# APPENDIX 9.3

# Surface Water Management Plan

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**LITTLETON WINDFARM, CO. TIPPERARY**

# SURFACE WATER MANAGEMENT PLAN

**FINAL REPORT**

Prepared for:

**LITTLETON WIND FARM DAC**

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**HYDRO-ENVIRONMENTAL SERVICES**

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# 1. INTRODUCTION

## 1.1 BACKGROUND

This document presents a Surface Water Management Plan (SWMP) and pollution prevention measures for the construction, operation and decommissioning of the proposed Littleton Wind Farm and the associated proposed Grid Connection (GC) route at Littleton, Co. Tipperary. A site location map is shown as **Figure A**.

The following SWMP provides the water management framework for potential Contractors and Sub-contractors, and it incorporates the mitigating principles described in the accompanying Environmental Impact Assessment Report (EIAR) to ensure that work is carried out with minimal impact on the water environment and in accordance with the mitigation measures and commitments made in the EIAR.

This report describes the existing hydrology of the Proposed Wind Farm Site (the Site) and the proposed GC route, and then sets out the proposed drainage measures required for surface water management during the construction and operation phase of the Proposed Development.

Design, management and mitigation proposals are presented for the following:

- Drainage design criteria and drainage design philosophy;
- Construction Phase drainage; and,
- Operational Phase drainage

The SWMP also outlines the proposed surface water monitoring plan for the construction and operational phase of the Proposed Development.

The surface water drainage plan for the proposed Littleton Wind Farm was developed by Hydro-Environmental Services (HES), and for completeness the proposed drainage plans for the development.

## 1.2 SITE DESCRIPTION

**Proposed Wind Farm**

The Site is located in east Co. Tipperary, with the Tipperary-Kilkenny county border located approximately 4.6km to the northeast. The closest settlements to the Site are Urlingford (approximately 5 km to the north-east), Gortnahoe (approximately 2.5 km to the east), Twomileborris (approximately 2 km to the west), Littleton (approximately 2.5 km to the west) and New Birmingham (approximately 2 km to the east). The town of Thurles is located approximately 9km to the west of the Site.

The Site consists of 3 no. Bord na Móna bogs which form part of the Littleton Bog Group. The bogs comprising the Site include Ballybeg Lanespark Derryvella Bog in the south, Littleton Bog towards the centre and Longfordpass Bog (Popes Bog) in the north. These bogs were historically used for peat extraction, with peat extraction ceasing in 2018. Today the Site comprises of cutover peat bogs with a large proportion of the Site consisting of revegetating cutaway (heath, scrub and woodland habitats) but also includes some open areas with large bodies of open water. Some areas have also been planted with coniferous forestry plantations. The total area of the Site is 1,177ha (11.77km$^2$).

The current topography of the Site is relatively flat with elevations ranging between 120 and 130mOD (metres above Ordnance Datum). Topography at the Site has been modified through the previous peat extraction activities and associated drainage. The highest

elevations are found at the headlands and remnant peat banks which create elevated boundary berms, forming a basin effect within the former extraction areas of the bogs.

**Proposed Grid Connection**

The proposed GC route extends from the proposed onsite 110kV electrical substation in the north of Littleton Bog to the existing Ballyragget 110/220kV substation within the townland of Ballyragget, Co. Kilkenny. The proposed GC route measures 30.9km in length and is located primarily within the curtilage of the public road corridor (28.4km). Ground elevations along the proposed GC route is variable with topography ranging from ~80 to ~140mOD.

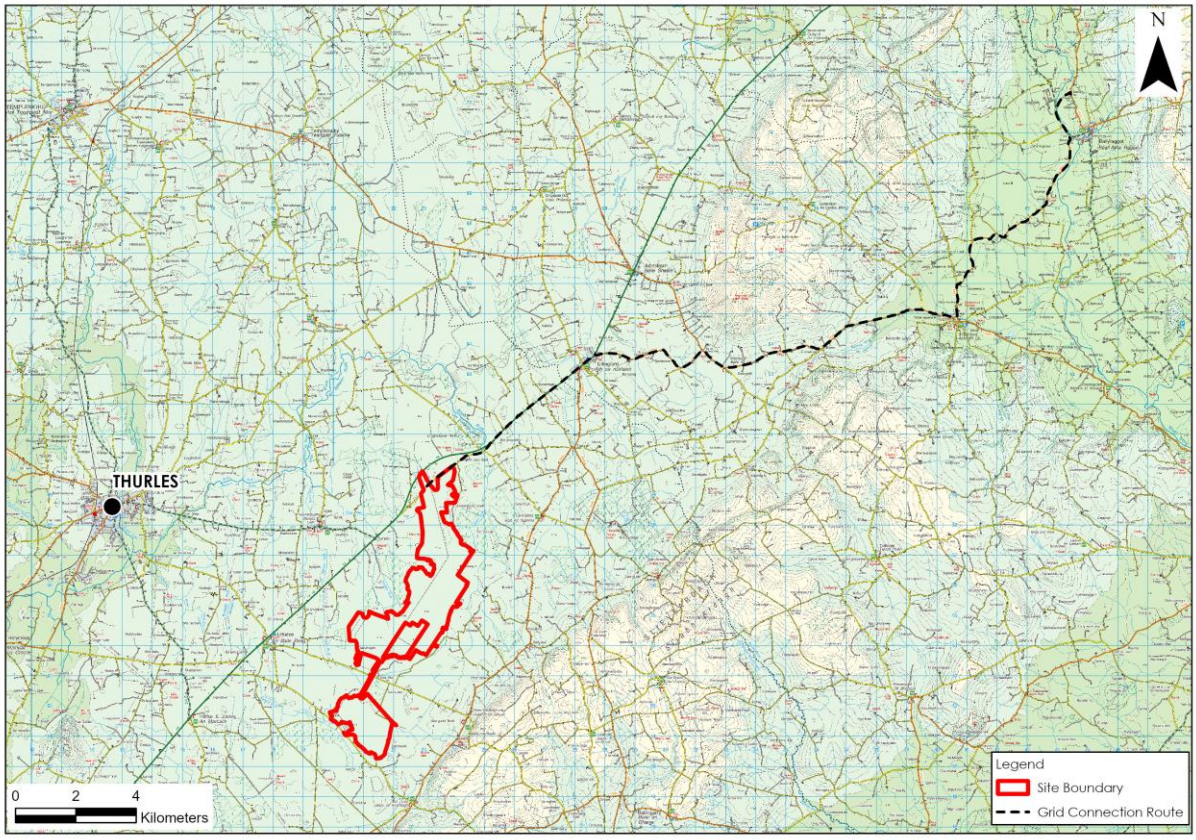


**Figure A: Site Location Map**

## 1.3 DEVELOPMENT DESCRIPTION

The Proposed Development consists of an 11 no. turbine wind farm and associated infrastructure including internal access tracks, hard standings, additional amenity trails, an onsite borrow pit, peat deposition areas, a permanent meteorological mast, an onsite 110kV substation and associated grid connection infrastructure, internal electrical and communications cabling, temporary construction compounds, drainage infrastructure, biodiversity management and enhancement measures, temporary accommodation works along the Proposed Turbine Delivery Route and all associated works related to the construction of the Proposed Development.

Please refer to Chapter 4 of the EIAR for a full description of the Proposed Development.

## 1.4 OUTLINE OF THE SURFACE WATER MANAGEMENT PLAN

This document aims to set out the proposed procedures and operations to be utilised on the proposed Littleton Wind Farm to mitigate against any water related environmental effects. The mitigation and control measures outlined herein and the EIAR will be employed on-site during the construction phase and operational phase of the Proposed Wind Farm and the proposed GC route.

The main areas of water related concerns covered by this document are:

a) Pre-Construction, Construction Phase and Operational Phase drainage controls;
b) Earthworks (*i.e.* infrastructure & drainage) and surface water quality protection;
c) Temporary stockpiles water management and controls;
d) Permanent soil/subsoil storage areas;
e) Fuel usage, storage and management;
f) Working at or near existing streams / watercourses;
g) Water supply and on-site sanitation; and,
h) Proposed GC route watercourse crossing works.

## 1.5 SWMP REPORT STATUS

The SWMP is considered a live document and will be modified over time as detailed contractor methods of work are developed. If the development is permitted an updated version of this document will be issued to all parties involved in the construction process when appropriate changes are deemed necessary.

# 2. EXISTING HYDROLOGICAL REGIME

## 2.1 INTRODUCTION

The existing geological and hydrological regime at the site is assessed in Chapter 9 of the EIAR for the wind farm development. A summary of geological and hydrological data is provided below in order to put the SWMP into perspective.

## 2.2 EXISTING GEOLOGICAL REGIME

**Proposed Wind Farm**
The published Teagasc soils map (www.gsi.ie) shows that the vast majority of the Site is underlain by cut peat. A small area in the south of Ballybeg Lanespark Derryvella Bog is overlain by made ground which corresponds to the existing Bord na Móna works depot. The mapped soils in the area of the proposed borrow pit include mainly basic poorly drained mineral soils (BminPD), mainly basic deep well drained mineral soils (BminDW) and mainly basic shallow poorly drained mineral soils (BminSP).

The published GSI subsoils map (www.gsi.ie) shows that the vast majority of the Site is underlain by cutover raised peat. The proposed borrow pit location is mapped to be underlain by bedrock outcrop or subcrop (Rck) and till derived from limestones (TLs).

The soils and subsoils present at the Site have been verified during site walkover surveys and intrusive site investigations. The results of these site investigations are detailed in Chapter 8 of the EIAR.

**Proposed Grid Connection**
As stated above the proposed GC will be placed within the carriageway of existing public roads. The published subsoils (www.epa.ie) map shows that subsoils along much of the proposed GC comprise of cutover peat and limestone derived tills (TLs). Gravels derived from limestones (GLs) in the east. Significant alluvium deposits are also mapped along the River Nore and other smaller watercourses.

## 2.3 EXISTING HYDROGEOLOGICAL REGIME

**Proposed Wind Farm**
The Ballysteen and Aghmacart Formations underlying the Site are mapped as Locally Important Aquifers - Bedrock which is Moderately Productive only in Local Zones. The Waulsortian Limestones are classified as being a Regionally Important Aquifer - Karstified. The Lisduff Oolite Member and the Crosspatrick Formation are classified as Locally Important Aquifers - Bedrock which is Generally Moderately Productive.

The Site is underlain by the Templemore and Thurles GWBs. Both of these GWBs achieved Good status in the latest WFD cycle (2019-2024).

**Proposed Grid Connection**
The majority of the proposed GC route is mapped to be underlain by a Regionally Important Aquifer - Karstified (diffuse). These areas include ~1.9km along the R639 to the southwest of Urlingford which corresponds to the mapped extent of the Waulsortian Limestones. The vast majority of the proposed GC route to the east of Woodsgift (~17.5km) is also mapped to be underlain by a Regionally Important (Karst) Aquifer corresponding to the Ballyadams Formation. In the vicinity of the Site and near Urlingford, the proposed GC is underlain by a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll). A small section along the R639 to the southwest of Urlingford is also mapped to be underlain by a Locally Important Aquifer - Bedrock which is Generally Moderately Productive (Lm). An overburden aquifer is also mapped along the proposed GC route in the Nore Valley. ~4.9km

of the proposed GC route is mapped to be underlain by a Regionally Important Gravel Aquifer which overlies the bedrock aquifer.

The proposed GC route is underlain by a total of 6 no. GWBs (Templemore, Shanahoe, Rathdowney, The Loughans Turlough GWDTE, Durrow and the Kilkenny-Ballynakill Gravels GWB). These GWBs all achieved Good status in the latest WFD cycle.

## 2.4 EXISTING HYDROLOGICAL REGIME

**Proposed Wind Farm**
The Site is located in River Suir surface water catchment within Hydrometric Area 16 of the South Eastern River Basin District.

More locally the Site is located in the Suir_040 WFD sub-catchment (Suir_SC_040) and is drained by the Drish River and its tributaries.

Due to the historic peat extraction activities at the Site, the bogs have been artificially drained in order to lower the peat water table. Drainage ditches were inserted into the upper surface of the bogs at different stages. Littleton Bog was the first bog within the Site to be cleared and drained in 1941. Longfordpass Bog was drained in 1947 whilst Ballybeg Lanespark Derryvella Bog was drained in 1968.

Drainage of the Site and the wider Littleton Bog Group is currently operating under licence from the EPA (P0499-01). The drainage system has been operating in accordance with this existing Integrated Pollution Control licence, with all drainage water from the bogs being discharged via an appropriately designed silt pond treatment arrangement.

Currently surface water (or runoff water) is drained from the Site via a network of field drains typically spaced at 15 to 20m intervals, piped drains, main drains, headland drains, and silt ponds.

The small section of Longfordpass Bog (Popes Bog) which is included in the Site drains to a small stream which is mapped along the western boundary of the Site. This stream is not assigned a name by the EPA and discharges into the Drish River ~4.8km downstream of the Site.

The drainage network in Littleton Bog is of variable orientation, with northeast to southwest orientated drains in the main bog area and northwest to southeast orientated drains in the northern section of the bog. Drainage of this bog was historically facilitated by pumping stations as the previous peat extraction activities resulted in the bog being unable to drain by gravity due to the lowering of the ground elevations. The pumping stations were located in the west of Littleton Bog and discharged to small streams which merge further downstream to form the Clover River. These pumping stations are no longer active. There remains 1 no gravity outfall to the Clover River at the western boundary of the bog. This outfall now drains much of the bog area including the large, flooded area which is present in the northwest of Littleton Bog. This flooded area drains to the south via a large drain and is directed into the central part of Littleton Bog. Some areas of Littleton Bog no longer drain by gravity and water pools in these limited areas. There may be some very limited recharge to ground in these areas. It is also noted that some small areas in the northeast of Littleton Bog drain by gravity and discharge to local drains which connect downstream to natural watercourses.

Ballybeg Lanespark Derryvella Bog is drained by a series of drains spaced at approximately 15m intervals. The drains are orientated northwest to southeast. Drainage from the bog occurs downstream of settlement ponds which outfall to the North Glengoole Stream in the north of the bog. This stream discharges into the Black (Two Mile Borris) River.

All watercourses draining the Site eventually discharge into the Drish River and the River Suir further downstream.

A full description of the hydrological regime is provided in Chapter 9 of the EIAR.

**Proposed Grid Connection**
There are a total of 11 no. crossings over watercourses along the proposed GC route.

Within the River Suir Catchment, there is 1 no. watercourse crossing proposed over an EPA mapped watercourse. This is situated at an existing crossing where a local road passes over the Black River (Drish River) within the Drish_020 WFD river sub-basin.

Within the River Nore surface water catchment, the proposed GC route is mapped across a total of 9 no. WFD river sub-basins with a total of 9 no. watercourse crossings over EPA mapped watercourses. There is also 1 no. crossing over a watercourse which is not included in the EPA blueline database. All crossing locations are situated at existing bridge/culvert locations as follows:

- There is an existing road bridge crossing over the Goul River (EPA Code: 15G02) to the southwest of Urlingford along the R639 in the Goul_202 WFD river sub-basin;
- An existing road bridge crossing along the R639 at Urlingford over the Ardreagh Stream (EPA Code: 15A03) in the Ardreagh_010 WFD river sub-basin;
- 2 no. existing crossings (road bridges) along the R693 over the Borrisbeg Stream (EPA Code: 15B18) in the Goul_030 WFD river sub-basin;
- A crossing along the R693 over the EPA mapped Clomantagh Lower Stream (EPA Code: 15C91) in the Nuenna_010 WFD river sub-basin. However, site inspections could not identify a watercourse at this location. This crossing is included in the impact assessment for the purposes of a conservative assessment;
- There are 2 no. existing crossings located in the Nuenna_020 WFD river sub-basin in the vicinity of Freshford. These crossings occur along the R693 over the Gorteenahilla Stream (EPA Code: 15G08) and along the R694 over an unmapped watercourse;
- An existing road bridge crossing over the Lismaine Stream (EPA Code: 15L16) along the R694 in the Nore_150 WFD river sub-basin;
- An existing crossing over the Lisdowney Stream (EPA Code: 15L02) along the R694 in the Nore_140 WFD river sub-basin; and,
- A new proposed crossing under the River Nore in the vicinity of Ballyragget substation.

## 2.5 FLOOD RISK ASSESSMENT

A Flood Risk Assessment (FRA) was completed for the Proposed Development and is attached as Appendix 9-1 of the EIAR.

The FRA found that the vast majority of the Site is located in Flood Zone C and is at low risk of flooding. The only infrastructure associated with the Proposed Wind Farm located in mapped fluvial flood zones comprises of internal site access tracks which are proposed at existing watercourse crossings (Bord na Móna railway line and machine pass crossing). All turbines and the proposed substation are located in Flood Zone C.

It is a key design of the Proposed Development water management system to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing greenfield rates. As such the mechanism by which downstream flooding is prevented and controlled is through avoidance by design. These proposed drainage attenuation measures are outlined in the impact assessment section below.

# 3. SURFACE WATER & SITE DRAINAGE MANAGEMENT

## 3.1 DRAINAGE DESIGN CRITERIA

The main design criteria for wind farm drainage plans are shown below. These criteria were incorporated into the design of the drainage plans for the wind farm.

- Minimise any change to the surface water and groundwater conditions within the Site and along the proposed GC route;
- Avoid sensitive areas where possible by employing hydrological constraints (*i.e.* buffer zones);
- Using a SUDS philosophy (with design flows adjusted to account for climate change) where physically possible, to replicate the natural drainage of the Site;
- Minimise sediment loads in the runoff, with particular attention being given to the construction phase of the Proposed Development;
- Maintain runoff rates and volumes at Greenfield rates for a range of storm events (to be incorporated into final detailed design); and,
- Avoid high flow velocities internally within new drain networks and at outfall locations to prevent erosion.

## 3.2 PROPOSED DRAINAGE MANAGEMENT

Runoff control and drainage management are key elements in terms of mitigation measures to reduce potential effects on downstream surface water bodies. Drainage management within the Site will be risk based, and will employ various methods, building on the existing drainage systems within the Site. The main tenet of the proposed drainage plan is ensuring to 'keep clean water clean' by avoiding unnecessary or significant disturbance to existing drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas through the construction of interceptor drains. Where possible (depending on orientation), existing field drains can be used as interceptors drains. Otherwise, new interceptor drains will be excavated and they will outfall to field drains downstream of the works areas.

The second method involves collecting any construction area drainage waters (from turbine base/hardstand areas, temporary construction compounds, and the substation) and routing that water through new proposed temporary Proposed Wind Farm settlement ponds (or stilling ponds) prior to controlled release into the existing field drain network. There will be no discharges to the existing field drains without prior treatment. Note that existing density of field drains across the site is variable and where there is a low drainage density, the construction phase drainage system will discharge via level spreaders / buffered outfalls onto the peat surface.

Within the Proposed Wind Farm layout there are sections of proposed floating road between turbine infrastructure. In these sections, and depending on intermediate topography, a collector drain (dirty water system as described above) may be used during construction stage, or over the edge (OTE) drainage will occur. Over the edge drainage allows runoff from access tracks to flow into local field drains and be managed via the existing site drainage system. OTE drainage will only occur where topography allows, and it is only proposed in areas of low risk and remote from outfall locations (at least 150m from bog outfall locations. Silt traps and check dams will be installed in field drains downstream of OTE drainage areas, and these will provide attenuation and treatment of dirty water.

During the construction phase, all runoff from works areas (i.e., dirty water) will be attenuated and treated prior to being released within the site. Settlement ponds will be designed in consideration of the greenfield runoff rates. All drainage outfall from the proposed work areas

will also be routed through the existing bog drainage network and the existing settlement ponds at the margin of the bog that remain in-situ from the previous site use.

Therefore, runoff generated within the construction areas, located within the bog, will be subject to a two-stage treatment process:

- Firstly, surface water runoff will be managed via the Proposed Wind Farm drainage infrastructure which includes appropriate attenuation and treatment for suspended solids.
- Secondly, the treated runoff will be discharged into the existing bog drainage network where it will be subject to additional attenuation and treatment, prior to the controlled release to the drains and natural watercourses surrounding the bog.

A schematic of this approach is presented in **Figure B** below, and this system of drainage control is shown in more detail on the drainage plan. During the construction phase all runoff from works areas (i.e., dirty water) will be attenuated and treated to a high quality prior to being released. **Figure B** presents a schematic of the drainage where level spreaders and buffered outfalls will be implemented to create a sheet flow reducing the potential for erosion of the peat surface. This will occur where there is a lack of existing bog drains in close proximity to the work areas. In other areas, the construction phase drainage system will discharge treated and attenuated into the existing bog drainage network and there will be no requirement for a level spreader.

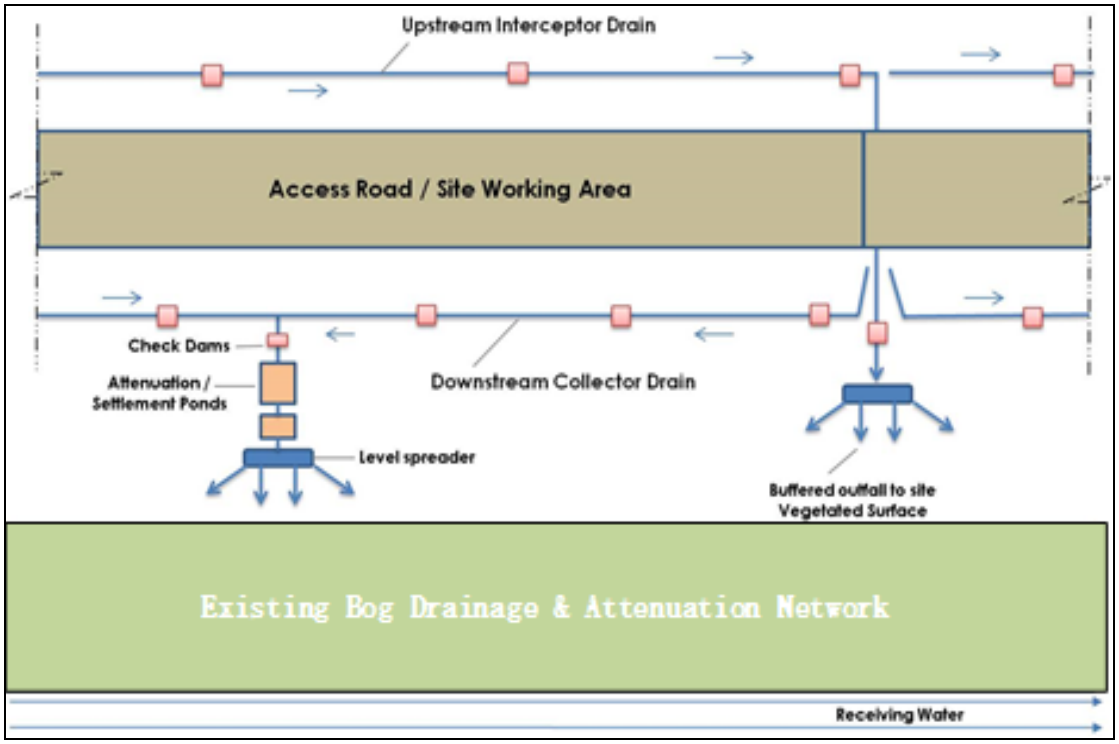


**Figure B: Schematic of Drainage Management within the Site**

## 3.3 DEVELOPMENT INTERACTION WITH THE EXISTING DRAINAGE

The Proposed Development drainage will not significantly alter the existing drainage regime at the site. Moreover, the proposed drainage system will be fully integrated into the existing bog drainage systems. The SWMP prescribes the advanced review of the drainage by the project drainage engineer and ECoW ahead of setting-out, to identify any potential locations where the drainage may interfere (during construction or operations) with the rehabilitation drain block measures completed or the wetlands established. The SWMP also recommends

measures that can be implemented on the ground in agreement with the ECoW to avoid such potential interferences.

Existing field drains and main drains will be routed under/around access tracks using culverts as required.

Runoff from access tracks, turbine bases, and developed areas (construction compounds, substation, met mast) will be collected and treated in local (proposed) silt traps and settlement ponds and then discharged to existing peat field drains or discharged via a level spreader onto a vegetated peat surface. From there, this water will flow towards the relevant bog boundaries in existing field drains and main drains and then be treated further in the existing main (bog) settlement ponds prior to discharge from the Site.

## 3.4 PROXIMITY TO STREAMS / WATERCOURSES

The key mitigation measure is the avoidance of sensitive hydrological features where possible, by application of suitable buffer zones (i.e. 50m to main watercourses, 10m to main drains and 20m to existing settlement ponds etc.). All of the key Proposed Development areas are located significantly away from the delineated 50m watercourse buffer zones with the exception of the upgrading of the existing watercourse crossing, new drain crossing and upgrades to existing site access tracks. Additional control measures, which are outlined further on in this section, will be undertaken at these locations.

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

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

## 3.5 PRE-EMPTIVE SITE DRAINAGE MANAGEMENT

The works programme for the construction phase will take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of peat/subsoil or peat stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

Earthworks should be suspended if forecasting suggests any of the following is likely to occur:

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

Prior to earthworks being suspended the following control measures should be completed:

- Secure all open peat/spoil excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

## 3.6 PRE-CONSTRUCTION DRAINAGE

The surface of the cutover bog is drained by a network of parallel field drains that are typically spaced every 15 - 20m. The field drains are approximately 0.5 - 1.5m deep and in most areas, they intercept the mineral subsoil underlying the peat. These field drains mostly feed into larger surface water drains which drain the main catchments across the Site. This existing drainage system will continue to function as it is during the pre-construction phase.

Prior to commencement of construction works in sub-catchments across the Site, main drain inspections will be completed to ensure ditches and streams are free from debris and blockages that may impede drainage. It is proposed to complete these inspections on a catchment-by-catchment basis as the construction works develop across the Site, as works in all areas will not commence simultaneously.

## 3.7 WIND FARM CONSTRUCTION PHASE DRAINAGE MANGEMENT

The Design Engineer will complete a site drainage and maintenance plan before construction commences and will attend the Site to set out and assist with micro-siting of proposed drainage controls as outlined in Chapter 4 of the EIAR.

A pre-construction walkover of the drainage is required by the project drainage engineer and ECoW ahead of setting-out, to identify any potential locations where the drainage may interfere (during construction or operations) with the existing drain blocking measures completed or the wetlands established. In the limited instances where the proposed infrastructure drainage may cross existing drain blocking measures, the alignment of the drainage shall be amended to avoid the feature or the drain blocking feature shall be replaced in a manner to restore its fully functionality. In the limited instances where the proposed infrastructure drainage may come within a 10m buffer of an established wetland area, and if it is apparent that the drainage could negatively interfere with that wetlands in the short or long term, the follows measures shall be implemented to prevent unintended overland flows and flows within the peat itself:

- adaptation of the vertical geometry of the drains themselves; and/or,
- installation of low permeability soil berms and/or plastic sheet piles on the wetland side of the drain.

The drainage system will be excavated and constructed in conjunction with the road and hard standing construction. Drains will be excavated and stilling ponds constructed to eliminate any suspended solids within surface water running off the Site.

Drainage infrastructure will include:

- Interceptor drains will convey clean runoff water around works areas to the existing downstream drainage system (field drains and main drains). Where required, interceptor drains will be installed in advance of any construction works commencing. This will ensure that clean water is kept clear by diverting surface water flow around excavations, construction areas and temporary storage areas. Where possible (depending on orientation), existing field drains can be used as interceptors drains;
- Collector drains will be used to collect runoff from construction areas (from turbine base/hardstand areas, construction compounds, and the substation). During the construction phase temporary settlement ponds will be used to attenuate and treat runoff from the construction areas (from turbine base/hardstand areas, construction compounds, and the substation) and treated water will then discharge into existing field drains and main drains or via a buffered outfall/level spreader into the peat surface depending on the density of the existing field drains;
- During the construction phase, temporary silt traps (silt fences) will be used as an additional water protection measures around the existing bog drainage network. The silt fences will be placed in the existing drains downstream of construction works, and

the associated construction area run-off water will be diverted into proposed interceptor drains, or culverted under/across the works area; During the construction phase, dewatering silt bags will also be used as required. They can be used downgradient of turbine bases, where temporary pumping is required. Discharge from dewatering silt bags will flow into settlement ponds and treated water from settlement ponds will outfall to existing field drains and main drains. Some discharge may also occur onto the peat surface via a buffered outfall / level spreader where there is a lack of existing field drains;

- Within the proposed site layout there are section of proposed floating road between turbine infrastructure. In these sections, and depending on intermediate topography, a collector drain (dirty water system as described above) may be used during construction stage, or over the edge (OTE) drainage will occur. Over the edge drainage allows runoff from access tracks to flow into local field drains and be managed via the existing site drainage system. OTE drainage will only occur where topography allows, and it is only proposed in areas of low risk and remote from outfall locations (at least 150m from bog outfall locations. Silt traps and check dams will be installed in field drains downstream of OTE drainage areas, and these will provide attenuation and treatment of dirty water; and,
- Culverts will be required where site roads and proposed hardstands cross the main bog drainage networks. These will be installed with a minimum gradient to reduce the entrainment of suspended solids. All culverts will be inspected regularly and maintained where appropriate. Culverts will remain in-situ during the Operational Phase of the Proposed Development.
- Excess surface water from the proposed borrow pit will either infiltrate to ground or will be pumped via a rising main to a proposed settlement pond to be located within the bog area. The proposed borrow pit settlement pond will be suitably sized and will discharge attenuated water to the existing bog drains within the northeast of Littleton Bog.

In relation to decisions that are made on site it is important to stress that these will be implemented in line with the associated drainage controls and mitigation measures, and to ensure protection of all watercourses.

## 3.8 WIND FARM OPERATIONAL PHASE DRAINAGE MANAGEMENT

The construction phase drainage system will be largely retained for the long-term operational drainage of the Site. Given the local hydrological regime at the Site, which comprises of an established network of field drains and main drains, the removal of the construction phase drainage systems would result in unnecessary disturbance and potential entrainment of suspended solids within the bog drainage network. The drainage system will also continue to provide hydrological benefits in terms of surface water attenuation and treatment (removal of suspended solids). Therefore, the construction phase drainage systems including interceptor and collector drains, roadside drains, culverts and settlement ponds will be retained for the operational phase. Only temporary construction phase features such as silt fences and check dams will be removed.

The ECoW will inspect and review the drainage system after construction has been completed to provide guidance on the requirements of an operational phase drainage system. This operational phase drainage system will comprise of.

- Interceptor drains will be maintained up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to the downstream drainage system within the bog (i.e. downgradient field drains);
- Swales/road side drains will be installed to intercept and collect runoff from access roads and hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to stilling ponds for sediment settling;

- Stilling ponds/settlement ponds, emplaced downstream of swales and roadside drains, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses. The stilling ponds will be sized according to the size of the area they will be receiving water from, but will be sufficiently large to accommodate peak flows storm events; and,
- Maintenance of the operational phase drainage system is essential. Monthly ongoing inspections by site maintenance staff along with quarterly inspections by for a period of two years into the operational phase.

## 3.9 GRID ROUTE CONSTRUCTION PHASE SURFACE WATER DRAINAGE MANGEMENT

The early establishment of temporary drainage facilities along the proposed GC route during construction will reduce the risk of pollution problems. In addition, construction operations will adopt best working practice. The construction of surface water drainage measures will start at the starting works point of the grid route and progress along the construction site. There will therefore need to be designed with sufficient flexibility to respond to an early phase of limited incoming flow during the construction phase.

During the construction of the proposed GC reroute, temporary sediment control measures will be put in place to treat any surface waters with entrained suspended sediment, which may arise as a results of excavated materials from the excavated trench.

Temporary Soil/Subsoil Storage area

- During the initial temporary placement of soil and subsoil, silt fences and straw bales will be used to control surface water runoff from the temporary storage areas. Biodegradable geogrids may be used in the event that an area of soil/subsoil is stored for a length of time (>48 hrs) before being reinstated within an excavation; and,
- An interceptor drain will be installed upslope of the temporary storage area. This drain will divert any surface water away from the storage area and hence preventing erosion and the entrainment of suspended sediment within runoff from the storage area.

Silt Bags

- Silt bags will also be emplaced within drains down-gradient of all construction areas. Silt bags are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment.

Silt fences:

- Silt fences will be emplaced along drains and parallel to grid route excavations as required. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff to nearby water courses.

- Inspection and maintenance of these structures during the construction phase of the grid route is critical to their functioning to stated purpose. They should remain in place until any excavated trench is reinstated. Silt fence material should be Terra Stop Premium or equivalent.

## 3.10 GRID ROUTE OPERATIONAL PHASE DRAINAGE MANAGEMENT

No additional measures are proposed for the operational phase of the GC route, as the trench will be closed in and the road surfaces will be reinstated. The road drainage along the grid route will function as normal during the operational phase.

Should minor repair works be required, then construction phase controls will be implemented as outlined in Section 3.9.

## 3.11 DECOMMISSIONING PHASE – DRAINAGE MANAGEMENT

The drainage measures to be implemented at the Wind Farm will be the same as those implemented during the construction phase.

There will be no requirement for drainage management along the GC route as the ducting will be left in place.

## 3.12 REACTIVE DRAINAGE MANAGEMENT

The final drainage design prepared for the site has provided for reactive management of drainage measures. The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat silt-laden water from the works areas, will be monitored by the Environmental Clerk of Works (ECoW) on-site.

The contractor is solely responsible for the implementation of the detailed drainage design on-site. The ECoW is responsible for monitoring the effectiveness of the drainage design as it is implemented om-site.

The ECoW or supervising hydrologist will respond to changing weather, ground or drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained. This may require the installation of additional check dams, interceptor drains or swales as deemed necessary on-site. The drainage design may have to be modified on the ground as necessary, and the modifications will draw on the various features outlined above in whatever combinations are deemed to be most appropriate to situation on the ground at a particular time.

In the event that works are giving rise to siltation of watercourses, the ECoW or supervising hydrologist will stop all works in the immediate area around where the siltation is evident. The source of the siltation will be identified and additional drainage measures such as those outlined above will be installed in advance of works recommencing.

# 4. DRAINAGE MITIGATION & CONTROL MEASURES

## 4.1 PEAT DEPOSITION AREAS - DRAINAGE CONTROLS

It is proposed that excavated soil, peat and spoil will be used in landscaping around the proposed infrastructure, will be used to reinstate the proposed borrow pit or will be stored in the designated peat deposition areas. During the initial placement of peat and spoil, silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff from the storage areas as required. Interceptor and collector drains will be used at storage areas. 'Siltbuster' treatment trains will be employed if previous treatment is not of a sufficient quality.

## 4.2 EXCAVATION DRAINAGE CONTROLS

There will be no significant requirement for groundwater dewatering during the excavation of turbine base foundations at the Site or within excavations along the proposed GC route. As a worst case, minor seepages and localised surface water runoff may require management but this will only account for a minimal volume. Management of any water build-up and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent the build-up of groundwater in the excavation;
- The interceptor drainage will be discharged to the existing drainage system or onto the bog surface within the overall bog drainage and treatment system;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a "Siltbuster" unit;
- There will be no direct discharge to the existing bog drainage network and therefore no risk of hydraulic loading or contamination will occur; and,
- Daily monitoring of excavations and the water treatment system by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped, and a geotechnical assessment will be undertaken.

## 4.3 STREAM / WATERCOURSE CROSSINGS

There are no proposed new watercourse crossings at the Site or along the proposed GC route.

## 4.4 BORROW PIT DRAINAGE MANAGEMENT

The topographical and hydrogeological setting of the proposed borrow pit locations means no significant groundwater dewatering will be required as described below.

Thereby, no regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at the proposed borrow pit excavations.

Moreover, direct rainfall and surface water runoff will be the main inflows that will require pumping and water quality management.

Drainage proposals at the proposed borrow pit are shown on Drainage Drawing D103 included in the planning pack.

Water in the floor of the borrow pit will either infiltrate to ground or be pumped by a rising main to the proposed borrow pit settlement pond to be located in the eastern area of Littleton Bog. From there the treated and attenuated water will be discharged into the existing bog drainage network. The existing bog drainage network will provide additional

treatment and attenuation before discharging to the north and into a tributary of the Drish River.

The borrow pit settlement pond has been designed to allow a 24hr retention time as per EPA guidance (2006), which is the highest level of protection recommended by the EPA with regard to retention time.

## 4.5 FUEL USAGE / STORAGE AND HAZARDOUS MATERIALS

Hydrocarbon Control Measures

Measures to control hydrocarbons at the Site and along the proposed GC route are as follows:

- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site;
- On-site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer or truck will be re-filled off site and will be towed/driven around the Site to where machinery is located. The 4x4 jeep/fuel truck will also carry fuel absorbent materials for the event of any accidental spillages. The fuel bowser will be parked in a designated location on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be available during all refuelling operations and used when required;
- Fuel volumes stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume during the construction phase; and,
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (Appendix 4-3). Spill kits will be available to deal with accidental spillages.

Cement Based Products Control Measures

- No batching of wet-cement products on-site is proposed. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will be the design approach;
- Where possible pre-cast elements for culverts and concrete works will be used;
- No washing out of the main body of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only the concrete truck chute will be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water will be isolated in temporary lined wash-out pits located near Site compounds. These temporary lined wash-out pits will be removed from the site their utility is no longer required or at the end of the construction phase;
- Any washing out of concrete pumping plant will also be into the temporary lined wash-out pits;
- Weather forecasts will be used to plan dry days for pouring concrete; and,
- Construction contractors will ensure each concrete pour site is free of standing water and plastic covers will be available in case of a sudden rainfall event.

## 4.6 WATER SUPPLY AND ON-SITE SANITATION

There will be no abstraction of surface water or groundwater during the operational phase. The water supply requirements will be provided by rainwater harvesting.

It is proposed to install a sealed underground holding tank for effluent (wastewater) from the onsite 110kV electrical substation building. The tank shall be routinely emptied by a licensed contractor. A level sensor will be installed in the tank which shall be linked to the on-site

SCADA system. If the level of the tank contents rise to a predetermined 'high' level a warning shall appear on the overall SCADA system for the site and automatic notification shall be sent to the facility manager. A formal service agreement will be entered into with a suitably permitted waste contractor, in relation to the servicing and de-sludging of the wastewater holding tank on site. There will be no discharge of wastewater to ground at the Site, and therefore there is no potential to impact groundwater or surface water quality.

## 4.7 GRID ROUTE WATER CROSSINGS

The proposed GC includes a total of 10 no. crossings over EPA mapped watercourses, with an additional 1 no. crossing over a watercourse which is not included in the EPA blueline database. These crossings are located at existing road bridge crossings with the exception of the crossing at the River Nore. A total of 10 no. crossings will be completed by Horizontal Directional Drilling (HDD) with 1 no. crossing over the EPA mapped Clomantagh Stream to be completed within the road carriageway. The schedule of watercourse crossings is included as Appendix 9-4 of the EIAR.

No in-stream works are required at any of these crossing locations, however due to the proximity of the streams to the construction work at the crossing locations, there is a potential for surface water quality impacts during trench excavation works and/ or HDD works.

A constraint/buffer zone will be maintained for all crossing locations where possible whereby all watercourses will be fenced off and construction works will be completed at a setback distance to the stream or riverbanks. In addition, measures which are outlined below will be implemented to ensure that silt laden or contaminated surface water runoff from the excavation work does not discharge directly to the adjacent watercourse.

The purpose of the constraint zone is to:

- Avoid physical damage to surface water channels;
- Provide a buffer against hydraulic loading by additional surface water run-off;
- Avoid the entry of suspended sediment and associated nutrients into surface waters from the trench excavation;
- Provide a buffer against direct pollution of surface waters by pollutants such as hydrocarbons; and,
- Provide a buffer against construction plant and materials entering any watercourse.

General Best Practice Pollution Prevention Measures will also include:

- Protection of the riparian zone watercourses by implementing a constraints zone around stream/river crossings, in which construction activity will be limited to the minimum, i.e. works solely in connection with duct laying at the stream crossing;
- No stockpiling of construction materials will take place within the constraints zone. No refuelling of machinery or overnight parking of machinery is permitted in this area (at least 100m separation distance from the 3 no. locations);
- No concrete truck chute cleaning is permitted in this area;
- Works shall not take place at periods of high rainfall or high stream/river flows, and works will be scaled back or suspended if heavy rain is forecast;
- Plant will travel slowly across bare ground at a maximum of 5km/hr;
- All machinery operations shall take place away from the stream and ditch banks, apart from where crossings occur. Although no instream works are proposed or will occur;
- Any excess construction material shall be immediately removed from the area and taken to a licensed waste facility;
- No stockpiling of materials will be permitted in the constraint zones;
- Spill kits shall be available in each item of plant required to complete the stream crossing; and,
- Silt fencing will be erected on ground sloping towards watercourses at the stream/river crossings if required.

- Double silt fences will be placed down-gradient of all construction areas inside the hydrological buffer zones (i.e., near stream crossings).
- Any roadside drains will be temporarily blocked using sandbags in the area where trenching works is taking place.

Proposed Mitigation Measures for Horizontal Directional Drilling:

- Although no in-stream works are proposed, the drilling works will only be done over a dry period between July and September (as required by IFI for in-stream works) to avoid the salmon spawning season and to have more favourable (dryer) ground conditions;
- The crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance of vegetation;
- There will be no storage of material / equipment or overnight parking of machinery inside these 15m buffer zones;
- Before any ground works are undertaken, double silt fencing will be placed upslope of the river channel along the 15m buffer zone boundary.
- Additional silt fencing or straw bales (pinned down firmly with stakes) will be placed across any natural surface depressions / channels that slope towards the river;
- Silt fencing will be embedded into the local soils to ensure all site water is captured and filtered;
- The area around the bentonite batching, pumping and recycling plant will be bunded using terram geotextile (as it will clog) and sandbags in order to contain any spillages;
- Drilling fluid returns will be contained within a sealed tank / sump to prevent migration from the works area;
- Spills of drilling fluid will be cleaned up immediately and stored in an adequately sized skip before being taken off-site;
- If rainfall events occur during the works, there will be a requirement to collect and treat small volumes of surface water from areas of disturbed ground (i.e. soil and subsoil exposures created during site preparation works);
- This will be completed using a shallow swale and sump downslope of the disturbed ground, and water will be pumped to a proposed percolation area at least 50m from the watercourses;
- The discharge of water onto vegetated ground at the percolation area will be via a silt bag which will filter any remaining sediment from the pumped water. The entire percolation area will be enclosed by a perimeter of double silt fencing;
- Any sediment laden water from the works area will not be discharged directly to a watercourse or drain;
- Works shall not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted;
- Daily monitoring of the compound works area, the water treatment and pumping system and the percolation area will be completed by a suitably qualified person during the construction phase. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter is discharged to the rivers;
- If high levels of silt or other contamination is noted in the pumped water or the treatment systems, all construction works will be stopped. No works will recommence until the issue is resolved and the cause of the elevated source is remedied;
- On completion of the works, the ground surface disturbed during the site preparation works and at the entry and exit pits will be carefully reinstated and re-seeded at the soonest opportunity to prevent soil erosion;
- The silt fencing upslope of the rivers will be left in place and maintained until the disturbed ground has re-vegetated;
- There will be no batching or storage of cement allowed at the watercourse crossing;
- There will be no refuelling allowed within 100m of the watercourse crossing; and,
- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing.

Mechanical Stabilisation

Mechanical Stabilisation will be required where HDD is proposed in gravelly, non-cohesive subsoils. This will be managed by installing steel conductor casing through the shallow gravels to bypass the cover zone (i.e. the material above the bore depth) where fluid would be most likely to breach the surface. This casing acts as a physical barrier, protecting the riverbed from pressure spikes and ensuring returns are directed back to the entry pit rather than into the sensitive substrate. Note that mechanical stabilisation may only be needed on the River Nore crossing.

Mitigation Measures relating to the use of a mixture of a natural, inert and fully biodegradable drilling fluid such as Clear Bore™ and water for directional drilling, and Contingency Plan for Blow-out (Frac-out), if required:

- The drilling fluid/bentonite will be non-toxic and naturally biodegradable (i.e., Clear Bore Drilling Fluid or similar will be used). Biocompatible Drilling Fluids (European Standards) utilize NSF/ANSI Standard 60 or CE-marked additives which are high-performance, biodegradable viscosifiers and will be used to provide the necessary "gel strength" to suspend heavy gravel cuttings. Fluid loss will be controlled using biodegradable sealants, which create a thin, flexible filter cake on the borehole wall to prevent fluid migration into the aquifer. These products break down naturally, ensuring no permanent alteration to the hydraulic conductivity of the aquifer;
- The area around the drilling fluid batching, pumping and recycling plants will be bunded using terram and/or sandbags to contain any potential spillage;
- One or more lines of silt fencing will be placed between the works area and the adjacent river;
- Spills of drilling fluid will be cleaned up immediately and transported off-site for disposal at a licensed facility;
- Adequately sized skips will be used where temporary storage of arisings are required;
- The drilling process / pressure will be constantly monitored to detect any possible leaks or breakouts into the surrounding geology or local watercourse;
- This will be gauged by observation and by monitoring the pumping rates and pressures. If any signs of breakout occur then drilling will be immediately stopped;
- Real-time annular pressure monitoring will be completed. By keeping pressures below the Delft Equation limits, operators can detect lost circulation before it becomes a surface frac-out;
- Any frac-out material will be contained and removed off-site;
- The drilling location will be reviewed, before re-commencing with a higher viscosity drilling fluid mix; and,
- If the risk of further frac-out is high, a new drilling alignment will be sought at the crossing location.
- The above mitigation measures are standard best practice measures for HDD works and have been successfully employed in multiple projects across Ireland.

# 5. SURFACE WATER QUALITY MONITORING PLAN

This section of the SWMP sets out the programme for water quality monitoring during the preconstruction, construction, commissioning and operational phases of the wind farm development.

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of the commencement of any works and will be included in the CEMP. Regular inspections of all installed drainage systems will be undertaken, especially before and after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended. Any excess build-up of silt sediment levels at dams, the settlement ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.

During the construction phase field testing (visual, supplemented with pH, electrical conductivity, temperature, dissolved oxygen and turbidity monitoring), sampling and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (i.e. weekly, monthly and event-based). The data will be processed and analysed and works will cease if elevated turbidity concentrations are recorded. In this event, all upstream silt traps and drainage routes will be inspected to identify the cause of the elevated turbidity levels. Works will not recommence until any issues have been resolved and the turbidity concentrations have returned to background concentrations.

The water monitoring programme is outlined in the following sections.

## 5.1 PRE-CONSTRUCTION MONITORING

Water quality field testing and laboratory analysis will be undertaken prior to commencement of construction. The monitoring programme is included in the EIAR mitigation schedule and in the CEMP.

Analysis will be for a range of parameters with relevant regulatory limits along with Environmental Quality Standard's (EQSs) and sampling will be undertaken at each of the 8 no. monitoring locations.

Baseline sampling will be completed on at least two occasions, and these will coincide with low flow and high flow stream conditions. The high flow sampling event will be undertaken after a period of sustained rainfall, and the low flow event will be undertaken after a dry spell.

The existing drainage system will continue to function as it is during the pre-construction phase.

However, prior to commencement of works in sub-catchments across the Site, main drain inspections will be completed to ensure ditches and streams are free from debris and blockages that may impede drainage. These inspections will be done on a catchment-by-catchment basis as the construction works develop across the site, as works in all areas will not commence simultaneously.

## 5.2 CONSTRUCTION PHASE MONITORING

### 5.2.1 Visual Drain Inspections

Daily visual inspections of the installed drains and outfalls will be performed during the construction period to ensure suspended solids are not entering streams and rivers on site, to identify any obstructions to channels and to allow appropriate maintenance of the drainage regime. Should the suspended solids levels measured during construction be higher than the

baseline levels, the source will be identified, and additional mitigation measures implemented.

Inspection sheets and photographic records will be kept on site. Inspection points will include the in-situ field monitoring point locations and the laboratory analysis sampling points. Inspection points will depend on works being completed within the catchment upstream of the identified monitoring locations. Visual inspections will also be completed after major rainfall events, i.e. after events of >25mm rainfall in any 24-hour period and data including photographs will be collected by visual inspections and independently assessed by the supervising hydrologist who will monitor and advise on the records being received.

Daily Visual Inspections are subject to change upon commencement of construction activity and works in progress within the catchment areas.

The following periodic inspection regime will be completed and recorded:

- Daily general visual inspections will be completed by site the Environmental Officer or a suitably qualified and competent person as delegated by the Environmental Officer during the construction phase;
- Inspection will include all elements of drainage systems to ensure that the drainage systems are operating correctly and to identify any maintenance that is required. Any changes, such as discolouration, odour, oily sheen or litter should be noted and corrective action should be implemented. High risk locations such as settlement ponds will be inspected on a daily basis. Daily inspections checks will be completed on plant and equipment, and whether materials such as straw bales or oil absorbent materials need replacement;
- Event based inspections by the Site Environmental Officer as follows, after:
    - >10 mm/hr (*i.e.* high intensity localised rainfall event);
    - >25 mm in a 24 hour period (heavy frontal rainfall lasting most of the day); or,
    - Rainfall depth greater than monthly average in 7 days (prolonged heavy rainfall over a week).
- Monthly inspections by the ECoW during construction phase.
- A written record will be maintained or available on-site within the CEMP during the construction phase.

### 5.2.2 Surface Water Quality Monitoring

#### *5.2.2.1 Sampling Locations*

Surface water quality within and downstream of the Site and along the proposed GC route will be monitored during the construction phase and this monitoring will also extend into the post construction phase for the wind farm.

There are 7 no. surface water monitoring locations (SW1-SW7) at the Site as shown on Figure C. These locations are situated on the main watercourses draining the site and on some of the larger existing main drains within the site.

In addition, there are 10 no. monitoring locations (SW8-SW17) along the proposed GC route. These locations are situated at the main watercourse crossings along the route. Works along the grid will be temporary and transient and monitoring will only need to be completed at each of these locations for a short period whilst works are ongoing in the vicinity of the watercourse crossing.

Grab sampling will be completed at monitoring points SW1 – SW7 for the Site and monitoring points SW7-SW17 for the proposed GC route (refer to Figure C). The proposed locations of the surface water monitoring points will be agreed with Inland Fisheries Ireland and Tipperary

County Council in advance of the construction phase. Coordination of the monitoring will be undertaken by the Site Environmental Officer.

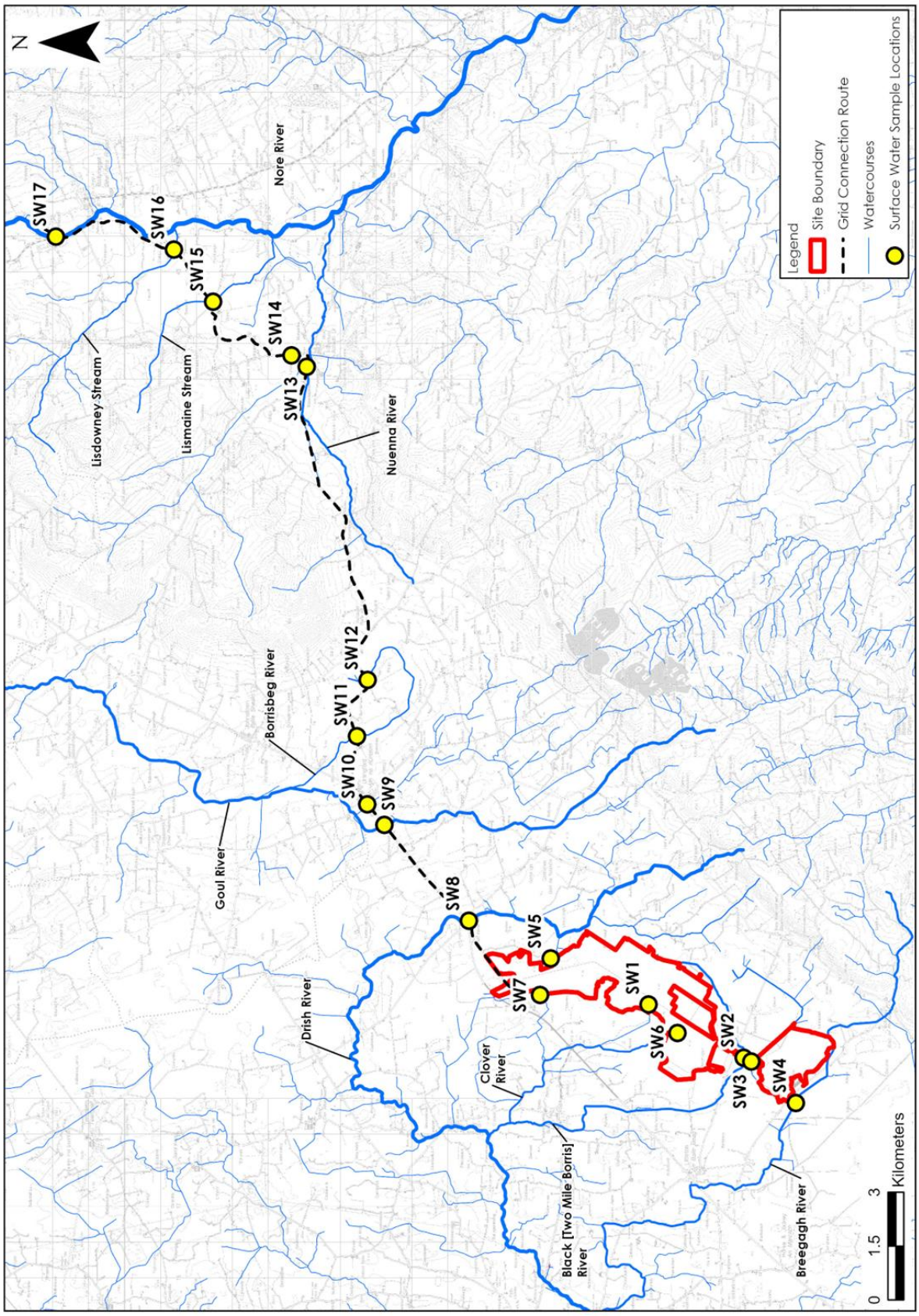


**Figure C: Surface Water Monitoring Locations**

#### *5.2.2.2 Field Monitoring*

Field chemistry measurements of unstable parameters, (pH, conductivity, temperature) will be taken at the surface water monitoring locations, as per water monitoring programme for the overall wind farm development and each primary watercourse along the route. These analyses will be carried out by the ECoW. In-situ field monitoring will be completed on a weekly basis (SW1-SW7). In-situ field monitoring will also be completed after major rainfall events, i.e. after events of >25mm rainfall in any 24-hour period. The ECoW will monitor and advise on the readings collected by in-situ field monitoring.

#### *5.2.2.3 Laboratory Analysis*

Grab sampling for laboratory analysis will also be undertaken as part of the monitoring programme by an independent and appropriately certified laboratory.

Coordination of the laboratory sampling and analytical programme will be undertaken by the Site Environmental Officer. Samples will be dispatched for analysis under chain of custody procedures. Laboratory analytical results will be sent to the Site Environmental Officer who will relay data onto the ECoW for their independent review.

Interpretation and reporting of both the field and laboratory data will be the responsibility of the Site Environmental Officer.

Proposed parameter suite for hydrochemistry analysis is as follows:

- pH (field measured)
- Electrical Conductivity (field measured)
- Temperature (field measured)
- Dissolved Oxygen (field measured)
- Total Phosphorus
- Chloride
- Nitrate
- Nitrite
- Ammonia N
- Total Nitrogen
- Ortho-Phosphate
- Total Phosphorus
- Biochemical Oxygen Demand
- Total Suspended Solids

#### *5.2.2.4 Monitoring Frequency*

Monitoring frequency will be specified and agreed with Inland Fisheries Ireland and Tipperary County Council prior to commencement of construction.

As a minimum, the monitoring programme will include:

- Daily visual checks across the Site, and along the proposed GC route when works are ongoing;

- Weekly sampling for suspended solids and turbidity in catchments where construction is on-going and monthly monitoring for all other parameters;
- Weekly sampling of monitoring points during the proposed GC construction works (SW8-SW17);
- Event based sampling, e.g. after heavy rainfall (at least 4 no. event-based monitoring rounds per year);
- Additional sampling in the event of trigger level exceedance, e.g. after heavy rainfall; and,
- Post construction sampling programme (monthly sampling for 3 months).

## 5.3 SURFACE WATER MONITORING REPORTING

Results of water quality monitoring shall assist in determining requirements for improvements in drainage and pollution prevention measures implemented at the wind farm site and during the works along the grid route.

It will be the responsibility of the Site Environmental Officer to present the ongoing results of water quality and weather monitoring at regular site meetings. There will also be regular meetings between the Environmental Officer and construction staff which will include a look ahead for upcoming works and any required environmental management required to facilitate ongoing construction works.

Reports on water quality will consider all field monitoring and results of laboratory analysis completed that period. Reports will describe how the results compare with baseline data as well as previous reports on water quality. The reports will also describe whether any deterioration or improvement in water quality has been observed, whether any effects are attributable to construction activities and what remedial measures or corrective actions have been implemented. The reports will be made available to Tipperary County Council on request.

## 5.4 POST CONSTRUCTION MONITORING

Monthly sampling for laboratory analysis for the range of parameters adopted during pre-commencement and construction phases will continue after construction is complete. The ECoW will monitor and advise on the readings received from the testing laboratory and monitoring will only cease once the hydrologist is satisfied that the monitoring results show that there is no adverse impact on the quality of surface water within the natural watercourses draining the Site.

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