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38KV GRID CONNECTION FEASIBILITY REPORT KELLYSTOWN WIND FARM

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1.0 Background

TLI Group (the Consultant) were engaged by EDF Renewables (the Client) to identify and analyse potential 38kV grid connection options available for the Kellystown Wind Farm Project, north of Drogheda, Co. Louth. The Client indicated that the proposed grid connection point is Drybridge 110kV Substation.

Only underground cable (UGC) grid connection options were assessed as part of this feasibility study. The scope of work for the Consultant was therefore to identify potential 38kV UGC grid connection options between the Drybridge 110kV Substation and Kellystown Wind Farm.

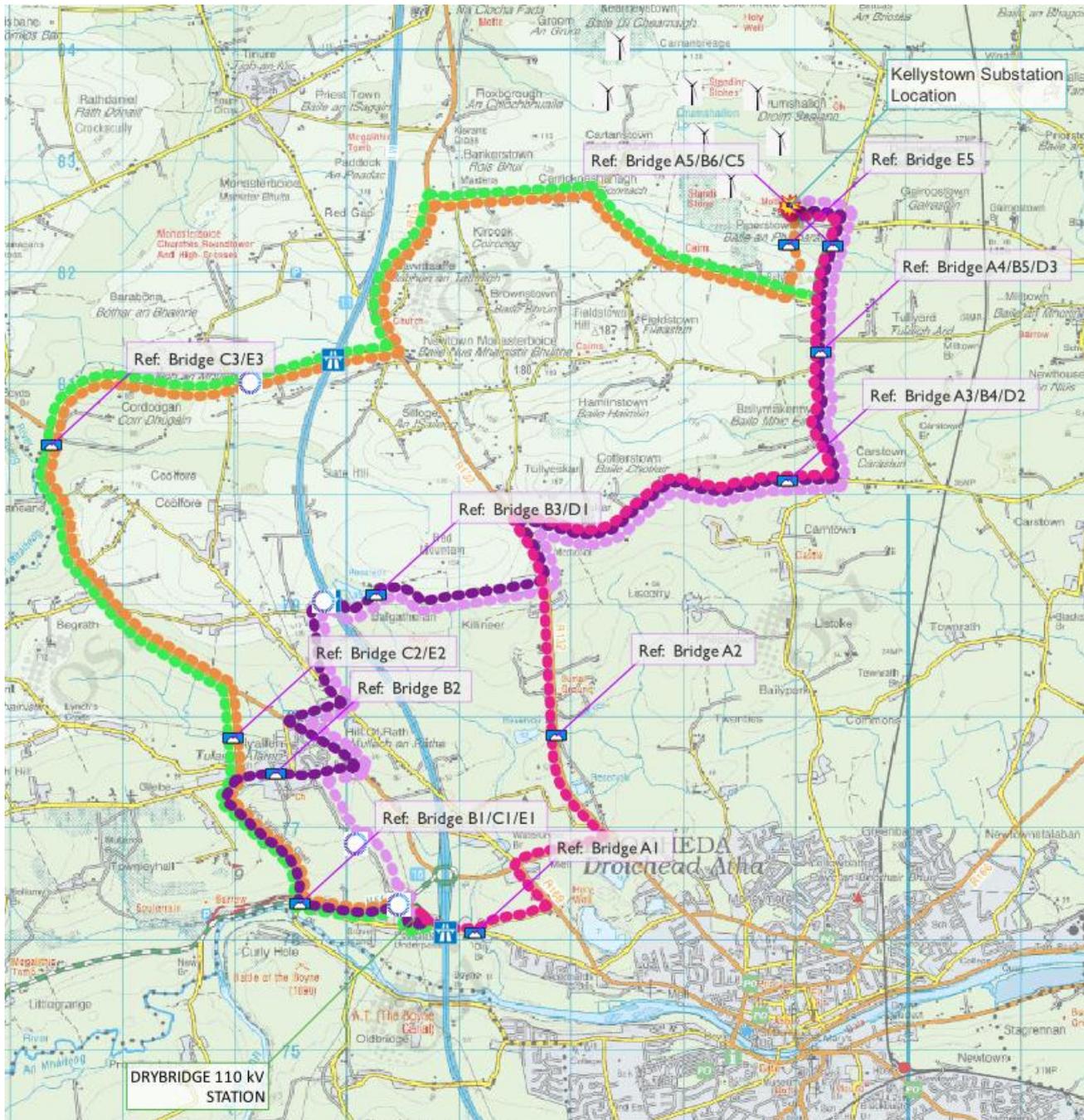


Figure 1 - Grid Route Options Overview

2.0 Route Development Overview

In order to identify potential grid connection options between the windfarm site and Drybridge 110kV Substation, a map series detailing the location of possible constraints within the study area was produced (see map series 05949-MS-001 to 05949-MS-008). For this purpose, publicly available databases were consulted regarding the following:

- Aerial imagery (Map Data: Google ©2022 Maxar Technologies)
- Road's network, including motorways, national, regional, and local roads (© OpenStreetMap contributors)
- Irish Rail network (© OpenStreetMap contributors)
- Electricity network (provided by ESBN)
- Gas network (provided by Gas Networks Ireland)
- Water distribution, wastewater, and stormwater networks (provided by Irish Water)
- Waterbodies (rivers, lakes, streams) made available by the Environmental Protection Agency
- Fluvial, coastal, pluvial, and historical flood maps made available by the Office of Public Works (OPW)
- Groundwater flood maps made available by Geological Survey Ireland
- Cultural heritage databases (Record of Monuments and Places (RMP), Record of Protected Structures (RPS), National Inventory of Architectural Heritage (NIAH), Architectural Conservation Areas) made available by the National Monuments Service
- Protected sites identified by the National Parks & Wildlife Service (NPWS) – Special Areas of Conservation (SAC), Special Protection Areas (SPA), and Natural Heritage Areas (NHA)
- Other environmental sensitive areas made available by the National Parks and Wildlife Service (NPWS) (Department of Housing, Local Government and Heritage), including ancient long-established woodlands, Margaritifera sensitive areas, among others.
- Granted planning applications taken from the national planning application database¹ provided by the Department of Housing, Local Government and Heritage (information is not up to date for all local authorities)

A desktop analysis was carried out using the study area constraints map to identify potential grid routes between the windfarm site and Drybridge 38kV Substation.

The feasibility assessment of the identified routes was then complemented with a high-level site survey.

2.1 Desktop Study Route Assessments

From an initial review of the study area, two potential UGC routes were explored. At this stage primarily public roads were considered to identify possible UGC routes.

The distance between Drybridge 110kV Substation and the proposed Kellystown wind farm site is approx. 7.2km, the selection of available public roads to utilise is very limited as a result. Figure 2 below illustrates the proposed routes, using the most direct routes. The proposed routes are presented on aerial imagery on map series 05949-MS-001 to 05949-MS-008.

From initial desktop surveys, it is very evident that the M1 motorway needs to be crossed, there are a number of watercourse crossings to be crossed along all routes.

Table 1 below contains the legend of the Red-Amber-Green assessment system used herein and Table 2 presents the initial aspects of the proposed routes.

Legend	Colour	Comparison with other routes
Low Potential Impact	●	Most Preferable
Medium Potential Impact	●	Acceptable
High Potential Impact	●	Least Preferable

Table 1: Constraint Assessment Legend

Assessment Criteria	UGC Options from Drybridge 110kV Substation to Kellystown WF									
	Option A		Option B		Option C		Option D		Option E	
Length	11.75	●	14.86	●	16.58	●	13.92	●	15.78	●
Length of Cable Route within Public Roads	11.11	●	13.65	●	16.02	●	11.25	●	14.88	●
Watercourse Crossings (insufficient Cover)	5 (2)	●	6 (5)	●	4 (3)	●	4 (3)	●	4 (2)	●

Table 2: Desktop Route Assessment – initial overview

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.

2.2 Technical Requirements Overview

Given the initial constraints identified in the desktop study, several requirements were outlined in order to inform the onsite survey for the cable routes, based on technical specifications from ESB and others, along with common best practices.

2.2.1 Other underground services

When crossing other electric power distribution cables, the UGC needs to be routed under the lower voltage cables for safety reasons. Additionally, when there is a need to cross (over or under) or run in parallel with an existing circuit, the cable system must be designed to ensure that no de-rating of existing circuits occurs as a result of the new proposed cable – detailed cable modelling and rating calculations need to be carried out to demonstrate this.

Additionally, according to ESB specifications, a minimum standard clearance of 300 mm must be maintained between the ESB ducts (power or communications) and all other services. In any case, if greater clearance (such as in the case of high-pressure gas pipes where it is 600mm) or any mitigation measures need to be installed on the UGC circuit or on related assets, as dictated by the authorities responsible for other utilities, these need to be adhered to.

2.2.2 Watercourse crossings

Regarding bridge crossings, based on ESB specifications, in order to install a cable on the bridge deck, the minimum depth required for a 38kV circuit cable trench is 675mm. This will be the minimum depth to be observed below the carriageway surface level, above the deck support element – the keystone in masonry arch bridges for example. This minimum depth also applies in the event of crossings above culverts.

When there is enough cover measured on the initial survey, a full survey shall be carried out afterwards regardless, including trial holes and bore holes as required, in order to ascertain the characteristics of the existing infrastructure.

When there's not enough cover available (675mm minimum), trenchless technology such as HDD (Horizontal Directional Drilling) is an alternative that allows for duct installation under the length of the bridge or culvert – this can/will result in cable de-rating. If there are Special Areas of Conservation in the vicinity of the watercourse, there is the potential of contaminating these Areas if precautionary measures aren't considered – for example, drilling beneath watercourses to a minimum of 1.5m depth from base of watercourse as per guidelines from Inland Fisheries Ireland.

Where the required level of cover is not available, it may be agreeable with the local roads engineers to raise the existing road level of the bridge deck. This will also require, in most cases, that the bridge parapet be raised in accordance with minimum standards.

In all events, the respective county council roads engineer will have to be consulted in order to determine the most acceptable crossing method and road works limitations.

For the purposes of this report the naming convention for each watercourse will be associated with the route option and the order in which the watercourse is encountered. For example, the 4th watercourse encountered on option C would be named Watercourse C4.

When a watercourse is encountered by multiple route options the name will be stacked.

2.2.3 Identification of areas with environmental designations

It is not an objective of this report to replace or reach the same level of detail as a dedicated environmental impact assessment, but only to bring to attention designated areas of environmental interest (according to information in the publicly available databases mentioned previously) and possible technical constraints arising from the proposed routes traversing or being in the vicinity of such areas. Ideally, these areas are avoided altogether.

2.3 Initial Site Survey

Each of the proposed routes was driven in their entirety and survey notes and photographs taken using ArcGIS Survey123 app. As part of the initial feasibility survey, the focus was to identify 'show-stopper' issues, such as bridges with no feasible options to cross with underground cables or other issues, which would preclude those route options from being considered further or which would demand the procurement of private land for suitable crossings. Gathered and assessed survey points are depicted in Figure 2 below.

To note that there was no survey conducted onsite regarding third party underground services crossing or running parallel with the proposed routes, all such notes below are derived solely from the desktop

analysis of the respective databases and are depicted with markers for ease of representation. For a more detailed representation, please see map series 05918-MS-001 to 05918-MS-017.

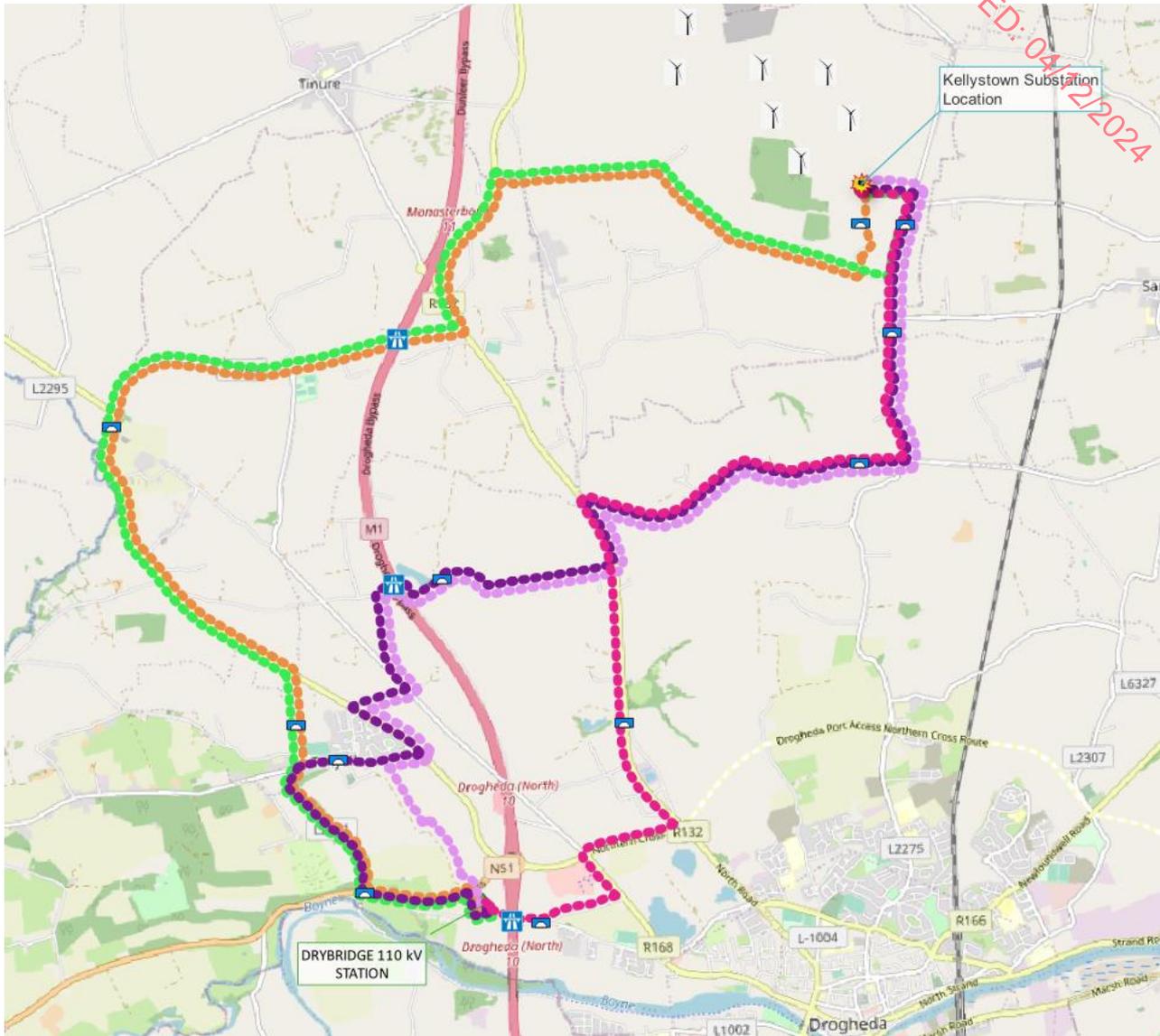


Figure 2 - Grid Route Options with Major Constraints

Legend:

Kellystown Wind Farm Site	Drybridge 110kV SS
Option A (Dashed Pink)	Option B (Dashed Purple)
Option C (Dashed Green)	Option D (Dashed Lilac)
Option E (Dashed Orange)	Motorway Crossing
Gas Networks Ireland Crossing	Bridge

Some constraints are common to all routes:

- Consultation needed with ESB to establish an UGC route into Drybridge 38kV Substation;
- Possible conflict or de-rating issues with other UGC entering Drybridge 38kV Substation;
- Road opening licenses and Traffic management obligations.

3.0 Grid Connection Route Options to Drybridge 110kV Substation

3.1 Option Comparison

The main parameters of each of the routes surveyed is summarised in Table 3. Consideration is given for the route distance in types of public road, the number of watercourse crossings by bridge, the number of crossings with motorway (M1), intersections with national monument zones of notification and with national architectural heritage, and the number of private land folios required where HDD crossings are not possible from road-to-road.

In the following sections, each of the five route options are discussed along with mapping and a summary table of the main constraints.

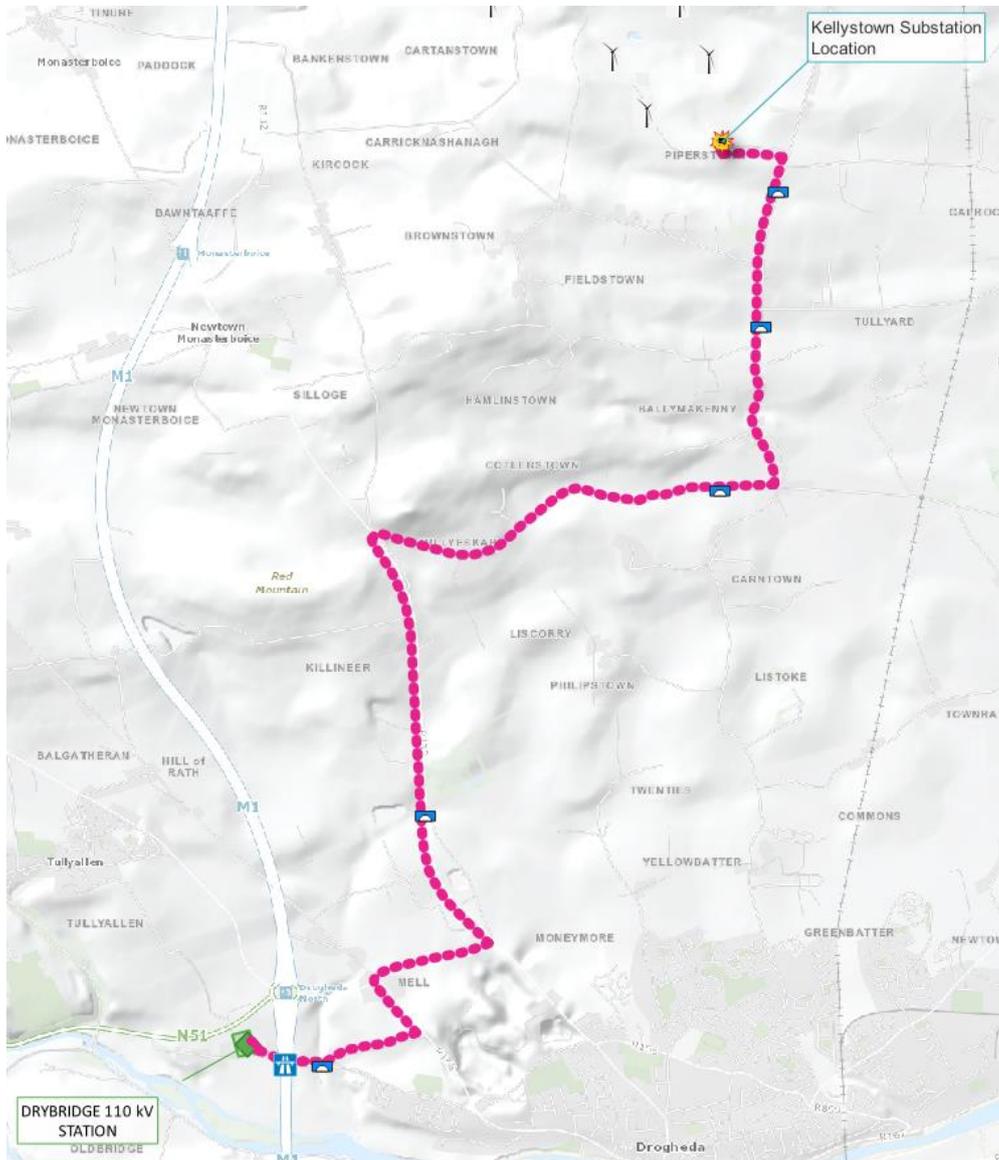
Assessment Criteria		UGC Options from Drybridge 110kV Substation to Kellystown WF									
		Option A		Option B		Option C		Option D		Option E	
Road Usage	Overall Length [km]	11.75	●	14.86	●	16.58	●	13.92	●	15.78	●
	Length of Cable Route within Public Roads [km]	11.11	●	13.65	●	16.02	●	11.25	●	14.88	●
	National Roads [km]	0.86	●	0.95	●	0.95	●	0.03	●	0.95	●
	Regional Roads [km]	3.60	●	1.36	●	7.92	●	1.36	●	7.92	●
	Local Roads [km]	6.65	●	11.34	●	7.16	●	9.87	●	6.02	●
	Route length within private lands [km]	0.64	●	1.21	●	0.56	●	2.67	●	0.90	●
Road Length narrower than two lanes [km]		0.70	●	-	●	-	●	1.80	●	-	●
Private Land Folios		1	●	6	●	1	●	17	●	1	●
Pinch Points possibly requiring third party engagement		1	●	1	●	-	●	2	●	1	●
Watercourse Crossings	Bridged Watercourse Crossings (insufficient cover)	5 (2)	●	6 (5)	●	4 (3)	●	4 (3)	●	4 (2)	●
	Drains/ Culverts (HDD)	3 (1)	●	3 (1)	●	1 (1)	●	3 (1)	●	1 (1)	●
Monuments and Heritage (ZoN)		5 (4)	●	6 (3)	●	6 (5)	●	12 (6)	●	6 (5)	●
Gas Networks Ireland Crossings		0	●	2	●	2	●	2	●	2	●

Table 3: Comparison Table of Main Route Options

3.2 Option A (Dashed Pink) – Drybridge 110kV Substation to Kellystown Wf – 11.75km 3.2.1 Route description and technical constraints

This UGC route has been identified between Drybridge 110kV Substation and the proposed Wind Farm. This UGC route is 11.75km long and follows primarily the public local road network to the wind farm site entrance.

This grid connection option is shown as UGC Option A on drawings 05949-MS-001 to 05949-MS-004.



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Figure 3: Route Option A Map

The UGC exits the Drybridge substation through the existing substation access track to the south for approx. 100m. After leaving the Drybridge substation, the route follows east on the Slane Road, local road. A few key points are of note in this section:

- Existing underground cables running in the southern verges of this road, minimum separation will need to be maintained from these cables, as per the HSA Code of Practice for Avoiding Danger from Underground Services;
- with current information, available space should not be an issue as the road is two-lane wide (~7m wide); this will need to be confirmed prior to the commencement of works.

- being a local road serving as a means to nearby residence may raise some opposition to works on this road – a road opening license will be sought from the local authorities roads department, to lessen the impact. Appropriate traffic management systems will be outlined prior to works commencing.

The UGC follows the Slane Road east for approximately 125m before entering a motorway underpass, a narrow single lane local road (approx. 2.5m wide), which would need to be closed during construction works. Existing scarring on the road indicates the presence of existing UGC located in the vicinity of the underpass. From ESB utility mapping, it can be seen that the UGC is taken offline of the road carriageway to the south of the underpass. A HDD may be required to pass under the motorway. Early engagement with TII (Transport Infrastructure Ireland) would be advised in order to determine the best method of crossing.



Figure 4 - M1 Underpass

After exiting the underpass, the UGC continues east in the Slane Road for a further 165m, before meeting the first watercourse crossing of the route. This watercourse [A1] is in the form of a stone arch bridge with approximately 1500mm of cover between the keystone and the road. It is proposed to cross this bridge utilising a flat formation trench within the bridge deck. It is evident that other services are already located within the bridge deck. This bridge is located adjacent to an Irish Water treatment facility.

The UGC continues for approximately 60m before diverting northeast into the Barrack Lane, single lane local road. The UGC maintains its course within this local road for approximately 675m. The Barrack Lane would require a full road closure for the duration of the works. Where the Barrack Lane meets the R168,

on the southwest and southeast sides of the junction, a Ritual Site – holy stone and Ritual Site – holy well are present. The Zone of Notification (ZoN) for the two historic sites encroach on the junction. A shallow flat formation trench may be required to traverse this junction.

The UGC enters the R168, Regional Road and continues northwest for 784m. This section of the route would share the road with existing ESB and Irish Water underground infrastructure. From here the UGC follows the R166, Regional Road to the east for approximately 850m. Currently the Port Access Northern Cross Route is being developed as part of a relief road connecting the port to the east of Drogheda to the national road scheme, N51. The alignment of the proposed cable will need to be cognizant of this future road alignment.

The UGC carries north onto the R132, Regional Road. The UGC follows the R132 for 1,000m before encountering the second watercourse [A2] of the route. This bridge will be crossed using a flat formation trench. There is also an Irish water main within the bridge. The UGC continues north in the R132 as far as the junction with the Cockle Road. The UGC must traverse a ZoN for Church & Graveyard and a drain that is located approximately 2,000mm below the road deck, 50m before the junction. These will be crossed using a shallow flat formation and the standard culvert crossing detail respectfully.

Approximately 2,850m east along the Cockle Road the UGC encounters the third watercourse of the route [A3/B4/D2]. This bridge has no visible structure above road level. There is approximately 1,700mm from the road level to the top of the key stone. It is proposed to cross this bridge using a flat formation trench within the bridge deck. The UGC follows the Cockle Road east for a further 390m before entering the L2275, Ballymakenny Road and heading north in the direction of the wind farm. The UGC follows this local road north for approximately 2,434m. This section of the UGC encounters 2 No. watercourse, 2 No. culverts and 2 No. ZoN. The 2 No. ZoN form part of a Church/Graveyard 390m after joining the L2275. The 2 zones cover 110m of the local road, a shallow flat formation trench is proposed to traverse this section of the route. Approximately 60m after the ZoN the UGC meets a drainage culvert, this will be crossed using the standard culvert crossing method. Continuing on the L2275, the UGC meets the fourth watercourse [A4/B5/D3]. This bridge presents with less than 500mm of cover between the keystone and the road level.

A HDD would be required to cross this bridge. It is proposed to HDD within the road corridor. Circa 220m after watercourse A4, the UGC meets a dry stone culvert. This culvert is in very poor condition and would most likely need a HDD to cross to avoid causing further damage to the structural integrity of the culvert. Circa 740m north the UGC meets the final watercourse [A5/B6/C4/D4] of the route. This watercourse is in the form of a stone double box arch bridge. The bridge presents with approximately 250mm of cover between the keystone and the road level. A HDD would be recommended to cross this structure. There is a grass verge on both sides of the road, the local authority may be agreeable to a flat formation crossing with a raised verge level or footpath detail. The UGC continues in the L2275 for a further 310m before entering a privately owned access track which leads to the proposed wind farm substation location.

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Figure 5 - Bridge A5/B6/C4/D4

3.2.2 Identification of flood risk areas

National Indicative Fluvial Mapping shows that the area surrounding the Drogheda Corporation Water Works Reservoir, has a flood zone associated with the respective rivers channels. All zones showing low to high probability of flooding. Although the expected areas of the cable trench would be outside of the flood plain and should have minor impacts, it is recommended that flood assessment take place as part of the planning process.

3.2.3 Identification of areas with environmental designations

No areas with environmental designations are traversed by this route according to the previously mentioned public databases.

3.2.4 Key takeaways

Option 1 Key takeaways

1. Route length = 11.75km (shortest route)
2. Consultation needed with ESB to establish an UGC route into Drybridge 110kV Substation.

Option 1 Key takeaways

3. Early engagement required with TII regarding M1, motorway crossing.
4. Third party engagement may be required at motorway crossing, should there be inadequate space with existing services.
5. Consultation with Transport Infrastructure Ireland (TII) and National Roads Authority (NRA) required for sections around the R166 and R132, which will form part of the permitted Port Access Northern Cross Route (PANCR)
6. Road opening licenses and Traffic management obligations.
7. Existing underground services crossings (water, MV circuit) and running parallel (MV Circuits, water) along the route, however sufficient space to allow for adequate clearance should not be an issue.
8. Route runs parallel and crosses Irish water infrastructure along the grid connection.
9. 3 No. HDD crossings required for bridges/culverts.
10. Narrow road sections along the route will be impassable during construction. Road closures would be required.
11. Zone of notification of a listed monument is traversed, which will require consideration during planning and construction stages to prevent damage.

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3.3 Option B (Dashed Purple) – Drybridge 110kV Substation to Kellystown WF – 14.84km 3.3.1 Route description and technical constraints

This UGC route has been identified between Drybridge 110kV Substation and the proposed Wind Farm. This UGC route is 14.84km long and follows primarily the public local road network in the direction of the wind farm site entrance.

This grid connection option is shown as UGC Option B on drawings 05949-MS-001 to 05949-MS-005.

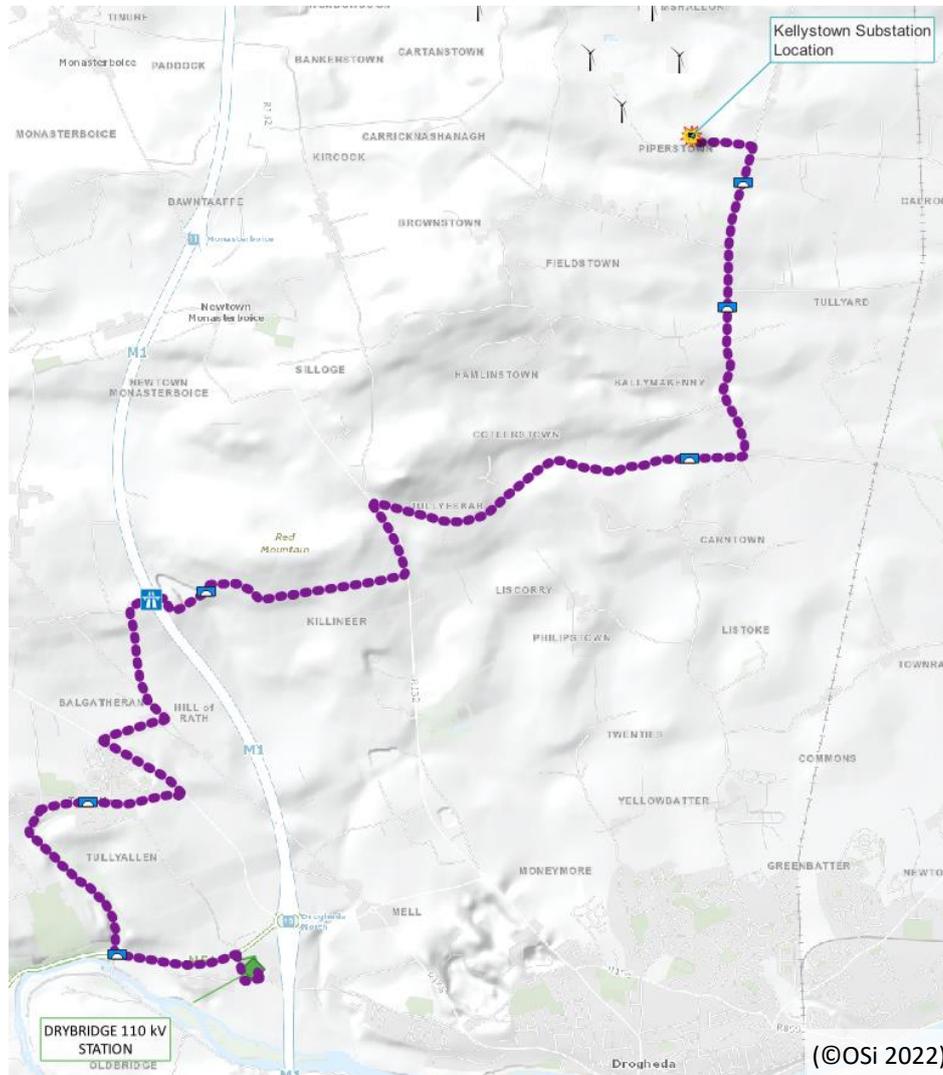


Figure 6: Route Option B Map

The UGC exits the Drybridge substation through the existing substation access track to the south for approx. 100m. After leaving the Drybridge substation, the route follows West on the Slane Road, local road. A few key points are of note in this section:

- Existing underground cables running in the southern verges of this road, minimum separation will need to be maintained from these cables, as per the HSA Code of Practice for Avoiding Danger from Underground Services;
- with current information, available space should not be an issue as the road is two-lane wide (~7m wide); this will need to be confirmed prior to the commencement of works.
- being a local road serving as a means to nearby residence may raise some opposition to works on this road – a road opening license will be sought from the local authorities’ roads department, to

lessen the impact. Appropriate traffic management systems will be outlined prior to works commencing.

The UGC follows the Slane Road west for circa 120m before following local road, L2322, north as far as the National Road (N51). The UGC carries west and immediately meets a high pressure gas main which will need to be crossed. Following the N51 for a further 890m, the UGC encounters the first watercourse [B1/C1/E1] of the route. This bridge is in the form of a precast concrete U-beam bridge with no visible structure above road level, that crosses the Tulaigh Álainn which is a tributary to the Boyne River. This bridge crossing will be a very challenging crossing as it is located on a crossroads. The western side of the bridge forms part of the River Boyne and River Blackwater SAC. The bridge structure has no visible clearance between the keystone and the road level, which would indicate a HDD would be required, however a HDD launch/receptor pit located with the SAC would likely be unacceptable from an environmental point of view. Similar to that of Bridge [A5/B6/C4], the local authority may be accepting of raising/installing a footpath detail to facilitate the installation of the cable within the bridge deck, however with the minimal available cover, it may be required to raise the current level by 650mm.

After passing the bridge the UGC exits the N51 and heads north along the L2321, Local Road. The majority of this section falls within the River Boyne and River Blackwater SAC. The UGC passes in close proximity to a military camp historic ZoN. This section of the route would require a full road closure to facilitate the trenching works. After leaving the L2321, the UGC L2318 local road and through the village of Tullyallen. This being a residential area, there are several existing underground services located within the L2318 (medium pressure gas, Irish water mains & Eir). There is 1 No. watercourse crossing [B2] within this section. This watercourse is in the form of a stone double arch bridge crossing the Tulaigh Álainn. This bridge has minimal cover (circa 70mm). The previously mentioned services are all contained within the bridge deck. It is proposed to cross this bridge utilising a HDD. The HDD would be contained within the road corridor. The UGC would then continue to the R168, regional road. The UGC follows the R168 northwest for approximately 710m again sharing the road with Irish water infrastructure and medium pressure gas lines.

The UGC joins the Barrahoule Lane and heads east as far as the L6322 local road, where it converges onto this local roadway to carry northwest for a short section before entering a single lane local road [L6312] to the north east. The UGC follows this local road as far as the M1 motorway crossing. It is proposed to utilise a HDD in private lands to cross the M1 motorway at this point. A high-pressure gas line runs parallel to the M1 motorway on the western side, this would also need to be crossed. On the eastern side of the M1 motorway, the UGC uses private lands and re-enters the local road [L6311] and continues east beside the Barnattin Reservoir.

At the most easterly point of the reservoir, the UGC meets the third watercourse crossing of the route [B3/D1]. This watercourse is in the form of concrete shuttered double arch bridge, with approximately 600mm of cover between the arch and the road level. This bridge would require a HDD to cross due to the insufficient cover above the bridge arches. The HDD would be contained within the road corridor.



Figure 7 - Bridge B3/D1 from the north

The UGC follows this local road east as far as the R132, regional road. From here the UGC follows the same route as discussed in Option A and encounters the same remaining constraints, as far as the wind farm site.

3.3.2 Identification of flood risk areas

No identified flood risk areas are traversed by this route according to the previously mentioned public databases.

3.3.3 Identification of areas with environmental designations

Sections of the route encroach and traverse areas with environmental designations according to the previously mentioned public databases. These areas include but are not limited to:

- River Boyne and River Blackwater SAC
- River Boyne and River Blackwater SPA

3.3.4 Key takeaways

Option 2 Key takeaways
1. Route length = 14.84km
2. Consultation needed with ESB to establish an UGC route into Drybridge 110kV Substation.
3. Early engagement required with TII regarding M1, motorway HDD crossing.
4. Third party engagement will be required at motorway crossing.
5. Road opening licenses and Traffic management obligations.
6. Existing underground services crossings (water, MV circuit) and running parallel (MV Circuits, water) along the route, however sufficient space to allow for adequate clearance should not be an issue.
7. Route runs parallel and crosses Irish water infrastructure along the grid connection.
8. 4 No. HDD crossings required for bridges/culverts.

Option 2 Key takeaways

9. Narrow road sections along the route will be impassable during construction. Road closures would be required.

10. Zone of notification of a listed monument is traversed, which will require consideration during planning and construction stages to prevent damage.

11. Consultation needed with Gas Networks Ireland for 2 No. high pressure gas mains crossings.

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3.4 Option C (Dashed Green) – Drybridge 110kV Substation to Kellystown WF – 16.55km

3.4.1 Route description and technical constraints

This UGC route has been identified between Drybridge 110kV Substation and the proposed Wind Farm. This UGC route is 16.55km long and follows primarily the public local road network in the direction of the wind farm site entrance.

This grid connection option is shown as UGC Option B on drawings 05949-MS-001 & 05949-MS-005 to 05949-MS-005.

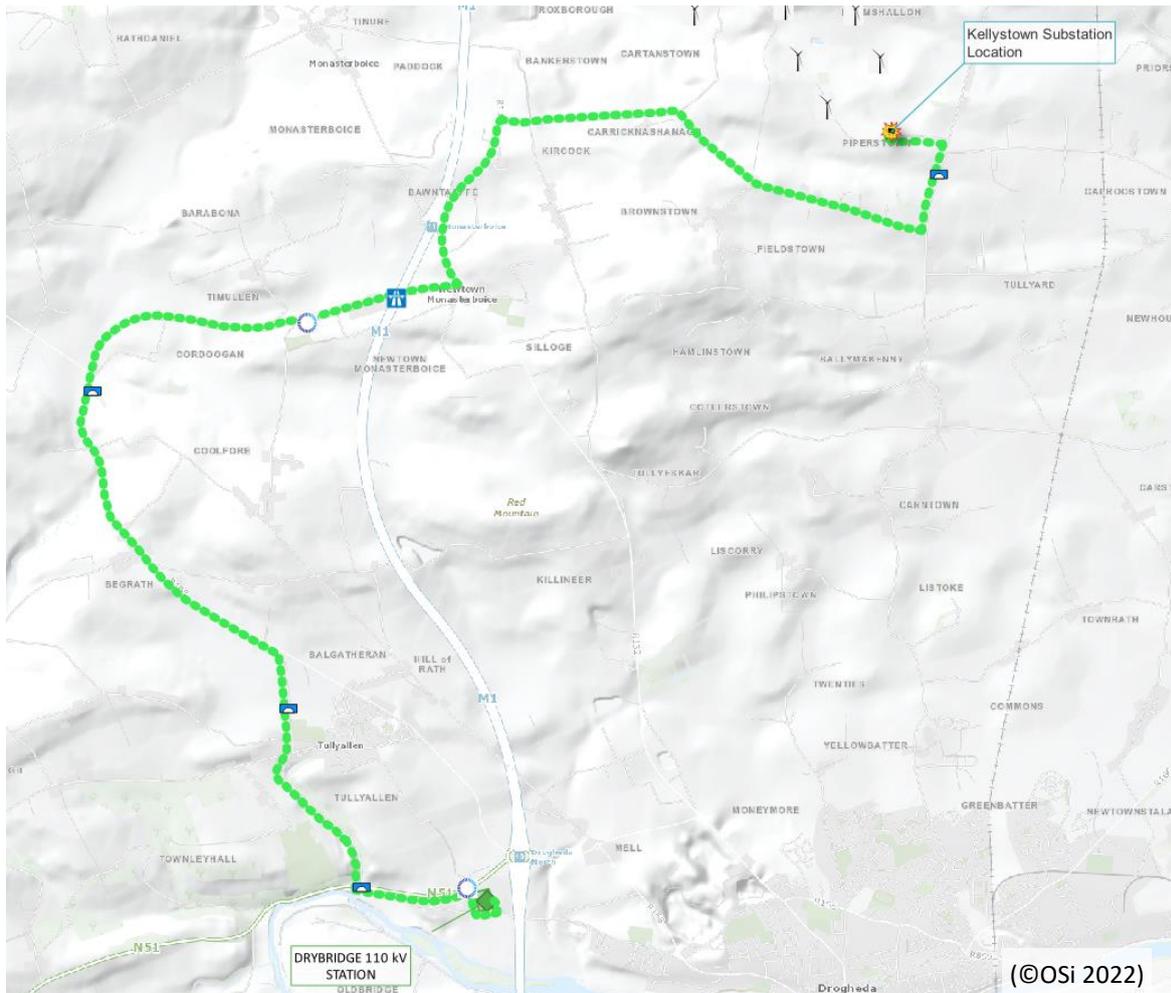


Figure 8: Route Option C Map

The UGC exits the Drybridge substation through the existing substation access track to the south for approx. 100m. After leaving the Drybridge substation, the route follows the same route as discussed for Option B, as far as the L2318, Tullyallen. A few key points are of note in this section:

- Existing underground cables running in the southern verges of this road, minimum separation will need to be maintained from these cables, as per the HSA Code of Practice for Avoiding Danger from Underground Services;
- with current information, available space should not be an issue as the road is two-lane wide (~7m wide); this will need to be confirmed prior to the commencement of works.
- being a local road serving as a means to nearby residence may raise some opposition to works on this road – a road opening license will be sought from the local authorities’ roads department, to

lessen the impact. Appropriate traffic management systems will be outlined prior to works commencing.

Once the UGC route meets the L2318, the cable will continue north and remain in the L2321, passing the Tullyallen National School and the Glen Emmets GAA club. Circa 115m after the GAA club, the UGC encounters the second watercourse of this option. This watercourse [C2/E2] is in the form of a bridge with approximately 1300mm of cover between the bridge and the road level. A standard trefoil trench will be used to cross this bridge, staying within the road deck. The UGC continues north in the R168, as far as the L2299. This section of the encounters 1 No. Watercourse crossing [C3/E3], this watercourse is in the form of a stone arch bridge in poor condition. The existing bridge structure has some maturing vegetation that will need removal prior to works. There is approximately 500mm of cover in the bridge deck, therefore a HDD would be required to cross this structure.

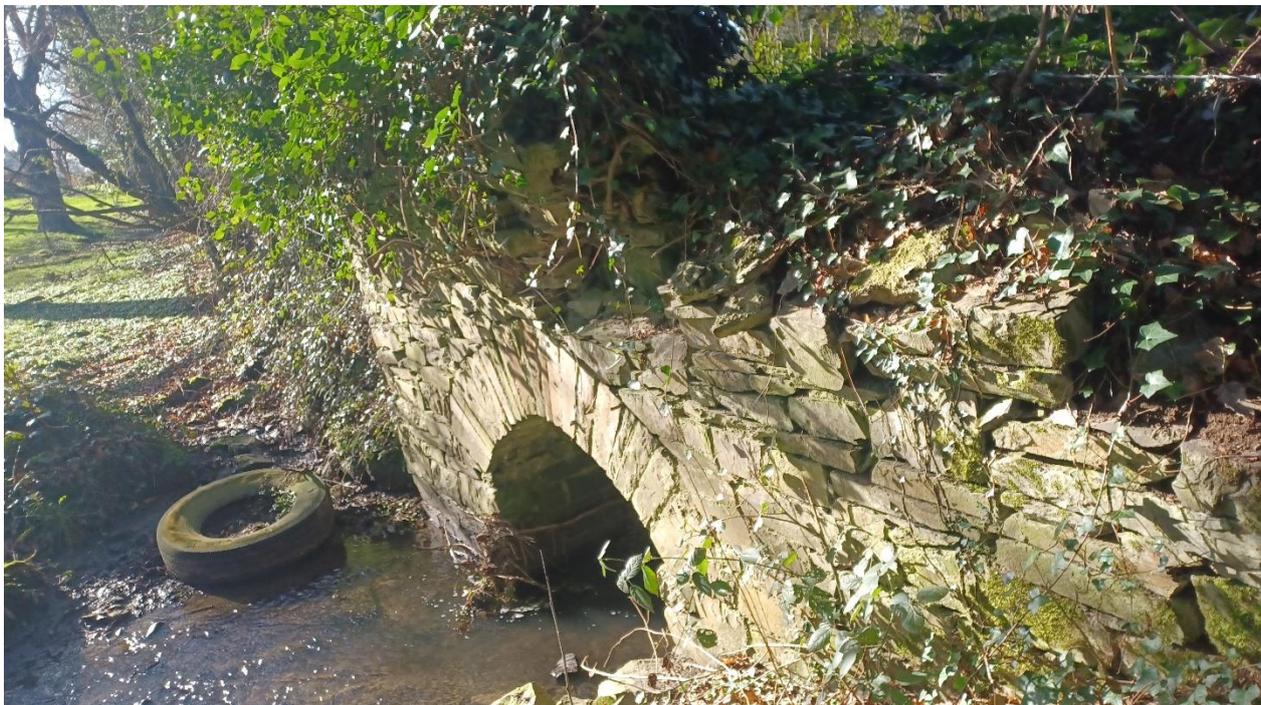


Figure 9 - Bridge C3/E3

Within the L2299 and before the UGC meets the R132, the UGC must cross a high-pressure gas pipeline and the M1 motorway. The gas pipeline will be crossed by means of a HDD. The L2299 under crosses the M1 motorway, a standard trench would be maintained for this section. There is 1 No. culvert crossing between the motorway and the R132, this culvert is a pipe culvert with approximately 1200mm of cover, this will be over crossed.

After entering the R132, the UGC follows the road northeast. This section of the regional road will converge with a slip road of the M1 motorway. It is proposed to stay in the western verge of the R132 as far as the start of the motorway slip road before crossing to the eastern verge, this will aid with traffic disruption.

A ZoN for a church & enclosure extends over a section of the R132 road where the regional road meets the motorway slip. This may require a shallow flat formation trench.

The UGC follows the R132 as far as the L6286 local road. The UGC then follows the L6286 east as far as the L2275. This section of the route encounters 1 No. stone u-beam culvert, a HDD would be required to

pass this culvert as the road has been built up directly on top of the culvert. The UGC follows the L6286 east and must cross the ZoN of a Church/ graveyard. Again the UGC may have to utilise a shallow flat formation trench for this 130m section. The UGC follows the L6286 as far as the L2275, and follows the same course as discussed in Options A & B.

3.4.2 Identification of flood risk areas

National Indicative Fluvial Mapping shows that the area along the western side of the R168, adjacent to the Mattock river, has a flood zone associated with the respective river. All zones showing low to medium probability of flooding. Although the expected areas of the cable trench would be outside of the flood plain and should have minimal impacts, it is recommended that flood assessment take place as part of the planning process.

3.4.3 Identification of areas with environmental designations

Sections of the route encroach and traverse areas with environmental designations according to the previously mentioned public databases. These areas include but are not limited to:

- River Boyne and River Blackwater SAC
- River Boyne and River Blackwater SPA

3.4.4 Key takeaways

Option 3 Key takeaways
1. Route length = 16.55km (longest route, shortest route is 11.69km)
2. Consultation needed with ESB to establish an UGC route into Drybridge 110kV Substation.
3. Road opening licenses and Traffic management obligations.
4. Existing underground services crossings (water, MV circuit) and running parallel (MV Circuits, water) along the route, however sufficient space to allow for adequate clearance should not be an issue.
5. Route runs parallel and crosses Irish water infrastructure along the grid connection.
6. 4 No. HDD crossings required for bridges/culverts.
7. Narrow road sections along the route will be impassable during construction. Road closures would be required.
8. Zone of notification of a listed monument is traversed, which will require consideration during planning and construction stages to prevent damage.
9. Consultation needed with Gas Networks Ireland for 2 No. high pressure gas mains crossings.

3.5 Option D (Dashed Lilac) – Drybridge 110kV Substation to Kellystown WF – 13.90km

3.5.1 Route description and technical constraints

This UGC route has been identified between Drybridge 110kV Substation and the proposed Wind Farm. This UGC route is 13.90km and follows the public local road network, regional, local roads and utilises section of private lands in the direction of the wind farm site entrance.

This grid connection option is shown as UGC Option D on drawings 05949-MS-001, 05949-MS-003 to 05949-MS-005.

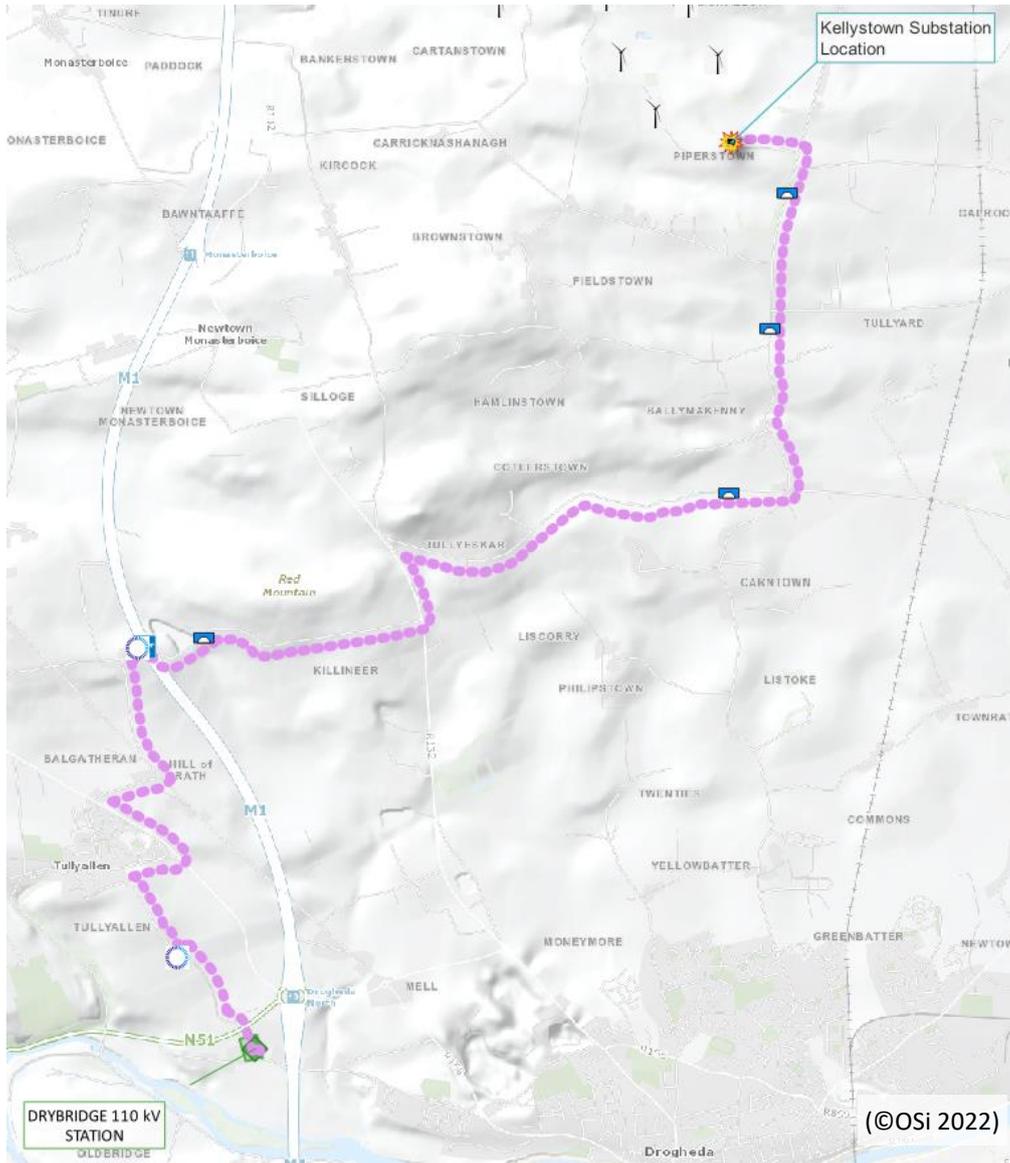


Figure 10: Route Option D Map

The UGC exits the Drybridge substation through the existing substation access track to the south for approx. 100m. After leaving the Drybridge substation, the route follows the same route as discussed for Option B, as far as the L2318, Tullyallen. A few key points are of note in this section:

- Existing underground cables running in the southern verges of this road, minimum separation will need to be maintained from these cables, as per the HSA Code of Practice for Avoiding Danger from Underground Services;
- with current information, available space should not be an issue as the road is two-lane wide (~7m wide); this will need to be confirmed prior to the commencement of works.

being a local road serving as a means to nearby residence may raise some opposition to works on this road – a road opening license will be sought from the local authorities roads department, to lessen the impact. Appropriate traffic management systems will be outlined prior to works commencing.

Option D follows the same route as discussed in Option B as far as the intersection with the N51, National Road. From the N51, the UGC continues north into a privately owned access track. The access track is followed north towards Tullyallen, crossing a gas main. The UGC re-joins the public road network via a local road serving the Church of Our Lady of Assumption, Tullyallen. This church possesses a 6 No. of sites & monuments records and 1 No. site of architectural heritage, all contained within a ZoN. This zone encompasses the local road. The UGC then enters the L2318, Local Road after watercourse B2. This route through the privately owned access track removes the need for the 2 No. watercourses encounters in the opening sections of Option B.

From here Option D follows the same route as discussed for Option B an encounters the same constraints.

3.5.2 Identification of flood risk areas

No identified flood risk areas are traversed by this route according to the previously mentioned public databases.

3.5.3 Identification of areas with environmental designations

No areas with environmental designations are traversed by this route according to the previously mentioned public databases.

3.5.4 Key takeaways

Option 3 Key takeaways
1. Route length = 13.90km (longest route is 16.55km, shortest route is 11.69km)
2. Consultation needed with ESB to establish an UGC route into Drybridge 110kV Substation.
3. Early engagement required with TII regarding M1, motorway HDD crossing.
4. Third party engagement will be required at motorway crossing.
5. Road opening licenses and Traffic management obligations.
6. Existing underground services crossings (water, MV circuit) and running parallel (MV Circuits, water) along the route, however sufficient space to allow for adequate clearance should not be an issue.
7. Route runs parallel and crosses Irish water infrastructure along the grid connection.
8. 3 No. HDD crossings required for bridges/culverts.
9. Narrow road sections along the route will be impassable during construction. Road closures would be required.
10. Zone of notification of a listed monument is traversed, which will require consideration during planning and construction stages to prevent damage.
11. 17 No. privately owned folios to be crossed along this route. Positive early landowner engagement is crucial to the success of this route option.

3.6 Option E (Dashed Orange) – Drybridge 110kV Substation to Kellystown WF – 15.76km

3.6.1 Route description and technical constraints

This UGC route has been identified between Drybridge 110kV Substation and the proposed Wind Farm. This UGC route is 15.76km and follows the public local road network, regional, local roads and utilises section of private lands in the direction of the wind farm site entrance.

This grid connection option is shown as UGC Option D on drawings 05949-MS-001, 05949-MS-005 to 05949-MS-008.

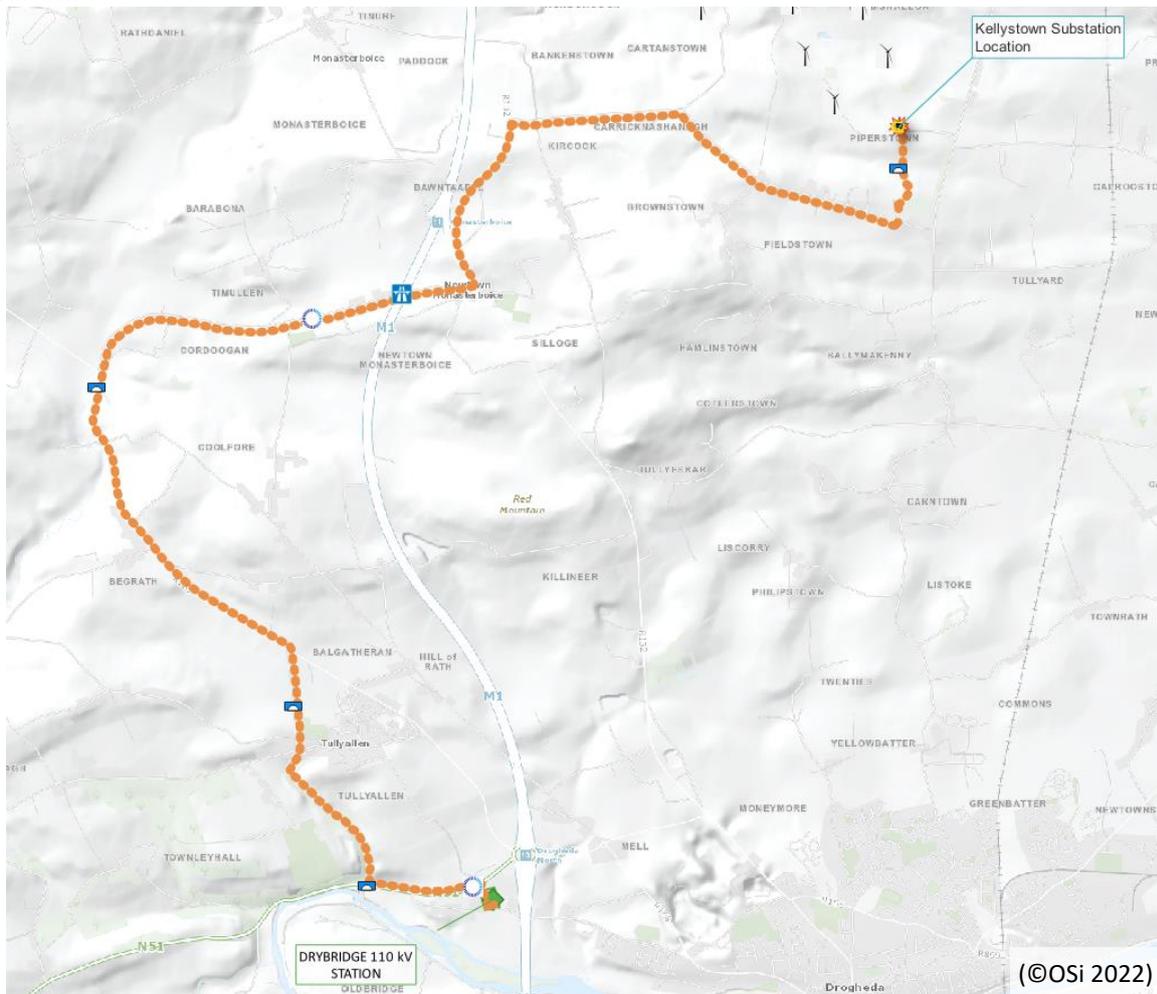


Figure 11: Route Option E Map

The UGC exits the Drybridge substation through the existing substation access track to the south for approx. 100m. After leaving the Drybridge substation, the route follows the same route as discussed for Option C, as far as the L6286. A few key points are of note in this section:

- Existing underground cables running in the southern verges of this road, minimum separation will need to be maintained from these cables, as per the HSA Code of Practice for Avoiding Danger from Underground Services;
 - with current information, available space should not be an issue as the road is two-lane wide (~7m wide); this will need to be confirmed prior to the commencement of works.
- being a local road serving as a means to nearby residence may raise some opposition to works on this road – a road opening license will be sought from the local authorities’ roads department, to lessen the impact. Appropriate traffic management systems will be outlined prior to works commencing.

Option D follows the same route as discussed in Option C as far as the L6286, Local Road. The key point of difference is an alternative entry into the wind farm. The Option E UGC exits the public road network before the L2275 and enters a privately owned access track. By doing this the UGC avoids the local authority reinstatement requirements associated with utilising the public road and the requirement for a HDD of watercourse A6/B6/C4. While Option does encounter a watercourse within the privately owned access track. It may be possible to dam and flume the Piperstown Stream 06 rather than requiring a HDD. After the stream crossing the UGC continues within the privately owned lands to the wind farm.

3.6.2 Identification of flood risk areas

National Indicative Fluvial Mapping shows that the area along the western side of the R168, adjacent to the Mattock river, has a flood zone associated with the respective river. All zones showing low to medium probability of flooding. Although the expected areas of the cable trench would be outside of the flood plain and should have minimal impacts, it is recommended that flood assessment take place as part of the planning process.

3.6.3 Identification of areas with environmental designations

Sections of the route encroach and traverse areas with environmental designations according to the previously mentioned public databases. These areas include but are not limited to:

- River Boyne and River Blackwater SAC
- River Boyne and River Blackwater SPA

3.6.4 Key takeaways

Option 3 Key takeaways
1. Route length = 13.90km (longest route is 16.55km, shortest route is 11.69km)
2. Consultation needed with ESB to establish an UGC route into Drybridge 110kV Substation.
3. Road opening licenses and Traffic management obligations.
4. Existing underground services crossings (water, MV circuit) and running parallel (MV Circuits, water) along the route, however sufficient space to allow for adequate clearance should not be an issue.
5. Route runs parallel and crosses Irish water infrastructure along the grid connection.
6. 3 No. HDD crossings required for bridges/culverts.
7. Narrow road sections along the route will be impassable during construction. Road closures would be required.
8. Zone of notification of a listed monument is traversed, which will require consideration during planning and construction stages to prevent damage.
9. Landowner negotiations required for final offroad section into wind farm. This appears to fall under the same landownership as the lands being used for the wind farm.
10. Consultation needed with Gas Networks Ireland for 2 No. high pressure gas mains crossings.

3.7 Constructability and Feasibility of UGC Routes

The routes selected at this stage of the process are preliminary, a more detailed review and analysis of the preferred routes will need to be carried out onsite during the next phase of the project to fully assess the suitability and constructability of the preferred options.

Initial site visits and a review of the routes did identify several major issues from a constructability point of view. All Options include watercourses crossed by a number of bridges, of which several not having enough cover on the deck to allow for a cable trench, which will demand sections of HDD to overcome. Of which is to be highlighted Bridge B1/C1/E1 (common to Options B, C & E) which, due to its location on a crossroads and its proximity to a SAC. The use of a HDD that would require to launch/receive from within the special area designation zone would be substantially difficult from an environmental point of view. Options B, C & E are estimated to be unfeasible due to the sensitive nature of the watercourse crossing, the negative outcomes from previous dealings with TII and the requirement for a HDD.

The requirement to cross the TII controlled motorway will require early positive engagement with Transport Infrastructure Ireland to ensure the success of all the potential grid routes.

Following visual surveys, it is estimated that adequate space is available to cross the M1 motorway utilising a HDD through the existing underpass, between the existing UGCs. However, these must be more adequately surveyed to confirm the exact locations and thus confirming the presence of required spacing available between the power ducts.

With Option B, the feasibility of the route is solely dependent on landowner engagement for the privately owned access track. It is estimated at least 17 landowner folios would be crossed within the access track. Getting the agreement of 17 landowners will prove very challenging and hence ruling the route option as high risk.

Other factors to be considered as part of the next phase of the project for the UGC routes will include smaller watercourses, and narrow road sections possibly requiring traffic management and/or diversion. Third party service crossings (water, sewage, electric power distribution, telecoms) or paralleling with the selected routes were not considered to be a major issue and that there is enough available underground space for a cable trench. These should be more adequately surveyed to confirm they are not showstoppers, GPR (Ground Penetrating Radar) surveys may be required to confirm the location of existing services.

4.0 Conclusions and Recommendations

Based on the analysis conducted as part of this study, there is at least one viable option for grid connection route from the Drybridge 110kV Substations to the proposed Kellystown Wind farm.

Route Options A is the most viable and shortest of all the routes, the route contains several bridges and culverts that would require a HDD, however this is the fewest required HDD of all the assessed routes. Option A would be avoiding interactions with any Gas Networks Ireland infrastructure. Option A will require consultation with both TII and the NRA in relation to the permitted development of the PANCR. The proposed grid route placement will have to align with the road development.

Route Option C is the longest of all the routes. This option has the most straight forward motorway crossing as the cable can be contained within the local road network. This would mitigate TII involvement. However, the crossing of Watercourse C1 deems this options very problematic.

Route Option D is the second shortest route of the five routes. This option encounters the greatest number of private landowner folios along the route. This option crosses a section of the N51 National Primary Road, which would require Transport Infrastructure Ireland (TII) permission.

From an engineering and design perspective, Option A is more favourable in terms of construction methodology and joint bay placement because of its shorter overall length, and the use of regional and local roads. The HDD crossing of the M1 motorway is the major constraint of this route – depending on outcomes of existing services locations it may require landowner engagement.

In conclusion, it is the consultant's opinion that **Option A (Dashed Pink)** will provide the most favourable route option and should be brought forward for a more detailed study and preliminary discussions with Louth County Council to ascertain the suitability of this route or if alternative routes will need to be surveyed.

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5.0 Progressing the Grid Selection Process

Based on initial analysis and site surveys there appear to be feasible UGC route options available to Drybridge 110kV Substation. The routes selected at this stage are indicative only and a more detailed analysis will need to be completed to determine the viability of each route proposed.

This process will involve the following tasks:

- Confirmation of Preferred UGC Route Option.
- More detailed survey and analysis of the preferred route.
- Additional surveying for Alternative Routes (if required).
- Siting of Joint Bays.
- Identification of any 3rd party landowners on cable route (where required).
- Confirmation of cable route entry to ESB Substation.
- Design of cable trench required for cable route.
- Analysis of all bridge crossings to facilitate the installation of cable trench.
- Review and analysis of existing services on cable route.
- Liaison with other wind developers in the area (if required).

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