# Appendix 9-1 – Surface Water Management Plan

Cloghercor Wind Farm Ltd.

# Cloghercor Wind Farm

# Surface Water Management Plan

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# 1.0 SURFACE WATER MANAGEMENT PLAN

## 1.1 INTRODUCTION

The objective of this Surface Water Management Plan (SWMP) is to ensure all site works are conducted in an environmentally responsible manner so as to minimise any adverse impacts on surface water quality that may occur as a result of works associated with the development of Cloghercor Wind Farm; incorporating the following specific objectives:

- Provide overall surface water management principles and guidelines for the construction phase of the Cloghercor Wind Farm project;
- Address erosion, sedimentation and water quality issues; and
- Present measures and management practices for the prevention and/or mitigation of potential downstream impacts.

The SWMP has been prepared taking into consideration the findings and conclusions within the Cloghercor Wind Farm Environmental Impact Assessment Report (EIAR) and supporting Appendix 2-8 - Flood Risk Assessment (FRA).

The protection of water quality and prevention of pollution events requires a sustained and concentrated input from the contractor with regard to the provision and maintenance of sediment control structures. The drainage system, as it is constructed, must not impact on the existing drainage regime on site.

## 1.2 GUIDANCE

The key legislation with respect to surface water management is as follows:

- Bathing Water Quality Regulations 2008 (S.I. 79 of 2008);
- EC Environmental Objectives (Surface Waters) Regulations (S.I. 272 of 2009 as amended);
- Groundwater Directive (2006/118/EC);
- EC Environmental Objectives (Groundwater) Regulations 2009 (S.I. 9 of 2010 as amended);
- European Communities (Quality of Shellfish Waters) Regulations 2009 (S.I. 272 of 2009);
- European Communities (Marine Strategy Framework) Regulations 2011 (S.I. 249 of 2011);
- European Communities (Quality of Salmonid Waters) Regulations 1998 (S.I. 293 of 1998);
- Local Government (Water Pollution) Acts 1977 – 1990;
- Urban Waste Water Treatment (UWWT) Regulations (S.I. 254 of 2001) as amended; and
- Water Framework Directive (WFD) 2000/60/EC.

The following guidelines were considered in the development of this management plan:

- COFORD (2004) Forest Road Manual, Guidelines for the design, construction and management of forest roads
- CIRIA Document C741 'Environmental Good Practice on Site'
- CIRIA document C532 – 'Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors'

- CIRIA document C648 and C649 – 'Control of Water Pollution from Linear Construction Projects'
- Department of Agriculture, Food and the Marine (2019) Standards for Felling & Reforestation
- The Irish Wind Energy Association (2012) Best Practice Guidelines
- 2006 Wind Energy Planning Guidelines, Department of Environment, Heritage and Local Government;
- Forest Service 2000a Forestry and Water Quality Guidelines;
- Forest Service 2008 Forestry and Fresh Water Pearl Mussel Requirements: Site Assessment and Mitigation Measures;
- Inland Fisheries Ireland, (2016) Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;
- Scottish Natural Heritage (2010) A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat with particular reference to Wind Farm Developments in Scotland;
- Consultation with Inland Fisheries Ireland; and
- Consultation with the Office of Public Works (OPW)

## 1.3 MATTERS FOR CONSIDERATION

### *1.3.1 Existing Site Hydrology and Water Quality*

On a regional scale the Cloghercor Wind Farm site and its environs are located in the Gweebarra-Sheephaven Water Framework Directive (WFD) catchments (hydrometric area) which covers an area of 1,451km$^2$ in west Donegal. These catchments are further subdivided into sub-catchments with the site located within the Gweebarra_SC_010 WFD sub-catchment and the Mulnamin_Beg_010 WFD river sub-basin which covers an area of 32.4km$^2$. All of these waters are of moderate to steep gradient and higher flow rate, representing natural streams typical eroding/upland rivers (FW1), that are actively eroding, unstable, where there is little or no deposition of fine sediment. Streams are remains largely unaltered and do not suffer from urban encroachment and associated point sources of pollution.

A catchment, also referred to as a drainage basin and watershed, is a topographic area that collects and discharges surface streamflow through one outlet or mouth. The catchment boundary is the dividing land where surface drainage flows toward a given stream from land where it drains into a separate stream. The regional natural surface water drainage pattern, in the environs of the proposed project is shown on Figure 1-1 'Regional Catchment Delineation Overview'.

![TOBIN Consulting Engineers]

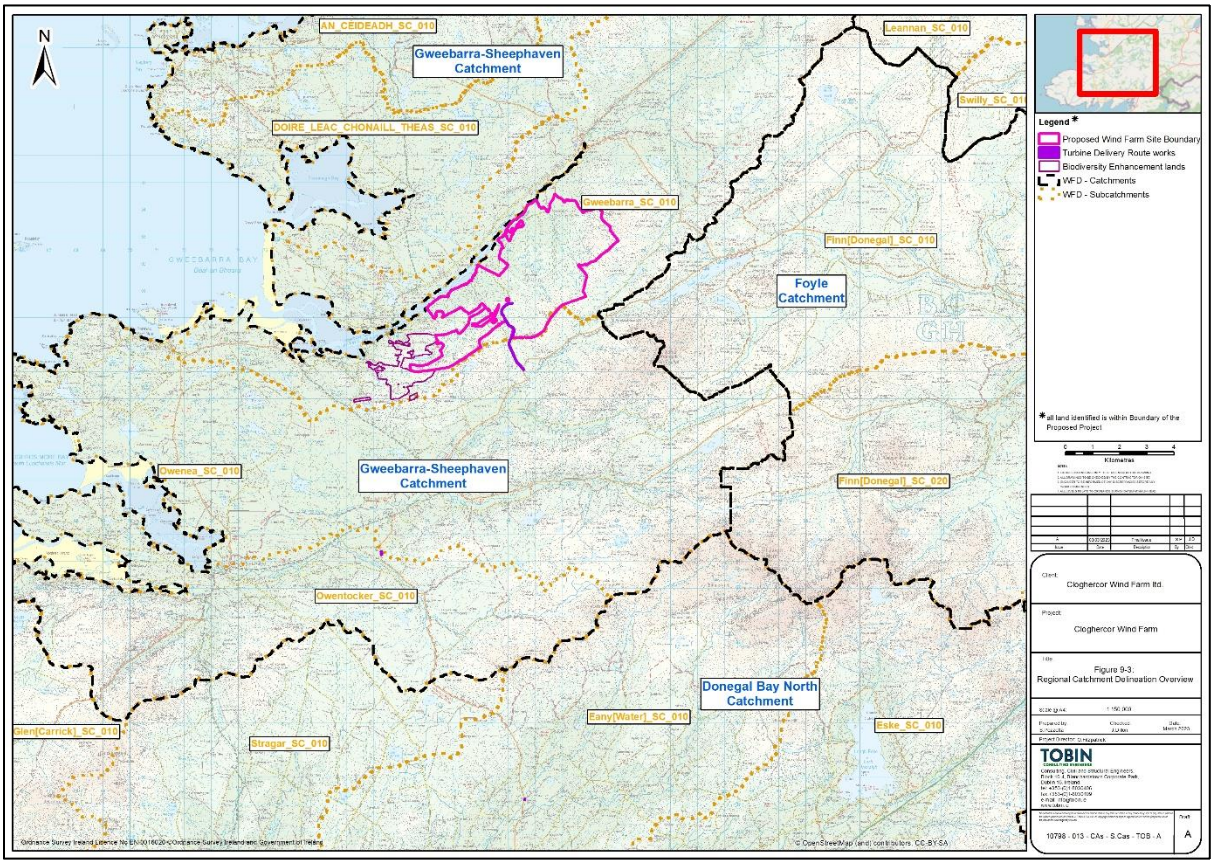


*Figure 1-1 Regional Catchment Delineation Overview*

The site itself stretches from the Gweebarra River which runs along the northwestern boundary toward the mountainous area in the east and south of the site. The area is moderately steep with areas of increase slope associated with frequent granitic rock outcrops.

Cloghercor is located 3.5km north-northeast of Glenties and the landscape is dominated by Croghleheen Mountain along the northwestern of the proposed wind farm; Garfarretmoyle (also known as Cloghercor South) and Gaffaretcor Mountains and Derkbeg Hill along the south-east; Cleengort Hill along the southwest of the proposed wind farm.

At a local scale, surface water flows in a general southeast to northwest direction into the Gweebarra Estuary. An unnamed stream and it's tributary in the north-eastern corner of the site flows in a northwest to south east direction into the Glenleheen (Stream), which flows northwards and meets the Gweebarra river and eventually flows into the Gweebarra Estuary approximately 1km north of the site. It is noted that all the streams within the site are collectively identified as the Mulnamin Beg 10 subcatchment and the two river waterbodies in the north are part of the site are part of the Glenleheen Stream 10 river system.

Derkmore Lough and a smaller unnamed lake are located to the west of the proposed wind farm site. No wind farm infrastructure is located in the Derkmore Catchment. Aneane More (Lough) and Aneane Beg (Lough) are located downgradient of T6 and T11 towards the centre of the site. A small lake, Lough Sallagh, is located to the south of T9.

There are several small stream crossings located within the proposed wind farm site. Surface water monitoring was conducted at the proposed wind farm site. Water samples were taken from onsite surface water channels within the proposed wind farm site. Further detailed results from this analysis can be found within Cloghercor Wind Farm EIAR – Chapter 9 (Hydrology, Hydrogeology and Water Quality). Results for the parameters tested were within the recommended surface water guideline thresholds for pH, Conductivity, phosphate and Suspended Solids. Colour is relatively high in the Cloghercor stream and Lough Aneane on site due to the presence of peat and forestry on site. These results provide a baseline set of results which can be used for comparative studies during the lifetime of the proposed project.

### 1.3.2 Forest Felling

A total of <90.9 hectares of felling is required to accommodate the installation of the proposed windfarm. Felling will be undertaken of a 20 m corridor along the access roads, and a 74-99 m buffer around the turbines based on ecological considerations. An additional 5 ha of felling is proposed around Aneane lakes as part of a biodiversity management plan. A 30 m wide buffer zone will be established around the lake. This buffer will be created by felling the existing areas of conifer plantation within the buffer zone, and by blocking drains to raise the water table.

The Felling and Reforestation Standards describe the universal standards that apply to all felling (thinning, clearfelling) and reforestation projects on all sites, undertaken under a felling licence issued by the Department of Agriculture, Food & the Marine.

Buffer zones will be identified and marked out on the ground. Correct buffer zone management will help reduce the risk of sedimentation from felling operations. Buffer zone guidelines for planting and felling activities are provided by the *Forestry Service in the Forestry and Water Quality Guidelines (2000). It is proposed to apply these buffer zone guidelines to construction activities also. Construction* activities will be curtailed within buffer zones in order to reduce erosion and sedimentation and, therefore, to protect water quality. Buffer zone widths vary from 10 m to 25 m, depending on slope and soil erosion classification.

The slopes across the proposed wind farm site are moderate with some steep slopes. As an additional measure, large infrastructure infrastructural elements (i.e. turbines, borrow pits, substation) on the proposed wind farm site will maintain a 50 m set back from streams and lakes.

All associated tree felling will be undertaken using good working practices as outlined in the Forest Service in their *Forestry Harvesting and Environment Guidelines* (2000) and the *Forestry and Water Quality Guidelines* (2000). The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils. Brash mats will also be used to support harvesting and forwarding machinery. The brash mats reduce erosion of the surface and will be renewed as they become used and worn over time.

As part of felling works, temporary water crossings include forest drains, roadside drains, relevant streams and aquatic watercourses.

Sediment traps will require monitoring and maintenance throughout the felling operations. Sediment traps are to be constructed and maintained in line with the requirements of the Forestry Schemes Manual (2011), the Forest Road Manual and Forest Drainage Engineering – A Design Manual.

**Forest Drains:**

- Minimise the crossing of drains during felling and extraction and restrict machine activity to brashed extraction racks and forwarding routes.

- Where a drain crossing is needed, based on the size of the forest drain one of the following methods will be selected that prevents the breakdown and erosion of drain sides, namely:
    - For larger drains , deploy a heavy-duty plastic culvert lengthways into the channel and cover with brash material. The culvert must be of a diameter approximating the depth of the drain, to avoid any unnecessary undulation along the extraction route;
    - Where required, a solution for smaller drains is to temporarily lay log sections lengthways into the channel and overlay with brash. Again, select logs that approximate the depth of the channel to be crossed.

**Aquatic Zones and Streams:**

- Minimise the crossing of aquatic zones and streams during felling and extraction by choosing alternative routes which avoid the streams/aquatic zones;
- Direct crossing over the stream bed is not permitted;
- If you must cross an aquatic zone install a temporary crossing point. When installing and removing the temporary crossing, ensure that no work is carried out within the aquatic zone, and that the stream bed and bankside remain undisturbed;
- Avoid crossing points in hollows where surface water gravitates towards, or in areas of the site more prone to sediment release, as indicated by terrain classification;
- Ensure the feature is crossed at a right angle to the flow of water;
- Where needed, any necessary crossing shall be via an appropriate structure that spans proud of the flow of water and prevents the breakdown and erosion of the banks;
- Typical solutions include the laying down of a bridge comprising logs overlaid with geotextile and brash to intercept soil falling off wheels;
- Alternatively, utilise prefabricated concrete drop-in bridging.

### *1.3.3 Drainage Design Overview*

Surface water design has been carried out in accordance with requirements of the Sustainable Urban Drainage Systems. The proposed wind farm site drainage system was designed as a measure to ensure that the proposal will not significantly alter the existing flow regime across the site, will maintain water quality and will safeguard existing water quality status of the catchment from wind farm related sediment runoff.

A fundamental principle of the drainage design is that clean water flowing in the upstream catchment, including overland flow and flow in existing drains, is allowed to bypass the works areas without being contaminated by silt from the works. This will be achieved by intercepting the clean water and conveying it to the downstream side of the works areas either by piping it or diverting it by means of new drains or earth mounds. This process will cause the normally dispersed flow to be concentrated at specific discharge points downstream of the works. Predominantly intercepted runoff will be diverted to the nearest existing drain or stream. Where existing drains are not available, dispersed outflow will be used. In order to disperse this flow, each such clean water drain will be terminated in a discharge channel running parallel to the ground contours that will function as a weir to disperse the flow over a wider area of vegetation. An alternative method is to allow the water to discharge through perforated pipes running parallel to the ground contours. Both of these methods will prevent erosion of the ground surface and will attenuate the flow rate to the downstream receiving waters. The specific drainage measures to be used at each location are shown on the drainage drawings included with the planning application. Separating the clean and dirty water will minimise the volume of water requiring treatment. The dirty water from the works areas will be collected in a separate drainage system and treated by removing the suspended solids before exiting the site.

The site drainage layout is presented in Planning Drawings 10798-2060 to 10798-2065. Settlement pond details and typical water crossing details are shown on Planning Drawings 05725-DR-134 and 10798-2029 respectively. The drainage layout is overlaid on background OSI mapping on the A1 drawings that accompany the planning application.

Sustainable Drainage Systems (SuDS) will be utilised as part of the water management and details of the proposed SuDS regime would be included in the CEMP (Appendix 2-2). SuDS are used to attenuate rates of runoff from development sites and can also have water quality benefits. The implementation of SuDS as opposed to conventional drainage systems provides several benefits by:

- Reducing peak flows to watercourses/lakes and potentially reducing risk of flooding downstream;
- Improving water quality by filtering and removing potential pollutants;
- Providing amenity and biodiversity benefits; and
- Replicating natural drainage patterns so that base flows are maintained.

The Contractor will employ the best practice measures outlined in CIRIA C532 publication *Control of Water Pollution from Construction Sites: Guidance for Consultants and Contractors*.

The surface water drainage design concept has been developed to capture surface water run-off from the roads and other hardstanding areas in swales and discharge into settlement ponds specifically constructed for managing surface water run-off generated from the wind farm infrastructure. After passing through the settlement pond, surface run-off will be permitted to spread across the adjacent lands. This treated water will percolate to ground or travel over ground and be assimilated into the existing drainage network within the boundary of the proposed project at appropriate greenfield run-off rates. There will be no direct discharges from the wind farm to any existing lakes or rivers.

The permanent surface water management infrastructure will be constructed early in the project along with the construction of impermeable surfaces so that surface water run-off during construction works will be controlled and managed to prevent discharge of sediment laden water to the existing surface water network and lakes. The internal access tracks will be constructed using unbound aggregate materials such that they will permit some degree of infiltration and reduce the volume of run-off generated. The permanent settlement ponds are shown on Drawing No. 10798-2029 at locations downstream of hardstand areas.

In addition, temporary settlement ponds will be established during construction works in areas of high construction activity and groundworks. The locations of temporary settlement ponds will be adjacent to significant earthworks, close to the source of sediment while maintaining a minimum 50m buffer distance from existing streams and lakes. These additional temporary ponds will be decommissioned and reinstated on completion of the construction works. The combination of temporary and permanent settlement ponds will provide the necessary attenuation to limit the rate of outflow from the new wind farm infrastructure areas at or below greenfield run-off rates and are classified as sustainable drainage system (SuDS) measures. The settlement ponds will also provide containment capacity in the event of a spill or leak on the installed infrastructure and the outflow can be closed off to contain any potential pollutants within the settlement ponds. In the event of contaminated run-off being contained in a settlement pond, the incident will be reported, samples taken of the contaminated liquid for classification, as required, and the liquid pumped out of the pond using a suitable vacuum truck and disposed of at a licensed waste facility off-site.

The surface water management system will be visually inspected on a daily basis during construction works by the SHEQ Officer to ensure that it is working optimally. The frequency of inspection will be increased at settlement ponds adjacent to areas where earthworks are being carried out and during excavations at T10 to T12. Where issues arise, construction works will be stopped immediately, and the source of the issue will be investigated. Records of all maintenance and monitoring activities associated with the surface water network will be retained by the Contractor on-site, including results of any discharge testing requirements.

The Contractor will implement control measures such as temporary drains and drainage diversions, from commencement of construction to limit the volume of water that requires treatment. Temporary control measures implemented during construction works may include silt fences, silt bags, temporary settlement tanks and run-off attenuation, as required. Examples of silt fences and temporary settlement tanks are shown in Figures 1-2 and 1-3.

*Figure 1-2 Silt fencing measures (Source: SSI Environmental (left) and Thrace Group (right)*


*Figure 1-3 Temporary site settlement tanks (Source: Siltbuster)*

There is potential for earthworks to lead to release of suspended solids to surface water bodies. The main factors influencing the rate of soil erosion and subsequent sediment release includes:

- Climate;
- Length and steepness of slopes;
- Characteristics of the soil/soil erosion potential;
- Soil vegetation/cover;
- Duration and extent of works; and
- Erosion and sediment control measures.

Erosion and sediment control measures which will be implemented will include, but will not be limited to:

- Minimisation of soil exposure, by controlling, in so far as is practical, the locations where vegetation/soil is stripped and when vegetation/soil is stripped;
- During the excavation of peat/soils, silt fences, straw bales and/or biodegradable geogrids will be used to control surface water run-off from material storage areas; and
- All surface water run-off from the development (including during construction works) will pass through either temporary or permanent settlement ponds.

To maximise the erosion and sediment control benefits of natural vegetation soil cover, stripping of soil is to be kept to a minimum and confined to construction areas only. Where practical, construction works will be staged to minimise the extent and duration of disturbance, e.g., plan for progressive site clearance, only disturbing areas when they are scheduled for current construction work.

<u>Pre-Emptive Site Drainage Management</u>

The works programme for the initial construction stage of the proposed project will take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of 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 and will 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 two 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 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 works being suspended the following control measures will be completed:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff;
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded; and
- Provide cover to material storage areas i.e., adequate tarpaulin over stockpile areas if material cannot be reinstated prior to suspension.

Run-off will be maintained at greenfield (pre-development) run-off rates. The layout of the development has been designed to collect surface water run-off from hardstanding areas within the development and discharge to associated surface water attenuation ponds adjacent to the proposed infrastructure. It will then be managed by gravity flow at greenfield run-off rates.

During the ground clearance of the proposed project, the Contractor will implement water control measures to limit the impact on water quality using standard measures as set out in the Forestry Report in Appendix 2-5 of the EIAR. Brash will be used along harvesting and extraction routes for soil protection. The forwarder will be loaded to the manufacturer's maximum specification and no more to avoid overloading and unnecessary soil compaction.

All temporary and permanent drainage from the site shall be designed to have as a minimum three stages of treatment, as defined in the SuDS Manual. Management of run-off will include the following:

- Filtration of water through filter media (sand / stone check dam, silt fence);
- Detention / settlement in settlement ponds or behind check dam in swales;
- and Conveyance of shallow depths of water in vegetated swale.

## Interceptor Drains

Interceptor drains/diversion ditches will be installed ahead of the main earthworks activities to minimise the effects of collected water on the stripped/exposed soils once earthworks commence. This drainage will integrate into the existing forestry drainage. These drainage ditches will be installed on the upgradient boundary of the areas affected by the access track earthworks operations and installed ahead of the main track construction operations commencing. They will follow the natural flow of the ground. The interceptor drains will intercept any storm water surface run-off and collect it to the existing low points in the ground, allowing the clean water flows to be transferred independently through the works without mixing with the construction drainage. It will then be directed to areas where it can be redistributed over the ground.

## Swales

Swales along access tracks will be installed in advance of the main construction phase. On sections of track where there is significant longitudinal gradient, regular surface water interception channels will be employed – these will typically be at 10-20m intervals to collect any surface water that is discharging as sheet flow along the track and discharge the flow into the trackside swale. Swales will provide additional storage of storm water where located along gradient. Given the steep longitudinal gradients on some sections of access track, regular check dams will be employed within the trackside swale on these sections to reduce the flow velocity and provide settlement opportunity. Check dams will be constructed from course gravel/ crushed rock. Check dams will have a minimum 0.2m freeboard (from top of check dam) to top of swale level, to prevent overtopping of flows onto the access track. All check dams, etc will be checked at least once weekly via a walkover survey during the full period of construction. All excess silts will be removed and placed in borrow pit reinstatement or embankments. Where check dams have become fully blocked with silt, they will be replaced.

*Figure 1-4 Typical example of stones used in a check dam to slow down water flow (Source: SNH, 2015)*[1]

Swales will be re-vegetated by hydro-seeding with indigenous seed mix as soon as is practicable following excavation. This will reduce the flow velocity, treat potential pollutants, increase filtration and silt retention.

**Settlement Ponds**

Settlement ponds will be located downstream of road swale sections and at turbine/hardstand locations, to manage/buffer volumes of run-off discharging from the drainage system during periods of high rainfall, thereby reducing the hydraulic loading to watercourses. Settlement ponds are designed in consideration of the greenfield run-off rates.

The following shall apply to construction of settlement ponds at the site:

- Pond depths to be excavated to less than 2m;
- Side slopes to be shallow, nominally at a 1 in 3 side slope (maximum); and
- Material excavated from the settlement pond should be compacted around the edge of the pond.

The settlement pond design is based on primary settling out of suspended solids from aqueous suspension. The theory behind the design of the settlement lagoons is the application of Stoke's Law. The settlement lagoons will be designed to provide sufficient retention time and a low

[1] Scottish Natural Heritage (SNH), *Good Practice during Wind Farm Construction* (2015)

velocity environment to allow suspended solids of a very small particle size to fall out of suspension prior to allowing the water to outfall to the receiving environment. Flow rates for storm events will be maintained at or below greenfield run-off rates.

Settlement ponds will be installed concurrently with the formation of the road and will be fenced off for safety. They will be located as close to the source of sediment as possible and maintain a buffer of 50m from existing streams. Machine access will be required at settlement ponds to remove accumulated sediment.

Further sediment pond control measures include:

- Settlement pond maintenance and/or cleaning will not take place during periods of extended heavy rain;
- Settlement ponds will, where practicable, be constructed on even ground and not on sloping ground and where possible will discharge into vegetation areas to aid dispersion; and
- Settlement ponds will be monitored closely over the construction timeframe to ensure that they are operating effectively.

Drains carrying construction site runoff will be diverted into sediment ponds, which will promote sediment deposition and reduce hydraulic loading by slowing flow velocities encouraging silt to settle. Sediment ponds have been designed with a staged pond system. The first pond will remove approximately 90% of the sediment load, while the remaining ponds will move most of the remaining load. The system also facilitates effective cleaning with minimal contamination of water exiting the pond (it is unlikely that the third pond will ever have to be cleaned).

<u>Temporary Settlement Tanks</u>

Temporary settlement tanks can be utilised, in lieu of constructing temporary settlement ponds, to remove suspended particles from controlled water in small works areas such as localised excavations that require pumping out of water. The tanks, as per Figure 1-3 are proven to be very effective, have a small footprint and are very mobile with the potential to move around the wind farm site using a telehandler.

These types of units are recommended for use on construction sites for the treatment of sediment laden water. Sediment retained in settlement ponds or tanks will be removed on a regular basis and deposited at a suitable location, such as borrow pit reinstatement area.

Dewatering silt bags allow the flow of water through them while trapping any silt or sediment suspended in the water. The silt bags provide a passive non-mechanical method of removing silt from silt-laden water collected from works areas within a construction site. Check dams will also be used in the site drainage system during construction to minimise sediment transport (see Figure 1-4). These check dams will slow down the movement of water in site drains, and thereby reducing the amount of sediment transported by the water. Stones are typically used at each dam to reduce soil erosion, to stabilise the dam and aid in filtration.

Monitoring of surface water quality during the construction works will be carried out on a regular basis and primarily through daily visual inspections and field monitoring for pH, conductivity and temperature. Continuous monitoring for turbidity will also be carried out during works in proximity to the lakes and streams. Monitoring will be carried out upgradient (where possible) and downgradient of active construction works to identify any unstable quality trends. Monitoring will be the responsibility of the SHEQ Officer.

Daily field monitoring will be supplemented by taking monthly water quality samples from the monitoring point locations for off-site laboratory analysis. Analysis will include water quality parameters listed in the *European Communities Environmental Objectives (Surface Waters) Regulations* and additional parameters as required by the relevant stakeholders or local authority. Additional locations for on and off-site monitoring, as required, will be agreed with the local authority in advance of construction works commencement.

Inspections of silt traps are critical after prolonged or intense rainfall while maintenance will ensure maximum effectiveness of the proposed measures. Turbidity monitors/alarms will be strategically placed upgradient on the Lough Aneane More to assess on-going construction works. The alarms will be programmed to notify the SHEQ Officer of any irregularities. A checklist of the inspection and maintenance control measures will be developed, and records kept.

The quality of runoff from the proposed project is improved by the fact that the surface water attenuation/storage ponds will also act as settlement ponds and furthermore, the runoff will pass through an oil interceptor prior to discharge to the ponds. The oil interceptors, which all the collected surface water passes through, will retain any hydrocarbons in the runoff and thereby improve the quality of the runoff.

**Check dams**

Check dams will be placed at regular intervals based on slope gradient along all drains to slow down runoff to encourage settlement and to reduce scour and ditch erosion. Check dams are relatively small and composed of gravels or other suitable material. They will be placed at distances and heights to allow small pools to develop behind them. Examples of check dam swales are shown below in Figure 1-5.

Key factors taken from CIRIA (2004)1 unless otherwise stated:

Limit velocities to prevent erosion (depending on soil type)

- Maintain flow height below vegetation (typically 100mm)
- Minimum length of 30-60m, with a residence time greater than 10 minutes
- Minimum base width 0.6m, maximum 2.5-3m
- Maximum side slope 1:4, check dams recommended if slope greater than 3%
- Vegetation - mixture of plants including wet and dry area grasses, fine growing grasses maximize filtration.

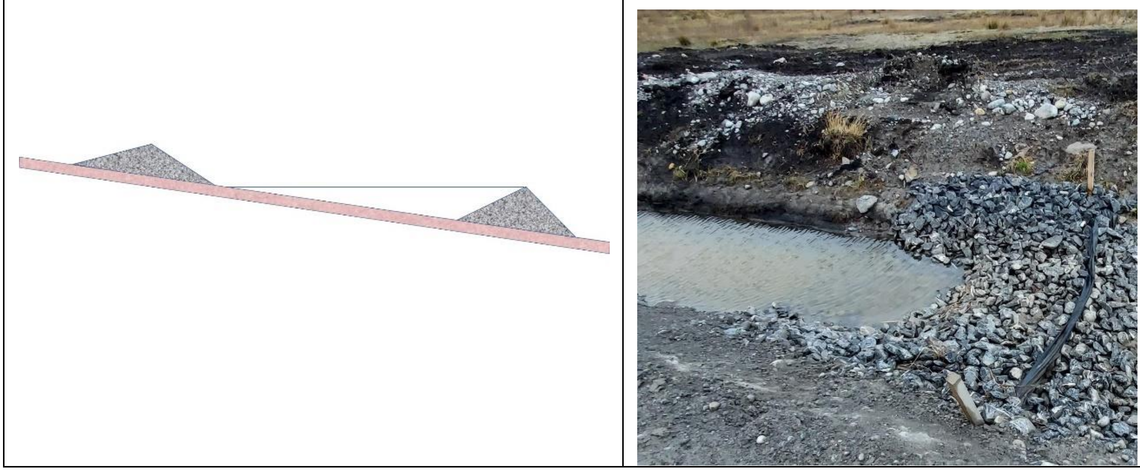

*Figure 1-5. Conceptual check dams along roadside drainage channels*

**Silt Fences**

Silt fences placed strategically along drains are an effective method of reducing the volume of suspended sediment. They can be placed at the end of any locally steep section of drain and have the double benefit of effectively producing a localised swale to reduce scour effect but then also to attenuate and filter the discharge.

**Silt traps**

Flow from the sediment ponds will enter the sediment traps where runoff will be cleaned further by a series of graded gravels. Silt traps will require regular inspection and cleaning and removed material will be disposed of at an appropriate location.

**Level spreader**

Drainage ditch outfalls from silt traps will discharge at regular intervals to mimic the natural hydrology by encouraging percolation and by decreasing individual hydraulic loadings from discharge points. The drainage ditches will flow onto the forestry floor by fanning out onto the surrounding vegetation via tapering drains. Forest drains will be blocked to ensure flow will disperse over floor. he level spreader changes concentrated flow into sheet flow and then outlets it onto stable areas without causing erosion. It allows concentrated runoff to be discharged at non-erosive velocities onto natural or man-made areas that have existing vegetation capable of preventing erosion. A minimum buffer width of 20m is imposed between the end of the drain fan and water courses. Buffer widths are designed in line with Scottish Forestry Commission Guidelines (2004) on protection of water courses during forestry operations and management. This method buffers the larger volumes of run-off discharging from the drainage system during periods of high precipitation, reducing the hydraulic loading to water courses and reducing suspended sediment load to surface water courses.

### *1.3.4 Erosion and Sediment Control Measures*

If not correctly managed earthworks and forestry clearfelling can lead to the loss of suspended solids to surface waters. The following mitigation measures and best management practices will be adopted for the construction phase of the proposed project to reduce the impacts associated with erosion and sediment laden surface water runoff. A range of techniques will be used to minimize impacts including:

- Ensuring works near streams (including crossings) are designed and constructed to minimise impacts and methodologies are pre-approved by Inland Fisheries Ireland (IFI);
- Monitor weather forecasts and plan work accordingly. Reduce or stop earthworks during periods of heavy or prolonged rainfall; Prior to works being suspended the following control measures will be implemented:
    - Secure all open 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; and
    - Provide cover to material storage areas i.e., adequate tarpaulin over stockpile areas if material cannot be reinstated prior to suspension.

- To maximise the erosion and sediment control benefits of natural vegetation soil cover, stripping of soil is to be kept to a minimum and confined to construction areas only. Where practical, construction works will be staged to minimise the extent and duration of disturbance, e.g., plan for progressive site clearance, only disturbing areas when they are scheduled for current construction work.
- As a natural means of erosion and sediment control, 15m vegetative buffer zones will be maintained around each on-site aquatic zone.
- All temporary and permanent drainage from the site shall be designed to have as a minimum three stages of treatment, as defined in the SuDS Manual. Management of runoff will include the following:
    - Filtration of water through filter media (sand/stone check dam, silt fence);
    - Detention/settlement in settlement ponds or behind check dam in swales; and
    - Conveyance of shallow depths of water in vegetated swale
- 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. These flows will discharge diffusely overland, creating a buffer before entering any stream. They will be provided to divert overland flows and prevent these flows from entering the borrow pits.
- As illustrated in Drawings 10798-2060 to 10798-2065, copies of which are included within Appendix A of the CEMP, all surface water run-off from the site will pass through settlement ponds. It is proposed to locate settlement ponds downstream of borrow pits and associated stockpile areas, each hardstand and along all site access tracks.
- A longitudinal cross-section and plan of a typical settlement pond is presented in Drawing 10798-2029. As shown, the proposed settlement pond design consists of a sediment forebay, which removes the majority of suspended solids from the inflow water. Inflow water enters the sediment forebay via an energy break, which removes energy from the incoming water resulting in a decrease in the incoming waters capacity to transport suspended solids and the deposition of material in the sediment forebay. The water then flows over a section of elevated channel bed into the flow control bay. Here the flow is controlled by a weir constructed of tightly fixed straw bales (or silt fence or equivalent). The straw acts as an effective silt trap for any remaining suspended solids while allowing the water to filter through its medium. Once the water has been filtered by the flow control device it then outfalls to an area of intact vegetation, which acts as a secondary filter. The outflow control from the settlement device is designed such that in an extreme event the device can overflow into adjacent vegetated areas.
- Settlement ponds will be located in line with Drawing 10798-2029, copies of which are included within Appendix A of the CEMP and will be installed concurrently with the formation of the road. Additional settlement ponds will be constructed as required on site. Settlement ponds are to be located as close to the source of sediment as possible, between the settlement pond outfall and any existing stream.
- Settlement ponds will be regularly cleaned/maintained to provide effective and successful operation throughout the works. Outfalls and ditches should be cleaned, when required, starting up stream with the outfalls blocked temporarily prior to cleaning. Settlement pond management will also include the following:
    - Sediment/silt removed via the contractor from ponds is to be disposed of at suitable locations on site, away from streams. Machine access is required to enable the accumulated sediment to be excavated.
    - Settlement pond maintenance and/or cleaning will not take place during periods of extended heavy rain.
    - Settlement ponds will be clearly marked for safety.

  - Settlement ponds will be constructed on even ground and not on sloping ground and discharge into vegetation areas to aid dispersion.
  - The settlement ponds will be monitored closely over the construction timeframe to ensure that they are operating effectively.
- Stone check dams or similar are to be installed at regular intervals along the road drainage channels. Check dams reduce erosion and gullying in the channel by slowing down the flow which allows sediments to settle.
- All stockpiled material will be battered back to reduce the rainfall erosion potential.
- Water will be limited by the contractor, from entering excavations.
- Silt fencing is to be installed in the path of sheet flow runoff to filter our heavy sediments. Silt fences are to be located at the toe of stockpiled areas to reduce sediment transport. Additional silt fencing and emergency spill kits will be kept on site for use in emergencies. All silt fencing on site will also require regular cleaning and maintenance in accordance with manufactures guidelines.
- Silt build up, within settlement ponds, check dams, silt fences is to be removed as required to ensure no carryover/breakthrough of suspended matter downstream in the drainage system. Any sediment removed will be disposed of in an appropriate manner so as to prevent any reintroduction into the drainage system.
- Cable trenches will be excavated in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows.
- Trafficking on site will be kept to a minimum. No haul roads will be used other than the proposed site tracks. Where haul roads pass close to streams, silt fencing will be used to protect the streams.
- Runoff will be maintained at Greenfield (pre-development) runoff rates. The layout of the development has been designed to collect surface water runoff from hardstanding areas within the development and discharge to associated surface water attenuation lagoons adjacent to the proposed infrastructure. It will then be managed by gravity flow at Greenfield runoff rates.
- It is proposed, that during the ground clearance of the development, the contractor will implement water control measures to limit the impact on water quality using standards measures. Suspended solid (silt) removal features will be implemented in accordance with CIRIA C697 SuDS Manual, and CIRIA C648 Control of water pollution from linear construction projects.
- Track edge drainage/swales are required to control run-off from the running surface to lower water levels in the subgrade, to control surface water and to carry this flow to outlet points. Swales will be re-vegetated by hydro-seeding with indigenous seed mix as soon as is practicable following excavation. This will reduce the flow velocity, treat potential pollutants, increase filtration and silt retention.
- Settlement ponds will be located downstream of road swale sections and at turbine/hardstand locations, to manage/buffer volumes of runoff discharging from the drainage system during periods of high rainfall, thereby reducing the hydraulic loading to watercourses. Settlement ponds are designed in consideration of the greenfield runoff rates.
- Where main drain crossings and stream crossings occur (i.e., access tracks), it is proposed to use a clear-span design bridges. Installation of such features will take place during dry periods to reduce the risk of sediment entering the watercourse. Smaller peatland/forest drains with be crossed using normal culverts.
- Crossing construction will be carried out, in so far as is practical, with minimal disturbance to the drain bed and banks. If they have to be disturbed, all practicable measures including location of stockpiles away from drainage ditches will be taken to prevent soils from entering any water. Any culverting works at drains will take place only

during dry periods when the drains are dry/stagnant. Silt traps will be placed on the downgradient side of the crossing.
- Cement and raw concrete will not be spilled into watercourses. No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and emplacement of pre-cast elements will take place. Pre-cast elements for bridge, culverts will be used.
- During the delivery of concrete on site, only the chute will be cleaned on-site, using the smallest volume of water practicable. Chute cleaning will be undertaken at lined cement washout lagoons. These lagoons will be cleaned out by a licensed waste contractor. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or stream will be allowed.
- Weather forecasting will be used to plan dry days for pouring concrete. The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event. Earth embankments constructed for bridge approaches will be protected against erosion e.g., by re-vegetation or rock surfacing etc.

#### 1.3.4.1 Borrow Pits

Prior to commencement of construction works a drainage system incorporating adequate mitigation measures would be installed to prevent silt pollution.

Temporary drainage ditches shall be constructed upslope of the borrow pit to prevent surface run-off into the excavation. These cut off ditches shall be of minimal length, depth and gradient, and silt traps and buffer strips shall be utilised to minimise erosion, sedimentation and peak flows.

Rainfall, surface and groundwater ingress shall be contained in a temporary sump situated in the lowest floor level of the excavation. A pit floor gradient not exceeding 1:10 shall be used to direct accumulated water to this point. At the sump, an oil interceptor shall be installed at the overflow.

Excess water would be pumped or drained into a settlement lagoon with a suitable sediment trap (silt trap/silt fences and/or straw bales) to capture suspended solids, prior to discharging to an agreed location. All on-site surface water discharges from excavations should be undertaken in an environmentally compliant manner.

### 1.3.5 Flood Risk Attenuation

Based on the results of the Flood Risk Assessment – Appendix 2-8 of the EIAR, the risk of flooding associated with the development site is minimal. It is predicted that the substation is located outside of the predicted fluvial flood extents and will not impede flow paths or floodplain storage during extreme flood events.

Residual risks to the site and to the proposed project during an extreme flood event can be managed to an acceptable level through a dedicated stormwater drainage system and effective landscaping and topography. The layout of the development will minimise the flood risk to people, property, the economy, and the environment.

### *1.3.6 Temporary Site Facilities*

During the construction phase, two temporary site compounds will be required and will include a site office, canteen and portaloo/chemical toilets in temporary portacabin type buildings. Temporary on-site toilet facilities (chemical toilets) will be used. These will be sealed with no discharge to the surface water or groundwater environment adjacent to the site. All waste water will be removed from site via a licensed waste disposal contractor.

### *1.3.7 Concrete*

Concrete (specifically, the cement component) is highly alkaline and any spillage to a local watercourse would be detrimental to water quality as well as to flora and fauna. Concrete is required for the construction of the turbine bases and foundations. After concrete is poured at a construction site, the chutes of ready mixed concrete trucks must be washed out to remove the remaining concrete before it hardens. Wash out of the main concrete bottle will not be permitted on site; wash out is restricted only to chute wash out. Wash down and wash out of the concrete transporting vehicles will take place at an appropriate facility off site i.e., at the premises of the concrete supplier.

The best management practice objectives for concrete chute washout are to collect and retain all the concrete washout water and solids in leak proof containers or impermeable lined wash out pits, so that the wash material does not reach the soil surface and then migrate to surface waters or into the ground water. The collected concrete washout water and solids will be emptied on a regular basis.

### *1.3.8 Fuels, Oils and Chemicals – Spill Control*

Poor storage, lack of care during refuelling, vandalism and poorly maintained plant can all result in a spillage of fuel, oil or chemicals potentially leading to environmental harm. The following mitigation measures will be employed on site:

- Fuels and chemicals will be stored within bunded areas as appropriate to guard against potential accidental spills or leakages. The bund area will have a volume of at least 110% of the volume of such materials stored;
- Store all containers of oil and fuel in a secure, bunded area.
- Regularly check tanks, containers and bunds for damage and leaks.
- Supervise all fuel and oil deliveries.
- Lock containers and tanks when not in use.
- Seek advice from a line manager before disposing of waste fuel or oil, or contaminated spill granules or absorbent mats – all contaminated materials to be disposed of in the appropriate manner.
- Liaise with a line manager to organise removal of contaminated water from bunds and trays by an appropriate contractor.
- Do not store fuel and oil, or carry out refuelling, within 50 m of a stream.
- All on-site refuelling will be carried out by a trained competent operative. Use a funnel when refuelling small plant. Use an automatic shut off or pistol grip delivery system when refuelling plant.
- Clear up and report all spillages immediately.
- Place a drip tray or absorbent mat under all static plant and mobile plant during fuelling.
- Mobile measures such as drip trays and fuel absorbent mats kept with all plant and bowsers and will be used as required during all refuelling operations;
- A spill kit will be stored with the bowser and the person operating the bowser will be trained in their use;

- All equipment and machinery will have regular checking for leakages and quality of performance and will carry spill kits;
- Any servicing of vehicles will be confined to designated and suitably protected areas such as construction compounds; and
- Additional drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.

### *1.3.9 Works near Streams*

Should construction work on site take place in the vicinity of streams; a buffer zone will be established to protect the surface water channels from disturbance from construction work. The width of a buffer zone will be determined by the risk of sediment movement. This depends on land use and soil type gradient in the surrounding area, in addition to the characteristics of the catchment area. As the slope across the site is moderate and the soil is considered highly erodible, the buffer zone required will be 25 m from the nearest surface water feature. Settlement lagoons will be installed concurrently with the formation of the road and will be fenced off for safety. They will be located as close to the source of sediment as possible and as far as possible from the buffer zones of existing streams.

Potential impacts on surface water flow during the construction phase of the wind farm are mitigated by the proposed drainage design which has been designed to minimise disturbance to the current hydrological regime by maintaining diffuse flows.

As mentioned above, where main drain crossings and stream crossings occur (i.e., access tracks), it is proposed to use a clear-span design bridge. Installation of such features will take place during dry periods to reduce the risk of sediment entering the watercourse. Smaller peatland drains with be crossed using normal culverts.

As a further precaution, near-stream construction work will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works guidance document *"Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites"*, that is, May to September inclusive. This time period coincides with the period of lowest expected rainfall and, therefore, minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. All stream works will be carried out in accordance with the advice of and in consultation with Inland Fisheries Ireland (IFI). Method statements for works near to watercourses will be in place prior to construction.

Culverts will be designed to be of a size adequate to carry expected peak flows. Culverts will be installed to conform, to the natural slope and alignment of the drainage line. Culverts will be buried at an appropriate depth below the channel bed and the original bed material placed at the bottom of the culvert. The sizing of any new internal drainage crossings will maintain existing depth of flow and channel characteristics.

As mentioned in section 1.3.3, cement and raw concrete will not be spilled into watercourses. No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and emplacement of pre-cast elements will take place. Pre-cast elements for bridge, culverts will be used. During the delivery of concrete on site, only the chute will be cleaned on-site, using the smallest volume of water practicable. Chute cleaning will be undertaken at lined cement washout lagoons.

No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Weather forecasting will be used to plan dry days for pouring concrete. The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

Earth embankments constructed for bridge approaches will be protected against erosion e.g., by re-vegetation or rock surfacing etc.

The implementation of the Surface Water Management Plan will be overseen by the appointed Site Ecologist and the Project Manager and will be regularly audited throughout the construction phase. The Project Manager will be required to stop works to undertake corrective action.

#### *1.3.9.1 Clear Span Bridges*

A total of 12 clear span bridges (10 access tracks and 2 amenity tracks) will be required at crossings along the access roads, the locations of which are included in Appendix A and Chapter 9 Water. Stream catchments are small as detailed in EIAR Chapter 9 Water.

Clear span bridges are located on small tributaries to the Cloghercor and Clogherachullion streams and a bridge design has been developed taking into account consultation with the Office of Public Works (OPW) and Inland Fisheries Ireland (IFI). This design is presented in Drawing 10798-2029 within Appendix A of the CEMP. It is required that a Section 50 Consent application be prepared and submitted to the OPW prior to construction.

### *1.3.10 Floating Roads*

Good practice for the design and installation of cross carriageway culverts is set out in "Good practice during wind farm construction", (SNH/SEPA 2010). Culverts under floating roads can be installed in the same fashion as normal site access roads using a gravel bed down to a firm layer. An alternative practice to the standard excavation method is to install unsupported pipes under the floating road and design these to be oversized, allowing for settlement, so that the desired waterway area can be available after the settlement has taken place.

The preservation of the local hydrology should always be the key consideration in the drainage arrangements associated with floating roads. The local hydrology not only supports the local ecology and habitat, it has a bearing on the engineering design as well. The equilibrium between a floating road and the underlying peat will be heavily dependent on a stable local hydrology and the consequences of any drainage measure planned should be fully understood before it is implemented. Any new drainage has the potential to affect the existing water regime and the established equilibrium.

### *1.3.11 Groundwater Protection*

The most vulnerable period for the underlying groundwater aquifer will be during the construction phase when rock is exposed, and construction is in progress.

As impacts on the surface water at the site can potentially impact the underlying groundwater, it is important that that surface water mitigation measures detailed above are implemented and enforced.

It is expected that groundwater will be encountered in some excavations at the site. Groundwater arising from excavations may have high levels of suspended solids. The waters from excavations will be discharged through silt control device to the cutover peat land. The partial or complete removal of material covering the bedrock and the increased vulnerability of the bedrock and groundwater system will be most acute during the excavation of turbine locations for the purposes of pouring foundations and during the operations to remove materials from the proposed borrow pits. A clear environmental protection protocol will be required from the contractors before construction takes place. The potential impact can be only mitigated or minimised by induction training for all workers on the site and a strict and enforced protocol on the use of liquids, solvents, fuels and spillages on the site.

Dust suppression measures and the enforced use of a wheel wash during the construction phase will reduce the potential for fugitive emissions/suspended solids to enter the underlying aquifer.

The potential risk of groundwater contamination will be significantly reduced when the development is complete. The excavated soils and peat will be used to cover and landscape areas of exposed rock.

## 1.4 SURFACE WATER MONITORING

Details of the proposed surface water monitoring plan are given in this section of the SWMP and will be agreed with the local authority. Records of all maintenance activities will be retained by the contractor on site.

### *1.4.1 Details of Monitoring Locations On Site*

It is proposed to have six surface water monitoring locations (see Figure 1-6 below) to be used for monitoring surface water quality within the Cloghercor Wind Farm site. The proposed monitoring schedule is robust and sufficient for the scale of the proposed project and in line with the relevant guidance. It is discussed below in detail.

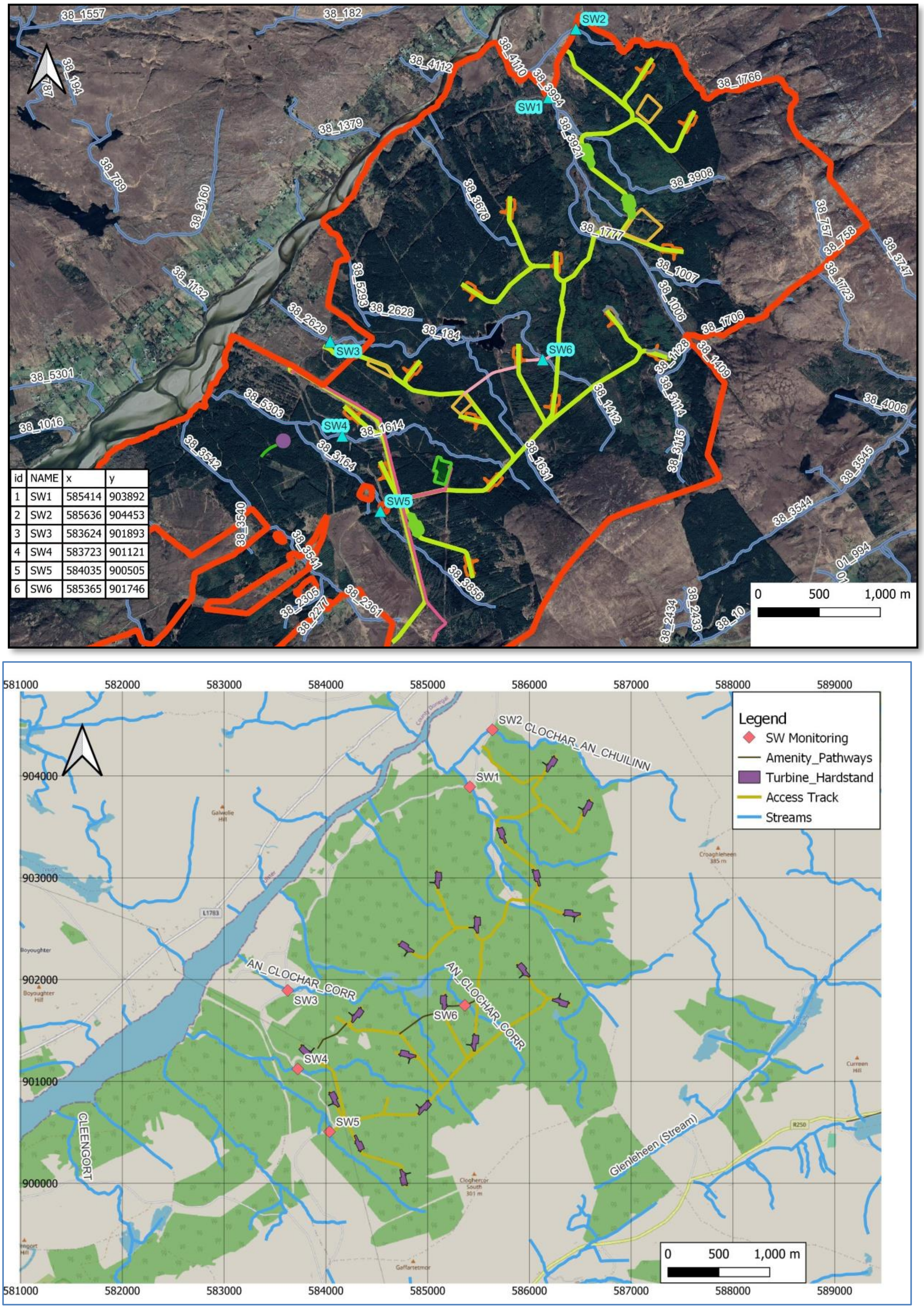


*Figure 1-6 Surface Water Monitoring Locations for the SWMP*

### 1.4.2 Surface Water Monitoring Schedule

All surface water control measures for the proposed Cloghercor Wind Farm will be adhered to in accordance with the mitigation measures detailed in Chapter 7 and Chapter 9 of the EIAR and CEMP (Appendix 2-2 of the EIAR). An outline surface water monitoring schedule for the construction stage of the proposed project has been developed (See Table 1-1 below) and outlines the selected parameters with their associated trigger limits (See Table 1-2 below), as well as the frequency of monitoring to be completed prior to, during, and at the post construction phase of the project.

### 1.4.3 Schedule of Monitoring

The critical water parameters in terms of their potential to cause damage to aquatic life, ecosystems, human health and water quality in the receiving waters are outlined in the surface water monitoring schedule (see Table 1-1 below).

*Table 1-1 Outline Surface Water Monitoring Schedule for Cloghercor Wind Farm*

| Phase | Preconstruction | Construction | Post construction |
|---|---|---|---|
| Monitoring Period | 3 Months | 2yr | 3 Months |
| Frequency | Weekly | Daily | weekly |
| Surface Water Parameters | N/A | Turbidity and visual checks (examination of surface drainage/sediment control measures/watercourses) | N/A |
| Frequency | Weekly | | |
| Surface Water Parameters | pH, Electrical Conductivity, Turbidity, Temperature (Handheld Meter) | pH, Electrical Conductivity, Turbidity, Temperature (Handheld Meter)<br><br>Monitoring during clearance phase and construction works at T10 | N/A |
| Frequency | Monthly | | |
| Surface Water Parameters | Conductivity, Chloride, Dissolved Oxygen, Molybdate Reactive Phosphorus, Mineral Oil, pH, Turbidity, Total Ammonia, Total Phosphorus, Total Suspended Solids (Grab Samples) | Conductivity, Chloride, Dissolved Oxygen, Molybdate Reactive Phosphorus, Mineral Oil, pH, Turbidity, Total Ammonia, Total Phosphorus, Total Suspended Solids (Grab Samples) | Conductivity, Chloride, Dissolved Oxygen, Molybdate Reactive Phosphorus, Mineral Oil, pH, Turbidity, Total Ammonia, Total Phosphorus, Total Suspended Solids (Grab Samples) |
| Frequency | Quarterly | | |
| Surface Water Parameters | N/A | Conductivity, Chloride, Dissolved Oxygen, | N/A |

| | | | |
|---|---|---|---|
| | | Molybdate Reactive Phosphorus, Mineral Oil, BTEX, pH, Turbidity, Nitrate, Total Ammonia, Total Phosphorus, Total Suspended Solids (Grab Samples) | |
| Frequency | Pre-Construction Report | Monthly and Quarterly Monitoring Report | Final Monitoring Report |
| Surface Water Parameters | Upgrade limits/trigger values for construction phase water monitoring | Results screened against construction phase surface water monitoring trigger levels | Results screened against construction phase surface water monitoring trigger levels |

### *1.4.4 Surface water Monitoring Trigger Values*

Surface Water Quality Monitoring (SWQM) will be conducted by the appointed contractor in accordance with the outline monitoring schedule proposed in Table 1-1 above. Prior to the commencement of construction, baseline pre construction monitoring will be carried out. The results of the monitoring suite will determine the baseline and trigger values for the construction monitoring phase of the development. This will be completed in order to establish if local trigger values are required due to existing water quality exceedances.

The final details of the monitoring schedule will be agreed with the relevant authorities, prior to the commencement of construction. Construction and post construction sampling results will be screened against the agreed trigger values as proposed in Table 1-2, except where local triggers are required.

*Table 1-2 Analysis and Proposed Trigger Values (Pre-Construction)*

| Parameter | Proposed Limits | Units |
|---|---|---|
| Conductivity | 1,000 µS/cm or within preconstruction values | µS/cm |
| Chloride | 200 mg/l or within preconstruction values | mg/l |
| Dissolved Oxygen | 80% to 120% | Average % Saturation |
| Molybdate Reactive Phosphorus | 0.035 mg/l or within preconstruction values | mg/l |
| BTEX | <0.005 mg/l | mg/l |
| Mineral Oil | 10 µg/l or within pre construction values | µg/l |
| pH | 4.5-9 | pH units |

| | | |
|---|---|---|
| Turbidity | 50 NTU or within preconstruction values | Nephelometric Turbidity Unit (NTU) |
| Nitrate | 50 mg/l or within preconstruction values | mg/l |
| Total Ammonia | 0.14 mg/l or within preconstruction values | mg/l |
| Total Phosphorus | 0.1 mg/l or within preconstruction values | mg/l |
| Total Suspended Solids | <0.25 mg/l or within preconstruction values | mg/l |

Field measurements will be taken by the contractor on a weekly basis during the main earthworks stage of the construction period. In addition, daily visual inspections of the surface drainage and sediment control measurements and the watercourses will be completed. Daily turbidity monitoring will also be undertaken on site. Indicators that show evidence of water quality issues include the following and will be noted.

- Changes in water quality; and
- Changes in water transparency.

In-situ field monitoring will also be conducted during major rainfall events i.e., 15 mm in a 6-hour period. The clerk of works will undertake monitoring during the rainfall events.

Laboratory samples will be taken on a monthly basis during construction as shown in Table 1-1. Thereafter, post construction monitoring will be undertaken for a three-month period as shown in Table 1-1.

### *1.4.5 Surface Water Quality Monitoring Locations*

Monitoring will be undertaken at six  locations around the site (see Figure 1-6). The proposed monitoring for the construction phase will be completed at the following locations along the following streams.

| NAME | | x | y |
|---|---|---|---|
| **SW1** | SW1 – Clogherachullion | 585414 | 903892 |
| **SW2** | SW2 – Clogherachullion | 585636 | 904453 |
| **SW3** | SW3 – Cloghercor | 583624 | 901893 |
| **SW4** | SW4 – Glenleheen | 583723 | 901121 |
| **SW5** | SW5 – Glenleheen | 584035 | 900505 |
| **SW6** | SW6 – Cloghercor | 585365 | 901746 |

Monitoring records should include the date and time of the monitoring period and relate to the relevant consent conditions, where applicable. A written log of the environmental performance of the works will be maintained. A monthly monitoring report on the findings of the monitoring exercises will be prepared within two weeks of receipt of analytical results. The monthly monitoring reports will cover the construction and post construction works.

### *1.4.6 Details of Monitoring Locations Off Site*

It is proposed that SW1 and SW4 will be used for surface water monitoring downstream of the Cloghercor Wind Farm site as shown in Figure 1-1 of this SWMP. SW1 is located at the site entrance and is relatively easy to access from the road. SW1 is located along the Cloghercor stream less than 1 km to the south west of the site. SW4 is located 300 m to the north west of the site. SW4 is located downstream of T6 along a tributary of the Clogherachullion stream. Any alterations to the proposed surface water monitoring will be agreed with the local authority in advance of commencement of monitoring at alternative and/or additional locations.

### *1.4.7 Proposed Monitoring Frequency and Parameters*

#### *1.4.7.1 Pre-Construction Monitoring*

Should planning approval be granted for the proposed project, three events of pre-construction stage surface water monitoring will be undertaken. Surface water monitoring parameters will be as per Table 1-3. It is proposed that the surface water monitoring will be scheduled in conjunction with the pre-construction stage forestry felling.

#### *1.4.7.2 Construction Stage Monitoring*

Surface water monitoring will be undertaken daily during the construction stage of the proposed project. The daily monitoring will include for a site walk around, visual inspection of the watercourses and field measurements for turbidity to be undertaken as required and, as a minimum, on a weekly basis. Weekly surface water monitoring will take place as per the daily surface water inspection and will include for a routine weekly measurement of turbidity at the surface water locations.

Monthly surface water samples will be collected during the construction stage of the proposed project and laboratory analysis will be undertaken for those monitoring parameters included in Table 1-3 of this SWMP.

#### *1.4.7.3 Operational Monitoring (Post-Construction)*

During the operational phase of the proposed wind farm, annual surface water samples will be collected, and laboratory analysis will be undertaken for those monitoring parameters included in Table 1-3 of this SWMP.

### *1.4.8 Trigger Values*

The trigger values for the surface water monitoring programme are those listed in Table 1-3 of this SWMP and where relevant Surface Water Quality standards given in the Surface Water (Environmental Objectives) Regulations S.I. 272 of 2009 (as amended), or as otherwise agreed with the Planning Authority in consultation with Inland Fisheries Ireland where required.

An Ecological Clerk of Work (ECoW) will be engaged for construction stage monitoring. Should the trigger values not be met, the ECoW will have ‘Stop Works Authority’ to direct the contractor’s construction manager to cease all works and activities on site pending further instruction.

*Table 1-3 Proposed Surface Water Parameters and Trigger Values*

| | | Proposed Trigger Values | SI No. 272 of 2009 EU Surface Water Environmental Objective Regulations | SI No. 293 of 1988 EC Regulations (Quality of Salmonid Waters) | SI No. 294 of 1989 EC Regulations (Quality of Surface Water Intended for Abstraction of Drinking Water) |
|---|---|---|---|---|---|
| Parameter | Units | Standard | Standard | Standard | Standard |
| Electrical Conductivity (EC) | µS/cm | 1,000 | | | 1,000 |
| pH (Soft Water) | pH units | >4.5 and <9 | >4.5 and <9 | >6 and <9 | >5.5 and <8.5 |
| Orthophosphate/MRP as P/l | mg/l | 0.035 (mean) | 0.035 (mean) | | 0.47 |
| Dissolved Inorganic Nitrogen as N | mg/l | 2.6 | 2.6 | | |
| Total Suspended Solids | mg/l | 25 | | 25 | 50 |
| BOD Unfiltered | mg/l | 2.6 | <1.5 (Mean) or <2.6 (95%ile) | <5 | 5 |
| COD Unfiltered | mg/l | 40 | | | 40 |
| Dissolved Iron | ug/l | 200 | | | 200 |
| Dissolved Manganese | ug/l | 50 | | | 50 |
| Sulphate | mg/l | 200 | | | 200 |
| Total Organic Carbon | mg/l | No abnormal change | | | |
| Carbonate Alkalinity as $CaCO_3$ | mg/l | No abnormal change | | No abnormal change | |
| Hydroxide Alkalinity as $CaCO_3$ | mg/l | No abnormal change | | No abnormal change | |

# 2.0 CONCLUSION

This Surface Water Management Plan as designed will ensure that all water within the construction works will be collected and treated before being dispersed overland to the downstream watercourses. The attenuation system will ensure that there will be no increase in flow rates downstream and consequently there will be no increase in flood risk downstream of the site as a result of the development.