

MWP

Chapter 03 Civil Engineering
Carrownagowan 110 kV Grid Connection

3. Civil Engineering

3.1 Introduction

This chapter describes the civil engineering design of the Proposed Development. Fundamental to the design was the requirement to eliminate or minimise adverse effects on the environment arising from the works during the construction phase of the Proposed Development.

The underground grid cable between the permitted Carrownagowan Wind Farm (An Bord Pleanála (ABP) Planning Ref: 308799-20) and the existing 110 kilovolt (kV) Gas Insulate Substation (GIS) in Ardnacrusha, will utilise public local road networks, existing access tracks (within Ardnacrusha), private forestry access tracks and private agricultural lands,, internal wind farm access roads, The grid will require trenching and will require temporary construction areas at joint bay locations and horizontal drilling areas which will have an increased footprint to contain excavated material and spoil removal from drilling procedures, all of which will be contained within the curtilage of the public roads and removed off site for disposal at a licenced facility. Any excavated topsoil/subsoil associated with the trench and access tracks in off road sections of the Proposed Development that isn't removed off-site to a licenced facility will be temporarily stored near the excavations and reused for reinstatement works.

All associated construction methods of grid are discussed within the accompanying Construction Methodology report in **Appendix 2-1**, Volume III and on the drawings accompanying this planning application. The full length of the Proposed Development is approximately 25 kilometre (km).

The Proposed Development location is described in **Chapter 2**.

3.1.1 Enabling Works

- Prior to works commencing, the area where excavations are planned will be resurveyed and all existing services will be reconfirmed. All relevant bodies i.e. Electricity Supply Board (ESB) Networks, EirGrid, Gas Networks Ireland, Eir, Clare County Council etc. will be recontacted and drawings for all existing services sought. A road opening licence will be obtained where required from Clare County Council for the relevant road sections. The 'Dial Before You Dig' approach along with CAT & Genie scanning equipment will be implemented before ground-breaking works commence. All plant operators and general operatives will be inducted and informed as to the location of any services.
- Prior to works commencing a dilapidation and dashcam survey will be carried out photographing and noting any existing damage or defects to structures or road surfaces. A copy of this survey will be submitted to Clare County Council prior to works commencing. A condition survey will be carried out on the roads and bridge structures impacted by the Proposed Development, both pre and post construction. This will include a video survey of the road extent with any significant dilapidations further recorded by photography and local surveying as required.
- Prior to works commencing, the site of the Proposed Development will be inspected and marked out on the ground. The works will be carried out by employing accepted good work practices during construction, and environmental management measures. These 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 Construction Environmental Management Plan (CEMP) (**Appendix 2-2** of Volume III of the EIAR). The CEMP sets out how the works

will be completed, the sequence of works and sets out how progress will be made along each section of road. It is envisaged that each day between 100 and 200 m of trenching will be completed, however, this will be subject to local topography, efficient access/storage of material and road width.

- A traffic management plan (TMP) is included in **Appendix 2-3** of Volume III of the EIAR. In the event planning consent is granted for the Proposed Development, the TMP will be updated prior to commencement of development to address the requirements of any relevant planning conditions, including any additional mitigation measures, which are conditioned and will be submitted to the planning authority for written approval.
- Prior to works commencing on the Proposed Development a CEMP and TMP will be reviewed and agreed with Clare County Council. The project plan will be updated every two weeks and communicated to the Area Roads Engineer of Clare County Council.

3.1.2 Excavation and Duct Installation

The Proposed Development will be carried within a single cable trench which will be 825 millimeters (mm) wide and a depth of 1,315 mm. Further detail is included in the Construction Methodology report **Appendix 2-1**, in Volume III of this EIAR.

The installation of the Proposed Development will involve the following process along the existing road network:

- The first stage of trenching work involves the trench extent being saw cut along the road surface. During construction works, the trench will be excavated down through the existing stone in the road using an excavator machine. As stone fill is removed it is temporarily stockpiled adjacent to the trench for re-use in backfilling (where safe to do so and the road corridors permit and if the material is suitable). In some instances some soil or unsuitable material may be encountered in the trench and this is removed from site and brought to an appropriate licensed facility for disposal.
- The trench is then prepared to receive a concrete bedding and surround for the ducts by grading a smooth trench floor and placing a bedding layer of Cement Bound Granular Mixture B (CBGM B) material. Ducting is then placed in the trench on the concrete bedding. The ducts are surrounded by concrete with adequate depth of cover over the duct as per ESN approved design specifications.
- Once the concrete is set, appropriate engineered backfill or imported stone material is placed over the concrete surround and filled back up to the top of trench. Suitable warning tapes will also be installed in the trench as per ESB Network's approved design specifications. Once the trench is filled, the trenching and ducting process will move along the road in planned stages.
- The trench surface receives a temporary surface dressing of either spray and chip or macadam. Once the overall scheme is completed, the Proposed Development and associated road areas will receive a new permanent macadam finish to at least pre-existing conditions as agreed with Clare County Council during pre-application consultations.
- Joint bays are to be installed where required along the Proposed Development located in the public road or along the grass margin of the public road as shown on drawing No **05641-DR-200-P6**. Once installed the surface is temporarily reinstated until they are opened again to allow for the pulling of cables through the ducts and jointing the cables. Cable pulling and jointing will not occur until the duct laying and trenching works have been completed in full. Traffic management signage will be erected to show unbound road surface material in agreement with Clare County Council roads engineer. The joint bays will then be permanently backfilled and reinstated with a finish to at least pre-existing conditions as agreed with Clare County Council.

- Horizontal Directional Drilling (HDD) will be used where there is insufficient cover or road profile depth on a bridge crossing to allow the Proposed Development to be placed within the bridge in a standard trefoil formation. Proposed locations are described in **Table 3-2** below. The launch and reception pits will be located in the public road corridor (i.e. along the grass margin of the public road or road to road) as shown on drawing No. **05641-DR-227-P5** and will be permanently backfilled and reinstated with a finish to at least pre-existing conditions as agreed with Clare County Council.
- The as-built location of the ducting will be surveyed using a total station / GPS. Marker posts will be installed along the Proposed Development to denote the location of ducting on the ground.

The installation of the Proposed Development will involve the following process along third party lands:

- Specific requirements on the design of any cable route through agricultural parcels will need to adhere to specification which states that a minimum 3 m paved and gated service road is suitably designed for heavy traffic will be installed to provide safe access for inspection, maintenance and fault repair along the entire cable route. The service road which accompanies the HV cable route will be suitably designed (i.e. if the road is to be used by heavy vehicles or machinery this will be reflected in the structural design for the road).
- All organic material and soft subsoil will be removed to formation level with excavated material to be reused and stored on site. Layers of geogrid/geotextile will be required at the surface of the competent stratum, a minimum subbase will be laid on the geotextile membrane which will consist of 200mm of crushed granular material. A surface layer will be laid which will consist of 75mm compacted 40mm material to accommodate Heavy Goods Vehicle (HGV) traffic.



Figure 3-1 Crushed Rock Roadway Build-up with Geotextile



Figure 3-2 Typical Access Road fully instated

- Once the concrete is set, appropriate engineered backfill or imported stone material is placed over the concrete surround and filled back up to the top of trench. Suitable warning tapes will also be installed in

the trench as per ESB Network’s approved design specifications. Once the trench is filled, the trenching and ducting process will move along the road in planned stages.

- The trench surface receives a temporary surface dressing of either spray and chip or macadam. Once the overall scheme is completed, the Proposed Development and associated road areas will receive a new permanent macadam finish to at least pre-existing conditions as agreed with Clare County Council during pre-application consultations.
- Joint bays are to be installed where required along the Proposed Development located in the public road or along the grass margin of the public road as shown on drawing No. **05641-DR-201-P05** to **05641-DR-216-P05**. Once installed the surface is temporarily reinstated until they are opened again to allow for the pulling of cables through the ducts and jointing the cables. Cable pulling and jointing will not occur until the duct laying and trenching works have been completed in full. Traffic management signage will be erected to show un-bound road surface material in agreement with Clare County Council roads engineer. The joint bays will then be permanently backfilled and reinstated with a finish to at least pre-existing conditions as agreed with Clare County Council.
- HDD will be used where there is insufficient cover or road profile depth on a bridge crossing to allow the Proposed Development to be placed within the bridge in a standard trefoil formation. Proposed locations are described in **Table 3-2** below. The launch and reception pits will be located in the public road corridor (i.e. along the grass margin of the public road or road to road) as shown on drawing No. **05641-DR-231-P05** to **05641-DR-233-P05** & **05641-DR-235-P05** to **05641-DR-239-P05** and will be permanently backfilled and reinstated with a finish to at least pre-existing conditions as agreed with Clare County Council.
- The as-built location of the ducting will be surveyed using a total station / GPS. Marker posts will be installed along the Proposed Development to denote the location of ducting on the ground.

Further information on the construction of the Proposed Development can be found in the Construction Methodology - 110kV Underground Cable Connection report (**Appendix 2-1**, Volume III). Estimated material quantities required for the construction of the Proposed Development are shown in **Table 3-1**.

Table 3-1 Summary of construction material quantities for grid connection

Construction Material	Quantity
Removal of Excavated Disposable Material	Quantity 22,204 m ³
Sourced Stone / Aggregate	Quantity 13,300 m ³
Sourced Internal access roads	Quantity 5,900 m ³
Reusable Site won Aggregate (Forestry Tracks)	Quantity 4,550 m ³
Imported Stone Cl.804 Aggregate	Quantity 8,900m ³
Total Volume of Stone/Aggregate Required	Quantity 23,400m ³
Concrete	Quantity 8,900 m ³
Tarmacadam & Chip Aggregate	Quantity 200 m ³
Total Volume of Sourced Material Required	Quantity 28,000 m ³



Figure 3-3 Typical excavation works for a grid connection cable trench



Figure 3-4 Typical duct installation works for a grid connection cable trench



Figure 3-5 Typical permanent reinstatement works for a grid connection cable trench

3.1.3 Grid Construction at Watercourse Crossings

There are a total of nine (9) no. major watercourse crossings along the route of the Proposed Development. The proposed methodologies for the provision of the Proposed Development at these locations are set out in **Table 3-2**, which provides a summary of the bridge survey results (ie. bridge type and depth of the bridge ie. from road level to the underside) and description of works for bridge crossings which are described in detail in the Construction Methodology report included in **Appendix 2-1** of Volume III of the EIAR.

A description of each crossing option is provided below. In-stream works are not proposed anywhere along the route of the Proposed Development.

Numerous other minor watercourses crossing locations have been noted along the proposed cable route i.e. culverts, pipe drains. The majority of these minor watercourses have been identified as part of the survey works.

Crossing existing culverts will be implemented using open trenching with either an undercrossing or an overcrossing, depending on the depth of the culvert. Please see **Appendix 2-2** Construction Methodology report for additional information.

3.1.3.1 Option 1 - Crossings over Bridges using Standard Trefoil Formation

Watercourses will not be directly impacted as no in-stream works or bridge alterations are proposed. Where adequate cover exists within a bridge, a standard trefoil arrangement will be used where the ducts will pass over the bridge without any contact with the top of the bridge or watercourse. The ducts will pass over the bridge in a standard cable trench which will be 1.3 m in depth and 0.8 m in width as outlined in **Section 3.1.1** above and in the Construction Methodology report (**Appendix 2-1**, Volume III).

3.1.3.2 Option 2 - Flatbed Formation over Bridges

Where ducts are to be installed over an existing bridge and sufficient cover cannot be achieved by installing a standard trefoil arrangement, the ducts will be laid in a much shallower trench. The ducts will be laid in a flatbed formation over the existing bridge and encased with galvanized steel plates in a concrete surround. This method of duct installation is further detailed in the Construction Methodology report (**Appendix 2-2**, Volume III).

3.1.3.3 Option 3 - Directional Drilling under Bridges and Watercourses

In the event that none of the above methods are appropriate, directional drilling will be utilised, which will require a service trench (launch pit) for the drill in the road either side of the watercourse. The directional drill process will require that the depth of the service trench will deepen in a defined slope as it approaches the watercourse crossing on either side, as to have sufficient passing depth of 1.5 m under the watercourse bed.

The direction drill will be carried out as follows:

- The directional drilling machine will set up at a launch and reception pit (an enlarged portion of on-road trench, i.e. a service trench on either side of the crossing point at an appropriate distance back from the watercourse). The drill will then bore in an arc under the watercourse feature. Full and approved traffic management will be incorporated prior to mobilization and set up of the directional drilling rig. A TMP is included in **Appendix 2-3** of **Volume III of the EIAR**.
- The drilling head of the boring tool has a series of nozzles that feed a liquid bentonite mix along the bore direction, which provides both lubrication and also seals the cut face of the bore.
- Once the bore reaches the far side, the duct is then attached to the drill head and the duct is pulled back along the Proposed Development of the bore to the original drilling point.

- Any bentonite mix is deposited within the bore shaft and spillage is collected at either end of the bore with dedicated sump; all excavated material and excess bentonite will be removed from site and brought to an authorised waste facility. Waste facilities in the waste study area include Clare Waste & Recycling at Tuamgraney, Inagh Central Waste Management Facility in Ballyduff Beg, Inagh and Enva, located at Smithstown Industrial Estate in Shannon, Co. Clare.
- Once the duct is in place under the watercourse, the normal process of road trenching can continue from either side of the watercourse structure.
- The launch and reception pits will be backfilled with appropriate engineered backfill and filled back up to the ground level with a finish to at least pre-existing conditions as agreed with Clare County Council. Suitable warning tapes will also be installed in the pits as per ESN approved design specifications.

The directional drilling methodology is further detailed in the Construction Methodology report (**Appendix 2-1, Volume III**).



Figure 3-6 Typical directional drilling rig and launch pit

Table 3-2 Summary of proposed crossing methodology

Crossing No.	Bridge Type	Cover from Road Surface Level to Top of Bridge Arch (Top of Keystone)	Location and Description	Watercourse Crossing Option	Extent of In-stream works
1	Two span concrete bridge	340mm	Due to a lack of sufficient depth within the structure of Trough Bridge, located on the L-70661 local road, the grid connection ducts will be installed under the watercourse by means of directional drilling. No contact will be made with the watercourse during the works.	Option 3	None. No in-stream works required
2	Single span concrete bridge	450mm	Due to a lack of sufficient depth within the bridge structure, located on the R471 regional road, the grid connection ducts will be installed under the watercourse by means of directional drilling. No contact will be made with the watercourse during the works.	Option 3	None. No in-stream works required
3	Two span stone arch bridge	600mm	Due to a lack of sufficient depth within the bridge structure, located on the R471 regional road, the grid connection ducts will be installed under the watercourse by means of directional drilling. No contact will be made with the watercourse during the works.	Option 3	None. No in-stream works required
4	Single span stone arch bridge	2.2m	The grid connection ducts will be laid in standard trefoil formation within the Ahnagor Bridge, located on the L-3022 local road, due to sufficient cover present. No contact will be made with the watercourse during the works.	Option 1	None. No in-stream works required
5	Single span stone arch bridge	575mm	Due to a lack of sufficient depth within the bridge structure, located on the L-3022 local road, the grid connection ducts will be installed under the watercourse by means of directional drilling. No contact will be made with the watercourse during the works.	Option 3	None. No in-stream works required
6	Single span stone arch bridge	520mm	Due to a lack of sufficient depth within the structure of the bridge, located on the L-7004 local road, the grid connection will be installed under the watercourse by means of directional drilling. No contact will be made with the watercourse during the works.	Option 3	None. No in-stream works required
7	Single span stone arch bridge	750mm	Due to a lack of sufficient depth within the bridge structure, located on the L-3022-8 local road, the grid connection ducts will be installed under the watercourse by means of directional drilling. No contact will be made with the watercourse during the works.	Option 3	None. No in-stream works required
8	Single span stone arch bridge	610mm	Due to a lack of sufficient depth within the bridge structure, located on the L-7004 local road, the grid connection ducts will be installed under the watercourse by means of directional drilling. No contact will be made with the watercourse during the works.	Option 3	None. No in-stream works required

Crossing No.	Bridge Type	Cover from Road Surface Level to Top of Bridge Arch (Top of Keystone)	Location and Description	Watercourse Crossing Option	Extent of In-stream works
9	Single span stone arch bridge	600mm	Due to a lack of sufficient depth within the bridge structure, located on the L-7004 local road, the grid connection ducts will be installed under the watercourse by means of directional drilling. No contact will be made with the watercourse during the works.	Option 3	None. No in-stream works required

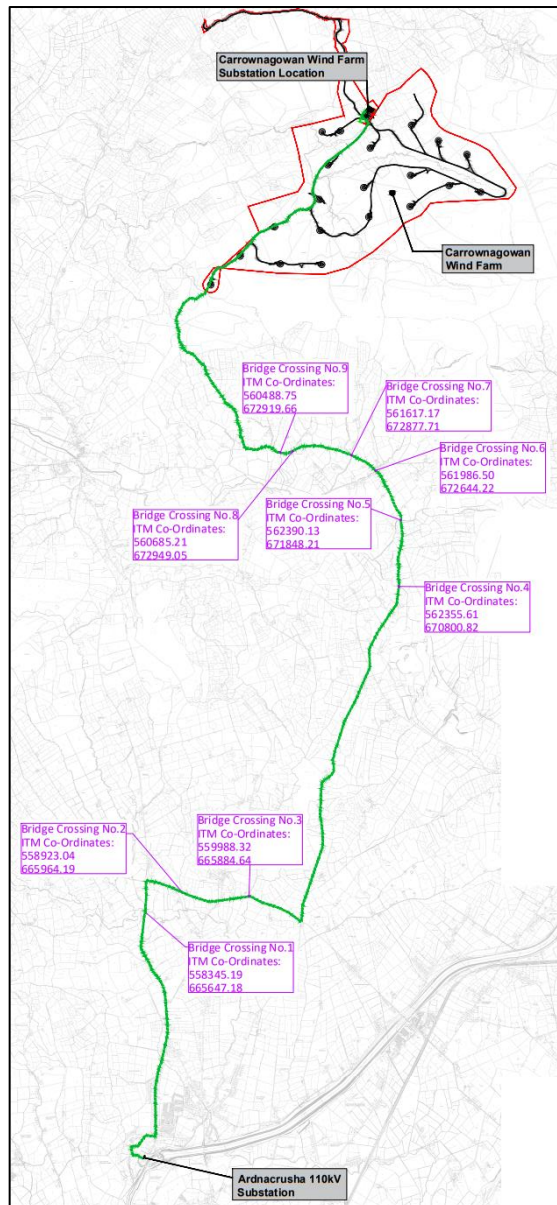


Figure 3-7 Bridge Locations Along Route

3.1.4 Grid Connection Construction and Existing Underground Services

All relevant bodies i.e. ESB Networks, EirGrid, Gas Networks Ireland, Eir, Clare County Council etc. will be re-contacted and drawings for all existing underground services along the Proposed Development sought. Any underground services encountered will initially be surveyed for levels in order to determine if there is adequate cover available for ducting to pass over these services. A minimum clearance of 300 mm is required from the bottom of the ducting to the top of any underground service as per ESB Networks' requirements. If this clearance cannot be achieved, the ducting will pass below the service with a minimum 300 mm clearance maintained from the top of the ducting to the bottom of the service.

All excavations will be kept within the public roadway boundaries i.e. in road or grass margins.

3.1.5 Grid Connection Construction Joint Bays and Communication Chambers

Joint bays are pre-cast concrete chambers that will be required along the Proposed Development over its entire length. They are required to join cables together to form one continuous cable. They will be located at various points along the Proposed Development approximately every 700 - 850 m depending on gradients, bends etc. and the proposed locations are shown in the planning application drawings accompanying this EIAR. It is proposed to install 35 no. joint bays and communication chambers along the Proposed Development. These locations will be within the existing/permitted corridor of road network (see Construction Methodology **Appendix 2-1**, Volume III).

Where possible, joint bays are proposed in areas where there is suitable widening or grass margin on the road in order to accommodate easier construction and disrupt less traffic. During construction, the joint bay locations will be fenced off and will be incorporated into the grid connection traffic management plan. A TMP is included in **Appendix 2-3**, Volume III of the EIAR. Once the joint bays have been constructed they will be temporarily backfilled until they are re-excavated later to allow for the pulling and jointing of cables at each joint bay. Traffic management signage will be erected to show un-bound road surface material in agreement with Clare County Council roads engineer. Once the cable pulling and jointing has been completed, the joint bays will be fully backfilled and permanently reinstated with a finish to at least pre-existing conditions as agreed with Clare County Council.

The joint bays which will be used to joint two sections of underground cable (**Figure 3-5**), communication chambers which will be used to join two sections of communications cables (**Figure 3-7**) and earth sheath link boxes which are used for earthing and bonding cable sheaths of underground power cables, so that the circulating currents and induced voltages are eliminated or reduced (**Figure 3-6**) In order to place the boxes, the area of excavation will first be marked out on the ground and all necessary preparatory protection measures put in place to avoid any run off or loss of soil materials. These include appropriate siltation measures along road side drainage (silt fences, check dams etc.).

The material excavated from the joint bay chambers along existing road surfaces will be removed from the Proposed Development site and brought to a suitably licensed facility. Any excavated topsoil/subsoil associated with joint bay chambers in off road sections of the Proposed Development that isn't removed off-site to a licensed facility will be temporarily stored near the excavations and reused for reinstatement works.

Prior to the chamber being installed in a compacted layer of suitable stone or lean mix concrete, appropriate material will be placed in the excavation to a level surface. The precast boxes are then positioned *in situ* and backfilled around them with imported crushed stone material. The precast concrete joint bay is filled with thermal sands and then backfilled and reinstated with a matching wearing course to the existing road surface. **Figure 3-5** shows a typical joint bay installation. Further information on the construction of the joint bays and cable installation can be found in the Construction Methodology report included in **Appendix 2-2** of Volume III.



Figure 3-8 Typical Joint Bay Construction



Figure 3-9 Typical Earth Sheet Link Box Construction



Figure 3-10 Typical Communications Chamber Construction