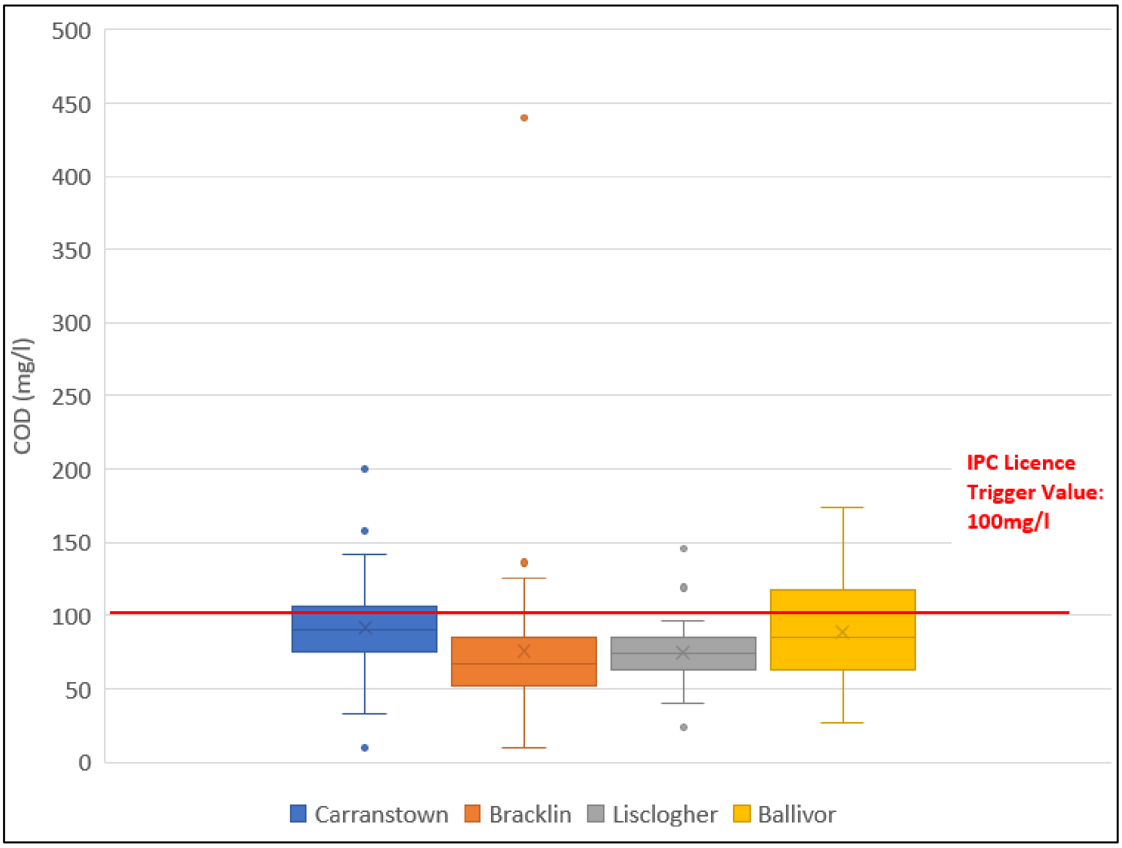


Figure 8-23: Bord na Móna COD Monitoring (2000-2022)

Table 8-13: Bord Na Móna water quality monitoring data (2000-2022)

Bog Name	No. Samples	COD (mg/L)	pH $[H^+]$	Ammonia (mg/L)	Total Phosphorous (mg/L)	Suspended Solids (mg/L)	Flow (L/s)
		Range	Range	Range	Range	Range	Range
Ballivor	36	27 - 174	7.1 - 8.1	0.02 - 2.51	0.05 - 0.21	2 – 56	-
Carranstown	86	10 – 200	6.0 – 8.3	0.02 - 2.8	0 - 0.65	2 - 56	0.1 65.7
Bracklin	81	10 - 440	5.4 - 7.9	0.019 - 2.6	0.05 - 0.5	2 37	0 - 20.5
Lisclogher & Lisclogher West	41	24 - 146	4.3 - 8.1	0.04 - 3.49	0.05 - 0.14	2 - 24	-
IPC Licence Limit		**100mg/l**	**6 - 9**	**2.78g/l**	-	**35mg/l**	-
n - (number of sample results)		244	244	244	243	243	NA
No. Exceedances		75	NA	10	NA	6	NA
% Compliant		69%	NA	96%	NA	98%	NA

8.4.5.3 HES Surface Water Quality Monitoring (2021 - 2022)

As part of the application for the proposed Ballivor Wind Farm, surface water sampling and field hydrochemistry was conducted by HES during 3 no. sampling rounds on 21st April, 28th October 2021 and 19th January 2022. Field hydrochemistry measurements were recorded within surface watercourses directly downstream of the Application Site. The results are listed in **Table 8-14.** The monitoring locations were typically small streams and drainage channels and are shown on **Figure 8-24**.

Specific conductivity (SPC) values at the monitoring locations ranged between 126 and 814µS/cm, with an average conductivity value of 581µS/cm. Turbidity ranged from 3.1 to 67.3NTU, with an average of 8.6NTU. The highest turbidity was recorded at SW1 within the Stonyford_030 SWB to the west of Lisclogher Bog. This (67.3NTU) turbidity value is anomalously high and most likely due to disturbance of sediment within the water column prior to sampling. Excluding this value, the turbidity ranged between 3.1 – 16.2 NTU. Dissolved Oxygen ranged from 4.72 to 11.04mg/l.

The pH values were generally slightly basic, ranging between 6.5 and 7.94, with an average pH of 7.54. Slightly acidic pH values of surface waters would be typical of peatland environments due to the decomposition of peat. However, the pH is likely higher due to the high temperatures and dry weather which preceded the monitoring.

Table 8-14: Field Parameters - Summary of Surface Water Chemistry Measurements (01/04/2021-19/01/2022)

Location ID	Easting	Northing	Temp °C	DO (mg/l)	SPC (µS/cm)	pH	Turbidity	Flow (l/s)
SW1	267157	258608	7.7 – 12.7	7.7 – 8.74	602 – 655	6.98 - 7.43	6.4 - 67.3	5 – 20
SW2	265941	256979	8.4 – 12.6	7.76 - 10.5	488 – 620	7 - 7.74	4.2 - 7.34	250 – 500
SW3	264510	257940	8.6 – 12.5	7.82 - 10.41	520 – 655	6.73 - 7.7	6.4 – 11.3	40 – 200
SW4	264256	257932	9.1 – 12.4	7.21 - 7.38	240	6.5 - 6.8	6.6 – 7.2	Dry – 15
SW5	263963	258213	8 – 12.5	7.68 - 10.31	534 – 653	7.1 - 7.72	4.5 - 6.9	150 – 500
SW6	262538	258647	8.1 – 12.4	6.08 - 10.52	635 – 747	6.9 - 7.84	5.07 – 16.2	150 – 200
SW7	259076	256500	8.4 – 12.9	9.32 - 9.48	561 – 582	7.47 – 7.62	6.03 – 11.4	60 – 150
SW8	265096	256383	9.3 – 12.8	7 - 9.9	438 – 538	6.75 - 7.67	9.05 - 13.5	100 – 300
SW9	261633	254196	8.5 – 12.7	7.57 - 9.94	667 - 752	7.33- 7.65	4.71 – 7.9	50 – 150
SW10	263431	254466	7.7 – 12.3	6.59 - 8.18	668 – 818	7.05 – 7.37	5.03 - 5.8	20 – 50
SW11	263814	254919	5.4 – 11.7	4.72 - 7.87	126 - 169	6.9 - 7.42	7.3 – 8.7	0
SW12	267169	254292	7.8 - 12.9	7.92 - 9.98	695 – 760	7.52 - 7.65	4.55 - 7.26	30 – 180
SW13	268774	253917	7.4 – 13.1	7.62 - 9.81	656 – 759	7.49 - 7.77	6.52 – 6.9	240 – 500
SW14	265783	256564	10 - 12.4	7.48 - 7.74	304	6.77 - 7.24	6.1 - 6.42	Dry - 20
SW15	268302	257158	8.4 – 12.9	8.27 - 11	725 -814	7.58 - 7.94	3.1 - 3.43	5000
SW16	267309	251730	7.8 – 13.3	7.32 - 8.85	504 -733	7.34 - 7.53	3.7 - 5.73	50 – 250
SW17	269032	249280	8.2 – 12.9	7.64 - 10.09	663 – 708	7 - 7.89	6.45 - 6.56	5000
SW18	266930	253281	7.1 – 12.9	9.75 - 11.04	357 - 422	7.76 - 7.91	7.4 - 8.36	15 - 75

Surface water samples were also taken at these locations for laboratory analysis. Results of the laboratory analysis are shown alongside relevant water quality regulations in Table 8-15 below. In addition, the European Communities Environmental Objectives (Surface Waters) Regulations (S.I. No. 272 of 2009) are shown in Table 8-15. Original laboratory reports are attached as Appendix 8-2.

Table 8-15:Laboratory Data (01/04/2021-19/01/2022)

Location ID	Suspended Solids (mg/l)	BOD_5 (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l NO_3)	Ammonia (mg/l)	Chloride (mg/l)
EQS	≤25(1)	≤ 1.3 to ≤ 1.5(2)	-≤ 0.035 to ≤0.025(2)	-	-≤0.065 to ≤ 0.04(2)	-
SW1	13 - 40	1 - 4	<0.02 – 0.09	<5 – 13.2	0.2 – 0.6	12.9 – 22
SW2	6 - 19	1 - 4	0.02 - 0.09	11.8 – 21.5	0.13 - 0.25	11 – 15.2
SW3	<5 – 10	1 - 4	0.02 – 0.04	14.8 – 27.9	0.09 - 0.12	12.5 - 15.8
SW4[3]	6 - 80	2 - 3	0.11 - 0.33	<5	0.03 – 0.05	10 - 18.4
SW5	<5 - 5	1 - 2	<0.02 – 0.03	<5 – 28.4	0.12 – 0.2	11 - 15.9
SW6	<5 - 6	1 - 4	<0.02 – 0.03	19.7 – 35.4	0.11 – 0.13	17.3 - 17.6
SW7	<5 - 14	1 - 3	<0.02 - 0.03	<5 – 5.2	0.23 - 0.46	4.6 - 13.6
SW8	<5 - 32	1 - 4	<0.02 - 0.03	6.3 – 8.5	0.14 - 0.74	8.1 - 10.8
SW9	<5	1 - 3	<0.02 – 0.02	5.5 – 10.2	0.03 - 0.08	8 – 13.1
SW10	<5 - 14	1 - 2	<0.02 – 0.05	6.1 – 21.8	0.04 - 0.39	22.8 – 28.5
SW11	<5 - 8	2 - 4	<0.02	<5	0.12 – 0.22	6.5 - 13.6
SW12	11 - 29	1 - 3	<0.02	<0.05 - 11.9	0.05 – 0.11	16.9 - 23.9
SW13	<5 - 13	1 - 3	0.02 - 0.04	7 – 11.8	0.06 – 0.18	13.7 – 20.9
SW14[4]	6 - 9	2 - 4	0.06 - 0.3	<5	0.14 - 0.56	9.7 - 13
SW15	6 - 31	<1 - 3	<0.02	11.4 – 20.3	0.06 – 0.11	15.6 – 18.3
SW16	<5 - 6	<1 - 3	0.02 - 0.04	<5 – 9.8	0.2 - 0.37	10.7 - 18.3
SW17	5 - 12	<1 - 4	<0.02 – 0.03	9 – 15.3	0.04 – 0.09	12 - 15.5
SW18	6 - 51	1 - 3	0.02 – 0.04	<5 – 6.2	0.03 – 0.12	8.3 – 12.3

Suspended solid concentrations ranged from <5 to 80mg/l. Suspended solids were above the S.I 293/1988 threshold limits of 25 mg/L in 8 of the 52 no. samples.

Ammonia ranged between 0.03 to 0.74 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 SI 272/2009. The presence of elevated ammonia is likely due to natural decomposition of peat.

Biological Oxygen Demand (BOD) ranged between <1 and 4 mg/l, with an average value of 2.07 mg/L, above the Good status[1] threshold value of 1.5 mg/L. Nitrate ranged between <5.0 and 35.4 mg/l and results were typically between 5-15 mg/l which is what would be expected in a peatland environment.

---

[1] S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations
[2] S.I. No. 272 of 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).
[3] Only 2 no. rounds of sampling completed on 21/04/2021 and 28/10/2021.
[4] Only 2 no. rounds of sampling completed on 21/04/2021 and 28/10/2021.

Nitrite was below the limit of detection of the laboratory in 67% of the samples, with the nitrite concentration in the remaining samples ranging from <0.05 to 0.15mg/l.

In comparison to S.I. No. 272/2009, 33 of 52 results (63%) for BOD exceeded the "Good Status" and "High Status" threshold values. In relation to ammonia, 41 of 52 samples (79%) exceeded the "Good Status" threshold of -≤0.065mg/l. For orthophosphate, 19 of the 52 no. samples (37%) were below the laboratory limit of detection (0.02mg/L), while a total of 13 of the 52 no (25%). no samples exceed the "Good Status" threshold of 0.035mg/l.

*Table 8-16: Chemical Conditions Supporting Biological Elements**

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	Good status ≤ 1.5 mean
Ammonia-N	High status ≤ 0.04 (mean)
	Good status ≤0.065 (mean)
Orthophosphate	High status ≤0.025 (mean)
	High status ≤0.025 (mean)
	Good status ≤0.035 (mean)

* S.I. No. 272 of 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).

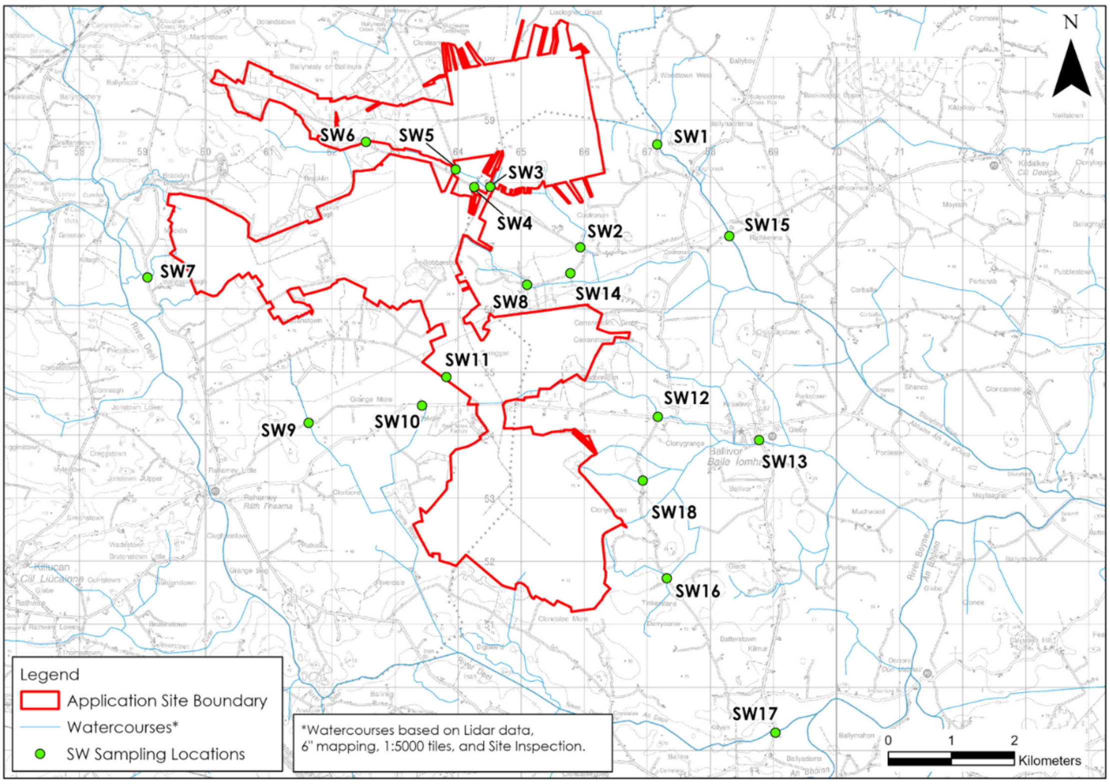


Figure 8-24: HES Surface Water Sampling Locations (2021-2022)

8.4.6 Hydrogeology

The majority of the bedrock geology underlying the Application Site including the Dinantian Pure Unbedded Limestones of the Waulsortian Limestone Formation and the Dinantian Upper Impure

Limestones of the Lucan Formation are classified by the GSI as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll). The Tober Colleen Formation which underlies sections of Lisclogher, Lisclogher West and Bracklin Bog is classified as a Poor Aquifer – Bedrock which is Generally Unproductive except for Local Zones (PI). A bedrock geology aquifer map is attached as Figure 8-25.

The 5 no. bogs comprising the Application Site are underlain by the Athboy Groundwater Body (GWB) (IE_EA_G_001) which is characterized by poorly productive bedrock. This is a large GWB that extends from Navan in the northeast to Tyrrellspass in Westmeath. The topography of the GWB is relatively low, with overall elevations falling from northwest to southeast. The GWB is composed primarily of moderate permeability rocks, although localized zones of enhanced permeability do occur. Groundwater flow will mainly occur laterally through the upper weathered zone of the aquifer. Below this, flow occurs along fractures, faults and karstic conduits. Recharge occurs diffusely through the subsoils and via outcrops and in some local areas direct recharge may be possible where via sinking streams. The aquifers are generally unconfined but may be locally confined where the subsoil is thicker and/or less permeable. Regional groundwater flow is from northwest to southeast, but locally, groundwater discharges to the streams and rivers crossing the aquifer. In general, groundwater flow paths will be less than a kilometre from recharge to discharge point; longer groundwater flow paths may develop where there is a higher degree of karstification. Groundwater discharges to the numerous small streams crossing the aquifer, and to the springs and seeps. There may also be some discharge to the Trim GWB to the east of this body.

Due to the presence of the peat at the Application Site and the bulk low permeability of the underlying mineral soil deposits, local groundwater recharge will be minimal. Recharge is likely to be limited to the perimeter of the bog where the peat is thin or absent (the presence of peat will prevent rapid recharge to underlying regional groundwater systems). Groundwater movement through the underlying subsoil glacial deposits will be relatively slow unless higher permeability sands and gravels are present. Based on topography and regional surface water drainage flows, local groundwater flow direction is towards the southeast of the Application Site, towards the River Boyne. As stated above more localised groundwater flow directions will occur, with groundwater discharging to nearby streams and rivers such as the Deel(Raharney) river to the west of the Application Site and the Stonyford river to the east.

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 till and bedrock). There has been little alteration of the hydrogeological (regional groundwater, i.e. the groundwater system below the bogs, which is separate (perched above) from the near surface peatland hydrogeology) environment at the Application Site from predevelopment to the present day. The underlying hydrogeological baseline environment *i.e.* the underlying bedrock and aquifer type does not change over time. However, the primary method of change is the alteration of the hydrological (surface water) regime.

Bog drainage may alter the hydrogeological regime very slightly, by increasing the ratio of runoff to recharge. In general, peat bogs are typically characterised by low groundwater recharge, with the GSI generally estimating recharge rates of ~4% of effective rainfall for peat bogs. Therefore, the scale of any change has to be understood in the context that the Application Site would have had a very high natural runoff rate. The peat at the Application Site is broadly underlain by low permeability clays and gravelly clay, which further limit the infiltration of water downwards into the underlying aquifer. Rainfall is therefore stored within the peat and slowly infiltrates to ground or discharges (via surface water runoff) to streams surrounding the bogs. Following the drainage of the bog, the hydrology changes and storage is reduced within the peat by creating drainage channels to channel rainwater off the bogs and directly to streams/waterbodies.

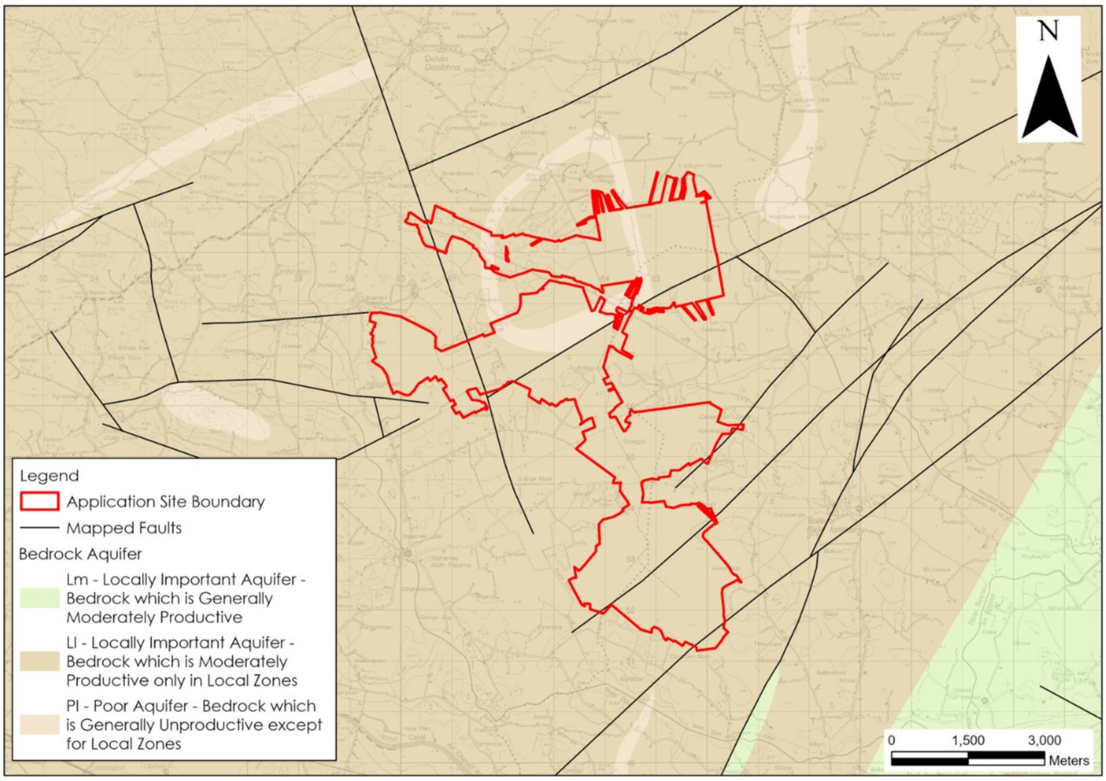


Figure 8-25: Bedrock Geology Aquifer Map

8.4.7 Groundwater Vulnerability

Groundwater Vulnerability is a term used to represent the natural ground characteristics that determine the ease with which groundwater may be contaminated by human activities (www.gsi.ie). More scientifically, groundwater vulnerability embodies the characteristics of the intrinsic geological and hydrogeological features at a site that determine the ease of contamination of groundwater.

According to the GSI online database (www.gsi.ie) the vulnerability rating of the bedrock aquifer underlying Application Site is classified as "Moderate" to "Low" which is consistent with the presence of basin peat underlain by lacustrine/mineral soil clays and glacial deposits. 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.

Groundwater vulnerability is extremely high in karst areas due to the high degree of interconnection between surface and groundwaters in these areas. The GSI does not record the presence of any karst features within the Application Site or in its immediate vicinity. The closest mapped karst feature is a spring (GSI Identifier: 2325SEK005) located in the townland of Dardistown, ~2.7km northwest of Bracklin Bog.

8.4.8 Groundwater Hydrochemistry

There is no groundwater quality data for the aquifers underlying the Application Site. Groundwater sampling would generally not be undertaken during the process of peat extraction activities and all ancillary works, as groundwater quality impacts would not be anticipated given the shallow nature of the peat extraction activities and all ancillary works, the low potential for groundwater dispersion and movement within the underlying bedrock aquifer is outlined in the preceding section. Consequently, no groundwater sampling was required as part of the IPC licence conditions for the extraction of peat at the Ballivor Works.

The Athboy Groundwater Body Initial Characterisation Report (www.gsi.ie) states that, data collected by the EPA for this GWB indicates that the groundwaters are typically hard with a calcium-bicarbonate signature and alkalinities of over 250mg/l. Hardness generally ranges from 250 - 350 mg/l as $CaCO_3$, with high electrical conductivities (600 – 700 µS/cm). Table 8-17 provides a summary of the hydrogeological characteristics on each of the 5 no. bogs.

Table 8-17: Hydrogeological characteristics of the Ballivor Bog Group.

Bog Name	Aquifer Type	GWB	GW Vulnerability	GW Hydrochemistry	Nearest Mapped Karst Feature
Ballivor	LI	Athboy	Generally Low, some Moderate vulnerability in south and east	Generally: Ca-HCO_3, with hard water	Spring located ~7.7km to the west
Carranstown	LI	Athboy	Moderate in the east and north, Low in the South and West.	Generally: Ca-HCO_3, with hard water	Spring located ~8.5km to the west
Bracklin	LI, PI	Athboy	Generally Moderate, Low in the West	Generally: Ca-HCO_3, with hard water	Spring located ~2.7km to the northwest
Lisclogher	LI, PI	Athboy	Low	Generally: Ca-HCO_3, with hard water	Spring located ~7km to the west
Lisclogher West	LI, PI	Athboy	Low	Generally: Ca-HCO_3, with hard water	Spring located ~3.5km to the southwest

8.4.9 Water Framework Directive Water Body Status & Objectives

The EU Water Framework Directive (2000/60/EC), as amended by Directives 2008/105/EC, 2013/39/EU and 2014/101/EU ("WFD"), was established to ensure the protection of the water environment. The Directive was transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003).

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 River Basin Management Plan (2018 - 2021) objectives include the following:

- Ensure full compliance with relevant EU legislation;
- 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 2021;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at (1) targeting water bodies close to meeting their objectives and (2) addressing more complex issues that will build knowledge for the third cycle.

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.

Please note that there is no requirement to assess the peat extraction activities and all ancillary works at the Application Site which predate 2003 and the transposition of the WFD Directive into Irish Law. The impacts of the activities on the WFD status of downstream and underlying waterbodies are assessed in Appendix 8-4.

8.4.10 Groundwater Body Status

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

The Athboy GWB (IE_EA_G_001) underlies the Application Site. This GWB has been assigned 'Good Status' in all 3 no. WFD cycles (2010-2015, 2013-2018 and 2016-2021) (Table 8-18). This status is defined based on the quantitative status and chemical status of the GWB. The Athboy GWB is deemed to be "At risk" of not meeting its WFD objectives, however, no significant pressures have been identified to be impacting this GWB.

Table 8-18: WFD Groundwater Body Status

Ground Waterbody	Status 2010-2015	Status 2013-2018	Status 2016-2021	3rd Cycle Risk Status	WFD Pressures
Athboy	Good	Good	Good	At Risk	-

8.4.11 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 Application Site are shown in Table 8-19 below.

The western section of Bracklin Bog is drained by the Deel(Raharney)_030 SWB. The status of this SWB has improved from "Moderate" in the 2013-2018 round to "Good" in the latest round (2016-2021). Further downstream the Deel(Raharney)_040 SWB achieved "Good" status in all 3 no. monitoring rounds while the Deel(Raharney)_050 SWB was assigned "Moderate" status. The Deel(Raharney)_060 SWB drains the western section of Ballivor Bog, and its status has increased from "Moderate" in the 2010-2015 round to "Good" in the 2013-2018 round and has remained of "Good" status in the latest 2016-2021 round. Further downstream the Boyne_050 achieved "Good" status in all 3 no. WFD rounds.

The Boyne_060 SWB drains the eastern section of Ballivor Bog and Carranstown Bog. This SWB has also experienced an improved status from "Moderate" in 2010-2015 to "Good" in 2013-2018 and 2016-2021. The Stonyford River drains Lisclogher, Lisclogher West and Bracklin bogs. The Stonyford_030 has consistently deteriorated in status throughout each of the WFD rounds, having "Good" status in 2010-2015, to "Moderate" in 2013-2018, to "Poor" in 2016-2021. The Stonyford_040 however, received a deterioration in status from "Good" in 2010-2015 to "Moderate" in 2013-2018 and remained to be of "Moderate" status in 2016-2021. Further downstream the Boyne_070 and Boyne_080 both achieved "Moderate" status in the latest WFD round.

The majority of these SWBs have been deemed to be "At risk" of not meeting their WFD objectives. Hydromorphological changes have been deemed to be significant stressors on several of these SWBs. Hydromorphological pressures mean that the waterbody has experienced change to its physical habitat or natural functioning caused by, for example, channelisation and straightening of rivers or land drainage. Drainage of the Application Site to facilitate peat extraction activities and all ancillary works will likely have impacted the local hydrological regime by altering the natural flow volumes and potentially increasing sediment concentrations (which is not borne out by water quality monitoring data as demonstrated above) in waterbodies due to the increase in connectivity of drains to the surrounding river network.

Table 8-19: Summary WFD Information for Surface Water Bodies

River Waterbody	Status 2010-2015	Status 2013-2018	Status 2016-2021	3rd Cycle Risk Status	WFD Pressures
Deel (Raharney)_030	Good	Moderate	Good	At Risk	-
Deel (Raharney)_040	Good	Good	Good	Not at Risk	-
Deel (Raharney)_050	Moderate	Moderate	Moderate	At Risk	Hydromorphology
Deel (Raharney)_060	Moderate	Good	Good	Under Review	Hydromorphology
Boyne_050	Good	Good	Good	Not at Risk	-
Boyne_060	Moderate	Good	Good	At Risk	Hydromorphology
Stonyford_030	Good	Moderate	Poor	At Risk	-
Stonyford_040	Good	Moderate	Moderate	At Risk	-
Boyne_070	Good	Moderate	Moderate	At Risk	-
Boyne_080	Moderate	Moderate	Moderate	At Risk	Hydromorphology

8.4.12 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). Designated sites that lie downstream of the Application Site include:

- River Boyne and River Blackwater SAC (Site Code: 002299), Deel (Raharney), Stonyford and Boyne rivers are mapped within this SAC;
- River Boyne and River Blackwater SPA (Site Code: 004232), Deel (Raharney), Stonyford and Boyne rivers are mapped within this SPA;
- Boyne Woods pNHA (Site Code: 001592), 26km northeast of Lisclogher Bog and to the east of Navan Town along the River Boyne;
- Crewbane March pNHA (Site Code: 000553), 35km northeast of Lisclogher Bog along the River Boyne;
- Dowth Wetland pNHA (Site Code: 001861), 40km northeast of Lisclogher Bog;
- Boyne River Islands pNHA (Site Code: 001862), 42km northeast of Lisclogher Bog and to the west of Drogheda; and,
- Boyne Coast and Estuary SAC and pNHA(Site Code: 001957), 48km northeast of the Lisclogher Bog.

The Application Site is hydrologically connected to the River Boyne and River Blackwater SAC and SPA via several drains and streams which flow from the bog areas into the Deel (Raharney), Stonyford and Boyne rivers. These flowpaths are outlined in detail in Section 8.4.3.

Several other designated sites are located downstream along the River Boyne and are therefore also hydrologically connected with the Application Site. However, these sites are located significant distances (>25km) from the Application Site. Consequently, the River Boyne and River Blackwater SAC/SPA remain the primary sensitive receptors due to their proximity to the Application Site and the direct hydrological linkage. This site was designated as a SAC in June 2003 and a SPA in November 2010.

A map of locally designated sites is included in Figure 8-26.

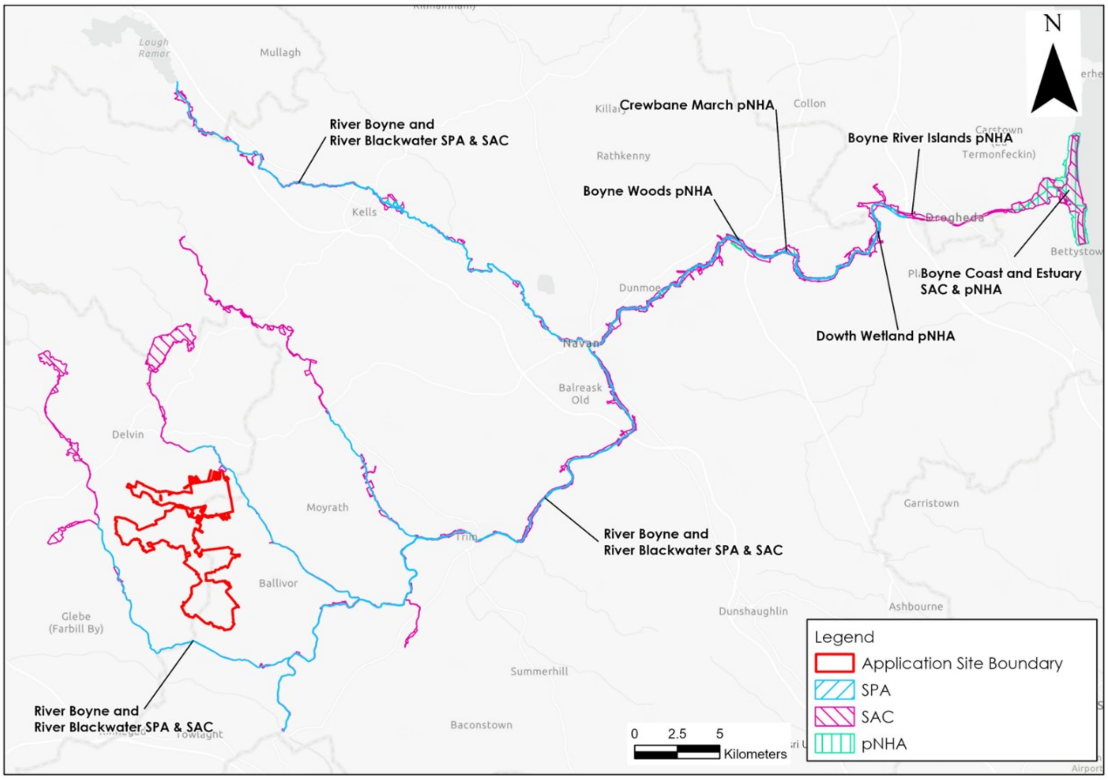


Figure 8-26: Map of Local Designated Sites

8.4.13 Water Resources

There is 1 no. mapped PWS (Public Water Supply Scheme) within 3 km of the Application Site. The Source Protection Area (SPA) for the Ballivor PWS is located to the east of Carranstown and Bracklin bogs, approximately 1.5 km north of Ballivor village. This SPA is more than 2km from the boundary of the Application Site.

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). One well (GSI Name: 2625SWW072) was identified in the east of Ballivor Bog in the townland of Clonycavan. This well reports a poor yield class of 8.7m^3/day.

Several additional wells with a location accuracy of 1km are mapped in the vicinity of the Application Site. These wells all have a poor yield class. As these wells are mapped only to an accuracy of 1km and therefore assessing potential impacts on these wells cannot be undertaken in any reliable manner.

8.4.14 Receptor Sensitivity

Due to the nature of peat extraction activities and all ancillary works being near surface activities, impacts on groundwater quality and quantity below individual bogs are generally negligible as there are still considerable depths of peat remaining in each of the 5 bogs, although deep perimeter drains may have local drainage impacts on surrounding land. Surface water quality is the main sensitive receptor as drainage of the Application Site will potentially have altered the local natural hydrological regime.

Based on the criteria set out in Table 8-2 above, the Locally and Moderately Important Aquifers underlying the Application Site can be classed as of Medium Importance. The primary risks to groundwater during peat extraction activities and all ancillary works would have been from hydrocarbon spillage and leakages from plant serving and facilitating the peat extraction activities and all ancillary works. The Application Site is covered in cutover peat which in turn is underlain by clay and silt dominated glacial deposits and these layers act as a protective cover to the underlying bedrock aquifer. The glacial deposits are not mapped as an aquifer, but they are likely to be used locally as a water supply and therefore they can also be classed as Sensitive to pollution. However, due to the presence of the peat and silt/clay layers (which have low permeability and act as a barrier to infiltration), any contaminants which may be accidentally released on-site are more likely to travel to nearby streams within surface runoff.

At the beginning of the assessment period i.e., the 1988 baseline, the Boyne River downstream of the Application Site was of Extremely High Importance due to its designation as a 'Salmonid waters' under the European Communities (Quality of Salmonid Waters) Regulations, 1988. Meanwhile in the vicinity of the Application Site, the Deel (Raharney) and Stonyford rivers were of Very High Importance with these waterbodies being of 'High' and 'Good' biological Q-value status respectively. The Deel, Stonyford and Boyne rivers were designated as a SAC in June 2003 and a SPA in November 2010. This recognition of the ecological importance of these SWBs, therefore, increased the importance of the Deel (Raharney) and Stonyford surface waterbodies to Extremely High. During peat extraction activities and all ancillary works, namely the associated bog drainage, the main risks to local surface water quality would have been increased concentration of suspended solids and increased flow volumes downstream. In addition, hydrocarbon spillage and leakages would have been a constant potential threat to water quality during peat extraction activities and all ancillary works.

8.5 Characteristics of the Project

8.5.1 Peat Extraction Phase (July 1988 – June 2020)

A full description of the peat extraction activities and all ancillary works completed at the Application Site from 1988 are described in detail in Chapter 4.

By 1988 peat extraction activities and all ancillary works were well established at Ballivor, Bracklin, Lisclogher and Carranstown (west). By this time drainage had already been inserted at all 5 no. bogs, and railway infrastructure had been laid on all bogs with the exception of Lisclogher West.

Lisclogher West itself was drained between 1973 and 1995, with 6 no. silt ponds and 6 no. surface water emission points inserted into the bog. However, Lisclogher West was never subject to industrial peat extraction activities and ancillary works.

Elsewhere across the Application Site peat extraction activities and all ancillary works continued at different times and at different levels of intensity from July 1988 to June 2020. A total of 2,880,975m^3 of peat has been extracted from the Application Site since 1988. Peat has been extracted using two different methods, milled and sod, outlined briefly below and described fully in Chapter 4. In general, milled peat extraction is extracted from deep peat layers while sod moss extraction occurs at the bog margins and in areas of high bog.

During this time period milled peat extraction activities and all ancillary works occurred at Ballivor, Carranstown, Bracklin and Lisclogher bogs. Records indicate that the Derrygreenagh Bog Group, of which the Ballivor Bog Group and thus the Application Site is a subset, supplied peat to the Rhode ESB Power Station, Croghan Briquette Factory, Kilberry and Cúil na Móna when required. Information regarding which bogs supplied which specific end user, quantities of supply, frequency of travel and travel routes are not available. From 1985, peat from the Application Site was also distributed in bulk from the peat loading facility at Ballivor Works to the horticulture industry overseas via Dublin Port

Milled peat extraction requires good solar drying condition and can occur anytime from April onwards once suitable drying conditions are present. There are 4 no. stages involved in the process of milled peat extraction activities and all ancillary works outlined below:

- **Milling** - During the milling process the top 10-15 mm of the surface of each field was broken into peat crumbs by powered milling drums towed behind agricultural tractors. This layer of crumbed or milled peat is called a crop and has a moisture content of about 80% when milled.
- **Harrowing** - After milling, the peat crop was dried. To assist in this drying, the loose peat was harrowed, or turned over. The harrow consisted of a series of spoons which are towed behind an agricultural tractor. The spoons on the harrow were fitted with special base plates which prevented the scraping of wet particles from below the milled peat layer. Harrowing was usually required 2 to 5 times per peat crop, depending drying conditions, the water table level in the peat production fields, the initial moisture content of the peat at milling, and peat quality. If rain interrupted the drying process, more harrowing may have been needed.
- **Ridging** - When the milled material was dried to a moisture content of between 45% and 55%, it was gathered into ridges in the centre of each peat production field. The ridger consisted of a pair of blades towed in an open V behind an agricultural tractor. The open V blades rest on the bog and channel the loose crop into a triangular ridge in the centre of each peat production field.
- **Harvesting** - Harvesting is the final stage of the milled peat production process. Each individual ridge was lifted mechanically by a machine called a harvester, transferred and dropped on top of the adjoining field's ridge, until five ridges had been accumulated into a single large ridge. This ridge forms the final lift into the peat storage stockpile.

As part of the development of the bogs for milled peat extraction activities and all ancillary works, parallel surface water drains were created at intervals of ~15m, with the section of bog between the drains referred to as production fields. The fields are slightly convex to facilitate runoff and to prevent surface water ponding. The drains fall towards the headland, located at the ends of the production fields. The drains are piped across the headland, allowing machinery to pass from one field to the next. The drainage network then continues to a series of silt ponds prior to discharging to a local watercourse. By 1988, drainage had already been implemented across much of the Application Site with the exception of Lisclogher West.

Meanwhile sod moss extraction was undertaken by the Applicant at both Lisclogher and Ballivor bogs during this time period. In addition to these, third party sod peat extraction activities and all ancillary works has occurred at Lisclogher Bog from the 1990s until 2020. Sod moss is the term used to describe peat produced in block form for horticultural use. The sod moss is extracted mechanically with specially equipped excavators. The sods are cut from mini face-banks or the margins of trenches that are gradually widened and left on the bog to dry for approximately 12 months, reducing moisture content from 90% to 50% - 60%. Once the required moisture content is reached the sod moss is stockpiled at the edge of bog prior to transportation for processing. One layer is typically cut at a time until the horticultural peat is exhausted.

The peat extraction activities and all ancillary works areas were served by a railway line which was moved around the Application Site as different areas came in and out of peat extraction activities and all ancillary works. During this time period several buildings and other infrastructures were constructed at the Application Site to support peat harvesting operations. These included a Welfare Centre constructed in the townland of Grange More (1988), an extension to the pre-existing storage facilities (1990), construction of an ESB sub-station (2005), the laying of 2 no. grass strips (2013) and the erection of a guyed wind monitoring mast (2015/2016). Apart from the latter monitoring mast, these developments supported the existing processing plant, loading bay and workshop located at the Ballivor Works.

In terms of environmental monitoring, control and monitoring measures have been implemented at the Application Site since 1988. Initially these included the incorporation of silt ponds into the bog drainage system to minimise the concentrations of suspended solids entering local watercourses from the bog drainage network. These control measures were upgraded and enhanced in accordance with IPC Licence conditions from April 2000. Please refer to Chapter 4 and Appendix 4-1 for full details of the IPC Licence conditions.

8.5.2 Current Phase (June 2020 – Present Day)

The Current Phase of the Project includes all activities carried out at the Application Site from the cessation of peat extraction activities and all ancillary works in June 2020 to the present day.

During this time period, the decommissioning activities at the Application Site have been limited to the removal of stockpiled peat with no peat extraction activities and all ancillary works occurring during this phase of the development. From mid-2020 to mid-2021 the operations at the Application Site reduced to transferring stockpiled peat to the Ballivor Works (the Works) for processing prior to transportation to Kilberry Horticulture Works in Co. Kildare the Edenderry Power Plant and Derrinlough Briquette Factory, both in Co. Offaly. The Works ceased operation mid-2021. From mid-2021, stockpiles of peat were removed from across the Application Site, transferred to a conveyor via tipple trucks and subsequent transport to either Kilberry Horticulture Works, Edenderry Power Plant, and/or the Derrinlough Briquette Factory. Final stockpiles at Ballivor Bog were removed in June 2022 and the last of the stockpiles at Bracklin, Lisclogher and Carranstown bogs were removed by the end of 2023.

The drainage infrastructure, silt ponds and surface water discharge locations continue to be in operation and to be maintained as per the IPC Licence requirements. The silt ponds are maintained in accordance with Condition 6 of the IPC Licence, which states that all drainage from boglands is discharged via appropriately designed silt ponds which are desilted twice a year. The silt arising from these operations is either stockpiled a safe distance from drainage features or spread onto production fields.

Environmental monitoring and drainage and silt maintenance continued during this phase of the development in accordance with IPC licence conditions.

The Peatland Climate Action Scheme (PCAS) is a programme of enhanced peatland rehabilitation measures, which is in addition to the IPC licence requirement (does not form part of this substitute consent application) and is being is being applied at specific locations across the Applicant's landbank that are identified as suitable for the prescribed enhancement measures. PCAS measures to rewet peat including intensive and targeted drain blocking have commenced in Carranstown East, Lisclogher West and Bracklin West (refer to Chapter 4 Section 4.8.2 for further details in relation to PCAS) during the Current Phase of the Project.

8.5.3 Remedial Phase

It is currently proposed to implement a Cutaway Bog Decommissioning and Rehabilitation Plan at each of the bogs comprising the Application Site. Rehabilitation has already commenced on a section of Carranstown Bog. These Cutaway Bog Decommissioning and Rehabilitation Plans are required in order to fulfil the requirements of Condition 10.2 of the IPC licence No. P0501. Each Cutaway Bog Decommissioning and Rehabilitation Plan, as per Condition 10 of the IPC Licence will be subject to agreement with the EPA. To date, Carranstown 2022 Cutaway Bog Decommissioning and Rehabilitation Plan and Lisclogher-West 2023 Cutaway Bog Decommissioning and Rehabilitation Plan have been approved by the EPA, Ballivor Bog 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan, Bracklin Bog 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan, and Lisclogher East 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan will be reviewed with the EPA and approved by same prior to their implementation.

The Applicant have devised Cutaway Bog Decommissioning and Rehabilitation Plans to stabilise and rehabilitate the peat bogs within the Application Site. The plans use bespoke interventions designed to first stabilise the environment and secondly to rehabilitate the Application Site as much as possible by placing the existing peatland environments on a path towards naturally functioning peatlands. Rehabilitation allows a site to naturally colonise with vegetation to stabilise the bare peat production fields and minimise water pollution. Whilst the proposed rehabilitation plans have a ~5 year timeframe, in general the Applicant's peatlands cannot be restored back to the raised bog in a reasonable timeframe as their environmental conditions have been so radically altered from its natural state.

The proposed Cutaway Bog Decommissioning and Rehabilitation Plans at the Application Site will be undertaken using standard best practices (refer to Appendix III of the Cutaway Bog Decommissioning and Rehabilitation Plans included as Appendix 4-2). Each individual bog comprising the Ballivor Bog Group has its own unique history of peat extraction activities and all ancillary works operations, therefore the most appropriate rehabilitation approach is bog-specific reflecting local ecological and hydrological factors. For example, the rehabilitation of the milled peat extraction activities and all ancillary works area in Bracklin West will be different to that of Lisclogher West, which was never subject to industrial scale peat extraction activities and all ancillary works.

The Applicant's rehabilitation plans identify two scenarios present at the Application Site which will determine any additional targeted revegetation or rewetting measures to be implemented. Firstly, in the case that significant acid peat remains at the surface, there will be an assessment of the area to implement an intensive programme of drain-blocking and promote the re-establishment of more typical bog communities. Secondly, where alkaline peat is exposed at the surface the land is likely to revert to more alkaline poor fen/wetland or birch dominated scrub ecosystems where the development of these communities will depend on the potential to rewet the site.

The greatest hydrological/hydrogeological effects will be experienced in those areas selected for rewetting following ecological surveying. Rewetting would be achieved through measures such as drain blocking. This would raise the local peat water table, establishing a more suitable hydrological/hydrogeological regime, making these areas suitable for colonisation by more typical bog communities. Elsewhere where rewetting is not suitable the drainage regimes will remain relatively unchanged.

The rehabilitation plans comprise of short-term planning actions, short term practical actions and long-term actions. The initial short-term planning actions will involve seeking approval of the rehabilitation plans from the EPA. In addition, detailed site plans of how the various rehabilitation measures will be applied will be developed for each bog and a review of all issues and constraints which may impact the proposed Cutaway Bog Decommissioning and Rehabilitation Plans will be completed. The short-term planning actions will ensure that all activities associated with the rehab plans will be completed in accordance with the requirements of the IPC licence. Several short-term actions will be completed in the first 2 years following EPA approval of the Cutaway Bog Decommissioning and Rehabilitation Plans. These actions will include intensive drain blocking and monitoring of the rehabilitation measures. Silt ponds will continue to function during this phase of the rehabilitation plans. Longer term actions (>3 years) include the evaluation of the success of the short-term rehabilitation measures and undertake further remediation where necessary. Long-term monitoring, aftercare and maintenance will be completed until the IPC licence is surrendered. It is understood that during this phase of the rehabilitation plans, silt ponds will be decommissioned if necessary.

Much of the work associated with the Cutaway Bog Decommissioning and Rehabilitation Plans will occur during the initial stages of the plan. Once drain blocking and other measures have been implemented the operational activities will comprise non-intrusive ecological and hydrological monitoring and may also include minimal maintenance and repair works if/as those works are deemed necessary.

The proposed Cutaway Bog Decommissioning and Rehabilitation Plans contain enhanced rehabilitation measures associated with the PCAS. The proposed enhanced measures include intensive drain blocking, reprofiling of peat fields, fertilizer application and seeding of vegetation. Note that some of these measures have already been implemented in some areas of the Application Site (Carranstown East, Lisclogher West and Bracklin West during the Decommissioning and Rehabilitation Phase).

8.6 Assessment of Significant Effects and Control/Mitigation Measures

8.6.1 Do Nothing Scenario

As outlined in the EPA Guidelines (May 2022), the description of 'Do-Nothing Effects' relates to the environment as it would be in the future should the project not be carried out. As discussed in Section 3.2.1 in Chapter 3, the assessment period of this rEIAR commenced in 1988, a time at which peat extraction was already well-established at the Application Site. In the context of this rEIAR, the Project has been ongoing since the baseline assessment year of 1988. As outlined in Section 3.2.1 in Chapter 3, peat extraction activities commenced at the Application Site in 1948 with the installation of drainage.

The 'Do-Nothing' option is defined as the Project (as described in Section 4.2 of Chapter 4) having ceased at the Application Site in 1988.

In the event of the cessation of the Project at the Application Site in 1988, it is assumed that those lands which by that point had not been subject to the installation of drainage and peat extraction would have remained as a relatively intact raised bog with varying raised bog habitats (such as bog woodland, fen, sphagnum mosses).

Subsequently. other land-use practices may also have taken place on the Application Site such as agricultural or commercial forestry, or other commercial or non-commercial uses. Alternative land uses are discussed in Chapter 3 – Alternatives. Under this 'Do-Nothing' option, the IPC licence and associated ongoing decommissioning and planned rehabilitation would not have occurred.

For those lands which as of 1988 had been subject to the installation of drainage in preparation for peat extraction but not peat extraction itself, it is assumed in the 'do-nothing' scenario that drainage would have remained insitu. Maintenance works to keep established drainage channels clear would have ceased as of 1988 in the 'do-nothing' scenario. It is likely that these areas would have been subject to natural recolonisation of the bog surface. Minor third party turbary activities likely would have occurred along the intact bog edges as was common practise at sites such as the Application Site.

Peat extraction was underway at the Application Site prior to the required date for the transposition of the EIA Directive in 1988. If peat extraction and related activities ceased from 1988 onwards, then the various residual effects, described throughout this rEIAR, would not have occurred.

However, consideration must be given to the following:

- The legislative mandate given to the Applicant in the form of the Turf Development Act 1946, as amended) to acquire and develop peatlands; and
- The uncertainty with respect to the planning status of the activity did not arise until 2019 and was not evident in 1988.

Therefore, this 'Do-Nothing' option was not the chosen option. Peat extraction and all ancillary works have occurred at the Application Site from July 1988 onwards. A decision to cease peat extraction at the Application Site was taken in 2020 and the Application Site needs to be considered in the context of regularising (without prejudice) the planning status of the lands to facilitate future development (subject to planning consent as required). The Application Site has and will continue to revegetate, and there will be a change from areas of cutover peatland to revegetated peatland. These are described in the individual chapters of the rEIAR.

In the event that Substitute Consent is not granted in effect, the 'Do-Nothing' option represents the current situation as at the date of the application for Substitute Consent. As part of the Applicant's statutory obligations under IPC licence requirements, Cutaway Bog Decommissioning and Rehabilitation Plans will continue to be implemented for the Application Site separate to, and independent of, the Substitute Consent application. The implementation of the plans is included in the impact assessment below.

The role of cutaway/cutover peatlands such as the Application Site as a significant potential resource for amenity, tourism, biodiversity enhancement and conservation, improvement in air quality, climate mitigation, renewable energy development and education are part of the Applicant's vision for the Application Site. The regularisation of the planning status of the Application Site is a significant facilitator in ensuring the sustainable use and management of these peatlands. If this does not occur, the opportunity to continue employment and alternative use of the Application Site for the potential resources and activities mentioned above will be significantly restricted.

8.6.2 Identification of Impacts

8.6.2.1 Peat Extraction Phase (1988 – 2020)

The Peat Extraction Phase of the Project includes all peat extraction activities and all ancillary works undertaken from July 1988 to the cessation of peat extraction activities and all ancillary works in June 2020.

8.6.2.1.1 *Effects of Bog Drainage on Bog Hydrogeology*

Impacts on bog hydrogeology can occur through drainage, both by surface water drainage and by groundwater drainage. Surface water drainage (increased frequency of drains and deeper perimeter drains) can impact peat water levels and have an indirect impact on surface vegetation. Increased drainage can also lead to increased runoff volumes from bog units, and this can alter the hydrology (by increased flow volumes, and increased magnitude of downstream flooding events) of the downstream receiving waters. Deep perimeter (bog perimeter) drains can alter the local underlying groundwater hydrogeology as they often intersect the mineral soil layers below the bogs.

To determine likely Zones of Influence (ZoI) of bog drainage infrastructures HES has previously completed a Peatland Hydrology Study as defined in Appendix 8. From that study, the following conservative ZoIs are defined for Bord na Móna bog units:

- Field drains can have a ZoI on peat water levels at a distance of up to 30m;
- Deep perimeter bog drains can have a ZoI on peat water levels at a distance of <100m;
- The ZoI of facebank drains depends on the height of the facebank. But a conservative ZoI for a 1.5m high facebank drain is 60m; and,
- The ZoI of the Applicant's pumping stations (which are generally <5m deep) on local groundwater levels is likely to be <300m (Please note that 2 no. pumping stations were located at Ballivor Bog during the Peat Extraction Phase).

These ZoIs are used in the assessment below, and also in the assessment of impacts on Designated Sites and groundwater supplies.

As stated in Section 8.3 the timing of drainage and the initiation of peat extraction varied across the 5 no. bogs comprising the Application Site. Ballivor Bog was the first bog to be drained between 1948 and 1953, with all remaining bogs drainage by the 1995 (Lisclogher West was the last area to be drained commencing in 1973). By 1995 drainage had already been inserted into all bogs within the Ballivor Group.

Following this initial drainage, there would have only been minor annual changes in local bog hydrology and hydrogeology associated with the annual removal of peat and the deepening of drains if required. According to figures supplied by the Applicant, the total volume of peat removed from the Application Site from 1988 to 2020 is estimated to be 2,880,975m^3 with an average of 90,030m^3 extracted per year. The depths of peat removed from the bogs vary as each individual bog has experienced its own unique history of peat extraction. As peat can act as a hydraulic sponge providing storage of water, the removal of peat potentially acts to reduce the [water] storage capacity of the bogs. However, when peat water levels within the bogs were reduced historically through initial bog drainage, the [water] storage capacity of the top ~0.5 – 1m of peat (dependent on the depth of drains) was essentially removed.

As such, the primary and significant hydrological and hydrogeological changes at each of the bogs commenced when their initial drainage occurred and the development of ancillary activities was installed (e.g. railway lines, machine passes, canteen structures, work sites, welfare facilities, mobile fuel tanks, fixed fuel tanks, and peat loading facilities).

Pathways: Groundwater volume and water level drawdown.

Receptors: Peat Bog Hydrogeology.

Control Measures:

The following measures were in place to mitigate against the effects of groundwater drainage of the bogs on the bog hydrogeology:

- Field drains with low gradients and shallow depths (<1.0m);
- Silt ponds, as well as being a control measure for sediment from the bogs, also acted as attenuation measures for higher flows during peak rainfall events. Each metre length of silt pond provides ~12m^3 of water storage, which aided in slowing down the discharge from the bog units;
- Silt ponds were cleaned at least twice a year to maintain adequate storage and treatment (sedimentation/settlement) capacity; and,
- Pipeline capacities were designed based on a runoff rate of 1.7 l/s/Ha, which is equivalent to the greenfield runoff rates.

Following drainage of the bogs they would no longer have been suitable for most natural bog vegetation. As the bogs were already drained by 1988 (except for Lisclogher West which had some minor drainage installed), the effect of continuing peat extraction activities and all ancillary works until 2020 would not have resulted in any major alteration of the local hydrogeological regime. The groundwater tables in these bogs had already been lowered during their initial draining which pre-dated 1988 and the hydrogeological regime at these bogs would already have been unsuitable for most bog communities. Only minor annual changes would have occurred during this phase of the Project.

8.6.2.1.2 Effects of Bog Drainage on Downstream Surface Water Hydrology/Quality

Hydrological changes at each of the bogs commenced when their initial drainage occurred. The initial implementation of the bog drainage was at that time a significant change to the local hydrology at each bog unit. Peat can act as a hydraulic sponge providing storage of water. However, with the implementation of bog drainage, the water levels in the peat bog are lowered and the capacity of the bog to store water is reduced. The available water storage within the bogs would have provided a small buffer for downstream flooding.

In terms of surface water quality, the primary potential negative impact on surface water quality would be the increase in suspended solid entrainment in surface waterbodies. The greatest risk of suspended sediment entrainment occurs during times of major earthworks, such as during the removal of vegetation and the construction of the bog drainage network. This potential pathway would pose a significant risk to local surface water quality downstream of the Application Site, particularly as the River Boyne which is capable of supporting populations of Salmonids which are particularly sensitive to elevated concentrations of sediments.

By 1988 the majority of the Application Site was already artificially drained, with some minor drainage installed on Lisclogher West within the Application Site. Consequently, the continued drainage of these bogs during the Peat Extraction Phase of the Project would have been limited in its potential to alter the hydrological regime in downstream watercourses. However, during the Peat Extraction Phase, there was an ongoing risk of elevated concentrations of suspended solids making their way into downstream surface watercourses from the erosion of peat sediment via the bog drainage network. This potential pathway would pose a significant risk to local surface water quality, particularly as the River Boyne, Deel and Stonyford Rivers were all of Extremely High or Very High Importance in 1988. Other water quality parameters of concern are ammonia and Chemical Oxygen Demand (COD).

Pathway: Drainage and surface water discharge routes.

Receptor: Surface water quality and quantity on down gradient rivers (R. Deel, R. Stonyford, R. Boyne, and associated tributaries).

Control Measures:

Pre-IPC Licence

Prior to the regulation of activities at the Derrygreenagh Bog Group (of which the Ballivor Bog is a subgroup) by the EPA which commenced in 2000, the Applicant were implementing several control measures to protect surface water quality in downstream waterbodies. These measures primarily relate to the concentrations of suspended sediments in discharge from the bogs and are summarised below:

- Internal drains cleaned on a regular basis in suitable weather. This was completed to remove sludge from the bottom of ditches, allowing them to retain full functionality. The sludge was disposed of by spreading it on the adjacent production fields where it was dried and harvested;
- Drain maintenance was carried out using draglines and excavators, ensuring that these drains were fit for purpose;
- Drain maintenance was carried out mainly prior to and post the harvesting season.
- Silt ponds were utilised to control the amount of sediment being discharged at outfalls. At this time, silt ponds were designed for an upper limit of 100mg/l suspended sediment;
- Silt ponds were upgraded in the 1990s to cater for the settling of sufficient amount of silt. This often included the construction of a second silt pond adjacent to the first, which was used as a backup and to facilitate desludging of the primary pond; and,
- Silt ponds were desludged twice per annum.

Active IPC Licence:

The Application Site has been regulated by the EPA under IPC Licence Registration No. P0501 since 2000. The bog group also has a Surface Water Management Plan[5] which defines how compliance with the Licences is achieved. The drainage system in place at the bogs comprising field drains, main drains, piped drains, silt ponds upstream of outfall locations, is designed to prevent the release of elevated concentrations of suspended sediments into nearby surface waterbodies. As part of the IPC Licence, there is a limit of 35mg/l for suspended solids. Quarterly monitoring only recorded 3 no. exceedances of this threshold during the monitoring period (2000–2020).

Existing control measures which were implemented under the IPC licence are also designed to limit runoff rates from the bog units. These include:

- Silt ponds providing attenuation limited runoff during periods of intense rainfall; and,
- Continuous mitigation included maintaining the schedule of cleaning the silt ponds at a minimum of twice per year.

8.6.2.1.3 Contamination of Groundwater by Leakages and Spills

Accidental spillage during refuelling of machinery and plant (static and mobile) with petroleum hydrocarbons is a pollution risk. The accumulation of small spills of fuels and lubricants during routine plant use can also be a significant pollution risk over time. Hydrocarbons have a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e., contamination of peat, subsoils and pollution of the underlying aquifer) on the geological and water environment.

Discharges from wastewater systems (septic tanks) at office buildings, and at welfare facilities and workshops could potentially have caused groundwater contamination. Activities and features associated with peat extraction include railway lines, machine passes, canteen structures, work sites, welfare facilities, mobile fuel tanks, fixed fuel tanks, and peat loading facilities. These potential impacts existed for all 5 no. bogs and their associated welfare facilities and workshops, but we understand from a review of available AERs (Annual Environmental Reports submitted to the EPA under the IPC licences) reports that no significant pollution events/spills to groundwater have occurred since 2000.

Pathway: Infiltration through pore space in peat, subsoil and bedrock.

Receptor: Local Groundwater Quality.

Control Measures:

<u>Pre-IPC Licence:</u>

Prior to the regulation of activities at the Application Site by the EPA which commenced in 2000, the Applicant were implementing several control measures to reduce the risk of contamination by spills and leakages. These measures primarily relate to the storage of peat harvesting machinery, refuelling procedures and waste management. These measures are summarised below and outlined in full in Chapter 4 at Section 4.6:

- All machinery were stored at the Ballivor Works at the end of each workday;
- All machinery were regularly inspected, serviced and cleaned. Cleaning was completed at a wash bay which drained towards an interceptor tank and associated soak pit;
- Where possible all refuelling was completed at the Ballivor Works;
- In the event that on-site refuelling was required, it was done with a mobile fuelling unit;

[5] *Current version: SWMP 0501 Derrygreenagh 31.01.2020.pdf*

- In the event of an emergency spill, the following procedures were in place:
  - The General Manager (GM) was immediately informed of the incident.
  - The spill was assessed by the GM to assess the potential for environmental and/or health consequences.
  - The spill would have been sourced, isolated and contained with polystyrene booms or dry peat.
  - Every effort would have been made to prevent the spill from entering the nearest drain or outfall.
  - Once the spill was contained, a suitable absorbent (typically dry peat) was used to soak the spillage.
  - Follow up measures were taken to prevent such a spillage recurring in the future.
  - In the event of a spillage the GM notified the local authority.
- All waste oil and break fluids drained from machinery were collected in drums and emptied into a waste oil storage tank which were transported off-site by a licenced disposal contractor;
- All used oil and fuel filters and used batteries were collected by licenced disposal and battery collection contractors respectively; and,
- All washing from the self-contained machine parts washer was collected within a sludge tank at the Works.

Active IPC Licence:

The refuelling procedures and control measures implemented by the Applicant were upgraded and enhanced in order to comply with IPC licence conditions with the Application Site being regulated by the EPA under IPC Licence Registration No. P0501 since 2000. The bogs also have Surface Water Management Plan[6] which define how compliance with the Licences is achieved. No additional control measures, other than compliance with the control measures regulated by the EPA, are considered necessary in terms of protecting groundwater quality. The list below outlines control measures conditioned under the IPC licencing regime, as regulated by the EPA:

- Effective spill/leak management of mobile fuelling units was undertaken;
- Replacement (and remediation where necessary) of all underground fuel tanks was undertaken;
- There was no other emissions to water of environmental significance;
- All tank and drum storage areas were rendered impervious to the materials stored therein. In addition, tank and drum storage areas was bunded;
- Drainage from bunded areas was diverted for collection and safe disposal;
- The integrity and water tightness of all the bunding structures and their resistance to penetration by water or other materials stored therein was tested and demonstrated by the licensee to the satisfaction of the Agency and shall be reported to the Agency within eighteen months from the date of grant of this licence and every two years thereafter;
- The loading and unloading of fuel oils was carried out in designated areas protected against spillage and leachate run-off;
- While awaiting disposal, all materials were collected and stored in designated areas protected against spillage and leachate run-off;
- Except for roof water, all surface water discharges from workshop areas were fitted with oil interceptors;
- An inspection for leaks on all flanges and valves on over-ground pipes used to transport materials other than water was carried out weekly;
- The Applicant undertook a programme of testing and inspection of underground fuel pipelines to ensure that all underground fuel lines were tested at least every three years; and,

[6] *Current versions: SWMP 0501 Derrygreenagh 31.01.2020.pdf*

- The Applicant maintained (in storage) an adequate supply of containment booms and/or suitable absorbent material to contain and absorb any spillage.

8.6.2.1.4 Contamination of Surface Water by Leakages and Spills

Accidental spillage of petroleum hydrocarbons during refuelling of machinery and plant (static and mobile) construction plant with petroleum hydrocarbons is a significant pollution risk to surface waters and associated ecosystems and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has 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.

Discharges from wastewater systems (septic tanks) at office buildings, and at welfare facilities and workshops could potentially have caused surface water contamination. Activities and features associated with peat extraction include railway lines, machine passes, canteen structures, work sites, welfare facilities, mobile fuel tanks, fixed fuel tanks, peat loading facilities, and end-user sites. These potential impacts existed for all 5 no. bogs and their associated production centres and workshops, but we understand from a review of available Annual Environmental Reports, (AERs) submitted to the EPA under the IPC licence, reports that no significant pollution events/spills to groundwater have occurred since 2000 (surface water is dealt with separately in this rEIAR).

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies (R. Deel, R. Stonyford, R. Boyne, and associated tributaries).

Control Measures:

<u>Pre-IPC Licence</u>:

Prior to the regulation of activities at the Application Site by the EPA which commenced in 2000, the Applicant were implementing several control measures to reduce the risk of contamination by spills and leakages. These measures primarily relate to the storage of peat harvesting machinery, refuelling procedures and waste management. These measures are the same as those outlined in Section 8.6.2.1.3.

<u>Active IPC Licence</u>:

The Application Site has been regulated by the EPA under IPC Licence Registration No. P0501 since 2000. The bogs also have Surface Water Management Plan[7] which define how compliance with the Licences is achieved. The control measures implemented to reduce to the risk of contamination by spills and leakages are the same as those outlined in Section 8.6.2.1.3.

8.6.2.1.5 Effects on Groundwater Abstractions

Historic impact on the nearby Ballivor PWS can be assessed on the basis of impacts relating to groundwater quality and water quantity (the volume of water available). The Ballivor PWS is the only large abstraction located within 5km of the Application Site. 5km is considered to be a very conservative screening distance considering the shallow nature (3-6m deep) of the peat extraction works and all ancillary activities, particularly the historic bog drainage works.

The Ballivor PWS comprises of 2 no. wells drilled in 1994 and are mapped downgradient of the Application Site with regional groundwater flow generally towards the southeast. At a more local scale,

[7] *Current versions: SWMP 0501 Derrygreenagh 31.01.2020.pdf*

groundwater flow is likely to be influenced by topography and in the vicinity of the PWS will move in all directions towards the Stonyford River. The aquifer feeding the Ballivor PWS source is Calp Limestone which is overlain by 5-10m of highly permeable limestone derived tills in the vicinity of the well. Groundwater flow to the PWS source is from the north and northwest, within the mapped Inner and Outer Source Protection Areas (SPAs). The Application Site is not located within the mapped SPA area.

The GSI also map several additional private boreholes and wells in the vicinity of the Application Site. These private water supplies are reliant on groundwater flows in the deeper bedrock aquifer underlying the glacial deposits.

Deep groundwater recharge from the Application Site to the underlying bedrock aquifers will have been minimal. The restriction of recharge relates to the generally impermeable layers which underlie much of Irelands' bogs leading to a 4% recharge coefficient for the bogs. Therefore, the majority of the groundwater drainage and seepage in the bogs would have a lateral flow direction, discharging into the perimeter drains and entering the surface water drainage network in the lands surrounding the bogs.

Pathway: Groundwater recharge and groundwater flow paths and site drainage network.

Receptor: Groundwater quality and groundwater quantity.

Control Measures: No control measures would be necessary due to the shallow nature of the works and the nature of the local hydrogeological regime.

8.6.2.1.6 *Effect on Designated Sites*

As previously identified, there is a conceptual link between groundwater and surface water across the bogs, whereby groundwater (entering shallow perimeter drains) and surface water within the bogs primarily drains to surface water bodies situated around the bogs. Pathways (flow routes) with nearby and regionally located (downstream) SAC/SPAs (Natura 2000 sites) were identified by digital tracing/tracking hydrological flow paths between the Application Site and their downstream discharge points on a local and a regional scale. The River Boyne and River Blackwater SAC/SPA is situated along the Deel, Stonyford and Boyne rivers immediately downstream of the Application Site.

Alteration of the hydrological regime at the upstream bogs may have altered flows from the bogs which ultimately discharge to the SAC/SPA. However, the 5 no. bogs (Ballivor, Carranstown, Bracklin, Lisclogher and Lisclogher West) were drained between 1948 and 1995, before the SAC designation in 2003 and the SPA designation in 2010. The local baseline environment for this SAC/SPA, therefore, included the bogs in their drained state.

Pathway: Surface water drainage network. Drainage from the Application Site discharges to outfall points and streams, which discharge to the River Deel to the west and the Stonyford River to the east. In this area, these river waterbodies form part of the River Boyne and River Blackwater SAC/SPA.

Receptor: River Boyne and River Blackwater SAC/SPA.

Control Measures:

As outlined above the Application Site has been regulated by the EPA under IPC Licence Registration No. P0501 since 2000. In addition, the drainage system has been designed to limit runoff from the site via low-gradient field drains, mains drains, and silt ponds. Control measures relating to the protection of water quality are outlined in Section 8.6.2.1.1 to 8.6.2.1.4 above.

Although surface pathways exist between the bogs and the SAC/SPA, the scale of flows from the bogs is small relative to the scale of flows in the designated site. As outlined in Section 8.4.2, flow volumes along the hydrological flow paths were separated into groups. Surface water flows between 0.01 – 0.1

m^3/s were classified within bog scale flows while sub-catchment to catchment scales flows were classified as being within 10 – 100+ m^3/s. The surface water connections between the Application Site and the SAC/SPA are between 1 and 6km in length and transition from bog scale flows near the bogs to sub-catchment and catchment scale of flows at the SAC/SPA boundaries (i.e., the Deel and Stonyford Rivers, which in turn discharge to the River Boyne, have a much higher volumetric flow).

There are also other activities in all catchments upstream and downstream of the Application Site that have and will contribute to changes in flows and changes in water quality in the receiving water environment (i.e. agriculture, forestry etc).

8.6.2.1.7 *Effect on the WFD Status of Surface and Groundwater Bodies*

The Application Site has been subject to drainage and peat extraction activities and all ancillary works since 1948, *i.e.* for more than 50 years before the WFD existed.

As described above, the primary hydrological and hydrogeological changes associated with the peat extraction activities and all ancillary works process occurs during the initial drainage of the bog in advance of peat extraction activities and all ancillary works. Constructed drainage ditches drain the upper surface of the bog by lowering the local peat water table. At this time, ancillary features were also constructed including railway lines, machine passes, canteens, work sites, production centres, mobile fuel tanks, fixed fuel tanks and peat loading facilities. After the Application Site was drained, vegetation was removed from the bog surface, leaving only bare peat fields between the drains. During the Peat Extraction Phase, only minimal landuse change occurs which predominantly relate to minor annual topographic changes (i.e., lower ground levels) caused by ongoing peat extraction activities and all ancillary works. While the timing of drainage and initiation of peat extraction activities and all ancillary works varies across the Application Site, the majority of the Application Site was drained before 1988, with Lisclogher West drained before 1995.

However, there is no requirement to assess the peat extraction activities and all ancillary works at the Application Site which predate 2003 and the transposition of the WFD Directive into Irish Law.

As the 1st WFD cycle was completed in 2010-2015, no WFD status existed for much of the Peat Extraction Phase. However, EPA Q-rating values are available from 2000 to 2020 for all watercourses downstream of the Application Site. The data shows a relatively stable trend in Q-values during this period with the majority of watercourses fluctuating between Q3.5 ("Moderate" Q-status) and Q4 ("Good" Q-status), being either slightly polluted or unpolluted. Only 1 no. waterbody achieved a "High" Q-status (Q4.5) during this period (Boyne_050). These EPA Q-rating values indicate a slight decline in water quality in comparison with the pre-2000 period. However, river waterbodies upstream of the Application Site have experienced a similar trend in Q-ratings (refer to WFD Compliance Assessment Report attached as Appendix 8-4). Therefore, the trend is likely to reflect land-use changes in the wider Boyne catchment rather than any specific peat extraction related activities within the Application Site. Consequently, changes in water quality during this period cannot be attributed solely to peat extraction activities which were being scaled back at this time.

It is considered that with the implementation of the control measures in accordance with IPC Licence Requirements the status of the SWBs throughout this Peat Extraction Phase of the Project were comparable to those recorded in the 1st WFD cycle (2010-2015).

Pathway: Groundwater recharge and surface water runoff.

Receptor: Downstream surface waterbodies and the underlying Athboy ground waterbody.

Control Measures:

Since 2003, the peat extraction activities and all ancillary works at the Application Site were completed under the conditions set out in IPC Licence No. P0501. This IPC Licence came into effect in April 2000 and upgraded and enhanced several pre-existing environmental monitoring and control measures which had been implemented at the Application Site since 1988. These pre-IPC measures largely included the incorporation of silt ponds into the bog drainage system to minimise the concentrations of suspended solids entering local watercourses. Further amendments were made to the IPC conditions in 2003 following the transposition of the WFD into Irish Law. The bogs also have Surface Water Management Plans[8] which define how compliance with the Licences is achieved. Therefore, throughout the Peat Extraction Phase of the Project, peat extraction activities and all ancillary wors have been operating under strict conditions designed to protect downstream water quality and quantity.

The control measures for the protection of surface and groundwater quality/quantity are outlined in full in Section 8.6.2.1.1 to 8.6.2.1.4 above.

8.6.2.2 Current Phase (June 2020 – Present Day)

The Current Phase of the Project encompasses the period of time between the cessation of peat extraction activities and all ancillary works at the Application Site in June 2020 to the present day.

8.6.2.2.1 *Effects of Bog Drainage on Bog Hydrogeology*

No significant effects on bog hydrogeology will have occurred from the cessation of peat extraction activities and all ancillary works in the June of 2020 to the present day. By the June of 2020, all drainage infrastructure (field drains, main drains, silt ponds etc.) would have been in place across the Application Site for between 25 – 70 years. The hydrogeological regime would have been well established with field drains lowering the perched groundwater table in the adjacent former peat production fields.

No additional drainage or deepening of drains would have occurred during this period. The only works completed comprised minor maintenance and minor repairs to the drainage network and silt ponds where required.

Pathways: Groundwater volume and water level drawdown.

Receptors: Peat Bog Hydrogeology

Control Measures:

During this period the Applicant continued to operate the Application Site in accordance with IPC licensing requirements. No further control measures, beyond that implemented to date, are deemed necessary as the conditions, emission limits etc. set out in the IPC licence are designed in accordance with the relevant legislation to ensure ongoing protection of ground and surface waters.

8.6.2.2.2 *Effects of Bog Drainage on Downstream Surface Water Hydrology*

With the cessation of peat extraction activities and all ancillary works, there was less potential for disturbance of peat and elevated concentrations of suspended sediments entering surface watercourses. Similarly, the activity of machinery and plant has been reduced, therefore lowering the potential occurrence of accidental spillages of hydrocarbons.

During this period the site drainage still operated under the same drainage systems as during the operational phase of peat extraction activities and all ancillary works *i.e.* field drains, main drains, silt ponds and discharge outlets etc. Therefore, discharge volumes from the Application Site to nearby surface watercourses will be comparable to surface water discharges during the operational phase.

Pathway: Site drainage and surface water discharge routes.

[8] *Current versions: SWMP 0501 Derrygreenagh 31.01.2020.pdf*

Receptor: Surface water quality and quantity on down gradient rivers (R. Deel, R. Stonyford, R. Boyne, and associated tributaries).

Control Measures:

During this period the Application Site continued to operate under IPC licensing requirements with respect to surface water discharge quality and quantity.

8.6.2.2.3 *Contamination of Groundwater by Leakages and Spills*

Despite the cessation of peat extraction activities and all ancillary works at the Application Site, there was still some limited activity at the Application Site involving machinery and plant with which there is always a risk of accidental spillage of hydrocarbons. Similarly, the office buildings at the Ballivor Works remained occupied and discharges from wastewater systems (septic tanks) etc. have the potential to cause surface water and groundwater contamination. These risks are the same as those outlined in Section 8.6.2.1.3 but to a lesser extent due to the lower volumes of plant, machinery and workers operating at the site during the Current Phase.

Pathway: Infiltration through pore space in peat, subsoil and bedrock.

Receptor: Local Groundwater Quality.

Control Measures:

Measures that mitigated against contamination of groundwaters are outlined in Section 8.6.2.1.3 and are currently being adhered to at the Application Site.

8.6.2.2.4 *Contamination of Surface Water by Leakages and Spills*

Despite the cessation of peat extraction activities and all ancillary works at the Application Site, there has been some limited activity at the Application Site during the Current Phase (removal of stockpiles and environmental monitoring) involving machinery and plant with which there is always a risk of accidental spillage of hydrocarbons. Similarly, the office buildings at the Ballivor Works remain occupied and discharges from wastewater systems (septic tanks) etc. have the potential to cause surface water and groundwater contamination. These risks are the same as those outlined in Section 8.6.2.1.4 but to a lesser extent due to the lower volumes of plant, machinery and workers operating at the Application Site during this phase.

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies (R. Deel, R. Stonyford, R. Boyne, and associated tributaries).

Control Measures:

Measures that mitigated against contamination of groundwaters are outlined in Section 8.6.2.1.3 and are currently being adhered to at the Application Site.

8.6.2.2.5 *Effects on Groundwater Abstractions*

No effect on local groundwater abstractions will have occurred from the cessation of peat extraction activities and all ancillary works in June 2020 to the present day. Drainage and hydrogeology of the Application Site are unchanged during this period.

Pathway: Groundwater recharge and groundwater flow paths and site drainage network.

Receptor: Groundwater quality and groundwater quantity.

Control Measures:

Any works during this time period have been completed under licence from the EPA and the Applicant's Environmental Management System.

8.6.2.2.6 Effect on Designated Sites

Despite the cessation of peat extraction activities and all ancillary works at the Application Site, there is still some very limited activity at the Application Site involving machinery and plant (removal of stockpiles), the maintenance of the existing drainage network and environmental monitoring.

The Application Site remains hydrologically linked with the River Boyne and River Blackwater SAC/SPA. The risks to the receiving waters (in terms of water quantity and water quality) are the same as those outlined in Section 8.6.2.1.6 but to a much lesser extent due to the lower intensity of works being completed at the site. Less activity on-site has decreased the likelihood of pollution incidents or exceedances of discharge limits occurring. The risk is much reduced in comparison to the Peat-Extraction Phase of the Project.

Pathway: Surface water drainage network. Drainage from the Application Site discharges to outfall points and streams, which discharge to the River Deel in the west, the Stonyford River to the east and the River Boyne to the South. In this area, these river waterbodies form part of the River Boyne and River Blackwater SAC/SPA.

Receptor: River Boyne and River Blackwater SAC/SPA.

Control Measures: Any works during this time period have been completed under licence from the EPA and the Applicant's Environmental Management System.

The only works completed comprised minor maintenance and minor repairs to the drainage network and silt ponds where required.

8.6.2.2.7 Effect on WFD Status of Surface and Groundwater Bodies

With the cessation of peat extraction activities and all ancillary works, there was less potential for disturbance of peat and elevated concentrations of suspended sediments entering surface watercourses. Similarly, the activity of machinery and plant has been reduced, therefore lowering the potential occurrence of accidental spillages of hydrocarbons.

During this period the site drainage still operated under the same drainage systems as during the operational phase of peat extraction activities and all ancillary works *i.e.* field drains, main drains, silt ponds and discharge outlets etc. Therefore, discharge volumes from the Application Site to nearby surface watercourses will be comparable to surface water discharges during the operational phase.

Therefore, there was little potential for the Current Phase of the Project to effect the WFD status of the receiving waterbodies.

Pathway: Groundwater recharge and surface water runoff.

Receptor: Downstream surface waterbodies and the underlying Athboy ground waterbody.

Control Measures:

During this period the Application Site continued to operate under IPC licensing requirements with respect to surface water discharge quality and quantity.

8.6.2.3 Remedial Phase

8.6.2.3.1 *Effect on Bog Hydrogeological Regime*

The overall aim of the Cutaway Bog Decommissioning and Rehabilitation Plans is to put the bogs comprising the Application Site on a trajectory towards becoming naturally functioning peatlands.

The current drainage system was designed to lower the local water table in each of the bogs to facilitate peat extraction activities and all ancillary works. This lowered peat water table does not support typical bog communities. Therefore, in order to achieve the aims of the Cutaway Bog Decommissioning and Rehabilitation Plans, it will be necessary to alter the drainage regime which currently exists on-site.

Those areas selected for rewetting will experience the greatest change in bog hydrogeology. Rewetting can be achieved through measures such as drain blocking which will encourage natural re-vegetation of the cutaway areas with typical bog communities. More intensive drain blocking will be completed in areas of bare peat whereas less intensive measures will be utilised in areas where habitats are already present. Drain blocking will help establish a more suitable hydrological/hydrogeological regime where the peat water table will be much closer to the surface than it is at present. Post restoration monitoring in other sites has shown that groundwater levels in rewetted bogs can recover relatively quickly *i.e.* within 2-5 years.

The magnitude of this positive effect will vary across the Application Site, dependent on the local intensity of the drain blocking programme where different areas of the site will be deemed more suitable for rewetting.

Pathways: Water volume and peat water level rise.

Receptors: Local peat bog hydrology/hydrogeology.

Mitigation Measures:

No 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.

Any works undertaken as part of the Cutaway Bog Decommissioning and Rehabilitation Plans will be completed under licence from the EPA with the Applicant reporting to the EPA until the IPC Licence is surrendered. All works completed during the Cutaway Bog Decommissioning and Rehabilitation Plans 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 in Section 8.6.2.3.2 and Section 8.6.2.3.4 below.

8.6.2.3.2 *Effect on Downstream Surface Water Quality*

Whereas draining the Application Site to facilitate peat extraction activities and all ancillary works had an adverse impact on downstream surface watercourses, improvements in flow and water quality can be achieved through bog rehabilitation and rewetting.

One of the successful criteria for rehabilitation, is revegetation of the Application Site. Vegetation will stabilise substrates in the current bare peat fields, thereby reducing the potential for elevated concentrations of suspended solids in site runoff. Additionally, vegetation can quickly stabilise material in blocked drains, further reducing the potential for the entrainment of suspended solids. Whereas the previously bare peat fields acted as a source of sediment and required silt control measures, a rehabilitated bog containing wetland habitats will increase the sites solids retention time. Silt ponds will continue to operate during the early stages of the rehabilitation process and will only be decommissioned when the Application Site is deemed to be on a trajectory of environmental stability and/or rehabilitation has been completed.

The water quality improvements associated with rehabilitated peatlands are not limited to reduced suspended solid concentrations. International studies have shown a long-term reduction in pollutant concentrations, including nitrate and ammonia, following rewetting in comparison to drained peatlands (Pschenyckyj. C. et al. 2021). While several studies have shown that the magnitude of these positive effects depends on site-specific factors such as the degree of degradation and local peat characteristics, all studies have shown an overall long-term decrease in pollutant concentrations (Negassa et al., 2020).

It is worth noting that some studies have shown a short-term increase in phosphorous and suspended solid concentrations following restoration (Harpenslager et al. 2015 and Koskinen et al, 2017). This short-term increase in pollutants is linked to initial drain-blocking activities before the hydrogeological regime of the Application Site becomes stabilised (Pschenyckyj. C. et al. 2021).

The rehabilitations plans will also improve water attenuation at the Application Site, with the blocked drains slowing the rate at which water moves through the Application Site and the rate at which water enters downgradient rivers.

Following rehabilitation, water will still discharge from the designated emission points. However, as discussed in the above paragraphs, this discharge will be of improved quality and of lower volumes.

Pathway: Site drainage and surface water discharge routes.

Receptor: Surface water quality and quantity on down gradient rivers (R. Deel, R. Stonyford, R. Boyne, and associated tributaries).

Mitigation Measures:

Any works undertaken as part of the Cutaway Bog Decommissioning and Rehabilitation Plans will be completed under licence from the EPA with the Applicant reporting to the EPA until the IPC Licence is surrendered.

The existing drainage systems and silt control measures, which have proven effect, will continue to operate during the early stages of the Cutaway Bog Decommissioning and Rehabilitation Plans when there is the potential for the entrainment of suspended solids in surface waters during drain blocking. During this time no remedial works will be completed during periods of prolonged rainfall. Silt ponds will continue to be in use and will be regularly inspected and maintained as per IPC licence requirements. All onsite activities will be completed in accordance with 'best practice' procedures.

Following implementation of the rehabilitation measures a programme of aftercare and maintenance, designed in accorded to meet the Conditions of the IPC Licence, will be completed at the Application Site. This will comprise of initial quarterly monitoring, with the number of site visits reducing after 2 years to bi-annually and then after 5 years to annual visits. A water quality monitoring program will be established to monitor the impact of rehabilitation on water quality discharge from the bog. The monitoring results will be reported on each year to the EPA with the parameters to be included as follows: monthly monitoring for pH, Suspended Solids, Total Solids, Total Phosphorus, Total Ammonia, Colour, and COD and DOC.

8.6.2.3.3 *Effect of Fertiliser Application on Downstream Surface Water Quality*

The Carranstown Bog – Cutaway Bog Decommissioning and Rehabilitation Plan (2022) includes the targeted application of fertiliser in order to accelerate the establishment on vegetation of bare peat on headlands, on high fields, and within areas of dry cutaway bog.

The application of fertilizer has the potential to enrich downstream surface waters and have a negative impact on local surface water quality.

However, only a very small area of Carranstown Bog (17.57ha) is proposed to be subject to fertilization. This represents approximately ~5.7% of the total area of Carranstown bog and ~0.7% of the total area of the Application Site.

Pathway: Site drainage and surface water discharge routes.

Receptor: Surface water quality on down gradient rivers (R. Deel, R. Stonyford, R. Boyne, and associated tributaries).

Mitigation Measures:

The Carranstown Bog – Cutaway Bog Decommissioning and Rehabilitation Plan (2022) includes mitigation measures for the application of fertiliser which are summarised below:

- Fertiliser will not be applied on land which is waterlogged, flooded, likely to flood, frozen or covered with snow;
- No fertiliser will be applied when heavy rain is forecast within the succeeding 48 hours;
- No fertiliser will be applied on steeply sloping ground or where there is a rick of water pollution (i.e. the presence of drains); and,
- No fertiliser will be spread on land within 2m of a surface watercourse.

Buffer zones, in accordance with EPA guidelines (www.epa.ie), will be utilised and adhered to in respect of waterbodies during fertiliser application.

8.6.2.3.4 Effect of Potential Leakages and Spillages on Groundwater Quality

During the Remedial Phase, there will be some activity at the Application Site involving machinery and plant with which there is always a risk of accidental spillage of hydrocarbons. This activity will be greatest during the initial stages of rehabilitation when works associated with rewetting and revegetation such as drain blocking will be completed. Once this work has been completed there will only be very limited activity at the Application Site which will mainly comprise of non-intrusive monitoring and minimal repairs to peat blockages and or additional fertilization to aid the development of successional vegetation communities.

Pathway: Infiltration through pore space in peat, subsoil and bedrock.

Receptor: Peat and subsoil, bedrock.

Mitigation Measures:

The following environmental control measures will be implemented during the remedial measures phase in order to mitigate against leaks and spills:

- All machinery will be regularly checked and maintained prior to arrival at the site;
- Fuelling and lubrication of equipment will only be completed in designated areas and away from surface water features;
- Vehicles will never be left unattended during refuelling;
- All refuelling will occur in mobile fuel bowsers;
- Only dedicated, trained and competent personnel will complete refuelling operations;
- Fuel bowsers will be bunded to 100% capacity to prevent any spills;
- Storage tanks for bowsers and generators will be double-skinned;

- Waste oils and fluids will be collected in leak proof containers and removed from the site for disposal;
- Spill kits will be kept on site; and,
- All activities will be completed in accordance with current 'best practice' procedures.

8.6.2.3.5 *Effect of Potential Leakages and Spillages on Surface Water Quality*

Same as Section 8.6.2.3.4 above.

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies (R. Deel, R. Stonyford, R. Boyne, and associated tributaries).

Mitigation Measures:

The mitigation measures outlined in Section 8.6.2.3.4 will be implemented and adhered to through the Remedial Phase of the Project and until the IPC Licence for the Application Site is surrendered. These measures significantly decrease the risk of surface water contamination by leaks and spills of hydrocarbons. No further mitigation measures are deemed necessary.

8.6.2.3.6 *Effect on Groundwater Abstractions*

Local groundwater resources are characterised in Section 8.4.13, with no groundwater supplies mapped within the Application Site.

The works associated with the proposed Cutaway Bog Decommissioning and Rehabilitation Plans are all near-surface activities. Therefore, the potential to impact local groundwater supplies (quality and quantity) is negligible.

Pathway: Groundwater recharge and groundwater flow paths and site drainage network.

Receptor: Groundwater quality and groundwater quantity.

Mitigation Measures: With the exception of the protection of groundwater quality from the accidental spillages of hydrocarbons as discussed in Section 8.6.2.3.4, no additional mitigation measures would be necessary due to the shallow nature of the works and the nature of the local hydrogeological regime.

8.6.2.3.7 *Effect on Downstream Designated Sites*

Peatlands and downstream terrestrial aquatic ecosystems are directly linked and while the degradation of the Application Site may have caused a deterioration in habitats and reduced levels of biodiversity in the downstream catchment, rewetting of bogs is linked with improved surface water quality (Section 8.6.2.3.2). Therefore, the proposed Cutaway Bog Decommissioning and Rehabilitation Plans and rewetting of the Application Site will likely improve the quality of aquatic ecosystems such as the downstream designated sites of the River Boyne and River Blackwater SAC/SPA.

Pathway: Surface water drainage network. Drainage from the site discharges to the Deel, Stonyford and Boyne rivers.

Receptor: River Boyne and River Blackwater SAC/SPA.

Mitigation Measures: Any works during this time period have been completed under licence from the EPA and the Applicant's Environmental Management System. These mitigation measures outlined in Sections 8.6.2.3.2, 8.6.2.3.3 and 8.6.2.3.5. The mitigation measures outlined above will be implemented and adhered to until the IPC Licence for the Application Site is surrendered.

8.6.2.3.8 Effect on Surface and Groundwater Body 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. Therefore, the Remedial Phase of the Project must not compromise the objectives of the WFD.

The status of the groundwater and surface water bodies in the vicinity and downstream of the Application Site are described in Section 8.4.10 and 8.4.11 respectively.

Potential effects on groundwater and surface water quality and quantity as a result of the Remedial Phase of the Project, in the absence of mitigation measures has the potential to result in a short-term deterioration in the WFD status of surface water bodies in the immediate vicinity of the Application Site. This short-term impact will be associated with the short-term actions phase of the rehabilitation plans during which drain blocking will be completed and there will be increased risk of hydrocarbon spills and entrainment of suspended solids in surface watercourses. However, even in an unmitigated scenario, the long-term effects of the Cutaway Bog Decommissioning and Rehabilitation Plans will have a positive impact on the WFD status of surface waterbodies in the vicinity of the Application Site due to the improved quality of surface water discharge from the site and the improved water attenuation within the Application Site.

The proposed activities on the Application Site during the Remedial Phase of the Project will be limited to near surface activities and due to the local hydrogeological regime of the site being characterised by low groundwater recharge rates, the potential for the Project to impact on the status of the underlying GWB is negligible.

The potential change in WFD status in an unmitigated scenario is summarised in Table 8-20 below and outlined in further detail in the WFD Compliance Assessment attached as Appendix 8-4.

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 8-20: Summary of WFD Status Change in an Unmitigated Scenario (Remedial Phase)

WFD Element	WFD Code	Current Status (2016-2021)	Assessed Short-term Status	Assessed Long-term Status
Deel(Raharney)_030	IE_EA_07D010200	Good	Moderate/Good	Good/High
Deel(Raharney)_040	IE_EA_07D010300	Good	Good	Good/High
Deel(Raharney)_050	IE_EA_07D010400	Moderate	Moderate	Moderate/ Good
Deel(Raharney)_060	IE_EA_07D010600	Good	Moderate/ Good	Good/High
Boyne_050	IE_EA_07B040800	Good	Good	Good
Boyne_060	IE_EA_07B040900	Good	Moderate/ Good	Good/High
Stonyford_030	IE_EA_07S020100	Poor	Poor	Poor/Moderate
Stonyford_040	IE_EA_07S020400	Moderate	Poor/Moderate	Moderate/ Good
Boyne_070	IE_EA_07B041000	Moderate	Moderate	Moderate
Boyne_080	IE_EA_07B041200	Moderate	Moderate	Moderate
Athboy GWB	IE_EA_G_001	Good	Good	Good

Pathway(s): Surface water drainage and downstream discharge to surface waterbodies. Groundwater recharge to the underlying groundwater body.

Receptor: The following surface waterbodies have been deemed to have the potential to be affected by the Remedial Phase of the Project dur to their proximal location downstream of the surface water emissions points associated with the Application Site (refer to Section 8.4.3.4 and Figure 8-11 to Figure 8-16): Deel (Raharney)_030, Deel(Raharney)_040, Boyne_060, Stonyford_030 and Stonyford_040. The other river waterbodies located downstream of the Application Site do not have the potential to be impacted. Please refer to the WFD Compliance Assessment attached as Appendix 9-6 for a detailed description of the screening process.

In terms of groundwater bodies, the Athboy GWB is the only receptor due to its location directly underlying the Application Site.

Impact Assessment/ Mitigation Measures: Due to the hydrogeological regime at the Application Site, the surface waterbodies directly downstream of the bog discharge locations are deemed to be the most sensitive receptors.

Strict mitigation measures in relation to the protection of surface and groundwaters are outlined above in Section 8.6.2.3.1 to 8.6.2.3.5. The implementation of these mitigation measures during the Remedial Phase of the Project will ensure the qualitative and quantitative status of the receiving surface and groundwaters will not be altered.

Consequently, there will be no change in GWB or SWB status in the underlying GWBs or downstream SWBs (refer to Table 8-21). There will be no change in quantitative (volume) or qualitative (chemical) status, and the downstream SWBs are protected from any potential deterioration from chemical pollution.

As such, the Remedial Phase is compliant with the requirements of the WFD (2000/60/EC).

Table 8-21: Summary WFD Status with the implementation of Mitigation Measures

WFD Element	WFD Code	Current Status (2013-2018)	Assessed Short-term Status	Assessed Long-term Status
Deel(Raharney)_030	IE_EA_07D010200	Good	Good	Good/High
Deel(Raharney)_040	IE_EA_07D010300	Good	Good	Good/High
Deel(Raharney)_050	IE_EA_07D010400	Moderate	Moderate	Moderate/ Good
Deel(Raharney)_060	IE_EA_07D010600	Good	Good	Good/High
Boyne_050	IE_EA_07B040800	Good	Good	Good
Boyne_060	IE_EA_07B040900	Good	Good	Good/High
Stonyford_030	IE_EA_07S020100	Poor	Poor	Moderate
Stonyford_040	IE_EA_07S020400	Moderate	Moderate	Moderate/ Good
Boyne_070	IE_EA_07B041000	Moderate	Moderate	Moderate
Boyne_080	IE_EA_07B041200	Moderate	Moderate	Moderate
Athboy GWB	IE_EA_G_001	Good	Good	Good

8.6.3 Residual Effects

8.6.3.1 Peat Extraction Phase (July 1988 – June 2020)

8.6.3.1.1 *Effects of Bog Drainage on Bog Hydrogeology*

The residual effect of Peat Extraction Phase of the Project is a permanent, moderate, negative, direct, long-term likely effect on the bog hydrogeology. It is intended to implement a Cutaway Bog Decommissioning and Rehabilitation Plans for each of the bogs and this will likely involve drain blocking and other measures to raise the subsurface water levels. The assessment of the implementation of the Cutaway Bog Decommissioning and Rehabilitation Plans is provided in Section 8.6.4.

8.6.3.1.2 *Effects of Bog Drainage on Downstream Surface Water Hydrology/Quality*

All activities predating 2000 were unlicensed and no records exist regarding the quality of discharges to nearby surface watercourses. However, by 1988 peat extraction activities and all ancillary works were already well established at the Application Site and while EPA Q-values throughout this phase of the Project fluctuate, there is no clear negative trend in terms of surface water quality between 1988 and 2020. Some improved sediment control measures were installed at the Application Site in the late 1990s and early 2000s and water quality discharge licence limits have been in place since 2000 in accordance with IPC licensing. The available monitoring data indicate that improvements in downstream water quality have not been significant, and this is because there are other activities in the catchment that effect water quality and also that the baseline water quality was reasonably good and has not changed significantly during the Peat Extraction Phase.

The effect on surface water quantity in downstream surface watercourse are not likely to be significant. The drainage systems were designed to reduce runoff to greenfield runoff rates. In addition, runoff from intact raised peat bogs can be quite high when saturated during the winter months.

The residual effect is a moderate, long-term, negative and indirect likely effect on downstream surface water quality and a moderate, long-term, negative and indirect effect on downstream surface water quantity (i.e. river flows).

The cessation of activities and the implementation of the Cutaway Bog Decommissioning and Rehabilitation Plans will limit the potential for significant effects into the future and this is assessed below.

8.6.3.1.3 *Contamination of Groundwater by Leakages and Spills*

From a review of the AER reports, we understand that no significant fuel spills or wastewater discharges have occurred since 2000. In addition, extensive control measures have been implemented since 2000 as part of the IPC licence which mitigates against the possibility of any groundwater contamination.

While there are no records to rely on, there does not appear to be any significant issues with hydrocarbons or wastewater discharges to groundwater resulting from the peat extraction activities and all ancillary works prior to IPC regulation (we note that no major issues are referenced in the IPC licence application or in subsequent annual environmental reports).

Therefore, the residual effect on local groundwater quality is imperceptible, long-term, negative, indirect and unlikely.

8.6.3.1.4 *Contamination of Surface Water by Leakages and Spills*

The Applicant did not record (in AER submissions to the EPA) the occurrence of any major significant fuel spills and/or wastewater discharges. In addition, extensive control measures have been implemented since 2000 as part of the IPC licence which mitigate against the possibility of any surface water contamination.

While there are no pre-IPC licence records to rely on, there does not appear to be any significant issues with hydrocarbons or wastewater discharges to surface water resulting from the peat extraction activities and all ancillary works prior to IPC regulation.

The residual effect is a slight, long-term, negative, indirect, unlikely impact on local surface water quality and downstream aquatic ecosystems.

8.6.3.1.5 *Effects on Groundwater Abstractions*

The potential for the peat extraction activities and all ancillary works to impact the hydrogeology of the Ballivor PWS has been reduced as the bog drainage regime was already largely in place at the time the source boreholes were drilled (1994). The natural hydrological and hydrogeological regime of peat bogs, with little groundwater recharge and high runoff rates, also limit the potential effects that peat extraction activities and all ancillary works may have had on local groundwater abstractions including the Ballivor PWS. The Application Site is not located within the mapped SPA area to the Ballivor PWS. The residual effect is considered to be – Neutral, imperceptible, indirect, long-term, unlikely effect on groundwater quality and groundwater quantity.

8.6.3.1.6 *Effect on Designated Sites*

The potential for the peat extraction activities and all ancillary works to impact the hydrology of the River Boyne and River Blackwater SAC/SPA has been reduced as the bog drainage regime was already in place at the time of the SAC and SPA designation. Proven and effective control measures have also been implemented to limit the runoff from the Application Site to original greenfield runoff rates. The Application Site has also been operating under IPC licence conditions since April 2000. The residual effect is imperceptible, long-term, negative, indirect likely effect on the hydrology (flows and water quality) of the River Boyne and River Blackwater SAC/SPA.

8.6.3.1.7 *Effect on the WFD Status of Surface and Groundwater Bodies*

As the 1st WFD cycle was completed in 2010-2015, no WFD status existed for much of the Peat Extraction Phase. However, EPA Q-rating values are available from 2000 to 2020 for all watercourses downstream of the Application Site. The data shows a relatively stable trend in Q-values during this period with the majority of watercourses fluctuating between Q3.5 ("Moderate" Q-status) and Q4 ("Good" Q-status), being either slightly polluted or unpolluted. These EPA Q-rating values indicate a slight decline in water quality in comparison with the pre-2000 period. However, river waterbodies upstream of the Application Site have experienced a similar trend in Q-ratings. Therefore, the trend is likely to reflect land-use changes in the wider Boyne catchment rather than any specific peat extraction activities and all ancillary works within the Application Site. Consequently, changes in water quality during this period cannot be attributed solely to peat extraction activities and all ancillary works which were being scaled back at this time. We consider that with the implementation of the control measures in accordance with IPC Licence Requirements the status of the SWBs during this phase were comparable to those recorded in the 1st WFD cycle (2010-2015).

The Stonyford_030 is the only SWB in the vicinity and downstream of the Application Site to have ever achieved "Poor" status (2016-2021), the remaining SWBs in the vicinity and downstream of the Application Site have achieved either "Moderate" or "Good" status in all WFD cycles. The effect on surface waterbody status is not likely to be significant. The drainage systems were designed to reduce runoff to greenfield runoff rates while the IPC licence controls also ensured high quality runoff from the site.

In addition, the Athboy GWB achieved "Good" status in all WFD cycles and IPC control measures ensured the protection of groundwater quality.

Therefore, we consider that there has been an insignificant, short-term, negative and indirect effect on downstream surface waterbody status and no residual effect on groundwater body status.

A full WFD Compliance Assessment is included as Appendix 8-4.

8.6.3.2 Current Phase (June 2020 – Present Day)

8.6.3.2.1 Effects of Bog Drainage on Bog Hydrogeology

The bog hydrogeology remained largely unchanged during this period due to a lack of activity in regard to drainage infrastructure. Therefore, the residual effect is a neutral, imperceptible, short-term, indirect, unlikely effect on bog hydrogeology.

8.6.3.2.2 Effects of Bog Drainage on Downstream Surface Water Hydrology/Quality

No significant effects on downstream surface water hydrology will have occurred from the cessation of peat extraction activities and all ancillary works in June 2020 to the present day. There has been no discernible trend (positive or negative) in Q-values in downstream surface watercourses since the termination of peat extraction activities and all ancillary works in 2020. However, a perceptible positive trend in Q-values would not have been expected given the relatively short time period since peat extraction activities and all ancillary works ceased (~4 years). Therefore, the residual effect is a neutral, imperceptible, short-term, indirect, unlikely effect on downstream surface water hydrology.

8.6.3.2.3 Contamination of Groundwater by Leakages and Spills

From a review of the available AER reports, we understand that no significant fuel spills or wastewater discharges have occurred during this period. Therefore, the residual effect is a negative, imperceptible, short-term, indirect unlikely effect on groundwater quality.

8.6.3.2.4 Contamination of Surface Water by Leakages and Spills

From a review of the available AER reports, we understand that no significant fuel spills or wastewater discharges have occurred during this period. Therefore, the residual effect is a negative, imperceptible, short-term, indirect, unlikely effect on surface water quality.

8.6.3.2.5 Effects on Groundwater Abstractions

For the reasons outlined above and due to the lower levels of activity onsite during the Current Phase of the Project, that there has not been any residual effect on groundwater abstractions.

8.6.3.2.6 Effect on Designated Sites

No significant change in the hydrology of the River Boyne and River Blackwater SAC/SPA will have occurred following the cessation of peat extraction activities and all ancillary works. Due to the reasons outlined above, we consider the residual effect is a neutral, imperceptible, short-term, indirect, unlikely effect on water quantity and water quality flowing from the bogs towards the River Boyne and River Blackwater SAC/SPA.

8.6.3.2.7 Effect on WFD Status of Surface and Groundwater Bodies

No change in the qualitative or quantitative status of the receiving waterbodies will have occurred following the cessation of peat extraction activities and all ancillary works. Due to the reasons outlined above, it is considered that the residual effect is a neutral, imperceptible, short-term, indirect, unlikely effect on WFD status of downstream surface waterbodies and underlying groundwater bodies.

8.6.3.3 Remedial Phase

8.6.3.3.1 Effects of Bog Drainage on Bog Hydrogeology

Following the implementation of the proposed Cutaway Bog Decommissioning and Rehabilitation Plans, the bogs will likely be wetter, they will retain more water, they will recolonise with vegetation slowly, and they will eventually become naturally functioning peatlands. As such, we consider the residual effects of the Cutaway Bog Decommissioning and Rehabilitation Plans to be moderate, positive, direct, long-term effect on local peat bog hydrology/hydrogeology.

8.6.3.3.2 Effects of Bog Drainage on Downstream Surface Water Hydrology/Quality

Following the implementation of the proposed Cutaway Bog Decommissioning and Rehabilitation Plans, the bogs will be wetter, they will retain more water, they will recolonise with vegetation slowly, and they will eventually become naturally functioning peatlands with much-reduced silt and nutrient output. As such, we consider the residual effects of the Cutaway Bog Decommissioning and Rehabilitation Plans to be a moderate, positive, indirect, long-term effect on downstream surface water hydrology and water quality.

8.6.3.3.3 Effect of Fertilizer Application on Downstream Surface Water Quality

The application of fertiliser in the early stages of the Cutaway Bog Decommissioning and Rehabilitation Plans will only occur over a small area of the overall Application Site. Strict mitigation measures have been proposed in regard to the application of fertiliser to ensure surface water quality is not impacted. As such, we consider the residual effects of the proposed fertilisation to be an imperceptible, negative, indirect, short-term effect on downstream surface water quality.

8.6.3.3.4 Effect of Potential Leaks and Spillages on Groundwater Quality

The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction or development sites. Proven and effective measures to mitigate the risk of spills and leaks will be implemented during the Remedial Phase of the Project. It is considered that the residual effect to be negative, imperceptible, direct, short-term, unlikely effect on groundwater quality.

8.6.3.3.5 Effect of Potential Leaks And Spillages on Surface Water Quality

The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks will be implemented throughout the Remedial Phase of the Project. Therefore, the residual effect is imperceptible, negative, direct, short-term, unlikely effect on surface water quality.

8.6.3.3.6 Effect on Groundwater Abstractions

There will be no effect on groundwater resources and existing abstractions.

8.6.3.3.7 Effect on Designated Sites

Due to the reasons outlined above, and with the implementation of the Cutaway Bog Decommissioning and Rehabilitation Plans the bogs will likely be wetter, they will retain more water, they will recolonise with vegetation slowly, and they will eventually become naturally functioning peatlands and or wetlands with much-reduced silt and nutrient output. It is considered that consider the likely residual effect to be moderate, positive, indirect, long-term effects on the River Boyne and River Blackwater SAC/SPA.

8.6.3.3.8 Effect on the WFD Status of Surface and Groundwater Bodies

Due to the local hydrogeological regime at the Application Site (very limited groundwater recharge), coupled with the implementation of the proposed mitigation measures for the protection of surface water quality, and the additional hydrological benefits associated with bog rehabilitation (improved surface water quality and improved water attenuation), we consider that there will be a slight, positive, long-term, indirect, likely effect on the WFD status of downstream SWBs. There will be no residual effect on the WFD status of the underlying GWB.

8.6.4 Significance of Effects

8.6.4.1 Peat Extraction Phase (July 1988 – June 2020)

8.6.4.1.1 Effects of Bog Drainage on Bog Hydrogeology

With the implementation of the control measures, it is considered that there has been a slight effect on local bog hydrogeology as a result of the Peat Extraction Phase of the Project between 1988 and 2020. The significant effects on local bog hydrogeology had occurred prior to 1988.

8.6.4.1.2 Effects of Bog Drainage on Downstream Surface Water Hydrology/Quality

For the reasons outlined above, and with the implementation of the control measures, it is considered that there has been a moderate effect on downstream surface water quality as a result of the Peat Extraction Phase of the Project between 1988 and 2020.

8.6.4.1.3 Contamination of Groundwater by Leakages and Spills

For the reasons outlined above and with the implementation of the control measures, it is considered that there has not been a significant effect on groundwater quality as a result of leaks and spills during the Peat Extraction Phase of the Project.

8.6.4.1.4 Contamination of Surface Water by Leakages and Spills

For the reasons outlined above and with the implementation of the control measures, it is considered that there has not been a significant effect on downstream surface water quality as a result of leaks and spills during the Peat Extraction Phase of the Project.

8.6.4.1.5 Effects on Groundwater Abstractions

For the reasons outlined above, it is considered that there has not been a significant effect on local groundwater abstractions during the Peat Extraction Phase of the Project.

8.6.4.1.6 Effect on Designated Sites

For the reasons outlined above and with the implementation of the outlined control measures we consider that there has not been a significant effect on the hydrology of the River Boyne and River Blackwater SAC/SPA during the Peat Extraction Phase of the Project.

8.6.4.1.7 Effect on the WFD Status of Surface and Groundwater Bodies

With the implementation of the IPC licence controls no significant effects on the status of downstream SWBs or the underlying Athboy GWB have occurred during the Peat Extraction Phase of the Project.

8.6.4.2 Current Phase (June 2020 – Present Day)

8.6.4.2.1 Effects of Bog Drainage on Bog Hydrogeology

For the reasons outlined above and with the implementation of the IPC Licence conditions, it is considered that there has not been a significant effect on the local bog hydrogeology during the Current Phase of the Project.

8.6.4.2.2 Effects of Bog Drainage on Downstream Surface Water Hydrology/Quality

For the reasons outlined above and with the implementation of the IPC Licence conditions it is considered that there has not been a significant effect on the downstream surface water hydrology during the Current Phase of the Project.

8.6.4.2.3 Contamination of Groundwater by Leakages and Spills

For the reasons outlined above and with the implementation of the IPC Licence conditions it is considered that there has not been a significant effect on local groundwater quality during the Current Phase of the Project.

8.6.4.2.4 Contamination of Surface Water by Leakages and Spills

For the reasons outlined above and with the implementation of the IPC Licence conditions it is considered that there has not been a significant effect on downgradient surface waterbodies during the Current Phase of the Project.

8.6.4.2.5 Effects on Groundwater Abstractions

For the reasons outlined above and with the implementation of the IPC Licence conditions it is considered that there has not been a significant effect on downgradient surface waterbodies during the Current Phase of the Project.

8.6.4.2.6 Effect on Designated Sites

For the reasons outlined above and with the implementation of the IPC Licence conditions it is considered that there has not been a significant effect on downgradient designated sites during the Current Phase of the Project.

8.6.4.2.7 Effect on WFD Status of Surface and Groundwater Bodies

With the implementation of the IPC Licence conditions it is considered that there has not been a significant effect on WFD status during the Current Phase of the Project.

8.6.4.3 Remedial Phase

8.6.4.3.1 Effects of Bog Drainage on Bog Hydrogeology

For the reasons outlined above it is considered that the proposed Cutaway Bog Decommissioning and Rehabilitation Plans will have a significant effect on local bog hydrogeology within the Application Site.

8.6.4.3.2 Effects on Downstream Surface Water Hydrology/Quality

For the reasons outlined above it is considered that the proposed Cutaway Bog Decommissioning and Rehabilitation Plans will have a significant effect on downstream water quality and quantity.

8.6.4.3.3 *Effect of Fertilizer Application on Downstream Surface Water Quality*

For the reasons outlined above and with the implementation of the mitigation measures, it is considered that the proposed fertilisation associated with the Cutaway Bog Decommissioning and Rehabilitation Plans will not have a significant effect on downstream water quality.

8.6.4.3.4 *Contamination of Groundwater by Leakages and Spills*

For the reasons outlined above and with the implementation of the mitigation measures, it is considered that there will not be a significant effect on groundwater quality.

8.6.4.3.5 *Contamination of Surface Water by Leakages and Spills*

For the reasons outlined above and with the implementation of the mitigation measures, it is considered that there will not be a significant effect on surface water quality.

8.6.4.3.6 *Effects on Groundwater Abstractions*

For the reasons outlined above it is considered that there will not be a significant effect on groundwater resources and abstractions.

8.6.4.3.7 *Effect on Designated Sites*

For the reasons outlined above and with the implementation of the mitigation measures, it is considered that there will not be a significant effect on groundwater resources and abstractions.

8.6.4.3.8 *Effect on the WFD Status of Surface and Groundwater Bodies*

With the implementation of the mitigation measures outlined above there will be no significant effects resulting from the Remedial Phase of the Project. The Remedial Phase 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.

8.6.5 Cumulative/In Combination Effects

8.6.5.1 Peat Extraction Phase (July 1988 – June 2020)

Indirect cumulative effects can occur via surface water and groundwater flow paths, but these are restricted by connectivity and proximity.

The Application Site is located in the River Boyne surface water catchment. Potential cumulative effects associated with landuse, hydrological and/or hydrogeological changes at the Application Site due to the peat extraction activities and all ancillary works would have had the potential to result in some cumulative effects associated with other activities occurring within the Boyne Catchment over this time period (1988 – 2020).

The assessment of cumulative impacts during the Peat Extraction Phase of the Project is divided as follows:

- Cumulative effects assessment of third party and private peat sod peat cutting (i.e. turbary activities);

- Cumulative effects of agriculture in the surrounding lands; and,
- Cumulative effects of forestry.

The cumulative effects of the Peat Extraction Phase (1988-2020) and the peat extraction and site preparation works which preceded 1988 would have had a profound negative effect on the bog hydrogeological regime whereby vegetation was cleared, drainage inserted, and peat extracted from much of the Application Site. The cumulative effect on downstream surface water quality and flow volumes is not considered to be significant given the control measures being implemented by the Applicant.

8.6.5.1.1 Cumulative effects of third party and private peat cutting

Private and third-party peat cutting was being undertaken at the Lisclogher Bog throughout the Peat Extraction Phase of the Project.

Following the Turf Development Act of 1981, the Applicant oversaw a private turf development scheme which provided grants to private bog developers. Third-party sod peat extraction activities and all ancillary works began at Lisclogher Bog in the 1990s and continued until 2020. Over the course of the years, it is estimated that approximately 1,200 tonnes of peat were extracted by third parties from Lisclogher.

The Peat Extraction Phase of the Project would potentially have interacted with these turbary activities and could have contributed to a deterioration of downstream surface water quality through the emissions of elevated concentrations of suspended solids and ammonia. Bog drainage would also have been required for these turbary activities and cumulative impacts on the local bog hydrology may have occurred.

Pathways: Peat drainage and surface water pathways.

Receptors: Surface water quality in downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers) and bog hydrogeology.

Control Measures:

Control measures relating to the protection of water quality are outlined in Sections 8.6.2.3.1 and 8.6.2.3.2 above.

Impact Assessment:

No control measures beyond those required to comply with the IPC licence conditions were implemented. Control measures were also implemented by the Applicant in an ad hoc manner between 1988 and 2000 by implementation of the pre-existing surface water management system (Refer to Section 8.6.2.2.2).

The areas of third-party peat cutting were small in comparison to the peat extraction activities and all ancillary works completed by the Applicant. The third-party peat cutting was also completed at bog margins.

By 1988 the majority of the Application Site was already artificially drained, with some minor drainage installed on Lisclogher West within the Application Site. Consequently, the continued drainage of these bogs during the Peat Extraction Phase of the Project would have been limited in its potential to alter the hydrological regime in downstream watercourses. However, during the Peat Extraction Phase, there was an ongoing risk of elevated concentrations of suspended solids making their way into downstream surface watercourses from the erosion of peat sediment via the bog drainage network. This potential pathway would pose a significant risk to local surface water quality, particularly as the River Boyne, Deel and Stonyford Rivers were all of Extremely High or Very High Importance in 1988. Other water quality parameters of concern are ammonia and Chemical Oxygen Demand (COD).

As outlined, EPA Q-values throughout the Peat Extraction Phase of the Project fluctuate, there is no clear negative trend in terms of surface water quality between 1988 and 2020. Some improved sediment control measures were installed at the Application Site in the late 1990s and early 2000s and water quality discharge licence limits have been in place since 2000 in accordance with IPC licensing. The available monitoring data indicate that improvements in downstream water quality have not been significant, and this is because there are other activities in the catchments that effect water quality and also that the baseline water quality was reasonably good and has not changed significantly during the Peat Extraction Phase of the Project.

Residual Effects: Any third party or private peat cutting completed at the Application Site during the Peat Extraction Phase of the Project (1988 - 2020) would have been infinitely small, in terms of the peat extraction activities and all ancillary works areas and the volumes of peat being removed from the Application Site, in comparison to the Applicant's operations. There are no indications from surface water quality monitoring data that third party peat extraction activities and all ancillary works in combination with the Applicant peat extraction activities and all ancillary works had a significant impact on downstream surface water quality. Therefore, any cumulative effects on local bog hydrogeology and downstream local surface water quality would have been consistent with emerging trends within the downstream catchments when compared to those which would have resulted solely from the large scale, commercial Bord na Móna peat harvesting operations. The residual effect is a moderate, long-term, negative, indirect likely effect on downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers).

Significance of Effects: For the reasons outlined above we consider that there has not been a significant cumulative effect during the Peat Extraction Phase of the Project.

8.6.5.1.2 *Cumulative effects with agriculture*

The Application Site is situated in the Boyne River catchment with agriculture being the largest land use in the surrounding lands and in the wider catchment. Corine land cover maps (1990 – 2018) show that the majority of lands in the Boyne catchment have been used for agricultural purposes during the Peat Extraction Phase of the Project (1988 – 2020).

Agriculture is the largest pressure on water quality in Ireland. Agricultural practices such as the movement of soil and the addition of fertilizers and pesticides can lead to nutrient losses and the entrainment of suspended solids in local surface watercourses. This can have a negative impact on local and downstream surface water quality.

The Peat Extraction Phase of the Project would potentially have interacted with these agricultural activities and could have contributed to a deterioration of downstream surface water quality through the emissions of elevated concentrations of suspended solids and ammonia.

Pathways: Surface water pathways.

Receptors: Surface water quality in downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers).

Control Measures:

No control measures beyond those required to comply with the IPC licence conditions are deemed necessary. These control measures have been implemented by the Applicant since 2000 and build upon pre-existing surface water management system which was already in operation at the Application Site (1988 – 2000).

Impact Assessment:

The area of the Application Site (24.21km^2) is small in comparison to the total area of the Boyne Catchment (2,694km^2) within which agriculture is the dominant landuse.

By 1988 the vast majority of the Application Site had already been artificially drained. Consequently, the continued drainage of these bogs during the Peat Extraction Phase of the Project would have been limited in its potential to alter the hydrological regime in downstream watercourses. However, during the Peat Extraction Phase, there was an ongoing risk of elevated concentrations of suspended solids and ammonia making their way into downstream surface watercourses via the bog drainage network. This potential pathway would pose a significant risk to downstream local surface water quality, particularly as the River Boyne, Deel and Stonyford Rivers were all of Extremely High or Very High Importance in 1988.

However, while the EPA Q-values throughout the Peat Extraction Phase of the Project fluctuate, there is no clear negative trend in terms of surface water quality between 1988 and 2020. Furthermore, EPA Q-stations located upstream of the Application Site fluctuate in a similar manner indicating that there are other activities in the catchment, including agriculture, which had a greater effect on downstream surface water quality.

Some improved sediment control measures were installed at the Application Site in the late 1990s and early 2000s and water quality discharge licence limits have been in place since 2000 in accordance with IPC licensing. Any cumulative effects will have been reduced in subsequent years with environmental monitoring showing that since 2000, the emission limit for ammonia (2.78mg/l) has only been exceeded on 10 no. occasions while the emission limit for suspended solids has only been exceeded on 6 no. occasions. As discussed in Section 8.4.5.2.2 above, 96% and 97% of the total samples analysed for ammonia and suspended solids have been compliant with the relevant IPC limits. Therefore, if significant cumulative effects were occurring, we would expect to see an improvement in downstream water quality following the implementation of the IPC licence control measures.

However, the available monitoring data indicate that improvements in downstream water quality have not been significant. This indicates that the wider land use in the catchment, which is dominated by agriculture, has a greater effect on surface water quality than the peat extraction activities and all ancillary works within the Application Site and any associated cumulative effects.

Residual Effect: The baseline 1988 environment comprised of a drained peatland located within a largely agricultural catchment. There are no indications from surface water quality monitoring data that peat extraction activities and all ancillary works within the Application Site in combination with agricultural activities in the wider catchment had a significant impact on downstream surface water quality. The EPA Q-values suggest that any cumulative effects were small in comparison to the effects resulting solely from agricultural practices in the wider catchment. Therefore, any cumulative effects on local downstream local surface water quality would have been consistent with emerging trends within the downstream catchments when compared to those which would have resulted solely from the large scale, commercial Bord na Móna peat harvesting operations. The residual effect is a moderate, long-term, negative, indirect, likely cumulative effect on downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers).

Significance of Effects: For the reasons outlined above we consider that there has not been a significant cumulative effect during the Peat Extraction Phase of the Project.

8.6.5.1.3 *Cumulative effects with forestry*

The Applicant's landholdings at the Application Site include approximately 10 hectares of conifer forestry (approximately 8.76ha in Lisclogher-West Bog and 1.78ha in Ballivor Bog) which is managed exclusively by Coillte. These areas of forestry do not fall within the peat extraction bogs and do not form part of the Substitute Consent application.

The most common water quality problems arising from forestry relate to the release of sediment and nutrients to the aquatic environment and impacts from acidification. Forestry may also give rise to modified stream flow regimes caused by associated land drainage.

Due to the close proximity of these areas of coniferous forestry to the Application Site and given that they drain to the same river waterbodies as the Application Site, the potential cumulative impacts on downstream water quality and quantity need to be assessed.

Pathways: Peat drainage and surface water pathways.

Receptors: Surface water quality and quantity in downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers).

Control Measures:

No control measures beyond those required to comply with the IPC licence conditions are deemed necessary. These control measures have been implemented by the Applicant since 2000 and build upon pre-existing surface water management system which was already in operation at the Application Site (1988 – 2000).

Impact Assessment:

The areas of conifer forestry were small in comparison to the peat extraction activities and all ancillary works completed by the Applicant.

By 1988 the vast majority of the Application Site had already been artificially drained. Consequently, the continued drainage of these bogs during the Peat Extraction Phase of the Project would have been limited in its potential to alter the hydrological regime in downstream watercourses. However, during the Peat Extraction Phase, there was an ongoing risk of elevated concentrations of suspended solids making their way into downstream surface watercourses from the erosion of peat sediment via the bog drainage network. This potential pathway would pose a significant risk to local surface water quality, particularly as the River Boyne, Deel and Stonyford Rivers were all of Extremely High or Very High Importance in 1988. Other water quality parameters of concern are ammonia and Chemical Oxygen Demand (COD).

As outlined previously, EPA Q-values throughout the Peat Extraction Phase of the Project fluctuate, there is no clear negative trend in terms of surface water quality between 1988 and 2020. In addition, there is no distinguishable improvement in surface water quality following the implementation of the improved sediment control measures in the late 1990s and early 2000s and the IPC licence control measures in 2000. The monitoring data indicates there are other activities in the catchments which effect water quality and also that the baseline water quality was reasonably good and has not changed significantly during the Peat Extraction Phase of the Project.

Residual Effects: By 1988 peat extraction activities and all ancillary works were already well established across the majority of the Application Site. Therefore, the baseline environment contained peat extraction activities and all ancillary works across much of the Application Site. Any cumulative effects with the commercial forestry activities will have been reduced in subsequent years as the Applicant implemented improved sediment control measures throughout the 1990s and IPC licencing controls in 2000.

EPA Q-values in downstream watercourses fluctuate throughout this phase of the Project, there is no clear negative trend in terms of surface water quality between 1988 and 2020.

Therefore, the cumulative effect of the Peat Extraction Phase of the Project and the forestry activities in the surrounding lands is moderate, long-term, negative, indirect, likely effect on downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers).

Significance of Effects: For the reasons outlined above we consider that there has not been a significant cumulative effect during the Peat Extraction Phase of the Project.

8.6.5.2 Current Phase (June 2020 – Present Day)

8.6.5.2.1 *Cumulative effects with agriculture*

The Application Site is situated within a largely agricultural catchment and any activities within the Application Site have the potential to interact with the agricultural practices in the surrounding lands and could contribute to a deterioration of downstream surface water quality.

The potential effects are similar to those associated with the Peat Extraction Phase of the Project but of a significantly reduced magnitude due to the reduced scale of any works. During this phase of the Project activities onsite are limited to the removal of stockpiles, maintenance of the existing drainage system and environmental monitoring.

Pathways: Surface water pathways.

Receptors: Surface water quality in downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers).

Control Measures:

All operations completed during this phase of the Project were done in accordance with IPC licence requirements and no additional control measures are deemed necessary.

Residual Effects: There are no indications from EPA Q-values or environmental monitoring data that there has been a significant impact on downstream surface water quality. No cumulative effects have occurred.

Significance of Effects: For the reasons outlined above and with the implementation of IPC licence control measures, we consider that there has not been a significant cumulative effect during the Current of the Project.

8.6.5.2.2 *Cumulative effects with forestry*

The Applicant landholdings at the Application Site include approximately 10ha of conifer forestry and due to the close proximity of these areas of coniferous forestry to the Application Site and given that they drain to the same river waterbodies as the Application Site, the potential cumulative impacts on downstream water quality and quantity need to be assessed.

The potential effects are similar to those associated with the Peat Extraction Phase of the Project but of a significantly reduced magnitude due to the reduced scale of any works. During this phase of the development peat extraction activities and all ancillary works are limited to the removal of stockpiles, maintenance of the existing drainage system and environmental monitoring.

Pathways: Surface water pathways.

Receptors: Surface water quality in downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers).

Control Measures:

All operations completed during this phase of the Project were done in accordance with IPC licence requirements and no additional control measures are deemed necessary.

Residual Effects: There are no indications from EPA Q-values or environmental monitoring data that there has been a significant impact on downstream surface water quality. No cumulative effects have occurred.

Significance of Effects: For the reasons outlined above and with the implementation of IPC licence control measures, we consider that there has not been a significant cumulative effect during the Current Phase of the Project.

8.6.5.3 Remedial Phase

8.6.5.3.1 *Cumulative effects with Proposed Ballivor Wind Farm*

The Applicant intend to utilise the Application Site for both peatland rehabilitation and wind energy infrastructure in order to facilitate environmental stabilisation of the bog group and to optimise climate action benefits.

The proposed Ballivor Wind Farm is a 26-no. turbine wind farm with development infrastructure proposed on Ballivor, Carranstown, Lisclogher and Bracklin bogs. The overall footprint of the proposed Ballivor Wind Farm is <1.4% of the total area of the Application Site. The Cutaway Bog Decommissioning and Rehabilitation plans for each of these bogs, (with the exception of Lisclogher West which does not contain any proposed Ballivor Wind Farm infrastructure) will be updated to incorporate the proposed wind farm infrastructure, with the key objectives of the Cutaway Bog Decommissioning and Rehabilitation Plans *i.e.* rewetting and revegetation, occurring between and surrounding the proposed wind farm infrastructure.

The EIAR for the proposed Ballivor Wind Farm development details the potential hydrological and hydrogeological issues relating to the construction, operation and decommissioning phases of the proposed wind farm and proposes a suite of best practice mitigation measures designed to ensure that the proposed development does not in any way have a negative impact on downstream surface water quality and quantity.

The main risk to downstream surface water quality and the underlying groundwater quality will occur during the construction phase of the proposed Ballivor Wind Farm development when there is greatest activity on site and large volumes of material being excavated, increasing the potential for elevated concentrations of suspended solids in runoff and heightening the risk of hydrocarbon spillages and leaks. However, extensive mitigation measures will be utilised to protect surface water quality during all phases of the proposed wind farm development. These mitigation measures will utilise and enhance the existing bog drainage network to ensure the proposed development will be in accordance with IPC licence conditions.

During the operational phase of the proposed Ballivor Wind Farm development, the majority of the remedial rehabilitation measures, such as drain blocking, will have been completed and there will be little activity on site with the exception of monitoring and maintenance. The increased surface water runoff associated with the wind farm development infrastructure will be offset by the increased surface water attenuation at the site following the implementation of the remedial measures.

Water quality of discharges from restored peatlands generally improves as a result of bog rehabilitation measures and site restoration. The proposed rehabilitation measures at the Application Site include drain blocking which will improve water attenuation by slowing the movement of water through the Application Site and the release of water downstream. Re-vegetation of the Application Site will stabilise substrates and reduce the risk of elevated concentrations of suspended sediment in downstream watercourses.

Pathways: Peat drainage and surface water pathways.

Receptors: Surface water quality in downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers) and bog hydrogeology.

Mitigation Measures:

No mitigation measures beyond those required to comply with the IPC licence conditions and those outlined in Sections 8.6.2.3.1 to Section 8.6.2.3.7 are deemed necessary.

It is recommended to complete the Remedial Phase site works (drain blocking etc) and the construction of the wind farm sequentially across the Application Site. This will spread the activity at the site rather than concentrate it in a particular location. Nevertheless, the activities associated with the Remedial Phase site works are low impact in comparison to the construction of the proposed wind farm.

Likely Cumulative Residual Effects: The proposed wind farm development contains a very small footprint within the Application Site. Effective mitigation measures have been proposed for the remedial phase of the proposed development and with the implementation of similar measures for all phases of the potential wind farm development the cumulative residual effect is a moderate, positive effect.

Significance of Effects: For the reasons outlined above we consider that there will not be a significant cumulative effect.

8.6.5.3.2 *Cumulative Effects with Enhanced Rehabilitation Measures (PCAS)*

In addition to the standard remedial measures as detailed in the Cutaway Bog Decommissioning and Rehabilitation Plans for the bogs comprising the Application Site, the Applicant is also committed to enhanced peatland rehabilitation and restoration measures, subject to government funding. Several of the bogs comprising the Application Site have been selected for this enhanced restoration which will comprise of targeted measures designed to rewet the peat. The implementation of PCAS measures will provide greater surface water attenuation and surface water quality benefits in and downstream of the restoration areas. This PCAS measures and the standard remedial measures will have a positive cumulative effect on bog hydrogeology and surface water quality.

Pathways: Peat drainage and surface water pathways.

Receptors: Surface water quality in downgradient waterbodies (i.e. the Deel (Raharney), Stonyford and Boyne Rivers) and bog hydrogeology.

Mitigation Measures: No mitigation measures beyond those required to comply with the IPC licence conditions and those outlined in Sections 8.6.2.3.1 to Section 8.6.2.3.7 are deemed necessary.

Likely Cumulative Residual Effects: The PCAS works will have a positive effect on the local bog hydrogeological environment and the local hydrological environment (in terms of surface water quality and attenuation). The cumulative residual effect is a moderate, positive effect.

Significance of Effects: For the reasons outlined above we consider that there will not be a significant cumulative effect.

8.6.6 Human Health

Due to the nature of the peat extraction activities and all ancillary works process, combined with the control measures and environmental monitoring implemented at the site, no water related impacts on human health have likely resulted from the Peat Extraction Phase nor the Current Phase of the Project.

Furthermore, the Remedial Phase will pose no risk to human health and will likely result in the improvement in local surface water quality.

8.6.7 Monitoring

Environmental monitoring will continue as per the existing IPC conditions until the current IPC licence is surrendered.

This monitoring will encompass surface water sampling to ensure that the discharge from the Application Site remains below the existing IPC emission limit values, thereby protecting downstream surface water quality.

It is also likely that some monitoring will be proposed in order to evaluate the success of the Cutaway Bog Decommissioning and Rehabilitation Plans. This shall include groundwater monitoring in the form of piezometers which will allow for the measurement of the peat groundwater table and assess the impact of the proposed rehabilitation measures, such as drain blocking, which are designed to raise the local peat groundwater table.

8.6.8 Major Accidents and Disasters (MADs)

The main risk of MADs at peatland sites is related to peat stability. However, due to the low-lying and flat nature of the Application Site, slope stability has posed no risk at the Application Site during all phases of the Project.

Flooding can also result in downstream MADs. However, there has been no risk of flooding downstream of the Application Site as a result of the historic and/or proposed activities at the site due to the low-lying nature of the Application Site and the attenuation provided by the on-site drainage system, in particular the presence of the settlement ponds.

There are no other foreseeable MADs.

8.6.9 Conclusions

The Application Site comprises 5 no. Bord na Móna bogs situated between the towns of Kinnegad and Delvin, Co. Westmeath. The bogs comprising the Application Site include Ballivor Bog to the south, Carranstown and Bracklin bogs towards the centre and Lisclogher and Lisclogher West bogs at the northern end of the site. The total Application Site area is approximately 2,421ha (24.21km^2). The current topography of the Application Site is relatively flat with an elevation range of between approximately 69 and 86mOD (metres above Ordnance Datum).

Regionally the Application Site is located in the Boyne surface water catchment. In the west the Application Site drains towards the Deel(Raharney) River, drainage in the north and east is directed towards the Stonyford River while the south of the Application Site drains to the southeast and into the River Boyne. All drainage pathways from the Application Site eventually discharge to the River Boyne.

Currently, the surface of the Application Site is drained by a network of field drains that are typically spaced every 15 to 20m. Larger arterial drains connect the smaller field drains and gently slope towards perimeter silt ponds and surface water outfalls. Surface water outflows from site discharge to small streams which in turn discharge into the Deel (Raharney) River to the west, the Stonyford River to the east and the River Boyne to the south. All outfalls are drained by gravity with no pumping locations situated within the Application Site.

The baseline for our assessment of peat extraction activities and all ancillary works at the Application Site is July 1988, and the Peat Extraction Phase covers the period between 1988 and 2020. The Applicant commenced works at Application Site in 1948. By 1988 peat extraction activities and all ancillary works were well established at Ballivor, Bracklin, Lisclogher and Carranstown. By this time drainage had already been inserted and railway infrastructure had been laid at Ballivor, Carranstown, Bracklin, and Lisclogher bogs. Lisclogher West was drained between 1973 and 1995. The emerging baseline trend was a drained set of bogs with peat extraction activities and all ancillary works having been ongoing for many years.

As a result, the potential impacts from peat extraction activities and all ancillary works were consistent with the baseline environment, and arising potential impacts on water quality from sediment, hydrocarbons, wastewater are all assessed as having moderate potential impacts. Available water quality data or upstream and downstream watercourses, and discharge water quality monitoring from the bogs, do not indicate any significant impacts on water quality occurred during the Peat Extraction Phase.

Since 2000, the Applicant have been operating the Application Site under IPC Licence requirements. The IPC Licence (P0501-01) sets out several conditions and emission limits designed to ensure the protection of surface and groundwaters.

Peat extraction activities and all ancillary works ceased at the Application Site in June 2020 and our assessment concludes that potential impacts on surface water flows and surface water quality, and groundwater quality are neutral during this period. No changes to the hydrological and/or hydrogeological environments will have occurred from Current Phase of the Project i.e. the cessation of peat extraction activities and all ancillary works to the present day.

The proposed decommissioning and Cutaway Bog Decommissioning and Rehabilitation Plans for the Application Site have also been assessed. The plans will generally involve the rewetting and revegetation of the drained bogs. These plans will have a long-term positive effect on the local peat hydrogeology within the site where groundwater tables in the peat bogs are stabilised and closer to the bog surface. These plans will also have positive long-term effects on downstream water quality and regulation of surface water flows.

Our assessment confirms that no significant cumulative effects on the hydrological or hydrogeological environments have resulted from the various phases of the Project. Similarly, no cumulative effects on the hydrological or hydrogeological environments will result from the implementation of the decommissioning and Cutaway Bog Decommissioning and Rehabilitation Plans, nor the proposed wind farm at the Application Site.