APPENDIX 8-1

Flood Risk Assessment

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PEAT EXTRACTION AT THE BALLIVOR BOG GROUP, CO. WESTMEATH/MEATH

FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:

BORD NA MÓNA PLC

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

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Signed:	Michael Gill ____________________________ **Michael Gill B.A., B.A.I., M.Sc., MIEI** **Managing Director – Hydro-Environmental Services**

Disclaimer:
This report has been prepared by HES with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our terms and conditions and taking account of the resources devoted to it by agreement with the client. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above. The flood risk assessment undertaken as part of this study is site-specific and the report findings cannot be applied to other sites outside of the survey area which is defined by the site boundary. This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by MKO Ireland (MKO), on behalf of Bord na Móna PLC to undertake a Flood Risk Assessment (FRA) for Ballivor, Carranstown, Bracklin, Lisclogher, and Lisclogher West Bogs (i.e. the "Application Site") with respect to the following conditions:

- The current baseline hydrology of the bogs; and,
- Implementation of the proposed Rehabilitation Plan for the Ballivor Bog Group.

The Application Site is located c. 2.5 km south-southeast of Delvin, c. 3.7 km east of Raharney, and c. 2.2 km west of Ballivor Village in Counties Meath and Westmeath. The bogs which comprise the Application Site have been extensively modified, cutover and drained as a result of historic peat extraction dating back to 1948. Peat extraction formerly ceased in June 2020.

This FRA is intended to support the remedial EIAR submitted as part of the substitute consent application. The Project is described in full in Chapter 4 of the EIAR. For the purposes of this FRA, and consistent with the rEIAR, the various components are described and assessed using the following references: the 'Project', 'Peat Extraction Phase', 'Current Phase' and the 'Remedial Phase'.

The following assessment is carried out in accordance with '*The Planning System and Flood Risk Management Guidelines for Planning Authorities*' (DoEHLG, 2009).

1.2 STATEMENT OF QUALIFICATIONS

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 area of expertise and experience in hydrology and hydrogeology, including flooding assessment and surface water modelling. We routinely work on surface water monitoring and modelling and prepare flood risk assessment reports.

Michael Gill PGeo (BA, BAI, MSc, MIEI) is an Environmental Engineer and Hydrogeologist with 22 years of environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological assessments for various developments across Ireland. Michael has significant experience in surface water drainage issues, SUDs design, and flood risk assessment.

Conor McGettigan (BSc, MSc) is an Environmental Scientist, with over 3 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc in Geology (2016) from University College Dublin. Conor routinely prepares flood risk assessments for a variety of proposed developments.

Jenny Law (BSc, MSc) is an environmental geoscientist holding a first honors degree in applied environmental geosciences from the University College Cork. Jenny has assisted in the preparation of the land, soils and geology and hydrology chapters for various environmental impact assessment reports, hydrological impact assessments, Water Framework Directive Assessment reports and Flood Risk Assessment reports for a variety of projects including wind farm developments and strategic housing developments.

1.3 REPORT LAYOUT

This FRA report has the following format:

- Section 2 describes the site setting and details of the Application Site;
- Section 3 outlines the hydrological and geological characteristics of the bogs and downstream surface water catchments and the existing site drainage;
- Section 4 presents the current site-specific flood risk conditions across the Application Site;
- Section 5 assesses the potential change in flood risk conditions (from the baseline) at the Application Site, and downstream of the bogs, as a result of the proposed Cutaway Bog Decommissioning and Rehabilitation Plans, and also cumulatively with the proposed Ballivor wind farm development; and,
- Section 6 presents the FRA report conclusions.

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

This section provides details on the topographical setting of the Application Site along with a description of the historical peat extraction activities.

2.2 SITE LOCATION AND TOPOGRAPHY

The Application Site comprises 5 no. Bord na Móna bogs (Ballivor, Carranstown, Bracklin, Lisclogher, and Lisclogher West), located at the Westmeath-Meath County border. The Application Site is located 2.5 km south-southeast of Delvin, 3.7km east of Raharney and 2.2km west of Ballivor Village.

A site location map is shown as **Figure A** below.

The Application Site is intersected by the R156 which links the villages of Ballivor in the east to Raharney in the west. Ballivor Bog lies to the south of this regional road with the other bogs comprising the site lying to the north. A Bord na Móna works area, known as Ballivor Works, lies in the northwest of Ballivor Bog, outside the Application Site boundary, in the townland of Grange More and contains offices, storage sheds, roads and a peat loading area. The remainder of Ballivor Bog is located in the townlands of Robinstown and Clonycavan in the east and Riverdale, Clondalee More and Derryconor in the west. Ballivor Bog has a total area of 638ha and is served by a Bord na Móna railway network which extends from the peat loading area at Ballivor Works into the bog.

To the north of the R156, Carranstown Bog has an area of 304ha and lies in the townlands of Grangemore in the West and Carranstown Great, Carranstown Little and Killaconnigan in the east. The Bord na Móna railway links Carranstown to Ballivor to the south and Bracklin to the north. Towards the centre of the Ballivor Bog Group, Bracklin Bog has an area of 772ha. Bracklin Bog lies in the townlands of Coolronan in the east, Craddanstown and Bracklin in the centre and Ballynaskeagh, Mucklin and Killagh in the west.

Lisclogher Bog is located to the northeast of Bracklin Bog, approximately 4.3km southeast of the town of Delvin and has an area of 479ha. This bog is located in the townlands of Lisclogher Great, Coolronan, Bracklin, Cockstown and Clonleame. A minor road separates Lisclogher from Lisclogher West. Lisclogher West Bog lies to the west of Lisclogher Bog and has a total area of 228ha.

The current topography of the Application Site is relatively flat with an elevation range of between approximately 69 and 83mOD (metres above Ordnance Datum). Along the majority of the bog boundaries, a ~1-2m high peat headland exists which is a remnant of the original bog. Today these headlands and remnant peat banks create a boundary berm, forming a basin effect within some of the extraction areas of the 5 bogs. There are some areas of higher ground near the centre of Bracklin Bog, directly south of Bracklin Lough.

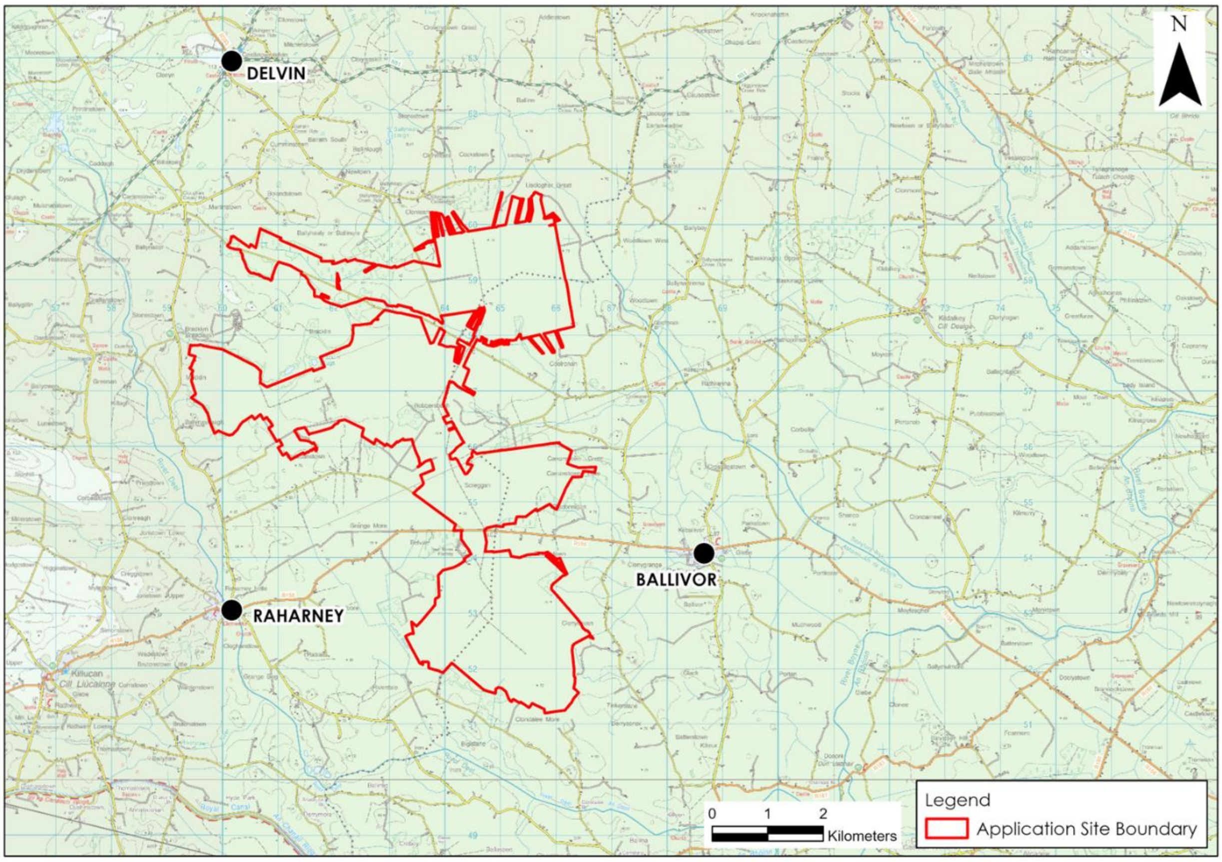

Figure A: Application Site Location Map

2.3 SITE HISTORY

The Application Site has been subject to drainage and peat extraction activities from 1948 up until the formal cessation of peat extraction activities in June 2020.

The primary hydrological and hydrogeological changes associated with the peat extraction process occurs during the initial drainage of the bog in advance of peat extraction. 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, welfare facilities, 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 relates to minor annual topographic changes (i.e., lower ground levels) caused by ongoing peat extraction.

The timing of the installation of drainage and initiation of peat extraction varies across the Application Site. Ballivor Bog was the first bog to be drained in 1948, with industrial peat extraction commencing in 1953. By the mid-1980s Carranstown, Bracklin and Lisclogher bogs had all been drained. Peat extraction began in Bracklin (main bog area), Lisclogher and Carranstown (western section) in 1957, 1960 and by 1988 respectively. Meanwhile drainage was inserted into Lisclogher West between 1973 and 1995, however, Lisclogher West was never subject to peat extraction.

Peat extraction within the Application Site has been regulated by the EPA under IPC Licence Registration No. P0501-01 since 2000. Prior to this date, the Bord na Móna had been completing environmental monitoring and control measures at the Application Site. These control measures were upgraded and enhanced in accordance with IPC Licence conditions from April 2000. The bogs also have Surface Water Management Plans[1] which define how compliance with the IPC Licence is achieved.

Peat extraction at the Application Site formally ceased in June 2020. Following cessation of peat extraction, the site drainage system has continued to operate under the same drainage systems as during the peat extraction phase *i.e.* field drains, main drains, silt ponds and discharge outlets etc. During the Decommissioning and Rehabilitation Phase all activities continue to be monitored in accordance with IPC Licence conditions.

Drainage from the bogs is regulated by the shallow (low gradient) nature of the drainage, and by routing all bog drainage via field drains, main drains, headland drains, then from silt ponds to outfalls, with final discharge to natural watercourses. Therefore, existing discharge volumes from the Application Site to nearby surface watercourses will be comparable to surface water discharges during the Peat Extraction Phase (1988-2020).

[1] Current versions: SWMP 0501 Derrygreenagh 31.01.2020.pdf

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics of the Application Site.

3.2 HYDROLOGY

3.2.1 Regional and Local Hydrology

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

On a more local scale, the majority of the Application Site, including Carranstown Bog, Lisclogher Bog, Lisclogher West Bog, the majority of Bracklin Bog and the eastern part of Ballivor Bog, are located in the Boyne_SC_050 sub-catchment. The west of Ballivor Bog is situated in the Boyne_SC_040 sub-catchment. Meanwhile, the north-western section of Bracklin Bog is located in the Deel[Raharney]_SC_010 sub-catchment.

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. Within the Boyne_050 sub-catchment, the Stonyford River (EPA Code: 07S02) flows to the southeast, approximately 700m east of Lisclogher Bog. The Stoneyford River discharges into the Boyne approximately 7.3km east of Ballivor Bog. The Boyne River then flows to the northeast, towards Navan becoming tidal to the west of my M1 motorway. The Boyne then flows through Drogheda and out to the Irish Sea between Haven and Mornington Point.

A regional hydrology map of the WFD sub-catchments is shown in **Figure B** below.

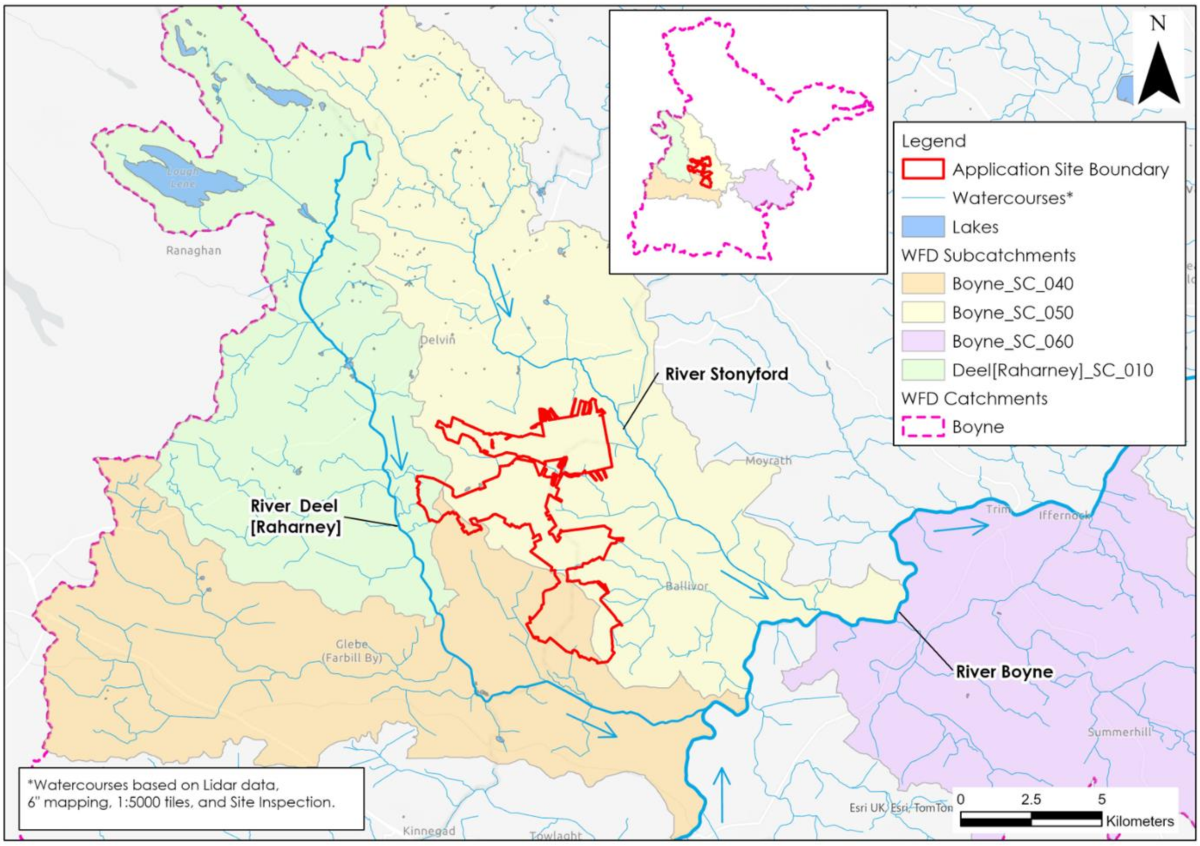

Figure B: Regional Hydrology Map

3.2.2 Rainfall and Evaporation

The SAAR (Standard Average Annual Rainfall) recorded at Ballivor rainfall station(~4.5km east of the site), the closest rainfall station to the Application Site with long term SAAR data, is 839mm (www.met.ie). The average potential evapotranspiration (PE) at Mullingar, approximately 17km west of the Application Site is taken to be 445mm (www.met.ie). The actual evapotranspiration (AE) is calculated to be 423mm (95% PE). Using the above values, the effective rainfall (ER)[2] for the area is calculated to be (ER = SAAR – AE) ~416mm/yr.

Based on recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 4% recharge is taken for the Application Site as an overall average. This value is for "Peat" with a "Low" to "Moderate" vulnerability rating. Areas, where peat is absent, may have slightly higher recharge rates, but on this site, these areas are generally very small and localised. The high drainage density in the area would also suggest that recharge rates are very low.

The lowest value in the available range was chosen to reflect the large coverage of blanket peat and high drainage density. Therefore, annual recharge and runoff rates for the Application Site are estimated to be 17mm/year and 399mm/year respectively.

Table A below presents return period rainfall depths for the area of the Application Site. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year, 100-year). These extreme rainfall depths will be the basis of the proposed wind farm drainage hydraulic design as described further below.

[2] ER – Effective Rainfall is the excess rainfall after evaporation which produces overland flow and recharge to groundwater.

Table A: Application Site Rainfall Return Period Depths (mm)

	Return Period (Years)			
Duration	**1**	**5**	**30**	**100**
5 mins	3.5	5.5	9.0	12.1
15 mins	5.7	9.1	14.7	19.9
30 mins	7.4	11.6	18.5	24.7
1 hours	9.6	14.8	23.1	30.4
6 hours	19.1	28.0	41.3	52.6
12 hours	25.0	35.8	51.8	65.1
24 hours	32.6	45.7	64.8	80.5
2 days	38.5	52.8	73.2	89.5

**Estimated using growth factors as data not available from (www.met.ie)*

3.3 GEOLOGY

According to GSI mapping (www.gsi.ie), soils are mapped generally as cutover/cutaway peat (Cut) across the Application Site. Soils in the surrounding lands are dominated by basic deep well-drained mineral soils (BminDW), basic deep poorly drained mineral soils and localised pockets of basic poorly drained mineral soils with peaty topsoil (BminPDT). Meanwhile, acid poorly drained mineral soils with peaty topsoil are mapped to the south of Lisclogher Bog (AminPDPT). Mineral alluvium (AlluvMin) is mapped along the main watercourses.

The published subsoils map for the Application Site (www.gsi.ie) shows that cutover raised peat (Cut) underlies the Application Site. Other subsoil types mapped in the wider area include Glacial Tills derived from Limestone (TLs) and Gravels derived from Limestone (GLs). An area of Till derived from cherts (TCh) is also mapped to the southeast of Lisclogher Bog.

The soils and subsoils present at the Application Site have been verified during site walkover surveys and intrusive site investigations completed by HES on 18th May 2020, 15th – 17th September 2020, 5th October 2020, 1st December 2020, 22nd March 2021, 1st April 2021, 20th September 2021, 28th October 2021 and 19th January 2022. A total of 457 no. peat probes have been completed at the site (HES, FT and MKO), revealing a peat depth range of 0.4 to 5.7m with an average of 1.93m. Subsoils encountered during the peat probing investigations and 78 no. trial pits consisted of glacial tills comprising slightly sandy gravelly silt/clay and/or silty sands and gravels with come cobbles and boulders.

A local subsoils map is attached below as **Figure C**.

The underlying bedrock geology at the Application Site is mapped by the GSI as being Dinantian Pure Unbedded Limestones (DPUL, comprising Waulsortion Limestone) and Dinantian Upper Impure Limestones (DUIL) (comprising the Lucan Formation and the Tober Colleen Formation) (refer to **Figure D** below). These types of rocks are classified as Locally Important Aquifer - bedrock which is Moderately Productive only in Local Zones – and as a Poor Aquifer – bedrock which is generally unproductive except for Local Zones – respectively by the GSI (www.gsi.ie).

The Waulsortian Limestones, of lower Visean age, underlie the majority of the Application Site and consist of dominantly grey, crudely bedded or massive limestones. Meanwhile, the northeast of Bracklin and west of Lisclogher bogs are underlain by the limestone shales of the Lucan Formation and calcareous shale and limestone conglomerates of the Tober Colleen Formation which are Dinantian in age. No bedrock exposures were noted during the walkover surveys.

There are 4 no. mapped faults underlying the Application Site, 3 of which trend in a northeast-southwest direction. A northwest-southeast trending fault is also found in the west, underlying Bracklin Bog.

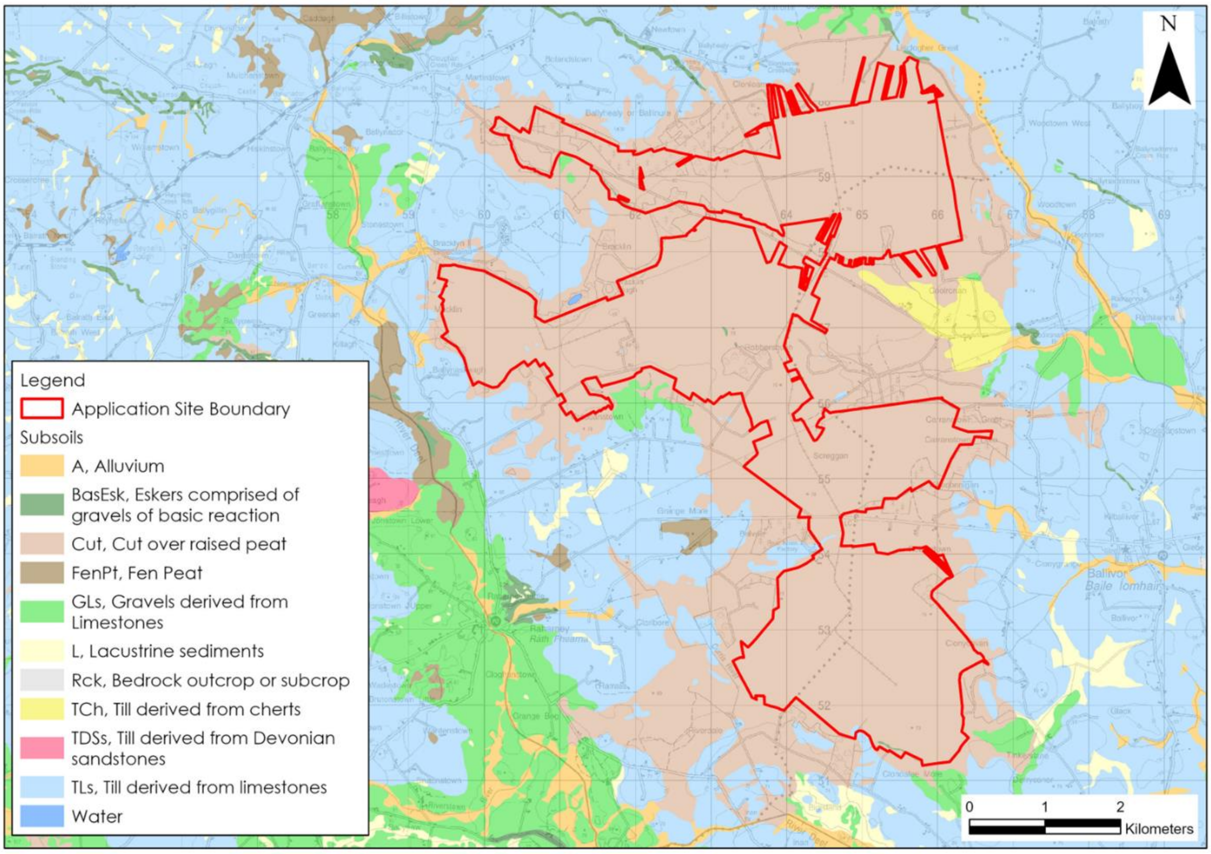

Figure C: Local Subsoils Map

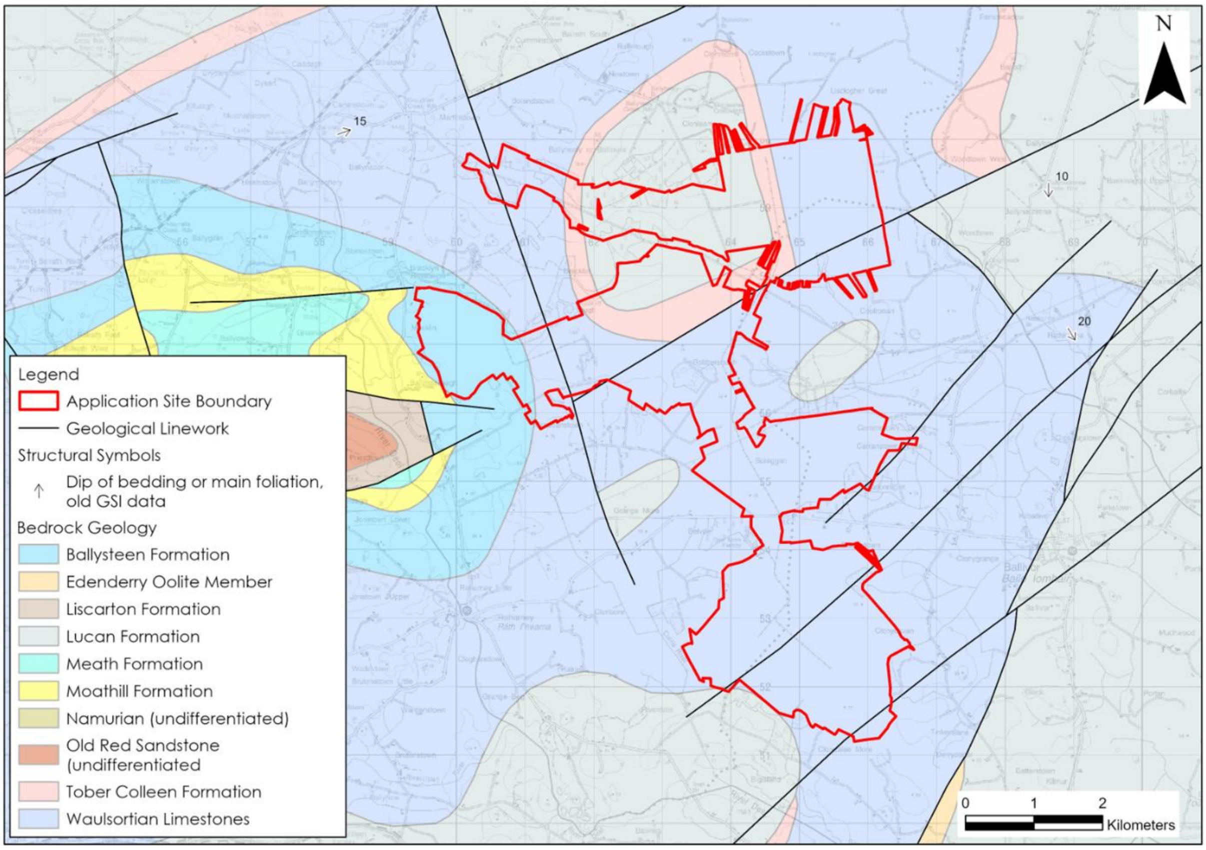

Figure D: Bedrock Geology Map

3.4 SITE DRAINAGE

3.4.1 Existing Site Drainage

Topography within the Application Site is relatively flat with an elevation range of between approximately 69 and 83mOD (metres above Ordnance Datum) with gentle slopes in some locations. Along many of the bog boundaries, a 1-2m high peat headland exists which is a remnant of the original bog. These headlands and in some areas remnant peat banks create a boundary berm, forming a basin effect within the previous peat extraction areas of each of the bogs. There are some areas of higher ground near the centre of Bracklin Bog, directly south of Bracklin Lough.

Surface water is drained from the Application Site via a network of field drains typically spaced at 15 to 20m intervals, piped drained drains, main drains, headland drains, and silt ponds. These drains discharge to collector/headland drains along the perimeter of the bog, which eventually discharges to a series of large silt (settlement) ponds. Drainage is then discharged to off-site drainage channels which flow into the local river network. The Application Site is primarily drained by gravity however historical records do indicate that 2 no. and 1 no. pumps have been used in the past to facilitate the drainage of Ballivor and Lisclogher Bogs respectively.

A flow diagram for the existing drainage system is shown as **Figure E** below.

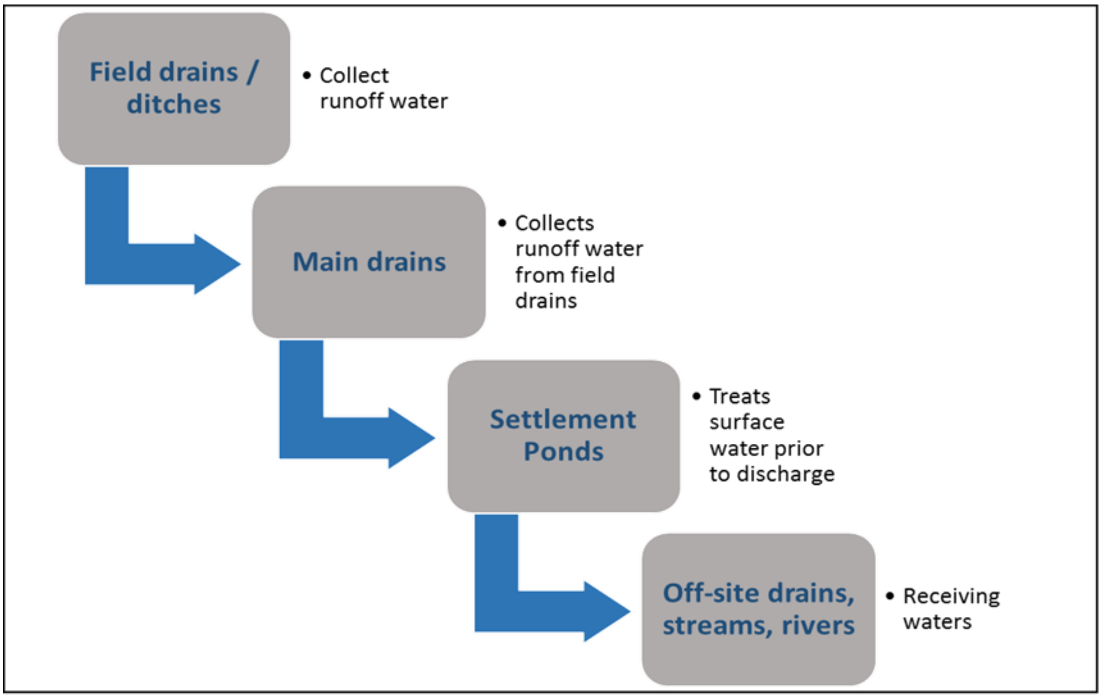

Figure E: Process Flow Diagram for the Existing Site Drainage System

A detailed hydrological audit of flowpaths from each bog to its eventual discharge point at the regional catchment scale was conducted for 5 no. bogs within the Application Site, including Ballivor, Carranstown, Bracklin, Lisclogher and Lisclogher West. The flowpaths are shown as **Figure F** to **Figure J**.

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 Ballivor Bog 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan). 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.

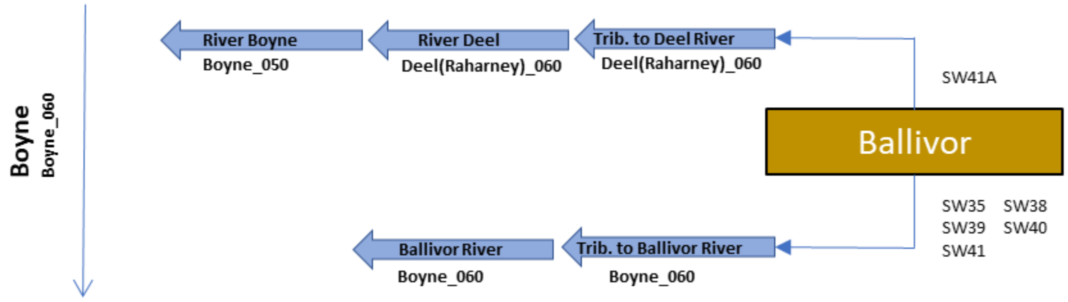

Figure F: Existing Drainage Within Ballivor Bog

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 Carranstown 2022 Cutaway Bog Decommissioning and Rehabilitation Plan). 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.

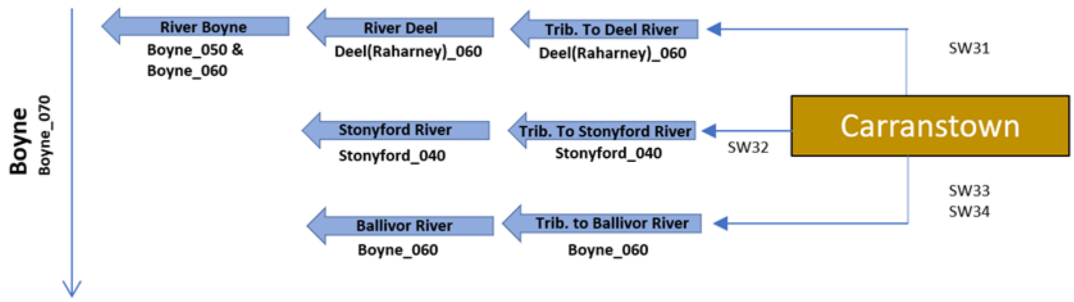

Figure G: Existing Drainage Within Carranstown Bog

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 Bracklin Bog 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan;). 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.

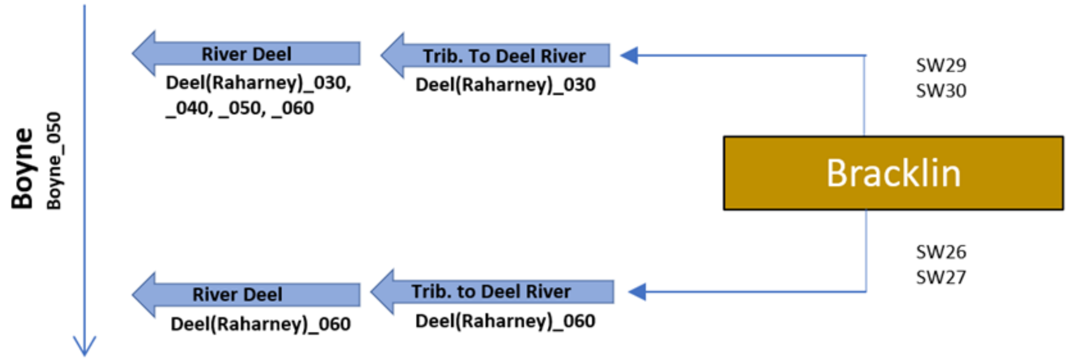

Figure H: Existing Drainage Within Bracklin Bog

Since the cessation of peat extraction, Lisclogher Bog has become overgrown with the Bord na Móna Lisclogher East 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan 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 Lisclogher East 2024 Draft Cutaway Bog Decommissioning and Rehabilitation Plan). 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.

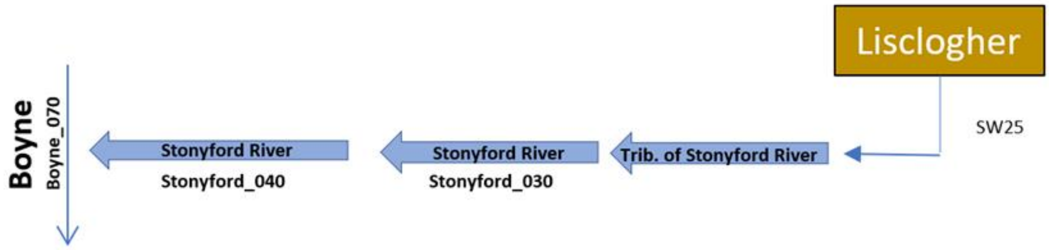

Figure I: Hydrological Flow Path for Lisclogher Bog

While Lisclogher West was never subject to peat extraction, ditches and drains were installed 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 Lisclogher West 2023 Cutaway Bog Decommissioning and Rehabilitation Plan). 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.

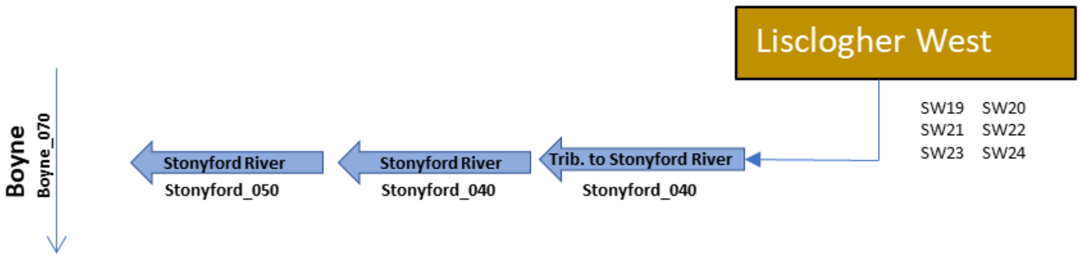

Figure J: Hydrological Flow Path for Lisclogher West

Additionally, Bord na Móna drainage mapping is available for 3 of the 5 no. bogs comprising the Application Site (Ballivor, Bracklin and Carranstown bogs). The respective settlement ponds and their outfall pipe elevations are presented in **Table B** below.

Outfall pipe elevations range from 66.99 – 79.13m OD (metres above Ordnance Datum) with the greatest outfall elevations recorded in Bracklin Bog. Outfalls generally discharge to nearby surface water bodies as mapped by the EPA or into smaller drains that flow towards these mapped watercourses.

Table B: Bord na Móna outfall elevations

Settlement Pond ID	Easting	Northing	Bog Name	Outfall Pipe Elevation (m OD)	Nearby Surface Waterbody
BR262	264995	251803	Ballivor	68.36	Clondalee More Stream
BR47	266375	251586	Ballivor	66.77	Ballivor River
BR48	266361	251599	Ballivor	66.99	Ballivor River
BR46	265879	253460	Ballivor	71.59	Unnamed waterbody which discharges into Ballivor River
BR45	265867	253506	Ballivor	71.47	Unnamed waterbody which discharges into Ballivor River
BR42	265139	254113	Ballivor	N/A	N/A
BN35&36	259502	257627	Bracklin	77.26	Graffanstown Stream
BN33	259429	256879	Bracklin	77.95	Ballynaskeagh Stream
BN34	259437	256862	Bracklin	77.64	Ballynaskeagh Stream
BN31&32	260577	256515	Bracklin	79.13	N/A
BN39	260945	256769	Bracklin	N/A	N/A
CN38&39	265306	255941	Carranstown	67.97	N/A
CN40	265648	254796	Carranstown	70.08	Killaconnigan Stream
CN41	265874	254978	Carranstown	N/A	Killaconnigan Stream

4. BASELINE FLOOD RISK DEFINITION

4.1 INTRODUCTION

The following assessment is carried out in accordance with '*The Planning System and Flood Risk Management Guidelines for Planning Authorities*' (DoEHLG, 2009). The basic objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and,
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

4.2 FLOOD RISK ASSESSMENT PROCEDURE

This section of the report details the site-specific flood risk assessment carried out for the Ballivor Bog Sub-Group and surrounding area. The primary aim of the assessment is to consider all types of flood risks and the potential impact on the development. As per the relevant guidance (DOEHLG, 2009), the stages of a flood risk assessment are:

- *Flood risk identification* – identify whether there are surface water flooding issues at a site;
- *Initial flood risk assessment* - confirm sources of flooding that may affect a proposed development; and,
- *Detailed flood risk assessment* – quantitative appraisal of the potential risk to a proposed development.

As per the Guidelines, there are essentially two major causes of flooding:

Coastal flooding, which is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by the following three factors, which often work in combination:

- High tide level;
- Storm surges caused by low barometric pressure exacerbated by high winds (the highest surges can develop from hurricanes); and,
- Wave action, which is dependent on wind speed and direction, local topography and exposure.

Coastal Flooding is not applicable to the Application Site.

Inland flooding which is caused by prolonged and/or intense rainfall. Inland flooding can include a number of different types:

- Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall and eventually enters a piped or natural drainage system.

- River flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying areas (the floodplain). This can occur rapidly in short steep rivers or after some time and some distance from where the rain fell in rivers with a gentler gradient.

- Flooding from artificial drainage systems results when flow entering a system, such as an urban stormwater drainage system, exceeds its discharge capacity and the system becomes blocked, and/or cannot discharge due to a high-water level in the receiving watercourse. This mostly occurs as a rapid response to intense rainfall. Together with overland flow, it is often known as pluvial flooding. Flooding arising from a lack of capacity in the urban drainage network has become an important source of flood risk, as evidenced during recent summers.

- Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding tends to be very local and results from interactions of site-specific factors such as tidal variations. While water levels may rise slowly, they may be in place for extended periods. Hence, such flooding may often result in significant damage to property rather than be a potential risk to life.

- Estuarial flooding may occur due to a combination of tidal and fluvial flows, i.e., the interaction between rivers and the sea, with tidal levels being dominant in most cases. A combination of high flow in rivers and a high tide will prevent water flowing out to sea, tending to increase water levels inland, which may flood over riverbanks.

The Flood Risk Management Guidelines (DoEHLG, 2009) provide direction on flood risk and development. The guidelines recommend a precautionary approach when considering flood risk management and the core principle of the guidelines is to adopt a risk-based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for inland and coastal flooding.

Flood zones are geographical areas within which the likelihood of flooding is in a particular range, and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning.

There are three types or levels of flood zones defined within the guidelines:

Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% (AEP)[3] or 1 in 100 for river flooding or 0.5% (AEP) or 1 in 200 for coastal flooding);

Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% (AEP) or 1 in 1000 and 1% (AEP) or 1 in 100 for river flooding and between 0.1% (AEP) or 1 in 1000 year and 0.5% (AEP) or 1 in 200 for coastal flooding); and,

Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% (AEP) or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

Once a flood zone has been identified for a site, the guidelines set out the different types of development appropriate to each identified zone (pg. 25, Table 3.1 of the Guidelines). Exceptions to the restriction of development due to potential flood risks are provided for

3 *AEP – Annual Exceedance Probability*

through the application of a Justification Test (JT), where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated by the applicant.

The Justification Test (JT) has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that, for the reasons outlined above, are being considered in areas of moderate or high flood risk. The test is comprised of two processes.

- The first is the **Plan-making Justification Test** described in chapter 4 of the Guidelines and used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding. Plan making Justification Tests are made at Plan/Policy development stage such as County Development Plans, or Local Area Plans.

- The second is the **Development Management Justification Test** described in chapter 5 of the Guidelines and used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land. For example, application of Development Management Justification Test would be required at a site-specific level, such as for this FRA assessment, if a Justification Test is required.

4.3 BASELINE FLOOD RISK ASSESSMENT

4.3.1 Flood Risk Identification

4.3.1.1 Historical Mapping

To identify those areas as being at risk of flooding, historical mapping was consulted and reviewed. There is no text on local available historical 6" or 25" mapping that identify areas that are "*prone to flooding*" within the Application Site.

4.3.1.2 Soils Maps - Fluvial Maps

A review of the soil types in the vicinity of the Application Site was undertaken as soils can be a good indicator of past flooding in an area. Due to past flooding of rivers deposits of transported silts/clays referred to as alluvium build up within the floodplain and hence the presence of these soils is a good indicator of potentially flood-prone areas.

Based on the EPA/GSI soil map for the area no regions of alluvium are mapped within the Application Site. Alluvium (fluvial deposits) is recorded along the Stoneyford River, to the east of the Application Site and along the Deel River to the west. Alluvium is also mapped locally on many of the tributaries of these rivers which drain the Application Site. In general, however, there is no significant alluvium deposition that would be associated with a flood plain or a large geographical area prone to flooding.

The EPA/GSI soil map for the area and on-site investigations reveal that the Application Site is underlain by poorly draining, waterlogged peaty soils. This would indicate that the area is historically prone to high water table levels. However, extensive drainage has occurred in the area for peat extraction and extraction and has lowered the local water table.

4.3.1.3 OPW National Flood Hazard Mapping

The OPW National Flood Hazard Maps have no records of any recurring or historic flood incidences within the Application Site (www.floodinfo.ie).

The closest mapped historic flood event is found approximately 300m east of Ballivor Bog at Cloneycavan (Flood ID: 10583). This flood event dates from 14th August 2008 and is described as follows: "*After very heavy and prolonged rainfall in the Boyne Catchment area flooding* *occurred in several parts of the catchment*" (www.floodinfo.ie). A photograph taken of this flood event on 16th August 2008 in Cloneycavan is included below as **Figure K**. A second historic flood event (Flood ID: 10586) dating from August 2008 is reported on the River Deel south of Raharney in the Anadruce area, approximately 3km southwest of Ballivor.

Several recurring flooding incidences (Flood ID: 2714, 2715, 2716) are mapped to the southwest of Raharney village along the R156 and in the vicinity of Kilucan (refer to **Figure L**). A report from the Mullingar Area Engineer states that some of these recurring flood incidents are due to annual flooding of low-lying land after heavy rain (Flood ID: 2715 and 2716) (www.floodinfo.ie). Meanwhile a stream to the east of Kilucan overflows its banks following heavy rainfall (Flood ID: 2714).

Downstream of the Application Site a historic flood event (Flood ID: 1954) dating from November 2002 is mapped on the Boyne at Derrindaly Bridge. Further downstream several historic and recurring flood incidents on the Boyne are recorded at Trim.

Figure K: Flooding in the Cloneycavan area, to the east of Ballivor Bog on 16th August 2008 (www.floodmaps.ie).

According to the OPW (www.floodmaps.ie), sections of the Application Site are classified as "*Benefiting Lands*". Benefiting lands are defined as a dataset prepared by the Office of Public Works identifying land that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945) and indicating areas of land subject to flooding or poor drainage. These lands tend to be located around the main rivers and streams which drain the individual bog basins.

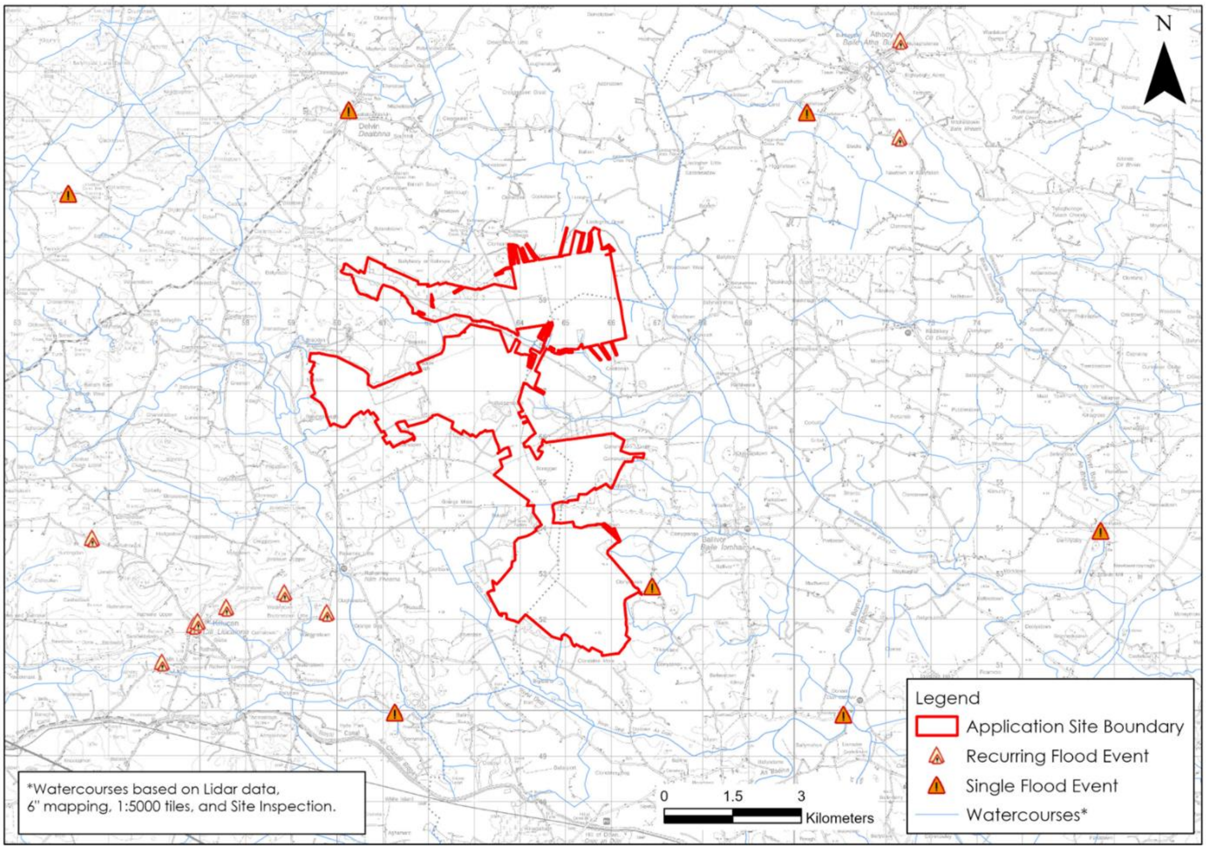

Figure L: OPW Indicative Flood Map (www.floods.ie)

4.3.1.4 OPW National Indicative Fluvial Flood Mapping

The OPW National Indicative Flood Maps (available at www.Floodinfo.ie) shows the modelled extent of land that might be flooded by rivers during a flood event with an estimated probability of occurrence. These flood maps have been produced for catchments greater than 5km^2 in areas for which flood maps were not produced under the National CFRAM Programme.

For the present day scenario, which does not consider the effects of climate change, the OPW have mapped potential flood extents for waterbodies draining the Application Site.

Low (1,000-year flood event) and Medium (100-year flood event) probability fluvial flood zones are recorded along the Stonyford and Deel (Raharney) Rivers to the east and west of the Application Site respectively. These modelled fluvial flood zones remain largely localised to the immediate vicinity of the river channel. The vast majority of the Application Site is not mapped within the 100-year and 1,000-year flood zones and is therefore located in Flood Zone C and is at Low Risk of fluvial flooding.

Fluvial flood zones however are also mapped along the Cartenstown stream, a tributary of the Stonyford River. These modelled flood extents encroach upon Lisclogher Bog, with an area towards the centre of the bog mapped within the medium probability fluvial flood zone. However, site walkovers have revealed that Cartenstown Stream, mapped by the EPA to flow south-eastwards across Lisclogher Bog, does not exist. 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 mapped flood zones as the modelling assumes the presence of the Cartenstown stream in this area.

No fluvial flood zones are mapped within Bracklin, Carranstown, Ballivor or Lisclogher West bogs. The closest mapped fluvial flood zones to the west of Bracklin Bog are found along the Greenan stream to the northwest. Meanwhile, widespread fluvial Flood Zone A is mapped to the southwest of Ballivor Bog along the Craddanstown stream and the River Deel further south.

4.3.1.5 CFRAM Fluvial Flood Mapping

Catchment Flood Risk Assessment and Management (CFRAM)[4] OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the previous PFRA[5] maps.

CFRAM mapping has been completed downstream of the Application Site near Ballivor Village. CFRAM mapping has also been completed on the Stoneyford and Boyne Rivers further to the southeast and downstream of the Application Site.

Local CFRAM flood mapping is shown in **Figure M** below.

The modelled CFRAM flood extents at Ballivor show flood levels of 64.19 to 65.34m OD for the 10-year and 100-year flood events respectively (refer to **Table C** below). Note these flood elevations are well below the pipe outfall elevations in **Table B**.

Table C: CFRAM Modelled Fluvial Water Levels (www.floodmaps.ie)

Node Label	Location Description	10% AEP WL (mOD)	1% AEP WL (mOD)	0.1% AEP WL (mOD)
00069	Ballivor River, ~1.4km east of Ballivor Bog	64.64	65.28	65.64
00023	Ballivor River, ~1.7km east of Ballivor Bog	64.19	64.77	65.11
00425	Stoneyford River, ~2km southeast of Carranstown Bog	64.82	65.34	65.66

4 CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011 and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.

5 Preliminary Flood Risk Assessment mapping.

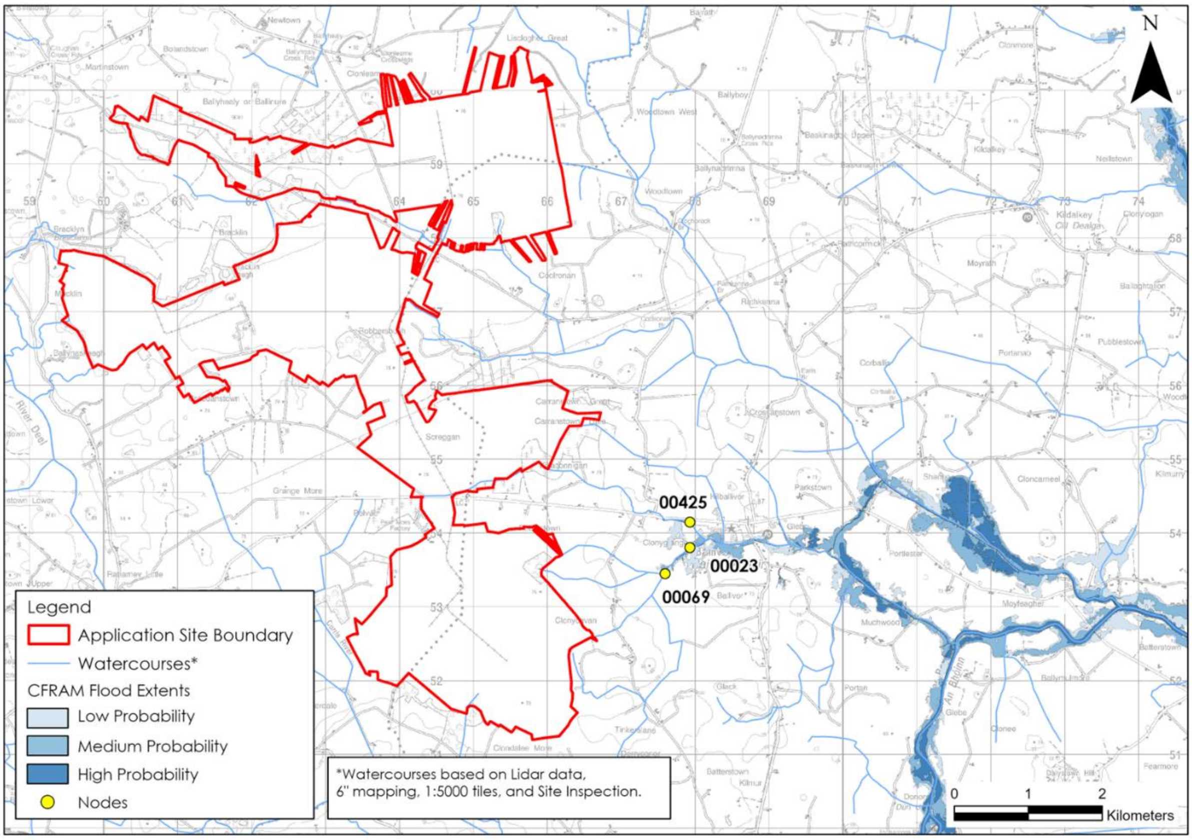

Figure M: Local CFRAM Fluvial Flood Zone Mapping

4.3.1.6 GSI Historical Surface Water Flood Mapping

Furthermore, the GSI Winter (2015/2016) Surface Water Flooding Map[6] shows areas of fluvial and pluvial flood extents during the Winter 2015/2016 flood event (www.gsi.ie), which was the largest recorded flood event in many areas. This map does not record any mapped flood areas within the Application Site. A small area of surface water flooding is recorded to the north of Bracklin Bog (Bracklin West) associated with Bracklin Lough.

4.3.1.7 Local Authority SFRA Flood Mapping

Local Authority Strategic Flood Risk Assessment (SFRA) mapping obtained from Meath and Westmeath County Councils is shown below in **Figure N**.

Within County Meath, SFRA mapping indicates flooding to the south of Lisclogher Bog on the Cartenstown stream and to the east of Bracklin and northeast of Carranstown Bog. Further south flood zones are also mapped along the Ballivor River to the east of Ballivor Bog at Cloneycavn and to the southwest along the Deel River in the townland of Clondalee More.

Within County Westmeath a significant portion of Lisclogher Bog is mapped as Flood Zone A (100-yr event). Mapped flooding here is likely associated with the Stonestown stream. No fluvial flood zones are mapped within Bracklin Bog or the western region of Ballivor Bog. The closest mapped fluvial flood zones to the west of Bracklin Bog are found along the Greenan stream. Meanwhile, widespread fluvial Flood Zone A is mapped to the southwest of Ballivor Bog along the Craddanstown stream and the River Deel further south.

[6] GSI Historical flood mapping principally developed using Sentinel-1 Satellite Imagery from the European Space Agency Copernicus Programme as well as any available historic records (from winter 2015/2016 or otherwise)

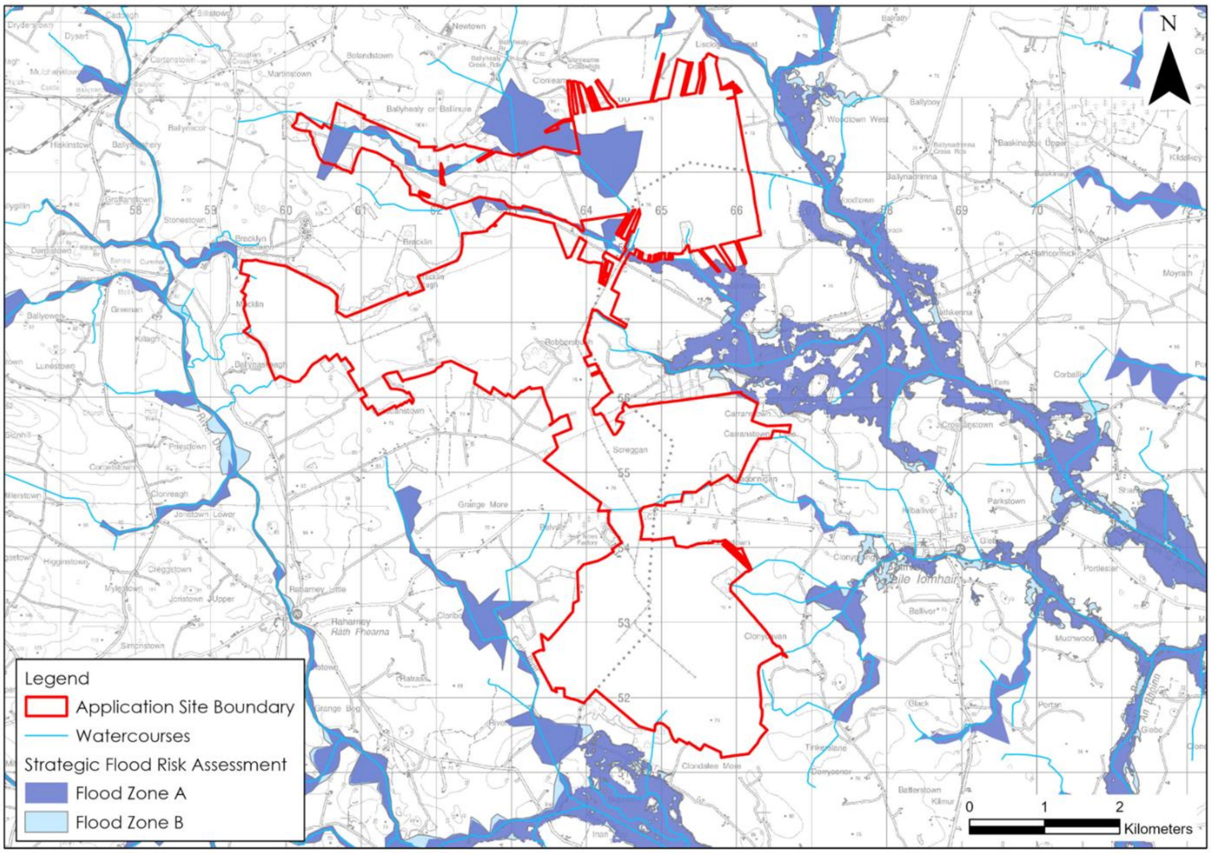

Figure N: Local Authority SFRA Flood Mapping

4.3.1.8 Groundwater Flooding

The GSI Historical 2015/2016 groundwater flood map does not record any groundwater flooding within the area of the Application Site. Areas of historic groundwater flooding are mapped in the surrounding lands, the closest of which is found approximately 200m to the south of the Bracklin Bog.

Other areas of groundwater flooding are mapped approximately 1km to the southeast of Ballivor Bog and approximately 500m to the northwest of Lisclogher West. These are small-localised areas of groundwater flooding and will not be impacted by, or impact upon, activities at the site.

In addition the GSI predictive groundwater flood maps do not record any zones of groundwater flooding within the Application Site.

4.3.1.9 Climate Change

National Indicative Fluvial Flood Mapping (NIFM) has also been completed for several climate change scenarios which assesses the potential changes in fluvial flood extents associated with climate change.

Fluvial flood modelling has been completed for 2 no. future scenarios, a Mid-Range Scenario and a High-End Future Scenario. The flood extents for the Mid-Range Future Scenario were modelled using a 20% increase in rainfall. Meanwhile the High-End Future Scenario was modelled using a 30% increase in rainfall and a sea level rise of 1,000mm.

For these future scenarios the modelled fluvial extents do not differ significantly from those described in **Section 4.3.1.4**. Fluvial flood zones associated with the High-End Future Scenario are shown in **Figure O** below.

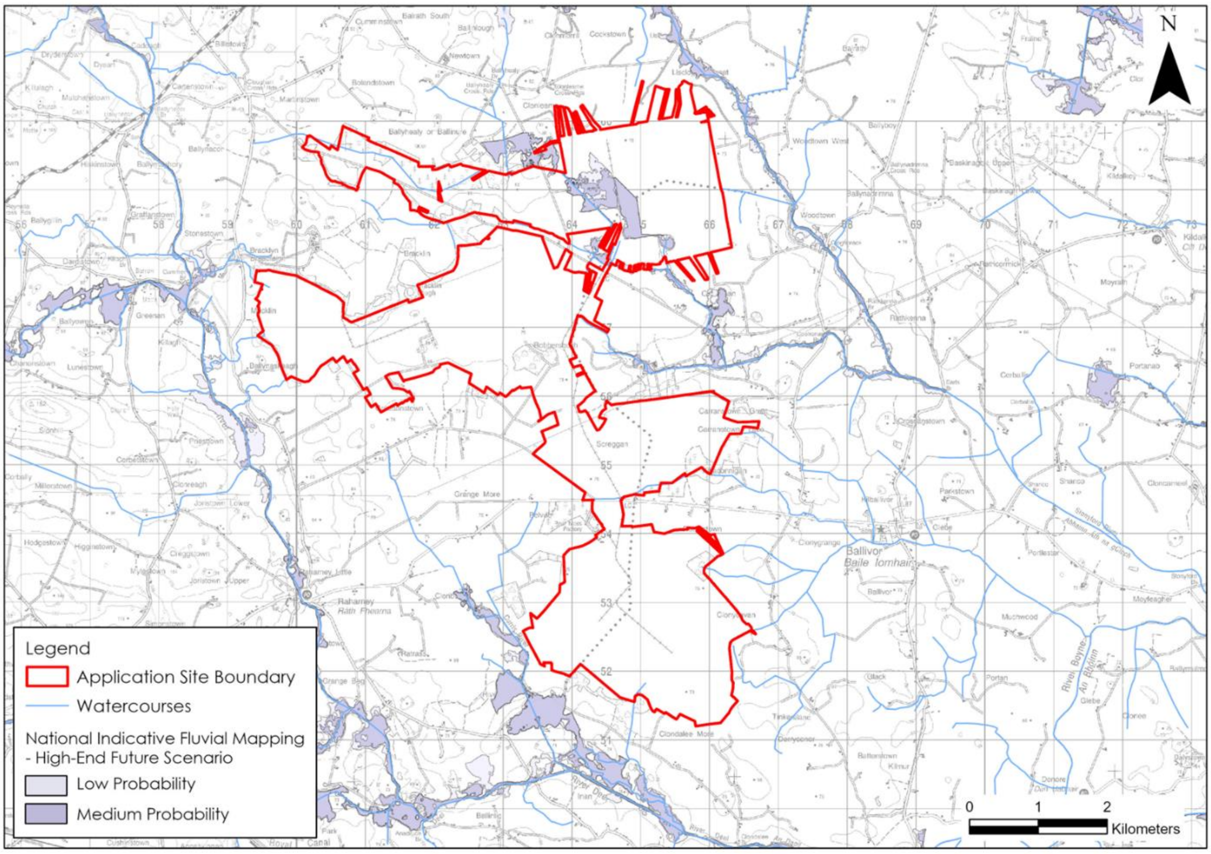

Figure O: High-End Future Scenario Fluvial Flood Zones

4.3.1.10 Site Walkover Survey

Hydrological walkover surveys and observations on the site drainage patterns were undertaken by HES on 18th May 2020, 15th – 17th September 2020, 5th October 2020, 1st December 2020, 22nd March 2021, 1st April 2021, 20th September 2021, 28th October 2021, and 19th January 2022.

During the walkover survey landuse across much of the area was noted as comprising of cutover bog where peat extraction has previously occurred. Note that peat extraction formally ceased at the Application Site in June 2020. The bogs were noted to be drained by regularly spaced field drains which drain towards larger arterial drains. Certain areas of the site have become overgrown, with peat production ceasing in these areas some time ago allowing vegetation to recover and recolonise the bare peat fields. At the boundaries of the bogs surface water draining from the Application Site is routed via large settlement ponds prior to discharge to off-site drainage channels which flow into the local rivers and streams.

During the walkover survey, an error was observed in the EPA map of local rivers. The EPA map shows the Cartenstown stream to flow from Lisclogher west to the southeast across Lisclogher Bog. However, site walkovers have revealed that this section of mapped river does not exist. Such small (local) errors are infrequent in the digitised EPA river database, but they do exist, especially where manmade drainage has been imposed upon natural drainage patterns. This error also indicates that the SFRA flood zones mapped in this region are incorrect as they assume the presence of a surface watercourse.

Low lying areas within the Application Site were observed to hold surface water following heavy rainfall, but ponding only occurs to very shallow depths, (<0.2m) and only in certain areas does ponding persist in drier periods.

4.3.1.11 Hydrological Flood Conceptual Model

Potential flooding in the vicinity of the Application Site can be described using the Source – Pathway – Receptor Model (S-P-R). The primary potential source of flooding in this area, and the one with the most consequence for the Application Site, is pluvial flooding.

During winter conditions the Application Site holds/retains rainwater following heavy rain. The depth of intermittent ponding is shallow (<0.2m). This retention of water on the bogs during such events will reduce downstream flooding risk. Potential receptors in the area are infrastructure, people, land and other private property.

4.3.2 Summary – Baseline Flood Risk Definition

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process the sources of flood risk for the Application Site are outlined and assessed in **Table D.**

Table D. S-P-R Assessment of Flood Sources for the Ballivor Bog Sub-Group.

Source	Pathway	Receptor	Comment
Fluvial	Overbank flooding of the Cartenstown Stream	Land, People, property, infrastructure, River Shannon Callows SAC	According to SFRA, there are areas within the Application Site potentially mapped in Fluvial Flood Zone A. However, we have surveyed these locations and we confirm there is no watercourse in this area, and therefore conclude the SFRA mapping is incorrect, and that these locations are in Flood Zone C, with a high density of surface water drains. The remainder of the Application Site is also located in Flood Zone C (Low Risk).
Pluvial	Ponding of rainwater on-site	Land and infrastructure.	The Application Site is generally low lying and flat in places and therefore localised pluvial flood is very likely after heavy or prolonged rainfall.
Surface water	Surface ponding/ Overflow	Land and infrastructure.	Same as above (pluvial)
Groundwater	Rising groundwater levels	Land and infrastructure.	Based on the local hydrogeological regime and GSI groundwater flood mapping, no apparent risk from groundwater flooding.
Coastal/tidal	Not applicable	Land and infrastructure	The Application Site is >50km from the coast and there is no risk of coastal flooding.

5. FLOOD RISK ASSESSMENT – REMEDIAL PHASE

5.1 DECOMMISSIONING AND REHABILIATION PLANS

It is currently proposed to implement a Cutaway Bog Decommissioning and Rehabilitation Plan at each of the bogs comprising the Application Site in order to stabilise and rehabilitate them, as outlined in detail in **Section 5.1.1**. 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 potential downstream water pollution and increased surface water runoff.

Rehabilitation has already commenced on a section of Carranstown Bog and Lisclogher West Bog. These Decommissioning and Rehabilitation Plans are required in order to fulfil the requirements of Condition 10.2 of the IPC licence No. P0501-01. These Cutaway Bog Decommissioning and Rehabilitation Plans, attached as Appendix 4-2 to the rEIAR, will be subject to consultation as well as input from the EPA prior to their implementation across the Application Site (Note that the Decommissioning and Rehabilitation Plans for Carranstown and Lisclogher West have been agreed and are no longer in draft format) .

Bord na Móna'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.

Much of the physical work associated with the 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 decommissioning and rehabilitation plans for the Application Site cannot be implemented without mitigation measures. All activities at the Application Site are required to operate in accordance with IPC Licence (P0501-01) until the licence is surrendered.

5.1.1 Proposed Rehabilitation Phase Site Drainage

Cutaway Bog Decommissioning and Rehabilitation Plans for each bog outline the proposed rehabilitation for the Application Site, including proposed site drainage, have been prepared and are summarised below in **Table E**.

Table E: Types of and areas for rehabilitation measures at the Ballivor Bog Group
Note that the types of rehab and specific areas of rehab may vary in response to stakeholder consultation and refinement of the rehabilitation measures.

Bog	Type	Description	Area (Ha)
Lisclogher	Deep Peat Cutover Bog	Regular drain blocking (3 per100 m) and blocking outfalls and managing water levels with overflow pipes	305.7
	Dry Cutaway	Blocking outfalls and managing water levels with overflow pipes	148.7
	Marginal Land	No Work Required	65.5
	Other	Silt Ponds	0.36
Carranstown	Deep peat	More intensive drain blocking (max 7 per 100m), blocking outfalls and Sphagnum inoculation. Berms and field re-profiling (45x60m cell), blocking outfalls and managing overflows & drainage channels for excess water & Sphagnum Inoculation	207.91
	Dry Cutaway 2	Regular drain blocking (3 per 100m) + blocking outfalls and managing water levels with overflow pipes + targeted fertiliser treatment	26.62
	Wetland	Turn off or reduce pumping to re-wet cutaway + blocking outfalls and managing water levels with overflow pipes + Targeted blocking of outfalls within a site + constructing larger berms to re-wet cutaway + transplanting Reeds and other rhizomes. More intensive drain blocking (max 7 per 100m), + blocking outfalls and managing overflows + transplanting Reeds and other rhizomes	9.57
	Marginal Land	No Work Required	45.46
	Other	Silt Ponds, Other Constraints (ROW)	16.1
Lisclogher West	Deep peat	More intensive drain blocking (max 7 per 100m), modifying outfalls	132.6
	Additional Works	Targeted Drain Blocking, where possible	22.2
	Marginal Land	No Work Required	58.1
	Other	Silt ponds, constrained areas	25.4
Ballivor	Deep Peat Cutover Bog	Regular drain blocking (3 per100m) and blocking outfalls and managing water levels with overflow pipes	537.9
	Dry Cutaway	Blocking outfalls and managing water levels with overflow pipes	19.1
	Marginal Land	No Work Required	82.4
	Other	Silt ponds	5.79
Bracklin	Deep Peat Cutover Bog	Regular drain blocking (3 per 100m) and blocking outfalls and managing water levels with overflow pipes	362.4
	Dry Cutaway	Modifying outfalls and managing water levels with overflow pipes	169.9
	Wetland	Modifying outfalls and managing water levels with overflow pipes	12.3
	Marginal Land	No Work Required	221.2
	Other	Silt pond	2.07

5.2 BASELINE HYDROLOGY & FLOOD RISK FOR PROPOSED REHABILITATION PLAN

The Cutaway Bog Decommissioning and Rehabilitation Plans will be implemented within the Application Site. The baseline hydrology is therefore identical to the existing environment and catchment characteristics outlined in **Section 3** above. Similarly, the flood risk identification and assessment is identical to the flood risk identification and assessment as described above in **Section 4.3.1**.

5.3 DISCUSSION ON PROPOSED REHABILITATION PLAN FLOOD RISK & FLOOD RISK ASSESSMENT

Improvements in flow and water quality can be achieved through bog rehabilitation and rewetting at the Application Site. The Cutaway Bog Decommissioning and Rehabilitation Plans will generally involve the rewetting and revegetation of the drained cutover bogs. The greatest hydrological/hydrogeological effects would be experienced in those areas selected for rewetting following ecological surveying. Rewetting would be achieved through measures such as drain blocking. These plans will likely have a positive effect on hydrogeology within the site where groundwater tables in the peat bogs are stabilised and closer to the bog surface. Water storage capacity within the site will therefore improve and reducing the risk of flooding within the vicinity and downstream of the site. Elsewhere, where rewetting is not suitable the drainage regimes will remain relatively unchanged.

In order to be conservative, we have completed a Justification test below in **Section 5.4** for the proposed Decommissioning and Rehabilitation plans at the Application Site.

5.4 REQUIREMENT FOR A JUSTIFICATION TEST – PROPOSED REHABILITATION PLAN

A matrix of vulnerability versus flood zone is shown in **Table F**. This table is used to illustrate appropriate development types or indicate when a Justification Test is required.

It may be considered that the proposed rehabilitation plan can be categorised as a "Water Compatible development". The key rehabilitation plans to be implemented include regular drain blocking, blocking outfalls and managing water levels with overflow pipes which will improve water storage capacity within the Application Site and will therefore improve and reduce the risk of flooding within the vicinity and downstream of the Application Site. Consequently, the Remedial Measures Phase is not at risk of flooding and would not require further justification from a planning perspective.

Table F: Matrix of Vulnerability versus Flood Zone

	Flood Zone A	**Flood Zone B**	**Flood Zone C**
Highly vulnerable development (including essential infrastructure)	Justification test	Justification test	Appropriate
Less vulnerable development	Justification test	Appropriate	Appropriate
Water Compatible development	Appropriate	Appropriate	**Appropriate**

Note: *Taken from Table 3.2 (DoEHLG, 2009)*
Bold: *Applies to this project.*

5.5 FLOOD RISK IMPLICATIONS ASSOCIATED WITH THE PROPOSED BALLIVOR WIND FARM

Bord Na Mona Powergen Ltd propose to develop a wind farm at the Ballivor Bog Group (Ref. PA25M.316212). The wind farm will comprise of a total of 26 no. turbines, turbine hardstands, temporary construction compounds, borrow pits, an on-site 110kV substation and all associated works including site drainage works. The Ballivor Wind Farm development is subject to a separate Flood Risk Assessment (HES, 2023) which accompanied the planning application for the wind farm development.

The FRA for the wind farm development includes a flood risk identification study which identifies existing potential flood risks associated with the proposed Ballivor wind farm (similar to Section 4 above). The FRA for the wind farm also includes an assessment of the risk of the wind farm development contributing to onsite and downstream flooding. The wind farm FRA found that the overall risk of flooding at the wind farm site (*i.e.* within the Ballivor Bog Group) is low and all proposed infrastructure, including the proposed substation location, will be located at or above Flood Zone C elevations. The FRA also concludes that the risk of the wind farm contributing to downstream flooding is very low.

Furthermore, the proposed Ballivor wind farm development and the Cutaway Bog Decommissioning and Rehabilitation Plans for the Application Site will not cause a cumulative increase in flood risk at the Ballivor Bog Group due to the following:

- All proposed wind farm development infrastructures, including the proposed onsite substation are located in Flood Zone C;
- The proposed wind farm drainage system will not significantly alter the existing drainage regime at the site;
- The proposed wind farm drainage will be fully integrated into the existing bog drainage system and rehabilitation plans;
- All surface water from the wind farm drainage system will be treated via silt traps and settlement ponds, to ensure there is no deterioration in downstream surface water quality;
- The proposed wind farm drainage system will be designed to provide surface water attenuation with the drainage system limiting discharge from the wind farm site to greenfield runoff rates; and,
- As a result, there will be no increase in surface water discharge from the site as a result of the wind farm development.

The overall aim of the Decommissioning and Rehabilitation Plans is to retain and slow down drainage within the Application Site which will result in areas of the site being wetter for longer. Therefore, the proposed rehabilitation works for the Bog Group and the wind farm development will not result in any increased downstream flood risk.

6. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the Application Site and the potential flood risks associated with the proposed Cutaway Bog Decommissioning and Rehabilitation Plans within the Ballivor Bog Group in Co. Meath and Co. Westmeath. From this study:
  - No instances of historical flooding were identified in historic OS maps;
  - No instances of recurring flooding were identified on OPW maps within the Ballivor Bog Group;
  - The GSI Historical 2015/2016 flood map does not record any areas of surface water flooding within the Ballivor Bog Group;
  - The GSI Groundwater flood mapping does not record any flood zones within the Ballivor Bog Group;
  - CFRAM maps, for Ballivor village and the surrounding areas, do not show any flood zones within the Ballivor Bog Group; and,
  - Areas of the Ballivor Bog Group were identified within Local Authority SFRA flood zones as described below.
- The Local Authority Strategic Flood Risk Assessment (SFRA) mapping indicates that there are areas of the Ballivor Bog Group located in Fluvial Flood Zone A. The remainder of the Bogs are mapped in Flood Zone C (Low Risk);
  - However, site surveys reveal that the EPA incorrectly mapped a watercourse (the Cartenstown stream) to cross Lisclogher bog from the west and this indicates that the SFRA mapping in this area is inaccurate;
  - We conclude, based on site observation, lack of flooding in winter 2015/2016, and the high drainage density within the bog at this location, that the actual flood risk in this area is the same for the entire Lisclogher bog, and it should be mapped in Flood Zone C.
- 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 below the current outfall pipe elevations of the Application Site (67.97 – 79.13m OD). Therefore, the risk of fluvial flooding along the Ballivor River, located to the east of the site, backing up into the existing 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 of peat soils and subsoils;
- The Cutaway Bog Decommissioning and Rehabilitation Plans for the Application Site can be categorised as a "Water Compatible Development" and a justification test is not therefore required. The Cutaway Bog Decommissioning and Rehabilitation Plans are designed to improve the hydrological regime within the Ballivor Bog Group (by holding water on the bogs) and these measures will reduce flood risk in the vicinity and downstream of the Ballivor Bog Group; and,
- Cumulatively, the risk of the Cutaway Bog Decommissioning and Rehabilitation Plans and the proposed wind farm development contributing to downstream flooding is also very low, as the long-term plan is to retain and slow down drainage from the bogs, and this will result in sections of the site being wetter for longer and therefore promoting more Fen like conditions.

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7. REFERENCES

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