APPENDIX 5

RELEVANT MITIGATION

Planning and Environmental Consultants

Appendix 5

Relevant Mitigation

DOCUMENT DETAILS

Client:	**Planree Ltd**
Project Title:	**Relevant Mitigation**
Project Number:	**240505**
Document Title:	**Appendix 5**
Document File Name:	**Appendix 5- Relevant Mitigation**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

Planning and Environmental Consultants

Rev	Status	Date	Author(s)	Approved By
01	Draft	30/06/2026	MK	PR
01	Final	01/07/2026	MK	PR

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1. INTRODUCTION

Below is a list of the relevant mitigation prescribed to protect water quality for the construction and operation of the Prospective Development of Meenbog Wind Farm. These mitigation measures are taken from the Hydrology chapter (Chapter 9) of the EIAR.

1.1 Construction Phase

1.1.1 Construction Mitigation

The drainage measures associated with the Prospective Development are proportionate to the works that are intended in each area. This is because much of the existing wind farm drainage network is sufficient to protect downstream water quality. More significant drainage infrastructure is proposed in areas where the main additional works are proposed (i.e. BP2, BP3, access track to T18, T18, access track to T2, T2 and T11). The Prospective Development drainage replicates what works well from the Existing Development drainage layout i.e. use of interceptor/collector drains, silt fencing, silt traps, settlement ponds and routing treated drainage downstream via the existing forestry drainage network.

- The Prospective Development drainage strategy replicates the proven approach which was successfully implemented for the Existing Development. Chapter 9 of the rEIAR for the Existing Development demonstrates that the construction activities did not result in any significant effects on surface water (quality and flows) and groundwater (quality and quantity), with the exception of the November 2020 Peat Slide which resulted in a, at worst, short-term significant effect. The drainage measures proposed for the Prospective Development are comparable to those successfully employed previously and are proportionate to the scale of the proposed works. Source controls:
  - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sandbags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.
  - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas.
- In-Line controls:
  - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sandbags, oyster bags, flow limiters, weirs, baffles, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.
- Treatment systems:
  - Temporary sumps and ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.

It should be noted that for the Prospective Development, an extensive network of forestry and agricultural drains already exist, and these will be integrated and enhanced as required and used within the Prospective Development drainage system. The integration of the existing forestry drainage network and the Prospective Development drainage network is relatively simple. The key elements being the upgrading and improvements to existing water treatment elements, such as in line controls and treatment systems, including silt traps, settlement ponds and buffered outfalls.

The main elements of interaction with existing drains will be as follows:

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the Wind Farm Site drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- Runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through settlement ponds and buffered outfalls onto vegetated surfaces; and,
- The treated runoff will be discharged into the existing downstream forestry drain network or re-distributed over natural ground

1.1.1.1 Pre-commencement Temporary Drainage Works

Prior to the commencement of construction works (new road/hardstand, turbine foundation installs or upgrade of existing roads) the following key temporary drainage measures will be installed:

- All existing land and forestry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using forestry check dams/silt traps;
- Clean water interceptor drains will be installed upgradient of the works areas;
- Check dams/silt fence arrangements (silt traps) will be placed in all existing drains that have surface water flows; and,
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the watercourse 50m buffer zone.

1.1.1.2 Silt Fences

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids such as those present in the subsoils/sandstone tills that overlie the site. This will act to prevent entry to water courses 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. Inspection and maintenance of these of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the hydrological buffer zones.

1.1.1.3 Silt Bags

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, the majority of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats Sediment entrapment mats, consisting of coir or jute matting, will be placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

1.1.1.4 Settlement Ponds:

The Prospective Development footprint has been divided into drainage catchments (based on topography, outfall locations, catchment size) and stormwater runoff rates based on the 10-year return period rainfall event were calculated for each catchment. These flows were then used to design settlement ponds for each drainage catchment. The settlement ponds are designed for 11hr or 24hr retention times used to settle out medium silt (0.006mm) and fine silt (0.004mm) respectively (EPA,

2006)[1]. Settlement ponds at the borrow pit are designed to allow 24hr retention and settlement ponds along access roads and at turbine hardstands will have 11hr retention as there is additional in-line drainage controls proposed along access tracks and at hardstands.

1.1.1.5 Pre-emptive Site Drainage Management

The works programme for the entire construction stage of the Prospective Development will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of soil/subsoil or vegetation 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.

The following forecasting systems are available to be used on a daily basis at the Site to direct proposed construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24-hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

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

Works will be suspended if forecasting suggests either 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 works being suspended the following control measures will be completed:

- All active excavations will be secured and sealed off;
- Temporary or emergency drainage will be installed to prevent back-up of surface runoff; and,
- No works will be completed during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

[1] *Environmental Protection Agency (2006): Environmental Management in the Extractive Industry (Non-Scheduled Minerals).*

1.1.1.6 Timing of Site Construction Works

Construction of the site drainage system will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and operational for all subsequent construction works.

1.1.1.7 Monitoring

An inspection and maintenance plan for the on-site construction drainage system will be prepared in advance of commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended. Inspections will also be undertaken after tree felling.

Any excess build-up of silt levels at dams, the settlement pond, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed. Checks will be carried out on a daily basis.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and Environmental Quality Standards (EQSs) will be undertaken for each primary watercourse and specifically following heavy rainfall events (as per the CEMP included in Appendix 4-3 of this EIAR).

1.1.1.8 Allowance for Climate Change

Climate change rainfall projections are typically for a mid-century (2050) timeline. The projected effects of climate change on rainfall are therefore modelled towards the end of the life cycle of the Prospective Development, as the turbines have a life span of 35 years. It is likely that the long-term effects of climate change on rainfall patterns will not be observed during the lifetime of the Meenbog Wind Farm. As outlined in the above sections we have designed settlement ponds for a 1 in 10-year return flow. This approach is conservative given that the Prospective Development will likely be built over a much shorter period (12-18 months), and therefore this in-built redundancy in the drainage design more than accounts for any potential short term climate change rainfall effects.

However, the settlement ponds are designed for 1 in 10 years flows with built in redundancy (+20%) to account for climate change effects on rainfall.

1.1.1.9 Mitigation during Tree Felling

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

- Forestry Standards Manual (Forest Service, 2015)
- Forest Protection Guidelines (Forest Service, 2002)
- Forest Operations and Water Protection Guidelines (Coillte, 2013)
- Forestry and Water Quality Guidelines (Forest Service, 2000b)
- Forestry and the Landscape Guidelines (Forest Service, 2000c)
- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (DAFM, 2018)
- Coillte Planting Guideline SOP
- Code of Best Forest Practice (Forest Service, 2000)

1.1.2 Potential Effects on Surface Water Quality from Excavation Dewatering

Some groundwater/surface water seepages will likely occur in turbine foundation excavations, sections of the internal cabling trenches and the continued borrow pit excavations and lateral expansion of BP3, and this will create additional volumes of water to be treated by the runoff management system.

However, groundwater inflows will likely be small. Walkover surveys of the existing borrow pits have not revealed any significant groundwater inflows and the borrow pits are above the local groundwater levels. No deepening of any of the existing borrow pits is proposed.

All works at the BMEP Site are shallow and will not require any dewatering of excavations.

1.1.2.1 Proposed Mitigation Measures

Management of groundwater seepages 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 build-up of water in the excavation;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters;
- 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 surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of excavations by the Environmental Clerk of Works will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

1.1.3 Potential Effects on Groundwater Levels During Excavation Works

The Prospective Development includes the continued use of 3 no. onsite borrow pits. No expansion is proposed at BP1 or BP2 with continued extraction proposed within the existing footprint of these borrow pits. Meanwhile, a lateral expansion of BP3 is proposed to the west and south (proposed extension area of 6,204m^3). However, no deepening of any existing borrow pit is proposed. The floor of the existing borrow pits are above the local groundwater table and surface water inflows are the main source of water requiring treatment. The continued use of the borrow pits, and the lateral expansion of BP3, has no potential to result in significant effects on local groundwater levels.

Furthermore, small-scale temporary dewatering may occur at some excavations (i.e. cable trenches), and these also have the potential to affect local groundwater levels. However, temporary reductions in

groundwater levels by temporary dewatering will be very localised and of small magnitude due to the nature and permeability of the local peat and subsoil geology, which are of low permeability.

The construction of the foundations for 5 no. turbines (T2, T7, T16, T18 and T19) and met mast may also require temporary dewatering of excavations.

1.1.3.1 Potential Effects Associated with Leakages or Spillages of Hydrocarbons

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

The potential release of hydrocarbons can occur during the works within the Wind Farm Site.

Whilst no oils are around the cables, a lubricant will be used during cable pulling. The lubricant to be used is Techlube PHD which is a pourable, non-flammable, non-toxic and substantially biodegradable water-based product that does not pose a threat to the environment (Techlube PHD Technical Information Datasheet: https://www.socomore.com/en/waterbased-lubricant-techlube-phd-20l-p-bk1.html).

1.1.3.2 Proposed Mitigation Measures

Mitigation measures proposed to avoid release of hydrocarbons at the Site are as follows:

- All plant will be inspected and certified to ensure that they are leak free and in good working order prior to use at the Site.
- On-site refuelling of machinery will be carried out at designated refuelling areas at various locations throughout the Site.
- Heavy plant and machinery will be refuelled on-site by a fuel truck, with spill kits kept onboard, that will come to the Site as required on a scheduled and organised basis.
- Other refuelling will be carried out using mobile double skinned fuel bowser. The fuel bowser will be parked on a level area in the construction compound when not in use;
- Only designated trained operatives will be authorised to refuel plant on-site;
- Refuelling or maintenance of machinery will not occur within 50m of a watercourse;
- Fuels stored on Site will be minimised;
- Any diesel or fuel oils stored at the temporary construction compound will be bunded. The bund capacity will be sufficient to contain 110% of the storage tank's maximum capacity;
- The plant used will be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction and Environmental Management Plan (Appendix 4-3). Spill kits will be available to deal with accidental spillages.

1.1.4 Potential Effects Associated with the Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can

physically damage fish by burning their skin and blocking their gills. A pH range of ≥ 6 ≤ 9 is set in S.I. No. 293/1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. Entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment.

Batching of wet concrete at the Wind Farm Site and the washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution. Placed concrete in foundations (5 no. turbine foundations and the foundation for the met mast) and the use of leanmix concrete along the underground cabling route can also have minor local effects on groundwater quality over time. However, due to the contained shuttering that concrete pours are put in, and the limited surface area of exposed concrete, the anoxic conditions below ground, and the higher rate of wider groundwater recharge and flow relative to the small volumes of shallow groundwater that would come in contact with the cured concrete, the potential for impacts are low.

It is also worth noting that concrete pours have been completed at 14 of the 19 no. turbines. As part of the Prospective Development concrete pours will be completed at T2 (in the catchment to the Glendergan River), T7 (in the catchment to the Shruhangarve Stream), T16, T18 and T19 (in the catchment of the Bunadowen River).

1.1.4.1 Proposed Mitigation Measures

- No batching of wet-concrete products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;
- Where possible pre-cast elements for culverts and concrete works will be used;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. 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 undertaken at lined concrete washout ponds;
- Weather forecasting will be used to plan dry days for pouring concrete; and,
- The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event; and,
- At turbine foundations, sand blinding, DPM, and lean-mix blinding are used to vertically contain the concrete. While the concrete is contained laterally by temporary/permanent shuttering. The concrete cures within 72 hrs.

1.1.5 Potential Effects from Wastewater Disposal

Release of effluent from on-site temporary wastewater treatment systems has the potential to impact on groundwater and surface water quality if site conditions are not suitable for an on-site percolation unit. Welfare facilities will be located at the proposed temporary construction compounds at the Wind Farm Site. Wastewater during the construction phase will be stored at the temporary construction compound located along the access track to the south of T10. This compound is located in the catchment to the Bunadowen River. Impacts on surface water quality could affect fish stocks and aquatic habitats.

1.1.5.1 Proposed Mitigation Measures

- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site construction compounds, maintained by the providing contractor, and removed from site on completion of the construction works;
- Welfare facilities are also present at the existing onsite substation (constructed as part of the Existing Development). Wastewater is stored in an underground tank and is removed

by a licenced contractor. These facilities will also be used during the construction of the Prospective Development;
- Water supply for the site office and other sanitation will be brought to the Wind Farm Site and removed after use from the Wind Farm Site to be discharged at a suitable off-site treatment location; and,
- No water or wastewater will be sourced on the Wind Farm Site, nor discharged to the Site.

1.1.6 Potential Effects from Morphological Changes to Watercourses

There are a total of 18 no. crossings located over EPA mapped watercourses within the Wind Farm Site. 14 of these crossings were upgraded/constructed as part of the Existing Development and no works will be required at these locations other than the minor upgrades to the existing roads.

More significant works are required at the following watercourse crossings:

- More substantial road upgrades and works are located on the road towards T18 and this section of road is mapped to cross 3 no. EPA mapped watercourses (unnamed tributaries of the Bunadaowen River). Existing culverts already exist at these locations and the Prospective Development includes the upgrades of these culverts (these crossings are labelled as NR 102 (EC18), NR 14 (EC12) and NR15 (EC19) on the drainage drawings – Appendix 4-4)
- It is proposed to upgrade an existing culvert on the road to T14 with a new box culvert (labelled as NR. 48 (PC2) on the drainage drawings);
- The proposed amenity track is mapped to cross the Bunadaowen River in the north of the Wind Farm Site.
- A culvert extension may also be required on the EPA mapped watercourse located to the east of the temporary construction compound to the south of T10 where it is proposed to extend the hardstand. Note that the watercourse is already culverted beneath the existing hardstand (labelled as NR. 37 (EC8) on the drainage drawings).

Works at these locations would have the potential to impact downstream surface water quality.

In addition, there is a high density of manmade forestry drains at the Site. Culverts already exist at these locations and no works will be required at these locations.

1.1.6.1 Proposed Mitigation Measures

Mitigation measures for the new proposed steel and timber footbridge crossing associated with the amenity proposals are detailed below:

- The proposed crossing will comprise a clear-span steel and timber footbridge. No permanent structures will be located within the watercourse channel and the existing bed and banks will remain undisturbed;
- All drainage and sediment-control measures will be installed prior to commencement of works in the vicinity of the watercourse;
- Construction activities will be undertaken from the banks where practicable and no plant or machinery will enter the watercourse;
- Plant and equipment will not be permitted to track across the channel;
- Access to the opposite bank will be required that avoids disturbance of the bed and banks;
- Any excavated material will be stored outside the watercourse buffer and protected from erosion.

- Appropriate sediment-control measures, including silt fencing will be installed down-gradient of works areas.
- Refuelling, plant maintenance and material storage will be undertaken in designated areas away from the watercourse.
- Spill kits will be maintained on site and emergency response procedures implemented in the event of an accidental release.

The following mitigation measures will be implemented with respect to upgrade of the crossing at T14 and the new box culvert:

- In-stream works will be undertaken during low-flow conditions and during the time period as recommended by IFI;
- Where required, the works area will be isolated from the watercourse using over-pumping, fluming or other appropriate flow management measures;
- Temporary flow management measures will be monitored throughout the works to ensure uninterrupted downstream flow and to prevent scour, erosion or sediment mobilisation;
- Where the box culvert is installed in sections, the joint will be sealed to prevent granular material entering the watercourse;
- Sediment and erosion control measures will be installed prior to commencement of works and maintained throughout construction;
- Excavated material and stockpiles will be stored away from the watercourse and protected from runoff;
- Refuelling, plant maintenance, and chemical storage will be undertaken in designated areas away from the watercourse;
- Spill kits will be available on-site and all personnel will be trained in spill response procedures.
- Plant and machinery entering the site will be inspected to ensure they are free from leaks and in good working order;
- Concrete works will be managed to prevent cementitious material or wash water entering the watercourse;
- Disturbed channel banks and riparian areas will be reinstated and stabilised immediately following completion of works;
- Regular environmental inspections will be undertaken to ensure compliance with water quality protection measures; and,
- Any pollution incident will be reported and remedial action implemented immediately.

Meanwhile, all new proposed culverts and proposed culvert upgrades at field drain crossings required for the Prospective Development will be suitably sized for the expected peak flows in the relevant drain. Some culverts may be installed to manage drainage waters from works areas of the Prospective Development, particularly where the waters have to be taken from one side of an existing roadway to the other for discharge. The size of culverts will be influenced by the depth of the track or road sub-base. In all cases, culverts will be oversized to allow mammals to pass through the culvert. All culverts will be inspected regularly to ensure they are not blocked by debris, vegetation or any other material that may impede conveyance.

All culvert upgrades and new culverts will be designed and constructed in accordance with OPW Guidance.

1.1.7 Potential Effects from the Use of Siltbuster

Siltbusters are regularly used to remove suspended sediments on construction sites by means of chemical dosing and sedimentation (i.e. use of coagulants and flocculants to accelerate the settlement process). The benefits of using enhanced settlement systems on downstream surface water quality are

widely known and provide a positive effect. However, potential overdosing with chemical agents means there is a perceived risk of chemical carryover in post treatment water which could result in negative effects on downstream water quality.

Wind farm construction water (i.e. surface water runoff or pumped groundwater) has sometimes very fine particles, particularly clays and peat, with slow settling velocities which do not settle out efficiently, even in a lamella clarifier at normal flow rates. In these cases, chemical dosing can be used to aggregate the particles (i.e. force them to combine and become heavier), increasing the particle settling rate and cleaning the water via gravity separation techniques. Agents commonly used include poly aluminium chloride (PAC), aluminium sulphate, ferric iron and ferrous iron. These agents are commonly used in drinking water treatment plants. So, their use is widespread, and there is significant scientific knowledge around their use and control.

The benefits of using a Siltbuster system in emergency scenarios where all other water treatment systems have proven ineffective are considerable. This is a duration curve of downstream water quality data post siltbuster treatment. The system was set up so that any water not meeting discharge criteria was recycled back to the settlement ponds. The graph shows all data, and only 24 data points out of 1194 records were above 20 mg/L (i.e. recycling, and repeat treatment occurred at these times to ensure compliance at the discharge location).

Note that the Siltbuster system will not be used under normal conditions during the construction phase. The mitigation proposed to protect water quality is already outlined above.

The use of Siltbuster is only proposed as an emergency back up in the event of failure of all other proposed water treatment mitigation measures, e.g. in the event of landslide failure. The Siltbuster system is a proven and effective method of water quality treatment during these events. It is extremely unlikely that the Siltbuster system will be utilised.

1.1.7.1 Mitigation Measures

Measures employed to prevent overdosing and potential chemical carryover:

- The siltbuster system comprises an electronic in-line dosing system which provides an accurate means of adding reagents, so overdosing cannot occur;
- Continued monitoring and water analysis of pre and post treated water by means of an in-house lab and dedicated staff, means the correct amount of chemical is added by the dosing system;
- Dosing rates of chemical to initiate settlement is small, being in the order of 2-10 mg/L and the vast majority of the chemical is removed in the deposited sediment;
- Final effluent not meeting the discharge criteria is recycled and retreated, which has a secondary positive effect of reducing carryover; and,
- Use of biodegradable chemical agents can be used at very sensitive sites (i.e. adjacent to SACs).

1.1.8 Potential Effects on Hydrologically Connected Designated Sites

The majority of the Wind Farm Site drains to the Mourne Beg River and the Derg River (within Northern Ireland) which also forms part of the River Foyle and Tributaries ASSI and SAC designated site. Croagh Bog ASSI (ASSI378) is located downstream of the Wind Farm Site and along the lower reaches of the Shruhangarve Stream. A small area in the northwest of the Wind Farm Site is drained by the Lowerymore River which drains to Lough Eske which is a designated SAC (Lough Eske and Ardnamona Wood SAC/pNHA). Furthermore, an area in the northwest of the Wind Farm Site, and directly downstream of the Mary Breen's Burn, forms part of the Croaghonagh Bog SAC/pNHA.

Effects on water quality and the water-dependent aspects of these designated could have been significant in the absence of mitigation.

There is no potential for the Prospective Development to impact any other designated site.

1.1.8.1 Proposed Mitigation Measures

Mitigation measures in relation to the protection of downstream surface water quality detailed in the preceding sections

Implementation of these mitigation measures will ensure the protection of water quality in receiving waters.

Furthermore, groundwater from below the Wind Farm Site may also discharge as baseflow, via shallow groundwater flow paths, to the local rivers and tributaries of the Mourne Beg River, thus entering the downstream designated sites. Groundwater quality and quantity will not be affected by the Prospective Development. Mitigation measures with respect to groundwater quality are prescribed in the preceding sections as follows:

- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 1.1.3.1;
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 1.1.4; and,
- Mitigation measures in relation to wastewater are detailed in Section 1.1.5.

1.1.9 Potential Effects on Local Private Groundwater Abstractions

The biggest risk to groundwater wells is potential groundwater contamination associated with any accidental release of hydrocarbons and cement-based products as a result of construction activities within the Wind Farm Site.

No effects on groundwater levels / quantity will occur due to the elevated nature of the Wind Farm Site and the low permeability of the underlying bedrock aquifer. No significant dewatering works will be required.

There are no downgradient public or group scheme groundwater supplies which may have been impacted by the Prospective Development at the Wind Farm Site.

An assessment of private wells within 1km of the Wind Farm Site has been completed, following the assumption that all dwellings are likely to have a private groundwater well. There are 4 no. houses (three inhabited, one derelict) located within one kilometre of the proposed turbine locations. The closest occupiable dwelling is a holiday cottage located 750 metres northwest of the nearest proposed turbine location The potential for effects at this distance are negligible given the local hydrogeological regime which is characterized by low rates of groundwater recharge and high rates of runoff as a result of the low permeability subsoils and the Poor Bedrock Aquifer. Groundwater flow paths are short and will discharge locally into nearby surface water features.

1.1.9.1 Proposed Mitigation Measures

Mitigation measures for the protection of groundwater quality have been detailed above:

- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 1.1.3.1;

- Mitigation measures for the control of cement-based products during construction works are detailed in Section 1.1.4; and,
- Mitigation measures in relation to wastewater are detailed in Section 1.1.5.

1.1.10 Potential Effects from works at the BMEP Site

The works proposed at the BMEP Site includes the upgrade of existing access road and the permanent felling of ~108ha of coniferous forestry to create wet heath, scrub and bog habitats for Hen Harrier and for peatland habitat enhancement. The potential effects of suspended solids entrainment in surface waters and felling are the same as those described above and would have the potential to release nutrients and suspended solids into nearby watercourses which will have a potential negative short-term effect on surface water quality.

The works will also pose a risk of contamination from hydrocarbons and wastewater. Meanwhile, no cement-based products will be used at the BMEP Site and works will be shallow and there will be no requirement for excavation dewatering.

The works have no potential for significant effects on local groundwater quality/quantity due to the local hydrogeological regime which is characterised by high rates of surface water runoff and low rates of groundwater recharge, and the shallow nature of the proposed enhancement works.

1.1.10.1 Proposed Mitigation Measures/Impact Assessment

The proposed mitigation measures in relation to suspended solids and felling will be the same as those prescribed above. These best practice measures will help protect surface water quality however nutrient release is an unavoidable consequence of deforestation. The mitigation measures with respect to hydrocarbons (Section 1.1.3.1) and wastewater (Section 1.1.5) will also be implemented at the BMEP Site.

The mitigation measures set out above will not completely prevent the release of nutrients to downstream watercourses. The release of phosphate into the environment is an unavoidable consequence of deforestation. However, the proposed BMEP Site, will remove a significant source of nutrients (i.e. the existing commercial forestry). The proposed BMEP works only includes 1 no. round of deforestation in comparison to the Do-Nothing Scenario in which the BMEP Site would be felled and replanted several times. This will have a positive long-term effect with regards to nutrient concentrations in local and adjacent watercourses.

1.1.10.2 Potential Effects on Groundwater Quality due to Blasting

Baseline nitrate recorded in groundwater is low. Nitrate can occur in groundwater from various sources including land spreading (organic N) and use of fertilizers (inorganic N).

The extraction of bedrock from the borrow pits may be achieved through blasting in order to break the rock into pieces suitable for crushing. Blasting activities typically involve the drilling of holes behind the existing rock face and the placement of explosives within these holes. The explosives are then detonated to dislodge the bedrock. The use of explosives has the potential to effect local groundwater quality at the Wind Farm Site.

Common explosives used at borrow pits, such as Ammonium Nitrate, often contain large percentages of nitrogen compounds. It has been found that small percentages of nitrogen compounds remain as residual coating on the rock following blasting. The ammonium nitrate has the potential to be dissolved when it comes into contact with water. The study that is most referenced was completed by Environment Canada in 1988 (Ferguson and Leak, 1988). This study outlines a procedure for determining the residual nitrogen compounds for various mine site types. The stepwise procedure in

the 1988 study for predicting aqueous concentrations of nitrogen, as outlined by Morin and Hutt (2009) is:

1. Calculate the annual leached nitrogen loading (kg/year) for the entire site based upon annual explosives mass usage and residual nitrogen fraction associated with the explosive type;
2. Separate the leached nitrogen loading among quarry components (e.g. entering water and remaining on the extracted rock);
3. Separate into loadings of nitrogen compounds (nitrate, nitrite and ammonia) and,
4. Calculate the flow concentration.

The concentration of nitrogen species in groundwater at the Wind Farm Site are calculated using this procedure. The highest residual is for nitrate (99%), and upper limit of the range is used in all cases to determine the concentration of nitrogen species in the water. The calculation also assumes that 100% of the residual nitrogen is dissolved in water and subsequently enters the underlying regional groundwater system.

1.1.10.3 Mitigation Measures

The extraction of bedrock at the proposed borrow pits will follow the current international best practice. This protocol will be employed to mitigate the potential effects of explosives on groundwater quality during blasting operations.

It is noted that no elevated concentrations of nitrate have been detected during the groundwater sampling completed at the Wind Farm Site.

1.2 Operational Phase

1.2.1 Potential Effects from the Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the Site and increase flood risk downstream of the Prospective Development. For the purposes of assessment, it is conservatively assumed that the Prospective Development footprint, including access roads and hardstands are impermeable. The assessed Prospective Development footprint (22.9ha). During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

1.2.1.1 Proposed Mitigation by Design

The operational phase drainage system of the Wind Farm Site will have been installed and constructed in conjunction with the road and hardstanding construction work as described below and as shown on the Drainage drawings submitted with this planning application (Appendix 4-4 of the EIAR):

- Interceptor drains will be installed 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 areas where it can outfall to the existing drainage network or be re-distributed over natural ground;

- Swales/road side drains will be used to collect runoff from access roads and turbine hardstanding areas of the Site, likely to have entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;
- Settlement ponds, emplaced downstream of road swale sections and at turbine locations, 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; and,
- Settlement ponds have been designed in consideration of the greenfield runoff rate.

As described above the proposed integration of the Prospective Development drainage with the Existing Development drainage is a key component of the proposed drainage management. By integration we mean maintaining surface water flowpaths where they already exist, avoid creation of new or altered surface water flowpaths, and maintaining the drainage regime (i.e. normal flow) within the agricultural lands and forested areas. Critically, there will be no alteration of the catchment size contributing to each of the main downstream watercourses. All wind farm drainage water captured within individual site sub-catchments will be attenuated and released within the same sub-catchments that it was captured.

1.2.2 Potential Effects from Suspended Solids Entrainment in Surface Waters

During the operational phase, the potential for silt-laden runoff is much reduced compared to the construction phase. In addition, all permanent drainage controls will be in place and the disturbance of ground and excavation works will be complete. Some minor maintenance works may be completed, such as maintenance of site entrances, internal roads, hardstand areas and amenity pathways. Maintenance works may also be required at the BMEP Site which could include tracking machinery over ground. These works would be of a very minor scale and would be very infrequent. Potential sources of sediment laden water would only arise from surface water runoff from small areas where new material is added during maintenance works

These minor activities could, however, result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects could be significant if not mitigated against.

During such maintenance works there is a small risk associated with release of hydrocarbons from site vehicles, although it is not envisaged that any significant refuelling works will be undertaken on site during the operational phase.

1.2.2.1 Proposed Mitigation Measures

Mitigation measures for sediment control are the same as those outlined above.

Mitigation measures for control of hydrocarbons during maintenance works are similar to those outlined above.

APPENDIX 1

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APPENDIX 2

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