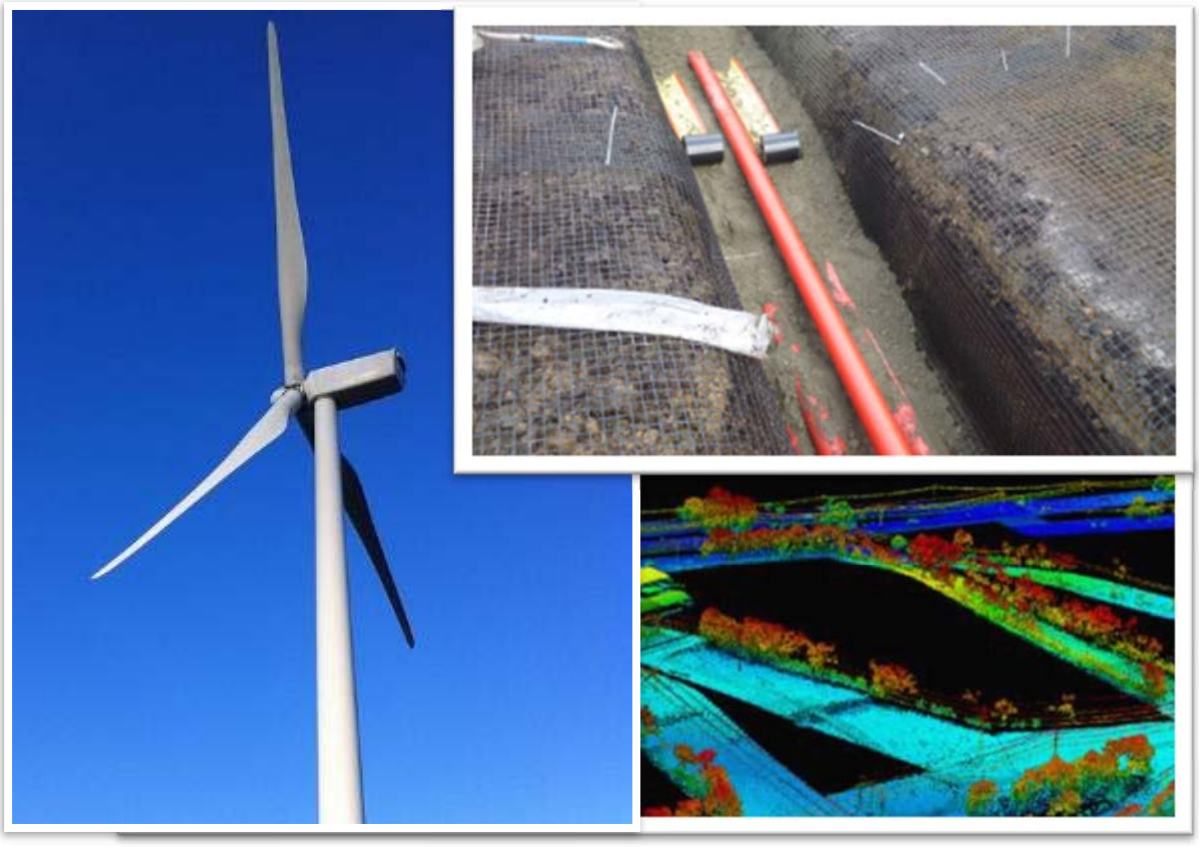
APPENDIX 4-5

GLENARD WIND FARMS 110KV GRID CONNECITON- CONSTRUCTION METHODOLOGY

Construction Methodology – 110kV Underground Cable Connection

Glenard Wind Farm
Grid Connection



Report Ref: 05701-R01-05

Client: FuturEnergy C/o McCarthy Kelville O'Sullivan

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04	DB	DT	04.01.22	*Issued for Client Comment*
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Table of Figures

1.0 Introduction

The purpose of this document is to outline and explain the construction techniques and methodologies which will be implemented during construction of the Glenard Wind Farm 110kV grid connection to the existing Trillick 110kV substation. The grid connection will consist entirely of underground cabling (UGC) with the majority of the UGC to be installed within the public road network.

The UGC works will consist of the installation of 6 No. ducts in an excavated trench to accommodate 3 No. power cables, 1 No. fibre communications cable to allow communications between the Glenard Wind Farm Substation and the existing Trillick 110kV substation, 1 No. spare communications duct and 1 No. earth continuity conductor duct.

This document outlines the methodologies to be employed during the construction of the grid connection and should be read in conjunction with the Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) which accompany the planning application.

The grid connection cabling trench is included in the planning application for the proposed Glenard Wind Farm. The methodologies and techniques to be implemented in the construction of the grid connection cabling trench are assessed in the Environmental Impact Assessment Report (EIAR).

2.0 Trillick Substation Upgrades & Building Extension

The upgrade works required within Trillick 110kV substation will involve a new 110kV Line Bay to connect Glenard Wind Farm. These works will consist of new structural steelwork and ancillary works to be carried out on a footprint area of 80m^2 . New electrical primary plant components will be installed to enable Glenard Windfarm connect to the grid network. Circuit Breakers, Current Transformers, Disconnects, Surge Arrestors, and Voltage Transformers will be erected to facilitate this generation as well as Grid Code Compliance Equipment.

Structural extension works required to extend to the existing Control Building to facilitate new control panels, switchgear and extension to existing battery room. The control building works will consist of foundation works, block work, roofing, low voltage electrical fit out, cladding and building finishing works.

Refer to Drawing No. 05701-DR-006 and 05701-DR-007 over.

3.0 110kV Underground Cable Route

The UGC route is approximately 8.0km in length and runs in an easterly direction from the existing Trillick 110kV substation to the Glenard Wind Farm substation location utilising public local road networks, existing access tracks and forestry access tracks.

The exact location of the UGC within the curtilage of the existing access tracks, public local road network and forestry access tracks may be subject minor modification following confirmatory site investigations, to be undertaken prior to construction of the proposed wind farm development, to confirm the conditions predicted in the EIAR. The cable location will take into consideration Donegal County Council and all other relevant stakeholder requirements. Installation of the cable will be carried out in line with the methodologies outlined in this document and all relevant environmental protection measures included in the EIAR.

Figure 1 outlines the UGC route, with the total length of each road type detailed in Table 1.

The UGC route layout drawings are shown on the drawings included in Appendix 4-1 of the EIAR.

Figure 1 - Grid Connection Route Layout Plan

Table 1 – Approximate UGC Route Location of Preliminary Design:		
Trillick Substation	**Public Roads**	**Wind Farm Site/Forestry Roads**
175 m	7268 m	732 m

Table 1: Glenard Wind Farm to Trillick 110kV Substation – UGC Route Location Summary

ISO A3 297mm x 420mm

Map Series:
1:5,000 Prime Data Raster

Sheet Reference No.'s
OS2242_D

Ordnance Survey Ireland Licence No.
EN 0073720

DSO Substation Site Layout Plan

Scale : 1:500

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PROJECT
Glenard Windfarm
110kV Grid Connection

SHEET TITLE
Site Layout Plan - Upgrades in Trillick Substation

DRAWING STATUS
For Approval

PROJECT NUMBER
05-701

SHEET NUMBER
05701-DR-006-P0

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P01	18.01.22	Issued for Planning
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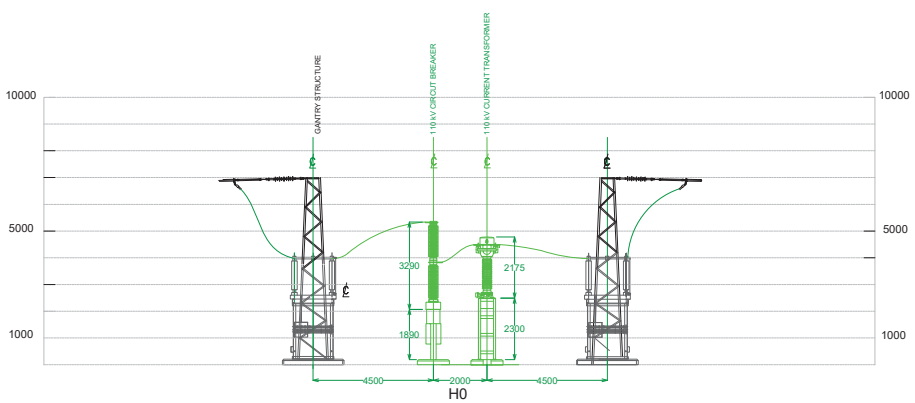
LEGEND/NOTES: -

- Proposed design is preliminary and should be used for planning purposes only.
- Detailed design to be completed and approved by EirGrid/ESB.
- Position/type of electrical equipment is indicative only and is subject to change following detailed design.
- Final Specifications of Electrical equipment is to be as per EirGrid and ESB specifications.
- See Dwg. 05701-DR-007 for Electrical Equipment Section details

ISO A1 594mm x 841mm



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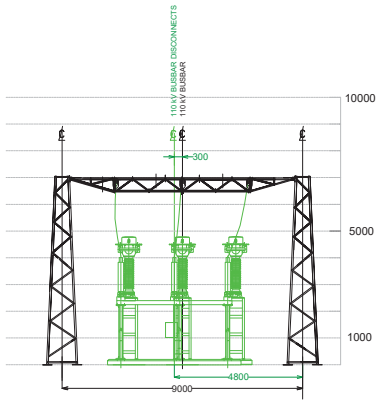

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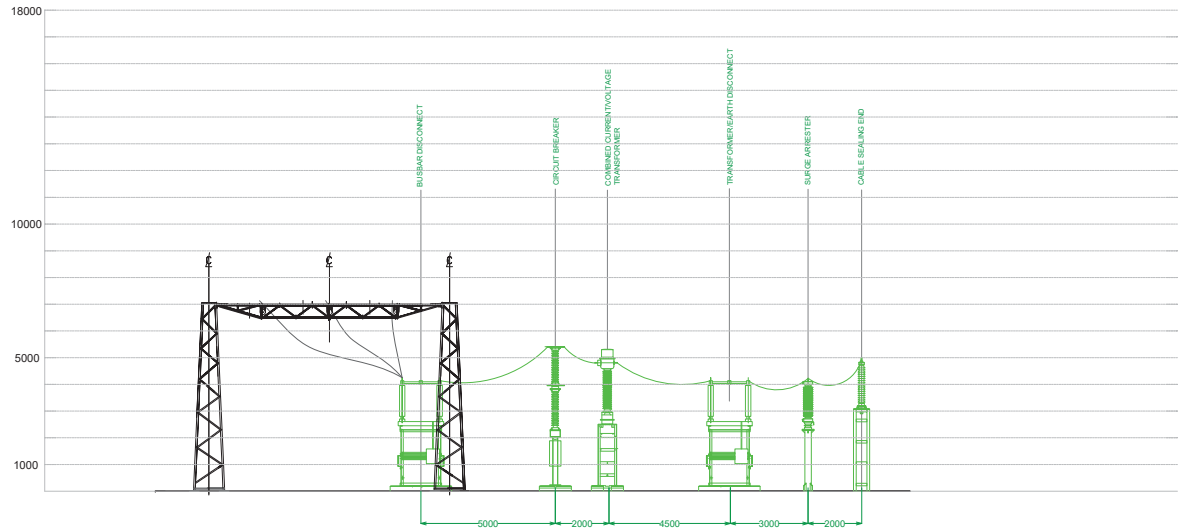

Section C- C

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NOTES:

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Glenard Windfarm
110kV Grid Connection

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MKO

NOTES: -

- See Notes window

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Trillick 110kV Substation
Equipment Section details

SHEET NUMBER

05701-DR-007

Project Management Initials: Designer: CH Checked: GH Approved: RG

Table 2 separates the UGC route into a number of sections and describes the specific construction requirements of each individual section along with assessment of access routes to the work areas.

Table 2 - Summary of Grid Connection Design Route	
Section	**Description**
Section 1 UGC 3,074 m	**UGC from Trillick 110kV substation to L-7241-2 Road, [Chainage 2850m]** The underground cable route initially begins within Trillick substation compound exiting the confines of the property on the southern boundary, converging onto the local secondary road route of the (L-7211-2) and continuing in an easterly direction. The UGC will encounter an existing 38kV cable connected to Beam Hill Wind farm on the roadway outside the periphery of Trillick Substation. The UGC will continue within the local secondary roadway for approximately 1.78km, encountering two bridge structures within the network before approaching a crossroad junction to allow the UGC merge with the local road L-7261-1. These bridge crossings will require the implementation of Horizontal Directional Drill method (HDD) due to insufficient deck cover within the bridges. Subsequent to crossing the second of these bridges (Bridge 2), the UGC will turn left onto this secondary road and continues for approximately 1.15km. The UGC will encounter a further two Bridge structures within the L-72612-1, heading northwards. The first of these two bridges will again be crossing with the HDD method due to inadequacies within the deck cover to accommodate 160mm ducting. The second of these bridges (Bridge 4) is in situ over the Owenkillew River. A replacement bridge 'deck' structure is to allow for UGC infrastructure so that the ducts are 'in' the public road when crossing over the bridge/river network within the replacement bridge with adequate deck coverage. An engineering solution has been implemented as the structural integrity of the existing bridge could be compromised due to the fragility of the structure. Once navigating this bridge crossing, the UGC will utilise another local secondary, L-7241-2 to continue towards Glenard Wind Farm site. Features Section 1 contains 4 No. joint bays. Joint bays, described in Section 6.6 below, will be located below ground, within the curtilage of the existing road and finished/reinstated to the required roads specification. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels. • Joint Bay 01 (JB01) will reside on the outer periphery of Trillick gated entrance. *[Chainage – 150m]* • Joint Bay 02 (JB02) will be located approximately 670m east of Trillick 110kV Substation. The joint bay will be installed within the L-7211-2, east of the entrance road to Trillick substation. *[Chainage – 820m]* • Joint Bay 03 (JB03) will be located approximately 780m east of JB02 within the L-7211-2 road network. *[Chainage – 1590m]*

	• Joint Bay 04 (JB04) will be located approximately 790m north of JB03 positioning the joint bay within the L-7261-1 network. *[Chainage – 2360m]* Section 1 has 1 No. Cable crossings: Beam Hill Wind farm grid cabling will be cross on the outer periphery of Trillick Substation by undercrossing method in a flat formation arrangement. Section 1 has 4 No. bridge crossings: The UGC route crosses over tributary watercourses and the Owenkillew River. Insufficient clearance exists within the bridge structures across these waterway networks. • The first bridge (Bridge 1) crosses over the Ballynahone Stream within the (L-7211-2) approximately 100m subsequent to JB01. Insufficient clearance exists within the bridge structure and will cross this bridge utilising the HDD method. *[Chainage – 925m]* • The second bridge (Bridge 2) crosses over the Annaslee watercourse within the (L-7211-2) approximately 122m subsequent to JB02. Insufficient clearance exists within the bridge structure and will cross this bridge utilising the HDD method. *[Chainage – 1725m]* • The third bridge (Bridge 3) crosses over the Maragh River within the (L-7261-1) approximately 176m after converging onto this local secondary road. Insufficient clearance exists within the bridge structure and will cross this bridge utilising the HDD method. *[Chainage – 1920m]* • The fourth bridge (Bridge 4) crosses over the Owenkillew River within the (L-1781-3) immediately before the UGC converges onto the local secondary road (L-7241-2). A new replacement bridge 'deck' structure is required is to allow for UGC infrastructure to cross the river network within the replacement bridge with adequate deck coverage. *[Chainage – 2825m]* Section 1 has 2 No. culvert crossings: • Culvert 1 is a 750mm x 700mm Stone Masonry Box culvert which will be crossed using an overcrossing method. • Culvert 2 is a 750mm x 700mm Twin Stone Masonry Box culvert which will be crossed using an undercrossing method. All bridge and culvert crossing methods are described in Section 8 below and in Appendix A of this report, respectively.
Section 2 UGC	**UGC within L-7241-2 to Glenard Wind Farm site entrance, [Chainage 7350m]** Utilising the local secondary, L-7241-2 to continue towards the wind farm site, the UGC route heads in an easterly direction. The UGC will traverse within this local secondary roadway for approximately 4.14km, encountering two bridge structures within the network before approaching the site boundary for Glenard Wind Farm.

Features

Section 2 contains 6 no. joint bays. Joint bays will be located below ground, within the curtilage of the existing road and finished/reinstated to the required roads specification. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels.

- Joint Bay 05 (JB05) will be located approximately 260m after converging onto the local secondary road (L-7241-2) east of the Tullydush Bridge (Bridge 4). *[Chainage – 3080m]*
- Joint Bay 06 (JB06) will be located within the (L-7241-2) roadway, approximately 750m east of JB05. *[Chainage – 3840m]*
- Joint Bay 07 (JB07) will be located within the (L-7241-2) roadway, approximately 760m east of JB06. *[Chainage – 4600m]*
- Joint Bay 08 (JB08) will be located within the (L-7241-2) roadway, approximately 750m northeast of JB07. *[Chainage – 5350m]*
- Joint Bay 09 (JB09) will be located within the (L-7241-2) roadway, approximately 760m east of JB08. *[Chainage – 6125m]*
- Joint Bay 10 (JB10) will be located within the (L-7241-2) roadway, approximately 750m east of JB09. *[Chainage – 6860m]*

Section 2 has 2 No. bridge crossings:

- The first bridge within this section (Bridge 5) crosses over the Meenkeeragh River within the (L-7241-2) approximately 230m prior to encountering JB06. Insufficient clearance exists within the bridge structure and will cross this bridge utilising the HDD method. *[Chainage – 4360m]*
- The second bridge within this section (Bridge 6) is situated on the boundary for the windfarm site. A new replacement bridge 'deck' structure to increase the overall size to allow for wind farm construction traffic and haulage is to be installed. The replacement bridge 'deck' will have sufficient load bearing capacity whilst allowing for UGC infrastructure to cross within the bridge deck. *[Chainage – 7075m]*

Section 2 has 3 No. Culvert Crossings:

- Culvert 3 is a 300mm HDPE twin walled pipe culvert which will be crossed using an undercrossing method.
- Culvert 4 is a 500mm x 500mm stone masonry box culvert which will be crossed using an undercrossing method.
- Culvert 5 is a 450mm HDPE twin walled pipe culvert which will be crossed using an undercrossing method.

All bridge and culvert crossing methods are described in Section 8 below and in Appendix A of this report, respectively.

Section 3 UGC	**UGC within the boundary for the windfarm site, [Chainage 8175m]** The UGC route continues within the site of Glenard Wind Farm within the public road network in an easterly direction. After circa. 280m the route will converge onto a forestry access track to carry the UGC on a slight upward gradient initially. The UGC will be accommodated within this track for 890m until reaching the location for the proposed on-site substation. Features Section 3 contains 1 no. joint bay. Joint bays will be located below ground and finished/reinstated to the required roads specification or landowner requirements. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels. • Joint Bay 11 (JB11) will be located approximately 490m within the site boundary, positioned along an existing forestry access road heading in a north easterly direction. *[Chainage – 7600m]*
Refer to Figure 1 and to the drawings included in Appendix 4-1 of the EIAR for location details. Note: The precise location of the UGC route within the curtilage of the existing access tracks, public roads and forestry tracks may be subject to minor modifications following confirmatory site investigations prior to the construction phase of the proposed wind farm development.	

4.0 Access Routes to Work Area

The majority of the proposed underground cable will be installed within the public road network and therefore will be accessed via the existing road network. The contractor(s) will be required to utilise the local public road network in the vicinity of the work area and from there utilise existing forestry access tracks, where appropriate.

In the event planning permission is granted for the proposed development, the Traffic Management Plan will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned. Some work areas will require a road closure where it is not possible to safely implement a Stop/Go system. Where road closures are necessary, a suitable diversion will be implemented using appropriate signage, following consultation with Donegal County Council.

Careful and considered local consultation will be carried out, to minimise the amount of disturbance caused during works. All plant and equipment employed during the proposed works (e.g. diggers, tracked machines, footwear etc.) will be inspected prior to arrival on site and on leaving site and cleaned where necessary to prevent the spread of dust and/or invasive aquatic / riparian species.

5.0 Traffic Management

Traffic management and road signage will be in accordance with the Department of Transport: Traffic Signs Manual - Chapter 8: Temporary Traffic Measures and Signs for Road Works and in agreement with Donegal County Council. All work on public roads will be subject to the approval of a road opening license application by Donegal County Council. The contractor will prepare a detailed traffic management plan for inclusion as part of the road opening applications. Where road widths allow, the UGC installation works will allow for one side of the road to be open to traffic at all times by means of a 'Stop/Go' type traffic management system, where a minimum 2.5m roadway will be maintained at all times.

Where it is not possible to implement a 'Stop/Go' system a full road closure will be required. Temporary traffic signals will be implemented to allow road users safely pass through the works area by channelling them onto the open side of the road. Typically, the UGC will be installed in 150m sections, and no more than 100m will be excavated without the majority of the previous section being reinstated. Where the construction requires the crossing of a road, works on one carriageway will be completed before the second carriageway is opened, to maintain traffic flows.

All construction vehicles will be parked appropriately within the works area so as not to cause additional obstruction or inconvenience to road users or local residents. The traffic signals will be in place prior to the works commencing and will remain in place until after the works are completed. The public road will be checked regularly and maintained free of mud and debris. Road sweeping will be carried out as appropriate to ensure construction traffic does not adversely affect the local road condition.

In the event of emergency; steel plates, which will be available on site, can be put in place across the excavation to allow traffic to flow on both sides of the road. Access for local residents can be accommodated, although traffic flows during works may have to minimised.

All traffic management measures will comply with those outlined in Section 14.1 of the EIAR and will be incorporated into a detailed Traffic Management Plan to be prepared, in consultation with Donegal County Council, prior to the commencement of UGC construction.

6.0 Road Opening Licence

The grid connection works, along the public road network, will require a road opening licence under Section 254 of the Planning and Development Act 2000-2015 from Donegal County Council. A Traffic Management Plan (TMP) will be agreed with Donegal County Council prior to the commencement of the development. The TMP will outline the location of traffic management signage, together with the location of any necessary road closures and the routing of appropriate diversions. Where diversions are required, these will be agreed with Donegal County Council in advance of the preparation of the detailed TMP.

7.0 UGC Construction Methodology

The UGC will consist of 3 No. 160mm diameter HDPE power cable ducts, 2 No. 125mm diameter HDPE communications ducts and 1 No. earth continuity conductor duct to be installed in an excavated trench, typically 825mm wide by 1,315mm deep, with variations on this design to adapt to bridge crossings, service crossings and watercourse crossings, etc. The power cable ducts will accommodate 1 No. power cables per duct. One of the communications ducts will accommodate a fibre cable to allow communications between the Glenard Wind Farm

substation and Trillick 110kV substation. The inclusion of 1 No. spare communications duct and 1 No. earth continuity conductor duct will also be required. The ducts will be installed, the trench reinstated in accordance with landowner or Donegal County Council specification, and then the electrical cabling/fibre cable is pulled through the installed ducts in approximately 700 to 850m section lengths. Construction methodologies to be implemented and materials to be used will ensure that the UGC is installed in accordance with the requirements and specifications of ESBN and EirGrid standards.

7.1 Trenching Methodology

The following section outlines the methodology to be followed during trenching works:-

- The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures included within the EIAR and as required by planning conditions where relevant;
- All existing underground services along the UGC route shall be confirmed prior to the commencement of construction works;
- At watercourse crossings, the contractor will be required to adhere to the environmental control measures outlined within the EIAR, the Construction Environmental Management Plan (CEMP) and best practice construction methodologies;
- Where the cable route intersects with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with ESB and Irish Water specifications;
- Traffic management measures will be implemented in accordance with those included in Section 14.1 of the EIAR, and a detailed Traffic Management Plan will be prepared and agreed with Donegal County Council;
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 50m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW);
- Excavated material shall be employed to backfill the trench where appropriate and any surplus material will be transported to the proposed on-site borrow pit;
- Any earthen (sod) banks to be excavated will be carefully opened with the surface sods being stored separately and maintained for use during reinstatement;
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, dirty water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature (please refer to Chapter 9 of the EIAR);
- Where required, grass will be reinstated by either seeding or by replacing with grass turves;
- No more than a 100m section of trench will be opened at any one time. The second 100m will only be excavated once the majority of reinstatement has been completed on the first;
- The excavation, installation and reinstatement process will take on average of 1 no. day to complete a 100m section;
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;
- Following the installation of ducting, pulling the cable will take approximately 1 no. day between each joint bay, with the jointing of cables taking approximately 1 week per joint bay location.

Figure 2 - Typical 110kV Underground Duct Installation

7.2 Ducting Installation Methodology

For the trenching and ducting works the following step by step methodology will apply:

1. Grade, smooth and trim trench floor when the required 1315mm depth and 825mm width have been obtained.
2. Place bedding layer of Cement Bound Granular Mixture B (CBGM B) material in accordance with the specification and compact it so that the compacted thickness is as per the drawings.
3. Lay the bottom row of ducts in trefoil formation as detailed on the design drawings. Use spacers as appropriate to establish horizontal duct spacing. Fit a secure cap / bung to the end of each duct run to prevent the ingress of dirt or water.
4. Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
5. Place cable protection strips on compacted CBGM B directly over the ducts.
6. Lay the top row of ducts onto the freshly compacted CBGM B including the cable protection strips above the bottom row of ducts. Place a secure cap at the end of each duct to prevent the ingress of dirt or water.
7. Carefully surround and cover ducts with CBGM B material in accordance with the drawings and thoroughly compact without damaging ducts.
8. Place red cable protection strip on top of compacted CBGM B over each set of ducts as shown on the drawings.
9. Place and thoroughly compact CBGM B material or Clause 804 backfill or soil backfill as specified and place warning tape at the depth shown on the drawings.
10. For concrete and asphalt/bitmac road sections, carry out immediate permanent reinstatement in accordance with the specification and to the approval of the local authority and/or landowners, unless otherwise agreed with local authorities *(Figure 3).*

11. For unsurfaced/grass sections, backfill with suitable excavated material to ground level leaving at least 100 mm topsoil or match existing level at the top to allow for seeding or replace turves as per the specification of the local authority or landowner *(Figure 4).*

12. Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12 mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes in preparation for cable installation at a later date. All the works should be witnessed by ESBN Clerk of Works (CoW) as required.

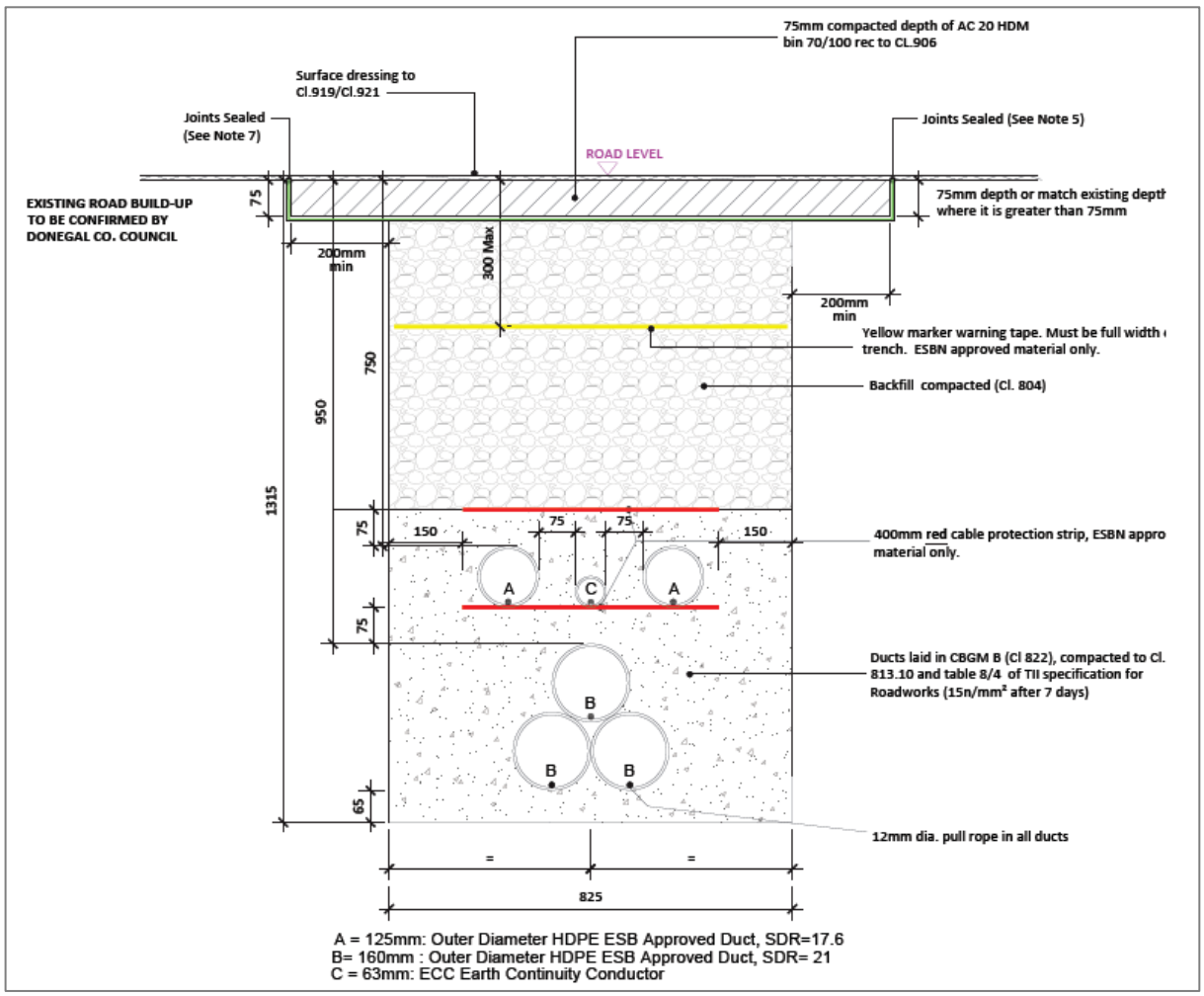


Figure 3 - Typical 110kV Trench in Roadway

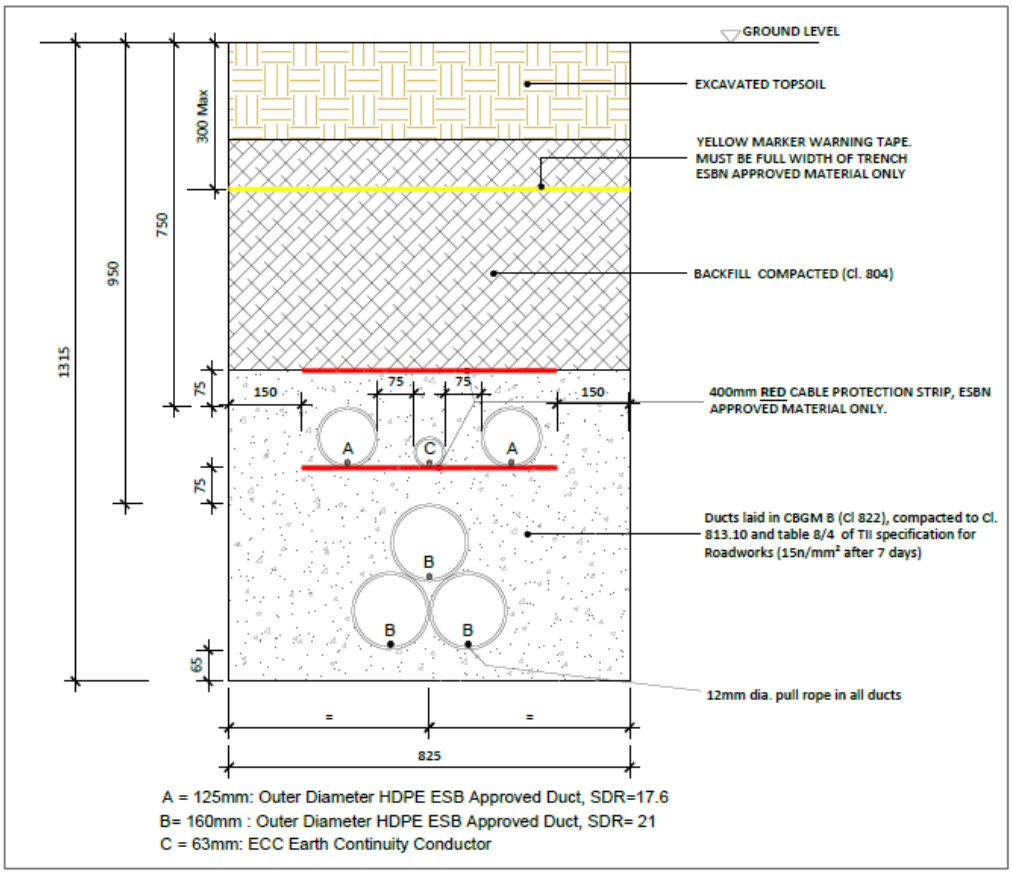


Figure 4 - Typical 110kV Trench in Off Road Section

Equipment:

- 2-3 General Operatives;
- 1 Excavator Operator;
- 1 no. tracked excavator (only rubber tracked machines will be allowed on public roads);
- 1 no. dumper or tractor and trailer.

Materials:

- Sand for pipe bedding;
- Ready-mix Concrete where necessary (delivered to site);
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 160mm diameter HDPE ducting;
- 125mm diameter HDPE ducting;
- 63mm diameter HDPE duct;
- Temporary Surface Reinstatement Materials

7.2.1 UGC Installation on Public Road

The majority of the 110kV UGC route is located within public road carriages and where applicable the trench will be installed in the non-trafficked strip between the wheel marks on the road. The cable will be micro-sited based on the presence of exiting utilities and the nature of the road and the adjoining terrain. It is preferable to excavate a trench within the middle of the lane, or the middle of the roadway to reduce load on the cable.

7.2.2 UGC Installation on Tracks

Where the cable is installed in private tracks the location where the cable is laid will depend on several factors such as; width of track, bends along the track and crossings. Where the track needs to be widened, stone will be brought in to build up the area to the same level of the track. The excess material from the track will be used elsewhere on reinstatement works.

7.3 Marker posts

Surface cable markers will be placed along the route where cable depth is unavoidably shallow, due to constraints such as existing services, to indicate the precise location of the UGC. These markers will be metallic plates in accordance with ESBN and EirGrid standards.

Marker posts will be used on non-roadway routes to delineate the cable route and joint bay positions. Corrosion proof aluminium triangular danger sign, with 700mm base, and with centred lightning symbol, on engineering grade fluorescent yellow background shall be installed in adequately sized concrete foundations. Marker post shall also be placed in the event that burial depth is not to standard *(Figure 5)*.

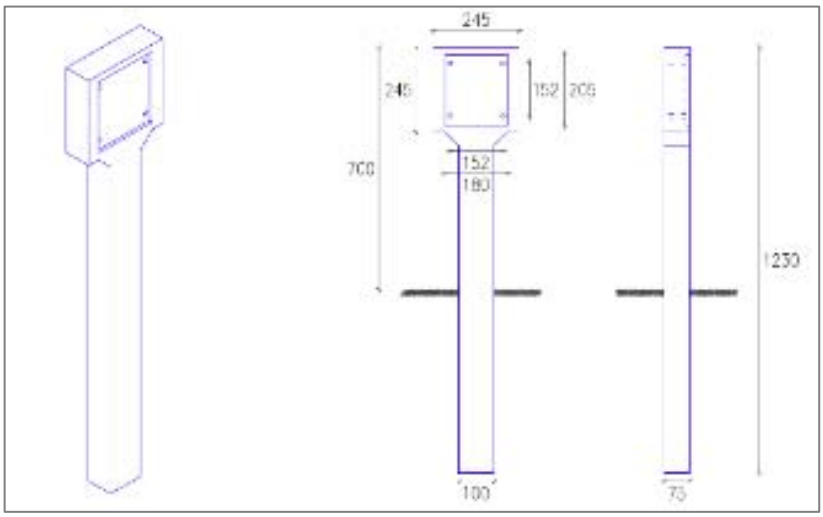


Figure 5 - Typical ESB Marker Posts Example

7.4 Managing Excess Material from Trench

All excavated material will be temporarily stored adjacent to the trench prior to re-use in the trench reinstatement (where applicable). Stockpiles will be restricted to less than 2m in height. Where excess peat and spoil material exists, it may be used in the reinstatement of the borrow pit as part of the Glenard Wind Farm. Excavated tar from the public road network will be transported off site by an appropriately authorised waste collector and disposed of at an appropriately licenced waste facility.

7.5 Storage of Plant and Machinery

All plant, machinery and equipment will be stored on site within the UGC works area or within the temporary construction compounds to be located within the Glenard Wind Farm. Oils and fuels will be stored in an appropriately bunded area within the temporary construction compounds.

7.6 Joint Bays and Associated Chambers

Joints Bays are to be installed approximately every 700m to 850m lengths along the UGC route to facilitate the jointing of 2 No. lengths of UGC. Joint Bays are typically 2.5m x 6m x 1.75m pre-cast concrete structures installed below finished ground level. Joint Bays will be located in the non-wheel bearing strip of roadways, however given the narrow profile of local roads this may not always be possible.

In association with Joint Bays, Communication Chambers are required at every joint bay location to facilitate communication links between the Glenard Wind Farm substation and the existing 110kV substation at Trillick. Earth Sheath Link Chambers are also required at every joint bay along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, so that the circulating currents and induced voltages are eliminated or reduced. Earth Sheath Link Chambers and Communication Chambers are located in close proximity to Joint Bays. Earth Sheath Link Chambers and Communication Chambers will typically be pre-cast concrete structures with an access cover at finished surface level.

The precise siting of all Joint Bays, Earth Sheath Link Chambers and Communication Chambers, within the curtilage of the public road, is subject to approval by ESBN and EirGrid.

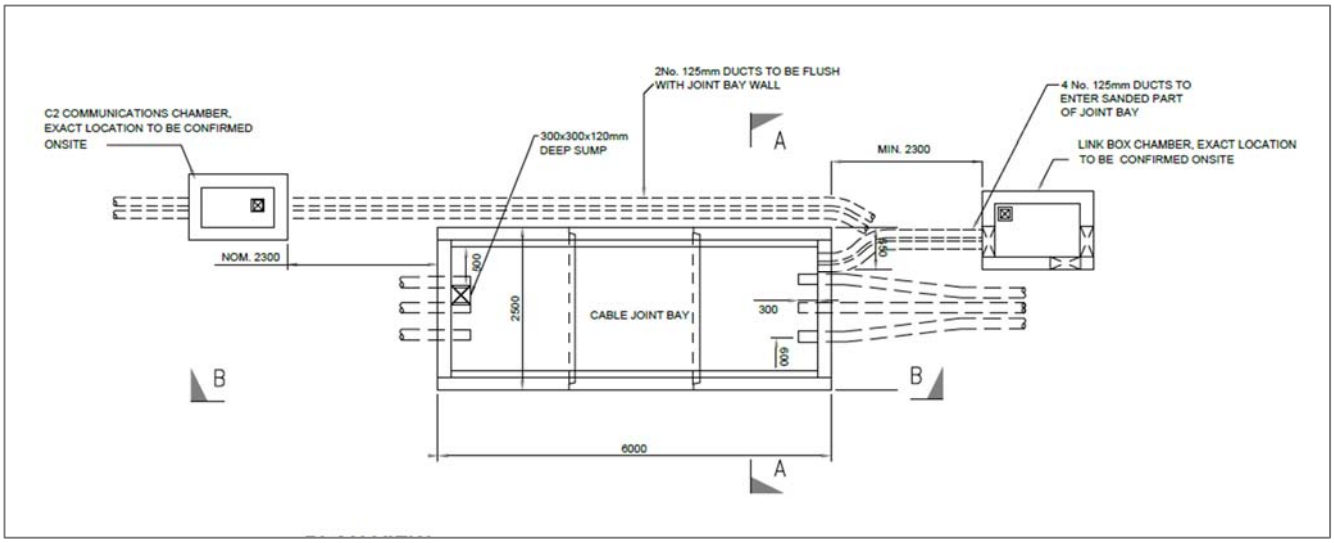


Figure 6 - 110kV Joint Bay Plan Layout

7.7 Joint Bay Construction and Cable Installation

Before starting construction, the area around the edge of the joint bay which will be used by heavy vehicles will be surfaced with a terram cover (if required) and stone aggregate to minimise ground damage. Any roadside drains within the temporary works area will be culverted and check dams made from stone or sandbags covered with terram will be inserted upstream and downstream of these culverts to intercept any solids generated during the insertion or which wash out during the works. If the ground slopes from the working area toward a watercourse or if there is evidence of solids washing off the works area toward nearby watercourses or drains, a silt fence with straw bales, will be interposed between the works area and the watercourse.

All excavated material will be stored near the excavations and reused for reinstatement works. Any soil required for reinstatement that will be temporarily stockpiled on site will be placed at least 15m back from the nearest watercourse on level ground and will be ringed at the base by silt fencing and be regularly monitored by a designated competent person for signs of solids escape. In which case an additional line of silt fencing with straw bales will be added in line with the relevant environmental control measures.

If the joint bay needs to be dewatered, this will be pumped to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the dewatering process to comply with the environmental control measures.

The risk of concrete reaching surface waters is considered very low given that all concrete will be poured into the pit excavated for the joint bay so that spills will be contained. The basic requirement therefore is that all pouring operations be constantly supervised to prevent accidental spillages occurring outside the pit.

Temporary storage of cement bound sand (if required) will be on hardstand areas only where there is no direct drainage to surface waters and where the area has been bunded e.g. using sand-bags and geotextile sheeting or silt fencing to contain any solids in run-off.

The following steps outline the methodology for joint bay construction and reinstatement:

1. The contractor will excavate a pit for joint bay construction, including for a sump in one corner.
2. Grade and smooth floor; then lay a 75 mm depth of blinding concrete (for in situ construction) or 50 mm thick sand (for pre-cast concrete construction) on 200 mm thick Clause 804 granular material.
3. In situ construction. Construct 200 mm thick reinforced concrete floor slab with sump and starter bars placed for walls as detailed on the drawings.
4. In situ construction. Construct 200 mm thick reinforced concrete sidewalls as detailed on the drawings. *(Figure 7)*

Figure 7- Typical joint bay under construction (in-situ)

5. In situ construction. Remove formwork and backfill with suitable backfill material in grassed areas or Clause 804 material once ducting has been placed in the bay. Backfill externally with granular material to Co. Council/TII Specification for Roadworks. *(Figure 8)*

Figure 8 - Completed joint bay prior to cable installation (in-situ)

6. Pre-cast concrete construction. Place pre-cast concrete sections on sand bedding. *(Figure 9)*

Figure 9 - Typical joint bay under construction (pre-cast)

7. Where joint bays are located under the road surface the joint bay will be backfilled with compacted layers of Clause 804 and the road surface temporarily reinstated as specified by the local authority.
8. Precast concrete covers may be used as temporary reinstatement of joint bays at off road locations. These covers are placed over the constructed joint bay and are then removed at the cable installation stage of the project.
9. At a later date to facilitate cable installation and jointing, reinstate traffic management signage, secure individual sites, re-excavate three consecutive joint bays and store excavated material for reuse.
10. The cable is supplied in pre-ordered lengths on large cable drums *(Figure 10).* Installing "one section" of cable normally involves pulling three individual conductors into three separate ducts. The cable pulling winch must be set at a predetermined cut off pulling tension as specified by the designer. The cable will be connected to the winch rope using approved suitably sized and rated cable pulling stocking and swivel or the pulling head fitted by the cable manufacturer**.** A sponge may also be secured to the winch rope to disperse lubricant through the duct. Lubrication is also applied to the cable in the joint bay before it enters the duct.

Figure 10 - HV cable pulling procedure (Typical drum set-up)

11. Once the "two sections" of cable (total of 6 conductors) are pulled into the joint bay, a jointing container is positioned over the joint bay and the cable jointing procedure is carried out in this controlled environment. *(Figure 11)*

Figure 11 - HV cable jointing container

Following the completion of jointing and duct sealing works in the joint bay, place and thoroughly compact cement-bound sand in approximately 200 mm layers to the level of the cable joint base to provide vertical support. Install additional layers of cement-bound sand and compact each layer until the cement-bound sand is level with the top of the joint. Install an additional 100 mm cement-bound sand layer. Install cable protection strip. Backfill with cement-bound sand to a depth of 250 mm below surface and carry out permanent reinstatement including placement of warning tape at 400 mm depth below finished surface.

Equipment:

- 2-3 General Operatives
- 1 Excavator Operator
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker)
- 1 no. tracked dumper or tractor and trailer

Materials:

- Sand for pipe bedding
- Blinding Concrete where necessary
- Clause 804 Material
- 160mm diameter HDPE ducting;

- 125mm diameter HDPE ducting;
- Precast Chamber Units / Relevant construction materials for chambers
- Link Box

8.0 Relocation of Existing Services

In order to facilitate the installation of the underground cable, it may be necessary to relocate existing underground services such as water mains, gas networks or existing cables. In advance of any construction activity, the contractor will undertake additional surveys and scans of the route to confirm the presence or otherwise of any services. If found to be present, the relevant service provider will be consulted with in order to determine the requirement for specific excavation or relocation methods and to schedule a suitable time to carry out works.

9.0 Major Watercourse Crossings

The cable route will involve 6 No. bridge crossings including 4 No. HDD crossings and 2 No. bridge replacement works. Where the cable route intersects with existing watercourses, a detailed construction method statement will be prepared by the Contractor prior to the commencement of construction and is to be approved by the Local Authority and relevant environmental agencies. The cable will be located within the bridge deck where there is sufficient depth and width available on the bridge, where there is insufficient depth and width available horizontal directional drilling (HDD) may be employed as an alternative.

Existing culverts will be crossed using open trenching with either an undercrossing or an overcrossing, depending on the depth of the culvert. A schedule of the culverts identified and the crossing method to be implemented is detailed in Appendix A of this report. A confirmatory site survey of all culverts will be completed as part of the next phase of the project prior to construction to confirm the findings of the design phase surveys. The proposed culvert crossing methods are detailed in *Figures 12* and *13.*

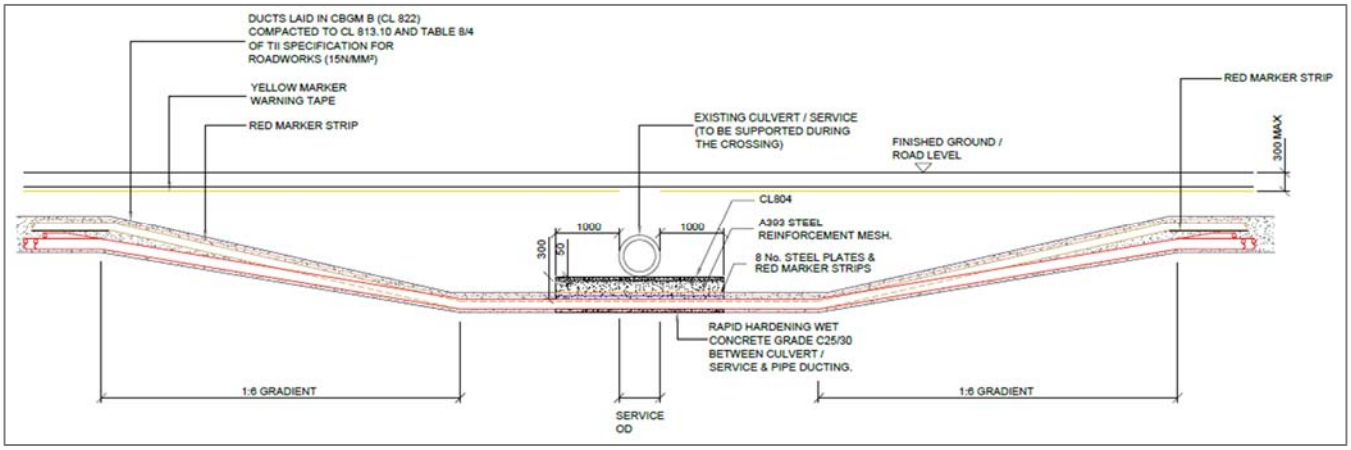


Figure 12 – 110kV UGC Culvert Undercrossing

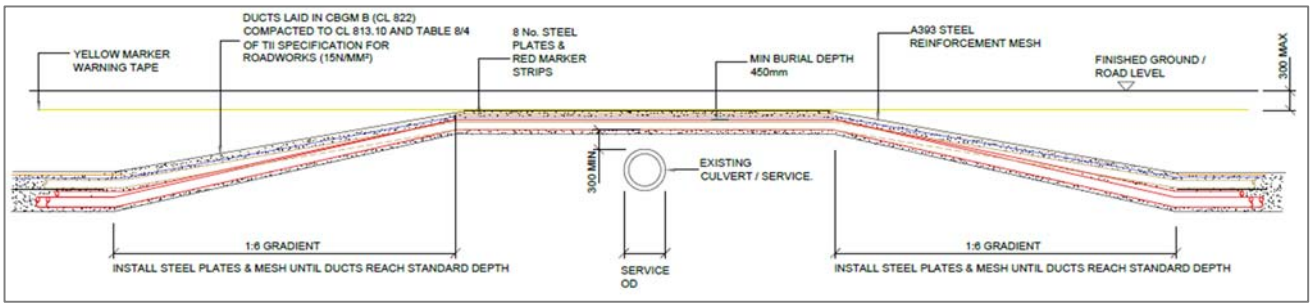


Figure 13 - 110kV UGC Culvert Overcrossing

Inland Fisheries Ireland have published guidelines relating to construction works along water bodies entitled 'Requirements for the Protection of Fisheries Habitats during Construction and Development Works at River Sites", and these guidelines will be adhered to during the construction of the development.

The bridge and culvert crossing locations are shown on the drawings included in Appendix 4-1 of the EIAR.

9.1 Bridge 1 - Horizontal Directional Drilling

ITM Coordinates: 637643.98, 929225.445

Bridge 1 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.** The methodology for HDD is outlined in Section 9 below.

See Drawing 05701-DR-231 for further details.

Figure 14 - Bridge 1 Location within L-7211-2

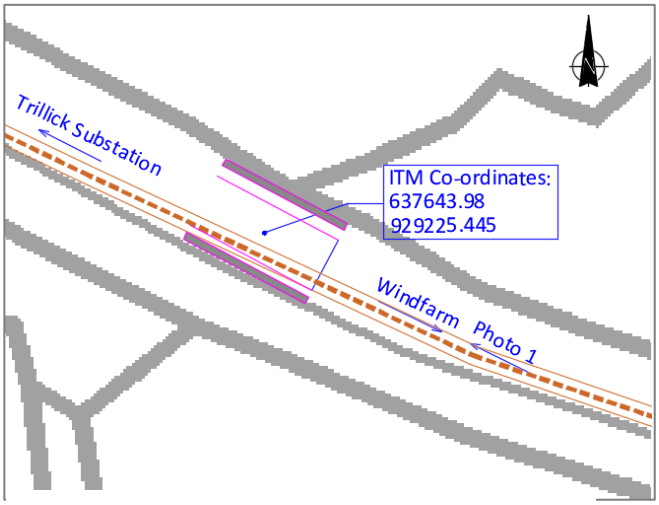


Figure 15 - Bridge 1 superimposed within OSI background

9.2 Bridge 2 - Horizontal Directional Drilling

ITM Coordinates: 638376.089, 929004.501

Bridge 2 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the scope of works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05701-DR-232 for further details.

Figure 16 - Bridge 2 within L-7211-2

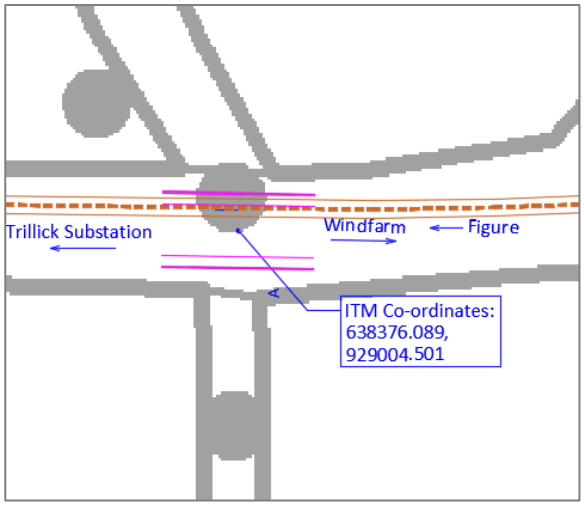


Figure 17 - Bridge 2 superimposed within OSI background

9.3 Bridge 3 - Horizontal Directional Drilling

ITM Coordinates: 638377.393, 929179.161

Bridge 3 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05701-DR-233 for further details.

Figure 18 - Bridge 3 within the L-7261-1

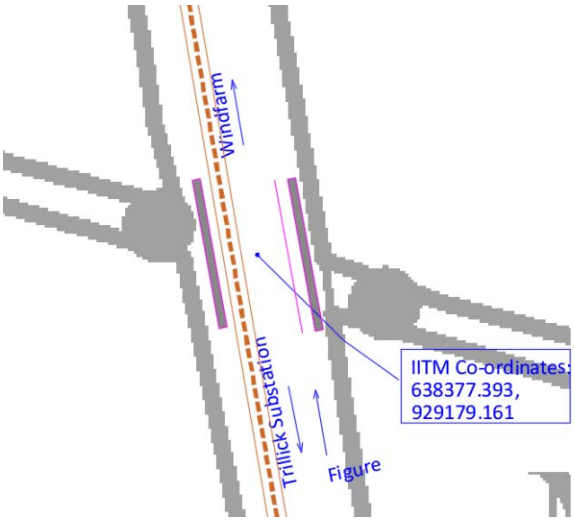


Figure 19 - Bridge 3 superimposed within OSI background

9.4 Bridge 4 – Bridge 'Deck' Replacement

ITM Coordinates: 638248.541, 930117.412

Bridge 4 has been found to have insufficient deck cover within the structure to accommodate the UGC to comply with ESB specifications. A replacement bridge 'deck' is to be installed to allow for UGC infrastructure to cross the river network within the replacement bridge with adequate deck coverage. The methodology for the replacement of the bridge 'deck' structure is outlined in Section 10 below.

Figure 20 - Bridge 4 within the L-1781-3

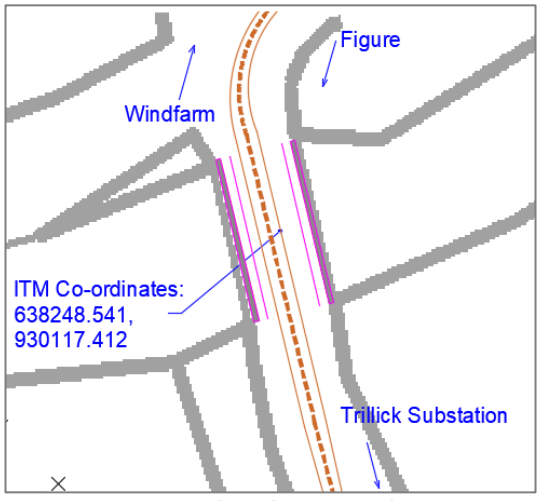


Figure 21 - Bridge 4 location within OSI

9.5 Bridge 5 - Horizontal Directional Drilling

ITM Coordinates: 639710.552, 929977.704

Bridge 5 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. It is proposed to horizontal directional drill (HDD) approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway.

See Drawing 05701-DR-234 for further details.

Figure 23 - Bridge 5 within the L-7241-2

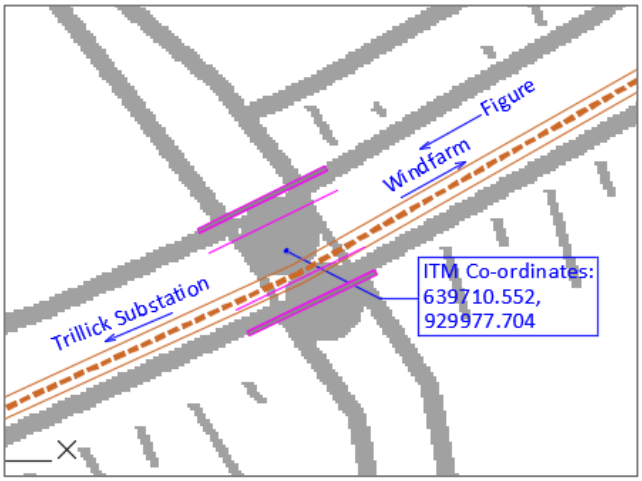


Figure 22 - Bridge 5 superimposed within OSI background

9.6 Bridge 6 – Horizontal Directional Drilling

ITM Coordinates: 642297.473, 930302.834

Bridge 6 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway.

Figure 24 - Bridge 6 on access to Windfarm Site boundary

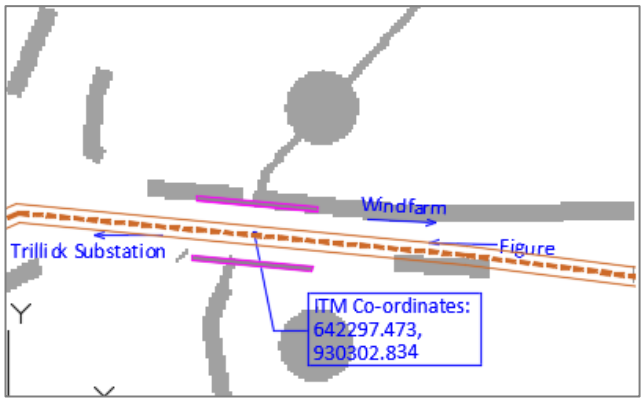


Figure 25 - Bridge 6 superimposed within OSI background

10.0 Horizontal Direction Drilling (HDD)

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, railways, water courses, etc. in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible. There are a number of bridges on this UGC route which will require HDD due to there being insufficient cover and depth in the bridge to cross within the bridge deck. The drilling methodology is as follows: -

1. A works area of circa. 40m^2 will be fenced on both sides of the river crossing,
2. The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5mm PVC bunds which will contain any fluid spills and storm water run-off.
3. Entry and exit pits (1m x 1m x 2m) will be excavated using an excavator, the excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
4. A 1m x 1m x 2m steel box will be placed in each pit. This box will contain any drilling fluid returns from the borehole.
5. The drill bit will be set up by a surveyor, and the driller will push the drill string into the ground and will steer the bore path under the watercourse.
6. A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded.
7. The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit.
8. Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side.
9. Once all bore holes have been completed, a towing assembly will be set up on the drill and this will pull the ducting into the bore.
10. The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.
11. The ducts will be cleaned and proven and their installed location surveyed.
12. The entry and exit pits will be reinstated to the specification of ESBN, EirGrid and Donegal County Council.
13. A transition coupler will be installed at either side of the bridge/ following the horizontal directional drilling as per ESBN and EirGrid requirements, this will join the HDD ducts to the standard ducts.

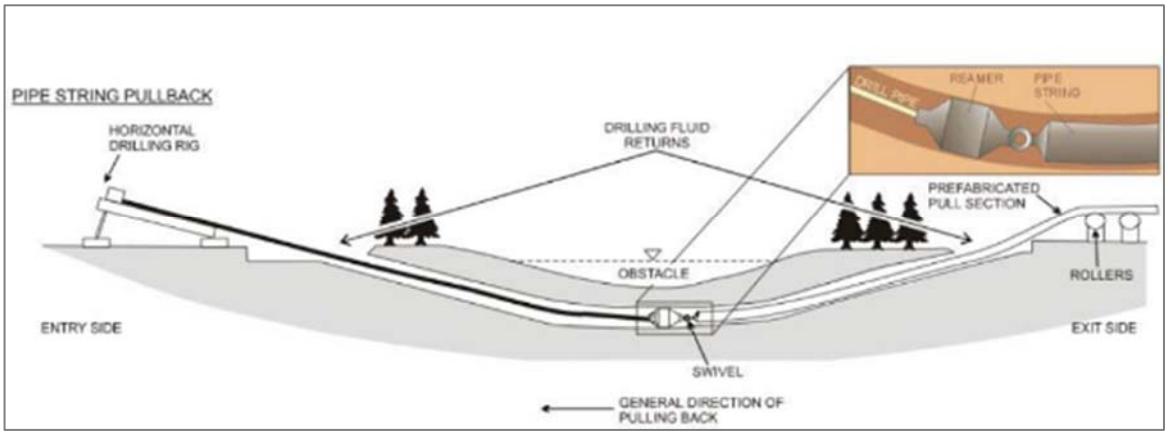


Figure 26 - Typical HDD Installation

11.0 Bridge Deck Replacements

The following section outlines the methodology to be followed for the replacement of bridge deck structure at Bridge 4 during trenching works:-

11.1 Barrier damming of Stream Flow

Temporary dams will be used during construction to divert and contain the flow from the works area to allow the work to be completed in the dry; this will prevent any material entering the watercourse. Barrier dams will be positioned around each abutment in turn. The stream will continue to flow on the other side of the channel to the works. Sandbag dams, using 25kg sandbags will be formed around the works area. Bags will be lowered from the road, either with an independent crane or one fixed to the back of a truck. Pumps will be used to dry the dammed area and will remain in place. The pumps will out-fall to a bunded area.

The Contractor shall employ best practice settling systems to ensure maximum removal of suspended solids prior to discharge of any surface water or groundwater from excavations to receiving waterbodies. This may include treatment via settlement tanks. Another effective method to collect harmful sediments from the pumped water will be the provision of Silt Dewatering Bags to protect the surrounding environment.

There will be no direct pumping of water from the works to watercourses at any time.

11.2 Demolition of Existing Structures

In advance of the works, it is proposed to remove and take down the existing structures to above ground level. This will require in-river works to remove the debris from the Owenkillew River and to reduce the levels of the intermediate support and abutments. It is proposed to reduce the intermediate support to above water level and the end supports to above ground level.

Prior to taking down the supports, the existing elements of the deck superstructure will be removed.

These works will be undertaken in the dry works area created between the dams once a sequence or predefining scenarios have occurred.

1. Sedimats will be laid on the riverbed to trap disturbed sediment that may pollute aquatic habitats downstream. These mats are an effective tool for the protection of watercourses from sedimentation damage during in stream construction activities.
2. Install solid crash mat/scaffold above water level; this crash mat/scaffold extends under the entire the plan area of the bridges;
3. Install debris netting;
4. Weather conditions will be considered when planning construction activities with the works to be undertaken during low flows in the river.
5. Once the area within the Owenkillew River to be worked upon is dry, the works can commence.

It will be requirement to remove and take down the existing structures above ground level. This will require 1 no. tracked excavator to be deployed for in-river works to remove the debris from the Owenkillew River and to reduce the levels of the intermediate support and abutments whilst reducing the intermediate support to above water level and the end supports to above ground level.

Prior to taking down the supports, the existing elements of the deck superstructure will be removed.

The following gives an indicative sequence of the demolition works:

1. Install temporary support to deck at each end;
2. Release deck from intermediate supports and abutment.
3. Lift deck and remove to tip off site.
4. Reduce existing abutment and approach embankment to above ground level.

11.3 Installation of Prefabricated/Preformed Structures

Construction of the new structure will require transportation, handling and lifting of prefabricated elements. The use of prefabricated units facilitates the speed of construction and minimises the period of time required for works over water.

The following gives an indication of the envisaged construction sequence:

1. Maintain solid crash mat/scaffold and debris netting;
2. Install double silt fence around extents of embankments;
3. Sedimats will be laid on the riverbed and along the banks of the watercourse
4. Fabricate beam / girder units (off site);
5. Excavate to the base of bankseat level. If dewatering of excavation is required, the water will be pumped for treatment via settlement tanks. There will be no direct pumping of water from the works to watercourses at any time;
6. Install and test bored piles at the locations (if required);
7. Construct reinforced concrete bankseat abutments and approach retaining walls;
8. Transport prestressed concrete bridge beams to site and crane into place from adjacent lands;
9. Fix reinforcement and pour concrete deck slab and parapet upstands at both structures;
10. Install back of wall drainage and below ground waterproofing;
11. Backfill bankseat excavation with Class 6N granular fill and construct road embankments on approaches;
12. Install new parapets;
13. Complete road surfacing and finishes;
14. Remove scaffold, debris netting, Sedimats, sandbags and silt fence.

12.0 Reinstatement of Land

Once all construction works are complete, the work areas will be reinstated with excavated soil and either seeded out with native species, allowed to vegetate naturally or reinstated with excavated grass turves and will be restored to their original condition. This work will be carried out in in consultation with the landowner and in line with any relevant measures outlined in the planning application, CEMP and planning conditions.

13.0 Best Practice Design and Construction & Environmental Management Methodology

Prior to commencement of construction works the contractor will draw up detailed Method Statements which will be informed by this Construction Methodology, environmental protection measures included within the EIAR, measures within the CEMP, and the guidance documents and best practice measures listed below. This method statement will be adhered to by the contractors and will be overseen by the Project Manager, Environmental Manager and ECoW where relevant.

The following documents will contribute to the preparation of the method statements in addition to those measures below: -

- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters*. Inland Fisheries Ireland*, Dublin,*
- *National Roads Authority (2008) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*. National Roads Authority, Dublin;
- E. Murnane, A. Heap and A. Swain. (2006) *Control of water pollution from linear construction projects.* Technical guidance (C648). CIRIA;
- E. Murnane et al., (2006) *Control of water pollution from linear construction projects*. Site guide (C649). CIRIA.
- Murphy, D. (2004) Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin;
- H. Masters-Williams et al (2001) *Control of water pollution from construction sites. Guidance for consultants and contractors* (C532);
- Enterprise Ireland (unknown). *Best Practice Guide (BPGCS005) Oil storage guidelines;*
- Law, C. and D'Aleo, S. (2016) *Environmental good practice on site pocket book*. (C762) 4th edition. CIRIA;
- CIRIA *Environmental Good Practice on Site (fourth edition) (C741) 2015*.

The works will be carried out by employing accepted good work practices during construction, and environmental management measures such as those discussed below. Please note that the following measures will be supplemented by further specific environmental protection measures that will be included in method statements prepared for specific tasks during the works and will form part of the detailed CEMP. These method statements will be prepared prior to the construction phase of the proposed wind farm and will incorporate all of the mitigation measures identified in the EIAR and NIS as well as the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned.

- All UGC construction materials shall be stored at the temporary construction compounds within the Glenard Wind Farm site and transported to the works zone immediately prior to construction;
- Where drains and watercourses are crossed with underground cables, the release of sediment will be prevented through the implementation of best practice construction methodologies. (See Section 4.X of the EIAR)
- Weather conditions will be considered when planning construction activities to minimise risk of run off from site;
- Provision of 50m exclusion zones and barriers (silt fences) between any excavated material and any surface water features to prevent sediment washing into the receiving water environment;
- If dewatering is required as part of the works e.g. in trenches for underground cabling or in wet areas, water must be treated prior to discharge;
- The contractor shall ensure that silt fences are regularly inspected and maintained during the construction phase;
- If very wet ground must be accessed during the construction process bog mats/aluminium panel tracks will be used to enable access to these areas by machinery. However, works will be scheduled to minimise access requirements during winter months;

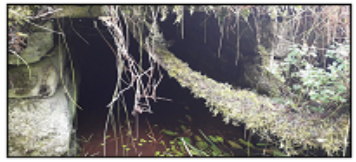
- The contractor shall ensure that all personnel working on site are trained in pollution incident control response. A regular review of weather forecasts of heavy rainfall is required, with the Contractor required to prepare a contingency plan for before and after such events;
- The contractor will carry out visual examinations of local watercourses from the works during the construction phase to ensure that sediment is not above baseline conditions. In the unlikely event of water quality concerns, the Environmental Manager and ECoW will be consulted;
- Excavations will be left open for minimal periods to avoid acting as a conduit for surface water flows.
- Only emergency breakdown maintenance will be carried out on site. Emergency procedures and spillage kits will be available and construction staff will be familiar with emergency procedures.
- Appropriate containment facilities will be provided to ensure that any spills from vehicles are contained and removed off site. Adequate stocks of absorbent materials, such as sand or commercially available spill kits shall be available;
- Concrete or potential concrete contaminated water run-off will not be allowed to enter any watercourses. Any pouring of concrete (delivered to site ready mixed) will only be carried out in dry weather. Washout of concrete trucks shall be strictly confined to a designated and controlled wash-out area within the Glenard Wind Farm site; remote from watercourses, drainage channels and other surface water features;
- Entry by plant equipment, machinery, vehicles and construction personnel into watercourses or wet drainage ditches shall not be permitted. All routes used for construction traffic shall be protected against migration of soil or waste water into watercourses;
- Cabins, containers, workshops, plant, materials storage and storage tanks shall not be located near any surface water channels and will be located beyond the 50m hydrological buffer at all times.

14.0 Implementation of Environmental Protection Measures

All environmental protection measures contained with the EIAR and NIS which accompanies the planning application will be incorporated into the final CEMP and construction method statements prior to the commencement of development and will be implemented in full during the construction phase. The Project Manager and Site Manager will be responsible for the implementation of measures following consultation with the Environmental Manager and ECoW where necessary.

The implementation of environmental protection measures, invasive species management and waste management will be addressed within the CEMP. Please see Appendix 4-X of the EIAR for the CEMP.

Appendix A – Culvert Crossings

Culvert Crossing Schedule					
Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Proposed Crossing Methodology	Photo
1.	750 wide x 700 deep	Stone Masonry Box	1030	OVERCROSSING	
2.	750 wide x 750 deep (x2)	Twin Stone Masonry Box	115	UNDERCROSSING	
3.	300 Ø	HDPE Twin Walled Pipe	124	UNDERCROSSING	
4.	500 wide x 500 deep	Stone Masonry Box	210	UNDERCROSSING	
5.	450 Ø	HDPE Twin Walled Pipe	854	UNDERCROSSING