



# 110KV GRID CONNECTION FEASABILITY STUDY

**Dyrick Hill Wind Farm**

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## Contents

1.0 Overview .....	4
2.0 Route Development Overview .....	4
3.0 Grid Connection Options.....	5
3.1 UGC Option A .....	5
3.2 UGC Option B .....	10
3.3 UGC Option C .....	11
4.0 Conclusions and Recommendations .....	13

## Table of Figures

Figure 1 – Dyrick Hill WF Grid Connection Site Overview .....	4
Figure 2 – Side elevation of Bridge Crossing A1 (WD-N72-007.00) .....	6
Figure 3 – Proposed direction of HDD.....	6
Figure 4 – Bridge A2 from the Northern side of the bridge .....	7
Figure 5 – Bridge A3 from the southeast of the Bridge .....	8
Figure 6 - Plan view of proposed HDD of Bridge A3.....	8
Figure 7 - Bride A6 View from North side of Bridge.....	9
Figure 8 - Cattle Underpass.....	10
Figure 9 - Watercourse C3 from the west.....	12

## 1.0 Overview

TLI Group (the Consultant) were engaged by EM Power (the Client) to identify and analyse potential 110kV grid connection options available for the Dyrick Hill Wind Farm Project, northwest of Dungarvan, Co. Waterford. The Client indicated that the proposed grid connection point offered by the ESB is Dungarvan 110kV Substation or Cahir 110kV.

Only underground cable (UGC) grid connection options were to be assessed as part of this feasibility study. The scope of work for the Consultant was therefore to identify potential 110kV UGC grid connection options between Dungarvan 110kV Substation and Dyrick Hill Wind Farm or between Cahir 110kV Substation and Dyrick Hill Wind Farm.

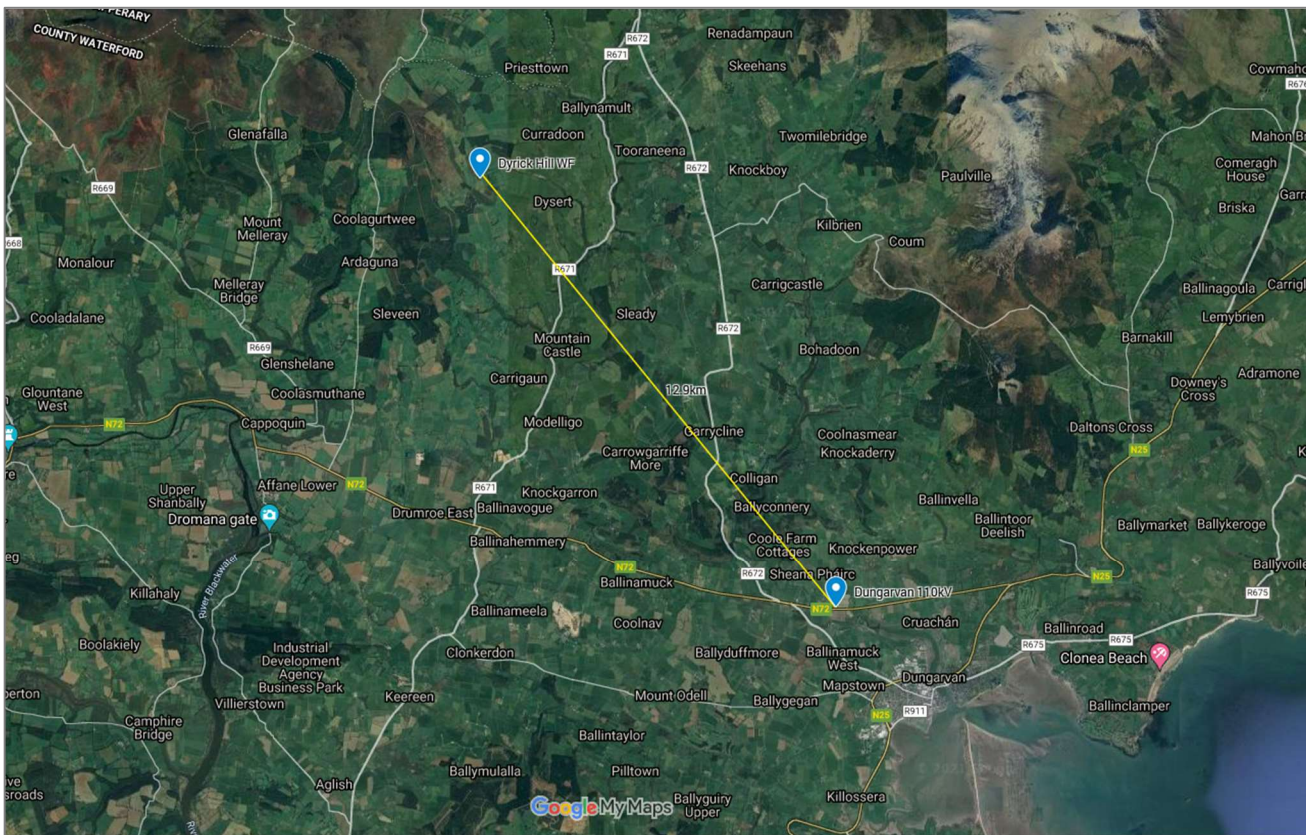


Figure 1 – Dyrick Hill WF Grid Connection Site Overview

## 2.0 Route Development Overview

In order to identify potential grid connection options between the wind farm site and Dungarvan 110kV/Cahir 110kV Substations a detailed study area constraints map was created in AutoCAD. The study area map combined data from numerous sources including available aerial imagery, protected areas, river networks, ESB network data, architectural heritage, and monuments data.

A desktop analysis was carried out using the study area constraints map to identify potential grid routes between the wind farm site and Dungarvan Substation.

Initially the following preliminary grid connection options were identified from the desktop analysis:

- UGC Option A - UGC from Dungarvan SS to Dyrick Hill WF utilizing sections of UGC in the national road (long section), primarily regional roads, and private lands - 19km.
- UGC Option B - UGC from Dungarvan SS to Dyrick Hill WF utilizing sections of UGC in the national road (short section), primarily regional roads, and private lands - 16.8km
- UGC Option C - UGC from Dungarvan SS to Dyrick Hill WF utilizing sections of UGC in the national road (short section), primarily regional roads, and private lands – 14.9km

**Note:** Any cable routes to Cahir 110kV Substation would be substantially longer (minimum length of 35km) and vastly more technical, due to the high volume of watercourse crossings. It is therefore proposed that grid connection options to Dungarvan Substation be assessed as a first preference.

Surveys of the preliminary routes identified were carried out onsite in order to examine the feasibility of each route and identify any additional constraints which were not visible during the desktop analysis (i.e. ground conditions, additional infrastructure, land use, etc.) The proposed routes were analysed and altered based on the site conditions in order to select the most feasible route corridors available.

### 3.0 Grid Connection Options

The following potential 110kV grid connection options have been identified for Dyrick Hill Wind Farm at this stage of the process based on desktop analysis and initial site surveys.

#### 3.1 UGC Option A

*UGC Option A - UGC from Dungarvan SS to Dyrick Hill WF utilizing sections of UGC in the national road (long section), primarily regional roads, and private lands - 19km.*

Route option A utilises UGC with a route length of approx. 19km in total. The proposed route would exit the Dungarvan 110kV Substation to the south, passing a number of existing UGCs in the vicinity of the substation gate, and continue onto the N72 heading in a westerly direction. The Radley Engineering factory, located on the west side of Dungarvan 110kV Substation, is prone to high volumes of traffic. It is also worth noting that Sunrise Energy Supply Limited have submitted a 10km UG grid connection for planning to connect a solar farm in Cappoquin, Co. Waterford to the Dungarvan 110kV Substation (Planning Ref. 16/126), the proposed UGC route follows a similar section of the N72 as chosen for this grid route. Following the N72 in a west direction for approx. 588m before meeting the first bridge on this route. Bridge A1 (Figure 2 & Figure 3 below) is a precast concrete bridge of approx. 80m length.

At this point it is worth noting that Coumragappul WF will also be seeking a 110kV grid connection to Dungarvan 110kV Substation. The Dyrick Hill WF UGC would follow the same route as proposed for the Coumragappul route as far as the junction between the N72 and the R672.





**Figure 2 – Side elevation of Bridge Crossing A1 (WD-N72-007.00)**

This bridge is TII owned bridge, labelled 'WD-N72-007.00'. As this bridge is precast concrete, 500mm concrete slab, with the road surface sitting 100mm below the top of the concrete slab. There is a 500mm concrete base to support the bridge. This would indicate insufficient cover available to allow the ducts to be installed in the bridge deck, it is therefore recommended to utilise Horizontal Directional Drilling (HDD) to pass under the bridge and riverbed, within the road corridor. It should also be noted that TII have objected to the installation of HV cables in any TII bridge infrastructure in recent times. There are existing footpaths on both sides of the road, however due to this being a TII owned bridge it is highly unlikely that permission to use the footpaths or road within the bridge for the cable would be granted.



**Figure 3 – Proposed direction of HDD**

From here the UGC route follows the N72 west for approx. 487m before passing through a busy junction between the N72 and the regional road R672. The UGC route follows the N72 for 3,120m before meeting the second watercourse crossing (A2) of the route, see Figure 4 below. Preliminary measurements show a cover of approx. 1m from the top of the keystone to the road level. The UGC could therefore cross this bridge using a flat formation arrangement. Road resurfacing was taking place on the N72 at the time of the site surveys. There are a number of existing Overhead Line (OHL) crossings along these sections of the route, however, there should be minimal impact to the UGC.



**Figure 4 – Bridge A2 from the Northern side of the bridge**

The UGC follows the N72 for another 3,690m. This section of the route would be required to share the road with existing Irish Water infrastructure. Similar to the previous section there are a number of OHL crossings. This section of the route comes in close proximity to the historically listed building, Cappagh House, however this should have minimal impact on the route as the cable would be within the public road network. The UGC encounters the third watercourse crossing (A3), 'WC-N72-006.00', of the route. This bridge is located on a bend on the N72. Preliminary measurements indicate a cover of approx. 400mm between the keystone and the road level. This does not meet the minimum required clearance of 640mm, there it is recommended that Horizontal Directional Drilling (HDD) be utilized to cross this bridge. The HDD would pass-through privately-owned lands and then return to the existing road corridor. The UGC would continue in the N72 for a further 880m west before adjusting north to progress onto the regional road, R671.





Figure 5 – Bridge A3 from the southeast of the Bridge



Figure 6 - Plan view of proposed HDD of Bridge A3

The UGC continues north for approx. 5,108m on the R671. The UGC would be required to cross under a number of existing ESB OHLs. This road would also be shared with existing Irish Water infrastructure for approx. 3,717m. The UGC would be required to cross the Irish Water pipework along this section of the route. This section of the UGC route has 2 No. watercourse crossing (A4 & A5) both crossings being drainage culverts. The Drains would be crossed using a typical culvert over/under crossing method, depending on site specific clearances available.



The UGC encounters the 6<sup>th</sup> watercourse crossing (A6), 'WD-R671-014.00', at the Furnane River. See Figure 7 below. This bridge is located on a bend in the R671. Preliminary measurements indicate a clearance of approx. 2m from the top of the key stone to the road level. The UGC would therefore cross the bridge using flat formation, following the R671.



**Figure 7 - Bride A6 View from North side of Bridge**

After crossing the bridge, the UGC curves around with the R671, approx. 150m, past a cluster of historically protected houses on the roadside. From here the UGC exits the R671 and enters a local road and heads north. This road has an uphill gradient with a number of drain crossings. The UGC follows this local road northwest for approx. 4,832m, passing a number of run off drains and ESB OHL crossings. This section of road is all single lane road that would require a road closure for any proposed works.

The UGC would then divert off-road and follow the access track into the Dyrick Hill Wind Farm (final track route to be confirmed) to the Dyrick Hill Wind Farm Substation (location to Be Confirmed). This off-road section would require an access track over the cable route.

Some Site Investigation works would likely need to be carried out on the proposed route as part of the design process in order to identify all services and select a final corridor for the new trench.

This grid connection option is shown as **UGC Option A** in **Drawings 05829-DR-001/017**

UGC Option A Constraints:

- Existing ESB UGCs installed at the entrance of Dungarvan Substation.
- Road opening Licences required.
- Large section of the cable route installed in the N72.
- A general high amount of traffic using the route (N72).
- Consent from Waterford Co.Co. / TII to install the cable in the N72.

- *No engagement with Waterford County Council has taken place regarding this proposal.*
- *2 No. Bridge crossings with HDD required.*
- *Private landowner consent required for one HDD crossing.*
- *4 No. Bridge crossings total*
- *Final location of Sunrise Energy Supply Limited's UGC will need to be confirmed.*
- *Sections of the cable route using the same proposed routes as Coumnagapple WF.*
- *Number of drainage crossings along all roadways.*

### 3.2 UGC Option B

UGC Option B - UGC from Dungarvan SS to Dyrick Hill WF utilizing sections of UGC in the national road (short section), primarily regional roads, and private lands - 16.8km

For the purposes of this report, Option B follows the same route as Option A until the UGC meets the junction between the N72 and the R672. From here the cable follows the same route as the propose Coumnagappul grid connection north. The UGC follows the R672 north for approx. 4,039m, encountering a number of ESB OHL and Irish water crossings. From here the UGC diverts Northwest onto a local road. The UGC follows this local road north for 2,030m, this section for the route has a number of ESB OHL crossings and must pass a busy industrial unit for Dungarvan Transport. A HDD would be required to pass an existing cattle underpass, concrete box culvert See Figure 8 below.



**Figure 8 - Cattle Underpass**

The UGC follows this local road west for a further 1,458m before encountering the second watercourse crossing of the route. Preliminary measurements taken indicate insufficient cover between the road and the arch, therefore a HDD is required to cross. This HDD would enter/exit within the road corridor. As this bridge is located on a bend on the road, the use of private lands may be required for the HDD drilling path. The UGC follows the local road for a further 2,926m before following the same route as seen in Option A from just after watercourse A6, for the remaining 5,074m.

Some Site Investigation works would likely need to be carried out on the proposed route as part of the design process in order to identify all services and select a final corridor for the new trench.

This grid connection option is shown as **UGC Option B** in **Drawings 05829-DR-001/017**

UGC Option B Constraints:

- Existing ESB UGCs installed at the entrance of Dungarvan Substation.
- Road opening Licences required.
- Section of the cable route installed in the N72.
- A general high amount of traffic using the route (N72).
- Consent from Waterford Co.Co. / TII to install the cable in the N72.
- No engagement with Waterford County Council has taken place regarding this proposal.
- 2 No. Bridge crossings with HDD required.
- Cattle Underpass requires HDD to cross.
- Potential Private landowner consent required for one HDD crossing.
- 2 No. Bridge crossings total
- Final location of Sunrise Energy Supply Limited's UGC will need to be confirmed.
- Sections of the cable route using the same proposed routes as Coumnagapple WF.
- Number of drainage crossings along all roadways.

### 3.3 UGC Option C

UGC Option C - UGC from Dungarvan SS to Dyrick Hill WF utilizing sections of UGC in the national road (short section), primarily regional roads, and private lands - 14.9km

For the purposes of this report, Option C follows the same route as Option B for approx. 13.5km until approx. 1,850m north of the Regional Road, R671. From here the UGC option C diverts east along a local road. Approx. 75m after the diversion the UGC route meets the third watercourse of the route. This watercourse is in the form of a stone arch bridge located on a bend in the road. There is approx. 150mm of cover from the road level to the top of the key stone, this would require a HDD to cross. This HDD crossing could be difficult due to the proximity of the bridge to the bend in the road and a private property located adjacent to the bridge (see Figure 9 below).





**Figure 9 - Watercourse C3 from the west**

After passing Watercourse C3 the UGC continues in the local road for a further 1,200m before meeting Watercourse C4. This watercourse is in the form of a double pipe culvert. This watercourse will be crossed using the standard culvert undercrossing method. From here the UGC exits the public road network and continues to the proposed wind farm substation via private lands.

Some Site Investigation works would likely need to be carried out on the proposed route as part of the design process in order to identify all services and select a final corridor for the new trench.

This grid connection option is shown as **UGC Option C** in **Drawings 05829-DR-001/017**

UGC Option C Constraints:

- Existing ESB UGCs installed at the entrance of Dungarvan Substation.
- Road opening Licences required.
- Section of the cable route installed in the N72.
- A general high amount of traffic using the route (N72).
- Consent from Waterford Co. Co. / TII to install the cable in the N72.
- No engagement with Waterford County Council has taken place regarding this proposal.
- 3 No. Bridge crossings with HDD required.
- Cattle Underpass requires HDD to cross.
- Potential Private landowner consent required for HDD crossings.
- 3 No. Bridge crossings total
- Final location of Sunrise Energy Supply Limited's UGC will need to be confirmed.
- Sections of the cable route using the same proposed routes as Coumragapple WF.
- Number of drainage crossings along all roadways.

## 4.0 Conclusions and Recommendations

The distance between Dungarvan 110kV Substation and the Dyrick Hill Wind Farm Substation is approx. 13km point to point. There is a very limited choice for a grid connection options for this location, due to the limited roads leading to the wind farm. The shortest/most direct options available was detailed in Section 3.0 Grid Connection Options. Within the constraints mapping carried out on AutoCAD and from initial site surveys it must be stated at this stage that there are significant constraints associated with the grid route options. Within the constraints mapping carried out on AutoCAD and from initial site surveys there are HV cables entering Dungarvan Substation from the south (N72). Although the position of the UGC's is detailed in the ESB network map data, these positions are indicative only. Site surveys and consultation with ESB would need to be completed as part of the design process in determining the actual position of these UGCs which would in turn determine the position of the proposed route for the new grid connection.

Dungarvan Substation is located in an urban area, however with the proximity to the industrial development of the Radley Engineering factory the area is prone to high volumes of traffic. It is also worth noting that Sunrise Energy Supply Limited have submitted a 10km UG grid connection for planning linking a solar farm in Cappoquin, Co. Waterford to the Dungarvan 110kV Substation (Planning Ref. 16/126) following a similar section of the N72 as chosen for this grid route. Discussions with Waterford County Co. Council on the proposed route will be key in ensuring that any proposed routes are feasible.

There are a number of bridge crossings to be negotiated in Option A. Bridge 1 & Bridge 3 would require a HDD in order to cross. There are number of drainage crossings to note along the entire route. Additional survey works will need to be completed on the preferred route selected to confirm the proposed crossing methods.

Option B utilises a shorter cable route to Option A between the Dungarvan 110kV substation and the Dyrick Hill wind Farm substation. Option B has much less constraints associated with the route.

A section of the recommended cable routes follows the same route as the proposed Coumnagappul WF 110kV grid connection. It follows the same route along the N72 and for a short section of the R672 for Option A and a longer section of the R672 for Option B and Option C. As a result, it may be worth combing the projects where possible to limit the amount of road opening licenses/road closures required.

While Option C may be the shortest of the 3 routes examined it does contain more HDD crossings to Option B and one being a difficult crossing to negotiate. While the route may be shorter to Option B the cost of the additional HDD and culvert crossing may outweigh the additional length required by Option B.

Routes to Cahir 110kV substation were analysed from a desktop point of view, however due to the substantial difference in length of cable required and the high volume of water course crossings it is the opinion of the consultant at this time that any route to Cahir substation would be very difficult. A minimum UGC length of 35km between Cahir 110kV Sub and Dyrick Hill WF could be found. The River Suir SAC would be particularly challenging to cross as all existing crossing points are located at very old bridge crossings (historically protected structures), located at. This would prove incredibly difficult to cross at these points, as a HDD would not be an option due to the lengths required to cross or bridges being located on very sharp bends in the road, entering/exiting outside the SAC. Any route to Cahir 110kV Substation would also be required to cross an Irish Railway track, which in the consultant's experience can prove very challenging.

The UGC route has been selected based on desktop analysis and initial site surveys and are indicative only. In order to design a final corridor for a potential UGC route, a detailed GPS survey would need to be carried out on the terrain. The UGC trench details will need to be designed to ensure that sufficient clearance distance is maintained between all hazards (existing UGCs, landowner boundaries, vegetation, etc.).

### **Recommendation**

At this stage of the process the first option is to progress UGC Option B as the grid connection option for the project. UGC Option B utilises as much public road as possible, while being the shorter of the two routes. Option B also encounters the least number of watercourse crossings required and utilises the least amount of cable in the National Primary Road (N72), which could prove difficult to gain council permission as the road has been recently resurfaced. However, the success of this grid connection option is dependent on landowner consent for the off-road UGC sections entering the wind farm and around the HDD locations of the route. Landowners should therefore be engaged at an early outset given the potential resistance to a new UGC in the area. It is the opinion of the consultant that the route selected provides minimal disruption to traffic as stop/go traffic management systems can be implemented on both the N72 and the R672. A detour would be required for the sections of UGC located in the local roads between the R672 and the wind farm.

The second option to progress is UGC Option A as the grid connection option for the project. UGC Option A utilises as much public road as possible. However, the success of this grid connection option is dependent on landowner consent for the off-road UGC sections entering the wind farm and around the HDD locations of the route. Landowners should therefore be engaged at an early outset given the potential resistance to a new UGC in the area. It is the opinion of the consultant that the route selected provides minimal disruption to traffic as stop/go traffic management systems can be implemented on both the N72 and the R671. A detour would be required for the sections of UGC located in the local roads between the R671 and the wind farm.