Jacobs

Kildare – Meath Grid Upgrade
Planning and Environmental Considerations Report
Volume 5: Supporting Documents

April 2023
EirGrid

This document is Volume 5: Supporting Documents of the Kildare-Meath Grid Upgrade Planning and Environmental Considerations Report (PECR).

The whole PECR consists of a number of documents and should be read together.

- Kildare-Meath Grid Upgrade PECR
  - Volume 1: Non-Technical Summary
  - Volume 2: Main Text
  - Volume 3: Appendices
  - Volume 4: Figures
  - Volume 5: Supporting Documents

Kildare-Meath Grid Upgrade Supporting Documents

Project No:	321084AH
Document Title:	Kildare-Meath Grid Upgrade Volume 5
Document No.:	KMGU-JAC-TN-0155-PECR Volume 5
Revision:	1
Document Status:	Final
Date:	April 2023
Client Name:	EirGrid
Client No:	CP966
Project Manager:	Andrew Power
Author:	Caroline Hannan
File Name:	

Jacobs Engineering Ireland Limited

Merrion House
Merrion Road
Dublin 4, D04 R2C5
Ireland
T +353 1 269 5666
F +353 1 269 5497
www.jacobs.com

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
Final	April 2023		CH	SJ	FL	FL

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Step 1 - Needs Report (July 2017)

Needs Report

Capital Project 966

July 2017

EIRGRID

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2 Introduction

EirGrid follow a six step approach when we develop and implement the best performing solution option to any identified transmission network problem. This six step approach is described in the document ‘Have Your Say’ published on EirGrid’s website[1]. The six steps are shown on a high-level in Figure 1. Each step has a distinct purpose with defined deliverables.

The Needs Report (this document) is a deliverable for Step 1. It will describe an identified transmission network problem. In this case it involves a transmission network problem regarding the transfer of power across the existing 400 kV transmission network from west to east and the transfer of this power within in the transmission network as it reaches the east coast. The issues encountered involve both capacity and voltage.

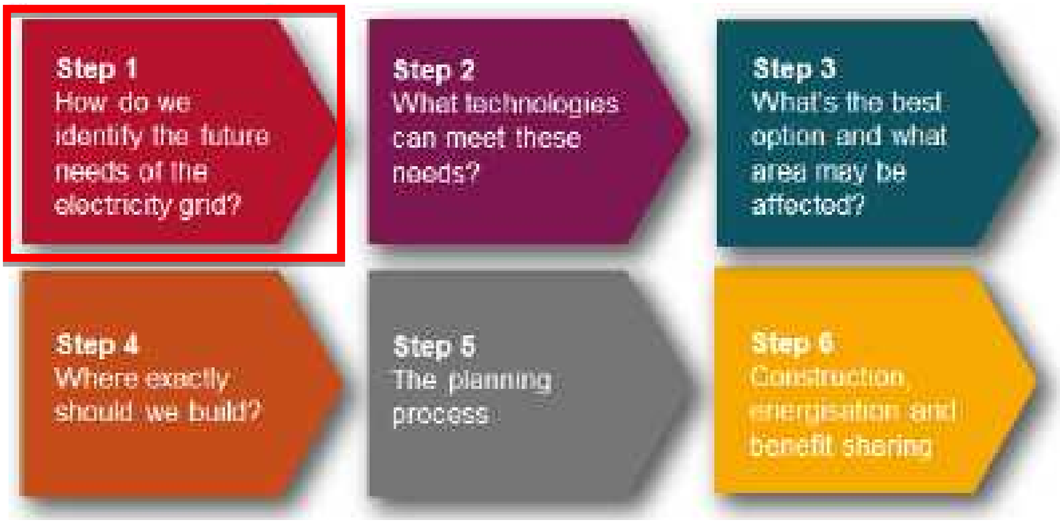

Figure 1 *High Level Project Development Process*

2.1 Our statutory role

EirGrid is the national electricity Transmission System Operator (TSO) for Ireland. Our role and responsibilities are set out in Statutory Instrument No. 445 of 2000 (as amended); in particular, Article 8(1) (a) gives EirGrid, the exclusive statutory function:

“To operate and ensure the maintenance of and, if necessary, develop a safe, secure, reliable, economical, and efficient electricity transmission system, and to explore and develop opportunities for interconnection of its system with other systems, in all cases

[1] http://www.eirgridgroup.com/the-grid/have-your-say/

with a view to ensuring that all reasonable demands for electricity are met and having due regard for the environment."

Furthermore, as TSO, we are statutorily obliged to offer terms and enter into agreements, where appropriate and in accordance with regulatory direction, with those using and seeking to use the transmission system. Upon acceptance of connection offers by prospective network generators and demand users, we must develop the electricity transmission network to ensure it is suitable for those connections.

3 Regulatory Targets and Policy

As mentioned previously, one of our roles is to plan the development of the electricity transmission grid to meet the future needs of society. To do this we consider how electricity may be used and generated years from now and what this means for the electricity grid of today.

The key to this process is considering the range of possible ways that energy usage may change in the future. This means that we will analyse different scenarios that would represent this. Using this approach will allow us to efficiently develop the grid taking account of the uncertainties associated with the future demand for electricity and the future location and technology used to generate electricity.

To help us account of the uncertainties of the future Tomorrow's Energy Scenarios 2017[2] have been developed. We did this using our own experience and significant input received from government departments and agencies, energy research groups and industry representatives. These scenarios have been out for public consultation inviting contributions from energy industry, members of the public and interested groups. The four scenarios are named Steady Evolution, Low Carbon Living, Slow Change and Consumer Action.

The drivers for the need and assumptions used in the analysis for this need are in line with the identified Tomorrow's Energy Scenarios. In particular the scenarios Steady Evolution and Low Carbon Living have specific assumptions that have been included:

- The demand levels in the cases were generally consistent with the demand levels presented in the Forecast Statement 2015-2024 (GCS 15-24). However a number of new and existing customers in the Dublin region have requested new connections or increases in existing connection agreements. This assumption is very similar to the assumptions used in the Steady Evolution scenario.
- Connection of data centres has been accounted for in line with latest known information at the start of the analysis (2016). In total, 900 MW of data centres have been assumed in the cases. This figure is based on executed connection agreements and offered connection agreements. This assumption is in line with the assumed data centre demand figure used in the Steady Evolution scenario, which is 850 MVA.

[2] Tomorrow's Energy Scenarios http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Tomorrows-Energy-Scenarios-Report-2017.pdf

- The connection of renewable generation to meet the Governance's renewable energy target of meeting 40% electricity demand from renewable generation by 2020 - covered by the Steady Evolution scenario.
- Repowering of coal fired generation – covered by the Low carbon Living scenario.
- Explore and develop opportunities for interconnection of its system with other systems as set out in our licence as Transmission System Operator (TSO) for Ireland. To reflect this, consideration has been given to the construction of additional interconnection on the south coast. In this particular instance an additional 700 MW interconnector at Knockraha in Co Cork - covered by the Steady Evolution scenario.

3.1 Scenarios analysed

The above mentioned assumptions were used to create the cases that were subsequently analysed. In line with our statutory obligation the future scenarios are then analysed to establish that the transmission system is in compliance with the Transmission System Security Planning Standards (TSSPS). If the system is in breach of any of these standards the issue must be addressed

The year 2025 was chosen for analysis as it was deemed an appropriate point in time to assess the long term strategic needs of the system and to design reinforcement options to address those needs. This year has been determined as the earliest stable point in the future. By this time it is expected that a number of network reinforcements will have been implemented. Gate 3 renewable generation will have been integrated into the system and a number of new loads will have been connected into the Dublin network.

Some of the reinforcements that have been assumed to be energised were the series compensation of the existing 400 kV circuits and a 400 kV sub-marine cable across the Shannon Estuary between Moneypoint 400 kV station and Kilpaddoge 220 kV station.

Three seasonal variations were studied to examine the effect of different load profiles, Winter Peak, Summer Valley and Summer Peak. Summer and Winter Peak represent points in time when the system is most heavily loaded and therefore the time when there is most likely to be thermal issues on the system. Summer Valley was also assessed to detect voltage issues which may arise with a lightly loaded system.

The existing Moyle Interconnector and East-West Interconnector (EWIC) were assumed available in 2025. Moyle and EWIC will be assumed to have 500 MW import/export capacity.

We have assumed that an additional interconnector may connect in the south. Under certain operating circumstances, connection of this third interconnector may lead to increased transfers across the transmission system. Likewise, the unavailability of this additional interconnector in the south may also cause increased transfers across the transmission system. Scenarios were created to capture the most extreme operating conditions using the interconnectors. We have model the interconnectors as either importing or exporting simultaneously.

Therefore, during import we have assumed three interconnectors. During export scenarios the most onerous situation would be the transfer of renewable generation in the south and west across the country for export through EWIC and Moyle. Therefore in the Export case it was assumed that the third interconnector in the south was unavailable, to ensure the worst case scenario.

An alternative way to operate the interconnector would have been to create a dispatch where the power is 'wheeling'. This would mean that the power is flowing through the Irish network and on to the National Grid in the UK. It was considered that a 'wheeling' scenario would be a bit too extreme and was not analysed.

A summer peak case and a winter peak case with no interconnection was used was also included.

Seven separate cases were created in order to assess the system and the need identified, namely:

- 2025 Winter peak – Exporting on two interconnectors
- 2025 Winter peak – Importing on three interconnectors
- 2025 Winter peak – No importing or exporting on interconnectors
- 2025 Summer peak – Exporting on two interconnectors
- 2025 Summer peak – Importing on three interconnectors
- 2025 Summer peak – No importing or exporting on interconnectors
- 2025 Summer Valley – Exporting on two interconnectors

4 Statement of Need

With regard to the assumptions identified in Tomorrow's Energy Scenarios there are two key drivers that highlight the need to further development of the transmission system, namely:

1. **Increased demand on East coast**. An increase in electricity demand as part of natural growth is expected. In addition, there is a demand increase in the order of 900 MW due to the connection of data centres. This is based on executed and offered connection agreements in the counties Kildare, Meath and Dublin. Part of this demand is expected to start to connect to the system in 2017 and ramp up to the total demand figure in 2025. The interest is high and it is expected that this trend will continue with further requests for connection.

2. **Integration of generation in South and South West.** Significant levels of new renewable generation have connected or are in the process of connecting to the transmission and distribution system in the south and south west of Ireland. This is also where the newer and more cost effective existing conventional generation units are located. This results in that a significant portion of the generation sources are located in the south and south west of Ireland away from the main demand centres. The power produced will hence have to be transported to get to where it is needed.

These two drivers introduce cross country power flows on the existing transmission system from the West to the East coast. These cross country power flows will start to appear when the renewable generation and the demand increases connect to the system. The current indications as of July 2017 are that nearly 1000 MW of wind is already connected in the south west[3] and that an additional 1600 MW of wind in this area is due to connect between now and 2025. Similarly, for the demand increase, 90 MW is due to connect in 2017 and this will ramp up to 900 MW between now and 2025.

Under these circumstances the system analysis indicates that the network is experiencing significant violations of the compliance with the Transmission System Security Planning Standards (TSSPS). The violations occur for the unplanned loss of any of the existing 400 kV circuits between Moneypoint 400 kV station in the West and

[3] South West refer to counties Clare, Cork, Kerry, Limerick, Tipperary

Dunstown 400 kV in County Kildare and Woodland 400 kV station in County Meath in the East.

The violations relates to two aspects:

- Bringing required power to the East coast; and
- Transferring this power within Counties Dublin, Kildare and Meath once the power reach the east coast.

  The main nodes for distributing the power around the capital and its surrounding areas are Carrickmines, Dunstown, Maynooth and Woodland transmission stations. The stations are highlighted in the Figure 2.The network connecting these nodes becomes essential for distributing the power around the capital.

Figure 2 *Main transmission stations for distributing power around the capital.*

The violations observed can be further divided into three technical issues:

– Thermal overloads

  For unplanned losses of any of the 400 kV circuits between the west coast and the east coast the following circuits are overloaded, Maynooth – Woodland 220 kV, Dunstown – Maynooth 220 kV, Maynooth – Ryebrook 110 kV, Killonan – Shannonbridge 220 kV, Maynooth – Shannonbridge 220 kV, Cashla – Prospect 220 kV and Bracklone – Portlaoise 110 kV. These circuits are also overloaded for maintenance trip combinations despite remedial action using generation dispatch of 400 MW.

– Voltage collapse

  Voltage collapse means that the voltage cannot be maintained in the transmission system. The voltage in the transmission system is supported by reactive power. During certain operating conditions, a lack of sufficient reactive power in Counties Dublin, Kildare and Meath area have been identified.

– Large phase angles

  Large phase angles are observed due to high power transfers on existing lines and the low connectivity between transmission stations during certain operating conditions

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5 Detailed analysis

This section will describe in detail the network problems which were identified for each case analysed. To be able to fully investigate and describe the need identified, generation re-dispatch was required in some cases.

5.1 Winter Export

5.1.1 Description of the case

In this case the two existing interconnectors, Moyle in Northern Ireland and EWIC on the east coast north of Dublin, are exporting, 500 MW each. The winter export dispatch consisted of a high wind dispatch of 95% in the south west and 40% elsewhere on the system. In order to demonstrate the most onerous credible scenarios there were relatively low levels of conventional generation close to load centres with two generators dispatched in Dublin and three generators in Northern Ireland. The remaining power requirements to supply the peak system demand along with 1000 MW of exported generation was provided by conventional generators in the south and west at Great Island, Whitegate, Aghada and Moneypoint. This creates a large cross county electricity flow from the south towards the east coast of Ireland. The SNSP[4] in the case is 72%.

5.1.2 Network problems

Power system analysis indicate heavy loading on the existing 400 kV circuits traversing the country with an intact system and the generation dispatch described in section 5.1.1. The existing 220 kV circuits traversing from the south west to the east coast are also experiencing heavy loading. It should, however, be noted that the circuits are not overloaded. This means that they are still operating within their power carrying capacity. Typical loading for transmission circuits are in the range of 30-40 %. This is to allow for redistribution of the power flow on a circuit following a contingency of that circuit. The loading of the 400 kV circuits in this case, intact system, is up to 56% with 220 kV circuits in the south east loaded up to 58%. These heavy loaded circuits are highlighted in Figure 3. A loss of any of the highlighted circuits or any generator in the

Figure 3 *Heavy loaded circuits (>50%) in an intact system Winter Export*

[4] Simultaneous Non Synchronous Penetration

Dublin region leads to major voltage issues and voltage collapse for 18 single contingencies (N-1). A list of these contingencies is included in Appendix 1A.

In order to avoid voltage collapse, an additional circa 850 MVars of reactive support would be required in the Dublin region. This value was determined by using four ‘dummy generators (at 0 MW)’ with a voltage setpoint of 1.02 pu in the Dublin network. Out of this, circa 90 Mvars would be required in the intact system for the generators in the Dublin area to move away from providing maximum reactive support and maintain voltages of 1.02 pu. With this reactive support included voltage collapse could be prevented and single contingencies (N-1) could be analysed.

With the reactive support included, a number of thermal overloads were identified. They are outlined in Appendix 1B. The thermal overloads were all caused by the single contingency (N-1) of Woodland – Oldstreet 400 kV circuit. The worst thermal overloads were observed on Maynooth – Woodland 220 kV circuit and Dunstown - Maynooth cct 2 220 kV circuit, with a loading of 168% and 127% respectively over their rated capacity. It is worth mentioning that Maynooth 220 kV station is planned to be operated in a ring arrangement by 2025 after extensive refurbishment and reconfiguration. When this project is completed the overload observed on the Dunstown - Maynooth cct 2 220 kV circuit will be reduced to 104%, and overloads on the Maynooth – Woodland 220 kV circuit will be 153%.

The same contingency caused a large phase angle difference of 40° between Oldstreet and Woodland 400 kV stations post the single contingency (N-1). The large phase angle would prevent auto-reclosing which would have impacts on system security.

5.1.3 Re-dispatched Case

Another way of preventing the voltage collapse and provide reactive support where it is needed, is to re-dispatch existing generation. This principal could drive high operational cost as generators not normally in merit would be scheduled to provide necessary voltage support. The generation in the case was adjusted until all N-1 analysis could be completed without voltage collapse occurring. The re-dispatch included the reduction of renewable and conventional generation levels in the south west and replaced with generation in the Dublin and Belfast regions. This required a reduction in generation at Moneypoint from 730 MW to 315 MW. This generation was replaced by two additional conventional generators in Dublin and one additional in Northern Ireland bringing the total of conventional generators in each region to four. The extra conventional generators provide voltage support in Dublin preventing voltage collapse for any single contingency (N-1) including the loss of a single generator. The extra generation in Dublin would reduce the loading on the circuits traversing the country, especially the 400 kV network. With this dispatch the loading of Woodland - Oldstreet and Laois - Dunstown 400 kV circuits in this case reduced to 47% and 26% respectively while the 220 kV circuits in the south east maintained a loading of up to 56%. It can be seen that the Woodland – Oldstreet 400 kV circuit (the most northern circuit) carries more power than the parallel Laois - Dunstown 400 kV circuit. This is due to the system topology at the end of the circuits, especially the fact that the exporting Interconnectors Moyle in Northern Ireland and EWIC connecting at Woodland are located north of Dublin.

The re-dispatch prevented any voltage issues, but thermal overloads and large phase angles remained. They are outlined in Appendix 1C. The thermal overloads were all caused by the single contingency (N-1) of Woodland – Oldstreet 400 kV circuit. The worst thermal overload was observed on Maynooth – Woodland 220 kV circuit with a loading of 127% over its rated capacity. The same contingency caused a large phase angle difference of 34° between Oldstreet and Woodland 400 kV stations post the single contingency (N-1). An angle of 34° is below the limit set in our Operating Security Standards (OSS) of 40°. In the Irish system this is still a relatively high angle to try to close a circuit breaker onto. The large phase angle would prevent auto-reclosing which would have impacts on system security.

5.2 Winter Import

5.2.1 Description of the case

This case have three interconnectors, Moyle in Northern Ireland (500 MW), EWIC on the east coast north of Dublin (500 MW), and an additional 700 MW interconnector located at Knockraha in Co. Cork. They are all importing at maximum capacity, which corresponds to 1700 MW in total. The wind was dispatched at 95% in the south west and 10% elsewhere. Two conventional generators were dispatched in Dublin and three in Northern Ireland. The remaining power requirements were made up by conventional generators in Great Island, Whitegate and Moneypoint in the South and West. When this import case is compared with the export case, this case has 2700 MW less power that is required to be generated and transported on the transmission network.

5.2.2 Network problems

Voltage collapse occurred for seven single contingencies (N-1). This included the loss of any Dublin generator and the loss of Moneypoint – Laois 400 kV circuit. A list of these contingencies is included in Appendix 1D. In order to avoid voltage collapse an additional circa 175 Mvars of reactive support would need to be required in the Dublin region. This value is based on a voltage setpoint of 1.02 pu at Belcamp 110 kV bus. With this reactive support included voltage collapse could be prevented and single contingencies (N-1) could be analysed. The only contingency that caused a thermal overload is listed in Appendix 1E. The overload observed is a local problem around Waterford and will not be addressed as part of this identified need.

5.2.3 Re-dispatched Case

Another way of preventing the voltage collapse and provide more reactive power where it is needed, is to re-dispatch generation. The redistribution of generation in the form of dispatching a third generator in Dublin and reducing thermal generation in the south supports the network and prevents voltage collapse for all contingencies. No other changes were made to this dispatch and the same local overload remains in Waterford as listed in Appendix 1E

A phase angle difference of 21° can be seen between Laois and Moneypoint 400 kV stations post the single contingency (N-1) of Laois- Moneypoint 400 kV circuit. A phase angle difference of 18° can be seen between Oldstreet and Woodland 400 kV stations post the single contingency (N-1) of Woodland – Oldstreet 400 kV circuit.

5.3 Winter No Import or Export on Interconnectors

5.3.1 Description of the Case

In this case the two existing interconnectors, Moyle in Northern Ireland and EWIC on the east coast north of Dublin, are not used for import or export. Nor are they offering reactive support. The winter dispatch consisted of a high wind dispatch of 95% in the south west and 40% elsewhere on the system. There were relatively low levels of conventional generation close to load centres with two generators dispatched in Dublin and two generators in Northern Ireland. The remaining power requirements were made up by conventional generators in Great Island, Whitegate and Moneypoint in the South and West.

5.3.2 Network problems

No network violations were identified for this dispatch.

5.4 Summer Export

5.4.1 Description of the case

In this case the two existing interconnectors, Moyle in Northern Ireland and EWIC on the east coast north of Dublin, are exporting, 500 MW each. The summer export dispatch consisted of a high wind dispatch of 85% in the south west and 21% elsewhere on the system. There were relatively low levels of conventional generation close to load centres with two generators dispatched in Dublin and three generators in Northern Ireland. The remaining power requirements to supply the peak system demand along with 1000 MW of exported generation was provided by conventional generators in the south and west at Great Island, Whitegate, Aghada and Moneypoint. This creates a large regional electricity flows from the south towards the east coast of Ireland.

5.4.2 Network problems

With this dispatch voltage collapse was observed for the single contingency (N-1) of Oldstreet – Woodland 400 kV circuit. In order to avoid voltage collapse an additional circa 240 Mvars of reactive support would be required in the Dublin region. This value is based on a voltage setpoint of 1.02 pu at two locations in the Dublin Network. With this reactive support included voltage collapse for this contingency could be prevented and results reported.

With the reactive support included, thermal overloads were identified throughout the network for a number of single contingencies (N-1). The thermal overloads were mostly caused by the single contingencies (N-1) of the 400 kV circuits. They are outlined in Appendix 1F. The worst thermal overloads were observed on Maynooth – Woodland 220 kV circuit and Dunstown – Maynooth 220 kV circuit, with a loading of 201% and 149% respectively over their rated capacity. It is also worth mentioning that the Maynooth – Ryebrook 110 kV circuit, is overloaded to 113% of its rated capacity for the loss of Oldstreet – Woodland 400 kV circuit. This circuit is already uprated to the largest conductor allowed on the 110 kV system. Other overloaded circuits are Killonan – Shannonbridge 220 kV, Maynooth – Shannonbridge 220 kV, Cashla – Prospect 220 kV and Bracklone – Portlaoise 110 kV.

The same contingency caused a large phase angle difference of 40° between Oldstreet and Woodland 400 kV stations post the single contingency (N-1). The large phase angle would prevent auto-reclosing which would have impacts on system security.

5.4.3 Re-dispatched Case

Again, to prevent voltage collapse and provide more reactive support where it is needed, a generation re-dispatch was carried out. The generation in the case was adjusted until all single contingency analysis could be completed without voltage collapse occurring. The re-dispatch included the reduction of renewable and conventional generation levels in the south west and replaced with generation in the Dublin and Belfast regions. The renewable generation in the south west was dispatched at 81%, 4% elsewhere in the Republic of Ireland (ROI) and 18% in Northern Ireland (NI). This dispatch was selected to maintain high west-east flows while adding support close to load centres. The reduced wind generation was replaced by one additional conventional generator in Dublin and two additional generators in Northern Ireland. The extra conventional generators provide voltage support in Dublin preventing voltage collapse for any single contingency (N-1). The remainder of the power came from Great Island, Whitegate, Aghada and Moneypoint in the south and west.

Following re-dispatch a single contingency (N-1) analysis was carried out. The results indicated that there was a number of thermal overloads were observed for contingencies of the 400 kV network, but no voltage issues observed for this case. The results are outlined in Appendix 1G. The worst contingency is the loss of Oldstreet – Woodland 400 kV circuit which caused overloads on the 220 kV network between Dunstown and Woodland with Woodland – Maynooth and Dunstown – Maynooth loaded to 150% and 121% respectively of their rated capacity. Other overloaded circuits are Cashla – Prospect 220 kV and Bracklone – Portlaoise 110 kV.

A phase angle difference of 30° can be seen between Oldstreet and Woodland 400 kV stations post the single contingency (N-1) of Oldstreet – Woodland 400 kV circuit. The large phase angle would prevent auto-reclosing which would have impacts on system security.

5.4.4 Maintenance Trip combinations (N-1-1)

Maintenance - trip (N-1-1) analysis was conducted on the case which was adjusted so no intact system violations occurred. A list of circuits considered for the maintenance trip (N-1-1) analysis can be found in Appendix 2A. The results of the analysis indicated a number of maintenance - trip (N-1-1) combinations with non – convergence or voltage collapse. Appendix 2B list all the non – convergences observed for the maintenance – trip combinations. To prepare for maintenance of circuits in the system, a generation re-dispatch of a maximum of 400 MW is allowed. Wind generation of 387 MW in the south west was replaced with generation from Poolbeg in Dublin. When this was done almost all cases converged. The exceptions were some maintenance trip combinations of the 400 kV circuits, which still cause voltage collapse. The results from the maintenance trip analysis (following re-dispatch) are listed in Appendix 2C. The circuits which were overloaded are highlighted in Figure 4. It should be noted that the violations which occurred for N-1 contingencies were exacerbated by the maintenance trip combinations.

These overloads occurred for a large number of maintenance trip combinations (N-1-1) and therefore only the worst overloads have been reported in the results.

Overloads occur during maintenance trip combinations of Oldstreet – Woodland 400 kV and Inchicore – Irishtown 220 kV / Maynooth Gorman 220 kV. This combination will limit the paths for the power to flow and as such limit the power transfer capability in Dublin. For these combinations the Woodland – Maynooth 220 kV and Dunstown – Maynooth 220 kV will see loadings of 170% and 140% of their ratings respectively.

Figure 4 *N-1-1 overloads which could not be mitigated through the re-dispatch of 400 MW of generation*

In addition, some of the maintenance trip combinations of the 400 kV circuits cause thermal overloads on the 220 kV circuits traversing the country between Killonan and Maynooth 220 kV stations, especially Killonan - Shannonbridge between 117 – 139% of its rated capacity and Maynooth – Shannonbridge between 118 – 139% of its rated capacity. Cashla – Prospect 220 kV circuit also see overloads up to 169%. Maintenance trip combinations of Cullenagh – Great Island 220 kV and other circuits in the south region cause an overload on Killoteran – Waterford 110 kV circuit. Barrymore – Cahir 110 kV circuit is loaded up to 131% for the loss of Ballynahulla – Knockanure 220 kV or Knockanure – Kilpaddoge 220 kV circuits. These overloads are observed despite allowing 400 MW of generation re-dispatch.

5.5 Summer Import

5.5.1 Description of the case

This case have three interconnectors, Moyle in Northern Ireland (500 MW), EWIC on the east coast north of Dublin (500 MW), and an additional 700 MW interconnector located at Knockraha in Co. Cork. They are all importing at maximum capacity which corresponds to 1700 MW. The wind was dispatched at 85% in the south west and elsewhere in Republic of Ireland at 4% and 3% in Northern Ireland. This dispatch was selected to maintain high west-east flows. Two conventional generators were dispatched in Dublin and two in Northern Ireland. The remaining power requirements were made up by conventional generators in Great Island, Aghada in the South. When this import case is compared with the export case, this case has 2700 MW less power that is required to be generated and transported on the transmission network.

5.5.2 Network problems

There was no voltage issues observed for this case. The contingency analysis indicated thermal overloads were observed in the south east, namely Waterford – Killoteran and Waterford – Cullenagh 110 kV circuits. These overloads are being addressed by an independent needs assessment. Thermal overloads were also observed on the 220 kV circuits between Corduff – Finglas – Woodland - Clonee for the loss of a parallel circuit. These overloads were due to the level of generation being fed through Woodland 400 kV station from EWIC and the renewable and conventional generation coming from the south and west. A sensitivity assessment was carried out to examine the effect of the additional generation from the third interconnector. By removing this interconnector, and dispatching generation in Dublin in its place, the overloads between Corduff and Woodland could be removed. A list of all overloads can be found in Appendix 1H.

5.5.3 Maintenance trip combinations (N-1-1)

Maintenance trip analysis was conducted on the less onerous Summer Import Case without an interconnector at Knockraha included. The less onerous case was chosen due to the high level for non-convergence for N-1 on the more onerous case. The interconnector was excluded as N-1 overloads associated purely with this new infeed had been identified in the previous analysis. A list of circuits considered for the maintenance trip (N-1-1) analysis can be found in Appendix 2A. The results of the analysis indicated a large number of maintenance - trip (N-1-1) combinations with overloads, non – convergence or voltage collapse. Appendix 2D lists all the non – convergences observed for the maintenance – trip combinations. To prepare for maintenance of circuits in the system, a generation re-dispatch of a maximum of 400 MW is allowed. Wind generation of 387 MW in the south west was replaced with generation from Poolbeg in Dublin. When this was done all cases converged. All thermal overloads which remained following the re-dispatch of generation are listed in Appendix 2E. The overloading of Killoteran – Waterford featured once more. In addition the Cashla – Prospect 220 kV circuit was loaded to 114% for the maintenance trip combination of Moneypoint – Oldstreet and Laois – Moneypoint 400 kV circuits.

5.6 Summer No Import or Export on Interconnectors

5.6.1 Description of the case

In this case the two existing interconnectors, Moyle in Northern Ireland and EWIC on the east coast north of Dublin, are not used for import or export. Nor are they offering reactive support. The summer dispatch consisted of a high wind dispatch of 95% in the south west and 21% elsewhere on the system. There were relatively low levels of conventional generation close to load centres with two generators dispatched in Dublin and two generators in Northern Ireland. The remaining power requirement to supply the peak system demand was provided by conventional generators in the south and west at Great Island and Moneypoint. This creates a large cross country electricity flows from the south towards the east coast of Ireland.

5.6.2 Network problems

There was no voltage issues observed for this case. The single contingency analysis indicated thermal overloads on three circuits. An N-1 on Oldstreet - Woodland 400 kV circuit caused the Woodland – Maynooth 220 kV circuit to be loaded to 119%.Bracklone – Portlaoise 110 kV circuit was loaded to 116.5% for an N-1 of Dunstown – Laois 400 kV circuit. Finally Bandon-Dunmanway 110 kV circuit was loaded to 114% for the loss of Clashavoon – Knockraha 220 kV circuit. The details of these overloads are included in Appendix 1I.

5.6.3 Maintenance Trip Combinations (N-1-1)

Maintenance trip analysis was conducted on the Summer Night Valley Case, the list of circuits included in the maintenance can be found in Appendix 2A.
A large number of maintenance trip combinations were observed. To prepare for maintenance of circuits in the system, a generation re-dispatch of a maximum of 400 MW is allowed. The case was re-dispatched with a reduction of 391 MW of wind generation from the south west and replaced with generation from Poolbeg in Dublin. All thermal overloads which remained following the re-dispatch of generation are listed in Appendix 2F.

5.7 Summer Valley

5.7.1 Description of the case

In this case the two existing interconnectors, Moyle in Northern Ireland and EWIC on the east coast, are each exporting 500 MW. In this case wind in the south west was dispatched at 58% with wind elsewhere on the system at 21%. Generation in Dublin was supplied by Dublin Bay and two generators in Northern Ireland. Great Island, Whitegate and Aghada provided power in the south and east.

5.7.2 Network problems

There were no voltage issues observed for this case. An N-1 on Oldstreet - Woodland 400 kV circuit caused the Woodland – Maynooth 220 kV circuit to be loaded to 118%. No other overloads were observed. The results are outlined in Appendix 1I

5.7.3 Maintenance trip combinations (N-1-1)

Maintenance trip analysis was conducted on the Summer Night Valley Case, the list of circuits included in the maintenance can be found in Appendix 2A.

A large number of maintenance trip combinations were observed. To prepare for maintenance of circuits in the system, a generation re-dispatch of a maximum of 400 MW is allowed. The case was re-dispatched with 392 MW of wind generation from the south west and replaced with generation from Poolbeg in Dublin.

All thermal overloads which remained following the re-dispatch of generation are listed in Appendix 2G. A large number of maintenance trip combinations caused overloads on the Maynooth – Woodland 220 kV circuit. Only the worst case combination has been included in Appendix 2G. The worst overload seen on this circuit was 135% for the maintenance of Gorman – Maynooth 220 kV and a subsequent tripping of Oldstreet – Woodland 400 kV circuit. Thermal overloads on Killonan - Shannonbridge (111% of its rated capacity) and Maynooth – Shannonbridge (between 118 – 126% of its rated capacity) and Maynooth – Ryebrook 110 kV (between 113 – 128% of its rated capacity) has been observed for maintenance trip combinations of various 400 kV circuits and 220 kV circuits.

5.8 High Impact Low Probability Analysis

High Impact Low Probability (HILP) analysis was carried out on a selected number of HILP combinations. A list of all HILP combinations can be found in Appendix 3. This analysis was carried out on the less onerous, re-dispatched summer and winter export cases. No issues were identified.

5.9 Summary of network problems

The analysis of the transmission network indicates that there are a number of issues in breach of our Transmission System Security Planning Standards (TSSPS) and therefore require to be addressed. The below paragraphs summarise the findings for all cases analysed. The technical solution must either resolve these issues inherently or be considered in conjunction with other future works.

5.9.1 Thermal overloads

A thermal overload can occur when the power flow on a circuit exceeds its power carrying capacity causing overheating of the circuit. Overheating will cause increased conductor sag and possibly breach safe clearance distances, and eventually lead to mechanical damage to the conductor. Under a number of scenarios thermal overloads on some of the existing circuits have been identified, namely:

Single contingency (N-1)

Three cases indicate thermal overloads for single contingencies (N-1). These cases all involve export on the interconnectors. For summer the worst overloads observed involve:

- Maynooth – Woodland 220 kV circuit (between 119 - 201% of its rated capacity)
- Dunstown – Maynooth 220 kV circuit (between 116 - 149% of its rated capacity)
- Bracklone – Portlaoise 110 kV circuit (132% of its rated capacity)
- Killonan – Shannonbridge 220 kV circuit (120% of its rated capacity)
- Maynooth – Shannonbridge 220 kV circuit (121% of its rated capacity)
- Maynooth – Ryebrook 110 kV circuit (113% of its rated capacity)

The worst contingency for the Summer export case is the loss of Oldstreet Woodland 400 kV circuit.

For winter scenarios the worst overload observed involve:

- Maynooth – Woodland 220 kV circuit (between 127 - 168% of its rated capacity)
- Dunstown – Maynooth 220 kV circuit (128% of its rated capacity).
- Bracklone – Portlaoise 110 kV circuit (120% of its rated capacity).

The overloads occur for the loss of the Oldstreet – Woodland 400 kV circuit.

This indicates that the network is short of capacity when certain high voltage circuits are lost. The loss of these circuits forces the power to take alternative paths through the transmission network and as a result thermal overload are observed. This is particularly evident during high regional power transfers from the south to the east coast.

Maintenance trip combinations (N-1-1)

During maintenance trip combinations (N-1-1) thermal overload have also been observed on circuits despite utilising generation re-dispatch to prepare for the maintenance. Overload of the Maynooth –Woodland 220 kV (up to 169% of its rated capacity) and Dunstown – Maynooth 220 kV (up to 140% of its rated capacity) have been seen for various maintenance trip combinations of 400 kV circuits and 220 kV in Dublin. In addition, maintenance trip combinations of the 400 kV circuits cause thermal overloads on the 220 kV circuits traversing the country between Killonan and Maynooth 220 kV stations, especially Killonan - Shannonbridge between 111 – 139% of its rated capacity and Maynooth – Shannonbridge between 118 – 139% of its rated capacity. Cashla – Prospect 220 kV circuit also see overloads up to 169%. In the summer peak export scenario the Maynooth – Ryebrook 110 kV circuit is also overloaded to 128% for the maintenance trip combination of Oldstreet – Woodland 400 kV and Woodland – Maynooth 220 kV.

5.9.2 Voltage collapse

If an adequate level of reactive power is not available to the network, a voltage collapse and loss of supply may occur. The analyses indicate that there is a lack of reactive power in the greater Dublin area during certain operating conditions. These operating conditions usually occur when the east coast relies on generation to be produced elsewhere and then transported to supply the demand in the greater Dublin area. Facilitation of new generation together with existing generation along with increased demand in Dublin introduces large regional electricity flows from the south towards the east coast of Ireland. During periods of high wind, there may arise scenarios where conventional generation in Dublin is displaced by cheaper wind generation and/or conventional generation located in the south of the country. In these instances large power transfers are seen between the south towards the east coast of Ireland. In these situations the existing 400 kV and 220 kV circuits are heavily loaded. An unplanned loss of any of these circuits (N-1[5]) increases the loading on remaining circuits. In three cases voltage collapse is seen when certain high voltage circuits are lost. Indicative figures of reactive support levels from 150 Mvar to 640 Mvar in the greater Dublin area are required to mitigate voltage collapse.

Another way voltage collapse can be avoided is by dispatch of generation to the greater Dublin area. It should be noted that this would be seen as potentially uneconomic during this operating condition and a disturbance to the market. Also it would not be compliant

5 (N-1) – a loss of one item of plant on the transmission network (e.g. a circuit or transformer).

with EirGrid's legal and license requirement to plan the transmission network reliant on the particular location of generators.

5.9.3 Large phase angles

Alternating electrical current or voltage is mathematically represented in waves (sinusoidal in shape). The difference in time between the peaks of the voltage and current waves is known as the phase angle and is expressed in degrees. The phase angle will vary at every point across the network due to the physical characteristics of the network that links these points together and the power transferred between those points.

Large phase angles can lead to instability; this will potentially lead to the loss of parts of the network as with a large phase angle it may not be possible to restore circuits to operation. Generator stability could also be impacted, a large phase angle change following a line tripping could lead to instability if insufficient damping and synchronizing torque is available.

This means that additional circuit(s) added into the network will affect the phase angles in a positive way (reduction) due to better connectivity. Also, with high power transfers across the network, an increased difference occurs between the phase angles at either end of circuits. When the network has circuits out of service, power will be redistributed across remaining circuits and will thereby increase the power flowing through these. The result is increased difference between the phase angle at either end of the circuits.

In this analysis phase angles of up to 40° have been indicated in two scenarios. This is just at the limit set in the Operating Security Standards (OSS), which are set at no more than 40°. Currently the Irish transmission system experiences phase angles which are less than 20° when re-closing/energising occurs.

6 Plausible scale of solutions

Section 5 describes large regional electricity flows from the south towards the east coast of Ireland cause three issues which affect security of supply of the transmission system. The identified need also indicates that the transmission system is short of capacity in the greater Dublin area. Plausible candidate solutions to these identified network problems must solve each individual issue or provide an overall system solution or involve a combination of these. A brief description of what type of solutions the three identified issues could require is given below to provide an estimate of the scale of the plausible options for reinforcement.

The identified voltage issues are caused by a lack of reactive power within the network or a lack of connectivity between generators/ reactive power source and demands/loads of reactive power. It should also be highlighted that heavily loaded circuits use more reactive power than lightly loaded circuits and this may also contribute to voltage issues. The solution to the voltage related issues may be the addition of a reactive power source or the addition or upscaling of new or existing circuits or a combination of both.

The large phase angles are caused by a lack of connectivity between various nodes in the network. Heavily loaded circuits absorbing reactive power also contribute to large phase angles. The large phase angles can be addressed in different ways by re-distributing power to other existing circuits or by the introduction of additional circuits.

The thermal overloads are due to excess powerflow through particular circuits for the loss of another circuit. The solution could involve diverting power by use of phase shifting transformers or other power flow control devices to encourage the use of other existing circuits. It could also involve the introduction of additional circuits or upscaling of existing circuits thus providing additional capacity and relieving the overloaded circuit.

The three identified issues can introduce a range of solution options involving both locally based reinforcements and/or provision of additional capacity in the form of new circuits. All solutions should maximise the utilisation or enhancement of existing infrastructure where spare capacity may exist prior to introducing new infrastructure. It is almost certain that even with the existing infrastructure maximised it may not be enough to resolve the issues identified and new infrastructure will have to be built. Considerations should be given to the level of additional power transfer capacity required. Dublin region is an area of rapid growth and any new infrastructure should provide sufficient capacity to cater for the future to minimise additional investment. The existing AC voltage level is 220 kV and 400 kV in the Dublin transmission network and any new AC infrastructure should be based on these levels. Based on existing technology the scale of a potential project with an assumed distance of 60 km provides an initial estimate in the range of €70m – €100m. The estimate can easily vary, depending on technology used (such as HVDC). The solution options will be further investigated in Step 2. The nature of a solution Counties Dublin, Kildare and Meath will very likely require extensive communication, stakeholder engagement and consultation.

7 Conclusions

There are two drivers that highlight the need to further development of the transmission system, namely:

1. **Increased demand on East coast**. An increase in electricity demand as part of natural growth is expected. In addition, there is a demand increase in the order of 900 MW due to the connection of data centres. This is based on executed and offered connection agreements mostly in the counties Kildare, Meath and Dublin. Part of this demand is expected to start to connect to the system in 2017 and ramp up to the total demand figure in 2025. The interest is high and it is expected that this trend will continue with further requests for connection.

2. **Integration of generation in South and South West.** Significant levels of new renewable generation have connected or are in the process of connecting to the transmission and distribution system in the south and south west of Ireland. This is also where the newer and more cost effective existing conventional generation units are located. This results in that a significant portion of the generation sources are located in the south and south west of Ireland away from the main demand centres. The power produced will hence have to be transported to get to where it is needed.

These two drivers introduce cross country power flows on the existing transmission system from the West to the East coast. Under these circumstances the system analysis indicates that the network is experiencing significant violations of the compliance with the Transmission System Security Planning Standards (TSSPS). The violations occur for the unplanned loss of any of the existing 400 kV circuits between Moneypoint 400 kV station in the West and Dunstown 400 kV in County Kildare and Woodland 400 kV station in County Meath in the East.

The violations relates to two aspects:

- Bringing required power to the East coast; and
- Transferring this power within Counties Dublin, Kildare and Meath once the power reach the east coast.

The violations observed can be further divided into three technical issues:

– Thermal overloads

  Under certain system conditions, for unplanned losses of any of the 400 kV circuits between the west coast and the east coast the following circuits are overloaded,

  - Maynooth – Woodland 220 kV,
  - Dunstown – Maynooth 220 kV,
  - Maynooth – Ryebrook 110 kV
  - Killonan – Shannonbridge 220 kV
  - Maynooth – Shannonbridge 220 kV
  - Cashla – Prospect 220 kV and
  - Bracklone – Portlaoise 110 kV.

  These circuits are also overloaded for maintenance trip combinations despite remedial action using generation dispatch of 400 MW.

– Voltage Profile

  Lack of reactive power in Counties Dublin, Kildare and Meath during certain operating conditions

– Large phase angles

  Due to high power transfers on existing lines and the low connectivity between transmission stations during certain operating conditions

Appendix 1 – Analysis Results

Appendix 1A - Winter Export – Non Converged Contingencies

Contingency
ARKLOW - LODGEWOOD 220 kV CCT 1
CORDUFF - HUNTSTOW 220 kV CCT 1
DUNSTOWN - LAOIS 400 kV CCT 1
GREAT ISLAND - KELLIS 220 kV CCT 1
GREAT ISLAND - LODGEWOOD 220 kV CCT 1
INCHICORE - IRISHTOWN 220 kV CCT 1
KNOCKANURE - BALLYNAHULLA 220 kV CCT 1
KNOCKANURE - KILPADDOGE 220 kV CCT 2
LAOIS - MNYPG3 400 kV CCT 1
MAYNOOTH - SHANNONBRIDGE 220 kV CCT 1
MNYPG1 - OLDSTREET 400 kV CCT 1
OLDSTREET - WOODLAND 400 kV CCT 1
WOODLAND - PORTAN 400 kV CCT 1 Loss of Generation/Power in-feed
ORIEL - ORIEL 220 kV CCT 1 Loss of Generation/Power in-feed
GREAT ISLAND - ENDESA 220/20 kV TRAFO Loss of Generation/Power in-feed
HUNTSTOWN - HUNTSTOWN 220/20 kV TRAFO Loss of Generation/Power in-feed
IRISHTOWN – DUBLIN BAY 220/ 20 kV TRAFO Loss of Generation/Power in-feed
COOLKEERAGH 275/15.800 TRAFO Loss of Generation/Power in-feed

Appendix 1B - Winter Export – Reactive Support N-1 Overloads

Contingency	Overloaded Circuit	Rating	Loading	%Loading
OLDSTREET - WOODLAND 400 kV CCT 1	DUNSTOWN - MAYNOOTH 220 kV CCT 2	534.0	682.5	127.8
OLDSTREET - WOODLAND 400 kV CCT 1	MAYNOOTH - WOODLAND 220 kV CCT 1	534.0	899.3	168.4
OLDSTREET - WOODLAND 400 kV CCT 1	BRACKLONE – PORTLAOISE 110 kV CCT 1	128.0	153.8	120.2

Appendix 1C - Winter Export – Re-dispatched N-1 Overloads

Contingency	Overloaded Circuit	Rating	Loading	%Loading
OLDSTREET - WOODLAND 400 kV CCT 1	DUNSTOWN - MAYNOOTH 220 kV CCT 2	534.0	549.8	103.1
OLDSTREET - WOODLAND 400 kV CCT 1	MAYNOOTH - WOODLAND 220 kV CCT 1	534.0	674.5	127.1

Appendix 1D - Winter Import Original N-1 Non –Converged Cases

Contingency
CORDUFF - HUNTSTOW 220 kV CCT 1
KNOCKANU BALLYNAH 220 kV CCT 1
LAOIS - MNYPG3 400 kV CCT 1
WOODLAND - PORTAN 400 kV CKT 1 Loss of Generation/Power in-feed
EASTWEST - PORTAN 400 kV CKT 1 Loss of Generation/Power in-feed
HUNTSTOWN - HUNTSTOWN 220/20 kV TRAFO Loss of Generation/Power in-feed
IRISHTOWN – DUBLIN BAY 220/ 20 kV TRAFO Loss of Generation/Power in-feed

Appendix 1E – Winter Import Reactive Support N-1 Overloads

Contingency	Overloaded Circuit	Rating	Loading	%Loading
CULLENAGH - GREAT IS 220 kV CCT 1	CULLENAGH - WATERFORD 110 kV CCT1*	219.0	249.0	112.0

* This overload is a local problem for the Waterford Area and will not be addressed as part of the need identified

Appendix 1F - Summer Export Reactive Support N-1 Overloads

Contingency	Overloaded Circuit	Rating	Loading	%Loading
CUSHALING - PORTLAOISE 110 kV CCT 1	BRACKLONE - PORTLAOISE 110 kV CCT 1	105.0	124.2	113.9
POOLBEG - INCHICORE 220 kV CCT 2	POOLBEG - INCHICOR 220 kV CCT 1	267.0	371.2	135.5
DUNSTOWN - LAOIS 400 kV CCT 1	BRACKLONE - PORTLAOISE 110 kV CCT 1	105.0	133.9	122.4
LAOIS - MNYPG3 400 kV CCT 1	KILLONAN - SHANNONBRIDGE 220 kV CCT 1	269.0	317.9	113.6
MNYPG1 - OLDSTREE 400 kV CCT 1	CASHLA - PROSPECT 220 kV CCT 1	392.0	530.0	131.4
	BRACKLONE - PORTLAOISE 110 kV CCT 1	105.0	125.9	123.0
	DUNSTOWN - MAYNOOTH 220 kV CCT 2	434.0	584.4	138.2
	KILLONAN - SHANNONBRIDGE 220 kV CCT1	269.0	324.5	118.1
	MAYNOOTH - WOODLAND 220 kV CCT 1	434.0	714.7	170.1
OLDSTREET - WOODLAND 400 kV CCT 1	BRACKLONE - PORTLAOISE 110 kV CCT 1	105	138.5	131.9
	DUNSTOWN - MAYNOOTH 220 kV CCT 2	434	646.4	148.9
	KILLONAN - SHANNONBRIDGE 220 kV CCT1	269	323.7	120.3
	MAYNOOTH - WOODLAND 220 kV CCT 1	434	874	201
	MAYNOOTH - RYEBROOK 110 kV CCT 1	187	212.3	113.5
	MAYNOOTH - SHANNONBRIDGE 220 kV CCT 1	269	324.8	120.7

Appendix 1G - Summer Export –Re-dispatched N-1 Overloads

Contingency	Overloaded Circuit	Rating	Loading	%Loading
MNYPG1 - OLDSTREE 400 kV CCT 1	CASHLA - PROSPECT 220 kV CCT 1	392.0	525.5	126.7
	DUNSTOWN - MAYNOOTH 220 kV CCT 2	434.0	522.2	116.0
	MAYNOOTH - WOODLAND 220 kV CCT 1	434.0	594.2	132.3
OLDSTREET - WOODLAND 400 kV CCT 1	BRACKLON - PORTLAOISE 110 kV CCT1	105.0	122.0	113.5
	DUNSTOWN - MAYNOOTH 220 kV CCT 2	434.0	542.0	121.4
	MAYNOOTH - WOODLAND 220 kV CCT 1	434.0	667.4	150.2

Appendix 1H - Summer Import – N-1 Overloads

Contingency	Overloaded Circuit	Rating	Loading	%Loading
CULLENAGH - WATERFOR 110 kV CCT 1	KILLOTERAN - WATERFOR 110 kV 1 CCT	99.0	117.7	113.9
CULLENAGH - GREAT IS 220 kV CCT 1	CULLENAGH - WATERFORD 110 kV CCT1	178.0	215.5	117.6
CORDUFF - FINGLAS 220 kV CCT 1	CORDUFFB - FINGLAS2 220 kV CCT2	434.0	514.2	112.0
CLONEE - WOODLAND 220 kV CCT 1	CORDUFFB - WOODLAND 220 kV CCT 2	434.0	509.0	110.2
CORDUFFB - FINGLAS2 220 kV CCT 2	CORDUFF - FINGLAS 220 kV CCT 1	434.0	514.2	112.0
CORDUFFB - WOODLAND 220 kV CCT 2	CLONEE - WOODLAND 220 kV CCT 1	434.0	511.7	110.7
GREAT ISLAND - LODGEWOO 220 kV CCT 1	GREAT ISLAND - WEXFORD 110 kV CCT1	99.0	156.4	150.1

Appendix 1I - Summer No Import/Export – N-1 Overloads

Contingency	Overloaded Circuit	Rating	Loading	%Loading
CLASHAVOON-KNOCKRAHA 220 kV CCT1	BANDON – DUNMANWAY 110 kV CCT1	99	116.7	114.1
DUNSTOWN - LAOIS 400 kV CCT 1	BRACKLON - PORTLAOISE 110 kV CCT1	105.0	128.1	116.5
MAYNOOTH – WOODLAND 220 kV CCT1	OLDSTREET – WOODLAND	434.0	525.0	118.9

Appendix 1J - Summer Night Valley – N-1 Overloads

Contingency	Overloaded Circuit	Rating	Loading	%Loading
OLDSTREET - WOODLAND 400 kV CCT 1	MAYNOOTH - WOODLAND 220 kV CCT 1	434.0	519.7	118.0

Appendix 2 –Maintenance Trip

Appendix 2A – Circuits Included for Maintenance

Moneypoint - Oldstreet 400 kV
Laois – Moneypoint 400 kV
Dunstown - Laois 400 kV
Woodland - Turleenan 400 kV
Killonan - Knockraha 220 kV
Killonan - Shannonbridge 220 kV
Killonan - Kilpaddoge 220 kV
Knockanure - Ballynahulla 220 kV
Knockraha - Cullenagh 220 kV
Great Island - Kellis 220 kV
Great Island - Lodgewood 220 kV
Cullenagh - Great Island 220 kV
Corduff - Huntstown 220 kV
Dunstown - Maynooth 220 kV circuit 1
Dunstown - Maynooth 220kV circuit 2
Maynooth - Woodland 220 kV
Corduff - Woodland 220 kV
Corduff - Finglas 220 kV
Corduff - Finglas 220 kV
Clonee - Woodland 220 kV
Inchicore - Poolbeg 220 kV
Inchicore - Irishtown 220 kV Circuit 1
Inchicore - Irishtown 220 kV Circuit 2
Maynooth – Gorman 220 kV
Gorman - Louth 220 kV
Killoteran - Waterford 110 kV
Cullenagh - Waterford 110 kV
Great Island - Wexford 110 kV
Corduff - Ryebrook 110 kV

Appendix 2B – Summer Export Maintenance Combinations Which Cause Non-Convergence Prior to Re-Dispatch

Maintenance	Contingency
Moneypoint - Oldstreet 400 kV	CASHLA 220.00 (1642) - PROSPECT 220.00 (4522) CKT 1
	CORDUFF 220.00 (2042) - HUNTSTOW 220.00 (2972) CKT 1 Loss of Generation/Power in-feed
	DUNSTOWN 400.00 (2204) - LAOIS 400.00 (3554) CKT 1
	FINGLAS 220.00 (2562) - HUNTSTOW 220.00 (2962) CKT 1
	LAOIS 400.00 (3554) - MNYPG3 400.00 (3944) CKT 1
	BELCAMP 110.00 (1471) - AMAZON 20.000 (14701) CKT 1
	BELCAMP 110.00 (1471) - AMAZON 20.000 (14701) CKT 2
	2962 HUNTSTOW TRAFO CKT 1 Loss of Generation/Power in-feed
	HUNTSTOW 220.00 (2972) - HUNTSTOW 20.000 (29673) CKT 2 Loss of Generation/Power in-feed
	IRISHTOW 220.00 (3122) - DUBLIN_B 21.000 (31271) CKT 1 Loss of Generation/Power in-feed
	HUNT_CC Loss of Generation/Power in-feed
Laois – Moneypoint 400 kV	MNYPG1 400.00 (3934) - OLDSTREE 400.00 (4384) CKT 1
	OLDSTREE 400.00 (4384) - WOODLAND 400.00 (5464) CKT 1
	CAUTEEN 110.00 (5271) - KILLONAN 110.00 (32810) CKT 1
Dunstown - Laois 400 kV	MNYPG1 400.00 (3934) - OLDSTREE 400.00 (4384) CKT 1
	OLDSTREE 400.00 (4384) - WOODLAND 400.00 (5464) CKT 1
Killonan - Knockraha 220 kV	BALLYNAH 220.00 (3332) - DUMMY 220.00 (8882) CKT 1
	KILPADDO 220.00 (3462) - DUMMY 220.00 (8882) CKT 2
Cullenagh - Great Island 220 kV	CAUTEEN 110.00 (5271) - KILLONAN 110.00 (32810) CKT 1
Corduff - Huntstown 220 kV	FINGLAS 220.00 (2562) - HUNTSTOW 220.00 (2962) CKT 1 Loss of Generation/Power in-feed
	MNYPG1 400.00 (3934) - OLDSTREE 400.00 (4384) CKT 1
	OLDSTREE 400.00 (4384) - WOODLAND 400.00 (5464) CKT 1
	BELCAMP 110.00 (1471) - AMAZON 20.000 (14701) CKT 1
	BELCAMP 110.00 (1471) - AMAZON 20.000 (14701) CKT 2
	2962 HUNTSTOW TRAFO CKT 1 Loss of Generation/Power in-feed
	HUNT_CC Loss of Generation/Power in-feed
Inchicore - Irishtown 220 kV Circuit 1	BELCAMP 110.00 (1471) - AMAZON 20.000 (14701) CKT 1
	BELCAMP 110.00 (1471) - AMAZON 20.000 (14701) CKT 2
	GRANGE C 110.00 (2861) - GRANGE C 10.000 (28601) CKT 2

Appendix 2C Summer Export Maintenance Trip Overloads Following Re-Dispatch

Maintenance	Contingency	Monitored Bus	Pre-Cnt	Post – Cnt	Rating (MVA)	% Loading
Moneypoint - Oldstreet 400 kV	Laois - Moneypoint 400 kV	Not converged	-	-	-	-
Laois - Moneypoint 400 kV	Moneypoint - Oldstreet 400 kV	Not converged	-	-	-	-
Laois - Moneypoint 400 kV	Oldstreet - Woodland 400 kV	Not converged	-	-	-	-
Cullenagh - Great 220kV Ckt 1	CULLENAG - WATERFOR 110 CKT 1	KILLOTER - WATERFOR 110 ckt 1	79.5	223.7	99	220.1
	KILPADDO - KNOCKANURE 220 CKT 2	KILLOTER - WATERFOR 110 ckt 1	79.5	118.2	99	119.7
	BALLYNAH - KNOCKANURE 220 CKT 1	KILLOTER - WATERFOR 110 ckt 1	79.5	117.4	99	118.7
Moneypoint - Oldstreet 400 kV	CASHLA - PROSPECT 220 ckt 1	CASHLA - ENNIS 110 ckt 1	167.7	255.8	178	142.3
		SHANNONB - SOMRST T 110 ckt 1	65	122.8	105	113.9
		LAOIS - PORTLAOI 110 ckt 1	164.8	203.7	178	111.1
		KILLONAN - SHANNONB 220 ckt 1	269.4	330.2	269	117.7
	DUNSTOWN - LAOIS 400CKT 1	KILLONAN - SHANNONB 220 ckt 1	269.4	383.6	269	137.9
		BRACKLON - NEWBRIDG 110 ckt 1	94.3	171.5	136	127.1
		MAYNOOTH - SHANNONB 220 ckt 1	194	323.5	269	118.7
		CASHLA - ENNIS 110 ckt 1	167.7	207.2	178	114.8
	POOLBEG - INCHICOR 220 CKT 2	POOLBEG - INCHICOR 220 CKT 1	198.9	411	267	147.7
Dunstown - Laois 400 kV	MONEYPOINT- OLDSTREET 400 CKT 1	LAOIS - PORTLAOI 110 ckt 1	164.5	316.4	178	173.3
		KILLONAN - SHANNONB 220 ckt 1	244.4	383.8	269	138
		CASHLA - PROSPECT 220 ckt 1	328	696.7	392	169.1
		BRACKLON - PORTLAOI 110 ckt 1	107.2	193.7	105	183.1
	OLDSTREET - WOODLAND 400 CKT 1	LAOIS - PORTLAOI 110 ckt 1	164.5	303	178	167.3
		MAYNOOTH - SHANNONB 220 ckt 1	194.2	376.4	269	139.5
		KILLONAN - SHANNONB 220 ckt 1	244.4	387.6	269	139
		CASHLA - FLAGFORD 220 ckt 1	198.4	471	405	114.3
Killonan - Knockraha 220kV Ckt 1	KILPADDO - KNOCKANURE 220 CKT 2	BARRYMOR - CAHIR 110 ckt 1	71.1	140.4	105	130.6
	BALLYNAH - KNOCKANURE 220 CKT 1	BARRYMOR - CAHIR 110 ckt 1	71.1	140.4	105	130.6
Inchicore - Irishtown 220kV Ckt 1	OLDSTREET - WOODLAND 400 CKT 1	DUNSTOWN - MAYNOOTH 220 ckt 2	396.5	629.5	434	140
Maynooth - Gorman 220kV Ckt 1	OLDSTREET - WOODLAND 400 CKT 1	MAYNOOTH - WOODLAND 220 ckt 1	343.7	762.6	434	169.1

Appendix 2D Summer Import Maintenance Trip Combinations Which Cause Non-Convergence Prior to Re-Dispatch

Maintenance	Contingency	Monitored line
Killonan - Knockraha 220kV Ckt 1	KILPADDO - KNOCKANURE 220 CKT 2	NOT CONVERGED

Appendix 2E Summer Import Maintenance Trip Overloads Following Re-Dispatch

Maintenance	Contingency	Monitored Bus	Pre-Cnt	Post – Cnt	Rating (MVA)	% Loading
Cullenagh - Great 220kV Ckt 1	CULLENAG - WATERFOR 110 CKT 1	KILLOTER - WATERFOR 110 ckt 1	49.4	151.8	99	147.4
	BUTLERST - CULLENAG 110 CKT 1	CULLENAG - WATERFOR 110 CKT 1	134.3	209	178	112.4
MNYPG - OLDSTREE 400kV Ckt 1	LAOIS - MONEYPOINT 400 CKT 1	CASHLA - PROSPECT 220 ckt 1	275.1	471.6	392	114.2

Appendix 2F - Summer No Import/Export – Maintenance Trip Combination overloads following Re-Dispatch

Maintenance	Contingency	Monitored Bus	Pre	Post	Rating (MVA)	% Loading
Dunstown - Laois 400 kV	MONEYPOINT- OLDSTREET 400 CKT 1	LAOIS 110.00 (3551) - PORTLAOI 110.00 (4481) ckt 1	151	282.2	178	154.5
		CASHLA 220.00 (1642) - PROSPECT 220.00 (4522) ckt 1	257.7	579.2	392	139.5
		BRACKLON 110.00 (1791) - NEWBRIDG 110.00 (4201) ckt 1	99.6	164.6	136	122.4
		KILLONAN 220.00 (3282) - SHANNONB 220.00 (4942) ckt 1	206.6	326.6	269	117.1
		MAYNOOTH 220.00 (3852) - SHANNONB 220.00 (4943) ckt 1	205.6	317.6	269	116
	OLDSTREET - WOODLAND 400 CKT 1	LAOIS 110.00 (3551) - PORTLAOI 110.00 (4481) ckt 1	151	275.2	178	151.7
		MAYNOOTH 220.00 (3852) - SHANNONB 220.00 (4943) ckt 1	205.6	368.7	269	135.9
		BRACKLON 110.00 (1791) - NEWBRIDG 110.00 (4201) ckt 1	99.6	173.2	136	130.4
		KILLONAN 220.00 (3282) - SHANNONB 220.00 (4942) ckt 1	206.6	333	269	119.3
Moneypoint – Oldstreet 400kV Ckt 1	CASHLA 220.00 (1642) - PROSPECT 220.00 (4522) CKT 1	MAYNOOTH 220.00 (3852) - WOODLAND 220.00 (5462) ckt 1	404.2	505.1	434	113
	CUSHALIN 110.00 (1941) - PORTLAOI 110.00 (4481) CKT 1	BRACKLON 110.00 (1791) - PORTLAOI 110.00 (4481) ckt 1	97.3	126.4	105	115.9
	Dunstown - Laois 400 kV	BRACKLON 110.00 (1791) - PORTLAOI 110.00 (4481) ckt 1	97.3	179	105	167.6
		LAOIS 110.00 (3551) - PORTLAOI 110.00 (4481) ckt 1	129.4	281.8	178	154.3
		CASHLA 220.00 (1642) - PROSPECT 220.00 (4522) ckt 1	361.9	578.9	392	139.4
		BRACKLON 110.00 (1791) - NEWBRIDG 110.00 (4201) ckt 1	86.9	164.6	136	122.4
		KILLONAN 220.00 (3282) - SHANNONB 220.00 (4942) ckt 1	213.2	326.4	269	116.9
		MAYNOOTH 220.00 (3852) - SHANNONB 220.00 (4943) ckt 1	187.9	318.3	269	116.1
	GORMAN 220.00 (2842) - MAYNOOTH 220.00 (3842) CKT 1	MAYNOOTH 220.00 (3852) - WOODLAND 220.00 (5462) ckt 1	404.2	505.5	434	112.3
	INCHICOR 220.00 (3082) - IRISHTOW 220.00 (3122) CKT 1	DUNSTOWN 220.00 (2202) - MAYNOOTH 220.00 (3852) ckt 2	390.2	508.2	434	113.2
	Laois – Moneypoint 400 kV	CASHLA 220.00 (1642) - PROSPECT 220.00 (4522) ckt 1	361.9	684.5	392	181.3
		KILLONAN 220.00 (3282) - SHANNONB 220.00 (4942) ckt 1	213.2	402.8	269	152
		MAYNOOTH 220.00 (3852) - SHANNONB 220.00 (4943) ckt 1	187.9	345.8	269	135.2
		AGANNYGA 110.00 (1071) - SHANNONB 110.00 (4941) ckt 1	83.2	124.7	105	120.8
	MAYNOOTH 220.00 (3852) - WOODLAND 220.00 (5462) CKT 1	MAYNOOTH 110.00 (3851) - RYEBROOK 110.00 (4621) ckt 1	153.1	215.9	187	112.8
	POOLBEG 220.00 (4462) - POOLBEG 220.00 (4472) CKT 1	MAYNOOTH 220.00 (3852) - WOODLAND 220.00 (5462) ckt 1	404.2	535.7	434	119

Laois – Moneypoint 400 kV	CLASHAVO 220.00 (1602) - KNOCKRAH 220.00 (3202) CKT 1	BANDON 110.00 (1441) - DUNMANWA 110.00 (2221) ckt 1	80.3	116.2	99	113.3
	MONEYPOINT- OLDSTREET 400 CKT 1	CASHLA 220.00 (1642) - PROSPECT 220.00 (4522) ckt 1	283.3	679.5	392	180.6
		KILLONAN 220.00 (3282) - SHANNONB 220.00 (4942) ckt 1	231.8	405.3	269	152.4
		MAYNOOTH 220.00 (3852) - SHANNONB 220.00 (4943) ckt 1	208.7	344.8	269	133.9
		AGANNYGA 110.00 (1071) - SHANNONB 110.00 (4941) ckt 1	93.1	126	105	121.4
	OLDSTREET - WOODLAND 400 CKT 1	MAYNOOTH 220.00 (3852) - SHANNONB 220.00 (4943) ckt 1	208.7	397.7	269	158.1
		KILLONAN 220.00 (3282) - SHANNONB 220.00 (4942) ckt 1	231.8	406.4	269	153.5
		AGANNYGA 110.00 (1071) - SHANNONB 110.00 (4941) ckt 1	93.1	133.5	105	128.9
		CASHLA 220.00 (1642) - FLAGFORD 220.00 (2522) ckt 1	163.6	493.1	405	122.1
		ARVA 110.00 (1181) - CARICKON 110.00 (1861) ckt 1	54.2	117.9	99	120.5
		LANESBOR 110.00 (3501) - MULLINGA 110.00 (4001) ckt 1	57.8	114.5	105	114
Corduff – Huntstown 220 kV	OLDSTREE 400.00 (4384) - WOODLAND 400.00 (5464) CKT 1	MAYNOOTH 220.00 (3852) - WOODLAND 220.00 (5462) ckt 1	231.6	537.6	434	121.7

Appendix 2G- Summer Night Valley Maintenance Trip Combination overloads following Re-Dispatch

Maintenance	**Contingency**	**Monitored Bus**	**Pre**	**Post**	**Rating (MVA)**	**% Loading**
Dunstown - Laois 400 kV	OLDSTREET - WOODLAND 400 CKT 1	BRACKLON - PORTLAOI 110 ckt 1	77.4	146.8	105	134.4
	OLDSTREET - WOODLAND 400 CKT 1	MAYNOOTH - SHANNONB 220 ckt 1	187.4	326.3	269	118
	MONEYPOINT- OLDSTREET 400 CKT 1	BRACKLON - PORTLAOI 110 ckt 1	77.4	127.9	105	117.4
Maynooth - Woodland 220kV Ckt 1	OLDSTREET - WOODLAND 400 CKT 1	MAYNOOTH - RYEBROOK 110 ckt 1	152.3	240.8	187	128
	OLDSTREET - WOODLAND 400 CKT 1	POOLBEG - POOLBEG 220 ckt 1	279.3	537.2	450	116
	POOLBEG - POOLBEG 220 CKT 1	MAYNOOTH - RYEBROOK 110 ckt 1	152.3	214.8	187	113
Laois – Moneypoint 400 kV	OLDSTREET - WOODLAND 400 CKT 1	MAYNOOTH - SHANNONB 220 ckt 1	185.4	343.3	269	125.8
	OLDSTREET - WOODLAND 400 CKT 1	KILLONAN - SHANNONB 220 ckt 1	170.7	309.7	269	111.5
Moneypoint - Oldstreet 400 kV	DUNSTOWN - LAOIS 400 CKT 1	BRACKLON - PORTLAOI 110 ckt 1	76.8	128.1	105	117.7
Great - Kellis 220kV Ckt 1	ARKLOW - CARRICKM 220 CKT 1	ARKLOW - BALLYBEG 110 ckt 1	66	158.1	136	117.5
Great - Kellis 220kV Ckt 1	ARKLOW - CARRICKM 220 CKT 1	BALLYBEG – CARRICKM 110 ckt 1	62.8	153.6	136	115.2
Cullenagh - GI 220kV Ckt 1	CULLENAG - WATERFOR 110 CKT 1	KILLOTER - WATERFOR 110 ckt 1	41.8	112	99	110.8
Maynooth - Gorman 220kV Ckt 1	OLDSTREET - WOODLAND 400 CKT 1	MAYNOOTH - WOODLAND 220 ckt 1*	288.2	594.7	434	134.6

*This circuit was overloaded for many maintenance trip combinations. Only the worst case is reported here.

Appendix 3 - High Impact Low Probability Analysis

Circuit 1	Circuit 2
Woodland – Corduff 220 kV cct 1	Woodland – Corduff 220 kV cct 2
Woodland – Corduff 220 kV cct 1	Maynooth – Woodland 220 kV cct 1
Woodland – Corduff 220 kV cct 2	Louth – Woodland 220 kV cct 1
Maynooth – Woodland 220 kV cct 1	Maynooth –Shannonbridge 220 kV cct 1
Dunstown – Moneypoint 400 kV cct 1	Moneypoint – Prospect 220 kV cct 1
Dunstown – Carrickmines 220 kV cct 1	Dunstown – Maynooth 220 kV cct 1
Dunstown – Kellis 220 kV cct 1	Great Island – Kellis 220 kV cct 1
Inchicore – Maynooth 220 kV cct 1	Inchicore – Maynooth 220 kV cct 2
Corduff – Finglas 220 kV cct 1	Corduff – Finglas 220 kV cct 2

Step 2A - Long List Options Report (December 2017)

Options Report
Part A
Capital Project 0966

December 2017

EIRGRID

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1 Table of Contents

2 Introduction

EirGrid follow a six step approach when we develop and implement the best performing solution option to any identified transmission network problem. This six step approach is described in the document 'Have Your Say' published on EirGrid's website[1]. The six steps are shown on a high-level in Figure 1. Each step has a distinct purpose with defined deliverables.

Figure 1 *High Level Project Development Process*

The transmission network problem was identified and described in previous Step 1 and was documented in the Need Report.

The Options Report Part A (this document) is a deliverable for Step 2. In Step 2, a technology overview will be carried out. This will determine the aspects that will be considered when creating any options. All the viable and technically acceptable options created will be shown in a list that is called 'the long list'. This list will be refined in a two-part approach with the aim to establish a shorter list of best performing solution options to bring forward for further investigation in Step 3. The outcome from the first part of refinement of the long list in Step 2 is presented in the Options Report Part A (this document) and the outcome of the second part of refinement of the list is presented in Options Report Part B.

The need, in this case, involves a transmission network problem regarding the transfer of power across the existing 400 kV transmission network from west to east and the transfer of this power within in the transmission network as it reaches the east coast. The issues encountered involve both capacity and voltage.

[1] http://www.eirgridgroup.com/the-grid/have-your-say/

3 Process followed and criteria

3.1 Description of process

The need to improve the transmission network is identified in Step 1. Following on from this step, the process of identifying viable and technically acceptable technology solution options starts. This involves a rigorous process spanning over two steps namely, Step 2 and Step 3. The outcome of Step 2 is a list of best performing solution options which will be taken to Step 3 for further investigation and evaluation. At the end of Step 3 we will have a best performing solution option which will be developed for construction and energisation.

Step 2 can further be broken down into a two-part approach, namely Part A and Part B. This report (Options Report Part A) details the findings of the first part (Part A) of the refinement of the long list.   Part B will involve a second refinement of the options list and the findings of this assessment will be presented in the Options Report Part B at the end of Step 2. Between Part A and Part B stakeholder engagement will take place. The stakeholder engagement is project specific and generally at this stage in the development process it is intended to engage with national and regional stakeholders. A project specific web-site will be set up and relevant material about the project will be published. Figure 2 provides an overview of the process and different tasks in Step 2, excluding stakeholder engagement. A more detailed description of the individual tasks is provided below.

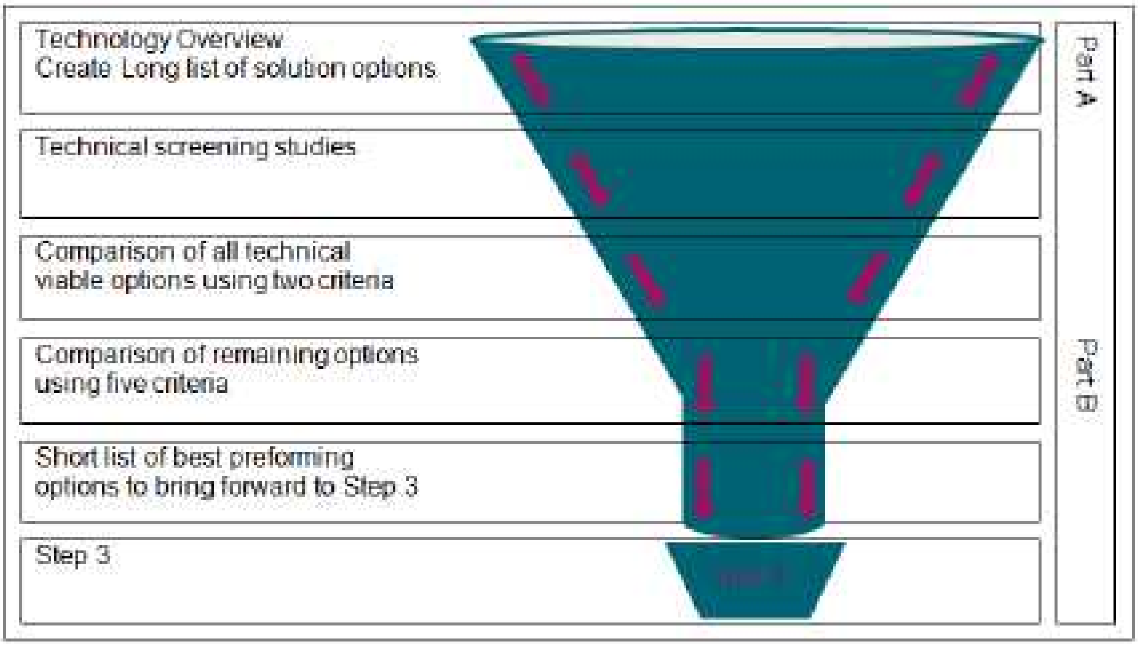

Figure 2 *Illustration of the process of developing of options in Step 2*

3.1.1 Part A

The initial development of viable and technically acceptable options starts with the Technology Overview. This involves consideration of technical aspects which will form the basis of developing the solution options, such as technologies, suitable voltage levels and potential connection points of the solutions. The reasoning and justification for any choices and decisions are outlined. This is discussed in section 4.1 Technology overview in more detail. The findings of the technology overview are then used to create a long list of viable and technically acceptable solution options.

The second task involves high level technical screening studies of the identified solution options to determine if they have a potential to solve the identified need. The solution options will also be assessed on their technical ability, relative to each other, to solve the identified problem. This is discussed in section 4.2.1 Technical screening studies. Further more detailed technical analysis will be carried out later in Part B in Step 2 to determine technical details of options.

The third task involves a multi-criteria comparison of the solution options in the long list using two criteria namely, technical performance and economic performance. This task may involve reducing a vast number of solution options to a more refined list of options to be further investigated. This is discussed in Section 4.3 Comparison of solution options.

3.1.2 Part B

The option list is further refined, this time using a multi-criteria comparison against five criteria. The five criteria are technical performance, economic performance, environmental, deliverability and socio-economic aspects. Each remaining option is assessed against the five criteria. At the end of Step 2 the outcome of this assessment will be available in the Options Report Part B. The outcome of Step 2 is a shorter list of solution options which will be taken to Step 3 for further investigation and evaluation.

3.2 Criteria used for comparison of options

As described in previous section the multi-criteria comparison is carried out twice in Step 2. The first time (Part A) the performance matrix is used only two criteria are compared namely, technical performance and economic performance. The second time (Part B) the performance matrix is used five criteria are compared, namely technical performance, economic performance, environmental, deliverability and socio-economic. Descriptions of the all criteria are outlined below.

3.2.1 *Technical performance*

Technical performance in Part A is based on high level technical screening studies of the identified solution options. This will determine if they have a potential to solve the identified need. The solution options will also be assessed on their technical ability, relative to each other, to solve the identified problem. In this case the initial technical screening study is based on assessing the worst contingency identified in load flow as part of the need analysis. The different options will be compared against identified indicators of the technical performance based on the need identified. This is further discussed in Section 4.2.1 Technical screening studies.

The second time (Part B) the technical performance is assessed the criteria is based on compliance with Transmission System Security and Planning Standards (TSSPS) and policies. Minimum technical requirements based on these have to be met to qualify an option for consideration, but options which extend technical performance margins beyond minimum acceptable levels are favoured over others. Operational flexibility will also be assessed. This will capture the complexity involved in operational switching and risks to operation during maintenance. The extent to which future reinforcement of, and/or connection to, the transmission network is facilitated will also be taken into account.

3.2.2 *Economic performance*

Economic performance in Part A will be based on high level estimated capital costs for each option for comparison purposes. The primary source for cost estimates have been developed with input from the Transmission Asset Owner (TAO) and are based on desktop designs and costings for similar works. Where costs were not available for a particular technology, the best most recent estimate will be used.

Economic performance in Part B will be based on estimated Total Project Cost (TPC) for comparison purposes. The TPC will comprise both estimated capital costs and an estimated cost for the Transmission System Operator (TSO) element for development the options. The primary source for cost estimates have been developed with input from the Transmission Asset Owner (TAO) and are based on desktop designs and costings for similar works. Where costs were not available for a particular technology the best, most recent estimate will be used.

3.2.3 *Environmental*

This criteria is used in Part B. Environmental issues are considered at a high level such as potential interactions with Natura 2000 sites (Special Areas of Conservation-SAC, or special Protection Areas-SPAs or other designated sites that may be in the zone of influence for the various options. Impacts on existing land use and landscape including cultural heritage is compared for the various options.

3.2.4 Deliverability

This criteria is used in Part B. Deliverability captures timelines as well as engineering and planning risks which could extend delivery timescales and costs.

3.2.5 Socio-Economic

This criteria is used in Part B. This criterion will consider the general location of the subject site of the substation and adjacent lands with regards to the nature of typical social impacts. This assessment is carried out in accordance with EirGrid's SIA Methodology.

3.3 Scale used to assess each criteria

The effect on each criteria parameter is presented along a range from "more significant"/"more difficult"/"more risk" to "less significant"/"less difficult"/"less risk". The following scale is used to illustrate each criteria parameter:

More significant/difficult/risk | Less significant/difficult/risk

In the text this scale is quantified by text for example mid-level (Dark Green), low-moderate (Green), low (Cream), high-moderate (Blue) or high (Dark Blue).

4 Long list and comparison of options

4.1 Technology Overview

This overview forms the pillars from which the solution options to resolve the identified need are developed. For the technology overview, EirGrid's approved technology toolbox has been used. To determine the possible solution options a number of aspects are considered. A brief discussion regarding these aspects and the decisions made are outlined below.

Prior to developing options for the identified need, it is important to analyse and understand the need. The need in this case, involves a transmission network problem regarding the transfer of power across the transmission 400 kV network from west to east and the transfer of this power within the counties Dublin, Kildare and Meath as it reaches the east coast. The issues encountered involve both capacity and voltage. As indicated by the need assessment, solutions with the best potential to solve the need are very likely to involve connection points on the 400 kV network or other strong nodes in its vicinity. The best performing solution needs to integrate with the existing network and provide a platform for the future expansion of the transmission network.

4.1.1 Technologies

The development of options may involve additional circuits or equipment which may allow for the more efficient use of existing transmission infrastructure on the system.

High Voltage Alternating Current (HVAC) will be considered for the majority of the reinforcement options. HVAC is the same technology as is used in the existing network and would integrate well. High Voltage Direct Current (HVDC) will also be considered when options are developed. HVDC is a suitable technology for the transfer of large amounts of power over long distances from one point to another. The lengths of circuits in the Irish transmission network are relatively small <100 km and this would not usually merit a HVDC solution. HVDC will therefore only been considered for a limited number of options. Only underground cable will be considered for HVDC.

In terms of new circuits, both underground cable (UGC) and overhead line (OHL) options will be considered. It should be noted that previous analysis has indicated that long lengths (more than 10 km) of AC 400 kV underground cable cannot be accommodated in the Irish transmission system. There are technical reasons why a longer AC underground cable cannot be accepted. The reasons include voltage control problems and electromagnetic transient phenomena associated with the capacitive characteristics of high voltage underground cables. The issues associated with long cables can only be determined by specialised system analysis and these studies are planned to be carried out if the option is brought forward to Step 3.

Although previous analysis have identified issues we have for completeness included two AC underground cable solution options in the long list, one at 400 kV and one at 220 kV. The cable options will be assessed on the same terms as the other options in Part A. If the cable options remain after the first refinement of the list their technical suitability and acceptability will be investigated further in Part B and in Step 3 if required.

Partial AC undergrounding of any overhead line solution using short lengths of underground cables will be considered as part of mitigation measured in Step 3 and/or Step 4.

As the need partly indicated issues with power transfers within the counties Dublin, Kildare and Meath the consideration of options included in the long list will also extend to circuits within these counties.

As indicated by the need assessment, the solutions with the best potential to solve the need involve connection points on the 400 kV network or other strong 220kV[2] nodes in its vicinity. More remote 220kV nodes were excluded as they would significantly increase the route length of the options which in turn, would result in higher cost, longer deliverability and potential for environmental impact.

The identified connection points, 400kV stations and other strong nodes, are all located far inland. Consequently fully offshore cable solutions are not possible. The use of a partial offshore cable solution has not been specifically identified. The reason is that the onshore cable elements alone would be longer than entirely onshore cable options as the distance to the coast from suitable connection points is substantial. In the event that subsequent detailed routing of cable options increases the route length sufficiently, the use of partial offshore cable will be reconsidered.

We will also consider technologies for voltage support as the need analysis has identified this as an issue. The technologies that provide voltage support will mostly be located in existing stations.

[2] As only 220kV and 400kV stations have sufficient power transfer capacities to be able to resolve the need

4.1.2 Voltage level

For the development of the options the voltage levels 220 kV and 400 kV will be considered. The magnitude of the problem identified, with thermal overloads on 220 kV circuits and voltage collapse the counties Dublin, Kildare and Meath, indicates that a reinforcement using the voltage levels of 220 kV and 400 kV at a minimum is required. Using a 110 kV reinforcement would not contribute with the capacity required and is not considered appropriate.

4.1.3 Connection points

The identified network problems indicate issues with loss of high voltage circuits, in particular the existing 400 kV circuits between the west coast and the east coast. The loss of one of these 400 kV circuits will force the power flow to alternative paths along the paths to the east coast.

Possible connection points for solution options should include connections between the 400 kV stations at Moneypoint, Woodland, Dunstown and other strong nodes on or around the 400 kV network. Figure 3 below highlights some of the identified possible connection points which will be used when creating the potential options.

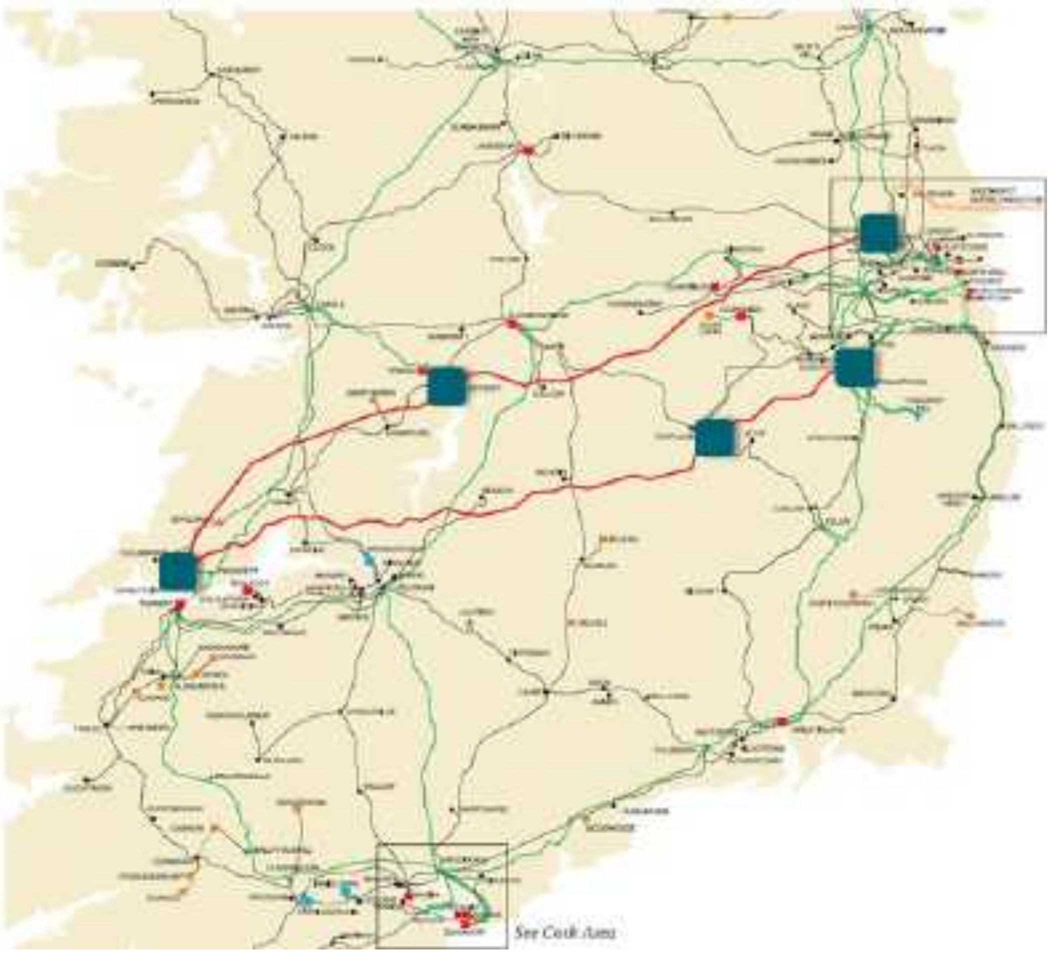

Figure 3 *Some the possible connection points for solutions*

4.2 Assessment of solution options in long list

The long list of solution options was established using the connection points, voltage levels and technologies described in previous section. Knowledge of the identified need and engineering judgement was also used when the long list was created. The long list consists of 15 technically viable and feasible solution options and they are listed in Table 1 in section 4.2.1 Technical screening studies.

The solution options identified in the long list were assessed based on two criteria namely, technical performance and economic performance. The aim of this assessment is to be able to compare the options and reduce the number of solution options that would be brought forward for more detailed evaluation. The sections below describe how these assessments were carried out and the outcome. The effect on each criteria parameter is presented along the following scale.

More significant/difficult/risk Less significant/difficult/risk

4.2.1 Technical screening studies

The technical performances of options, at this stage, is based on high level technical screening studies to determine if the options have a potential to solve the identified need. The solution options will also be assessed on their technical ability relative to each other. The aim of the high level technical screening studies is to reduce the number of solution options that would be brought forward for more detailed evaluation.

The high level technical screening studies are carried out on a network situation where major problems occurred on the transmission system in the needs analysis. The major problems occurred during a network situation representing Winter Peak 2025 with EWIC and Moyle interconnectors exporting with high wind generation in the west and south west. This situation was previously identified in the needs analysis as the worst scenario. This situation creates a cross country power flow on the existing transmission system from the West to the East coast.

The high level technical screening studies are based on assessing the worst contingency, loss of Oldstreet – Woodland 400 kV circuit, identified as part of the need analysis. The need analysis also found that three technical issues had to be addressed as part of the solution to cater for unplanned losses of any of the 400 kV circuits. These issues were:

- thermal overloads
- voltage collapse
- large phase angle differences which would prevent reclosing

It was decided to use these three issues as indicators of the technical performance of the options in the long list. This enabled us to assess the options technical ability to solve the identified issues above in a concise way. It also allowed us to compare the options technical ability relative to each other.

Each solution option in the long list was modelled in the above mentioned network situation and the worst contingency, loss of Oldstreet – Woodland 400 kV circuit, was applied. The impact that the solution option made on the three issues was recorded and compared with a reference case. The reference case represents a network with no solution option included.

Table 1 below highlights the high level technical performance of the options based on the three indicators, compared to the reference case. The table also displays the combined technical performance of the options in Step 2 Part A.

Options	Amount of voltage support required	No. of overloads observed on top of option	Phase Angle observed across open breaker on Oldsteet - Woodland	Combined Technical Performance in Part A
Reference case without any solution				
New Coolnabacky – Dunstown 400 kV OHL				
New Dunstown – Moneypoint 400 kV OHL				
New second Oldstreet – Woodland 400 kV OHL				
New Moneypoint – Woodland 400 kV OHL				
Upvoltage existing 220 kV circuits to 400 kV to create new Dunstown –Woodland 400 kV OHL				
New Dunstown – Woodland 400 kV OHL				
Upvoltage existing 220 kV circuits to 400 kV to create new Kilpaddoge-Killonan-Shannonbrige 400 kV OHL				
New Coolnabacky – Oldstreet 400 kV OHL				
New Dunstown – Woodland 220 kV OHL				
New Moneypoint – Woodland 220 kV OHL				
New Maynooth – Woodland 220 kV OHL				
New Dunstown – Woodland 220 kV UGC				
New Dunstown – Woodland 400 kV UGC				
New HVDC circuit between Moneypoint – Woodland				
New HVDC circuit between Dunstown – Woodland				

Table 1 *Result of the high level technical screening studies in Step 2 Part A for options in long list*

4.2.2 Economic performance

Economic Performance in Part A in Step 2 is based on estimated capital costs for each option for comparison purposes. Table 2 below summaries the estimated capital cost for the long list of options and provides a colour code relative to each other for comparison purposed.

Options	Economic Performance	
	Capital cost (€m)	Colour code
New Coolnabacky – Dunstown 400 kV OHL	56	
New Dunstown – Moneypoint 400 kV OHL	249	
New second Oldstreet – Woodland 400 kV OHL	151	
New Moneypoint – Woodland 400 kV OHL	371	
Upvoltage existing 220 kV circuits to 400 kV to create new Dunstown –Woodland 400 kV OHL	68	
New Dunstown – Woodland 400 kV OHL	64	
Upvoltage existing 220 kV circuits to 400 kV to create new Kilpaddoge-Killonan-Shannonbrige 400 kV OHL	203	
New Coolnabacky – Oldstreet 400 kV OHL	117	
New Dunstown – Woodland 220 kV OHL	38	
New Moneypoint – Woodland 220 kV OHL	159	
New Maynooth – Woodland 220 kV OHL	18	
New Dunstown – Woodland 220 kV UGC	98	
New Dunstown – Woodland 400 kV UGC	130	
New HVDC circuit between Moneypoint – Woodland	645	
New HVDC circuit between Dunstown – Woodland	258	

Table 2 *Economic performance of option in long list*

4.3 Comparison of solution options

Table 3 provides a summary of the performance of each option against the two evaluation criteria.

Options	Technical Performance	Economic Performance	Combined Performance in Part A
New Coolnabacky – Dunstown 400 kV OHL			
New Dunstown – Moneypoint 400 kV OHL			
New second Oldstreet – Woodland 400 kV OHL			
New Moneypoint – Woodland 400 kV OHL			
Upvoltage existing 220 kV circuits to 400 kV to create new Dunstown –Woodland 400 kV OHL			
New Dunstown – Woodland 400 kV OHL			
Upvoltage existing 220 kV circuits to 400 kV to create new Kilpaddoge-Killonan-Shannonbrige 400 kV OHL			
New Coolnabacky – Oldstreet 400 kV OHL			
New Dunstown – Woodland 220 kV OHL			
New Moneypoint – Woodland 220 kV OHL			
New Maynooth – Woodland 220 kV OHL			
New Dunstown – Woodland 220 kV UGC			
New Dunstown – Woodland 400 kV UGC			
New HVDC circuit between Moneypoint – Woodland			
New HVDC circuit between Dunstown – Woodland			

Table 3 *Multi criteria assessment based on two criteria in Step 2 Part A*

In terms of technical performance, options which included duplication of the existing 400 kV circuits or improved connectivity between the 400 kV circuits, to create a loop or circle, were found to have a very favourable performance. It is also evident that the duplication or part duplication of the more southern existing 400 kV circuit has a less favourable technical performance then a duplication or part duplication of the northern existing 400 kV circuit. In part this is due to the worst contingency being loss of part of the upper circuit. It should also be noted that any solution option using a 220 kV solution has a less preferential technical performance than a solution using a 400 kV.

The introduction of a new HVDC circuit has not been modelled as part of the initial technical screening studies. It is assumed that the HVDC solution and its control system can be designed as required to meet the system needs including required reactive support. Therefore the technical performance for the HVDC options has been assumed to be optimal for the purpose of the high level screening studies.

In accordance with our strategy to maximise the use of our existing infrastructure before developing new circuits, EirGrid has been investigating the possibility of modifying existing 220 kV towers in order to accommodate 400 kV circuits. One option will use this technology and the initial studies found that this option performs almost as well as the introduction of a new 400 kV overhead line. The better technical performance of a new 400 kV is due to the fact that it provides a net increase in the number of circuits compared to the upvoltaging solution, which involves the replacement of existing 220 kV circuits with 400 kV circuits.

Previous analysis has indicated that long lengths of AC 400 kV underground cable cannot be accommodated in the Irish transmission network. Although previous analysis have identified issues we have for completeness included two AC underground cable solution options in the long list, one at 400 kV and one at 220 kV. The cable options are assessed on the same terms as the other options in the high level screening studies in Part A. AC cable solutions will require very detailed specific technical analysis to determine if they are technically feasible. These detailed specific technical analyses will be carried out in Step 3 if the cable options remain. Partial AC undergrounding of any overhead line solution using short lengths of underground cables will be considered as part of mitigation measured in Step 3 and/or Step 4.

Load flow analysis of a 220 kV underground cable between Dunstown and Woodland stations indicated that the new cable became overloaded for the loss of Oldstreet-Woodland 400 kV circuit. The low impedance of the 220 kV cable caused the power to be directed through this new cable instead of using the parallel existing overhead lines. To alleviate this issue, Woodland 400 kV busbar had to be operated split. This may not be optimal from an operations point of view, and may reflect on the options technical performance at a later stage.

The economic performance has a dependence on the length of the proposed circuit and this is evident from the options that stretch across the country. Long circuits perform economically less favourably compared to the options which have a shorter length. The HVDC circuits have also proven to be prohibitively expensive when compared with the other candidate solutions.

It should be noted that almost all of the options required some additional voltage support devices. The most optimal location for these and their size will be determined when the refined list are analysed in more detail in Part B.

4.4 Proposed solution options to be brought forward

The proposed options that will be taken through for further investigation are marked with the two lighter colours on the scale, **Cream** and **Green,** in Table 3. The proposed options can be influenced by stakeholders if reasonable justification is provided for modification of the proposed list of options. Based on the analysis to date, below is a proposed refined list of solution options to be brought forward for more detailed evaluation in Part B:

- Upvoltage existing 220 kV circuits to 400 kV to create new Dunstown – Woodland 400 kV OHL
- New Dunstown – Woodland 400 kV OHL
- New Dunstown – Woodland 220 kV OHL
- New Dunstown – Woodland 220 kV UGC
- New Dunstown – Woodland 400 kV UGC

5 Conclusion of Step 2 Part A

After completing a technology overview, a long list of 15 viable and technically feasible solution options was presented. The solution options identified in the long list were assessed based on two criteria namely, technical performance and economic performance.

The aim of the assessment in Part A is to be able to compare the options and reduce the number of solution options that would be brought forward for more detailed evaluation. Based on the analysis to date, below is a proposed refined list of solution options to be brought forward for more detailed evaluation in Part B:

- Upvoltage existing 220 kV circuits to 400 kV to create new Dunstown –Woodland 400 kV OHL
- New Dunstown – Woodland 400 kV OHL
- New Dunstown – Woodland 220 kV OHL
- New Dunstown – Woodland 220 kV UGC
- New Dunstown – Woodland 400 kV UGC

The proposed list of options can be influenced by stakeholders if reasonable justification is provided for modification of the refined list.

All options involve a new connection between Dunstown 400/220 kV station and Woodland 400/220 kV station.

Almost all of the options required some additional voltage support devices and the most optimal location for these and their size will be determined when the refined list are analysed in more detail in Part B.

In Part B the remaining options will be assessed under five criteria;

- Technical Performance
- Economic Performance
- Deliverability
- Environmental
- Socio-economic

This assessment will allow the refined long list to be further reduced to create a shorter list to bring forward to Step 3.

Step 2B - Short List Options Report (March 2019)

Options Report
Part B
Capital Project 0966

March 2019

EIRGRID

Revision Table:

Revision	Issue Date	Description
01	26-10-2018	Issued for Gateway 2 Governance in Framework for Grid Development – Step 2
02	2-04-2019	Section 5 updated after 10-week consultation period ended 4th February 2019. Appendix 4G updated to reflect short circuit values. Correction to typographical errors and clarifications throughout document.

1 Table of Contents

2 Introduction

EirGrid follow a six step approach when we develop and implement the best performing solution option to any identified transmission network problem. This six step approach is described in the document 'Have Your Say' published on EirGrid's website[1] and is known as the framework for developing the grid. The six steps are shown on a high-level in Figure 1. Each step has a distinct purpose with defined deliverables.

Figure 1 *High Level Project Development Process*

The transmission network problem was identified and described in previous Step 1 and was documented in the Need Report.

The need, in this case, involves a transmission network problem regarding the transfer of power across the existing 400 kV transmission network from west to east and the transfer of this power within the transmission network as it reaches the east coast. The issues encountered involve on a high level capacity and voltage.

In Step 2 there are two reports to be delivered, namely Options Report Part A and Options Report Part B. The Options Report Part A, covers the aspects that will be considered when creating the long list of options and the first refinement of this list. The outcome of the second part of refinement of the list is presented in Options Report Part B (this document).

[1] http://www.eirgridgroup.com/the-grid/have-your-say/

3 Process followed and criteria

3.1 Description of process

The transmission network problem was identified and described in previous Step 1 and documented in the Need Report. Following on from Step 1, the process of identifying viable technology solution options starts. This involves a rigorous process spanning over two steps namely, Step 2 and Step 3. The outcome of Step 2 is a list of best performing solution options which will be taken to Step 3 for further investigation and evaluation. At the end of Step 3 we will have a best performing solution option which will be developed for construction and energisation. This report details the outcome of the second part of the refinement of the long list in Step 2.

Figure 2 provides an overview of the process and different tasks in Step 2. The first three tasks were covered in Options Report Part A. The outcome of these three first tasks was a refined long list.

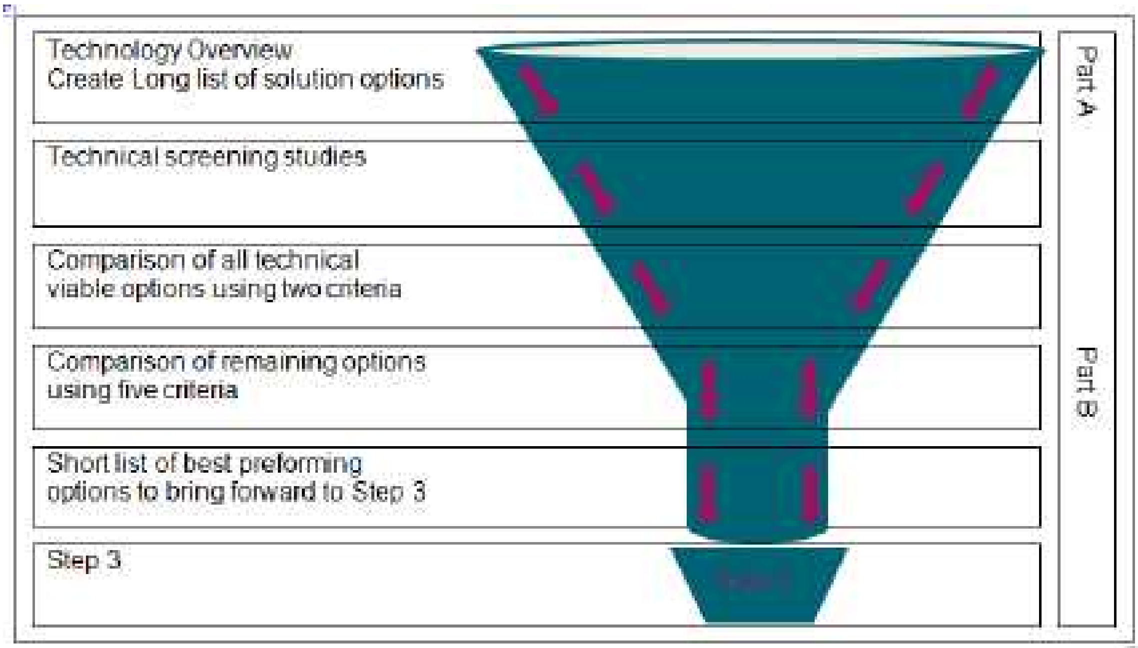

Figure 2 *Illustration of the process of developing of options in Step 2*

The list is further refined in Step 2, this time using a multi-criteria comparison against five criteria namely, technical performance, economic performance, environmental aspects, deliverability aspects and socio-economic aspects. Each remaining option is assessed against the five criteria. This is discussed in Section 7 Detailed evaluation of the options. The outcome of Step 2 is a short list of solution options which will be taken to Step 3 for further investigation and evaluation.

3.2 Criteria used for comparison of remaining options

The second time the performance matrix is used in Step 2, each remaining option is assessed against the five criteria. The five criteria are technical performance, economic performance, environmental aspects, deliverability aspects and socio-economic aspects. Descriptions of the five criteria are outlined below. It should be noted that the assessments provided are for comparison against each other and not absolute assessments of the individual options.

3.2.1 Technical performance

In Part B in Step 2 the technical performance criteria is based on compliance with Transmission System Security and Planning Standards (TSSPS) and compliance with current transmission investment policies. Only options that meet the minimum technical requirements set out in the TSSPS qualify for consideration in Step 2 Part B. Options which extend or enhance technical performance margins beyond minimum acceptable levels are favoured over others.

The options will be assessed against five technical performance criteria to be able to distinguish between their individual technical performances. The technical criteria in Step 2 Part B relate to the needs identified and are thermal overload, voltage phase angle, reactive support requirements, short circuit performance and performance during maintenance conditions. A short description of these is given below.

3.2.1.1 Thermal overload criteria

The options are assessed for compliance with the Transmission System Security and Planning Standards (TSSPS). If thermal overload violations are identified additional potential reinforcements will be added to the options until the enhanced option fully meets the TSSPS. For this technical criterion we have assessed the options based on how many additional thermal overloads are remaining after the option has been added. This will provide an indication of how the options are performing in terms of adding thermal capacity.

3.2.1.2 Voltage phase angle

The options are assessed for compliance with the Operating Security Standards (OSS), which EirGrid is required to comply with in its licence. The OSS states that EirGrid should maintain a voltage phase angle of 40 degrees or below. The need analysis in Step 1 identified a voltage phase angle difference above 40 degrees between Woodland and Oldstreet stations when the Woodland – Oldstreet 400 kV circuit was opened. Only options that remain within the requirement set out in the OSS qualify for consideration in Step 2 Part B. All options therefore reduce the voltage phase angle to 40 degrees or less.

The options will be assessed on how much they can reduce this angle difference for the above described event. Angle differences are influenced by, among other things, the relative impedances of the new network reinforcements suggested.

3.2.1.3 Reactive support requirements

The needs assessment (Step 1) for CP0966 identified voltage stability problems. None of the basic options alone meet this need. The requirement for reactive support has been analysed as part of the solution options to solve the voltage instability.

To determine the amount of reactive support required for each of the solution options we used two criteria. The first criterion is to meet the need based on the assumptions set out in Step 1. In Step 1 the assumptions were that approximately 900 MW of additional demand was connected in the counties Kildare, Meath and Dublin. This was based on executed and offered connection agreements at that point in time.

The second criterion is to meet further demand on the East coast that could materialise in the future. Ireland is currently experiencing an increased interest in connecting large scale demand on the East coast and the options were assessed based on their capability of accommodating this. Given the interest in connecting large scale demand on the East coast an extra 500 MW of demand, on top to the 900 MW mentioned earlier, was deemed prudent for assessing the options against.

3.2.1.4 Short circuit performance

The options are assessed based on the scale that they improve or exacerbate the existing short circuits levels in existing stations. Additional circuits and/or transformers connected into stations will create another path for the fault current to flow into the station and as such the short circuit levels will increase in the station. Similarly, if circuits are removed the number of paths for the fault current to flow has reduced and as such the short circuit levels will decrease in the station.

3.2.1.5 Performance during maintenance conditions

The options are assessed based on their requirement for additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. It should be noted that investments resulting from violations during planned maintenance are subject to an economic appraisal of the value in solving the identified problem compared to constraining generation. Before we would bring these forward as projects we will individually appraise whether each of these reinforcements could be financially justified. To ensure value for money, we will defer a decision until much closer to the required commissioning date of the best performing option. This will allow us to take account of new requirements for each reinforcement, which may include both local and regional needs which could have emerged in the meantime. As such, for the purpose of this assessment in Step 2, we have only assessed the number of indicated violations of thermal capacity for each option. It should be noted that these possible additional reinforcements are not included in the full solution list of the options in Section 4.3.

3.2.2 Economic performance

In Part B in Step 2, the economic performance is based on estimated Total Project Cost (TPC) for each option for comparison purposes. The TPC will comprise both estimated capital costs and an estimated cost for the Transmission System Operator (TSO) element for development of the options.

The primary source for capital cost estimates have been developed with input from the Transmission Asset Owner (TAO) and are based on desktop designs and costings for similar works. The capital cost includes all items to achieve a fully compliant solution with Transmission System Security and Planning Standards (TSSPS), but are excluding reinforcements driven by maintenance conditions as discussed in section 3.2.1.5. Where capital costs were not available for a particular technology the best, most recent estimates or quotes from manufacturers or assumed costs based on EirGrid or international experience have been used.

The TSO cost can be described as the cost for the Transmission System Operator to develop the project during the planning and construction phase. The cost comprise among other things, project management, wayleaving and landowner engagements and cost attributed to developing the planning application. The estimated cost is based on experience of developing previous projects.

3.2.3 Environmental

This is a high-level consideration of environmental impacts in the context of the project. It is largely based on a desktop study. Under this criterion, consideration is given to biodiversity, soil and water, climatic factors, material assets and noise. Note that cultural heritage, landscape and visual are examined under the heading of Socio-economic and not repeated in this section.

3.2.4 Deliverability

Deliverability captures timelines as well as engineering and planning risks which could extend delivery timescales and costs. A high level assessment of the impacts of any planned transmission equipment outages required to carry out the necessary work is also carried out.

3.2.5 Socio-Economic

This is a high-level consideration of social impacts in the context of the project. It is largely based on a desktop study. Under this criterion consideration is given to settlement and communities; recreation and tourism; landscape and visual; and cultural heritage and other relevant issues.

3.3 Scale used to assess each criteria

The effect on each criteria parameter is presented along a range from “more significant”/”more difficult”/“more risk” to “less significant”/”less difficult”/“less risk”. The following scale is used to illustrate each criteria parameter:

More significant/difficult/risk Less significant/difficult/risk

In the text this scale is quantified by text for example mid-level/moderate (Dark Green), low-moderate (Green), low (Cream), high-moderate (Blue) or high (Dark Blue).

4 Development of a short list

In Step 2, the identified list of options are refined twice with the aim to establish a short list of best performing solution options to bring forward for further investigation in Step 3. The outcome from the first part of the refinement of the long list is presented in the Options Report Part A. The second time the list is refined, each remaining option will be assessed against the five criteria. The summary of this assessment is presented in this section and further details are given in section 7, Detailed evaluation of options.

4.1 Options brought forward from Part A of Step 2

The outcome of first part of the refinement of the long list is presented in the Options Report Part A. This assessment identified five solution options using three different technologies that would address the need identified. The technologies were:

- Overhead line (OHL)
- Underground cable (UGC)
- Up-voltage technology
  This will maximise existing infrastructure by modifying existing 220 kV towers to towers of similar scale and size, but will be capable of carrying a 400 kV conductor.

All the five remaining solution options reinforce the transmission network between existing Dunstown station in County Kildare and Woodland station in County Meath. The five solution options in the refined list were:

- Up-voltage existing 220 kV circuits to 400 kV to create new Dunstown – Woodland 400 kV overhead line (OHL)
- New Dunstown – Woodland 400 kV overhead line (OHL)
- New Dunstown – Woodland 220 kV overhead line (OHL)
- New Dunstown – Woodland 220 kV underground cable (UGC)
- New Dunstown – Woodland 400 kV underground cable (UGC)

4.2 Summary of assessment of remaining options

The five remaining solution options were assessed against the five criteria. Table 1 provides a summary of the performance of each option against the five evaluation criteria. The details of each option are presented in section 7, Detailed evaluation of options.

The outcome of the multi criteria assessment is that all except one of the options will be brought forward into step 3 for further more detailed assessment.

Options	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Combined Performance in Step 2 Part B
Upvoltage 220 kV to 400 kV						
New 400 kV OHL						
New 220 kV OHL						
New 220 kV UGC						
New 400 kV UGC						

Table 1 *Overall comparison of options using five criteria in Step 2 Part B*

The options brought forward to Step 3 are:

- Up-voltage existing 220 kV circuits to 400 kV to create new Dunstown – Woodland 400 kV overhead line (OHL)
- New Dunstown – Woodland 400 kV overhead line (OHL)
- New Dunstown – Woodland 220 kV underground cable (UGC)
- New Dunstown – Woodland 400 kV underground cable (UGC)

This means that three technologies are still being investigated to come up with the best performing solution option. In Step 3, these technologies and the options using them will be investigated in even more detail. In Step 3 the five main criteria are broken down into sub-criteria, which the remaining options will be assessed against. It should be recognised that two of these technologies have features and technical aspects which have not yet been studied or investigated.

The up-voltage technology is a new innovation that has not been used in the Irish transmission system previously. This presents its own opportunities and challenges. In Step 3 we will be able to investigate these in more detail.

The underground cable technology (AC cable) requires very detailed specific technical analysis to determine if they are technically feasible. These studies include analysis to investigate Temporary Over Voltages (TOV) and harmonic distortion among other things. Previously, for other projects, the acceptable length of underground cable (AC) has varied depending on voltage and location of the cable within the network. It should be recognised that analysis for other projects has indicated that long lengths of AC 400 kV underground cable cannot be accommodated in the Irish transmission network. A full investigation into these aspects will be completed in Step 3 for both remaining underground cable options. The result of these analyses may lead to that some options are not technically feasible or that further investments are required to accommodating them.

4.3 Recommended short list of best performing options

The options in the refined list were assessed against the five criteria. This resulted in four solution options being brought forward for more detailed analysis in Step 3. All options involve a suite of transmission network reinforcements centred on strengthening the network between existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. There are some common requirements for all options and for the 220 kV underground cable option there are additional reinforcements required. The four options are:

1. Up-voltage option
    - Up-voltage some of the existing 220 kV circuits between existing Dunstown 400 kV station and Woodland 400 kV station. Using a new technology which would enable the existing 220 kV towers to be modified and the 220 kV conductors replaced with 400 kV conductor to create a new Dunstown – Woodland 400 kV circuit. The circuits selected to achieve this are Gorman – Maynooth 220 kV circuit and the Dunstown – Maynooth 2 220 kV circuit.
2. 400 kV OHL option
    - Construction of a new 400 kV overhead line linking Dunstown 400 kV station to Woodland 400 kV station.
3. Underground cable (220 kV or 400 kV)

- Construction of a new 220 kV or 400 kV underground cable linking Dunstown 400 kV station to Woodland 400 kV station.

If a 220 kV cable is the best performing option then, the following additional reinforcements are required:

  - Uprating of the Cashla – Prospect 220 kV overhead line
  - Uprating of the Killonan – Shannonbridge 220 kV overhead line
  - Woodland 220 kV station would be required to be operated “split” in order to prevent thermal overloading of the new 220 kV cable for an unplanned loss of a circuit

4. Common requirements for all options:
   - Uprating of the Bracklone – Portlaoise 110 kV overhead line
   - Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

5 Stakeholder Engagement

The aim of stakeholder engagement in Step 2 is to transparently communicate our findings so far in the project to key stakeholders and receive feedback on chosen technologies and refined short list.

In order to ensure appropriate stakeholder feedback and inform our decision-making process during Step 2 on Capital Project 966, EirGrid have identified key strategic stakeholders in the study area. This engagement has enabled us to understand the spatial and economic planning that is underway at local and regional authority level, as well as the potential requirements for future investments by large energy users in the area. It has also allowed us to brief key stakeholders in the area, and to garner their view of the opportunities and challenges that exist for the project, as well as receive feedback on chosen technologies and the refined short list.

The stakeholder engagement for Capital Project 966 in Step 2 was divided into two phases, phase A and phase B. In phase A, we have consulted with relevant stakeholders such as the Government Departments, Meath and Kildare County Council Senior Executives, the IDA and the Eastern and Midlands Regional Assembly. This phase was completed between March and June 2018.

In phase B, a 10-week consultation period started in November 2018 and finished in early February 2019. The consultation period covered a broad range of stakeholder engagement with the general public, local communities and their elected representatives. They had the opportunity to provide feedback in relation to the assessment carried out to date and the solutions to be brought forward for further consideration in Step 3.

No additional technology options were either removed or added as a result of the consultation period. Most of the responses covered personal views of preferences for one or other technologies. Mostly these preferences were in relation to the underground technology or the up-voltage technology. Many stakeholders also welcomed the opportunity for early engagement.

As part of the 10-week consultation period the following tasks were carried out:

- published project related material on the project website, including reports and project brochures;
- issued a press statement to the media;

- communicated details of our work on this project to local elected representatives and offering briefings; and,
- engaged with the Public Participation Networks in Kildare and Meath to provide information on the project to local community groups in the region.

6 Assessment of project complexity

Each project may be of a different scale and/or complexity. To reflect the unique features of each project, the framework for grid development introduced three categories of projects, called Tiers.

The Tier of a project indicates the required level of governance, external consultation and engagement, social impact assessment and analysis.

To decide the Tier for a project a number of factors have to be considered. An assessment should consider different aspects such as project complexity, customer impact, deliverability, health and safety, legacy issues, operational risks, stakeholder engagement, and technical risks.

Capital Project 966 has been assigned a Tier 3 which is the most complex category with the highest level of governance. This is based on the most complex remaining option. In this case, it is a new 400 kV overhead line. New linear projects have the potential to traverse many different stakeholders and as such increasing the number of stakeholders that need to be considered. As well as this, the potential impact on society and the environment also require significant investigations and consideration. For this reason this project has been assigned a Tier 3.

7 Detailed evaluation of options

This section will describe in detail the assessment of each of the five remaining options against the five criteria. The criteria are described in section 3.2 and the below assessment of the options require an understanding of these. All remaining solution options reinforce the transmission network between existing Dunstown and Woodland stations.

7.1 Up-voltage existing 220 kV circuits to 400 kV OHL circuit

7.1.1 Description of option

This option involves a suite of transmission network reinforcements centred on strengthening the network between existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. These consist of:

- Up-voltage some of the existing 220 kV circuits between existing Dunstown 400 kV station and Woodland 400 kV station. Using a new technology which would enable the existing 220 kV towers to be modified and the 220 kV conductors replaced with 400 kV conductor to create a new Dunstown – Woodland 400 kV circuit. The circuits selected to achieve this are Gorman – Maynooth 220 kV circuit and the Dunstown – Maynooth 2 220 kV circuit.
- Uprating of the Bracklone – Portlaoise 110 kV overhead line.
- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar.

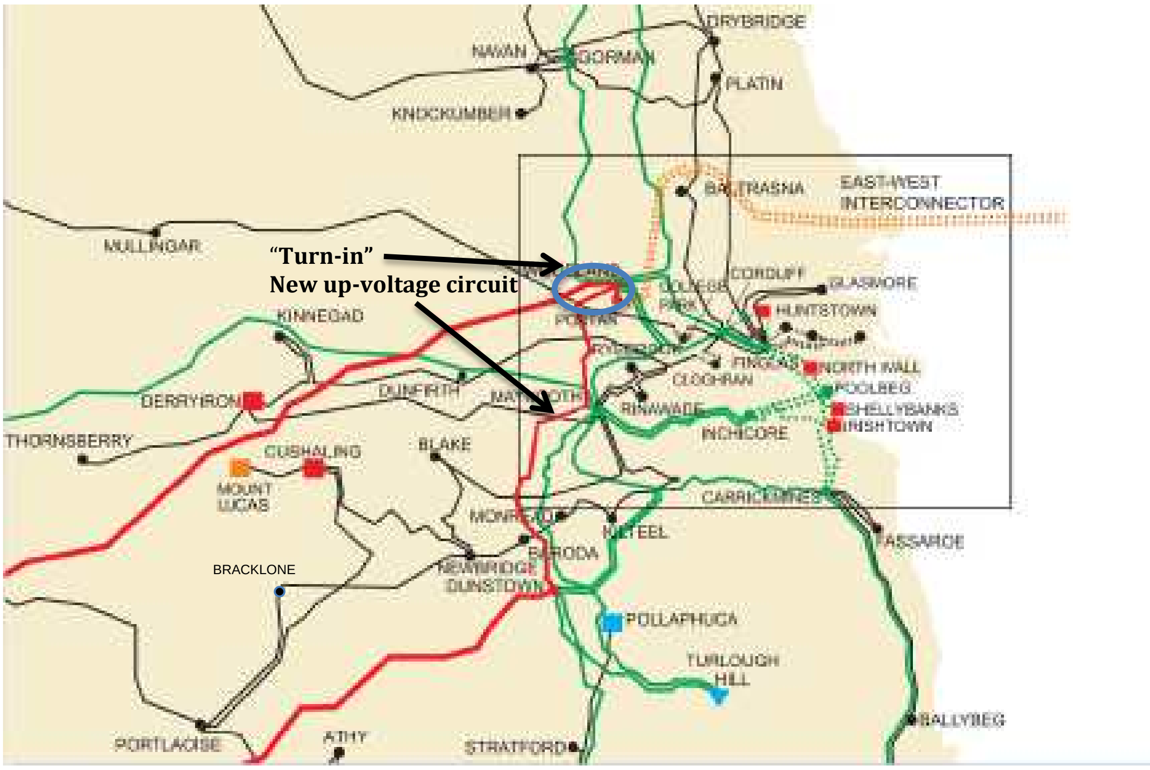

Figure 3 *Transmission system map showing the option to up-voltage existing 220 kV circuits to 400 kV OHL (the up-voltaged lines between Dunstown and Woodland 400kV stations are shown in red, in a north southerly direction following the existing paths of Gorman – Maynooth and Maynooth – Woodland 220 kV circuits).*

7.1.2 Selection of existing 220 kV circuits to use for the up-voltage option

This option uses existing 220 kV circuits to create a new 400 kV circuit between Woodland and Dunstown stations. There are a number of existing 220 kV circuits between Woodland and Dunstown stations which would be suitable for the up-voltage technology. To be able to select the best candidate, all these existing 220 kV circuits were assessed based on five criteria. The details and findings of this assessment are outlined in Appendix 1.

The new circuit would be created by linking circuits north and south of Maynooth 220 kV station. The northern section between Woodland and Maynooth would be achieved by using the existing Gorman – Maynooth 220 kV circuit and the southern section would be achieved by using Dunstown – Maynooth 2 220 kV circuit.

- The existing Gorman - Maynooth 220 kV overhead line circuit will be modified to incorporate a “turn in” to Woodland 400 kV station. The “turn in” is marked in figure 3 by a blue oval. This will create two new circuits into Woodland station, namely a Gorman – Woodland 220 kV circuit and a circuit connecting Maynooth and Woodland (that will be used for up-voltage option). It should be noted that the technology used to create the connection into Woodland station will be determined in Step 3 and the any required routing will be carried out in Step 4.

- The newly created circuit connecting Maynooth and Woodland would be linked together with the existing Dunstown – Maynooth 2 220 kV circuit in the vicinity of Maynooth station. The circuits would then be modified to enable operation at 400 kV. The exact order of how this work will be achieved will be further investigated in Step 3 if this option remains.

7.1.3 Technical Performance

7.1.3.1 Thermal overload

In comparison to the alternative options, the up-voltage option performs very well in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). Just one additional uprate is required, the uprating of Bracklone – Portlaoise 110 kV circuit. This option is considered to have a low impact due to the small quantity of remaining thermal overloads after the up-voltage option have been implemented (**Cream**).

7.1.3.2 Phase angle

This option will reduce the difference in voltage phase angle to 20 degrees for the same event as described in the criteria. The result of this, is that the voltage phase angle does improve significantly relative to the other options and is as such considered to retain a low to moderate risk in relation to acceptable phase angles (**Green**).

7.1.3.3 Reactive support requirements

This option requires a dynamic reactive support device to fully meet the need, namely:

- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

The reactive support device is needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of any of the 400 kV overhead lines running from the west to the east of the country, in particular the Oldstreet – Woodland 400 kV line.

In addition, as Ireland is currently experiencing an increased interest in connection of more large scale demand on the East coast, the options were assessed based on their ability to accommodate more demand on the East coast. For this option to achieve the target described in the technical performance criteria in section 3.2.1 a suite of dynamic reactive support devices are required in addition to the above.

- Series capacitor installed on the Moneypoint – Oldstreet 400 kV overhead line

- Dynamic reactive support device in area of Dunstown station rated at approximately ±250 Mvar
- Dynamic reactive support device in area of Maynooth station rated at approximately ±250 Mvar

The series capacitor is required to prevent voltage collapse for the loss of the Coolnabacky – Moneypoint 400 kV line. Two reactive support devices are needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of the 400 kV overhead lines. Appendix 3 provides detail of the analysis done to identify reactive support requirements for this option. This option is considered to have a moderate performance based on the need for reactive support required (**Dark Green**).

7.1.3.4 Short Circuit Analysis

This option performs well in terms of reducing the short circuit currents at Maynooth station. The option will remove two existing 220 kV circuits currently connecting into Maynooth. Short circuit levels are immaterially increased at Woodland and Dunstown stations where the new circuit is connected. The results of the short circuit analysis can be found in Appendix 4. This option is considered to have a low to moderate performance in terms short circuit levels (**Green**).

7.1.3.5 Reinforcements to cater for maintenance conditions

This option may require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. Details of the criteria are found in section 3.2.

For the purpose of this assessment in Step 2, we have assessed the number of indicated violations of thermal capacity. A summary of the potential reinforcements are listed in table 2 and the full results of the analysis are shown in Appendix 2. This option is considered to have a moderate performance in terms of possible future reinforcements (**Dark Green**).

	Potential reinforcements areas following a subsequent loss of plant whilst another is out for maintenance
1	Coolnabacky – Portlaoise 110 kV
2	Cashla – Prospect 220 kV
3	Killonan - Shannonbridge 220kV OHL
4	Bracklone – Newbridge 110 kV
5	Maynooth - Shannonbridge 220kV OHL
6	Cashla – Flagford 220 kV
7	Agannygal – Shannonbridge 110 kV
8	Maynooth – Woodland 220 kV

9	Killoternan – Waterford 110 kV
10	Cullenagh – Waterford 110 kV

Table 2 *Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance for up-voltage option*

7.1.3.6 Conclusion of technical performance

This option is considered to have moderate performance from a technical point of view when all technical aspects were considered and (**Dark Green)**.

Technical performance Up-voltage existing 220 kV circuits to 400 kV	Thermal overloads	Phase angle	Reactive support	Short circuit	Maintenance conditions	Combined Technical Performance

Table 3 *Summary of technical performance for up-voltage existing 220 kV to 400 kV*

7.1.4 Economic Performance

The estimated capital costs for the full solution for the up-voltage option is approximately €92m. This includes new bays, busbar extensions, line uprates or reactive support required. The estimated cost for the transmission system operator to develop the up-voltage option is approximately €15m. This option is considered to have moderate impact in terms of the cost (**Dark Green**).

7.1.5 Environmental

Having considered the potential environmental impacts for the up-voltage option it is concluded that this option will have moderate environmental impact (**Dark Green**) with impacts mainly related to the construction phase. This option uses existing corridors and maximises existing infrastructure as opposed to introducing the need to build new infrastructure in an area. Once operational, the up-voltage option would not be significantly different from the current baseline. The technology used will modify existing towers in existing corridors to towers of similar size and scale.

7.1.6 Deliverability

The technology proposed for the up-voltage option would enable the existing 220 kV towers to be modified and the 220 kV conductors replaced with 400 kV conductor to create a new Dunstown – Woodland 400 kV circuit. This would mean that the new towers will be of similar size and scale as the existing towers. Having assessed high level deliverability aspects for up-voltage existing 220 kV circuits to 400kV it is concluded that this option would have low to moderate planning risks. The deliverability of this option will involve prolonged outages of existing circuits to allow the existing towers to be replaced with new towers. In Step 3 mitigation may be found for these outages. However, it is considered that this option will have a high to moderate impact in terms of potential circuit outages required. Overall, this option is considered to have a moderate impact on deliverability (**Dark Green**).

7.1.7 Socio-economic

A new asset in a socio-economic environment will, in general, always performance poorly relative to the re-use of the existing electricity grid. There is, however, a difference between above ground and underground options. This becomes evident in the scoring for settlements & communities; recreation & tourism landscape & visual criteria for the above ground option. The visual impact is significant and is interrelated to several other criteria

Overall, using the available information at this stage in the project, the up-voltage option perform better than a new circuit, this is largely due to the established nature of existing infrastructure in the socio economic environment. The replacement of existing infrastructure and up-voltage of an existing asset has the least impact in a socio-economic environment. From the analysis, it can be seen there is still an impact to settlements and communities who will facilitate the construction of and host the up-voltage. Having considered typical social impacts for the proposed upvoltage option it is concluded that it will have a neutral social impact, neither adverse nor beneficial. Therefore this option is considered to have moderate socio-economic impact (**Dark Green**).

7.1.8 Summary of option

Overall performance Up-voltage existing 220 kV circuits to 400 kV	**Technical Performance**	**Economic Performance**	**Environmental**	**Deliverability**	**Socio-economic**	**Overall Performance**

Table 4 *Summary of performance of all criteria for up-voltage option*

7.2 Dunstown – Woodland 400 kV OHL

7.2.1 Description of option

This option involves a suite of transmission network reinforcements centred on strengthening the network between existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. These consist of:

- Construction of a new 400 kV overhead line linking Dunstown 400 kV station to Woodland 400 kV station.
- Uprating of the Bracklone – Portlaoise 110 kV overhead line
- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

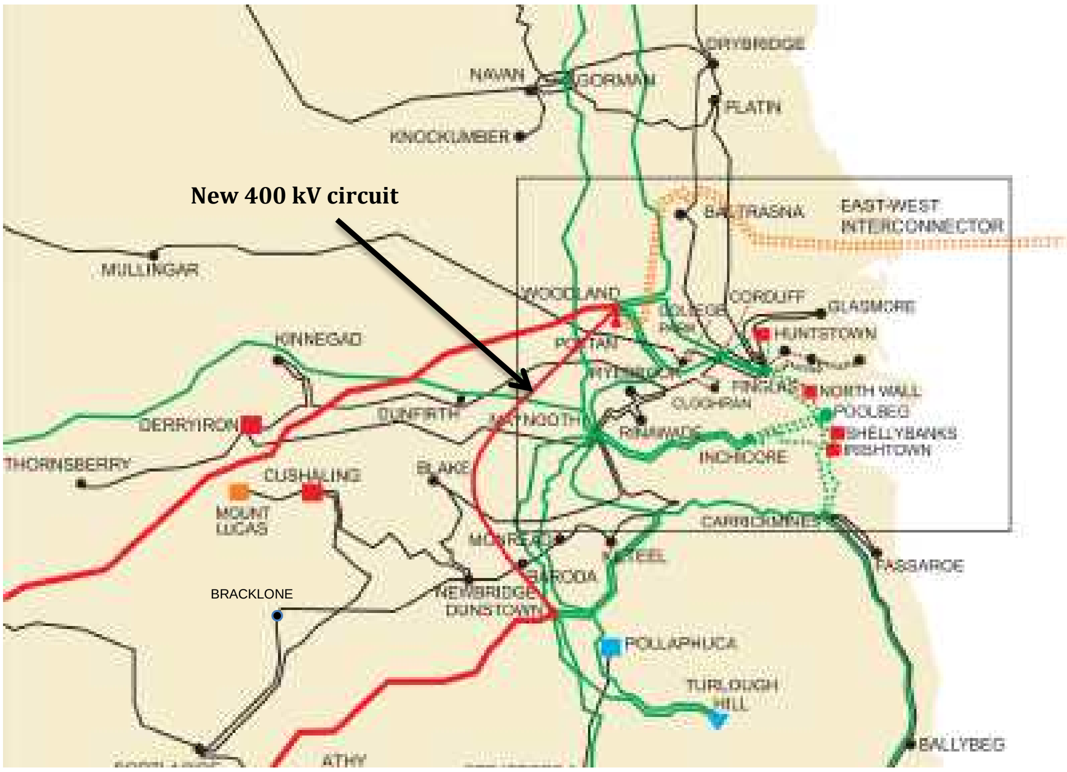

Figure 4 *Transmission system map showing a new 400 kV OHL (indicative) (the new 400 kV OHL between Dunstown and Woodland 400kV stations are shown in red, in a north southerly direction)*

7.2.2 Technical Performance

7.2.2.1 Thermal overloads

In comparison to the alternative options, the 400 kV OHL option performs very well in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). Just one additional uprate is required, the uprating of Bracklone – Portlaoise 110 kV circuit. This option is considered to have a low impact due to the small quantity of remaining thermal overloads after the 400 kV OHL option have been implemented (**Cream**).

7.2.2.2 Phase angle

This option will reduce the difference in voltage phase angle to 20 degrees for the same event as described in the criteria. The result of this is that the voltage phase angle does improve significantly relatively to the other options and is as such considered to retain a low to moderate risk in relation to acceptable phase angles (**Green**).

7.2.2.3 Reactive support requirements

This option requires a dynamic reactive support device to fully meet the need, namely:

- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

The reactive support device is needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of any of the 400 kV overhead lines running from the west to the east of the country, in particular the Oldstreet – Woodland line.

In addition, as Ireland is currently experiencing an increased interest in connection of more large scale demand on the East coast, the options were assessed based on their ability to accommodate more demand on the East coast. For this option to achieve the target described in the technical performance criteria in section 3.2.1, a suite of dynamic reactive support devices are required in addition to the above.

- Series capacitor installed on the Moneypoint – Oldstreet 400 kV overhead line
- Dynamic reactive support device in area of Dunstown station rated at approximately ±250 Mvar
- Dynamic reactive support device in area of Maynooth station rated at approximately ±250 Mvar

The series capacitor is required to prevent voltage collapse for the loss of the Coolnabacky – Moneypoint 400 kV line. Two reactive support devices are needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of the 400 kV overhead line. Appendix 3 provides detail of the analysis done to identify reactive support requirements for this option. This option is considered to have a moderate performance based on the need for reactive support required (**Dark Green**).

7.2.2.4 Short Circuit analysis

This option results in some increases in existing short circuit level due to the inclusion of an additional circuit. All increases in short circuit level remain within Grid Code levels, but represent a reduction in available headroom. Appendix 4 shows the result of the short circuit analysis. This option is considered to have a moderate performance in regards to short circuit levels (**Dark Green**).

7.2.2.5 Reinforcements to cater for maintenance conditions

This option may require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. Details of the criteria are found in section 3.2

For the purpose of this assessment in Step 2, we have assessed the number of indicated violations of thermal capacity. A summary of the potential reinforcements are listed in table 2 and the full results of the analysis are shown in Appendix 2. This option is considered to have a moderate performance in terms possible future reinforcements (**Dark Green**).

	Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance
1	Coolnabacky – Portlaoise 110 kV
2	Cashla – Prospect 220 kV
3	Killonan - Shannonbridge 220kV OHL
4	Bracklone – Newbridge 110 kV
5	Maynooth - Shannonbridge 220kV OHL
6	Cashla – Flagford 220 kV
7	Maynooth – Woodland 220 kV
8	Agannygal – Shannonbridge 110 kV
9	Killoternan – Waterford 110 kV
10	Cullenagh – Waterford 110 kV

Table 5 *Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance for 400 kV OHL option*

7.2.2.6 Conclusion of technical performance

This option is considered to have moderate performance from a technical point of view when all technical aspects were considered and (**Dark Green)**.

Technical performance for 400 kV OHL option	Thermal overloads	Phase angle	Reactive support	Short circuit	Maintenance conditions	Combined Technical Performance

Table 6 *Summary of technical performance for 400 kV OHL option*

7.2.3 Economic Performance

The estimated capital costs for the full solution for a new 400 kV overhead line option is approximately €95m. This includes new bays, busbar extensions, line uprates or reactive support required. The estimated cost for the transmission system operator to develop the 400 kV overhead line option is approximately €20m.This option is considered to have a moderate impact in terms of the cost (**Dark Green**).

7.2.4 Environmental

Using the available information at this stage in the project, and having considered the potential environmental impacts for a new 400 kV overhead line circuit, it is concluded that this option could result in a high environmental impact (**Dark Blue**) in comparison to utilising an existing transmission corridor. The construction of any new transmission infrastructure will compare poorly against other options using existing infrastructure.

7.2.5 Deliverability

Having assessed high level deliverability aspects for a new 400 kV overhead line circuit it is concluded that this option could potentially be associated with high planning risks. It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation. Given the nature of the project the planning risks are considered to more difficult to mitigate and more dominant in delivering the project. Therefore, this option is considered to have an overall high to moderate impact on deliverability (**Blue**).

7.2.6 Socio-economic

A new asset in a socio-economic environment will, in general, always perform least favourably relative to other options which may use existing infrastructure. There is, however, a difference between above ground and underground options. This becomes evident in the evaluation regarding settlements & communities; recreation & tourism landscape & visual criteria for the above ground options. The visual impact is significant and is interrelated to several other criteria.

Overall, using the available information at this stage in the project, this option performs least favourably against socio-economic aspects in comparison to the other available alternative options. The performance of the OHL option is least favourable largely as a result of the visual impact of OHL infrastructure which can be difficult to mitigate, particularly in a socio-economic environment. Therefore this option is considered to have high socio-economic impact (**Dark Blue**).

7.2.7 Summary of option

Overall performance of new 400 kV OHL circuit	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 7 *Summary of performance of all criteria for 400 kV OHL option*

7.3 Dunstown – Woodland 220 kV OHL circuit

7.3.1 Description of option

This option involves a suite of transmission network reinforcements centred on strengthening the network between existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. These consist of:

- Construction of a new 220 kV overhead line linking Dunstown 400 kV station to Woodland 400 kV station.
- Uprating of the Bracklone – Portlaoise 110 kV overhead line
- Uprating of the Cashla – Prospect 220 kV overhead line
- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

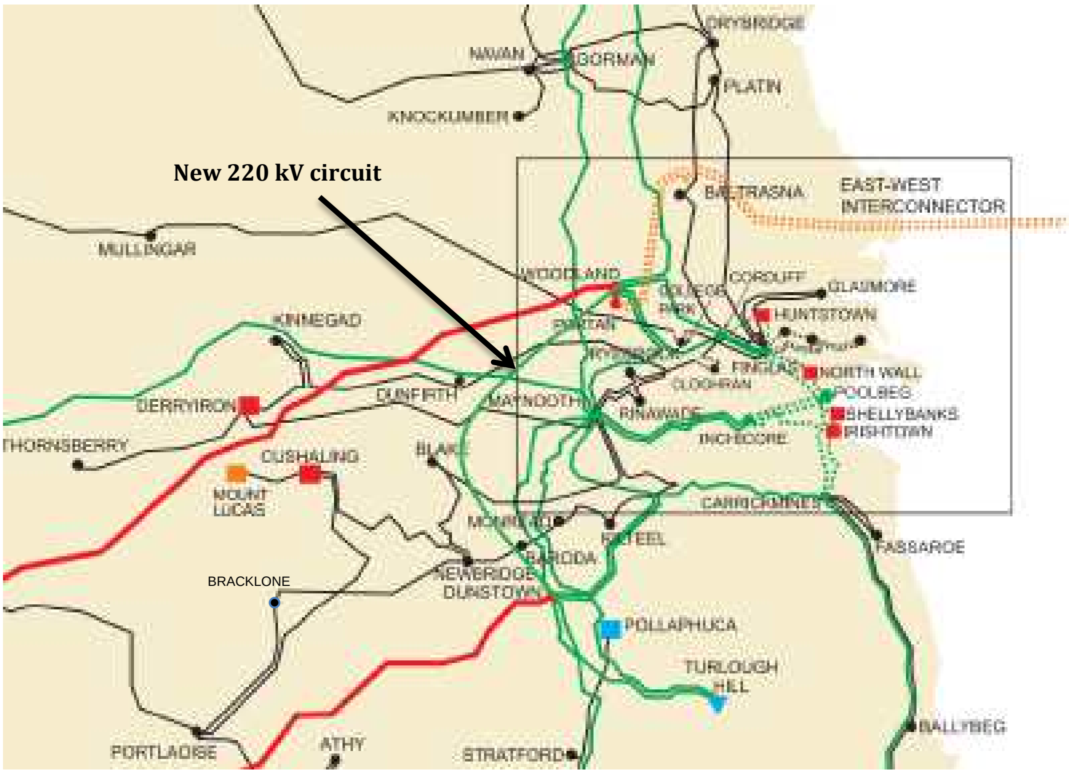

Figure 5 *Transmission system map showing a new 220 kV OHL (indicative) (the 220kV OHL between Dunstown and Woodland 400kV stations are shown as a green bow, in a north southerly direction)*

7.3.2 Technical Performance

7.3.2.1 Thermal overloads

In comparison to the alternative options the 220 kV OHL option performs poorly in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). Two additional uprates are required, the uprating of Bracklone – Portlaoise 110 kV circuit and Cashla – Prospect 220 kV. This option is considered to have a high to moderate impact on remaining overloads after the 220 kV OHL option have been implemented (**Blue**).

7.3.2.2 Phase angle

This option will reduce the difference in voltage phase angle to 35 degrees for the same event as described in the criteria. The result of this is that the voltage phase angle does not improve much relatively to the other options and is as such considered to retain a high risk in relation to acceptable phase angles (**Dark Blue**).

7.3.2.3 Reactive support requirements

This option requires a dynamic reactive support device to fully meet the need, namely:

- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

The reactive support device is needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of any of the 400 kV overhead lines running from the west to the east of the country, in particular the Oldstreet – Woodland line.

In addition, as Ireland is currently experiencing an increased interest in connection of more large scale demand on the East coast, the options were assessed based on their ability to accommodate more demand on the East coast. For this option to achieve the target described in the technical performance criteria in section 3.2.1, a suite of dynamic reactive support devices are required in addition to the above.

- Series capacitor installed on the Moneypoint – Oldstreet 400 kV overhead line
- Dynamic reactive support device in area of Dunstown station rated at approximately ±250 Mvar
- Dynamic reactive support device in area of Maynooth station rated at approximately ±250 Mvar

- Dynamic reactive support device in area of Belcamp station rated at approximately ±250 Mvar
- Dynamic reactive support device in area of Carrickmines station rated at approximately ±250 Mvar

The series capacitor is required to prevent voltage collapse for the loss of the Coolnabacky – Moneypoint 400 kV line. Four reactive support devices are needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of the 400 kV overhead line. Appendix 3 provides detail of the analysis done to identify reactive support requirements for this option. This option is considered to have a high requirement in regards to reactive support required (**Dark Blue**).

7.3.2.4 Short Circuit Analysis

This option results in some increases in existing short circuit levels due to the inclusion of an additional circuit. All increases in short circuit level remain within acceptable Grid Code levels, but represent a reduction in available headroom. Appendix 4 shows the result of the short circuit analysis. This option is considered to have a moderate performance in regards to short circuit levels (**Dark Green**).

7.3.2.5 Reinforcements to cater for maintenance conditions

This option may require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. Details of the criteria are found in section 3.2

For the purpose of this assessment in Step 2, we have assessed the number of indicated violations of thermal capacity. A summary of the potential reinforcements are listed in table 8 and the full results of the analysis are shown in Appendix 2. This option is considered to have a high to moderate performance in terms possible future reinforcements (**Blue**).

	Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance
1	Coolnabacky – Portlaoise 110 kV
3	Killonan - Shannonbridge 220kV OHL
4	Bracklone – Newbridge 110 kV
5	Maynooth - Shannonbridge 220kV OHL
6	Cashla – Flagford 220 kV
7	Agannygal – Shannonbridge 110 kV
8	Athlone – Lanesboro 110 kV
9	Maynooth – Woodland 220 kV
10	Third 400/220 kV transformer in Dunstown

11	Killoternan – Waterford 110 kV
12	Cullenagh – Waterford 110 kV

Table 8 *Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance for the 220 kV OHL option*

7.3.2.6 Conclusion of technical performance

This option is considered to have less favourable performance from a technical point of view when all technical aspects were considered. It is considered that the thermal overloads, voltage phase angles and reactive support requirement are the more dominant concerns from a technical perspective and as such the combined technical performance leaned to the low performance **(Dark Blue)**

Technical performance for 220 kV OHL option	Thermal overloads	Phase angle	Reactive support	Short circuit	Maintenance conditions	Combined Technical Performance

Table 9 *Summary of the* technical performance for *220 kV OHL option*

7.3.3 Economic Performance

The estimated capital costs for the full solution for a new 220 kV overhead line option is approximately €86m. This includes new bays, busbar extensions, line uprates or reactive support required. The estimated cost for the transmission system operator to develop the 220 kV overhead line option is approximately €20m.This option is considered to have moderate impact in terms of the cost (**Dark Green**).

7.3.4 Environmental

Using the available information at this stage in the project, in terms of potential environmental impacts, the construction and operation of a 400 kV or 220 kV overhead line would be similar. Therefore, having considered the potential environmental impacts for a new 400 kV overhead line circuit, it is concluded that similar impacts would be associated with a new 220 kV option. This could result in a high environmental impact (**Dark Blue**) in comparison to utilising an existing transmission corridor. The construction of any new transmission infrastructure will compare poorly against other options using existing infrastructure.

7.3.5 Deliverability

Having assessed high level deliverability aspects for a new 220 kV overhead line circuit it is concluded that this option could potentially be associated with high planning risks. It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation. Given the nature of the project the planning risks are considered to more difficult to mitigate and more dominant in delivering the project. Therefore, this option is considered to have an overall high to moderate impact on deliverability (**Blue**).

7.3.6 Socio-economic

A new asset in a socio-economic environment will, in general, always perform least favourably relative to other options which may use existing infrastructure. There is, however, a difference between above ground and underground options. This becomes evident in the evaluation regarding settlements & communities; recreation & tourism landscape & visual criteria for the above ground options. The visual impact is significant and is interrelated to several other criteria.

Overall, using the available information at this stage in the project, this option performs least favourably against socio-economic aspects in comparison to the other available alternative options. The performance of the OHL option is least favourable largely as a result of the visual impact of OHL infrastructure which can be difficult to mitigate, particularly in a socio-economic environment. . Therefore this option is considered to have high socio-economic impact (**Dark Blue**)

7.3.7 Summary of option

Overall performance of new 220 kV OHL circuit	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 10 *Summary of performance of all criteria for the 220 kV OHL*

7.4 Dunstown – Woodland 220 kV UGC circuit

7.4.1 Description of option

This option involves a suite of transmission network reinforcements centred on strengthening the network between existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. These consist of:

- Construction of a new 220 kV underground cable linking Dunstown 400 kV station to Woodland 400 kV station.
- Uprating of the Bracklone – Portlaoise 110 kV overhead line
- Uprating of the Cashla – Prospect 220 kV overhead line
- Uprating of the Killonan – Shannonbridge 220 kV overhead line
- Woodland 220 kV station would be required to be operated “split” in order to prevent thermal overloading of the new 220 kV cable for an unplanned loss of a circuit
- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

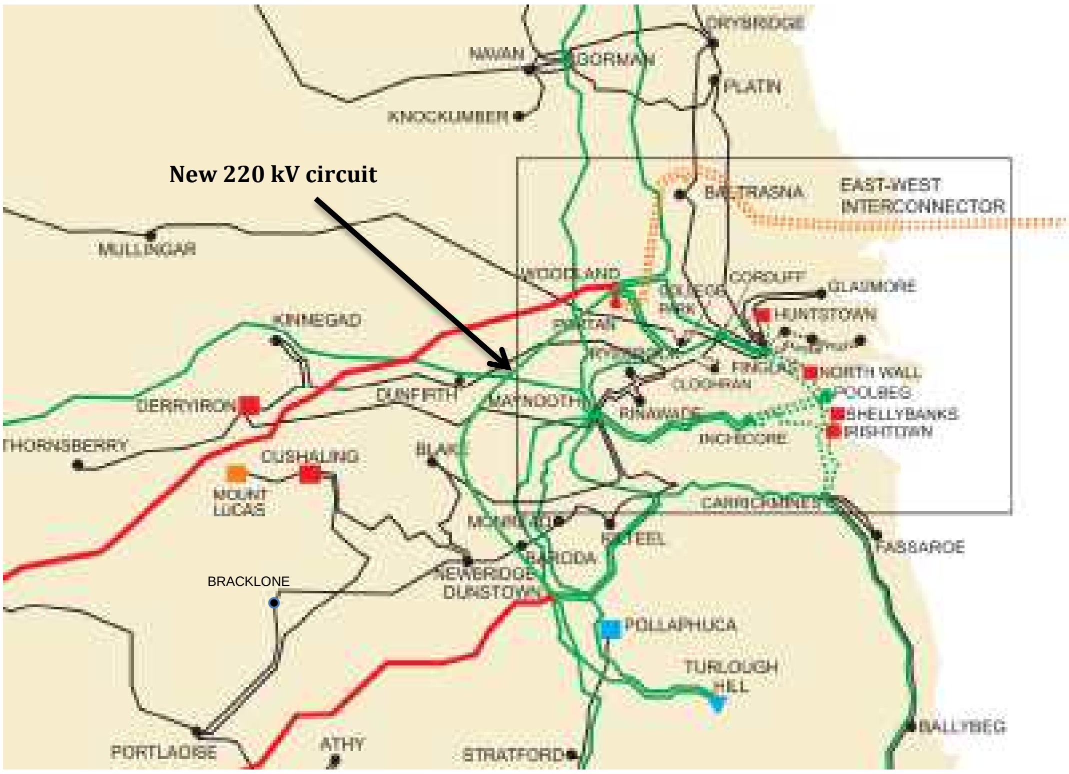

Figure 6 *Transmission system map showing a new 220 kV UGC (indicative) (the 220kV UGC between Dunstown and Woodland 400kV stations are shown as a green bow, in a north southerly direction)*

7.4.2 Technical Performance

7.4.2.1 Thermal overloads

In comparison to the alternative options, the 220 kV UGC option performs poorly in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). Three additional uprates are required, the uprating of Bracklone – Portlaoise 110 kV circuit, Cashla – Prospect 220 kV and the uprate of Killonan – Shannonbridge 220 kV. The two latter circuits are very long and are 220 kV circuits. This option is considered to have a high impact on remaining overloads after the 220 kV UGC option have been implemented (**Dark Blue**).

7.4.2.2 Phase angle

This option will reduce the difference in voltage phase angle to 32 degrees for the same event as described in the criteria. This option results in that the voltage phase angle do not improve much relatively to the other options and is as such considered to retain a high risk in relation to acceptable phase angles (**Dark Blue**)

7.4.2.3 Reactive support requirements

This option requires reactive a support device to fully meet the need, namely:

- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

The reactive support device is needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of any of the 400 kV overhead lines running from the west to the east of the country, in particular the Oldstreet – Woodland line.

In addition, as Ireland is currently experiencing an increased interest in connection of more large scale demand on the East coast, the options were assessed based on their ability to accommodate more demand on the East coast. For this option to achieve the target described in the technical performance criteria in section 3.2.1, a suite of dynamic reactive support devices are required in addition to the above.

- Series capacitor installed on the Moneypoint – Oldstreet 400 kV overhead line
- Dynamic reactive support device in area of Maynooth station rated at approximately ±250 Mvar
- Dynamic reactive support device in area of Belcamp station rated at approximately ±250 Mvar
- Dynamic reactive support device in area of Carrickmines station rated at approximately ±250 Mvar

The series capacitor is required to prevent voltage collapse for the loss of the Coolnabacky – Moneypoint 400 kV line. Three reactive support devices are needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of the 400 kV overhead line. Appendix 3 provides detail of the analysis done to identify reactive support requirements for this option. This option is considered to have a high to moderate requirement in regards to reactive support required (**Blue**).

7.4.2.4 Short Circuit Analysis

This option results in some increases in existing short circuit levels due to the inclusion of an additional circuit. All increases in short circuit level remain within acceptable Grid Code levels, but represent a reduction in available headroom. Appendix 4 shows the result of the short circuit analysis. This option is considered to have a moderate performance in regards to short circuit levels (**Dark Green**).

7.4.2.5 Reinforcements to cater for maintenance conditions

This option may require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. Details of the criteria are found in section 3.2

For the purpose of this assessment in Step 2, we have assessed the number of indicated violations of thermal capacity. A summary of the potential reinforcements are listed in table 11 and the full results of the analysis are shown in Appendix 2. This option is considered to have a moderate performance in terms possible future reinforcements (**Dark Green**).

	Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance
1	Coolnabacky – Portlaoise 110 kV
2	Bracklone – Newbridge 110 kV
3	Maynooth - Shannonbridge 220kV OHL
4	Cashla – Flagford 220 kV
5	Agannygal – Shannonbridge 110 kV
6	Maynooth – Woodland 220 kV
7	Third 400/220 kV transformer in Dunstown
8	Killoternan – Waterford 110 kV
9	Cullenagh – Waterford 110 kV
10	Butlerstown – Cullenagh 110 kV

Table 11 *Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance for the 220 kV UGC option*

7.4.2.6 Conclusion of technical performance

This option is considered to have less favourable performance from a technical point of view when all technical aspects were considered. It is considered that the thermal overloads, voltage phase angles and reactive support requirement are the more dominant concerns from a technical perspective and as such the combined technical performance leaned to the low performance (**Dark Blue**).

Technical performance for 220 kV UGC option	Thermal overloads	Phase angle	Reactive support	Short circuit	Maintenance conditions	Combined Technical Performance

Table 12 *Summary of technical performance for 220 kV UGC option*

7.4.3 Economic Performance

The estimated capital costs for the full solution for a new 220 kV underground cable option is approximately €173m. This includes new bays, busbar extensions, line uprates or reactive support required. The estimated cost for the transmission system operator to develop the 220 kV underground cable option is approximately €13m.This option is considered to have high impact in terms of the cost (**Dark Blue**).

7.4.4 Environmental

Using the available information at this stage in the project, and having considered the potential environmental impacts that may be associated with the construction and operation of a new 220kV underground circuit, it is concluded that this option may result in a high to moderate environmental impacts (**Blue**) in comparison to utilising an existing transmission corridor. The construction of any new transmission infrastructure will compare poorly against other options using existing infrastructure. The installation of an underground cable is not without environmental impacts, the determination of the significance of which would require more detailed assessment as the options move through the various steps in the framework for Grid Development.

7.4.5 Deliverability

Having assessed high level deliverability aspects for a new 220 kV underground circuit it is concluded that this option would not be associated with significant planning risks as cables are exempt from planning. However, some other elements of the option still require planning, such as reactive support requirements, so the option will still have moderate planning risks associated. It is considered that this option will have a low to moderate impact in terms of potential circuit outages required as it is mostly a new build with only outages required for energisation. In addition, it is assumed that the 220 kV underground cable will be laid along existing roads and during construction this will most likely have an impact on traffic and should be recognised. Therefore, this option is considered to have an overall moderate impact on deliverability (**Dark Green**).

7.4.6 Socio-economic

A new asset in a socio-economic environment will, in general, always perform least favourably relative to other options which may use existing infrastructure. There is, however, a difference between above ground and underground options. This becomes evident in the evaluation regarding settlements & communities; recreation & tourism landscape & visual criteria for the above ground options.

Overall, this option performs moderately against socio-economic aspects. The introduction of new infrastructure onto the socio-economic environment will create impacts, however this is mitigated to a certain extent as this option is underground. However, there is still some socio-economic impact. Therefore this option is considered to have moderate socio-economic impact (**Dark Green**).

7.4.7 Summary of option

Overall performance of new 220 kV UGC circuit	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 13 *Summary of performance of all criteria for the 220 kV UGC option*

7.5 Dunstown – Woodland 400 kV UGC circuit

7.5.1 Description of option

This option involves a suite of transmission network reinforcements centred on strengthening the network between existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. These consist of:

- Construction of a new HVAC 400 kV underground cable linking Dunstown 400 kV station to Woodland 400 kV station.
- Uprating of the Bracklone – Portlaoise 110 kV overhead line
- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

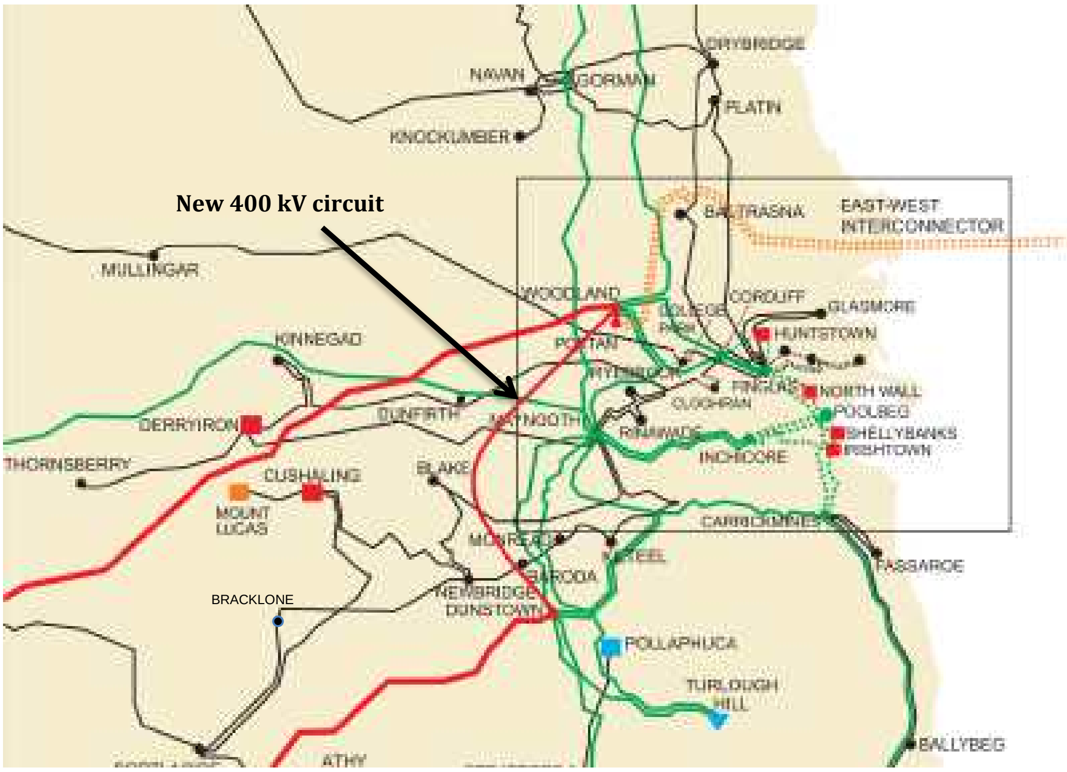

Figure 7 *Transmission system map showing a new 400 kV UGC (indicative) (the 400kV UGC between Dunstown and Woodland 400kV stations are shown as a red bow, in a north southerly direction)*

7.5.2 Technical Performance

7.5.2.1 Thermal overloads

In comparison to the alternative options the 400 kV UGC option performs very well in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). Just one additional uprate is required, the uprating of Bracklone – Portlaoise 110 kV circuit. This option is considered to have a low impact on remaining overloads after the 400 kV UGC option have been implemented (**Cream**).

7.5.2.2 Phase angle

This option will reduce the difference in voltage phase angle to 17 degrees for the same event as described in the criteria. The result of this is that the voltage phase angle does improve significantly relative to the other options and is as such considered to retain a low risk in relation to acceptable phase angles (**Cream**).

7.5.2.3 Reactive Compensation Requirements

This option requires a dynamic reactive support device to fully meet the need, namely:

- Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

The reactive support device is needed to help the conventional generators on the East coast to supply reactive power to prevent voltage collapse for an unplanned loss of any of the 400 kV overhead lines running from the west to the east of the country, in particular the Oldstreet – Woodland line.

In addition, as Ireland is currently experiencing an increased interest in connection of more large scale demand on the East coast, the options were assessed based on their ability to accommodate more demand on the East coast. For this option to achieve the target described in the technical performance criteria in section 3.2.1, another compensation device is required in addition to the above.

- Series capacitor installed on the Moneypoint – Oldstreet 400 kV overhead line

The series capacitor is required to prevent voltage collapse for the loss of the Coolnabacky – Moneypoint 400 kV line. Appendix 3 provides detail of the analysis done to identify reactive support requirements for this option. This option is considered to have a low requirement in regards to reactive support required (**Cream**).

7.5.2.4 Short Circuit Analysis

This option results in some increases in existing short circuit levels due to the inclusion of an additional circuit. All increases in short circuit level remain within acceptable Grid Code levels, but represent a reduction in available headroom. Appendix 4 shows the result of the short circuit analysis. This option is considered to have a moderate performance in regards to short circuit levels (**Dark Green**).

7.5.2.5 Reinforcements to cater for maintenance conditions

This option may require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. Details of the criteria are found in section 3.2

For the purpose of this assessment in Step 2, we have assessed the number of indicated violations of thermal capacity. A summary of the potential reinforcements are listed in table 14 and the full results of the analysis are shown in Appendix 2. This option is considered to have a moderate performance in terms possible future reinforcements (**Dark Green**).

	Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance
1	Coolnabacky – Portlaoise 110 kV
2	Cashla – Prospect 110 kV
3	Bracklone – Newbridge 110 kV
4	Killonan – Shannonbridge 220 kV
5	Maynooth - Shannonbridge 220kV OHL
6	Cashla – Flagford 220 kV
7	Agannygal – Shannonbridge 110 kV
8	Maynooth – Woodland 220 kV
9	Killoternan – Waterford 110 kV
10	Cullenagh – Waterford 110 kV
11	Butlerstown – Cullenagh 110 kV

Table 14 *Potential reinforcements following a subsequent loss of plant whilst another is out for maintenance for the 400 kV UGC option*

7.5.2.6 Conclusion of technical performance

This option is considered to have good performance from a technical point of view (**Green**) when all technical aspects were considered.

Technical performance for 400 kV UGC option	**Thermal overloads**	**Phase angle**	**Reactive support**	**Short circuit**	**Maintenance conditions**	**Combined Technical Performance**

Table 15 *Summary of technical performance for 400 kV UGC option*

7.5.3 Economic Performance

The estimated capital costs for the full solution for a new 400 kV underground option is approximately €160m. This includes any new bays, busbar extensions, line uprates or reactive support required. The estimated cost for the transmission system operator to develop the 400 kV underground option is approximately €13m.This option is considered to have high impact in terms of the cost (**Dark Blue**).

7.5.4 Environmental

In terms of potential environmental impacts, the construction and operation of a 400 kV or 220 kV underground circuit would be similar. Therefore, having considered the potential environmental impacts for a new 220 kV underground circuit, it is concluded that this option may result in a high to moderate environmental impacts (**Blue**) in comparison to utilising an existing transmission corridor. The installation of an underground cable is not without environmental impacts, the determination of the significance of which would require more detailed assessment as the options move through the various steps in the framework for Grid Development.

7.5.5 Deliverability

Having assessed high level deliverability aspects for a new 400 kV underground circuit it is concluded that this option would not be associated with planning risks as cables are exempt from planning. However, some other elements of the option still require planning, such as reactive support requirements, so the option will still have moderate planning risks associated. It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation. In addition, it should be recognised that it may not be possible to lay a 400 kV underground cable along existing roads due to the cable trench width required . If this is the case, the 400 kV underground cable option may have to be laid across open fields. During construction this will most likely have an impact on various issues that will be considered in Step 3 but the possibility of impact on deliverability should be recognised. Therefore, this option is considered to have an overall moderate impact on deliverability (**Dark Green**).

7.5.6 Socio-economic

A new asset in a socio-economic environment will, in general, always perform least favourably relative to other options which may use existing infrastructure. There is, however, a difference between above ground and underground options. This becomes evident in the evaluation regarding settlements & communities; recreation & tourism landscape & visual criteria for the above ground options.

Overall, this option performs moderately against socio-economic aspects. The introduction of new infrastructure onto the socio-economic environment will create impacts, however this is mitigated to a certain extent as this option is underground. However, there is still some socio-economic impact. Therefore this option is considered to have moderate socio-economic impact (**Dark Green**).

7.5.7 Summary of option

Overall performance of new 400 kV UGC circuit	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 16 *Summary of performance of all criteria for the 400 kV UGC*

7.6 Summary of the performance of options

7.6.1 Technical Performance

The technical performance of each option was assessed to achieve Transmission System Security and Planning Standards (TSSPS) compliant solutions. In addition, certain aspects were looked at in detail to distinguish between the options such as the difference in thermal overloads, improvements in phase angles, difference in reactive support requirements, changes in short circuit levels and how the options performed under maintenance conditions. It should be noted that the relative performance between the options may change in Step 3 when further analysis is carried out.

Estimated Technical performance for options	Up-voltage option	400 kV OHL	220 kV OHL	220 kV UGC	400 kV UGC

Table 17 *Summary of technical performance for all options*

7.6.2 Economic Performance

The economic performance of the options is based on capital costs for each option. Each option is fully assessed to achieve a Transmission System Security and Planning Standards (TSSPS) compliant solution. The capital costs for the five options range between €86m – €173m.   Each option is also assessed on estimated cost for the transmission system operator to develop. These costs range between €13-20m for the five options.

Estimated economic performance for options	Up-voltage option	400 kV OHL	220 kV OHL	220 kV UGC	400 kV UGC

Table 18 *Summary of economic performance for all options*

7.6.3 Environmental

The options were assessed, on a high level, for potential environmental impacts. The construction of any new transmission infrastructure will compare poorly against other options using existing infrastructure. It is also recognised that the installation of an underground option is not without environmental impacts. An underground option will have a slightly better environmental performance in comparison with an above ground solution on a high level general comparison. Exceptions may be found in further, more detailed, investigations of routes which happen in Step 4.

Estimated environmental aspects	Up-voltage option	400 kV OHL	220 kV OHL	220 kV UGC	400 kV UGC

Table 19 *Summary of environmental aspects for all options*

7.6.4 Deliverability

The deliverability aspects in regards to timelines, planning risks and outages were assessed on a high level for the options. All the options involving new infrastructure were associated with low outages as is assumed that they will be constructed off-line with minimal outages required to connect to the transmission system. The up-voltage option is very dependent on outages as it requires existing circuits to be out of service for a prolonged period of time to facilitate the up-voltage work. All options could have a range of different planning risks and other aspects associated with their technology and this was reflected in the assessment.

Estimated deliverability aspects	Up-voltage option	400 kV OHL	220 kV OHL	220 kV UGC	400 kV UGC

Table 20 *Summary of deliverability aspects for all options*

7.6.5 Socio-economic

A new asset in a socio-economic environment will, in general, always perform poorly relative to other options which may use existing infrastructure. There is also a difference between above ground and underground options.

Estimated socio-economic aspects	Up-voltage option	400 kV OHL	220 kV OHL	220 kV UGC	400 kV UGC

Table 21 *Summary of socio-economic performance for all options*

8 Conclusions

EirGrid follow a six step approach when we develop and implement the best performing solution option to any identified transmission network problem. The transmission network problem for Capital Project 966 was identified and described in previous Step 1 and was documented in the Need Report.

The need, in this case, involves a transmission network problem regarding the transfer of power across the existing 400 kV transmission network from west to east and the transfer of this power within the transmission network as it reaches the east coast. The issues encountered involve both capacity and voltage.

Capital Project 966 has now gone through Step 2 of the framework for grid development. Step 2 was carried out in two parts. Part A covered the aspects that were considered when the long list of options was created and the first refinement of this list. This is documented in Options Report Part A. The outcome of the second part of refinement of the list has been presented in this report, Options Report Part B (this document).

The outcome from the Part B in Step 2 is that four solution options will be brought forward for further analysis in Step 3. There are some common requirements for all options and they are listed last. The four options are:

1. Up-voltage option

    - Up-voltage some of the existing 220 kV circuits between existing Dunstown 400 kV station and Woodland 400 kV station. Using a new technology which would enable the existing 220 kV towers to be modified and the 220 kV conductors replaced with 400 kV conductor to create a new Dunstown – Woodland 400 kV circuit. The circuits selected to achieve this are Gorman – Maynooth 220 kV circuit and the Dunstown – Maynooth 2 220 kV circuit.

2. 400 kV OHL option
    - Construction of a new 400 kV overhead line linking Dunstown 400 kV station to Woodland 400 kV station.
3. Underground cable (220 kV or 400 kV)
    - Construction of a new 220 kV or 400 kV underground cable linking Dunstown 400 kV station to Woodland 400 kV station.

    If a 220 kV cable is the best performing option then, the following additional reinforcements are required:

    - Uprating of the Cashla – Prospect 220 kV overhead line
    - Uprating of the Killonan – Shannonbridge 220 kV overhead line
    - Woodland 220 kV station would be required to be operated "split" in order to prevent thermal overloading of the new 220 kV cable for an unplanned loss of a circuit
4. Common requirements for all options:
    - Uprating of the Bracklone – Portlaoise 110 kV overhead line
    - Dynamic reactive support device in area of Inchicore station rated at approximately ±250 Mvar

Appendix 1 – Selection of existing 220 kV circuit to use for up-voltage option

This appendix provides a summary of the assessment of which of the existing 220 kV circuits between Dunstown and Woodland stations would be the best candidates to use for the up-voltage option. The new circuit would be created by linking circuits north and south of Maynooth 220 kV station. The circuits possible to use for the up-voltage option are:

A. Gorman – Maynooth 220 kV (indicated with red colour in figure below)

B. Maynooth – Woodland 220 kV (indicated with yellow colour in figure below)

C. Dunstown – Maynooth 220 kV crt 2 (indicated with gry colour in figure below)

D. Maynooth – Turlough Hill 220 kV (indicated with green colour in figure below)

E. Dunstown – Maynooth 220 kV crt 1 (indicated with black colour in figure below)

All the existing 220 kV circuits between Dunstown and Maynooth were assessed based on five criteria. It is assumed that the Bracklone – Portlaoise 110 kV overhead line is uprated before the works involved in the up-voltage option can be carried out as this overload was common to all options in in the refined long list. This was previously identified in the report in section 7, Detailed evaluation of options.

This is a high level assessment to get an indication of potential differences between the circuits. In addition, more detailed analysis of the best preforming circuits will be carried out in Step 3 if this option remains. Some nuances in the technical, economic and deliverability criteria were added to make the comparison useful for this specific assessment. For the deliverability criteria we assessed the outage implications that each individual circuit will impose on the system during the required up-voltage works. We assumed each line option to be taken out of service in turn and subsequently applied an unplanned trip of another item of plant to get an indication of the severity impact on the system that this may cause. The implications for the system were then assessed on a high level by the amount of re-dispatch required to resolve the issue. As this is a new technology we do not have any cost assumptions available. To make an assessment for the economic criteria it was decided to use the cost of building a new circuit along the existing route.

Northern section between Maynooth and Woodland

In the northern section, there are two circuits which could be used to link the circuits north of Maynooth 220 kV station with circuits to the south. Each option is assessed against the five criteria and a justification and reasoning given for the assessment.

Existing 220 kV circuits	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Combined Performance
Gorman-Maynooth 220 kV						
Maynooth Woodland 220 kV						

Table 22 *Overall comparison of up-voltage options in northern section using five criteria*

Technical performance and Deliverability aspects

The technical performance of the Gorman – Maynooth 220 kV circuit option does not cause any thermal overloads for an unplanned loss of any item of plant during the assumed construction phase. This is in contrast to Maynooth – Woodland 220 kV circuit, which would require significant generation constraint to allow the Maynooth – Woodland

220 kV circuit to be switched out for a longer period of time to implement the up-voltage work. The most influencing factor is that the Maynooth – Woodland 220 kV circuit share double circuit towers with Woodland – Clonee 220 kV for approximately 9 km and Maynooth – Shannonbridge 220 kV for approximately 1 km. The sharing of towers means that both circuits have to be taken out at the same time. This has an impact on the security and capacity of the transmission network in Dublin, which is reflected in the technical and deliverability criteria. The two options, respectively, have a low to moderate (**Green**) impact and a high impact (**Dark Blue**).

Economic Performance

A high level assessment of the estimated capital cost for the circuits in the northern section concluded that both circuits have a low to moderate cost impact (**Green**). The estimates are in the range €19 – 22m.

Environmental aspects

Having considered the potential environmental impacts for the up-voltage of the circuits in the northern section, it is concluded that the Maynooth – Woodland 220 kV circuit may have a slightly lower impact than the Gorman – Woodland 220 kV circuit. Potential impacts take into account construction and the requirement for a section of new build infrastructure on the Gorman – Woodland 220 kV circuit gives this a performance of moderate environmental impact (**Dark Green**) while Maynooth – Woodland 220 kV circuit has a performance of low to moderate environmental impact (**Green**). Both alternatives perform similarly overall. The transmission lines traverse farmland in the main and do not cross areas of high environmental sensitivity such as European Sites etc.

Socio-economic

Having considered typical socio-economic impacts for the circuits in the northern section it is concluded both options perform similarly in terms of socio—economic aspects. While the Gorman – Woodland 220 kV circuit will require a section of new build infrastructure, the Maynooth – Woodland 220 kV circuit's proximity to Maynooth Town and its amenities created additional risk. Both options are considered to have moderate socio-economic impact (**Dark Green**).

Southern section between Dunstown and Maynooth

In the southern section, there are three existing circuits which could be used to link the circuits south of Maynooth 220 kV station with circuits to the north. Each option is assessed against the five criteria and a justification and reasoning given for the assessment.

Existing 220 kV circuits	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Combined Performance
Dunstown – Maynooth 220 kV cct 1						
Dunstown – Maynooth 220 kV cct 2						
Maynooth – Turlough Hill 220 kV						

Table 23 *Overall comparison of up-voltage options in southern section using five criteria*

Technical performance and Deliverability

The technical performance of the Maynooth – Turlough Hill 220 kV circuit option does not cause any thermal overloads for an unplanned loss of any item of plant during the assumed construction phase. It should be noted that this is one of two lines feeding the pump storage plant Turlough Hill. This option is considered to have low to moderate technical and deliverability impact (**Green**).

The Dunstown – Maynooth 220 kV circuit 2 does also perform well as it does not cause any thermal overloads for an unplanned loss of any item of plant during the assumed construction phase. This option is considered to have low to moderate technical and deliverability impact (**Green**).

The Dunstown – Maynooth 220 kV circuit 1, would require significant generation constraint to allow the this 220 kV circuit to be switched out for a longer period of time to implement the up-voltage work. The most influencing factor is that the Dunstown – Maynooth 220 kV circuit 1 shares double circuit towers with Carrickmines – Dunstown 220 kV circuit for approximately 19 km. The sharing of towers means that both circuits have to be taken out at the same time. This has an impact on the security and capacity of the transmission network in Dublin, which is reflected in the technical and deliverability criteria. This option is considered to have high technical and deliverability impact (**Dark Blue**).

Economic Performance

A high level assessment of the estimated capital cost for up-voltaging the circuits in the southern section concluded that Dunstown – Maynooth 220 kV cricuit 1 have a high cost impact (**Dark Blue**), while both Dunstown – Maynooth 220 kV circuit 2 have a moderate cost impact (**Dark Green**) and Maynooth – Turlough Hill 220 kV have a high to moderate cost impact (**Blue**). The estimates range between €25-33m.

Environmental

Based on the information available at this stage, having considered the potential environmental impacts that may be associated with any up-oltage for the circuits in the southern section, it is concluded that the Dunstown – Maynooth 220 kV circuit 2 may have a moderate to low significance (**Green**) impact on environment when compared to Dunstown – Maynooth 220 kV circuit 1 and Maynooth – Turlough Hill 220 kV circuits which have been scored moderate impact (**Dark Green**). The alternatives perform very similarly overall and the impacts are mainly related to construction activities. The transmission lines traverse farmland in the main and do not cross areas of high environmental sensitivity such as European Sites etc. Peatland sites to west are avoided by all circuits. All the circuits oversail the Grand Canal and the River Liffey. Dunstown Maynooth circuit 1 crosses an area of ecological value (undesignated natural grassland) close to Dunstown Station which was considered in the scoring. The requirement for a short section of new infrastructure on the Maynooth Turlough Hill circuit contributes to its slightly lower scoring for environmental criteria.

Socio-economic

Maynooth – Turlough Hill 220 kV performs poorly against the socio-economic aspects. This is largely as a result of the circuit travelling through defined settlements, in particular Clane where recreation features are located. There will be an increased impact on landscape also due to the construction of new infrastructure for a short section. The impact to other criteria was not thought to be as significant. This option is considered to have moderate socio-economic impact (**Dark Green**).

Dunstown – Maynooth 220 kV circuit 1 performs low to moderate against socio-economic aspects. This is primarily as a result of not travelling in proximity to defined settlements, its low-moderate impact on the landscape and cultural heritage. The circuit does travel in proximity to Baldonnell Aerodrome. There are impacts expected to some recreation and tourism features due to the proximity of the circuit to these features, however, this are not expected to be direct. This option is considered to have low to moderate socio-economic impact (**Green**).

Dunstown – Maynooth 220 kV circuit 2 performs low to moderate against socio-economic aspects. It does travel in proximity to defined settlements (Two Mile House). The impact on the landscape and cultural heritage is low-moderate. It is also significant distance from Baldonnell Aerodrome. There are low-moderate impacts expected to some recreation and tourism features due to the proximity of the circuit to these features, however, this are not expected to be direct. This option is considered to have low to moderate socio-economic impact (**Green**).

Conclusion

In the northern section the existing Gorman – Maynooth 220 kV circuit is the best performing option to use for the up-voltage option and in the southern section the best performing option is the existing Dunstown – Maynooth 220 kV circuit 2.

It should be noted that it is only part of the Gorman – Maynooth 220 kV that will be used for the up-voltage option in the northern section. The technology used to create the connection into Woodland station from the Gorman – Maynooth 220 kV circuit will be determined in Step 3 and the any required routing will be carried out in Step 4.

Appendix 2 – Analysis Result

Appendix 2A – Up-voltage existing 220 kV circuits to 400 kV OHL circuit

N-1 Overloads

Scenario	Contingency	Overloaded Circuit	Rating	Loading	%Loading
Winter Peak Export	Dunstown - Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV circuit	128	146.5	112.0
Summer Peak Export	Dunstown - Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV circuit	105	124.7	112.5

N-1-1 Overloads which remain following re-dispatch of generation

Maintenance	Contingency	Overloaded Circuit	Pre – Cnt	Post – Cnt	Rating (MVA)	Loading %	Potential candidate Solution
Dunstown - Coolnabacky 400 kV	Moneypoint - Oldstreet 400 kV	Coolnabacky – Portlaoise 110 kV	166.1	314.2	178	172	Additional capacity requirement
		Cashla - Prospect 220 kV	330.4	678.6	392	164.5	Additional capacity requirement
		Bracklone - Newbridge 110 kV	96.4	171.5	136	126.8	Additional capacity requirement
		Maynooth – Shannonbridge 220 kV	202.7	335.5	269	123.1	Additional capacity requirement
		Killonan – Shannonbridge 220 kV	249.7	389.1	269	139.9	Additional capacity requirement
		Cashla – Ennis 110 kV	130.9	201.3	178	111.5	Additional capacity requirement but related to Cashla Prospect overload above
		Bracklone –Portlaoise 110 kV	107.3	185.1	105	173.1	Additional capacity requirement
	Oldstreet – Woodland 400 kV	Coolnabacky – Portlaoise 110 kV	166.1	297.3	178	163.3	Same as above
		Maynooth – Shannonbridge 220 kV	202.7	381.2	269	140.4	Same as above
		Killonan – Shannonbridge 220 kV	249.7	388.1	269	139	Same as above
		Bracklone - Newbridge 110 kV	96.4	176.6	136	131.5	Same as above
		Cashla – Flagford 220 kV	204.5	463.1	405	112	Additional capacity requirement
		Bracklone –Portlaoise 110 kV	107.3	190.8	105	179.1	Same as above
	Cushaling – Portlaoise 110 kV	Bracklone –Portlaoise 110 kV	107.3	142	105	127.8	Same as above
	Dunstown – Kellis 220 kV	Bracklone –Portlaoise 110 kV	107.3	125.1	105	112.8	Same as above
	Maynooth – Shannonbridge 220 kV	Bracklone –Portlaoise 110 kV	107.3	122.5	105	110.4	Same as above
Coolnabacky – Moneypoint 400 kV	Oldstreet – Woodland 400 kV	Killonan – Shannonbridge 220 kV	269.3	438.3	269	173.6	Same as above
		Maynooth – Shannonbridge 220 kV	205.3	410.2	269	162.5	Same as above
		Cashla – Flagford 220 kV	214.4	544.4	405	137.5	Same as above
		Agannygal – Shannonbridge 110 kV	83.8	131.3	105	126.4	Additional capacity requirement
		Cashla - Prospect 220 kV	352.4	433.3	392	113	Same as above
	Moneypoint - Oldstreet 400 kV	Agannygal – Shannonbridge 110 kV	83.8	129.8	105	123.6	Same as above

		Cashla – Ennis 110 kV	138.1	234.6	178	131.7	Same as above
		Cashla - Prospect 220 kV	352.4	829.8	392	211.7	Same as above
		Killonan – Shannonbridge 220 kV	241.1	486.6	269	180.9	Same as above
		Maynooth – Shannonbridge 220 kV	177.3	394.6	269	146.7	Same as above
Moneypoint - Oldstreet 400 kV	Dunstown - Coolnabacky 400 kV	Coolnabacky – Portlaoise 110 kV	107	314.2	178	172	Same as above
		Bracklone –Portlaoise 110 kV	77.3	185	105	172.9	Same as above
		Cashla - Prospect 220 kV	352.6	679.1	392	164.6	Same as above
		Killonan – Shannonbridge 220 kV	241.1	389	269	139.8	Same as above
		Bracklone - Newbridge 110 kV	68	171.4	136	126.7	Same as above
		Maynooth – Shannonbridge 220 kV	177.3	334.9	269	122.9	Same as above
		Cashla – Ennis 110 kV	138.1	201.6	178	111.7	Same as above
	Coolnabacky – Moneypoint 400 kV	Agannygal – Shannonbridge 110 kV	83.8	129.8	105	123.6	Same as above
		Cashla – Ennis 110 kV	138.1	234.6	178	131.8	Same as above
		Cashla - Prospect 220 kV	352.4	830.5	392	211.9	Same as above
		Killonan – Shannonbridge 220 kV	241.1	484.8	269	180.2	Same as above
		Maynooth – Shannonbridge 220 kV	177.3	392.8	269	146	Same as above
	Dunstown – Woodland 400 kV	Maynooth – Woodland 220 kV cc1	219.2	633.4	434	140.9	Additional capacity requirement
		Cashla - Prospect 220 kV	352.6	552	392	133.1	Same as above
Cullenagh - Great 220kV Ckt 1	Cullenagh - Waterford 110 kV	Killoternan – Waterford 110 kV	58.6	173.7	99	169.4	Additional capacity requirement
	Butlerstown - Cullenagh 110 kV	Cullenagh - Waterford 110 kV	150.5	233	178	125.9	Additional capacity requirement
	Butlerstown – Killoternan 110kV	Cullenagh - Waterford 110 kV	150.5	213	178	115.1	Same as above
Cullenagh - Waterford 110kV Ckt 1	Cullenagh – Great Island 220kV	Killoternan – Waterford 110 kV	85.5	173.7	99	169.4	Same as above

Appendix 2B – New 400 kV OHL circuit

N-1 Overloads

Scenario	Contingency	Overloaded Circuit	Rating (MVA)	Loading (MVA)	Loading %
Winter Peak Export	Dunstown - Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV	128	146.9	111.4
Summer Peak Export	Dunstown - Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV	105	124.6	112.3

N-1-1 Overloads which remain following re-dispatch of generation

Maintenance	Contingency	Overloaded Circuit	Pre-Cnt	Post – Cnt	Rating (MVA)	Loading %	Potential candidate Solution
Dunstown - Coolnabacky 400 kV	Moneypoint – Oldstreet 400kV	Coolnabacky – Portlaoise 110 kV	165.9	312.7	178	171.3	Additional capacity requirement
		Cashla - Prospect 220 kV	327.4	670.7	392	162.4	Additional capacity requirement
		Killonan – Shannonbridge 220 kV	246.6	385.6	269	138.5	Additional capacity requirement
		Bracklone –Newbridge 110 kV	97.5	172.5	136	127.6	Additional capacity requirement
		Maynooth – Shannonbridge 220 kV	197.6	331.8	269	121.5	Additional capacity requirement
		Bracklone –Portlaoise 110 kV	108.5	186.1	105	174.1	Additional capacity requirement
		Cashla – Ennis 110 kV	129.9	199	178	110.1	Additional capacity requirement but related to Cashla Prospect overload above
	Oldstreet – Woodland 400kV	Coolnabacky – Portlaoise 110 kV	165.9	296.7	178	163.2	Same as above
		Bracklone –Portlaoise 110 kV	108.5	192	105	180.5	Same as above
		Maynooth – Shannonbridge 220 kV	197.6	379.3	269	139.6	Same as above
		Killonan – Shannonbridge 220 kV	246.6	386	269	138.2	Same as above
		Bracklone - Newbridge 110 kV	97.5	177.9	136	132.5	Same as above
	Cushalin – Portlaoise 110 kV	Bracklone –Portlaoise 110 kV	108.5	143.6	105	129.3	Same as above
	Dunstown – Kellis 220 kV	Bracklone –Portlaoise 110 kV	108.5	127.5	105	114.9	Same as above
	Maynooth – Shannonbridge 220 kV	Bracklone –Portlaoise 110 kV	108.5	122.5	105	110.4	Same as above
Coolnabacky – Moneypoint 400 kV	Oldstreet – Woodland 400kV	Killonan – Shannonbridge 220 kV	266.6	468.6	269	172.4	Same as above
		Maynooth – Shannonbridge 220 kV	200	409.5	269	161	Same as above
		Cashla – Flagford 220 kV	210.7	534.6	405	134.3	Additional capacity requirement
		Agannygal – Shannonbridge 110kV	83.8	131.6	105	126	Additional capacity requirement
		Cashla - Prospect 220 kV	350.4	429.2	392	111.4	Same as above
	Moneypoint – Oldstreet 400kV	Cashla - Prospect 220 kV	350.4	754	392	209.3	Same as above
		Killonan – Shannonbridge 220 kV	266.6	475.5	269	179.2	Same as above
		Maynooth – Shannonbridge 220 kV	200	360.2	269	144.5	Same as above
		Cashla – Ennis 110 kV	131.6	219	178	130	Same as above
		Agannygal – Shannonbridge 110kV	83.8	123.5	105	123.2	Same as above

Moneypoint – Oldstreet 400kV	Dunstown - Coolnabacky 400 kV	Coolnabacky – Portlaoise 110 kV	100.7	312.7	178	171.2	Same as above
		Bracklone –Portlaoise 110 kV	75.9	186	105	173.9	Same as above
		Cashla - Prospect 220 kV	340.4	671.3	392	162.6	Same as above
		Killonan – Shannonbridge 220 kV	231.9	385.5	269	138.4	Same as above
		Bracklone - Newbridge 110 kV	66.5	172.4	136	127.5	Same as above
		Maynooth – Shannonbridge 220 kV	164.1	331.1	269	121.3	Same as above
		Cashla – Ennis 110 kV	135.1	199.2	178	110.3	Same as above
	Dunstown – Woodland 400kV	Cashla - Prospect 220 kV	340.4	480.3	392	115.4	Same as above
		Maynooth – Woodland 220 kV crt1	234.5	524.2	434	120.8	Additional capacity requirement
	Coolnabacky – Moneypoint 400 kV	Cashla - Prospect 220 kV	340.4	754.5	392	209.3	Same as above
		Killonan – Shannonbridge 220 kV	231.9	475.3	269	179	Same as above
		Maynooth – Shannonbridge 220 kV	164.1	359.8	269	144.2	Same as above
		Cashla – Ennis 110 kV	135.1	219.2	178	130.1	Same as above
		Agannygal – Shannonbridge 110kV	74.1	123.5	105	123.1	Same as above
Cullenagh - Great Island 220kV	Cullenagh - Waterford 110 kV	Killoternan – Waterford 110 kV	60.6	178.7	99	174.5	Additional capacity requirement
	Butlerstown - Cullenagh 110 kV	Cullenagh - Waterford 110 kV	154.2	238.6	178	129	Additional capacity requirement
	Butlerstown – Killoternan 110kV	Cullenagh - Waterford 110 kV	154.2	218.6	178	118.3	Same as above
Cullenagh - Waterford 110kV	Cullenagh - Great Island 220kV	Killoternan – Waterford 110 kV	87.4	178.8	99	174.5	Same as above

Appendix 2C – New 220 kV OHL circuit

N-1 Overloads

Scenario	Contingency	Overloaded Circuit	Rating (MVA)	Loading (MVA)	Loading (%)
Winter Peak Export	Coolnabacky – Dunstown 400 kV	Bracklone –Portlaoise 110 kV	128	146.7	111
Summer Peak Export	Coolnabacky – Dunstown 400 kV	Bracklone –Portlaoise 110 kV	105	124.5	112.3
Summer Peak Export	Moneypoint – Oldstreet 400 kV	Cashla – Prospect 220 kV	392	489.1	117.9

N-1-1 Overloads which remain following re-dispatch of generation

Maintenance	Contingency	Overloaded Circuit	Pre-Cnt	Post Cnt	Rating (MVA)	Loading (%)	Potential candidate Solution
Dunstown - Coolnabacky 400 kV	Moneypoint – Oldstreet 400kV	Coolnabacky – Portlaoise 110 kV	164.5	312.6	178	170.9	Additional capacity requirement
		Killonan – Shannonbridge 220 kV	245.6	382.9	269	137.5	Additional capacity requirement
		Bracklone - Newbridge 110 kV	96.9	171.1	136	126.4	Additional capacity requirement
		Maynooth – Shannonbridge 220 kV	196.4	324.8	269	118.9	Additional capacity requirement
		Cashla – Ennis 110 kV	129.7	202.9	178	112.4	Additional capacity requirement but related to Cashla Prospect overload above
		Bracklone –Portlaoise 110 kV	107.7	184.7	105	172.4	Additional capacity requirement
		Cashla – Prospect 220 kV	320.2	649.8	392	165.8	Additional capacity requirement
	Oldstreet – Woodland 400kV	Bracklone –Portlaoise 110 kV	107.7	192.1	105	180.7	Same as above
		Coolnabacky – Portlaoise 110 kV	164.5	298.4	178	164.1	Same as above
		Maynooth – Shannonbridge 220 kV	196.4	376.1	269	138.6	Same as above
		Killonan – Shannonbridge 220 kV	245.6	385.4	269	138	Same as above
		Bracklone - Newbridge 110 kV	96.9	177.8	136	132.7	Same as above
		Cashla – Flagford 220 kV	197.9	460.6	405	111.5	Additional capacity requirement
	Cushalin – Portlaoise 110 kV	Bracklone –Portlaoise 110 kV	107.7	142.7	105	128.4	Same as above
	Dunstown – Kellis 220 kV	Bracklone –Portlaoise 110 kV	107.7	128	105	115.4	Same as above
	Maynooth – Shannonbridge 220 kV	Bracklone –Portlaoise 110 kV	107.7	122.2	105	110.1	Same as above
Coolnabacky – Moneypoint 400 kV	Oldstreet – Woodland 400kV	Killonan – Shannonbridge 220 kV	266.7	433.3	269	174.8	Same as above
		Cashla – Flagford 220 kV	209.8	548.1	405	140.3	Same as above
		Cashla - Prospect 220 kV	342.2	449.5	392.0	114.7	Same as above
		Maynooth – Shannonbridge 220 kV	197.8	442.2	269	164.4	Same as above
		Agannygal – Shannonbridge 110kV	83.9	130.3	105	127.3	Additional capacity requirement
	Cullenagh – Knockraha 220 kV	Killonan – Shannonbridge 220 kV	260.3	296	269	110.1	Same as above
		Moneypoint – Oldstreet 400 kV	1133.2	1141.6	997	114.5	Uprate CTs to match line ratings
		Oldstreet – Woodland 400 kV	1118.3	1168.5	997	117.2	Uprate CTs to match line ratings

	Moneypoint - Oldstreet 400 kV	Maynooth – Shannonbridge 220 kV	187	355.3	269	144.8	Same as above
		Cashla – Ennis 110 kV	159.9	224.8	178	134.9	Same as above
		Agannygal – Shannonbridge 110kV	83.9	129.5	105	123.4	Same as above
		Athlone – Lanesboro 110 kV	70.0	117.3	105	111.7	Additional capacity requirement
		Cashla – Prospect 220 kV	342.2	848.2	392	216.4	Same as above
		Killonan – Shannonbridge 220 kV	266.7	484.7	269	180.2	Same as above
Moneypoint – Oldstreet 400kV	Dunstown - Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV	97.7	184.6	105	172.3	Same as above
		Cashla - Prospect 220 kV	326.7	683.9	392	165.6	Same as above
		Coolnabacky – Portlaoise 110 kV	148.4	312.2	178	170.5	Same as above
		Killonan – Shannonbridge 220 kV	260.3	382.6	269	137.3	Same as above
		Cashla – Ennis 110 kV	159.9	200.3	178	112.5	Same as above
		Bracklone - Newbridge 110 kV	87.7	171	136	126.2	Same as above
		Maynooth – Shannonbridge 220 kV	187	319.7	269	118.9	Same as above
	Dunstown – Woodland 220 kV	Cashla – Prospect 220 kV	435.3	451.3	392	115.1	Same as above
		Maynooth – Woodland 220 kV	347.2	525.3	434	121	Additional capacity requirement
	Coolnabacky – Moneypoint 400 kV	Cashla – Ennis 110 kV	159.9	237.1	178	133.2	Same as above
		Agannygal – Shannonbridge 110kV	77.8	127.1	105	121	Same as above
		Cashla – Prospect 220 kV	435.3	834.7	392	212.9	Same as above
		Killonan – Shannonbridge 220 kV	260.3	471.2	269	177.4	Same as above
		Maynooth – Shannonbridge 220 kV	187	355.3	269	142.4	Same as above
	2202 DUNSTOWN TRAFO CKT 1	Cashla – Prospect 220 kV	435.3	454.4	392	115.9	Same as above
		2204 DUNSTOWN TRAFO no.2	467.8	746.8	500	149.4	Third Dunstown 400/220 kV trafo required
	2202 DUNSTOWN TRAFO CKT 2	Cashla – Prospect 220 kV	435.3	457.5	392	116.7	Same as above
		2204 DUNSTOWN TRAFO no.1	441.2	743	500	148.6	Third Dunstown 400/220 kV trafo required
	Cashla - Prospect 220 kV	Cashla – Ennis 110 kV	159.9	239.2	178	132.2	Same as above
		Killonan – Shannonbridge 220 kV	260.3	314.1	269	111.6	Same as above
	2962 HUNTSTOWN TRAFO CKT 1	Cashla – Prospect 220 kV	447.2	463.7	392	111.3	Same as above
	3551 LAOIS TRAFO CKT 1	Cashla – Prospect 220 kV	447.2	459.3	392	110.1	Same as above
	5462 WOODLAND TRAFO CKT 1	Cashla – Prospect 220 kV	447.2	463.4	392	111.2	Same as above
	5462 WOODLAND TRAFO CKT 4	Cashla – Prospect 220 kV	447.2	463.4	392	111.2	Same as above
	Arklow – Lodgewood 220 kV	Cashla – Prospect 220 kV	447.2	458.6	392	110.1	Same as above
	Athlone – Shannonbridge 110 kV	Cashla – Prospect 220 kV	447.2	466.2	392	112	Same as above
	Booltiag – Ennis 110 kV	Cashla – Prospect 220 kV	447.2	465.2	392	111.7	Same as above
	Cashla – Ennis 110 kV	Cashla – Prospect 220 kV	447.2	506.6	392	121.8	Same as above
	Cashla – Somrst T 110 kV	Cashla – Prospect 220 kV	447.2	459.1	392	110.1	Same as above
	Corduff – Huntstown 220 kV	Cashla – Prospect 220 kV	447.2	459.9	392	110.4	Same as above
	Cullenagh – Knockraha 220 kV	Cashla – Prospect 220 kV	447.2	466.4	392	112.3	Same as above
	Cushalin – Portlaoise 110 kV	Bracklone –Portlaoise 110 kV	97.7	129	105	117.7	Same as above
	Dunstown – Maynooth 220 kV	Cashla – Prospect 220 kV	447.2	461.3	392	110.7	Same as above
	Finglas – Huntstown 220 kV	Cashla – Prospect 220 kV	447.2	463.8	392	111.3	Same as above
	Gorman – Louth 220 kV	Cashla – Prospect 220 kV	447.2	459.6	392	110.3	Same as above
	Gorman – Maynooth 220 kV	Cashla – Prospect 220 kV	447.2	473.6	392	113.7	Same as above
	Great Island – Lodgewood 220 kV	Cashla – Prospect 220 kV	447.2	460	392	110.5	Same as above
	Inchicore - Irishtown 220 k	Cashla – Prospect 220 kV	447.2	461.5	392	110.8	Same as above
	Killonan - Shannonbridge 220 kV	Cashla – Prospect 220 kV	447.2	485	392	116.6	Same as above
	Coolnabacky - Portlaoise 110 kV	Cashla – Prospect 220 kV	447.2	460.7	392	110.5	Same as above
	Maynooth – Woodland 220 kV	Cashla – Prospect 220 kV	447.2	466	392	111.9	Same as above

	Shannonbridge – Somrst T 110 kV	Cashla – Prospect 220 kV	447.2	462.8	392	111	Same as above
Cullenagh - Great Island 220kV	Cullenagh - Waterford 110kV	Killoternan – Waterford 110 kV	60.8	179	99	174.6	Additional capacity requirement
	Butlerstown - Cullenagh 110 kV	Cullenagh - Waterford 110kV	154.4	229.8	178	129.1	Additional capacity requirement
	Butlerstown – Killoternan 110kV	Cullenagh - Waterford 110kV	154.4	210.6	178	118.3	Same as above
Cullenagh - Waterford 110kV Ckt 1	Cullenagh - Great Island 220kV	Killoternan – Waterford 110 kV	87.1	172.9	99	174.7	Same as above

Appendix 2D – New 220 kV UGC

N-1 Overloads

Scenario	Contingency	Overloaded Circuit	Rating (MVA)	Loading (MVA)	Loading (%)
Winter Peak Export	Dunstown- Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV circuit	128	150	113.3
Summer Peak Export	Dunstown- Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV circuit	105	127.2	114.6
Summer Peak Export	Moneypoint – Oldstreet 400 kV	Cashla – Prospect 220 kV circuit	392	468	112.6
Summer Peak Export	Coolnabacky –Moneypoint 400 kV	Killonan – Shannonbridge 220 kV circuit	267	311.4	110.4

N-1-1 Overloads which remain following re-dispatch of generation

Maintenance	Contingency	Overloaded Circuit	Pre-Cnt	Post-Cnt	Rating (MVA)	Loading (%)	Potential candidate Solution
Dunstown - Coolnabacky 400 kV	Moneypoint – Oldstreet 400kV	Coolnabacky – Portlaoise 110 kV	167.5	312.6	178	170.4	Additional capacity requirement
		Killonan – Shannonbridge 220 kV	249.7	371.1	269	137.9	Additional capacity requirement
		Bracklone - Newbridge 110 kV	99.3	172.7	136	126.8	Additional capacity requirement
		Maynooth – Shannonbridge 220 kV	202.4	330.5	269	120.4	Additional capacity requirement
		Bracklone –Portlaoise 110 kV	109.9	185.8	105	172.8	Additional capacity requirement
		Cashla - Prospect 220 kV	327.4	672.7	392	162.9	Additional capacity requirement
		Cashla – Ennis 110 kV	129.5	199.6	178	110.4	Additional capacity requirement but related to Cashla Prospect overload above
	Oldstreet – Woodland 400kV	Coolnabacky – Portlaoise 110 kV	167.5	296.6	178	162.6	Same as above
		Bracklone –Portlaoise 110 kV	109.9	191.9	105	179.7	Same as above
		Maynooth - Shannonbridge 220 kV	202.4	378.5	269	138.7	Same as above
		Killonan - Shannonbridge 220 kV	249.7	370.7	269	137.8	Same as above
		Bracklone - Newbridge 110 kV	99.3	178.2	136	132	Same as above
	Cushalin – Portlaoise 110 kV	Bracklone –Portlaoise 110 kV	109.9	145.3	105	130.8	Same as above
	Dunstown – Kellis 220 kV	Bracklone –Portlaoise 110 kV	109.9	129.2	105	116.5	Same as above
	Maynooth – Shannonbridge 220 kV	Bracklone –Portlaoise 110 kV	109.9	124.8	105	112.4	Same as above
Coolnabacky –Moneypoint 400 kV	Oldstreet – Woodland 400kV	Maynooth – Shannonbridge 220 kV	206	415.1	269	160.3	Same as above
		Cashla – Flagford 220 kV	213.6	534.4	405	133.6	Additional capacity requirement
		Agannygal – Shannonbridge 110kV	84.7	131.1	105	124.1	Additional capacity requirement
		Killonan – Shannonbridge 220 kV	270.8	467.6	269	171.1	Same as above
		Cashla - Prospect 220 kV	350.9	428	392	110.5	Same as above
	Cullenagh – Knockraha 220 kV	Killonan – Shannonbridge 220 kV	213.9	299.4	269	111.3	Same as above

	Moneypoint – Oldstreet 400kV	Maynooth – Shannonbridge 220 kV	206	365	269	141.6	Same as above
		Cashla – Ennis 110 kV	131.2	220.2	178	127.9	Same as above
		Agannygal – Shannonbridge 110kV	84.7	123.4	105	119.7	Same as above
		Killonan – Shannobridge 220 kV	270.8	473	269	175.6	Same as above
		Cashla - Prospect 220 kV	350.9	759.9	392	205.7	Same as above
	Cullenagh – Knockraha 220 kV	Killonan – Shannobridge 220 kV	270.8	313.1	269	111.3	Same as above
		Moneypoint – Oldstreet 400 kV	1136.2	1141.6	997	114	Uprate CTs to match line ratings
		Oldstreet – Woodland 400 kV	1118.3	1159.8	997	116.3	Uprate CTs to match line ratings
Moneypoint – Oldstreet 400kV	Dunstown - Coolnabacky 400 kV	Coolnabacky – Portlaoise 110 kV	144.7	312.8	178	169.9	Same as above
		Bracklone –Portlaoise 110 kV	97.2	185.9	105	172.3	Same as above
		Bracklone - Newbridge 110 kV	87.3	172.7	136	126.4	Same as above
		Maynooth – Shannonbridge 220 kV	190.7	329.8	269	119.9	Same as above
		Cashla – Ennis 110 kV	154.9	200.2	178	110.5	Same as above
		Cashla - Prospect 220 kV	427.8	672.3	392	162.7	Same as above
		Killonan – Shannonbridge 220 kV	260.3	383.9	269	137.6	Same as above
	Dunstown - Woodland 220 kV	Maynooth – Woodland 220 kV ckt1	333.7	521.9	434	115.4	Additional capacity requirement
		Cashla - Prospect 220 kV	427.8	494	392	118.7	Same as above
	Coolnabacky –Moneypoint 400 kV	Maynooth – Shannonbridge 220 kV	190.7	364.2	269	140.1	Same as above
		Cashla – Ennis 110 kV	154.9	222.2	178	127.8	Same as above
		Agannygal – Shannonbridge 110kV	78.2	123.4	105	118.5	Same as above
		Killonan – Shannonbridge 220 kV	260.3	471.5	269	174.2	Same as above
		Cashla - Prospect 220 kV	427.8	766.8	392	204.6	Same as above
	2202 DUNSTOWN TRAFO CKT 1	2204 DUNSTOWN TRAFO no.2	487.2	768.5	500	153.7	Third Dunstown 400/220 kV trafo required
		Cashla - Prospect 220 kV	427.8	464.4	392	111.4	Same as above
	2204 DUNSTOWN TRAFO CKT 2	2204 DUNSTOWN TRAFO no.1	444.7	756.9	500	151.4	Same as above
		Cashla - Prospect 220 kV	427.8	468.2	392	112.3	Same as above
	Cashla - Prospect 220 kV	Cashla – Ennis 110 kV	154.9	228.6	178	125.9	Same as above
		Killonan – Shannonbridge 220 kV	260.3	310.8	269	110.2	Same as above
	Cashla – Ennis 110 kV	Cashla - Prospect 220 kV	427.8	484.1	392	116.2	Same as above
	5464 WOODLAND TRAFO CKT 1	Maynooth – Woodland 220 kV crt1	333.7	514.9	434	112.8	Same as above
		Cashla - Prospect 220 kV	427.8	490.5	392	117.8	Same as above
	Cushalin – Portlaoise 110 kV	Bracklone –Portlaoise 110 kV	97.2	128.1	105	116.5	Same as above
	Killonan – Shannonbridge 220 kV	Cashla - Prospect 220 kV	427.8	464.9	392	111.7	Same as above
Cullenagh - Great Island 220kV	Cullenagh - Waterford 110kV	Killoternan – Waterford 110 kV	61.8	181.3	99	176.9	Additional capacity requirement
	Butlerstown - Cullenagh 110 kV	Cullenagh - Waterford 110kV	156.1	241.3	178	130.5	Additional capacity requirement
	Butlerstown – Killoternan 110kV	Cullenagh - Waterford 110kV	156.1	221.4	178	119.7	Same as above
	Killoternan – Waterford 110 kV	Cullenagh - Waterford 110kV	156.1	205.2	178	111.2	Same as above
	Cullenagh - Waterford 110kV	Butlerstown - Cullenagh 110 kV	99.4	221.3	192	110.8	Additional capacity requirement
Cullenagh - Waterford 110kV Ckt 1	Cullenagh - Great Island 220kV	Killoternan – Waterford 110 kV	88.2	181.4	99	176.9	Same as above
		Butlerstown - Cullenagh 110 kV	127.5	221.3	192	110.8	Same as above

Appendix 2E – New 400 kV UGC circuit

N-1 Overloads

Scenario	Contingency	Overloaded Circuit	Rating (MVA)	Loading (MVA)	Loading (%)
Winter Peak Export	Dunstown - Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV circuit	128	146.6	110.6
Summer Peak Export	Dunstown - Coolnabacky 400 kV	Bracklone –Portlaoise 110 kV circuit	105	124.5	112.2

N-1-1 Overloads which remain following re-dispatch of generation

Maintenance	Contingency	Overloaded Circuit	Pre-Cnt	Post–Cnt	Rating (MVA)	Loading (%)	Potential candidate Solution
Dunstown - Coolnabacky 400 kV	Moneypoint – Oldstreet 400kV	Coolnabacky – Portlaoise 110 kV	165	312.3	178	170.2	Additional capacity requirement
		Cashla - Prospect 220 kV	326	665.2	392	160.9	Additional capacity requirement
		Killonan – Shannonbridge 220 kV	247.1	385.5	269	138.2	Additional capacity requirement
		Bracklone - Newbridge 110 kV	97.6	173.1	136	127.1	Additional capacity requirement
		Bracklone –Portlaoise 110 kV	108.3	186.4	105	173.3	Additional capacity requirement
		Maynooth – Shannonbridge 220 kV	199	333.6	269	121.6	Additional capacity requirement
	Oldstreet – Woodland 400kV	Coolnabacky – Portlaoise 110 kV	165	296.2	178	162	Same as above
		Maynooth – Shannonbridge 220 kV	199	380.5	269	139.2	Same as above
		Bracklone –Portlaoise 110 kV	108.3	192.1	105	179.5	Same as above
		Killonan – Shannonbridge 220 kV	247.1	385.7	269	137.9	Same as above
		Bracklone - Newbridge 110 kV	97.6	178.4	136	131.8	Same as above
	Cushalin – Portlaoise 110 kV	Bracklone –Portlaoise 110 kV	108.3	143.2	105	128.7	Same as above
	Dunstown – Kellis 220 kV	Bracklone –Portlaoise 110 kV	108.3	127.2	105	114.6	Same as above
	Maynooth - Shannonbridge 220 kV	Bracklone –Portlaoise 110 kV	108.3	122.3	105	110.1	Same as above
Coolnabacky – Moneypoint 400 kV	Oldstreet – Woodland 400kV	Killonan – Shannonbridge 220 kV	267	467.5	269	170.9	Same as above
		Maynooth – Shannonbridge 220 kV	200.8	412.3	269	158.7	Same as above
		Cashla – Flagford 220 kV	209.9	527.2	405	131.3	Additional capacity requirement
		Agannygal – Shannonbridge 110kV	84	132.1	105	124.8	Additional capacity requirement
	Moneypoint – Oldstreet 400kV	Cashla - Prospect 220 kV	349.4	821.3	392	202	Same as above
		Killonan – Shannonbridge 220 kV	267	473.1	269	174.7	Same as above
		Maynooth – Shannonbridge 220 kV	200.8	364.7	269	140.1	Same as above
		Cashla – Ennis 110 kV	131.3	218.2	178	125.4	Additional capacity requirement but related to Cashla Prospect overload above
		Agannygal – Shannonbridge 110kV	84	124.8	105	119.7	Same as above
Moneypoint – Oldstreet 400kV	Dunstown - Coolnabacky 400kV	Coolnabacky – Portlaoise 110 kV	89.8	312.3	178	170.2	Same as above
		Cashla - Prospect 220 kV	318.9	666	392	161.1	Same as above
		Bracklone –Portlaoise 110 kV	71.2	186.2	105	173.2	Same as above
		Killonan – Shannonbridge 220 kV	226.5	385.4	269	138.2	Same as above

		Bracklone - Newbridge 110 kV	61.8	172.9	136	127	Same as above
		Maynooth – Shannonbridge 220 kV	160.2	332.8	269	121.3	Same as above
	Dunstown – Woodland 400kV	Maynooth – Woodland 220 kV crt1	152.7	547.3	434	120.7	Additional capacity requirement
		Cashla - Prospect 220 kV	318.9	480.5	392	115.5	Same as above
	Coolnabacky –Moneypoint 400 kV	Cashla - Prospect 220 kV	318.9	822	392	202.1	Same as above
		Killonan – Shannonbridge 220 kV	226.5	472.9	269	174.7	Same as above
		Cashla – Ennis 110 kV	130.1	218.4	178	125.6	Same as above
		Agannygal – Shannonbridge 110kV	73.4	124.7	105	119.7	Same as above
		Maynooth – Shannonbridge 220 kV	160.2	364.1	269	139.8	Same as above
Cullenagh – Great Island 220kV	Cullenagh - Waterford 110kV	Killoternan – Waterford 110 kV	61.3	180.1	99	175.6	Additional capacity requirement
		Butlerstown - Cullenagh 110 kV	98.9	220	192	110.2	Additional capacity requirement
	Butlerstown - Cullenagh 110 kV	Cullenagh - Waterford 110kV	155.2	239.9	178	129.7	Additional capacity requirement
	Butlerstown – Killoternan 110kV	Cullenagh - Waterford 110kV	155.2	220	178	118.9	Same as above
	Killoternan – Waterford 110 kV	Cullenagh - Waterford 110kV	155.2	203.8	178	110.4	Same as above
Cullenagh - Waterford 110kV Ckt 1	Cullenagh – Great Island 220kV	Killoternan – Waterford 110 kV	88.3	180.1	99	175.7	Same as above
		Butlerstown - Cullenagh 110 kV	127.7	220	192	110.2	Same as above

Appendix 3 – Reactive support requirements

The needs assessment (Step 1) for CP0966 identified voltage stability problems. The requirement for reactive support has been analysed as part of the solution options to solve the voltage instability. The amount of reactive support required depends on how much additional demand connects on the East coast and how much of this demand is met by remote generation in the west and south west of Ireland.

To determine the amount of reactive support required for each of the solution options we used two criteria. The first criterion is to meet the need based on the assumptions set out in Step 1. In Step 1 the assumptions were for approximately 900 MW of additional demand in the counties Kildare, Meath and Dublin. This was based on executed and offered connection agreements at that point in time.

The second criterion is to meet further demand on the East coast that could materialise in the future. Ireland is currently experiencing an increased interest in connecting large scale demand on the East coast and the options were assessed based on their capability of accommodating this. Increased demand results in higher levels of reactive power load as well as higher power transfers particularly on the existing 400 kV lines, running from the west to the east. A transfer on the 400 kV circuits, running from the west to the east, of approximately 2200 MVA was modelled. With the generation assumptions in the analysis, this equates to approximately 1400 MW additional demand on the East coast. This target included the approximately 900 MW offered and executed demand connection agreements in Kildare, Meath and Dublin, leaving a margin of additional demand of 500 MW available. The 500 MW demand margin was deemed prudent for assessing the options against. It should be noted that this margin could be further increased using additional reactive support or generation in the eastern part of the network.

PV analysis was used to assess the impact that increasing power transfers would have on voltage stability. To test this, generation sources were increased in the west and south west to meet increasing demand on the East coast.

A three phase process was used in reactive support solution planning for each of the five network reinforcement options. These were:

1. Identify successive network limitations for increasing levels of power transfer;
2. Identify best performing solution locations;

3. Determine solution plan (total volumes needed applied to best performing locations) for specific demand and transfer levels.

The first phase increased power transfers until each successive network limitation is reached.As transfers are increased the voltage is pulled down until voltage collapse is reached. By monitoring the changes in reactive power draw on both lines and demand the locations and amounts of needed reactive support to restore voltage to the original condition can be identified. The shortages can then be addressed before increasing transfers again and repeating the process.

The second phase was a comparison of the effectiveness of different locations. Sources of reactive power are added to individual nodes in turn and power transfer levels recorded.

Finally, needed levels of reactive support were tested among multiple locations to determine the number of installations (at specific volumes) needed to reach certain power transfer levels.

It was found that the 400 kV underground cable option creates the most transfer margin. This is largely due to the characteristics of the cable which contributes reactive power to the network. A new 400 kV overhead line and 400 kV up-voltage options perform similarly relatively to each other but not as well as the 400 kV underground cable option. The 220 kV options create the least amount of transfer margin although the 220 kV underground cable option performs better than the 220 kV overhead line option.

Appendix 4 – Short Circuit Results

The following tables give the short circuit results for the options in the refined long list.

Appendix 4A – Base Case (no options)

			Maximum SC Study													
			3 phase							1 phase						
Node	Voltage	Minimum SC rating (kA)	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating
BELCAMP	110	25	31.1803	37.1	59%	13.7163	55%	15.2904	61%	28.7349	28.8829	46%	10.4918	42%	12.2533	49%
BELCAMP	220	40	12.7162	64.2	64%	25.3193	63%	24.4435	61%	10.1076	69.4607	69%	26.6196	67%	27.913	70%
CARRICKMINES	110	26.2	28.4771	36.8	56%	13.6772	52%	14.7078	56%	23.1081	38.291	58%	13.8676	53%	15.4724	59%
CARRICKMINES	220	40	11.5807	58.7	59%	23.352	58%	22.3836	56%	7.9824	64.483	64%	25.6306	64%	26.1775	65%
CORDUFF	110	31.5	9.0135	60.0	76%	24.6365	78%	22.4231	71%	10.6107	61.6596	78%	23.9622	76%	24.1859	77%
CORDUFF	220	40	14.7657	71.8	72%	27.9095	70%	27.8577	70%	12.5789	77.128	77%	28.8272	72%	31.3598	78%
DUNSTOWN	220	40	6.4771	56.8	57%	24.5458	61%	22.8455	57%	7.3921	59.3488	59%	24.3751	61%	24.7406	62%
DUNSTOWN	380	50	3.3873	22.2	18%	11.0126	22%	10.4704	21%	4.7403	24.0304	19%	10.8422	22%	10.8571	22%
FIN_URBAN	110	31.5	35.1347	41.1	52%	15.1491	48%	17.2004	55%	30.7021	49.4424	63%	17.5317	56%	20.9255	66%
FINGLAS	220	40	15.7452	71.0	71%	27.4208	69%	27.721	69%	14.4079	80.9408	81%	29.7034	74%	33.2687	83%
FIN_RURAL	110	31.5	33.5536	41.0	52%	15.1195	48%	16.626	53%	27.6828	42.938	55%	15.2016	48%	17.727	56%
INCH_CITY	110	31.5	27.4702	42.9	54%	15.9821	51%	16.9384	54%	24.0457	52.2014	66%	18.688	59%	21.0726	67%
INCHICORE	220	40	11.5125	71.3	71%	28.3977	71%	26.7213	67%	8.525	77.9185	78%	30.4334	76%	31.2784	78%
INCH_COUNTRY	110	31.5	41.6135	43.2	55%	15.7962	50%	18.5621	59%	31.8943	52.5002	67%	18.4288	59%	22.2607	71%
IRISHTOWN	220	40	12.6608	66.9	67%	26.38	66%	25.4547	64%	10.1359	76.1203	76%	29.0896	73%	30.5219	76%
WEST DUBLIN	110	31.5	21.7218	49.6	63%	18.7119	59%	18.9896	60%	23.1481	36.1966	46%	13.2998	42%	14.8023	47%
WEST DUBLIN	220	40	9.2593	67.5	68%	27.6122	69%	25.5237	64%	8.2956	63.4008	63%	25.2836	63%	25.8976	65%
MAYNOOTH A	110	31.5	10.0312	36.8	47%	14.8844	47%	14.0978	45%	10.782	43.5727	55%	17.0617	54%	17.2302	55%
MAYNOOTH B	220	40	7.9751	52.7	53%	22.0211	55%	20.7257	52%	8.6395	41.7766	42%	16.8651	42%	17.3238	43%
MAYNOOTH B	110	31.5	7.5459	45.2	57%	19.0466	60%	17.9487	57%	9.1639	43.0394	55%	17.2974	55%	17.3718	55%
MAYNOOTH A	220	40	8.4558	62.5	62%	25.8733	65%	24.3041	61%	8.5399	51.4654	51%	20.7365	52%	21.2811	53%
POOLBEG	110	40	26.3863	43.5	43%	16.2279	41%	17.0791	43%	21.0509	52.0708	52%	18.8395	47%	20.6432	52%
POOLBEG NORT	220	31.5	13.4914	63.0	80%	24.6709	78%	24.2277	77%	6.6883	54.9122	70%	22.5437	72%	22.7678	72%
POOLBEG	110	40	26.3536	43.4	43%	16.1917	40%	17.0366	43%	21.0388	51.975	52%	18.8059	47%	20.604	52%
POOLBEG SOUT	220	31.5	11.4261	65.5	83%	26.1067	83%	24.7517	79%	8.5567	66.4059	84%	26.1425	83%	26.8661	85%
SHELLYBANKS	220	40	13.1832	62.7	63%	24.639	62%	24.0663	60%	8.1554	60.0519	60%	23.8312	60%	24.3818	61%
SHELLYBANKS	220	40	12.3372	64.1	64%	25.3415	63%	24.3911	61%	8.83	70.6667	71%	27.5629	69%	28.4244	71%
SHELLYBANKSB	220	40	12.3372	64.1	64%	25.3415	63%	24.3911	61%	8.83	70.6667	71%	27.5629	69%	28.4244	71%
WOODLAND	220	40	11.5873	68.8	69%	27.4022	69%	27.0176	68%	11.7713	67.9009	68%	26.1832	65%	28.0447	70%
WOODLAND	380	40	13.2077	35.7	36%	14.0031	35%	13.0818	33%	13.441	37.1549	37%	14.2205	36%	14.2205	36%

Appendix 4B – Up-voltage existing 220 kV circuits to 400 kV OHL circuit

			Maximum SC Study														
			3 phase							1 phase						
Node	Voltage	Minimum SC rating (kA)	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating
BELCAMP	110	25	30.8	37.1	59%	12.6	51%	15.3	61%	28.6	28.9	46%	10.5	42%	12.3	49%
BELCAMP	220	40	12.4	64.8	65%	22.4	56%	24.6	61%	9.9	70.0	70%	26.9	67%	28.1	70%
CARRICKMINES	110	26.2	29.8	36.8	56%	12.3	47%	14.8	57%	23.7	38.3	58%	13.8	53%	15.5	59%
CARRICKMINES	220	40	12.5	58.5	58%	20.4	51%	22.4	56%	8.3	64.3	64%	25.4	63%	26.0	65%
CORDUFF	110	31.5	9.0	59.8	76%	22.2	71%	22.3	71%	10.6	61.6	78%	23.9	76%	24.1	77%
CORDUFF	220	40	14.4	72.9	73%	24.7	62%	28.1	70%	12.3	78.1	78%	29.2	73%	31.7	79%
DUNSTOWN	220	40	8.9	54.8	55%	20.9	52%	21.6	54%	9.2	59.6	60%	23.7	59%	24.5	61%
DUNSTOWN	380	50	5.1	33.0	26%	14.1	28%	14.1	28%	6.2	33.3	27%	14.3	29%	14.3	29%
FIN_URBAN	110	31.5	34.7	41.2	52%	13.7	43%	17.2	55%	30.4	49.6	63%	17.6	56%	20.9	66%
FINGLAS	220	40	15.3	71.8	72%	24.1	60%	27.9	70%	14.1	81.7	82%	30.0	75%	33.5	84%
FIN_RURAL	110	31.5	33.2	41.1	52%	13.2	42%	16.6	53%	27.5	43.0	55%	15.2	48%	17.7	56%
INCH_CITY	110	31.5	28.4	42.7	54%	14.2	45%	17.0	54%	24.7	52.0	66%	18.6	59%	21.1	67%
INCHICORE	220	40	12.4	70.0	70%	24.0	60%	26.4	66%	8.9	77.0	77%	29.8	75%	30.8	77%
INCH_COUNTRY	110	31.5	43.6	43.0	55%	13.9	44%	18.7	59%	32.9	52.4	66%	18.3	58%	22.3	71%
IRISHTOWN	220	40	13.6	66.3	66%	22.6	57%	25.4	64%	10.6	75.7	76%	28.7	72%	30.3	76%
WEST DUBLIN	110	31.5	22.1	48.9	62%	16.8	53%	18.7	59%	23.4	36.1	46%	13.2	42%	14.8	47%
WEST DUBLIN	220	40	9.8	64.5	65%	23.2	58%	24.4	61%	8.6	62.3	62%	24.7	62%	25.4	63%
MAYNOOTH A	110	31.5	9.8	36.0	46%	13.7	44%	13.8	44%	10.6	43.3	55%	16.9	54%	17.1	54%
MAYNOOTH B	220	40	8.4	47.0	47%	18.0	45%	18.5	46%	8.7	42.4	42%	17.1	43%	17.5	44%
MAYNOOTH B	110	31.5	7.4	44.2	56%	17.6	56%	17.6	56%	9.0	42.5	54%	17.1	54%	17.2	55%
MAYNOOTH A	220	40	8.5	54.3	54%	20.6	52%	21.2	53%	8.5	47.7	48%	19.2	48%	19.7	49%
POOLBEG	110	40	27.2	43.4	43%	14.5	36%	17.1	43%	21.5	52.0	52%	18.8	47%	20.6	52%
POOLBEG NORT	220	31.5	13.1	63.4	81%	21.8	69%	24.3	77%	6.6	55.2	70%	22.7	72%	22.9	73%
POOLBEG	110	40	27.1	43.3	43%	14.5	36%	17.1	43%	21.4	51.9	52%	18.7	47%	20.6	52%
POOLBEG SOUT	220	31.5	12.2	64.6	82%	22.4	71%	24.5	78%	8.9	65.8	84%	25.7	82%	26.6	84%
SHELLYBANKS	220	40	12.9	63.2	63%	21.8	55%	24.2	60%	8.0	60.4	60%	24.0	60%	24.5	61%
SHELLYBANKS	220	40	13.2	63.6	64%	21.9	55%	24.4	61%	9.2	70.3	70%	27.2	68%	28.2	71%
SHELLYBANKSB	220	40	13.2	63.6	64%	21.9	55%	24.4	61%	9.2	70.3	70%	27.2	68%	28.2	71%
WOODLAND	220	40	11.7	75.1	75%	27.2	68%	29.3	73%	11.7	74.1	74%	28.5	71%	30.5	76%
WOODLAND	380	40	11.4	44.2	44%	16.6	41%	17.7	44%	11.2	45.0	45%	17.6	44%	18.7	47%

Appendix 4C – New 400 kV OHL circuit

			Maximum SC Study														
			3 phase							1 phase						
Node	Voltage	Minimum SC rating (kA)	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating
BELCAMP	110	25	30.8	37.1	59%	12.6	50%	15.3	61%	28.5	28.9	46%	10.5	42%	12.2	49%
BELCAMP	220	40	12.5	64.3	64%	22.2	55%	24.4	61%	10.0	69.6	70%	26.7	67%	27.9	70%
CARRICKMINES	110	26.2	29.7	36.9	56%	12.4	47%	14.9	57%	23.7	38.4	59%	13.9	53%	15.6	59%
CARRICKMINES	220	40	12.3	59.4	59%	20.8	52%	22.8	57%	8.2	65.1	65%	25.8	64%	26.4	66%
CORDUFF	110	31.5	9.0	60.1	76%	22.3	71%	22.4	71%	10.6	61.8	79%	24.0	76%	24.3	77%
CORDUFF	220	40	14.4	72.1	72%	24.4	61%	27.8	70%	12.3	77.4	77%	29.0	72%	31.4	79%
DUNSTOWN	220	40	8.9	63.8	64%	24.2	60%	25.0	62%	9.2	64.8	65%	25.8	64%	26.6	67%
DUNSTOWN	380	50	5.2	34.0	27%	14.4	29%	14.4	29%	6.3	33.9	27%	14.4	29%	14.5	29%
FIN_URBAN	110	31.5	34.7	41.1	52%	13.7	43%	17.2	54%	30.4	49.5	63%	17.5	56%	20.9	66%
FINGLAS	220	40	15.3	71.1	71%	23.8	60%	27.6	69%	14.1	81.1	81%	29.8	75%	33.3	83%
FIN_RURAL	110	31.5	33.1	41.0	52%	13.2	42%	16.6	53%	27.5	43.0	55%	15.2	48%	17.7	56%
INCH_CITY	110	31.5	28.4	43.0	55%	14.3	46%	17.1	54%	24.6	52.3	66%	18.7	59%	21.2	67%
INCHICORE	220	40	12.1	71.9	72%	24.8	62%	27.1	68%	8.7	78.4	78%	30.5	76%	31.4	79%
INCH_COUNTRY	110	31.5	43.6	43.3	55%	14.0	44%	18.8	60%	32.8	52.6	67%	18.4	59%	22.4	71%
IRISHTOWN	220	40	13.4	67.6	68%	23.2	58%	25.9	65%	10.5	76.7	77%	29.2	73%	30.8	77%
WEST DUBLIN	110	31.5	22.5	49.8	63%	17.1	54%	19.2	61%	23.6	36.3	46%	13.3	42%	14.9	47%
WEST DUBLIN	220	40	9.7	68.2	68%	24.6	62%	25.8	64%	8.5	63.8	64%	25.3	63%	26.0	65%
MAYNOOTH A	110	31.5	10.2	36.9	47%	14.0	45%	14.1	45%	10.9	43.7	56%	17.1	54%	17.3	55%
MAYNOOTH B	220	40	8.5	53.7	54%	20.5	51%	21.1	53%	8.9	42.2	42%	16.9	42%	17.5	44%
MAYNOOTH B	110	31.5	7.6	45.3	57%	17.9	57%	18.0	57%	9.2	43.1	55%	17.3	55%	17.4	55%
MAYNOOTH A	220	40	8.7	62.7	63%	23.6	59%	24.4	61%	8.6	51.6	52%	20.8	52%	21.3	53%
POOLBEG	110	40	27.0	43.6	44%	14.6	37%	17.2	43%	21.3	52.2	52%	18.9	47%	20.7	52%
POOLBEG NORT	220	31.5	13.2	63.0	80%	21.7	69%	24.2	77%	6.6	55.0	70%	22.6	72%	22.8	72%
POOLBEG	110	40	26.9	43.5	43%	14.6	36%	17.1	43%	21.3	52.1	52%	18.8	47%	20.7	52%
POOLBEG SOUT	220	31.5	11.9	65.9	84%	23.0	73%	25.0	79%	8.7	66.7	85%	26.2	83%	27.0	86%
SHELLYBANKS	220	40	12.9	62.8	63%	21.7	54%	24.0	60%	8.1	60.1	60%	23.9	60%	24.4	61%
SHELLYBANKS	220	40	13.0	64.7	65%	22.3	56%	24.8	62%	9.1	71.1	71%	27.7	69%	28.6	72%
SHELLYBANKSB	220	40	13.0	64.7	65%	22.3	56%	24.8	62%	9.1	71.1	71%	27.7	69%	28.6	72%
WOODLAND	220	40	11.3	70.7	71%	25.8	64%	27.6	69%	11.5	69.7	70%	26.9	67%	28.7	72%
WOODLAND	380	40	11.2	43.6	44%	16.4	41%	17.5	44%	11.0	44.5	45%	17.5	44%	18.5	46%

Appendix 4D – New 220 kV OHL circuit

			Maximum SC Study													
			3 phase							1 phase						
Node	Voltage	Minimum SC rating (kA)	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating
BELCAMP	110	25	30.825	37.1	59%	12.6218	50%	15.2714	61%	28.5613	28.8996	46%	10.5016	42%	12.2472	49%
BELCAMP	220	40	12.4403	64.5	65%	22.2537	56%	24.4775	61%	9.9574	69.682	70%	26.7547	67%	27.9963	70%
CARRICKMINES	110	26.2	29.1006	36.9	56%	12.3973	47%	14.8531	57%	23.3823	38.3671	59%	13.8943	53%	15.5395	59%
CARRICKMINES	220	40	11.8373	60.0	60%	21.1744	53%	22.9858	57%	8.0422	65.5422	66%	26.0493	65%	26.6204	67%
CORDUFF	110	31.5	9.0008	60.1	76%	22.3678	71%	22.4699	71%	10.6009	61.7684	78%	24.0071	76%	24.2302	77%
CORDUFF	220	40	14.3622	72.3	72%	24.5213	61%	27.9187	70%	12.3393	77.5534	78%	29.042	73%	31.4776	79%
DUNSTOWN	220	40	7.2744	67.2	67%	26.1166	65%	26.5264	66%	7.7357	71.2101	71%	28.961	72%	29.4874	74%
DUNSTOWN	380	50	3.6449	23.5	19%	10.874	22%	10.8762	22%	5.0652	25.3181	20%	11.2645	23%	11.288	23%
FIN_URBAN	110	31.5	34.7096	41.2	52%	13.6672	43%	17.1759	55%	30.4208	49.4914	63%	17.5584	56%	20.9097	66%
FINGLAS	220	40	15.3211	71.3	71%	23.9198	60%	27.7227	69%	14.1102	81.2821	81%	29.8854	75%	33.3197	83%
FIN_RURAL	110	31.5	33.153	41.0	52%	13.2242	42%	16.6008	53%	27.4675	42.9733	55%	15.2219	48%	17.7169	56%
INCH_CITY	110	31.5	27.9339	43.1	55%	14.382	46%	17.0867	54%	24.313	52.3919	67%	18.7528	60%	21.196	67%
INCHICORE	220	40	11.7297	72.4	72%	25.0421	63%	27.2197	68%	8.5863	78.7872	79%	30.7651	77%	31.6404	79%
INCH_COUNTRY	110	31.5	42.7044	43.3	55%	14.0395	45%	18.7601	60%	32.376	52.6815	67%	18.4883	59%	22.4126	71%
IRISHTOWN	220	40	12.9236	68.1	68%	23.4604	59%	26.0141	65%	10.2361	77.1191	77%	29.4634	74%	30.9551	77%
WEST DUBLIN	110	31.5	22.1937	50.0	63%	17.1946	55%	19.2178	61%	23.4052	36.3901	46%	13.3654	42%	14.9092	47%
WEST DUBLIN	220	40	9.4412	68.7	69%	24.8913	62%	25.9989	65%	8.3754	64.1361	64%	25.5551	64%	26.1975	65%
MAYNOOTH A	110	31.5	10.1503	37.1	47%	14.1142	45%	14.2266	45%	10.8902	43.9439	56%	17.1908	55%	17.3685	55%
MAYNOOTH B	220	40	8.2069	54.3	54%	20.8124	52%	21.3397	53%	8.7827	42.5562	43%	17.1469	43%	17.6409	44%
MAYNOOTH B	110	31.5	7.5652	45.4	58%	17.9892	57%	18.0156	57%	9.1816	43.1988	55%	17.3572	55%	17.4326	55%
MAYNOOTH A	220	40	8.5611	63.2	63%	23.8563	60%	24.5742	61%	8.5962	51.8818	52%	20.8885	52%	21.4501	54%
POOLBEG	110	40	26.6733	43.6	44%	14.6562	37%	17.1828	43%	21.1821	52.2076	52%	18.8882	47%	20.721	52%
POOLBEG NORT	220	31.5	13.1903	63.1	80%	21.7529	69%	24.2243	77%	6.6226	55.0104	70%	22.6233	72%	22.838	73%
POOLBEG	110	40	26.6393	43.5	44%	14.6246	37%	17.1398	43%	21.1696	52.1113	52%	18.8543	47%	20.6814	52%
POOLBEG SOUT	220	31.5	11.5833	66.3	84%	23.2114	74%	25.126	80%	8.5975	66.9645	85%	26.3627	84%	27.1041	86%
SHELLYBANKS	220	40	12.8965	62.9	63%	21.7247	54%	24.0691	60%	8.0608	60.1737	60%	23.9217	60%	24.4502	61%
SHELLYBANKS	220	40	12.5633	65.2	65%	22.6034	57%	24.8889	62%	8.8867	71.509	72%	27.8928	70%	28.7828	72%
SHELLYBANKSB	220	40	12.5633	65.2	65%	22.6034	57%	24.8889	62%	8.8867	71.509	72%	27.8928	70%	28.7828	72%
WOODLAND	220	40	11.1551	72.0	72%	26.2557	66%	28.0789	70%	11.5596	70.5813	71%	27.2393	68%	29.0906	73%
WOODLAND	380	40	13.6818	41.2	41%	15.2224	38%	16.8538	42%	13.8622	43.1949	43%	16.5376	41%	18.2372	46%

Appendix 4E – New 220 kV UGC

			Maximum SC Study													
			3 phase							1 phase						
Node	Voltage	Minimum SC rating (kA)	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating
BELCAMP	110	25	30.825	37.1	59%	12.6218	50%	15.2714	61%	28.5613	28.8996	46%	10.5016	42%	12.2472	49%
BELCAMP	220	40	12.4403	64.5	65%	22.2537	56%	24.4775	61%	9.9574	69.682	70%	26.7547	67%	27.9963	70%
CARRICKMINES	110	26.2	29.1006	36.9	56%	12.3973	47%	14.8531	57%	23.3823	38.3671	59%	13.8943	53%	15.5395	59%
CARRICKMINES	220	40	11.8373	60.0	60%	21.1744	53%	22.9858	57%	8.0422	65.5422	66%	26.0493	65%	26.6204	67%
CORDUFF	110	31.5	9.0008	60.1	76%	22.3678	71%	22.4699	71%	10.6009	61.7684	78%	24.0071	76%	24.2302	77%
CORDUFF	220	40	14.3622	72.3	72%	24.5213	61%	27.9187	70%	12.3393	77.5534	78%	29.042	73%	31.4776	79%
DUNSTOWN	220	40	7.2744	67.2	67%	26.1166	65%	26.5264	66%	7.7357	71.2101	71%	28.961	72%	29.4874	74%
DUNSTOWN	380	50	3.6449	23.5	19%	10.874	22%	10.8762	22%	5.0652	25.3181	20%	11.2645	23%	11.288	23%
FIN_URBAN	110	31.5	34.7096	41.2	52%	13.6672	43%	17.1759	55%	30.4208	49.4914	63%	17.5584	56%	20.9097	66%
FINGLAS	220	40	15.3211	71.3	71%	23.9198	60%	27.7227	69%	14.1102	81.2821	81%	29.8854	75%	33.3197	83%
FIN_RURAL	110	31.5	33.153	41.0	52%	13.2242	42%	16.6008	53%	27.4675	42.9733	55%	15.2219	48%	17.7169	56%
INCH_CITY	110	31.5	27.9339	43.1	55%	14.382	46%	17.0867	54%	24.313	52.3919	67%	18.7528	60%	21.196	67%
INCHICORE	220	40	11.7297	72.4	72%	25.0421	63%	27.2197	68%	8.5863	78.7872	79%	30.7651	77%	31.6404	79%
INCH_COUNTRY	110	31.5	42.7044	43.3	55%	14.0395	45%	18.7601	60%	32.376	52.6815	67%	18.4883	59%	22.4126	71%
IRISHTOWN	220	40	12.9236	68.1	68%	23.4604	59%	26.0141	65%	10.2361	77.1191	77%	29.4634	74%	30.9551	77%
WEST DUBLIN	110	31.5	22.1937	50.0	63%	17.1946	55%	19.2178	61%	23.4052	36.3901	46%	13.3654	42%	14.9092	47%
WEST DUBLIN	220	40	9.4412	68.7	69%	24.8913	62%	25.9989	65%	8.3754	64.1361	64%	25.5551	64%	26.1975	65%
MAYNOOTH A	110	31.5	10.1503	37.1	47%	14.1142	45%	14.2266	45%	10.8902	43.9439	56%	17.1908	55%	17.3685	55%
MAYNOOTH B	220	40	8.2069	54.3	54%	20.8124	52%	21.3397	53%	8.7827	42.5562	43%	17.1469	43%	17.6409	44%
MAYNOOTH B	110	31.5	7.5652	45.4	58%	17.9892	57%	18.0156	57%	9.1816	43.1988	55%	17.3572	55%	17.4326	55%
MAYNOOTH A	220	40	8.5611	63.2	63%	23.8563	60%	24.5742	61%	8.5962	51.8818	52%	20.8885	52%	21.4501	54%
POOLBEG	110	40	26.6733	43.6	44%	14.6562	37%	17.1828	43%	21.1821	52.2076	52%	18.8882	47%	20.721	52%
POOLBEG NORT	220	31.5	13.1903	63.1	80%	21.7529	69%	24.2243	77%	6.6226	55.0104	70%	22.6233	72%	22.838	73%
POOLBEG	110	40	26.6393	43.5	44%	14.6246	37%	17.1398	43%	21.1696	52.1113	52%	18.8543	47%	20.6814	52%
POOLBEG SOUT	220	31.5	11.5833	66.3	84%	23.2114	74%	25.126	80%	8.5975	66.9645	85%	26.3627	84%	27.1041	86%
SHELLYBANKS	220	40	12.8965	62.9	63%	21.7247	54%	24.0691	60%	8.0608	60.1737	60%	23.9217	60%	24.4502	61%
SHELLYBANKS	220	40	12.5633	65.2	65%	22.6034	57%	24.8889	62%	8.8867	71.509	72%	27.8928	70%	28.7828	72%
SHELLYBANKSB	220	40	12.5633	65.2	65%	22.6034	57%	24.8889	62%	8.8867	71.509	72%	27.8928	70%	28.7828	72%
WOODLAND	220	40	11.1551	72.0	72%	26.2557	66%	28.0789	70%	11.5596	70.5813	71%	27.2393	68%	29.0906	73%
WOODLAND	380	40	13.6818	41.2	41%	15.2224	38%	16.8538	42%	13.8622	43.1949	43%	16.5376	41%	18.2372	46%

Appendix 4F – New 400 kV UGC circuit

			Maximum SC Study													
			3 phase							1 phase						
Node	Voltage	Minimum SC rating (kA)	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating	X/R	Peak Make	% of rating	RMS AC Break	% of rating	TOT RMS Break	% of rating
BELCAMP	110	25	30.7	37.1	59%	12.6	50%	15.2	61%	28.5	28.9	46%	10.5	42%	12.2	49%
BELCAMP	220	40	12.4	64.3	64%	22.2	55%	24.4	61%	9.9	69.6	70%	26.7	67%	27.9	70%
CARRICKMINES	110	26.2	30.0	36.9	56%	12.4	47%	14.9	57%	23.8	38.3	58%	13.9	53%	15.6	59%
CARRICKMINES	220	40	12.4	59.8	60%	21.0	52%	23.0	58%	8.3	65.4	65%	25.9	65%	26.5	66%
CORDUFF	110	31.5	9.0	60.1	76%	22.3	71%	22.4	71%	10.6	61.8	78%	24.0	76%	24.2	77%
CORDUFF	220	40	14.3	72.1	72%	24.4	61%	27.8	69%	12.3	77.4	77%	29.0	73%	31.4	79%
DUNSTOWN	220	40	9.4	65.6	66%	24.6	62%	25.6	64%	9.7	66.5	67%	26.3	66%	27.3	68%
DUNSTOWN	380	50	5.6	37.7	30%	15.7	31%	15.7	31%	6.9	38.2	31%	16.0	32%	16.1	32%
FIN_URBAN	110	31.5	34.6	41.1	52%	13.7	43%	17.1	54%	30.3	49.5	63%	17.5	56%	20.9	66%
FINGLAS	220	40	15.2	71.1	71%	23.8	60%	27.6	69%	14.0	81.1	81%	29.8	75%	33.2	83%
FIN_RURAL	110	31.5	33.0	41.0	52%	13.2	42%	16.6	53%	27.4	43.0	55%	15.2	48%	17.7	56%
INCH_CITY	110	31.5	28.5	43.1	55%	14.3	46%	17.1	54%	24.7	52.3	66%	18.7	59%	21.2	67%
INCHICORE	220	40	12.2	72.2	72%	24.8	62%	27.2	68%	8.8	78.6	79%	30.6	76%	31.5	79%
INCH_COUNTRY	110	31.5	43.9	43.3	55%	14.0	44%	18.9	60%	32.9	52.6	67%	18.4	59%	22.5	71%
IRISHTOWN	220	40	13.5	67.9	68%	23.3	58%	26.1	65%	10.5	76.9	77%	29.3	73%	30.9	77%
WEST DUBLIN	110	31.5	22.7	49.9	63%	17.1	54%	19.2	61%	23.7	36.4	46%	13.3	42%	14.9	47%
WEST DUBLIN	220	40	9.8	68.4	68%	24.7	62%	25.9	65%	8.5	64.0	64%	25.4	64%	26.1	65%
MAYNOOTH A	110	31.5	10.2	37.1	47%	14.1	45%	14.2	45%	11.0	43.9	56%	17.1	54%	17.3	55%
MAYNOOTH B	220	40	8.6	54.0	54%	20.5	51%	21.2	53%	9.0	42.4	42%	17.0	43%	17.6	44%
MAYNOOTH B	110	31.5	7.6	45.4	58%	18.0	57%	18.0	57%	9.2	43.2	55%	17.3	55%	17.4	55%
MAYNOOTH A	220	40	8.7	62.9	63%	23.7	59%	24.4	61%	8.7	51.8	52%	20.8	52%	21.4	53%
POOLBEG	110	40	27.1	43.6	44%	14.6	37%	17.2	43%	21.4	52.2	52%	18.9	47%	20.7	52%
POOLBEG NORT	220	31.5	13.1	63.0	80%	21.7	69%	24.1	77%	6.6	54.9	70%	22.6	72%	22.8	72%
POOLBEG	110	40	27.1	43.5	43%	14.6	36%	17.2	43%	21.4	52.1	52%	18.8	47%	20.7	52%
POOLBEG SOUT	220	31.5	12.0	66.2	84%	23.0	73%	25.1	80%	8.7	66.8	85%	26.2	83%	27.0	86%
SHELLYBANKS	220	40	12.8	62.8	63%	21.7	54%	24.0	60%	8.0	60.1	60%	23.9	60%	24.4	61%
SHELLYBANKS	220	40	13.1	65.0	65%	22.4	56%	24.9	62%	9.1	71.4	71%	27.7	69%	28.7	72%
SHELLYBANKSB	220	40	13.1	65.0	65%	22.4	56%	24.9	62%	9.1	71.4	71%	27.7	69%	28.7	72%
WOODLAND	220	40	11.1	71.1	71%	25.9	65%	27.7	69%	11.5	70.4	70%	27.2	68%	29.0	72%
WOODLAND	380	40	9.5	44.9	45%	17.1	43%	17.8	44%	10.2	46.7	47%	18.4	46%	19.3	48%

Appendix 4G – Summary of general short circuit level trends observed at main buses

The following table gives the short circuit levels at a number of buses for the various options. These values are expressed as a percentage of the lowest rated short circuit value of equipment in the station. A large red arrow beside a table row indicates that the short circuit levels increased on all indicated buses in relation to the base case. For the row related to the up-voltage option the small black downward arrows indicate that short circuit levels decreased on those buses, and similarly the small red upward arrow indicates the short circuit levels increased in relation to the base case.

Bus	Inchicore	Maynooth A 220	Maynooth B 220	Dunstown 220	Dunstown 380	Woodland 220	Woodland 380	
Base case	71%	62%	53%	57%	18%	69%	36%	
Upvoltage existing circuits to 400 kV	70% ↓	54% ↓	47% ↓	55% ↓	↑ 26%	↑ 75%	↑ 44%	
New Dunstown-Woodland 400 kV OHL	72%	63%	54%	64%	27%	71%	44%	}↑
New Dunstown-Woodland 220 kV OHL	72%	63%	54%	67%	19%	72%	41%	}↑
New Dunstown-Woodland 220 kV UGC & Split Woodland	72%	63%	54%	67%	19%	72%	41%	}↑
New Dunstown-Woodland 400 kV UGC	72%	63%	54%	66%	30%	71%	45%	}↑

Step 3A - Emerging Best Performing Technology Options Report (October 2020)

Step 3
Emerging Best Performing Option Report

The Kildare-Meath Grid Upgrade

Capital Project 966

October 2020

EIRGRID

Revision Table:

Revision	Issue Date	Description
01	5 October 2020	Emerging Best Performing Option Report in Step 3

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1 Table of Contents

2 Introduction

The Kildare Meath Grid Upgrade (Capital Project 966) is a proposed reinforcement project of the electricity network between Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. The project is essential to enable the further integration of renewable energy in line with Government Policy ambitions. It will further be a key enabler in meeting the growing demand for electricity in the eastern part of the country. This report describes the outcome of various assessments with regard to identified options for the project. It presents the results that underpin the identified emerging best performing option.

EirGrid follows a six step approach when we develop and implement a solution to any identified transmission network problem. This six step approach is described in the document 'Have Your Say' published on EirGrid's website[1]. The six steps are shown at a high-level in Figure 1. Each step has a distinct purpose with defined deliverables.

Figure 1 *High level description of Project Development Process*

In Step 2, this project was publicly referred to as Capital Project 966, given that the geographical area of the project had not been confirmed at that stage. The name "The Kildare-Meath Grid Upgrade" is now being used in all external engagement material for this project, due to all project options being located within these counties. The aim of the project title update is to provide a greater level of geographical association for stakeholders with where it will be located. Capital Project 966 will still be retained as the official technical project name and is therefore the term used in this report.

[1] http://www.eirgridgroup.com/the-grid/have-your-say/

At the time of writing, Capital Project 966 (The Kildare - Meath Grid Upgrade) is in Step 3.

The activities and process followed in Step 3 are described in Section 4. The Kildare - Meath Grid Upgrade is nearing the end of Step 3. The remaining Step 3 process activities reference some terminology which will be used throughout this report. For clarity, these terminologies and expressions are introduced and listed below:

- Emerging Best Performing Option (EBPO)
  This is the option or options that emerge in Step 3 after the five criteria have been assessed. It will be announced at the start of the consultation period.
- Public consultation on EBPO
  A consultation period lasting 10 weeks will be held on the process followed and the EBPO. This provides for public participation and stakeholder engagement in the decision-making process. It allows for stakeholders and communities to be informed about the EBPO and any possible alternatives.
- Consideration of feedback
  The feedback received throughout the consultation period will be carefully considered and will inform selection of the Best Performing Option.
- Best Performing Option (BPO)
  This is the option which will be taken forward into Step 4 for further investigation and development into a proposal that will be the subject of consenting of the relevant consenting authority and further on toward detailed design, construction and energisation.

2.1 External professional assistance with the assessment

In Step 3 we assess the options against five criteria and these are described further in section 4. The assessments and investigations in relation to the environmental criterion and socio-economic criterion as well as some technical feasibility studies have been carried out by external parties. Where relevant, this is highlighted in this report and the referenced reports are named and a summary of the findings is presented.

Jacobs[2] assessed the environmental criterion and socio-economic criterion and also conducted certain technical feasibility studies. PSC[3] carried out the technical cable integration study. The detailed assessment reports can be found on our website[4].

[2] Jacobs Ireland Ltd
[3] PSC Ireland
[4] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/

3 The Project

3.1 Confirmation of the Need

Capital Project 966 is a proposed electricity transmission development project that will help transfer electricity to the east of the country and distribute it within the network in Counties Meath, Kildare and Dublin. It involves a suite of transmission network reinforcements centred on strengthening the network between the existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath, with some dynamic reactive devices also required to support the voltage.

This project is in Step 3 of our six step approach and the reports from previous steps provide background to how we reached the conclusion that strengthening the electricity network between Dunstown and Woodland 400 kV stations and adding dynamic reactive devices is the most efficient way to avoid capacity and voltage problems in the electricity transmission grid in the future.

This section provides a summary of the need and the detailed report is available on our website[5] together with reports from previous steps.

In Step 3, we updated our assumptions to be in-line with Tomorrow's Energy Scenarios (TES) 2019[6] and carried out a set of studies to re-confirm the need. The need is based on two drivers, namely integration of generation and an increase in demand on the east coast. The review indicates that the previously identified drivers still remain and have further increased the need to strengthen the transmission network between Dunstown and Woodland stations, and that the need for the reinforcement is still robust.

The project is essential to enable the further integration of renewable energy in line with Government policy ambitions. It will further be a key enabler in meeting the growing demand for electricity in the east region, by improving the capacity of the network in this region. This forecasted growth within the region is due to increased economic activity and the planned connection of new large scale energy users.

A significant number of Ireland's electricity generators are located in the south and south west regions of the country. This is where many wind farms and some modern, conventional generators are located. This power needs to be transported to where it is

[5] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

[6] Tomorrows Energy Scenarios (TES 2019) presents credible pathways for Ireland's clean energy transition with specific focus on what this means for the electricity transmission system over the next twenty years. The report is available on our website http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-TES-2019-Report.pdf

used. This need is also present when planned offshore wind generation facilities connect on the East coast. The Government's Climate Action Plan sets a target to connect 3.5 GW of offshore wind by 2030. This is more than three times the peak demand in the East Coast today. Once connected to the transmission system, this offshore power will have to be transported around the network to where it is used. The need associated with this offshore wind on the East coast is indicated in the TES System Needs Assessment.

When the transmission system is experiencing these generation and demand patterns, the system analysis indicates that the network experiences significant violations of the Transmission System Security and Planning Standards (TSSPS). The TSSPS is the standard the transmission network should adhere to so that a reliable and secure electricity system can be provided for all customers in Ireland.

The violations occur for the unplanned loss of any of the existing 400 kV circuits between Moneypoint 400 kV station in County Clare and Dunstown 400 kV in County Kildare and Woodland 400 kV station in County Meath in the East. The unplanned loss of one of number of 220 kV circuits running in parallel with these 400 kV circuits has the same effect.

3.2 Options considered

All options involve a suite of transmission network reinforcements centred on strengthening the network between the existing Dunstown 400 kV station in County Kildare and the Woodland 400 kV station in County Meath.

Four solution options were brought forward from Step 2[7] for more detailed analysis in Step 3. They represent three different technologies, namely:

- Overhead line (OHL);
- Underground cable (UGC); and
- A new technology which would involve an increase in the operating voltage of existing 220 kV circuits, called an up-voltage of existing 220 kV towers.

As described in the document 'Have Your Say' published on EirGrid's website, EirGrid has committed to bringing an equivalent cable option forward if an OHL option is the best performing option. In Step 2, there was uncertainty about the technical performance in relation to long high voltage UGC options. A 220 kV UCG was brought forward to Step 3, despite not performing as well technically as the other options in Step 2 because a long

[7] For details of Step 2 outcome and documents please refer to our website. http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

220 kV cable is known to create fewer technical issues compared to long 400 kV cables. Studies in Step 3 confirmed that all identified cable options were technically feasible for this reinforcement.

In Step 3, due to the nature of the UGC options and their ability to meet the technical criteria, a number of variations of UGC have been investigated to provide a broader view of their impact on all of the assessment criteria. The variations are presented as sub-options under Option 3.

With the additional UGC variations, the total number of options investigated in Step 3 is five:

1. Option 1: Up-voltage existing 220 kV OHL circuits
    - Using a new technology which would enable two existing 220 kV circuits connecting to Dunstown and Woodland stations to be modified, primarily by means of replacing existing 220 kV conductors (and associated tower structures if necessary) with 400 kV conductors to create a new Dunstown – Woodland 400 kV circuit.
    - The circuits selected to achieve this are the Gorman – Maynooth 220 kV circuit and the Dunstown – Maynooth 2 220 kV circuit.
2. Option 2: New 400 kV OHL circuit
3. Option 3: New UGC circuit;
    - Option 3A: 220 kV UGC;
    - Option 3B: 400 kV UGC: one circuit constructed along one route;
    - Option 3C: 400 kV UGC:
        i. Sub Option 3Ci: two circuits constructed along one route;
        ii. Sub Option 3Cii: two circuits constructed along two separate routes.

During Step 3, Option 3Ci was determined to be not feasible in the Cable Feasibility Report (Report Number 321084AE-REP-001). The reason was that the trench width, required to meet the standard capacity of a 400 kV circuit, far exceeded the width of the existing road network in the study area. It was therefore not considered further in this assessment. The remaining Option 3Cii will be called Option 3C in the report hereafter.

3.3 Project Study Area

The Project Study Area is defined as the area investigated for the possible installation of any of the options in Step 3. This study area is based on the study area identified in Step 2[8]

As part of this Step of the project (Step 3), the Project Study Area has been further refined by considering a wide variety of factors. These included technical requirements of the project, road network presence, settlements, presence of existing electrical utilities, physical constraints e.g. motorway, river or rail crossings and some environmental constraints. In particular, the Project Study Area has been confined to the west by peatlands and likely difficulties with construction and environmental protection in these areas, and to the east by the western edge of the conurbations surrounding Dublin.

The current Project Study Area is smaller than the Step 2 Study Area, but is still large enough for the examination of feasible options for the project. To ensure that a comprehensive and accurate environmental and social appraisal is carried out, a wider perspective is often needed for particular topics of relevancy (e.g. Natura 2000 Sites which may be located beyond the study area but are connected). The assessment of the project will cover all likely significant environmental impacts whether they occur inside the study areas or outside of it.

Figure 2 shows the Project Study Area for Capital Project 966. This study area is of sufficient size to accommodate Options 2, 3A, 3B and 3C. The study area for Option 1, the up-voltage of existing 220 kV circuits to 400 kV, is more refined, given that it focuses on specific existing OHL alignments. The Study Area for Option 1 is illustrated in Figure 3.

[8] The study area for Step 2 is shown in our project brochure from Spring 2019. http://www.eirgridgroup.com/site-files/library/EirGrid/Capital-Project-966-Brochure-Spring-2019.pdf

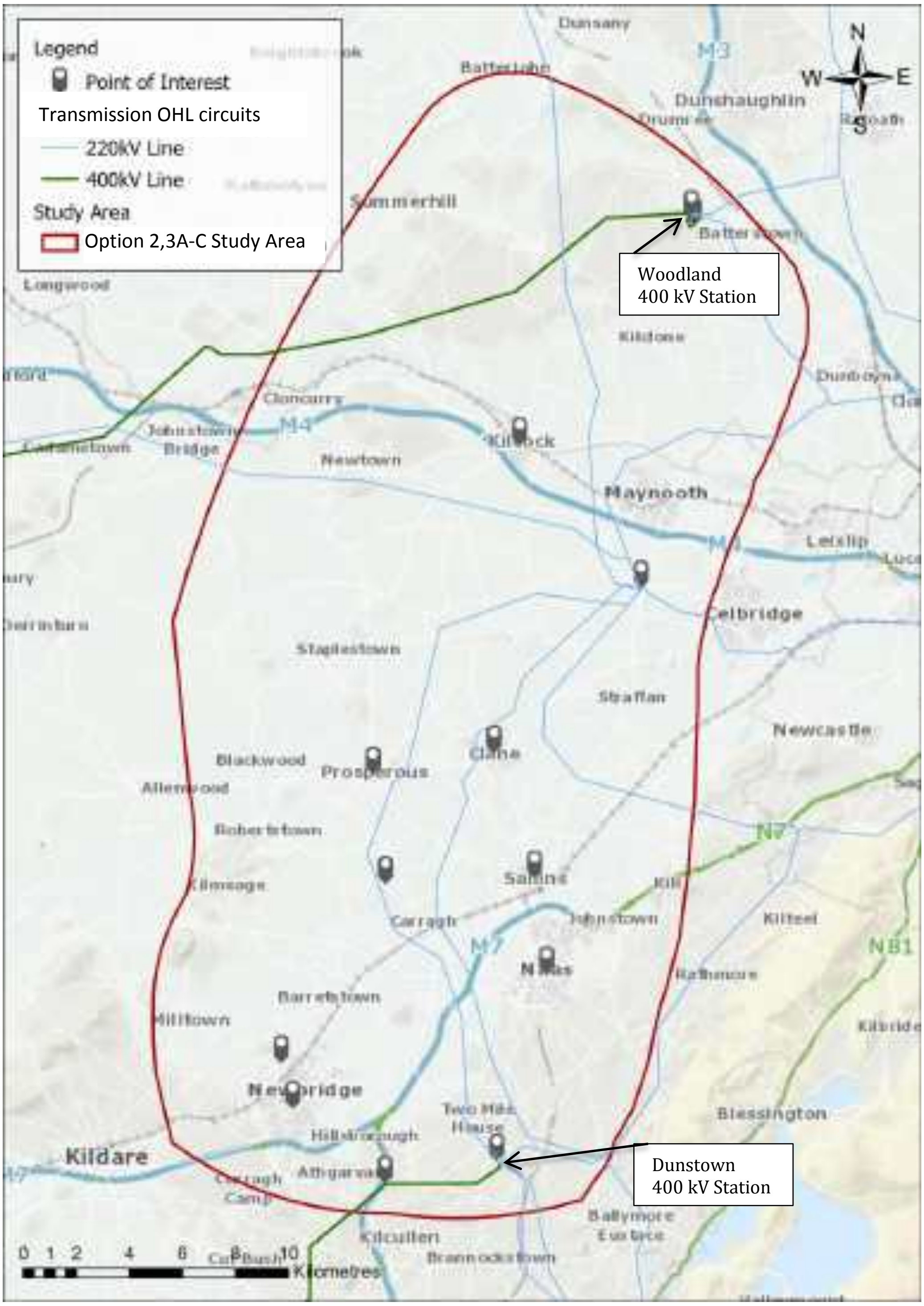

Figure 2 *Illustrative map showing the project study area in Step 3 for options 2, 3A, 3B and 3C.*

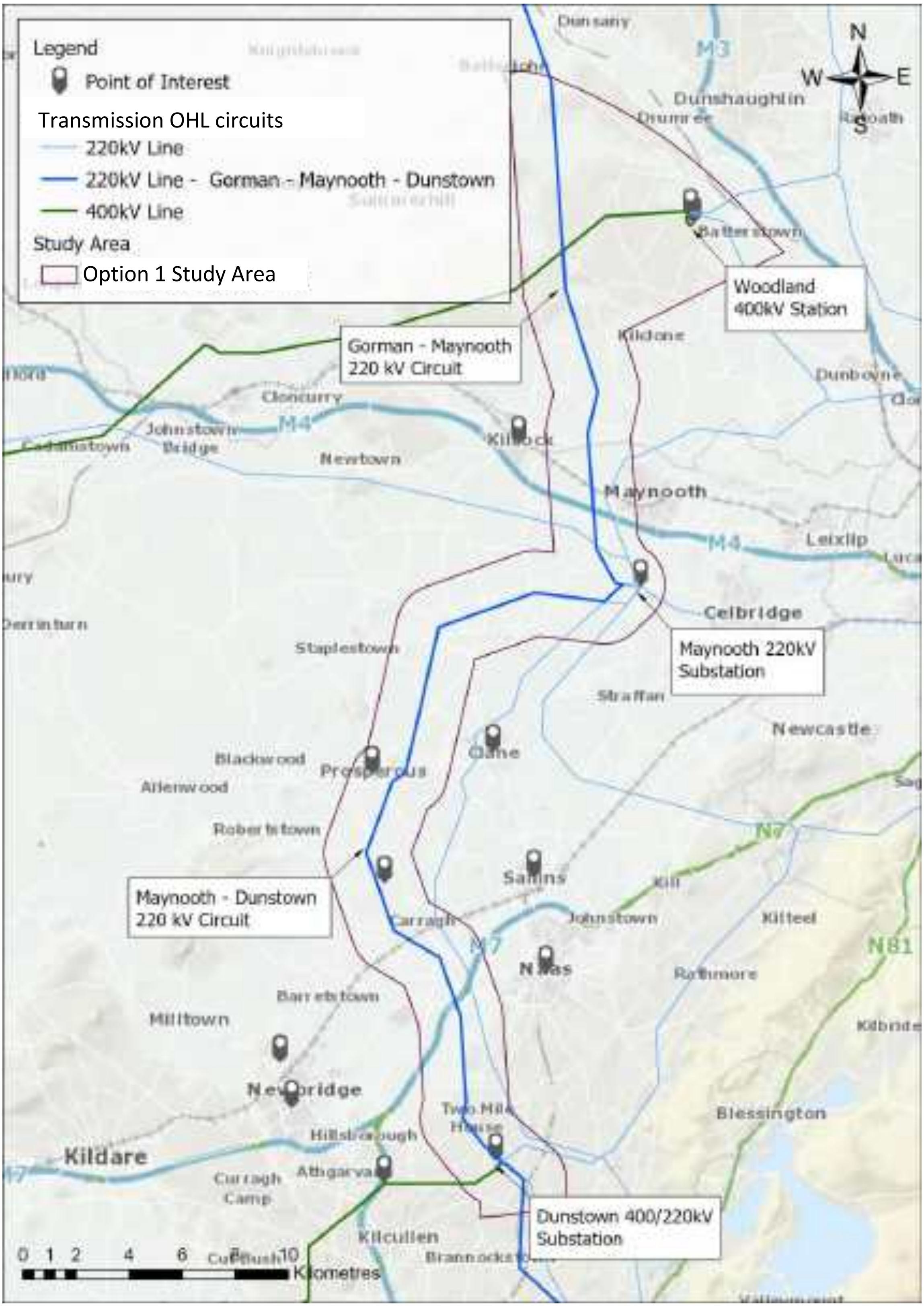

Figure 3 *Illustrative map showing the study area for Option 1 in Step 3.*

3.4 Stakeholder Engagement

3.4.1 Project complexity

In general, every grid development project is of a different scale and / or complexity, with no two projects being identical. To reflect the uniqueness of each project, the six-step Framework for Grid Development introduced three categories of projects, called Tiers. The Tier of a project indicates the considered required level of governance, external consultation and engagement, social impact assessment and analysis for a project.

Capital Project 966 is considered to be Tier 3 which is the most complex category. This assessment of the Tier is based on the most complex identified option, which in this case is a new linear project. New linear projects have the potential to traverse many different stakeholders, and as such, increase the number of stakeholders that need to be considered. As well as this, the potential impact on communities and the environment also requires significant investigations and consideration. For this reason, this project has been assigned a Tier 3 designation.

3.4.2 Stakeholder engagement activities

The aim of stakeholder engagement in Step 3 is to transparently communicate our findings so far in the project to key stakeholders and to ensure opportunities for public participation in the development of the project. In particular, this comprises receiving and taking on board feedback on the assessment and emerging conclusions, which will then inform EirGrid's decision-making prior to announcement of a Best Performing Option.

In order to ensure appropriate stakeholder feedback and inform our decision-making process during Step 3 on Capital Project 966, EirGrid has identified key strategic stakeholders in the study area. This engagement has enabled us to understand the spatial and economic planning that is underway at local and regional authority level, as well as the potential requirements for future investments by large energy users in the area. It has also allowed us to brief key stakeholders in the area, and to garner their views regarding the opportunities and challenges that exist for the project, as well as to receive feedback which will inform identification of the best performing option.

The stakeholder engagement for Capital Project 966 in Step 3 is divided into two phases: an information phase and a public consultation phase.

In the information phase, we have informed and engaged with relevant regional and national stakeholders such as Government Departments, Meath County Council, Kildare County Council, Elected Representatives, the IDA, the Eastern and Midlands Regional Assembly, Chambers of Commerce, Public Participation Networks and the Irish Farmers'

Association. This phase also included an information campaign in local newspapers and radio, video animation for social media awareness raising, the publication of investigative reports and technical assessments, an online interactive map and a webinar. This phase covered the period between 20 July and 5 October 2020.

At the end of the information phase, the Emerging Best Performing Option (EBPO) will be announced and a 10 week consultation period will commence. The feedback from this consultation will be collected and taken on board in the decision making process before the identification of the Best Performing Option (BPO) in early 2021.

4 Process followed and criteria

4.1 Description of process

This report details the outcomes of the assessments undertaken in Step 3. In Step 3, the options presented in Section 3.2 are investigated in more detail in order to identify an Emerging Best Performing Option (EBPO) to meet the identified need for the project. Each option is assessed against five criteria. A multi-criteria performance matrix is used to compare the options against each other.

As noted in Section 3, the EBPO will be announced at the start of the consultation period. The process provides for public participation and stakeholder engagement in the decision-making process; in addition to all the consultation and engagement that has occurred on the project to date[9], there occurs a specific period of consultation and engagement on the EBPO. Any feedback received during this consultation period will be carefully considered and will inform identification of the Best Performing Option (BPO) for the project.

In accordance with our six step approach, the BPO will be developed further in Step 4. It will then be the subject of a planning application in Step 5. In the event that the application is consented by the relevant consenting authority, the permitted development will be subject to detailed design, construction and energisation.

4.2 Criteria used for comparison of options

In Step 3, we consider a broad assessment of performance for each of the identified options. The broad assessment considers five different criteria that ensure that the full range of impacts and benefits of each option can be appropriately understood. .

These criteria are:

- Technical performance;
- Economic performance;
- Environmental aspects;
- Deliverability aspects; and
- Socio-economic aspects.

[9] A 10-week consultation period was held at the end of Step 2 (November 2018 to February 2019). This gathered feedback on the five technology options. No technology options were removed or added as a result of the consultation. Most of the responses declared a preference for either the underground option or the uprate option. More information can be found in our project brochure from Spring 2019. http://www.eirgridgroup.com/site-files/library/EirGrid/Capital-Project-966-Brochure-Spring-2019.pdf

Descriptions of the five criteria are provided below. The assessments undertaken for each option in Step 3 are for comparative purposes between the options and are not absolute assessments of the individual options.

4.2.1 Technical performance criteria

The technical performance criterion includes seven sub-criteria. Descriptions of these are provided below.

- Compliance with health and safety standards

  Regardless of the technical option chosen, it will be designed, constructed and maintained in accordance with applicable Irish and EU health and safety regulations and approved codes of practice. In undertaking a project, we are at all times aware of, and comply with, the applicable health and safety legislation, approved codes of practice and industry standards and all subsequent modifications or amendments in relation to same.

  The solution option should comply with relevant safety standards such as those from the European Committee for Electrotechnical Standardisation (CENELEC). Materials should comply with IEC or CENELEC standards.

- Compliance with EirGrid Security and Planning Standards

  The solution option should comply with the network reliability and security standards defined in the Transmission System Security and Planning Standards (TSSPS)[10] and the Operation Security Standards (OSS)[11]. All options investigated will meet the minimum technical requirements set out in the above standards. Options which extend or enhance technical performance margins beyond minimum acceptable levels are favoured over others.

  To be able to distinguish between the individual technical performance of each solution option, the options are assessed against three main technical criteria. A short description of these is given below. The technical criteria are based on the previous technical criteria used in the Step 2B report[12] and relate to the need identified. The criteria are thermal overload, voltage phase angle, and performance during maintenance conditions. It should be noted that in Step 2B, we also investigated short circuit performance and reactive support requirements.

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[10] EirGrid, Transmission System Security and Planning Standard, 2016 (http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Transmission-System-Security-and-Planning-Standards-TSSPS-Final-May-2016.pdf

[11] EirGrid, Operational Security Standards, 2011 (http://www.eirgridgroup.com/site-files/library/EirGrid/Operating-Security-Standards-December-2011.pdf)

[12] http://www.eirgridgroup.com/site-files/library/EirGrid/Step-2-Part-B-Options-Report-Capital-project-966.pdf

For the analysis in Step 3, we have not assessed the short circuit performance of the solution options as it was found in Step 2B that all of the options have very similar outcomes and the short circuit performance will not be the deciding factor between the options.

The reactive support requirements have been assessed under a different technical criterion, ‘Headroom’, and this criterion is described later in this section. In addition to the criteria set out above, the cable options have been assessed on the specific impact that cables will have on the network.

Thermal overload criteria

The options are assessed for compliance with the TSSPS. If thermal overload violations are identified, additional potential reinforcements will be added to the options until the enhanced option fully meets the TSSPS. For this technical criterion, we have assessed the options based on how many identified thermal overloads are remaining after the option has been added. This will provide an indication of how the options are performing in terms of adding thermal capacity.

Voltage phase angle

The options are assessed for compliance with the Operating Security Standards (OSS), which EirGrid is required to comply with in its licence. The OSS states that the maximum recommended voltage phase angle is 40˚.

We have recognised that a decrease in large voltage phase angles is beneficial to the operation of the electricity grid. The assessment of the options takes account of how much each option can reduce the angle difference between Woodland and Oldstreet stations when the Woodland – Oldstreet 400 kV circuit is opened. Improvements to angle differences are influenced by, among other things, the difference in impedance of the proposed new network reinforcements.

Performance during maintenance conditions

The options are assessed based on their requirement for additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance.

It should be noted that investments resulting from violations during planned maintenance are subject to an economic appraisal of the value in solving the identified problem compared to constraining generation. Before we would bring these forward as projects we will individually appraise whether each of these reinforcements could be economically justified.

To ensure value for money, we will defer a decision until much closer to the required commissioning date of the Best Performing Option. This will allow us to take account of new requirements for each reinforcement, which may include both local and regional needs which could have emerged in the meantime.

As such, for the purpose of this assessment in Step 3, we have only assessed the number of indicated violations of thermal capacity for each option and these possible additional reinforcements are not included in the full solution list of the options.

- Reliability performance

  The technologies and equipment associated with the different options have different performance and reliability characteristics. The reliability of transmission infrastructure is associated with two categories or type of outages, namely unplanned outages and planned outages. Each technology or type of equipment is associated with faults (unplanned outages) that routinely occur. These can be represented as average failure rates usually expressed as unplanned outages/100km/year.

  This criterion will also account for the mean time to repair. This is the time taken to return the equipment to service after a fault has occurred. The assessment has been based on transmission performance statistics[13] or industry standard reliability data.

  This sub-criterion will also assess the typical time the options would be unavailable for during planned outages. Planned outages are normally associated with annual routine maintenance and will be based on typical outage durations taken from maintenance policies. The reliability for each option will be based on a combination of the above type of outages. The reliability of the station equipment associated with the options is assumed to be the same for all options and is therefore not included in this analysis.

- Headroom

  This criterion assesses the ability of each option to accommodate increases in large scale demand growth in the Dublin and mid-east region, and replacement of thermal generation located in Dublin with increased renewable generation in the west and south of the country.

[13] Analysis of System Disturbances 2018, EirGrid, April 2019

Each option is compared relative to the others to determine the increase in demand, or renewable generation outside Dublin, that can be accommodated without further network reinforcements being required. The limit for each option can be found by increasing large scale demand in Dublin and renewable generation in the south and west until a voltage stability limit is reached.

The headroom for each option is the difference between the demand that can be accommodated by the network with that option included and the demand that can be accommodated by the network with no option included.

- Expansion or extendibility

  This considers the ease with which the option can be expanded, i.e. it may be possible to uprate an OHL to a higher capacity or a new voltage in the future. It will also consider the rating or capacity of the options.

- Repeatability

  This criterion examines whether this option can be readily repeated in the Irish network. One-off or bespoke solutions carry additional system integration, operational, and maintenance complexity. For example, an OHL option is very repeatable, but a fully or partially underground cable option is less repeatable as there may be harmonic filter and reactive compensation requirements that are bespoke for each option. The amount of cable that can be integrated in certain parts of the network may also be limited.

- Technical operational risk

  This criterion aims to capture the risk of operating different technologies on the network. It will consider if the option requires special procedures when energising or switching in the network. An example would be long cables which may require reactive compensation and special procedures when energised to prevent technical issues in the network.

4.2.2 Economic performance criteria

The economic appraisal we conduct as part of the Multi Criteria Assessment assesses the relative overall cost performance of the various options which meet the TSSPS and the impact on overall costs of production in meeting the demands on the system – it does not seek to replicate the economic trade-offs which have already been considered within the TSSPS itself.

The TSSPS, in driving new investment in transmission reinforcements, recognises that the economic cost to society of not preserving the security of supply standards defined by the TSSPS (N-1 etc.) is greater than the cost of maintaining such a standard. The TSSPS reflects the explicit and implicit economic trade-offs between enhanced security of supply and reduced risk of interruptions on the one hand and additional cost, including the full societal cost, of grid development on the other.

In this context then, the economic assessment described in Step 3 considers costs and benefits associated with each option.

A description of each of the cost criteria is given below.

- Pre-engineering cost

  The pre-engineering cost refers to the cost associated with the design and specification, route evaluation and management of the statutory planning application. The costs are capital in nature and are typically costs incurred by the Transmission System Operator (TSO) in the development of the reinforcement. The cost for the TSO to develop the option is based on experience of developing other current and previous projects.

- Implementation cost

  The project implementation costs are the costs associated with the procurement, installation and commissioning of the option. The capital cost estimates have been developed with input from the Transmission Asset Owner (TAO) and are based on desktop designs and costings for similar works. The capital cost estimates include all items to achieve a fully compliant solution with Transmission System Security and Planning Standards (TSSPS) and other investment policies, but exclude reinforcements driven by maintenance conditions as discussed in Section 4.2.1.

  Where capital costs were not available for a particular technology, the best, most recent estimates or quotes from manufacturers or assumed costs based on EirGrid or international experience have been used. The assumed cost for landowner payments, community fund and proximity payments are included under this cost category, as these costs are typically incurred during the implementation phase of the option.

- Life-cycle cost

  Life-cycle costs refer to the costs incurred over the useful life of the option and include the on-going cost of ensuring that it remains viable for the evaluation period. For the purposes of our assessments, decommissioning of assets is not considered. This criterion includes:

– Operation and maintenance cost

These costs are annualised and are based on estimated costs incurred to be able to maintain the option.

– Electrical losses

Losses are the electrical energy consumed by the transmission system as it transmits electricity. The more efficient a transmission reinforcement is, the lower the electrical losses it incurs.

The quantity of electrical losses is calculated for a standard year with each option included in turn and compared with the reference situation without the reinforcement. The losses calculation for a standard year includes assumptions in regards to other plant and equipment being unavailable due to faults or planned routine maintenance.

During the months between March and October, in any given year, the operation of the transmission system caters for approximately 20 circuits unavailable for various reasons per day. During the winter months, the transmission system has less than five circuits unavailable for various reasons per day.

The calculation has taken these aspects into account to a certain degree and assumed different 220 kV circuits, one at a time, unavailable for a week during the entire maintenance season simultaneously with different 110 kV circuits, one at a time, unavailable for a week during the entire year.

This assumption will provide a better understanding of the benefit in terms of losses that the proposed reinforcements will bring. A cost will be put against the losses incurred for each year during its lifetime following commissioning of the option. For this analysis, the average Day Ahead Market (DAM) price is used to represent the marginal cost of generation and is calculated to be €50.3 per MWh. The figure has been derived from the average Day Ahead Market (DAM) price for 2019, which was sourced from the Single Electricity Market Operator (SEMO) website[14].

– Replacement cost

The standard lifespan of a transmission asset is 50 years and this is the also the evaluation period for the economic assessment. Assets that have a

[14] https://www.semopx.com/news/market-summary-2019-repor-1/

shorter useful life would have to include the cost of replacement at the end of its useful life and thereafter factor in a residual value equivalent to the depreciated asset value at the end of the evaluation period.

In the economic assessments, it has been assumed that underground cable (UGC) options will have a useful lifespan of 40 years. The assumption is based on research of other utilities internationally. This indicates that there is recognition by some reputable utilities that the useful lives of OHL and UGC may not be the same. There isn't consensus about what the useful lifespan of UGCs could be and it may be dependent on differences in environmental conditions, duty cycle and operational use, installation choices etc. The cost of replacement is taken to be precisely the same as the project pre-engineering cost and project implementation cost.

A description of the benefit criteria is provided below.

- Socio-economic welfare:

  The benefits arising from transmission reinforcement project will usually be avoided costs. The value of some of these avoided costs is difficult to measure, especially in terms of beneficial contributions to society and the country's welfare and economy. Benefits in relation to the transmission system and its operations only have been taken into account in this assessment. In this case, the benefits refer to the difference in production cost savings between the system with the reinforcement option and the system without the reinforcement.

  The transmission system operational benefit can be measured by the amount of generation that is not constrained due the lack of transmission capability of the existing infrastructure. The benefit is therefore expressed as savings in generation costs due to the enhanced transmission capability. The constraints calculations are a result of annual market simulations. The simulations optimise the generation dispatch required to meet the electricity demand while taking into account the power carrying capability of the transmission system and contingencies.

  The calculation of the production cost savings for each option is based on the assumption that each MW produced by a generation unit that can't be exported due to a capacity constraint in the transmission network has to be procured elsewhere from another generation unit. The buying and selling of electricity is facilitated by the Single Electricity Market in order to meet the electricity demand in the All-Island electricity system.

On a very high level, the market is operated on the basis that the most efficient (cheapest) generation unit should be generating at any given time to reduce the electricity price. When the most efficient units are constrained due to a capacity constraint in the transmission network, a more expensive generation unit will be used to supply the electricity required. This will incur a higher cost in the operation of the system and market.

Transmission reinforcements will address network constraints and as such will help to reduce cost incurred. The project benefit can be expressed as expected annual savings of generation costs in the All-Island system depending on the respective option. For the estimate of annual savings in generation costs the hourly marginal generation costs are used from the simulations carried out.

- Cost to the Single Electricity Market

  This criterion will take account of the impact of the cost to the electricity market for the periods where the reinforcement option is not available. The technologies and equipment associated with the different options have different performance and reliability characteristics. The reliability of transmission infrastructure is associated with two categories or type of outages, namely unplanned outages and planned outages. The reliability performance criterion was described in Section 4.2.1 and will be used in combination with the calculated production cost benefits described in Section 4.2.2 to represent the cost to the Single Electricity Market for each option.

The robustness of each option's economic performance is also considered as part of the economic assessment. The robustness test considers two different aspects, namely:

- Least worst regrets

  To assess the robustness of each option's economic performance, 'Least Worst Regret' (LWR) analysis is carried out. This will indicate if some options perform better or worse under different future energy scenarios.

- Sensitivity analysis

  In addition, the options' sensitivity to changes in the reference parameters (implementation cost, WACC and Benefits) are assessed and taken into account.

4.2.3 Deliverability

In Step 3, the deliverability performance criterion includes a number of sub-criteria. A short description of these is provided below.

- Implementation timelines

  This criterion assesses the length of time required for each option to progress through each phase (including pre-consenting, consenting, pre-engineering (detailed design) and implementation (construction) up to project energisation). This will include timelines starting from Step 4, where the process will identify the exact location of the development. It assumes planning consent times or other permissions required, with the assumption of no unreasonable delays and/or potential judicial review.

- Project plan flexibility

  This criterion assesses the flexibility of the project plan to include for issues arising during pre-planning conceptual design, post-planning design, consenting and construction.

- Risk of untried technology

  This criterion assesses any aspects (positive or negative) and risks each technology option may have including if the technology has been used in the past internationally or on the Irish transmission network.

- Dependence on other projects (outages)

  This criterion assesses dependence on completion of other projects and outage length required to implement the option. It also considers general inter-dependence with other projects, including in terms of multi-project programme sequencing.

- Supply chain constraints, permits, wayleaves

  This criterion assesses any constraints (e.g. small number of suppliers in Ireland or internationally) that would affect the procurement of materials or services (e.g. cable laying vessels waiting list lead time) to complete the project.

  This criterion also assesses the complexity and challenge in respect of various permissions and consents required, including the potential risk to achieving statutory consent(s) without reasonable delay (having regard to environmental and other impacts), the potential level of public interest, and the potential for Oral Hearings, considered potential for Judicial Review.

This criterion also addresses the complexity and challenge of obtaining community and landowner “social licence” to construct an option, including securing access to land for pre-application survey, and obtaining post-consent wayleaves/easements.

4.2.4 Environmental

This criterion is assessed to identify and describe the types of environmental constraints that are most likely to be affected by the construction and operation of the identified solution options. It is based on a review of publicly available datasets, information gathered from County Development Plans (CDP) and Local Area Plans and mapping from state agencies such as the National Parks and Wildlife Service (NPWS).

The online resources were referenced between September 2019 and December 2019 to inform this assessment. This assessment was carried out by Jacobs and a summary of its findings are presented in this report. Jacobs’ detailed report (321084AE-REP-003 – CP 966 Environmental Constraints report is available on our website – see Section 2.1 for the link.

The environmental constraints have been organised into the following topics to aid understanding and presentation of the assessment findings:

- Biodiversity: Assessment of the potential impacts on protected sites for nature conservation, habitats and protected species;
- Soils and Water Impacts: Potential impact on soils (geology, Irish geological heritage sites, etc.) and water (water quality of surface waters and groundwater);
- Planning Policy and Land Use: Impact on land use (forestry, farmland, bogs/peats, horticulture);
- Landscape and Visual: Assessment of landscape constraints and designations and the potential impact on visual amenity; and
- Cultural Heritage (Archaeological and Architectural Heritage): The potential for impacts on the cultural heritage resources.

These topics have been selected as they are the most likely to represent the key considerations, constraints, risks and opportunities for the project.

Only environmental constraints are described in this criterion; the socio-economic constraints are described under the socio-economic criterion. It is acknowledged that there is potential for environmental issues to result in socioeconomic effects; this is particularly the case for potential effects on amenities of local communities which could be adversely affected by noise, air quality, views and traffic. Notwithstanding this interrelationship, this criterion does not consider amenity effects; these are presented in the socio-economic criteria.

4.2.5 Socio-Economic

This criterion is assessed to identify and describe the social issues and their potential impacts within the study area(s) that are most likely to be affected by the construction and operation of the identified solution options. This assessment was carried out by Jacobs and a summary of its findings are presented in this report. Jacobs' detailed report (321084AE-REP-003 – CP 966 Strategic SIA Scoping Report) is available on our website – see Section 2.1 for the link.

The assessment is based on a number of data sources, such as County Development Plans for Kildare and Meath County Councils, Census 2016 Data, Central Statistical Office (CSO.ie), National datasets from Prime 2 (Ordnance Survey Ireland's central database of spatial information) and some of the other findings from the investigation carried out by Jacobs as part of its assessment. It is also based on public consultation.

The social issues considered have been organised under particular topics to aid understanding and presentation of the assessment findings. These topics have been selected as they are the most likely to represent the key considerations, constraints, risks and opportunities for the project. Other criteria such as Land Use and Cultural Heritage are assessed under the environmental criterion.

- Amenity: Here 'amenity' is the term used to describe the overall pleasantness or attractiveness of surroundings. This includes effects on local communities, community facilities, local businesses and recreation and tourism assets. This builds on the work in the 321084AE-REP-003 – CP 966 Environmental Constraints report compiled by Jacobs.
- Health: To determine potential effects on humans, this considers amenity effects as well as considering WHO health thresholds; EMF is considered as set out in EirGrid's Guidelines[15];
- Local Economy: Effects on the regional and local economy;
- Traffic & transport: This considers potential effects on traffic and transport in the study area, during the construction phases of the different solutions. Of concern to communities is the potential for severance, isolation and significant delays

[15] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-The-Electricity-Grid-and-Your-Health.pdf

during the construction phase. Also considered in this topic are potential effects on the crossings of major roads, railways and navigable waterways if relevant;

- Utilities: Consideration of third-party assets, including telecommunications and aviation.

4.3 Scale used to assess each criteria

The effect on each criterion parameter is qualitatively determined using expert judgement and experience. This is presented by means of colour coding, along a range from “more significant”/”more difficult”/“more risk” to “less significant”/”less difficult”/“less risk”.

The following scale is used to illustrate the performance of each criterion. :

More significant/difficult/risk   Less significant/difficult/risk

In the text, this colour-coded scale is qualified by text comprising:-

- Low (Cream);
- Low-Moderate (Green);
- Moderate (Mid-level) (Dark Green);
- Moderate-High (Blue);
- High (Dark Blue).

5 Option Evaluation Summary

In Step 3, the short-listed options, described in Section 3.2, are further analysed and assessed. Each short-listed option has been assessed against the five criteria and sub-criteria, which are outlined in Section 4 of this report.

The summary of this multi-criteria assessment is presented in this section and reveals the Emerging Best Performing Option (EBPO). Further detail on each option is provided in Section 6 for the existing circuit up-voltage option, Section 7 for the new 400 kV OHL option, and Section 8 for the new UGC options.

A period of public consultation will focus on the EBPO and the analysis that underpins it and the possible alternatives. All feedback received will be carefully considered before the Best Performing Option (BPO) or options are identified and taken forward to Step 4 for further investigations.

As described in Section 4, the following scale is used to illustrate the performance of each criterion. The lighter the colour the better the option performs. It should be noted that the assessments undertaken for each option in Step 3 are for comparison against each other and are not absolute assessments of the individual options.

More significant/difficult/risk Less significant/difficult/risk

5.1 Basis of evaluation of multi-criteria assessment

In line with EirGrid's roles and responsibilities, we have an obligation to develop a safe, secure, reliable, economical, and efficient electricity transmission system while having due regard for the environment of Ireland. In our decision making, these fundamentals are captured in the five criteria considered. In addition, our decision making process also provides for public participation and stakeholder engagement and deliverability aspects.

All of the five criteria are important when considering the options in the assessment and establishing the EBPO. The options were assessed on an equal basis with no weighting applied for any of the criteria. We have also taken on board experience from other projects where applicable.

5.2 Emerging Best Performing Option based on the multi-criteria assessment

Table 1 provides a summary of the performance of each option against the five evaluation criteria and the resulting overall combined performance. The detail of the performance of each option for each criterion is contained in sections 6, 7, and 8 of this report.

Based on the multi-criteria assessment, Option 1, the up-voltage option, is the emerging best performing option. Option 3B, which is the emerging best performing alternative, does not perform as well as Option1 for three of the five criteria.

	Option 1 Up-voltage	Option 2 400 kV OHL	Option 3A 220 kV UGC	Option 3B 400 kV UGC	Option 3C 400 kV UGC (2 routes)
Technical Performance					
Economic Performance					
Deliverability					
Environmental					
Socio-economic					
Combined Performance					

Table 1 *Overall comparison of options using five criteria in Step 3*

Option 2, the 400 kV OHL option, performs well from a technical and economic performance perspective, but is considered to have high risk or significant impact (**Dark Blue**) from a deliverability and socio-economic perspective making this option not preferable.

Option 3A performs poorly from a technical perspective in comparison to the other options and in addition it has a relatively high level of risk associated with the deliverability and socio-economic aspects making this option not preferable.

Option 3C does not perform well overall based on the multi-criteria assessment. For three out of the five criteria assessed, this option is considered to have a high risk or significant impact (**Dark Blue**) and is therefore not preferable.

5.3 Summary of technical performance of options

All options investigated will meet the minimum technical requirements. Options which extend or enhance technical performance margins beyond minimum acceptable levels are favoured over others. Figure 4 shows the technical performance of the various options in relation to the different sub-criteria. This figure is also displayed in Appendix 2.

Figure 4 *Overall technical performance of the options.*

The two OHL options, Option 1 and Option 2, have a similar technical performance with both performing very well.

Option 1 would be using two existing circuits to achieve the new reinforcement. Option 1 would need a bespoke design for large parts of the reinforcement as an existing route is used, resulting in a reduced performance in the repeatability criterion.

Option 2 is based on our standard 400 kV OHL design and will provide an additional new circuit when compared to Option 1 which would give more operational flexibility.

Option 3A is the worst performing option under the technical criterion. Connecting the Woodland and Dunstown stations using a 220 kV voltage level will not support the network as effectively as the other options in transferring the electricity to where it is needed. This option would not provide enough headroom for future growth. This option would require an additional reinforcement compared to the other options, the uprate of the existing Cashla – Tynagh 220 kV OHL.

The cable options 3B and 3C have some advantages in their technical performance in the criterion ‘Headroom’ and ‘Compliance with planning and security standards’. However, they also have some challenges and difficulties, which vary depending on the cable option; these are in relation to reliability, extendibility, repeatability and technical operational risk.

5.4 Summary of economic performance of options

The economic performance of each option is a combination of the economic result and a robustness test. All options have costs and savings which are considered in the economic result. A robustness test to check the options’ performance for different credible future energy scenarios was also carried out including sensitivity to changes in some reference parameters. Figure 5 shows a summary of the economic assessment inputs and resulting economic performance of the various options. This figure is also displayed in Appendix 3.

Summary of Economic performance all options 2020 values						
	units	Option 1 Up-voltage	Option 2 400 kV OHL	Option 3A 220 kV UGC	Option 3B 400 kV UGC	Option 3C 400 kV UGC (2 routes)
Pre-Engineering Costs	[€M]	9.4	11.2	8.4	8.4	8.9
Project Implementation Costs	[€M]	239	166	372	356	678
Project Life-Cycle Costs (Losses)	[€M] pa	1.2	-0.529	-1.28	-1.28	-1.76
Project Life-Cycle Costs (O & M) Presented in period of years (1-20), (20-40), (40-60)	[€k] pa	0.84 0.458 0.14	0.42 0.524 0.86	0.96 0.259 0.96	0.129 0.252 0.129	0.244 0.491 0.244
Project Life-Cycle Costs (Decommissioning & Replacement)	[€M]	N/A	N/A	380.3	364.3	687.6
Cost to SEM based on unavailability of reinforcement (TES Scenario used)	[€M] pa	Range -3 to 13	Range 1 to 20	Range 0 to 16	Range 1 to 20	Range 1 to 21
Combined Economic Performance						

Figure 5 *Summary of economic inputs and performance for all options*

Option 2 has the best economic performance followed by Option 1 and Option 3B which perform equally in this criterion. Option 3C has the worst economic performance overall.

5.5 Summary of deliverability aspects of the options

All options would be challenging to deliver, but for different reasons. Figure 6 shows the deliverability performance of the various options in relation to the different sub-criteria. This figure is also displayed in Appendix 4.

Option 1, Option 3A and Option 3B perform the same overall under the deliverability criterion, but there are differences that are worth pointing out.

Option 1 would have a relatively long delivery timeline and risks associated with it as this is a new technology. This option would require existing OHLs to be taken out of service for extended periods of time while the option is constructed and the other options do not have this as an impact. Option 1 may require in-line modification of the existing tower locations for construction reasons.

Option 2, comprising a new 400 kV OHL, has in this aspect the longest implementation timeline based on similar projects undertaken by EirGrid. It is also anticipated that it would be very challenging to achieve societal acceptance for such a development.

Option 3A and 3B are UGC options, and have the best implementation timelines when compared to all options under consideration. They would preferably be accommodated in the public road network and would require a 4 metre wide cable trench and an additional working strip, thereby requiring an overall cable alignment width (permanent and temporary). Road closures and potentially significant implications for traffic movements for both local access and commuter traffic would be a factor for all the UGC options during construction.

Option 3C, which will require two separate routes or roads, introduces a significant risk to the deliverability of the reinforcement in three of the sub-criteria and as such this option does not perform very well in the deliverability criteria.

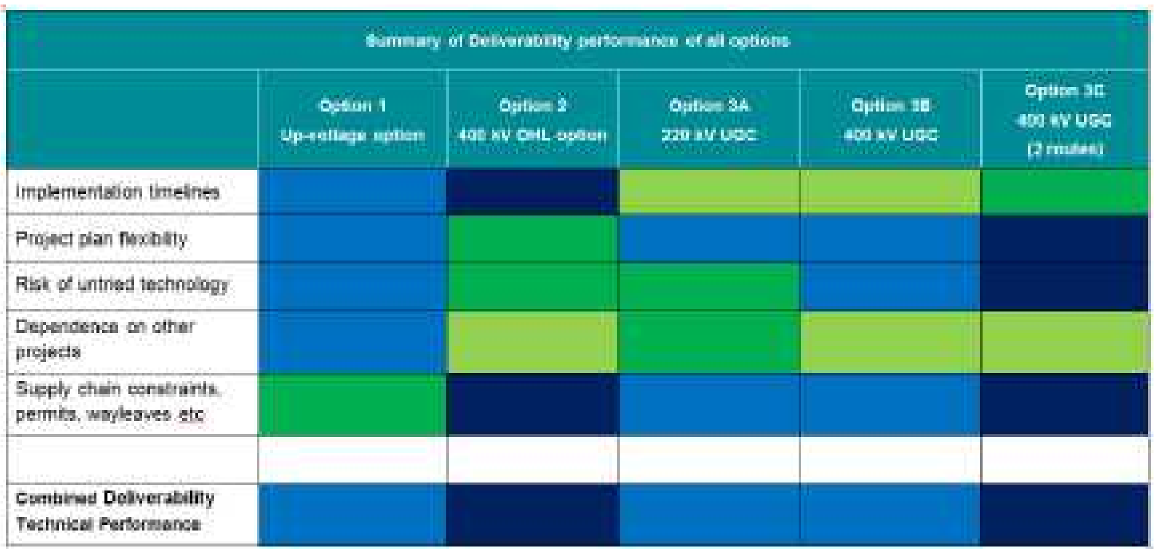

Figure 6 *Overall deliverability performance of the options.*

5.6 Summary of Environmental aspects of the options

Figure 7 shows the environmental performance of the various options in relation to the different sub-criteria. This figure is also displayed in Appendix 5.

Summary of Environmental performance of all options					
	Option 1 Up-voltage option	Option 2 400 kV OHL option	Option 3A 220 kV UGC	Option 3B 400 kV UGC	Option 3C 400 kV UGC (2 routes)
Biodiversity					
Soils and water					
Planning policy and land use					
Landscape and views					
Cultural heritage					
Combined Environmental Performance					

Figure 7 *Summary of the Environmental performance of the options.*

Option 1 has the best overall performance in relation to environmental aspects and impacts. This option uses existing corridors and maximises use of existing infrastructure thereby minimising the need to build new infrastructure in an area. The impacts for Option 1 are mainly related to the construction phase. Once operational, the up-voltage option would not be significantly different from the current baseline.

Option 2, Option 3A and Option 3B are all deemed to have a moderate overall impact on the environmental considerations, but there are differences in the individual sub-criteria.

Option 3C has the worst performance under this criterion as it uses two routes.

5.7 Summary of Socio-Economic aspects of the options

The assessment in this criterion has not considered the feedback from the consultation and stakeholder engagement, as this process has not yet been concluded. All feedback received will be carefully considered before the Best Performing Option (BPO) or options are identified and taken forward to Step 4 for further investigations.

To account for social acceptance in identifying the Emerging Best Performing Option for stakeholder engagement, and taking account of previous experience with 400 kV OHL technology on other projects, EirGrid has deviated from the draft outcome of Jacobs' assessment. The combined socio-economic performance for this criterion for Option 2 was considered to have a high significance impact to reflect this aspect. It should be noted that this anticipated outcome could be amended depending on the feedback from the consultation period in Step 3.

Figure 8 shows the socio-economic performance of the various options in relation to the different sub-criteria. This figure is also displayed in Appendix 6.

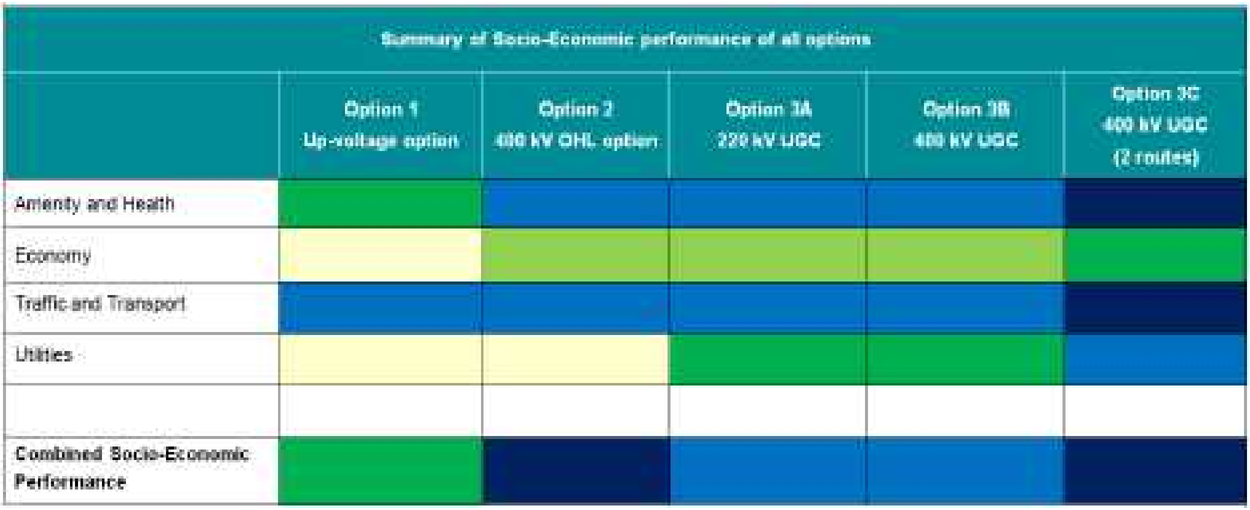

Figure 8 *Summary of the Socio-economic performance of the options.*

Option 1 has the overall best performance in relation to socio-economic aspects and impacts and Option 2 and Option 3C have the worst performance under this criterion.

6 Up-voltage existing 220 kV OHL circuits to 400 kV OHL circuit

This section describes the assessment of the up-voltage option against the five criteria and their sub-criteria as described in Section 4.2. Each criterion is described in separate sections and a summary of the overall performance of the option is provided in Section 6.7.

The assessments for the environmental and socio-economic criteria have been carried out by Jacobs, and a summary of its findings are presented in this report. Jacobs' detailed reports of these assessments can be found on our website and the links can be found in Section 2.1.

6.1 Description of option

This option would involve a suite of transmission network reinforcements centred on strengthening the network between the existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. In the below text reference is made to Gorman 220 kV station and Belcamp 220 kV station. A Map in Appendix 1 shows the location of these stations.

This option consists of:

- Up-voltage part of the Gorman – Maynooth 220 kV circuit and all of the Dunstown – Maynooth 2 220 kV circuit. This would involve using a new technology which would enable the existing 220 kV towers to be modified or replaced, and the 220 kV conductors and insulation hardware to be replaced with 400 kV equipment to create a new Dunstown – Woodland 400 kV circuit.
    - The existing Gorman - Maynooth 220 kV overhead line circuit (shown in blue in Figure 9 would be modified to incorporate a "turn in" to Woodland 400 kV station. This would create two new circuits into Woodland station, namely a Gorman – Woodland 220 kV circuit and a circuit connecting Maynooth and Woodland (that would be used for the up-voltaging element of the option).
    - The newly created circuit connecting Maynooth and Woodland would be linked together with the existing Dunstown – Maynooth 2 220 kV circuit (shown in green in Figure 9) in the vicinity of Maynooth station. The circuits would then be modified to enable operation at 400 kV.

- Two dynamic reactive support devices, located preferably in the vicinity of Belcamp 220 kV station in north county Dublin and Dunstown 400 kV station in County Kildare. The devices will be connected at 220 kV, and rated at approximately ±250 Mvar.
- This option would require work in the Woodland and Dunstown 400 kV stations to facilitate the connection. Bays would have to be constructed on the 400 kV busbars in both stations. Both these stations would require extensions to the 220 kV busbars. In Dunstown, the extension would be required to accommodate the connection of the dynamic reactive support device and in Woodland the extension would be required to accommodate the connection of the 220 kV circuit coming from Gorman station. Gorman 220 kV station is located in Causestown, Co Meath.

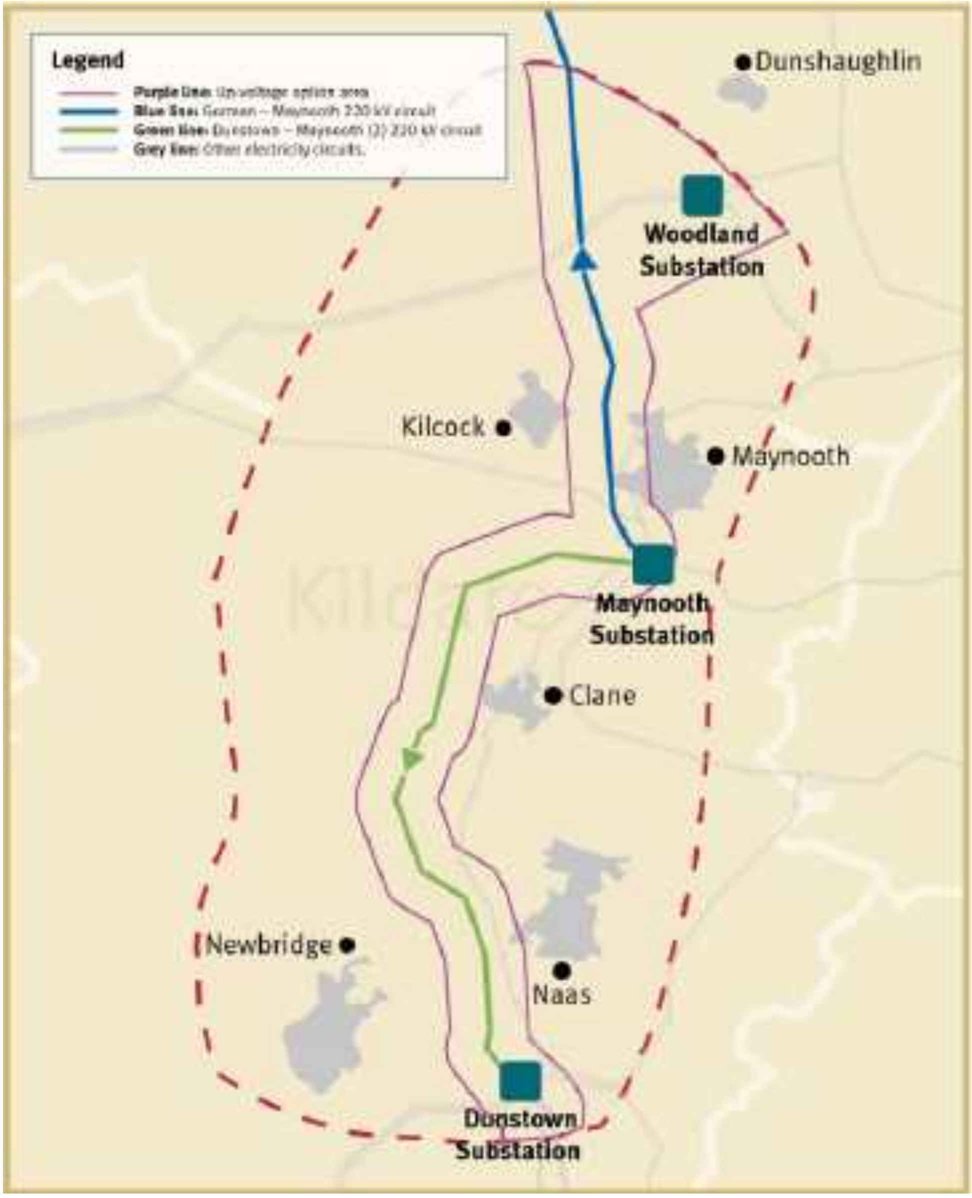

Figure 9 *Illustrative map showing the option to up-voltage existing 220 kV circuits to 400 kV OHL. The lines chosen for the up-voltage are the Gorman – Maynooth 220 kV (shown in Blue) and the Maynooth – Woodland 220 kV (shown in Green).*

The various alternatives to create the turn-in of the Gorman - Maynooth 220 kV overhead line circuit into Woodland 400 kV station and their impact on the five criteria was investigated by Jacobs and is presented in its reports (321084AE-REP-002 – CP 966 Environmental Constraints report and 321084AE-REP-003 – CP 966 Strategic SIA scoping report). This report can be found on our website – see Section 2.1 for the link.

There are three alternatives on how to achieve the turn-in:

1. Two single circuits using OHL between new towers positioned on the line of, or adjacent to, existing OHL alignment and into new 220kV and 400kV bays at Woodland station
2. Two single circuits using UGC between new towers and cable sealing end compounds positioned on the line of, or adjacent to, existing OHL alignment into new 220kV and 400kV bays at Woodland station
3. One double circuit OHL between new a tower positioned on the line of, or adjacent to, existing OHL alignment either north or south of the existing crossing point and into new 220 kV and 400 kV bays at Woodland station.

These three alternatives will have their own challenges and impacts on the five criteria. The decision on which of these is the best alternative will be taken in Step 4 and engagement and consultation with the local community will feed in to this decision. These alternatives and impacts will be further considered and investigated if the up-voltage option is brought forward into Step 4.

6.2 Technical Performance

6.2.1 Compliance with health and safety standards

The text included in this section applies to all options and will be referenced in the assessment of the other options rather than repeating the text.

Most technical standards for high voltage equipment are inherently based on safety requirements. Therefore, as a general rule, compliance with recognised technical standards will mean that the equipment is designed and manufactured to be safe.

The applicable standards originate from the European Committee for Electro-technical Standardization (or a similar internationally recognised standard). These standards take into account the integrity of installations and systems by operating conformity assessment systems to verify plant and systems perform to acceptable technical and safety standards.

All materials will be designed, manufactured, tested and installed according to relevant IEC or CENELEC standards. Where no IEC or CENELEC standards have been issued to cover a particular subject, another internationally recognised standard will be applied. The latest edition and amendments to standards and specifications will apply in all cases.

Regardless of the technical option chosen, the Capital Project 966 project will be designed, constructed and maintained in accordance with applicable Irish and EU health and safety regulations and approved codes of practice. In undertaking a project, we are at all times aware of, and comply with, the applicable health & safety legislation, approved codes of practice and industry standards and all subsequent modifications or amendments in relation to same.

All prospective technical options will comply with the Safety, Health and Welfare at Work (General Application) Regulations 2007, in particular Part 3: Electricity.

All designs will meet the requirements of our functional or operational specifications which incorporate CENELEC standards and contain specific national requirements e.g. environmental conditions, procedures and system network parameters. All equipment will be compliant with the most recent version of the Grid Code at the time of design.

The Up-voltage option will be compliant with the relevant safety standards, and is considered to have a low (**Cream**) risk of not complying with health and safety standards.

6.2.2 Compliance with Security and Planning Standards

The security standards of the transmission network are defined in the following:

- The Transmission System Security and Planning Standards (TSSPS)[16]; and
- The Operational Security Standards (OSS)[17].

These standards will ensure that the system is planned and operated in a manner which adheres to system security and integrity, and reliability of supply criteria.

The Up-voltage option proposed will comply with the relevant system reliability and security standards listed above. Although the option will meet the minimum technical requirements, certain aspects may differentiate the option's technical performance compared to other options. A high level summary of the technical aspects considered and investigated is presented below.

The need analysis for 2030 indicated that, without mitigation, single contingencies (the unexpected loss of a single circuit or piece of equipment), such as the loss of any of the 400 kV circuits, the loss of any of several major 220 kV circuits or the loss of any of

[16] EirGrid, Transmission System Security and Planning Standard, 2016 (http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Transmission-System-Security-and-Planning-Standards-TSSPS-Final-May-2016.pdf
[17] EirGrid, Operational Security Standards, 2011 (http://www.eirgridgroup.com/site-files/library/EirGrid/Operating-Security-Standards-December-2011.pdf)

several generators or interconnectors leads to major, widespread, voltage issues and voltage collapse in the counties of Dublin, Kildare, and Meath in particular, and sometimes extends towards the South East, Midlands and North East.

The analysis indicates widespread low voltage and voltage collapse issues across a large part of the country for certain single contingencies. When the up-voltage option is added to the system model, the analysis indicates an improvement in these issues by reducing the extent of the indicated voltage collapses in Winter Peak from 47 to 12 instances. These improvements were similarly indicated for the Summer Peak cases. Despite the improvement in security of supply, the up-voltage option requires two additional dynamic reactive support devices to comply with the TSSPS.

The need analysis indicated capacity problems related to thermal overload and highly loaded circuits. When the up-voltage option is added, the overall loading of the circuits under an intact network is reduced. However, this solution results in increased congestion on some circuits in the Dublin area because two existing 220 kV circuits have been replaced with one, higher capacity 400 kV circuit.

In terms of voltage phase angle, this option performs well as it reduces the difference in voltage phase angle to 19˚ between the Oldstreet and Woodland stations post the single contingency on the Oldstreet – Woodland 400 kV circuit. This is a reduction of 12˚ compared to that observed in the needs analysis.

An assessment was undertaken into keeping the transmission network within standards following a loss of plant and equipment while another is out for planned maintenance. Maintenance is carried out annually during March to October. For planned outages, some re-dispatch of generation is allowed, but this should be kept to a minimum to ensure the most cost effective generation is dispatched.

The assessment shows that the capacity ratings of 33 circuits were exceeded for multiple maintenance and contingency trip combinations (N-1-1). The highest circuit capacity loading observed was 156.9%. This is a reduction compared to the issues indicated in the needs assessment, which highlighted 42 circuits had exceeded their thermal rating with a worst case loading of 177.5%. This will have a positive effect on the amount of generation that will have to be re-dispatched to overcome circuits exceeding their capacity limits during maintenance.

When all aspects are considered, the up-voltage option is considered to have a low to moderate compliance when assessed against the above standards and hence has been given a low to moderate impact (**Green**) in the assessment.

6.2.3 *Reliability performance*

This criterion has been assessed using three inputs, namely unplanned outages, planned outages and the time it takes to repair the circuit. The collective impact of these provides an indication of the annual availability of the asset. The reliability and outages of the station equipment associated with the circuit are assumed to be the same for all options and are therefore not included in this analysis.

The statistics for reliability are based on EirGrid's and international failure statistics, the mean time to repair and the availability in days per 100 km per year for OHL and UGC. It has been assumed that the new up-voltaged circuit will be approximately 50 km in length.

There are 439 km of existing 400 kV OHLs in Ireland. This length of 400 kV OHL is too small a sample for determining meaningful performance statistics.

Meaningful statistics can, however, be obtained by considering the fault statistics of the combined quantity of 400 kV, 275 kV and 220 kV OHLs (approximately 2326 km) in the All Island transmission system.

Unplanned Outages:

Almost all OHL faults are of short duration as a result of transient faults such as lightning strikes. If an auto-reclose function is provided for the protection of the line, it will restore the circuit shortly after the fault, generally in 0.5 – 3 seconds. Even if the line suffers physical damage, faults can be rapidly located and identified by visual inspection from the ground or air, and repairs effected in a matter of hours. Transmission system statistics indicate that 91.5 % of unplanned overhead line outages lasted less than one day[18].

Taking the fault statistics of the above combined network length of OHL for the period 2004 to 2018, gives a projected fault rate of 0.38 unplanned outages/100km/year.

Given typical repair times this would equate to the circuit being out of service due to a permanent fault for less than 9 hours per annum. The average failure rates during normal operation, average repair times and availabilities of the main elements of a typical 400 kV OHL are set out in the table below and adjusted to reflect the length of the proposed option.

[18] EirGrid, Analysis of Disturbance and Faults 2018, System Performance, April 2019

Transient faults are not considered, as any interruptions to supply that they may cause would be of such short duration that their effect is considered to be negligible, despite being an inconvenience for electricity users.

Planned outages:

Planned outages are normally associated with routine maintenance. For a 400 kV OHL, much of the required routine maintenance can be completed without an outage of the circuit, therefore the planned outage rates and the typical outage durations taken from our maintenance policies result in an annual planned outage rate of 0.65% for the 400 kV option, or circa 2.5 days per annum[19].

Combination of the planned and unplanned outages:

Due to the length of the Up-voltage OHL circuit (approximately 50km), the total unplanned outage time per year is circa 9 hours, which combined with the planned outage rate of 2.5 days can be taken as 3 days per annum (rounded to nearest half day).

Parameter	Average statistics for 400 kV & 220 kV OHL combined
Reliability (Unplanned outages/50km/year)	0.19
Mean time to repair (days)	Circa 2 days
Unplanned Outages (combined) Unavailability due to disturbance (days/50km/year)	0.38 days (c.9 hours)
Planned Outages	2.5 days
Total Annual Unavailability (days/50km/year)	3 days

Table 2 *Average failure statistics for a 50 km 400 kV OHL*

The availability rate for the up-voltage option is high at 99.2% over any given year and this up-voltage option is deemed to have a low risk of not meeting the reliability criterion (**Cream**).

[19] http://www.eirgridgroup.com/site-files/library/EirGrid/Guide-to-Transmission-Equipment-Maintenance-March-2018.pdf

6.2.4 Headroom

The up-voltage option accommodates a similar amount of large-scale demand in the Dublin and Mid-East region compared to Option 2, the new 400 kV OHL option.

The assessment indicates that the up-voltage option creates headroom (increases the amount of additional large-scale demand that could be accommodated) of approximately 70 - 110 MW compared to no reinforcement, depending on which scenario is analysed. As indicated in Section 6.2.2, the option requires two dynamic reactive support devices to be in compliance with planning and security standards of the transmission network. With two dynamic reactive support devices added the total headroom created by this option is approximately 370 – 470 MW depending on which scenario is analysed.

The up-voltage option performs in the mid-range in the headroom criteria compared to the other options and is deemed to have a moderate (**Dark Green**) performance in terms of headroom.

6.2.5 Expansion or extendibility

The up-voltage option is based on Overhead Line (OHL) technology and has a thermal capacity[20] equivalent to the existing 400 kV circuits. The option provides a platform for future demand or generation development within the east of the country.

The up-voltage option will use existing circuit corridors, which pass near many areas where it is expected that demand will increase significantly. In the event that another connection along the circuit would be required, this could be achieved by constructing another station which could be connected into this line. This is a very common way to expand the transmission network and is normally technically feasible and achievable. As such, this option has the potential to provide a base for further expansion of the transmission network and the option offers a low to moderate (**Green**) difficulty to accommodate potential for future expansion.

6.2.6 Repeatability

This option uses Overhead Line (OHL) technology, which is already in use in the Irish transmission system with more than 4,500 km of circuit length. This option will also use a new technology which will mean that existing OHL towers along a route can be modified to accommodate a higher voltage level. To be able to accommodate this new technology,

[20] Thermal capacity of existing 400 kV OHL is a winter rating of 2963 A and summer rating of 2506A based on conductor 2 x 600 mm2 ACSR CURLEW at 80°C,

bespoke design of the OHL in question will have to be carried out to ensure that the circuit will meet design criteria.

The up-voltage technology is repeatable, but will require bespoke design if it were to be used on another circuit in the future. In principle, there are no limits in regards to repeatability of the up-voltage technology on the Irish transmission system, but consideration has been given to the bespoke design that has to be completed for future applications. This option is considered to have a moderate to low risk of not meeting the repeatability criteria (**Green**).

6.2.7 Technical operational risk

This option uses Overhead Line (OHL) technology, which is widely used internationally and in Ireland. This option will also use a new technology which will modify or replace the OHL towers along an existing route to be able to accommodate a higher voltage level.

This up-voltage technology has been used internationally and it is not anticipated that this technology would introduce any technical operational risk once it is in use on the Irish transmission system. This new technology has not been used on the Irish transmission network previously and could initially introduce some operational uncertainty. Any uncertainty would be mitigated by tests and trials prior to implementation to gain experience with the new OHL design. This option is considered lowest on the difficult/ risk scale (**Cream**) in terms of operational risk.

6.2.8 Conclusion of technical performance

When all technical aspects are considered, the up-voltage option has a moderate to low (**Green)** overall technical performance.

Summary of technical performance of Up-voltage option	
Health and Safety Standard compliance	
Security & Planning Standard compliance	
Reliability performance	
Headroom	
Expansion or Extendibility	
Repeatability	
Technical Operational risk	
Combined Technical Performance	

Table 3 *Summary of technical performance for up-voltage option*

6.3 Economic Assessment

The economic performance of the options is represented using our colour scale with the individual performance of an option assessed relative to the performance of the other solution options.

6.3.1 Input cost for the economic appraisal

6.3.1.1 Pre-engineering cost

The pre-engineering costs are estimated to be €9.4 million. In the economic appraisal, a contingency provision of 5% has been applied to this amount.

The phasing of the pre-engineering costs is as follows:

	2021	*2022*	*2023*	*2024*	*2025*
Phasing of Pre-Engineering Spend	24%	30%	22%	14%	10%

Table 4 *Phasing of Pre-engineering spend for Option 1*

6.3.1.2 Implementation cost

The capital investment required to deliver the up-voltage option is estimated to be €239 million. For the purpose of this cost assessment, this cost included an assumption that the turn-in would be using UGC as this is the worst case scenario from a cost perspective. A provision for Transmission System Operator (TSO) related implementation cost and landowner payments, proximity allowance and local community fund has been included in this cost. In the economic appraisal, a contingency provision of 10% has been applied to this amount. The estimated implementation cost is categorised into its general components and is summarised in Table 5.

Categorised implementation cost Option 1 – Up-voltage	
Cost category	**Implementation cost (€m)**
Overhead line	71.1
Underground cable	56.8
Stations	20.7
STATCOMs	66.0
Other (TSO related implementation cost, flexibility & proximity payments and other allowances)	24.4
SUB-TOTAL	239
Contingency (10%)	23.9
TOTAL	263

Table 5 *Categorised implementation cost for Option 1*

The phasing of the implementation costs is as follows:

Phasing of Implementation Spend – Option 1				
2025	**2026**	**2027**	**2028**	**2029**
2%	14%	18%	32%	24%

Table 6 *Phasing of Implementation cost for Option 1*

6.3.1.3 Life-cycle cost

This sub-criterion consists of three separate inputs incurred over the useful life of the option, namely operation and maintenance cost, electrical losses and replacement cost.

The equipment associated with the up-voltage option is expected to be maintained in accordance with the well-established existing practices. The operation and maintenance cost varies over the assets' life time and as such three periods of approximate costs are assumed. Table 7 displays rounded figures to the nearest thousand. No replacement cost is assumed as the equipment has a life expectancy of 50 years which is line with the period for the economic assessment.

Life-cycle cost for Option 1 – Up-voltage		
Annual Operation and maintenance cost (€k)	0-20 year period	€84k
	21-40 year period	€458k
	41-50 year period	€14k
Annual Electrical losses cost (€k)	€1.2*	
Replacement cost	N/A	

Table 7 *Life-cycle cost for Option 1*

*This option will not add any new circuits. It will use two existing circuits to create the solution. This will effectively remove two 220 kV circuits instead of adding additional circuits to the network, which will increase the losses in the system.

6.3.1.4 Cost to Single Electricity Market

As described in Section 4.2.2, the cost to the single electricity market will represent the cost for the periods when the reinforcement is unavailable. The unavailability is based on the reliability performance of the option. This is a cost to the single electricity market and is calculated as a combination of the benefit in production cost saving (project benefit) and reliability performance of the option. The reliability performance of the option is taken from Section 6.2.3. The production cost savings assessment used the TES 2019 scenarios and as such a range of annual production cost savings are used in the assessments as the different scenarios have different demand and generation patterns.

Cost to Single Electricity Market for Option 1 – Up-voltage	
Annual Production cost saving (Benefit) (€m/annum)	Range €-3m to €13m
Annual unavailability of option during which benefits cannot be attributed	Unavailable for 3 days, available 99.18%
Annual Cost (saving) to SEM	Range €-2.97m to €12.89m

Table 8 *Cost to single electricity market for Option 1*

6.3.2 Economic performance for Up-voltage option

When all of the above costs and savings are considered, the Up-voltage option (Option 1) has a good economic result compared to the other options and hence is considered to have a low to moderate (**Green**) impact on the economic result. To be able to differentiate between competing options in a measured way and to check the options' performance in different credible future energy scenarios, a robustness and sensitivity test was carried out. The objective is to identify the option that is impacted the least from an economic perspective for a range of credible future energy scenarios. This robustness test indicates a stable performance compared to the other options independent from which future energy scenario is used in the assessment.

After considering both the economic result and the robustness test, the up-voltage option is considered to provide a relatively good economic performance in comparison with the other options and hence has been given a low to moderate impact (**Green**) in the assessment.

Summary of economic performance of Up-voltage option	
Economic result	
Robustness	
Combined Economic Performance	

Table 9 *Summary of economic performance for up-voltage option*

6.4 Deliverability

6.4.1 Implementation timelines

The expected timeline for implementation of the up-voltage option is a period of 9 years in total. This is subject to and following statutory consenting for the structures and associated access routes. This time frame can be divided into two phases.

The first phase is based on 4.75 years for the mechanical, electrical and insulation coordination studies required for the new up-voltaging design, environmental assessment and the planning process.

The second phase is 4.25 years and includes detailed circuit design, procurement of materials and all construction works. This assumption includes time for securing landowner consents and a materials order period. This assumption incorporates time required for the outages associated with the works.

The design works, material procurement and construction period for the works required in the existing stations will be incorporated into the above timeline for the overhead line works. There are several elements required in the stations to accommodate the up-voltage option.

The timeline for new 400 kV bays at Dunstown and Woodland 400 kV stations is estimated at 1.5 years. Woodland and Dunstown stations will require extensions to the 220 kV busbars to accommodate the dynamic reactive support device in Dunstown and the 220 kV circuit coming from Gorman station. The timeline for these works are anticipated as 2.5 years. The installation of the dynamic reactive support devices at Belcamp (into spare bay) and Dunstown is anticipated to take three years and will be incorporated into the overall programme.

The up-voltage option has the second worst implementation timeline compared to the other options. The impact of the implementation timelines on the project is assessed to be high to moderate (**Blue**) for the Up-voltage option.

6.4.2 Project plan flexibility

As this option is based around infrastructure which is already in place, the route corridors have little flexibility to be modified. The constraint identified is the current angle mast locations, which would be unlikely to change along the whole route.

The route would be designed to a level that would incorporate the foundation enhancements, tower strengthening and access routes to the existing structures as well as any new structures that would be required along the route.

Once the best performing route option has considered all the constraints, an emerging preferred route would be the basis for the planning submission.

There is very little flexibility on the route once the planning consent is in place. Some of the tower locations may have the potential for minor modifications, but this could be subject to a modification to the planning consent. Access routes to the tower locations would also form part of the planning consent and changes to these would also require modification to the planning consent.

The up-voltage option is assessed to have a high to moderate (**Blue**) impact with regard to project plan flexibility.

6.4.3 Risk to untried technology

The up-voltage technology proposed is new to the Irish transmission system. The technology solution would have to be designed specifically for this project. It would involve upgrading the existing 220 kV towers to operate at 400 kV by modifying or replacing the structures on existing (or upgraded) foundations and replacing the conductor.

This technology is the subject of a separate trial project currently underway. The trial is being implemented on the Donard 220 kV Test Line in Co Wicklow. The scope includes the installation of the 400 kV upgraded towers, stringing of required conductors and other associated work to test this technology. This trial provides the opportunity to get more familiar with the technology and highlight any complications that may have to be resolved prior to use in the Irish transmission system.

While implemented elsewhere in the world, this technology has currently not been implemented on the Irish transmission system. Although this technology is safe to use, it is considered to have a greater risk to the project as unknown technical issues may have to be resolved and therefore this sub-criteria is deemed to have a high to moderate (**Blue**) significance on the project.

6.4.4 Dependence on other projects (outages)

This option has a number of elements which will require planned outages. The construction works will be dependent on the availability of outages to complete the enabling works ahead of the transfer of the existing Gorman to Maynooth line to create a new line from Gorman to Woodland. These outages will be competing with other network projects and may not be granted in successive outage windows.

The works to enhance the foundations and string sections of the existing 220 kV lines will have to be completed while the circuits are out of service.

The required work in both Woodland and Dunstown stations will need proximity and commissioning outages. In Woodland, the work involves the construction of an extension to the 220 kV busbar to create a point of connection for the 220 kV circuit coming from Gorman. In Dunstown, the work involves the construction of an extension to the 220 kV busbar, which is required to connect the dynamic reactive support device.

Other on-going projects in both these stations may cause conflicting outages depending on the projects' individual programmes and this will have to be taken into consideration and could have impacts on granting necessary outages.

Relative to the other options the up-voltage option is considered to have high to moderate (**Blue**) dependence on other projects.

6.4.5 Supply chain constraints, permits, wayleaves

For the purposes of this analysis, while angle towers (where the OHL changes direction) would be of a similar 400 kV design as existing angle towers, intermediate towers would comprise a new and bespoke design that does not currently exist on the Irish Transmission system. In addition, there may be a limited number of suppliers with the ability to supply the composite insulators in the manner envisaged for the intermediate towers.

Overall, while standard timelines for procurement and design may not apply given the bespoke nature of much of the option, it is envisaged that there would be no significant supply chain constraints, given this primarily relates to the design of steel structures.

Permitting is likely to be challenging irrespective of final scope, nature and design. Based on established precedent, the up-voltage option comprises work to an existing circuit and is likely to require planning permission.

However, given the proposed voltage of the overall circuit, and the fact that the up-voltage option includes portions of new circuit, An Bord Pleanála (ABP) could deem the up-voltage option to comprise Strategic Infrastructure Development (SID). In either consenting scenario, it is envisaged that there could be considerable public interest in the planning application and, combined with the relative complexity of the option, this could result in the holding of an Oral Hearing in respect of any such proposed development.

Given the nature of the proposed development as ultimately comprising a 400 kV OHL circuit (albeit using smaller towers sited more frequently than a standard 400 kV circuit, there is the potential for any planning application to be subject to Environmental Impact Assessment (EIA).

Notwithstanding all the above, the 400 kV OHL circuit would be assumed to follow the alignment of the existing long-established 220 kV circuits – although it is noted that there will be locations for the tie-ins between the existing circuits, and between the circuit and Woodland station, where new OHL or UGC would be required. The decision on which of the three alternatives would be used for the turn-in would be taken in Step 4 and engagement and consultation with the local community will feed in to this decision. Therefore, the existing 220 kV OHLs form part of the baseline receiving environment for the purposes of environmental assessment of the proposed up-voltage circuit.

This would not be the case if the up-voltage option would result in towers, apparatus and other equipment at materially different locations to that which exists at present, as there are likely to be resultant new or altered impact in relation to topics such as visual impact, and impact on land use activities.

It is assumed new wayleaves would be required to be issued having regard to the altered voltage of the OHL. This process would occur in engagement with landowners who have an established relationship with the asset owner (ESB Networks).

This wayleave process would become significantly more complicated if the design of the up-voltage option would stray from the existing alignment of the OHL circuit. In addition, it may be challenging if new 400 kV OHL is used to tie-in the existing 220 kV circuits, and the tie-in to Woodland Station. The final decision to use OHL or UGC for the tie-in to Woodand will be made in Step 4 if this option is progressed.

Having regard to all the above, the option is considered to have a moderate risk (**Dark Green)** with regard to Supply Chain Constraints, Permits and Wayleaves.

6.4.6 Conclusion of deliverability performance

There are five aspects considered when the overall deliverability performance is assessed. For the up-voltage option, most of these aspects indicate a moderate to high significance. This means that overall this option is considered relatively challenging to deliver, with some risks and unknown technical issues that will have to be solved during the subsequent stages of project development.

The implementation timeline for any network reinforcement is important to be able to ensure that the transmission network will be in compliance with security standards and that all consumers have a secure electricity supply.

On the other hand, this option is assumed to use existing OHL alignments, and indeed uses conductors and structures that are very similar in terms of nature and scale as that existing along those OHL alignments. It does not thereby introduce wholly new overhead line electricity infrastructure into the receiving environment, and this is considered beneficial for the purposes of consenting and social acceptance.

When all of these deliverability aspects are considered, the up-voltage option is deemed to have high to moderate impact (**Blue)** from a deliverability point of view.

Summary of deliverability performance of Up-voltage option	
Implementation timelines	
Project plan flexibility	
Risk of untried technology	
Dependence on other projects	
Supply chain constraints, permits, wayleaves etc.	
Combined Deliverability Performance	

Table 10 *Summary of deliverability performance for up-voltage option*

6.5 Environmental Assessment

This assessment was carried out by Jacobs and a summary of its findings are presented in this report. The detailed Jacobs report (321084AE-REP-002 – CP 966 Environmental Constraints report) is available on our website[21].

6.5.1 Biodiversity

The greatest potential for effects on biodiversity is expected to be during construction as a result of the modification of the OHL. There would be few significant impacts during operation, as a similar footprint is assumed for the new OHL as the existing. EirGrid's Evidence-Based Studies on birds[22] concluded that collisions with power lines were considered to be rare events. Whilst the conductors and towers would be slightly higher, this is not expected to pose a significant collision risk to birds. For the up-voltage of the 220 kV, effects on biodiversity are considered to be moderate (**Dark Green**).

[21] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/
[22] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Evidence-Based-Environmental-Study-5-Birds.pdf

6.5.2 Soils and water

There would be no significant effects from this technology during the operational phase; the effects would only occur during construction. These would be fairly limited as the proposed solution would be to replace the existing 220 kV OHL with towers in the same locations as those currently, thereby minimising excavations of soils and potential impacts on soils and water. For the up-voltage of the 220 kV OHL, effects on soils and water are considered to be low to moderate (**Green**).

6.5.3 Planning Policy and Land Use

It is likely that this technology would accord with regional and local planning policies. From a land use perspective, there would be no significant effects from this technology during the operational phase; the effects would only occur during construction as a result of temporary land take. However, this would not be significant. For the up-voltage of the 220 kV OHL, effects on planning policy and land use are likely to be low (**Cream**).

6.5.4 Landscape and Views

It is likely that the up-voltage of the 220 kV OHL would have some limited effects on landscape and views during operation as a result of the slightly increased height of the towers. There may be some effects during construction, but these are unlikely to be significant. For the up-voltage of the 220 kV OHL, the risk to landscape and views are considered to be low to moderate (**Green**).

6.5.5 Cultural Heritage

It is likely that this technology would have limited effects on heritage assets during operation. There may be some effects during construction, but these are unlikely to be significant if the new towers are installed within a similar footprint as the existing towers. For the up-voltage of the 220 kV OHL, effects on heritage assets are likely to be low (**Cream**).

6.5.6 Summary of Environmental assessment of the Up-voltage option

Having considered the potential environmental impacts for the up-voltage option, it is concluded that this option would have low to moderate environmental impact (**Green**) when all the above aspects were considered. The impacts are mainly related to the construction phase. This option uses existing corridors and maximises existing infrastructure as opposed to introducing the need to build new infrastructure in an area.

Once operational, the up-voltage option would not be significantly different from the current baseline. The technology used will replace existing towers in existing corridors with towers of similar size and scale.

Summary of environmental assessment of Up-voltage option	
Biodiversity	
Soils and water	
Planning policy and land use	
Landscape and views	
Cultural heritage	
Combined Environmental Performance	

Table 11 *Summary of Environmental assessment of the up-voltage option*

6.6 Socio-economic Assessment

This assessment was carried out by Jacobs and a summary of its findings are presented in this report. It should be noted that this is a draft report and it will be finalised after the consultation period has been completed for the project in Step 3. This is normal procedure as this criterion will have to incorporate stakeholder engagement and any feedback resulting from this engagement. The detailed draft Jacobs report (321084AE-REP-003 – CP 966 Strategic SIA Scoping Report) is available on our website[23].

6.6.1 Amenity and Health

The greatest potential impact is during construction. Once installed, the new OHL would look very similar in size and form to the existing OHL. There could be increased anxiety regarding the OHL in operation as a result of the increased voltage and EMF, potentially leading to some stress related health effects, although these would not likely be greater than low to moderate risk. The risk during construction is based on the worst-case scenario of the existing OHL having to be fully dismantled and all foundations removed. For the up-voltage of the 220 kV towers, effects on amenity and health are considered to be a moderate risk (**Dark Green**).

[23] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/

6.6.2 Local Economy

There is some potential for adverse and beneficial effects during construction as a result of possible traffic and access disruption but also additional employment locally. For the up-voltage option, the effects on the local economy are considered to be a low to neutral effect (**Cream**).

6.6.3 Traffic & Transport

There is some potential for adverse effects during construction as a result of possible traffic and access disruption. For the up-voltage of the 220 kV OHL, effects on Traffic and Transport are considered to be a high to moderate risk (**Blue**).

6.6.4 Utilities

It is unlikely that there would be additional third-party utilities to consider for the Up-voltage works as it will utilise the existing locations of towers and foundations. For the up-voltage option, the effects on utilities are considered to be low (**Cream**).

6.6.5 Summary of Socio-economic assessment of up-voltage option

Having considered the above described socio-economic aspects for the proposed up-voltage option, it is considered that it will have a moderate (**Dark Green**) socio-economic impact. This evaluation could be amended depending on the feedback from the stakeholder engagement in Step 3.

Summary of Socio-economic assessment of Up-voltage option	
Amenity and Health	
Local Economy	
Traffic and Transport	
Utilities	
Combined Socio-economic Performance	

Table 12 *Summary of Socio-economic performance for up-voltage option*

6.7 Summary of the assessment for the Up-voltage option

This option would involve using a new technology which would enable the existing 220 kV towers to be modified or replaced, and the 220 kV conductors and insulation hardware to be replaced with 400 kV equipment to create a new Dunstown – Woodland 400 kV circuit. This option performs well under the technical and economic criteria.

As the option seeks to maximise existing infrastructure with minimum new build, the impact on the environmental and socio-economic aspects are less compared with the other options which use new infrastructure. The Deliverability of the option is considered to be challenging. Having considered all of the five criteria, the outcome of the multi criteria assessment indicates that the up-voltage option has a moderate (**Dark Green**) overall performance.

	Option 1 Up-voltage 220 kV to 400 kV
Technical Performance	
Economic Performance	
Deliverability	
Environmental	
Socio-economic	
Combined Performance	

Table 13 *Overall assessment outcome for the Up-voltage option*

7 New 400 kV OHL

This section describes the assessment of a new 400 kV OHL option against the five criteria, and their sub-criteria as described in Section 4.2. Each criterion is described in separate sections and a summary of the overall performance of the option is provided in Section 7.7.

The assessments for the environmental and socio-economic criteria have been carried out by Jacobs, and a summary of its findings are presented in this report. Jacobs' detailed reports of these assessments can be found on our website and the links can be found in Section 2.1.

7.1 Description of option

This option involves a suite of transmission network reinforcements centred on strengthening the network between the existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. These consist of:

- Construction of a new 400 kV overhead line linking Dunstown 400 kV station to Woodland 400 kV station. For the purpose of this investigation, we have assumed the length of the overhead line to be approximately 50 km;
- Two dynamic reactive support devices, located preferably in the vicinity of Belcamp 220 kV station in north County Dublin and Dunstown 400 kV station in County Kildare. Appendix 1 provides clarification on the location of Belcamp station. The devices would be connected at 220 kV and rated at approximately ±250 Mvar each;
- This option would require work in the Woodland and Dunstown 400 kV stations to facilitate the connection. Bays would have to be constructed on the 400 kV busbars in both stations. The Dunstown station would require an extension to the 220 kV busbar to accommodate the dynamic reactive support device in Dunstown.

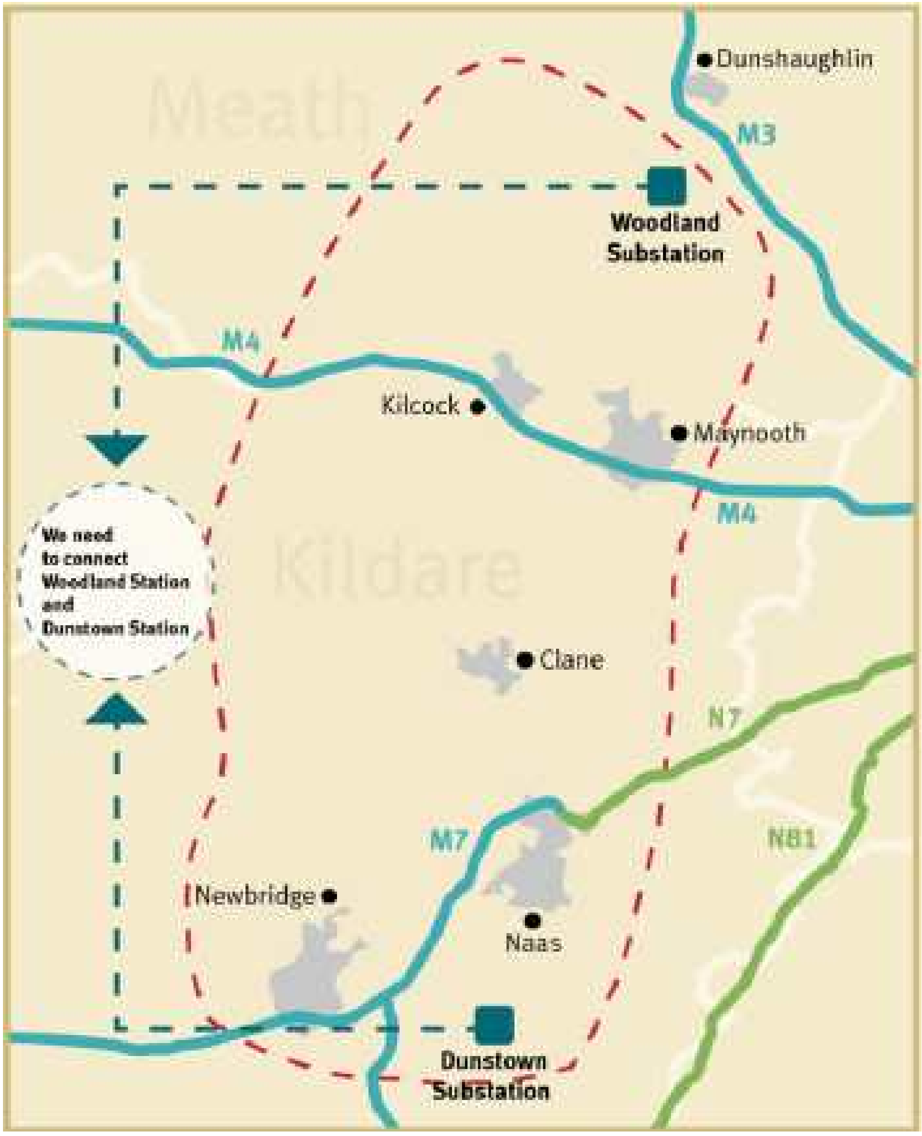

Figure 10 *Illustrative map showing the study area where the new 400 kV OHL option could be located.*

7.2 Technical Performance

7.2.1 Compliance with health and safety standards

Please refer to Section 6.2.1 for a detailed description. The new 400 kV OHL option will be compliant with the relevant safety standards, and is considered to have a low (**Cream**) risk of not complying with health and safety standards.

7.2.2 Compliance with Security and Planning Standards

The security standards of the transmission network are defined in the following:

- The Transmission System Security and Planning Standards (TSSPS)[24]; and
- The Operational Security Standards (OSS)[25].

These standards will ensure that the system is planned and operated in a manner which adheres to system security and integrity, and reliability of supply criteria.

The 400 kV OHL option proposed will comply with the relevant system reliability and security standards referenced above. Although the option will meet the minimum technical requirements, certain aspects may differentiate the option's technical performance compared to other options. A high level summary of the technical aspects considered and investigated is presented below.

The need analysis indicated that, without mitigation, single contingencies (the unexpected loss of a circuit or piece of equipment), such as the loss of any of the 400 kV circuits, the loss of any of several major 220 kV circuits or the loss of any of several generators or interconnectors leads to major voltage issues and voltage collapse in the counties of Dublin, Kildare, and Meath in particular, and sometimes extends towards the South East, Midlands and North East. The analysis indicates widespread low voltage and voltage collapse issues across a large part of the country for certain single contingencies.

When the 400 kV OHL option is added to the system model, the analysis indicates an improvement in these issues by reducing the extent of the indicated voltage collapses in Winter Peak from 47 to 9. These improvements were similarly indicated for the Summer Peak cases. Despite the improvement in security of supply provided by the 400 kV OHL circuit, the option also requires two additional dynamic reactive support devices to comply with the TSSPS.

The need analysis indicated capacity problems related to thermal overload and highly loaded circuits. When the 400 kV OHL option is added, the overall loading of the circuits under an intact network is reduced. However, this solution results in increased congestion on some circuits in the Dublin area.

In terms of voltage phase angle, this option performs well as it reduces the difference in voltage phase angle to 18˚ between the Oldstreet and Woodland stations post the single

[24] EirGrid, Transmission System Security and Planning Standards, 2016 (http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Transmission-System-Security-and-Planning-Standards-TSSPS-Final-May-2016.pdf
[25] EirGrid, Operational Security Standards, 2011 (http://www.eirgridgroup.com/site-files/library/EirGrid/Operating-Security-Standards-December-2011.pdf)

contingency on the Oldstreet – Woodland 400 kV circuit. This is a reduction of 13˚ compared to the needs analysis.

An assessment was undertaken into keeping the transmission network within standards following a loss of plant and equipment while another is out for planned maintenance. Maintenance is carried out annually during March to October. For planned outages, some re-dispatch of generation is allowed, but this should be kept to a minimum to ensure the most cost effective generation is dispatched.

The assessment shows that the capacity ratings of 33 circuits were exceeded for multiple maintenance and contingency trip combinations (N-1-1). The highest circuit capacity loading observed was 157.1%. This is a reduction compared to the issues indicated in the needs assessment, which highlighted 42 circuits had exceeded their thermal rating with a worst case loading of 177.5%.

When all aspects are considered, the 400 kV OHL option is considered to have good compliance when assessed against the above standards and hence has been given a low impact (**Cream**) in the assessment.

7.2.3 Reliability performance

This criterion has been assessed using three inputs namely unplanned outages, planned outages and the time it takes to repair the circuit. The collective impact of these provides an indication of the annual availability of the asset. The reliability and outages of the station equipment associated with the circuit is assumed to be same for all options and is therefore not included in this analysis.

The statistics for reliability are based on EirGrid's and international failure statistics, the mean time to repair and the availability in days per 100 km per year for OHL and UGC. It has been assumed that the new OHL circuit will be approximately 50 km in length for the purpose of this assessment.

There are 439 km of existing 400 kV OHLs in Ireland. This length of 400 kV OHL is too small a sample for determining meaningful performance statistics.

Meaningful statistics can, however, be obtained by considering the fault statistics of the combined quantity of 400 kV, 275 kV and 220 kV OHLs (approximately 2326 km) in the All-Island transmission system.

Unplanned Outages:

Almost all OHL faults are of short duration as a result of transient faults such as lightning strikes. If an auto-reclose function is provided for the protection of the line, it will restore the circuit shortly after the fault, generally in 0.5 – 3 seconds. Even if the line suffers physical damage, faults can be rapidly located and identified by visual inspection from the ground or air, and repairs effected in a matter of hours. Transmission system statistics indicate that 91.5 % of overhead line outages lasted less than one day[26].

Taking the fault statistics of the above combined network length of OHL for the period 2004 to 2018, gives a projected fault rate of 0.38 unplanned outages/100km/year.

Given typical repair times, this would equate to the circuit being out of service due to a permanent fault for less than 9 hours per annum. The average failure rates during normal operation, average repair times and availabilities of the main elements of a typical 400 kV OHL are set out in Table 14 and adjusted to reflect the length of the proposed option.

Transient faults are not considered, as any interruptions to supply that they may cause would be of such short duration that their effect is considered to be negligible, despite being an inconvenience for electricity users.

Planned outages:

Planned outages are normally associated with routine maintenance. For a 400 kV OHL, much of the required routine maintenance can be completed without an outage of the circuit. The planned outage rates and the typical outage durations taken from our maintenance policies[27] result in an annual planned outage rate of 0.65% for the 400 kV option, or circa 2.5 days per annum[28].

Combination of the planned and unplanned outages:

Due to the length of the new OHL circuit (approximately 50km), the total unplanned outage time per year is circa 9 hours, which combined with the planned outage rate of 2.5 days sums to a total of 3 days per annum (rounded to nearest half day).

[26] EirGrid, Analysis of Disturbance and Faults 2018, System Performance, April 2019
[27] EirGrid, Routine Maintenance Activities Overhead Transmission Lines, April 2018
[28] EirGrid, Transmission Engineering Maintenance Statistics

Parameter	Average statistics for 400 kV & 220 kV OHL combined
Reliability (Unplanned outages/50km/year)	0.19
Mean time to repair (days)	Circa 2 days
Unplanned Outages (combined) Unavailability due to disturbance (days/50km/year)	0.38 days (c.9 hours)
Planned Outages	2.5 days
Total Annual Unavailability (days/50km/year)	3 days

Table 14 *Average failure statistics for a 50 km 400 kV OHL*

The availability rate for this OHL option is high at 99.2% over any given year and this OHL option is deemed to have a low risk of introducing additional reliability issues in the system (**Cream**).

7.2.4 Headroom

The new 400 kV OHL option accommodates a similar amount of large-scale demand in the Dublin and Mid-East region compared to option 1, the Up-voltage option.

The assessment indicates that the 400 kV OHL option creates headroom (increases the amount of additional large-scale demand that could be accommodated) of approximately 100 - 190 MW compared to no reinforcement, depending on which scenario is analysed. As indicated in Section 7.2.2, the option requires two dynamic reactive support devices to be in compliance with planning and security standards of the transmission network. With two dynamic reactive support devices added, the total headroom created by this option is approximately 400 - 500 MW depending on which scenario is analysed.

The 400 kV OHL option performs well in the headroom criteria compared to the other options and is deemed to have a moderate (**Dark Green**) performance in terms of headroom.

7.2.5 Expansion or extendibility

The 400 kV OHL option is based on Overhead Line (OHL) technology and has a thermal capacity[29] equivalent to the existing 400 kV circuits. The option provides a platform for future demand or generation development within the east of the country.

In the event that another connection along the circuit would be required, this could be achieved by constructing another station which could be connected into this line. This is a very common way to expand the transmission network and is normally technically feasible and achievable, depending on the required connection size. As such, this option has the potential to provide a base for any further expansion of the transmission network and the option offers a low to moderate (**Green**) difficulty to accommodate potential future expansion.

7.2.6 Repeatability

Overhead Line (OHL) technology is already in use on the Irish transmission system with more than 4,500 km of circuit length. This criterion is assessed on a technical basis and there are few technical issues with OHL technology that would introduce additional system integration, operational, and maintenance complexity that would affect the repeatability of OHL circuits on the Irish transmission system. There may of course be other challenges with OHL technology, but they are assessed under other criteria. This option is considered to have a low risk of not meeting the repeatability criteria (**Cream**).

7.2.7 Technical operational risk

The new 400 kV overhead line option is based on Overhead Line (OHL) technology. This technology is tried and tested internationally and in Ireland and it is considered to have a low operational risk. This option is therefore considered lowest on the difficult/ risk scale (**Cream**) in terms of operational risk.

[29] Thermal capacity of existing 400 kV OHL is a winter rating of 2963 A and summer rating of 2506A based on conductor 2 x 600 mm2 ACSR CURLEW at 80°C,

7.2.8 Conclusion of technical performance

This option is considered to perform very well when all of the technical sub-criteria are considered and hence has been given a low impact (**Cream**) in the assessment.

Summary of technical performance of 400 kV OHL option	
Health and Safety Standard compliance	
Security & Planning Standard compliance	
Reliability performance	
Headroom	
Expansion or Extendibility	
Repeatability	
Technical Operational risk	
Combined Technical Performance	

Table 15 *Summary of technical performance for 400 kV OHL option*

7.3 Economic Performance

The economic performance of the options is represented using our colour scale with the individual performance of an option assessed relative to the performance of the other solution options.

7.3.1 Input cost to the economic appraisal

7.3.1.1 Pre-engineering cost

The pre-engineering costs are estimated to be €11.2 million. In the economic appraisal, a contingency provision of 5% has been applied to this amount.

The phasing of the pre-engineering costs is as follows:

	2021	2022	2023	2024	2025	2026
Phasing of Pre-Engineering Spend	36%	24%	17%	10%	10%	3%

Table 16 *Phasing of pre-engineering spend for Option 2 – New 400 kV OHL*

7.3.1.2 Implementation cost

The capital investment required to deliver the new 400 kV OHL option is estimated to be €168 million. A provision for Transmission System Operator (TSO) related implementation cost and landowner payments, proximity allowance and local community fund has been included in this cost. In the economic appraisal, a contingency provision of 10% has been applied to this amount. The estimated implementation cost is categorised into its general components and is summarised in Table 17.

Categorised implementation cost Option 2 – 400 kV OHL	
Cost category	**Implementation cost (€m)**
Overhead line	64.2
Underground cable	N/A
Stations	10.4
STATCOMs	66.0
Other (flexibility & proximity payments and other allowances)	27.5
SUB-TOTAL	168
Contingency (10%)	16.8
TOTAL	185

Table 17 *Categorised implementation cost for Option 2*

The phasing of the implementation costs is as follows:

Phasing of implementation spend – 400 kV OHL option										
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
4%	5%	20%	21%	13%	10%	10%	6%	5%	5%	1%

Table 18 *Phasing of implementation cost spend for Option 2*

7.3.1.3 Life-cycle cost

This sub-criterion consists of three separate inputs incurred over the useful life of the option, namely operation and maintenance cost, electrical losses and replacement cost.

The equipment associated with the new OHL option is expected to be maintained in accordance with the well-established existing practices. The operation and maintenance cost varies over the assets' life time and as such three periods of approximate costs are assumed. Table 19 displays rounded figures to the nearest thousand. No replacement cost is assumed as the equipment has a life expectancy of 50 years which is line with the period for the economic assessment.

Life-cycle cost for up-voltage option		
Annual Operation and maintenance cost (€k)	0-20 year period	€420k
	21-40 year period	€524k
	41-50 year period	€86k
Annual Electrical losses cost (€k)	-€529k*	
Replacement cost	N/A	

Table 19 *Life-cycle cost for Option 2*

*This option will reduce the losses and as such is a saving.

7.3.1.1 Cost to Single Electricity Market

As described in Section 4.2.2, Economic performance criteria, the cost to the Single Electricity Market represents the cost for the periods when the reinforcement is unavailable. The unavailability is based on the reliability performance of the option. This is a cost to the single electricity market and is calculated as a combination of the benefit in production cost saving (project benefit) and reliability performance of the option.

The reliability performance of the option is taken from Section 7.2.3 Reliability. The production cost savings assessment used the TES 2019 scenarios and as such a range of annual production cost savings are used in the assessments as the different scenarios have different demand and generation patterns. Table 20 show the input for this criterion.

Cost to Single Electricity Market for 400 kV OHL option	
Annual Production cost saving (Benefit) (€m/annum)	Range €1m to €20m
Annual unavailability of option during which benefits cannot be attributed	Unavailable for 3 days, available 99.18%
Annual Cost (saving) to SEM	Range €0.99m to €19.84m

Table 20 *Cost to single electricity market for Option 2*

7.3.1 Economic performance for Option 2 – New 400 kV OHL

When all of the above costs and savings are considered, the economic result of the new 400 kV OHL (Option 2) indicates a very good result compared to the other options and hence is considered to have a low (**Cream**) impact on the economic result. To be able to differentiate between competing options in a measured way and to check the options' performance in different credible future energy scenarios, a robustness and sensitivity test was carried out. The objective is to identify the option that is impacted the least in its economic result for a range of credible future energy scenarios. This robustness test indicates a stable performance compared to the other options independent from which future energy scenario is used in the assessment.

After considering both the economic result and the robustness test, the new 400 kV OHL (Option 2) is considered to provide a very good economic performance in comparison with the other options and hence has been given a low impact (**Cream**) in the assessment.

Summary of economic performance of the new 400 kV option	
Economic result	
Robustness	
Combined Economic Performance	

Table 21 *Summary of economic performance for new 400 kV option*

7.4 Deliverability

7.4.1 Implementation timelines

The expected timeline for implementation of the 400 kV overhead is a period of 15 years in total. This time frame can be divided into two phases.

The first phase is based on 4.25 years for the outline design, environmental assessment and the planning process, and would be subject to the outcome of the consenting process.

The second phase is 10.75 years and includes detailed design, procurement of materials and construction works. This assumption includes time for the design to be confirmed, all landowner consents to be obtained by EirGrid including the use of compulsory acquisition powers if necessary, and materials procurement in the first 5.75 years of this period.

This includes a period of one (1) year to allow for a modification of the approved planning permission, which in EirGrid's experience of grid development is a normal process, as the permitted development is subject to detailed design and the accommodation where possible of landowner preferences for tower siting. The time to construct the OHL (five (5) years) includes construction access, foundation works, tower erection and stringing which would include sections that require transmission outages.

The design works, material procurement and construction period for the works required in the existing stations has been incorporated into the above timeline for the OHL works. The timeline for new 400 kV bays at Dunstown and Woodland 400 kV stations is estimated at 1.5 years. Dunstown station would require an extension to the 220 kV busbar to accommodate the additional bay needed to accommodate the dynamic reactive support device and this work is anticipated to take 2.5 years. The installation of the dynamic reactive support devices at Belcamp (into spare bay) and Dunstown is anticipated to take three (3) years.

The implementation timeline for the 400 kV OHL option is the longest compared to the other options. The impact of the implementation timelines is assessed to be high (**Dark Blue**) for the 400 kV OHL option.

7.4.2 Project plan flexibility

Route corridors for the OHL would be developed in Step 4 of our grid development process and would factor in constraints in the study area. Within the corridors, there would be a reasonable level of flexibility to identify the OHL routes. Once the route options have considered all the constraints, an emerging preferred OHL route would be the basis for the planning submission.

The preferred route would be designed within the identified corridor and the design would consider the access routes for construction, stringing locations and tree cutting requirements. The design would be completed to a level that we would consider the foundation requirements and would identify all the requirements for the line construction.

There would be very little flexibility on the route once the planning consent is in place. Some of the tower locations may have the potential for minor modifications, which could require a modification to the planning consent. Access routes to the tower locations would also form part of the planning consent and changes to these would also require modification to the planning consent.

The 400 kV OHL option is assessed to have a moderate (**Dark Green**) impact on the project plan flexibility compared to the other options.

7.4.3 Risk to untried technology

OHL technology is tried and tested in Ireland and internationally. This technology is considered international best practice and is a proven technical solution for transmission of high-voltage electricity. It is the technology around which the transmission network in Ireland has been developed to date. Nevertheless, it has been some time since new 400 kV infrastructure was built in Ireland and therefore it is not without some technological risk. Overall, this option is considered to have a moderate (**Dark Green**) risk in relation to this sub-criterion when compared to the other options.

7.4.4 Dependence on other projects (outages)

This option has a number of elements which would require planned outages. There are a number of existing 220 kV and 110 kV overhead lines which would need to be crossed between Dunstown and Woodland stations. These would require a transmission outage to allow the line stringing to take place.

The required work in both Woodland and Dunstown stations would need proximity and commissioning outages. In Woodland, the work is in relation to the construction of the 400kV bay. In Dunstown, the work involves the construction of an extension to the 220 kV busbar, which would be required to connect the dynamic reactive support device. The works required to connect the dynamic reactive support device at Belcamp station would also require commissioning outages.

Other on-going projects in both these stations may cause conflicting outages depending on the projects’ individual programmes and this would have to be taken into consideration and could have impacts on granting necessary outages.

The impact on the dependence on other projects for the 400 kV overhead line option is considered to be at a low to moderate (**Green**) level.

7.4.5 Supply chain constraints, permits, wayleaves

For the purposes of this analysis, it is assumed that 400 kV structures, apparatus and equipment would be equivalent, if not similar in terms of nature and extent of materials, to that being planned and procured for the North South Interconnector (NSIC) development. There are no significant supply chain constraints envisaged, with standard procurement and design timelines and scopes involved.

Permitting is likely to be very challenging, with the provision of new 400 kV OHL infrastructure in what can be described as a peri-urban commuter belt of the Greater Dublin Area, irrespective of final design and location. The Woodland station is also the terminus of the existing Moneypoint – Woodland 400 kV OHL circuit, and the permitted North-South Interconnector (NSIC) 400 kV OHL.

Based on established precedent, the infrastructure development comprising the provision of a new 400 kV OHL circuit is likely to be the subject of an application directly to An Bord Pleanála (ABP) as Strategic Infrastructure Development (SID). Given the nature of the proposed development as comprising a new 400 kV OHL circuit, the planning application would be subject to Environmental Impact Assessment (EIA). These factors make it almost inevitable that ABP would hold a full Oral Hearing in respect of a new 400 kV OHL development.

A new 400 kV OHL circuit would need to be located on a new alignment. This would result in potentially significant environmental and social impacts on receiving environments and communities, including biodiversity, land use activities, and visual impacts. Social impacts may include community concerns regarding the provision of new large-scale OHL within an area.

Significant engagement with landowners and communities would be required in the delivery of the new circuit, for such purposes as surveying, siting and construction. These parties may be new to accommodating electricity infrastructure on their landholdings and within their communities.

New wayleaves would be required to facilitate construction of the new circuit. Based on recent precedent in terms of the provision of new 400 kV transmission infrastructure, there is the potential for significant landowner, community and public concerns with this option, with the likely consequence of project delays or difficulties in gaining access to land.

Having regard to all the above aspects, the 400 kV OHL option is deemed to have a significant (**Dark Blue)** impact and risk in terms of Supply Chain Constraints, Permits and Wayleaves.

7.4.6 Conclusion of deliverability performance

There are five aspects considered when the overall deliverability performance is assessed. For the new 400 kV OHL option, two of the aspects indicate a significant risk to the deliverability of the reinforcement. The two areas that have a significant risk identified are implementation timelines and required permits and wayleaves.

This is a new 400 kV OHL development and based on experience on other similar OHL projects, permitting would be expected to be very challenging due to societal acceptance of such a development. This means that overall the option could very likely experience delays in its development compared to the other options.

The implementation timeline for any network reinforcement is important to be able to ensure that the transmission network will be in compliance with security standards and that all consumers have a secure electricity supply. The time it takes to develop and construct reinforcements is also important in terms of accommodating new generation and demand that would like to connect to the system.

This option has the longest implementation timeline compared to the other options and this, in combination with the perceived risk of delays due to societal acceptance, means this option does not perform well from a deliverability point of view and this has been taken into account in the overall assessment of this option.

When all of these deliverability aspects are considered the 400 kV OHL option is deemed to have a very high and significant impact (**Dark Blue)** from a deliverability point of view. Table 22, presents the conclusion of each sub-criterion and the overall assessment.

Summary of deliverability performance of new 400 kV OHL option	
Implementation timelines	
Project plan flexibility	
Risk of untried technology	
Dependence on other projects	
Supply chain constraints, permits, wayleaves etc.	
Combined Deliverability Performance	

Table 22 *Summary of deliverability performance for 400 kV OHL option*

7.5 Environmental Assessment

This assessment was carried out by Jacobs and a summary of its findings is presented in this report. The detailed Jacobs report (321084AE-REP-002 – CP 966 Environmental Constraints report) is available on our website.

7.5.1 Biodiversity

During construction, permanent habitat loss would be one of the significant impacts. Additional temporary loss of habitats, including biodiversity-rich hedgerows and ditches may occur to accommodate temporary works. During operation there would be pruning requirements for mature trees and there is a potential collision risk to whooper swans and other bird species from the new OHL. For the new OHL, effects on biodiversity are considered to be low to moderate (**Green**).

7.5.2 Soils and water

There would be no significant effects from this technology during the operational phase; significant effects would only occur during construction. The potential level of impact significance during construction would be likely to be limited as the proposed solution would avoid designated water bodies and excavations would be limited to the tower foundations; access tracks from local roads would require minimal soil strip in site preparation. The significant karst feature to the north of Woodland station would not be affected as any new connection would come from the south. For the new OHL option, effects on soils and water are considered to be low to moderate (**Green**).

7.5.3 Planning Policy and Land Use

As a worst case, it is possible that this technology would not fully accord with county planning policies as new structures are proposed and the route is not yet defined, however it is assumed that protected areas would not be crossed, main settlements avoided and the more sensitive landscape also avoided where possible.

From a land use perspective, there may be a small number of significant effects on particular parcels of land during the operational phase. For the new OHL option, effects on planning policy and land use are considered to be moderate (**Dark Green**).

7.5.4 Landscape and Views

As set out above, there is potential for effects on landscapes and views across the Study Area, and the new OHL could be in the order of 50km in length depending on the exact route. However, with the more sensitive landscapes, viewpoints and main settlements largely avoided, this effect would be moderate to high. This would be an effect during the operation of the OHL, effects on landscape and views would be limited and not likely to be significant during construction. For the new OHL option, effects on landscape and views are considered to be moderate to high (**Blue)**.

7.5.5 Cultural Heritage

There is a combined effect of the potential for harm to unknown archaeological assets during construction and to the setting of built heritage assets during operation. Of these two potential effects, however, it is during operation that the more significant effects are likely to arise. For the new OHL option, effects on heritage assets are considered to be moderate risk (**Dark Green**).

7.5.6 Summary of Environmental assessment of a new 400 kV OHL

Having considered the potential environmental impacts for the new OHL option it is concluded that this option will have moderate environmental impact (**Dark Green**) with a mixed impact during both the construction and operational phase. Table 23, presents the conclusion of each sub-criterion and the overall assessment.

Summary of environmental assessment of a new 400 kV OHL option	
Biodiversity	
Soils and water	
Planning policy and land use	
Landscape and views	
Cultural heritage	
Combined Environmental Performance	

Table 23 *Summary of Environmental assessment of a new 400 kV OHL option*

7.6 Socio-economic Assessment

This assessment was carried out by Jacobs and a summary of its findings is presented in this report. It should be noted that this is a draft report and it will not be finalised until after the consultation period has been completed for the project in Step 3. This is normal procedure as this criterion will have to incorporate stakeholder engagement and any feedback resulting from this engagement. The detailed draft Jacobs report (321084AE-REP-003 – CP 966 Strategic SIA Scoping Report) is available on our website – see Section 2.1 for the link.

7.6.1 Amenity and Health

There would be a moderate to high risk impact during construction. However, this solution proposes a new OHL in an area which is heavily constrained by communities and it is likely that it would be routed within 200m of some properties and community facilities. During operation, therefore, there could be an amenity effect from the combined effects of noise and visual impact from the new OHL as well as increased anxiety relating to EMFs, potentially leading to some stress related health effects. For the new OHL, effects on amenity and health are considered to be high to moderate risk (**Blue**).

7.6.2 Local Economy

The effects on the local economy could be quite mixed; both adverse and beneficial effects are possible. With careful routing to avoid significant industrial, tourism and equine sites, it is not considered that there would be significant adverse effects. On the basis that this is not always possible, a low to moderate (**Green**) impact on the local economy has been identified. Beneficial effects, whilst welcome, are not likely to be significant in the local economy.

7.6.3 Traffic & Transport

There is some potential for adverse effects during construction as a result of possible traffic and access disruption and temporary effects on the conditions of local roads. For the new OHL option, effects on traffic and transport are considered to be moderate to high risk (**Blue**).

7.6.4 Utilities

There is some potential for disruption; this would necessarily occur during construction as other utilities may need to be removed or diverted to accommodate the new 400 kV OHL. For the new OHL option, effects on utilities are considered to be low (**Cream**).

7.6.5 Summary of Socio-economic assessment of a new 400 kV OHL option

It should be noted that the above sub-criteria have not considered social acceptance or any feedback from the stakeholder engagement as the announcement of the EBPO happens at the start of the consultation period. To account for this aspect, and mindful of previous experience with 400 kV OHL line technology in projects, EirGrid has deviated from the draft outcome of Jacobs' assessment for the overall performance assessment for this criterion. Jacobs' draft overall outcome, without the feedback from the stakeholder engagement, was given a moderate (Dark Green) impact in regards to this criterion.

Having considered the different aspects in this criterion, and to reflect an anticipated outcome from the stakeholder engagement in regards to this option, it is considered that a new 400 kV OHL option would have a high (**Dark Blue**) socio-economic impact. This evaluation could be amended depending on the feedback from the stakeholder engagement in Step 3. Table 24, presents the conclusion of each sub-criterion and the overall assessment.

Summary of Socio-economic assessment of a new 400 kV OHL option	
Amenity and Health	
Local Economy	
Traffic and Transport	
Utilities	
Combined Socio-economic Performance	

Table 24 *Summary of Socio-economic performance for a new 400 kV OHL option*

7.7 Summary of the assessment for the 400 kV OHL option

This option would involve constructing a new 400 kV OHL. This option is the best performing option in the technical and economic criteria compared to the other options. The environmental criterion is considered to be of moderate impact when compared to the other options.

Based on other projects of a similar nature, some aspects under the deliverability and the socio-economic criteria are anticipated to be very challenging and would bring high risks to the completion of the project.

Having considered all of the five criteria, the outcome of the multi-criteria assessment indicates that the new 400 kV OHL option (Option 2) does not perform very well and it has been given a high impact (**Dark Blue**) on its overall performance i.e. the worst performance in terms of the colour scale used.

	Option 2 400 kV OHL
Technical Performance	
Economic Performance	
Deliverability	
Environmental	
Socio-economic	
Combined Performance	

Table 25 *Overall assessment outcome for the 400 kV OHL option*

8 New Underground Cable options

This section describes the assessment of the new underground cable options against the five criteria and their sub-criteria as described in Section 4.2. Each criterion is described in separate sections below and a summary of the overall performance of the option is provided in Section 8.7.

The assessments for the environmental and socio-economic criteria have been carried out by Jacobs, and a summary of its findings is presented in this report. Jacobs' detailed reports of these assessments can be found on our website and the links can be found in Section 2.1.

Due to the nature of UGC options, additional investigations were carried out to better inform the assessment from a feasibility and technical point of view. There are certain aspects that we need to understand before an UGC option can be deemed feasible. For instance, the power carrying capacity (rating) of the cable is dependent on how it is laid in the ground.

These investigations included how wide the cable trench would have to be to meet the required power carrying capacity (rating) and a high level feasibility study to determine if indicative feasible routes (which achieve required capacity ratings) can be found in the road network in the study area and what type of obstacles the cables may have to cross. Jacobs carried out this assessment and its detailed report (321084AE-REP-001 Rev C – Cable route feasibility report) can be found on our website – see Section 2.1 for the link.

Also, other technical behaviours of UGCs had to be examined to avoid the cables causing damage to other electrical equipment once installed. These investigations included cable integration studies and indicative reactive compensation requirements, harmonic filter requirements, and temporary overvoltage assessments (TOV).

PSC carried out these assessments and its detailed report (Final report for Capital Project 966 Cable Integration Studies – JI7867-03-02 (Rev2)) can be found on our website – see Section 2.1 for the link.

Further investigations will have to be carried out in relation to these issues if any of the underground cable options are brought forward to Step 4 to reflect the actual route and parameters of the cable option.

8.1 Description of underground options

There were originally two underground cable options taken forward to Step 3. During the investigations in Step 3, another underground option was added to take account of the UGC and their ability to provide power carrying capacity (rating) depending on, among other things, the width of the cable trench and voltage level. Ideally, we would like all options to provide an equal power rating capacity, but we also know that as this may trigger UGC options which have other technical limitation and challenges in deliverability. As a result, the three UGC options have different technical abilities and deliverability aspects.

Option 3A, a new Dunstown – Woodland 220 kV UGC, was investigated as 220 kV cables generally have fewer technical issues than 400 kV cables in terms of reactive compensation requirements, harmonic filter requirements, and temporary overvoltage assessments (TOV). This option provides the lowest thermal capacity of all options, but was brought forward to Step 3 in case it was found that 400 kV UGC could not be accommodated on the network.

Option 3B, a new Dunstown – Woodland 400 kV UGC (one circuit constructed along one route), was developed to maximise the power carrying capacity (rating) using only one 400 kV circuit. From other projects, we know that this will not provide an equal power carrying capacity (rating) to standard 400 kV OHLs, but it may provide other benefits when the assessment criteria are examined in more detail. As a result, this option has a lesser power carrying capacity (rating) than our standard 400 kV OHLs.

Option 3C, a new Dunstown – Woodland 400 kV UGC (two circuits constructed along two separate routes), would provide an equivalent power carrying capacity (rating) to our standard 400 kV OHLs but presents other challenges when assessed against the other criteria.

All UGC options involve a suite of transmission network reinforcements centred on strengthening the network between existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath.

A dynamic reactive support device, located preferably in the vicinity of Belcamp 220 kV station in north county Dublin is also required for each UGC option. Appendix 1 provides detail of the location. The device would be connected at 220 kV, and rated at approximately ±250 Mvar and is common to all of the underground cable options.

The underground cable options are:

- Option 3A: New Dunstown – Woodland 220 kV UGC

In addition to the new cable circuit, the following are required:

- Uprating of the Oldsteet – Tynagh 220 kV overhead line
- Woodland and Dunstown station would require extensions to the 220 kV busbars to facilitate the connection.
- Shunt reactors (50 Mvar) at each end of the cable
- Possible filters (to be determined at design phase to take account of more accurate data)

- Option 3B: New Dunstown – Woodland 400 kV UGC (one circuit constructed along one route)

  In addition to the new cable circuit, the following are required:

  - Bays would have to be constructed on the 400 kV busbars in both Woodland and Dunstown stations
  - Shunt reactors (145 Mvar) at each end of the cable
  - Possible filters (to be determined at design phase to take account of more accurate data)

- Option 3C: New Dunstown – Woodland 400 kV UGC (two circuits constructed along two separate routes)

  In addition to the new cable circuits, the following are required:

  - Bays would have to be constructed on the 400 kV busbars in both Woodland 400 kV station and Dunstown 400kV station.
  - Shunt reactors (435 Mvar) at each end of the circuit, before the two cables enter into the 400 kV bay
  - Possible filters (to be determined at design phase to take account of more accurate data)

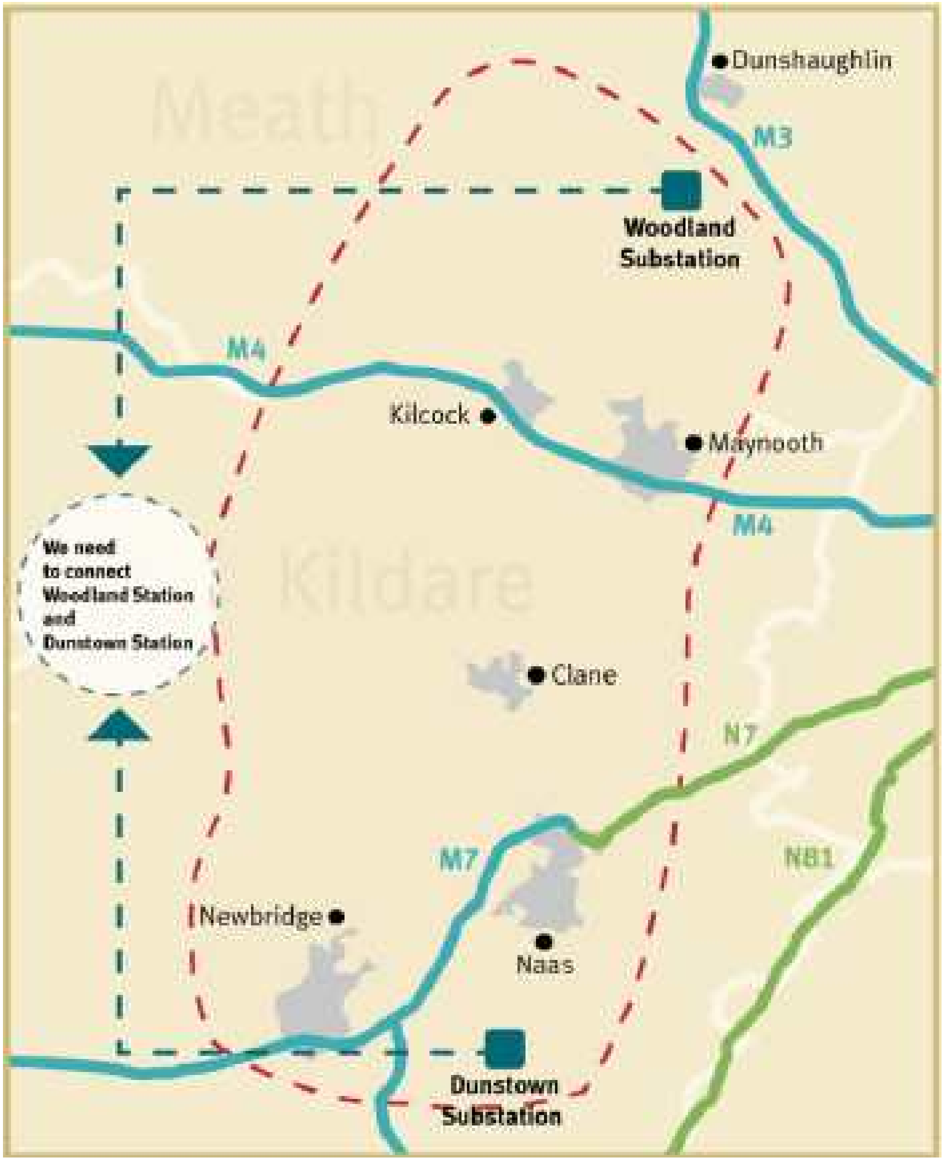

Figure 11 *Illustrative map showing the study area where the UGC options could be located.*

8.2 Technical Performance

8.2.1 Compliance with health and safety standards

Please refer to Section 6.2.1 for a detailed description. All underground cable (UGC) options perform the same for this criterion. All of the UGC options would comply with health and safety standards and hence have been given a low (**Cream**) impact in the assessment.

8.2.2 *Compliance with Security and Planning Standards*

The security standards of the transmission network are defined in the following:

- The Transmission System Security and Planning Standards (TSSPS)[30]; and
- The Operational Security Standards (OSS)[31].

These standards will ensure that the system is planned and operated in a manner which adheres to system security and integrity, and reliability of supply criteria.

The UGC options proposed would comply with the relevant system reliability and security standards above. Although the options would meet the minimum technical requirements, certain aspects may differentiate each option's technical performance compared to other options. A high level summary of the technical aspects considered and investigated is presented below.

The need analysis indicated that, without mitigation, single contingencies (the unexpected loss of a circuit or piece of equipment), such as the loss of any of the 400 kV circuits, the loss of any of several major 220 kV circuits or the loss of any of several generators or interconnectors leads to major voltage issues and voltage collapse in the counties of Dublin, Kildare, and Meath in particular, and sometimes extending towards the South East, Midlands and North East. The analysis indicates widespread low voltage and voltage collapse issues across a large part of the country for certain individual contingencies.

When the UGC cable options are added to the system model, the analysis indicates an improvement in these issues by reducing the extent of the indicated voltage collapses in Winter Peak from 47 to 2 for Option 3A and to 1 for Options 3B and 3C. These improvements were similarly indicated for the Summer Peak cases. Despite the improvement in security of supply, the UGC options required one additional dynamic reactive support device to comply with the TSSPS.

The need analysis indicated capacity problems related to thermal overload and highly loaded circuits. When the UGC options are added, the overall loading of the circuits under an intact network is reduced. However, these solutions result in increased congestion on some circuits in the Dublin area under certain operating conditions. In addition, when Option 3A is added to the system model, the analysis showed an overload on the Oldstreet – Tynagh 220 kV circuit and so it is required to be uprated for

[30] EirGrid, Transmission System Security and Planning Standard, 2016 (http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Transmission-System-Security-and-Planning-Standards-TSSPS-Final-May-2016.pdf
[31] EirGrid, Operational Security Standards, 2011 (http://www.eirgridgroup.com/site-files/library/EirGrid/Operating-Security-Standards-December-2011.pdf)

this option to be compliant with the TSSPS. Connecting the required Woodland and Dunstown stations using a 220 kV voltage level will not support the network as effectively as the other options in transferring the electricity to where it is needed. The uprate of Oldstreet – Tynagh 220 kV circuit is not required for Options 3B and 3C.

In terms of voltage phase angle, Option 3A performs the least well of all options as it reduces the difference in voltage phase angle to 28˚ between the Oldstreet and Woodland stations post the single contingency on the Oldstreet – Woodland 400 kV circuit. This is a reduction of only 3˚ compared to that observed in the needs analysis.

In terms of voltage phase angle, options 3B and 3C perform well, as they reduce the difference in voltage phase angle to 17˚ and 16˚ between the Oldstreet and Woodland stations post the single contingency on the Oldstreet – Woodland 400 kV circuit, respectively. This is a reduction of 14˚ and 15˚, respectively, compared to that observed in the needs analysis.

An assessment was undertaken into keeping the transmission network within standards following a loss of plant and equipment while another is out for planned maintenance. Maintenance is carried out annually during March to October. For planned outages, some re-dispatch of generation is allowed, but this should be kept to a minimum to ensure the most cost effective generation is dispatched.

The assessment shows that the capacity ratings of 33 circuits were exceeded for multiple maintenance and contingency trip combinations (N-1-1) for Option 3B and Option 3C. The highest circuit capacity loading observed was 157.8%. The amount of circuits observed is a reduction compared to the issues indicated in the needs assessment, which highlighted 42 circuits had exceeded their thermal rating with a worst case loading of 177.5%. This will have a positive effect on the amount of generation that will have to be re-dispatched to overcome circuits exceeding their capacity limits during maintenance.

The assessment for Option 3A shows the same circuits, as above, exceeding the capacity ratings for multiple maintenance and contingency trip combinations (N-1-1). The circuit capacity loadings observed with Option 3A included are slightly higher compared with Option 3B and Option 3C and, as such, Option 3A performs slightly worse during planned maintenance.

Underground cables by their nature introduce a number of additional technical aspects which have to be considered compared to overhead line solutions. UGCs are effectively a large capacitance and will store electrical energy. This will impact the grid in various ways which we will have to be able to manage to guarantee a safe and secure grid. The cables would have to be compensated with shunt reactors (inductive) to avoid large increases in voltage during both normal operation and during switching of the cable.

The amount of compensation is dependent on the length of the cable and the voltage level to which it is connected. For Option 3A (220 kV UGC), one reactor of approximated 50 Mvar at either end of the cable is required. For Option 3B (400 kV UGC 1 route), one reactor of approximately 145 Mvar at each end of the cable is required. For Option 3C (400 kV UGC 2 separate routes) the size of the reactor(s) needs to be approximately 435 Mvar at each end of the circuit (before the two cables enter into the the 400 kV bay).

The cables may also require harmonic filters to mitigate against harmonic resonances which can occur. These resonances occur because the transmission network is made up mostly of overhead lines making it overall inductive while underground cables are capacitive. The combination of the inductive and capacitive elements can create resonances in the system which, if not mitigated, can damage transmission network and customer equipment.

The three cable options would have different filter requirements. The level (size and location) of filters required is dependent on available harmonic limit 'headroom' at the time of connection of the cable. Analysis indicates that in the worst case scenario, harmonic filters may be required involving the installation of 5, 7, or 8 harmonic filters in the Dublin region for options 3A, 3B, or 3C, respectively.

No filters are associated at this stage of the development as these would have to be designed closer to the time of connection to achieve the best tuning. The technical analysis also covered Temporary Over-Voltage (TOV) which may be associated with underground cables. No unacceptable TOV issues were identified for any of the underground cable options[32].

When all aspects are considered for this criterion, Option 3A is considered to have a high (**Dark Blue**) impact on compliance with security and planning standards as it will not support the network as effectively as the other options in transferring the electricity to where it is needed. Options 3B and 3C are considered to have a low (**Cream**) impact on compliance with security and planning standards as these options perform well.

8.2.3 Reliability performance

This criterion is assessed using three inputs namely unplanned outages, planned outages and the time it takes to repair the circuit. The collective impact of these provides

[32] The cable integration studies (carried out by PSC) assumed a cable length of 60 km. This was based on existing OHL lengths between the stations plus a margin to cover that the cable will have to follow roads. This was the best available assumption at the time, as no feasibilities had been carried out at the initiation of these studies.

an indication of the annual availability of the asset. The reliability and outages of the station equipment associated with the circuit are assumed to be the same for all options and are therefore not included in this analysis.

The statistics for reliability are based on EirGrid's and international failure statistics, the mean time to repair and the availability in days per 100 km per year for UGC. It is assumed that the options with one conductor per phase (Option 3A and 3B) would be approximately 50 km in length and the option with two conductors per phase (Option 3C) would be 100 km in length as it has double the amount of cable.

Unplanned Outages:

As mentioned in Section 7.2.3, almost all faults on OHLs are of short duration as a result of transient faults. If an auto-reclose function is provided for the protection of the OHL, it will restore the circuit shortly after the fault. Auto-reclose is not available for faults on UGC and as such faults are considered to be long-lasting and will not be re-energised until an investigation has been undertaken. Consequently when a cable fault occurs, finding a fault location and resolving it can result in prolonged circuit outages. As such, cable circuits have a lower availability than OHLs because of the prolonged outage times in the event of a fault.

There is only 1 km of existing 400 kV UGC in Ireland. This length of 400 kV UGC is too small a sample for determining meaningful performance statistics.

As previously detailed in Section 6.2.3, meaningful statistics can, however, be obtained by considering the fault statistics of the combined quantity (approximately 144 km) of 400 kV and 220 kV UGC under our control along with international failure statistics for cables[33]. Taking the fault statistics of this existing 144 km of UGC for the period 2004 to 2018, gives a projected fault rate of 0.27 Unplanned outages/100km/year.

Parameter	Average statistics for 400 kV & 220 kV UGC combined
Reliability (Unplanned outages/100km/year)	0.27
Mean time to repair (days)	25 – 45 Days[34]
Unavailability due to disturbance (days/100km/year)	7 – 12 days

Table 26 *Average failure statistics for a 100 km 400 kV or 220 kV UGC*

[33] Cigre, TB379 Update of service experience of HV underground and submarine cable systems, 2009
[34] Dependant on installation method and number of joint bays

Table 26 shows the statistics for reliability, the mean time to repair faults, and the unavailability for 220 kV and 400kV cables (based on international failure statistics for cables[35]). These statistics, given that they apply to XLPE[36] cables, are taken to be applicable for this option.

Planned outages:

Planned outages are normally associated with routine maintenance. The typical routine maintenance outage duration for 400 kV cables taken from our maintenance policies is 2-3 days per annum (dependent on the number of joint bays and cable sections). Each year an operational test is performed, and periodically an ordinary service. These maintenance outages equate to a total unavailability of 0.84%, or c.2.5 days per annum.

Combination of the planned and unplanned outages:

The combination of the planned and unplanned outages for the three UGC options and the total annual unavailability are set out in the table below and adjusted to reflect the length of each proposed option.

Summary of reliability performance of UGC options			
	Option 3A 220 kV UGC (50 km)	Option 3B 400 kV UGC (50 km)	Option 3C 400 kV UGC (2 routes, 100 km)
Reliability (Unplanned outages/circuit length(km)/year)	0.135	0.135	0.27
Mean time to repair (days)	25 – 45 days[37]	25 – 45 days	25 – 45 days
Unplanned outages (Combined) Unavailability due to disturbances (days/circuit length(km)/year)	3.5 – 6 days/annum	3.5 – 6 days/annum	7 – 12 days/annum
Planned Outages	2.5 days	2.5 days	2.5 days
Total Annual Unavailability	6 – 8.5 days/annum	6 – 8.5 days/annum	9.5 – 14.5 days/annum
Difficulty/risk scale			

Table 27 *Reliability comparison of all cable options*

[35] Cigre, TB379 Update of service experience of HV underground and submarine cable systems, 2009
[36] XLPE cable means cross linked polyethylene
[37] Dependant on method of cable installation: direct lay or in ducts respectively.

The average failure rate and time to repair for the UGC options are deemed to be high when compared to the two OHL options. The availability of Options 3A and 3B as a result of outages is in the range of 97-98% at best and unavailability could potentially be greater than a month per annum. Based on this assessment, the reliability criterion for Options 3A and 3B is considered to be at a moderate performance (**Dark Green)**.

As Option 3C effectively doubles the length of the circuit, the inherent risk of failure is increased. The average failure rate and repair time is again deemed high. The availability of this option is in the range of 96-97% at best and unavailability could potentially be greater than a month per annum. Based on this assessment, the reliability criterion for option 3C is considered to be at a high risk of unavailability performance **(Blue)**.

8.2.4 Headroom

8.2.4.1 Option 3A

Compared to the other options, Option 3A, the 220 kV UGC option, accommodates the least amount of increase in large-scale demand in the Dublin and Mid-East region.

The assessment indicates that Option 3A creates headroom (increases the amount of additional large-scale demand that could be accommodated) of approximately 80 - 110 MW compared to no reinforcement, depending on which scenario is analysed. As indicated in Section 8.2.2, the option requires one dynamic reactive support device to be in compliance with the planning and security standards of the transmission network. With one dynamic reactive support device added the total headroom created by this option is approximately 270 – 300 MW depending on which scenario is analysed.

Option 3A, the 220 kV UGC option, performs worst in the headroom criteria compared to the other options and hence has been given a high to moderate (**Blue**) impact in the assessment

8.2.4.2 Option 3B

Of the cable options, Option 3B, the 400 kV UGC option (one circuit constructed along one route), accommodates the second largest increase in large-scale demand in the Dublin and Mid-East region.

The assessment indicates that Option 3B creates headroom (increases the amount of additional large-scale demand that could be accommodated) of approximately 320 - 420 MW compared to no reinforcement, depending on which scenario is analysed. As indicated in Section 8.2.2, this option requires one dynamic reactive support device to be in compliance with the planning and security standards of the transmission network. With one dynamic reactive support device added the total headroom created by this option along with the dynamic reactive support device is approximately 560 – 600 MW depending on which scenario is analysed.

Option 3B, the 400 kV UGC option, performs relatively well in the headroom criteria compared to the other options and hence has been given a low to moderate (**Green**) impact in the assessment.

8.2.4.3 Option 3C

Of all the cable options, Option 3C, the 400 kV UGC option (two circuits constructed along two separate routes), accommodates the largest increase in large-scale demand in the Dublin and Mid-East region when thermal generation is minimised.

The assessment indicates that Option 3C creates headroom (increases the amount of additional large-scale demand that could be accommodated) of approximately 590 - 660 MW compared to no reinforcement, depending on which scenario is analysed. As indicated in Section 8.2.2, the option requires one dynamic reactive support device to be in compliance with the planning and security standards for the transmission network. With one dynamic reactive support device added, the total headroom created by this option along with the dynamic reactive support device is approximately 760 – 830 MW depending on which scenario is analysed.

Option 3C, the 400 kV UGC option, performs very well in the headroom criteria compared to the other options and hence has been given a low impact (**Cream**) in the assessment.

8.2.5 Expansion or extendibility

All three underground cable options will provide a future new circuit and as such there are opportunities for further expansion of the transmission network using these cable options as a platform in the future. In the event that another connection along the cable route would be required, these cable options may make the opportunity for expansion and extendibility more challenging and difficult compared to if an OHL technology was used.

There are a number of aspects which make this more challenging. The cables used for the options are relatively long. Each cable option would have bespoke reactors at each end of the of the cable to limit the impact during energisation of the cables and also during normal operation as the reactors will make sure that the voltage does not deviate outside planning standards.

If the length of the cable is changed then these reactors would have to be resized and new reactors purchased. In the event that the cable is associated with harmonic filters, then additional studies would have to be undertaken to ensure that the filters are properly tuned for any new cable length and size. This could mean that some purchased equipment would become redundant in the future, if the cable option chosen is altered. There may also be difficulties in accommodating additional cables in the road network (cables would preferably be accommodated in roads to have an easier access to the asset for maintenance and repair) and this may further limit the cable options' extendibility.

In addition, each of the cable options would provide different thermal capacities and this would in turn have an effect on the future expandability of the transmission network. A lower capacity associated with a proposed reinforcement may result in additional reinforcements of the network being required earlier than some of the options that have a higher capacity.

The 220 kV UGC option (Option 3A) would be designed with a thermal capacity (rating) equivalent to a 220 kV High Temperature Low Sag (HTLS) conductor[38]. This is less than the capacity provided by any of the other options under consideration.

The aim for the 400 kV UGC option (Option 3B) would be to achieve an equivalent rating to the existing 400 kV circuits. However, cable rating calculations indicate that this would not be achievable and a lesser rating would have to be accepted for this option. The rating that potentially can be achieved is a winter rating of 2377A and summer rating of 2289A. This is less than the capacity of a 400 kV OHL circuit.

The 400 kV UGC option (option 3C) would be designed with a thermal capacity[39] (rating) equivalent to the existing 400 kV circuits.

It should be noted that further possible rating limitations may apply to the cable circuits as it may be difficult to achieve the required thermal rating due to obstacles that would have to be crossed on a potential route. Crossing of obstacles such as rivers, train tracks, bridges and motorways etc. may require that the cable(s) be buried deeper and this would have an impact on the thermal rating of the cable.

After considering all aspects in this criterion, all cable options provide a worse base for any further expansion of the transmission network compared to OHL technology.

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[38] Thermal rating of a 220 kV HTLS conductor, 586 GZTACSR Traonach 210° conductor, with a winter rating of 2377A and summer rating of 2289A

[39] Thermal capacity of existing 400 kV OHL is a winter rating of 2963 A and summer rating of 2506A based on conductor 2 x 600 mm2 ACSR CURLEW at 80°C,

Although there are some differences in each UGC option's ability to accommodate future expansion, especially in terms of capacity, this is not significant enough to provide a difference in their performance for this criterion. The implications of the opportunity for expansion and extendibility is more challenging and difficult compared to OHL technology and all of the UGC options will have a high (**Dark Blue**) impact in terms of difficulty to accommodate potential for future expansion.

8.2.6 Repeatability

All three cable options perform the same for this sub-criterion. Underground Cable (UGC) technology for 220 kV and 400 kV voltages is already in use in the Irish transmission system, but on a smaller scale compared to OHL. Every time an UGC option is proposed as a solution, each cable option will have to be studied on its own merits. Bespoke network design would have to be considered for each option that would take account of necessary harmonic distortion introduced by any cable or if voltage limiting equipment is required to accommodate the cable options into the transmission network.

In terms of repeatability, it is therefore considered that there may be limitations in the network in regards to accommodating cables. The impacts of the above points are usually greater the higher the operating voltage of the cable used. As such, it is considered that the UGC options have high to moderate risk of not meeting the repeatability criteria (**Blue**).

8.2.7 Technical operational risk

The cable options use a technology that is tried and tested internationally and in Ireland. However, the nature of this technology means that when cables are used over long lengths they required a bespoke design to be able to be accommodated technically into the network.

The higher voltage level and the considerable length will influence the technical operational risk in regards to cable options. In addition, depending on the network, these cable options will require filter banks to filter out harmonics that they may introduce. Special energising and switching procedures will be required to manage any of the UGC options in an operational environment.

All these aspects and additional equipment required to accommodate these options will increase the technical operational risk. The cable options 3A and 3B are considered to have a high to moderate (**Blue**) impact in relation to technical operational risk and option

3C is considered to have a high (**Dark Blue**) impact in relation to technical operational risk as it consists of two parallel UGCs and will increase the operational risk further.

8.2.8 Conclusion of technical performance

When all technical aspects are considered for the three UGC options, the following sets out the overall technical performance:

Option 3A is the worst performing option from a technical perspective compared with the other options and hence has been given a high (**Dark Blue**) impact in the assessment. Connecting the required Woodland and Dunstown stations using a 220 kV voltage level will not support the network as effectively as the other options in transferring the electricity to where it is needed. This option will not provide enough headroom for future growth. This option also requires an additional reinforcement compared to the other options.

Option 3B has some advantages in its technical performance in the criterion ‘Headroom’ and ‘Compliance with planning and security standards’. However, this option also has some challenges and difficulties in relation to reliability, extendibility, repeatability and technical operational risk and hence has been given a moderate (**Dark Green**) impact in the assessment.

Option 3C has some advantages in its technical performance in the criterion ‘Headroom’ and ‘Compliance with planning and security standards’. However, this option also has some challenges and difficulties in relation to reliability, extendibility, repeatability and technical operational risk and hence has been given a high to moderate (**Blue**) impact in the assessment. This option has a more significant impact than Option 3B due to the additional cable length. Table 28 show the individual technical sub-criterion and overall technical performance of the UGC options.

Summary of technical performance of UGC options			
	Option 3A 220 kV UGC	**Option 3B 400 kV UGC**	**Option 3C 400 kV UGC (2 routes)**
Health and Safety Standard compliance			
Security & Planning Standard compliance			
Reliability performance			
Headroom			
Expansion or Extendibility			
Repeatability			
Technical Operational risk			
Combined Technical Performance			

Table 28 *Summary of technical performance for all cable options*

8.3 Economic Assessment

The economic performance of the options is represented using our colour scale with the individual performance of an option assessed relative to the performance of the other solution options.

8.3.1 Input cost to economic appraisal

8.3.1.1 Pre-engineering cost

The associated pre-engineering costs for the three cable options are presented in this section in turn.

The pre-engineering costs for Options 3A (220 kV UGC) and 3B (400 kV UGC) are estimated to be €8.4 million each. In the economic appraisal, a contingency provision of 5% has been applied to this amount.

The phasing of the pre-engineering costs is as follows:

Option 3A and Option 3B	*2021*	*2022*	*2023*	*2024*	*2025*
Phasing of Pre-Engineering Spend	33%	27%	18%	15%	7%

Table 29 *Phasing of pre-engineering spend for Option 3A & 3B*

The pre-engineering costs for Option 3C (400 kV UGC) is estimated to be €8.9 million. In the economic appraisal a contingency provision of 5% has been applied to this amount.

The phasing of the pre-engineering costs is as follows:

Option 3C	*2021*	*2022*	*2023*	*2024*	*2025*
Phasing of Pre-Engineering Spend	35%	27%	17%	14%	7%

Table 30 *Phasing of pre-engineering spend for Option 3C*

8.3.1.2 Implementation cost

The associated implementation cost (rounded values).for the three cable options are presented in this section.

The capital investment required to deliver the reinforcement for Option 3A (220 kV UGC) is estimated to be €372 million.

The capital investment required to deliver the reinforcement for Option 3B (400 kV UGC) is estimated to be €356 million.

The capital investment required to deliver the reinforcement for Option 3C (400 kV UGC 2 routes) is estimated to be €679 million.

A provision for Transmission System Operator (TSO) related implementation cost and landowner payments, proximity allowance and local community fund has been included in this cost. In the economic appraisal a contingency provision of 10% has been applied to this amount.

The estimated implementation cost is categorised into its general components and is summarised in the table below. No filters are associated at this stage of the development as these would have to be designed closer to the time of connection to achieve the best tuning and, as such, no provision for potential requirement for filters has been made in the cost.

Cost category	Implementation cost (€m)		
	Option 3A UGC 220kV	Option 3B - UGC 400kV	Option 3C - UGC 400kV (2 routes)
Overhead line	1.8	N/A	N/A
Underground cable	308.9	315.8	634
Stations	20.7	N/A	N/A
STATCOMs	33	33	33
Other (flexibility & proximity payments and other allowances)	7.4	7.1	11.6
SUB-TOTAL	371.8	355.9	678.7
Contingency (10%)	37.1	35.5	67.8
TOTAL	409	391	746

Table 31 *Categorised implementation cost for UGC Options 3A, 3B and 3C*

The phasing of spend of the implementation cost is as follows for both Options 3A and 3B:

Option 3A and Option 3B	*2025*	*2026*	*2027*	*2028*	*2029*
Phasing of Implementation Spend	7%	23%	35%	35%	-

Table 32 *Phasing of implementation cost spend for Option 3A & 3B*

The phasing of spend of the implementation cost is as follows for Option 3C.

Option 3C	*2025*	*2026*	*2027*	*2028*	*2029*
Phasing of Implementation Spend	7%	23%	35%	28%	7%

Table 33 *Phasing of implementation cost spend for Option 3C*

8.3.1.3 Life-cycle cost

This sub-criterion consists of three separate inputs incurred over the useful life of the option, namely operation and maintenance cost, electrical losses and replacement cost.

The equipment associated with the cable options is expected to be maintained in accordance with the well-established existing practices. The operation and maintenance cost varies over the assets' life time and, as such, three periods of approximate costs are assumed. Table 34 below displays rounded figures to nearest thousand.

A replacement cost is assumed for all underground cable options as it is assumed that cables will have a life expectancy of 40 years which is less than the 50 year period for the economic assessment. The cost of replacement is taken to be precisely the same as the project pre-engineering and implementation cost. A residual value will be applied at the end of the 50 years to account for the remaining value of the investment and make it comparable with the other options which has a life cycle of 50 years.

Life-cycle cost for cable options				
		Option 3A 220 kV UGC	**Option 3B 400 kV UGC**	**Option 3C 400 kV UGC (2 routes)**
Annual Operation and maintenance cost (€k)	0-20 year period	€96k	€129k	€244k
	21-40 year period	€259k	€252k	€491k
	41-50 year period	€96k	€129k	€244k
Annual Electrical losses cost (€k)		-€1280k*	-€1280k*	-€1760k*
Replacement cost (€m)		380.3	364.3	687.6

Table 34 *Life-cycle cost for UGC Options*

*This option will reduce the losses and as such is a saving.

8.3.1.1 Cost to Single Electricity Market

As described in Section 4.2.2, Economic performance criteria, the cost to the Single Electricity Market represents the cost for the periods when the reinforcement is unavailable. The unavailability is based on the reliability performance of the option. This is the cost to the Single Electricity Market and is calculated as a combination of the benefit in production cost saving (project benefit) and reliability performance of the option. The reliability performance of the option is taken from Section 8.2.3 Reliability.

The production cost savings assessment used the TES 2019 scenarios and, as such, a range of annual production cost savings are used in the assessments as the different scenarios have different demand and generation patterns. Table 35 show the inputs for this criterion.

Cost to Single Electricity Market for cable options			
	Option 3A **220 kV UGC**	**Option 3B** **400 kV UGC**	**Option 3C** **400 kV UGC** **(2 routes)**
Annual Production cost saving (Benefit) (€m/annum)	Range €0 to 16m	Range €1m to 20m	Range €1m to 21m
Annual unavailability of option during which benefits cannot be attributed	Unavailable for 8.5 days, available 97.6%	Unavailable for 8.5 days, available 97.6%	Unavailable for 14.5 days, available 96.03%
Annual Cost (saving) to SEM	Range €0 to 15.633m	Range €0.97m to 19.53m	Range €0.96m to 20.17m

Table 35 *Cost to single electricity market for UGC Options*

8.3.2 Economic performance for UGC Options

Table 36 shows the economic result for the three cable options when all of the above input costs and savings are considered. To be able to differentiate between competing options in a measured way and to check the options' performance in different credible future energy scenarios, a robustness and sensitivity test was carried out. The objective is to identify the option that is impacted the least in its economic result for a range of credible future energy scenarios. The combined economic performance is then presented.

Summary of economic performance of cable options			
	Option 3A 220 kV UGC	Option 3B 400 kV UGC	Option 3C 400 kV UGC (2 routes)
Economic result			
Robustness			
Combined Economic Performance			

Table 36 *Summary of economic performance for cable options*

Option 3B has a good economic result compared to the other options and the robustness test indicates a similar performance across all the future energy scenarios. Option 3B is considered to have a low to moderate (**Green**) impact in regards to the economic performance and has the best economic performance of out of the cable options.

It is clear that Option 3C has the worst economic result of all of the options across all future energy scenarios and hence Option 3C is considered to have a high significant (**Dark Blue**) impact in regards to the economic performance. This option has a very high capital cost and not enough savings are generated during the period for the economic assessment in comparison with the other options.

Similarly, Option 3A does not provide a good economic result and this result is consistent across all future energy scenarios and hence Option 3A is considered to have a high to moderate significant (**Blue**) impact in regards to the economic performance.

8.4 Deliverability

8.4.1 Implementation timelines

The expected timeline for the implementation of the 220 kV and the 400 kV single circuit cable options (3A & 3B) is a period of 7.75 years in total. The equivalent timeframe for the 400 kV cable with two parallel cables in separate routes (3C) is a period of 8.25 years in total. This is subject to and following statutory consenting for the structures and associated access routes. This time frame can be divided into two phases.

The first phase for all options is based on 4.5 years for the outline design, environmental assessment and the planning and permits process.

The second phase for the 220 / 400 kV single circuit cable (3A & 3B) options totals 3.25 years with the timeframe for the 400 kV cable with two cables per phase (3C) totalling 3.75 years and includes detailed design, procurement of materials and construction works. This assumption includes time for the design to be confirmed, landowner consents being obtained by EirGrid and materials ordered in the first 1.5 years of this period.

The design works, material procurement and construction period for the works required in the existing stations will be incorporated into the timeline. The installation of the dynamic reactive support device at Belcamp 220 kV station is anticipated to take 3 years.

To facilitate the cable connections to the network, there is a need to install reactor devices and associated equipment at either end of the cable circuit. The size of the reactor is dependent on the cable option, but the anticipated construction timeline is the same for all options, approximately 2 years.

In addition, for Option 3A, Woodland station will require an extension to the 220 kV busbar to accommodate the connection with a construction timeline of 2.5 years. . This option does also have a further required reinforcement. The Oldstreet – Tynagh 220 kV OHL would need to be uprated and the construction timeline for the completion of this would be 1.5 years.

For options 3B & 3C, the two new 400 kV bays at the Dunstown and Woodland 400 kV stations are estimated to take 1.5 years.

Both Option 3A and 3B have the same estimated implementation timeline and this is the shortest timeline of all of the options. The impact of the implementation timelines on the project is assessed to be low to moderate (**Green**) for these options.

The impact of the implementation timelines on the project for Option 3C is assessed to be moderate (**Dark Green**) compared to the other options.

8.4.2 Project plan flexibility

Routes for the cables will be developed in Step 4 of our grid development process should they be brought forward to that step. The cable route would be developed in line with EirGrid standard practices. It is established practice in grid development that transmission cables should be constructed in the existing public road network if possible. This is to make access and maintenance to the cable easier once the project is constructed.

One consideration in the selection of a suitable road to accommodate the cable options is the width of the required cable trench. All the cable options will require a 4 metre wide trench and a working strip area wide enough to accommodate the required machinery. The road network in the study area will provide some flexibility in the identification of the best performing route for the single circuit options of 3A and 3B. As Option 3C uses two routes, the flexibility will be somewhat limited compared to the other two cable options. The use of Horizontal Directional Drill (HDD) technology to cross existing rivers, rail and roads will provide flexibility to avoid crossing point constraints.

Once the emerging preferred route has been submitted for planning consent, there is limited flexibility as we would need to work within the constraints of the site development boundary (otherwise known as the redline) of the route and the technical limitations of the cable route such as bending radius and fixed joint bay locations of the cable.

Options 3A and 3B are considered to have a high to moderate (**Blue**) impact on the project plan flexibility.

Based on the fact that Option 3C requires two routes, the project plan flexibility is deemed to be reduced compared to the other cable options and based on this, Option 3C is considered to have a high (**Dark Blue**) impact on the project plan flexibility.

8.4.3 Risk to untried technology

In general, cables are increasingly used in transmission systems across the world and the mitigations to technical issues that arise with the technology are well known, and generally tried, and tested. In an Irish context, the first 220 kV XLPE cable was installed in 1984, and there are a number of recent projects on the Irish transmission system using this technology.

That being said, every project has its own particular requirements and the non-standard 4 metre trench width to achieve the required capacity may pose challenges in delivery.

Another consideration in terms of untried technology is the use of long sections of UGC. This can lead to many technical issues which require specialised technical studies to determine if it is technically feasible to use a particular length of cable. Although, these studies have been carried out in Step 3 they will have to be repeated in Step 4 if any cable option is progressed to take account of the actual cable route determined. All cable options will require shunt reactors at either end of the cable to compensate the cable capacitance to keep the voltage within standards under normal operation.

Although shunt reactors are in place in the transmission system today, the size of the required shunt reactors for some of the UGC options is large and there is limited experience with these types of installations. The cable option may also require installation of filters in several stations in the network to mitigate any harmonic voltage distortions. The location of the filters cannot be determined until the design of the cable is known and this poses a risk for UGC options.

The installation of long lengths of 400 kV XLPE UGC became possible in the late 1990s with the development of a suitable cable joint for connecting lengths of such cable together. Nevertheless, EirGrid's experience with 400 kV cable is limited, with only a very small amount currently installed on the network.

Furthermore, it is worth noting that Option 3C requires two separate cable routes merging into a single bay in the station. As the cables follow two different routes, this could lead to different impedances of the two cables and this could potentially cause technical issues which will have to be resolved. This is a non-standard solution which has not been tried on the system before.

Another aspect in relation to the UGC option is that Horizontal Directional Drilling (HDD) technology will very likely have to be used to cross specific obstacles within the study area, such as rivers, for short lengths of the cable route. This poses another risk to the UGC options as it is an expensive methodology, requiring the use of specialist equipment.

Overall, the risk to untried technology for the 220 kV cable option (3A) is considered to be moderate (**Dark Green)**. The risk to untried technology for the 400 kV single route cable option (3B) is considered to be greater than option 3A and the risk to untried technology is therefore considered to be high to moderate (**Blue**). The 400 kV UGC option (3C), using two parallel routes, is considered to have the highest risk to untried technology of the three cable options and is therefore deemed high (**Dark Blue)**.

8.4.4 Dependence on other projects (outages)

The UGC options would require a number of elements which would require planned outages, with some options requiring more outages than others.

All UGC options would require work in both Woodland and Dunstown stations that would need proximity and commissioning outages.

Options 3B and 3C would require work in both stations in relation to the construction of the 400kV bays.

Other on-going projects in both these stations may cause conflicting outages depending on the projects' individual programmes and this would have to be taken into consideration and could have impacts on granting necessary outages.

Option 3A would require some work in Woodland. The work involves the construction of an extension to the 220 kV busbar to accommodate an additional bay for the connection of the option at 220 kV.

Option 3A is dependent on uprating the Oldstreet – Tynagh 220 kV overhead line circuit. This would require transmission outages including a 1 km double circuit section of the Cashla – Tynagh 220 kV circuit that would have a significant impact on the operation of the transmission network and could become critical to the delivery of the project.

The dependence on other projects for Option 3A is considered to have a moderate (**Dark Green**) level of impact.

Option 3B and Option 3C are both considered to have a low to moderate (**Green**) impact in terms of the dependence on other projects.

8.4.5 Supply chain constraints, permits, wayleaves

For the purposes of this analysis, it is assumed that 220 kV UGC will be equivalent, if not similar in terms of nature and extent of materials, to that occurring on the Irish grid network. There is an assumption that there would be no significant supply chain constraints envisaged with the increased distance of cable, with known procurement and design timelines and scopes involved.

With the two 400 kV options – one involving a single circuit, and the other involving two circuits, there may be significant supply chain constraints. This relates to the procurement and delivery of significant lengths (either approx. 50km or 2 x 50km) of 400 kV UGC, the required reactive compensation, required filters, and other associated large-scale equipment and testing apparatus. Cumulatively, this could result in significant supply chain constraints.

Permitting is likely to be challenging, with the provision of either new 220 kV or 400 kV UGC infrastructure in a peri-urban commuter belt of the Greater Dublin Area, irrespective of final design and location. It is confirmed, for the purpose of this analysis, that cable trenches will require to be 4m in width; in addition, it is envisaged that an 8m working width corridor will be required adjacent to the cable trench, thereby requiring an overall cable alignment width (permanent and temporary) of approx. 12m.

There are no roads within the receiving environment that could accommodate this width of construction corridor without significant temporary and/or permanent alteration, such as the removal of ditches, boundary vegetation, front gardens, walls and piers etc. Moreover, such roads would have to be closed for a considerable period of time, with potentially significant implications for traffic movements for both local access and commuter traffic. Overall, this would result in an impact of some significant scale and extent along the entire width of any UGC route. In the case of the 400 kV double circuit option, this would require two separate roads within the receiving environment and the impact as a result of this option would be greater than the other two UGC options.

It is currently considered that the UGC options, due to their size, scale and likely impact, are likely to require planning permission. While there is precedent for 220 kV UGC within the public road to comprise exempted development, it is considered that the scale of the overall UGC development, combined with the new associated infrastructure likely to be required as outlined above, will result in the overall development not comprising exempted development.

If statutory consent is required, it is likely to be the subject of an application directly to An Bord Pleanála (ABP) as Strategic Infrastructure Development (SID). It is considered likely that, given the nature and extent of the development and its potential environmental and community impact, as well as the potential public interest in the proposed development, ABP would hold a full Oral Hearing in respect of either a new 220 kV or 400 kV UGC development.

There is the potential for the UGC circuits to occur cross-country – i.e. away from public roads. This brings its own significant challenges in terms of landowner engagement and concerns, environmental and land use impacts – in particular the inability to undertake certain types of agricultural activity thereon.

It is assumed that significant engagement with landowners with properties along public roads would be required in the delivery of either a new 220 kV or 400 kV circuit, for such purposes as surveying, siting and construction. These landowners may be new to accommodating electricity infrastructure on their landholdings. New temporary and permanent easements would be required to facilitate construction of the new circuit. Based on recent precedent in terms of the provision of new high-voltage UGC transmission infrastructure, there is the potential for significant landowner opposition to this option.

Having regard to all the above, Options 3A and 3B is considered to have a high to moderate (**Blue**) impact in relation to the Supply Chain Constraints, Permits and Wayleaves criterion. Option 3C is considered to have a high (**Dark Blue**) impact in relation to the Supply Chain Constraints, Permits and Wayleaves criterion.

8.4.6 Conclusion of deliverability performance

There are five aspects considered when the overall deliverability performance is assessed. The UGC options have the best implementation timelines when compared to the other options under consideration. This is a benefit to these options as implementation timelines for any network reinforcement are important to be able to assure that the transmission network will be in compliance with security standards and that all consumers have a secure electricity supply.

It is likely that all of the UGC options would require planning permission or statutory consent, due to their size, scale and likely impact on the receiving environment. They would preferably be accommodated in the public road network and would require a 4 metre wide cable trench and an additional working strip, thereby requiring an overall cable alignment width (permanent and temporary) of up to 12 metres in certain places. This could have significant impacts and may impact deliverability of these UGC options. Road closures and potentially significant implications for traffic movements for both local access and commuter traffic would be a factor for all the UGC options during construction

For Option 3C, which would require two separate routes or roads, the impact is greater than for Options 3A and 3B. Three of the criteria indicate a significant risk to the deliverability of the reinforcement for this option. The three areas that have a significant risk identified are risk of untried technology, required permits and wayleaves and project plan flexibility, and this is reflected in the assessments. When all of these deliverability aspects are considered for Option 3C the impact on the deliverability aspects for this option are high (**Dark Blue).**

For Options 3A and 3B, some of the aspects are considered to have high to moderate impact on the deliverability of the option. The aspects with the highest risks for these options are required permits and wayleaves and project plan flexibility. Option 3B has a higher impact of risk of untried technology than Option 3A due to the voltage level. Option 3A has higher impact in regards to dependence of other projects than Options 3B and 3C and this could ultimately affect the deliverability. When all of these deliverability aspects are considered Option 3A and Option 3B are both deemed to have a high to moderate impact (**Blue)** from a deliverability point of view.

Summary of deliverability performance of cable options			
	Option 3A 220 kV cable	Option 3B 400 kV cable	Option 3C 400 kV cable (2 routes)
Implementation timelines			
Project plan flexibility			
Risk of untried technology			
Dependence on other projects			
Supply chain constraints, permits, wayleaves etc.			
Combined Deliverability Performance			

Table 37 *Summary of deliverability performance for cable options*

8.5 Environmental

This assessment was carried out by Jacobs and a summary of its findings are presented in this report. The detailed Jacobs report (321084AE-REP-002 – CP 966 Environmental Constraints report) is available on our website – see Section 2.1 for the link.

8.5.1 Biodiversity

The greatest effects on biodiversity would be during construction, where despite cables being primarily laid in public roads, there is potential for impacts on hedgerows and aquatic ecosystems in particular; other habitats may also be disturbed or fragmented during the construction phase and effects could be permanent in some cases. Options 3A and 3B would have the same effects on biodiversity and are considered to have a moderate (**Dark Green**) impact. Option 3C could have a greater magnitude of effects on biodiversity, depending on the route chosen, and the impact is considered to be moderate to high (**Blue**).

8.5.2 Soils and water

The greatest impacts on soils and water would be during construction for all UGC options. The risk to watercourses from silt and spillages during the construction process is moderate (**Dark Green**) for Options 3A and 3B as there would be a high number of water bodies crossed by the cables and there is potential for effects on roadside ditches during construction.

For Option 3C, the impacts on soils and water are considered to be moderate to high (**Blue**), as this option would require twice the route length compared to Options 3A and 3B. If the cables were to be installed in third party lands, the risks would be higher for all options.

8.5.3 Planning Policy and Land Use

The UGC would accord with the ambitions of county development plans to install new services underground wherever possible. There would be temporary disruption to the road network; the use of regional roads reduces this risk as any routes chosen would be ones large enough for the swathe to be within one carriageway only, however carriageway closures could be for a prolonged period of time. As such, it is anticipated that there would be no third-party land take except for the connection into Woodland.

At the connection into Woodland, it is likely that the cable would have to be installed across third party land. This would require a significant temporary land take during construction, but limited during operation, although a permanent wayleave and some restriction of agricultural practices above the UGC is likely. Options 3A and 3B are considered to have a moderate to low risk of impact (**Green**) on planning policy and land use, while Option 3C is considered to have a moderate risk of impact (**Dark Green**) on planning policy and land use, as the route is twice as long as for Options 3A and 3B.

8.5.4 Landscape and Views

For all three options, the effects on landscape and views from the UGC would be greatest during construction; although this would be temporary, it may take three years or more to install the UGC for Options 3A and 3B (one conductor per phase). Option 3C could also take three years if both phases were constructed at the same time, however the effects on landscape and for views would be greatest for Option 3C (moderate risk) as this has twice the footprint compared to Options 3A and 3B (low to moderate).

During operation, the effects would be limited: there would be visible joint boxes periodically along the cable, although these would be quite small; and some loss of hedgerows at Woodland station. These effects would be greatest for Option 3C as it is twice as long and would have twice the number of joint boxes and a higher loss of hedgerows. Overall Option 3A and 3B are considered to have a moderate to low risk of impact (**Green**) on landscape and views, while Option 3C is considered to have a moderate risk of impact (**Dark Green**).

8.5.5 Cultural Heritage

The effects on cultural heritage from the UGC would be greatest during construction, both in terms of ground disturbance and effects on the settings of heritage assets. The risk is identified as low to moderate (**Green**) for Options 3A and 3B, acknowledging there may be some effects given the length of the route.

Option 3C would be more significant in terms of risks to heritage assets and is identified as moderate risk (**Dark Green**). During operation, there is some potential for effects on the setting of heritage assets from the joint boxes; these effects would be greatest for Option 3C as it is twice as long and would have twice the number of joint boxes.

8.5.6 Summary of Environmental assessment of the UGC options

Having considered the potential environmental impacts for the UGC options it is concluded that option variations 3A and 3B will have moderate environmental impact (**Dark Green**). Option 3C is considered to have a moderate to high environmental impact (**Blue**). The environmental impact is related to both the construction and operational phase.

Summary of environmental assessment of New UGC options			
	Option 3A 220 kV UGC	**Option 3B 400 kV UGC**	**Option 3C 400 kV UGC (2 routes)**
Biodiversity			
Soils and water			
Planning policy and land use			
Landscape and views			
Cultural heritage			
Combined Environmental Performance			

Table 38 *Summary of Environmental assessment of the new UGC options*

8.6 Socio-economic

This assessment was carried out by Jacobs and a summary of their findings are presented in this report. It should be noted that this is draft report and it will be finalised after the consultation period has been competed for the project in Step 3. This is normal procedure as this criterion will have to incorporate stakeholder engagement and any feedback resulting from this engagement. The detailed draft Jacobs report (321084AE-REP-003 – CP 966 Strategic SIA Scoping Report) is available on our website – see Section 2.1 for the link.

8.6.1 Amenity and Health

There would be a moderate to high (**Blue**) impact on amenity and health during construction for options 3A and 3B. Combined impacts on communities, especially those linear communities alongside the regional road networks, could come from dust, noise, traffic and visual impacts. The impact for Option 3C would be worse as there are two 'routes' and Option 3C is therefore assessed to have a high risk (**Dark Blue**) on amenity and health during construction only.

8.6.2 Local Economy

The effects on the local economy could be quite mixed; both adverse and beneficial effects are possible. Beneficial effects, whilst welcome, are not likely to be significant in the local economy; disruption to local businesses and tourism venues could have a moderate risk impact as a result of construction works in regional roads over a period of three years.

This is especially the case for Option 3C, as this option requires two separate circuits. For Options 3A and 3B, effects on the local economy are considered to be low-moderate (**Green**) and for Option 3C it is considered to be moderate (**Dark Green**).

8.6.3 Traffic & Transport

For Options 3A and 3B, there is likely to be a moderate to high (**Blue**) risk of disruption to traffic on the regional road networks during the three years it would take to install the cables. This would lead to pedestrian and driver delay and potential local severance issues. Option 3C has the potential for a higher risk impact when compared to the level of impacts of Options 3A and 3B as it is twice as long. Option 3C has therefore been considered to have a high (**Dark Blue**) risk of disruption to traffic and transport.

8.6.4 Utilities

There is some potential for disruption; this would necessarily occur during construction as other utilities may need to be removed or diverted to accommodate the UGC option.

Option 3A and 3B would have a moderate (**Dark Green**) risk of impact to utilities whilst Option 3C would have a moderate to high (**Blue**) risk of impact.

8.6.5 Summary of Socio-economic assessment of UGC options

Having considered the above described socio-economic aspects for UGC options it is considered that Option 3A and 3B would have a high to moderate (**Blue**) socio-economic impact and that Option 3C would have a high (**Dark Blue**) socio-economic impact.

It should be noted that this evaluation could be amended depending on the feedback from the stakeholder engagement in Step 3.

Summary of socio-economic assessment of UGC options			
	Option 3A 220 kV UGC	**Option 3B 400 kV UGC**	**Option 3C 400 kV UGC (2 routes)**
Amenity and Health			
Local Economy			
Traffic and Transport			
Utilities			
Combined Socio-economic Performance			

Table 39 *Summary of Socio-economic performance for UGC options*

8.7 Summary of the assessment for the cable options

Three underground cable variations have been investigated and they all involve a suite of transmission network reinforcements centred on strengthening the network between existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath.

	Option 3A 220 kV UGC)	Option 3B 400 kV UGC)	Option 3C 400 kV UGC (2 routes)
Technical Performance			
Economic Performance			
Deliverability			
Environmental			
Socio-economic			
Combined Performance			

Table 40 *Overall assessment outcome for the Underground cable options*

Having considered all of the five criteria, the outcome of the multi-criteria assessment indicates that Option 3A (a 220 kV UGC) will not perform very well overall. The option's performance for the technical criterion is of particular concern. Connecting the Woodland and Dunstown stations using a 220 kV voltage level will not support the network as effectively as the other options in transferring the electricity to where it is needed. It also does not solve some of the technical aspects as well as the other options. In addition, this option does not perform very well in some of the other criteria and hence has been given a high impact (**Dark Blue**) on its overall performance, the worst performance in terms of the colour scale used.

Having considered all of the five criteria, the outcome of the multi-criteria assessment indicates that Option 3B (a 400 kV UGC, one circuit constructed along one route) performs equally or better in all of the criteria compared with the other UGC options. Some of the criteria indicate challenges and risks and hence this option has been given a high to moderate (**Blue**) impact in its overall performance.

Having considered all of the five criteria, the outcome of the multi criteria assessment indicates that Option 3C (a 400 kV UGC, two circuits constructed along two routes) has the worst performance in three of the five criteria compared to the other options and hence has been given a high impact (**Dark Blue**) on its overall performance, the worst performance in terms of the colour scale used.

9 Conclusions

The Kildare Meath Grid Upgrade (Capital Project 966) is a proposed reinforcement of the electricity network between Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. The project is in Step 3 of the six step approach that we use when we develop and implement a solution to any identified transmission network problem.

The project is essential to enable the further integration of renewable energy in line with Government policy ambitions. It will further be a key enabler in meeting the growing demand for electricity in the east region. The development involves a suite of transmission network reinforcements centred on strengthening the network between the existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath, and some dynamic reactive devices to support the voltage will also be required. The purpose of Step 3 is to decide on the Best Performing Option. In Step 3, there were five options investigated.

- Option 1: Up-voltage existing 220 kV OHL circuits;
- Option 2: New 400 kV OHL circuit;
- Option 3A: New 220 kV UGC circuit;
- Option 3B: 400 kV UGC: one circuit constructed along one route;
- Option 3C: 400 kV UGC: two circuits constructed along two separate routes

Each of these options has been assessed against the five criteria covering technical performance, economic performance, deliverability performance, environmental impacts and socio-economic impacts.

Based on the multi-criteria assessment, Option 1, the up-voltage option, is the Emerging Best Performing Option (EBPO). Option 3B, which is the emerging best performing alternative, does not perform as well as Option1 for three of the five criteria.

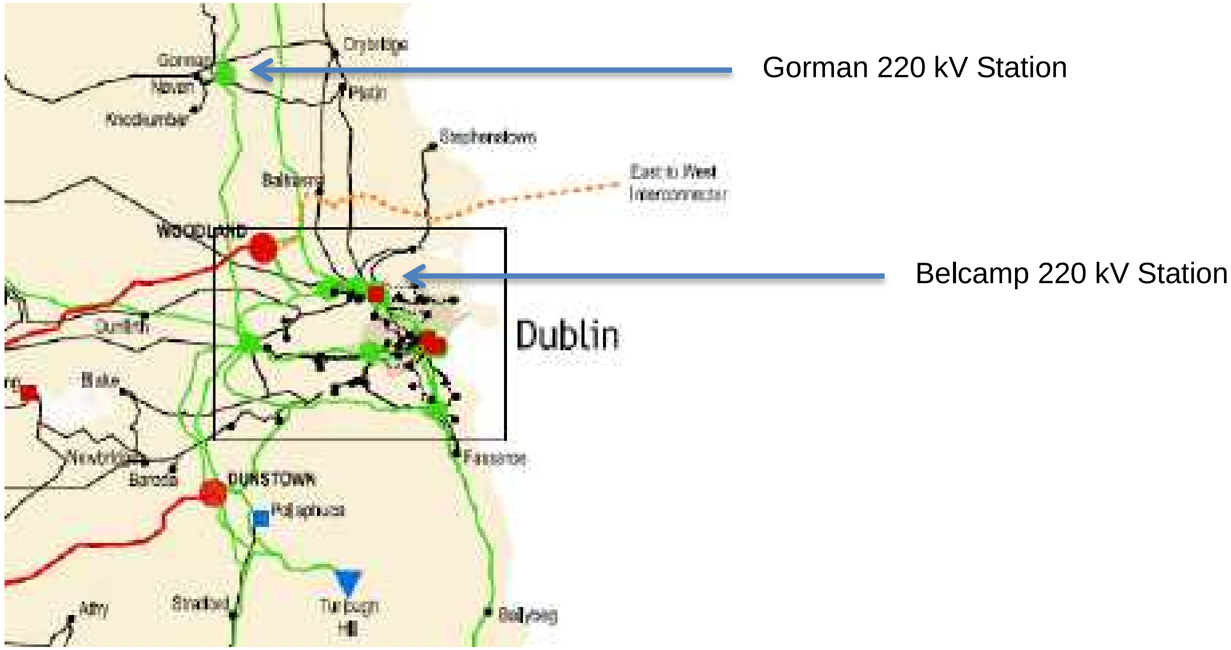
A period of public consultation will focus on the EBPO and the analysis that underpins it and the possible alternatives. All feedback received will be carefully considered before the Best Performing Option (BPO) or options are identified and taken forward to Step 4 for further investigations.

Appendix 1 – Transmission map showing stations locations

An extract of the transmission map is presented below. The entire map can be found on our website in the following link
http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-Transmission-Map-January-2020.pdf

Gorman 220 kV station is located in Causetown County Meath

Belcamp 220 kV station is located in north County Dublin along the R139. This station is relatively new and is not shown in the transmission map yet. The station's location is indicated for clarity.



Appendix 2 – Technical performance of options

Summary of technical performance all options					
	Option 1 Up-voltage option	**Option 2** 400 kV OHL option	**Option 3A** 220 kV UGC	**Option 3B** 400 kV UGC	**Option 3C** 400 kV UGC (2 routes)
Health and Safety Standard compliance					
Security & Planning Standard compliance					
Reliability performance					
Headroom					
Expansion or Extendibility					
Repeatability					
Technical Operational risk					
Combined Technical Performance					

Appendix 3 – Economic performance of options

Summary of Economic performance all options 2020 values						
	units	Option 1 Up-voltage	Option 2 400 kV OHL	Option 3A 220 kV UGC	Option 3B 400 kV UGC	Option 3C 400 kV UGC (2 routes)
Pre-Engineering Costs	[€M]	9.4	11.2	8.4	8.4	8.9
Project Implementation Costs	[€M]	239	168	372	356	679
Project Life-Cycle Costs (Losses)	[€M] pa	1.2	-0.529	-1.28	-1.28	-1.76
Project Life-Cycle Costs (O & M) Presented in period of years (1-20), (20-40), (40-50)	[€k] pa	0.84 0.458 0.14	0.42 0.524 0.86	0.96 0.259 0.96	0.129 0.252 0.129	0.244 0.491 0.244
Project Life-Cycle Costs (Decommissioning & Replacement)	[€M]	N/A	N/A	380.3	364.3	687.6
Cost to SEM based on unavailability of reinforcement (TES Scenario used)	[€M] pa	Range -3 to 13	Range 1 to 20	Range 0 to 16	Range 1 to 20	Range 1 to 21
Combined Economic Performance						

Summary of Economic performance all options 2020 values					
	Option 1 Up-voltage	Option 2 400 kV OHL	Option 3A 220 kV UGC	Option 3B 400 kV UGC	Option 3C 400 kV UGC (2 routes)
Economic Result					
Robustness					
Combined Economic Performance					

Appendix 4 – Deliverability performance of options

Summary of Deliverability performance of all options					
	Option 1 **Up-voltage option**	**Option 2** **400 kV OHL option**	**Option 3A** **220 kV UGC**	**Option 3B** **400 kV UGC**	**Option 3C** **400 kV UGC** **(2 routes)**
Implementation timelines					
Project plan flexibility					
Risk of untried technology					
Dependence on other projects					
Supply chain constraints, permits, wayleaves etc.					
Combined Deliverability Technical Performance					

Appendix 5 – Environmental performance of options

Summary of Environmental performance of all options					
	Option 1 **Up-voltage option**	**Option 2** **400 kV OHL option**	**Option 3A** **220 kV UGC**	**Option 3B** **400 kV UGC**	**Option 3C** **400 kV UGC** **(2 routes)**
Biodiversity					
Soils and water					
Planning policy and land use					
Landscape and views					
Cultural heritage					
Combined Environmental Performance					

Appendix 6 – Socio-economic performance of options

Summary of Socio-Economic performance of all options					
	Option 1 **Up-voltage option**	**Option 2** **400 kV OHL option**	**Option 3A** **220 kV UGC**	**Option 3B** **400 kV UGC**	**Option 3C** **400 kV UGC** **(2 routes)**
Amenity and Health					
Local Economy					
Traffic and Transport					
Utilities					
Combined Socio-Economic Performance					

Step 3B - Best Performing Technology Option Report (March 2021)

Step 3
Best Performing Option Report

The Kildare-Meath Grid Upgrade
Capital Project 966

March 2021

EIRGRID

Revision Table:

Revision	Issue Date	Description
01	24 March 2021	Best Performing Option Report in Step 3

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1 Table of Contents

2 Introduction

The Kildare Meath Grid Upgrade is a proposed reinforcement of the electricity network between Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. The project is essential to enable the further integration of renewable energy in line with Government policy ambitions. It will further be a key enabler in meeting the growing demand for electricity in the eastern part of the country. This report describes the outcome of various assessments undertaken with regard to the identified options for the project after the public consultation was closed. It presents the results that underpin the identified best performing option.

EirGrid follows a six step approach when we develop and implement a solution to any identified transmission network problem. This six step approach is described in the document 'Have Your Say' published on EirGrid's website[1]. The six steps are shown at a high-level in Figure 1. Each step has a distinct purpose with defined deliverables.

The Kildare - Meath Grid Upgrade project is at the end of Step 3 and this report will detail the final decision and its justification of the Best Performing Option (BPO) which will be developed further in Step 4 in accordance with our six step approach.

Figure 1 *High level description of Project Development Process*

2.1 Previous reports and supporting documentation

Some of the assessments and investigations of the options or analysis of the feedback from the public consultation have been carried out by external parties. Where relevant,

[1] http://www.eirgridgroup.com/the-grid/have-your-say/

this is highlighted in this report and the referenced reports are named and a summary of the findings is presented. There are also reports from previous steps and earlier published Step 3 reports which provide background to the assessments and the process followed and should be read in conjunction with this report. All these reports are available on our website[2].

2.2 Description to frequently used terminology in report

The remaining Step 3 process references some terminology which will be used throughout this report. For clarity, these terminologies and expressions are introduced and listed below:

- Multi-criteria assessment (MCA)
  This is the tool we use to compare options against each other. It is a multi-criteria performance matrix and includes five criteria.
- Emerging Best Performing Option (EBPO)
  This is the option or options that emerge in Step 3 after the five criteria have been assessed using a multi-criteria performance matrix. The EBPO for the Kildare - Meath Grid Upgrade project was announced at the start of the consultation period.
- Emerging Best Performing Option Report (EBPO Report)
  This is the report detailing the assessment in Step 3 after the five criteria have been assessed using a multi-criteria performance matrix. This assessment was carried out before the consultation period.
- Best Performing Option (BPO)
  This is the option which will be taken forward into Step 4 for further investigation and development into a proposal that will be the subject of consenting of the relevant consenting authority and subsequently taken forward to construction and energisation.
- Best Performing Option Report (BPO Report)
  This is the report detailing the assessment in Step 3 after the feedback and other new information have been taken into consideration. This report aims to detail the final decision and its justification of the Best Performing Option (BPO).

[2] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

3 The Project

3.1 Background information

The Kildare Meath Grid Upgrade is a proposed electricity transmission development project that will help transfer electricity to the east of the country and distribute it within the network in Counties Meath, Kildare and Dublin. It involves a suite of transmission network reinforcements centred on strengthening the network between the existing Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath, with a dynamic reactive device required to support the voltage. This project is at the end of Step 3 of our six step approach.

The need for the project was reviewed in Step 3 and it indicates that the previously identified drivers still remain and have further increased the need to strengthen the transmission network between Dunstown and Woodland stations, and that the need for the reinforcement is still robust. The project is essential to enable the further integration of renewable energy in line with Government policy ambitions. It will further be a key enabler in meeting the growing demand for electricity in the east region, by improving the capacity of the network in this region. This forecasted growth within the region is due to increased economic activity and the planned connection of new large scale energy users. The confirmation of need report can be found on our website[3].

3.2 Options assessed in Step 3

In Step 3 five different options were assessed and evaluated representing three different technologies, namely:

- A new technology which would involve an increase in the operating voltage of existing 220 kV circuits, called an up-voltage of existing 220 kV towers.
- Overhead line (OHL);
- Underground cable (UGC).

All options involve a suite of transmission network reinforcements centred on strengthening the network between the existing Dunstown 400 kV station in County Kildare and the Woodland 400 kV station in County Meath.

[3] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

The five options assessed and evaluated in Step 3 were:

1. Option 1: Up-voltage existing 220 kV OHL circuits
   - Using a new technology which would enable two existing 220 kV circuits connecting to Dunstown and Woodland stations to be modified, primarily by means of replacing existing 220 kV conductors (and associated tower structures if necessary) with 400 kV conductors to create a new Dunstown – Woodland 400 kV circuit.
   - The circuits selected to achieve this are the Gorman – Maynooth 220 kV circuit and the Dunstown – Maynooth 2 220 kV circuit.

2. Option 2: New 400 kV OHL circuit

3. Option 3: New 220 kV UGC circuit[4]

4. Option 4: New 400 kV UGC circuit: one circuit constructed along one route[5]

5. Option 5: New 400 kV UGC circuit: two circuits constructed along two separate routes[6]

[4] Note that Option 3 was called option 3A in previous reports
[5] Note that Option 4 was called option 3B in previous reports
[6] Note that Option 5 was called option 3C in previous reports

4 Process followed

4.1 Description of process

This report details the decision and its justification with regards to the Best Performing Option (BPO) for the Kildare - Meath Grid Upgrade project in Step 3.

In Step 3, the options presented in Section 3.2 were investigated in more detail and a multi-criteria performance matrix was used to compare the options against each other. The multi-criteria assessment (MCA) in Step 3 identified an Emerging Best Performing Option (EBPO) and an emerging best performing alternative. The assessment and evaluation of the options were documented in the EBPO report which was published on our website[7].

The process provides for public participation and stakeholder engagement in the decision-making process. A 10-week consultation, lasting between October and December 2020, was held on the process followed and the options evaluated in Step 3.

To arrive at the Best Performing Option (BPO) for the Kildare - Meath Grid Upgrade and to conclude the Step 3 process there was three remaining activities that needed to be completed after the consultation period closed. Figure 2 shows the high level process identifying these activities. These three activities and their outcomes will be considered in the decision making process. A short description of each activity is provided below.

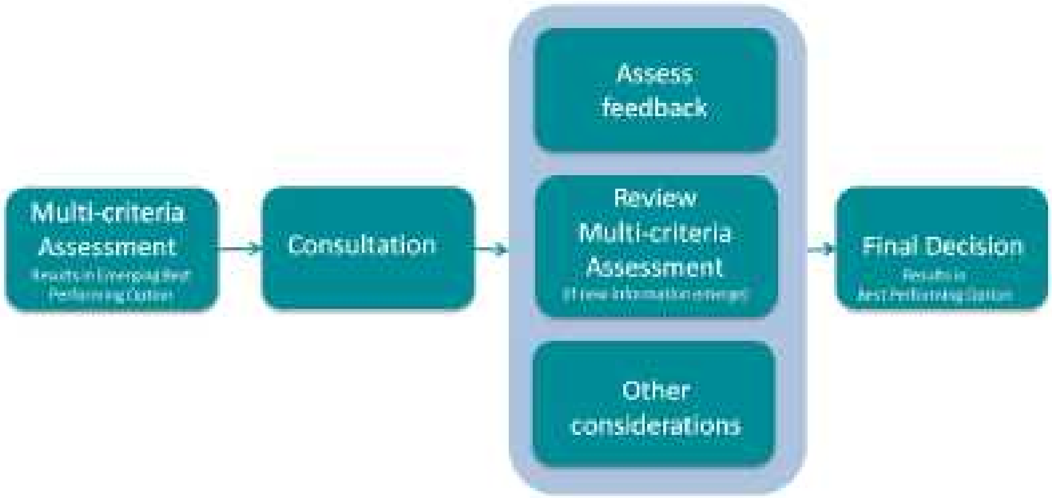

Figure 2 *High level process describing remaining activities in Step 3 after public consultation closed*

[7]http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

- Task 1 – Assess feedback from public consultation

  The feedback received during the consultation period will be carefully considered and analysed using a coding framework. This coding framework will be based on the responses received to display and capture views and concerns raised during the consultation period. The feedback analysis will be conducted by an independent consultancy specialising in stakeholder engagement analysis and published on our website in a consultation feedback report.

  The feedback will be incorporated in the multi-criteria assessment (MCA) or be dealt with outside the MCA depending on the nature of the feedback. If the feedback concerns the criteria assessed in the MCA, it will be considered and incorporated in the review of the MCA as explained in Task 2. If the feedback does not concern the criteria assessed in the MCA it will also be incorporated and considered in the decision making process, but outside the MCA as described in Task 3.

  In addition, the feedback will inform us how to best to progress the BPO in the next step with regard to the views and concerns raised.

- Task 2 – Review of the multi-criteria assessment

  The review will incorporate the feedback and other new information received that concerns the criteria assessed in the MCA. A clear description of the new information received will be provided. If the review results in a change to the previous assessment a justification will be outlined.

- Task 3 – Other considerations

  In some cases information emerges that is not covered by the criteria in the MCA. In such cases the information will be considered outside the MCA and may influence the identification of the BPO for the project. A clear description of the new information received and a justification for any changes made to the original assessment will be provided.

  In other cases the MCA may result in an outcome with equal performance of options and other measures may have to be used to distinguish between the options. These measures may relate to technical and/or operational issues of the transmission system, strategic decisions in terms of the developments of the Irish transmission system in a timely manner and any risks that these items may impose to the transmission system. A clear description of the factors influencing the decision will be provided.

The above three activities, Task 1 – 3, and their outcomes will be considered in order to inform the decision of the BPO for the project. At the end of Step 3 the Best Performing Option Report will be published.

In accordance with our six step approach, the BPO will be developed further in Step 4. It will then be the subject of a planning application in Step 5. If the application is consented by the relevant consenting authority, the permitted development will then be subject to detailed design, construction and energisation.

4.2 Scale used to assess each criteria

The effect on each criterion parameter is qualitatively determined using expert judgement and experience. This is presented by means of colour coding, along a range from “more significant”/”more difficult”/“more risk” to “less significant”/”less difficult”/“less risk”.

The following scale is used to illustrate the performance of each criterion.:

More significant/difficult/risk Less significant/difficult/risk

In the text, this colour-coded scale is qualified by text comprising:-

- Low (Cream);
- Low-Moderate (Green);
- Moderate (Mid-level) (Dark Green);
- Moderate-High (Blue);
- High (Dark Blue).

5 Stakeholder engagement

5.1 Stakeholder engagement activities

The aim of stakeholder engagement in Step 3 is to transparently communicate our findings so far to key stakeholders and to ensure opportunities for public participation in the development of the project. In particular, this comprises taking on board feedback on the assessment and emerging conclusions, which will then inform EirGrid's decision-making prior to announcement of a BPO.

The stakeholder engagement for Kildare - Meath Grid Upgrade in Step 3 was divided into two phases: an information phase and a public consultation phase.

In the information phase, we informed and engaged with relevant regional and national stakeholders such as Government Departments, Meath County Council, Kildare County Council, Elected Representatives, the IDA, Chambers of Commerce, and the Public Participation Networks. This phase also included an information campaign in local newspapers, radio, online advertising, social media video animations, the publication of investigative reports and technical assessments, an information leaflet to all homes in the study area, an online interactive map and webinars. This phase covered the period between 20 July and 5 October 2020. At the end of the information phase, the EBPO was announced and a 10 week public consultation period commenced.

5.2 Public consultation

The public consultation requested feedback on the five options presented in Section 3.2, including the emerging best performing option and the emerging best performing alternative. The consultation also sought feedback on the study area, ideas for the proposed community fund, and the consultation process.

The consultation phase included awareness raising measures as outlined in 5.1 with the addition of a virtual exhibition room and additional formal meetings with the local authority, public participation networks and chambers of commerce. A Community Liaison Officer was in regular contact with stakeholders and dealt with incoming queries about the project on an on-going basis. Freepost questionnaires were distributed to all homes in the study area in order to encourage the public to participate in the consultation process safely in the context of Covid-19 and to minimise any potential digital divide in the provision of information.

An overview of the consultation feedback and the review of this information is provided in section 6.

6 Selection of best performing option

As described in section 4, three activities had to be completed in order to confirm the BPO for the Kildare - Meath Grid Upgrade project after the public consultation closed. This section will outline the assessments carried out for these activities and provide justification if this resulted in changes to the previous assessments.

To provide some background and context, the outcome of the MCA that was announced before the public consultation will be presented in section 6.1. The EBPO report published on our website[8] will provide more detail of the evaluation of the individual options and their sub-criteria prior to the public consultation. Section 6.2 gives an overview of the consultation feedback. Section 6.3 and 6.4 outline the assessments made in regards to the review of the MCA and other considerations influencing the identification of the BPO. In section 6.5, the Best Performing Option (BPO) for the Kildare - Meath Grid Upgrade project is presented and the justification given.

6.1 Multi-criteria assessment prior to consultation

In line with EirGrid's roles and responsibilities, we have an obligation to develop a safe, secure, reliable, economical, and efficient electricity transmission system while having due regard for the environment of Ireland. In our decision making, these fundamentals are captured in the five criteria considered in the multi-criteria assessment (MCA).

The MCA in Step 3 identified an Emerging Best Performing Option (EBPO) and an emerging best performing alternative and these were announced at the start of the consultation period.

Table 1 shows the outcome of the MCA which indicate the EBPO as Option 1 – Up-voltage and the emerging best performing alternative as Option 4 – 400 kV underground cable (UGC).

[8] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

	Option 1 Up-voltage	Option 2 400 kV OHL	Option 3 220 kV UGC	Option 4 400 kV UGC	Option 5 400 kV UGC (2 routes)
Technical Performance					
Economic Performance					
Deliverability					
Environmental					
Socio-economic					
Combined Performance					

Table 1 *Overall comparison (MCA) of options using five criteria in Step 3 prior to consultation*

6.2 Assess feedback from public consultation

The consultation process was owned and managed by EirGrid. Traverse, an independent consultancy specialising in stakeholder engagement analysis, was commissioned to analyse responses to the consultation and report on the findings. Their report (Kildare-Meath Grid Upgrade Step 3 Consultation Final Report) provides detailed information on the analysis process and the responses received. This report is available on our website[9]. The public consultation received a total of 178 responses from stakeholders. Each response was analysed and reported on. A summary of the findings are provided below.

Many respondents express support for Option 1 (Up-voltage existing 220 kV OHL circuits), often saying that they do so because this option would make use of existing infrastructure. Some respondents feel that this option would be less disruptive to the environment and to local people and communities than other options. Opposition to and concerns about Option 1 focus on the presence of overhead lines. Some respondents express concern that electric and magnetic fields (EMFs) from overhead lines might have a potential negative impact on the health of local people, that overhead lines could

[9] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

be placed too close to properties or affect their value, and that overhead lines could have a potential negative impact on the local landscape.

Many respondents express support for Option 4 (New 400 kV UGC circuit). Respondents frequently said that they prefer underground cables to overhead lines. Some respondents believe that Option 4 would be safer for human health, saying that they believe that there would be less of a potential impact on local people from EMFs, and that cables would be less vulnerable to damage from storms. Some respondents also support Option 4 because they feel it would have less of a potential impact on the environment than the other options. Some respondents express opposition to Option 4 without providing additional details. Several respondents express concern about the cost of this option, while several others raise fears about its deliverability and performance, saying that it could incur delays or cost overruns, or be difficult to maintain. Several respondents express concern about the possible disruption this option could cause to local people and communities, and a small number of those who responded say that this option could potentially impact upon the local environment.

More generally, there were a small number of supporters for Options 2, 3 and 5. Several respondents supported the project generally, noting the economic and sustainability necessities. There was a general preference for putting cables underground and general opposition to overhead lines. A small number of respondents expressed that they would support both Option 1 and 4 and agree with EirGrid's assessment that these are the best options available. Some of the concerns expressed by respondents focused on electric and magnetic fields, biodiversity, historical sites, visual impact and traffic disruption.

The responses from the consultation can be summarised as follows:

- Provided valuable insight into views and opinions about the proposals.
- Will influence our approach to consultation in next step of this project.
- Identified both support and concerns for all five options, the consultation process and the study area.
- Included feedback across a broad range of issues.
- Included feedback indicating little opposition to any of the options at this point.
- Identified no new information that would influence the multi-criteria assessment.
- Revealed several respondents support the project generally, noting the economic and sustainability necessities.
- Indicated general concerns that focused on issues such as EMF, wildlife, historical sites, visual impact and traffic disruption.

6.3 Review of multi-criteria assessment

After the feedback had been carefully reviewed and documented by our expert in stakeholder engagement analysis, Traverse, EirGrid and our consultants Jacobs incorporated the outcome of the feedback into the MCA. In addition, any new information presented during the consultation period was also assessed and incorporated.

This section will describe which of the five criteria in the MCA were affected by the consultation feedback or new information and provide justification for any change.

6.3.1 Review of Socio-economic assessment criteria

In Step 3, in line with EirGrid's Social Impact Assessment Methodology, a draft Strategic Social Impact Assessment (SIA) Scoping Report was compiled. It included all of the assessments and investigations in relation to potential socio-economic impacts and was prepared by our external consultant Jacobs. It was published on our website during the Information Stage in July 2020, before the start of the Public consultation period which began in October 2020. The draft report presented an initial signpost of likely social impact and, in accordance with our SIA Methodology, it was required to be updated once the maximum amount of information has been gathered, including from stakeholder engagement.

The feedback from the Public Consultation and Landowner Engagement has now been assessed and taken into account by Jacobs in the preparation of a final Strategic SIA Scoping report, which will inform the SIA to take place during Step 4. The final Jacobs report (32108AE-REP-003 – Kildare-Meath Grid Upgrade Step 3 Strategic SIA Scoping Report Final) is available on our website[10].

Feedback from stakeholders has been included in the final Strategic SIA Scoping Report and discussed in relation to the initial assessment and whether any changes might be required. The feedback didn't highlight any social or economic aspects that hadn't already been identified and assessed in the draft Strategic SIA Scoping Report and used in the previous MCA. Further, no feedback was received on the draft Strategic SIA Report itself. As such, the preliminary findings in the draft report are confirmed and no changes have been made to the methodology proposed, the potential impacts identified or the conclusions of the previous MCA assessment.

[10] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

6.3.2 Review of Deliverability criteria Option 1 – Up-voltage option

The deliverability criterion assesses transmission equipment outage length required to implement the option. It also considers general inter-dependence with other projects. In total there are five sub-criteria considered when the overall deliverability performance is assessed for each option.

In relation to Option 1, one sub-criterion under deliverability was reviewed namely, 'Dependence on other projects (outages)'.

The final feasibility report[11] in relation to how Option 1 could be implemented was received during the consultation period. The report also included durations of the required outages, which we did not have in the original assessment. This new information was assessed in regards to the acceptability of the required outage durations.

The outcome of the review is that the outages and the required durations will be very difficult to grant and will require a specific sequence of the outages to limit their potential impact on the system integrity. Prioritisation between required outages for this option and other projects is necessary to complete Option 1. Prioritisation of outages occur in today's transmission system as well, but it is anticipated that this will become more challenging due to further new connections of customers and other planned reinforcements and tighter generation capacity margins[12]. For Option 1 to be delivered in a timely manner a prioritisation decision would be necessary over at least three consecutive outage seasons and this would create delays for other project works such as other planned reinforcements, new connections, maintenance works and required generation outages.

The implementation of Option 1 would mean that some existing 220 kV circuits between Dunstown and Woodland stations would have to be taken out of service for the duration of the works. This will further contribute to the inflexibility of the transmission system to accommodate other outages and this in turn will have an impact on the risk to security of supply. The risk is very high that the duration of the required outages would over run due to the nature of the innovative construction method and complexity of the works or due to land access issues.

The required outages and their duration, to implement Option 1, have a greater potential impact than previously considered. As a result in regards to the sub-criteria 'Dependence on other projects (outages), this new information means an increased potential impact

[11] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/
[12] http://www.eirgridgroup.com/site-files/library/EirGrid/All-Island-Generation-Capacity-Statement-2020-2029.pdf

for Option 1. This sub-criteria has been assigned a high impact (**Dark Blue**) to reflect this, instead of the previously assigned moderate to high impact (**Blue)**.

Table 2 shows the overall deliverability performance in the previous MCA and the outcome of the review. With the new information incorporated it is considered that Options 1 is still deemed to have moderate to high impact (**Blue)** from a combined deliverability performance point of view when this change is incorporated.

Deliverability performance of Up-voltage (Option 1)			
	Original MCA		Review of MCA
Implementation timelines			
Project plan flexibility			
Risk of untried technology			
Dependence on other projects			
Supply chain constraints, permits, wayleaves etc.			
Combined Deliverability Performance			

Table 2 *Deliverability performance for Option 1 in Original MCA and after review*

6.3.3 Review of Deliverability criteria Option 4 – New 400 kV UGC

The deliverability criterion assesses transmission equipment outage length required to implement the option. It also considers general inter-dependence with other projects. In total there are five sub-criteria considered when the overall deliverability performance is assessed for each option.

In relation to Option 4, two sub-criteria under deliverability received more detailed information during the consultation period namely, ‘Project Plan Flexibility and Supply Chain Constraints Permits, Wayleaves’.

During the consultation period, new information was received in the form of advice from the Asset Owner cable specialists suggesting that UGC can be constructed in a more efficient manner than was previously assumed. This new information gives rise to opportunities to reduce the width of the trench required from 4 metres to approximately 2 metres, and still maintain the required thermal rating of the UGC. In turn, this change is more likely to result in less potential community / traffic impacts during construction, less need to enter third party lands and more options available to mitigate routing constraints. It is also considered that further improvements in relation to permitting and wayleave can be achieved with proactive engagement during the pre-planning stage of the UGC route. For these reasons Option 4 is deemed to have a reduced potential impact in regards to the sub criteria ‘Project plan flexibility’ and ‘Supply chain constraints, permits, wayleaves’ compared to the previous assessment. Both sub-criteria have been assigned a moderate impact (**Dark Green**) in the review assessment compared to the previous moderate to high (**Blue**) impact.

It should be noted that the previous assessment of these two sub-criteria were assessed based on existing term contracts for UGC and the standard cable laying methods. The new information is based on potential new cable types and different laying and construction techniques which may result in a reduced trench width. This information was not available to us at the start of Step 3.

Table 3 shows the overall deliverability performance in the previous MCA and the outcome of the review. With the new information incorporated it is considered that Options 4 has an improved deliverability performance compared to the previous assessment and has been deemed to have a moderate impact (**Dark Green)** from a deliverability performance point of view.

Deliverability performance of new 400 kV UGC (Option 4)			
	Original MCA		Review of MCA
Implementation timelines			
Project plan flexibility			
Risk of untried technology			
Dependence on other projects			
Supply chain constraints, permits, wayleaves etc.			
Combined Deliverability Performance			

Table 3 *Deliverability performance for Option 4 in Original MCA and post consultation MCA*

6.3.4 *Final MCA after review of feedback and inclusion of new information*

Having assessed the consultation feedback and new information received and considered the impact that this has had on the overall MCA, the final Step 3 MCA is presented in Table 4.

The final Step 3 MCA combined performance indicates one material change from the original MCA.

- **Option 4:** Due to an improvement of the Deliverability performance of this option the overall combined performance for Option 4 changes from a moderate to high (**Blue**) to a moderate risk (**Dark Green**).

The final Step 3 MCA results in the two options, Option 1 and Option 4, having an equal overall combined performance across the criteria considered in the MCA.

	Option 1 Up-voltage	Option 2 400 kV OHL	Option 3 220 kV UGC	Option 4 400 kV UGC	Option 5 400 kV UGC (2 routes)
Technical Performance					
Economic Performance					
Deliverability					
Environmental					
Socio-economic					
Combined Performance					

Table 4 *Final MCA after review of feedback and inclusion of the new information received*

6.4 Further consideration of information to aid the decision making

The outcome of the revised MCA for the Kildare Meath Grid Upgrade indicates that two of the options, Option 1 – Up-voltage and Option 4 – New 400 kV underground cable, have an equal combined performance across all of the criteria.

An equal combined MCA performance does not mean that the options have the same risks or impact on the transmission system. In fact the options may be very different and may create different challenges for us as the licenced Irish Transmission System Operator (TSO). Although these issues are taken into account in the MCA, all sub-criteria are treated with an equal value in the MCA to initially evaluate the options.

We focus on technical risk and deliverability challenges to help distinguish between the options. Ultimately, the decision comes down to a fine balance of these considerations.

The sections below discuss the balance between technical and deliverability risk of the two options in turn.

6.4.1 Option 1 – Up-voltage

Option 1 is technically more straight forward but it is more difficult to deliver. This option requires significant transmission circuit outages and the facilitation of these outages will be very challenging in a transmission system that is already facing challenges in term of plant margins and the granting of outages for required work such as maintenance, connection of new customers or network reinforcements.

There are a number of factors contributing to the difficulty in granting outages. The network on the east coast is lacking in alternative pathways for electricity to be transported to where it is needed when circuits are out of service. The system demand is growing, mainly due to increases in electricity demand from large energy users on the east coast. This increase in demand is forecast to continue in the period out to 2030. In addition, generation margins are reducing significantly as older generators are retiring from the system. Tighter generation margins make it more difficult to grant outages as transmission outages can also reduce flexibility of generation dispatch.

For Option 1, long duration outages of the Gorman – Maynooth 220 kV circuit and the Dunstown – Maynooth 2 220 kV circuit would be required to complete the works. These two circuits are key paths between the north and south greater Dublin network, and outages of either of these circuits would prevent other outages on the 220 and 400 kV network taking place. It is not expected that the simultaneous planned outage of both these circuits could be facilitated and therefore the works would need to be carried out in sequence. Additionally, due to the requirement to carry out other essential maintenance works on the 220 kV and 400 kV network, and also to facilitate other upgrade or connection works, it is anticipated that the works would need to be split over a number of outage seasons. This could potentially cause delays to the urgently needed Kildare-Meath Grid Upgrade project.

The intention at the start of Step 3, for Option 1 – Up-voltage, was to use as many of the existing tower locations as possible. New information indicates that in order to minimise (as much as possible) the required circuit outages and their duration, the location of the majority of the towers would need to be offset from their current location[13].

The construction of this option will require access to third party land. Although, this option is using an existing circuit, past experience of new build and uprate of overhead lines is that they have often experienced delays in completion of projects for a variety of reasons. If this were to occur on this project, it would have a knock-on impact on other projects and the maintenance programme in the region and would reduce operational flexibility of the transmission system particularly around high load periods.

Taking these factors into account, there is deemed to be a high risk that there would be delays to the project schedule if Option 1 was progressed

6.4.2 Option 4 – New 400 kV underground cable

Option 4 is more straight forward to deliver but is more technically challenging to integrate onto the transmission system. There are very few examples of 400 kV underground cable circuits installed in meshed transmission systems internationally. Typically, long lengths of high voltage underground cable circuits are installed in larger systems where a greater level of alternative pathways already exists. Because of their characteristics, 400 kV underground cables can introduce technical challenges to the system such as temporary over voltages or power quality issues related to harmonic voltage distortion.

Each high voltage underground cable project is unique and can't be compared with other cable projects either in Ireland or internationally. Each project has to be individually assessed to determine its technical impact on the transmission system and requires advanced system analysis to determine if it can be accommodated. The technical feasibility of underground cables depend on the need of the reinforcement, existing circuit redundancy or alternative pathways, the strength of the system or the stations that are being connected, among other things. As a result of this, the acceptable length of high voltage UGC may be different for different projects depending on where the project is located in the transmission network. Some parts of the transmission system are

[13] ESB Engineering and Major Projects feasibility report for Option 1 (PE610-F0045-R00-001-000) http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

stronger than other parts and have a more meshed configuration and may as such be better able to accommodate UGCs.

The analysis[14] carried out to-date indicates that we can mitigate the technical challenges that high voltage UGC introduces for this project. Notwithstanding this, there remains a risk that technical issues could potentially be identified during the lifetime of the project as further information on the evolution of the network becomes available. Detailed technical studies based on the latest network information will be carried out at each stage of the project to ensure the technical challenges can be effectively mitigated.

Another challenge is the evolving nature of the Irish transmission system where many new network reinforcements will be required over the next 10 years to integrate new generation and accommodate new transmission reinforcements in order to meet the Government's energy policy ambitions. Selecting 400 kV UGC for the Kildare-Meath Grid Upgrade project, may mean that other future projects in this vicinity may face limitations on the length of UGC that can be accommodated. It is not possible to sufficiently predict the future evolution of the network to rule out this potential impact.

The new information from the asset owner in relation to cable trench width has further improved the deliverability assessment for Option 4 per the updated MCA. A reduced cable trench width makes it more feasible for the existing public road network to accommodate the proposed new cable route. It allows for easier access should the cable need repair or maintenance in the future. Where cables are installed in the public road, there may be some local traffic restrictions required such as temporary road closures, diversions during the construction works and use of certain temporary measures such as passing bays to mitigate the impact to traffic caused by the cable installation works. Cross country routing on third party lands will be considered where cable routing constraints arise. The cable route, while not yet designed is likely to require use of regional, local roads and involve crossings of the national road network. Discussions with key stakeholders such as local authorities and Transport Infrastructure Ireland will be required in the coming months before we are able to confirm a specific route for the project. Early and regular engagement with individuals, stakeholders and communities impacted will be an important part of the our engagement process.

The interaction of the cable route with works by other infrastructure providers will be an important consideration and may make installation of the cable more difficult at some points along the route and may require a cross-country route for parts of the circuit.

[14] http://www.eirgridgroup.com/site-files/library/EirGrid/Cable-integration-studies-for-Kildare-Meath-Grid-Upgrade-Step-3.pdf

The potential deliverability challenges of implementing an underground cable can be mitigated by appropriate design solutions.

Taking all of the above factors into account, it is deemed that Option 4 has a low risk in terms of timely delivery, noting that it will still be a challenging option to deliver, and it is anticipated that the technical challenges in relation to integration of high voltage underground cable can be mitigated.

6.5 Best performing option

Having reviewed the consultation feedback and the new information received since October 2020, and considered the balance between technical and deliverability risks of the two equal performing options, Option 4 the 400 kV Underground Cable (UGC) has been selected as the Best Performing Option (BPO) in Step 3.

It is concluded that Option 4 has a lower risk in terms of the delivery timeline when compared to the Option 1 and has lower impact on the existing transmission system in terms of outages and other maintenance and capital works that are routinely required on the system. Option 4 will introduce a new transmission pathway between Dunstown and Woodland stations while keeping the existing 220 kV circuits intact. This means that the existing 220 kV circuits between Dunstown and Woodland stations, which is essential for supplying the greater Dublin network, can remain in service during the implementation of the project. This would provide flexibility to the system operator to accommodate other outages (generation and transmission) whilst also minimising the risk to security of supply. The additional transmission pathway creates greater capacity on the network to accommodate growth.

As the need for greater capacity grows on the transmission system into the future it is possible that it may be necessary to progress the Option 1 - Up-voltage at some point. It is envisaged that Option 1 - Up-voltage would present a lesser risk to the existing system at that point as the new 400 kV cable option would have been successfully delivered creating an additional pathway for redundancy. If we were to look to progress the Up-voltage option at some point in the future it would follow our six step approach to developing the grid and would include engagement with stakeholders as part of the process.

7 Conclusions

The Kildare Meath Grid Upgrade is a proposed reinforcement of the electricity network between Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. The project is at the end of Step 3 of the six step approach that we use when we develop and implement a solution to any identified transmission network problem.

The project is essential to enable the further integration of renewable energy in line with Government policy ambitions. It will also be a key enabler in meeting the growing demand for electricity in the east region. The options investigated reinforce between Dunstown 400 kV station in County Kildare and Woodland 400 kV station in County Meath. In Step 3, there were five options investigated.

- Option 1: Up-voltage existing 220 kV OHL circuits;
- Option 2: New 400 kV OHL circuit;
- Option 3: New 220 kV UGC circuit;
- Option 4: New 400 kV UGC: one circuit constructed along one route;
- Option 5: New 400 kV UGC: two circuits constructed along two separate routes

Each of these options has been assessed against the five criteria covering technical performance, economic performance, deliverability performance, environmental impacts and socio-economic impacts to compare the options against each other. The multi-criteria assessment (MCA) in Step 3 identified an Emerging Best Performing Option (EBPO) and an emerging best performing alternative. The assessment and evaluation of the options were documented in the EBPO report which was published on our website[15].

The process provided for public participation and stakeholder engagement in the decision-making process. A 10-week consultation, lasting between October and December 2020, was held on the process followed and the options evaluated in the EBPO report.

To arrive at the Best Performing Option (BPO) for the Kildare - Meath Grid Upgrade and to conclude the Step 3 process, the MCA was updated to incorporate the consultation feedback and any new information received since October 2020. The updated MCA resulted in two options, Option 1 and Option 4, having an equal overall combined performance across the criteria considered in the MCA. We focused on the technical risk

[15] http://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

and deliverability challenges to help distinguish between the two options. Option 1 is technically more straight forward but it is more difficult to deliver. Option 4 is more straight forward to deliver but is more technically challenging to integrate onto the system Ultimately, the decision came down to a fine balance of these considerations.

The conclusion of Step 3 is that Option 4 (400 kV Underground Cable) has been identified as the Best Performing Option (BPO) to be developed further in Step 4. It will then be the subject of a planning application in Step 5. In the event that the application is consented by the relevant consenting authority, the permitted development will be subject to detailed design, construction and energisation.

Step 4A – Emerging Best Performing Route Option Report (March 2022)

Kildare-Meath Grid Upgrade

Step 4A Report - Analysis of the Route Options

KMGU-JAC-TN-0017

March 2022

EirGrid

Kildare-Meath Grid Upgrade

Project No:	321084AH
Document Title:	Step 4A Report
Document No.:	KMGU-JAC-TN-0017
Revision:	Final
Document Status:	For Publication
Date:	March 2022
Client Name:	EirGrid
Client No:	CP966
Project Manager:	Fay Lagan
Author:	Various
File Name:	KMGU-JAC_TN-0017

Jacobs Engineering Ireland Limited

Merrion House
Merrion Road
Dublin 4, D04 R2C5
Ireland
T +353 (0)1 269 5666
F +353 1 269 5497
www.jacobs.com

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
Final	08/03/22	Final version	Various	GG	HC	FL

Contents

Glossary and Abbreviations

Abbreviations	
ACA	Architectural Conservation Areas
AAP	Areas of Archaeological Potential
AEOS	Agri Environmental Options Scheme
AIS	Air insulated
ASI	Archaeological Survey of Ireland
CAFE	Cleaner Air for Europe
CFRAM	Catchment Flood Risk Assessment and Management
CPD	County Development Plan
CSO	Central Statistics Office
EHV	Extra High Voltage
End-to-End	A cable option that runs from Woodland to Dunstown substation. Made up of smaller route sections added together.
EPA	Environmental Protection Agency
GIS	Geographic Information System
GSI	Geological Survey Ireland
HDD	Horizontal Directional Drilling
IGHS	Irish Geological Heritage Sites
i-WeBS	Irish Wetland Bird Survey
LCA	Landscape Character Area
MVAr	Mega Volt Amps (reactive)
MCA	Multi-Criteria Analysis
Node	A point where two or more route sections meet – labelled alphabetically.
NIAH	National Inventory of Architectural Heritage
NHA/ pNHA	Natural Heritage Area/ Proposed Natural Heritage Area
NPWS	National Parks and Wildlife Services
OHL	Overhead Line
OPW	Office of Public Works
PWS	Public Water Supply
Route section	A potential route of cable that has been assessed as an option. Not a full length from Woodland to Dunstown substation but a small length in between. Several can be added together to make an End-to-End option.
RHM	Register of Historic Monuments
RMP	Record of Monuments and Places
RPS	Records of Protected Structures
RBMP	River Basin Management Plan
SAC	Special Area of Conservation, designated under the EU Habitats Directive
SI	Statutory Instrument
SMR	Sites and Monuments Record

SPA	Special Protection Area, designated under the EU Birds Directive
TPC	Total Project Cost
TSO	Transmission System Operator
TSSPS	Transmission System Security and Planning Standards
UGC	Underground cable
WFD	Water Framework Directive
XLPE	Cross-linked polyethylene

Executive Summary

Key Points:

- The Kildare-Meath Grid Upgrade project is needed to more effectively transfer power to the east of the country and help meet the growing demand for electricity in Kildare, Meath, and Dublin. The project is essential to enable further development of renewable energy generation in line with Government policy.
- Extensive design, surveys, consultation, and assessment were undertaken for all options.
- The Emerging Best Performing Option is Option A (Red).
- Option A (Red) was selected because:
  - it scored more favourably in terms of its overall Deliverability assessment when compared to the other options. Option A (Red) had more favourable scores in terms of Design Complexity; Dependence on Other Projects; Permits and Wayleaves; and Implementation Timelines.
  - it also has less Socio-economic (community) impacts – affecting the least amount of agricultural land, and avoids impacts that the other options would have resulted in, such as impacts to the settlement of Rathcoffey, and Ovidstown along the R403 and R406; and greater impacts to areas of amenity, such as Alexandra Bridge, near Clane.
- Further design, survey, consultation, and assessment will be undertaken to further reduce the impacts.

This Report

EirGrid follows a six-step approach when they develop and implement solutions to any identified transmission network problem. The process and timescale of this project is show in Figure A1-1 below. The Kildare-Meath Grid Upgrade project is currently at Step 4 – Where exactly should we build? To help identify the best location for the project, Step 4 has been divided into two sub-steps: Step 4A and Step 4B. This Step 4A Report presents an analysis of the proposed route options. It describes the process followed to identify and evaluate the proposed route options. This report identifies what EirGrid, on the basis of information currently gathered, considers to be the Emerging Best Performing Option for the route of the underground cable.

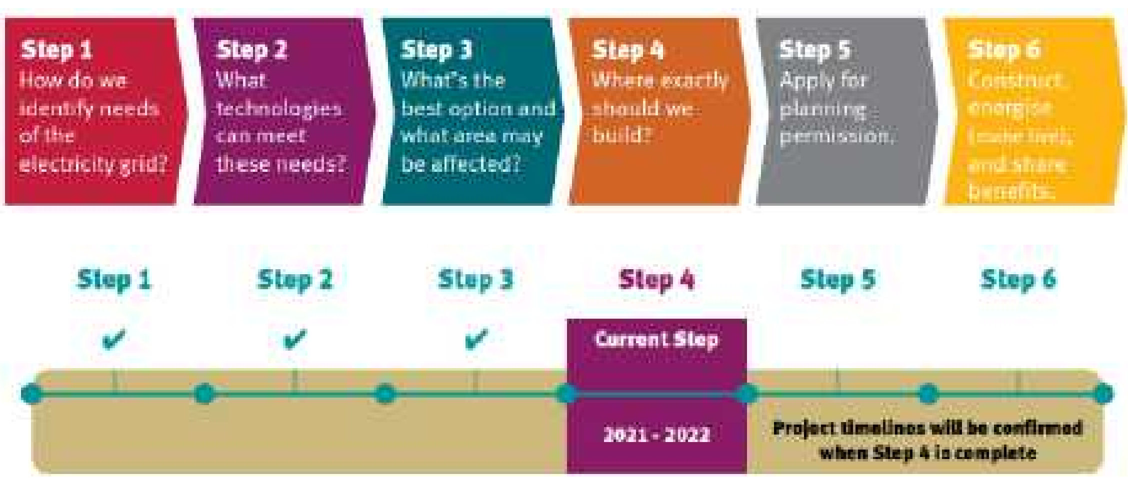

Figure A1-1: EirGrid's six-step approach and timeline for the Proposed Project

Introduction

The Kildare – Meath Grid Upgrade project will help transfer electricity to the east of the country and distribute it within the network in Meath, Kildare and Dublin. The Proposed Project will add or upgrade a high-capacity electricity connection between Dunstown substation in Kildare and Woodland substation in Meath. The need for the project is integration of generation and an increase in demand on the east coast.

The project is essential to meet the Government of Ireland's Climate Action Plan target of 80% renewable energy generation by 2030, this includes transporting electricity from offshore renewable sources. It will also help meet the growing demand for electricity in the East. This growth is due to increased economic activity in the region.

A significant number of Ireland's electricity generators are in the South and South West, where many wind farms and some modern electricity generators are located. The power they generate needs to be transported to where it is needed. The power is mainly transported cross-country on the two existing 400 kV lines from the Moneypoint station in Clare to the Dunstown substation in Kildare and Woodland substation in Meath. The proposed Kildare Meath project will connect these two lines and this will strengthen the transmission network by improving reliability and security in the region.

Overview of Study Area

The Study Area lies in the Mid-East Region of Ireland, specifically within the counties of Kildare and Meath. Project Ireland 2040 describes this region as having experienced high levels of population growth in recent decades, at more than twice the national growth rate. If the 2016 trend of internal migration outflows from Dublin to the other regions returns to 2006 levels, the mid-East region is projected to show the highest percentage population increases by 2036, from 690,900 to 965,300 by 2036. The manufacturing industry employs a significant number of people in the region and it is the location of high tech industries in areas such as Leixlip. The Study Area for this assessment is illustrated in Figure A1-2.

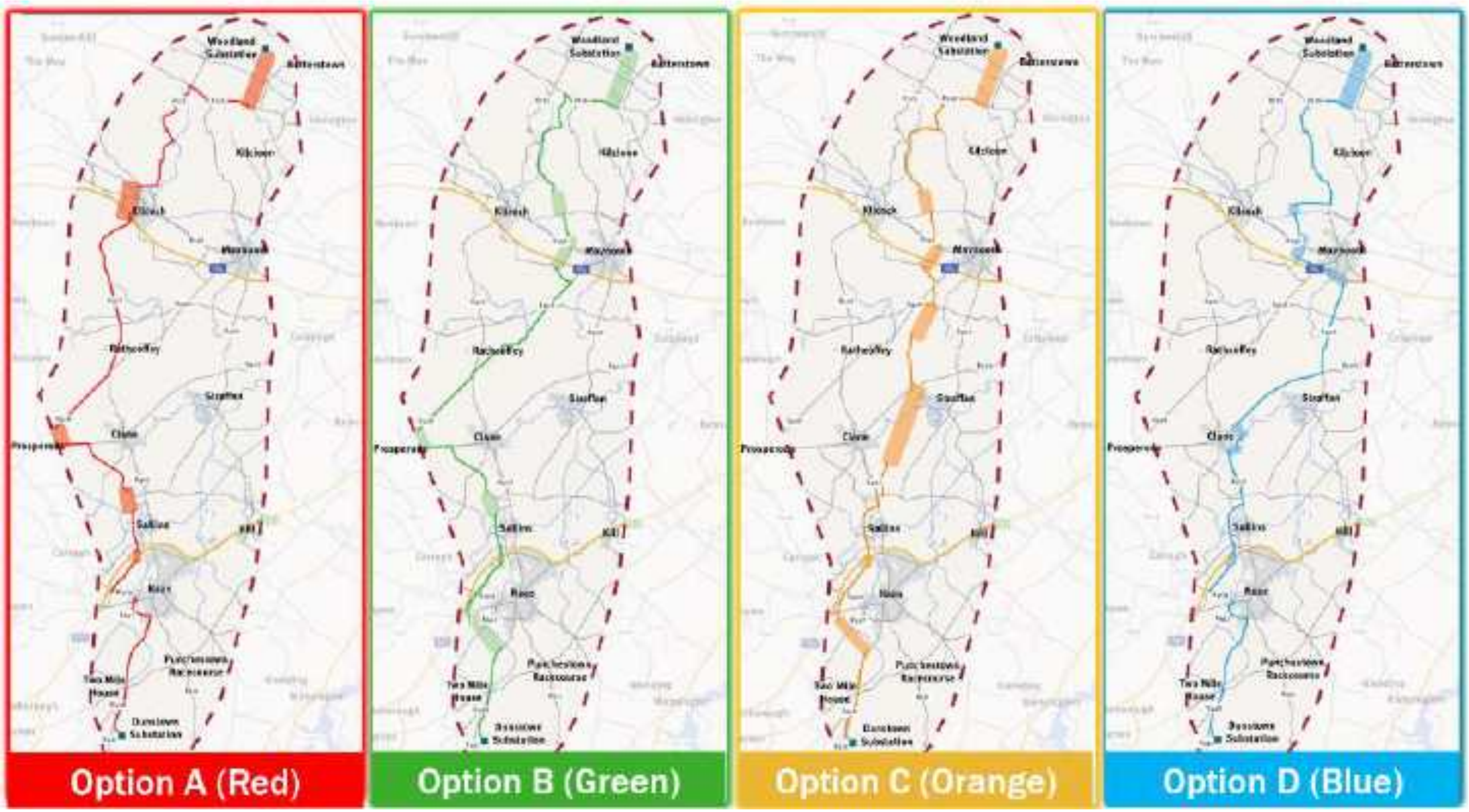

Figure A1-2: Shortlisted Options - shown in Public Consultation (2021)

Proposed Route Options

The project team examined the Study Area to design route options between Woodland and Dunstown Substations. Site surveys, information gathered through consultations, and desktop information were used to inform the options. The design of the proposed route options was based on the following routing principles:

- Avoid motorways;
- Maximise the use of national, regional and local roads;
- Avoid town centres and industrial estates;
- Avoid going off-road, through private land and through agricultural land where possible;
- Avoid sensitive natural and built heritage locations;
- Minimise impact on communities where possible; and
- Minimise the overall length of the route.

These routing principles align with EirGrid's five key assessment criteria - Environmental; Socio-Economic; Technical; Economic; and Deliverability. In-line with the routing principles, options have avoided going off-road, through private land and through agricultural land, where possible. The balancing with the other routing principles means that there are some options which do impact agricultural land. The impacts to agricultural land have been carefully considered and a balance has been sought between impacts to farming operations, the importance of field drains and hedgerows at the edges of field for their ecological value, and technical considerations.

None of the options directly impact private dwellings or gardens and none would require demolitions of dwellings.

The four proposed route options are described and set out as follows:

Table A1.1: Summary of Environmental Assessment for Options

Option	Overall Length (km)	Off-road Section (km)
Option A (Red)	51.4	6.0
Option B (Green)	50.4	10.6
Option C (Orange)	46.7	15.5
Option D (Blue)	50.5	9.0

Please note that these are estimated based on the current information at the time of assessment. Further surveys, design, assessment, and consultation will be completed to determine the final length of the selected option. Further changes will be possible in order to avoid unknown utilities, at the request of landowners, to minimise environmental impacts, or for other reasons.

Option A (Red)

Option A (Red) is the most westerly of the shortlisted cable route options and it is also the longest at 51.4km. All the shortlisted options have a common section coming out of Woodland substation.

The common section out of Woodland substation travels to the townland of Jenkinstown. At the junction of the R156 and the L1012 (Mulhussey Road), Option A (Red) is proposed to travel along the R156 to the north west towards the Mullagh Cross Roads. It will then travel south along the R125, and R158 towards Kilcock. It is proposed that Option A (Red) will pass to the west of the town of Kilcock and a potential corridor is shown on the project mapping. In this section, crossings of third party lands are anticipated in addition to the Rye Water (at locations not designated as a Special Area of Conservation), the Royal Canal (a proposed Natural Heritage Area (NHA), the Dublin-Sligo railway line, and the M4 Motorway will be required. It is proposed that the cable will be directionally-drilled under these to avoid potential impacts.

To the south of Kilcock, Option A (Red) is proposed to travel to the south along the R407 towards Clane. To the north of Clane at the Boherhole Cross Roads, it is proposed to take Option A (Red) to the west to avoid Clane. It is one of the project's routing principles to avoid towns and villages. Option A (Red) will travel along the R408 (the road towards Prosperous). Close to the townland of The Cott, it is proposed to route the cable across agricultural land to the south east of the R408. This is required so that the route can continue to travel to the south towards the Dunstown substation. A potential corridor is shown at this location on the project mapping. Option A (Red) will meet the R403, travelling along it until the Firmount Cross Roads, where it will continue south along the L2002. It will travel south to the new Sallins Bypass where a potential corridor is shown for a crossing of agricultural land. Along the Sallins Bypass, Option A (Red) will cross the River Liffey and Grand Canal (pNHA). A potential corridor is shown for the required crossing of the M7 Motorway.

Under the M7 Motorway, Option A (Red) will then travel along the Millennium Link Road (Western Distributor Road), travelling to the west around Naas avoiding a more direct route towards Naas town centre. Option A (Red) will connect with the R409 and travel east towards Naas, passing the Naas Sports Centre and across the Grand Canal (a proposed NHA). The proposed route then travels along the R445 and the R447 (South Ring Road). Option A (Red) connects with the R448 (Kilcullen Road) and travels south past Killashee. It meets the junction of R412 and then travels into the Dunstown substation.

Option B (Green)

Option B (Green), at 50.4km in length, is similar in parts to Option A (Red) but differs in the section between the R156 to the north of Clane.

The common section out of Woodland substation travels to the townland of Jenkinstown. At the junction of the R156 and the L1012 (Mulhussey Road), Option B (Green) is proposed to travel south along the L1012 (Mulhussey Road). The route cable will pass the Mulhussey National School (St Josephs). The proposed route travels west and passes the roadside Mulhussey Castle and Cemetery toward Kiltens Gap Cross Roads. Here, the route travels south towards Rodanstown and then south east to Bryanstown. Along this road a potential corridor is shown on the project mapping where Option B (Green) will travel south to cross the Rye Water (at locations not designated as a Special Area of Conservation) and under agricultural land. Another potential corridor is shown where the route will cross the Royal Canal (pNHA), the River Lyreen, the Dublin-Sligo railway line, and M4 Motorway, avoiding Laraghbryan Cemetery. To the south of motorway, Option B (Green) connects with R408 where it will travel south west. Along this route, Option B (Green) will travel through the settlements of Rathcoffey and Moortown, then meeting with the R407 at the Boherhole Cross Roads.

It is proposed to take Option B (Green) to the west to avoid Clane as it is one of the project's routing principles to avoid towns and villages. Option B (Green) will travel along the R408 (the road to Prosperous). Close to the townland of The Cott, it is proposed to route the cable across agricultural land to the south east of the R408. This is required so that the route can continue to travel to the south towards the Dunstown substation. A potential corridor is shown at this location on the project mapping. Option B (Green) will meet the R403, travelling along it until the Firmount Cross Roads, where it will continue south along the L2002. It will travel south to the new Sallins Bypass where a potential corridor is shown for a crossing of agricultural land. Along the Sallins Bypass, Option B (Green) will cross the River Liffey and Grand Canal (pNHA). A potential corridor is shown on the project mapping for the required crossing of the M7 Motorway.

Under the M7 Motorway, Option B (Green) will then travel along the Millennium Link Road (Western Distributor Road), travelling to the west around Naas. To the south of the Southern Link Business Park, a potential corridor over agricultural land is shown at this location on the project mapping. This section of Option B (Green) will cross the Grand Canal (pNHA). Option B (Green) connects with the R448 (Kilcullen Road) and travels south past Killashee. It meets the junction of R412 and then travels into the Dunstown substation.

Option C (Orange)

Option C (Orange) is the shortest of the four options at 46.7km, however, it will potentially affect much more agricultural land than the other shortlisted options.

The common section out of Woodland substation travels to the townland of Jenkinstown. At the junction of the R156 and the L1012 (Mulhussey Road), Option C (Orange) is proposed to travel south along the L1012 (Mulhussey Road). The route cable will pass the Mulhussey National School (St Josephs). The proposed route travels west and passes the roadside Mulhussey Castle and Cemetery toward Kiltens Gap Cross Roads. Here, the route travels south towards Rodanstown and then south east to Bryanstown. A potential corridor is shown on the project mapping where Option C (Orange) will travel south to cross the Rye Water(at locations not designated as a Special Area of Conservation), and under agricultural land. Another potential corridor is shown on the project mapping where the cable will cross the Royal Canal (pNHA), the River Lyreen, the Dublin-Sligo railway line, and the M4 Motorway, avoiding Laraghbryan Cemetery. To the south of motorway, Option C (Orange) crosses the R408 at Crinstown Cross Roads. It will travel south east on the L5042 until it meets the L5037 close to Maguire's Wood. At this point, a potential corridor is shown at this location on the project mapping to where the Option C (Orange) will cross under agricultural land. It will then connect with a local road in the townland of Smithtown, travelling south thorough Johninstown and Ovidstown, crossing the R403 to the north of the K Club.

Another potential corridor is shown on the project mapping travelling to the south until the townland of Blackhall. Here it travels under local roads, past the now closed Bodenstown Golf Club, and the roadside Bodenstown Cemetery, before connecting the R407. Option C (Orange) will travel along the R407 for a short length before connecting to the new Sallins Bypass. Along the Sallins Bypass, Option C (Orange) will cross the River Liffey twice and Grand Canal (pNHA). A potential corridor is shown on the project mapping for the required crossing of the M7 Motorway.

Under the M7 Motorway, Option C (Orange) will then travel along the Millennium Link Road (Western Distributor Road), travelling to the west around Naas. To the south of the Southern Link Business Park, a potential corridor over agricultural land is shown at this location on the project mapping. This section of Option C (Orange) will cross the Grand Canal (pNHA). Option C (Orange) connects with the R448 (Kilcullen Road) and travels south past Killashee. It meets the junction of R412 and then travels into the Dunstown substation.

Option D (Blue)

Option D (Blue) is the second longest option at 50.5km in length and it potentially affects the least amount of agricultural land of the shortlisted options.

The common section out of Woodland substation travels to the townland of Jenkinstown. At the junction of the R156 and the L1012 (Mulhussey Road), Option D (Blue) is proposed to travel south along the L1012 (Mulhussey Road). The route will pass the Mulhussey National School (St Josephs). The proposed route travels east and then south following the L1012 until the Moyglare Road. Here it will travel west to avoid Maynooth. Along this road a potential corridor is shown on the project mapping where Option D (Blue) will travel south to cross the Rye Water and under agricultural land. Another potential corridor is shown on the project mapping where the cable will cross Royal Canal (pNHA), the River Lyreen, and the Dublin-Sligo railway line, avoiding Laraghbryan Cemetery.

Option D (Blue) is proposed to travel parallel to the north of the M4 Motorway. It will then cross the motorway to the west of the Maynooth Junction (junction number 7) and connects to the R406. Option D (Blue) travels along this to the north of Straffan, where it meets the R403. This road will take the cable past Barberstown Castle towards Clane. Option D (Blue) will travel to the east of Clane, crossing the River Liffey but avoiding the town. A potential corridor is shown on the project mapping in this area. The route connects the R407 to the south of Clane and then connects with the Sallins Bypass. Along the Sallins Bypass, Option D (Blue) will cross the River Liffey and Grand Canal (pNHA). A potential corridor is shown on the project mapping for the required crossing of the M7 Motorway at this location.

Under the M7 Motorway, Option D (Blue) will then travel along the Millennium Link Road (Western Distributor Road), travelling to the west around Naas. Option D (Blue) will connect with the R409 and travel east towards Naas, passing the Naas Sports Centre and across the Grand Canal (pNHA). The proposed route then travels along the R445 and the R447 (South Ring Road). Option D (Blue) connects with the R448 (Kilcullen Road) and travels south past Killashee. It meets the junction of R412 and then travels into the Dunstown substation.

Assessment of Proposed Options

Each of the proposed route options was considered against the following set of criteria:

- Environment:
  - Biodiversity;
  - Soils and Water;
  - Planning Policy and Land Use;
  - Landscape and Visual; and
  - Archaeology, Architectural Heritage and Cultural Heritage
- Socio-economic:
  - Traffic & transport;
  - Noise, Vibration and Air Quality;
  - Visual;
  - Amenity;
  - Health;
  - Employment and Economy;
  - Land-use (and Land Take);
  - Agriculture (including Equine); and
  - Utilities
- Technical;
- Deliverability; and
- Economic.

Assessment Outcomes

Each of the proposed route options have been assessed across the constraints criteria detailed below based on the ranking approach presented below.

More significant/difficult/risk Less Significant/difficult/risk

This risk scale is clarified by text, as follows:

- High: Dark Blue;
- Moderate-High: Blue;
- Moderate: Dark Green;
- Low-Moderate: Light Green; and
- Low: Cream.

Environment Assessment

Table A1.2 below summarises the findings of the environmental assessment for each of the solution options. For more detail on how each individual option was appraised, please see Section 4.2, 5.2, 6.2 and 7.2, respectively.

Table A1.2: Summary of Environmental Assessment for Options

Option	Biodiversity	Soils and Water	Planning Policy and Land Use	Landscape and Visual	Archaeology, Architectural Heritage, and Cultural Heritage	Combined Environment Score
Option A (Red)	Moderate-High	Moderate	Moderate	Low-Moderate	Moderate-High	Moderate
Option B (Green)	Moderate-High	Low-Moderate	Low	Low-Moderate	Moderate	Low-Moderate
Option C (Orange)	Moderate-High	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate
Option D (Blue)	Moderate-High	Moderate	Moderate	Low-Moderate	Moderate	Moderate

Overall, Option A (Red) has been scored as **Moderate (Dark Green)** in terms of risk of environmental impact. This is due to crossings within the zoned land, increased watercourse crossings, and increased cultural heritage effects (mitigation measures to reduce the effects will be considered at the next step). This route option is in proximity to the highest number Recorded Monuments (including Jigginstown Castle), Protected Structures, and Gardens and Designed Landscapes. Option B (Green) has been scored as **Low-Moderate (Light Green)** overall. This Option interacts with less zoned land than Option A (Red) as it avoids Kilcock. Option C (Orange) has been scored as **Low-Moderate (Light Green)** overall. Option C (Orange) scores higher in terms of Land Use Planning due to impacts to a solar farm application. Option D (Blue) has been scored as **Moderate (Dark Green)** overall. This is due to crossing with zonings within the Clane and Draft Naas Local Area Plans, a longer section within the River Liffey 'Principal Landscape Sensitivity Factor'.

Socio-economic Assessment

Outlined below are the findings of the socio-economic assessment of each of the solution options. For more information on these findings, please see Section 4.3, 5.3, 6.3 and 7.3 respectively.

Table A1.3: Summary of Socio-economic Assessment of Options

Option	Traffic and Transport	Noise and Vibration	Air Quality	Visual	Amenity	Health	Employment and Economy (and Tourism)	Land Use (and Land-take)	Agriculture (including Equine)	Utilities	Combined Socio-economic Score
Option A (Red)	Moderate - High	Moderate	Moderate	Low-Moderate	Low-Moderate	Low-Moderate	Low	Low	Low	Low-Moderate	Low-Moderate
Option B (Green)	Moderate - High	Low-Moderate	Low-Moderate	Low-Moderate	Moderate	Low	Low	Low	Low-Moderate	Low-Moderate	Moderate
Option C (Orange)	Moderate - High	Low-Moderate	Low	Low-Moderate	Low-Moderate	Low	Low	Low	Moderate	Low-Moderate	Moderate
Option D (Blue)	Moderate - High	Moderate	Moderate	Low-Moderate	Moderate-High	Low-Moderate	Low	Low	Low-Moderate	Low-Moderate	Moderate-High

Option A (Red) will pass less properties than Option D (Blue) and will require less full road closures compared to Options B and C. However because more of its length is in regional roads, construction traffic disturbance will be comparatively greater due to the increased traffic using those roads. Mitigation measures to reduce the effects will be considered at the next step. Option A (Red) has the least significant agricultural land issues as in crosses the least amount of agricultural/private land. Option B (Green) travels through the settlement of Rathcoffey, which will result in disruption to this settlement during the construction phase. Option C (Orange) is considered to have a similar combined social impact to Option A (Red) and Option B (Green), however individual social impacts are more similar to Option B (Green) than Option A (Red). As such, it has been assigned a **'Moderate (Dark Green)'** score. Option D (Blue) passes the greater number of properties than the other options; has a greater visual impact at Alexandra Bridge; passes along the R403 and R406 which are densely populated and importance routes for local and regional traffic. It has been assigned a **Moderate – High (Light Blue)** score.

Technical Assessment

For more information on these findings, please see Section 4.3, 5.3, 6.3, and 7.3 respectively.

Table A1.4: Summary of Technical Assessment of Options

Option	General Compliance	Headroom	Maintainability	Technology Operational Risk	Average Reliability Rates	Repeatability	Combined Technical Score
Option A (Red)	Low	Low	Low	Low	Low	Low	Low
Option B (Green)	Low	Low	Low	Low	Low	Low	Low
Option C (Orange)	Low	Low	Low	Low	Low	Low	Low
Option D (Blue)	Low	Low	Low	Low	Low	Low	Low

At this stage in the Proposed Project, are there no technical differentiations apart from the number of major crossings. All four of the options are technically sound and could be constructed in-line with EirGrid's technical standards. Options A (Red) and B (Green) will have two fewer than Options C (Orange) and D (Blue). However this may not present a technical issue in terms of the rating of the cable. Other technical factors will have no impact on the selection of the best performing option. Each of the four options have been assessed to have a **Low (Cream)** score for the technical criterion. This demonstrates that only technically sound options have been taken forward for assessment. Further assessment of the Emerging Best Performing Option in terms of the technical criterion will be undertaken through the next steps of the Proposed Project.

Deliverability Assessment

Outlined below are the findings of the deliverability assessment of each of the solution options. For more information on these findings, please see Section 4.4, 5.4, 0, and 7.4 respectively.

Table A1.5: Summary of Deliverability Assessment of Options

Solution Option	Design complexity	Traffic disturbance	Dependence on other infrastructure projects	Permits and wayleaves	Implementation Timelines	Combined Deliverability Score
Option A (Red)	Low-Moderate	Moderate-High	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate
Option B (Green)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Option C (Orange)	High	Moderate-High	Moderate	Moderate-High	Moderate-High	High
Option D (Blue)	Moderate -High	Moderate	Moderate -High	Low- Moderate	Moderate	Moderate

Considering the design complexity, traffic disturbance from temporary construction traffic, impact dependence and implementation timelines, a rating of **'Moderate-High' (Light Blue)** has been assigned. Option A (Red) has generally scored well (Low-Moderate) over all in the Deliverability sub-topics, however the impact in terms of construction traffic disturbance has elevated the overall score. Option A (Red) has the least amount of off-road section and impacts more regional roads than the other options, meaning fewer full road closures than Options B and C.

Economic Assessment

Outlined below are the findings of the economic appraisal of each of the solution options. For more information on these findings, please see Section 4.5, 5.5, 6.5, and 7.5 respectively.

Table A1.6: Summary of Economic Assessment of Options

Route Option	Length of Installed Cable	Quantity of Crossings	Combined Economic Score
Option A (Red)	Moderate	Low	Low-Moderate
Option B (Green)	Moderate	Low	Low-Moderate
Option C (Orange)	Low	Moderate-High	Low Moderate
Option D (Blue)	Moderate	Moderate-High	Moderate-High

At this stage in the Proposed Project, the only differentiations between route options are cable route lengths and the impact from the quantity of expected major crossings. Option A (Red) has been assessed to have a **Low-Moderate (Light Green)** score for the economic criterion due to the fewer HDDs balancing out the longer length of the route when compared to the shortest Option C.

Conclusion

Table A1.7: Assessment Summary

Option	Environment Score	Socio-economic Score	Technical Score	Deliverability Score	Economic Score
Option A (Red)	Moderate	Low-Moderate	Low	Low-Moderate	Low-Moderate
Option B (Green)	Low-Moderate	Moderate	Low	Moderate	Low-Moderate
Option C (Orange)	Low-Moderate	Moderate	Low	High	Low-Moderate
Option D (Blue)	Moderate	Moderate-High	Low	Moderate	Moderate-High

It was determined that Option A (Red) would be selected as the Emerging Best Performing Option. This is due to several factors including its better Socio-Economic and Deliverability scores compared to the other options. These lower Socio-economic impacts means that there will be less impacts to communities including the farming community. While it is the longest of the four options, it passes fewer properties compared to Option D (Blue) and it has fewer major crossings (such as HDD) compared to Options C and D. It also impacts the least amount of agricultural land of the four options. Additionally, by crossing less agricultural land, there are likely to be fewer impacts to hedgerows and treelines, and therefore reduced ecological and landscape effects. While Option A (Red) has increased cultural heritage and temporary construction traffic impacts compared to the other options, further survey, consultation, design, and assessment work will be undertaken to reduce and/or avoid the impacts.

Consultation Feedback on Option A (Red)

In terms of Option A (Red), many respondents expressed their support for this option, stating that in general terms Option A (Red) was the 'best option' or a 'reasonable' option. A few respondents stated that Option A (Red) represented the most direct route by following existing roads and many respondents highlighted that Option A (Red) would have less of an impact on the surrounding area than the other proposed options. Some of these respondents stated that Option A (Red) would be less disruptive to local communities, arguing that less landowners would be affected and that the option would not contribute to traffic in areas that are already experiencing congestion, such as Sallins, Clane and Kilcock. Many respondents outlined that the additional length of Option A (Red) compared to other options was acceptable, as this option would not impact on high-output soils, and would therefore have the least impact on agricultural land. These respondents stated that agriculture is an important sector in this area. In addition, a small number of respondents stated that Option A (Red) would have less of an environmental impact than the other options given the fact that there is a lower estimated figure for off-road sections.

Summary

In summary, Option A (Red) was selected as it scored more favourably in terms of Deliverability compared to the other options. Option A (Red) generally scored more favourably in four of the Deliverability topics compared to the other options – Design Complexity; Dependence on Other Projects; Permits and Wayleaves; and Implementation Timelines. Option A (Red) did score more highly or equal for Traffic Disturbance because it has the most amount road sections and impacts more regional roads than the other options, which will increase traffic disturbance. While the traffic impacts will be temporary and restricted to the construction phase, in order to minimise the disturbance, traffic surveys will be undertaken to confirm this assumption. Other survey and design work will be completed to confirm the assumptions made on the required working area. In addition, localised route changes could be designed and assessed to minimise impacts further. Consultation will be undertaken with Meath and Kildare County Councils to agree the approach to traffic management and avoid and/or reduce the impacts.

Option A (Red) also has less Socio-economic (community) impacts compared to other options. . This is reinforced by the feedback received from respondents during the consultation period. Option A (Red) impacts the least amount of agricultural land, and avoids concerns that the other options would have resulted in, such as impacts to the settlement of Rathcoffey, and Ovidstown along the R403 and R406; and greater impacts to areas of amenity, such as Alexandra Bridge, near to Clane. Further design, survey, consultation, and assessment will be undertaken to further reduce the impacts and maintain engagement with stakeholders in the project area.

Next Steps

The following actions will be completed on the Proposed Project:

- This Step 4A report will be published and any feedback will be considered by the project team and amendments will be made where it is considered appropriate;
- EirGrid will meet with affected landowners (subject to Covid protocols) to discuss the Proposed Project to seek agreement on the way forward. Further meetings will also be held with bodies such as Meath and Kildare County Councils, TII, Irish Rail, Waterways Ireland, and the utility providers such as Irish Water and Gas Networks Ireland;

- The project team will undertake a wide range of surveys to help to refine the design and location of the proposed cable. This will also include designing how the cable will be constructed and how traffic disturbance will be minimised through traffic management. The surveys include archaeology, ecology, agriculture, ground investigations, utilities surveys, hydrology, technical assessments, etc. These surveys will likely result in changes to the route shown in this report. This is a normal part of the design process – as further information is gathered, new issues can be identified resulting in changes to the route. The changes are likely to be minor in nature and will not affect the conclusion that Option A (Red) is the Emerging Best Performing Option. If large scale changes are required, then the assessment will be remade, and further consultation will be undertaken;
- Further design work will be progressed at the substations to determine the works required to connect the proposed cable into the grid;
- When the proposed cable route and design have been progressed further, a further report called the Step 4B report will be published for public consultation. This will allow further comments on the proposed route which will be addressed by the project team. The Step 4B report is likely to be published in the middle of 2022; and
- Following that, the project team will prepare the planning submission for the Proposed Project. Further updates will be published by EirGrid on the project website: www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/

1. Introduction

1.1 The Proposed Project

The Kildare – Meath Grid Upgrade project (referred to as the 'Proposed Project' in this Report) will help transfer electricity to the east of the country and distribute it within the network in Meath, Kildare and Dublin.

The Proposed Project will add or upgrade a high-capacity electricity connection between Dunstown substation in Kildare and Woodland substation in Meath. The project is essential to meet the Government of Ireland's Climate Action Plan target of 80% renewable energy generation by 2030, this includes transporting electricity from offshore renewable sources. It will also help meet the growing demand for electricity in the East. This growth is due to increased economic activity in the region.

A significant number of Ireland's electricity generators are in the South and South West, where many wind farms and some modern electricity generators are located. The power they generate needs to be transported to where it is needed. The power is mainly transported cross-country on the two existing 400 kV lines from the Moneypoint station in Clare to the Dunstown substation in Kildare and Woodland substation in Meath (shown in Figure 1-1).

Figure 1-1: Cross-country 400 kV lines

To solve this emerging issue, EirGrid needs to strengthen the electricity network between Dunstown and Woodland to avoid capacity and voltage problems.

The Proposed Project aims to strengthen the transmission network between Dunstown and Woodland substations - and suggests a number of technical solutions to do so. EirGrid has identified that the Proposed Project will have the following benefits:

- Community - Deliver community benefit in the areas that facilitate the project infrastructure;
- Competition - Apply downward pressure on the cost of electricity;
- Sustainability - Help facilitate Ireland's transition to a low carbon energy future;
- Security of Supply - Improve electricity supply for Ireland's electricity consumers; and
- Economic - Contribute to the regional economy and support foreign direct investment.

The need for the Proposed Project has been established through a series of reports completed at Steps 1 to 3 (see Figure 1-2 below for reference). These reports are available on the project website[1]. This series of studies identified the need for a new connection between Woodland and Dunstown substations and that an underground cable would be the best technology for this connection. The Proposed Project is a high voltage (400 kV) underground cable between Woodland and Dunstown substations and the need for the project remains robust.

1.2 Construction of the Project

All four proposed route options have been assessed to be buildable, reasonable, and practicable. Detailed designs will need to be produced with regards to alignment and build-up in the next steps on the Proposed Project.

Further design will be undertaken at the next steps in the Proposed Project. This work will refine the location and nature of the construction works and allow an assessment of the environmental impacts of the Proposed Project. The further design will include matters such as construction sequencing, traffic management, management of excavated material, and construction compounds, and ensuring existing utilities and structures are not affected.

Consultations have already started with statutory bodies such as Iarnród Éireann (Irish Rail) and Transport Infrastructure Ireland (TII) and the local road authorities Kildare County Council and Meath County Council. Utility operators have been contacted for the location of their services and further consultations will be undertaken.

Each of the four proposed route options will have significant groundworks associated with them whether that is following carriageways or across agricultural land. Due to the nature of this type of construction works there will be a requirement to temporarily stockpile large amounts of the excavated material during the ongoing works and will need to be factored into the site setups and planning boundaries.

Dependent on road conditions and highways specification, there could be opportunity to reuse the initially removed asphalt surface, treatment and conditioning and returning to be used as a temporary road surface before the final permanent surface is applied. This would require an agreed crushing and treatment suite suitable for the chosen route, however, would ensure that vehicles being used for the transport of aggregate and fills are used at peak optimum (i.e. always travelling with a load) and may reduce the overall carbon footprint of the scheme and disruption to neighbours.

All four of the proposed route options require two crossings of railway lines, two crossings of motorways, and three crossings of canals (Royal Canal once, and the Grand Canal twice). These crossings are not key differentiators in the assessment between the proposed route options.

[1] https://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

A proposed construction sequence and methodology for the Proposed Project is as follows:

- Setup traffic management (road closure / lane closure / diversions);
- Saw cut and remove road surface;
- Address any existing utilities (the details will be confirmed with utility owners);
- Excavate trench (2.1m wide by 1.3m deep approximately);
- Install concrete base;
- Install ducts for High Voltage cables and control / pilot cables;
- Install concrete surround to ducts;
- Installation of cable identification tape / tiles;
- Back fill and compacting;
- Resurfacing and lining of the road surface; and
- Removal of traffic management.

These activities would then be repeated until a cable jointing bay is needed to be installed. Cable jointing bays will be provided approximately every 650m and will allow sections of cable to be linked together as well as providing future access points for maintenance. The jointing bays are installed below ground at fixed intervals corresponding to the cable length. Joint bays are firstly installed and then later for use subsequently in cable installation and jointing. The jointing bays can be constructed in a number of different ways – one method is to use prefabricated joint bays or precast bays which can be delivered to site and lifted into position. Passing bays will be located and assessed at the next step of the project. These temporary passing bays will be located adjacent to jointing bays and will allow traffic to flow around the bay during its construction, reducing the need for diversions or road closures.

Following the installation of ducts and jointing bays, the following activities occur:

- Pulling the cables into the ducts;
- Jointing of the cables; and
- Testing and commissioning of the entire cable at the end of the construction phase but prior to the operational phase.

Associated works will be required at a number of substations including Woodland and Dunstown. These works continue to be scoped and will be determined in the next step of the Proposed Project and are not part of this report. It should be noted that the selected route option for the Proposed Project will continue to be refined until the planning application is submitted. Changes may be made for technical reasons (e.g. crossing a watercourse), the results of environmental surveys, or through consultations with affected landowners. Should changes be made, these will be fully communicated through the reports, planning application, landowner meetings, and public consultations.

Overall, it is estimated that the construction of the Proposed Project will have a duration of two to three years assuming no unforeseen delays. The construction duration will be refined at the next step of the Proposed Project (i.e. Step 5) when further design and assessment will be carried out.

1.3 Purpose of this Step 4A Report

EirGrid follow a six-step approach when they develop and implement the best performing solution option to any identified transmission network problem. This six-step approach is described in the document 'Have Your Say' published on EirGrid's website[2]. The six steps are shown at a high-level in Figure 1-2. Each step has a distinct purpose with defined deliverables and represents a lifecycle of a development from conception through to implementation and energisation.

Figure 1-2: EirGrid's six-step approach to developing the electricity grid

The Proposed Project is currently in Step 4, where the project team in consultation with stakeholders and the community identifies exactly where the underground electricity connection will be built. The timeline for Step 4 can be seen in Figure 1-3.

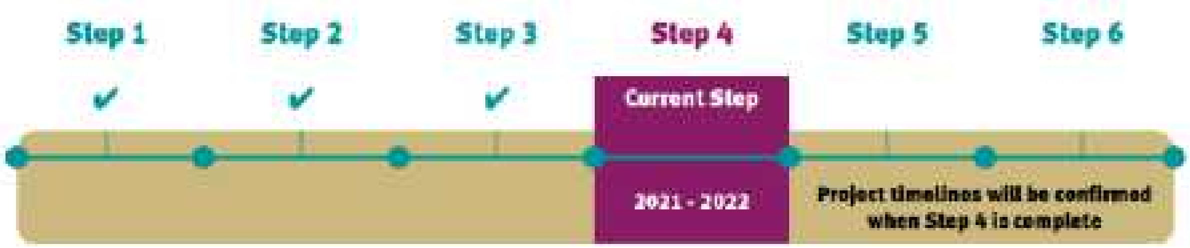

Figure 1-3: EirGrid's six-step timeline for the Proposed Project

In Step 1, EirGrid identified the need for the Proposed Project.

In Step 2, EirGrid compiled a shortlist of best performing technical options, which went out for public consultation between November 2018 and February 2019. This included a mix of overhead line, underground cable and upvoltage technologies. Four of those options were taken forward to Step 3 in April 2019.

In Step 3, EirGrid re-confirmed the need for the Proposed Project and investigated and consulted on the shortlisted technology options to strengthen the electricity network between the Woodland and Dunstown substations. In April 2021, EirGrid identified the 400 kV underground cable option as the best performing option to progress for this Proposed Project.

2 http://www.eirgridgroup.com/the-grid/have-your-say/

As part of Step 4, EirGrid has identified four potential underground cable route options and have consulted on these. The four proposed route options are being assessed against five key assessment criteria:

1. Environmental factors;
2. Socio-economic factors – such as the local economy and local amenities;
3. Technical aspects;
4. Deliverability factors – such as timeline and potential risks; and
5. Economic factors.

Figure 1-4: EirGrid's Five Assessment Criteria for Projects

Step 4 has been divided into two sub-steps: Step 4A and Step 4B. This Step 4A Report presents an analysis of the proposed route options. It describes the process followed to identify the proposed route options and presents a comparative evaluation of those sites against a set of criteria. This report identifies what EirGrid, on the basis of information currently gathered, considers to be the Emerging Best Performing Option for the route of the underground cable. This report will be published and EirGrid will consider all feedback arising and will use this, and any further survey and analysis undertaken, to confirm the Best Performing Option at Step 4B. The Best Performing Option will be the route option taken forward to the planning process (and Step 5 of the six-step development process).

Sustainability

There is no national guidance on the assessment of sustainability within infrastructure projects and so this section outlines the approach that has already been completed on the Proposed Project and that will be completed in future steps. The assessment of sustainability issues will be completed at a level of detail appropriate to this Step (i.e. Step 4) of the Proposed Project. Further details on design, materials and impacts such as exact area of land-take and social effects will be available at the next Step of the Proposed Project and they will be assessed appropriately at that time.

Chapter 2 of this report outlines how the options have been developed for the Proposed Project. The routing principles, as specified in Section 2.2, establish how the proposed route options considered social, economic, and environmental issues from the outset, and therefore had sustainability at the core of the process. Examples such as avoiding designated sites and towns, minimising the length of the route to reduce impacts and cost, and avoiding agricultural land where possible show how the selected route options considered a blend of sustainability issues. Further details are provided in Chapter 2 of this report.

Assessment against EirGrid's five assessment criteria (Environment; Socio-economic; Technical; Deliverability; and Economic – as identified in Section 2.3 of this report) is the key to the consideration of sustainability on the Proposed Project. These five assessment criteria address economy, society, and environment (key sustainable development considerations) and ensure that this Step 4A Report has sustainability fully addressed in the selection of the preferred route. The assessment of the proposed route options is provided in Chapters 4 - 7 of this report.

Community involvement is another key consideration in sustainability. EirGrid has met with affected landowners directly, held online presentations, hosted interactive mapping on a dedicated project website, visited nine communities with their Mobile information unit, and invited members of the public and statutory bodies to submit comments and queries on the Proposed Project. A community forum has been established to identify local community representatives and obtain feedback through regular engagement. Further details on the consultation process are provided in Section 2.2.4 of this report.

In the next step of the Proposed Project (i.e. Step 5), further consultation, surveys, design, and assessment will be undertaken as the Proposed Project evolves. There will be further details available for consideration and these details will be assessed following national guidelines and legislation. In addition, further updates will be provided to the application of the United Nations Sustainable Development Goals. Ultimately the Proposed Project will be submitted for due consideration through the planning process. The planning permission application that is submitted will be accompanied by environmental reports that outline the impacts of the Proposed Project and what mitigation will be in place to reduce or remove these impacts.

Accompanying Reports

The following reports accompany this Step 4A Report:

- Jacobs. 2021. Step 4A Environmental Constraints Report. Available at:

  https://consult.eirgrid.ie/system/files/materials/2055/Environmental%20Constraints%20Report%20-%20Step%204A%20-%20KMGU.pdf
- Jacobs. 2020. Cable Feasibility Report. Available at:

  https://www.eirgridgroup.com/site-files/library/EirGrid/Cable-Feasibility-Report.pdf
- Traverse. 2022. Consultation Summary Report.

  https://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

1.4 Structure of this Report

This report is structured as outlined in Table 1.1.

Table 1.1: Report Structure

Section	Overview
Executive Summary	A summary of the report.
Chapter 1 Introduction	An outline of the report, a description of the Proposed Project; information on the approach to its development, as well as information on sustainability relevant to the Proposed Project.
Chapter 2 Methodology and Approach	An explanation of how the options were designed and assessed, and what process was followed: • Constraints mapping; • Designing short route sections; • Combining the route sections to create four end-to-end route options; Options A to D; and • Public consultation.
Chapter 3 Route Identification	A description of the Route Section Assessment, Public Consultation, and the End-to-End Assessment – the route option designs, and the findings of the assessment.
Chapter 4 Option A (Red)	The assessment of the options against the five assessment criteria: environment, socio-economics, technical, deliverability and economic.
Chapter 5 Option B (Green)	
Chapter 6 Option C (Orange)	
Chapter 7 Option D (Blue)	
Chapter 8 Emerging Best Performing Option and Conclusion	A comparison of the four route options (Option A – D) and the selection of the Emerging Best Performing Option with an explanation of why it has been selected.
Appendices	Supporting information for the text of this report.
Figures	Supporting maps and drawings. Some figures are inset within the text and some are stand-alone at the end of the report.

2. Methodology and Approach

2.1 Introduction

As detailed in Section 1.3, this Step 4A Report presents an analysis of the proposed route options which were shortlisted in Step 3 (in accordance with EirGrid's Framework for Grid Development). As noted in Section 1, the aim of this process is to identify the location of an Emerging Best Performing Option. The following sections of this report outline how the proposed route options were designed and how they were assessed. The proposed route options are described in Chapter 3 and assessed in the subsequent chapters.

2.2 Identification of Options

This approach to route options identification and appraisal is a best practice approach to the Consideration of Alternatives for a linear infrastructure project and a key tenant of EirGrid's Framework for Grid Development. The Proposed Project has not yet been subject to a screening to determine if an Environmental Impact Assessment (EIA) is required. This will be at the next step of the Proposed Project (i.e. Step 5). The EIA Directive 2014/52/EU requires that an EIA in respect of a Proposed Project outlines the reasonable alternatives studied by the developer, which are relevant to the Proposed Project and its specific characteristics, and gives an indication of the main reasons for the option chosen, taking into account the impacts of the Proposed Project on the environment.

'Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment' (August 2018) as prepared by the Department of Housing, Planning and Local Government confirms that "reasonable alternatives" may relate to matters such as project design, technology, location, size, and scale. The purpose of considering alternatives is to provide a framework for sound decision-making based on the principles of sustainable development, and to find the most effective way of meeting the need and purpose of a project, which enhances the environmental benefits of the planned activity, while avoiding, reducing or remediating potentially significant negative environmental impacts.

The proposed route options have been designed using the Proposed Project's Geographical Information System (GIS), which allows known relevant data and constraints to be easily mapped and route options drawn to minimise the impacts. The first step in the design is the avoidance of key social and environmental constraints, in so far as possible. Examples of social and environmental constraints include cultural heritage features, community facilities such as GAA clubs, and community halls; , and many more. the width and quality of the road; other services in the road such as water, gas and drainage; impact on the environment including European and nationally protected areas for biodiversity, invasive and protected species and other important biodiversity areas (including undesignated habitats); City and County Development Plans and Local Area Plans; areas of high amenity; and ongoing works. These locations were identified in the *Environmental Constraints Report*[3] for the Proposed Project, which was published for consultation in August 2021. Environmental and social constraints have been updated site surveys by the project team, through the consultation process, and through iterative reviews of the Study Area.

In Step 3, two feasible route options for an underground cable were published[4] as part of the assessment of the technology options for the Proposed Project. The two feasible route options are shown in Figure 2-1 below. These route options were subject to a high-level assessment and it was intended that these two route options would be subject to change as the Proposed Project evolved. The routes shown were indicative and identified as part of a feasibility exercise only using the existing road network to facilitate discussion on an underground cable route feasibility .

[3] Jacobs. 2021. Step 4A Environmental Constraints Report. Available at: https://consult.eirgrid.ie/system/files/materials/2055/Environmental%20Constraints%20Report%20-%20Step%204A%20-%20KMGU.pdf
[4] Jacobs. 2020. Cable Feasibility Report. Available at: https://www.eirgridgroup.com/site-files/library/EirGrid/Cable-Feasibility-Report.pdf

Figure 2-1: Step 3 Feasible Cable Options (extracted from the Step 3 Cable Feasibility Report for the Proposed Project).

In Step 4, the project team re-examined the Study Area to design improved route options from the two feasible route options established during Step 3. The design of the proposed route options at Step 4 were based on the following routing principles:

- Avoid motorways;
- Maximise the use of national, regional and local roads;
- Avoid town centres and industrial estates;
- Avoid going off-road, through private land and through agricultural land where possible;
- Avoid sensitive natural and built heritage locations;
- Minimise impact on communities where possible; and
- Minimise the overall length of the route.

These routing principles align with EirGrid's five key assessment criteria - Environmental; Socio-Economic; Technical; Economic; and Deliverability. These are outlined in Section 2.3 below in more detail. By following the routing principles, improved route options were designed. Figure 2-2 outlines the process that was followed and further detail on the process is provided below.

Study Area	• The Study Area from Step 3 was used to identify and map constraints that should be avoided. This was an area of approximately 760km².
Constraints Identification	• A large list of environmental and social constraints/receptors were identified and mapped. These were highlighted as areas to be avoided. It included (amongst other things): houses, towns and villages, equine and agricultural land, motorways, designated sites, archaeological features, area of peat, woodland, rivers, businesses, and more.
Possible route options	• Workshops were held with specialists in the project team to examine all reasonable options between Woodland and Dunstown substations, taking into account the mapped constraints, the routing principles, and the five assessment criteria.
Route Section Assessment	• A long list of route sections was identified and assessed. There were 36 individual route sections that could be combined to create over 50 different end-to-end cable route options. The individual sections were assessed against the five assessment criteria and comparatively rated. • The individual sections which scored poorly or did not connect well with other lengths were not progressed.
End-to-End Assessment	• The short listed individual sections were combined to create four end-to-end options. • These four end-to-end options were presented to the public at the August - November 2021 consultation. • The options were assessed against the five assessment criteria and comparatively rated.

Figure 2-2: The Route Design Process for Step 4A

For the purposes of this route option assessment, a trench width of 2.1m was assumed. Figure 2-3 below shows an indicative High-Voltage Alternating Current (HVAC) cable.

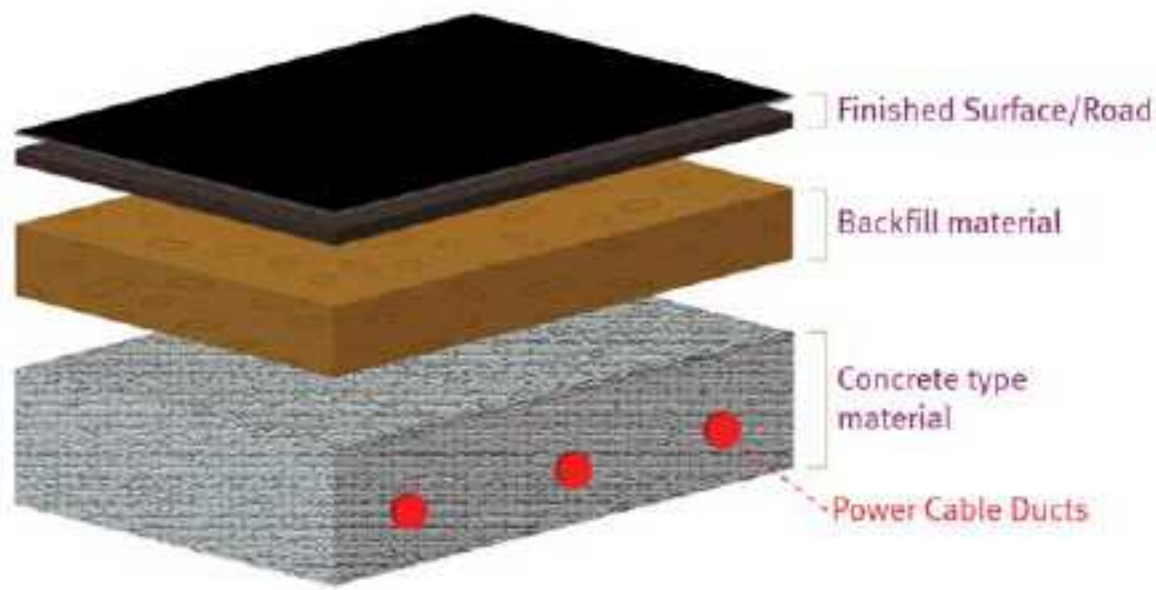

Figure 2-3: Indicative High-Voltage Alternating Current (HVAC) Cable Duct Arrangement (single conductor per phase solution)

A trench of 2.1m is the typical maximum estimated width and further studies may reduce this width. In certain circumstances, where there is a constraint on the route such as a river, the width may be increased to avoid constraints.

2.2.1 Constraints Identification

As part of the Public Consultation (August – November 2021) for this step of the Proposed Project (i.e. Step 4), an Environmental Constraints Report was prepared and published. The purpose of the Environmental Constraints Report was to review and update the constraints identified in Step 3, and ensure they were considered appropriately in the determination of the Emerging Best Performing Option for the Proposed Project. The objective of the Environmental Constraints Report was to identify the international, national, county, and local constraints that would need to be taken into account to better inform the design of the Proposed Project. .

The project team used site visits, consultation, online mapping, and GIS to ensure that details are not missed and would be fully taken into account in when developing potential route options. This mapping is available for public viewing on the EirGrid website[5].

The Environmental Constraints Report identified the following constraints:

- Socio-Economic Factors:
    - Planning Policy and Legislation;

[5] https://www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/

  - Amenity and Human Health (including population);
  - Economy (including employment, economic sectors and tourism);
  - Agronomy and Equine;
  - Other Land Use (including settlements, forestry, bogs, peats, horticulture);
  - Electric and Magnetic Fields (EMF);
  - Transport; and
  - Utilities and Critical Infrastructure (non-transport related).
- Environmental Factors:
  - Biodiversity,
  - Geology, Soils and Groundwater;
  - Water;
  - Flood Risk;
  - Noise;
  - Air Quality;
  - Landscape and Visual; and
  - Archaeology, Architectural Heritage, and Cultural Heritage.

2.2.2 Route Section Assessment

With the features mapped and routing principles established, the project team designed potential route options. Because of the large number of potential route options, it was decided that the proposed route options would be broken down into shorter sections first, and then assessed. Thirty-six individual route sections were designed and labelled for the nodes[6] they connected (for example the section between Nodes A and B was labelled as Route Section AB).

This process has been described as like building with bricks. The individual bricks can be swapped out or added together to make something larger. The shorter route sections could be added with other sections to create longer route sections. For example, the route section between Nodes A and B could be added to the length B to C and then C to D. The route section approach (sometimes referred to as the 'node-to-node' approach) allows greater flexibility in the design and subsequent assessment of route options. In addition, constraints can be more easily avoided by switching to a different route section, and the routing principles could be followed more closely.

Following the completion of the Route Section Assessment, a review of the Project Study Area was undertaken. The Step 2 Study Area was the largest Study Area initially, however this was refined at Step 3 to better reflect a more focussed development of the Proposed Project. The Step 3 Study Area decreased the size of the initial project Study Area to roughly 760km^2 . The Step 3 Study Area was used for the Route Section Assessment.

The Route Section Assessment identified all route sections within the Step 3 Project Study Area that were available to the Proposed Project. A number of these route sections, mainly those in the central and eastern portions of the Step 3 Project Study Area, avoided many key environmental and social constraints and were considered feasible from a technical and deliverability standpoint. Route sections in the western portion of the Step 3 Project Study Area were considered unnecessarily distant from either Woodland or Dunstown substations and also closer to a

[6] Nodes are points where two or more route sections meet.

larger number of environmentally designated sites. As a result it was determined that no route sections in the western portion of the Step 3 Project Study Area should progress and that the Project Study Area was to be refined further to better inform the Step 4 assessment. This further refined Project Study Area would be described as the 'Step 4 Project Study Area'.

The Step 4 Project Study Area is roughly 340km^2 – a reduction of approximately 55% from the Step 3 Project Study Area, reflecting the location of the route section. Any assessments of these route sections would be unaffected by any changes in Project Study Area from Step 3 to Step 4. In-line with national guidance (in the context of Environmental Impact Assessment)[7], impacts would be assessed regardless of whether they occur inside the Study Area or outside it, where applicable. The changes to the Study Area were made to focus in on the key constraints of the project and better identify the communities closest to the route options.

The assessment of route sections was based on the five key assessment criteria (Environmental; Socio-Economic; Technical; Deliverability; and Economic (see Section 2.3 for further details). Because of the use of GIS, a large amount of environmental, social and technical data was collected on each route section. This included the number of houses along each route section, how many watercourses it crossed, the geology of the route section, how many archaeological sites were within 25m, 50m, 200m, etc. The data collected is presented in Appendix B.1 of this report. This data helped to assess the individual route sections. Environmental specialists used this data and their professional judgment to identify the potential impacts / difficulties / risk of each route section and to assign it a ranking based on the process outlined in Section 2.3 of this report. Route sections which had more significant impact / greater difficulties / more risk were not progressed. This process is outlined in Chapter 3 of this report.

2.2.3 End-to-End Assessment

By the end of the Route Section assessment, better performing route sections could be added together to create end-to-end options. The End-to-End assessment considered longer route options travelling from Woodland substation to Dunstown substation. The four (End-to-End) route options which were presented to the public in the Step 4A consultation were identified through this process. These four route options are assessed in Chapters 4 to 7 of this report. The four options share some common sections in certain areas (e.g. on approach to Woodland substation and crossing the M7 at Naas). This is because the route sections at these locations were assessed to be the best performing and therefore have been used in all four options. Other alternative route sections at these locations were explored in accordance with the process described above and were ruled out.

The four options presented to the public are shown in Section 2.2.4 below. The off-road sections within the options were shown as larger potential corridors. This was because consultations were required with affected landowners and further assessment was required.

2.2.4 Public Consultation (August – November 2021)

EirGrid's approach to public consultation was to try to safely reach as many people as possible while taking into account Covid restrictions at the time. The project team facilitated in person meetings and also online methods to reach as wide an audience as possible. Public Consultation was promoted through Community Forum meetings, onsite engagement in the project area, stakeholder engagement, public webinars, multi-channel advertisements

[7] Environmental Protection Agency. 2017. Draft Guidelines on The Information to be Contained in Environmental Impact Assessment Reports. https://www.epa.ie/publications/monitoring--assessment/assessment/EPA_EIAR_Guidelines.pdf. NB the EIA screening exercise has not yet been completed for the Proposed Project. The EPA's Guidelines have been referenced here as best practice.

and a project website. The consultation opened on 31 August 2021 and remained open for twelve weeks, closing on 22 November 2021. EirGrid undertook engagement to promote the consultation amongst local stakeholders. This phase included:

- Four Community Forum meetings (members of the Community Forum include An Taisce Meath, Batterstown Village Enhancement Group, Clane Community Council, Kilcock Tidy Towns, Kildare Chamber of Commerce, Maynooth Community Council, Red Road Residents Association, Straffan Community Association, Twomilehouse Community Centre, and Twomilehouse Say No Action Group alongside elected representatives from Kildare County Council and Meath County Council);
- Onsite engagement with a Mobile Information Unit visiting nine towns and villages for one week: Batterstown, Kilcock, Maynooth, Straffan, Prosperous, Clane, Sallins, Naas, Two Mile House;
- Engagement (including meetings and/or written communications) with multiple stakeholders including:
    - Transport Infrastructure Ireland Kildare Meath Working Group,
    - Department of the Environment, Climate and Communications,
    - Local Authorities: Meath County Council, Kildare County Council,
    - Business stakeholders: Kildare Chamber, Meath Chamber, Enterprise Ireland, the Industrial Development Agency,
    - Public Participation Networks (PPNs): Kildare Partnership, Meath Partnership,
    - Elected representatives: including Teachtaí Dála from Meath East, Meath West, Kildare North and Kildare South, as well as Senators,
    - Kildare Councillors from Athy Municipal District, Kildare-Newbridge Municipal District, Celbridge-Leixlip Municipal District, Clane-Maynooth Municipal District, and Naas Municipal District,
    - Meath Councillors from Ashbourne Municipal District, Ratoath Municipal District, and Trim Municipal District,
    - Two Mile House Says No (battery objection group),
    - Maynooth Community Council;
- Two public webinars;
- A media campaign in regional press and radio, social media, a project website, and online consultation portal.

The public consultation process allowed members of the public to view the four options presented in Figure 2-4 and to view the route sections that were not progressed (see Figure 3-1). The public were invited to provide comments, including identifying any information they felt should be considered about each option. Three channels were provided for submission of responses to the consultation:

- Online: by using the consultation webform at consult.eirgrid.ie, accessible via the EirGrid website,
- Email: by emailing the project's dedicated email address, kildaremeath@eirgrid.com, administered by the project team at EirGrid,
- Post: by sending in a hardcopy response to the address provided by EirGrid.

A total of 108 responses were received during the consultation period. Further details on the responses are provided in Section 3.3 of this report.

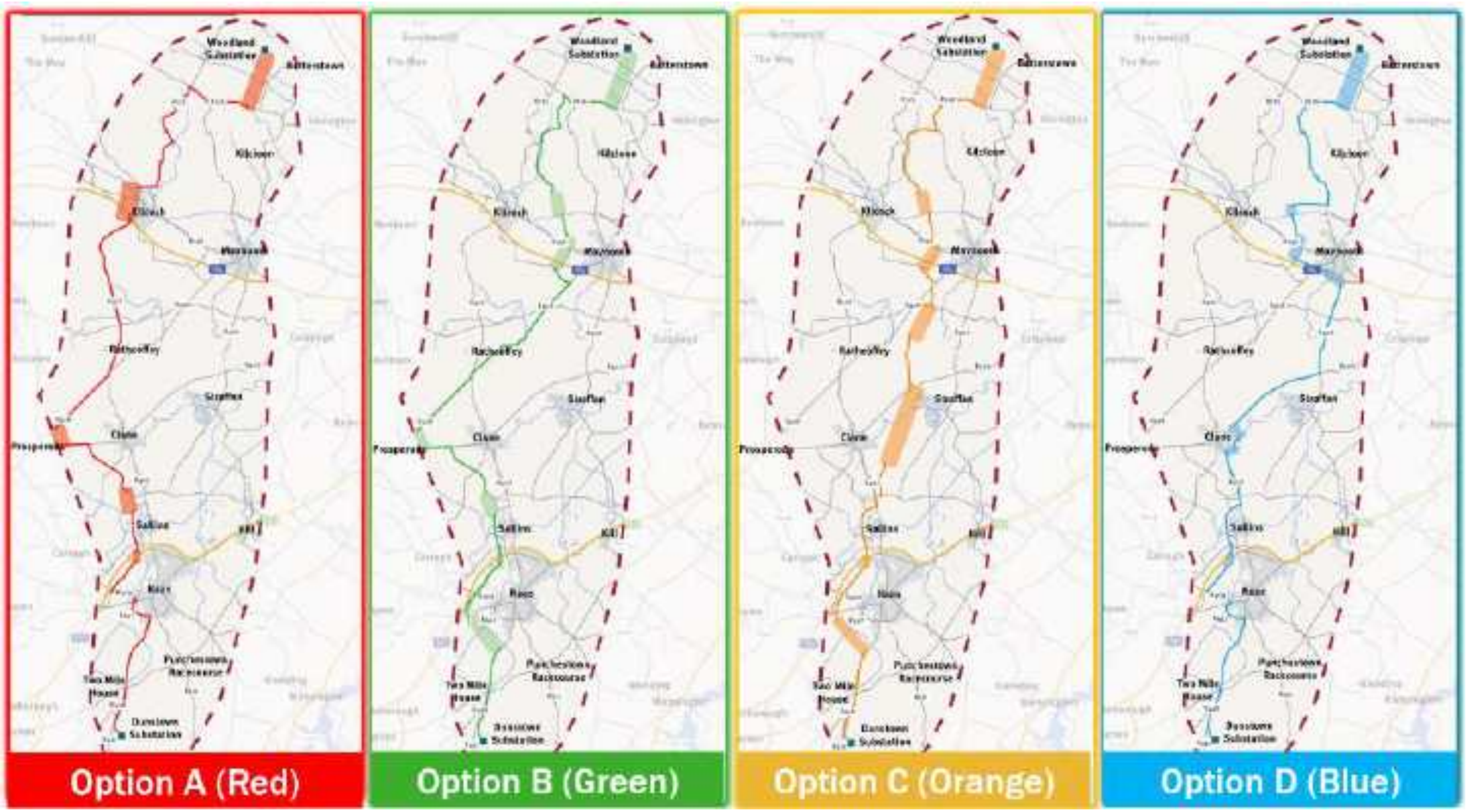

Figure 2-4: Options Shown in Public Consultation (2021)

2.3 Criteria Used for Comparison of Options

The Proposed Project has followed EirGrid's six-step approach to grid development as outlined in EirGrid's '*Have Your Say*' document. This approach facilitates engagement and consultation with stakeholders and the public which helps to explore route options fully and make more informed decisions. As part of the approach, a comprehensive and consistent multi criteria analysis is applied to decision making. The multi criteria analysis facilitates a balanced consideration of the following assessment criteria relating to the Proposed Project:

- Environment;
- Socio-Economic;
- Technical;
- Deliverability; and
- Economic.

Each of the proposed route options have been assessed across the constraints criteria detailed below based on the ranking approach presented below.

More significant/difficult/risk Less Significant/difficult/risk

This risk scale is clarified by text, as follows:

- High: Dark Blue;
- Moderate-High: Blue;
- Moderate: Dark Green;
- Low-Moderate: Light Green; and
- Low: Cream.

2.3.1 Environment Criterion

The environmental risks and considerations associated with the proposed route options, are considered under the following environmental assessment topics:

- Biodiversity (Flora and Fauna);
- Soils and Water;
- Planning Policy and Land Use;
- Landscape; and
- Archaeology, Architectural Heritage, and Cultural Heritage.

The assessment approach undertaken by each environmental assessment topic is outlined below with the detail on each individual option assessment outlined within Chapters 4 to 7. The environmental assessment topics use a mixture of qualitative and quantitative assessment to assign the overall score (e.g. low, moderate, high, etc.) to the assessment topic under consideration.

2.3.1.1 Biodiversity (Flora and Fauna)

The following aspects were considered in the assessment of the four route options in terms of biodiversity (flora and fauna):

- **Distance and connectivity to European and Ramsar sites –** the assessment looked at the proximity and hydraulic connection from the proposed route options to both SACs and SPAs in addition to any Ramsar sites. This allowed an understanding of potential pollution pathways and /or impact to Qualifying Interest (QI) species including potential impacts to foraging bird species from each route option;
- **Distance and connectivity to nationally important sites -** as above in the context of national sites;
- **Watercourse crossings, aquatic species and Water Framework Directive (WFD) status -** The assessment looked at the number and potential watercourse crossings, proposed crossing technique in addition to the aquatic species of interest and the current WFD waterbody status i.e. good, poor etc.; and
- **Known or presumed of species and/or habitats of conservation interest -** the assessment considered findings from desk based review in addition to initial site visits to identify species/habitats of conservation interest potential impacted by each of the proposed route options.

The next stage of the assessment (i.e. Step 5) will consider the potential for significant impacts on European sites in the context of Article 6(3) of the Habitats Directive and the need for measures to mitigate against significant impacts will be determined. A detailed ecological and hydrogeological/hydro morphological assessment would be required to ensure that river crossings do not alter the physical, chemical or biological standards necessary for the achievement of favourable conservation status of European site features and avoidance of impacts to protected species as set out in EirGrid's Ecology Guidelines for Electricity Transmission Projects (EirGrid 2020). Ecological constraints are shown in Appendix A.1.

2.3.1.2 Soils and Water

The following aspects were considered in the assessment of the four route options in terms of soils and water:

- **Geology, Soils and Economic deposits -** a review of desk based data to understand the geological and soils assets potentially impacted by the proposed route options. This aspect also considered potential for the proposed route options to encounter karst features and known mines;
- **Groundwater -** a review of desk based data to understand aquifer importance, groundwater vulnerability, WFD status, public or private water supplies and any groundwater dependent water bodies potentially effected by each route option;
- **Surface Water-** closely connected to the biodiversity criteria this assessment looked at the number and potential watercourse crossings, proposed crossing technique in addition to the current WFD waterbody status (i.e. good, poor etc.) and proximity to designated sites. Sensitivities are determined based upon their WFD status and proximity to a designated habitat – in this case, the Rye Water Valley/Carton SAC.
    - Likely crossing techniques are determined as follows:
        - Open Cut (OC): shallow crossings (i.e. streams, very small/shallow canals, roadside water) can be open cut using temporary over-pumping to maintain water flow during installations;
        - Cable bridges/micro-tunnels: for anything (approximately) wider than 4m and deeper than 1m where Horizontal Directional Drilling (HDD) not adopted, alternative solutions like cable bridges/culverts/micro-tunnels are also considered;
        - HDD: When the crossing becomes consistent (i.e. a large and/or sensitive watercourse);
        - If the crossing is particularly impactful from a cable ratings prospective (i.e. very deep, very poor ground), and creating mini substations both sides of the river to double the

number of cables at the crossing for the HDD is not an option, then tunnelling is also considered.

  - Potential impacts are identified by considering the sensitivity of the water body and the risk associated with the crossing technique employed;

- **Flood Risk –** The National Indicative Flood Mapping[8] was reviewed for each route option and the number of watercourse crossings were also taken into account.

2.3.1.3 Planning Policy and Land Use:

The following aspects were considered in the assessment of the four route options in terms of Planning Policy and Land Use:

- **Planning Policy and Legislation -** The Planning and Development Act 2000 (as amended) forms the foundation for planning in Ireland and covers a large range of planning-related issues, consolidating a wide range of different legislation into one place. There have been a number of amendments to the Act since 2000; collectively these are known as the 'Planning and Development Acts'. These Acts are underpinned and implemented by the Planning and Development Regulations 2001 (and amendments). Other National, Regional and Local Planning Policy relevant to the Study Area will also be taken into account to identify potential impacts at a national, regional and local level.
  - National and Regional Planning Policy set out high-level strategic objectives for shaping the future growth and development of Ireland. The Local Plans should align with these policies and plans.
  - County Development Plans and Local Area Plans detail development objectives and policies that influence the siting of projects at county and local level. These objectives and policies may relate to constraints such as land use zoning biodiversity, flood risk, cultural heritage, landscape designations and characterisations, protection corridors, amenity and existing and proposed residential land use.
- **Planning Applications (including other large infrastructure projects) -** A review of planning applications has been performed in order to gain insight into the future built environment which may have developed by the time construction commences on the Proposed Project. This includes all granted and live applications over the last five years within a 50m buffer of each route option.

2.3.1.4 Landscape

The following aspects were considered in the assessment of the four route options in terms of Landscape:

- **Landscape Character -** this aspect of the landscape criteria assessment looked at the existing Landscape Character Areas (LCAs) and their sensitivity to the Proposed Project in order to identify the potential magnitude and significance of any impact to these LCAs. These significance ratings were used to feed into the overall score for each route option in terms of landscape impacts.
- **Landscape elements –** a review of designated and non-designated highly sensitive landscape elements was undertaken in the context of proximity to each route option. Again, the sensitivity, magnitude and potential significance to these Landscape elements is defined in order to develop the overall score in term of landscape.

[8] www.floodinfo.ie

2.3.1.5 Archaeology, Architectural Heritage, and Cultural Heritage.

The locations of the following aspects were considered in the assessment of the four route options in terms of archaeology, architectural heritage, and cultural heritage:

- Designated Archaeology:
  - National Monuments and Preservation Orders
  - Register of Historic Monuments (RHM)
  - Recorded Monuments
  - Sites on the Sites and Monuments Record (SMR)
- Designated Architectural Heritage
  - Record of Protected Structures
  - Architectural Conservation Areas (ACA)
  - National Inventory of Architectural Heritage (NIAH)
  - Historic Gardens and Designed Landscapes (GDL)
- Cultural Heritage Assets

In order to identify and quantify the constraints above that may be impacted by the proposed route options, including indirect impacts, a Study Area of 100m was established around the route option under consideration. A 100m Study Area is considered sufficient to capture impacts given any direct impacts would largely result from the excavation for the cable trench, joint boxes, and temporary launch and reception pits for directional drilling, and be focussed on the alignment of the route option. Any indirect impacts are anticipated to be temporary (lasting the duration of construction in each location), localised along the wayleave corridor and are not anticipated beyond 100m.

Baseline conditions were established through desk-based research, including a review of the following sources:

- The archaeological and architectural features identified as part of the Environmental Constraints Report;
- Aerial imagery, including Google, OSi Digital Globe, and EirGrid aerial photography;
- Historic mapping available online, comprising:
  - The Down Survey of Ireland[9];
  - Noble and Keenan's map of Kildare (1752)[10];
  - Larkin's map of Meath (1812)[11]; and
  - Historic Ordnance Survey mapping (Ordnance Survey 6", 1837 – 1842 and Ordnance Survey 25", 1888-1913);
- Placename information available online[12];
- The National Folklore Collection via the UCD digital library available online[13]; and
- Topographical files of the National Museum of Ireland through the online National Museum of Ireland: Finds Database (up to 2010) available online[14].

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9 http://downsurvey.tcd.ie/index.html [Accessed 05.11.21].
10 https://www.logainm.ie/Eolas/Data/Brainse/logainm.ie-map-j-noble-and-j-keenan-1752-grand-jury-kildare-south.jpg and logainm.ie-map-j-noble-and-j-keenan-1752-grand-jury-kildare-north.jpg (4800×3501) [Accessed 09.11.21].
11 https://www.logainm.ie/Eolas/Data/Brainse/logainm.ie-map-william-larkin-1812-grand-jury-meath-sheet-06.jpg [Accessed 09.11.21].
12 www.loganim.ie
13 https://digital.ucd.ie/
14 http://heritagemaps.ie/

A unique reference number was assigned to each constraint. Archaeological constraints are prefixed with 'AY' and architectural heritage constraints are prefixed with 'AH'. Demesne lands are prefixed with 'DL' and undesignated cultural heritage sites are prefixed with 'CH'. Archaeological, architectural heritage and cultural heritage constraints are identified in the sections below and are also shown in Appendix B.1. Supporting baseline information for the archaeological, architectural heritage and cultural heritage constraints identified is provided in Appendix B.1.

The assessment was undertaken based on the guidance provided in EirGrid's '*Cultural Heritage Guidelines for Electricity Transmission Projects*'[15]. The assessment looked at the potential for direct and indirect impacts on the identified feature within the 100m Study Area in order to ascertain the overall score for the archaeology, architectural heritage, and cultural heritage criteria. Full details for the archaeology, architectural heritage and cultural heritage constraints identified are provided in Appendix B.1.

2.3.2 Socio-Economic Criterion

The socio-economic risks and considerations associated with the four route options were considered under the following assessment topics. These assessment topics are consistent with the assessment topics considered within the Step 3 Strategic Social Impact Assessment Scoping Report (EirGrid 2020[16]) and the Step 3 Environmental Constraints Report (EirGrid 2020[17]). The assessment topics for the socio-economic criterion are:

- Traffic, Transport and Access;
- Noise, Vibration and Air Quality;
- Visual;
- Amenity;
- Health;
- Employment and Economy;
- Land-use (and Land Take);
- Agricultural (and Equine); and
- Utilities.

The assessment approach undertaken by each assessment topic is outlined below with the detail of the assessment of each individual route option outlined within Chapters 4 to 7 of this report. These assessment topics use a mixture of qualitative and quantitative assessment to assign the overall score (e.g. low, moderate, high, etc.) to the assessment topic under consideration.

Electromagnetic Fields (EMF) are an important consideration in any electrical transmission project. EirGrid's design standards require all underground cables to operate within existing public exposure guidelines from the International Commission on Non-Ionising Radiation Protection (ICNIRP) and as such there will be no effect from EMFs in terms of human health and interference to other electrical devices and systems. In this way, EMFs are not a differentiator between the cable options and are not assessed at this stage in the Proposed Project. They will be assessed at the next Step in the project.

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[15] EirGrid, 2015, *Cultural Heritage Guidelines for Electricity Transmission Projects.*

[16] EirGrid. 2020. Step 3 Strategic Social Impact Assessment Scoping Report. https://www.eirgridgroup.com/site-files/library/EirGrid/Draft-Strategic-SIA-Scoping-Report-Kildare-Meath-Grid-Upgrade-Step-3.pdf

[17] EirGrid. 2020. Environmental Constraints Report. https://www.eirgridgroup.com/site-files/library/EirGrid/Environmental-Constraints-Report-Kildare-Meath-Grid-Upgrade-Step-3.pdf

2.3.2.1 Traffic, Transport and Access

The following aspects were considered in the assessment of the four route options in terms of traffic and transport:

- **Road Network –** the road type, its length per type (km) and consideration of the available width along stretches of the corridor (e.g. hardshoulder, and/or cycleway, footway provision along the route).
- **Junction -** the number of key junctions potentially affected by the route option; and
- **Access –** the number of properties located along the route option that could be potentially affected in terms of access as a result of the route option.

Consideration of these aspects if construction works were undertaken along the route and the likely traffic management measures required to accommodate current traffic movements along the routes. The likely impact of these measures on traffic progression and journey time reliability has been used to inform the ranking scoring applied.

2.3.2.2 Noise, Vibration and Air Quality

The assessment of potential impacts of noise, vibration and air quality is based on the quantification of sensitive receptors close to the proposed route options within a number of distance bands from each of the proposed route options. These distance bands are up to 300m for noise and 350m for air quality. The noise assessment focused on potential impact as a result of "noisy" elements during construction and the air quality assessment focused on potential impacts as a result of dust during construction.

2.3.2.3 Visual

The visual assessment focused on the proximity of the route option to specific receptors such as scenic designations.

2.3.2.4 Amenity

'Amenity' is the term used to describe the overall pleasantness and the 'feel' of a community and the ability for people to enjoy the general character or quality of their surroundings.

The impact on amenity of the four route options is determined by considering the indirect (in-combination) impact of the following environmental effects:

- Air quality;
- Noise (and vibration);
- Visual; and
- Traffic and transport.

Where there is a combination of at least two direct environmental effects on a receptor or group of receptors, this is classified as an indirect (in-combination) impact on amenity. For example, where there are both visual and air quality impacts on a receptor or group of receptors, it would be concluded that these receptors(s) would be indirectly impacted by an in-combination amenity effect.

2.3.2.5 Health

Impacts on human health relate to the likely impacts stemming from the direct 'nuisance effects' of noise (and vibration), air quality, visual and traffic. These environmental effects could impact individuals as well as groups of individuals directly, or indirectly by way of inducing stress or fear. Examples of how such environmental effects can impact human health during construction are outlined below.

Dust and pollutant emissions from plant machinery or construction-related traffic, in the absence of mitigation measures, could lead to general annoyance as well as being detrimental to the respiratory health of individuals and communities in close proximity to construction activities.

Noise (and vibration) impacts that are considered to be excessively noisy and brought on by construction or operational activities can lead to impaired hearing, sleep disturbance, and general annoyance. There is also increasing evidence of a link to heart disease and hypertension (WHO, 2018)[18].

Changes in the long-standing visual environment can also lead to distress and annoyance for people and communities. This distress and annoyance would not just be in respect to changes in visual amenity but also due to changes in the landscape itself and its use by people and communities as a recreational amenity / asset.

2.3.2.6 Employment and Economy

The potential impacts on employment and the economy as a result of the four route options are determined by professional judgement, informed by currently known project information (particularly in respect to likely workforce composition, the duration of construction, and the construction methodology more generally), statistical data and evidence of the current economic climate in Ireland from the Central Statistics Office (CSO) as well as past professional experience on infrastructure projects of a similar scale and nature.

2.3.2.7 Land-use (and Land Take)

The assessment of the potential impacts on land-use, associated with land-take resulting from the construction and operation of the as a result of the four route options, are informed by currently known project information relative to likely construction methodology and the operational nature and scale of the Proposed Project.

2.3.2.8 Agriculture (including Equine)

The following aspects were considered in the assessment of the four route options in terms of agricultural (and equine):

- **Agricultural Land –** the amount of agricultural land crossed by the option.
- **High sensitivity agricultural enterprises –** the number of enterprises such as equine, dairy and horticultural potential potentially affected by the option. Sensitivity of enterprises is determined mainly from the type of farm enterprise. The appraisal of sensitivity is subject to professional judgement and evaluation of other site specific factors such as the land quality and importance of the enterprise.

[18] https://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf

Table 2.1: Application of United Nations' Sustainable Development Goals on the Proposed Project

Farm Enterprise Type	Sensitivity
Stud farm, Equestrian centre, horticultural enterprise, intensive agriculture (poultry & pigs)	High - Very High
Dairy farm, intensive equine enterprises	High
Non-dairy grazing livestock enterprises (including beef, sheep and non-intensive equine) and grass cropping enterprise	Medium
Tillage	Medium
Rough Grazing, Bog, Forestry, Woodland (where poor land quality restricts farming practices)	Low - Very low

2.3.2.9 Utilities

Utilities provide many different services that people, and communities rely upon. There are many different types of utility infrastructure, which may be situated overhead (such as other electricity or telephone lines) or underground (such as electricity cables, water services, sewers, gas, fibre optic cables).

The assessment of potential impacts on utilities is informed by desk-based research on the extent and nature of utilities likely present in the Study Area, currently known project information relative to likely construction methodology and best practice measures in respect to treatment of utility infrastructure during construction (and operation, as applicable).

2.3.3 Technical Criterion

The technical assessment included review of the proposed route options against the criteria laid out in EirGrid's Framework for Grid Development:

- **General Compliance with System Reliability, Security Standards –** EirGrid's reliability and security standards are defined in the Transmission System Security and Planning Standards and their Operation Security Standards;
- **Headroom and Ratings Impact –** This is the amount of additional capacity each route option offers that would be available for the future without requiring further upgrade;
- **Maintainability –** This considers the ease with which the route option can be serviced and maintained, for example how easy it is to access joint bays and link boxes;
- **Technology Operational Risk –** This criterion aims to capture the risk of operating different technologies on the network;
- **Average Reliability Rates –** This is the likelihood of the chosen cable technologies such as cables, joint bays, and bonding failing during operation; and
- **Repeatability –** Repeatability means whether the proposed technical solution can be readily repeated in the transmission network.

2.3.3.1 Technical Delivery Solution

It should be noted that there will be no additional reactive compensation and additional Harmonic filtering on the network for all the proposed route options. The small percentage difference in the lengths of each route option does not trigger any substantial change for any of the required auxiliary equipment noted above.

The technical delivery solution presented below follows on from the Step 3 report, as well as technical discussions and meetings with EirGrid. A 400 kV 2500mm^2 Cu conductor, single conductor per phase, cable solution was chosen. This is subject to confirmation through further studies. Preliminary cable data was received, courtesy of NKT Cables, which is reported below in Figure 2-5 and Figure 2-6.

nkt cables

nkt document no. TDA 230 Rev. 2 / 13.02.2017
1 x 2500Cu XLPE Al PE 400 kV

TECHNICAL SCHEDULE TS – 9a

400kV XLPE Land Cable – 2,500mm² Cu XLPE — Physical Characteristics

Note: All dimensions to be confirmed at scheme application

Item	Query	Unit	Reply
1	Conductor		
	(a) Material Grade		copper
	(b) Type e.g. round, etc.		round
	(c) Design e.g. stranded, segmental, enamelled etc.		stranded, segmental
	(d) Nominal diameter	mm	63
	(e) Cross sectional area	mm²	2500
	(f) Method of water blocking		swelling yarns and/or swelling tapes
2	Inner Semi-conducting Layer		
	(a) Material Grade		XLPE
	(b) Nominal thickness	mm	1.8
	(c) Minimum thickness	mm	0.7
3	Insulation		
	(a) Material Grade		XLPE
	(b) Nominal thickness	mm	26.2
	(c) Minimum thickness	mm	[illegible]
	(d) Ovality of insulation ≤ 10%		≤ 10%
4	Outer Semi-conducting Layer		
	(a) Material Grade		
	(b) Thickness	mm	1.5
	(c) Minimum thickness	mm	0.7
5	Nominal diameter over core screen	mm	123
	Roundness of core: maximum ovality ≤ 0.0mm	mm	max. 5.0
6	Radial thickness of insulation incl. semi-conducting layers		
	(a) Nominal	mm	29.5
	(b) Minimum	mm	[illegible]
7	Bedding Layer/Water Barrier		
	(a) Material		semiconducting and swellable tapes
	(b) Thickness	mm	2.5
	(c) OD of bedding layer	mm	128
	(d) Method of electrical connection between 4 and 8 to avoid discharges		semiconducting and swellable tapes
	(e) Method of water blocking		semiconducting and swellable tapes
8	Metallic Sheath		
	(a) Material		aluminium
	(b) Type, corrugated or smooth		smooth
	(c) Nominal thickness	mm	1.5
	(d) Mean diameter	mm	129
	(e) Cross sectional area	mm²	608
	(f) Diameter over crest of corrugations	mm	n. a.
	(g) OD of sheath if not corrugated	mm	131
	(h) Diameter and no. of extra copper wires required to ensure short circuit performance of cable meets Specification 18000 (if needed)		n. a.
9	Outer HDPE/MDPE Sheath		
	(a) Material		HD PE
	(b) Nominal thickness	mm	5.0
	(c) Minimum thickness	mm	4.15
	(d) Shore D hardness		appr. 58
	(e) Shrinkage %		max. 3%
10	Nominal diameter of completed cable (max overall diameter must be ≤140mm) including thickness of conductive layer	mm	142
11	Conductive Outer Layer		graphite coating
	Extruded Layer Material		
	Extruded Layer thickness	mm	–
	Extruded Layer Surface resistivity	kOhm/m	–
	Graphite Layer Surface Resistivity	kOhm/m	max. 11 kOhm/m
	Coefficient of friction of cable based on sidewall force equal to		(a): in PE tube 0.4
	(a) for graphite layer		(b): n.a. here
	(b) extruded outer conductive layer	mm	in PE tube, greased: 0.1 ... 0.2
	Coefficient of Friction based on 5000N/m sidewall force		(a): in PE tube 0.4
	(a) for graphite layer		(b): n.a. here
	(b) for extruded outer conductive layer	m	in PE tube, greased: 0.1 ... 0.2
12	(a) Nominal length per drum	m	[illegible]
	(b) Maximum length per drum	m	[illegible]
13	(a) Nominal gross weight of loaded drum	kg	23000
	(b) Maximum gross weight of loaded drum	kg	[illegible]
14	Maximum drum dimensions width/height	m/m	2.7 / 4.2
15	Minimum radius of bend around which cable can be pulled	kN	
	(a) Laid Direct	m	3.6
	(b) In ducts	m	3.6
	(c) Cable placed in position with former	m	2.1
	(d) Cable placed in position without former	m	3.6
16	Permissible pulling force allowed on conductors during installation	kN	125
17	Maximum permissible sidewall forces	kN	10

Figure 2-5: Typical High Voltage Cable Technical Schedule

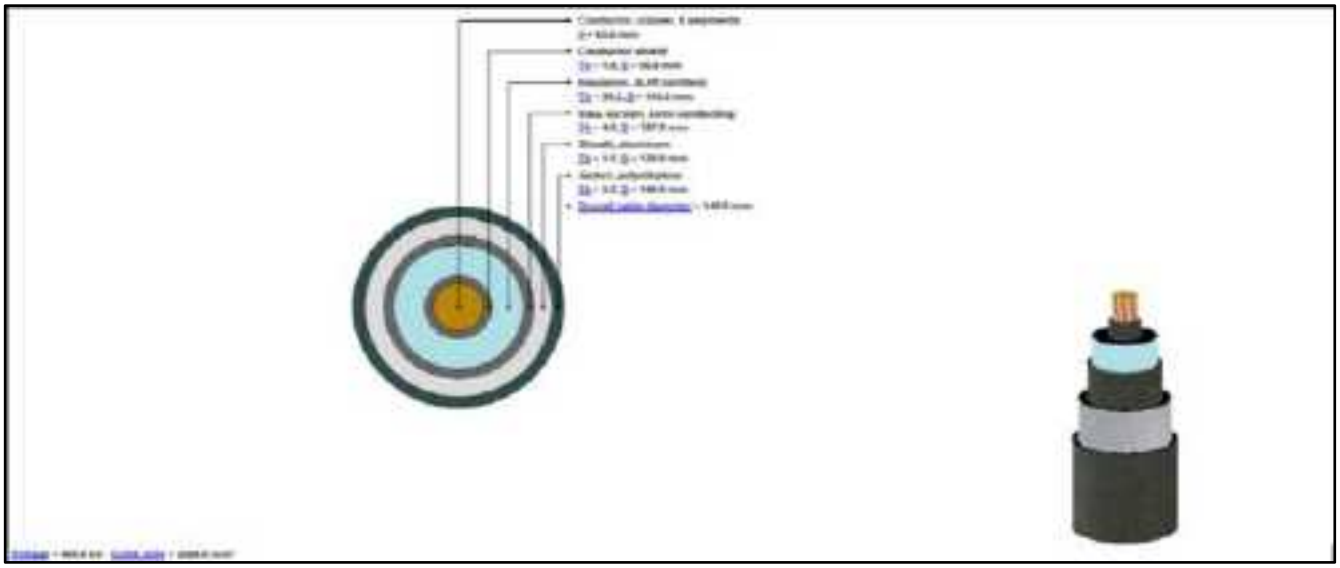

Figure 2-6: Cable model re-constructed in Cymcap

In order to understand the impact of the Proposed Project on the physical environment, Jacobs prepared a typical trench cross-section for reference (see Figure 2-7).

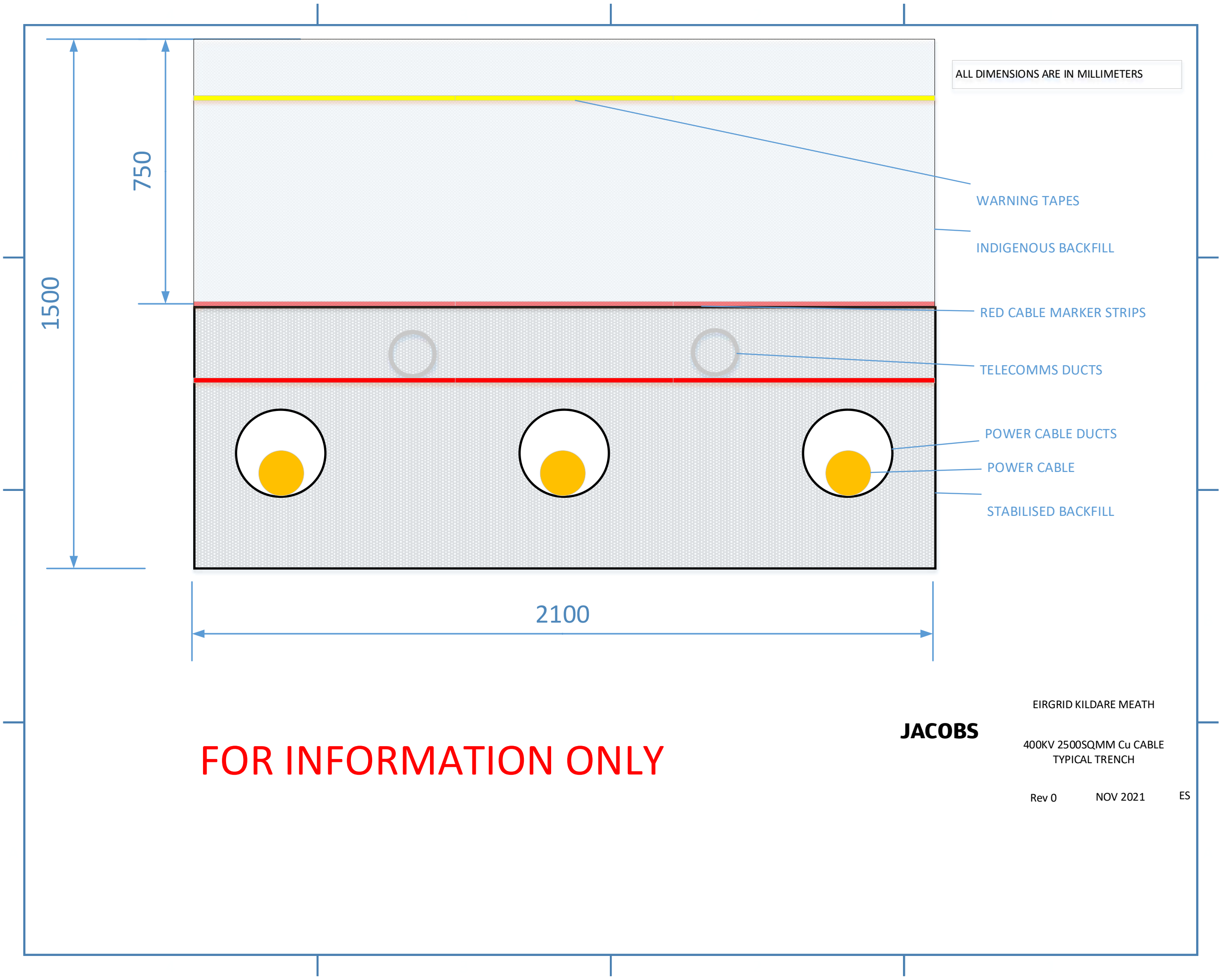

Figure 2-7: Preliminary typical trench cross-section for 400 kV 2500sqmm Cu solution. Trench width 2100mm.

This construction solution is expected to be utilised for the majority of the length of the Emerging Best Performing Option, where the circuit is installed in roads.

This solution carries the following advantages:

- A fully ducted route solution allows for decoupling of civil works from cable installation and testing works;
- Will minimise the duration of any required road closure along the route sections;
- Will facilitate future maintenance and repair works;
- Is compliant with EirGrid standards and best practices; and
- Allows for the delivery of transmission power as outlined in Table 2.2.

Table 2.2: Target Transmissible Power (continuous ratings)

	Winter	Summer
Transmissible Power/ Current*	1570MVA /2268A	1408MVA/ 2032A

(Correct at the time of writing – further changes in the cable rating may change this)

2.3.3.2 Technical Delivery Solution at crossing points

The delivery option described in Section 2.3.3.1, will be adopted for all options (Option A, Option B, Option C, and Option D) for cable installation in road like conditions.

Due to the presence of numerous and different obstacles along each of the proposed route options, a number of different crossing methodologies will need to be adopted for each obstacle outlined in Table 2.3.

Table 2.3: Obstacle crossings solutions

Obstacle description	Solution Description	Comment
Shallow crossings like Utilities, road drainage ducts, telecoms, medium pressure gas and other.	Typical trench as per Figure 2.8 with increased depth of ducts	Measures to improve rating, including thermal backfill material
Small streams/roadside water ditch/ shallow water crossings.	Typically open cut installation to avoid shallow obstacles with temporary water over-pumping to maintain flow during works (unless environmental risks drive HDD)	N/A
Larger waterways.	Cable bridges or cable culverts or micro tunnels	Solution will depend on ground conditions and impact to surrounding environment.
Large rivers/ wide canals/ motorways/ railways	Horizontal Directional Drills (HDD) or Auger Bores solutions	Solution will depend on ground conditions. Assume maximum depth of approximately 10m for these types of installation. Further spacing will be required to counteract the effects of depth on ratings.
Large rivers/canals/motorways/railways with very poor ground conditions.	Tunnel installation	Solution will depend on ground conditions

2.3.3.3 Impact on deliverable ratings caused by crossings

The crossings noted above that will necessitate deep HDD excavations, will have an impact on the overall circuit transmissible power. Along each of the proposed route options, the deepest crossing will act as a “ratings pinch point” for the route option and limit the overall transmissible power.

Preliminary calculations show the following:

- Solution A): A HDD, 10m Deep, with phase separation of 12m, will deliver 90% of target winter ratings as described in Table 2.1

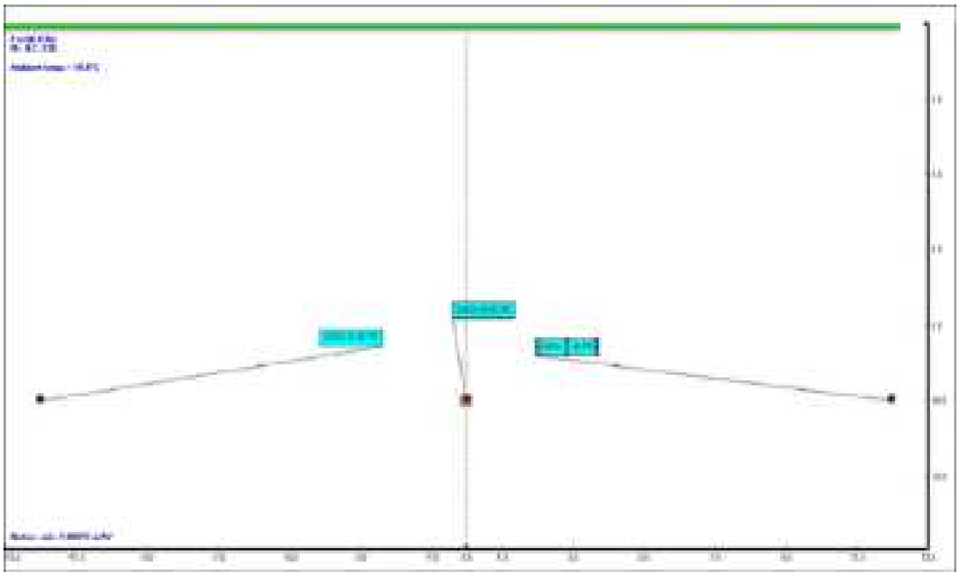

Figure 2-8: Calculation showing Solution A

- Solution B): A HDD, 10m Deep, with phase separation of 10m, will deliver 88% of target winter ratings as described in table 2.1

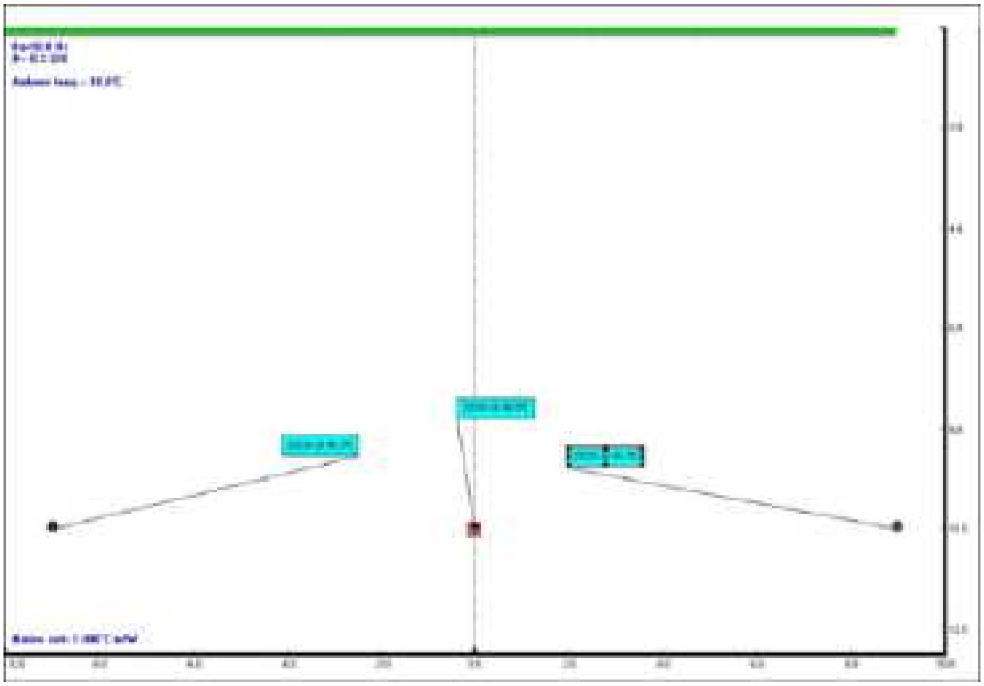

Figure 2-9: Calculation showing Solution B

There are a number of solutions to mitigate such effects:

- Utilise Bentonite in HDD ducts;
- Increase conductor size (2800, 3000mm^2) at HDD crossing;
- Double number of phases at crossing; and
- Utilise a tunnel crossing solution.

2.3.4 Economic Criterion

Each route option is evaluated on the following:

- Kilometres of installed cable;
- Quantity of Minor and Major service crossings; and
- Number of Major Crossings (such as Horizontal Directional Drills).

The economic evaluation consisted in counting the occurrences of each crossing solution per section, for each of the four route options. The crossings were matched to the standard crossings highlighted in Table 2.3 above. Each of the crossing solutions above has an associated cost which is a multiplier of the standard trench cost. When added together, an indication of the relative cost for the selected route option is provided. A relative weight was also assigned to each route option based on its relative length over the shortest route. When assessing service crossings, focus has been placed on the differences between the reference installation rate (typical trench) and that of the crossing. This results in the key differences being the:

- Depth of excavation;
- Additional trench support;

- Support for the service being crossed;
- Method of excavation;
- Special equipment used; and
- Additional material used.

The method of excavation changes where either an existing gas main or electrical cable is being crossed. In these circumstances, hand digging is required. For water service crossings mechanical excavation methods with suitable supervision and controls are assumed to be used. Traffic management costs are included in the reference rate and consequently incur no additional cost for a service crossing.

2.3.5 Deliverability Criterion

Each route option shall be assessed with respect to deliverability performance on the basis of the following criteria:

- Design complexity: Each route section will be assessed in terms of the length of the route, obstacles encountered along the section, the number of utility crossings that will need to be made, the need for Horizontal Directional Drilling (HDD), requirements to micro-route to ensure a minimum duct bending radius of 20m, and the extent to which services have already been installed within the roadway;
- Traffic disturbance impact: Each route section will be assessed in terms of level of disruption including: the need for traffic management; the availability of alternate routes for diversion during installation works; and anticipated length of time the diversion or traffic management shall be in place;
- Dependence on other infrastructure projects: This will assess the extent to which the route may be impacted/may impact other infrastructure projects in the area;
- Permits and wayleaves: This will include consideration of the number of permits required for crossing other utilities, licenses, and easement/wayleaves; and
- Implementation Timelines: The installation timelines will be directly impacted by the deliverability criteria outlined above. Consideration will be given to the length of ducting that can be installed per day, as well as any seasonal and local constraints that may impact the implementation. Installation of the cable route will assume a standard 5-day working week.

3. Route Identification

This chapter outlines the findings of the following:

- Route Section Assessment;
- End-to-End Assessment; and
- Public Consultation (August – November 2021).

3.1 Route Section Assessment

The process of how the route sections were designed and assessed is presented in Chapter 2 of this report. This section will describe the route sections.

3.1.1 Description of Route Sections

The route sections designed are presented in Figure 3-1 of this report and an overview is provided in Table 3.1. The route sections vary in length and location, which were determined taking into account the mapped constraints, the five assessment criteria, and the routing principles.

In-line with the routing principles, route sections have avoided going off-road, through private land and through agricultural land, where possible. The balancing with the other routing principles means that there are some route sections which do impact agricultural land. The impacts to agricultural land have been carefully considered and a balance has been sought between impacts to farming operations, the importance of field drains and hedgerows at the edges of field for their ecological value, and technical considerations.

None of the route sections directly impact private dwellings or gardens and none would require demolitions of dwellings.

The off-road sections within the options were shown as larger potential corridors. This was because consultations were required with affected landowners and further assessment was required. The larger potential corridors are included in the assessment that follows. However an indicative route within these corridors has been assumed in some cases. This is to allow an assessment to be undertaken at this Step of the Proposed Project. When the Emerging Best Performing Option is selected, further survey, design, consultation, and assessment will be completed to refine the potential corridors into a narrow route. This will be present at Step 4B and further refined at Step 5.

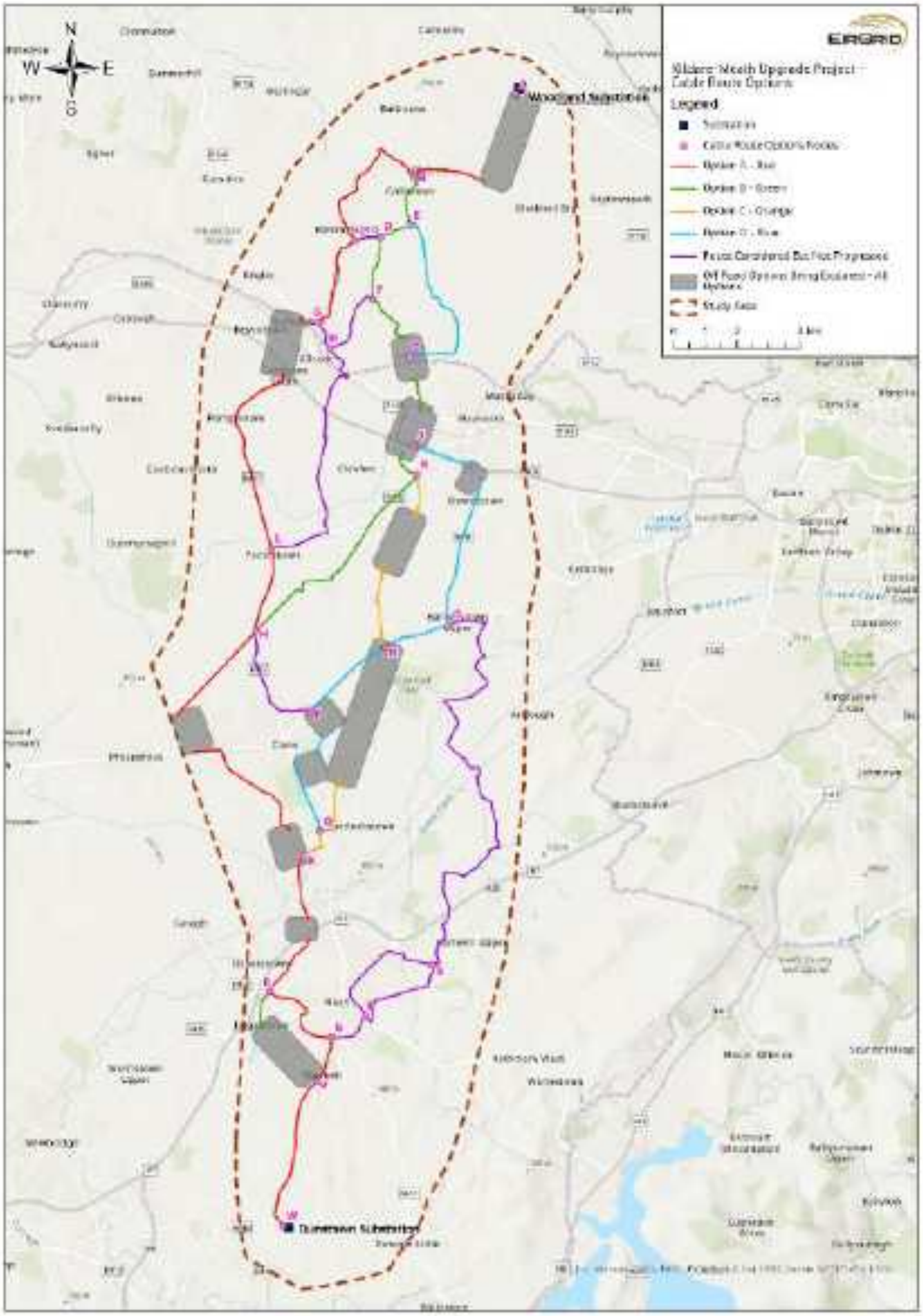

Figure 3-1: Route Sections

Table 3.1: Overview of Route Sections

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
AB	6.1	Partial off-road section of 880m and the remainder on roads. Minor watercourse crossings on road and associated floodplains. No designated sites or cultural heritage sites adjacent. Off-road impacts to hedgerows and trees.	Ribbon development along L6207. Properties and businesses along R156 - including Barstown business park, restaurant (Hatchet Inn) and petrol station. No equine operations on off-road section. One small equine operation adjacent to L6207.	Cable entry at Woodland Substation will have to be coordinated with other existing, ongoing, and future projects in design to minimise interaction. Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	No additional costs	The section is common to all routes. The cable will need to maintain clearance from the existing Portan AC cables connecting the HVDC converter station to the AC Substation. Design will need to consider ground levels in the final 300m to the Substation approach. Narrow road (first sector only) and watercourse/drains crossings, various services to houses along road One overhead 110kV line. Water main 125mm (public and Mulhussey GWS) in western portion of R156. Regional road affected and accesses to ribbon development.
BC	5.2	No off-road sections. Two crossings of the Jenkinstown Stream and associated floodplains. Larch Hill Demesne and Gardens is adjacent to the R125.	Some ribbon development along R125. Home Furniture Shop adjacent to the R125. Larch Hill Demesne and Gardens is adjacent to the R125.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	No additional costs	Road gets narrow in sections with trees both sides, 2 stream crossings of which one is via bridge. Local high point at Mullagh cross roads (Mullagh Hill 131m). Two crossings of 110kV and one 220kV. No water or sewer in road. Regional road affected.
CG	3.2	No off-road sections. St Bride's Well and a designated Field system (an archaeological feature) directly adjacent to the R125. Several on road minor watercourse crossings - crossing on floodplain.	Some ribbon development along the R125. One equine operation adjacent to R125 (Calgath House). No other key socio receptors.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve open cut installation.	No additional costs	A number of watercourse crossings one of which with a bridge. Narrow road at points with hedges and trees on both sides No water or sewer network in R125. Regional road affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
BE	1.7	No off-road section. Minor watercourse crossings on road - crossing one floodplain on road. No designated ecology and cultural heritage sites adjacent.	Dense residential ribbon development. St. Joseph's Primary School adjacent to road. One depot adjacent to the road. No off-road sections. No equine operations adjacent.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	No additional costs	Drain crossings, narrow road. Services for the houses along road. Water mains (Mulhussey GWS) in full length of the road. Regional road affected and accesses to ribbon development, including primary school.
ED	1.0	No off-road section. Mulhussey Castle, historic church and cemetery set back from road.	Small number of houses adjacent to the road. No other key socio receptors.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve bentonite filled ducts to meet the required ratings.	No additional costs	short section passing by historical setting. One crossing of 220kV. No water or sewer network in R125. Regional road affected.
DC	0.8	No off-road section. Watercourse crossing on road. No designated ecology or cultural heritage sites adjacent.	Some ribbon development. No other key socio receptors.	Technical issues are common to all lengths at this stage	No additional costs	Narrow road, hedges both sides, expect services to houses. No utilities recorded. Local road affected.
DF	2.1	No off-road section. No key environmental constraints.	Ribbon development along road. Local feature known as the Dancing Tree was adjacent to southern end of length.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve bentonite filled ducts to meet the required ratings.	No additional costs	No. 2 drain crossings, narrow road in spots. Trees and hedges. One crossing of 110kV. No water or sewer network in the road. Local road affected and accesses to ribbon development.
FH	2.5	No off-road section. One on road crossing of tributary of the Rye Water and associated floodplain.	More roadside houses located on southern end of the length. Large equine operation (Dolanstown House) adjacent to the road.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may	Additional costs due to bridge crossing ad substation	1 waterway crossing with bridge, route goes past electrical Substation with impressed voltage working and potential for underground cable crossing. Two 38kV crossings. Roadside Kilcock 38kV substation. 100mm water mains on last 400m of road. Local road affected and approach to Kilcock.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
			Breakdown recovery service located roadside.	involve both open cut installation and/or bentonite filled ducts to meet the required ratings.		
FI	2.5	Passes roadside historic church and cemetery. Approximately 630m off-road section through agricultural (equine) land - impacts to hedgerows and trees. Some minor watercourse crossings (on and off-road). One on road crossing of tributary of the Rye Water and associated floodplain.	Some ribbon development. Passes roadside adjacent Bryanstown Stud. Approximately 630m off-road section through agricultural (equine) land - Moyglare. Passes within 150m of Moyglare airstrip.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve bentonite filled ducts to meet the required ratings.	No additional costs	Potential for 2 drain crossings, route goes past a graveyard (ground issues) , the final section is through private property. One 220kV crossing. No water or sewerage network in road. Local roads affected.
GH	1.0	No off-road section. No key environmental constraints.	No off-road section. Dense ribbon development. No other key socio constraints	Technical issues are common to all lengths at this stage.	No additional costs	Narrow road, hedges and trees both sides. No water or sewerage network in road. Local road and access to ribbon development affected.
EI	6.4	No off-road section. Passes roadside church and graveyard. This is also the Meath and Kildare Col Diocesan Office. Two on road crossings of tributaries of the Rye Water and associated floodplains.	No off-road section (to be adjusted). Dense ribbon development along Moyglare Road (north and centre of length). Passes roadside equine operations (Barrockstown House, Moyglare Manor, and Moyglare Stud Farm). Passes roadside Lavins (large ice cream distributor), Sean Doyle Auctioneers, and John Lee Furniture. The entrance to Moyglare Manor (tours and self-catering location) is passed.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings. HDD or auger bore will be required for larger obstacles such as bridges.	Additional costs due to bridge crossing	1 bridge crossing, section shared watercourse along road, 1 watercourse crossing. Residential area along route expects services in road. Water mains (Mulhussey GWS) in (NS) Moyglare road. No services in (EW) Moyglare Road. Local roads with accesses to dense ribbon development affected.
HL	8.8	Two off-road section - one 240m and one 380m. The first off-road section crosses a tributary of the Rye Water. The second (380m) crosses the Royal Canal and its	Two off-road section - the first is 240m in length, the second is 380m in length, and the third is 320m in length.	Technical issues are common to all lengths at this stage – each to be individually assessed.	Additional costs due to motorway, canal and railway crossings	Hedges and trees along sections of the road, bridge crossing and a very deep drain ditch. Good locations available for launch reception pits for motorway crossing. Deviation required around railway and canal crossing where a lot of new developments are ongoing

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
		pNHA, the Sligo railway line, within the notification zone of a ringfort and agricultural land - impacts to hedgerows and trees. On road sections: Passes roadside church and graveyard at Barreen Crossroads. Crosses several on road watercourses included Baltracey River and River Lyreen, and associated floodplains.	The first off-road section (240m) crosses land zones for housing before tying into the road for the housing development (Millerstown). The second (380m) crosses the Royal Canal, the Sligo railway line, and agricultural land. The third (320m) crosses the M4 motorway and agricultural land. Dense ribbon development along the L5039 and L1010. Passes roadside Clonfert Maynooth Equestrian Centre and Rheindross Stud farm. Clonfert Maynooth Equestrian Centre is also a tourist attraction, as is at Laragh Demesne.	Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings. HDD or auger bore will be required for larger obstacles such as deep ditches.		Water network (250mm) in road. Crossing of 220kV line, 38kV line, and 110kv line. Gas distribution line (medium pressure) located in new Millerstown estate and its access road. Crosses the proposed Water Supply Project at Barreen. Local roads affected with access to new housing development and dense ribbon development also affected.
IJ	3.3	Two off-road sections. Approximately 630m off-road section through equine operation (Moyglare Stud Farm). Off-road crossing of the Rye Water and its flood plain. Separate approximately 1.5km off-road section crossing agricultural land, River Lyreen and its floodplain, a designated enclosure and close to Laraghbryan church and cemetery, Royal Canal and pNHA, and the Sligo Railway line. Off-road impacts to hedgerows and trees. Several on road crossing of watercourses.	Passes some ribbon development. Approximately 630m off-road section through equine operation (Moyglare Stud Farm). Separate approximately 1.5km off-road section crossing agricultural land, Royal Canal, and the Sligo Railway line.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings. 2 separate HDD or auger bore crossing will be required for the larger obstacles such as canals, railways, and motorways.	Additional costs due to motorway, canal and railway crossings	One combined canal and railway and 1 motorway crossing with easy location for launch and reception pits. Gas distribution line (medium pressure) located in R148. Two crossings of 220kV and one 38kV crossing. No water or sewer network. Crosses the proposed DART+ West scheme. Local road affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
JK	1.5	One off-road section at 240m in length, crossing the M4 motorway and agricultural land - impacts to hedgerows and trees. No key environmental constraints.	One off-road section at 240m in length, crossing the M4 motorway and agricultural land. Passes a roadside equine holding. Small number of houses adjacent. Robinson Farms (agri business) adjacent to L5042.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings. HDD or auger bore crossing will be required for the larger obstacles such as motorways.	Additional due to motorway crossings	One motorway crossing with ample space for launch and reception pits. 300mm water main in L5042. Two crossings of 220kV. Local road affected.
JO	7.3	One off-road section at approximately 2.5km which crosses agricultural land and the M4 motorway - impacts to hedgerows and trees. Two off-road minor watercourses crossings and associated floodplain. Passes one roadside designated enclosure and a ringfort. It also passes through the notification zones of a ringfort close to the R406.	One off-road section at approximately 2.5km which crosses agricultural land and the M4 motorway. The offline section is largely parallel to the M4 and is not zoned for use. There is the potential the M4 could be upgraded in this area in the future. On road section: Passes roadside TLC nursing home, Maynooth Business Park, and Straffan Antiques. Passes roadside two equine operations Iona Park Stud and Moneycooly Stud. Corbally Stud is set back from the R406 and is adjacent to the road.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings. HDD or auger bore crossing will be required for the larger obstacles such as motorways.	Additional due to motorway crossings	One motorway crossing. Noted on the survey that motorway level is lower than surrounding fields, with ample space for launch and reception pits. Three crossings of 110kV, two crossings of 220kV and three crossings of 38kV. Road passes roadside Maynooth substation. Gas distribution line (medium pressure) located in R406 (connection to TLC nursing home). Water main 100mm in R406. Regional road and access to Straffan and ribbon development affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
KN	6.7	One off-road section of 2.4km that passes through agricultural land - impacts to hedgerows and trees. Off-road crossings of minor watercourses. On road section: Passes close to ringfort. Passes along road which is between two small native woodlands (partially severed due to 220kV line). On road crossings of watercourses including associated floodplain of one.	One off-road section of 2.4km that passes through agricultural land. This section avoids Cowanstown Stud. It also passes along the north boundary of a proposed 25ha solar farm which had planning permission at Smithstown. On road section: Passes the roadside Derrinstown Stud and a large dairy farm at Johninstown. Dense ribbon development on L5047 (Ovidstown)	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which will involve bentonite filled ducts to meet the required ratings.	No additional costs	Mostly off-road, and elsewhere on narrow roads with some very narrow pinch points with hedges both sides. Six crossings of 220kV lines and one crossing of a 110kV line. 125mm water main in L5044 and L5047 (Smithstown and Ovidstown). Crosses the proposed Water Supply Project at Smithstown. Local roads with dense ribbon development affected.
KM	7.5	No off-road sections. Length is on the R408. Passes roadside Donaghstown Church and Rathcoffey Church (both protected structures). On road crossing of River Lyreen (and its floodplain), one of its tributaries and other minor watercourses.	Passes roadside equine operations - Derrinstown Stud (both side of the road) and Cowanstown Stud. Some ribbon development along the R408 and more significant roadside properties in Rathcoffey and Moortown. Also passes roadside Farrington's Mill Restaurant, Cafe & Bar, roadside animal feed store .	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	No additional costs	2 watercourse crossings. Three crossings of 220kV lines and one crossing of 110kV line. 100mm water main in R408. Crosses the proposed Water Supply Project at Raheen. Regional road affected and the settlements of Rathcoffey and Moortown affected.
GL	9.1	Off-road sections will impact on hedgerows and trees, including at the crossing of the Royal Canal and Royal Canal pNHA. On road crossing of the Rye Water, Baltracey River, and the tributary of the River Lyreen, and their associated floodplains.	The section travels along the R158, along the western edge of Kilcock town. It moves off-road to cross the Royal Canal and pNHA, and the Sligo railway. It travels off-road through agricultural land, which is zoned for	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or	Additional costs due to the crossings	1 bridge crossing, 1 combined canal+ road+ rail crossing with space for launch an reception pits, 2 x watercourse crossing an 1x motorway crossing. One crossing of 220kV and one crossing of 110kV. Crosses the proposed Water Supply Project at Baltracey. 150mm water main in R408 and around Kilcock. Gas distribution line (medium pressure) located in R148. Western edge of Kilcock and regional roads affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
			development, and then crosses the M4 motorway. The crossing of the Canal and Railway would likely require a long HDD as there is a home fuel deport/sawmill at this location. The remainder of the length is on road on the R407. Passes Courtown equine operation, Mountpleasant Lodge nursing home, Damastown Stud (all roadside). Significant ribbon development south of Kilcock becoming less dense	bentonite filled ducts to meet the required ratings. HDD crossing will be required for the larger obstacles such as bridge crossing and combined canal+ road+ rail crossing		
LM	2.6	No off-road section. On road crossing of Clonshanbo tributary. No other key ecological and cultural heritage constraints.	Passes roadside Terra Grove Stud, Painestown Stud, Rheindross Stud, and Boherhole equine operations. Ribbon development at Painestown Cross roads, and roadside petrol station, Precast Concrete business, and horse transport supplier.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve bentonite filled ducts to meet the required ratings.	No additional costs	One crossing of 220kV line. 400mm water main in R408. regional roads and ribbon development affected.
MP	3.8	On road crossing of the Gollmochy River and its floodplain. Passes the roadside Mainham Castle, church, graveyard and mausoleum (national monuments). Short off-road section in agricultural land (impacts to hedgerows and trees).	Passes roadside Redthorn Stud, Clane Golf course, and the entrances to Clane Business Park and Clongowes Wood College (boarding school). Dense ribbon development and passes through the northern suburbs of Clane to an off-road section (280m).	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	No additional costs	Very narrow road with large services. Residential area. One small watercourse crossing. Gas distribution line (medium pressure) located in part of the R408. 400mm water main in R408 and small main (65cm) in suburban road. One crossing of 220kV line. Regional road, ribbon development, approach to Clane affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
			This off-road section is agricultural land but is zoned for development.			
MX	10.6	Two off-road sections of 1.3km and 800m. Both passes through agricultural land - impacts on hedgerows and trees. Two on road crossings and three off-road crossings of tributaries of the Liffey (including the Clane Stream and Gollmochy River). Southern end of the length is with the Liffey floodplain. Passes roadside Col church on L2002 (protected structure) and roadside tumulus (designated).	Passes roadside Redthorn Stud and wholesale plant nursery along R408. Dense ribbon development on R408, R403, and L2002. Two off-road sections of 1.3km and 800m. Both passes through agricultural land. Passes roadside Millicent airfield, Firmount House (undesignated events venue), and Millicent Estate Houses (protected structure) on L2002. Millicent Golf Club (community amenity and tourism venue) in the vicinity.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve bentonite filled ducts to meet the required ratings.	Some additional costs due to the numerous waterways	Three crossings 220kV lines and one crossing of 110kV line. Gas distribution line (medium pressure) located in part of the R403. Water mains along all of the on road sections. Regional road affected for part of length.
ON	2.2	No off-road section - all on R403. The road is adjacent to the Barberstown Castle and complex of designated sites (national monuments). On road crossing of tributary of the Liffey and its floodplain.	No off-road section - all on R403. Dense ribbon development on R403. roadside bar and restaurant and B&Bs, and Straffan Antiques and Design Centre.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve bentonite filled ducts to meet the required ratings.	No additional costs	Wide road, with residential services. 100mm water main and Gas distribution line (medium pressure) located in R403. Regional road and access to dense ribbon development affected.
NP	3.1	No off-road section - all on R403. On road crossings of minor watercourses.	No off-road section - all on R403. Ribbon development on R403. Passes roadside Abbeyfield Farm Equine and Activity Centre, car wash, used car dealer, and seasonal fruit stand.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to	No additional costs	1 watercourse crossing, . 100mm water main and Gas distribution line (medium pressure) located in R403. One crossing of 220kV line. Regional road and access to dense ribbon development affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
				meet the required ratings.		
PQ	4.9	Two off-road sections to the east of Clane (930m and 720m). The off-road section is agricultural but zoned in part for development. Off-road crossing of the Liffey and one its tributaries. The off-road sections are within its floodplain. Roadside castle (national monument) in Castlesize.	Two off-road sections to the east of Clane (930m and 720m). The off-road section is agricultural but zoned in part for development. Part of the off-road section (360m) passes through the northern section of the Blackhall Stud farm. Limited roadside properties. Roadside haulage and storage company off R407.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	No additional costs	2 watercourse crossings, 200mm Water main and Gas distribution line (medium pressure) located in R407. Water main in also L20044. No OHL crossings. Regional road and residential accesses affected.
NQ	6.6	One 4.6km off-road section. Passes through agricultural land - impacts to hedgerows and trees. One off-road crossing of the Liffey and associated floodplain, and minor tributaries and other minor watercourses. Also, passes Irishtown House (protected structure). On road section passes the historic Bodenstown church and graveyard (which includes Wolfe Tone's grave).	One 4.6km off-road section. Passes through agricultural land and adjacent to Kilmorna Daars North equine operation. Passes the western edge of the K Club. The field to the west of the existing Bodenstown graveyard has planning permission for a new graveyard. On road section also passes the now closed Bodenstown Golf Course.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	Some additional costs due to bridge crossing	1 watercourse crossing with existing bridge, route narrow at points with trees and hedges both sides. One 220kV crossing. Water mains in L2010, L6003, and L60031. Local roads affected.
QX	1.2	This length first follows the R407 and then largely follows the Sallins Bypass. On road crossing of the Liffey and its floodplain.	This length first follows the R407 and then largely follows the Sallins Bypass.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	No additional costs	Wide road, potential space in cycle tracks, large modern bridge. Ample space for launch reception pits. One 110kV crossing. Gas distribution line (medium pressure) and Water mains located in R407. Regional road and Sallins Bypass affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
				HDD crossing will be required for the larger obstacles such as bridge crossing river crossing.		
XR	5.0	The Sallins Bypass section has a crossing of the Liffey (and its floodplain), a crossing on the Grand Canal, its walkway and Grand Canal pNHA. This section also crosses the Kildare railway line and is adjacent to a number of cultural heritage sites. There is one minor off-road section through agricultural land to cross the M7 motorway. It then follows the Millennium Link Road (also called Western Distributor Road).	This length first follows the Sallins Bypass. There is one off-road section (400m) through agricultural land to cross the M7 motorway. It then follows the Millennium Link Road (also called Western Distributor Road). This road has a number of large business units adjacent, including a large Kerry Group manufacturing centre, motorway services and many planning applications for further development.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings. HDD crossing will be required for the larger obstacles such as bridge crossing, rail crossing and motorway crossing	Additional costs due to crossings	1 bridge , 1 motorway (level below surroundings), 1 railway crossing. One 110kV crossing. Gas distribution line (medium pressure) located in the Millennium Link Road (also called Western Distributor Road). Water mains crossing under the Sallins Bypass in Osberstown, and in the Millennium Link Road. Regional road and Sallins Bypass affected.
OS	16.2	Three offline sections - 2.4km, 4.8km, and 790m. The first offline section (2.4km) comes after a short section on the R403. It is to avoid the village of Straffan and Lodge Park Demesne. Passes historic Whitechurch church, holy well, and graveyard. Crossing of the Kildare railway, Grand Canal and Grand Canal pNHA (off-road through agricultural land - impacts to hedgerows and trees). On road crossing of the Slane River (tributary of the Liffey). Crosses the M7 motorway. Off-road crossing of the Tobenavoher River and through agricultural	Three offline sections - 2.4km, 4.8km, and 790m. The first offline section (2.4km) comes after a short section on the R403. It is avoiding the village of Straffan but it passes through the land of Castle Dillion equine operation. Some ribbon development along the L2007, roadside Ballyhays Equine operation, Whitechurch equine operation, and Baronrath Stud. Crossing of the Kildare railway, Grand Canal (off-road	Technical issues are common to all lengths at this stage. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings. HDD crossing will be required for the larger obstacles such as river/canal crossing, rail crossing and motorway crossing.	Additional costs due to crossings and long sector	1 river, 1 canal , 1 waterway crossing, 1 railway, 1 motorway (ample space for launch and reception pits) crossings. Route crosses woodland around Johnstown. New housing developments along route . Two crossings of the proposed Water Supply Project. Two crossings of 38kV, one 220kV, two 110kV, and runs beside a 38kV UGC at southern end of length. Crossing of Gas distribution line (medium pressure) in Johnstown local road at southern end, it is also present in R403 at northern end. Water mains in R403, two crossings of 900mm water main on first off-road section in L2007, crossing of 400mm on second off-road section, in M7 , and Johnstown local road. Regional and Local roads affected. Approach to Johnstown affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
		land. Second offline section (4.8km) is through agricultural land (impacts to hedgerows and trees). Off-road crossing of the Painestown River. There is a short on road section before the length continues onto agricultural land, with an off-road crossing of a tributary of the Morell River. The length crosses a number of floodplains.	through agricultural land). Crosses the M7 motorway. Off-road crossing through agricultural land. Second offline section (4.8km) is through agricultural land. Off-road crossing of the Painestown River. It passes the Goffs bloodstock sales complex and then passes behind a planning permission for a new hotel and the edge of the Palmerstown House Estate. There is a short on road section before the length continues onto agricultural land (third off-road section), passes to the rear of the Irish Equine Centre. The area is densely populated.			
ST North	4.3	One off section (1.6km) which runs parallel to and crosses tributaries of the Morell River and associated floodplain. This off-road section is through agricultural land - impacts to hedgerows and treelines. Passes roadside Maudlines Cemetery (designated) and a modern graveyard. On road crossing of a tributary of the Liffey and its associated floodplain.	Off-road Section : north of the Naas Racecourse via Naas Industrial Estate. On Road Section : R410 and R445 . These roads are very densely developed and the R445 is the main road into Naas from Dublin. The route passes Maudlins Industrial Estate (includes a cinema), a GP surgery, An Post sorting depot, and other community amenities.	Technical issues are common to all lengths at this stage – each to be individually assessed. Risk of various shallow crossings which may involve bentonite filled ducts to meet the required ratings.	Additional costs due to services diversions	Narrow pass as length passes by Naas Industrial Estate . Wide road but expect all services and heavy traffic. Water mains and Gas distribution line (medium pressure) in R445. One crossing of 38kV line. Regional roads and Naas town affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
ST South	3.4	One off-road Section (700m) through agricultural land - impacts to hedgerows and trees. Two on road crossing of tributaries of the Morell River and one off-road crossing, also crossing their floodplains.	Passes western boundary of Equine facility (Forenaghts Little). Dense ribbon development along L6035 and L6037. Off-road Section : traverses south western boundary of Naas Racecourse and through an area zoned for development.	Technical issues are common to all lengths at this stage Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	Some additional costs due to watercourses	Two watercourse crossings, narrow road at points with hedges and trees both sides. 100mm water mains in local roads. One crossing of 38kV line. Regional and local roads affected.
TU	1.4	On Road Section: Eastern side of Ring road (R447). Two on road crossings of tributaries of the Morell River and associated floodplain.	Densely developed area with roadside amenities, including primary school, church, and shops.	Technical issues are common to all lengths at this stage. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	No additional costs	Gas distribution line (medium pressure) and water mains in the R447. Regional road affected. This section of route would be the closest section to Naas General Hospital and A&E. This road would be the main route to the hospital.
UV	1.5	On road section (R448): no designated sites adjacent.	On road section built up area with existing housing estates on west and eastern of the length. Passes two roadside primary schools and the entrance to Piper's Hill College. Existing Equine facility at Bluebell.	Technical issues are common to all lengths at this stage. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings.	Some additional costs due to cable crossing	38kV cable crossing and nearby substation (expect impressed voltages) wide road with expected services. Gas distribution line (medium pressure) and water main in the R448. Regional road with roadside developments affected.
RU	3.1	On Road Section: traverses the Grand canal (pNHA), a tributary of the Liffey and its floodplain. Western side of Ring road. Jigginstown Castle to the west of the route.	On road section : via the Naas South Ring road (R447). Densely developed with housing on both sides of the road. Passes the entrance to Naas Sports Centre, supermarket , building suppliers, and children's charity.	Technical issues are common to all lengths at this stage. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to	Some additional costs due to canal crossing	1 canal crossing with available locations to launch and reception pits. Wide road with expected services. Water main along full length and Gas distribution line (medium pressure) along most of the length. Regional road with roadside developments affected.

Route Section	Approx. Length (m)	Environmental	Socio - Economic	Technical	Economic	Deliverability
				meet the required ratings. HDD crossing will be required for the larger obstacles such as river/canal crossing.		
RV	4.0	One off-road Section (2.2km). Traverses the Grand Canal pNHA and through agricultural land (impact to hedgerows and trees). One on road crossing of a tributary of the Liffey and its floodplain.	One off-road Section (2.2km). Traverses the Grand Canal, through agricultural land, through the north eastern edge of Rathasker Stud Farm, and adjacent to Bluebell equine operation. On road section is on the Millennium Link Road, passes business parks and passes through the car park of a supermarket. Southern end is on L6066 passing between two houses.	Technical issues are common to all lengths at this stage. Risk of various shallow crossings which may involve both open cut installation and/or bentonite filled ducts to meet the required ratings. HDD crossing will be required for the larger obstacles such as river/canal crossing.	Some additional costs due to canal crossing	1 canal crossing. Route levels change at transition from on road to off-road. Crossing of Gas distribution line (medium pressure) at R445. Water main in Millennium Link Road. One crossing of 38KV line. Regional road affected.
VW	4.9	No off-road section. Entrance road to Dunstown substation passes through cluster of cultural heritage sites - likely previously resolved with construction of road. The R412 passes within 100m of Harristown Common - an important natural grassland habitat.	No off-road section. Ribbon development along R445 and R412, including roadside primary school. Passes a number of roadside Equine facilities.	Technical issues are common to all lengths at this stage. Cable entry at Dunstown Substation will have to be coordinated with other existing, ongoing, and future projects in design to minimise interaction.	No additional costs	Final approach to Dunstown SS, common to all routes. Ongoing ESB works in June 2021 along main road. Two crossing of 220kV line. 500mm water main in and runs adjacent to R448 and R412. Regional roads affected.

3.1.2 Assessment of Route Sections

The route sections assessment, completed in-line with the methodology in Chapter 2, is summarised in Table 3.2.

Table 3.2: Route Sections Assessment

Route Sections	Assessment Criteria				
	Environmental	Socio - Economic	Technical	Economic	Deliverability
AB					
BC					
CG					
BE					
ED					
DC					
DF					
FH					
FI					
GH					
EI					
HL					
IJ					
JK					
JO					
KN					
KM					
GL					
LM					
MP					
MX					
ON					
NP					
PQ					
NQ					
QX					
XR					
OS					
ST North					
ST South					
TU					
UV					
RU					
RV					
VW					

3.1.3 Route Sections Not Progressed

Following the route sections assessment, it was determined that several route sections should not be taken forward. These route sections are described in Table 3.3. Generally, the reasons were lower socio – economic assessment rankings as shown in Table 3.2. Additionally, there are route sections which were ranked highly by themselves, but they were not progressed. This was because they connected to other route sections with low assessment rankings and could not be connected to other route sections.

Table 3.3: Route Sections Not Progressed

Route Sections	Reason for Not Progressing
C-D	Located to the north of Kilcock, this short length scored favourably, however, in identifying end-to-end options, it was determined that this length was not required.
F-H	Located to the northeast of Kilcock, this length scored favourably by itself however, selecting this length meant a crossing to the east of Kilcock. See Route Section H-L below.
G-H	Located to the northeast of Kilcock, this length scored favourably by itself but had denser housing along the road. Selecting this length meant a crossing to the east of Kilcock. See Route Section H-L below.
H-L	The eastern crossing of Kilcock (Nodes H-L) scored poorly because of the impacts to housing and lands zoned for development, and an elongated crossing of the Royal Canal (pNHA) and railway. To the south of Kilcock, the affected roads have a denser housing settlement along them, a roadside equestrian centre, and demesne.
M-P	Located to the north of Clane, the length was not progressed due to the social impacts. Passes roadside Redthorn Stud, Clane Golf course, and the entrances to Clane Business Park and Clongowes Wood College (boarding school). Passes dense housing development and through the northern suburbs of Clane to an off-road section (280m). This off-road section is agricultural land but is zoned for development.
O-S, S-T (North) S-T (South) T-U	The sections to the east of Straffan and Naas scored poorly because of social impacts. O-S - Several long off-road sections - Crossing of Grand Canal, its walkway and pNHA, railway, and M7 - Close to bloodstock sales (Goffs) and proposed hotel site. - Dense housing in sections S-T (North) - One off-road section - Passes through Naas town - very densely developed S-T (South) - One off-road section - Densely developed T-U - On road section - Passes through south edge of Naas, closest section to hospital (traffic disruption during construction) - Very densely developed

3.2 End-to-End Assessment

With the completion of the Route Section Assessment, the project team were able to add the route sections together to create End-to-End route options. These route options were the proposed four route options presented at the Public Consultation between August-November 2021.

The Public Consultation between August-November 2021 presented the proposed route options with highlighted off-road sections (wider potential corridors). These sections were presented in this way as consultation was required with the potentially affected landowners and as further survey, design, consultation, and assessment were required. Within those highlighted off-road sections, indicative routes were assumed. These assumptions allowed the project team to complete their assessment as assessing a much wider corridor would not have been feasible. The wider corridors are shown in the accompanying figures to reflect the further work required to optimise the route at the next step of the Proposed Project.

The result of this assessment is shown in Chapters 4 – 7 of this report. All of the proposed route options are subject to further design and changes as the Proposed Project continues to the next steps. This will be as a result of further surveys, through public consultation, or information from landowners and statutory bodies. This is normal for linear infrastructure projects as the design will be subject to further changes as the project team move to find the best overall option. The following sections describe the four proposed route options.

3.2.1 Option A (Red)

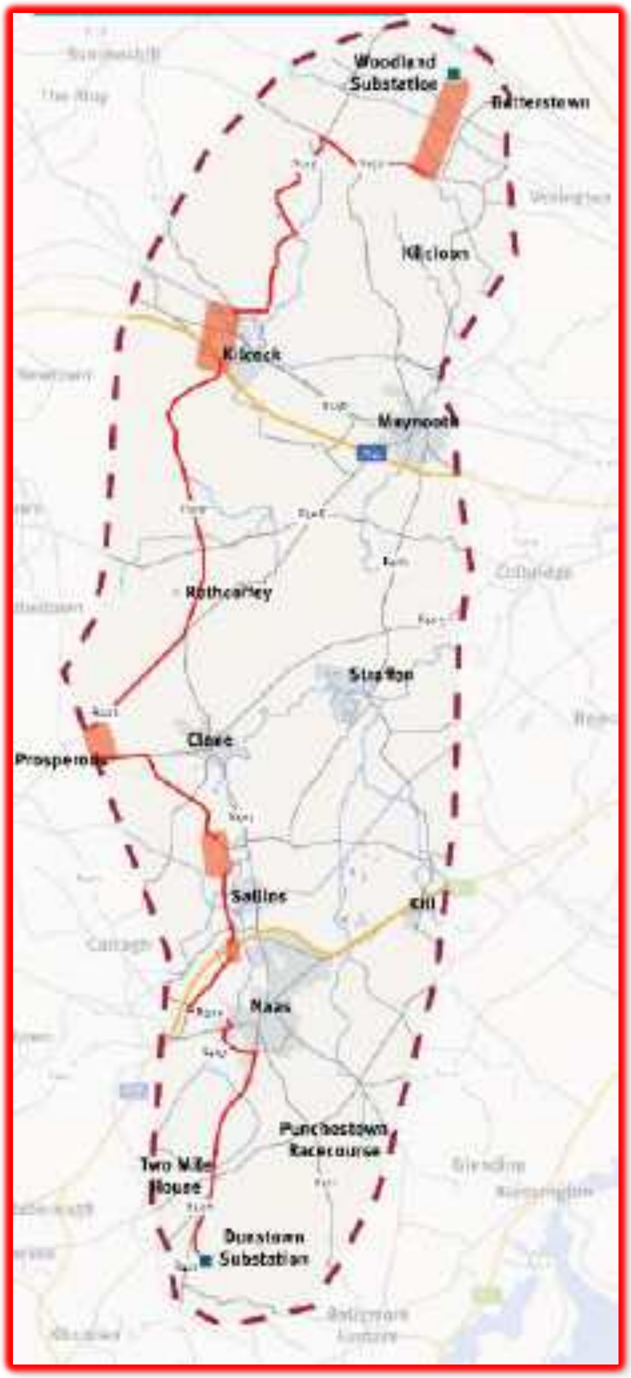

Figure 3-2: Option A (Red) Location map

Option A (Red) is the most westerly of the shortlisted cable route options and it is potentially the longest. All the shortlisted route options have a common section coming out of Woodland substation.

The common section out of Woodland substation travels to the townland of Jenkinstown. At the junction of the R156 and the L1012 (Mulhussey Road), Option A (Red) is proposed to travel along the R156 to the north west towards the Mullagh Cross Roads. It will then travel south along the R156, R125, and R158 towards Kilcock. It is proposed that Option A (Red) will pass to the west of the town of Kilcock and a potential corridor is shown on the project mapping. Crossings of the Rye Water, Royal Canal (a proposed NHA), Dublin-Sligo railway line, and M4 Motorway will be required. It is proposed that the cable will be drilled under these to avoid potential impacts.

To the south of Kilcock, Option A (Red) is proposed to travel to the south along the R407 towards Clane. To the north of Clane at the Boherhole Cross Roads, it is proposed to take Option A (Red) to the west to avoid Clane. It is one of the Proposed Project's routing principles to avoid towns and villages. Option A (Red) will travel along the R408 (the road to Prosperous). Close to the townland of The Cott, it is proposed to route the cable across agricultural land to the south east of the R408. This is required so that the route option can continue to travel to the south towards the Dunstown substation. A potential corridor is shown at this location on the project mapping. Option A (Red) will meet the R403, travelling along it until the Firmount Cross Roads, where it will continue south along the L2002. It will travel south to the new Sallins Bypass where a potential corridor is shown for a crossing of agricultural land. Along the Sallins Bypass, Option A (Red) will cross the River Liffey and Grand Canal (pNHA). A potential corridor is shown for the required crossing of the M7 Motorway.

Under the M7 Motorway, Option A (Red) will then travel along the Millennium Link Road (Western Distributor Road), travelling to the west around Naas. Option A (Red) will connect with the R409 and travel east towards Naas, passing the Naas Sports Centre and across the Grand Canal (a proposed NHA). The cable route then travels along the R445 and the R447 (South Ring Road). Option A (Red) connects with the R448 (Kilcullen Road) and travels south past Killashee. It meets the junction of R412 and then travels into the Dunstown substation.

3.2.2 Option B (Green)

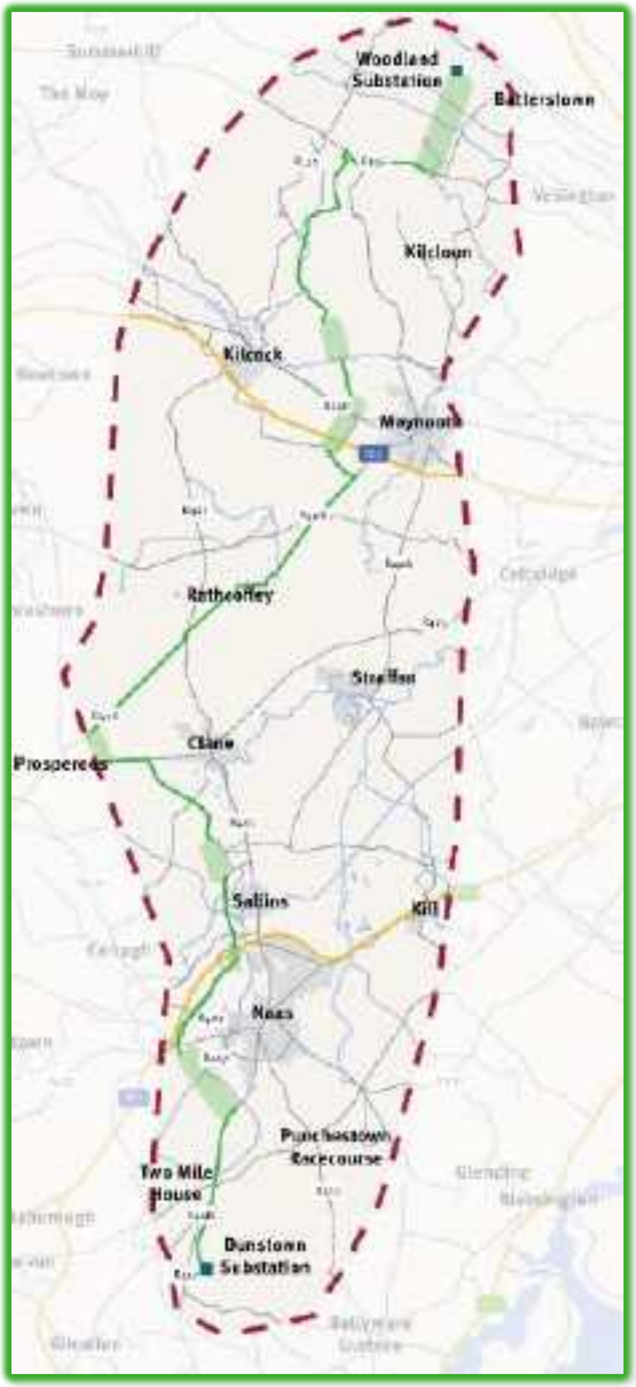

Figure 3-3: Option B (Green) Location Map

Option B (Green) has similar parts to Option A (Red) but differs in the section between the R156 to the north of Clane.

The common section out of Woodland substation travels to the townland of Jenkinstown. At the junction of the R156 and the L1012 (Mulhussey Road), Option B (Green) is proposed to travel south along the L1012 (Mulhussey Road). The route option passes the Mulhussey National School (St Josephs) and travels west and passes the roadside Mulhussey Castle and Cemetery toward Kiltens Gap Cross Roads. Here, the route option travels south towards Rodanstown and then south east to Bryanstown. Along this road a potential corridor is shown where Option B (Green) will travel south to cross the Rye Water and under agricultural land. Another potential corridor is shown where the cable will cross Royal Canal (pNHA), the River Lyreen, the Dublin-Sligo railway line, and M4 Motorway, avoiding Laraghbryan Cemetery. To the south of motorway, Option B (Green) connects with R408 where it will travel south west. Along this route, Option B (Green) will travel through the settlements of Rathcoffey and Moortown, then meeting with the R407 at the Boherhole Cross Roads.

It is proposed to take Option B (Green) to the west to avoid Clane. It is one of the Proposed Project's routing principles to avoid towns and villages. Option B (Green) will travel along the R408 (the road to Prosperous). Close to the townland of The Cott, it is proposed to route the cable across agricultural land to the south east of the R408. This is required so that the route option can continue to travel to the south towards the Dunstown substation. A potential corridor is shown at this location on the project mapping. Option B (Green) will meet the R403, travelling along it until the Firmount Cross Roads, where it will continue south along the L2002. It will travel south to the new Sallins Bypass where a potential corridor is shown for a crossing of agricultural land. Along the Sallins Bypass, Option B (Green) will cross the River Liffey and Grand Canal (pNHA). A potential corridor is shown for the required crossing of the M7 Motorway.

Under the M7 Motorway, Option B (Green) will then travel along the Millennium Link Road (Western Distributor Road), travelling to the west around Naas. To the south of the Southern Link Business Park, a potential corridor over agricultural land is shown. This section of Option B (Green) will cross the Grand Canal (pNHA). Option B (Green) connects with the R448 (Kilcullen Road) and travels south past Killashee. It meets the junction of R412 and then travels into the Dunstown substation.

3.2.3 Option C (Orange)

Figure 3-4: Option C (Orange) Location Map

Option C (Orange) is potentially the shortest of the four options, However, it will potentially affect much more agricultural land than the other shortlist sections.

The common section out of Woodland substation travels to the townland of Jenkinstown. At the junction of the R156 and the L1012 (Mulhussey Road), Option C (Orange) is proposed to travel south along the L1012 (Mulhussey Road). The route option passes the Mulhussey National School (St Josephs) and travels west and passes the roadside Mulhussey Castle and Cemetery toward Kiltens Gap Cross Roads. Here, the route option travels south towards Rodanstown and then south east to Bryanstown. A potential corridor is shown where Option C (Orange) will travel south to cross the Rye Water and under agricultural land. Another potential corridor is shown where the route option will cross Royal Canal (pNHA), the River Lyreen, the Dublin-Sligo railway line, and M4 Motorway, avoiding Laraghbryan Cemetery. To the south of motorway, Option C (Orange) crosses the R408 at Crinstown Cross Roads. It will travel south east on the L5042 until it meets the L5037 close to Maguire's Wood. At this point, a potential corridor is shown to where the Option C (Orange) will cross under agricultural land. It will then connect with a local road in the townland of Smithtown, travelling south thorough Johninstown and Ovidstown, crossing the R403 to the north of the K Club.

Another potential corridor is shown travelling to the south until the townland of Blackhall. Here it travels under local roads, past the now closed Bodenstown Golf Club, and the roadside Bodenstown Cemetery, before connecting the R407. Option C (Orange) will travel along the R407 for a short length before connecting to the new Sallins Bypass. Along the Sallins Bypass, Option C (Orange) will cross the River Liffey twice and Grand Canal (pNHA). A potential corridor is shown for the required crossing of the M7 Motorway.

Under the M7 Motorway, Option C (Orange) will then travel along the Millennium Link Road (Western Distributor Road), travelling to the west around Naas. To the south of the Southern Link Business Park, a potential corridor over agricultural land is shown. This section of Option C (Orange) will cross the Grand Canal (pNHA). Option C (Orange) connects with the R448 (Kilcullen Road) and travels south past Killashee. It meets the junction of R412 and then travels into the Dunstown substation.

3.2.4 Option D (Blue)

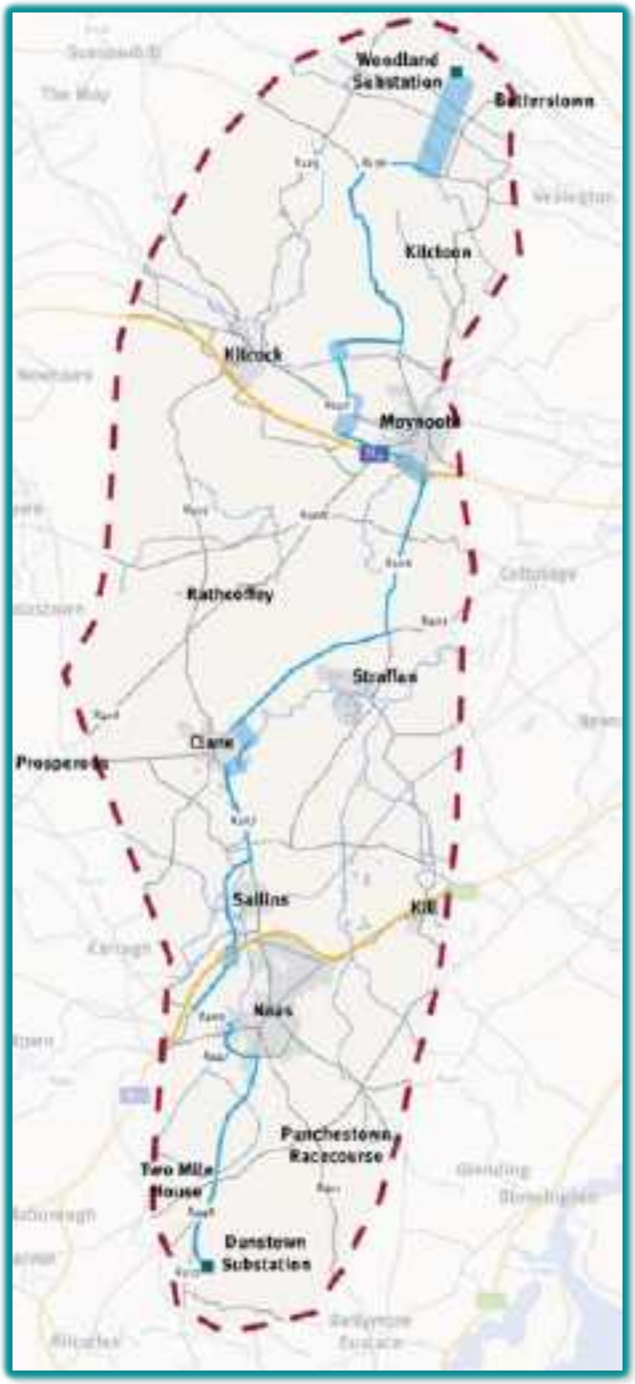

Figure 3-5: Option D (Blue) Location Map

Option D (Blue) potentially affects the least amount of agricultural land of the shortlist options.

The common section out of Woodland substation travels to the townland of Jenkinstown. At the junction of the R156 and the L1012 (Mulhussey Road), Option D (Blue) is proposed to travel south along the L1012 (Mulhussey Road). The route option passes the Mulhussey National School (St Josephs) and travels east and then south following the L1012 until the Moyglare Road. Here it will travel west to avoid Maynooth. Along this road a potential corridor is shown where Option D (Blue) will travel south to cross the Rye Water and under agricultural land. Another potential corridor is shown where the cable will cross Royal Canal (pNHA), the River Lyreen, and the Dublin-Sligo railway line, avoiding Laraghbryan Cemetery.

Option D (Blue) is proposed to travel parallel to the north of the M4 Motorway. It will then cross the motorway to the west of the Maynooth Junction (number 7) and connects to the R406. Option D (Blue) travels along this to the north of Straffan, where it meets the R403. This road will take the cable past Barberstown Castle towards Clane.

Option D (Blue) will travel to the east of Clane, crossing the River Liffey but avoiding the town. A potential corridor is shown in this area. The route connects the R407 to the south of Clane and then connects with the Sallins Bypass. Along the Sallins Bypass, Option D (Blue) will cross the River Liffey and Grand Canal (pNHA). A potential corridor is shown for the required crossing of the M7 Motorway.

Under the M7 Motorway, Option D (Blue) will then travel along the Millennium Link Road (Western Distributor Road), travelling to the west around Naas. Option D (Blue) will connect with the R409 and travel east towards Naas, passing the Naas Sports Centre and across the Grand Canal (pNHA). The cable route then travels along the R445 and the R447 (South Ring Road). Option D (Blue) connects with the R448 (Kilcullen Road) and travels south past Killashee. It meets the junction of R412 and then travels into the Dunstown substation.

3.3 Public Consultation (August – November 2021)

The consultation process was promoted through Community Forum meetings, on-site engagement in the Proposed Project area, stakeholder engagement, public webinars, multi-channel advertisements and via the project website.

A total of 108 responses were received during public consultation. Consultation responses were received via an online forum (38), by email (nine) or by post (61). Public consultation has been an integral part of the Proposed Project, with each response being considered in the routing of the Proposed Project. A number of respondents expressed support for the overall Proposed Project, highlighting that the Proposed Project is needed, as it would bring economic benefits to the area by supporting job creation and by contributing to the development of a resilient energy network based on renewable energy sources. A number of respondents expressed support for the proposed route options generally following the road network, outlining that this would ensure ease of access for maintenance. A few of these responses outlined that the selection of roads should be determined by the amount of disruption on their use that the Proposed Project would cause and emphasised that motorways should be avoided.

Several respondents expressed concern about the general project. A small number of respondents outlined their concern about the potential for cable installation to impact on road safety and to exacerbate existing traffic issues in the area, particularly on the L5041 Local Road and the general road network around Maynooth, Prosperous and Clane. Some respondents raised concerns about the potential for project works to increases the frequency of accidents and the number of road hazards. One respondent expressed concern about the effect of the Proposed Project on its ability to maintain and improve roads and operational infrastructure, including embankments, drainage, bridges, and road furniture. This respondent also highlights that cabling may need to be moved as roads are changed, moved, or upgraded in the future.

A small number of respondents voiced concerns about potential negative impacts on the integrity of historical and recreational assets in the local area, including the Royal Canal and Grand Canal. Others raised concerns about the potential for impacts on local people, the potential for impacts on the equine industry due to soil disturbance on stud land, including the movement of selenium from the sub-soil to the grass during cable installation and the potential for impacts to other developments in the area. However, a few respondents outlined their preference for the routing of the project through agricultural land instead of through more biodiverse areas and that the routing of cables through these lands would allow for easier access in future. Additional concerns raised by respondents included:

- The potential for health effects associated with locating power lines in close proximity to local people;
- The potential for environmental impacts, including impacts on wildlife arising from any disturbance to hedgerow and native woodland;
- The need to mitigate against environmental impacts and to ensure that Proposed Project minimises impacts on biodiversity, including by following the road network; and
- The possibility that underground cables would be expensive or difficult to access or maintain.

A number of respondents provided details of major events that EirGrid should be aware of prior to scheduling works for the Proposed Project, including details on sporting events (racing, fishing and hunting events) and cultural events such as Seachtain na Gaeilge, Féile na Sollán, parades at Bodenstown, Straffan Car Boot Sale, and national holidays such as St Patrick's Day and Christmas. In addition, some respondents offered more general suggestions for the scheduling of works, including requests to avoid scheduling works during summer, and on the other hand, requesting that term-time works should be avoided. The general theme of these scheduling requests centred around ensuring that EirGrid consider the needs of commuters and farmers in the area prior to scheduling project works. A small number of respondents offered other suggestions for the Proposed Project, including:

- Inviting members of the local community to determine the exact route the cabling would take through any towns or villages;
- Routing the cable along motorways, as motorways often take the shortest route from one place to another;
- Considering how to compensate people for any disruption they experience;
- Prioritising the route that would have the least financial impact on affected people;
- Avoiding the felling of mature trees and replacing any felled trees with newly planted ones; and
- Using large international suppliers with experience of completing similar projects.

Some respondents expressed support for the general consultation process, outlining that it was informative and that the consultation materials provided were helpful and appropriate. A similar number of respondents welcomed the opportunity to provide feedback on the Proposed Project.

A report has been prepared on the details on of the consultation process and it is available on the project website[19].

[19] EirGrid. 2022. Consultation Summary Report. https://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

4. Option A (Red)

This section outlines the assessment of Option A (Red) against the five assessment criteria – Environment; Socio-Economic; Technical; Deliverability and Economic; and their sub-topics.

4.1 Environment

As set out in Section 2.3.1, the 'Environment' criterion assessment topics under consideration to assist with determining the Emerging Best Performing Option are as follows:

- Biodiversity (Flora and Fauna);
- Soils and Water;
- Planning Policy and Land Use;
- Landscape; and
- Archaeology, Architectural Heritage, and Cultural Heritage.

4.1.1 Biodiversity (Flora and Fauna)

4.1.1.1 European Sites

Option A (Red) is not located within and does not adjoin any European site. The nearest European site is Ballynafagh Bog SAC located approximately 2km to the west of Option A (Red) and designated for bog habitats (Appendix A.1). There is no hydrological or ecological connection to this SAC. Although this route option involves the least off-road section length it does require a high number of river crossings (20) including crossing of watercourses with direct hydrological links to a complex of European sites within Dublin Bay including Rye Water/Carton SAC, South Dublin Bay and River Tolka Estuary SPA and South Dublin Bay SAC (see Appendix A.1). During construction and depending on crossing methodology there is the potential for impacts to aquatic habitats and species downstream through a pollution event. Habitats along the southern section of Option A (Red) are suitable to support foraging qualifying interests bird species from Poulaphouca Reservoir SPA (located 8km east of this option) namely greylag goose (*Anser anser*) and lesser-black backed gull (*Larus fuscus*), and therefore there is the potential for disturbance impacts to these species and temporary loss of habitat during construction if undertaken during the wintering bird season.

4.1.1.2 National Sites

No NHA sites are located in proximity to this route option. The closest NHA site is Hodgestown Bog NHA located 4km west of Option A (Red). This route option also directly crosses the Royal Canal pNHA at Kilcock and the Grand Canal pNHA on two occasions at Sallins and Naas however a HDD method will be employed for these major crossings and, subject to a rigorous mitigation plan for HDD works, impacts to aquatic receptors can be minimised or avoided.

4.1.1.3 Watercourses and Aquatic Species

This route option involves the crossing of several major rivers including the Rye Water, River Liffey, Lyreen River and tributaries of the River Tolka with varying WFD status' ranging from 'Good' to 'Poor'. There are potentially four major river crossings requiring HDD and eighteen smaller rivers and streams likely to employ other crossing methods such as open cut including the Rye Water River and its tributaries however this option is the greatest distance away from the Rye Water/Carton SAC. Open cut may not be possible across salmonid watercourse crossings. The majority of rivers crossed are classified as Moderate to Poor status under WFD. These rivers host an abundance of aquatic species. The River Liffey supports Atlantic salmon *(Salmo salar)* and brown trout *(Salmo trutta)* whilst the Rye Water River is known to support minnow (*Phoxinus phoxinus*), European eel *(Anguilla anguilla)* and lamprey sp. and is also a spawning ground for trout and salmon. White-clawed crayfish (*Austropotamobius pallipes*) has been recorded at Leixlip within the Rye Water River. Otter (*Lutra lutra*) have been recorded in all the major watercourses. Where open cut is employed there is the potential for impacts to aquatic habitats and species through pollution, disturbance, loss/damage of fish spawning habitat and lamprey beds and spread of invasive species. Several rivers were noted to be suitable to support kingfisher (*Alcedo atthis*) with one bird recorded hunting along the River Liffey during field surveys.

4.1.1.4 Recent Field Survey Data and Desk Based Review

An initial drive over comprising visual assessments and targeted spot checks at static locations of the accessible sections of the route option was undertaken on the 11th, 12th and 13th of October 2021 to scope wintering bird surveys. The dominant habitats recorded along Option A include hedgerows, treelines, agricultural grassland, tillage land (predominantly cereal production), amenity grassland and watercourses. Habitats along Option A (Red) have the potential to support breeding and wintering bird species including Annex I species and birds included in the amber and red list of Birds of Conservation Concern in Ireland (BoCCI). Snipe *(Gallinago gallinago)* which is red-listed in BoCCI and kingfisher (*Alcedo atthis*) which is an Annex I listed bird species within the EU Birds Directive was recorded during visit one of the wintering bird surveys in October 2021. Hen-harrier *(Circus cyaneus)* winter roost surveys commenced in October 2021 at Prosperous and Ballynafagh Bog SAC west of Option A (Red). No hen harrier was recorded during the surveys. Devil's bit scabious (*Succisa pratensis*), the food plant of the Annex II and IV listed marsh fritillary butterfly (*Euphydryas aurinia*), was recorded near Dunstown substation within Harristown Common.

A data request submitted to Birdwatch Ireland for Irish Wetland Bird Survey (I-WeBS) data for Poulaphouca Reservoir SPA and any incidental records available for Co. Kildare and Co. Meath were received in October 2021. The records returned for years 2016 – 2020 showed large numbers of greylag goose, mallard (*Anas platyrhynchos*) and teal *(Anas Crecca)* with lower numbers of several other species including whooper swan (*Cygnus cygnus*), wigeon *(Anas penelope),* curlew *(Numenius arquata)* and lesser black-backed gull approximately 8km from Option A (Red). Several incidental records were received within 2km from Option A (Red) mainly for the areas of Friarstown, Straffan and Lakelands in Naas including two large aggregations of lapwing (*Vanellus vanellus*) and golden plover (*Pluvialis apricaria*). A search of the National Biodiversity Data Centre records included records for several protected species including common frog (*Rana temporaria*), pine marten (*Martes martes*), common lizard (*Zootoca vivipara*), red squirrel (*Sciurus vulgaris*), badger (*Meles meles*) and otter in the vicinity of Option A (Red).

Given the routing of a considerable proportion of the route option along narrow road networks bordered by hedgerows and treelines there will be a requirement for vegetation removal to accommodate the cable installation. The route option is bounded in parts by species rich hedgerows and mature tree lines and the removal of these has the potential to result in habitat fragmentation and impacts on protected species including bats, badger and other small mammals. There is also potential for impacts to wintering and breeding birds through disturbance, habitat loss and pollution during construction. Given the distance of the route option there is a high likelihood that invasive non-native species listed on the Third Schedule to the European Communities (Birds and Natural Habitats) Regulations (S.I. 477 of 2011) as amended will be encountered along the road networks. All lengths of the proposed route option not situated in the road surface have the potential for impacts on biodiversity.

4.1.1.5 Summary of Assessment

The greatest impacts on biodiversity for Option A (Red) would be during construction, where despite cables primarily being laid in public roads, there is potential (especially from passing bays and watercourse crossings) for impacts on hedgerows, tree lines and aquatic ecosystems in particular; other habitats and species may also be disturbed or fragmented during the construction phase and impacts could be permanent in some cases (e.g. in the event of a permanent off-road maintenance track). In the absence of mitigation, there is the potential for impacts to Rye Water/Carton SAC in the event of a pollution incident during construction. However out of the four route options, Option A (Red) is located the greatest distance away from this SAC.

In summary there is a **Moderate-High risk (Light Blue)** of a significant impact to biodiversity assets due to Option A (Red).

Moderate-High

4.1.2 Soils and Water

4.1.2.1 Geology and Soils

Option A (Red) is underlain predominantly by Carboniferous limestone bedrock, with associated calcareous shales, sandstone in the north and older Silurian greywacke, siltstone and shale in the south of the Study Area. There are no mapped karst landforms or Geological Heritage sites recorded in the vicinity of the route option. However, the route option crosses rocks in which karst features have been recorded and the potential exists for unmapped features to occur in proximity to the route option. Karst features are associated with the dissolution of limestone and the formation of ground cavities, which may not always be apparent at the surface, with consequent subsidence risks and enhanced subsurface drainage.

Superficial deposits underlying the Option A (Red) route option are predominantly glacial tills, derived from the underlying limestone and, in the north, sandstone and shale bedrock. There is also alluvium associated with watercourses and some limited areas of sand and gravel are crossed by the route in the southern half of the Study Area.

The route option crosses areas of potential geologic economic deposits (sand and gravel, granular aggregate and crushed rock), predominantly in the southern half of the Study Area. However, the areas crossed are small and these deposits are widely available in the surrounding area, so that this is not considered a significant constraint for route selection.

4.1.2.1.1 Summary of Assessment

In terms of geology and soils the overall evaluation for Option A (Red) is ranked as **Low risk (Cream)** risk based on currently available information. However, the potential for unmapped karst features should be noted and further assessment may be needed to identify potential for ground stability issues.

Low

4.1.2.2 Groundwater

The majority of Option A (Red) lies within the Dublin (poorly productive bedrock) WFD groundwater body, with a small area in the north within the Moynalvy (poorly productive bedrock) and Dunshaughlin (productive fissured bedrock) groundwater bodies. In the southern half of the Study Area the route option crosses the Naas (karstic) and Curragh Gravels East (gravel) groundwater bodies.

The majority of the route option is underlain by bedrock classified as Locally Important Aquifer (bedrock which is generally moderately productive in local zones), with a small area of Regionally Important Aquifer - Karstified (diffuse) crossed in the southern half of the project Study Area. Some areas classified as of High groundwater vulnerability are crossed by the route, predominantly in the southern half of the project Study Area, along with some very small areas of Extreme groundwater vulnerability. While there are no mapped karst landforms in the vicinity of the route option, the route option crosses rocks in which karst features have been recorded and the potential exists for unmapped features to occur. Karst features can be associated with significant groundwater flowpaths and may be important in supporting surface water features.

There are no Public & Group Supply Source Protection Areas or Group Water Schemes in the vicinity of the route option. There are a large number of groundwater wells and springs mapped by the Geological Survey Ireland across the project Study Area. However, in accordance with TII guidance[20] and the observation that low yielding wells, used mainly for domestic and farm water supply, are very common in Ireland, the assessment has focused on high-yielding springs and wells used for public water supply and their surrounding protection zones and the total number of wells and springs along each route corridor has not been used in assessing relative impacts between route options at this stage.

At this stage of assessment, no groundwater dependent water bodies or groundwater dependent terrestrial ecosystems (GWDTEs) have been identified and so these features have not been used in assessing relative impacts between route options at this stage. However, the potential exists for such features to be present within the Study Area and it cannot be conclusively determined at this stage whether or not they may be a constraint for the proposed route.

There is potential for dewatering operations associated with crossings of large watercourses, major roads and railways. This applies to all route options but there is potential higher difficulty associated with the Option A (Red) as both canals are crossed in built up areas, with consequent increased risk of dewatering induced subsidence effects.

4.1.2.2.1 Summary of Assessment

In terms of groundwater the overall evaluation for Option A is ranked as **Low-moderate (Light Green)** risk based on currently available information. However, the potential for unmapped karst features should be noted and further assessment may be needed to identify potential for interference with groundwater flows and potential for groundwater flooding issues.

Low - Moderate

4.1.2.3 Surface Water

There are 13 surface waterbodies crossed along the length of Option A (Red). Some are crossed more than once. A full list of water bodies and their current status is provided in Table 4.1 as well as their proximity to the Rye Water Valley/Carton SAC, their sensitivity to change, the likely crossing technique to be employed and the potential for impacts as a result.

[20] TII. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. Unreferenced. Obtained from: www.tii.ie/technical-services/environment/planning/ (accessed October 2021). TII guidelines have been used as they are relevant to all linear infrastructure projects.

Table 4.1 Surface Water Bodies Option A – Status and Crossing Techniques

Waterbody	Status	No. Crossings	Connection & Proximity to Rye Water Valley/Carton SAC (at closest crossing)	Sensitivity	Impact Potential
Liffey_100	Moderate	2	No connection	Medium	Low
Grand Canal Naas Line	Good	1	No connection	Very High	Low
Grand Canal Main Line	Good	1	No connection	Very High	Low
Liffey_120	Good	3	No connection	Very High	Medium
Liffey_130	Good	3	No connection	Very High	Medium
Clonshanbo_010	Poor	2	11km	Low	Low
Lyreen_010	Poor	1	11km	Low	Low
Royal Canal Main Line	Good	1	No connection	Very High	Low
Rye Water_010	Moderate	1	7.75km	Medium	High
Rye Water_020	Moderate	2	8.5km	Medium	High
Rye Water_030	Moderate	1	9km	Medium	Medium
Dunboyne Stream_010	Moderate	1	No connection	Medium	High
Tolka_020	Poor	1	No connection	Low	High
Total		20			

In addition to water bodies being directly crossed by the route option, for Option A (Red) there are also a number in close proximity which may be at risk from unmitigated silty water runoff or spillages of hydrocarbons during construction. These water bodies are less than 50m from the route option:

- Liffey_120[21]: the route option runs alongside this water body, at approximately 10m from the bank edge, for 375m. The Liffey_120 is of very high sensitivity and there is a high impact potential from having a trench in such close proximity for this length;
- Liffey_130: the route option runs alongside this water body, at between10m and 30m from the bank edge, for 480m. The Liffey_130 is of very high sensitivity and there is a high impact potential from having a trench in such close proximity for this length; and
- Lyreen_010: the route option runs alongside this water body, at approximately 10m from the bank edge, for 450m. The Lyreen_010 is of low sensitivity; the cable is being laid in a road in this location so there is reduced risk of silty water runoff, compared to the two Liffey water bodies. However since it is possible that the surface water drains in the road discharge to the water body, there is a likely pathway for contaminants and a short one also. Therefore there is a low to medium impact potential.

4.1.2.4 Flood Risk

For Option A (Red), the length (in metres) within a PFRA flood risk area is:

- Pluvial: 619m; and
- Fluvial: 1986m.

[21] The Environmental Protection Agency has given technical names to individual watercourses and spilt larger ones in sections. The watercourses could be known locally by different names. The EPA 's names have been used in this report.

There are 20 No. watercourse crossings along the route option; all crossings will be designed so do not present an increase in flood risk, either pluvial or fluvial.

4.1.2.4.1 Summary of Assessment

Considering the number of crossings of water bodies (approximately 20 no.), in particular the crossings of those with high or very high sensitivities, as well as the potential for open cut crossings in addition to potential flood risk, Option A (Red) is scored as **Moderate (Green)** in respect to the Soils and Water assessment topic.

Moderate

4.1.3 Planning Policy and Land Use

4.1.3.1 Planning Policy and Legislation

Option A (Red) travels along the R156 to the north west towards the Mullagh Crossroads before heading south, along the west of the village of Kilcock, interacting with both the Kilcock Environs LAP in Meath and the Kilcock Town LAP in Kildare along the way. It then travels south around the western side of Clane, avoiding lands zoned within both the Clane LAP and the Prosperous LAP further west. It then heads south before re-joining the other route options north west of Sallins, before diverging towards Naas at Ploopluck along the same path as Option D, interacting with a number of LAP zonings. It passes through Naas West and East before joining the rest of the routes at Killashee and heading south towards Dunstown substation.

Kilcock Environs LAP 2009-2015 & Kilcock LAP 2015-2021

Kilcock straddles two Local Authority Boundaries, namely Kildare County Council and Meath County Council. Meath County Council prepared a Local Area Plan for 105 hectares of land in the Kilcock environs within their administrative boundary, while Kildare County Council prepared a Local Area Plan for Kilcock Town.

Option A (Red) is situated on the western side of Kilcock. It traverses both lands zoned in the Kilcock Environs LAP of Meath County Council and Kilcock LAP land zoned by Kildare County Council.

The single type of zoned land Option A (Red) crosses in the Kilcock Environs LAP was zoned F1 (open space) by Meath County Council.

Table 4.2: Relevant Zoning Objectives Kilcock Environs LAP

Zoning Objective (Kilcock Environs Local Area Plan 2009-2015)	
Zoning Objective F1	To provide for and improve open spaces for active and passive recreational amenities.

The lands which Option A (Red) traverses are on the north-western quadrant and south-western quadrant of the town and zoned C, E1 and F3 by Kildare County Council.

Table 4.3: Relevant Zoning Objectives Kilcock LAP

Zoning Objective (Kilcock LAP 2015-2021)	
Zoning Objective C New Residential	To provide for new residential development in the Bawnogues area of the town. This zoning provides for new residential development and other services incidental to residential development.
Zoning Objective E1 Community & Educational	To provide for institutional, community and educational facilities
Zoning Objective F3 : Open Space & Amenity	To preserve a buffer zone from the Motorway

The north-western quadrant and south-quadrant are divided by the R148, railway line (Dublin-Sligo) and Royal Canal, therefore Option A (Red) would also have to cross this existing infrastructure.

Draft Naas Local Area Plan 2021-2027

Option A (Red) crosses the railway line (Dublin-Cork) and M7 motorway before entering Millennium Park and via R407 through the Millennium Park to join the R409 through Naas West before travelling south via the R448 through Naas East . The following zonings applicable to Millennium Park, Naas West and Naas East.

Table 4.4: Relevant Zoning Objectives Naas LAP

Zoning Objective (Naas Local Area Plan 2021-2027)	
B Existing/Infill Residential	To protect and enhance the amenity of established residential communities and promote sustainable intensification.
C(1) New Residential	To provide for new residential development.
E Community & Education	To provide for education, recreation, community and health
F(2) Strategic Open Space	South of Kilcullen and Ballymore Eustace Roundabouts: These lands comprising 11.94 ha are identified for the development of a proposed active recreation area catering for the future population of this area of town. The development of such facilities shall include the provision of strong links to existing and future residential lands in the surrounding area, as well as the development of the old Naas-Baltinglass/Tullow railway line Greenway.
F3 Strategic Open Space	To preserve, provide for and improve recreational amenity, open space and green infrastructure networks.
H Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
H(5) Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
H(9) Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
I Agriculture	To retain and protect agricultural uses.
K(2) Commercial/Residential	To provide for commercial and appropriate residential mixed-use developments.
P1 Data Centre /Warehouse	To provide for Data Centre development and their associated infrastructure only.
Q4 Office, Enterprise and Employment	To provide for and facilitate the provision of high job-generating uses.
Q5 Office . Enterprise and Employment	To provide for and facilitate the provision of high job-generating uses.
U Utilities	To provide for and improve public utilities

4.1.3.2 Planning Applications

A review of all granted and live applications over the last five years within a 50m buffer 25m either side of Option A (Red) has been performed. Some of these applications will be new receptors which will have already been constructed by the time construction on the Proposed Project commences. These include both individual dwellings and larger development as shown in the Local Area Plans (LAPs). Of these, some of the larger applications and their locations are highlighted in the table below.

Table 4.5: Notable Applications in proximity to Option A (Red)

Local Authority	App. Number	Brief Description	Address	Status
Kildare County Council	16434	New right hand turning lane, bus set down area and associated works, lift to existing 110kv overhead power lines, removal of derelict prefabricated structures and culvert of ditch within site and construction of a 10,450sqm two & three storey 1000 pupil post-primary school and associated infrastructure; ESB substation, 92 carpark & 250 cycle parking spaces, bus and car set down & pick up facilities, play areas	Plots No. 71 and 72 and part Plots 85 and 86 of the Millennium Park Master Plan , Millennium Park , Naas	Granted 09/06/2017
Kildare County Council	161145	183 no. residential dwellings comprising 16 no. 2-two storey terrace dwellings (Type A); 134 no. 3-bed two storey terrace and semi-detached dwellings (Type A1 & B) and 33 no. 4-bed two storey semi-detached and detached dwellings (Type C, C1 & C2); provision of single storey childcare facility (approximately 324sq.m GFA); and associated infrastructure.	Jigginstown , Naas , Co. Kildare	Granted 16/06/2017
Kildare County Council	17886	Amendment to previously permitted residential development Ref. 16/1145. Proposed amendments relate to 83 No. units only, representing Phase 1 & 2 of the permitted scheme, and comprises of minor modifications to elevational treatments, together with associated and ancillary modifications at a site	Jigginstown , Naas , Co. Kildare.	Granted 09/11/2017
Kildare County Council	20840	the construction of a 5627sqm Specialist Packaging Single Storey High Level Manufacturing Facility with Three Storey Head office and associated infrastructure	Millennium Business Park , Osberstown , Naas	Granted 30/03/2021 (currently under financial appeal)
Kildare County Council	201564	(a) Extension of existing 7.3m wide two-lane carriageway by 137m to north (b) 2m grass verge, 2m cycle path and 2m footpath along east & west of proposed access road extension (c) vehicular entrance to west of proposed extension to facilitate proposed access to a planned commercial development (Kildare Co. Co. Ref. 20840) (d) vehicular entrance to east of proposed extension to facilitate proposed access to planned commercial development (Kildare Co. Co. Ref. 20561) (e) parking provision & associated infrastructure	Millennium Park , Osberstown , Naas	Granted 01/07/2021
Kildare County Council	19305701	STRATEGIC HOUSING DEVELOPMENT (ABP Decision) - the demolition of an existing dwelling and agricultural buildings on the subject site and the construction of a residential development of 314 no. dwellings, a crèche (c. 610sqm), retail unit (c. 169sqm)	Naas West & , Jigginstown , Naas	Granted 13/03/2020
Kildare County Council	211454	the construction of a permanent fourth arm on the Southern Ring Road/Devoy Link Road roundabout to serve future lands to the south of the Southern Ring Road and provision of a temporary construction related car park for a maximum of	Naas West , Naas , Co. Kildare.	New Application

Local Authority	App. Number	Brief Description	Address	Status
		100 No. cars for a period of 3 No. years to serve the construction of the Elsmore, and Whitethorn residential developments to the north, permitted under SHD Ref: ABP-305701-19.		

These applications, as well as the more minor/domestic applications, will be taken into account in the routing of the cable. Other larger scale planning applications will also be examined and taken into account within the routing process. Such applications include other energy projects, the Water Supply Project, and road schemes.

4.1.3.3 Summary of Assessment

Taking the above into account, Option A has the potential to interact with a significant number of granted and live planning applications, as well as zonings within the Kilcock Environs, Kilcock Town, and Draft Naas LAPs. However, it is also acknowledged that with appropriate siting and mitigation, the impacts of these interactions can be minimised. Therefore, Option A has been assigned **Moderate risk (Green)** in terms of the combined impacts to land use and planning policy.

Moderate

4.1.4 Landscape

4.1.4.1 Landscape character

4.1.4.1.1 Sensitivity – landscape character

Whilst influenced by the value and sensitivity judgements for particular Landscape Character Areas in the County Landscape Character Assessments for Meath and Kildare, independent landscape sensitivity judgements are provided for this assessment based on the more universal criteria, which are derived from the GLVIA-2013 Guidelines (Landscape Institute and Institute of Environmental Management & Assessment 2013) and accounts for the susceptibility of the landscape to the Proposed Project. This approach is consistent with best practice and also accounts for the inconsistency that commonly occurs in assigning landscape sensitivity to similar or adjoining landscape units between Counties. Furthermore, the receiving landscape is considered at a finer grain than that of a County-wide Landscape Character Assessment.

Option A (Red), like the others, involves a piece of linear underground infrastructure which, similar to water and waste pipes, are, by their very nature, difficult to discern once operational. Construction activity will be localised, transitory and will largely occur along the road network. For these reasons, the sensitivity of the landscape character within the Study Area to a project of this nature is deemed to be low-negligible.

4.1.4.1.2 Magnitude of impacts – landscape character

For all route options, the conductor will be installed below-ground in a 1.8m wide and 1.5m deep trench with joint bays (and associated temporary passing bays) positioned at intervals along the route; thus, the physical impact of the trench on the landscape is modest in scale, contained within already modified ground, temporary in duration, transient in location and reversible. Impacts on the land-cover will be limited to a 12m wide swathe within which some vegetation will need to be removed. During the construction phase, there may be a small degree of impact at certain locations within this swathe; however, it would not be at a scale that would have any material impact on the overall landscape fabric or on the landscape character along the route. Although construction activity may alter the landscape character in the immediate vicinity of where the cable is being laid, it will be transitory and temporary. Impacts will predominantly occur on the road network where vehicular movements are already part of the existing character.

The trenches will be backfilled, top soiled and vegetation will be reinstated having regard for agricultural land-use and/or biodiversity requirements. Any potentially noticeable permanent changes will be highly localised and will generally be limited to river crossings and where it was not possible to reinstate vegetation directly over the cable trench/within the permanent wayleave (noting that pre-existing hedged or wooded habitats cannot be re-instated over the cable duct). For these reasons, the magnitude of impact on the landscape character within the Study Area due to the Proposed Project will be low-negligible during the construction phase and negligible during the operational phase.

4.1.4.1.3 Significance of impacts – landscape character

When the magnitude of impact on the landscape character is considered in conjunction with the low-negligible sensitivity of the landscape within the Study Area, it is anticipated that the significance of the impacts will be **Slight-Imperceptible** during the construction phase and **Imperceptible** during the operational phase.

Table 4.6: Summary - landscape character

Landscape Character Area/Type	Summary of landscape character assessment in County Development Plan	Landscape sensitivity	Likely operational magnitude of impact	Likely operational significance of impact
Meath 10. The Ward Lowlands	• Landscape Character Type: Lowland Landscape • Value: Low • Importance: Regional • Sensitivity: High • Potential capacity to accommodate development - underground services: Low	Low-negligible	Negligible	Imperceptible
Meath: 11. South East Lowlands	• Landscape Character Type: Lowland Landscape • Value: Very High • Importance: Regional • Sensitivity: Medium • Potential capacity to accommodate development - underground services: Medium	Low-negligible	Negligible	Imperceptible
Meath: 12. Tara Skryne Hills	• Landscape Character Type: Hills and Upland Areas (southern portion of this area that does not encompass Hill of Tara or Skryne Hill) • Value: Exceptional • Importance: National/International • Sensitivity: High • Potential capacity to accommodate development - underground services: Low	Low-negligible	Negligible	Imperceptible

Landscape Character Area/Type	Summary of landscape character assessment in County Development Plan	Landscape sensitivity	Likely operational magnitude of impact	Likely operational significance of impact
Meath: 13. Rathmoylan Lowlands	• Landscape Character Type: Lowland Landscape • Value: High • Importance: National • Sensitivity: High • Potential capacity to accommodate development - underground services: Low	Low-negligible	Negligible	Imperceptible
Meath: 14. Royal Canal	• Landscape Character Type: River Corridor and Estuaries • Value: High • Importance: Regional • Sensitivity: Medium • Potential capacity to accommodate development - underground services: Medium	Low-negligible	Negligible	Imperceptible
Kildare: Chair of Kildare	• Class 4 – Special Sensitivity	Low-negligible	Negligible	Imperceptible
Kildare: Northern Lowlands	• Class 1 – Low Sensitivity	Low-negligible	Negligible	Imperceptible
Kildare: North-western Lowlands	• Class 1 – Low Sensitivity	Low-negligible	Negligible	Imperceptible
Kildare: Western Boglands	• Class 3 – High Sensitivity	Low-negligible	Negligible	Imperceptible
Kildare: Northern Hills	• Class 4 – Special Sensitivity	Low-negligible	Negligible	Imperceptible
Kildare: Allen Bog	• Class 4 – Special Sensitivity	Low-negligible	Negligible	Imperceptible
Kildare: Pollardstown Fen	• Class 5 – Unique Sensitivity • Areas of High Amenity	Low-negligible	Negligible	Imperceptible
Kildare: The Curragh	• Class 5 – Unique Sensitivity • Areas of High Amenity	Low-negligible	Negligible	Imperceptible
Kildare: Central Undulating Lands	• Class 1 – Low Sensitivity	Low-negligible	Negligible	Imperceptible
Kildare: Eastern Transition	• Class 2 – Medium Sensitivity	Low-negligible	Negligible	Imperceptible
Kildare: River Liffey	• Class 4 – Special Sensitivity • Areas of High Amenity	Low-negligible	Negligible	Imperceptible

Landscape Character Area/Type	Summary of landscape character assessment in County Development Plan	Landscape sensitivity	Likely operational magnitude of impact	Likely operational significance of impact
Kildare: Eastern Uplands	• Class 3 – High Sensitivity • Areas of High Amenity	Low-negligible	Negligible	Imperceptible

4.1.4.2 Landscape elements

No designated or highly sensitive landscape elements were identified within the portion of the Study Area that occurs within County Meath.

Included in Table 14.4 of Chapter 14 (and indicated on Map 14.2) of the Kildare County Development Plan are:

> *'12 "principal landscape sensitivity factors": Major Rivers and Water bodies; Canals; Ridgelines; Green Urban Areas; Broad-Leaved Forestry; Mixed Forestry; Natural Grasslands; Moors and Heathlands; Agricultural Land with Natural Vegetation; Peat Bogs; Scenic View; and Scenic route'.*

This option will pass within 300m of the following 'principal landscape sensitivity factors' (from north to south):

- Woodland near the R407 regional road;
- River Liffey; and
- Woodland R412 regional road.

4.1.4.2.1 Sensitivity - landscape elements

The sensitivity of these '*principal landscape sensitivity factors*' are recorded in Table 4.7.

4.1.4.2.2 Magnitude of impacts - landscape elements

The magnitude of impacts on landscape elements are as follows:

- **Woodland near the R407 Regional road:** It is likely that the R407 regional road is wide enough to accommodate the cable trench without the need to remove roadside vegetation; therefore, there will be no material change to the view and thus the magnitude of impact is deemed to be negligible during both the construction and operational phases;
- **River Liffey:** Approximately 3.7km of the route passes within an area of '*special sensitivity*' that buffers the River Liffey '*principal landscape sensitivity factor*'. This area would have a heightened sensitivity to the removal of vegetation. Within this '*principal landscape sensitivity factor*' approximately 5.6km of the route occurs within agricultural fields; thus, the construction activity here would be uncharacteristic. For these reasons, the magnitude of impact during the construction phase is deemed to be low. The agricultural land use will be reinstated, and the river crossing is likely to be by directional drilling; therefore the likely magnitude of impact during the operational phase is likely to be negligible; and
- **Woodland R412 Regional road:** It is likely that the R412 regional road is wide enough to accommodate the trenching work without the need to remove roadside vegetation; therefore, there will be no material change. Thus the magnitude of impact is deemed to be negligible during both the construction and operational phases.

4.1.4.2.3 Significance of impacts - landscape elements

All the impacts on the '*principal landscape sensitivity factors*' identified are of a negligible magnitude during the operational phase; therefore, all are considered, by default, to have a significance of impact that is **Imperceptible**. During the construction phase only the River Liffey '*principal landscape sensitivity factor*' is likely to have a significance of **Slight-Imperceptible**, while for all the others, it will be **Imperceptible**.

Table 4.7: Summary - Principal Landscape Sensitivity Factors within County Kildare

Principal Landscape Sensitivity Factor	Specific feature	Sensitivity of feature	Likely operational magnitude of impact	Likely operational significance of impact
Major Rivers and Water bodies	River Liffey	High-medium	Negligible	Imperceptible
Mixed Forestry	Woodland near the R407 regional road	High	Negligible	Imperceptible
Mixed Forestry	Woodland R412 regional road	High	Negligible	Imperceptible

4.1.4.3 Summary of Assessment

A 5.6km offline section passes through agricultural fields near the River Liffey '*Principal Landscape Sensitivity Factor*'; therefore, there is a potential for some impact on the landscape character within this area of 'special' sensitivity, but significant impacts are not anticipated. Assuming riparian vegetation along the west bank of the River Liffey is to be retained, and protected by a Root Protection Zone during construction, then no significant landscape or visual impacts are anticipated. Whilst the magnitude of impact during both construction and operation is at the very bottom end of the magnitude spectrum; some receptors are deemed to have a sensitivity that is at the upper end of the sensitivity spectrum thus a relatively small increase in the magnitude of impact during the construction phase could result in a significant impact therefore the attributed risk score is **Low-Moderate (Light Green).**

Low - Moderate

4.1.5 Archaeology, Architectural Heritage, and Cultural Heritage

A summary of archaeology, architectural heritage, and cultural heritage constraints identified within the Step 3 Project Study Area is presented in the Environmental Constraints Report[22] along with a discussion on the general character and nature of the constraints present, comprising National Monuments and Preservation Orders, sites on the RHM, Recorded Monuments and sites recorded on the SMR, Protected Structures, structures recorded on the NIAH, ACAs, and GDLs identified by the Survey of Historic Gardens and Designed Landscapes.

Baseline information on the archaeology, architectural heritage and cultural heritage constraints identified within 100m of Option A (Red) is provided in Appendix B.1 and these constraints are shown in Appendix B.1.

4.1.5.1 Archaeology

The Jigginstown Castle complex, comprising one National Monument (AY_39; also a Protected Structure, AH_16) and three sites with Preservation Orders placed on them (AY_40, AY_42, and AY_43), is located approximately 40m to the west of Option A (Red). The complex includes two further sites with Preservation Orders placed on them (AY_38, AY_44; also a Protected Structure, AH_17) approximately 195m and 230m to the west of Option A (Red), respectively. Five of these sites (AY_38, AY_39, AY_42, AY_43, and AY_44; see Appendix B.1), are also on the RHM.

A linear earthwork (AY_13), a site on the RHM, is located immediately to the east of Option A (Red).

A total of four[23] Recorded Monuments are located within 100m of Option A (Red) (see Appendix B.1). These comprise an earthen mound (AY_02) associated with 'Brides Well' (see AY_01), a field system of unknown date comprising upstanding banks and ditches (AY_03), a poorly preserved early medieval rath (AY_24), and an earthen 'moat' (AY_26; also a Protected Structure).

A total of six sites recorded on the SMR have been identified within 100m of Option A (Red). These are characterised by the locations of cropmarks and evidence of post-medieval religious and domestic activity (AY_01, AY_27, AY_36, AY_46 – 8).

Further information on the archaeological constraints identified within 100m of Option A (Red) is included in Appendix B.1 and are shown in Appendix B.1.

4.1.5.1.1 Archaeological Potential

Areas of alluvium, lake marl and raised peat identified along the route have the potential to preserve previously unknown archaeological monuments and remains, including palaeoenvironmental[24] remains and preserved organic materials. There is also the potential for votive offerings, objects apparently deposited for religious reasons, in bog and in rivers such River Liffey and the Rye Water, as well as in minor watercourses.

4.1.5.2 Architectural Heritage

Architectural heritage constraints within 100m of Option A (Red) comprise:

- Five Protected Structures comprising four houses (AH_06, AH_11, AH_15, and AH_18) and a church and lych gate (AH_12).
- One country house recorded on the NIAH (Larch Hill House; AH_01).

[22] Jacobs. 2021. Step 4A Environmental Constraints Report. Available at: https://consult.eirgrid.ie/system/files/materials/2055/Environmental%20Constraints%20Report%20-%20Step%204A%20-%20KMGU.pdf.

[23] A further Recorded Monument, a linear earthwork located immediately to the east of Option A (Red) (AY_13), is also on the RHM and, to avoid double counting constraints, is described above.

[24] An environment at a period in the geological past.

- 12 GDLs comprising ten recorded by the Survey of Historic Gardens and Designed Landscapes and two identified from historic mapping (Ordnance Survey 6", 1837 – 1842).

No ACAs are located within 100m of Option A (Red).

Further information on the architectural constraints identified within 100m of Option A (Red) is included in Appendix B.1.

4.1.5.3 Cultural Heritage

A total of 27 cultural heritage sites have been identified within 100m of Option A (Red) from the sources identified in Section 2.3.1.5. These are largely characterised by post-medieval built heritage including stone road bridges, houses and farm buildings. Further information on these cultural heritage sites is presented in Appendix B.1.

4.1.5.4 Potential Impacts on Archaeological, Architectural and Cultural Heritage

4.1.5.4.1 Construction – Direct Impacts

Archaeology

No direct impacts have been identified on National Monuments, sites with Preservation Orders, or sites on the RHM as a result of the construction of Option A (Red).

Where Option A (Red) is located within the Zone of Notification associated with a Recorded Monument, this has been identified as a direct impact below. While the option would not directly impact the Recorded Monument itself, excavation of the cable trench and joint bays would have a direct impact on any archaeological remains that may survive within this zone.

Option A (Red) is located within the Zones of Notification of four Recorded Monuments (AY_02, AY_13, AY_24 and AY_26[25]). Within these zones the option is located in the carriageway of existing roads the construction of which is more than likely to have removed or truncated any archaeological remains associated with these monuments that may have been present. However, construction, including the excavation of the cable trench and joint bays would have a direct impact on any archaeological remains that may survive. Construction would also have a direct impact on any archaeological remains associated with these Recorded Monuments that may survive within any additional land take required for construction (e.g. in temporary passing bays).

While construction of the existing access track to Dunstown substation may have partially removed or truncated any remains associated with AY_46 – 48, construction of Option A (Red) including the excavation of the cable trench and joint bays would have a direct impact on any archaeological remains associated with these constraints that may survive. In addition construction would have a direct impact on any unknown archaeological remains associated with AY_46 – 48 that may survive within any additional land take required for construction.

Excavation of the cable trench and joint bays, and the excavation of temporary launch and reception pits for directional drilling may also result in a direct impact to any previously unknown archaeological remains that may be present within the land required for Option A (Red). The potential for this impact is considered to be higher in previously undeveloped areas than within the existing carriageways, the construction of which is likely to have likely to have removed or truncated any archaeological remains that may have been present.

[25] Please note, this constraint is also a Protected Structure (RPS B14-07; tumulus); however, given the option is located within the Zone of Notification associated with the Recorded Monument (AY_26), a direct impact on the monument itself is not predicted and therefore, no direct impact has been identified on the Protected Structure.

Architectural Heritage

Welds Thatched House (AH_11), which is a Protected Structure and has been assessed by the NIAH to be of Regional importance, Millicent Church and Lych Gate (AH_12), a Protected Structure, and one historic building assessed by the NIAH to be of Regional importance (AH_01) are located immediately adjacent to Option A (Red). There is therefore potential for a direct impact on these architectural heritage constraints as a result of accidental damage from construction plant.

Should Option A (Red) require additional land take for construction, the removal of boundary features would have a direct impact on ten GDLs (Jenkinstown House; DL_02, Phepotstown House; DL_03, Larch Hill House; DL_04, Calgath House; DL_06, Brides Stream House; DL_07, Painestown House; DL_10, Firmount House; DL_14, Moatfield House; DL_15, Millicent House; DL_17, and Killashee House; DL_20).

Cultural Heritage

Six post-medieval stone road bridge are located on the existing road network (CH_01, CH_04, CH_06, CH_07, CH_12, and CH_24). There is therefore potential for a direct impact on these cultural heritage constraints as a result of accidental damage from construction plant.

Option A (Red) is located within the site of a racecourse (CH_14). The excavation of the cable trench and joint bays, and the excavation of temporary launch and reception pits for directional drilling, would have a direct impact through the removal of any surviving remains associated with this constraint.

CH_03 is a public house located immediately adjacent Option A (Red). There is therefore potential for a direct impact on this cultural heritage constraint as a result of accidental damage from construction plant.

4.1.5.4.2 Construction - Indirect Impacts

Archaeology

Option A (Red) is located approximately 40m to the east of the boundary of Jigginstown Castle complex, which comprises a National Monument (AY_39) and five sites with Preservation Orders (AY_38, AY_40, AY_42, AY_43, and AY_44) (five of which are also sites on the RHM), and two Protected Structures (AH_16 and AH_17). Noise and visual intrusion from construction plant may have an indirect impact on this complex. However, it is anticipated any intrusion would be temporary (lasting the duration of construction in this location) and would be largely screened by the intervening mature trees along the eastern boundary of the complex which would be retained.

Architectural Heritage

This option is located within 65m the following five Protected Structures[26]:

- Moortown (AH_06; assessed by the NIAH to be of Regional importance);
- Ballynagappagh (AH_11; assessed by the NIAH to be of Regional importance);
- Millicent Church and Lych Gate (AH_12);
- Millicent Estate Houses (AH_15); and
- Bluebell Farm House (AH_18).

[26] Please note, indirect impacts have been identified on two additional Protected Structures (AH_16 and AH_17); however, these form part of the Jigginstown Castle complex and have been considered alongside the archaeological constraints that form this group.

While there is potential for an indirect impact on the setting of these constraints during construction due to noise and visual intrusion from construction plant, it is anticipated any intrusion would be temporary (lasting the duration of construction in each location) and would largely be screened by established vegetation and intervening built features.

Cultural Heritage

Movement and operation of plant during the construction of Option A (Red) would have an indirect impact on the setting of 12 cultural heritage sites (CH_03, CH_05, CH_15, CH_16, CH_17, CH_37, CH_43, CH_46, CH_55, CH_57, CH_58, and CH_59). However, it is anticipated any intrusion would be temporary (lasting the duration of construction in each location).

4.1.5.4.3 Operational Impacts

As the Proposed Project would be located beneath the road surface, and any offline sections would be reinstated after construction no impacts on archaeological, architectural or cultural heritage constraints have been assessed as a result of the operation of Option A (Red).

4.1.5.5 Summary of Assessment

While Option A (Red) may result in fewer impacts on sites identified on the SMR than the other route options and has the least off-road sections (totalling approximately 5.9km), Option A (Red) would potentially have a direct impact on the highest number of Recorded Monuments (five) and Protected Structures (two). This route option also has the potential to directly impact the highest number of GDLs (ten).

Option A (Red) also has the potential for an indirect impact on the Jigginstown Castle complex. Due to these potential impacts, Option A (Red) has been assigned a risk of **'Moderate-High' (Light Blue)**.

Moderate-High

A Route Corridor Summary Matrix for archaeology, architectural heritage and cultural heritage is provided in Appendix B.1.

As the project progresses it may be possible to avoid impacts on archaeology, architectural heritage, and cultural heritage constraints through design, including localised realignments of the route. Where impacts on archaeology, architectural heritage, and cultural heritage constraints cannot be avoided it is possible impacts could be reduced through recording in advance of, or during, construction, including the archiving and documentation of the results of this recording for public reference.

4.2 Socio-Economic

4.2.1 Traffic, Transport and Access

From a traffic perspective all the potential route options identified for the Proposed Project aim to maximise the use of national, regional, and local roads by avoiding, where possible, the motorways, going off-road, through private land and through agricultural land and have been assessed based on number of themes as below.

Option A (Red) is the most westerly of the shortlisted route options and the longest between the Woodland and Dunstown substations. The route option is mainly located along regional and local roads, running close to the town of Kilcock and bypassing the towns of Clane and Sallins before re-joining the regional road network at Naas and passing close to residential areas in the south-west of the town.

Table 4.8 presents the break-down of road classifications for Option A (Red).

Table 4.8: Option A (Red) Road Classification

Option	Total Length (km)	Road Length Percentage Distribution		
		Regional	Local Roads and Smaller	Off-road and other Land Types
Option A (Red)	51.4	64.2%	20.6%	15.2%

Option A (Red) route is proposed mainly along the regional roads, with a smaller proportion of the proposed route running through local roads. There are some off-road sections along this route option, in particular west of Kilcock and Clane. Option A (Red) affects the greatest percentage of regional roads of the four potential options, at 64%.

Along stretches of this regional road network it has been identified that the construction works will reduce the carriageway width to 2.5m-3.0m, particularly along the route sections (single lane in either direction) where limited additional width (hardshoulder, footway or verge etc.) is available. Therefore temporary road closures and associated diversions will be required to accommodate this phased construction work. Some of these road closures have been identified and discussed at Section 4.4.2 under Deliverability. It is acknowledged that these closures and diversions will likely have an impact on vehicles in terms of additional delay and journey time reliability during periods of the day. However to minimise this impact, these temporary closures and diversions will be tested and assessed in robust traffic management plans prior to implementation. Where road closures are not required, some localised traffic management measures will also be introduced in a traffic management plan.

A review of the Option A (Red) also highlights that the construction works will likely impact a number of key junctions and roundabouts. These sections are also identified in Section 4.4.2. Similar to the route sections there might be a requirement to temporarily divert traffic or restrict certain vehicle movements at these locations. Traffic management measures would be assessed on a case-by-case basis for each signalised junction and standard roundabout. The number of key junctions impacted along Option A (Red) is the second highest compared to other potential route options.

Option A (Red) also has the second highest number of properties within 0 to 50 meters from the roadway centreline (433 properties), and as a result it is anticipated that there will be significant local traffic disruption to access during construction. Access is anticipated to be disrupted to Larch Hill Gardens, Mountpleasant Lodge Nursing Home and five schools along the R448, south of Naas.

4.2.1.1 Summary of Assessment

Option A (Red) is the longest proposed route and also affects the greatest percentage of regional roads among the four potential route options. In addition, Option A (Red) has the second highest number of properties within 50 meters along its route and passes a nursing home and five schools. Therefore in terms of risk of traffic disruption, the Traffic, Transport and Access (Social) criteria for Option A (Red) is assessed to be **'Moderate-High' (Light Blue)**. It is acknowledged that that the phased construction works will have an impact on private vehicles using this route, however this impact will only be temporary and the traffic management measures or diversions will be planned to minimise this traffic impact. A robust traffic management plan will be proposed for each phase of construction and the traffic management measures will be tested and analysed before implementation. The use of regional roads will generally affect more traffic as these types of roads are busier than local roads. However their use allows less full road closures as regional roads are generally wider and so lane closures with temporary traffic lights/stop-go systems can be put into place. Full road closures will result in more disruption through diversions. Mitigation measures through consultation and traffic management will reduce the impacts. The measures can include ensuring that the works do not disrupt access to the nursing home and the schools. Phasing of the works will be important to minimise disruption. This can be done by ensuring that works are completed at less busy times and are carefully planned to avoid road users being disrupted in multiple locations by construction teams in one journey. These measures will be designed at the next step in the Proposed Project.

Moderate-High

4.2.2 Noise, Vibration and Air Quality

4.2.2.1 Noise and Vibration

4.2.2.1.1 Baseline

Option A (Red) runs along the western portion of the Study Area between the Woodland and Dunstown substations. The route option is mainly located along regional and local roads, running close to the town of Kilcock and bypassing the towns of Clane and Sallins before re-joining the regional road network at Naas and going close to residential areas in the south-west of the town. There are some off-road areas in this route, in particular west of Kilcock and west of Clane. Offline or off-road sections are sections where the route option does not follow alongside a road but cuts across, for example, agricultural land.

Baseline noise levels are likely to vary along this route option with higher noise levels likely closer to transport infrastructure and during periods of peak transport activity. The main noise source along this route option is from road traffic noise. Environmental Protection Agency (EPA) traffic noise data for Round 3 contained in EPA Maps[27] shows that traffic noise levels will be highest where the route crosses the M4, the R403 and the M7 and where it runs alongside the R407 and the R448.

EPA railway noise data shows that where the route crosses the Dublin to Cork railway line rail noise levels are elevated.

[27] https://gis.epa.ie/EPAMaps/

4.2.2.1.2 Methodology

The noise and vibration assessment at this stage of the Proposed Project involves gaining an appreciation of the baseline noise environment close to each of the proposed route options and identifying noise and vibration sensitive receptors within distance bands up to 300m from each of the proposed routes. Noise impacts from construction activities do not normally occur beyond 300m and vibration impacts do not normally occur beyond 100m. The locations of major crossings where HDD is likely to be required and off-road sections where noise impacts are likely to be greater compared to on-road sections is also used to assess each route in terms of the noise risk according to the multi criteria analysis at Step 4A. The risk scale is as follows:

- High: dark blue;
- Moderate-high: blue;
- Moderate: dark green;
- Low-moderate: green; and
- Low: cream.

No baseline noise surveys were undertaken, and no noise modelling was undertaken at this stage of the Proposed Project. However these will be completed at Step 5 of the Proposed Project.

4.2.2.1.3 Noise and Vibration Sensitive Receptors

Table 4.9 shows the residential property counts in distance bands up to 300m from the proposed route. Overall, there are a total of 2657 sensitive receptors within 300m of the proposed route.

Table 4.9: Residential Property Counts within 300m of Option A (Red)

Option	No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	No. of sensitive receptors 100-200m	No. of sensitive receptors 200-300m	Total no. of receptors within 300m
A	433	414	802	1008	2657

As well as residential properties there are other sensitive receptors within 300m of the proposed route and which are not included in the above counts including:

- Millicent Golf Club;
- Gaelscoil Nás Na Ríogh School;
- St David's National School;
- Piper's Hill College;
- Killashee National School; and
- Several equine operations.

4.2.2.1.4 Potential Noise and Vibration Impacts

Areas of Potential Horizontal Directional Drilling (HDD)

There is greater potential for adverse noise and/or vibration impacts at sensitive receptors where construction activities would occur over a longer period (e.g. at trenchless crossings). It is recognised that certain construction activities at certain trenchless crossings could be required to take place outside of normal working hours, which would increase the likelihood of adverse noise effects occurring. In addition, certain potential trenchless crossing techniques that may be employed (e.g. HDD) also have the potential to cause adverse vibration impacts at nearby receptors.

There is potential for adverse impacts at receptors within 300m of HDD works and there could be six major crossings on Option A (Red). An initial assessment has shown there are the potential for adverse noise impacts at the Royal Canal Main Line, the Dublin-Sligo Railway line, the M4 Motorway, the Dublin-Cork railway line, and the M7 Motorway.

Offline sections

For the majority of the proposed route option, the underground cables are expected to be installed using 'Open Cut' techniques. Where 'Open Cut' works are undertaken adjacent to the existing road network, there is a relatively low potential for temporary impacts due to construction noise. This is due to the relatively high levels of local environmental noise that are typically experienced adjacent to roads. Also, as the works are expected to progress in sections, noise levels at any receptor would only be elevated for a relatively short period of time. However, where 'Open Cut' works are undertaken in relatively quiet areas (such as offline sections) close to sensitive receptors there is the potential for adverse temporary impacts due to construction noise.

Table 4.10 shows the total length, the total offline length and whether there are receptors within 300m of the offline route for Option A (Red).

Table 4.10: Total length and total offline length for Option A (Red)

Option	Total Length (km)	Offline Length (km)	Receptors within 300m of offline section
A (Red)	51.4	6	Yes

The table above shows that the route option goes offline for approximately 5.9km of its total length where there is a greater potential to result in adverse noise effects at receptors compared to where works are undertaken adjacent to existing roads.

4.2.2.2 Summary of Assessment

There are relatively large numbers of receptors within 300m of Option A (Red), there is 5.9km of potential offline construction activity and there are receptors within 300m of major crossings at six crossing points with the potential for experiencing adverse noise and/or vibration effects, therefore it is appropriate to give a risk score of **'Moderate (Dark Green)'.**

Moderate

4.2.2.3 Air Quality

4.2.2.3.1 Baseline

Option A (Red) runs along the western portion of the Study Area between the Woodland and Dunstown substations. The route is mainly located adjacent to regional and local roads, running close to the town of Kilcock and bypassing the towns of Clane and Sallins before re-joining the regional road network at Naas and going close to residential areas in the south-west of the town. There are some offline sections (i.e. not within roads) in this route, in particular west of Kilcock and west of Clane.

Baseline air pollutant concentrations are likely to vary along this route due to the difference in emissions between the rural and urban environment. Higher concentrations are likely at locations closer to transport infrastructure and where the route option is closer to larger settlements. The main air quality sources along this route option are from road traffic, particularly where the route option crosses or is close to the M4 and the M7.

The Air Quality Index for Health across the Study Area[28] is Good (with an index score ranging from 1-3). The majority of the Study Area, as defined by the Environmental Protection Agency (EPA)[29], is located within Air Quality Zone D – Rural Ireland apart from locations in Naas, which are within Air Quality Zone C – other cities and large towns.

4.2.2.3.2 Sensitive receptors

For human exposure to air pollutants, sensitive receptors (termed 'human receptors') include, for example, residential properties, schools and care homes. Air pollutants can also impact on sensitive vegetation and habitats (termed 'ecological receptors'). These include the following ecological receptor designations:

- Special Area of Conservation (SAC);
- Special Protection Area (SPA);
- Ramsar site;
- Natural Heritage Area (NHA) and proposed NHA (pNHA); and
- Ancient Woodland.

The Institute of Air Quality Management (IAQM) dust guidance[30]. has been adapted for the purposes of this assessment. The number of residential properties and schools have been counted and identified as receptors.

Table 4.11 shows the human receptor count within 300m of each of Option A (Red).

Table 4.11 Sensitive Receptors within 300m of Option A (Red)

Option	No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	No. of sensitive receptors 100-200m	No. of sensitive receptors 200-300m	Total no. of receptors within 300m
A	433	414	802	1008	2657

Option A (Red) passes the following schools:

- Gaelscoil Nás Na Ríogh School;
- St David's National School;
- Piper's Hill College; and
- Killashee National School.

With regard to ecological receptors, Option A (Red) crosses the Royal Canal pNHA and crosses the Grand Canal pNHA twice. Therefore, these are in close proximity (i.e. less than 20m) from the route.

[28] Environmental Protection Agency (EPA), Air Quality Index for Health, https://airquality.ie/information/air-quality-index-for-health, accessed October 2021.
[29] Environmental Protection Agency (EPA), Air Quality Zones, https://airquality.ie/information/air-quality-zones, accessed October 2021.
[30] Institute of Air Quality Management. 2016. Guidance on the assessment of dust from demolition and construction. Version 1.1. http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf

4.2.2.3.3 Assessment Criteria

The main criteria used for the assessment of each route option was adapted from Table 2 (repeated in Table 4.12) of the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction (June 2016).

Table 4.12: Sensitivity of the area to dust soiling impacts on people and property

Number of receptors	Distance from the source (m)		
	<50	**<100**	**<350**
>100	High	Medium	Low
10-100	Medium	Low	Low
1-10	Low	Low	Low

The following scoring was applied:

- Route options with a high sensitivity to dust soiling - Risk Score 3 (moderate risk);
- Route options with a medium sensitivity to dust soiling - Risk Score 2 (low to moderate risk); and
- Route options with a low sensitivity to dust soiling - Risk Score 1 (low risk).

The IAQM dust guidance states that *"for almost all construction activity, the aim should be to prevent significant impacts on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual impact will normally be not significant."* With the good practice mitigation that would be implemented, which would reduce the maximum risks, a risk score higher than moderate was not considered suitable so a maximum risk score of 3 was adopted.

The overall score for the Option A (Red) was based on the average risk score from each node within the option, taking into account the total length of each option and total number of properties within 300 m of the option.

4.2.2.3.4 Potential Impacts

Construction activities associated with the Proposed Project have the potential to generate fugitive dust emissions. These may give rise to annoyance due to the soiling of surfaces, risk of health effects due to the increase in exposure to fine particulates such as PM_{10} and $PM_{2.5}$ and damage to vegetation and ecosystems (where very high levels of dust soiling occur).

The main construction activities associated with the Proposed Project that could generate dust include earthworks, trench excavation and material storage. Dust may also be generated by vehicle movements through resuspending dust from haul roads and surfaces. The works associated with the construction of the Proposed Project would be split into several stages, which would involve different periods of earthworks, construction (including setting up compounds and pipeline installation) and trackout[31] and activity levels would not necessarily peak simultaneously. Also, as the works are expected to progress in sections, potential dust generation would only occur for a relatively short period of time at any one location.

Table 4.13 shows the number of receptors, the sensitivity of these to dust soiling and the associated risk score.

31 The transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy duty vehicles (HDVs) leave the construction/demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site.

Table 4.13: Potential Air Quality Impact for Option A (Red)

No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	Sensitivity of Option to dust soiling	Risk score
433	414	Medium	2

4.2.2.4 Summary of Assessment

For Option A (Red), most of its length is classed as medium sensitivity areas for dust soiling apart from to the west of Clane and around Naas, both areas have a slightly higher receptor count and are classed as high sensitivity areas. Option A (Red) is the longest option and has the second largest number of receptors within 50m of the route. Option A (Red) passes through the southwest of Naas. Option A (Red) runs adjacent to four schools. Option A (Red) crosses over two ecological receptors (Royal Canal pNHA and Grand Canal pNHA (twice)). Therefore, an overall risk score of **Moderate (Dark Green)** has been applied.

Moderate

4.2.3 Visual

There is the potential for visual impacts at scenic designations, residential dwellings and along public roads, with scenic designations carrying a greater potential for risk.

4.2.3.1 Scenic designations

No designated scenic designations were identified within the portion of the Study Area that occurs within County Meath.

Included in Table 14.4 of Chapter 14 (and indicated on Map 14.2) of the Kildare County Development Plan are '12 "principal landscape sensitivity factors": Major Rivers and Water bodies; Canals; Ridgelines; Green Urban Areas; Broad-Leaved Forestry; Mixed Forestry; Natural Grasslands; Moors and Heathlands; Agricultural Land with Natural Vegetation; Peat Bogs; Scenic View; and Scenic route'. This option will pass within 300m of the following 'principal landscape sensitivity factors' that relate to scenic designations (from north to south):

- Royal Canal View RC11 ('Allen Bridge');
- River Liffey view RL6 ('Millicent Bridge'); and
- Grand Canal view (stone bridge crossing the Grand Canal between the R445 and the R409 regional roads).

4.2.3.1.1 Sensitivity - scenic designations

The sensitivity of these '*principal landscape sensitivity factors*' are recorded in Table 4.7.

4.2.3.1.2 Magnitude of impacts - scenic designations

Royal Canal View RC11 ('Allen Bridge'): View from the bridge towards the route is obscured / beyond sight line therefore the likely magnitude of impact is negligible during both the construction and operational phases.

River Liffey view RL6 ('Millicent Bridge'): View from the bridge towards the route option is obscured by riparian vegetation on the west bank of the river; therefore, the likely magnitude of impact is negligible during both the construction and operational phases.

Grand Canal view (stone bridge crossing the Grand Canal between the R445 and the R409 regional roads): At this section of the route option, the cable will be underground below the regional road, so no change material to the view; therefore, the likely magnitude of impact is deemed to be negligible during both the construction and operational phases.

4.2.3.1.3 Significance of impacts - scenic designations

All the impacts on the '*principal landscape sensitivity factors*' identified are of a negligible magnitude during the construction and operational phase; therefore, all are considered, by default, to have a significance of impact that is Imperceptible.

Table 4.14: Summary - Principal Landscape Sensitivity Factors within County Kildare – scenic designations

Principal Landscape Sensitivity Factor	Risk - Direct Impacts (Constraints Study)	Risk – Impacts Within 300m (Constraints Study)	Specific feature	Sensitivity of feature	Likely operational magnitude of impact	Likely operational significance of impact
Scenic View	High	Moderate-High	Royal Canal View RC11 ('Allen Bridge')	High	Negligible	Imperceptible
Scenic View	High	Moderate-High	River Liffey view RL6 ('Millicent Bridge')	High	Negligible	Imperceptible
Scenic View	High	Moderate-High	Grand Canal view (stone bridge crossing the Grand Canal between the R445 and the R409 regional roads)	High	Negligible	Imperceptible

4.2.3.2 Summary of Assessment

The assessment of the potential for significant visual impacts as a result of Option A (Red) can be summarised by the following points:

- There is the potential for visual impacts at residential dwellings and along public roads; and
- Visual impacts on the identified scenic designations are not anticipated to be greater than Negligible during the construction or operational phases, therefore no significant visual impacts are anticipated.

As such, the attributed risk score is **Low-Moderate (Light Green).**

Low – Moderate

4.2.4 Amenity

This section outlines the likely impact on the amenity of residential, commercial, and community (and recreational) receptors, collectively, by way of consideration of contributing environmental effects. Issues of access and severance are outlined in Section 4.2.1. All residential, commercial, and community (and recreational) receptors are shown in Figure C.1.1 in Appendix C.1.

The alignment of Option A (Red) passes through both rural and urban areas along its length, as outlined in Section 3.2.1. Table 4.15 lists the known commercial and community receptors that are situated immediately adjacent to the route alignment (this list is not exhaustive but represents a high-level analysis for the purposes of informing the Step 4A selection process). No tourism receptors (i.e. receptors whose main function is aimed at visitors to its locality) were encountered along the alignment of Option A (Red), while one-off or ribboned residential receptors are located along all sections of the route. Option A (Red) is also routed in close proximity or within a number of built-up areas, such as the western edge of Kilcock, the western extent of Rathcoffey village and the western / southern side of Naas.

Table 4.15: Known Commercial and Community Receptors Adjacent to the Alignment of Option A (Red)

Commercial receptors:	Community receptors:
Barstown Business Park;	Larchill Arcadian Gardens;
Hatchet Inn (and associated filling station);	Mountpleasant Lodge Nursing Home;
Fordes Superstore (Home Furnishings);	Royal Canal;
Tyre Centre Kilcock;	Millicent Golf Club;
Inver Filling Station;	Naas Sports Centre (and Playground / Skate Park);
Painestown Precast Concrete;	Enable Ireland Kildare Children's Services;
Firmount House;	Naas United Football Club
Kerry Group Global Centre;	Gaelscoil Nás Na Ríogh;
Irish Commercials (and Volvo Trucks);	Piper's Hill Montessori School;
Applegreen Millennium Park;	Piper's Hill College (Secondary School);
ALDI (Naas);	St David's National School
Europcar (Naas);	Killashee National School
Chadwicks Builders Providers;	

Outlined below are details of potential impacts considered likely during the construction of Option A (Red) according to each environmental effect, with a concluding paragraph summing up the overall impact on amenity. Given that the Proposed Project would be underground, there are no operational impacts anticipated on amenity.

Table 4.16 outlines the assessment ratings and associated justifications for each of the contributing environmental effects that, when in-combination, may result in an impact on amenity.

Table 4.16: Ratings and Associated Justifications for Environmental Effects Contributing to Potential Impact on Amenity

Air Quality	Noise (and vibration)	Visual	Traffic and Transport
For Option A (Red), most of its length is classed as medium sensitivity areas for dust soiling apart from to the west of Clane and around Naas, both areas have a slightly higher receptor count and are classed as high sensitivity areas. Option A (Red) is the longest option and has the second largest number of receptors within 50m of the route. Option A (Red) passes through the southwest of Naas. Option A (Red) runs adjacent to four schools.	Relatively greater number of noise sensitive receptors impacted compared to other options. Construction noise and vibration impacts temporary in nature, no permanent impacts expected.	(i) Potential for visual impacts at residential dwellings and along public roads. (ii) Visual impacts on the identified scenic designations are not anticipated to be greater than Negligible during the construction or operational phases. No significant visual impacts are anticipated.	Option A (Red) is the longest of the options but also affects the greatest percentage of regional roads of the four options (over 64% - second place is 46%). Disruption to the regional roads will affect more traffic and result in longer diversions. Option A also has the second highest number of properties within 0-50m of its route (433) and so there will be more disruption to access. The number of properties is in part due to the route across Kilcock and through part of Naas. Access will also be disrupted to Larch Hill gardens, Mountpleasant Lodge Nursing Home and five schools (along the R448, south of Naas). Option A (Red) requires the highest amount of HGV diversions with lane closures and relatively low full closures compared to the other options. Same number of key junctions along the route compared to the other options.

In relation to the assigned scoring for potential impacts relating to Air Quality, Noise (and vibration), Visual and Traffic and Transport, it is considered likely that, in a worse-case scenario, there is the potential for considerable but not significant impacts on amenity. Therefore, a risk scoring of **'Moderate (Dark Green)'** has been assigned. For more information in relation to the potential impacts of Option A (Red) in relation to any of these environmental effects, please see Section 4.2.1 to Section 4.2.3.

Moderate

4.2.5 Health

The Study Area is largely considered to be 'marginally above average' in terms of the deprivation indices provided for 'my Pobal' (Pobal, 2016[32]), however there are some Electoral Divisions (EDs) within the Study Area which are considered to be 'affluent', such as Maynooth, Straffan, Donaghcumper, Naas Rural, Ladytown, and Newtown[33]. According to the Institute of Public Health (in Ireland), people in higher socio-economic groups are at lower risk of chronic conditions and associated disability than those in lower socio-economic groups (Institute of Public Health, 2020).

Using the outcomes of the amenity assessment as reported in Table 4.21, it is considered unlikely that the construction of Option A (Red) would result in significant impacts on human health. This is primarily because processes and activities required during construction of the Proposed Project are temporary in nature, while the nature and scale of the Proposed Project means that construction activity would occur at any one location for a limited time; thereby not significantly impacting human health.

Electromagnetic Fields (EMFs) are considered in this assessment. To ensure EMF levels from electricity cables remain within the safe limits for human health, EirGrid's design standards require all UGCs to operate within existing public exposure guidelines from the International Commission on Non-Ionising Radiation Protection (ICNIRP), therefore EMFs from UGCs are unlikely to be a cause of public concern for local communities. Such potential impacts are the same for all proposed route options.

See Section 2.3.2 for more details on EMFs.

Given the expected potential impacts a scoring of '**Low-Moderate (Light Green)**' has been assigned for the consideration of potential impacts on Health.

Low - Moderate

4.2.6 Employment and Economy

During construction and operation, impacts on employment as well as the national, regional, and local economy are anticipated to be similar among each of the proposed route options given that they are all similar in nature, extent and scale, and located in close proximity to one another within the same Study Area.

There is currently no information on the expected size or composition of the construction workforce required to construct any of the proposed route options, however given the similarities in extent and scale, it is considered that the size and composition of any construction workforce would be broadly the same to construct any of the proposed route options. Such a construction workforce is expected to be at relatively low numbers given the likely scale of works and envisaged construction methodology (i.e. a 'section-by-section' piecemeal construction method is expected to be employed). Furthermore, any employment opportunities are expected to be limited given there is considered to be low unemployment within the Study Area at present (the unemployment rate across all key settlement areas within the Study Area is estimated to be 4.5%)(CSO, 2021[34]). It is also likely that skilled workers with particular experience in laying underground cables will be required rather than currently unemployed, unskilled, workers, thereby further reducing the possibility for new employment.

32 https://maps.pobal.ie/WebApps/DeprivationIndices/index.html
33 https://publichealth.ie/wp-content/uploads/2020/04/20200416-AGEING-PUBLIC-HEALTH-MAIN.pdf
34 https://cso.maps.arcgis.com/apps/webappviewer/index.html?id=4d19cf7b1251408c99ccde18859ff739

Due to the aforementioned factors and assumptions, potential impacts on employment during the construction of any of the proposed route options are expected to be positive, albeit limited and not significant. There is expected to be no impact on the labour market during the operation of the Proposed Project given its nature (i.e. underground cables between two unmanned electricity sub-stations).

In respect to potential impacts on the national, regional, and local economy during the construction of any of the proposed route options, these are expected to be positive, limited and not significant. This is due to the expectation that there would be limited economic activity associated with the construction workforce given its small size but also the skilled nature of such employment which is likely to be sourced from outside of the Study Area. Furthermore, given the specialist nature of the equipment being installed, it is likely that most of the capital expenditure would be outside of the Study Area, thereby also limiting supply-chain opportunities.

The operation of the Proposed Project (by way of any of the proposed route options) is expected to have a positive, potentially significant impact on the local, regional and national economies, primarily given its purpose to ensure the security of the electricity supply for consumers which will contribute to the regional economy and support foreign direct investment. The Proposed Project is also expected to provide benefits for local communities, promote sustainability, and stimulate competition in the electricity supply market, as outlined in Section 1.1. These benefits will be achieved regardless of which route option is selected and therefore there is no differentiation as a result.

4.2.6.1.1 Summary of Assessment

Given the expected potential impacts, it is appropriate to assign a score of '**Low (Cream)**' for the consideration of potential impacts on 'Employment and Economy' (applicable to all route options as there is no differentiation).

Low

4.2.6.2 Tourism Sector

Potential impacts on the tourism sector are anticipated to be similar for each of the proposed route options given they are all similar in nature, extent and scale, are located in close proximity to one another, and within the same Study Area.

No tourism receptors were encountered that would be directly impacted by Option A (Red). However there is potential for impacts on such receptors during construction (e.g. disruption to access). These access issues are separately addressed in this report and mitigation measures will be in pace to minimise any disruption. There are no direct impacts expected on the tourism sector overall during the construction of any of the proposed route options due to the nature and scale of the Proposed Project.

During operation, there is the potential for positive impacts on the tourism sector, however this would be within the context of positive impacts within the wider local, regional and national economies and would be realised regardless of which route option was identified as the emerging best performing route. As such there is no differentiation between the proposed route options in respect to tourism.

4.2.6.2.1 Summary of Assessment

Given the expected potential impacts, it is appropriate to assign a score of '**Low (Cream)**' for the consideration of potential impacts on 'Tourism Sector' (applicable to all route options as there is no differentiation).

Low

4.2.7 Land-use (and Land Take)

Option A (Red) is 51.4km in length, with the majority of the alignment routed along regional and local roads between Woodland substation and Dunstown substation. Some sections of the route alignment are not routed along roadways and are instead aligned across open agricultural land. Approximately 5.9km of Option A (Red) is routed through open greenfield land, largely classed as 'pastures or non-irrigated land' according to 2018 Corine Land Class data. The impacts on agricultural land (including land-take) are considered in Section 4.2.8.

It can be expected that there will be temporary land-take requirements to facilitate the construction of the Proposed Project along the route of Option A (Red). However, it is envisaged that construction activities would proceed on a section-by-section basis, thereby limiting the extent of such land-take requirements to a relatively small area at any one time. Furthermore, given the nature and scale of the Proposed Project, land-take requirements are expected to be minor and, as mentioned above, largely confined to regional and local roads. As such, there is anticipated to be no requirement for land-take from any residential, commercial or community receptors.

4.2.7.1 Summary of Assessment

Given the nature of the Proposed Project, there are no impacts on land-use and land take for residential, commercial or community receptors envisaged during the operational phase. Therefore, it is considered appropriate to assign a score of **'Low (Cream)'** for issues relating to land-use (and land-take), for non-agricultural land / receptors.

Low

4.2.8 Agriculture (including Equine)

This section addresses potential effects on agricultural land use. Where the construction of the Proposed Project crosses agricultural land there will be direct impacts on agricultural land-use and the operation of individual farms. The permanent land-take will be restricted to locations where inspection booths and other small structures associated with HVAC cable construction may be located. The use of temporary construction compounds located on agricultural land adjoining the works may be required. In general, the permanent land-take requirement will be very low and for the majority of the route crossing agricultural land the impacts will be restricted to soil disturbance and potential compaction due to excavation. This has the potential to affect the quality of the land along the working area and affect land drainage. For the majority of the route the land over the cable will be re-instated after construction is complete and returned to the farmer.

The potential effects of EMF are addressed in Section 2.3.2 of this report.

During the construction period there will be temporary disturbances to the operation of farms. The works area will be temporarily fenced off and this could result in temporary severances of access to fields or farm yards and to water and power supplies (e.g. power supplies to electric fencing and water supplies to water troughs). The excavation works and construction traffic movements have the potential to create noises and movements which may disturb sensitive livestock such as thoroughbred horses. Other potential impacts include the introduction of invasive species and impacts on permanent low input pastures due to disturbance of top-soil. The construction duration will generally be for a period of a few weeks or a few months on most farms. There may be extended periods where alternative construction techniques are required (e.g. directional boring beneath rivers) or where project infrastructure is required. Construction of public utilities such as gas pipelines and water mains on agricultural land is common place in Ireland and with best practice (discussed below) the temporary construction impacts do not cause significant effects on agriculture. The risk of significant impacts rises with increasing farm enterprise sensitivity and therefore this assessment compares the numbers of high sensitivity enterprises, such as equine and dairy, along each option.

4.2.8.1 Potential Effects on Agriculture from Construction on Public Roads

Where the construction of the Proposed Project is confined to public roads the impacts on agricultural land-use and the operation of individual farms will be minimal. Farmers (and livestock) use the local road network to access fields and farm yards and for the transportation of livestock and goods. Therefore there will be temporary disturbances to farms located along the route while construction is in progress. This period is likely to be a few weeks or months at any one location. The in-road construction will cross entrances to fields and farm yards, potentially causing temporary disturbance to access. Excavation works and construction traffic movements have the potential to create noises and movements which may disturb sensitive livestock (such as Thoroughbred horses) on lands adjoining the public road. Construction of public utilities in public roads is common place in Ireland and with best practice (discussed below) the temporary impacts do not cause significant effects on agriculture.

4.2.8.2 Best Practices Which Minimise Impacts on Agriculture

This assessment assumes the implementation of the principle of best practice during the construction and operation of the Proposed Project. Best practices in relation to safety and EMF involve laying the proposed HVAC cable in a concrete type material beneath the field surface. Adherence to this methodology ensures safety of farm machinery operators and livestock. To ensure EMF levels from electricity cables remain within the safe limits for human health, EirGrid's design standards require all UGCs to operate within existing public exposure guidelines from the International Commission on Non-Ionising Radiation Protection (ICNIRP), therefore EMFs from UGCs are unlikely to be a cause of public concern for local communities. Such potential impacts are the same for all proposed route options.

The contractor will engage with all landowners along the route of construction and discuss their requirements for access. The contractor will maintain reasonable access at all times. Reasonable access will respond to the individual needs of farmers and stud farms on a case by case basis. For example it would be essential to allow access for milk lorries into dairy farms whereas, with agreement, it may not be necessary to maintain continuous access to some roadside field gates when alternative access is available through the farmer's land. It may also be reasonable to restrict access to land for a period of time which is agreed in advance with the farmer. The contractor will notify the adjoining landowners in advance when construction noises may occur so that landowners have time to manage sensitive livestock such as thoroughbred horses. The contractor will maintain services such as water and power to ensure livestock have continuous access to water or provide an alternative source where necessary. It is best practice that the contractor provides a key contact person whom landowners can contact on an on-going basis during construction. Agricultural land, land drainage, local roads and affected accesses will be re-instated to pre-works condition. Services will be diverted where necessary should they be impacted by the construction works and access to severed sections of land will arranged as necessary with landowners during the construction works.

4.2.8.3 Existing Agricultural Land-Use Along Option A (Red)

The Option A (Red) crosses mineral soils along its entire length avoiding significant areas of peat to the west. From Woodland Substation to Dunstown Substation there are twelve high sensitive enterprises located along Option A (Red) – eight equine enterprises, three dairy enterprises and one horticultural enterprise. Option A (Red) will cross agricultural land for approximately 6km (12% of the entire length) and will cross one high sensitive dairy farm adjoining the Sallins Bypass.

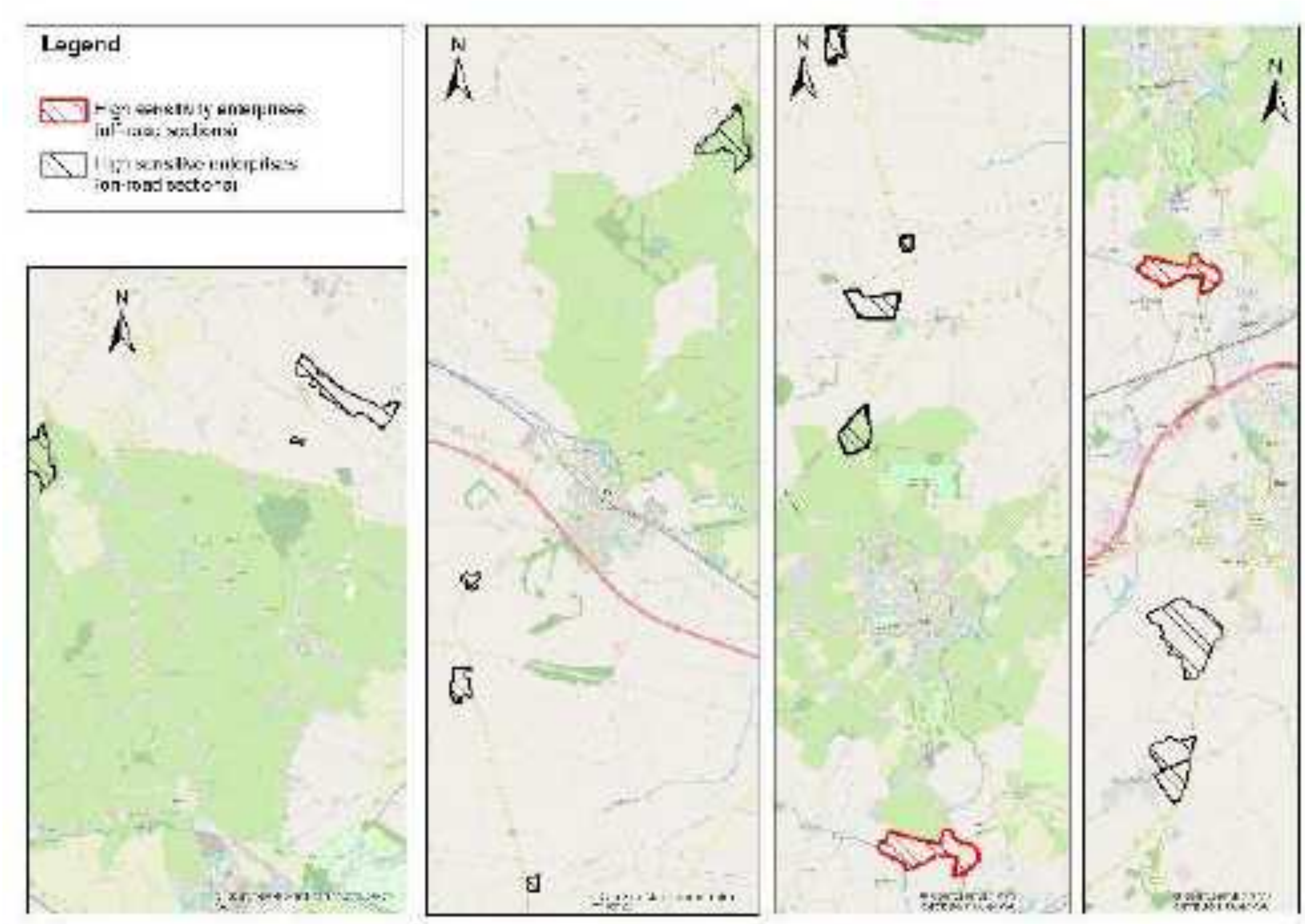

Figure 4-1: High sensitivity enterprises affected by Option A (Red).

4.2.8.4 Summary of Assessment

The ranking score for Option A (Red) is considered to be **'Low' (Cream)** given the moderate length across agricultural land and the low number of high sensitive enterprises it impacts.

Low

4.2.9 Utilities

There are numerous underground utilities in the regional road network between Woodland and Dunstown, including other electricity cables; telephone and broadband cables; sewers; and public and private water supplies. The public water supply is extensive in the area, with the network predominately using the road network for local residential supply while other larger mains being located off-road in agricultural land. There is no known group water supply with protected areas within the Study Area.

The assessment of Option A (Red), based on mapping provided by the utility owners, has found that it crosses existing 38kV underground cables (twice), existing fibre cables (nine times), existing medium pressure gas pipelines (28 times), existing water supply network (95 times) and existing wastewater network (16 times). The count of crossing locations includes points within the same roads. For example, Option A meets the medium-pressure gas network in five locations with multiple crossings within these sections. The five locations are at Kilcock; on the R403 (Clane to Prosperous road); Millennium Parkway, R445, and R448 (roads within Naas). However, because of the layout of gas network crossing from one side of the road to the other, it is counted as 28 crossings.

It is expected that all utilities encountered during construction will either remain in-situ or, where absolutely necessary, appropriate diversions or modifications carried out (with the permission of the respective provider) so as to ensure disruption to surrounding communities is kept to an absolute minimum and that any required service disruption will only be permitted for an agreed set period of time per day (generally a set number of hours) and will not be permitted to be continuous for full days at a time. Any required disruptions would be carefully planned so as to ensure that the duration of disruption is minimised in so far as is possible.

4.2.9.1 Summary of Assessment

Given the number and type of utility interfaces along the length of Option A (Red), along with the potential for disruption to people and neighbouring communities, it is appropriate to assign a risk score of '**Low-Moderate (Light Green)**'.

Low-Moderate

4.3 Technical

As set out in Section 2.3.3, the topic areas under consideration to assist with determining the best route option are as follows:

- General Compliance with System Reliability, Security Standards;
- Headroom and Ratings Impact;
- Maintainability;
- Technology Operational Risk;
- Average Reliability Rates; and
- Repeatability.

4.3.1 General Compliance with System Reliability, Security Standards

This is EirGrid's reliability and security standards are defined in the Transmission System Security and Planning Standards and their Operation Security Standards.

All technical input to the Kildare Meath project will comply to EirGrid's Standards for Security and Reliability. Therefore, there is no differentiation between the proposed route options and route Option A has been assigned a score of **Low (Cream)**.

Low

4.3.2 Headroom and Ratings Impact

Headroom is the amount of additional capacity each route option offers that would be available for the future without requiring further upgrade. All the proposed route options carry little additional headroom (spare current capacity) due to the nature of the corridor therefore giving no technical differentiation between the proposed routes in this aspect.

The current ratings bottleneck is the impact on the overall circuit ratings of the worst-case deepest obstacle crossing. As all the proposed route options will require some deep crossing solutions (below railways, motorways, rivers or a combination) of similar design, these will be the ratings bottleneck of that particular route. The connection spans north to south, whilst major natural and man-made obstacles are east west orientated, therefore all options cross the river Liffey, the railways, the M4, etc;

On account for the potential total number of Horizontal Directional Drills, Option A (Red) has been assigned a score of **Low (Cream).**

Low

4.3.3 Maintainability

This considers the ease with which the route option can be serviced and maintained, for example how easy it is to access joint bays and link boxes.

All the proposed route options will be developed with the same design principles. For example, maximum standing sheath voltages, typical trench cross-section, separation between joint bays, location of link boxes (underground in chambers or pillar mounted), same substation entry locations. Whilst some route options come with a greater proportion of off-road build as opposed to road, with the level of design detail available at this stage, is not possible to substantially differentiate between the proposed route options.

As there is no differentiation between the proposed route options and route Option A has been assigned a score of **Low (Cream)**.

Low

4.3.4 Technology Operational Risk

This criterion aims to capture the risk of operating different technologies on the network.

The same technology is applied to all solutions including cables, joint bays, and bonding. All technology will be the standard technology in the industry and also the dominant technology on EirGrid's existing network (i.e. XLPE insulated underground cables). Therefore, there is no differentiation between the proposed route options and route Option A has been assigned a score of **Low (Cream)**.

Low

4.3.5 Average Reliability Rates

This is the likelihood of the chosen cable technologies such as cables, joint bays, and bonding failing during operation is low. This is a technical issue, which would not cause any safety issues. All cable technology listed above are common to all route options.

Industry data on Cross-Linked Polyethylene (XLPE) insulation technology indicates that cable failures on a statistical basis are related to cable length in km.

The proposed route options lengths are as per Table 4.17 (all values are based on desktop surveys).

Table 4.17: Option Length Comparison

Route Option	Length (km)	% increase over the shortest	Notes
Option A (Red)	51.4	10%	
Option B (Green)	50.4	8%	
Option C (Orange)	46.7	-	This is the reference route
Option D (Blue)	50.5	8%	

The small variation in length (km) between the proposed route options does not trigger any substantial increase in the risk of failure. Furthermore, there is not currently sufficient technical detail, at this point, to determine the number increase of joint bays of each route against the shortest (Option C).

Therefore, there is no discernible differentiation between the differentiation between the proposed route options and route Option A has been assigned a score of **Low (Cream)**.

Low

4.3.6 Repeatability

Repeatability is whether the proposed technical solution can be readily repeated in the transmission network.

All the proposed route options will be developed with the same design principles; therefore, all route options are easily repeatable across the transmission network. Therefore, there is no differentiation between the proposed route options and route Option A has been assigned a score of **Low (Cream)**.

Low

4.4 Deliverability

4.4.1 Design Complexity

There are 13 surface waterbodies crossed along the length of Option A (Red), some of which crossed more than once; therefore there will be 20 crossings in total. These waterbodies will be crossed in a variety of different ways in order to minimise the environmental impacts, and to ensure construction and operational efficiency. Option A (Red) also has the least off-road sections, thus interface with private assets is minimised.

The utilities crossings are assessed in Section 4.2.9 of this report. Option A (Red) meets the medium-pressure gas network in five locations with multiple crossings within these sections. The five locations are at Kilcock; on the R403 (Clane to Prosperous road); Millennium Parkway, R445, and R448 (roads within Naas). Option A (Red) will require six major crossings (such as HDD), which is the same number as Option B (Green) and less than Option C (Orange) and Option D (Blue).

Option A (Red) has been assigned a score of **Low Moderate (Light Green)**.

Low-Moderate

4.4.2 Traffic Disturbance

As outlined in the Socio-Economic section, it is anticipated that the road closures will be required where the road does not have sufficient width to accommodate live traffic and the works associated with the construction. Any works along this route will be undertaken during normal daytime working hours with no night-time or weekend working, unless in the case of emergencies. For Option A (Red), it is anticipated that the full road closures might be required at the following locations:

- L6207 from Ribstown through Cullendragh to Barstown junction with the R156, an overall distance of 2,460 meters. In this location the carriageway is between 2.5 and 4.0 meters wide and does not allow adequate space for vehicles to pass the construction works safely;
- R125 from Mullagh Junction with the R156 through to the Balfeaghan roundabout, an overall distance of 7,580 meters. At this location, the carriageway is between 4.0 meters and 7.0 meters wide, which will be reduced to 2.0 meters wide once the construction work commences. Once below 2.5 meters wide a full road closure is required. Note, it is anticipated that this might not be required for the full length of the road section; and
- At the end of Option A (Red) from Stephenstown South Junction to the R412 through to the Dunstown Substation, a distance of 1,240 meters has a width of only 3.0 meters. Therefore, the construction works is likely to take up most of the width of the road, thereby requiring a full road closure.

In other areas of Option A (Red), the road width will be reduced to a minimum of 3.0 meters by the proposed construction works. In these areas it is anticipated that a lane closure may be required, with diversions for HGV vehicles:

- Jenkinstown Junction to the Mullagh Junction of the R156 and the R125;
- From the southern M4 crossing to the R408 Junction;
- From Longtown North to the Millicent South Junction; and
- From the R448 Kilcullen Road roundabout at Naas East to the Stephenstown South Junction.

For all the remaining road sections along Option A (Red), the roads may require lane closures with localized traffic management measures to allow the construction works to be carried out, specifically:

- Barstown Junction with R156 to the Jenkinstown Junction;
- Balfeaghan R1 Roundabout to the Junction between R158 and R148;
- Sallins Bypass North to the South section;
- From M7 Crossing South to the R409 Ploopluck Roundabout; and
- From the R409 Ploopluck Roundabout to the R448 Kilcullen Road Roundabout.

Table 4.18 provides a high-level summary of the proposed traffic management measure during construction period for Option A (Red). It is recommended that, following selection of the proposed option, a detailed analysis be undertaken with regards to the phasing of road closures.

Table 4.18: Summary of Option A (Red) Traffic Management

Option A	Total Length (in km)	Lane Closures (in km)	HGV Diversions (in km)	Road Closures (in km)	Field Crossings (in km)
	51.4	10.9 (21.1%)	24.2 (46.7%)	11.3 (21.8%)	6 (11.6%)

As outlined in the Socio-Economic section, in terms of traffic disturbance, it has been acknowledged that the construction works will impact the private vehicle. A moderate to high-ranking score has been assigned to Option A (Red) based on the level of temporary Traffic Management which is anticipated to be required during the phased construction works. For Option A (Red), full lane or a road closure during the phased construction works ‘with’ or ‘without’ Heavy Goods Vehicles (HGVs), diversions are mostly available while at all times maintaining access for local residents. On this basis, the significance of the traffic disturbance impact is assessed to be low. Where suitable diversions for through traffic are available along the length of the route option, the average installation rate is anticipated to be 80 meters per day, resulting in a minimum timeline of approximately two years to install this option. The exact location of the cable trench will be defined later in the project and this will depend on further design, surveys, consultation, and assessment. Consultations with the local authorities will help to define where the cable trench will go in the road to minimise disruption. For example, if a safe alternative could be provided for access with significant disruption for pedestrians, a footpath could be used to minimise disruption to the road network.

4.4.2.1 Summary of Assessment

Option A (Red) is anticipated to require mostly HGV diversions for lane closures and less full road closures compared to the other Options B and C with alternative routes for traffic diversion. In terms of traffic disturbance related to the Traffic Management, these measures will Option A (Red) has been assessed as **Moderate-High (Light Blue)**.

Moderate-High

4.4.3 Dependence on Other Infrastructure Projects

As outlined in Chapter 1 of this report, all route options will have the same dependence on works required at the associated substations in terms of connections. In terms of other infrastructure projects in the area, similar crossing of existing motorways, railways and canals are required. All four of the proposed route options will cross the same infrastructure but, in some cases, in different locations. All four route options will cross or run parallel with utilities, including water mains and the low to medium pressure gas network.

All four of the proposed route options will cross the proposed Water Supply Project[35]. This is a water pipeline scheme from the lower River Shannon at Parteen Basin in Co. Tipperary, travelling 170km to a new termination point reservoir at Peamount in South County Dublin. The proposed underground pipeline will cross the Proposed Project Study Area in a west to east direction and so all four route options will cross the pipeline. At the time of writing, the Water Supply Project has not yet been finalised and submitted for planning. However, based on public consultation information, the pipeline will enter the Project Study Area close to Baltracey, halfway between Kilcock and Clane. It travels in a south easterly direction to towards Straffan and exist the Project Study Area to the south of Celbridge. Further design and assessment will be required at the next step of the Proposed project; however, the proposed pipeline can be crossed by the Proposed Project and as all four route options will cross it, it is not considered a differentiator at this point in the Proposed Project.

Option A (Red) could impact the route of the proposed Leinster Orbital Route. This is a proposed motorway linking Drogheda with Navan and Naas and has been discussed for over 20 years. There is no defined route for the motorway and the proposed route is not in the current Transport Strategy for the Greater Dublin Area 2022 – 2042[36]. The route would travel south from Navan along the western edge of the Project Study Area with a connection to the M4 Junction at Kilcock, and then past Prosperous towards Naas and the N7. There are no firm plans for the proposed motorway therefore, it cannot be included in this assessment. Option A (Red) has been assessed as **Low-Moderate (Light Green)** in terms of dependence on other infrastructure projects.

Low-Moderate

[35] http://www.watersupplyproject.ie/

[36] National Transport Authority. 2021. Transport Strategy for the Greater Dublin area 2022-2042. https://www.nationaltransport.ie/gda/

4.4.4 Permits and Wayleaves

At this stage of the assessment, all route options will have a similar issue with permits. A wayleave is a right of access that will be agreed with an affected landowner and will cover the area of the cable, as well as land required for access and maintenance. The greater the area of off-road sections, the greater the amount of wayleaves that will be required to be negotiated and agreed with landowners. Due to the nature of these legal agreements, typically this can be quite an extended process. The approximate length of off-road sections for the route options are:

- Option A (Red) – 6.0km;
- Option B (Green) – 10.6km;
- Option C (Orange) – 15.5km; and
- Option D (Blue) – 9.0km.

Option A (Red) has the least amount of off-road sections (approximately 6km compared to Option C's 15.5km) and so this will reduce the number of landowners directly affected and reduce the amount of wayleaves required. As such, Option A (Red) has been therefore assessed as **Low-Moderate (Light Green)** for this criterion.

Low-Moderate

4.4.5 Implementation Timelines

This route option requires the least amount of off-road access and the highest amount of lane closures. This will facilitate a reduction in implementation programmes. The reduction in off-road access, will negate the need for extended remediation following construction works i.e. decompaction and re-seeding of agricultural land. The ability to work under lane closure will assist in 'corridor working' and reduce the requirements to manoeuvre construction vehicles through narrow roads.

Option A has therefore been assigned a score of **Low Moderate (Light Green)** for this criterion.

Low-Moderate

4.4.6 Combined Deliverability Performance

Considering the design complexity, traffic disturbance, impact dependence and implementation timelines, a rating of **'Moderate' (Dark Green)** has been assigned. Option A (Red) has generally scored well (Low-Moderate) over all of the Deliverability sub-topics, however the impact in terms of traffic disturbance has elevated the overall score. Option A (Red) has the least amount of off-road section and impacts more regional roads than the other route options, which will increase traffic disturbance.

Moderate

4.5 Economic

As set out in Section 2.3.4, the topic areas under consideration to assist with determining the best route option are as follows:

- Length of installed cable;
- Quantity of Minor and Major service crossings; and
- Number of Major Crossings (such as Horizontal Directional Drills.

4.5.1 Length of Installed Cable

The first economic assessment is from the overall lengths of the cable routes (see Section 4.3.5) . From this, Option A (Red) has a total length of 51.4 km which is 10% longer than the shortest route (Option C (Orange)) and therefore it can be assumed to have 10% more of an economic impact in this aspect.

While this is the longest route out of the proposed options, 10% will not greatly impact the project. For this reason, Option A (Red) has been assigned a score of **Moderate (Dark Green).**

Moderate

4.5.2 Quantity of Crossings

An assessment of both the minor and major crossings expected to be encountered for the cable route options has been carried out by categorising them into the different crossing types (presented in Section 2.3.3.2). Summaries of these are listed below where Type 1 has the lowest impact and Type 4 has the highest.

- Type 1 Crossings - shallow crossings (utility/drainage/other) - deeper installation;
- Type 2 Crossings - shallow water crossings (Likely open cut solution);
- Type 3 Crossings - larger water crossings (Cable bridges/culverts/micro tunnels); and
- Type 4 Crossings - large crossings (Horizontal directional drills/ Auger bores or tunnel solutions).

From our study of the routes, it has been found that route Option A (Red) has the fewest Type 1 crossings, joint most Type 2 crossings, no Type 3 crossings and joint least Type 4. For this reason, route Option A (Red) has been assigned a score of **Low (Cream).**

Low

4.6 Summary of Option A (Red) Assessment

4.6.1 Environment Summary

A summary of the environment appraisal of Option A (Red) is provided in Table 4.19. Overall, Option A (Red) has been scored as **Moderate (Dark Green)** in terms of risk of environmental impact. This is due to crossings within the zonings within the Kilcock Environs, Kilcock Town, and Draft Naas LAPs, increased watercourse crossings, and increased cultural heritage effects. This route option is in proximity to the highest number Recorded Monuments (including Jigginstown Castle), Protected Structures, and Gardens and Designed Landscapes.

Table 4.19: Summary of Environment Assessment for Option A (Red)

Biodiversity	Soils and Water	Planning Policy and Land Use	Landscape	Archaeology, Architectural Heritage, and Cultural Heritage	Combined Environment Score
Moderate-High	Moderate	Moderate	Low-Moderate	Moderate-High	Moderate

4.6.2 Socio-Economic Summary

Option A (Red) has the most significant traffic, transport and access issues and the least significant agricultural land issues. It passes to the west of Kilcock, and through the town of Naas. This increases the social impacts through its proximity to properties and communities. It passes the access to five schools, sports facilities within Naas, Larchill Gardens and a Nursing Home. A summary of the socio-economic appraisal of Option A (Red) is provided in Table 4.20. The combined socio-economic rating for Option A (Red) has been assigned as **'Moderate' (Dark Green)**. Option A (Red) will pass less properties than Option D (Blue) and require less full road closures compared to Options B and C. However because more of its length is in regional roads, construction traffic disturbance will be comparatively greater due to the increased traffic using those roads. While the traffic impacts will be temporary and restricted to the construction phase, in order to minimise the disturbance, traffic surveys will be undertaken to confirm this assumption. Other survey and design work will be completed to confirm the assumptions made on the required working area. In addition, localised route changes could be designed and assessed to minimise impacts further. Consultation will be undertaken with Meath and Kildare County Councils to agree the approach to traffic management and avoid and/or reduce the impacts.

Table 4.20: Summary of Socio-economic Assessment for Option A (Red)

Traffic and Transport	Noise and Vibration	Air Quality	Visual	Amenity	Health	Employment and Economy (and Tourism)	Land Use (and Land-take)	Agriculture (including Equine)	Utilities	Combined Socio-economic Score
Moderate -High	Moderate	Moderate	Low-Moderate	Moderate	Low-Moderate	Low	Low	Low	Low-Moderate	Moderate

4.6.3 Technical Summary

At this stage in the Proposed Project are there no technical differentiations apart from the number of major crossings. Options A (Red) and B (Green) will have two fewer than Options C (Orange) and D (Blue). Other technical factors will have no impact on the selection of the best performing option. Option A (Red) has been assessed to have a **Low (Cream)** score for the technical criterion.

Table 4.21: Summary of Technical Assessment for Option A (Red)

General Compliance	Headroom	Maintainability	Technology Operational Risk	Average Reliability Rates	Repeatability	Combined Technical Score
Low	Low	Low	Low	Low	Low	Low

4.6.4 Deliverability Summary

Considering the design complexity, traffic disturbance, impact dependence and implementation timelines, a rating of **'Moderate' (Dark Green)** has been assigned. Option A (Red) has generally scored well (Low-Moderate) over all in the Deliverability sub-topics, however the impact in terms of traffic disturbance has elevated the overall score. Option A (Red) has the least amount of off-road section and impacts more regional roads than the other options, which will increase traffic disturbance. Option A (Red) has the least amount of off-road sections and so this will reduce the number of landowners directly affected and reduce the amount of wayleaves required.

Table 4.22: Summary of Deliverability Assessment of Option A (Red)

Design complexity	Traffic disturbance	Dependence on other infrastructure projects	Permits and wayleaves	Implementation Timelines	Combined Deliverability Score
Low-Moderate	Moderate -High	Low-Moderate	Low-Moderate	Low-Moderate	Moderate

4.6.5 Economic Summary

At this stage in the Proposed Project, the only differentiations between route options are cable route lengths and the impact from the quantity of expected major crossings. Option A (Red) has been assessed to have a **Low-Moderate (Light Green)** score for the economic criterion due to the fewer major crossings (such as HDDs) balancing out the longer length of the route when compared to the shortest Option C (Orange).

Table 4.23: Summary of Economic Assessment of Option A (Red)

Length of Installed Cable	Quantity of Crossings	Combined Economic Score
Moderate	Low	Low-Moderate

5. Option B (Green)

This section outlines the assessment of Option B (Green) against the five assessment criteria – Environment; Socio-Economic; Technical; Economic; and Deliverability; and their sub-topics.

5.1 Environment

As set out in Section 2.3.1, the 'Environment' criterion assessment topics under consideration to assist with determining the Emerging Best Performing Option are as follows:

- Biodiversity (Flora and Fauna);
- Soils and Water;
- Planning Policy and Land Use;
- Landscape; and
- Archaeology, Architectural Heritage, and Cultural Heritage.

5.1.1 Biodiversity (Flora and Fauna)

5.1.1.1 European Sites

Option B (Green) broadly follows the Option A (Red) route south of Boherhole. Option B (Green) is not located within or adjoined to any European site. The nearest European site is Ballynafagh Bog SAC located approximately 2km to the west of Option B (Green) (Appendix A.1). There is no hydrological or ecological connection to this SAC. Option A (Red) requires the greatest number of river crossings (21) including crossing of watercourses with direct hydrological links to a complex of European sites within Dublin Bay including Rye Water/Carton SAC (located 3km downstream at the closest point and designated for petrifying springs and two whorl snails), South Dublin Bay and River Tolka Estuary SPA and South Dublin Bay SAC (see Appendix A.1). In the absence of mitigation during construction and depending on crossing methodology there is the potential for impacts to aquatic habitats and species downstream through a pollution event. Habitats along the southern section of Option B (Green) (as with Option A (Red)) are suitable to support foraging qualifying interests bird species from Poulaphouca Reservoir SPA (located 8km east of this route option), and therefore there is potential for disturbance impacts to these species and temporary loss of habitat during construction if undertaken during wintering bird season.

5.1.1.2 National Sites

No NHA sites are located in proximity to this route option. The closest NHA site is Hodgestown Bog NHA located 4km west of Option B (Green). This route option directly crosses the Royal Canal pNHA west of Maynooth and the Grand Canal pNHA on two occasions at Sallins and Naas. HDD accompanied by a rigorous mitigation plan is to be employed at these major crossings and this will minimise or avoid impacts.

5.1.1.3 Watercourses and Aquatic Species

This route option involves the crossing of several major rivers including Rye Water, River Liffey and tributaries of the River Tolka with varying water framework directive (WFD) status's ranging from 'Good' to 'Poor'. There are potentially six major river crossings requiring HDD and twelve smaller rivers and streams requiring other crossing methods such as open cut including the River Liffey, Lyreen River and Rye Water River and tributaries. Open cut may not be possible across salmonid watercourses. The majority of rivers crossed are classified as of Moderate to Poor status under WFD however tributaries of the River Liffey which are crossed are classed as of Good status under the WFD. These rivers host an abundance of aquatic species. The River Liffey supports Atlantic salmon and brown trout whilst the Rye Water River is known to support minnow, European eel and lamprey sp. and is also a spawning ground for brown trout and salmon. White-clawed crayfish has been recorded at Leixlip within the Rye Water River. Otter have been recorded in all the major watercourses. Several rivers were noted to be suitable to support kingfisher with one bird recorded hunting along the River Liffey during field surveys.

5.1.1.4 Recent Field Survey Data and Desk Based Review

An initial drive over comprising visual assessments and targeted spot checks at static locations of the accessible sections of the option was undertaken on 11th, 12th and 13th of October 2021 to scope for wintering bird surveys. The dominant habitats recorded along Option B include hedgerows, treelines, agricultural grassland, tillage land (predominantly cereal production), amenity grassland and watercourses. Habitats along Option B have the potential to support breeding and wintering bird species including Annex I species and birds included in the amber and red list of Birds of Conservation Concern in Ireland (BoCCI). Snipe which is red-listed in BoCCI and kingfisher and golden plover which are Annex I listed bird species were recorded during visit one of the wintering bird surveys in October 2021. Hen-harrier winter roost surveys commenced in October 2021 west of Option B (Green). No hen harrier was recorded during the surveys. Devil's bit scabious, the food plant of the Annex II and IV listed marsh fritillary butterfly, was recorded near Dunstown substation within Harristown Common.

A search of the National Biodiversity Data Centre records included records for several protected species including common frog, pine marten, common lizard, red squirrel, badger and otter in the vicinity of Option B (Green). As noted above with Option A (Red), a data request submitted to Birdwatch Ireland for Irish Wetland Bird Survey (I-WeBS) data for Poulaphouca Reservoir SPA and any incidental records available for Co. Kildare and Co. Meath was received in October 2021 and showed large numbers of greylag goose, mallard and teal with lower numbers of several other species including whooper swan, wigeon, curlew and lesser black-backed gull previously recorded approximately 8km from Option B. Several incidental records were received mainly for the areas of Friarstown Straffan and Lakelands in Naas including two large aggregations of lapwing and golden plover. A search of the National Biodiversity Data Centre records included records for several protected species including common frog, pine marten, common lizard, red squirrel, badger and otter in the vicinity of Option B (Green).

Given the routing of a considerable proportion of the route option along narrow road networks bordered by hedgerows and treelines there will be a requirement for vegetation removal to accommodate the cable installation. The route option is bounded in parts by species rich hedgerows and mature tree lines and the removal of these has the potential to result in habitat fragmentation and impacts on protected species and wintering and breeding birds through disturbance, habitat loss and pollution during construction. Given the distance of the cable there is a high likelihood that invasive non-native species listed on the Third Schedule of the EC (Birds and Natural Habitats) Regulations will be encountered along the road networks. All lengths of the proposed route option not in the road surface has the potential for impacts on biodiversity.

5.1.1.5 Summary of Assessment

As with Option A (Red), the greatest impacts on biodiversity for Option B (Green) would be during construction, where despite cables primarily being laid in public roads, there is potential (particularly from passing bays and watercourse crossings) for impacts on hedgerows, tree lines and aquatic ecosystems in particular; other habitats and species may also be disturbed or fragmented during the construction phase and effects could be permanent in some cases (e.g. in the event of a permanent off-road maintenance track). This route option involves the greatest number of river crossings. In the absence of mitigation there is the potential for impacts to Rye Water/Carton SAC in the event of a pollution incident during construction.

There is considered to be '**Moderate-High (Light Blue)**' risk of a significant impact to biodiversity due to Option B.

Moderate-High

5.1.2 Soils and Water

5.1.2.1 Geology and Soils

Option B (Green) is underlain predominantly by Carboniferous limestone bedrock, with associated calcareous shales, sandstone in the north and older Silurian greywacke, siltstone and shale in the south of the Study Area. There are no mapped karst landforms or Geological Heritage sites recorded in the vicinity of the route. However, the route crosses rocks in which karst features have been recorded and the potential exists for unmapped features to occur in proximity to the route option. Karst features are associated with the dissolution of limestone and the formation of ground cavities, which may not always be apparent at the surface, with consequent subsidence risks and enhanced subsurface drainage.

Superficial deposits underlying Option B (Green) are predominantly glacial tills, derived from the underlying limestone and, in the north, sandstone and shale bedrock. There is also alluvium associated with watercourses and some limited areas of sand and gravel are crossed by the route option in the southern half of the Study Area.

The route option crosses areas of potential geologic economic deposits (sand and gravel, granular aggregate and crushed rock), predominantly in the south of the Study Area. However, the areas crossed are small and these deposits are widely available in the surrounding area, so this is not considered a significant constraint for route selection.

5.1.2.1.1 Summary of Assessment

The overall evaluation for Option B for geology and soils is ranked as '**Low (Cream)**' risk based on currently available information. However, the potential for unmapped karst features should be noted and further assessment may be needed to identify potential for ground stability issues.

Low

5.1.2.2 Groundwater

The majority of Option B (Green) lies within the Dublin (poorly productive bedrock) WFD groundwater body, with a small area in the north within the Moynalvy (poorly productive bedrock) and Dunshaughlin (productive fissured bedrock) groundwater bodies. In the southern half of the Study Area, the route option crosses the Naas (karstic) and Curragh Gravels East (gravel) groundwater bodies.

The majority of the route option is underlain by bedrock classified as Locally Important Aquifer (bedrock which is generally moderately productive in local zones), with a small area of Regionally Important Aquifer - Karstified (diffuse) crossed in the southern half of the Study Area. Some areas classified as of High groundwater vulnerability are crossed by the route option, predominantly in the southern half of the Study Area, along with some very limited areas of Extreme groundwater vulnerability. However, Option B (Green) crosses a smaller total area of higher groundwater vulnerability than Options A (Red) and Option D (Blue). While there are no mapped karst landforms in the vicinity of the route option, it crosses rocks in which karst features have been recorded and the potential exists for unmapped features to occur. Karst features can be associated with significant groundwater flowpaths and may be important in supporting surface water features.

There are no Public & Group Supply Source Protection Areas or Group Water Schemes in the vicinity of the route option. There are a large number of groundwater wells and springs mapped by the Geological Survey Ireland across

the Study Area. However, in accordance with TII guidance[37] and the observation that low yielding wells, used mainly for domestic and farm water supply, are very common in Ireland, the assessment has focused on high-yielding springs and wells used for public water supply and their surrounding protection zones and the total number of wells and springs along each route has not been used in assessing relative impacts at this stage.

No groundwater dependent water bodies or groundwater dependent terrestrial ecosystems (GWDTEs) have been identified at this stage of assessment, so these features have not been used in assessing relative impacts between route options. However, the potential exists for such features to be present within the Study Area and it cannot be conclusively determined at this stage whether or not they may be a constraint for the proposed route.

There is potential for dewatering operations associated with crossings of large watercourses, major roads and railways. This applies to all route options and no specific issues have been identified for Option B at this stage.

5.1.2.2.1 Summary of Assessment

In terms of groundwater the overall evaluation for Option B (Green) is ranked as **Low** risk based on currently available information. However, the potential for unmapped karst features should be noted and further assessment may be needed to identify potential for interference with groundwater flows and potential for groundwater flooding issues.

Low

5.1.2.3 Surface Water

There are 13 surface waterbodies crossed by Option B (Green), some crossed more than once. A full list of water bodies and their current status is provided in Table 5.1 as well as their proximity to the Rye Water Valley/Carton SAC, their sensitivity to change, the likely crossing technique to be employed and the potential impacts as a result.

Table 5.1 Surface Water Bodies Option B (Green)

Waterbody Name	WFD Status	No. Crossings	Connection & Proximity to Rye Water Valley/Carton SAC (at closest crossing)	Sensitivity	Impact Potential
Liffey_100	Moderate	2	No connection	Medium	Low
Grand Canal Naas Line	Good	1	No connection	Very High	Low
Grand Canal Main Line	Good	1	No connection	Very High	Low
Liffey_120	Good	3	No connection	Very High	Medium
Liffey_130	Good	3	No connection	Very High	Medium
Clonshambo_010	Poor	1	15km	Low	Low
Lyreen_010	Poor	2	7km	Low	Low
Royal Canal Main Line	Good	1	No connection	Very High	Low
Lyreen_020	Poor	2	3.2km	High	Low
Rye Water_020	Moderate	1	3.3km	High	High
Rye Water_030	Moderate	2	4.5km	High	Medium
Dunboyne Stream_010	Moderate	1	No connection	Medium	High
Tolka_020	Poor	1	No connection	Low	High
Total		21			

[37] TII. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. Unreferenced. Obtained from: www.tii.ie/technical-services/environment/planning/ (accessed October 2021). TII guidelines have been used as they are relevant to all linear infrastructure projects.

In addition to water bodies being directly crossed by the cable, for Option B (Green) there are also a number in close proximity which may be at risk from silty water runoff or spillages of hydrocarbons during construction. These water bodies are less than 50m from the route option:

- Liffey_120: the cable route runs alongside this water body, at approximately 10m from the bank edge, for 375m. The Liffey_120 is of very high sensitivity and there is a high impact potential from having a trench in such close proximity for this length;
- Liffey_130: the cable route runs alongside this water body, at between10m and 30m from the bank edge, for 480m. The Liffey_130 is of very high sensitivity and there is a high impact potential from having a trench in such close proximity for this length;
- Rye Water_020: the cable route runs alongside this water body, at approximately 25m from the bank edge, for 140m. The Rye Water_020 is of high sensitivity and there is a medium to high impact potential from having a trench in such close proximity for this length; and
- Rye Water_030: the cable route runs alongside this water body, at less than10m from the bank edge, for 260m. The Rye Water_030 is of high sensitivity. The cable is being laid within a road in this location, however it is likely that surface water drains will discharge to the water body or that the road is designed for 'over the edge' runoff from the road to the water body. Therefore there is a high impact potential from having a trench in such close proximity for this length.

5.1.2.4 Flood Risk

For Option B (Green), the length (in metres) within a PFRA flood risk area is:

- Pluvial: 844m; and
- Fluvial: 1948m.

There are 21 No. watercourse crossings along the route option; all crossings will be designed so do not present an increase in flood risk, either pluvial or fluvial.

5.1.2.4.1 Summary of Assessment

Considering the number of crossings of water bodies (approximately 21 no.), in particular the crossings of those with high or very high sensitivities, as well as the potential for open cut crossings in addition to potential flood risk, Option B (Green) is scored as **Low-Moderate (Light Green)** in respect to the Soils and Water assessment topic.

Low-Moderate

5.1.3 Planning Policy and Land Use

5.1.3.1 Planning Policy and Legislation

Option B (Green) bypasses Kilcock and passes west of Maynooth, avoiding zoned lands. It follows the same alignment as Option A (Red) from Boherhole until Ploopluck in Naas, avoiding zoned lands in Sallins LAP, where it avoids the town centre and follows and runs parallel with the M7 through Naas South, cutting through Jigginstown and Bluebell before joining the R448 and turning south towards Dunstown station. The following zonings are applicable to Millennium Park, Naas South, Jigginstown and Naas East.

5.1.3.1.1 Draft Naas Local Area Plan 2021-2027

Option B (Green) passes along the western boundary of Naas, interacting with a number of zoned lands, the objectives for which are described within the table below.

Table 5.2: Relevant Zoning Objectives Naas LAP

Zoning Objective (Naas Local Area Plan 2021-2027)	
B Existing/Infill Residential	To protect and enhance the amenity of established residential communities and promote sustainable intensification.
E Community & Education	To provide for education, recreation, community and health
F Strategic Open Space	To preserve, provide for and improve recreational amenity, open space and green infrastructure networks.
H Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
H(5) Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
P2 Data Centre/Warehouse	To provide for Data Centre development and their associated infrastructure only.
Q3Office, Enterprise and Employment	To provide for and facilitate the provision of high job-generating uses.
Q4 Office . Enterprise and Employment	To provide for and facilitate the provision of high job-generating uses.
R Retail/Commercial	To support continued operation of existing commercial uses.

5.1.3.2 Planning Applications

A review of all granted and live applications over the last five years within a 50m buffer, 25m either side of Option B (Green), has been performed. Some of these applications will be new receptors which will have already been constructed by the time construction on the Proposed Project commences. These include individual dwellings and larger development as shown in the Local Area Plans.

Of the applications identified in the analysis, the majority were minor residential/domestic in scope, consisting of single dwellings or extensions to existing dwellings. The only other application within the buffer was a commercial proposal located in Farringtons , Rathcoffey in Co. Kildare, which was also minor in scope, consisting of the change of use of a part of the ground floor of a commercial building and internal alterations (Kildare County Council Application no. 191267).

These applications will be taken into account in the routing of the cable. Other larger scale planning applications will also be examined and taken into account within the routing process. Such applications include other energy projects, the Water Supply Project, and road schemes.

5.1.3.3 Summary of Assessment

Taking the above into account, Option B (Green) has the least potential to interact with a significant number of recent and current planning applications, and these are all domestic/minor in scope. Furthermore, Option B (Green) has been routed in such a way that it avoids many potential interactions with LAP zonings, only traversing lands zoned within the Draft Naas LAP. It is also acknowledged that with appropriate siting and mitigation, the impacts of these interactions can be further minimised. Therefore, Option B (Green) has been assigned less significant risk in terms of the combined impacts to land use and planning policy, with an overall '**Low**' (Cream) scoring.

Low

5.1.4 Landscape

5.1.4.1 Landscape character

Refer to Section 4.1.4.1 for information on landscape character.

5.1.4.2 Landscape elements and scenic designations

No designated or highly sensitive landscape elements were identified within the portion of the Study Area that occurs within County Meath.

Included in Table 14.4 of Chapter 14 (and indicated on Map 14.2) of the Kildare County Development Plan are:

> *'12 "principal landscape sensitivity factors": Major Rivers and Water bodies; Canals; Ridgelines; Green Urban Areas; Broad-Leaved Forestry; Mixed Forestry; Natural Grasslands; Moors and Heathlands; Agricultural Land with Natural Vegetation; Peat Bogs; Scenic View; and Scenic route'.*

This option will pass within 300m of the following '*principal landscape sensitivity factors*' (from north to south):

- River Liffey; and
- Woodland R412 regional road.

5.1.4.2.1 Sensitivity - landscape elements

The sensitivity of these '*principal landscape sensitivity factors*' are recorded in Table 5.3.

5.1.4.2.2 Magnitude of impacts - landscape elements

The magnitude of impacts on landscape elements are as follows:

- **River Liffey:** Approximately 10km of the route passes within an area of 'special sensitivity' that buffers the River Liffey 'principal landscape sensitivity factor'. This area would have a heightened sensitivity to the removal of vegetation. Within this 'principal landscape sensitivity factor' approximately 2.2km of the route occurs within agricultural fields; thus, the construction activity here would be uncharacteristic. For these reasons, the magnitude of impact during the construction phase is deemed to be low. The agricultural land use will be reinstated and the river crossing is likely to be by directional drilling; therefore the likely magnitude of effect during the operational phase is likely to be negligible; and

- **Woodland R412 regional road**: It is likely that the R412 regional road is wide enough to accommodate the trenching work without the need to remove roadside vegetation; therefore, there will be no material change. Thus the magnitude of effect is deemed to be negligible during both the construction and operational phases.

5.1.4.2.3 Significance of impacts - landscape elements

All the impacts on the '*principal landscape sensitivity factors*' identified are of a negligible magnitude during the operational phase; therefore, are considered, by default, to have a significance of impact that is **Imperceptible**. During the construction phase only, the River Liffey '*principal landscape sensitivity factor*' is likely to have a significance of **Slight-Imperceptible**, while for all the others, it will be **Imperceptible**.

Table 5.3: Summary - Principal Landscape Sensitivity Factors within County Kildare

Principal Landscape Sensitivity Factor	Specific feature	Sensitivity of feature	Likely operational magnitude of effect	Likely operational significance of effect	
Major Rivers and Water bodies		River Liffey	High-medium	Negligible	Imperceptible
Mixed Forestry		Woodland R412 regional road	High	Negligible	Imperceptible

5.1.4.3 Summary of Assessment

A 10km offline section passes through agricultural fields near the River Liffey '*Principal Landscape Sensitivity Factor*'; therefore, there is a potential for some impact on the landscape character within this area of 'special' sensitivity, but significant impacts are not anticipated. No significant landscape impacts are anticipated. Whilst the magnitude of impact during both construction and operation is at the very bottom end of the magnitude spectrum; some receptors are deemed to have a sensitivity that is at the upper end of the sensitivity spectrum thus a relatively small increase in the magnitude of impact during the construction phase could result in a significant impact therefore the attributed score is **Low-Moderate (Light Green)**.

Low - Moderate

5.1.5 Archaeology, Architectural Heritage and Cultural Heritage

Option B (Green) includes sections common to Option A (Red), and therefore the receiving environment is similar to that described in Section 4.1.5 above.

A summary of archaeology, architectural heritage, and cultural heritage constraints identified within the Step 3 Study Area is presented in the Environmental Constraints Report along with a discussion on the general character and nature of the constraints present, comprising National Monuments and Preservation Orders, sites on the RHM, Recorded Monuments and sites recorded on the SMR, Protected Structures, structures recorded on the NIAH, ACAs, and GDLs identified by the Survey of Historic Gardens and Designed Landscapes.

Further details for the archaeology, architectural heritage and cultural heritage constraints identified are provided in Appendix B.1.

Option B (Green) is largely located within the existing carriageways of regional and local roads, passing through a number of roadside settlements including Rathcoffey and Moortown along the R408. This option also includes seven offline sections which cross areas of agricultural land in the townlands of Rathasker, Ribstown, Woodland, Moyglare, Timard, Laraghbryan East, Newtown, Crinstown, Longtown North, Curryhills, Cott, Ballynagappagh, Barrettstown, Millicent South, Osberstown, and Jigginstown. While these areas remain largely agricultural, some development is present including the M4 and M7 motorways. This route option crosses the River Lyreen and River Liffey, as well as a number of minor watercourses. The underlying geology is largely limestone, with superficial deposits of till and gravel, as well as alluvium which has the potential to preserve previously unknown archaeological monuments and remains. There is also the potential for votive (religious) offerings in rivers and bogs. Areas of outcropping bedrock have also been noted along the route of Option B (Green).

Baseline information on the archaeology, architectural heritage and cultural heritage constraints identified within 100m of Option B (Green) is provided in Appendix B.1.

5.1.5.1 Archaeology

There are no National Monuments, sites with Preservation Orders placed on them, or sites on the RHM located within 100m of Option B (Green).

Three Recorded Monuments are located within 100m of Option B (Green) (see Appendix B.1). These comprise the site of a medieval parish church (AY_04), a rath (AY_24), and a mound (AY_26).

Eight sites recorded on the SMR have been identified within 100m of Option B (Green). These are characterised by the locations of cropmarks (AY_10, AY_36, and AY_46 – 48) and evidence of post-medieval religious activity (AY_05, AY_06, and AY_27).

Further information on the archaeological constraints identified within 100m of Option B (Green) is included in Appendix B.1.

5.1.5.1.1 Archaeological Potential

The underlying geology is largely limestone, with superficial deposits of till and gravel, as well as alluvium which has the potential to preserve previously unknown archaeological monuments and remains. There is also the potential for votive offerings, objects apparently deposited for religious reasons, in bogs and in rivers such as the River Lyreen and River Liffey , as well as in minor watercourses.

5.1.5.2 Architectural Heritage

Architectural heritage constraints within 100m of Option B (Green) comprise:

- Six Protected Structures characterised by post-medieval churches (AH_02, AH_04, AH_05, and AH_12) and houses (AH_11 and AH_15)[38].
- Eight GDLs comprising seven recorded by the Survey of Historic Gardens and Designed Landscapes and one identified from historic mapping (Ordnance Survey 6", 1837 – 1842).

No ACAs are located within 100m of Option B (Green).

Further information on the architectural constraints identified within 100m of Option B (Green) is included in Appendix B.1.

5.1.5.3 Cultural Heritage

A total of 27 cultural heritage sites have been identified within 100m of Option B (Green) from the sources identified in Section 2.3.1.5. These are characterised by post-medieval built heritage including houses and farm buildings. Further information on these cultural heritage sites is presented in Appendix B.1.

[38] AH_04, AH_05 and AH_11 are also included on the NIAH and, to avoid double counting constraints, have been included under Protected Structures.

5.1.5.4 Potential Impacts

5.1.5.4.1 Construction – Direct Impacts

Archaeology

No direct impacts have been identified on National Monuments, sites with Preservation Orders, or sites on the RHM as a result of the construction of Option B (Green).

Where Option B (Green) is located within the Zone of Notification associated with a Recorded Monument, this has been identified as a direct impact below. While the option would not directly impact the Recorded Monument itself, excavation of the cable trench and joint bays would have a direct impact on any archaeological remains that may survive within this zone.

Option B (Green) is located within the Zones of Notification of three Recorded Monuments (AY_04, AY_24, and AY_26[39]). Within these zones it is located in the carriageway of existing roads the construction of which is more than likely to have removed or truncated any archaeological remains associated with these monuments that may have been present. However, construction, including the excavation of the cable trench and joint bays would have a direct impact on any archaeological remains that may survive. Construction would also have a direct impact on any archaeological remains associated with these Recorded Monuments that may survive within any additional land take required for construction.

While construction would be within the existing carriageways may have partially removed or truncated any remains associated with, the option has the potential to remove archaeological remains associated with AY_05 and AY_46 – 48, construction of Option B (Green) would have a direct impact on any archaeological remains associated with these constraints that may survive. In addition, construction would have a direct impact on any unknown archaeological remains associated with these constraints that may survive within any additional land take required for construction.

The excavation of the cable trench and joint bays would have a direct impact through the removal of any archaeological remains associated with AY_10 (an enclosure) which is located in an offline section in Laraghbryan East.

Excavation of the cable trench and joint bays, and the excavation of temporary launch and reception pits for directional drilling may also result in a direct impact any previously unknown archaeological remains that may be present within the land required for Option B (Green). The potential for this impact is considered to be higher in previously undeveloped areas than within the existing carriageways, the construction of which is likely to have likely to have removed or truncated any archaeological remains that may have been present.

Architectural Heritage

Welds Thatched House (AH_11), a Protected Structure and assessed by the NIAH to be of Regional importance, and Millicent Church and Lych Gate (AH_12), a Protected Structure, are located immediately adjacent to Option B (Green). There is therefore potential for a direct impact on these architectural heritage constraints as a result of accidental damage from construction plant.

[39] Please note, this constraint is also a Protected Structure (RPS B14-07; tumulus); however, given the option is located within the Zone of Notification associated with the Recorded Monument (AY_26), a direct impact on the monument itself is not predicted and therefore, no direct impact has been identified on the Protected structure.

Should Option B (Green) require additional land take for construction, the removal of boundary features would have a direct impact on seven GDLs (Jenkinstown House; DL_02, Rodanstown House; DL_05, Rathcoffey House; DL_11, Firmount House; DL_14, Moatfield House; DL_15, Millicent House; DL_17, and Killashee House; DL_20).

Cultural Heritage

One post-medieval road bridge (CH_01) is located on the existing road through Culcommon. There is therefore potential for a direct impact on this cultural heritage constraint as a result of accidental damage from construction plant.

The excavation of the cable trench and joint bays may have a direct impact through the removal of any surviving remains associated with three cultural heritage sites (CH_08, CH_18 and CH_52). Direct impacts would result from the excavation of the cable trench and joint bays.

CH_03 is a public house located immediately adjacent Option B (Green). There is therefore potential for a direct impact on this cultural heritage constraint as a result of accidental damage from construction plant.

5.1.5.4.2 Construction - Indirect Impacts

Archaeology

No indirect impacts have been identified on archaeological constraints as a result of the construction of Option B (Green).

Architectural Heritage

This option is located within 44m of the following five Protected Structures:

- Rodanstown Church (AH_02);
- Donaghstown Catholic Church (AH_04; also assessed by the NIAH to be of Regional importance);
- Ballynagappagh (AH_11; also assessed by the NIAH to be of Regional importance);
- Millicent Church and Lych Gate (AH_12); and
- Millicent Estate Houses (AH_15).

While these potential impacts would result from the introduction of noise and visual intrusion into the setting of these constraints during construction from the movement and operation of plant, it is anticipated any intrusion would be temporary (lasting the duration of construction in each location) and, for all constraints except Rodanstown Church (AH_02), construction activities would be largely screened by established vegetation and intervening built features.

Cultural Heritage

Movement and operation of plant during the construction of Option B (Green) would have an indirect impact on the setting of 13 cultural heritage sites (CH_03, CH_09, CH_28, CH_30, CH_31, CH_37, CH_43, CH_46, CH_54, CH_55, CH_57, CH_58, and CH_59). However, it is anticipated any intrusion would be temporary (lasting the duration of construction in each location).

5.1.5.4.3 Operational Impacts

As the Proposed Project would be located beneath the road surface, and any offline sections would be reinstated after construction no impacts on archaeological, architectural or cultural heritage constraints have been assessed as a result of the operation of Option B (Green).

5.1.5.5 Summary of Assessment

While some potential impacts would be comparable to other route options, Option B (Green) would potentially have a direct impact on three Recorded Monuments (one of which is also a Protected Structure). Due to these potential impacts, Option B (Green) has been assigned a risk of '**Moderate (Dark Green)**'.

Moderate

A Route Corridor Summary Matrix for archaeology, architectural heritage and cultural heritage is provided in Appendix B.1.

As the project progresses it may be possible to avoid impacts on archaeology, architectural heritage, and cultural heritage constraints through design, including localised realignments of the route. Where impacts on archaeology, architectural heritage, and cultural heritage constraints cannot be avoided it is possible impacts could be reduced through recording in advance of, or during, construction, including the archiving and documentation of the results of this recording for public reference.

5.2 Socio-Economic

5.2.1 Traffic, Transport and Access

Option B (Green) runs partly through the centre and partly through the western portion of the Study Area, between the Woodland and Dunstown substations. The route option is mainly located along regional and local roads, with offline sections to the west of Maynooth, passing through the settlement of Rathcoffey, and to the west of Clane. The route option then follows the same alignment as Option A (Red) until west of Naas where it splits, avoiding the built-up area of the town before re-joining the alignment of Option A (Red) to the south of Naas.

Table 5.4 presents the break-down of road classifications for Option B (Green).

Table 5.4: Option B (Green) Road Classification

Option	Total Length (km)	Road Length Percentage Distribution		
		Regional	Local Roads and Smaller	Off-road and other Land Types
Option B	50.4	38.9	35.9	25.2

Option B (Green) has a similar alignment to Option A (Red) and is mainly located along regional and local roads, although in comparison to Option A (Red), Option B (Green) is running along regional roads for approximately half of its length whereas at least 30% of the route is within local and lower roads. It is noted that the access to the local roads during construction could be challenging for the construction vehicles.

The narrow local roads along Option B (Green) could pose a significant constraint to the use of the public highway to deliver construction materials. In attempting to use these roads, potential impacts include driver and pedestrian delay; increased fear of accidents; and severance effects for local communities and businesses.

It is anticipated that during the installation of cable works, construction would extend through a number of key junctions and roundabouts along Option B (Green), which could have significant impact in traffic disturbance. These sections are also identified in Section 5.4.2. Similar to the route sections there might be a requirement to temporarily divert traffic or restrict certain vehicle movements at these locations. Traffic management measures would be assessed on a case-by-case basis for each signalised junction and standard roundabout. It is noted that the number of the key junctions along Option B (Green) is the highest in comparison to the other potential route options.

Option B (Green) has the third highest number of properties, compared to the other options, within 0 to 50 meters of its centreline – approximately 327 properties.

It is noted that the proposed alignment could potentially impact among the least amount of community assets compared to the other options. In its close proximity it is anticipated that Option B (Green) could impact the access to the St. Joseph's National School in Mulhussey.

5.2.1.1 Summary of Assessment

Option B (Green) is within regional roads for 39% of its length, has the third highest number of properties within 50 meters along its route and passes next to only one school (which is less than the other options). This option presents a higher number of key junctions along the route compared to the other options. The use of regional roads will allow less full road closures as regional roads are generally wider and so lane closures with temporary traffic lights/stop-go systems can be put into place. Mitigation measures through consultation and traffic management will reduce the traffic impacts. The measures can include ensuring that the works do not disrupt access to the school and other receptors. Phasing of the works will be important to minimise disruption. This can be done by ensuring that works are completed at less busy times and are carefully planned to avoid road users being disrupted in multiple locations by construction teams in one journey. These measures will be designed at the next step in the Proposed Project. In terms of risk of traffic disruption, the Traffic, Transport and Access (Social) for Option B is assessed to be of **Moderate - High (Light Blue)**.

Moderate - High

5.2.2 Noise, Vibration and Air Quality

5.2.2.1 Noise and Vibration

5.2.2.1.1 Baseline

Option B (Green) runs partly through the centre of the Study Area and partly through the western portion of the Study Area between the Woodland and Dunstown substations. The route option is mainly located along regional and local roads with offline sections to the west of Maynooth and to the west of Clane. Offline or off-road sections are sections where the route option does not follow alongside a road but cuts across, for example, agricultural land. The route option then runs follows the route of Option A (Red) until west of Naas where it splits, avoiding the built-up area of the town, before re-joining the alignment of Option A (Red) to the south of Naas.

Baseline noise levels are likely to vary along this route option with higher noise levels likely closer to transport infrastructure and during periods of peak transport activity. The main noise source along this route option is from road traffic noise. Environmental Protection Agency (EPA) traffic noise data for Round 3 contained in EPA Maps[40] shows that traffic noise levels will be highest where the route option crosses the M4 and the M7 and where it runs alongside the R408 and the R448.

EPA railway noise data shows that where the route option crosses the Dublin to Cork railway line rail noise levels are elevated.

5.2.2.1.2 Methodology

The noise and vibration assessment at this stage of the Proposed Project involves gaining an appreciation of the baseline noise environment close to each of the proposed route options and identifying noise and vibration sensitive receptors within distance bands up to 300m from each of the proposed routes. Noise impacts from construction activities do not normally occur beyond 300m and vibration impacts do not normally occur beyond 100m. The locations of major crossings where Horizontal Directional Drilling (HDD) is likely to be required and off-road sections where noise impacts are likely to be greater compared to on-road sections is also used to assess each route in terms of the noise risk according to the multi criteria analysis at Step 4A. The risk scale is as follows:

- High: dark blue;
- Moderate-high: blue;
- Moderate: dark green;
- Low-moderate: green; and
- Low: cream.

No baseline noise surveys were undertaken, and no noise modelling was undertaken at this stage of the Proposed Project. However these will be completed at Step 5 of the Proposed Project.

5.2.2.1.3 Noise and Vibration Sensitive Receptors

Table 5.5 shows the residential property counts in property counts in distance bands up to 300m from the proposed route. Overall there are a total of 743 sensitive receptors within 300m of the proposed route.

Table 5.5: Residential Property Counts within 300m of Option B (Green)

Option	No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	No. of sensitive receptors 100-200m	No. of sensitive receptors 200-300m	Total no. of receptors within 300m
Option B	327	118	175	123	743

As well as residential properties there are other sensitive receptors within 300m of the proposed route which are not included in the above counts including:

- St. Joseph's National School;
- Millicent Golf Club;
- Several equine operations;
- Gaelscoil Nás Na Ríogh School;
- Piper's Hill College;
- St. David's National School; and
- Killashee National School.

[40] https://gis.epa.ie/EPAMaps/

5.2.2.1.4 Potential Noise and Vibration Impacts

Areas of Potential Horizontal Directional Drilling (HDD)

There is greater potential for adverse noise and/or vibration impacts at sensitive receptors where construction activities would occur over a longer period, e.g. at trenchless crossings. It is recognised that certain construction activities at certain trenchless crossings could be required to take place outside of normal working hours, which would increase the likelihood of adverse noise effects occurring. In addition, certain potential trenchless crossing techniques that may be employed (e.g. HDD) also have the potential to cause adverse vibration effects at nearby receptors.

There is potential for adverse impacts at receptors within 300m of HDD works and there could be six major crossings on Option B (Green). An initial assessment has shown there are the potential for adverse noise impacts at Lyreen_020, the M4 Motorway, the Dublin-Cork railway line, and the M7 Motorway.

Offline Sections

For the majority of the proposed route option, the underground cables are expected to be installed using 'Open Cut' techniques. Where 'Open Cut' works are undertaken adjacent to the existing road network, there is a relatively low potential for temporary impacts due to construction noise. This is due to the relatively high levels of local environmental noise that are typically experienced adjacent to roads. Also, as the works are expected to progress in sections, noise levels at any receptor would only be elevated for a relatively short period of time. However, where 'Open cut' works are undertaken in relatively quiet areas (such as offline sections) close to sensitive receptors there is the potential for temporary impacts due to construction noise.

Table 5.6 shows the total length, the total offline length and whether there are receptors within 300m of the offline route for Option B.

Table 5.6: Total length and offline length for Option B

Option	Total Length (km)	Offline Length (km)	Receptors within 300m of offline section
Option B	50.4	10.5	Yes

The table above shows that the route option goes offline for approximately 10.5km of its total length where there is a greater potential to result in adverse noise effects at receptors compared to where works are undertaken adjacent to existing roads.

5.2.2.2 Summary of Assessment

There are relatively small numbers of receptors within 300m of Option B, there is 10.5km of potential offline construction activity and there are receptors within 300m of potential major crossings such as HDDs at six crossing points with the potential to experience adverse noise and/or vibration effects, therefore it is appropriate to give a score of **'Low-Moderate (Light Green)'.**

Low-Moderate

5.2.2.3 Air Quality

5.2.2.3.1 Baseline

Option B (Green) runs partly through the centre of the Study Area and partly through the western portion of the Study Area between the Woodland and Dunstown substations. The route option is mainly located adjacent to regional and local roads with offline sections (i.e. not adjacent to roads) to the west of Maynooth and to the west of Clane. The route option then runs follows Option A (Red) until west of Naas where it splits from the Option A (Red) route, avoiding the built-up area of the town before re-joining the Option A (Red) route to the south of Naas.

Baseline air pollutant concentrations are likely to vary along this route option. Higher concentrations are likely closer to transport infrastructure and where the route option is closer to larger settlements. The main air quality sources along this route option are from road traffic, particularly where the route option crosses the M4 and the M7.

The Air Quality Index for Health across the Study Area[41] is Good (with an index score ranging from 1-3). The majority of the Study Area, as defined by the EPA[42], is located within Air Quality Zone D – Rural Ireland apart from locations in Naas, which are within Air Quality Zone C – other cities and large towns.

5.2.2.3.2 Sensitive receptors

Human and ecological receptors are consistent with those listed in Section 4.2.2.3.

The Institute of Air Quality Management (IAQM) dust guidance[43]. has been adapted for the purposes of this assessment. The number of residential properties and schools have been counted and identified as receptors. Table 5.7 shows the human receptor count within 300m of each of Option B (Green).

Table 5.7: Residential Property Counts within 300m of Option B (Green)

Option	No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	No. of sensitive receptors 100-200m	No. of sensitive receptors 200-300m	Total no. of receptors within 300m
B	327	118	175	123	743

Overall, there are a total of 743 residential receptors within 300m of Option B (Green).

As well as residential properties there are other sensitive receptors within 300m of the proposed route option which are not included in the above counts including:

- St. Joseph's National School;
- Gaelscoil Nás Na Ríogh School;
- St David's National School;
- Piper's Hill College; and
- Killashee National School.

[41] Environmental Protection Agency (EPA), Air Quality Index for Health, https://airquality.ie/information/air-quality-index-for-health, accessed October 2021.
[42] Environmental Protection Agency (EPA), Air Quality Zones, https://airquality.ie/information/air-quality-zones, accessed October 2021.
[43] Institute of Air Quality Management. 2016. Guidance on the assessment of dust from demolition and construction. Version 1.1. http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf

With regard to ecological receptors, Option B (Green) crosses the Royal Canal pNHA and the Grand Canal pNHA. Therefore, these are in close proximity (i.e. less than 20m) from the route option.

5.2.2.3.3 Assessment Criteria

The main criteria used for the assessment of each option is set out in Section 4.2.2.3.3.

5.2.2.3.4 Potential Impacts

The potential impacts are consistent with those set out in Section 4.2.2.3.4.

Table 5.8 shows the number of receptors, the sensitivity to dust soiling and the risk score.

Table 5.8: Potential air quality impact for Option B (Green)

No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	Sensitivity of section to dust soiling	Risk score
327	118	Medium	1.8

For Option B (Green) most of its length is classed as low or medium sensitivity areas apart from around Mulhussey and west of Clane, which have a slightly higher receptor count and are classed as high sensitivity areas.

5.2.2.4 Summary of Assessment

Option B (Green) has the third most receptors within 50m but has higher numbers around Mulhussey and west of Clane. Option B (Green) passes three schools and crosses over two pNHA (Royal Canal pNHA and Grand Canal pNHA (twice). Therefore, an overall risk score of **Low-Moderate (Light Green)** has been applied.

Low-Moderate

5.2.3 Visual

There is the potential for visual impacts at scenic designations, residential dwellings and along public roads, with scenic designations carrying a greater potential for risk.

5.2.3.1 Scenic designations

No scenic designations were identified within the portion of the Study Area that occurs within County Meath.

Included in Table 14.4 of Chapter 14 (and indicated on Map 14.2) of the Kildare County Development Plan are:

> *'12 "principal landscape sensitivity factors": Major Rivers and Water bodies; Canals; Ridgelines; Green Urban Areas; Broad-Leaved Forestry; Mixed Forestry; Natural Grasslands; Moors and Heathlands; Agricultural Land with Natural Vegetation; Peat Bogs; Scenic View; and Scenic route'.*

This route option will pass within 300m of the following '*principal landscape sensitivity factors*' related to scenic designations (from north to south):

- Royal Canal View RC8 ('Jackson's Bridge' L5041);
- River Liffey view RL6 ('Millicent Bridge'); and

- Grand Canal view GC33 ('Limerick Bridge').

5.2.3.1.1 Sensitivity - scenic designations

The sensitivity of these '*principal landscape sensitivity factors*' are recorded in Table 5.3.

5.2.3.1.2 Magnitude of impacts - scenic designations

Royal Canal View RC8 ('Jackson's Bridge' L5041): There is a direct line of sight from the bridge towards the canal crossing point of this route option c.300m away, but there is an existing high voltage overhead line crossing the canal at c.150m so the view is already characterised by infrastructure. Construction activity is likely to be visible from this bridge; therefore, the magnitude of impact during the construction phase is deemed to be low, but during the operational phase, it is deemed to be low-negligible as a crossing such as a cable bridge (to be determined at next step of the project) may be visible.

River Liffey view RL6 ('Millicent Bridge'): View from the bridge towards the route option is obscured by riparian vegetation on the west bank of the river; therefore, the likely magnitude of impact is negligible during both the construction and operational phases (assuming riparian vegetation along the west bank of the River Liffey is to be retained, and protected by a Root Protection Zone during construction).

Grand Canal view GC33 ('Limerick Bridge'): This bridge is heavily visually enclosed by vegetative screening; therefore, the likely magnitude of impact is deemed to be negligible during both the construction and operational phases.

5.2.3.1.3 Significance of impacts - scenic designations

The impacts identified on Royal Canal View RC8 ('Jackson's Bridge' L5041) are of a low magnitude during the construction phase. The impacts identified during the operational phase are low-negligible therefore is considered, by default, to have a significance of effect that is **Slight**. The impacts identified on River Liffey view RL6 ('Millicent Bridge') and Grand Canal view GC33 ('Limerick Bridge') are of a negligible magnitude during the construction and operational phase; therefore, all are considered, by default, to have a significance of impact that is **Imperceptible**.

Table 5.9: Summary - Principal Landscape Sensitivity Factors within County Kildare – scenic designations

Principal Landscape Sensitivity Factor	Risk - Direct Impacts (Constraints Study)	Risk – Impacts Within 300m (Constraints Study)	Specific feature	Sensitivity of feature	Likely operational magnitude of effect	Likely operational significance of effect
Scenic View	High	Moderate-High	Royal Canal View RC8 ('Jackson's Bridge' L5041)	High	Low-Negligible	Slight
Scenic View	High	Moderate-High	River Liffey view RL6 ('Millicent Bridge')	High	Negligible	Imperceptible
Scenic View	High	Moderate-High	Grand Canal view GC33 ('Limerick Bridge')	High	Negligible	Imperceptible

5.2.3.2 Summary of Assessment

The assessment of the potential or significant visual impacts as a result of Option B (Green) can be summarised by the following points:

- Potential for visual impacts at residential dwellings and along public roads;
- Potential visual impacts at Royal Canal View RC8 ('Jackson's Bridge' L5041) during construction and operational phases, but the magnitude of the impact is not likely to be greater than Low, therefore no significant visual impacts are anticipated.

As such, the attributed score is **Low-Moderate (Light Green)**.

Low - Moderate

5.2.4 Amenity

This section outlines the likely impact on the amenity of residential, commercial, community (and recreational), and tourism receptors, collectively, by way of consideration of contributing environmental effects. Issues of access and severance are outlined in Section 5.2.1. All residential, commercial, and community (and recreational) receptors are shown in Figure C.1.2 in Appendix C.1.

The alignment of Option B (Green) passes through both rural and urban areas along its length, as outlined in Section 3.2.2. Table 5.10 lists the known commercial and community receptors that are situated immediately adjacent to the route alignment (this list is not exhaustive but represents a high-level analysis for the purposes of informing the Step 4A selection process). No tourism receptors (i.e. receptors whose main function is aimed at visitors to its locality) were encountered along the alignment of Option B (Green), while one-off or ribboned residential receptors are located along all sections of the route (outwith off-line sections). Option B (Green) is also routed in close proximity or within a number of built-up areas, such as directly through the centre of Rathcoffey village and the western side of Naas.

Table 5.10: Known Commercial and Community Receptors Adjacent to the Alignment of Option B (Green)

Commercial receptors:	Community receptors:
Barstown Business Park;	St Joseph's National School;
Hatchet Inn (and associated filling station);	Royal Canal;
Robinson Farm Agrifoods;	Millicent Golf Club;
Farrington's Mill Restaurant;	Gaelscoil Nás Na Ríogh;
Glanbia Agrifoods;	Piper's Hill Montessori School;
Firmount House;	Piper's Hill College (Secondary School);
Kerry Group Global Centre;	St David's National School
Irish Commercials (and Volvo Trucks);	Killashee National School
Applegreen Millennium Park;	
LIDL (Naas)	

Outlined below are details of potential impacts considered likely during the construction of Option B (Green) according to each environmental effect, with a concluding paragraph summing up the overall impact on amenity. Given that the Proposed Project would be underground, there are no operational impacts anticipated on amenity.

Table 5.11 outlines the assessment ratings and associated justifications for each of the contributing environmental effects that, when in-combination, may result in an impact on amenity.

Table 5.11: Ratings and Associated Justifications for Environmental Effects Contributing to Potential Impact on Amenity

Air Quality	Noise (and vibration)	Visual	Traffic and Transport
Option B (Green) has the third most receptors within 50m but has higher numbers around Mulhussey and west of Clane. For Option B (Green) most of its length is classed as low or medium sensitivity areas apart from around Mulhussey and west of Clane, which have a slightly higher receptor count and are classed as high sensitivity areas. The option has five schools within 300m.	Relatively fewer noise sensitive receptors impacted compared to other options. Construction noise and vibration impacts temporary in nature, no permanent impacts expected.	(i) Potential for visual impacts at residential dwellings and along public roads.(ii) Potential visual impacts at Royal Canal View RC8 ('Jackson's Bridge' L5041) during construction and operational phases, but the magnitude of the impact is not likely to be greater Low. No significant visual impacts are anticipated.	Option B (Green) is within regional roads for approximately 39% of its length. It requires more full closures than Route A and D with a few options for traffic diversion. Higher number of key junctions along the route compared to the other options. It has the third highest number of properties within 0-50m (327) and will heavily disrupt traffic and access with Rathcoffey. It passes the access to St. Joseph's National School in Mulhussey.

5.2.4.1 Summary of Assessment

In relation to the assigned scoring for potential effects relating to Air Quality, Noise (and vibration), Visual and Traffic and Transport, it is considered likely that, in a worse-case scenario, there is the potential for considerable but not significant impacts on amenity. Therefore, a scoring of **Moderate (Dark Green)** has been assigned. For more information in relation to the potential impacts of Option B (Blue) in relation to any of these environmental effects, please see Section 5.2.1 to Section 5.2.3.

Moderate

5.2.5 Health

The Study Area is largely considered to be 'marginally above average' in terms of the deprivation indices provided for my Pobal (Pobal, 2016[44]), however there are some Electoral Divisions (EDs) within the Study Area are considered to be 'affluent', such as Maynooth, Straffan, Donaghcumper, Naas Rural, Ladytown, and Newtown. According to the Institute of Public Health (in Ireland), people in higher socio-economic groups are at lower risk of chronic conditions and associated disability than those in lower socio-economic groups (Institute of Public Health, 2020[45]).

Using the outcomes of the amenity assessment as reported in Table 5.11, it is considered unlikely that the construction of Option B (Green) would result in significant impacts on human health. This is primarily because processes and activities required during construction of the Proposed Project are temporary in nature, while the nature and scale of the Proposed Project means that construction activity would occur at any one location for a limited time; thereby not significantly impacting human health.

[44] https://maps.pobal.ie/WebApps/DeprivationIndices/index.html
[45] https://publichealth.ie/wp-content/uploads/2020/04/20200416-AGEING-PUBLIC-HEALTH-MAIN.pdf

5.2.5.1 Summary of Assessment

In light of the above findings, a scoring of '**Low (Cream)**' has been assigned for the consideration of potential impacts on Human Health.

Low

5.2.6 Employment and Economy

During construction and operation, potential impacts on employment and the national, regional and local economy are anticipated to be similar among each of the proposed route options given that they are all similar in nature, extent and scale, are located in close proximity to one another, and within the same Study Area.

The potential impacts on employment and the national, regional and local economy are the same as that outlined in Section 4.2.6.

5.2.6.1 Impacts on the Tourism Sector

Similarly to the potential impacts on employment and the national, regional and local economy, potential impacts on the tourism sector are anticipated to be similar among each of the proposed route options given they are all similar in nature, extent and scale, are located in close proximity to one another, and within the same Study Area.

The potential impacts on the tourism sector are the same as that outlined in Section 4.2.6.2.

5.2.7 Land-use (and Land Take)

Option B (Green) is 50.4km in length, with the vast majority of its alignment being routed along regional and local roads between Woodland substation and Dunstown substation. Some sections of the route alignment are not routed along roadways however and are instead aligned across open agricultural land. Approximately 10.5km of Option B (Green) is routed through open greenfield land, largely classed as 'pastures or non-irrigated land' according to 2018 Corine Land Class data. The impacts on agricultural land (including land-take) are considered in Section 5.2.8.

Given the similarities around construction methodology and subsequent land-take requirements in respect to people and communities, the potential impacts in regard to land-use (and land-take) are the same as those outlined in Section 4.2.7 and thereby assigned a similar rating of **'Low (Cream)**'.

Low

5.2.8 Agriculture (including Equine)

The potential impacts on agriculture are addressed in general in Section 4.2.8. This Section addresses the impacts of Option B (Green).

The Option B (Green) crosses mineral soils along its entire length avoiding significant areas of peat to the west. From Woodland Substation to Dunstown Substation there are sixteen high sensitive enterprises located along

Option B (Green) – thirteen equine enterprises, three dairy enterprises and one horticultural enterprise. Option B (Green) will cross agricultural land for approximately 10.6km (21% of the entire length) and will cross one high sensitivity dairy farm adjoining the Sallins Bypass, the north east part of one very high sensitive stud farm in Rathasker and the centre of one very high sensitive stud farm in Moyglare.

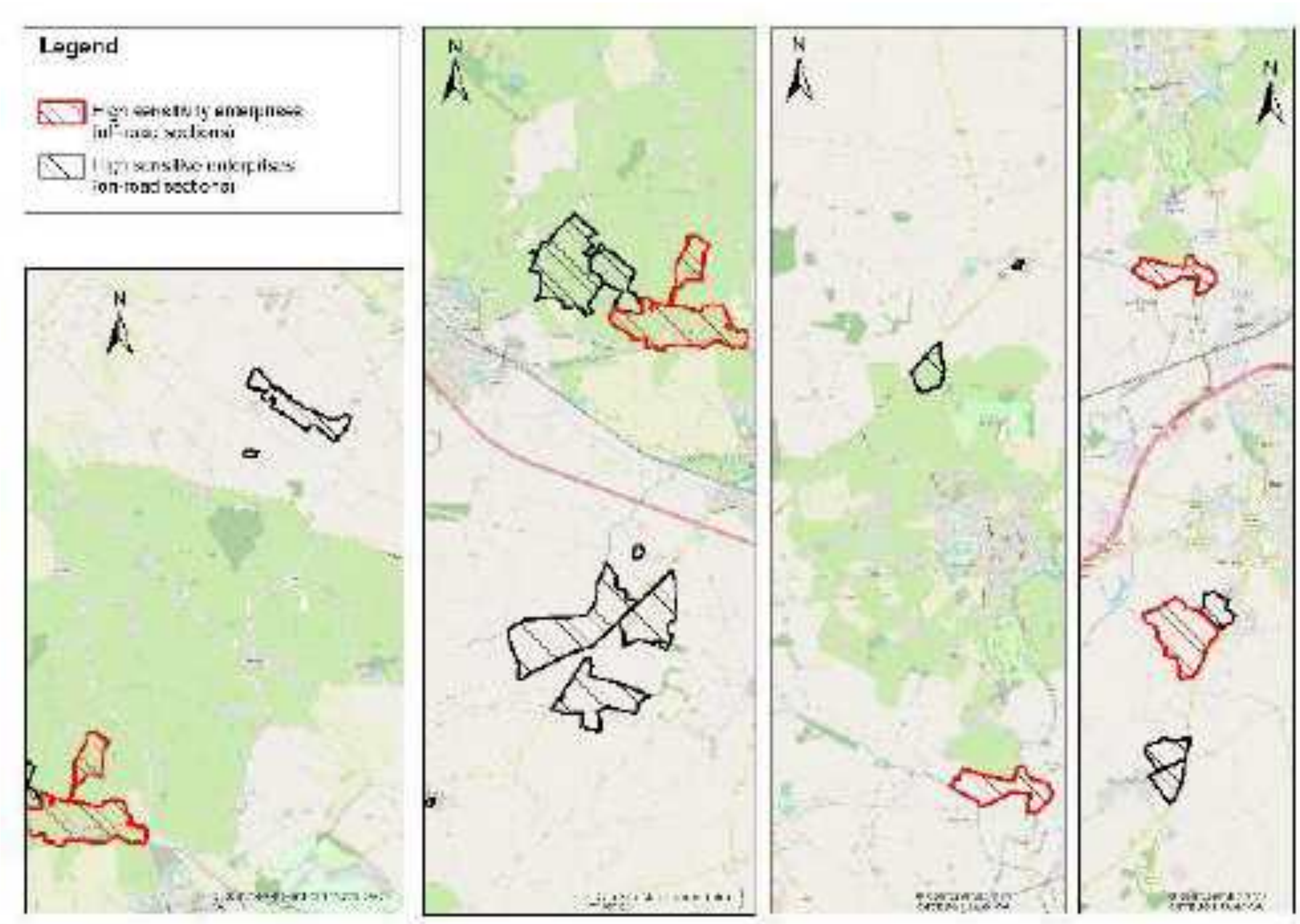

Figure 5-1: High sensitivity enterprises affected by Option B (Green)

5.2.8.1 Summary of Assessment

The ranking score for Option B (Green) is considered to be **'Low-Moderate'** given the moderate length across agricultural land and the low-moderate number of high sensitive enterprises it impacts.

Low-Moderate

5.2.9 Utilities

There are numerous underground utilities in the regional road network between Woodland and Dunstown, including other electricity cables; telephone and broadband cables; sewers; and public and private water supplies. The public water supply is extensive in the area, with the network predominately using the road network for local residential supply while other larger mains being located off-road in agricultural land. There is no known group water supply with protected areas within the Study Area.

The assessment of Option B (Green) has found that it crosses existing fibre cables (twice), existing medium pressure gas pipelines (eight times), existing water supply network (62 times) and existing wastewater network (five times). The counts of crossing locations include points within the same roads. For example, Option B (Green) meets the medium-pressure gas network in five locations with multiple crossings within these sections. The four locations are at R148 (Kilcock to Maynooth); on the R403 (Clane to Prosperous road); Millennium Parkway, R445, and R448 (roads within Naas). The crossing through the settlement of Rathcoffey will also increase the complexity due to the number of services, access, and dwellings. However, because of the layout of gas network crossing from one side of the road to the other, it is counted as eight crossings.

It is expected that all utilities encountered during construction will either remain in-situ or, where absolutely necessary, appropriate diversions or modifications carried out (with the permission of the respective provider) so as to ensure disruption to surrounding communities is kept to a minimum. Any required service disruption will only be permitted for an agreed set period of time per day (generally a set number of hours) and will not be permitted to be continuous for full days at a time. Any required disruptions will be carefully planned so as to ensure that the duration of disruption is minimised in so far as is possible.

5.2.9.1 Summary of Assessment

Given the number of utility interfaces along the length of Option B (Green), along with the potential for disruption to people and neighbouring communities, it is appropriate to assign a score of **'Low-Moderate (Light Green)'**.

Low-Moderate

5.3 Technical

As set out in Section 2.3.3, the topic areas under consideration to assist with determining the best route option are as follows:

- General Compliance with System Reliability, Security Standards;
- Headroom;
- Maintainability;
- Technology Operational Risk;
- Average Reliability Rates; and
- Repeatability.

5.3.1 General Compliance with System Reliability, Security Standards

This is EirGrid's reliability and security standards are defined in the Transmission System Security and Planning Standards and their Operation Security Standards.

All technical input to the Proposed Project will comply to EirGrid's Standards for Security and Reliability. Therefore, there is no differentiation between the proposed route options and route Option B has been assigned a score of '**Low (Cream)**'.

Low

5.3.2 Headroom and Ratings Impact

Headroom is the amount of additional capacity each route option offers that would be available for the future without requiring further upgrade. All the proposed route options carry little additional headroom (spare current capacity) due to the nature of the corridor therefore giving no technical differentiation between the proposed routes in this aspect.

The current ratings bottleneck is the impact on the overall circuit ratings of the worst-case deepest obstacle crossing. As all the proposed route options will require some deep crossing solutions (below railways, motorways, rivers or a combination) of similar design, these will be the ratings bottleneck of that particular route. The connection spans north to south, whilst major natural and man-made obstacles are east west orientated, therefore all options cross the river Liffey, the railways, the M4, etc;

On account for the potential total number of Horizontal Directional Drills, Option B (Green) has been assigned a score of **Low (Cream).**

Low

5.3.3 Maintainability

This considers the ease with which the route option can be serviced and maintained, for example how easy it is to access joint bays and link boxes.

All the proposed route options will be developed with the same design principles. For example, maximum standing sheath voltages, typical trench cross-section, separation between joint bays, location of link boxes (underground in chambers or pillar mounted), same substation entry locations. Whilst some route options come with a greater proportion of off-road build as opposed to road, with the level of design detail available at this stage, is not possible to substantially differentiate between the proposed route options.

As there is no differentiation between the proposed route options and route Option B has been assigned a score of '**Low (Cream)**'.

Low

5.3.4 Technology Operational Risk

This criterion aims to capture the risk of operating different technologies on the network.

The same technology is applied to all solutions including cables, joint bays, and bonding. All technology will be the standard technology in the industry and also the dominant technology on EirGrid's existing network (i.e. XLPE insulated underground cables). Therefore, there is no differentiation between the proposed route options and route Option B (Green) has been assigned a score of '**Low (Cream)**'.

Low

5.3.5 Average Reliability Rates

This is the likelihood of the chosen cable technologies such as cables, joint bays, and bonding failing during operation. All cable technology listed above are common to all route options.

Industry data on Cross-Linked Polyethylene (XLPE) insulation technology indicates that cable failures on a statistical basis are related to cable length.

The proposed route options lengths are as per Table 4.17, Section 4.3.5 (all values are based on desktop surveys).

The small percentage difference between the lengths of the proposed route options does not trigger any substantial increase in the risk of failure. Furthermore, there is not currently sufficient technical detail, at this point, to determine the number increase of joint bays of each route against the shortest (Option C).

Therefore, there is no discernible differentiation between the solutions and route Option B (Green) has been assigned a score of '**Low (Cream)**'.

Low

5.3.6 Repeatability

Repeatability is whether the proposed technical solution can be readily repeated in the transmission network.

All the proposed route options will be developed with the same design principles; therefore, all route options are easily repeatable across the transmission network. Therefore, there is no differentiation between the proposed route options and route Option B has been assigned a score of '**Low (Cream)**'.

Low

5.4 Deliverability

5.4.1 Design Complexity

There are 13 surface waterbodies crossed along the length of Option B (Green), some of which are crossed more than once; therefore there will be 21 crossings in total. These waterbodies will be crossed in a variety of different ways in order to minimise the environmental impacts, and to ensure construction and operational efficiency. Option B (Green) also has the second most amount of off-road sections (10.5km approximately), thus interface with private assets is increased.

The utilities crossings are assessed in Section 5.2.9 of this report. Option B (Green) meets the medium-pressure gas network in five locations with multiple crossings within these sections. The four locations are at R148 (Kilcock to Maynooth); on the R403 (Clane to Prosperous road); Millennium Parkway, R445, and R448 (roads within Naas). The crossing through the settlement of Rathcoffey will also increase the complexity due to the number of services, access, and dwellings. Option B (Green) will require six major crossings (such as HDD), which is the same number as Option A (Red) and less than Options C (Orange) and D (Blue).

Option B (Green) has been assigned a score of **Moderate (Dark Green)**.

Moderate

5.4.2 Traffic Disturbance

Option B (Green) is very similar to Option A (Red) but differs in the section between the R156 to the north of the Clane. Where Option B (Green) follows the road network, it is anticipated that full road closures might be required at the following locations:

- L6207 from Ribstown through Cullendragh to Barstown Junction with the R156 an overall distance of 2,460 meters. In this location the carriageway is between 2.5 and 4.0 meters wide and does not allow adequate space for vehicles to pass the construction works safely;
- R125 from Mullagh Junction with the R156 through to the Balfeaghan roundabout, an overall distance of 7,580 meters. At this location, the carriageway is between 4.0 meters and 7.0 meters wide which will be reduced to 2.0 meters wide once the construction work commences. Once below 2.5 meters wide a full road closure is required. Note, it is accepted that this might not be required for the full length;
- Moyglare Stud Farm to Moyglare Road Junction, an overall distance of 225 meters. In this location the carriageway is between 2.5 and 3.0 meters wide. Therefore, there is insufficient space for vehicles to safely pass;
- From Timard to Laraghbryan West is a section of road that is 1,170 meters long that is sandwiched between the option running across fields. In this section the road is between 2.5 and 3.5 meters wide and it is expected the construction works to take up all this width of road;
- From Crinstown to the R408 Junction with the L5042, a distance of 1,015 meters. The road width is between 3.0 and 5.5 meters. Once the construction works commences this may leave not space for traffic to pass safely; and
- At the end of Option B from the Stephenstown South Junction the R412 through to the Dunstown Substation including turn off, a distance of 1,240 meters. Here the road has a width of 3.0 meters before any construction works commences and it is expected the construction works will take up most of the width of the road, therefore requiring a full road closure.

In other areas of Option B (Green), the road width will be reduced to a minimum of 3.0 meters by the proposed construction works. In these areas it is anticipated that there might require a lane closure with diversions for HGV vehicles:

- R408 Junction at Crinstown to the Junction of the R408.

All the remaining roads along Option B (Green) might require lane closures with the correct traffic management in place to allow the construction works to be carried out, specifically:

- From Barstown Junction with the R156 to the Jenkinstown Junction;
- From Jenkinstown Junction to the Mulhussey Junction adjacent to castle;
- From Sallins Bypass from North to South;
- At M7 crossing South to the R409 Ploopluck roundabout; and
- From the R409 Ploopluck roundabout to the Southern Link Business Park roundabout.

Table 5.12 below provides a high-level summary on the proposed traffic management plans during installation for Option B (Green). It is recommended that following the selection of the proposed route option, a detailed analysis to be undertaken with regards to phasing of road closures.

Table 5.12: Summary of Option B Traffic Management

Option B	Total Length (in km)	Lane Closures (in km)	HGV Diversions (in km)	Road Closures (in km)	Field Crossings (in km)
	50.4	10 (20%)	11.2 (22.4%)	14.7 (29.3%)	10.6 (21%)

In terms of traffic disturbance, a Moderate score has been assigned to Option B (Green) based on the Traffic Management which is anticipated to be required during construction works.

For the Option B (Green), in each section requiring a lane closure 'with' or 'without' HGV, diversions are mostly available while at all times maintaining access for local residents. It is anticipated though that few road sections are likely to require full closure and there may not be suitable diversions for the through traffic along the length of the option.

Where suitable diversions for through traffic are available along the length of the route, the average installation rate is anticipated to be 80 meters per day, resulting in approximately two years to install this route option.

The exact location of the cable trench will be defined later in the project and this will depend on further design, surveys, consultation, and assessment. Consultations with the local authorities will help to define where the cable trench will go in the road to minimise disruption. For example, if a safe alternative could be provided for access with significant disruption for pedestrians, a footpath could be used to minimise disruption to the road network.

Option B (Green) follows a similar alignment to Option A (Red) but differs in the section between the R156 to the North of Clane, located along local roads and fields. It requires more full closures than Option A (Red) and Option D (Blue) with a few options for traffic diversion. In terms of traffic disturbance related to the Traffic Management, Option B (Green) has been assessed as **Moderate (Dark Green)**.

Moderate

5.4.3 Dependence on Other Infrastructure Projects

As outlined in Chapter 1 of this report, all route options will have the same dependence on works required at the associated substations in terms of connections. In terms of other infrastructure projects in the area, similar crossing of existing motorways, railways and canals are required. All four of the proposed route options will cross the same infrastructure but, in some cases, in different locations. All four route options will cross or run parallel with utilities, including water mains and the low to medium pressure gas network.

All four of the proposed route options will cross the proposed Water Supply Project[46] and therefore it is not considered a differentiator as outlined in Section 4.4.3.

Option B (Green), Option C (Orange), and Option D (Blue) will cross the proposed DART+ West railway line at the crossing point of the Dublin Sligo railway line. This project proposes the electrification and re-signalling of the Maynooth line and construction of a new DART depot facility west of Maynooth for the maintenance and parking of trains. West of Maynooth, the rail track will be upgraded to a twin-track between Maynooth and the proposed depot. This twin track configuration will divert offline to the south, running parallel to the existing railway on the approach to the proposed depot. The planning application is expected to be made to An Bord Pleanála in 2022, with construction possible in 2025. At this location, it is proposed that Options B (Green), Option C (Orange), and Option D (Blue) will cross the existing railway line with a major crossing (such as HDD). The proposed DART+ West project will require a long crossing and additional studies and shielding to ensure that there are no electro-magnetic forces issues between the Kildare-Meath Grid Upgrade project and the electrified line.

At this stage, it is not considered that there would be any conflicts between the two projects and both could be constructed without significant constraint. It is possible that both projects would be at construction at the same time and additional consideration would be needed to the cumulative effects, if Options B (Green), Option C (Orange), or Option D (Blue) were selected as the Emerging Best Performing Option.

Option B (Green) has been assessed as **Moderate (Dark Green)** in terms of dependence on other infrastructure projects.

Moderate

5.4.4 Permits and Wayleaves

At this stage of the assessment, all route options will have a similar issue with permits. However, Option B (Green) has a greater amount of off-road sections and will have greater requirements for wayleaves than Options A and D but less than Option C. As such, Option B has been assessed as **Moderate (Dark Green)**.

Moderate

46 http://www.watersupplyproject.ie/

5.4.5 Implementation Timelines

This route option is the second shortest of the four proposed route options however it requires more full closures than Option A (Red) and Option D (Blue) with a few options for traffic diversion. There are higher numbers of key junctions along this route option compared to the other route options. Construction through the settlement of Rathcoffey will also increase timescales due to the complex nature of construction.

Option B (Green) has been assigned a score of **Moderate (Dark Green)** for this criterion.

Moderate

5.4.6 Combined Deliverability Performance

Considering the design complexity, traffic disturbance, impact dependence and implementation timelines, a rating of **'Moderate' (Dark Green)** has been assigned. Option B has generally scored well (Moderate) over all but one of the Deliverability sub-topics (traffic disturbance has been assigned a Moderate-High).

Moderate

5.5 Economic

As set out in Section 2.3.4, the topic areas under consideration to assist with determining the best route option are as follows:

- Length of installed cable;
- Quantity of Minor and Major service crossings; and
- Number of Major Crossings (such as Horizontal Directional Drills.)

5.5.1 Length of Installed Cable

The first economic assessment is from the overall lengths of the cable routes (presented in Table 4.17, Section 4.3.5). From this, Option B (Green) has a total length of 50.4 km which is 8% longer than the shortest route (Option C (Orange)) and therefore it can be assumed to have 8% more of an economic impact in this aspect.

For this reason, route Option B (Green) has been assigned a score of **Moderate (Dark Green).**

Moderate

5.5.2 Quantity of Crossings

An assessment of both the minor and major crossings expected to be encountered for the cable route options has been carried out by categorising them into the different crossing types (presented in Section 2.3.3.2). Summaries of these are listed below where Type 1 has the lowest impact and Type 4 has the highest:

- Type 1 Crossings – shallow crossings (utility/drainage/other) – deeper installation;
- Type 2 Crossings – shallow water crossings (Open cut solution);

- Type 3 Crossings – larger water crossings (Cable bridges/culverts/micro tunnels); and
- Type 4 Crossings – large crossings (Horizontal directional drills/ Auger bores or tunnel solutions).

It has been found that Option B (Green) has the second most Type 1, Joint most Type 2, no Type 3, and joint least Type 4. For this reason, Option B (Green) has been assigned a score of **Low (Cream).**

Low

5.6 Summary of Option B (Green) Assessment

5.6.1 Environment Summary

Option B (Green) has been scored as **Low-moderate (Light Green)** overall. There are a range of scores across the environmental topics including a Low score for Planning Policy and Land Use. This Option interacts with less LAP zonings than Option A (Red) as it avoids Kilcock. The environment topics score lower than Option A (Red) and that is reflected in the lower combined performance score. The cultural heritage score is Moderate as there are two more Recorded Monuments (one of which is also a Protected Structure) in proximity to the route option. A summary of the environmental appraisal of Option B (Green) is provided in Table 5.13.

Table 5.13: Summary of Environment Assessment for Option B (Green)

Biodiversity	Soils and Water	Planning Policy and Land Use	Landscape	Archaeology, Architectural Heritage, and Cultural Heritage	Combined Environment Score
Moderate-High	Low-Moderate	Low	Low-Moderate	Moderate	Low-Moderate

5.6.2 Socio-Economic Summary

While Option B (Green) travels through the settlement of Rathcoffey, the route option overall is largely considered to have a lower level of social impact than Option A (Red) however in combination, the combined social impact is likely to be similar. As such a risk scoring of 'Moderate' (Dark Green) has been assigned. A summary of the socio-economic appraisal of Option B (Green) is provided in Table 5.14.

Table 5.14: Summary of Socio-economic Assessment for Option B (Green)

Traffic and Transport	Noise and Vibration	Air Quality	Visual	Amenity	Health	Employment and Economy (and Tourism)	Land Use (and Land-take)	Agriculture (including Equine)	Utilities	Combined Socio-economic Score
Moderate –- High	Low-Moderate	Low-Moderate	Low-Moderate	Moderate	Low	Low	Low	Low-Moderate	Low-Moderate	Moderate

5.6.3 Technical Summary

At this stage in the Proposed Project are there no technical differentiations apart from the number of major crossings. Options A (Red) and B (Green) will have two fewer than Options C (Orange) and D (Blue). Other technical factors will have no impact on the selection of the best performing option. Option B (Green) has been assessed to have a **Low (Cream)** score for the technical criterion.

Table 5.15: Summary of Technical Assessment for Option B (Green)

General Compliance	Headroom	Maintainability	Technology Operational Risk	Average Reliability Rates	Repeatability	Combined Technical Score
Low	Low	Low	Low	Low	Low	Low

5.6.4 Deliverability Summary

Considering the design complexity, traffic disturbance, impact dependence and implementation timelines, a rating of **'Moderate' (Dark Green)** has been assigned. Option B (Green) has generally scored well (Moderate) over all but one of the Deliverability sub-topics (traffic disturbance has score a 'Moderate-High'). Further design assessment work and consultation with the County Councils will be undertaken at the next stage of the Proposed Project to minimise the disturbance.

Table 5.16: Summary of Deliverability Assessment of Option B (Green)

Design complexity	Traffic disturbance	Dependence on other infrastructure projects	Permits and wayleaves	Implementation Timelines	Combined Deliverability Score
Moderate	Moderate-High	Moderate	Moderate	Moderate	Moderate

5.6.5 Economic Summary

At this stage in the Proposed Project, the only differentiations between route options are cable route lengths and the impact from the quantity of expected major crossings. Option B (Green) has been assessed to have a **Low-Moderate (Light Green)** score for the economic criterion due to the fewest amount of major crossings (such as HDD) and second shortest in length when compared to the shortest Option C (Orange).

Table 5.17: Summary of Economic Assessment of Option B (Green)

Length of Installed Cable	Quantity of Crossings	Combined Economic Score
Moderate	Low	Low-Moderate

6. Option C (Orange)

This section outlines the assessment of Option C (Orange) against the five assessment criteria – Environment; Socio-Economic; Technical; Economic; and Deliverability and their sub-topics.

6.1 Environment

As set out in Section 2.3.1, the 'Environment' criterion assessment topic under consideration to assist with determining the Emerging Best Performing Option best route option are as follows:

- Biodiversity (Flora and Fauna);
- Soils and Water;
- Planning Policy and Land Use;
- Landscape; and
- Archaeology, Architectural Heritage, and Cultural Heritage.

6.1.1 Biodiversity (Flora and Fauna)

6.1.1.1 European Sites

Option C (Orange) broadly follows the Option B (Green) route south to Maynooth and from Sallins to Dunstown substation. Option C (Orange) is not located within or adjoining any European site. The nearest European site is Rye Water/Carton SAC located approximately 3km downstream of Option C (Orange) and designated for petrifying springs with tufa formation, narrow-mouthed whorl snail and Desmoulin's whorl snail (Appendix A.1). Option C (Orange) is hydrologically connected to this European site by four river crossings that flow into the SAC. This route option requires the least river crossings (18 crossings) however involves the greatest length of off-road section. This route option involves crossing of watercourses with direct hydrological links to a complex of European sites within Dublin Bay including Rye Water/Carton SAC (located 3km downstream at the closest point), South Dublin Bay and River Tolka Estuary SPA and South Dublin Bay SAC (see Appendix A.1). In the absence of mitigation, during construction and depending on crossing methodology there is potential for impacts to aquatic habitats and species downstream through a pollution event. Habitats along the south of Option C (Orange) (as with Option A (Red) and Option B (Green)) are suitable to support foraging qualifying interests bird species from Poulaphouca Reservoir SPA and are within the foraging ranges of SCI bird species. Therefore, there is potential for disturbance impacts to these species and temporary loss of habitat during construction if undertaken during wintering bird season.

6.1.1.2 National Sites

No NHA sites are located in proximity to this route option. This route option directly crosses the Royal Canal pNHA west of Maynooth and the Grand Canal pNHA on two occasions at Sallins and Naas however a HDD method adopting a rigorous mitigation plan will be employed at these major crossings and therefore impacts to aquatic receptors will be minimised or avoided.

6.1.1.3 Watercourses and Aquatic Species

This route option involves the crossing of several major rivers including Rye Water, River Liffey and tributaries of the River Tolka with varying WFD status's ranging from 'Good' to 'Poor'. There are potentially six major river crossings requiring HDD and six smaller rivers and streams likely to require alternative crossing methods such as open cut. These rivers host an abundance of aquatic species. Open cut may not be possible across salmonid watercourses. The River Liffey supports Atlantic salmon and brown trout whilst the Rye Water River is known to support minnow, European eel and lamprey sp. And is also a spawning ground for brown trout and salmon. White-clawed crayfish has been recorded at Leixlip within the Rye Water River. Otter have been recorded in all the major watercourses. Several rivers were noted to be suitable to support kingfisher with one bird recorded hunting along the River Liffey during field surveys.

6.1.1.4 Recent Field Survey Data and Desk Based Review

An initial drive over comprising visual assessments and targeted spot checks at static locations of the accessible sections of the option was undertaken on the 11th, 12th and 13th of October 2021 to scope for wintering bird surveys. The dominant habitats recorded along Option C (Orange) include hedgerows, treelines, agricultural grassland, tillage land (predominantly cereal production), amenity grassland and watercourses. Habitats along Option C (Orange) have the potential to support breeding and wintering bird species including Annex I species and birds included in the amber and red list of Birds of Conservation Concern in Ireland (BoCCI). A number of red listed (snipe and golden plover) and Annex I (kingfisher) bird species were recorded during visit one of the wintering bird surveys in October 2021. Hen-harrier winter roost surveys commenced in October 2021 west of Option C (Orange) however no birds were recorded during the surveys. Devil's bit scabious, the food plant of the Annex II listed marsh fritillary butterfly, was recorded near Dunstown substation within Harristown Common. In the absence of mitigation, this route option could have direct habitat loss impacts on an area of Annex I Oak-ash-hazel woodland habitat (91A0 Old sessile oak woods with Ilex and Blechnum in the British Isles) south of Maynooth which the L5042 road currently bisects.

A search of the National Biodiversity Data Centre records included records for several protected species including common frog, pine marten, common lizard, red squirrel, badger and otter in the vicinity of Option C (Orange). As noted above with Option A (Red) and Option B (Green), a data request submitted to Birdwatch Ireland for Irish Wetland Bird Survey (I-WeBS) data for Poulaphouca Reservoir SPA and any incidental records available for Co. Kildare and Co. Meath was received in October 2021 and showed a number of wintering bird species recorded 8km from Option C at Poulaphouca and across the two counties.

Given the routing of a considerable proportion of the route option along narrow road networks bordered by hedgerows and treelines there will be a requirement for vegetation removal to accommodate the cable installation. The route option is bounded in parts by species rich hedgerows and mature tree lines and the removal of these has the potential to result in habitat fragmentation and impacts on protected species. There is also potential for impacts to wintering and breeding birds through disturbance, habitat loss and pollution during construction. Given the distance of the route option there is a high likelihood that invasive non-native species listed on the Third Schedule of the EC (Birds and Natural Habitats) Regulations will be encountered along the road networks. All lengths of the proposed route option not situated in the road surface has the potential for impacts on biodiversity.

6.1.1.5 Summary of Assessment

As with Option A (Red) and Option B (Green), the greatest impacts on biodiversity for Option C (Orange) would be during construction. There is potential (particularly from passing bays and watercourse crossings) for impacts on hedgerows, tree lines and aquatic ecosystems in particular; other habitats and species may also be disturbed or fragmented during the construction phase and effects could be permanent in some cases. This route option could involve direct habitat loss to an area of Annex II woodland. In the absence of mitigation there is the potential for impacts to Rye Water/Carton SAC in the event of a pollution incident during construction.

In summary there is a **Moderate-High risk (Light Blue)** risk of a significant impact to biodiversity assets due to Option C (Orange).

Moderate-High

6.1.2 Soils and Water

6.1.2.1 Geology and Soils

Option C (Orange) is underlain predominantly by Carboniferous limestone bedrock, with associated calcareous shales, and older Silurian greywacke, siltstone and shale in the south of the Study Area. There are no mapped karst landforms or Geological Heritage sites recorded in the vicinity of the route option. However, the route option crosses rocks in which karst features have been recorded and the potential exists for unmapped features to occur in proximity to the route option. Karst features are associated with the dissolution of limestone and the formation of ground cavities, which may not always be apparent at the surface, with consequent subsidence risks and enhanced subsurface drainage.

Superficial deposits underlying Option C (Orange) are predominantly glacial tills, derived from the underlying limestone and, in the north, sandstone and shale bedrock. There is also alluvium associated with watercourses and some areas of sand and gravel are crossed by the route in the southern half of the Study Area.

The route option crosses areas of potential geologic economic deposits (sand and gravel, granular aggregate and crushed rock), predominantly in the southern half of the Study Area. However, the areas crossed are small and these deposits are widely available in the surrounding area, so that this is not considered a significant constraint for route selection.

6.1.2.1.1 Summary of Assessment

In terms of geology and soils the overall evaluation for Option C (Orange) is ranked as **Low (Cream)** risk based on currently available information. However, the potential for unmapped karst features should be noted and further assessment may be needed to identify potential for ground stability issues.

Low

6.1.2.2 Groundwater

The majority of Option C (Orange) lies within the Dublin (poorly productive bedrock) WFD groundwater body, with a small area in the north within the Dunshaughlin (productive fissured bedrock) groundwater body. In the south of the Study Area the route option crosses the Naas (karstic) and Curragh Gravels East (gravel) groundwater bodies.

The majority of the route option is underlain by bedrock classified as Locally Important Aquifer (bedrock which is generally moderately productive in local zones), with a small area of Regionally Important Aquifer – Karstified (diffuse) crossed in the southern half of the Study Area. Some areas classified as of High groundwater vulnerability are crossed by the route option, predominantly in the southern half of the Study Area, along with some very limited areas of Extreme groundwater vulnerability. However, Option C (Orange) crosses a smaller total area of higher groundwater vulnerability than Options A (Red) and Option D (Blue). While there are no mapped karst landforms in the vicinity of the route, the route option crosses rocks in which karst features have been recorded and the potential exists for unmapped features to occur. Karst features can be associated with significant groundwater flowpaths and may be important in supporting surface water features and sensitive groundwater-fed ecosystems.

There are no Public & Group Supply Source Protection Areas or Group Water Schemes in the vicinity of the route option. There are a large number of groundwater wells and springs mapped by the Geological Survey Ireland across

the Study Area. However, in accordance with TII guidance[47] and the observation that low yielding wells, used mainly for domestic and farm water supply, are very common in Ireland, the assessment has focused on high-yielding springs and wells used for public water supply and their surrounding protection zones and the total number of wells and springs along each route corridor has not been used in assessing relative impacts between route options.

No groundwater dependent water bodies or groundwater dependent terrestrial ecosystems (GWDTEs) have been identified at this stage of assessment and so these features have not been used in assessing relative impacts between route options. However, the potential exists for such features to be present within the Study Area and it cannot be conclusively determined at this stage whether or not they may be a constraint for the proposed route.

There is potential for dewatering operations associated with crossings of large watercourses, major roads and railways. This applies to all options and no specific issues have been identified for Option C at this stage.

6.1.2.2.1 Summary of Assessment

The overall evaluation for Option C (Orange) is ranked as **Low (Cream)** risk based on currently available information. However, the potential for unmapped karst features should be noted and further assessment may be needed to identify potential for interference with groundwater flows and potential for groundwater flooding issues.

Low

6.1.2.3 Surface Water

There are 11 surface waterbodies crossed by route Option C; some more than once. A full list of water bodies and their current status is provided in Table 6.1 as well as their proximity to the Rye Water Valley/Carton SAC, their sensitivity to change, the likely crossing technique to be employed and the potential for impacts as a result.

Table 6.1: Surface Water Bodies Option C

Waterbody	Status	Number of Crossings	Connection & Proximity to Rye Water Valley/Carton SAC (at closest crossing)	Sensitivity	Impact Potential
Liffey_100	Moderate	2	No connection	Medium	Low
Grand Canal Naas Line	Good	1	No connection	Very High	Low
Grand Canal Main Line	Good	1	No connection	Very High	Low
Liffey_120	Good	2	No connection	Very High	Low
Liffey_130	Good	4	No connection	Very High	Medium
Royal Canal Main Line	Good	1	No connection	Very High	Low
Lyreen_020	Poor	2	No connection	Low	Medium
Rye Water_020	Moderate	1	3.3km	High	High
Rye Water_030	Moderate	2	4.5km	High	Medium
Dunboyne Stream_010	Moderate	1	No connection	Medium	Low
Tolka_020	Poor	1	No connection	Low	Low
		18			

[47] TII. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. Unreferenced. Obtained from: www.tii.ie/technical-services/environment/planning/ (accessed October 2021). TII guidelines have been used as they are relevant to all linear infrastructure projects.

In addition to water bodies being directly crossed by the route option, for Option C (Orange) there are also a number in close proximity which may be at risk from silty water runoff or spillages of hydrocarbons during construction. These water bodies are less than 50m from the cable route:

- Liffey_120: the route option runs alongside this water body, at approximately 10m from the bank edge, for 375m. The Liffey_120 is of very high sensitivity and there is a high impact potential from having a trench in such close proximity for this length;
- Liffey_120: Further north, at Bodenstown Golf Club, the route option passes in close proximity (less than 10m) to this water body again, this time a tributary to the main channel. However this is only for a very short stretch as the water body is perpendicular to the route option at this point. The route option is in the road in this section, however it is likely that surface water drains would discharge to the water body, or else the road drains 'over the edge' to it. The impact on this water body at this location would be low to medium;
- Rye Water_020: the route option runs alongside this water body, at approximately 25m from the bank edge, for 140m. The Rye Water_020 is of high sensitivity and there is a medium to high impact potential from having a trench in such close proximity for this length; and
- Rye Water_030: the route option runs alongside this water body, at less than10m from the bank edge, for 260m. The Rye Water_030 is of high sensitivity. The cable is being laid within a road in this location, however it is likely that surface water drains will discharge to the water body or that the road is designed for 'over the edge' runoff from the road to the water body. Therefore there is a high impact potential from having a trench in such close proximity for this length.

6.1.2.4 Flood Risk

For Option C (Orange), the length (in metres) within a PFRA flood risk area is:

- Pluvial: 987m; and
- Fluvial: 1606m.

There are 18 No. watercourse crossings along the route; all crossings will be designed so do not present an increase in flood risk, either pluvial or fluvial.

6.1.2.4.1 Summary of Assessment

Considering the number of crossings of water bodies (approximately 18 no.), in particular the crossings of those with high or very high sensitivities, as well as the potential for open cut crossings in addition to potential flood risk, Option C (Orange) is ranked as **Low-Moderate risk (Green)** in respect to the Soils and Water assessment topic.

Low-Moderate

6.1.3 Planning Policy and Land Use

6.1.3.1 Planning Policy and Legislation

Option C (Orange) follows the same route as Option B (Green) until Crinstown, south west of Maynooth. As with Option B (Green), it bypasses zoned lands in both Kilcock and the west of Maynooth. After Crinstown, it follows a more direct southerly route, passing to the east of Clane and to the west of Straffan, avoiding zoned lands within the LAPs for both towns. It then rejoins the same route as all other route options north west of Sallins, avoiding zoned lands designated in the Sallins LAP. From there it follows the same route as Option B (Green), avoiding Naas town centre and runs parallel with the M7 through Naas South, cutting through Jigginstown and Bluebell before joining the R448 and turning south towards Dunstown station.

6.1.3.1.1 Draft Naas Local Area Plan 2021-2027

Option B (Green) passes along the western boundary of Naas, interacting with a number of zoned lands at Millennium Park, Naas South, Jigginstown and Naas East. These zonings are described in the Table Below.

Table 6.2: Relevant Zoning Objectives Naas LAP

Zoning Objective (Naas Local Area Plan 2021-2027)	
B Existing/Infill Residential	To protect and enhance the amenity of established residential communities and promote sustainable intensification.
E Community & Education	To provide for education, recreation, community and health
F Strategic Open Space	To preserve, provide for and improve recreational amenity, open space and green infrastructure networks.
H Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
H(5) Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
P2 Data Centre/Warehouse	To provide for Data Centre development and their associated infrastructure only.
Q3Office, Enterprise and Employment	To provide for and facilitate the provision of high job-generating uses.
Q4 Office . Enterprise and Employment	To provide for and facilitate the provision of high job-generating uses.
R Retail/Commercial	To support continued operation of existing commercial uses.

6.1.3.2 Planning Applications

A review of all granted and live applications over the last five years has been performed within a 50m buffer, 25m either side of Option C (Orange). Some of these applications will be new receptors which will have already been constructed by the time construction on the Proposed Project commences. These include both individual dwellings and larger development as shown in the LAPs. Of these, some of the notable applications are highlighted in the table below.

Table 6.3: Notable Applications in proximity to Option C (Orange)

Local Authority	App. Number	Brief Description	Address	Status
Kildare County Council	16434	New right hand turning lane, bus set down area and associated works, a lift to existing 110kv overhead power lines, removal of derelict prefabricated structures and culvert of ditch within the site and the construction of a 10,450sqm two and three storey 1000 pupil post-primary school and associated infrastructure including, ESB substation, 92 car park spaces, 250 cycle parking spaces, bus and car set down and pick up facilities, and play areas	Plots No. 71 and 72 and part Plots 85 and 86 of the Millennium Park Master Plan , Millennium Park , Naas	Granted 09/06/2017
Kildare County Council	171143	a cemetery comprising a total of 1,448 plots, 30 car parking spaces, overflow parking area (with gates), new vehicular entrance and associated site works and infrastructure	Bodenstown , Sallins , Co. Kildare.	Granted 15/08/2018

Local Authority	App. Number	Brief Description	Address	Status
Kildare County Council	1971	a 4,326 sqm. Two storey office building, 166 no. surface car parking spaces, 36 no. cycle parking spaces, signage, a standalone single storey substation and associated site works and infrastructure	lands to west of the existing Aldi Regional Office and Distribution Centre , Southern Link Business Park Newbridge Road	Granted 15/07/2019
Kildare County Council	191269	change of use of existing warehouse building to light industry/workshop use together with new single storey extension. Entrance alterations, on-site parking and associated site works and infrastructure.	Mylerstown , Two Mile House , Naas	Granted 02/06/2020
Kildare County Council	20840	the construction of a 5627sqm Specialist Packaging Single Storey High Level Manufacturing Facility with Three Storey Head office and associated infrastructure	Millennium Business Park , Osberstown , Naas	Granted 30/03/2021 (subject to financial appeal)
Kildare County Council	201564	(a) Extension of the existing 7.3m wide two-lane carriageway by 137m to the north (b) a 2m grass verge, 2m cycle path and 2m footpath along the east and west of the proposed access road extension (c) a vehicular entrance to the west of the proposed extension to facilitate a proposed access to a planned commercial development (Kildare Co. Co. Planning Ref. 20840) (d) a vehicular entrance to the east of the proposed extension to facilitate a proposed access to a planned commercial development (Kildare Co. Co. Planning Ref. 20561) I parking provision and associated infrastructure	Millennium Park , Osberstown , Naas	Granted 01/07/2021
Kildare County Council	21114	Application to amend the design of Kildare County Council Planning Reg Ref 17/535 for the development of a solar photovoltaic panel array of up to 74,172 m^2 of solar panels and associated infrastructure on ground mounted steel frames within a site area of 25.04 hectares. Amendments involve an increase in the solar panel area from the permitted up to 74,180 m^2 of solar panels to up to 150,000 m^2 of solar panels and an increase in height of panels.	Smithstown and Roosk , Co. Kildare.	Granted 05/08/2021

These applications, as well as the more minor/domestic applications, will be taken into account in the routing of the cable. Other larger scale planning applications will also be examined and taken into account within the routing process. Such applications include other energy projects, the Water Supply Project, and road schemes.

6.1.3.3 Summary of Assessment

Taking the above into account, Option C (Orange) has the potential to interact with a number of granted and live planning applications. However, it has been routed in such a way that it avoids many potential interactions with LAP zonings, only traversing lands zoned within the Draft Naas LAP. Furthermore, it is also acknowledged that with appropriate siting and mitigation, the impacts of these interactions can be further minimised. Therefore, Option C (Orange) has been assigned **Low-Moderate (Light Green)** in terms of the combined impacts to land use and planning policy.

Low-Moderate

6.1.4 Landscape

6.1.4.1 Landscape character

Refer to Section 4.1.4.1 for information on landscape character.

6.1.4.2 Landscape elements

No designated or highly sensitive landscape elements were identified within the portion of the Study Area that occurs within County Meath.

Included in Table 14.4 of Chapter 14 (and indicated on Map 14.2) of the Kildare County Development Plan are:

> *'12 "principal landscape sensitivity factors": Major Rivers and Water bodies; Canals; Ridgelines; Green Urban Areas; Broad-Leaved Forestry; Mixed Forestry; Natural Grasslands; Moors and Heathlands; Agricultural Land with Natural Vegetation; Peat Bogs; Scenic View; and Scenic route'.*

This route option will pass within 300m of the following 'principal landscape sensitivity factors' (from north to south):

- River Liffey; and
- Woodland R412 regional road.

6.1.4.2.1 Sensitivity - landscape elements

The sensitivity of these '*principal landscape sensitivity factors*' are recorded in Table 6.4.

6.1.4.2.2 Magnitude of impacts - landscape elements

The magnitude of impacts on landscape elements are as follows:

- **River Liffey**: Approximately 3.7km of the route option passes within an area of '*special sensitivity*' that buffers the River Liffey '*principal landscape sensitivity factor*'. This area would have a heightened sensitivity to the removal of vegetation. Within this '*principal landscape sensitivity factor*' approximately 14.2km of the route option occurs within agricultural fields; thus, the construction activity here would be uncharacteristic. For these reasons, the magnitude of impact during the construction phase is deemed to be low. The agricultural land use will be reinstated and the river crossing is likely to be by directional drilling; therefore the likely magnitude of impact during the operational phase is likely to be negligible; and
- **Woodland R412 regional road**: It is likely that the R412 regional road is wide enough to accommodate the trenching work without the need to remove roadside vegetation; therefore, there will be no material change. Thus the magnitude of impact is deemed to be negligible during both the construction and operational phases.

6.1.4.2.3 Significance of impacts - landscape elements

All the impacts on the '*principal landscape sensitivity factors*' identified are of a negligible magnitude during the operational phase; therefore, are considered, by default, to have a significance of impact that is **Imperceptible**. During the construction phase only the River Liffey '*principal landscape sensitivity factor*' is likely to have a significance of **Slight-Imperceptible**, while for all the others, it will be **Imperceptible**.

Table 6.4: Summary - Principal Landscape Sensitivity Factors within County Kildare

Principal Landscape Sensitivity Factor	Specific feature	Sensitivity of feature	Likely operational magnitude of effect	Likely operational significance of effect
Major Rivers and Water bodies	River Liffey	High-medium	Negligible	Imperceptible
Mixed Forestry	Woodland R412 regional road	High	Negligible	Imperceptible

6.1.4.3 Summary of Assessment

A 14.2km offline section passes through agricultural fields near the River Liffey '*Principal Landscape Sensitivity Factor*'; therefore, there is a potential for some impact on the landscape character within this area of 'special' sensitivity, but significant impacts are not anticipated. No significant landscape or visual impacts are anticipated. Whilst the magnitude of impact during both construction and operation is at the very bottom end of the magnitude spectrum; some receptors are deemed to have a sensitivity that is at the upper end of the sensitivity spectrum thus a relatively small increase in the magnitude of effect during the construction phase could result in a significant impact, therefore the attributed score is **Low-Moderate (Green)**.

Low - Moderate

6.1.5 Archaeology, Architectural Heritage, and Cultural Heritage

Option C (Orange) includes sections common to Option A (Red) and Option B (Green), and therefore the receiving environment is similar to that described in Sections 4.1.5 and 5.1.5 above.

A summary of archaeology, architectural heritage, and cultural heritage constraints identified within the Step 3 Study Area is presented in the Environmental Constraints Report along with a discussion on the general character and nature of the constraints present, comprising National Monuments and Preservation Orders, sites on the RHM, Recorded Monuments and sites recorded on the SMR, Protected Structures, structures recorded on the NIAH, ACAs, and GDLs identified by the Survey of Historic Gardens and Designed Landscapes.

Baseline information on the archaeology, architectural heritage and cultural heritage constraints identified within 100m of Option C (Orange) is provided in Appendix B.1

6.1.5.1 Archaeology

There are no National Monuments, sites with Preservation Orders placed on them, or sites on the RHM located within 100m of Option C (Orange).

Three Recorded Monuments are located within 100m of Option C (Orange) (see Appendix B.1). These comprise the site of a medieval parish church (AY_04) and two enclosures identified from aerial photographs (AY_14 and AY_17).

A total of 15 sites recorded on the SMR have been identified within 100m of Option C (Orange). These comprise evidence of medieval and post-medieval religious activity (AY_05, AY_06, AY_29, AY_30, and AY_31) and the locations of cropmarks (AY_10, AY_25, AY_32 – 34, AY_35, AY_36, and AY_46 – 48).

Further information on the archaeological constraints identified within 100m of Option C (Orange) is included in Appendix B.1.

6.1.5.1.1 Archaeological Potential

Alluvium and lacustrine deposits have the potential to preserve previously unknown archaeological monuments and remains, including organic and palaeoenvironmental remains, and there is also the potential for votive (religious) offerings in rivers such as the Rye Water, River Lyreen and the River Liffey, minor watercourses and bogs.

6.1.5.2 Architectural Heritage

Architectural heritage constraints within 100m of Option C (Orange) comprise:

- Four Protected Structures characterised by post-medieval churches (AH_02 and AH_13) and estate buildings (AH_10 and AH_14).
- Eight GDLs comprising five recorded by the Survey of Historic Gardens and Designed Landscapes and three identified from historic mapping (Ordnance Survey 6", 1837 – 1842).

No structures included on the NIAH, or ACAs, are located within 100m of Option C (Orange).

Further information on the architectural constraints identified within 100m of Option C (Orange) is included in in Appendix B.1.

6.1.5.3 Cultural Heritage

A total of 27 cultural heritage sites identified within 100m of Option C (Orange) from the sources identified in Section 2.3.1.5. These are characterised by extant post-medieval buildings and structures, including road bridges, houses and farm buildings. Further information on these cultural heritage sites is presented in Appendix B.1.

6.1.5.4 Potential Impacts

6.1.5.4.1 Construction – Direct Impacts

Archaeology

No direct impacts have been identified on National Monuments, sites with Preservation Orders, or sites on the RHM as a result of the construction of Option C (Orange).

Where Option C (Orange) is located within the Zone of Notification associated with a Recorded Monument, this has been identified as a direct impact. While the route option may not directly impact the Recorded Monument itself, excavation of the cable trench and joint bays could have a direct impact on any archaeological remains that may survive within this zone.

Option C (Orange) is located within the Zone of Notification of one Recorded Monument (AY_04). Within this zone it is located in the carriageway of the existing road the construction of which is more than likely to have removed or truncated any archaeological remains associated with this monument that may have been present. However, construction, including the excavation of the cable trench and joint bays would have a direct impact on any archaeological remains that may survive. Construction would also have a direct impact on any archaeological remains associated with this Recorded Monument that may survive within any additional land take required for construction.

While construction would be within the existing carriageways may have partially removed or truncated any remains associated with, the option has the potential to remove archaeological remains associated with AY_05, AY_31, AY_35, and AY_46 – 48, construction of Option C (Orange) would have a direct impact on any archaeological remains associated with these constraints that may survive. In addition construction would have a direct impact on any unknown archaeological remains associated with these constraints that may survive within any additional land take required for construction.

The excavation of the cable trench and joint bays would have a direct impact through the removal of any archaeological remains associated with AY_10 (an enclosure) which is located in an offline section in Laraghbryan East.

Excavation of the cable trench and joint bays, and the excavation of temporary launch and reception pits for directional drilling may also result in a direct impact any previously unknown archaeological remains that may be present within the land required for Option C (Orange). The potential for this impact is considered to be higher in previously undeveloped areas than within the existing carriageways, the construction of which is likely to have likely to have removed or truncated any archaeological remains that may have been present.

Architectural Heritage

Should Option C (Orange) require additional land take for construction, the removal of boundary features would have a direct impact on five GDLs (Jenkinstown House; DL_02, Rodanstown House; DL_05, Irishtown; DL_12, Blackhall; DL_16 and Killashee House; DL_20).

Cultural Heritage

One post-medieval road bridge (CH_01) is located on the existing road through Culcommon. There is potential for a direct impact on this cultural heritage constraint as a result of accidental damage from construction plant.

The excavation of the cable trench and joint bays may have a direct impact through the removal of any surviving remains associated with five cultural heritage sites (CH_08, CH_18, CH_25, CH_44 and CH_52).

CH_03 is a public house located immediately adjacent Option C (Orange). There is therefore potential for a direct impact on this cultural heritage constraint as a result of accidental damage from construction plant.

6.1.5.4.2 Construction - Indirect Impacts

Archaeology

No indirect impacts have been identified on archaeological constraints as a result of the construction of Option C (Orange).

Architectural Heritage

This route option is located within 28m of Rodanstown Church (AH_02), Irishtown House (AH_10), Bodenstown Church (AH_13), and the gate lodge and entrance of Castlesize House (AH_14). While these potential impacts would result from the introduction of noise and visual intrusion into the setting of these constraints during construction from the movement and operation of plant, it is anticipated any intrusion would be temporary (lasting the duration of construction in each location).

Cultural Heritage

Movement and operation of plant during the construction of Option C (Orange) would have an indirect impact on the setting of 11 cultural heritage sites (CH_03, CH_09, CH_23, CH_27, CH_32, CH_49, CH_54, CH_55, CH_57, CH_58, and CH_59). However, it is anticipated any intrusion would be temporary (lasting the duration of construction in each location).

6.1.5.4.3 Operational Impacts

As the Proposed Project would be located beneath the road surface, and any offline sections would be reinstated after construction no impacts on archaeological, architectural or cultural heritage constraints have been assessed as a result of the operation of Option C (Orange).

6.1.5.5 Summary of Assessment

Fewer impacts overall have been identified on designated archaeology, architectural heritage and cultural heritage constraints as a result of the construction of Option C (Orange) in comparison with the other options.

While potential direct impacts on sites identified on the SMR would be comparable to other route options, this route option also requires more off-road sections (totalling approximately 15.5km) and may potentially result in direct impacts resulting from the removal of previously unknown archaeological monuments and remains within these areas. Therefore, Option C (Orange) has been assigned a risk of '**Low-Moderate (Light Green)**'.

Low-Moderate

A Route Corridor Summary Matrix for archaeology, architectural heritage and cultural heritage is provided in Appendix B.1.

As the project progresses it may be possible to avoid impacts on archaeology, architectural heritage, and cultural heritage constraints through design, including localised realignments of the route. Where impacts on archaeology, architectural heritage, and cultural heritage constraints cannot be avoided it is possible impacts could be reduced through recording in advance of, or during, construction, including the archiving and documentation of the results of this recording for public reference.

6.2 Socio-Economic

6.2.1 Traffic, Transport and Access

Option C (Orange) runs mainly through the centre of the Study Area between the Woodland and Dunstown substations. The route is the shortest one compared to the other potential route options and it mainly follows the alignment of Option B (Green), except for the sections of the route in the middle of the Study Area between Maynooth and Sallins.

Table 6.5 presents the break-down of road classifications for the Option C route:

Table 6.5: Option C (Orange) Road Classification

Option	Total Length (km)	Road Length Percentage Distribution		
		Regional	Local Roads and Smaller	Off-road and other Land Types
Option C	46.7	17.1	42.8	40.1

Option C (Orange) affects the lowest number of regional roads and is located mostly along local or lower roads, with offline sections to the west of Maynooth and to the east of Clane, crossing the most agricultural land compared to the other route options.

The access to the local roads during construction could be challenging for the construction vehicles. The narrow local roads along Option C (Orange) could pose a significant constraint to the use of the public highway to deliver construction materials. In attempting to use these roads, potential impacts include driver and pedestrian delay; increased fear of accidents; and severance effects for local communities and businesses.

It is anticipated that during the installation of cable works, construction would extend through a number of key junctions and roundabouts along Option C (Orange), which could have a significant impact in traffic disturbance. There might be a requirement to divert traffic, particularly at congested junctions and areas which may give rise to more complex traffic management plans during the construction phase. These areas are identified in section 6.4.2. Similar to the route sections there might be a requirement to temporarily divert traffic or restrict certain vehicle movements at these locations. Traffic management measures would be assessed on a case-by-case basis for each signalised junction and standard roundabout along Option C (Orange). The number of the key junctions along Option C (orange) is the third highest compared to the other proposed route options.

Option C (Orange) has the lowest number of properties impacted compared to the other route options within 0 to 50 meters from its centreline – approximately 209 properties. It is noted that the proposed alignment would potentially impact the least amount of community assets compared to the other route options. It is anticipated that Option C (Orange) could also impact the access to the St. Joseph's National School in Mulhussey.

6.2.1.1 Summary of Assessment

Option C (Orange) is the shortest of the options and affects the lowest number of regional roads. It has the greatest amount of agricultural land impacted and has the lowest number of properties within 0 to 50 metres. The smaller number of regional roads affected would reduce the overall amount of traffic affected. The lower number of regional roads affected would reduce the overall amount of traffic affected, although the narrower width of the local roads might require as a result a greater number of full road closures compared to other options. Full road closures will result in more disruption through diversions. Mitigation measures through consultation and traffic management will reduce the impacts. The measures can include ensuring that the works do not disrupt access to the schools and other receptors. Phasing of the works will be important to minimise disruption. This can be done by ensuring that works are completed at less busy times and are carefully planned to avoid road users being disrupted in multiple locations by construction teams in one journey. These measures will be designed at the next step in the Proposed Project. In terms of risk of traffic disruption, the Traffic, Transport and Access (Social) for Option C (Orange) is assessed to be of **Moderate – High (Light Blue)**.

Moderate - High

6.2.2 Noise, Vibration and Air Quality

6.2.2.1 Noise and Vibration

6.2.2.1.1 Baseline

Option C (Orange) runs mainly through the centre of the Study Area between the Woodland and Dunstown substations. The route mainly follows the green route except for the sections in the middle of the Study Area between Maynooth and Sallins. The route is located along regional and local roads with offline sections to the west of Maynooth and to the east of Clane. Offline or off-road sections are sections where the route option does not follow alongside a road but cuts across, for example, agricultural land.

Baseline noise levels are likely to vary along this route option with higher noise levels likely closer to transport infrastructure and during periods of peak transport activity. The main noise source along this route option is from road traffic noise. Environmental Protection Agency (EPA) traffic noise data for Round 3 contained in EPA Maps[48] shows that traffic noise levels will be highest where the route option crosses the M4 and the M7 and where it runs alongside the R448.

EPA railway noise data shows that where the route option crosses the Dublin to Cork railway line rail noise levels are elevated.

6.2.2.1.2 Methodology

The noise and vibration assessment at this stage of the Proposed Project involves gaining an appreciation of the baseline noise environment close to each of the proposed route options and identifying noise and vibration sensitive receptors within distance bands up to 300m from each of the proposed route options. Noise impacts from construction activities do not normally occur beyond 300m and vibration impacts do not normally occur beyond 100m. The locations of major crossings where HDD is likely to be required and off-road sections where noise impacts are likely to be greater compared to on-road sections is also used to assess each route in terms of the noise risk according to the multi criteria analysis at Step 4A. The risk scale is as follows:

- High: dark blue;
- Moderate-high: blue;
- Moderate: dark green;
- Low-moderate: green; and
- Low: cream.

No baseline noise surveys were undertaken, and no noise modelling was undertaken at this stage of the Proposed Project. These will be completed at Step 5 of the Proposed Project.

6.2.2.1.3 Noise and Vibration Sensitive receptors

Table 6.6 shows the residential property counts in distance bands up to 300m from the proposed route option. Overall there are a total of 552 sensitive receptors within 300m of the proposed route option.

Table 6.6: Residential Property Counts within 300m of Option C (Orange)

Option	No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	No. of sensitive receptors 100-200m	No. of sensitive receptors 200-300m	Total no. of receptors within 300m
Option C	209	103	136	114	562

As well as residential properties there are other sensitive receptors within 300m of the proposed route option which are not included in the above counts including:

- St. Joseph's National School;
- Gaelscoil Nás Na Ríogh School;
- St David's National School;
- Piper's Hill College;
- Killashee National School;

[48] https://gis.epa.ie/EPAMaps/

- The K Club; and
- Several equine operations.

6.2.2.1.4 Potential Noise and Vibration Impacts

Areas of Potential Horizontal Directional Drilling (HDD)

There is greater potential for adverse noise and/or vibration impacts at sensitive receptors where construction activities would occur over a longer period, e.g. at trenchless crossings. It is recognised that certain construction activities at certain trenchless crossings could be required to take place outside of normal working hours, which would increase the likelihood of adverse noise effects occurring. In addition, certain potential trenchless crossing techniques that may be employed (e.g. HDD) also have the potential to cause adverse vibration effects at nearby receptors.

There is potential for adverse impacts at receptors within 300m of HDD works and there could be eight major crossings on Option C (Orange). An initial assessment has shown there are the potential for adverse noise impacts at the Royal Canal Main Line, the Dublin-Sligo Railway line, the M4 Motorway, the Dublin-Cork railway line, and the M7 Motorway.

Offline Sections

For the majority of the proposed route option, the underground cables are expected to be installed using 'Open Cut' techniques. Where 'Open Cut' works are undertaken adjacent to the existing road network, there is a relatively low potential for temporary impacts due to construction noise. This is due to the relatively high levels of local environmental noise that are typically experienced adjacent to roads. Also, as the works are expected to progress in sections, noise levels at any receptor would only be elevated for a relatively short period of time. However, where 'Open cut' works are undertaken in relatively quiet areas close to sensitive receptors there is the potential for temporary impacts due to construction noise.

Table 6.7 shows the total length, the total offline length and whether there are receptors within 300m of the offline route for Option C (Orange).

Table 6.7: Total length and offline length for Option C

Option	Total Length (km)	Offline Length (km)	Receptors within 300m of offline section
Option C	46.7	15.5	Yes

The table above shows that the route option goes offline for approximately 15.5km of its total length where there is a greater potential to result in adverse noise effects at receptors compared to where works are undertaken adjacent to existing roads.

6.2.2.1.5 Assessment

There are relatively small numbers of receptors within 300m of Option C, and while there is 15.5km of offline construction activity this is largely through open land with few near-by receptors. There are receptors within 300m of potential major crossings such as HDD works at eight crossing points with the potential for experiencing adverse noise and/or vibration effects. As such, it is appropriate to give a score of **Low-Moderate (Light Green)**.

Low-Moderate

6.2.2.2 Air Quality

6.2.2.2.1 Baseline

Option C (Orange) runs mainly through the centre of the Study Area between the Woodland and Dunstown substations. The route option mainly follows the route of Option B (Green) except for the sections of the route in the middle of the Study Area between Maynooth and Sallins. The route option is located adjacent to regional and local roads with offline sections (i.e. not adjacent to roads) to the west of Maynooth and to the east of Clane.

Baseline air pollutant concentrations are likely to vary along this route option. Higher concentrations are likely closer to transport infrastructure and where the route is closer to larger settlements. The main air quality sources along this route are from road traffic, particularly where the route option crosses the M4 and the M7 motorways.

The Air Quality Index for Health across the Study Area[49] is Good (with an index score ranging from 1-3). The majority of the Study Area, as defined by the EPA[50], is located within Air Quality Zone D – Rural Ireland apart from locations in Naas, which are within Air Quality Zone C – other cities and large towns.

6.2.2.2.2 Sensitive receptors

Human and ecological receptors are consistent with those listed in Section 4.2.2.3.

The Institute of Air Quality Management (IAQM) dust guidance[51]. has been adapted for the purposes of this assessment. The number of residential properties and schools have been counted and identified as receptors. Table 6.8 shows the human receptor count within 300m of each of Option C (Orange).

Table 6.8: Residential Property Counts within 300m of Option C (Orange)

Option	No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	No. of sensitive receptors 100-200m	No. of sensitive receptors 200-300m	Total no. of receptors within 300m
C	209	103	136	114	562

As well as residential properties there are other sensitive receptors within 300m of the proposed route which are not included in the above counts including:

- St. Joseph's National School;
- Gaelscoil Nás Na Ríogh School;
- St David's National School;
- Piper's Hill College; and
- Killashee National School;

With regard to ecological receptors, Option C (Orange) crosses the Royal Canal pNHA and crosses the Grand Canal pNHA twice. Therefore, these are in close proximity (i.e. less than 20m) from the route option.

[49] Environmental Protection Agency (EPA), Air Quality Index for Health, https://airquality.ie/information/air-quality-index-for-health, accessed October 2021.
[50] Environmental Protection Agency (EPA), Air Quality Zones, https://airquality.ie/information/air-quality-zones, accessed October 2021.
[51] Institute of Air Quality Management. 2016. Guidance on the assessment of dust from demolition and construction. Version 1.1. http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf

6.2.2.2.3 Assessment Criteria

The main criteria used for the assessment of each option is set out in Section 4.2.2.3.3.

6.2.2.2.4 Potential Impacts

The potential impacts are consistent with those set out in Section 4.2.2.3.4.

Table 6.9 shows the number of receptors, the sensitivity to dust soiling and the risk score.

Table 6.9: Potential air quality impact for Option C (Orange)

No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	Sensitivity of section to dust soiling	Risk score
209	103	Medium	1.7

For Option C (Orange) most of its length is classed as low or medium sensitivity areas, apart from around Mulhussey, which has a slightly higher receptor count due to the Proximity of St Joseph's National School, and is classed as high sensitivity area. Therefore, it is appropriate to give a score of low-moderate (green).

6.2.2.3 Summary of Assessment

Option C (Orange) is the shortest option and has the fewest number of receptors within 300m and within 50m of the route. Option C (Orange) runs adjacent to three schools, with a total of five within 300m. Option C (Orange) crosses over two pNHA (Royal Canal pNHA and Grand Canal pNHA (twice). Therefore, an overall risk score of **Low (cream)** has been applied.

Low

6.2.3 Visual

There is the potential for visual impacts at scenic designations, residential dwellings and along public roads, with scenic designations carrying a greater potential for risk.

6.2.3.1 Scenic designations

No scenic designations were identified within the portion of the Study Area that occurs within County Meath.

Included in Table 14.4 of Chapter 14 (and indicated on Map 14.2) of the Kildare County Development Plan are':

> *'12 "principal landscape sensitivity factors": Major Rivers and Water bodies; Canals; Ridgelines; Green Urban Areas; Broad-Leaved Forestry; Mixed Forestry; Natural Grasslands; Moors and Heathlands; Agricultural Land with Natural Vegetation; Peat Bogs; Scenic View; and Scenic route'.*

This route option will pass within 300m of the following 'principal landscape sensitivity factors' that relate to scenic designations (from north to south):

- Royal Canal View RC8 ('Jackson's Bridge' L5041); and
- Grand Canal view GC33 ('Limerick Bridge').

6.2.3.1.1 Sensitivity - scenic designations

The sensitivity of these '*principal landscape sensitivity factors*' are recorded in Table 6.4.

6.2.3.1.2 Magnitude of impacts - scenic designations

Royal Canal View RC8 ('Jackson's Bridge' L5041): There is a direct line of sight from the bridge towards the canal crossing point of this route c.300m away, but there is an existing high voltage overhead line crossing the canal at c.150m so the view is already characterised by infrastructure. Construction activity is likely to be visible from this bridge; therefore, the magnitude of impact during the construction phase is deemed to be low, but during the operational phase, it is deemed to be low-negligible as a crossing such as a cable bridge (to be determined at next step of the project) may be visible.

Grand Canal view GC33 ('Limerick Bridge'): This bridge is heavily visually enclosed by vegetative screening; therefore, the magnitude of impact is deemed to be negligible during the construction and operational phases.

6.2.3.1.3 Significance of impacts - scenic designations

The impact on the Royal Canal View RC8 ('Jackson's Bridge' L5041) '*principal landscape sensitivity factors*' identified are of a low magnitude during the operational phase; therefore, is considered, by default, to have a significance of impact that is **Slight**. The impacts on the Grand Canal view GC33 ('Limerick Bridge') '*principal landscape sensitivity factors*' identified are of a negligible magnitude during the operational phase; therefore, is considered, by default, to have a significance of impact that is **Imperceptible**. During the construction phase only the Royal Canal View RC8 ('Jackson's Bridge' L5041) '*principal landscape sensitivity factor*' is likely to have a significance of **Moderate-slight**, while for all the others, it will be **Imperceptible**.

Table 6.10: Summary - Principal Landscape Sensitivity Factors within County Kildare

Principal Landscape Sensitivity Factor	Risk - Direct Impacts (Constraints Study)	Risk – Impacts Within 300m (Constraints Study)	Specific feature	Sensitivity of feature	Likely operational magnitude of effect	Likely operational significance of effect
Scenic View	High	Moderate-High	Royal Canal View RC8 ('Jackson's Bridge' L5041)	High	Low-Negligible	Slight
Scenic View	High	Moderate-High	Grand Canal view GC33 ('Limerick Bridge')	High	Negligible	Imperceptible

6.2.3.2 Summary of Assessment

The assessment of the potential or significant visual impacts as a result of Option C (Orange) can be summarised by the following points:

- Potential for visual impacts at residential dwellings and along public roads;
- Potential visual impacts at Royal Canal View RC8 ('Jackson's Bridge' L5041) during construction and operational phases, but the magnitude of the impact is not likely to be greater than Low, therefore no significant visual impacts are anticipated.

As such, the attributed score is **Low-Moderate (Light Green)**.

Low - Moderate

6.2.4 Amenity

This section outlines the likely impact on the amenity of residential, commercial, community (and recreational), and tourism receptors, collectively, by way of consideration of contributing environmental effects. Issues of access and severance are outlined in Section 6.2.1. All residential, commercial, community (and recreational) receptors are shown in Figure C.1.3 in Appendix C.1.

The alignment of Option C (Orange) passes through both rural and urban areas along its length, as outlined in Section 3.2.3. Table 6.11 lists the known commercial and community receptors that are situated immediately adjacent to the route alignment (this list is not exhaustive but represents a high-level analysis for the purposes of informing the Step 4A selection process). No tourism receptors (i.e. receptors whose main function is aimed at visitors to its locality) were encountered along the alignment of Option C (Orange), while one-off or ribboned residential receptors are located along all sections of the route (with the exception of off-line sections). Option C (Orange) is also routed along the western side of Naas.

Table 6.11: Known Commercial and Community Receptors Adjacent to the Alignment of Option C (Orange)

Commercial receptors:	Community receptors:
Barstown Business Park; Hatchet Inn (and associated filling station); Robinson Farm Agrifoods; Kerry Group Global Centre; Irish Commercials (and Volvo Trucks); Applegreen Millennium Park; LIDL (Naas)	St Joseph's National School; Royal Canal; Western edge of K-Club; Bodenstown Graveyard (and proposal for new amenity); Gaelscoil Nás Na Ríogh; Piper's Hill Montessori School; Piper's Hill College (Secondary School); St David's National School Killashee National School

Outlined below are details of potential impacts considered likely during the construction of Option C (Orange) according to each environmental effect, with a concluding paragraph summing up the overall impact on amenity. Given that the Proposed Project would be underground, there are no operational impacts anticipated on amenity.

The table below outlines the assessment ratings and associated justifications for each of the contributing environmental effects that, when in-combination, may result in an impact on amenity.

Table 6.12: Ratings and Associated Justifications for Environmental Effects Contributing to Potential Impact on Amenity

Air Quality	Noise (and vibration)	Visual	Traffic and Transport
Option C (Orange) is the shortest option and has the fewest number of receptors within 300m and within 50m of the route. It runs adjacent to three schools, with a total of five within 300m. Most of its length is classed as low or medium sensitivity areas, apart from around Mulhussey, which has a slightly higher receptor count due to the Proximity of St Joseph's National School, and is classed as high sensitivity area.	Relatively fewer noise sensitive receptors impacted compared to other options. Construction noise and vibration impacts temporary in nature, no permanent impacts expected.	(i) Potential for visual impacts at residential dwellings and along public roads. (ii) Potential visual impacts at Royal Canal View RC8 ('Jackson's Bridge' L5041) during construction and operational phases, but the magnitude of the impact is not likely to be greater Low. No significant visual impacts are anticipated.	Option C (Orange) is the shortest option and affects the least amount of regional roads (17%), reducing the overall amount of traffic affected. However the narrower local roads that will be used means there are greater amounts of full road closures. Impacts to local roads will be comparatively easier to divert than regional roads. It has the greatest amount of agricultural land impacted and lowest amount of properties within 0-50m (209). It passes the access to St. Joseph's National School in Mulhussey.

6.2.4.1 Summary of Assessment

In relation to the assigned scoring for potential effects relating to Air Quality, Noise (and vibration), Visual and Traffic and Transport, it is considered likely that there is the potential for considerable but not significant impacts on amenity. Therefore, a scoring of **'Low-Moderate (Light Green)'** has been assigned. For more information in relation to the potential impacts of Option C (Orange) in relation to any of these environmental effects, please see Section 6.2.1 to Section 6.2.3.

Low-Moderate

6.2.5 Health

The Study Area is largely considered to be 'marginally above average' in terms of the deprivation indices provided for my Pobal (Pobal, 2016[52]), however are some Electoral Divisions (EDs) within the Study Area are considered to be 'affluent', such as Maynooth, Straffan, Donaghcumper, Naas Rural, Ladytown, and Newtown. According to the Institute of Public Health (in Ireland), people in higher socio-economic groups are at lower risk of chronic conditions and associated disability than those in lower socio-economic groups (Institute of Public Health, 2020)[53].

Using the outcomes of the amenity assessment as reported in Table 6.12, it is considered unlikely that the construction of Option C (Orange) would result in significant impacts on human health. This is primarily because processes and activities required during construction of the Proposed Project are temporary in nature, while the nature and scale of the Proposed Project means that construction activity would occur at any one location for a limited time; thereby not significantly impacting human health.

[52] https://maps.pobal.ie/WebApps/DeprivationIndices/index.html

[53] https://publichealth.ie/wp-content/uploads/2020/04/20200416-AGEING-PUBLIC-HEALTH-MAIN.pdf

6.2.5.1 Summary of Assessment

In light of the above findings, a scoring of '**Low (Cream)**' has been assigned for the consideration of potential impacts on Human Health.

Low

6.2.6 Employment and Economy

During construction and operation, potential impacts on employment and the national, regional and local economy are anticipated to be similar among each of the proposed route options given that they are all similar in nature, extent and scale, are located in close proximity to one another, and within the same Study Area.

The potential impacts on employment and the national, regional and local economy are the same as that outlined in Section 4.2.6.

6.2.6.1 Impacts on the Tourism Sector

Similarly to the potential impacts on employment and the national, regional and local economy, potential impacts on the tourism sector are anticipated to be similar among each of the proposed route options given they are all similar in nature, extent and scale, are located in close proximity to one another, and within the same Study Area.

The potential impacts on the tourism sector are the same as that outlined in Section 4.2.6.2.

6.2.7 Land-use (and Land-take)

Option C (Orange) is 46.7km in length, with the vast majority of its alignment being routed along regional and local roads between Woodland substation and Dunstown substation. Some sections of the route alignment are not routed along roadways however and are instead aligned across open agricultural land. Approximately 15.5km of Option C (Orange) is routed through open greenfield land, largely classed as 'pastures or non-irrigated land' according to 2018 Corine Land Class data. The impacts on agricultural land (including land-take) are considered in Section 6.2.8.

6.2.7.1 Summary of Assessment

Given the similarities around construction methodology and subsequent land-take requirements in respect to people and communities, the potential impacts in regard to land-use (and land-take) are the same as those outlined in Section 4.2.7 and thereby assigned a similar rating of **'Low (Cream)'**.

Low

6.2.8 Agriculture (including Equine)

The potential impacts on agriculture are addressed in general in Section 4.2.8. This Section addresses the impacts of Option C (Orange).

The Option C (Orange) crosses mineral soils along its entire length avoiding significant areas of peat to the west. From Woodland Substation to Dunstown Substation Option C (Orange) is the shortest overall option – 46.7km compared to 50.5km – 51.4km for the other route options. There are fifteen high sensitive enterprises located along Option C (Orange) – twelve equine enterprises and three dairy enterprises. Option C (Orange) will cross agricultural land for approximately 15.5km (33% of the entire length) and will cross the north east part of one very high sensitive stud farm in Rathasker and the centre of one very high sensitive stud farm in Moyglare.

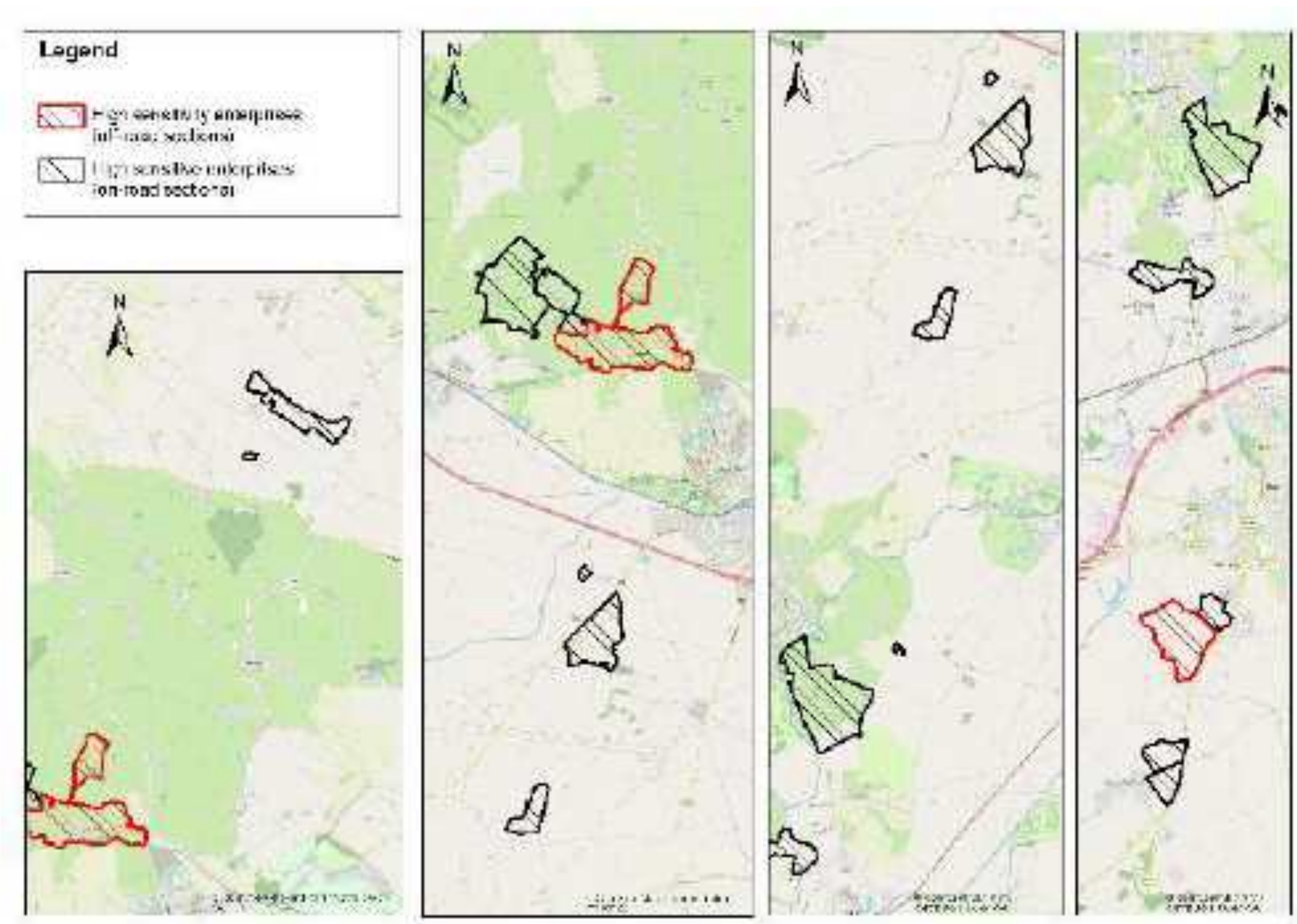

Figure 6-1: High sensitivity enterprises affected by Option C (Orange)

6.2.8.1 Summary of Assessment

The ranking score for Option C (Orange) is considered to be '**Moderate (Dark Green)** given the moderate length across agricultural land and the moderate number of high sensitive enterprises it impacts.

Moderate

6.2.9 Utilities

There are numerous underground utilities in the regional road network between Woodland and Dunstown, including other electricity cables; telephone and broadband cables; sewers; and public and private water supplies. The public water supply is extensive in the area, with the network predominately using the road network for local residential supply while other larger mains being located off-road in agricultural land. There is no known group water supply with protected areas within the Study Area.

The assessment of Option C (Orange) has found that it crosses existing fibre cables (once), existing medium pressure gas pipelines (six times), existing water supply network (64 times) and existing wastewater network (four times). The count of crossing locations includes points within the same roads. For example Option C meets the medium-pressure gas network in five locations with multiple crossings within these sections. The four locations are at R148 (Kilcock to Maynooth); on the R403 (Clane to Straffan road); Millennium Parkway, R445, and R448 (roads within Naas). However, because of the layout of gas network crossing from one side of the road to the other, it is counted as six crossings.

It is expected that all utilities encountered during construction will either remain in-situ or, where absolutely necessary, appropriate diversions or modifications carried out (with the permission of the respective provider) so as to ensure disruption to surrounding communities is kept to a minimum. Any required service disruption will only be permitted for an agreed set period of time per day (generally a set number of hours) and will not be permitted to be continuous for full days at a time. Any required disruptions will be carefully planned so as to ensure that the duration of disruption is minimised in so far as is possible.

6.2.9.1 Summary of Assessment

Given the number of utility interfaces along the length of Option C (Orange), along with the potential for disruption to people and neighbouring communities, it is appropriate to assign a score of **'Low-Moderate (Light Green)'.**

Low-Moderate

6.3 Technical

As set out in Section 2.3.3, the topic areas under consideration to assist with determining the best route option are as follows:

- General Compliance with System Reliability, Security Standards;
- Headroom;
- Maintainability;
- Technology Operational Risk;
- Average Reliability Rates; and
- Repeatability.

6.3.1 General Compliance with System Reliability, Security Standards

This is EirGrid's reliability and security standards are defined in the Transmission System Security and Planning Standards and their Operation Security Standards.

All technical input to the Kildare Meath project will comply to EirGrid's Standards for Security and Reliability. Therefore, there is no differentiation between the proposed route options and route Option C has been assigned a score of '**Low (Cream)**'.

Low

6.3.2 Headroom and Ratings Impact

Headroom is the amount of additional capacity each route option offers that would be available for the future without requiring further upgrade. All the proposed route options carry little additional headroom (spare current capacity) due to the nature of the corridor therefore giving no technical differentiation between the proposed routes in this aspect.

The current ratings bottleneck is the impact on the overall circuit ratings of the worst-case deepest obstacle crossing. As all the proposed route options will require some deep crossing solutions (below railways, motorways, rivers or a combination) of similar design, these will be the ratings bottleneck of that particular route. The connection spans north to south, whilst major natural and man-made obstacles are east west orientated, therefore all options cross the river Liffey, the railways, the M4, etc;

On account for the potential total number of Horizontal Directional Drills, Option C (Orange) has been assigned a score of **Low (Cream).**

Low

6.3.3 Maintainability

This considers the ease with which the route option can be serviced and maintained, for example how easy it is to access joint bays and link boxes.

All the proposed route options will be developed with the same design principles. For example, maximum standing sheath voltages, typical trench cross-section, separation between joint bays, location of link boxes (underground in chambers or pillar mounted), same substation entry locations. Whilst some route options come with a greater proportion of off-road build as opposed to road, with the level of design detail available at this stage, is not possible to substantially differentiate between the proposed route options.

As there is no differentiation between the proposed route options and route Option C has been assigned a score of '**Low (Cream)**'.

Low

6.3.4 Technology Operational Risk

This criterion aims to capture the risk of operating different technologies on the network.

The same technology is applied to all solutions including cables, joint bays, and bonding. All technology will be the standard technology in the industry and also the dominant technology on EirGrid's existing network (i.e. XLPE insulated underground cables). Therefore, there is no differentiation between the proposed route options and route Option C has been assigned a score of '**Low (Cream)**'.

Low

6.3.5 Average Reliability Rates

This is the likelihood of the chosen cable technologies such as cables, joint bays, and bonding failing during operation. All cable technology listed above are common to all route options.

Industry data on Cross-Linked Polyethylene (XLPE) insulation technology indicates that cable failures on a statistical basis are related to cable length.

The proposed route options lengths are as per Table 4.17, Section 4.3.5 (all values are based on desktop surveys).

The small percentage difference between the lengths of the route option does not trigger any substantial increase in the risk of failure. Furthermore, there is not currently sufficient technical detail, at this point, to determine the number increase of joint bays of each route against the shortest (Option C).

Therefore, there is no discernible differentiation between the solutions and route Option C has been assigned a score of '**Low (Cream)**'.

Low

6.3.6 Repeatability

Repeatability is whether the proposed technical solution can be readily repeated in the transmission network.

All the proposed route options will be developed with the same design principles; therefore, all route options are easily repeatable across the transmission network. Therefore, there is no differentiation between the proposed route options and route Option C has been assigned a score of '**Low (Cream)**'.

Low

6.4 Deliverability

6.4.1 Design Complexity

There are 11 surface waterbodies crossed along the length of Option C (Orange), some of which crossed more than once; so there will be 18 crossings in total. These waterbodies will be crossed in a variety of different way in order to minimise the environmental impacts, and to ensure construction and operational efficiency. Option C (Orange) has the highest amount of off-road sections, thus interface with private assets is increased. The difficulties associated with the increased agricultural land including reinstatement works increase the overall complexity.

The utilities crossings are assessed in Section 6.2.9 of this report. Option C meets the medium-pressure gas network in five locations with multiple crossings within these sections. The four locations are at R148 (Kilcock to Maynooth); on the R403 (Clane to Straffan road); Millennium Parkway, R445, and R448 (roads within Naas).

Option C (Orange) will require eight major crossings (such as HDD), which is the same number as Option D (Blue) and more than Options A (Red) and B (Green). The two additional crossings are on the River Liffey – a major river and a sensitive receptors these crossings will be of particular complexity.

Option C has been assigned a score of **High (Dark Blue).**

High

6.4.2 Traffic Disturbance

For Option C (Orange) it is anticipated that full road closures might be required at the following locations:

- L6207 from Ribstown through Cullendragh to Barstown Junction with the R156 an overall distance of 2,460 meters. In this location the carriageway is between 2.5 and 4.0 meters wide and does not allow adequate space for vehicles to pass the construction works safely;
- R125 from Mullagh Junction with the R156 through the Kiltens Gap Junction and Ferrestown Graveyard to Bryanstown, an overall distance of 6,670 meters. On this section of the route option the carriageway width is between 2.5 and 4.0 meters at the tightest section. It is therefore, recommended a full road closure. Note the road does increase to 12 meters in isolated areas and could present isolated opportunities to implement a lane closure;
- Moyglare Stud Farm to Moyglare Junction, a distance of 160 meters where the road width is between 2.5 and 3.5 meters wide;
- Timard to Laraghbryan West, a distance of 1,150 meters where the road with is between 2.5 and 3.5 meters wide;
- Smithstown to Longtown, an overall distance of 2,860 meters along roads of 2.5 to 5.7 meters wide which are not wide enough to set up lane closures;
- Irish Town Lower to Longtown South an overall distance of 270 meters with a road width between 2.7 and 4.7 meters;
- From Blackhall via Bodenstown Graveyard to the Junction with the R407, a distance of 2,290 meters. The road width reduces to a minimum of 2.3 meters. It is noted that the road width does increase to 10 meters in some areas so it expected that lane closures could be invoked instead of full road closure in isolated areas;
- Rasker Road to the Junction with the R448, a distance of 610 meters where the road width is between 2.8 and 5 meters wide. Therefore, not allowing a lane closure and requiring a full road closure; and
- At the end of Option C from the Stephenstown South Junction the R412 through to the Dunstown Substation including turn off, a distance of 1,240 meters with a road width of 3.0 meters. The construction works will take up most of the width of the road, therefore, requiring a full road closure.

In other areas of Option C (Orange); the road width will be reduced to 6.0 meters by the proposed construction works. In these areas it is anticipated that a lane closure with diversions for HGV vehicles may be required:

- Jenkinstown Junction to the Mullagh junction of the R156 and R125, a total distance of 2,810 meters; and
- R448 Junction with Rathasker Road and the Stephenstown South junction, a total distance of 3,730 meters.

All the remaining roads along the route of Option C (Orange) may require lane closures with the correct traffic management in place to allow the construction works to be carried out safely, specifically:

- From Junction R407 to Sallins Bypass;

- From Sallins Bypass to M7 South; and
- From Jigginstown to Rathasker Road.

Table 6.13 below provides a high-level summary on the proposed traffic management plans during installation for Option C (Orange). It is recommended that following the selection of the proposed route option, a detailed analysis to be undertaken with regards to phasing of road closures.

Table 6.13: Summary of Option C Traffic Management

Option C	Total Length (in km)	Lane Closures (in km)	HGV Diversions (in km)	Road Closures (in km)	Field Crossings (in km)
	46.7	6.9 (14.9%)	6.5 (13.9%)	20.3 (43.4%)	15.5 (33%)

In terms of traffic disturbance, a High score has been assigned to Option C (Orange) based on the Traffic Management which is anticipated to be required during construction works.

For Option C (Orange), in each route section requiring a lane closure 'with' or 'without' HGV, diversions are mostly available while at all times maintaining access for local residents. It is anticipated though that on a few route sections requiring full closure there might not be suitable diversions for through traffic along the length of the option.

Where suitable diversions for through traffic are available along the length of the option, the average installation rate is anticipated to be 80 meters per day, resulting in approximately two years to install this route option.

The exact location of the cable trench will be defined later in the project and this will depend on further design, surveys, consultation, and assessment. Consultations with the local authorities will help to define where the cable trench will go in the road to minimise disruption. For example, if a safe alternative could be provided for access with significant disruption for pedestrians, a footpath could be used to minimise disruption to the road network.

Option C (Orange) is the shortest of the options and is mainly located along local roads and agricultural lands. The lower number of regional roads affected would reduce the overall amount of traffic affected, although the narrower width of the local roads might require as a result a greater number of full road closures. Impacts to local roads will be comparatively easier to divert than regional roads. In terms of traffic disturbance related to the Traffic Management, Option C (Orange) has been assessed as **Moderate-High (Light Blue).**

Moderate-High

6.4.3 Dependence on Other Infrastructure Projects

As outlined in Chapter 1 of this report, all route options will have the same dependence on works required at the associated substations in terms of connections. In terms of other infrastructure projects in the area, similar crossing of existing motorways, railways and canals are required. All four of the proposed route options will cross the same infrastructure but, in some cases, in different locations. All four options will cross or run parallel with utilities, including water mains and the low to medium pressure gas network.

All four of the proposed route options will cross the proposed Water Supply Project[54] and therefore it is not a differentiator at this point.

Options B (Green), Option C (Orange), and Option D (Blue) will cross the proposed DART+ West railway line at the crossing point of the Dublin Sligo railway line. This project proposes the electrification and re-signalling of the Maynooth line and construction of a new DART depot facility west of Maynooth for the maintenance and parking of trains. West of Maynooth, the rail track will be upgraded to a twin-track between Maynooth and the proposed depot. This twin track configuration will divert offline to the south, running parallel to the existing railway on the approach to the proposed depot. The planning application is expected to be made to An Bord Pleanála in 2022, with construction possible in 2025. At this location, it is proposed that Options B (Green), Option C (Orange), and Option D (Blue) will cross the existing railway line by major crossing (such as HDD). The proposed DART+ West project will require a long crossing and additional studies and shielding to ensure that there are no electro-magnetic forces issues between the Proposed Project and the electrified line. At this stage, it is not considered that there would be any conflicts between the two projects, and both could be constructed without significant constraint. It is possible that both projects would be at construction at the same time and additional consideration would be needed to the cumulative effects, if Options B (Green), Option C (Orange), or Option D (Blue) were selected as the Emerging Best Performing Option.

Option C (Orange) has been assessed as **Moderate (Dark Green)** in terms of dependence on other infrastructure projects.

Moderate

6.4.4 Permits and Wayleaves

At this stage of the assessment all route options will have a similar issue with permits. However, Option C (Orange) has the largest amount of off-road sections and will have greatest requirements for wayleaves.

Option C (Orange) has been assessed as **Moderate-High (Light Blue).**

Moderate-High

6.4.5 Implementation Timelines

This route option is the shortest of all route options and requires the least amount of excavation and thus will reduce in programme durations. The route option however affects the most agricultural land, which will increase the risk of working on the land during inclement weather, requiring extended periods for reinstatement. This will likely increase the timelines for the construction period.

Option C (Orange) has been assigned a score of **Moderate-High (Light Blue).**

Moderate-High

[54] http://www.watersupplyproject.ie/

6.4.6 Combined Deliverability Performance

Considering the design complexity, traffic disturbance, and implementation timelines, a rating of '**High' (Dark Blue)** has been assigned. Option C (Orange) has scored very highly in terms of Traffic Disturbance (due to closures of local roads) and Design Complexity (due to the increased number of major crossings (such as HDDs), crossing of the River Liffey and potential increase impact to private assets). It has score Moderate-High (Light Blue) in terms of Implementation Timelines and Permits and Wayleaves (due to the longer lengths through agricultural land).

High

6.5 Economic

As set out in Section 2.3.4, the topic areas under consideration to assist with determining the best route option are as follows:

- Length of installed cable;
- Quantity of Minor and Major service crossings; and
- Number of Major Crossings (such as Horizontal Directional Drills.)

6.5.1 Length of Installed Cable

The first economic assessment is from the overall lengths of the cable routes (presented in Table 4.17, Section 4.3.5). From this, route Option C has a total length of 46.7 km which is the shortest route and therefore it has the lower economic impact in this aspect.

For this reason, route Option C has been assigned a score of **Low (Cream).**

Low

6.5.2 Quantity of Crossings

An assessment of both the minor and major crossings expected to be encountered for the cable route options has been carried out by categorising them into the different crossing types (presented in Section 2.3.3.2). Summaries of these are listed below where Type 1 has the lowest impact and Type 4 has the highest:

- Type 1 Crossings - shallow crossings (utility/drainage/other) - deeper installation;
- Type 2 Crossings - shallow water crossings (Open cut solution);
- Type 3 Crossings - larger water crossings (Cable bridges/culverts/micro tunnels); and
- Type 4 Crossings - large crossings (Horizontal directional drills/ Auger bores or tunnel solutions)

It has been found that route Option C (Orange) has the joint most Type 1 crossings, the second most Type 2 crossings, no Type 3 and joint most Type 4. For this reason, route Option C (Orange) has been assigned a score of **Moderate-High (Light Blue).**

Moderate-High

6.6 Summary of Option C (Orange) Assessment

6.6.1 Environment Summary

Option C (Orange) has been scored as **Low-moderate (Light Green)** overall. The environment assessment topic scores for Option C (Orange) were generally lower than Option A (Red) and similar to those scored for Option B (Green) and that is reflected in the similar combined performance score as Option B (Green). In comparison to Option B (Green), Option C (Orange) scores higher in terms of Land Use Planning (impacts to a solar farm application) but less in terms of cultural heritage. A summary of the environmental appraisal of Option C (Orange) is provided in Table 6.14.

Table 6.14: Summary of Environment Assessment for Option C (Orange)

Biodiversity	Soils and Water	Planning Policy and Land Use	Landscape	Archaeology, Architectural Heritage, and Cultural Heritage	Combined Environment Score
Moderate-High	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate

6.6.2 Socio-Economic Summary

Option C (Orange) is considered to have a similar in-combination social impact to Option A (Red) and Option B (Green), however individual social impacts are more similar to Option B (Green) than Option A (Red). As such, it has been assigned a **Moderate (Dark Green)** score. A summary of the socio-economic appraisal of Option C (Orange) is provided in Table 6.15.

Table 6.15: Summary of Socio-economic Assessment for Option C (Orange)

Traffic and Transport	Noise and Vibration	Air Quality	Visual	Amenity	Health	Employment and Economy (and Tourism)	Land Use (and Land-take)	Agriculture (including Equine)	Utilities	Combined Socio-Economic Score
Moderate-High	Low-Moderate	Low	Low-Moderate	Low-Moderate	Low	Low	Low	Moderate	Low-Moderate	Moderate

6.6.3 Technical Summary

At this stage in the Proposed Project are there no technical differentiations apart from the number of major crossings. Options A (Red) and B (Green) will have two fewer than Options C (Orange) and D (Blue). Other technical factors will have no impact on the selection of the best performing option. Option C (Orange) has been assessed to have a **Low-Moderate (Light Green)** score for the technical criterion.

Table 6.16: Summary of Technical Assessment for Option C (Orange)

General Compliance	Headroom	Maintainability	Technology Operational Risk	Average Reliability Rates	Repeatability	Combined Technical Score
Low	Low	Low	Low	Low	Low	Low

6.6.4 Deliverability Summary

Considering the design complexity, traffic disturbance, and implementation timelines, a rating of **High (Dark Blue)** has been assigned. Option C (Orange) has scored very highly in terms of Traffic Disturbance (due to closures of local roads) and Design Complexity (due to the increased number of major crossings (such as HDDs), crossing of the River Liffey and potential increase impact to private assets). It has score Moderate-High (Light Blue) in terms of Implementation Timelines and Permits and Wayleaves (due to the longer lengths through agricultural land).

Table 6.17: Summary of Deliverability Assessment of Option C (Orange)

Design complexity	Traffic disturbance	Dependence on other infrastructure projects	Permits and wayleaves	Implementation Timelines	Combined Deliverability Score
High	Moderate-High	Moderate	Moderate-High	Moderate-High	High

6.6.5 Economic Summary

At this stage in the Proposed Project, the only differentiations between route options are cable route lengths and the impact from the quantity of expected major crossings. Option C (Orange) has been assessed to have a **Low-Moderate (Light Green)** score for the economic criterion due to the high number of major crossings (such as HDD) while having shortest route length.

Table 6.18: Summary of Economic Assessment of Option C (Orange)

Length of Installed Cable	Quantity of Crossings	Combined Economic Score
Low	Moderate-High	Low-Moderate

7. Option D (Blue)

This section outlines the assessment of Option D (Blue) against the five assessment criteria – Environment; Socio-Economic; Technical; Economic; and Deliverability and their sub-topics.

7.1 Environment

As set out in Section 2.3.1, the 'Environment' criterion assessment topics under consideration to assist with determining Emerging Best Performing Option are as follows:

- Biodiversity (Flora and Fauna);
- Soils and Water;
- Planning Policy and Land Use;
- Landscape; and
- Archaeology, Architectural Heritage, and Cultural Heritage.

7.1.1 Biodiversity (Flora and Fauna)

7.1.1.1 European Sites

Option D (Blue) is not located within or directly adjoins any European site. The nearest European site is Rye Water/Carton SAC located approximately 2km to the south-east of Option D (Blue) and designated for petrifying springs with tufa formation, narrow-mouthed whorl snail and Desmoulin's whorl snail (Appendix A.1). Option D (Blue) is also hydrologically connected to this European site and has the closest river crossing (approximately 2.2km upstream following the course of the waterbody) to the site out of all the options via the Rye Water River. This route option requires 18 river crossings however involves the second shortest length of off-road section. This route option involves crossing of watercourses with indirect hydrological links to a complex of European sites within Dublin Bay including South Dublin Bay and River Tolka Estuary SPA and South Dublin Bay SAC also (see Appendix A.1). There is the potential for impacts to aquatic habitats and species downstream through a pollution event during construction. Habitats along the southern section of Option D (Blue) (as with all other route options) are suitable to support foraging qualifying interests bird species from Poulaphouca Reservoir SPA and are within the foraging range of QI bird species. Therefore, there is the potential for disturbance impacts to these species and temporary loss of habitat during construction.

7.1.1.2 National Sites

No NHA sites are located in close proximity to this route option. The closest NHA site is Hodgestown Bog NHA located 8km west of Option D (Blue). This route option also directly crosses the Royal Canal pNHA west of Maynooth and the Grand Canal pNHA on two occasions at Sallins and Naas however HDD will be employed at these major crossings and therefore impacts to aquatic receptors will be minimised or avoided.

7.1.1.3 Watercourses and Aquatic Species

This route option involves the crossing of several major rivers including Rye Water, River Liffey, Lyreen River and tributaries of the River Tolka with varying water framework directive (WFD) status's ranging from 'Good' to 'Poor'. This route option potentially involves the most crossings of major rivers (seven crossings) requiring HDD and nine smaller rivers and streams requiring alternative crossing methods such as open cut if not designated as a salmonid watercourse. These rivers are important for aquatic species and otter. Atlantic salmon and brown trout are found in the River Liffey and the Rye Water River along with minnow, European eel and lamprey sp. White-clawed crayfish has been recorded at Leixlip within the Rye Water River. Several rivers were noted to be suitable to support kingfisher with one bird recorded hunting along the River Liffey during field surveys.

7.1.1.4 Recent Field Survey Data and Desk Based Review

A drive over comprising visual assessments and targeted spot checks at static locations was undertaken along the accessible sections of the route option on the 11th, 12th and 13th of October 2021. The dominant habitats recorded along Option D (Blue) include hedgerows, treelines, agricultural grassland, tillage land (predominantly cereal production), amenity grassland and watercourses. A number of red listed (snipe) and Annex I (kingfisher and golden plover) bird species were recorded during visit one of the wintering bird surveys in October 2021. Devil's bit scabious, the food plant of the Annex II listed marsh fritillary butterfly, was recorded near Dunstown substation within Harristown Common.

A search of the National Biodiversity Data Centre records included records for several protected species including common frog, pine marten, common lizard, red squirrel, badger and otter in the vicinity of Option D (Blue). A number of records of wintering bird species at Poulaphouca and across counties Meath and Kildare were returned as part of a data request received from Birdwatch Ireland approximately 8km from Option D.

As with Options A (Red), Option B (Green), and Option C (Orange), the routing of Option D (Blue) traverses along narrow road networks bordered by hedgerows and treelines and there will be a requirement for vegetation removal to accommodate the cable installation. Given the presence of species rich hedgerows and mature tree lines along these road networks and throughout the off-road sections there is the potential for habitat loss, habitat fragmentation and impacts on protected species, wintering and breeding birds through disturbance, habitat loss and pollution during construction. Given the distance of the route option there is a high likelihood that invasive non-native species listed on the Third Schedule of the E C (Birds and Natural Habitats) Regulations will be encountered along the road networks. All lengths of the proposed route option not in the road surface has the potential for impacts on biodiversity.

7.1.1.5 Summary of Assessment

As with Option A (Red), Option B (Green), and Option C (Orange), the greatest effects on biodiversity for Option D (Blue) would be during construction, where despite cables primarily being laid in public roads, there is potential (particularly from passing bays and watercourse crossings) for impacts on hedgerows, tree lines and aquatic ecosystems in particular; other habitats and species may also be disturbed or fragmented during the construction phase and effects could be permanent in some cases. In the absence of mitigation there is the potential for impacts to Rye Water/Carton SAC in the event of a pollution incident during construction.

There is considered to be a **Moderate-High (Light Blue)** risk of a significant impact to biodiversity assets due to Option D (Blue).

Moderate-High

7.1.2 Soils and Water

7.1.2.1 Geology and Soils

Option D (Blue) is underlain predominantly by Carboniferous limestone bedrock, with associated calcareous shales, and older Silurian greywacke, siltstone and shale in the south of the Study Area. There are no mapped karst landforms or Geological Heritage sites recorded in the vicinity of the route option. However, the option route crosses rocks in which karst features have been recorded and the potential exists for unmapped features to occur in proximity to the route option. Karst features are associated with the dissolution of limestone and the formation of ground cavities, which may not always be apparent at the surface, with consequent subsidence risks and enhanced subsurface drainage.

Superficial deposits underlying the Option D (Blue) route are predominantly glacial tills, derived from the underlying limestone and, in the north, sandstone and shale bedrock. There is also alluvium associated with watercourses and some areas of sand and gravel are crossed by the route in the southern half of the Study Area.

The route option crosses areas of potential geologic economic deposits (sand and gravel, granular aggregate and crushed rock), predominantly in the southern half of the Study Area. A slightly greater area of potential deposits lies under Option D (Blue) than the other proposed route options, however, the areas crossed are still small and these deposits are widely available in the surrounding area, so that this is not considered a significant constraint for route selection. One mine is recorded within 200 m of the Option D route (to the south of Maynooth), no further details were available at the time of this assessment and this will need to be further investigated at later stages.

7.1.2.2 Summary of Assessment

In terms of geology and soils the overall evaluation for Option D (Blue) is ranked as **Low-moderate** risk based on currently available information. However, the potential for unmapped karst features should be noted and further assessment may be needed to identify potential for ground stability issues.

Low-Moderate

7.1.2.3 Groundwater

The majority of Option D (Blue) lies within the Dublin (poorly productive bedrock) WFD groundwater body, with a small area in the north within the Dunshaughlin (productive fissured bedrock) groundwater body. In the south of the Study Area the route option crosses the Naas (karstic) and Curragh Gravels East (gravel) groundwater bodies.

The majority of the route option is underlain by bedrock classified as Locally Important Aquifer (bedrock which is generally moderately productive in local zones), with a small area of Regionally Important Aquifer - Karstified (diffuse) crossed in the southern half of the Study Area. Some areas classified as of High groundwater vulnerability are crossed by the route option, predominantly in the southern half of the Study Area, along with some small areas of Extreme groundwater vulnerability. While there are no mapped karst landforms in the vicinity of the route option, the route option crosses rocks in which karst features have been recorded and the potential exists for unmapped features to occur. Karst features can be associated with significant groundwater flowpaths and may be important in supporting surface water features.

There are no Public & Group Supply Source Protection Areas or Group Water Schemes in the vicinity of the route option. There are a large number of groundwater wells and springs mapped by the Geological Survey Ireland across

the Study Area. However, in accordance with TII guidance[55] and the observation that low yielding wells, used mainly for domestic and farm water supply, are very common in Ireland, the assessment has focused on high-yielding springs and wells used for public water supply and their surrounding protection zones and the total number of wells and springs along each route corridor has not been used in assessing relative impacts between route options.

No groundwater dependent water bodies or groundwater dependent terrestrial ecosystems (GWDTEs) have been identified at this stage of assessment, so these features have not been used in assessing relative impacts between route options at this stage. However, the potential exists for such features to be present within the Study Area and it cannot be conclusively determined at this stage whether or not they may be a constraint for the proposed route.

There is potential for dewatering operations associated with crossings of large watercourses, major roads and railways. This applies to all route options so no specific issues have been identified for Option D (Blue) at this stage.

7.1.2.4 Summary of Assessment

In terms of groundwater the overall evaluation for Option D (Blue) is ranked as **Low-moderate** risk based on currently available information. However, the potential for unmapped karst features should be noted and further assessment may be needed to identify potential for interference with groundwater flows and potential for groundwater flooding issues.

Low-Moderate

7.1.2.5 Surface Water

There are 11 surface waterbodies crossed along the length of route Option D. Some are crossed more than once. A full list of water bodies and their current status is provided in Table 7.1 as well as their proximity to the Rye Water Valley/Carton SAC, their sensitivity to change, the likely crossing technique to be employed and the potential for impacts as a result.

Table 7.1 Surface Water Bodies Option D (Blue)

Waterbody	Status	Number of Crossings	Connection & Proximity to Rye Water Valley/Carton SAC (at closest crossing)	Sensitivity	Impact Potential
Liffey_100	Moderate	2	No Connection	Medium	Low
Grand Canal Naas Line	Good	1	No Connection	Very high	Low
Grand Canal Main Line	Good	1	No Connection	Very high	Low
Liffey_120	Good	3	No Connection	Very high	Low
Liffey_130	Good	3	No Connection	Very high	Medium
Lyreen_020	Poor	2	3.2km	High	High
Royal Canal Main Line	Good	1	No Connection	Very high	Low
Rye Water_020	Moderate	1	3.3km	High	High
Rye Water_030	Moderate	2	2km	Very High	Medium

[55] TII. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. Unreferenced. Obtained from: www.tii.ie/technical-services/environment/planning/ (accessed October 2021). TII guidelines have been used as they are relevant to all linear infrastructure projects.

Waterbody	Status	Number of Crossings	Connection & Proximity to Rye Water Valley/Carton SAC (at closest crossing)	Sensitivity	Impact Potential
Dunboyne Stream_010	Moderate	1	No Connection	Medium	Low
Tolka_020	Poor	1	No Connection	Low	Low
Total		18			

In addition to water bodies being directly crossed by the cable, for Option D (Blue) there are also a number in close proximity which may be at risk from silty water runoff or spillages of hydrocarbons during construction. These water bodies are less than 50m from the cable route:

- Liffey_120: the route option runs alongside this water body, at approximately 10m to 50m from the bank edge, for 420m close to Bodenstown Golf Club and then again a short distance upstream from this point the route option is approximately 50m from the water body for a stretch of 220m. The Liffey_120 is of very high sensitivity and, whilst the cable will be laid in the road in these locations, it is likely the road drains to the water body and so a pathway for contaminants exists. There is a medium to high impact potential from having a trench in such close proximity for this length.
- Rye Water_020: the route option runs alongside this water body, at approximately 25m from the bank edge, for 140m. The Rye Water_020 is of high sensitivity and there is a medium to high impact potential from having a trench in such close proximity for this length.

7.1.2.6 Flood Risk

For this route option, the length (in metres) within a PFRA flood risk area is:

- Pluvial: 303m; and
- Fluvial: 2,654m.

There are 18 crossings of water bodies along the route; all crossings will be designed so do not present an increase in flood risk, either pluvial or fluvial.

7.1.2.7 Summary of Assessment

Considering the number of crossings of water bodies (approximately 18 no.), in particular the crossings of those with high or very high sensitivities, as well as the potential for open cut crossings in addition to potential flood risk, Option D (Blue) is ranked as **Moderate risk (Green)** in respect to the Soils and Water assessment topic.

Moderate

7.1.3 Planning Policy and Land Use

7.1.3.1 Planning Policy and Legislation

Option D (Blue) follows the same route as Option B (Green) and Option C (Orange) until Mulhussey, where it follows the Moyglare Road south then east, rejoining the same route as Option B (Green) and Option C (Orange) to the south west of Moyglare Stud Farm. It then diverges again from Option B (Green) and Option C (Orange) at the M4 motorway to the south west of Maynooth, following the road until Dowdstown, and then follows the R406 to Barberstown. There it heads south west before skirting Clane, where it interacts with a number of Clane LAP zonings to the north east of the town. The route option then follows the R407 to Bodenstown, joining with the other route options to the north west of Sallins. It then follows the same path as Option A (Red), passing through Naas West and East before joining the rest of the routes at Killashee and heading south towards Dunstown substation.

7.1.3.1.1 Clane Local Area Plan 2017 - 2023

Option D (Blue) follows the R403 towards Clane, turning off just before the town heading south east through Clapdoo Commons, crossing three areas of land zoned within the Clane LAP before crossing the Liffey. The zoning objectives for these lands are contained within the table below.

Table 7.2: Relevant Zoning Objectives Clane LAP

Zoning Objectives (Clane Local Area Plan 2017 - 2023)	
F2: Strategic Open Space	To preserve, provide for and improve recreational amenity, open space and green infrastructure networks.
SR: Strategic reserve	To protect strategic lands from inappropriate forms of development which would impede the orderly expansion of a strategic urban centre.
I : Agricultural Land	To retain and protect agricultural uses.

Option D (Blue) also passes through Key Development Area 1 (KDA 1), the vision for which is as follows:

> *'The extension of the urban area of Clane through new residential development and open space and amenity, with a high quality permeable urban form, which protects natural heritage and delivers important connectivity to the River Liffey and to the future town park.' (P.62)*

7.1.3.1.2 Draft Naas Local Area Plan 2021-2027

Option D (Blue) crosses the railway line (Dublin-Cork) and M7 motorway before entering Millennium Park and via R407, traversing through the commercial park to join the R409 through Naas West before travelling south via the R448 through Naas East. The following zonings applicable to Millennium Park, Naas West and Naas East.

Table 7.3: Relevant Zoning Objectives Naas LAP

Zoning Objective (Naas Local Area Plan 2021-2027)	
B Existing/Infill Residential	To protect and enhance the amenity of established residential communities and promote sustainable intensification.
C(1) New Residential	To provide for new residential development.
E Community & Education	To provide for education, recreation, community and health
F(2) Strategic Open Space	South of Kilcullen and Ballymore Eustace Roundabouts: These lands comprising 11.94 ha are identified for the development of a proposed active recreation area catering for the future population of this area of town. The development of such facilities shall include the provision of strong links to existing and future residential lands in the surrounding area, as well as the development of the old Naas-Baltinglass/Tullow railway line Greenway.
F3 Strategic Open Space	To preserve, provide for and improve recreational amenity, open space and green infrastructure networks.
H Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
H(5) Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
H(9) Industry and Warehousing	To provide for industry, manufacturing, distribution and warehousing.
I Agriculture	To retain and protect agricultural uses.
K(2) Commercial/Residential	To provide for commercial and appropriate residential mixed-use developments.

Zoning Objective (Naas Local Area Plan 2021-2027)	
P1 Data Centre /Warehouse	To provide for Data Centre development and their associated infrastructure only.
Q4 Office, Enterprise and Employment	To provide for and facilitate the provision of high job-generating uses.
Q5 Office . Enterprise and Employment	To provide for and facilitate the provision of high job-generating uses.
U Utilities	To provide for and improve public utilities

7.1.3.2 Planning Applications

A review of all granted and live applications over the last five years has been performed within a 50m buffer, 25m either side of Option D (Blue). Some of these applications will be new receptors which will have already been constructed by the time construction on the Proposed Project commences. These include both individual dwellings and larger development as shown in the LAPs. Of these, some of the notable applications are highlighted in the table below.

Table 7.4: Notable Planning Applications in proximity to Option D (Blue)

Local Authority	App. Number	Brief Description	Address	Status
Kildare County Council	16434	New right hand turning lane, bus set down area and associated works, a lift to existing 110kv overhead power lines, removal of derelict prefabricated structures and culvert of ditch within the site and the construction of a 10,450sqm two and three storey 1000 pupil post-primary school and associated infrastructure including, ESB substation, 92 car park spaces, 250 cycle parking spaces, bus and car set down and pick up facilities, and play areas	Plots No. 71 and 72 and part Plots 85 and 86 of the Millennium Park Master Plan, Millennium Park Naas	Granted 09/06/2017
Kildare County Council	161145	183 no. residential dwellings comprising 16 no. 2-two storey terrace dwellings (Type A); 134 no. 3-bed two storey terrace and semi-detached dwellings (Type A1 & B) and 33 no. 4-bed two storey semi-detached and detached dwellings (Type C, C1 & C2); provision of a single storey childcare facility (approximately 324sq.m GFA); and all associated infrastructure.	Jigginstown, Naas, Co. Kildare	Granted 16/06/2017
Kildare County Council	17886	an amendment to previously permitted residential development Reg. Ref. 16/1145. The proposed amendments relate to 83 No. units only, representing Phase 1 and 2 of the permitted scheme, and comprises of minor modifications to elevational treatments, together with all other associated and ancillary modifications at a site	Jigginstown, Naas, Co. Kildare.	Granted 09/11/2017
Kildare County Council	191269	Change of use of existing warehouse building to light industry/workshop use together with new single storey extension. Entrance alterations, on-site parking and associated site works and infrastructure.	Mylerstown, Two Mile House, Naas	Granted 02/06/2020
Kildare County Council	20840	the construction of a 5627sqm Specialist Packaging Single Storey High Level Manufacturing Facility with Three Storey Head office and associated infrastructure	Millennium Business Park, Osberstown, Naas	Granted 30/03/2021 (under financial appeal)
Kildare County Council	201564	(a) Extension of the existing 7.3m wide two-lane carriageway by 137m to the north (b) 2m grass verge, 2m cycle path and 2m footpath east and west of the proposed access road extension (c) vehicular entrance west of the proposed extension to facilitate a	Millennium Park, Osberstown, Naas	Granted 01/07/2021

Local Authority	App. Number	Brief Description	Address	Status
		proposed access to a planned commercial development (Kildare Co.Co. Ref. 20840) (d) vehicular entrance east of the proposed extension to facilitate a proposed access to a planned commercial development (Kildare Co.Co. Ref. 20561) (e) parking provision and associated infrastructure		
Kildare County Council	19305701	STRATEGIC HOUSING DEVELOPMENT (ABP Decision) - the demolition of an existing dwelling and agricultural buildings on the subject site and the construction of a residential development of 314 no. dwellings, a crèche (c. 610sqm), retail unit (c. 169sqm)	Naas West & Jigginstown, Naas	Granted 13/03/2020

These applications, as well as the more minor/domestic applications, will be taken into account in the routing of the cable. Other larger scale planning applications will also be examined and taken into account within the routing process. Such applications include other energy projects, the Water Supply Project, and road schemes.

7.1.3.3 Summary of Assessment

Taking the above into account, Option D has the potential to interact with a significant number of recent and current planning applications, as well as zonings within the Clane and Draft Naas LAPs. However, it is acknowledged that with appropriate siting and mitigation, the impacts of these interactions can be minimised. Therefore, Option D has been assigned moderate risk in terms of the combined impacts to land use and planning policy.

Moderate

7.1.4 Landscape

7.1.4.1 Landscape character

Refer to Section 4.1.4.1 for full information on landscape character.

7.1.4.2 Landscape elements

No designated or highly sensitive landscape elements were identified within the portion of the Study Area that occurs within County Meath.

Included in Table 14.4 of Chapter 14 (and indicated on Map 14.2) of the Kildare County Development Plan are:

> *'12 "principal landscape sensitivity factors": Major Rivers and Water bodies; Canals; Ridgelines; Green Urban Areas; Broad-Leaved Forestry; Mixed Forestry; Natural Grasslands; Moors and Heathlands; Agricultural Land with Natural Vegetation; Peat Bogs; Scenic View; and Scenic route'.*

This option will pass within 300m of the following 'principal landscape sensitivity factors' (from north to south):

- River Liffey; and
- Woodland R412 regional road.

7.1.4.2.1 Sensitivity - landscape elements

The sensitivity of these '*principal landscape sensitivity factors*' are recorded in Table 7.5.

7.1.4.2.2 Magnitude of impacts - landscape elements

The magnitude of impacts on landscape elements are as follows:

- **River Liffey**: Approximately 8.7km of the route option passes within an area of '*special sensitivity*' that buffers the River Liffey '*principal landscape sensitivity factor*'. This area would have a heightened sensitivity to the removal of vegetation. Within this '*principal landscape sensitivity factor*' approximately 9km of the route occurs within agricultural fields; thus, the construction activity here would be uncharacteristic, however, works will be temporary and transitory. For these reasons, the magnitude of impact during the construction phase is deemed to be low. The agricultural land use will be reinstated and the river crossing is likely to be by directional drilling; therefore the likely magnitude of effect during the operational phase is likely to be negligible.
- **Woodland R412 regional road**: It is likely that the R412 regional road is wide enough to accommodate the trenching work without the need to remove roadside vegetation; therefore, there will be no material change. Thus the magnitude of effect is deemed to be negligible during both the construction and operational phases.

7.1.4.2.3 Significance of impacts - landscape elements

All the impacts on the '*principal landscape sensitivity factors*' identified are of a negligible magnitude during the operational phase; therefore, are considered, by default, to have a significance of effect that is **Imperceptible**. During the operational phase only the River Liffey '*principal landscape sensitivity factor*' is likely to have a significance of **Slight-Imperceptible**, while for all the others, it will be **Imperceptible**.

Table 7.5: Summary - Principal Landscape Sensitivity Factors within County Kildare

Principal Landscape Sensitivity Factor	Specific feature	Sensitivity of feature		Likely operational magnitude of effect	Likely operational significance of effect
Major Rivers and Water bodies		River Liffey	High-medium	Negligible	Imperceptible
Mixed Forestry		Woodland R412 regional road	High	Negligible	Imperceptible

7.1.4.3 Summary of Assessment

A 9km offline section passes through agricultural fields near the River Liffey '*Principal Landscape Sensitivity Factor*'; therefore, there is a potential for some impact on the landscape character within this area of 'special' sensitivity, but significant impacts are not anticipated. No significant landscape impacts are anticipated. Whilst the magnitude of impact during both construction and operation is at the very bottom end of the magnitude spectrum; some receptors are deemed to have a sensitivity that is at the upper end of the sensitivity spectrum thus a relatively small increase in the magnitude of impact during the construction phase could result in a significant impact therefore the attributed score is **Low-Moderate (Light Green)**.

Low-Moderate

7.1.5 Archaeology, Architectural Heritage, and Cultural Heritage

Option D (Blue) includes sections common to Option A (Red), Option B (Green), and Option C (Orange), and therefore the receiving environment is similar to that described in Sections 4.1.5, 5.1.5, and 6.1.5 above.

A summary of archaeology, architectural heritage, and cultural heritage constraints identified within the Step 3 Study Area is presented in the Environmental Constraints Report along with a discussion on the general character and nature of the constraints present, comprising National Monuments and Preservation Orders, sites on the RHM, Recorded Monuments and sites recorded on the SMR, Protected Structures, structures recorded on the NIAH, ACAs, and GDLs identified by the Survey of Historic Gardens and Designed Landscapes.

Baseline information on the archaeology, architectural heritage and cultural heritage constraints identified within 100m of Option D (Blue) is provided in Appendix B.1.

7.1.5.1 Archaeology

The Jigginstown Castle complex, comprising one National Monument (AY_39; also a Protected Structure, AH_16) and three sites with Preservation Orders placed on them (AY_40, AY_42, and AY_43), is located approximately 40m to the west of Option D (Blue). The complex includes two further sites with Preservation Orders placed on them (AY_38, AY_44; also a Protected Structure, AH_17) approximately 195m and 230m to the west of Option D (Blue), respectively. Five of these sites (AY_38, AY_39, AY_42, AY_43, and AY_44; see Appendix B.1), are also on the RHM.

Three Recorded Monuments are located within 100m of Option D (Blue) (see Appendix B.1). These comprise the site of a medieval parish church (AY_09), the site of medieval domestic activity (AY_11), and the site of a castle (AY_28) of unknown date.

A total of 18 sites recorded on the SMR have been identified within 100m of Option D (Blue). These are characterised by the locations of cropmarks (AY_10, AY_15 – 16, AY_18, AY_19, AY_21 – 22, AY_23, AY_32 – 34, AY_35, AY_36 and AY_46 – 48), a medieval bawn wall (AY_20), and evidence of post-medieval religious activity (AY_08).

Further information on the archaeological constraints identified within 100m of Option D (Blue) is included in in Appendix B.1.

7.1.5.1.1 Archaeological Potential

Option D (Blue) crosses the Rye Water, River Lyreen and the River Liffey, as well as a number of minor watercourses with the potential for votive (religious) offerings to be present. The underlying geology is largely limestone, with superficial deposits of till, gravel and alluvium, which has the potential to preserve previously unknown archaeological monuments and remains.

7.1.5.2 Architectural Heritage

Architectural heritage constraints within 100m of Option D (Blue) comprise:

- Six Protected Structures characterised by post-medieval churches (AH_03; also included on the NIAH) and dwellings (AH_07, AH_08 and AH_18), including estate buildings (AH_14) and a castle (AH_09).
- Seven GDLs comprising six recorded by the Survey of Historic Gardens and Designed Landscapes and one identified from historic mapping (Ordnance Survey 6", 1837 – 1842).

No ACAs are located within 100m of Option D (Blue).

Further information on the architectural constraints identified within 100m of Option D (Blue) is included in Appendix B.1.

7.1.5.3 Cultural Heritage

A total of 24 cultural heritage sites identified within 100m of Option D (Blue) from the sources identified in Section 2.3.1.5. These are characterised by extant post-medieval buildings and structures, including stone road bridges, vernacular housing and farm buildings, as well as cropmarks corresponding with post-medieval field systems. Further information on these cultural heritage sites is presented in Appendix B.1.

7.1.5.4 Potential Impacts

7.1.5.4.1 Construction – Direct Impacts

Archaeology

No direct impacts have been identified on National Monuments, sites with Preservation Orders, or sites on the RHM as a result of the construction of Option D (Blue).

Where Option D (Blue) is located within the Zone of Notification associated with a Recorded Monument, this has been identified as a direct impact below. While the option would not directly impact the Recorded Monument itself, excavation of the cable trench and joint bays would have a direct impact on any archaeological remains that may survive within this zone.

Option D (Blue) is located within the Zone of Notification of one Recorded Monument (AY_09). Within this zone it is located in the carriageway of the existing road the construction of which is more than likely to have removed or truncated any archaeological remains associated with this monument that may have been present. However, construction, including the excavation of the cable trench and joint bays would have a direct impact on any archaeological remains that may survive. Construction would also have a direct impact on any archaeological remains associated with this Recorded Monument that may survive within any additional land take required for construction.

While construction would be within the existing carriageways may have partially removed or truncated any remains associated with, the option has the potential to remove archaeological remains associated with AY_08, AY_15, AY_35, and AY_46 – 48, construction of Option D (Blue) would have a direct impact on any archaeological remains associated with these constraints that may survive. In addition construction would have a direct impact on any unknown archaeological remains associated with these constraints that may survive within any additional land take required for construction.

The excavation of the cable trench and joint bays would have a direct impact through the removal of any archaeological remains associated with AY_10 (an enclosure) which is located in an offline section in Laraghbryan East.

Excavation of the cable trench and joint bays, and the excavation of temporary launch and reception pits for directional drilling may also result in a direct impact any previously unknown archaeological remains that may be present within the land required for Option D (Blue). The potential for this impact is considered to be higher in previously undeveloped areas than within the existing carriageways, the construction of which is likely to have likely to have removed or truncated any archaeological remains that may have been present.

Architectural Heritage

Should Option D (Blue) require additional land take for construction, the removal of boundary features would have a direct impact six GDLs (Jenkinstown House; DL_02, Killashee House; DL_20, Blackhall; DL_16, Castlesize; DL_18, Dollardstown House; DL_08, and Dowdstown House; DL_09).

Cultural Heritage

One post-medieval road bridge (CH_01) is located on the existing road through Culcommon. There is therefore potential for a direct impact on this cultural heritage constraint as a result of accidental damage from construction plant.

The excavation of the cable trench and joint bays may have a direct impact through the removal of any surviving remains associated with three cultural heritage sites (CH_08, CH_36 and CH_40).

CH_03 is a public house located immediately adjacent Option D (Blue). There is therefore potential for a direct impact on this cultural heritage constraint as a result of accidental damage from construction plant.

7.1.5.4.2 Construction - Indirect Impacts

Archaeology

Option D (Blue) is located approximately 40m to the east of the boundary of Jigginstown Castle complex, which comprises a National Monument (AY_39) and five sites with Preservation Orders (AY_38, AY_40, AY_42, AY_43, and AY_44) (five of which are also sites on the RHM), and two Protected Structures (AH_16 and AH_17). Noise and visual intrusion from construction plant may have an indirect impact on this complex. However, it is anticipated any intrusion would be temporary (lasting the duration of construction in this location) and would be largely screened by the intervening mature trees along the eastern boundary of the complex which would be retained.

Architectural Heritage

This route option is located within 87m the following six Protected Structures[56]:

- Saint Paul's Church of Ireland Church (AH_03, assessed by the NIAH to be of Regional importance);
- Greygates (AH_07);
- Barberstown House (AH_08);
- Barberstown Castle (AH_09);
- the gate lodge and entrance of Castlesize House (AH_14); and
- Bluebell Farm House (AH_18).

While these potential impacts would result from the introduction of noise and visual intrusion into the setting of these constraints during construction from the movement and operation of plant, it is anticipated any intrusion would be temporary (lasting the duration of construction in each location).

[56] Please note, indirect impacts have been identified on two additional Protected Structures (AH_16 and AH_17); however, these form part of the Jigginstown Castle complex and have been considered alongside the archaeological constraints that form this group.

Cultural Heritage

Movement and operation of plant during the construction of Option D (Blue) would have an indirect impact on the setting of nine cultural heritage sites (CH_03, CH_13, CH_29, CH_34, CH_45, CH_55, CH_57, CH_58, and CH_59). However, it is anticipated any intrusion would be temporary (lasting the duration of construction in each location).

7.1.5.4.3 Operational Impacts

As the Proposed Project would be located beneath the road surface, and any offline sections would be reinstated after construction no impacts on archaeological, architectural or cultural heritage constraints have been assessed as a result of the operation of Option D (Blue).

7.1.5.5 Summary of Assessment

While some potential impacts are comparable to the other route options, Option D (Blue) has the potential to directly impact seven sites identified on the SMR and given the proximity of this route option to the Jigginstown Castle complex, there is the potential for an indirect impact on this historically significant constraint. Due to these potential impacts, Option D (Blue) has been assigned a risk of '**Moderate (Dark Green)**'.

Moderate

A Route Corridor Summary Matrix for archaeology, architectural heritage and cultural heritage is provided in Appendix B.1.

As the project progresses it may be possible to avoid impacts on archaeology, architectural heritage, and cultural heritage constraints through design, including localised realignments of the route. Where impacts on archaeology, architectural heritage, and cultural heritage constraints cannot be avoided it is possible impacts could be reduced through recording in advance of, or during, construction, including the archiving and documentation of the results of this recording for public reference.

7.2 Socio-Economic

7.2.1 Traffic, Transport and Access

Option D (Blue) passes close to Maynooth before crossing the M4 and following the R406 and R403, the R407 and the R448 between the Woodland and Dunstown substations. The route option is mainly located along regional and local roads, bypassing the towns of Clane and Sallins before re-joining the regional road network at Naas and passing close to residential areas in the south-west of the town.

Table 7.6 presents the break-down of road classifications for the route of Option D (Blue).

Table 7.6: Option D (Blue) Road Classification

Option	Total Length (km)	Road Length Percentage Distribution		
		Regional	Local Roads and Smaller	Off-road and other Land Types
Option D	50.5	45.7	31.5	22.8

Option D (Blue) for the most part is located along regional roads for approximately 46% of its length and has some off-road sections along the route, in particular west of Maynooth and east of Clane. It affects the least amount of agricultural land compared to the other route options and its proposed alignment crosses a total of six waterways, which is a relatively high number compared to the other alternatives.

It is anticipated that during the installation of cable works, construction would extend through some key junctions and roundabouts along Option D (Blue), which could have significant impact in traffic disturbance. These locations are described in section 7.4.2 Deliverability. There might be a requirement to divert traffic, particularly at congested junctions and areas which may give rise to more complex traffic management plans during the construction phase. Traffic management measures would be assessed on a case-by-case basis for each signalised junction and standard roundabout. The number of the key junctions along Option D (Blue) is the lowest compared to the other route options.

Option D (Blue) has the highest number of properties impacted compared to the other options within 0 to 50 meters of its centreline which as a result would have the more traffic disruption to access – approximately 445. The number of properties impacted are in part due to the route along the R403, Irishtown and through part of Naas. Access will also be de disrupted to St. Joseph's National School, TLC Centre Nursing Home, and five schools along the R448, south of Naas. Its alignment also passes the entrance to a large Storage Facility (Kennedy Clane).

7.2.1.1 Summary of Assessment

Option D (Blue) is the third longest of the options. It is mainly located along regional roads (roughly 46% of its length). The use of regional roads will generally affect more traffic as these types of roads are busier than local roads. However their use allows less full road closures as regional roads are generally wider and so lane closures with temporary traffic lights/stop-go systems can be put into place. Full road closures will result in more disruption through diversions. Mitigation measures through consultation and traffic management will reduce the impacts. The measures can include ensuring that the works do not disrupt access to the nursing home and the schools. Phasing of the works will be important to minimise disruption. This can be done by ensuring that works are completed at less busy times and are carefully planned to avoid road users being disrupted in multiple locations by construction teams in one journey. These measures will be designed at the next step in the Proposed Project. Its proposed alignment has the highest number of properties within 0 to 50 meters of its centreline and passes five schools. In terms of risk of traffic disruption, the Traffic, Transport and Access for Option D (Blue) is assessed to be **Moderate-High (Light Blue)**.

Moderate - High

7.2.2 Noise, Vibration and Air Quality

7.2.2.1 Noise and Vibration

7.2.2.1.1 Baseline

Option D (Blue) passes close to Maynooth before crossing the M4 and following the R406 and R403, the R407 and the R448 between the Woodland and Dunstown substations. The route option is mainly located along regional and local roads, bypassing the towns of Clane and Sallins before rejoining the regional road network at Naas and going close to residential areas in the south-west of the town. There are some off-road sections in this route option, in particular west of Maynooth and east of Clane. Offline or off-road sections are sections where the route option does not follow alongside a road but cuts across, for example, agricultural land.

Baseline noise levels are likely to vary along this route option with higher noise levels likely closer to transport infrastructure and during periods of peak transport activity. The main noise source along this route option is from road traffic noise. Environmental Protection Agency (EPA) traffic noise data for Round 3 contained in EPA Maps[57] shows that traffic noise levels will be highest where the route option crosses the M4 and the M7 and where it runs alongside regional roads.

EPA railway noise data shows that where the route crosses the Dublin to Cork railway line rail noise levels are elevated.

7.2.2.1.2 Methodology

The noise and vibration assessment at this stage of the Proposed Project involves gaining an appreciation of the baseline noise environment close to each of the proposed route options and identifying noise and vibration sensitive receptors within distance bands up to 300m from each of the proposed route options. Noise impacts from construction activities do not normally occur beyond 300m and vibration impacts do not normally occur beyond 100m. The locations of major crossings where Horizontal Directional Drilling (HDD) is likely to be required and off-road sections where noise impacts are likely to be greater compared to on-road sections is also used to assess each route option in terms of the noise risk according to the multi criteria analysis at Step 4A. The risk scale is as follows:

- High: dark blue;
- Moderate-high: blue;
- Moderate: dark green;
- Low-moderate: green; and
- Low: cream.

No baseline noise surveys were undertaken, and no noise modelling was undertaken at this stage of the Proposed Project.

7.2.2.1.3 Noise and Vibration Sensitive Receptors

Table 7.7 shows the residential property counts in distance bands up to 300m from the proposed route option. Overall, there are a total of 2802 properties within 300m of the proposed route.

Table 7.7: Residential Property Counts within 300m of Option D (Blue)

Option	No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	No. of sensitive receptors 100-200m	No. of sensitive receptors 200-300m	Total no. of receptors within 300m
Option D	445	384	874	1099	2802

As well as residential properties there are other sensitive receptors within 300m of the proposed route option which are not included in the above counts including:

- St. Joseph's National School;
- Gaelscoil Nás Na Ríogh School;
- St David's National School;
- Piper's Hill College;
- Killashee National School; and
- Several equine operations.

57 https://gis.epa.ie/EPAMaps/

7.2.2.1.4 Potential Noise and Vibration Impacts

Areas of Potential Horizontal Directional Drilling (HDD)

There is greater potential for adverse noise and/or vibration impacts at sensitive receptors where construction activities would occur over a longer period, e.g. at trenchless crossings. It is recognised that certain construction activities at certain trenchless crossings could be required to take place outside of normal working hours, which would increase the likelihood of adverse noise effects occurring. In addition, certain potential trenchless crossing techniques that may be employed (e.g. HDD) also have the potential to cause adverse vibration effects at nearby receptors.

There is potential for adverse impacts at receptors within 300m of HDD works and there could be eight major crossings on Option D (Blue). An initial assessment has shown there are the potential for adverse noise impacts at the Royal Canal Main Line, the Dublin-Sligo Railway line, the M4 Motorway, the Dublin-Cork railway line, and the M7 Motorway.

Offline sections

For the majority of the proposed route, the underground cables are expected to be installed using 'Open Cut' techniques. Where 'Open cut' works are undertaken adjacent to the existing road network, there is a relatively low potential for temporary impacts due to construction noise. This is due to the relatively high levels of local environmental noise that are typically experienced adjacent to roads. Also, as the works are expected to progress in sections, noise levels at any receptor would only be elevated for a relatively short period of time. However, where 'Open cut' works are undertaken in relatively quiet areas (such as offline sections) close to sensitive receptors there is the potential for temporary impacts due to construction noise.

Table 7.8 shows the total length, the total offline length and whether there are receptors within 300m of the offline route for Option D (Blue).

Table 7.8: Total length and offline length for Option D

Option	Total Length (km)	Offline Length (km)	Receptors within 300m of offline section
Option D	50.5	9.0	Yes

The table shows that the route goes offline for around 9km of its total length where there is the potential to result in noise increases at receptors within 300m.

7.2.2.1.5 Summary of Assessment

There are relatively large numbers of receptors within 300m of Option D (Blue), there is 9km of potential offline construction activity and there are receptors within 300m of potential major crossings such as HDD works at eight crossing points with the potential for experiencing adverse noise and/or vibration effects, therefore it is appropriate to give a score of **Moderate (Dark Green).**

Moderate

7.2.2.2 Air Quality

7.2.2.2.1 Baseline

Option D (Blue) passes close to Maynooth before crossing the M4 and following the R406 and R403, the R407 and the R448 between the Woodland and Dunstown substations. The route option is mainly located adjacent to regional and local roads, bypassing the towns of Clane and Sallins before re-joining the regional road network at Naas and going close to residential areas in the south-west of the town. There are some offline sections (i.e. not within roads) in this route, in particular west of Maynooth and east of Clane.

Baseline air pollutant concentrations are likely to vary along this route due to the difference in emissions between the rural and urban environment. Higher concentrations are likely closer to transport infrastructure and where the route is closer to larger settlements. The main air quality sources along this route are from road traffic, particularly where the route crosses the M4 and the M7.

The Air Quality Index for Health across the Study Area[58] is Good (with an index score ranging from 1-3). The majority of the Study Area, as defined by the EPA[59], is located within Air Quality Zone D – Rural Ireland apart from locations in Naas, which are within Air Quality Zone C – other cities and large towns.

7.2.2.2.2 Sensitive receptors

Human and ecological receptors are consistent with those listed in Section 4.2.2.3.

The Institute of Air Quality Management (IAQM) dust guidance[60]. has been adapted for the purposes of this assessment. The number of residential properties and schools have been counted and identified as receptors. Table 7.9 shows the human receptor count within 300m of each of Option D (Blue).

Table 7.9: Residential Property Counts within 300m of Option D (Blue)

Option	No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	No. of sensitive receptors 100-200m	No. of sensitive receptors 200-300m	Total no. of receptors within 300m
Option D	445	384	874	1099	2802

As well as residential properties there are other sensitive receptors within 300m of the proposed route option which are not included in the above counts including:

- St. Joseph's National School;
- Gaelscoil Nás Na Ríogh School;
- Killashee National School;
- St David's National School; and
- Piper's Hill College.

58 Environmental Protection Agency (EPA), Air Quality Index for Health, https://airquality.ie/information/air-quality-index-for-health, accessed October 2021.
59 Environmental Protection Agency (EPA), Air Quality Zones, https://airquality.ie/information/air-quality-zones, accessed October 2021.
60 Institute of Air Quality Management. 2016. Guidance on the assessment of dust from demolition and construction. Version 1.1. http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf

With regard to ecological receptors, Option D (Blue) crosses the Royal Canal pNHA and crosses the Grand Canal pNHA twice. Therefore, these are in close proximity (i.e. less than 20m) from the route.

7.2.2.2.3 Assessment Criteria

The main criteria used for the assessment of each option is set out in Section 4.2.2.3.3.

7.2.2.2.4 Potential Impacts

The potential impacts are consistent with those set out in Section 4.2.2.3.4.

Table 7.10 shows the number of receptors, the sensitivity to dust soiling and the risk score.

Table 7.10: Potential air quality impact for Option D (Blue)

No. of sensitive receptors 0-50m	No. of sensitive receptors 50-100m	Sensitivity of section to dust soiling	Risk score
445	384	Medium	2

For Option D (Blue) most of its length is classed as medium sensitivity areas apart from around Mulhussey and around Naas, which have a slightly higher receptor count and are classed as high sensitivity areas. Therefore, it is appropriate to give a score of low-moderate (green).

7.2.2.2.5 Summary of Assessment

Option D (Blue) is the second longest option and Option D (Blue) has the largest number of receptors within 50m of the route option. Option D (Blue) passes through the southwest of Naas and runs adjacent to five schools. Option D (Blue) crosses over two pNHA (Royal Canal pNHA and Grand Canal pNHA (twice). Therefore, an overall risk score of **Moderate (Dark Green)** has been applied.

Moderate

7.2.3 Visual

There is the potential for visual impacts at scenic designations, residential dwellings and along public roads, with scenic designations carrying a greater potential for risk.

7.2.3.1 Scenic designations

No scenic designations were identified within the portion of the Study Area that occurs within County Meath.

Included in Table 14.4 of Chapter 14 (and indicated on Map 14.2) of the Kildare County Development Plan are:

> *'12 "principal landscape sensitivity factors": Major Rivers and Water bodies; Canals; Ridgelines; Green Urban Areas; Broad-Leaved Forestry; Mixed Forestry; Natural Grasslands; Moors and Heathlands; Agricultural Land with Natural Vegetation; Peat Bogs; Scenic View; and Scenic route'.*

This route option will pass within 300m of the following 'principal landscape sensitivity factors' (from north to south):

- Royal Canal View RC8 ('Jackson's Bridge' L5041);
- Designated scenic route (34) ('Views to Lyons Hill, Liffey Valley and Oughterard');

- River Liffey view RL5 (‘Alexandra Bridge’); and
- Grand Canal view (stone bridge crossing the Grand Canal between the R445 and the R409 regional roads).

7.2.3.1.1 Sensitivity - scenic designations

The sensitivity of these ‘*principal landscape sensitivity factors*’ are recorded in Table 7.5.

7.2.3.1.2 Magnitude of impacts - scenic designations

Royal Canal View RC8 (‘Jackson’s Bridge’ L5041): There is a direct line of sight from the bridge towards the canal crossing point of this route c.300m away, but there is existing high voltage overhead line crossing the canal at c.150m so the view is already characterised by infrastructure. Construction activity is likely to be visible from this bridge; therefore, the magnitude of impact during the construction phase is deemed to be low, but during the operational phase, it is deemed to be low-negligible as a crossing such as a cable bridge (to be determined at next step of the project) may be visible.

Designated scenic route ((34)‘Views to Lyons Hill, Liffey Valley and Oughterard’): This view is orientated towards the distant mountains to the South and Southwest. At this section of the route, the cable will be underground below the R403 regional road, so no change material change to the view; therefore, the likely magnitude of impact is deemed to be negligible during both the construction and operational phases.

River Liffey view RL5 (‘Alexandra Bridge’): At this section of the route option will be offline in agricultural fields close to the existing low voltage overhead line. This field is within the River Liffey ‘*Principal Landscape Sensitivity Factor*’. Construction activity would be uncharacteristic within the available view of the agricultural fields but it will be transitory and temporary; therefore, the magnitude of impact during the construction phase will be low. During the operational phase, it may be possible to see joint bays in the view; however, if the design of the locations of the joint bays is undertaken with consideration of the view from this designated scenic view, the magnitude of impact is likely to be negligible during the operational phase.

Grand Canal view (stone bridge crossing the Grand Canal between the R445 and the R409 regional roads): At this section of the route, the cable will be underground below the regional road, so no change material change to the view; therefore, the likely magnitude of impact is deemed to be negligible during both the construction and operational phases.

7.2.3.1.3 Significance of impacts - scenic designations

The effects on the Royal Canal View RC8 (‘Jackson’s Bridge’ L5041) ‘*principal landscape sensitivity factor*’ are of a low magnitude during the construction phase; therefore, are considered to have a significance of impact that is **Slight**, while for all the others, it will be **Imperceptible**. Operational phase impacts at Royal Canal View RC8 (‘Jackson’s Bridge’ L5041) will reduce to a low-negligible magnitude; therefore the significance is considered to be **Slight**.

Table 7.11: Summary - Principal Landscape Sensitivity Factors within County Kildare – scenic designations

Principal Landscape Sensitivity Factor	Risk - Direct Impacts (Constraints Study)	Risk – Impacts Within 300m (Constraints Study)	Specific feature	Sensitivity of feature	Likely operational magnitude of effect	Likely operational significance of effect
Scenic View	High	Moderate-High	Royal Canal View RC8 ('Jackson's Bridge' L5041)	High	Low-Negligible	Slight
Scenic View	High	Moderate-High	River Liffey view RL5 ('Alexandra Bridge')	High	Negligible	Imperceptible
Scenic View	High	Moderate-High	Grand Canal view (stone bridge crossing the Grand Canal between the R445 and the R409 regional roads)	High	Negligible	Imperceptible
Scenic route	High	Moderate-High	Designated scenic route (34) ('Views to Lyons Hill, Liffey Valley and Oughterard')	High	Negligible	Imperceptible

7.2.3.2 Summary of Assessment

The assessment of the potential or significant visual impacts as a result of Option D (Blue) can be summarised by the following points:

- Potential for visual impacts at residential dwellings and along public roads.
- Potential visual impacts at Royal Canal View RC8 ('Jackson's Bridge' L5041) during construction and operational phases, but the magnitude of the impact is not likely to be greater Low.
- Potential visual impacts at River Liffey designated scenic view at 'Alexandra Bridge' during construction phases, but the magnitude of the impact is not likely to be greater Low and assuming there will be no new permanent above-ground elements introduced into the view, the magnitude of the impact will be negligible during the operational phase, therefore, no significant visual impacts are anticipated.

As such, the attributed score is **Low-Moderate (Light Green).**

Low-Moderate

7.2.4 Amenity

This section outlines the likely impact on the amenity of residential, commercial, community (and recreational), and tourism receptors, collectively, by way of consideration of contributing environmental effects. Issues of access and severance are outlined in Section 7.2.1. All residential, commercial, and community (and recreational) receptors are shown in Figure C.1.4 in Appendix C.1.

The alignment of Option D (Blue) passes through both rural and urban areas along its length, as outlined in Section 3.2.4. Table 7.12 lists the known commercial and community receptors that are situated immediately adjacent to the route alignment (this list is not exhaustive but represents a high-level analysis for the purposes of informing the Step 4A selection process). No tourism receptors (i.e. receptors whose main function is aimed at visitors to its locality) were encountered immediately adjacent to the alignment of Option D (Blue), while one-off or ribboned residential receptors are located along all sections of the route (outwith off-line sections). Option D (Blue) is also routed in close proximity or within a number of built-up areas, such as passing along the southern extent of Maynooth, through parts of Straffan as well as the western and southern side of Naas.

Table 7.12: Known Commercial and Community Receptors Adjacent to the Alignment of Option D (Blue)

Commercial receptors:	Community receptors:
Barstown Business Park; Hatchet Inn (and associated filling station); Lavins (Ice Cream Distributor); Sean Doyle Auctioneers; John Lee Furniture; Moyglare Manor; Maynooth Business Park; Straffan Antiques; Barberstown Castle (Hotel); Friel's of Straffan; DB Coatings Ltd.; Maynooth Used Cars; Kennedy International Transport; Kerry Group Global Centre; Irish Commercials (and Volvo Trucks); Applegreen Millennium Park; ALDI (Naas); Europcar (Naas); Chadwicks Builders Providers	St Joseph's National School; TLC Centre Maynooth (Nursing Home); Naas Sports Centre (playground and skatepark) Enable Ireland Kildare Children's Services; Naas United Football Club Gaelscoil Nás Na Ríogh; Piper's Hill Montessori School; Piper's Hill College (Secondary School); St David's National School Killashee National School

Outlined below are details of potential impacts considered likely during the construction of Option D according to each environmental effect, with a concluding paragraph summing up the overall impact on amenity. Given that the Proposed Project would be underground, there are no operational impacts anticipated on amenity.

Table 7.13 outlines the assessment ratings and associated justifications for each of the contributing environmental effects that, when in-combination, may result in an impact on amenity.

Table 7.13: Ratings and Associated Justifications for Environmental Effects Contributing to Potential Impact on Amenity

Air Quality	Noise	Visual	Traffic and Transport
Option D has the largest number of receptors within 50m of the route. Option D (Blue) is the second longest option and Option D (Blue) has the largest number of receptors within 50m of the route option. Option D (Blue) passes through the southwest of Naas and runs adjacent to five schools.	Relatively greater number of noise sensitive receptors impacted compared to other options. Construction noise and vibration impacts temporary in nature, no permanent impacts expected.	(i) Potential for visual impacts at residential dwellings and along public roads.(ii) Potential visual impacts at Royal Canal View RC8 ('Jackson's Bridge' L5041) during construction and operational phases, but the magnitude of the impact is not likely to be greater Low. (iii) Potential visual impacts at River Liffey designated scenic view at 'Alexandra Bridge' during construction phases, but the magnitude of the impact is not likely to be greater Low and assuming there will be no new permanent above-ground elements introduced into the view, the magnitude of the impact will be negligible during the operational phase. No significant visual impacts are anticipated.	Option D (Blue) is within regional road for approximately 46% of its length. It has the highest number of properties within 0-50m of its route (445) and so there will be more disruption to access. The number of properties is in part due to the route along the R403 (Irishtown) and through part of Naas. Access will also be disrupted to, St. Joseph's National School, TLC Centre Nursing Home, and five schools (along the R448, south of Naas). Also passes the entrance to a large Storage Facility (Kennedys Clane). This route has the least amount of road closures/HGV diversions.

7.2.4.1 Summary of Assessment

In relation to the assigned scoring for potential impacts relating to Air Quality, Noise (and vibration), Visual and Traffic and Transport, it is considered likely that there is the potential for significant impacts on amenity. Therefore, a scoring of '**Moderate-High (Light Blue)**' has been assigned. For more information in relation to the potential impacts of Option D (Blue) in relation to any of these environmental effects, please see Section 7.2.1 to Section 7.2.3.

Moderate-High

7.2.5 Health

The Study Area is largely considered to be 'marginally above average' in terms of the deprivation indices provided for 'my Pobal' (Pobal, 2016), however there are some Electoral Divisions (EDs) within the Study Area are considered to be 'affluent', such as Maynooth, Straffan, Donaghcumper, Naas Rural, Ladytown, and Newtown. According to the Institute of Public Health (in Ireland), people in higher socio-economic groups are at lower risk of chronic conditions and associated disability than those in lower socio-economic groups (Institute of Public Health, 2020).

Using the outcomes of the amenity assessment as reported in Table 7.13, it is considered unlikely that the construction of Option D (Blue) would result in significant impacts on human health. This is primarily because processes and activities required during construction of the Proposed Project are temporary in nature, while the nature and scale of the Proposed Project means that construction activity would occur at any one location for a limited time; thereby not significantly impacting human health.

In light of the above findings, a scoring of '**Low-Moderate (Light Green)**' has been assigned for the consideration of potential impacts on Human Health.

Low - Moderate

7.2.6 Employment and Economy

During construction and operation, potential impacts on employment and the national, regional and local economy are anticipated to be similar among each of the proposed route options given that they are all similar in nature, extent and scale, are located in close proximity to one another, and within the same Study Area.

The potential impacts on employment and the national, regional and local economy are the same as that outlined in Section 4.2.6.

7.2.6.1 Impacts on the Tourism Sector

Similarly to the potential impacts on employment and the national, regional and local economy, potential impacts on the tourism sector are anticipated to be similar among each of the proposed route options given they are all similar in nature, extent and scale, are located in close proximity to one another, and within the same Study Area.

The potential impacts on the tourism sector are the same as that outlined in Section 4.2.6.2.

7.2.7 Land-use (and Land-take)

Option D (Blue) is 50.5km in length, with the vast majority of its alignment being routed along regional and local roads between Woodland substation and Dunstown substation. Some sections of the route alignment are not routed along roadways however and are instead aligned across open agricultural land. Approximately 9km of Option D (Blue) is routed through open greenfield land, largely classed as 'pastures or non-irrigated land' according to 2018 Corine Land Class data. The impacts on agricultural land (including land-take) are considered in Section 7.2.8.

Given the similarities around construction methodology and subsequent land-take requirements in respect to people and communities, the potential impacts in regard to land-use (and land-take) are the same as those outlined in Section 4.2.7 and thereby assigned a similar rating of '**Low (Cream)**'.

Low

7.2.8 Agriculture (including Equine)

The potential impacts on agriculture are addressed in general in Section 4.2.6. This Section addresses the impacts of Option D (Blue).

The Option D (Blue) crosses mineral soils along its entire length avoiding significant areas of peat to the west. From Woodland Substation to Dunstown Substation there are fifteen high sensitive enterprises located along Option D (Blue) – twelve equine enterprises, two dairy enterprises and one poultry enterprise. Option D (Blue) will cross agricultural land for approximately 9km (18% of the entire length) and will cross the northern part of one very high sensitive stud farm in Blackhall and the southern edge of one very high sensitive stud farm in Moyglare.

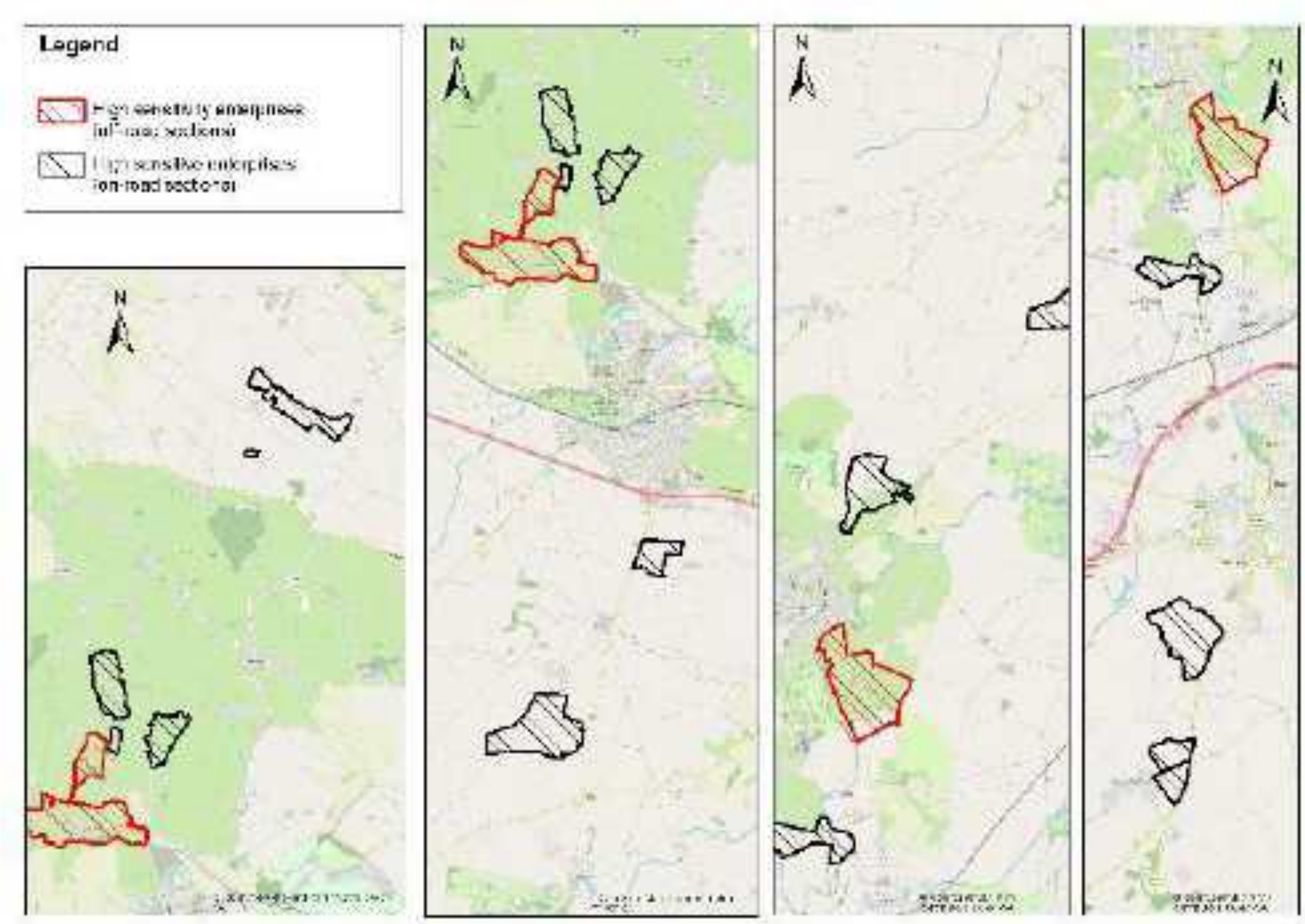

Figure 7-1: High sensitivity enterprises affected by Option D (Blue)

7.2.8.1 Summary of Assessment

The ranking score for Option D (Blue) is considered to be **'Low-Moderate'** given the moderate length across agricultural land and the low-moderate number of high sensitive enterprises it impacts.

Low-Moderate

7.2.9 Utilities

There are numerous underground utilities in the regional road network between Woodland and Dunstown, including other electricity cables; telephone and broadband cables; sewers; and public and private water supplies. The public water supply is extensive in the area, with the network predominately using the road network for local residential supply while other larger mains being located off-road in agricultural land. There is no known group water supply with protected areas within the Study Area.

The assessment of Option D (Blue) has found that it crosses existing 38kV underground cables (twice), existing fibre cables (8 times), existing medium pressure gas pipelines (33 times), existing water supply network (94 times) and existing wastewater network (23 times). The count of crossing locations includes points within the same roads. For example Option D meets the medium-pressure gas network in seven locations with multiple crossings within these sections. The seven locations are at R148 (Kilcock to Maynooth); One the R406 (Maynooth to Straffan road), on the R403 (Clane to Straffan road); on the R407 (Clane to Naas Road), and Millennium Parkway, R445, and R448 (roads within Naas). However, because of the layout of gas network crossing from one side of the road to the other, it is counted as 33 crossings.

It is expected that all utilities encountered during construction will either remain in-situ or, where absolutely necessary, appropriate diversions or modifications carried out (with the permission of the respective provider) so as to ensure disruption to surrounding communities is kept to a minimum. Any required service disruption will only be permitted for an agreed set period of time per day (generally a set number of hours) and will not be permitted to be continuous for full days at a time. Any required disruptions will be carefully planned so as to ensure that the duration of disruption is minimised in so far as is possible.

Given the number of utility interfaces along the length of Option D (Blue), along with the potential for disruption to people and neighbouring communities, it is appropriate to assign a score of '**Low-Moderate (Light Green)**'.

Low-Moderate

7.3 Technical

As set out in Section 2.3.3, the topic areas under consideration to assist with determining the best route option are as follows:

- General Compliance with System Reliability, Security Standards;
- Headroom;
- Maintainability;
- Technology Operational Risk;
- Average Reliability Rates; and
- Repeatability.

7.3.1 General Compliance with System Reliability, Security Standards

This is EirGrid's reliability and security standards are defined in the Transmission System Security and Planning Standards and their Operation Security Standards.

All technical input to the Kildare Meath project will comply to EirGrid's Standards for Security and Reliability. Therefore, there is no differentiation between the proposed route options and route Option D has been assigned a score of '**Low (Cream)**'.

Low

7.3.2 Headroom and Ratings Impact

Headroom is the amount of additional capacity each route option offers that would be available for the future without requiring further upgrade. All the proposed route options carry little additional headroom (spare current capacity) due to the nature of the corridor therefore giving no technical differentiation between the proposed routes in this aspect.

The current ratings bottleneck is the impact on the overall circuit ratings of the worst-case deepest obstacle crossing. As all the proposed route options will require some deep crossing solutions (below railways, motorways, rivers or a combination) of similar design, these will be the ratings bottleneck of that particular route. The connection spans north to south, whilst major natural and man-made obstacles are east west orientated, therefore all options cross the river Liffey, the railways, the M4, etc;

On account for the potential total number of Horizontal Directional Drills, Option D (Blue) has been assigned a score of **Low (Cream).**

Low

7.3.3 Maintainability

This considers the ease with which the route option can be serviced and maintained, for example how easy it is to access joint bays and link boxes.

All the proposed route options will be developed with the same design principles. For example, maximum standing sheath voltages, typical trench cross-section, separation between joint bays, location of link boxes (underground in chambers or pillar mounted), same substation entry locations. Whilst some route options come with a greater proportion of off-road build as opposed to road, with the level of design detail available at this stage, is not possible to substantially differentiate between the proposed route options.

As there is no differentiation between the proposed route options and route Option D has been assigned a score of '**Low (Cream)**'.

Low

7.3.4 Technology Operational Risk

This criterion aims to capture the risk of operating different technologies on the network.

The same technology is applied to all solutions including cables, joint bays, and bonding. All technology will be the standard technology in the industry and also the dominant technology on EirGrid's existing network (i.e. XLPE insulated underground cables). Therefore, there is no differentiation between the proposed route options and route Option D has been assigned a score of '**Low (Cream)**'.

Low

7.3.5 Average Reliability Rates

This is the likelihood of the chosen cable technologies such as cables, joint bays, and bonding failing during operation. All cable technology listed above are common to all route options.

Industry data on Cross-Linked Polyethylene (XLPE) insulation technology indicates that cable failures on a statistical basis are related to cable length.

The proposed route options lengths are as per Table 4.17, Section 4.3.5 (all values are based on desktop surveys).

The small percentage difference between the lengths of the proposed route options does not trigger any substantial increase in the risk of failure. Furthermore, there is not currently sufficient technical detail, at this point, to determine the number increase of joint bays of each route against the shortest (Option C).

Therefore, there is no discernible differentiation between the solutions and route Option D has been assigned a score of '**Low (Cream)**'.

Low

7.3.6 Repeatability

Repeatability is whether the proposed technical solution can be readily repeated in the transmission network.

All the proposed route options will be developed with the same design principles; therefore, all route options are easily repeatable across the transmission network. Therefore, there is no differentiation between the proposed route options and route Option D has been assigned a score of '**Low (Cream)**'.

Low

7.4 Deliverability

7.4.1 Design Complexity

There are 11 surface waterbodies crossed along the length of Option D (Blue), some of which crossed more than once; so there will be 18 crossings in total. These waterbodies will be crossed in a variety of different way in order to minimise the environmental impacts, and to ensure construction and operational efficiency. Option D (Blue) has the second least amount of off-road sections, thus interface with private assets is reduced.

The utilities crossings are assessed in Section 7.2.9 of this report. Option D (Blue) meets the medium-pressure gas network in seven locations with multiple crossings within these sections. The seven locations are at R148 (Kilcock to Maynooth); One the R406 (Maynooth to Straffan road), on the R403 (Clane to Straffan road);on the R407 (Clane to Naas Road), and Millennium Parkway, R445, and R448 (roads within Naas).

Option D (Blue) will require eight major crossings (such as HDD), which is the same number as Option C (Orange) and more than Options A (Red) and B (Green). The two additional crossings are on the River Liffey – a major river and a sensitive receptors these crossings will be of particular complexity.

Option D (Blue) has been assigned a score of **Moderate High (Light Blue).**

Moderate - High

7.4.2 Traffic Disturbance

For Option D (Blue) it is anticipated that full road closures might be required at the following locations:

- L6207 from Ribstown through Cullendragh to Barstown Junction with the R156 an overall distance of 2,460 meters. At this location the carriageway is between 2.5 and 4.0 meters wide and does not allow adequate space for vehicles to pass the construction works safely;
- Moyglare Road Junction (adjacent graveyard) to Moyglare Junction preceding the field crossings, a total distance 1,460 meters the carriageway width is between 4.5 and 6.0 meters. This does not allow adequate room to install a lane closure and carry out the construction works;
- Timard to Laraghbryan West a total distance of 1,170 meters where the carriageway width is between 2.5 and 3.5 meters for the entire duration. The construction works will take the entire width of this carriageway;
- Rathmore Junction to Rathmore a total distance of 850 meters where the carriageway is 3.0 meters wide. The construction works will require the full width of the carriageway;
- At the end of Option A from the Stephenstown South Junction the R412 through to the Dunstown; and
- Substation including turn off, a distance of 1,240 meters. The road is three meters wide so the construction works will take up the width of the road, thereby requiring a full road closure.

There are two road sections along Option D (Blue) where the road width might be reduced to 6.0 meters by the proposed construction works. In these road sections it is anticipated that there might require a lane closure and diversions for the HGV vehicles:

- Mulhussey junction (adjacent to castle in ruins) to Moyglare Road Junction adjacent to graveyard, a total distance of 4,830 meters; and
- R448 Kilcullen Road roundabout at Naas East to the Stephenstown South Junction, a total distance of 5,250 meters.

All the remaining roads on planned Option D (Blue) may require lane closures with appropriate traffic management measures to allow the construction works to be carried out safely, specifically:

- From Barstown Junction with R156 to the Jenkinstown Junction;
- From Jenkinstown Junction to the Mulhussey Junction adjacent to castle;
- From R406 South of the roundabout to R406 Barberstown roundabout;
- From R406 Barberstown roundabout to R406 Capdoo Commons;
- From M7 South crossing to the R409 Ploopluck roundabout; and
- From the R409 Ploopluck roundabout to R448 Kilcullen Road roundabout (Naas East).

The table below provides a high-level summary on the proposed traffic management plans during installation for Option D (Blue). It is recommended that following the selection of the proposed option, a detailed analysis will be carried out with regards to the phasing of the road closures.

Table 7.14: Summary of Option D (Blue) Traffic Management

Option D	Total Length (in km)	Lane Closures (in km)	HGV Diversions (in km)	Road Closures (in km)	Field Crossings (in km)
	50.5	25.7 (50.8%)	10.1 (20.0%)	7.2 (14.2%)	9 (18%)

Option D (Blue) requires the lowest number of full road closures compared to the other route options. In terms of traffic disturbance, a Moderate score has been assigned to Option D (Blue) based on the Traffic Management which is anticipated to be required during construction works. Option D (Blue) is also likely to have a lane closure 'with' or 'without' HGV diversions. However, the diversions are likely to be mostly available while at all times maintaining access for the local residents.

It is anticipated though few road sections may require full road closure but there may not be suitable diversions for the through traffic along the length of the route option. Where suitable diversions for through traffic are available along the length of the option, the average installation rate is anticipated to be 80 meters per day, resulting in approximately two years to install this option.

The exact location of the cable trench will be defined later in the project and this will depend on further design, surveys, consultation, and assessment. Consultations with the local authorities will help to define where the cable trench will go in the road to minimise disruption. For example, if a safe alternative could be provided for access with significant disruption for pedestrians, a footpath could be used to minimise disruption to the road network.

Option D (Blue) has the lowest number of road closures and HGV diversions plus the highest number of single lane closures compared to other potential options, thereby having the lowest traffic disruption during construction works. On this basis, in terms of traffic disturbance related to the Traffic Management, Option D (Blue) has been assessed as **Moderate (Dark Green).**

Moderate

7.4.3 Dependence on Other Infrastructure Projects

As outlined in Chapter 1 of this report, all options will have the same dependence on works required at the associated substations in terms of connections. In terms of other infrastructure projects in the area, similar crossing of existing motorways, railways and canals are required. All four of the options will cross the same infrastructure but, in some cases, in different locations. All four options will cross or run parallel with utilities, including water mains and the low to medium pressure gas network - this is further assessed in Section 7.2.9.

All four of the options will cross the proposed Water Supply Project[61] and therefore it is not a differentiator at this point.

Option B (Green), Option C (Orange), and Option D (Blue) will cross the proposed DART+ West railway line[62] at the crossing point of the Dublin Sligo railway line. This project proposes the electrification and re-signalling of the Maynooth line and construction of a new DART depot facility west of Maynooth for the maintenance and parking of trains. West of Maynooth, the rail track will be upgraded to a twin-track between Maynooth and the proposed depot. This twin track configuration will divert offline to the south, running parallel to the existing railway on the approach to the proposed depot. The planning application is expected to be made to An Bord Pleanála in 2022, with construction possible in 2025. At this location, it is proposed that Options B (Green), Option C (Orange), and Option D (Blue) will cross the existing railway line by HDD. The proposed DART+ West project will require a long crossing and additional studies and shielding to ensure that there are no electro-magnetic forces issues between the Kildare-Meath Grid Upgrade project and the electrified line. At this stage, it is not considered that there would be any conflicts between the two projects and both could be constructed without significant constraint. It is possible that both projects would be at construction at the same time and additional consideration would be

[61] http://www.watersupplyproject.ie/
[62] https://www.dartplus.ie/en-ie/projects/dart-west

needed to the cumulative effects, if Options B (Green), Option C (Orange), and Option D (Blue) were selected as the Emerging Best Performing Option.

The M4 Maynooth to Leixlip project[63] is listed as a section of the transport network to be progressed through pre-appraisal and early planning. The proposed 10km project involves the M4 mainline carriageway from Maynooth to Leixlip and the associated mainline junctions, Maynooth train line, the surrounding road network and any existing and proposed alternative transport modes or routes that provide suitable alternatives in favour of the M4/N4. The widening of the M4 could take place to the north of the existing M4 route, where Option D runs parallel to the motorway to the south of Maynooth. If Option D (Blue) were selected as the Emerging Best performing Option, additional consideration would need to be given to ensure there are no conflicts to either project.

Option D is **Moderate-High (Light Blue)** in terms of dependence on other infrastructure projects.

Moderate-High

7.4.4 Permits and Wayleaves

At this stage of the assessment all route options will have a similar issue with permits. However, Options D (Blue) will have similar amounts of off-road sections and similar requirements for wayleaves as Option A (Red). As such, Option D (Blue) has been assessed as **Low-Moderate (Light Green).**

Low-Moderate

7.4.5 Implementation Timelines

This route option has the highest amount of live lane working / lane closures and the second lowest of field crossings. Therefore, Option D (Blue) has been assigned a score of **Moderate (Dark Green).**

Moderate

7.4.6 Combined Deliverability Performance

Considering the design complexity, traffic disturbance, impact dependence and implementation timelines, a rating of **Moderate (Dark Green)** has been assigned. Option D (Blue) has scored more highly in terms of design complexity because of additional major crossings (HDD) and additional crossings of the River Liffey. It has also scored highly in terms of impact on other infrastructure projects as it crossed the area of the DART+ West project and the M4 widening.

Moderate

[63] https://maynoothleixlip.ie/

7.5 Economic

As set out in Section 2.3.4, the topic areas under consideration to assist with determining the best route option are as follows:

- Length of installed cable;
- Quantity of Minor and Major service crossings; and
- Number of Major Crossings (such as Horizontal Directional Drills.)

7.5.1 Length of Installed Cable

The first economic assessment is from the overall lengths of the cable routes (presented in Table 4.17, Section 4.3.5). From this, Option D (Blue) has a total length of 50.5 km which is 8% longer than the shortest route (Option C (Orange)) and therefore it can be assumed to have 8% more of an economic impact in this aspect.

For this reason, Option D (Blue) has been assigned a score of **Moderate (Dark Green).**

Moderate

7.5.2 Quantity of Crossings

An assessment of both the minor and major crossings expected to be encountered for the cable route options has been carried out by categorising them into the different crossing types (presented in Section 2.3.3.2). Summaries of these are listed below where Type 1 has the lowest impact and Type 4 has the highest.

- Type 1 Crossings - shallow crossings (utility/drainage/other) - deeper installation;
- Type 2 Crossings - shallow water crossings (Open cut solution);
- Type 3 Crossings - larger water crossings (Cable bridges/culverts/micro tunnels); and
- Type 4 Crossings - large crossings (Horizontal directional drills/ Auger bores or tunnel solutions).

It has been found that route Option D (Blue) has the Joint most Type 1, least amount of Type 2, most amount of Type 3, and joint most Type 4 crossings. For this reason, Option D (Blue) has been assigned a score of **Moderate-High (Light Blue).**

Moderate-High

7.6 Summary of Option D (Blue) Assessment

7.6.1 Environment Summary

Option D (Blue) has been scored as **Moderate (Dark Green)** overall. This is due to crossing with zonings within the Clane and Draft Naas LAPs, a longer section within the River Liffey 'Principal Landscape Sensitivity Factor', Areas of potential geological deposits including a Mine within 200m of the route option, increased watercourse crossings, and increased cultural heritage effects (including Jigginstown Castle). A summary of the environmental appraisal of Option D (Blue) is provided in Table 7.15.

Table 7.15: Summary of Environment Assessment for Option D (Blue)

Biodiversity	Soils and Water	Planning Policy and Land Use	Landscape	Archaeology, Architectural Heritage, and Cultural Heritage	Combined Environment Score
Moderate-High	Moderate	Moderate	Low-Moderate	Moderate	Moderate

7.6.2 Socio-Economic Summary

Option D (Blue) passes the greater number of properties than the other options; has a greater visual impact at Alexandra Bridge; passes along the R403 and R406 which are densely populated and importance routes for local and regional traffic. It has been assigned a **Moderate – High (Light Blue)** score. A summary of the socio-economic appraisal of Option D (Blue) is provided in Table 7.16.

Table 7.16: Summary of Socio-economic Assessment for Option D (Blue)

Traffic and Transport	Noise and Vibration	Air Quality	Visual	Amenity	Health	Employment and Economy (and Tourism)	Land Use (and Land-take)	Agriculture (including Equine)	Utilities	Combined Socio-economic Score
Moderate -High	Moderate	Moderate	Low-Moderate	Moderate-High	Low-Moderate	Low	Low	Low-Moderate	Low-Moderate	Moderate -High

7.6.3 Technical Summary

At this stage in the Proposed Project are there no technical differentiations apart from the number of major crossings. Options A (Red) and B (Green) will have two fewer than Options C (Orange) and D (Blue). Other technical factors will have no impact on the selection of the best performing option. Option D (Blue) has been assessed to have a **Low-Moderate (Light Green)** score for the technical criterion.

Table 7.17: Summary of Technical Assessment for Option D (Blue)

General Compliance	Headroom	Maintainability	Technology Operational Risk	Average Reliability Rates	Repeatability	Combined Technical Score
Low	Low	Low	Low	Low	Low	Low

7.6.4 Deliverability Summary

Considering the design complexity, traffic disturbance, impact dependence and implementation timelines, a rating of **Moderate (Dark Green)** has been assigned. Option D (Blue) has scored more highly in terms of design complexity because of additional major crossings (HDD) and additional crossings of the River Liffey. It has also scored highly in terms of impact on other infrastructure projects as it crossed the area of the DART+ West project and the M4 widening. It has scored Moderate and Low-Moderate in the other topics and so an overall score of Moderate has been assigned.

Table 7.18: Summary of Deliverability Assessment of Option D (Blue)

Design complexity	Traffic disturbance	Dependence on other infrastructure projects	Permits and wayleaves	Implementation Timelines	Combined Deliverability Score
Moderate -High	Moderate	Moderate -High	Low- Moderate	Moderate	Moderate

7.6.5 Economic Summary

At this stage in the Proposed Project, the only differentiations between route options are cable route lengths and the impact from the quantity of expected major crossings. Option D (Blue) has been assessed to have a **Moderate-High (Light Blue)** score for the economic criterion due to the high number of major crossings (such as HDDs) and longer route length when compared to the shortest Option C (Orange).

Table 7.19: Summary of Economic Assessment of Option D (Blue)

Length of Installed Cable	Quantity of Crossings	Combined Economic Score
Moderate	Moderate-High	Moderate-High

8. Emerging Best Performing Option and Conclusion

Table 8.1 summarises the findings of the assessment of the four options.

8.1 Environment Assessment

Table A1.2 below summarises the findings of the environmental assessment for each of the solution options. For more detail on how each individual option was appraised, please see Section 4.1, 5.1, 6.1 and 7.1, respectively.

Table 8.1: Summary of Environmental Assessment for Options

Option	Biodiversity	Soils and Water	Planning Policy and Land Use	Landscape and Visual	Archaeology, Architectural Heritage, and Cultural Heritage	Combined Environment Score
Option A (Red)	Moderate-High	Moderate	Moderate	Low-Moderate	Moderate-High	Moderate
Option B (Green)	Moderate-High	Low-Moderate	Low	Low-Moderate	Moderate	Low-Moderate
Option C (Orange)	Moderate-High	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate
Option D (Blue)	Moderate-High	Moderate	Moderate	Low-Moderate	Moderate	Moderate

Overall, Option A (Red) has been scored as **Dark Green (Moderate)** in terms of risk of environmental impact. This is due to crossings within the zoned land, increased watercourse crossings, and increased cultural heritage effects (mitigation measures to reduce the effects will be considered at the next step). This route option is in proximity to the highest number Recorded Monuments (including Jigginstown Castle), Protected Structures, and Gardens and Designed Landscapes. Option B (Green) has been scored as **Low-moderate (Light Green)** overall. This Option interacts with less zoned land than Option A (Red) as it avoids Kilcock. Option C (Orange) has been scored as **Low-moderate (Light Green)** overall. Option C (Orange) scores higher in terms of Land Use Planning due to impacts to a solar farm application. Option D (Blue) has been scored as **Moderate (Dark Green)** overall. This is due to crossing with zonings within the Clane and Draft Naas Local Area Plans, a longer section within the River Liffey 'Principal Landscape Sensitivity Factor'.

8.2 Socio-economic Assessment

Outlined below are the findings of the socio-economic assessment of each of the solution options. For more information on these findings, please see Section 4.2, 5.2, 6.2 and 7.2 respectively.

Table 8.2: Summary of Socio-economic Assessment of Options

Option	Traffic and Transport	Noise and Vibration	Air Quality	Visual	Amenity	Health	Employment and Economy (and Tourism)	Land Use (and Land-take)	Agriculture (including Equine)	Utilities	Combined Socio-economic Score
Option A (Red)	Moderate - High	Moderate	Moderate	Low-Moderate	Low-Moderate	Low-Moderate	Low	Low	Low	Low-Moderate	Low-Moderate
Option B (Green)	Moderate - High	Low-Moderate	Low-Moderate	Low-Moderate	Moderate	Low	Low	Low	Low-Moderate	Low-Moderate	Moderate
Option C (Orange)	Moderate - High	Low-Moderate	Low	Low-Moderate	Low-Moderate	Low	Low	Low	Moderate	Low-Moderate	Moderate
Option D (Blue)	Moderate - High	Moderate	Moderate	Low-Moderate	Moderate-High	Low-Moderate	Low	Low	Low-Moderate	Low-Moderate	Moderate-High

Option A (Red) will pass less properties than Option D (Blue) and require less full road closures during construction compared to Options B and C. However because more of its length is in regional roads, traffic disturbance will be comparatively greater due to the increased traffic on those roads. While the traffic impacts will be temporary and restricted to the construction phase, in order to minimise the disturbance, traffic surveys will be undertaken to confirm this assumption. Mitigation measures to reduce the effects will be considered at the next step. Consultation will be undertaken with Meath and Kildare County Councils to agree the approach to traffic management and avoid and/or reduce the impacts. Option A (Red) has the least significant agricultural land issues as in crosses the least amount of agricultural/private land. Option B (Green) travels through the settlement of Rathcoffey, which will result in disruption to this settlement during the construction phase. Option C (Orange) is considered to have a similar combined social impact to Option A (Red) and Option B (Green), however individual social impacts are more similar to Option B (Green) than Option A (Red). As such, it has been assigned a **Moderate (Dark Green)** score. Option D (Blue) passes the greater number of properties than the other options; has a greater visual impact at Alexandra Bridge; passes along the R403 and R406 which are densely populated and importance routes for local and regional traffic. It has been assigned a **Moderate – High (Light Blue)** score.

8.3 Technical Assessment

At this stage in the Proposed Project there no technical differentiations apart from the number of major crossings. Options A (Red) and B (Green) has two fewer than Options C (Orange) and D (Blue). Other technical factors will have no impact on the selection of the Best Performing Option. Outlined below are the findings of the technical appraisal of each of the options. For more information on these findings, see Section 4.3, 5.3, 6.3, and 7.3.

Table 8.3: Summary of Technical Assessment of Options

Option	General Compliance	Headroom	Maintainability	Technology Operational Risk	Average Reliability Rates	Repeatability	Combined Technical Score
Option A (Red)	Low	Low	Low	Low	Low	Low	Low
Option B (Green)	Low	Low	Low	Low	Low	Low	Low
Option C (Orange)	Low	Low	Low	Low	Low	Low	Low
Option D (Blue)	Low	Low	Low	Low	Low	Low	Low

At this stage in the Proposed Project, are there no technical differentiations apart from the number of major crossings. All four of the options are technically sound and could be constructed in-line with EirGrid's technical standards. Options A (Red) and B (Green) will have two fewer than Options C (Orange) and D (Blue). However this may not present a technical issue in terms of the rating of the cable. Other technical factors will have no impact on the selection of the best performing option. Each of the four options have been assessed to have a **Low (Cream)** score for the technical criterion. This demonstrates that only technically sound options have been taken forward for assessment. Further assessment of the Emerging Best Performing Option in terms of the technical criterion will be undertaken through the next steps of the Proposed Project.

8.4 Deliverability Assessment

Outlined below are the findings of the deliverability assessment of each of the solution options. For more information on these findings, please see Section 4.4, 5.4, 0, and 7.4 respectively.

Table 8.4: Summary of Deliverability Assessment of Options

Solution Option	Design complexity	Traffic disturbance	Dependence on other infrastructure projects	Permits and wayleaves	Implementation Timelines	Combined Deliverability Score
Option A (Red)	Low-Moderate	Moderate-High	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate
Option B (Green)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Option C (Orange)	High	Moderate-High	Moderate	Moderate-High	Moderate-High	High
Option D (Blue)	Moderate - High	Moderate	Moderate -High	Low- Moderate	Moderate	Moderate

Option A (Red) has more favourable Deliverability scores compared to the other options. Option A (Red) generally performed better in four of the Deliverability topics compared to the other options – Design Complexity; Dependence on Other Projects; Permits and Wayleaves; and Implementation Timelines. Option A (Red) has the least amount of off-road sections and so this will reduce the number of landowners directly affected and reduce the amount of wayleaves required. Option A (Red) did score more highly or equal for Traffic Disturbance because it has the most amount road sections and impacts more regional roads than the other options, which will increase traffic disturbance. While the traffic impacts will be temporary and restricted to the construction phase, in order to minimise the disturbance, traffic surveys will be undertaken to confirm this assumption. Other survey and design work will be completed to confirm the assumptions made on the required working area. In addition, localised route changes could be designed and assessed to minimise impacts further. Consultation will be undertaken with Meath and Kildare County Councils to agree the approach to traffic management and avoid and/or reduce the impacts.

8.5 Economic Assessment

At this stage in the Project, the only differentiations between route options are route lengths and the impact from the quantity of expected major crossings. Table 8.5 outlines the findings of the economic appraisal of each of the solution options. For more information on these findings, please see Section 4.5, 5.5. 6.5, and 7.5 respectively.

Table 8.5: Summary of Economic Assessment of Options

Route Option	Length of Installed Cable	Quantity of Crossings	Combined Economic Score
Option A (Red)	Moderate	Low	Low-Moderate
Option B (Green)	Moderate	Low	Low-Moderate
Option C (Orange)	Low	Moderate-High	Low-Moderate
Option D (Blue)	Moderate	Moderate-High	Moderate-High

At this stage in the Proposed Project, the only differentiations between route options are cable route lengths and the impact from the quantity of expected major crossings. Option A (Red) has been assessed to have a **Moderate (Dark Green)** score for the economic criterion due to the fewer HDDs balancing out the longer length of the route when compared to the shortest Option C (Orange).

8.6 Overall Summary

Table 8.6: Summary of Options Assessment

Option	Environment Score	Socio-economic Score	Technical Score	Deliverability Score	Economic Score
Option A (Red)	Moderate	Low-Moderate	Low	Low-Moderate	Low-Moderate
Option B (Green)	Low-Moderate	Moderate	Low	Moderate	Low-Moderate
Option C (Orange)	Low-Moderate	Moderate	Low	High	Low-Moderate
Option D (Blue)	Moderate	Moderate-High	Low	Moderate	Moderate-High

It was determined that Option A (Red) would be selected as the Emerging Best Performing Option. This is due to several factors including its better Socio-Economic and Deliverability scores compared to the other options. These lower Socio-economic impacts means that there will be less impacts to communities. While it is the longest of the four options, it passes fewer properties compared to Option D (Blue) and it has fewer major crossings (such as HDD) compared to Options C and D. It also impacts the least amount of agricultural land of the four options. Additionally, by crossing less agricultural land, there are likely to be fewer impacts to hedgerows and treelines, and therefore reduced ecological and landscape effects. While Option A (Red) has increased cultural heritage and traffic impacts compared to the other options, further survey, consultation, design, and assessment work will be undertaken to reduce and/or avoid the impacts.

Option A (Red) also has more favourable Deliverability scores compared to the other options. Option A (Red) generally performed better in four of the Deliverability topics compared to the other options – Design Complexity; Dependence on Other Projects; Permits and Wayleaves; and Implementation Timelines.

Option B (Green) was not selected because of the socio-economic impacts from travelling through Rathcoffey. It was also found to have scored less-well in Deliverability: including design complexity, other projects (e.g. impacting the proposed area of the Dart+ West project), permits and wayleaves, and implementation timelines.

Option C (Orange) was not selected as it required two additional major crossings of the River Liffey compared to Option A (Red). It also affects much more agricultural land, and scores poorly in terms of Deliverability – more road closures and impacting the proposed area of the Dart+ West project

Option D (Blue) was not selected as it also has two additional major crossings of the River Liffey, and impacts the R403 and R406 significantly, meaning it travels past more roadside properties, it also has significant impact to the east of Clane, and scores less well on Impact Dependence on other Infrastructure (e.g. impacting the proposed area of the Dart+ West project) and Design Complexity.

The next Step for the Proposed Project is Step 4B, which is about routing the cable in more detail following further survey, consultation, design, and assessment work. This will provide an opportunity to seek to further reduce and potentially avoid some of the impacts in this option and to consult on mitigation measures. These can then be designed into this option. Step 4B will seek to reduce the archaeological, architectural heritage, and cultural heritage effects, which assessed to be greater at this point on the project for Option A (Red) compared to the other options. This is largely due to passing more Gardens and Designed Landscapes than the other options.

Option A (Red) will pass less properties than Option D (Blue) and require less full road closures compared to Options B and C; however because more of its length is in regional roads, construction traffic disturbance will be comparatively greater due to the increased traffic using those roads. While the traffic impacts will be temporary and restricted to the construction phase, in order to minimise the disturbance, traffic surveys will be undertaken to confirm this assumption. Other survey and design work will be completed to confirm the assumptions made on the required working area. In addition, localised route changes could be designed and assessed to minimise impacts further. While Option A (Red) will have negative effects as any large infrastructure project would have, it has been determined to the best overall option for the Proposed Project. All of the options will have some degree of impact and it has been determined that Option A (Red)'s impacts are less or could be reduced with further design and assessment. Mitigation measures that will be applied include Construction Environmental Management Plans, Traffic Management Plans, reinstatement of agricultural land, archaeological investigations, ecological and landscape planting, habitat enhancements, and consultation with affected landowners, people living in the area affected, and with statutory bodies to identify the best way to construct the Proposed Project.

In conclusion, Option A (Red) was selected as the Emerging Best Performing Option because of less Socio-Economic and Deliverability impacts, fewer major crossings (such as HDD), and it impacts the least amount of agricultural land. impacts in terms of construction traffic and cultural heritage can be reduced at the next step in the project through further design, surveys, consultations, and assessment. This will provide an opportunity to seek to further reduce and potentially avoid some of the impacts in this option and to consult on mitigation measures. These can then be designed into this option.

8.7 Consultation Feedback on Option A (Red)

In terms of Option A (Red), many respondents expressed their support for this option, stating that in general terms Option A (Red) was the 'best option' or a 'reasonable' option. A few respondents stated that Option A (Red) represented the most direct route by following existing roads and many respondents highlighted that Option A (Red) would have less of an impact on the surrounding area than the other proposed options. Some of these respondents stated that Option A (Red) would be less disruptive to local communities, arguing that less landowners would be affected and that the option would not contribute to traffic in areas that are already experiencing congestion, such as Sallins, Clane and Kilcock. Many respondents outlined that the additional length of Option A (Red) compared to other options was acceptable, as this option would not impact on high-output soils, and would therefore have the least impact on agricultural land. These respondents stated that agriculture is an important sector in this area. In addition, a small number of respondents stated that Option A (Red) would have less of an environmental impact than the other options given the fact that there is a lower estimated figure for off-road sections.

A few respondents, however, were generally opposed to this option, with these respondents stating that Option A (Red) is too long or makes use of a circuitous route, and would result in significant environmental impacts, as well affecting agricultural land. Several respondents expressed concerns about Option A (Red), such as impacts on traffic, as the area already experiences high volumes of traffic, including Heavy Goods Vehicles. Respondents specifically mentioned the R407 Regional Road which was recently subjected to works over a lengthy period of time and the L2002 Local Road which is used as a bypass for Clane. A small number of respondents raised concerns about potential impacts on local communities, with some referring to the possibility of dust and noise impacts or restrictions to movements due to project works. Concerns were also raised about potential damage that could occur to the heritage buildings or sewerage infrastructure in Prosperous. In addition, a few respondents outlined that other recent or current development projects have already impacted on their homes in the vicinity, while a similar number raised concern about the potential disruption to the operation of Larchill Arcadian Gardens due to works on the R125 Regional Road.

A few respondents offered suggestions for Option A (Red), including suggestions to:

- Avoid Kilcock;
- Route the cables along roads;
- Ensure that access in both directions along the R125 Regional Road is maintained during construction through the use of a traffic light management system; and
- Amend the route between Prosperous and Sallins to pass through Millicent and Digby Bridge, then along the canal walkway, restoring the path afterwards to an improved standard.

Table 8.7: Option A (Red) Consultation Feedback and How Feedback Has Been Considered / Addressed

Consultation Feedback Topic	How Feedback Has Been Considered / Addressed
Traffic Impacts	The potential for traffic related impacts associated with Option A (Red) have been considered in Section 4.2.1 of this Report. For Option A (Red), full lane or a road closure during the construction works 'with' or 'without' Heavy Goods Vehicles, diversions are mostly available while at all times maintaining access for local residents. Public consultation feedback in relation to traffic will be considered further in the next Step of the Proposed Project.
People and Communities (including Kilcock)	Potential impacts on people and communities associated with Option A (Red) have been considered in the socio-economic assessment in Section 4.2. Concerns raised in relation to people and communities during public consultation will be considered further in the next phase of the Proposed Project and appropriate mitigation measures will be outlined to minimise any potential impacts.
Route	The route for Option A (Red) has been assessed in detail in this Report under a number of key criteria including environment, socio-economic, technical, deliverability and economic topics (refer to Section 4). Route Option A (Red) scored better in terms of socio-economic and technical assessment criteria compared to the other options, while it is the longest of the proposed options. Consultation feedback in relation to the route will also be considered further during the next phase of the Proposed Project.
Environment	The potential environmental impacts of Option A (Red) have been considered in Section 4.1. Environmental concerns raised during public consultation will be considered further in the next phase of the Project and appropriate mitigation measures will be outlined to minimise potential impacts.
Agricultural Land	Option A (Red) will impact the least amount of agricultural land of all of the proposed options. Agricultural land take required for Option A (Red) has been assessed as part of Section 4.2.8 of this Report and best practice measures will be applied to minimise any impacts on agricultural land. Consultation feedback in relation to agricultural land will also be considered further during the next phase of the Proposed Project.
Cost	Costs associated with route sections for Option A (Red) have been considered in Section 4.5 of this Report. Consultation feedback in relation to costs will be considered further in the next phases of the Proposed Project, when more specific project details are available.
Heritage buildings or sewerage infrastructure in Prosperous	Option A (Red) will not pass through Prosperous. Water mains and sewerage infrastructure will be a key consideration in the next steps of the Proposed Project.
Cumulative Impacts from recent or current development projects	These suggestions will be addressed in Step 4B of the Proposed Project.
Larchill Arcadian Gardens	Larchill Arcadian Gardens is assessed in Chapter 4 of this report. During construction, access to tourist and community facilities such as Larchill will be maintained to minimise any impacts.
Amend the route between Prosperous and Sallins to pass	These suggestions will be examined in Step 4B of the Proposed Project.

Consultation Feedback Topic	How Feedback Has Been Considered / Addressed
through Millicent and Digby Bridge	

8.8 Next Steps

The following actions will be completed on the Proposed Project:

- This Step 4A report will be published and any feedback will be considered by the project team and amendments will be made where it is considered appropriate;
- EirGrid will meet with affected landowners (subject to Covid protocols) to discuss the Proposed Project to seek agreement on the way forward. Further meetings will also be held with bodies such as Meath and Kildare County Councils, TII, Irish Rail, Waterways Ireland, and the utility providers such as Irish Water and Gas Networks Ireland;
- The project team will undertake a wide range of surveys to help to refine the design and location of the proposed cable. This will also include designing how the cable will be constructed and how traffic disturbance will be minimised through traffic management. The surveys include archaeology, ecology, agriculture, ground investigations, utilities surveys, hydrology, technical assessments, etc. These surveys will likely result in changes to the route shown in this report. This is a normal part of the design process – as further information is gathered, new issues can be identified resulting in changes to the route. The changes are likely to be minor in nature and will not affect the conclusion that Option A (Red) is the Emerging Best Performing Option. If large scale changes are required, then the assessment will be remade, and further consultation will be undertaken;
- Further design work will be progressed at the substations to determine the works required to connect the proposed cable into the grid;
- When the proposed cable route and design have been progressed further, a further report called the Step 4B report will be published for public consultation. This will allow further comments on the proposed route which will be addressed by the project team. The Step 4B report is likely to be published in the middle of 2022; and
- Following that, the project team will prepare the planning submission for the Proposed Project. Further updates will be published by EirGrid on the project website: www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/

Appendix A. 1 – Biodiversity (Flora and Fauna) Figures

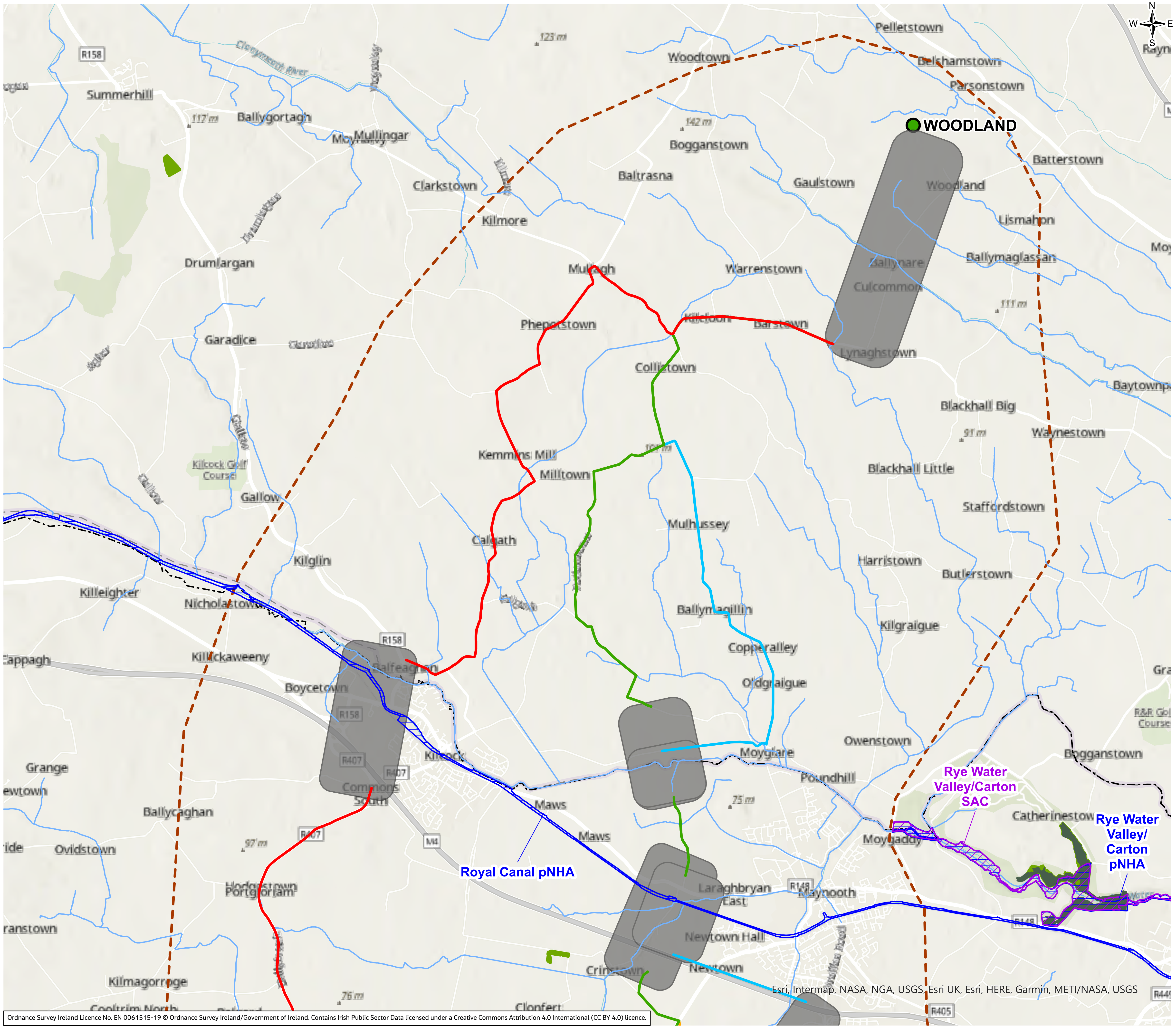

FIGURE A.1.1

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Special Area of Conservation (SAC)
- Proposed Natural Heritage Area (pNHA)
- Ancient & Long-Established Woodland
- Native Woodland
- Watercourse (EPA Data)

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	Dec 2021	Draft issue	GB	AR	GG	FL

Jacobs

Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
Tel: +353 1269 5666 Fax:+353 1269 5497
www.jacobs.com

Client: EIRGRID

Project: EirGrid Kildare-Meath Grid Upgrade

Drawing Title: Ecological Constraints (All Options) Sheet 1 of 3

Drawing Status: DRAFT

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Jacobs No.: 321084AH

Client No.:

Drawing No.: 321084AH-MAP-S4A-A.1.1

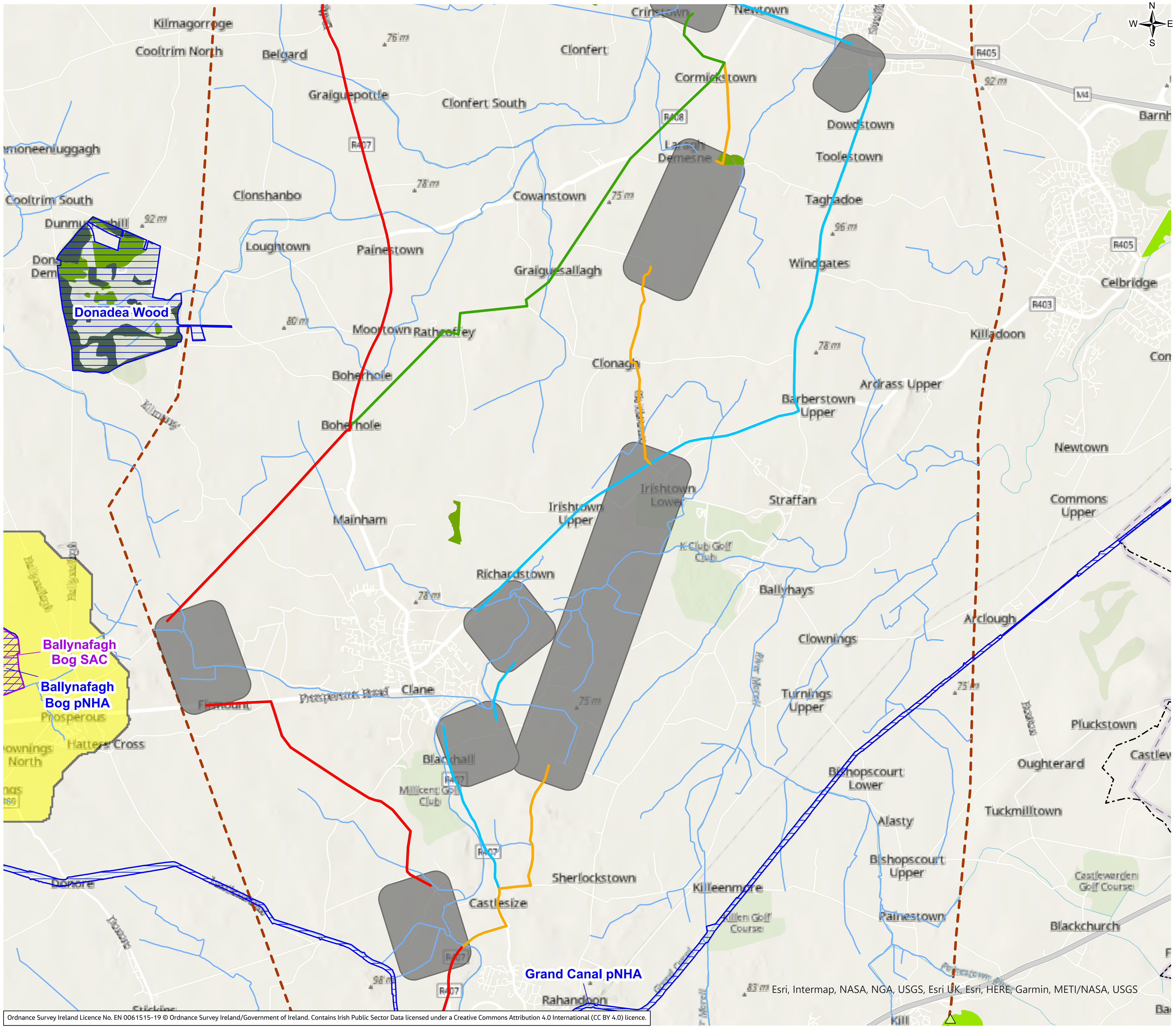

FIGURE A.1.1

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Special Area of Conservation (SAC)
- Proposed Natural Heritage Area (pNHA)
- Ancient & Long-Established Woodland
- Native Woodland
- Semi-Natural Grassland Releve
- Semi-Natural Grassland Habitat

Margaritifera Sensitive Areas

- Catchments with previous records of Margaritifera, but current status unknown
- Watercourse (EPA Data)

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	Dec 2021	Draft issue	GB	AR	GG	FL

Jacobs
Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
Tel: +353 1269 5666 Fax:+353 1269 5497
www.jacobs.com

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Drawing Title: Ecological Constraints (All Options) Sheet 2 of 3

Drawing Status: DRAFT

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Jacobs No.: 321084AH

Client No.:

Drawing No.: 321084AH-MAP-S4A-A.1.1

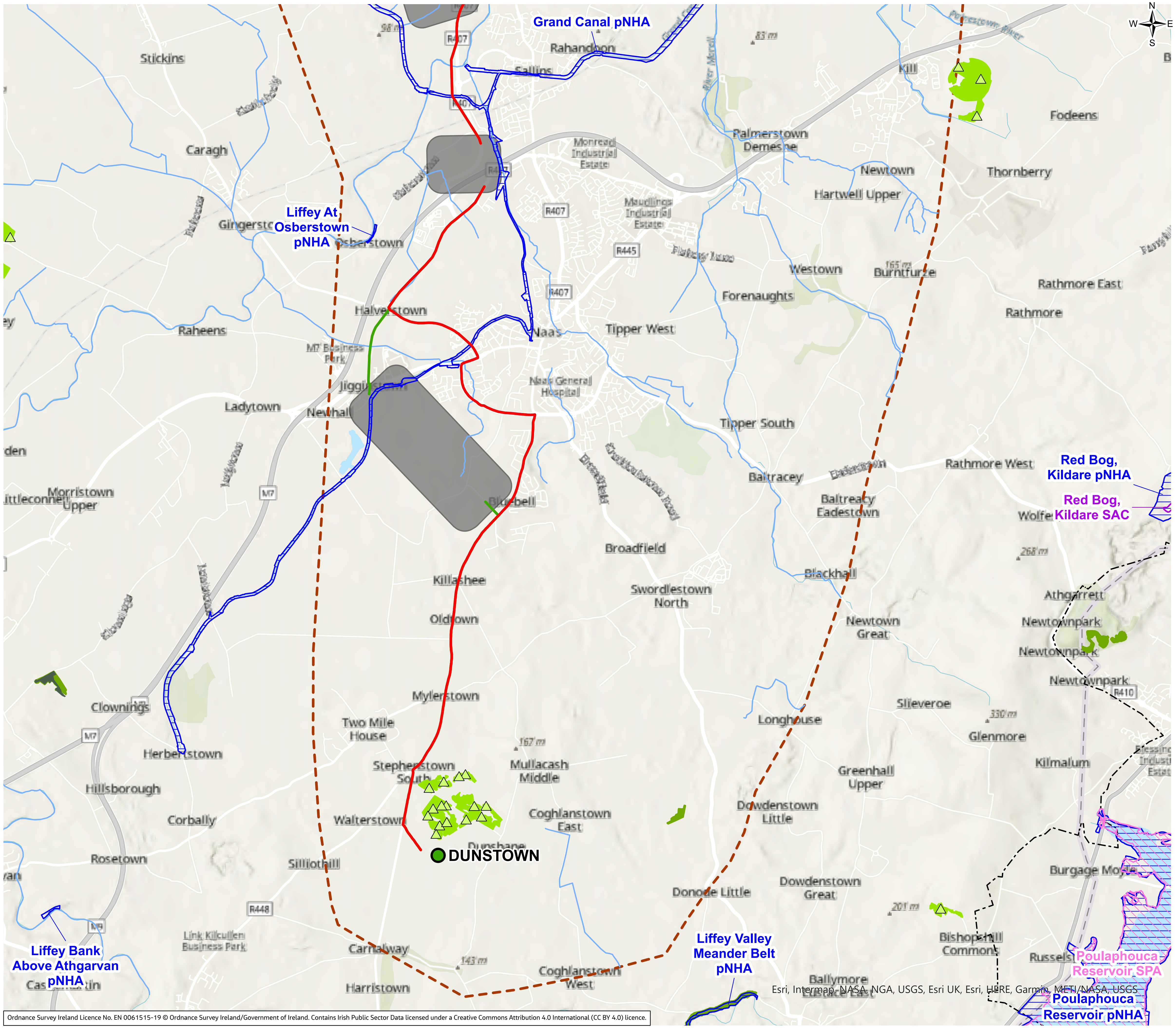

FIGURE A.1.1

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Proposed Natural Heritage Area (pNHA)
- Ancient & Long-Established Woodland
- Native Woodland
- Semi-Natural Grassland Releve
- Semi-Natural Grassland Habitat
- Watercourse (EPA Data)

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	Dec 2021	Draft issue	GB	AR	GG	FL

Jacobs
Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
Tel: +353 1269 5666 Fax:+353 1269 5497
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Drawing Title
Ecological Constraints (All Options)
Sheet 3 of 3

Drawing Status
DRAFT

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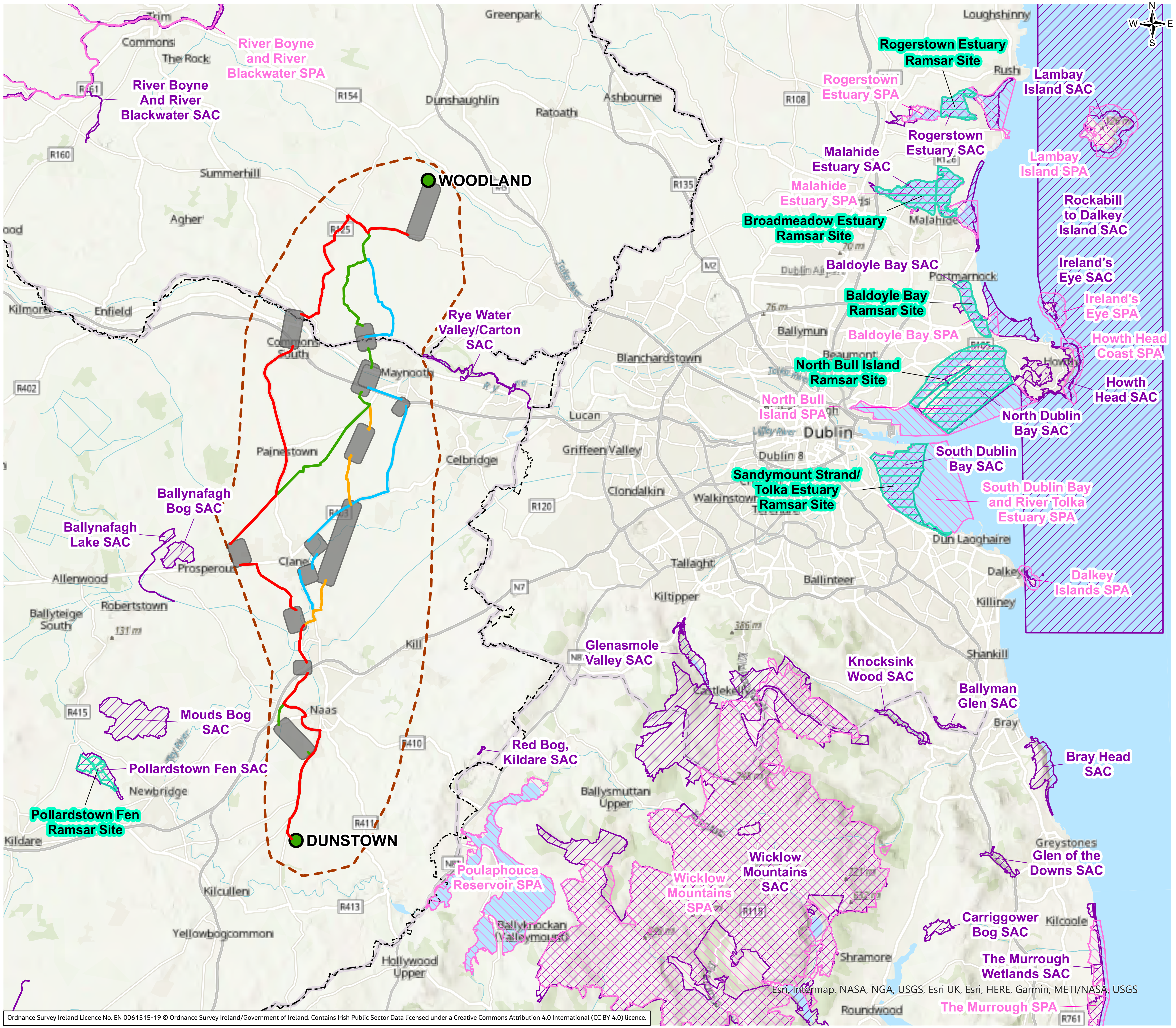
Client No.		
Drawing No.	321084AH-MAP-S4A-A.1.1	

FIGURE A.1.2



Legend

- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Ramsar Site
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- 400kV Substation
- County Boundary
- Study Area

0 8 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	Dec 2021	Draft issue	GB	AR	GG	FL

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Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
Tel: +353 1269 5666 Fax:+353 1269 5497
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Project

EirGrid Kildare-Meath Grid Upgrade

Drawing Title

European Sites and Ramsar Sites (All Options)

Drawing Status

DRAFT

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Client No.		
Drawing No.	321084AH-MAP-S4A-A.1.2	

Appendix B. 1 – Archaeology, Architectural Heritage and Cultural Heritage

Kildare-Meath Grid Upgrade

Step 4A Report – Appendix B.1

Archaeology, Architectural Heritage, and Cultural Heritage Baseline Information

KMGU-JAC-TN-0017

February 2022

EirGrid

Kildare-Meath Grid Upgrade

Project No:	321084AH
Document Title:	Step 4A Report – Appendix B.1: Archaeology, Architectural Heritage, and Cultural Heritage Baseline Information
Document No.:	KMGU-JAC-TN-0017-B1
Revision:	R01
Document Status:	Final Draft
Date:	February 2022
Client Name:	EirGrid
Client No:	CP966
Project Manager:	Fay Lagan
Author:	Abby Cooper
File Name:	Step 4A Report Appendix B.1 Archaeology, Architectural Heritage, and Cultural Heritage Baseline Information

Jacobs Engineering Ireland Limited

Merrion House
Merrion Road
Dublin 4, D04 R2C5
Ireland
T +353 (0)1 269 5666
F +353 1 269 5497
www.jacobs.com

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
R01	February 2022	Final Draft	Abby Cooper	David Bull	Jonathan Dempsey	Fay Lagan

Contents

1. Introduction

This appendix presents the baseline information gathered for the archaeology, architectural heritage and cultural heritage constraints identified within 100m of each of the four route options (Option A (Red), Option B (Green), Option C (Orange), and Option D (Blue)) identified for the Kildare-Meath Grid Upgrade project (the 'Proposed Project'). The purpose of the appendix is to support the archaeology, architectural heritage and cultural heritage input into the Step 4A Report - Analysis of the Route Options for the Proposed Project. Figures showing the locations of the archaeology, architectural heritage and cultural heritage constraints are presented in Appendix B.1.

In line with the guidance provided by *Cultural Heritage Guidelines for Electricity Transmission Projects* (EirGrid, 2015), cultural heritage has been assessed under the following topics:

- Archaeology - defined as '*the study of past societies through the material remains left by those societies and the evidence of their environment. The 'archaeological heritage' consists of such material remains (whether in the form of sites and monuments or artefacts in the sense of moveable objects) and environmental evidence*' (EirGrid, 2015, page 5).
- Architectural Heritage - comprising '*all structures and buildings (together with their settings and attendant grounds, fixtures and fittings, groups of such structures and buildings and sites), which are of architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. Architectural heritage is generally visible and has a presence in the landscape which requires assessment*' (EirGrid, 2015, page 6).
- Cultural Heritage - defined as '*a general term used to describe aspects of the environment and intangible heritage which are valued for their age, beauty, history or tradition. It encompasses aspects of archaeology, architecture, history, landscape and garden design, folklore and tradition and topography. Cultural heritage is expressed in the physical landscape in numerous often interrelated ways*' (EirGrid, 2015, page 6).

Section 2 of this appendix provides the methodology, including the legislative background and sources of information, used to identify archaeology, architectural heritage and cultural heritage constraints within 100m of each of the four route options identified for the Proposed Project. Section 3 describes the archaeology, architectural heritage and cultural heritage constraints within 100m of each of the four route options.[1] An Inventory of Archaeology, Architectural Heritage and Cultural Heritage Constraints is also provided (Annex A).

[1] Please note a summary of archaeology, architectural heritage, and cultural heritage constraints identified within the Step 3 Project Study Area along with a discussion on the general character and nature of the constraints present is presented in the Step 4A Environmental Constraints Report and has not been duplicated here. The Step 4A Environmental Constraints Report is available at: https://consult.eirgrid.ie/system/files/materials/2055/Environmental%20Constraints%20Report%20-%20Step%204A%20-%20KMGU.pdf.

2. Methodology

2.1 Legislation and Guidance

This appendix was informed by the following legislation and best practice guidance:

- National Monuments Act 1930 to 2014;
- European Cultural Convention 1954;
- International Council on Monuments and Sites (ICOMOS) International Charter for the Conservation and Restoration of Monuments and Sites 1964;
- United Nations Educational, Scientific and Cultural Organisation (UNESCO) Convention Concerning the Protection of the World Cultural and Natural Heritage 1972;
- Convention for the Protection of the Architectural Heritage of Europe (Granada, 1985);
- Convention for the Protection of the Archaeological Heritage of Europe (revised) (Valletta, 1992);
- Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 1999;
- Framework and Principles for the Protection of the Archaeological Heritage (Department of Arts, Heritage, Gaeltacht and Islands (now Department of Culture, Heritage and Gaeltacht), 1999);
- Planning and Development Act 2000 to 2020;
- Convention on the Value of Cultural Heritage for Society (Faro Convention, 2005);
- Code of Practice between the Department of the Environment, Heritage and Local Government and EirGrid (Department of the Environment, Heritage and Local Government and EirGrid, 2009);
- Architectural Heritage Protection Guidelines for Planning Authorities (Department of Arts Heritage and the Gaeltacht, 2011); and
- Cultural Heritage Guidelines for Electricity Transmission Projects (EirGrid, 2015).

Archaeological sites and monuments are protected under the National Monument Act 1930 – 2014 primarily through inclusion in the Record of Monument and Places (RMP), the Register of Historic Monuments (RHM) and/or by being declared a National Monument. Section 2 of the National Monument Act 1930 - 2014 defines a National Monument as '*a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic, or archaeological interest attaching thereto*'. In addition, Section 8 of the Act states that the Minister may also place a Preservation Order on a monument '*which in his [the minister's] opinion is a national monument is in danger of being or is actually being destroyed, injured, or removed, or is falling into decay through neglect*'. It is illegal to demolish, or remove wholly or in part, a National Monument or disturb the ground within, around or in proximity to a National Monument, without written consent from the Minister (and/or the local authority if they are the owners or guardians).

Under Section 5 of the National Monuments (Amendment) Act 1987, an RHM is required to be established and maintained. Monuments included on the RHM are afforded statutory protection under this Act, of a similar level to Recorded Monuments (see below).

Section 12 (1) of the National Monuments (Amendment) Act 1994 requires the establishment and maintenance of an RMP. Sites included in the RMP are legally protected and are referred to as Recorded Monuments. The RMP is maintained by the National Monuments Service (NMS) of the Department of Housing, Local Government and Heritage who have defined Zones of Notification around each Recorded Monument. Zones of Notification do not define the extent of a site but are defined for the purposes of notification to the Minister under Section 12 of the National Monuments Act (1930-2004).

The Sites and Monuments Record (SMR) is the national database of the Archaeological Survey of Ireland (ASI) compiled and maintained by the NMS. The SMR details all sites where a monument is known to the ASI pre-dating AD 1700 and includes a selection of monuments from the post-AD 1700 period. The addition of a monument to the SMR does not, in itself, confer legal protection.

The Planning and Development Act 2000 sets out the conditions relating to the protection of architectural heritage. Structures of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest are protected under this Act, through their inclusion on the Record of Protected Structures (RPS) and are known as Protected Structures.

The Planning and Development Act 2000 as amended defines an Architectural Conservation Area (ACA) as '*a place, area, group of structures or townscape, taking account of building lines and heights, that:*

a) *is of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest or value, or*

b) *contributes to the appreciation of protected structures*' (Planning and Development Act, 2000, Part IV, Chapter II).

Development plans are required to include an objective to preserve the character of an ACA. In considering applications for permission for development within an ACA, the effect of a Proposed Project on the character of an ACA is a consideration for the planning authority. Both the Kildare County Development Plan 2017 – 2023[2] and Meath County Development Plan 2021 - 2027[3] include a list of ACAs protected under the Act.

Undertaken under the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act 1999 the National Inventory of Architectural Heritage (NIAH) is a nationwide survey of architectural heritage including buildings, structures, and historic gardens and design landscapes. Inclusion on the NIAH alone does not in itself confer legal protection. The NIAH includes an assessment of the significance of structures based on an appraisal of their contribution to architectural heritage. Significance ratings are: International, National, Regional, Local and Record Only. Structures which are considered of International, National, and Regional significance are recommended by the Minister to the relevant Local Authority for inclusion in their RPS.[4]

The Survey of Historic Gardens and Designed Landscapes, undertaken by the NIAH, includes the sites of demesne lands from First Edition Ordnance Survey maps and assesses the level of survival and change. These gardens and designed landscapes (GDLs) largely date from the post-medieval period when the lands surrounding large houses assumed an increasingly ornamental role providing a landscape setting for the house.[5]

2.2 Study Areas

In order to identify and quantify the archaeology, architectural heritage and cultural heritage constraints that may be impacted by the route options, including indirect impacts, a study area of 100m was established around the route option under consideration. A 100m study area is considered sufficient to identify impacts given any direct impacts would largely result from the excavation for the cable trench, joint boxes, and temporary launch and reception pits for directional drilling, and be focussed on the alignment of the route option. Any indirect impacts are anticipated to be temporary (lasting the duration of construction in each location) as the Proposed Project

[2] https://www.kildare.ie/CountyCouncil/AllServices/Planning/DevelopmentPlans/KildareCountyDevelopmentPlan2017-2023/.
[3] https://consult.meath.ie/en/consultation/meath-adopted-county-development-plan.
[4] Department of Culture, Heritage and the Gaeltacht, 2021, NIAH Handbook.
[5] http://buildingsofireland.com/Surveys/Gardens/AShortHistory/ [Accessed 5.11.21].

would be largely located beneath road surfaces and offline sections would be reinstated after construction, localised along the wayleave corridor and are not anticipated beyond 100m.

The four route options and their 100m study areas are shown on Figures B.1.1 – B.1.4 (Appendix B.1).

2.3 Sources of Information

Baseline conditions for archaeology, architectural heritage and cultural heritage were established through desk-based research using the following sources of information:

- The archaeological and architectural features identified as part of the Environmental Constraints Report[6], comprising National Monuments and sites with Preservation Orders placed on them, Recorded Monuments listed on the RMP, sites on the RHM, and sites recorded on the SMR, Protected Structures and structures on the NIAH, ACAs identified in the Kildare County Development Plan 2017 – 2023 and Meath County Development Plan 2021 – 2027, and GDLs identified from the Survey of Historic Gardens and Designed Landscapes;
- Modern aerial imagery, including Google, OSi Digital Globe, and EirGrid aerial photography;
- Historic aerial photographs available online[7];
- Historic mapping available online, comprising:
  - The Down Survey of Ireland[8];
  - Noble and Keenan's map of Kildare (1752)[9];
  - Larkin's map of Meath (1812)[10]; and
  - Historic Ordnance Survey mapping (Ordnance Survey 6", 1837 – 1842 and Ordnance Survey 25", 1888 - 1913);
- Placename information available online[11];
- The National Folklore Collection via the UCD digital library available online[12];
- Topographical files of the National Museum of Ireland through the online National Museum of Ireland: Finds Database (up to 2010) available online[13];
- Excavations Bulletin[14]; and
- Transport Infrastructure Ireland (TII) Archaeological Excavation Reports.[15]

Some archaeology, architectural heritage and cultural heritage constraints are entered separately on one or more datasets. Where constraints appear on more than one dataset these have been deconflicted to avoid double counting of constraints with its designation (or more significant designation) taking precedence as it affords the constraint legal protection. Where a constraint does appear on more than one dataset, this has been identified in Section 3 below and Annex A (Inventory of Archaeology, Architectural Heritage and Cultural Heritage Constraints).

[6] https://consult.eirgrid.ie/system/files/materials/2055/Environmental%20Constraints%20Report%20-%20Step%204A%20-%20KMGU.pdf.
[7] https://www.cambridgeairphotos.com/.
[8] http://downsurvey.tcd.ie/index.html [Accessed 05.11.21].
[9] https://www.logainm.ie/Eolas/Data/Brainse/logainm.ie-map-j-noble-and-j-keenan-1752-grand-jury-kildare-south.jpg and logainm.ie-map-j-noble-and-j-keenan-1752-grand-jury-kildare-north.jpg (4800×3501) [Accessed 09.11.21].
[10] https://www.logainm.ie/Eolas/Data/Brainse/logainm.ie-map-william-larkin-1812-grand-jury-meath-sheet-06.jpg [Accessed 09.11.21].
[11] www.loganim.ie.
[12] https://digital.ucd.ie/.
[13] http://heritagemaps.ie/.
[14] https://excavations.ie/ [Accessed November 2021].
[15] https://repository.dri.ie/catalog [Accessed November 2021].

In addition to a review of sources of recorded archaeological and architectural features identified as part of the Environmental Constraints Report, cultural heritage constraints within the study areas for each of the four route options were recorded, mapped and assessed through desk-based research using the sources identified above. Information from these sources has been incorporated into Section 3 below and in the Inventory of Archaeology, Architectural Heritage and Cultural Heritage Constraints (Annex A). Additional cultural heritage sites identified from these sources are also described in Sections 3.1.3, 3.2.3, 3.3.3, and 3.4.3 below. Cultural heritage will be looked into in more detail, including verifying the results of the desk study through field survey, at a later stage of the Proposed Project.

A unique reference number was assigned to each constraint identified from the sources listed above. Archaeological constraints are prefixed with 'AY' and architectural heritage constraints are prefixed with 'AH'. Demesne lands are prefixed with 'DL' and undesignated cultural heritage sites are prefixed with 'CH'. Archaeological, architectural heritage and cultural heritage constraints are identified in the sections below and are also shown on Figures B.1.1 – B.1.4 (Appendix B.1). Full details for the archaeology, architectural heritage and cultural heritage constraints identified are provided in Annex A (Inventory of Archaeology, Architectural Heritage and Cultural Heritage Constraints).

3. Receiving Environment

This section presents baseline information for the archaeology, architectural heritage and cultural heritage constraints within the study areas for each of the four route options.

A summary of archaeology, architectural heritage, and cultural heritage constraints identified within the Step 3 Project Study Area is presented in the Environmental Constraints Report[16] along with a discussion on the general character and nature of the constraints present.

Further details for the archaeology, architectural heritage and cultural heritage constraints identified within the study areas for each of the four route options are provided in Annex A (Inventory of Archaeology, Architectural Heritage and Cultural Heritage Constraints).

3.1 Option A (Red)

3.1.1 Archaeology

Archaeological constraints identified within the study area for Option A (Red) (see Annex A and Figure B.1.1 in Appendix B.1) comprise:

- One National Monument and three sites with Preservation Orders placed on them;
- One site on the RHM;
- Four Recorded Monuments; and
- Six sites recorded on the SMR.

National Monuments & Preservation Orders

There is one National Monument (AY_39; also a Protected Structure, AH_16) and three sites with Preservation Orders placed on them (AY_40, AY_42, and AY_43) located within the study area for Option A (Red) (see Figure B.1.1 of Appendix B.1). These form part of the Jigginstown Castle complex, located approximately 40m to the west of Option A (Red). Two further sites with Preservation Orders placed on them (AY_38, AY_44; also a Protected Structure, AH_17), approximately 195m and 230m to the west of Option A (Red) respectively, also form part of the complex.

Built by the Earl of Wentworth, Lord Lieutenant of Ireland, as a summer residence and to accommodate Charles I on royal visits to Ireland[17], the complex includes the 17th century house (AY_39) and gardens (AY_43), enclosed within a large oval enclosure (AY_42). Local legend states men formed a chain from Dublin to Naas and passed the bricks along the line to build the house, and that a tunnel leads from Jigginstown to Killashee. [18] The complex fronts directly onto the R445 to the north; however, is largely screened from the road to the east by established trees and vegetation.

[16] https://consult.eirgrid.ie/system/files/materials/2055/Environmental%20Constraints%20Report%20-%20Step%204A%20-%20KMGU.pdf.
[17] https://kildare.ie/Heritage/historic-sites/jigginstown-castle.asp [Accessed 25.10.21].
[18] https://digital.ucd.ie/view-media/duchas:4819384/canvas?manifest=https://data.ucd.ie/api/img/manifests/duchas:4819384 [Accessed 04.11.21].

Register of Historic Monuments

A total of six sites on the RHM have been identified within the study area for Option A (Red). Five of these sites (AY_38, AY_39, AY_42, AY_43, and AY_44), form part of the Jigginstown Castle complex and, to avoid double counting constraints, have been included above under their more significant designations (see above).

A linear earthwork (AY_13), located immediately to the east of Option A (Red), is also a Recorded Monument, (see below) and forms the townland boundary between Ballyloughan and Graiguepottle. Identified as 'The Pale' on historic mapping (Ordnance Survey 25", 1888 - 1913), and depicted as a narrow trackway, this monument may be part of a boundary constructed by the Anglo-Normans in the 14th century to divide their lands from those held by the Irish. Aerial photographs show an ephemeral ditch feature aligned north-south running adjacent to the R407, alongside the current field boundary.[19] Lydon has suggested that AY_13 was by and large conceptual and may only have been fortified in parts.[20]

Recorded Monuments

A total of four[21] Recorded Monuments are located within the study area for Option A (Red) (see Figure B.1.1 in Appendix B.1). These comprise:

- A mound (AY_02), comprising a low circular earth mound, is located approximately 33m to the west of Option A (Red). The mound is depicted on historic mapping as a 'Mound' associated with 'Brides Well' (Ordnance Survey 6", 1837 – 1842). The mound was topped by a single ash tree[22], until recent restoration to the well (AY_01; a site recorded on the SMR; see below), appears to have removed the tree and included the erection of a post-and-rail fence around the top of the mound.
- A field system (AY_03) of unknown date, approximately 3m to the east of Option A (Red), comprising the earthwork remains of a series of irregular fields. These features, identified from aerial photographs, are formed by banks and ditches and have been interpreted as the remains of ridge and furrow and possible trackways. The earthworks extend into the large field to the north.
- A poorly preserved rath (AY_24), in Ballynagappagh, approximately 62m to the south-east of Option A (Red). Raths are farmsteads of early medieval date enclosed by one or more banks and ditches, and AY_24 comprises a low, circular earth bank, approximately 3.8m in width, with a possible entrance to the north. This monument is depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) as an oval earthwork, with a field boundary running along its eastern extent, and measures approximately 44m in length. Aerial imagery shows this monument to be overgrown with established vegetation.
- A 'moat' (AY_26; also a Protected Structure) depicted on historic mapping (Ordnance Survey 25", 1888-1913), adjacent to the road through Firmount East, within the demesne lands of Moatfield House (DL_15). This circular, round-topped, earth mound, located approximately 33m to the north-east of Option A (Red), may comprise the remains of a motte or Anglo-Norman defended homestead dating to the 12th and 13th centuries.[23,24] Topped with palisaded towers, these sites often had an associated enclosure (a bailey), which contained other buildings, attached. However, this area is overgrown, with a number of trees growing from the mound, and no evidence for a bailey was identified from aerial photographs of this location.

[19] https://www.cambridgeairphotos.com/location/bdu041/ [Accessed 04.11.21].
[20] Lyndon, J., 1973, *Ireland in the later Middle Ages*, pp. 130 – 133.
[21] A further Recorded Monument, a linear earthwork located immediately to the east of Option A (Red) (AY_13), is also on the RHM and, to avoid double counting constraints, is described above.
[22] https://digital.ucd.ie/view/duchas:49398 [Accessed 04.11.21].
[23] Department of the Environment, Heritage and Local Government, 2004, *Irish Field Monuments*.
[24] National Monuments Service, 2012, *Anglo-Norman castles*. Available online: https://www.archaeology.ie/sites/default/files/media/publications/nms-farmers-journal-10.pdf [Accessed 25.10.21].

Sites on the Sites and Monuments Record

A total of six sites recorded on the SMR have been identified within the study area for Option A (Red). These are the locations of cropmarks and evidence of post-medieval religious and domestic activity. The six sites recorded on the SMR within the study area for Option A (Red) are included in Table 3.1 and are shown on Figure B.1.1 (Appendix B.1).

Three further sites recorded on the SMR have not been included in Table 3.1. These comprise the site of two small pits identified during archaeological monitoring (AY_07), the site of a midden (AY_41) identified at Jigginstown Castle complex, and a redundant record (AY_45). While AY_07 and AY_41 provide an indication of possible activity in these locations, given these sites have been removed and, in the case of AY_07, the area developed, they are no longer constraints.

Table 3.1: Sites recorded on the SMR within the study area for Option A (Red)

Reference Number	SMR Reference	Description	Townland	Location (Easting / Northing)
AY_01	ME049-014001	A holy well (AY_01) depicted on historic mapping as 'Brides Well' (Ordnance Survey 6", 1837 – 1842) comprising a small natural spring at the centre of a low earth mound (AY_02; a Recorded Monument, see above). The well is described as one of the hot wells in Meath which sprung up when St Brigid rested in the location and is said to cure deafness. [25] The well has more recently been conserved and is now stone lined.	Calgath	689223 / 742511
AY_27	KD014-054	The present location of a square stone font found in the wall of the church in Clane.	Millicent Demesne	687361 / 725841
AY_36	KD019-081	A cropmark, approximately 80m to the west of Option A (Red), identified from aerial imagery measuring approximately 10m in diameter. The feature was interpreted as a ring ditch and may comprise the remains of a prehistoric funerary monument or hut circle. A further possible circular cropmark, of similar size and form, is visible on aerial imagery to the west, along with a number of linear features which correspond with historic field boundaries (Ordnance Survey 6", 1837 – 1842).	Osberstown	687886 / 722860
AY_46	KD024-050004	A group of small rectangular cropmarks, interpreted as enclosures, identified from aerial photographs, within approximately 6m of Option A (Red). These features are not depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888-1913) and no above ground remains remain extant. It is likely AY_46 – 48 have been removed or truncated as a result of the construction of the R412 and access track to Dunstown substation. These enclosures form part of a larger group, with further examples identified to the south-east.	Dunstown	687302 / 712740
AY_47	KD024-050005		Dunstown	687328 / 712725
AY_48	KD024-050006		Dunstown	687335 / 712719

Archaeological Potential

Option A (Red) crosses the River Liffey and the Rye Water, as well as a number of minor watercourses. While the underlying geology is largely limestone, with superficial deposits of till and gravel, areas of alluvium, lake marl and

[25] 'St. Brigid's Well', *Ireland's Holy Wells County-by-County*. Available online: https://ihwcbc.omeka.net/items/show/416 [Accessed 12.11.21].

raised peat have the potential to preserve previously unknown archaeological monuments and remains, including palaeoenvironmental remains and preserved organic materials. There is also the potential for votive offerings, objects apparently deposited for religious reasons, in rivers and bogs.

3.1.2 Architectural Heritage

Architectural heritage constraints within the study area for Option A (Red) comprise:

- Five Protected Structures (see Figure B.1.2 in Appendix B.1);
- One structure included on the NIAH (see Figure B.1.2 in Appendix B.1), assessed by the NIAH to be of Regional importance; and
- 12 GDLs (see Figure B.1.3 in Appendix B.1).

No ACAs have been identified within the study area for Option A (Red).

Record of Protected Structures

A total of five Protected Structures comprising post-medieval houses and a church have been identified within the study area for Option A (Red) (see Figure B.1.2 in Appendix B.1).

AH_06 and AH_11 comprise roadside houses with high-pitched thatched roofs constructed of unrefined local materials[26,27] dating to the 18th century. Both houses are also included on the NIAH and have been assessed by the NIAH to be of Regional importance. A thatched house in Moortown (AY_06) overlooks Mooretown Drive, off the R407. While the view north is directly over the road, views in other directions are screened by the surrounding established vegetation and trees, and other residential buildings. Located in Ballynagappagh, AH_11 comprises a single-storey range positioned perpendicular to the R408. The building forms part of a working farmyard and includes a later range depicted on historic mapping (Ordnance Survey 25”, 1888-1913), and a low roadside boundary wall (approximately 0.6km in length) with two sets of gate piers to north-west, and a small modern lean-to. These buildings are located approximately 64m to the east and 20m to the south-east of Option A (Red) respectively.

A house identified as ‘Millicent Estate Houses’ on the RPS (AH_15) is located approximately 7m to the north-east of Option A (Red) within Millicent Demesne (DL_17; see below). The building comprises a square plan, two-storey house with a conservatory and outbuilding, both possibly of later date. While AH_15 is shown as a 'lodge' on historic mapping (Ordnance Survey 25”, 1888-1913), the plan of the current building differs from that depicted on the historic mapping and the building therefore may have been altered at a later date. The principal elevation of the house is to the south-east, with views across a private access track. Views in all directions are largely screened by trees and an established boundary hedge.

Bluebell Farm House (AH_18), is located approximately 35m to the west of Option A (Red) and comprises a roadside three bay, two storey Victorian farm house. Historic mapping (Ordnance Survey 25”, 1888 - 1913) depicts the house, and associated ranges forming a yard, enclosed by a boundary wall which surrounds the farm complex. The house forms part of a working farmyard with modern agricultural buildings to the west. Views from AH_18 are across Kilcullen Road and are largely screened by a high rubblestone wall, immediately adjacent to the former alignment of the road.

Millicent Church and Lych Gate (AH_12), is located approximately 44m to the north-east of Option A (Red) within Millicent House Demesne (DL_17). Consecrated in 1883, the church comprises a Hiberno-Romanesque building, located on a rise towards the centre of the parish of Clane, with a square tower that is visible for some distance.

[26] https://www.buildingsofireland.ie/buildings-search/building/11901001/moortown-celbridge-ed-kildare [Accessed 25.10.21].
[27] https://www.buildingsofireland.ie/buildings-search/building/11901401/ballynagappagh-clane-ed-kildare [Accessed 25.10.21].

The lych gate comprises a covered gateway at the entrance of the graveyard where a coffin could be set down during a funeral until the celebrant arrived. The structure has a slate pitched roof with decorative ridge pieces and is the only entrance leading directly from the L2002 into the treelined graveyard. Despite its roadside location, the church is surrounded by established trees which largely screen it from the road.

Architectural Conservation Areas

There are no ACAs located within the study area for Option A (Red). The nearest ACA to the option is Naas ACA, located approximately 700m to the east of Option A (Red).

National Inventory of Architectural Heritage

Three post-medieval houses included on the NIAH have been identified within the study area for Option A (Red) and comprise a country house (AH_01), and two thatched houses (AH_06 and AH_11). These houses have assessed by the NIAH to be of Regional importance. AH_06 and AH_11 are also Protected Structures (see descriptions above) and, to avoid double counting constraints, have been included above under Protected Structures.

Larch Hill House (AH_01) comprises a five-bay two-storey country house, built in the late 18th century. The house is located within its demesne (DL_04), which includes extant estate buildings such as the gate lodge, as well as rendered entrance piers with limestone wheel guards and cast-iron double gates on the R125.

Survey of Gardens and Designed Landscapes

A total of 12 GDLs have been identified within the study area for Option A (Red). Of these ten were recorded by the Survey of Historic Gardens and Designed Landscapes and two have been identified from historic mapping (Ordnance Survey 6", 1837 – 1842). Information on these GDLs is summarised in Table 3.2 and are shown on Figure B.1.3 (Appendix B.1).

Table 3.2: GDLs identified within the study area for Option A (Red)

Reference Number	Name	Description	Townland	NIAH Reference
DL_01	Glebe House	Demesne identified from historic mapping as 'Paget Priory' (Ordnance Survey 6", 1837 – 1842). Mature trees, hedges and a low stone boundary wall with cast iron railings mark the boundary with the R156 and R126. Roughcast and painted gate piers are located at the entrance on the junction of the R125 and R126, leading to a driveway as depicted on historic mapping.	Mullagh	N/A
DL_02	Jenkinstown House	Demesne identified from historic mapping (Ordnance Survey 6", 1837 – 1842). The principal house remains extant (CH_02), and the demesne includes a roughcast boundary wall, gate piers, and driveway leading to the house. Mature trees and a ditch mark the boundary along the R156.	Jenkinstown	N/A
DL_03	Phepotstown House	The GDL to Phepotstown House (CH_05), including principal house and ancillary buildings depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Retains elements of parkland and formal gardens, as well as original driveways and entrances with gate piers and cast-iron gates. Hedgerows and mature trees, as well as roughcast walling, form the boundaries.	Phepotstown	NIAH 5151
DL_04	Larch Hill House	The GDL to Larch Hill House (AH_01) which includes extant water features and woodland. Tradition notes a previous owner believed he would return after death as a fox so constructed a fox-cover in the grounds, although the location is unknown. Established trees and hedgerows bound the R125. A gated entrance with lodge house (with additional ancillary building) are also present and a low rubble stone wall runs from entrance to the carriageway. The southern boundary to the demesne comprises an established woodland belt.	Phepotstown	NIAH 5104
DL_05	Rodanstown House	Demesne associated with Rodanstown House. The boundaries of the demesne reflect those depicted on historic mapping (Ordnance Survey 6", 1837 – 1842); however, some estate features, including areas of woodland and boundary trees have been removed. Some development, including modern agricultural ranges, has taken place within the boundary. Roadside boundary features include roughcast and brick walls and low hedges.	Rodanstown	N/A
DL_07	Brides Stream House	The GDL to Bridestream House with legible features including areas of parkland and belts of trees. A lodge (CH_09) depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913) remains extant to the south; however, the driveway appears to be overgrown and disused. The boundary along the R125 comprises a low stone wall and ditch, with a mature hedgerow and tree line.	Calgath	NIAH 4983
DL_10	Painestown House	The GDL to Painestown House. The principal building appears to be ruinous, and a large amount of woodland depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) is no longer present. The R407 is bounded by established hedgerows and mature trees, with the entrances recessed from the carriageway.	Painestown	NIAH 1884
DL_14	Firmount House	The GDL to Firmount House, includes the principal building and other estate features such as the walled garden, parkland and some estate trees. The walled garden bounds the L2002 and includes a small pedestrian doorway directly onto the carriageway.	Firmount Demesne	NIAH 1882

Reference Number	Name	Description	Townland	NIAH Reference
		All entrances appear to have been modernised and the L2002 is largely bounded by modern post and rail fence, ditch and tree line.		
DL_15	Moatfield House	The GDL to Moatfield House, includes principal building (RPS B14-18), agricultural range, and a wide tree-lined avenue. A ditch and established hedgerow bound the L2002; however, modern entrances and boundary features, including post and rail fencing, are also present. The entrance to the demesne is recessed with rubble stone walls and a set of simple square gate piers.	Firmount East	NIAH 1883
DL_17	Millicent House	The GDL to Millicent House. The extensive riverside demesne lands surrounding the principal house (RPS B14-26) include extant estate features such as lodges (including AH_15), a walled garden, drives, and areas of woodland and parkland depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913). Sections of rubble stone wall delimit the demesne and line the road from the entrance to Millicent Bridge.	Millicent Demesne	NIAH 1889
DL_19	Osberstown Hill	The GDL to Osberstown Hill house. The principal building remains extant; however, the Dublin-Cork (and others) railway line has replaced the northern boundary and the Sallins Bypass has removed a section of the eastern corner.	Osberstown	NIAH 1887
DL_20	Killashee House	The GDL to Killashee House. Largely developed include Killashee National School, and the majority of demesne features have been removed. The R448 is located within the western boundary of the demesne. Extant boundary features include established hedgerows and a ditch, and modern post and rail fencing. A section of roughly coursed rubble stone wall is extant to the south of the demesne, along with a later recessed entrance.	Killashee	NIAH 1980

3.1.3 Cultural Heritage

A total of 27 cultural heritage sites have been identified within the study area for Option A (Red) from the sources identified in Section 2. These comprise post-medieval built heritage including stone road bridges, houses and farm buildings. Summary information on these cultural heritage sites is presented in Table 3.3 below and are shown on Figure B.1.4 (Appendix B.1).

Table 3.3: Cultural heritage sites identified within the study area for Option A (Red)

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_01	694713 / 746280	Culcommon	Road Bridge	The western coursed, rubble stone parapet of a road bridge or culvert carrying a single lane carriageway over a small watercourse depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 2m to the east of Option A (Red).
CH_02	691765 / 745557	Warrenstown	House	'Jenkinstown House' depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) comprising the main house and a long range to north, approximately 65m to the north-west of Option A (Red). Principal elevation of house is south-east facing, towards the R156 - however, this is screened by a belt of established trees and vegetation.
CH_03	693262 / 745438	Jenkinstown	Public House	A public house depicted on historic mapping (Ordnance Survey 25", 1888-1913) comprising a one and a half storey, roughcast immediately adjacent to the R156, approximately14m to the south-east of Option A (Red).
CH_04	691671 / 745333	Jenkinstown	Road Bridge	A low rubble stone bridge that carries the R156 across a small watercourse. Depicted on historic mapping as 'Jenkinstown Bridge' (Ordnance Survey 6", 1837 – 1842).
CH_05	689469 / 744597	Phepotstown	House	'Phepotstown House' depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) comprising a farmhouse with an attached long range and ancillary buildings. Located approximately 74m to the south of Option A (Red). Principal elevation of farmhouse towards the R125 to the north.
CH_06	689725 / 743478	Martinstown	Road Bridge	A stone road bridge depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888-1913) comprising two low parapets with alternate horizontal and vertical copes on the R125.
CH_07	689372 / 743057	Phepotstown; Calgath	Road Bridge	A stone road bridge depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888-1913) comprising two low stone parapets with rough vertical copes on the R125.
CH_10	689017 / 740938	Dolanstown	Farm	A farm depicted on depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888-1913). While some ranges remain extant, the complex has largely been replaced by more recent agricultural buildings. Located approximately 70m to the south-east of Option A (Red).
CH_11	689025 / 740886	Balfeaghan	House	A rendered two-storey house depicted on historic mapping (Ordnance Survey 25", 1888-1913), with low walled garden to north. A number of modern farm buildings are located to the south-east, and the house is largely screened from the R158 (approximately 20m to the west).
CH_12	688018 / 740642	Balfeaghan; Boycetown	Road Bridge	'Balfeaghan Bridge' depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), carries the R158 across the River Rye and the Meath-Kildare county boundary. The bridge comprises a slightly humped stone structure with parallel parapets and vertical roughly hewn copes.
CH_14	692931 / 739788	Commons West	Racecourse	The site of Commons West racecourse depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) as a sub-circular circuit with some small buildings to the south. The form of the racecourse remains perceptible however, some modern development has occurred.
CH_15	687572 / 739143	Commons South	House	A small single storey vernacular building with a corrugated metal roof depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Located within an overgrown plot on the R407 and L5028, approximately 24m to the west of Option A (Red).

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_16	687151 / 738719	Courtown Great	Lodge	A single storey rendered lodge located adjacent to a lane leading to Courtown House. The lodge is depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913) and is positioned perpendicular to the R407, approximately 24m to the south-east of Option A (Red).
CH_17	686497 / 738292	Portgloriam	Agricultural building	An agricultural range depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Later mapping identified the building as 'The Mount' (Ordnance Survey 25", 1888 - 1913). The building is positioned at an angle to the R407, set away from the road (approximately 44m to the south-east of Option A (Red)), amongst other later agricultural buildings.
CH_24	687121 / 733948	Baltracey	Road Bridge	A road bridge depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) carries the R407 over the Baltracey River. The bridge comprises a squared rubble stone structure with parallel parapets with squared blocks as copes.
CH_37	685351 / 729626	Betaghstown	House	A house on Betaghstown Cross Roads, depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913) comprising a rendered two storey house, with single storey attached range and later additions. Located approximately 9m to the west of Option A (Red), a low rendered boundary wall runs along the R408 and L1023.
CH_39	685606 / 727306	Firmount West	Farm	A complex of buildings positioned on Firmount Cross Roads depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913). The buildings are arranged around a courtyard with later buildings and additions. The main house faces onto the R403, with the junction with the L2002 and a local road adjacent. Located approximately 27m to the west of Option A (Red).
CH_41	685720 / 727075	Firmount West	Field barn	A single storey rendered field barn with corrugated gable roof. Positioned perpendicular to the L2002, approximately 12m to the east of Option A (Red).
CH_42	685788 / 726882	Firmount West	Outbuilding	A single storey stone outbuilding, depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913), partially missing roof, approximately 19m to the north-east of Option A (Red).
CH_43	685934 / 726668	Firmount Demesne	House	A single storey roughcast house, depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913), approximately 16m to the south-west of Option A (Red). A low stone boundary wall, bounds the L2002.
CH_46	687359 / 725731	Millicent South	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913), as a 'Vicarage'. Likely associated with Millicent Church and Lych Gate (AH_12). The church tower is glimpsed from plot; however, otherwise the house is largely screened by established trees and vegetation. Located approximately 24m to the south-west of Option A (Red).
CH_51	688232 / 719268	Jigginstown	Aqueduct	'Aquaduct' identified on historic mapping (Ordnance Survey 6", 1837 – 1842). Forms part of the Grand Canal, approximately 22m to the north-east of Option A (Red).
CH_55	688073 / 716071	Killashee	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). The house comprises a six bay, one and a half storey rendered building, with gabled roof. Located approximately 13m to the east of Option A (Red).

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_56	687962 / 715565	Oldtown	Farm	A farm depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) in a courtyard plan with later ranges added to the west. The complex includes a two-storey farmhouse, with gabled roof and a series of single storey ranges and a stone roadside wall along the R448. Located approximately 25m to the west of Option A (Red).
CH_57	687884 / 714478	Mylerstown	House	A single storey cottage depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) with later additions. The cottage is positioned on the R448, overlooking the road, approximately 14m to the east of Option A (Red).
CH_58	687418 / 713423	Stephenstown South	House	A cottage depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) comprising a half-thatched cottage with a high-pitched roof. The building has been subject to later additions and modification. The house is located on the roadside, with views across the junction between the R412 and R448, approximately 20m to the west of Option A (Red).
CH_59	687356 / 713137	Stephenstown South	House	A two-storey 'L'-shaped house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Positioned on the R412, approximately 23m to the west of Option A (Red).

Previous Excavations

A review of Excavations Bulletin and TII's Archaeological Excavation Reports identified the following archaeological excavations in the Option A (Red) study area.

- Archaeological monitoring of road realignment works for the R407 (Licence number: 10E0445) in Portgloriam identified the foundation of a vernacular building depicted on the First Edition Ordnance Survey mapping (1840); however, the building had been removed by 1900;[28] and
- Archaeological monitoring and excavations in advance of proposed bridge redevelopment works at Kildare Bridge on the R157 in Maynooth (Licence number: 05E1090) identified the remains of a stone structure, possibly an outhouse or a coal-storage building, possibly dating to the 17th century.[29]

A further five archaeological excavations were also identified (under Licence numbers: 02E0148, 11E0309; 05E1334, 05E1334 ext., and 14E0452); however, these did not identify any archaeological remains or deposits of archaeological significance.

A total of four casual finds were also identified within the study area for Option A (Red), these comprise bronze pins and a fibula (1984: 5,6, and 1969:75) in Jigginstown and Naas West, as well as well as finds (1935:544-8 R.I.A.) associated with a cemetery of pit burials (KD019-017; a Recorded Monument) in Ploopluck, and a glazed medieval pot sheard (1979:13) in Jigginstown.

3.2 Option B (Green)

3.2.1 Archaeology

Archaeological constraints identified within the study area for Option B (Green) (see Annex A and Figure B.1.1 in Appendix B.1) comprise:

- Three Recorded Monuments; and
- Eight sites recoded on the SMR.

There are no National Monuments, sites with Preservation Orders placed on them, or sites on the RHM located within the study area for Option B (Green).

National Monuments & Preservation Orders

There are no National Monuments or sites with Preservation Orders placed on them located within the study area for Option B (Green). The nearest National Monument or site with a Preservation Order placed on it to Option B (Green) is Rathasker Castle and Enclosure (KD024-001001 and KD024-001002; both Preservation Orders), located approximately 350m to the south-east of Option B (Green).

Register of Historic Monuments

No sites on the RHM have been identified within the study area for Option B (Green). The nearest site on the RHM is a rath (ME050-005; also a Recorded Monument) in Lynaghstown, approximately 304m to the south-east of the option.

[28] http://excavations.ie/report/2010/Kildare/0021615/ [Accessed 05.11.21].
[29] http://excavations.ie/report/2005/Kildare/0013775/ [Accessed 05.11.21].

Recorded Monuments

Three Recorded Monuments are located within the study area for Option B (Green) (see Figure B.1.1 in Appendix B.1) comprising:

- The site of a medieval parish church (AY_04), located approximately 20m to the west of Option B (Green) in the townland of Rodanstown. The boundary of the site is defined by an earthen bank and stone wall enclosing an oval graveyard (AY_05; a site recorded on the SMR; see below). The memorials within the graveyard largely date from the mid-18th century and the upstanding remains of a church (AH_02; a Protected Structure; see below) are also probably of this date.
- A rath (AY_24) in Ballynagappagh, approximately 62m to the south-east of Option B (Green) (see Section 3.1.1 above).
- A mound (AY_26; also a Protected Structure) in Firmount East, approximately 33m to the north-east of Option B (Green) (see Section 3.1.1 above).

Sites on the Sites and Monuments Record

A total of eight sites recorded on the SMR have been identified within the study area for Option B (Green). These are the locations of cropmarks and evidence of post-medieval religious activity. Information on these constraints are presented in Table 3.4 and they are shown on Figure B.1.1 in Appendix B.1.

Three further sites on the SMR have not been included in Table 3.4. These comprise the site of a fulacht fia (AY_37) identified during the construction of the Millennium Park Western Link Road, the site of a midden (AY_41) identified at Jigginstown Castle complex, and a redundant record (AY_45). While AY_37 and AY_41 provide an indication of possible activity in these locations, given these sites have been removed and, in the case of AY_37, the area developed, they are no longer constraints.

Table 3.4: Sites recorded on the SMR within the study area for Option B (Green)

Reference Number	SMR Reference	Description	Townland	Location (Easting / Northing)
AY_05	ME049-021001	An oval graveyard defined by an earth bank and stone wall, immediately adjacent to the road. The graveyard encircles the site of a medieval parish church; the memorials within the graveyard largely date from the mid-18th century and the ruinous church is also probably of this date.	Rodanstown	690573 / 741320
AY_06	ME049-021002	The location of an octagonal font, since removed.	Rodanstown	690580 / 741315
AY_10	KD005-036	A large circular cropmark, measuring approximately 44m in diameter in Laraghbryan East, approximately 50m to the south and 74m west of Option B (Green), interpreted as an enclosure.	Laraghbryan East	692023 / 737926
AY_27	KD014-054	The present location of a font (see Table 3.1 in Section 3.1.1 above).	Millicent Demesne	687361 / 725841
AY_36	KD019-081	A cropmark, interpreted as a ring ditch, approximately 80m to the west of Option B (Green) (see Table 3.1 in Section 3.1.1 above).	Osberstown	687886 / 722860
AY_46	KD024-050004		Dunstown	687302 / 712740

Reference Number	SMR Reference	Description	Townland	Location (Easting / Northing)
AY_47	KD024-050005	A group of small rectangular cropmarks, interpreted as enclosures, within approximately 6m of Option B (Green) (see Table 3.1 in Section 3.1.1 above).	Dunstown	687328 / 712725
AY_48	KD024-050006		Dunstown	687335 / 712719

Archaeological Potential

Option B (Green) crosses the River Lyreen and River Liffey, as well as a number of minor watercourses. The underlying geology is largely limestone, with superficial deposits of till and gravel, as well as alluvium which has the potential to preserve previously unknown archaeological monuments and remains. There is also the potential for votive (religious) offerings in rivers and bogs. Areas of outcropping bedrock (visible exposures of solid rock) have also been noted along the route of Option B (Green) and the potential for previously unknown archaeological monuments and remains in these areas would be limited.

3.2.2 Architectural Heritage

Architectural heritage constraints within the study area for Option B (Green) comprise:

- Six Protected Structures (see Figure B.1.2 in Appendix B.1); and
- Eight GDLs (see Figure B.1.3 in Appendix B.1).

No ACAs have been identified within the study area for Option B (Green).

Record of Protected Structures

Six Protected Structures have been identified within the study area for Option B (Green). These comprise post-medieval churches and houses. Protected Structures identified within the study area for Option B (Green) are shown on Figure B.1.2 (Appendix B.1).

A ruinous church (AH_02), set within the graveyard (AY_05; see above) in Rodanstown, is located approximately 10m to the west of Option B (Green). On the site of a medieval parish church (AY_04), the roofless structure comprises a single storey, rectangular stone church with a large apse and blocked arched windows. A church is depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842) as a rectangular building, orientated north-west to south-east; however, later mapping (Ordnance Survey 25”, 1888 - 1913) shows the curved apse, as well as the east-west orientation, of the current structure. The church is located in an elevated position, overlooking the bend in the road, surrounded by a number of memorials within the graveyard and enclosed by a low rough-cast roadside wall. Views to the south and west are limited by a mature belt of trees.

Donaghstown Catholic Church (AH_04) and Catholic Church of the Sacred Heart (AH_05) are Protected Structures which also have been assessed by the NIAH to be of Regional importance. Built in a modest Gothic-style, both churches are on historic mapping (Ordnance Survey 25”, 1888 - 1913), labelled ‘R.C. Church’; however, only a church in Rathcoffey North is depicted on earlier mapping (Ordnance Survey 6”, 1837 – 1842) as a ‘chapel’. Donaghstown Catholic Church is located on a wedge of land on the junction between the R408 and L5037 and is bounded by a low coursed rubblestone wall, and landscaped grounds. The Catholic Church of the Sacred Heart is set back from the R408 within its associated grounds, with views outward limited by established trees and vegetation.

Ballynagappagh (AH_11), Millicent Church and Lych Gate (AH_12), and 'Millicent Estate Houses' (AH_15) - Millicent Demesne lodge are Protected Structures which are located within the study area for Option B (Green) and also located within the study area for Option A (Red). These Protected Structures are described in Section 3.1.2.

Architectural Conservation Areas

There are no ACAs located within the study area for Option B (Green). The nearest ACA to the option is Maynooth ACA, located approximately 1.2km to the east of Option B (Green).

National Inventory of Architectural Heritage

Three structures included on the NIAH have been identified within the study area for Option B (Green). These comprise two post-medieval churches (AH_04 and AH_05) and a thatched house (AH_11). These buildings are also Protected Structures and, to avoid double counting constraints, have been included above under Protected Structures.

Survey of Gardens and Designed Landscapes

Eight GDLs have identified within the study area for Option B (Green). Of these seven were recorded by the Survey of Historic Gardens and Designed Landscapes and one has been identified from historic mapping (Ordnance Survey 6", 1837 – 1842). Information on these GDLs is summarised in Table 3.5 and are shown on Figure B.1.3 (Appendix B.1).

Table 3.5: GDLs identified within the study area for Option B (Green)

Reference Number	Name	Description	Townland	NIAH Reference
DL_02	Jenkinstown House	Demesne identified from historic mapping (Ordnance Survey 6", 1837 – 1842). The principal house remains extant (CH_02), and the demesne includes a roughcast boundary wall, gate piers, and driveway leading to the house. Mature trees and a ditch mark the boundary along the R156.	Jenkinstown	N/A
DL_05	Rodanstown House	Demesne associated with Rodanstown House. The boundaries of the demesne reflect those depicted on historic mapping (Ordnance Survey 6", 1837 – 1842); however, some estate features, including areas of woodland and boundary trees have been removed. Some development, including modern agricultural ranges, has taken place within the boundary. Roadside boundary features include roughcast and brick walls and low hedges.	Rodanstown	N/A
DL_11	Rathcoffey House	Garden and designed landscape to Rathcoffey House. While the principal building is ruinous, the boundary of the site is still perceptible. However, the area is largely agricultural, and fields have been consolidated. Historic divisions (such as the garden boundary) remain perceptible as cropmarks on aerial imagery. The drive off School Road remains on the same alignment.	Rathcoffey Demesne	NIAH 1894
DL_14	Firmount House	The GDL to Firmount House, includes the principal building and other estate features such as the walled garden, parkland and some estate trees. The walled garden bounds the L2002 and includes a small pedestrian doorway directly onto the carriageway. All entrances appear to have been modernised and the L2002 is largely bounded by modern post and rail fence, ditch and tree line.	Firmount Demesne	NIAH 1882
DL_15	Moatfield House	The GDL to Moatfield House, includes principal building (RPS B14-18), agricultural range, and a wide tree-lined avenue. A ditch and established hedgerow bound the L2002; however, modern entrances and boundary features, including post and rail fencing, are also present. The entrance to the demesne is recessed with rubble stone walls and a set of simple square gate piers.	Firmount East	NIAH 1883
DL_17	Millicent House	The GDL to Millicent House. The extensive riverside demesne lands surrounding the principal house (RPS B14-26) include extant estate features such as lodges (including AH_15), a walled garden, drives, and areas of woodland and parkland depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913). Sections of rubble stone wall delimit the demesne and line the road from the entrance to Millicent Bridge.	Millicent Demesne	NIAH 1889
DL_19	Osberstown Hill	The GDL to Osberstown Hill house. The principal building remains extant; however, the Dublin-Cork (and others) railway line has replaced the northern boundary and the Sallins Bypass has removed a section of the eastern corner.	Osberstown	NIAH 1887
DL_20	Killashee House	The GDL to Killashee House. Largely developed include Killashee National School, and the majority of demesne features have been removed. The R448 is located within the western boundary of the demesne. Extant boundary features include established hedgerows and a ditch, and modern post and rail fencing. A section of roughly coursed rubble stone wall is extant to the south of the demesne, along with a later recessed entrance.	Killashee	NIAH 1980

3.2.3 Cultural Heritage

A total of 27 cultural heritage sites have been identified within the study area for Option B (Green) from the sources identified in Section 2. These largely comprise post-medieval built heritage including houses and farm buildings. Summary information on these cultural heritage sites is presented in Table 3.6 below and are shown on Figure B.1.4 (Appendix B.1).

Table 3.6: Cultural heritage sites identified within the study area for Option B (Green)

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_01	694713 / 746280	Culcommon	Road Bridge	The stone parapet of a road bridge or culvert depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 2m to the east of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_02	691765 / 745557	Warrenstown	House	'Jenkinstown House' depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) comprising the main house and a long range to north, approximately 65m to the north-west of Option B (Green) (See Table 3.3 in Section 3.1.3 above).
CH_03	693262 / 745438	Jenkinstown	Public House	A public house depicted on historic mapping (Ordnance Survey 25", 1888-1913) immediately adjacent to the R156, approximately14m to the south-east of Option B (Green) (See Table 3.3 in Section 3.1.3 above).
CH_04	691671 / 745333	Jenkinstown	Road Bridge	A stone road bridge that carries the R156 across a small watercourse - depicted on historic mapping as 'Jenkinstown Bridge' (Ordnance Survey 6", 1837 – 1842) (see Table 3.3 in Section 3.1.3 above).
CH_08	690331 / 742110	Rodanstown	Mill Dam	'Old Mill Dam' depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), north of Rodanstown House. Located within two undeveloped agricultural fields adjacent to the road, no features associated with the mill were visible on aerial imagery.
CH_09	690365 / 741843	Dolanstown	Lodge	A small single storey lodge building depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913), and associated with Bridestream House. Located within an overgrown plot adjacent to entrance to the demesne (DL_07) with a farm entrance to south. Located approximately 21m to the west of Option B (Green).
CH_18	692330 / 737877	Laraghbryan East	Earthworks	Linear banks and ditches in a field to the north of Kilcock Road, immediately to the east of Option B (Green), identified from historic aerial photographs.[30] Possibly associated with AY_10 (a large circular enclosure), or a nearby ecclesiastical site (KD005-021).
CH_19	691947 / 737649	Laraghbryan East	Bridge	The site of a possible bridge or crossing point over the River Lyreen, approximately 88m to the west of Option B (Green), depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). No corresponding features are visible on modern aerial imagery.

[30] https://www.cambridgeairphotos.com/location/ape008/ [Accessed 07.11.21].

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_21	691258 / 736597	Crinstown	Farm	A farm complex depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), only the farmhouse remains extant. The house comprises a three bay, two storey structure with gable stacks, approximately 19m to the west of Option B (Green).
CH_26	689693 / 733526	Graiguesallagh	Farm	A farm complex depicted on historic mapping (Ordnance Survey 6", 1837 – 1842); however, the current layout reflects the layout depicted on later mapping (Ordnance Survey 25", 1888 - 1913). The complex includes a square plan house with long L'-shaped range to south-south-west. A boundary wall of similar stone is located adjacent to the R408, approximately 23m to the west of Option B (Green).
CH_28	689117 / 732739	Rathcoffey North	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), with a later house located immediately to the south (Ordnance Survey 25", 1888 - 1913). Positioned adjacent to the R408 and L5046, approximately 23m to the east of Option B (Green).
CH_30	688156 / 732339	Rathcoffey North	House	A roadside building, immediately overlooking R408, depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) with two perpendicular ranges; however, these have since been demolished and the area redeveloped. The house comprises a four bay, two storey stone house with a surrounding boundary wall of similar material.
CH_31	688190 / 732277	Rathcoffey South	House	A five bay, two storey house with hipped roof and central stack depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Located off the L50351, approximately 50m to the south-east of Option B (Green).
CH_37	685351 / 729626	Betaghstown	House	A house on Betaghstown Cross Roads, depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913), approximately 9m to the west of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_39	685606 / 727306	Firmount West	Farm	A complex of buildings positioned on Firmount Cross Roads depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913), located approximately 27m to the west of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_41	685720 / 727075	Firmount West	Field barn	A single storey rendered field barn with corrugated gable roof approximately 12m to the east of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_42	685788 / 726882	Firmount West	Outbuilding	A single storey stone outbuilding, depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913), approximately 19m to the north-east of Option B (Green) (see Table 3.3 in Section 3.1.3 above).

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_43	685934 / 726668	Firmount Demesne	House	A house, depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842; Ordnance Survey 25”, 1888 - 1913), approximately 16m to the south-west of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_46	687359 / 725731	Millicent South	House	A house depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842; Ordnance Survey 25”, 1888 - 1913), as a 'Vicarage', approximately 24m to the south-west of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_52	687422 / 718375	Jigginstown	Field boundaries	Cropmarks comprising two, roughly parallel linear features, a smaller rectangular feature, and possible cultivation marks identified from aerial imagery. The linear features correspond to a field boundary depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842), but not later mapping (Ordnance Survey 25”, 1888 - 1913). The field to the north includes a north-south linear and a circular feature north of the existing field boundary - no corresponding features on historic mapping.
CH_53	687650 / 718026	Jigginstown	Field boundaries	A linear cropmark interpreted as a former field boundary identified from aerial imagery. Corresponds with a field boundary depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842). Perpendicular linear features were also identified and interpreted as possible cultivation marks. Located approximately 40m to the east of Option B (Green).
CH_54	688148 / 717337	Rathasker	House	A small house depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842), located on Rathasker Road approximately 43m to the south of Option B (Green).
CH_55	688073 / 716071	Killashee	House	A house depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842), approximately 13m to the east of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_56	687962 / 715565	Oldtown	Farm	A farm depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842), approximately 25m to the west of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_57	687884 / 714478	Mylerstown	House	A single storey cottage depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842), approximately 14m to the east of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_58	687418 / 713423	Stephenstown South	House	A cottage depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842) located on the roadside, approximately 20m to the west of Option B (Green) (see Table 3.3 in Section 3.1.3 above).

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_59	687356 / 713137	Stephenstown South	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 23m to the west of Option B (Green) (see Table 3.3 in Section 3.1.3 above).

Previous Excavations

A review of Excavations Bulletin and TII's Archaeological Excavation Reports identified the following archaeological excavations in the Option B (Green) study area.

- Archaeological monitoring in Rathcoffey North (Licence number: 03E1005) for the ground works for a mobile phone mast identified a large quantity of medieval pottery and a metalled surface, along with a pit, gully, and slag;[31]
- Archaeological monitoring and excavations in advance of proposed bridge redevelopment works at Kildare Bridge on the R157 in Maynooth (Licence number: 05E1090) identified the remains of a stone structure, possibly an outhouse or a coal-storage building, were identified possibly dating to the 17th century;[32]
- Archaeological testing for a business park in Jigginstown (Licence number: 02E0672) identified a single flint flake;[33] and
- Archaeological excavations undertaken as part of investigations at Jigginstown Castle (Licence number: 02E1603) identified evidence of post-medieval construction debris and material.[34]

A further five archaeological excavations were also identified (under Licence numbers: 11E0309, 09E0148, 02E1751, 04E0073, and 04E1338); however, these did not identify any archaeological remains or deposits of archaeological significance.

A total of two casual finds were also identified within the study area for Option B (Green), these comprise finds (1935:544-8 R.I.A.) associated with a cemetery of pit burials (KD019-017; Recorded Monument) in Ploopluck, and 'various archaeological finds' (E 412:1) in Crinstown.

3.3 Option C (Orange)

3.3.1 Archaeology

Archaeological constraints identified within the study area for Option C (Orange) (see Annex A and Figure B.1.1 in Appendix B.1) comprise:

- Three Recorded Monuments; and
- 15 sites recorded on the SMR.

There are no National Monuments, sites with Preservation Orders placed on them, or sites on the RHM located within the study area for Option C (Orange).

National Monuments & Preservation Orders

There are no National Monuments or sites with Preservation Orders placed on them located within the study area for Option C (Orange). The nearest National Monument or site with a Preservation Order placed on it to the option is Rathasker Castle and Enclosure (KD024-001001 and KD024-001002; both Preservation Orders), located approximately 350m to the south-east of Option C (Orange).

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[31] http://excavations.ie/report/2003/Kildare/0010019/ [Accessed 05.11.21].
[32] http://excavations.ie/report/2005/Kildare/0013775/ [Accessed 05.11.21].
[33] https://excavations.ie/report/2002/Kildare/0008229/ [Accessed 05.11.21].
[34] https://excavations.ie/report/2002/Kildare/0008231/ [Accessed 05.11.21].

Register of Historic Monuments

No sites on the RHM have been identified within the study area for Option C (Orange). The nearest site on the RHM is a rath (ME050-005; also a Recorded Monument) in Lynaghstown, over 300m to the south-east of the route option.

Recorded Monuments

Three Recorded Monuments are located within the study area for Option C (Orange) (see Figure B.1.1 in Appendix B.1). These comprise the site of a medieval parish church (AY_04) which has already been described in Section 3.2.1 above, and two enclosures identified from aerial photographs (AY_14 and AY_17). The enclosure in Donaghstown (AY_14) comprises a long, narrow, sub-rectangular feature, approximately 80m to the east of Option C (Orange). The large enclosure in Roosk (AY_17), measuring approximately 120m in diameter, comprises an ephemeral fosse located approximately 98m to the east of Option C (Orange).

Sites on the Sites and Monuments Record

A total of 15 sites recorded on the SMR have been identified within the study area for Option C (Orange). These comprise the locations of cropmarks and evidence of medieval and post-medieval religious activity. These are included in Table 3.7Table and are shown on Figure B.1.1 (Appendix B.1).

Two further sites on the SMR have not been included in Table 3.7. These comprise the site of a fulacht fia (AY_37) identified during the construction of the Millennium Park Western Link Road and a redundant record (AY_45). While the former provides an indication of possible prehistoric activity in this location, given this site has been removed and the area developed it is no longer a constraint.

Table 3.7: Sites recorded on the SMR within the study area for Option C (Orange)

Reference Number	SMR Reference	Description	Townland	Location (Easting / Northing)
AY_05	ME049-021001	An oval graveyard defined by an earth bank and stone wall, immediately adjacent to the road (see Table 3.4 in Section 3.2.1 above).	Rodanstown	690573 / 741320
AY_06	ME049-021002	The location of an octagonal font, since removed (see Table 3.4 in Section 3.2.1 above).	Rodanstown	690580 / 741315
AY_10	KD005-036	A large circular cropmark interpreted as an enclosure, approximately 50m to the south and 74m west of Option C (Orange) (see Table 3.4 in Section 3.2.1 above).	Laraghbryan East	692023 / 737926
AY_25	KD014-059	A cropmark of a curvilinear enclosure, measuring approximately 58m in diameter, approximately 56m to the south-east of Option C (Orange).	Ladycastle Upper	690311 / 727931
AY_29	KD014-041003	The location of a 13th century stone baptismal font.	Bodenstown	689044 / 724810
AY_30	KD014-041001	A ruinous medieval church comprising a rectangular structure with three extant walls of roughly dressed, uncoursed limestone. Historic mapping identified the church 'in ruins' (Ordnance Survey 25", 1888 - 1913). The church is located within its associated enclosed graveyard (AY_31), approximately 26m to the south of Option C (Orange). The monuments surrounding the church date to the post-medieval period.	Bodenstown	689044 / 724808

Reference Number	SMR Reference	Description	Townland	Location (Easting / Northing)
AY_31	KD014-041002	A square enclosed graveyard located to the south of the L2010 in Bodenstown. The associated church (AY_30) retains 14th century building material; however, the monuments within the graveyard date to the post-medieval period and include a memorial to Wolfe Tone (1763 – 1798), a leader of the 1798 rebellion.	Bodenstown	689044 / 724781
AY_32	KD014-062	A cluster of possible barrows (AY_32, AY_33, and AY_34, approximately 55m to the north, 40m to the south, and 94m to the south of Option C (Orange), respectively) identified from aerial imagery comprising circular cropmarks between approximately 7m and 12m in diameter.	Castlesize	688409 / 724218
AY_33	KD014-073		Castlesize	688644 / 724200
AY_34	KD014-076		Castlesize	688590 / 724128
AY_35	KD014-074	A cropmark identified from aerial imagery and interpreted as a large circular enclosure, measuring approximately 90m in diameter. Located approximately 40m to the south-east of Option C (Orange), close to a group of barrows (AY_32 – 34).	Castlesize	688419 / 724116
AY_36	KD019-081	A cropmark, interpreted as a ring ditch, approximately 80m to the west of Option C (Orange) (see Table 3.1 in Section 3.1.1 above).	Osberstown	687886 / 722860
AY_46	KD024-050004	A group of small rectangular cropmarks, interpreted as enclosures, within approximately 6m of Option C (Orange) (see Table 3.1 in Section 3.1.1 above).	Dunstown	687302 / 712740
AY_47	KD024-050005		Dunstown	687328 / 712725
AY_48	KD024-050006		Dunstown	687335 / 712719

<u>Archaeological Potential</u>

Option C (Orange) crosses the Rye Water, River Lyreen and the River Liffey (twice), as well as a number of minor watercourses. The underlying geology is largely limestone, with superficial deposits of till, gravel and alluvium, as well as lacustrine sediments in Donaghstown. Alluvium and lacustrine deposits have the potential to preserve previously unknown archaeological monuments and remains, including organic and palaeoenvironmental remains, and there is also the potential for votive (religious) offerings in rivers and bogs. Outcropping bedrock (visible exposures of solid rock) has also been noted along the route of Option C (Orange) and the potential for previously unknown archaeological monuments and remains in these areas would be limited.

3.3.2 Architectural Heritage

Architectural heritage constraints within the study area for Option C (Orange) comprise:

- Four Protected Structures (see Figure B.1.2 in Appendix B.1); and
- Eight GDLs (see Figure B.1.3 in Appendix B.1).

No ACAs or structures included on the NIAH have been identified within the study area for Option C (Orange).

Record of Protected Structures

Four Protected Structures have been identified within the study area for Option C (Orange), comprising post-medieval churches and estate buildings. Protected Structures identified within the study area for Option C (Orange) are shown on Figure B.1.2 (Appendix B.1).

Irishtown House (AH_10) is located within its associated demesne lands (DL_12) and comprises a double pile structure with two additional gable bays extending to the east and west, as depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). The house is set within a private garden, overlooking the River Liffey, with a trackway and working farm to the east. Views to the south are across the garden towards the river, and north over pasture fields.

A ruined medieval church (AH_13) within its associated enclosed square graveyard (AY_31) is located approximately 26m to the south of Option C (Orange), south of the L2010 in Bodenstown. The church retains original 14th century building material comprising the western gable and sections of rubble stone wall, and a font (AY_29) of possible 13th century date was also recovered from the structure. However, the monuments surrounding the church date to the post-medieval period and include a memorial to Wolfe Tone (1763 – 1798), a leader of the 1798 rising.

The Gate Lodge and entrance gates/walls to east of Castlesize House (AY_14) is located approximately 28m to the north-west of Option C (Orange). Castlesize House (RPS B14-13) itself is located approximately 188m to the west of Option C (Orange). The lodge is located to the north of the driveway to the main house at the eastern entrance to the Castlesize GDL (DL_18) and is depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913). The lodge is set behind a high stone boundary wall, surrounded by mature trees and established vegetation.

In addition, the ruinous post-medieval church (AH_02) in Rodanstown, located approximately 16m to the south-east of Option C (Orange), is also located within the study area for Option B (Green) (see Section 3.2.2 above).

Architectural Conservation Areas

There are no ACAs located within the study area for Option C (Orange). The nearest ACA to the route option is Maynooth ACA, located approximately 1.2km to the east of Option C (Orange).

National Inventory of Architectural Heritage

There are no structures included on the NIAH located within the study area for Option C (Orange). The nearest structure included on the NIAH to the route option is Limerick Bridge (NIAH 11901903), assessed by the NIAH to be of Regional importance, located approximately 170m to the north-east of Option C (Orange).

Survey of Gardens and Designed Landscapes

A total of eight GDLs have been identified within the study area for Option C (Orange). Of these five have been identified from the Survey of Historic Gardens and Designed Landscapes and three have been identified from historic mapping (Ordnance Survey 6", 1837 – 1842). Information on these eight GDLs is presented in Table 3.8 and are shown on Figure B.1.3 (Appendix B.1).

Table 3.8: GDLs identified within the study area for Option C (Orange)

Reference Number	Name	Description	Townland	NIAH Reference
DL_02	Jenkinstown House	Demesne identified from historic mapping (Ordnance Survey 6", 1837 – 1842). The principal house remains extant (CH_02), and the demesne includes a roughcast boundary wall, gate piers, and driveway leading to the house. Mature trees and a ditch mark the boundary along the R156.	Jenkinstown	N/A
DL_05	Rodanstown House	Demesne associated with Rodanstown House. The boundaries of the demesne reflect those depicted on historic mapping (Ordnance Survey 6", 1837 – 1842); however, some estate features, including areas of woodland and boundary trees have been removed. Some development, including modern agricultural ranges, has taken place within the boundary. Roadside boundary features include roughcast and brick walls and low hedges.	Rodanstown	N/A
DL_12	Irishtown House	A large portion of this demesne has been redeveloped as a golf course. The principal building (AH_10) remains extant, as well as a pigeon house depicted on historic mapping (Ordnance Survey 25", 1888 - 1913) to the west.	Ladycastle Lower; Irishtown Lower	NIAH 1900
DL_13	Ladycastle	Demesne lands south of the River Liffey. Depicted as large areas of open parkland, a large portion of this demesne has been redeveloped as a golf course.	Ladycastle Upper	N/A
DL_16	Blackhall	The GDL associated with Blackhall. The principal building and agricultural ranges remain extant, along with the layout of the gardens and woodland, including a belt of trees along boundary with the R407.	Blackhall	NIAH 1890
DL_18	Castlesize	The GDL associated with Castlesize which largely retains the buildings and layout as depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). The entrance opposite the junction between the R407 and Castlesize Green includes entrance walls, gate piers, and cast-iron gates. The boundary along the R407 comprises a rubblestone wall with alternate vertical and horizontal copes.	Castlesize	NIAH 1893
DL_19	Osberstown Hill	The GDL to Osberstown Hill house. The principal building remains extant; however, the Dublin-Cork (and others) railway line has replaced the northern boundary and the Sallins Bypass has removed a section of the eastern corner.	Osberstown	NIAH 1887
DL_20	Killashee House	The GDL to Killashee House. Largely developed include Killashee National School, and the majority of demesne features have been removed. The R448 is located within the western boundary of the demesne. Extant boundary features include established hedgerows and a ditch, and modern post and rail fencing. A section of roughly coursed rubble stone wall is extant to the south of the demesne, along with a later recessed entrance.	Killashee	NIAH 1980

3.3.3 Cultural Heritage

A total of 27 cultural heritage sites identified within the study area for Option C (Orange) from the sources identified in Section 2. These largely comprise extant post-medieval buildings and structures, including road bridges, houses and farm buildings. Summary information on these cultural heritage sites is presented in Table 3.9 below and are shown on Figure B.1.4 (Appendix B.1).

Table 3.9: Cultural heritage sites identified within the study area for Option C (Orange)

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_01	694713 / 746280	Culcommon	Road Bridge	The stone parapet of a road bridge or culvert depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 2m to the east of Option C (Orange) (see Table 3.3 in Section 3.1.3 above).
CH_02	691765 / 745557	Warrenstown	House	'Jenkinstown House' depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) comprising the main house and a long range to north, approximately 65m to the north-west of Option C (Orange) (See Table 3.3 in Section 3.1.3 above).
CH_03	693262 / 745438	Jenkinstown	Public House	A public house depicted on historic mapping (Ordnance Survey 25", 1888-1913) immediately adjacent to the R156, approximately14m to the south-east of Option C (Orange) (See Table 3.3 in Section 3.1.3 above).
CH_04	691671 / 745333	Jenkinstown	Road Bridge	A stone road bridge that carries the R156 across a small watercourse - depicted on historic mapping as 'Jenkinstown Bridge' (Ordnance Survey 6", 1837 – 1842) (see Table 3.3 in Section 3.1.3 above).
CH_08	690331 / 742110	Rodanstown	Mill Dam	The site of 'Old Mill Dam' depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), no features associated with the mill were visible on aerial imagery (see Table 3.6 in Section 3.2.3 above).
CH_09	690365 / 741843	Dolanstown	Lodge	A lodge depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888-1913), located approximately 21m to the west of Option C (Orange) (see Table 3.6 in Section 3.2.3 above).
CH_18	692330 / 737877	Laraghbryan East	Earthworks	Linear banks and ditches in a field to the north of Kilcock Road, identified from historic aerial photographs (see Table 3.6 in Section 3.2.3 above).
CH_19	691947 / 737649	Laraghbryan East	Bridge	The site of a possible bridge or crossing point over the River Lyreen, approximately 88m to the west of Option C (Orange), depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) (see Table 3.6 in Section 3.2.3 above).
CH_21	691258 / 736597	Crinstown	Farm	A farm complex depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), only the farmhouse remains extant, approximately 19m to the west of Option C (Orange) (see Table 3.6 in Section 3.2.3 above).

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_22	691777 / 734898	Donaghstown	Bridge	A possible bridge or historic crossing over an unnamed watercourse depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 25m to the west of Option C (Orange).
CH_23	691783 / 734648	Donaghstown	Building	A small rectangular building depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) adjacent to the L5037, approximately 25m to the east of Option C (Orange). The plot is now densely wooded.
CH_25	691356 / 733724	Bryanstown	Enclosure	A series of cropmarks in an agricultural field identified from aerial imagery. Features include a small possible rectilinear enclosure near the eastern field boundary and two possible pits. No corresponding features were identified on historic mapping. Located immediately to the west of Option C (Orange).
CH_27	690854 / 733168	Smithstown	Building	Farm buildings depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Two ranges remain extant, incorporated into other buildings, with later buildings forming part of the complex. Set back from a local road, approximately 61m to the south of Option C (Orange).
CH_32	690510 / 731928	Johninstown	Building	A small rectangular building, possible agricultural, depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) adjacent to the L5046, approximately 21m to the south of Option C (Orange).
CH_44	689320 / 726235	Littlerath	Water feature	A sub-circular water feature with an associated small square building depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Later mapping (Ordnance Survey 25", 1888-1913) identified the areas as a disused quarry. While the building appears to have been removed, the body water remains extant. Located immediately to the west of the L6003.
CH_47	689213 / 725435	Ladyhill	House	Two ranges depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) which appear to have been incorporated into later house. Set back from the L6003, approximately 60m to the east of Option C (Orange).
CH_48	688707 / 724866	Blackhall	Farm	A farm complex depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Located adjacent to the R407, approximately 11m to the east of Option C (Orange).
CH_49	689127 / 724824	Bodenstown	House	A small square roadside (L2010) building with 'L'-shaped range attached another range further south depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Identified as 'Bodenstown Cottage' on later mapping (Ordnance Survey 25", 1888-1913)

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
				comprising a large building with two smaller rectangular ranges to the west. Located approximately 16m to the south of Option C (Orange).
CH_50	688567 / 724291	Johninstown	Watch Tower	A watch tower depicted on historic mapping and identified as 'in ruins' (Ordnance Survey 25", 1888 - 1913). Located in agricultural fields approximately 70m to the north of Option C (Orange).
CH_52	687422 / 718375	Jigginstown	Field boundaries	Cropmarks corresponding with a field boundary depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) and cultivation marks (see Table 3.6 in Section 3.2.3 above).
CH_53	687650 / 718026	Jigginstown	Field boundaries	A cropmark corresponding with a field boundary depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) and cultivation marks, approximately 40m to the east of Option C (Orange) (see Table 3.6 in Section 3.2.3 above).
CH_54	688148 / 717337	Rathasker	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) (see Table 3.6 in Section 3.2.3 above).
CH_55	688073 / 716071	Killashee	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 13m to the east of Option C (Orange) (see Table 3.3 in Section 3.1.3 above).
CH_56	687962 / 715565	Oldtown	Farm	A farm depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 25m to the west of Option C (Orange) (see Table 3.3 in Section 3.1.3 above).
CH_57	687884 / 714478	Mylerstown	House	A single storey cottage depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 14m to the east of Option B (Green) (see Table 3.3 in Section 3.1.3 above).
CH_58	687418 / 713423	Stephenstown South	House	A cottage depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) located on the roadside, approximately 20m to the west of Option C (Orange) (see Table 3.3 in Section 3.1.3 above).
CH_59	687356 / 713137	Stephenstown South	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 23m to the west of Option C (Orange) (see Table 3.3 in Section 3.1.3 above).

Previous Excavations

A review of Excavations Bulletin and TII's Archaeological Excavation Reports identified the following archaeological excavations in the Option C (Orange) study area.

- Archaeological investigations in advance of the development of a golf course in Ladycastle Lower identified medieval deposits including structures, metalled surfaces, a substantial ditch, and a medieval lime kiln (Licence numbers: 02E1782[35], 02E1513[36], 03E0043[37], and 02E1781[38]);
- Archaeological testing undertaken in advance of the M7 motorway (Licence number: E004777) in Osberstown, Castlesize, Sallins, Waterstown, Barrettstown, and Bodenstown identified a number of sites of archaeological potential which were subsequently excavated;[39]
- Archaeological excavations undertaken as part of investigations at Jigginstown Castle (Licence number: 02E1603) identified evidence of post-medieval construction debris and material;[40] and
- Archaeological testing for a business park in Jigginstown (Licence number: 02E0672) identified a single flint flake.[41]

A further six archaeological excavations were also identified (under Licence numbers: 99E0027, 02E1654, 04E0073, 02E1751, 03E0555, and 04E1338); however, these did not identify any archaeological remains or deposits of archaeological significance.

A total of two casual finds were also identified within the study area for Option C (Orange), and these comprise finds (1935:544-8 R.I.A.) associated with a cemetery of pit burials (KD019-017; Recorded Monument) in Ploopluck, and 'various archaeological finds' (E 412:1) in Crinstown.

3.4 Option D (Blue)

3.4.1 Archaeology

Archaeological constraints identified within the study area for Option D (Blue) (see Annex A and Figure B.1.1 in Appendix B.1) comprise:

- One National Monument and three sites with Preservation Orders placed on them;
- Three Recorded Monuments; and
- 18 sites recorded on the SMR.

National Monuments & Preservation Orders

There is one National Monument (AY_39; also a Protected Structure, AH_16) and three sites with Preservation Orders placed on them (AY_40, AY_42, and AY_43) located approximately 40m to the west of Option D (Blue) (see Figure B.1.1 in Appendix B.1). These, along with two further sites with Preservation Orders placed on them (AY_38 and AY_44; also a Protected Structure, AH_17), form the Jigginstown Castle complex (see Section 3.1.1 above).

[35] https://excavations.ie/report/2003/Kildare/0009985/ [Accessed 05.11.21].
[36] https://excavations.ie/report/2002/Kildare/0008267/ [Accessed 05.11.21].
[37] https://excavations.ie/report/2003/Kildare/0009986/ [Accessed 05.11.21].
[38] https://excavations.ie/report/2003/Kildare/0009984/ [Accessed 05.11.21].
[39] https://excavations.ie/report/2017/Kildare/0026981/ [Accessed 05.11.21].
[40] https://excavations.ie/report/2002/Kildare/0008231/ [Accessed 05.11.21].
[41] https://excavations.ie/report/2002/Kildare/0008229/ [Accessed 05.11.21].

Register of Historic Monuments

Five sites on the RHM have been identified (AY_38, AY_39, AY_42, AY_43, and AY_44) along the route of Option D (Blue), these form part of the Jigginstown Castle complex and, to avoid double counting constraints, have been included above under their more significant designations (see above).

Recorded Monuments

Three Recorded Monuments are located within the study area for Option D (Blue) (see Figure B.1.1 in Appendix B.1). These comprise:

- The site of a medieval parish church (AY_09), located approximately 46m to the south of Option D (Blue), in the townland of Moyglare. The church, surrounded by an enclosed graveyard (AY_08), continued in use until the 1870s when it was replaced with the current Gothic-style Saint Paul's Church of Ireland Church (AH_03; see Section 3.4.2 below). No evidence of the medieval church is visible.
- Archaeological investigations in advance of construction of the M4 motorway in Crinstown identified a site of medieval domestic activity (AY_11). The site included a cobbled area and two large ditches, with pottery sherds dating from the 13th to the 16th centuries.[42] While this site provides evidence of medieval activity in this location, given this site has been removed and the area developed it is no longer a constraint.
- The site of a castle (AY_28) of unknown date in Castlesize, approximately 76m to the west of Option D (Blue). While the site of that castle is depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), no trace of the castle remains extant.

Sites on the Sites and Monuments Record

A total of 18 sites recorded on the SMR have been identified within the study area for Option D (Blue). These comprise the locations of cropmarks and evidence of medieval religious and domestic activity. These are included in Table 3.10Table and are shown on Figure B.1.1 (Appendix B.1).

A further two sites on the SMR have not been included in Table 3.10 as these comprise the site of a midden (AY_41) identified at Jigginstown Castle complex, and a redundant record (AY_45). While AY_41 provides an indication of possible activity in this location, given this site has been removed it is no longer a constraint.

Table 3.10: Sites recorded on the SMR within the study area for Option D (Blue)

Reference Number	SMR Reference	Description	Townland	Location (Easting / Northing)
AY_08	ME049A002001	A sub-rectangular graveyard surrounding the site of a medieval parish church (AY_09). The graveyard is depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) and is defined by a low rubblestone wall. Saint Paul's Church of Ireland Church (AH_03; see Section 3.4.2 below) is located within the graveyard.	Moyglare	692690 / 739763
AY_10	KD005-036	A large circular cropmark interpreted as an enclosure (see Table 3.4 in Section 3.2.1 above).	Laraghbryan East	692023 / 737926
AY_15	KD010-066	A pair of circular cropmarks, measuring approximately 8 - 9m in diameter, located on opposite sides of the R406 approximately	Toolestown	693401 / 734497

[42] http://excavations.ie/report/1987/Kildare/0000733/ [Accessed 07.11.21].

Reference Number	SMR Reference	Description	Townland	Location (Easting / Northing)
AY_16	KD010-067	26m to the east (AY_15) and 55m to the west (AY_16) of Option D (Blue) respectively	Toolestown	693296 / 734447
AY_18	KD010-070	A circular cropmark measuring approximately 8m in diameter in Windgates (AY_18), approximately 54m to the east of Option D (Blue). Interpreted as a ring ditch, this feature is located in an arable field with other, possibly associated, features identified from aerial imagery including a circular enclosure (KD010-071) to the south-east and linear features running north-south.	Windgates	693081 / 733087
AY_19	KD010-042	An enclosure comprising two circular concentric ditches, and measuring approximately 40m in diameter, is located in Barberstown Upper, approximately 69m to the west of Option D (Blue). While of unknown date, this bivalate cropmark is located in proximity to a second, more ephemeral, example which has been interpreted as the remains of a possible barrow.	Barberstown Upper	692654 / 731590
AY_20	KD010-022001	A roughly coursed rubble bawn wall (defensive wall), associated with Baberstown Castle (AH_09; see Section 3.4.2 below) is located approximately 100m to the south of Option D (Blue).	Barberstown	692674 / 731143
AY_21	KD010-057	A pair of barrows, which form part of a cluster, in Baberstown (including AY_21 and AY_22) are located approximately 90m to the south of Option D (Blue). Visible on aerial imagery within arable fields, one of the barrows (AY_21) is bisected by a field boundary.	Barberstown	692558 / 731133
AY_22	KD010-058		Barberstown	692523 / 731116
AY_23	KD014-096	A ring ditch comprising a circular cropmark, measuring approximately 10m in diameter, identified on aerial imagery in Longtown (AY_23), approximately 98m to the south-east of Option D (Blue).	Longtown	690299 / 730172
AY_32	KD014-062	A cluster of possible barrows (AY_32, AY_33, and AY_34, approximately 55m to the north, 40m to the south, and 94m to the south of Option D (Blue), respectively) (see Table 3.7 in Section 3.3.1 above).	Castlesize	688409 / 724218
AY_33	KD014-073		Castlesize	688644 / 724200
AY_34	KD014-076		Castlesize	688590 / 724128
AY_35	KD014-074	A large circular approximately 40m to the south-east of Option D (Blue), close to a group of barrows (AY_32 – 34) (see Table 3.7 in Section 3.3.1 above).	Castlesize	688419 / 724116
AY_36	KD019-081	A cropmark, interpreted as a ring ditch, approximately 80m to the west of Option D (Blue) (see Table 3.1 in Section 3.1.1 above).	Osberstown	687886 / 722860
AY_46	KD024-050004	A group of small rectangular cropmarks, interpreted as enclosures, within approximately 6m of Option D (Blue) (see Table 3.1 in Section 3.1.1 above).	Dunstown	687302 / 712740
AY_47	KD024-050005		Dunstown	687328 / 712725
AY_48	KD024-050006		Dunstown	687335 / 712719

Archaeological Potential

Option D (Blue) crosses the Rye Water, River Lyreen and the River Liffey, as well as a number of minor watercourses with the potential for votive (religious) offerings to be present. The underlying geology is largely limestone, with superficial deposits of till, gravel and alluvium, which has the potential to preserve previously unknown archaeological monuments and remains. Areas of outcropping bedrock (visible exposures of solid rock) have also been noted along the route of Option D (Blue) and the potential for previously unknown archaeological monuments and remains in these areas would be limited.

3.4.2 Architectural Heritage

Architectural heritage constraints within the study area for Option D (Blue) comprise:

- Six Protected Structures (see Figure B.1.2 in Appendix B.1); and
- Seven GDLs (see Figure B.1.3 in Appendix B.1).

No ACAs or structures included on the NIAH have been identified within the study area for Option D (Blue).

Record of Protected Structures

Six Protected Structures have been identified within the study area for Option D (Blue), comprising post-medieval churches and dwellings, including estate buildings and a castle. Protected Structures identified within the study area for Option D (Blue) are shown on Figure B.1.2 (Appendix B.1).

Saint Paul's Church of Ireland Church (AH_03; also assessed by the NIAH to be of Regional importance) is located approximately 26m to the south of Option D (Blue) and comprises a Gothic-style structure set within a sub-rectangular churchyard (AY_08). Built in the late 19th century the church includes a three-stage tower with ashlar limestone spire, is a typical example of contemporary church design. The church overlooks Moygale Road to the north, and agricultural fields to the south, with views outward largely uninterrupted.

Greygates (AH_07) is located approximately 18m to the west of Option D (Blue) and comprises a house depicted on historic mapping (Ordnance Survey 25”, 1888 - 1913). The building is a modest one and a half storey, five bay house, positioned perpendicular to the R406, of coursed rubble stone construction.

Barberstown House (AH_08), on the junction between the R406 and R403, approximately 40m to the north of Option D (Blue), comprises a five bay, two-storey double pile farmhouse to the south of a number of stone ranges. This square-plan house appears to have replaced an earlier building, ‘Barberstown Cottage’ depicted on historic mapping (Ordnance Survey 6”, 1837 – 1842), in the late 19th or early 20th century (Ordnance Survey 25”, 1888 - 1913).

Originally the site of a 13th century structure, Baberstown Castle (AH_09), approximately 87m to the south of Option D (Blue) comprises a medieval tower house with an associated roughly coursed rubble bawn (AY_20; see above). A tower house is a multi-storey, fortified hall house and a bawn is a defensive wall. The tower house comprises a coursed rubble masonry structure with two square corner towers with battered bases. The castle, now a hotel, was extended and modified during the post-medieval period, with later buildings dating to the 17th and 18th centuries, as well as more recent renovations.

The gate lodge and entrance (AH_14) to the east of Castlesize demesne (DL_18) is located approximately 25m to the west of Option D (Blue). The lodge comprises a single storey building, on the driveway to the main house (RPS B14-13). The lodge is set behind a high stone boundary wall to the north of the entrance gates (off the R407), surrounded by mature trees and established vegetation.

Bluebell Farm House (AH_18) is located approximately 35m to the west of Option D (Blue) and is described in Section 3.1.2.

Architectural Conservation Areas

There are no ACAs located within the study area for Option D (Blue). The nearest ACA to the option is Naas ACA, located approximately 700m to the east Option D (Blue).

National Inventory of Architectural Heritage

One structure included on the NIAH has been identified within the study area for Option D (Blue). Saint Paul's Church of Ireland Church (AH_03) is also a Protected Structure and, to avoid double counting constraints, has been included above under Protected Structures.

Survey of Gardens and Designed Landscapes

A total of seven GDLs have been identified within the study area for Option D (Blue). Of these six were recorded by the Survey of Historic Gardens and Designed Landscapes and one has been identified from historic mapping (Ordnance Survey 6", 1837 – 1842). Information on the GDLs is presented in Table 3.11Table and are shown on Figure B.1.3 (Appendix B.1).

Table 3.11: GDLs identified within the study area for Option D (Blue)

Reference Number	Name	Description	Townland	NIAH Reference
DL_02	Jenkinstown House	Demesne identified from historic mapping (Ordnance Survey 6", 1837 – 1842). The principal house remains extant (CH_02), and the demesne includes a roughcast boundary wall, gate piers, and driveway leading to the house. Mature trees and a ditch mark the boundary along the R156.	Jenkinstown	N/A
DL_09	Dowdstown House	Garden and designed landscape associated with Dowdstown House. The area within the boundary of this demesne has largely been redeveloped.	Dowdstown	NIAH 1911
DL_16	Blackhall	The GDL associated with Blackhall. The principal building and agricultural ranges remain extant, along with the layout of the gardens and woodland, including a belt of trees along boundary with the R407.	Blackhall	NIAH 1890
DL_17	Millicent House	The GDL to Millicent House. The extensive riverside demesne lands surrounding the principal house (RPS B14-26) include extant estate features such as lodges (including AH_15), a walled garden, drives, and areas of woodland and parkland depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913). Sections of rubble stone wall delimit the demesne and line the road from the entrance to Millicent Bridge.	Millicent Demesne	NIAH 1889
DL_18	Castlesize	The GDL associated with Castlesize which largely retains the buildings and layout as depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). The entrance opposite the junction between the R407 and Castlesize Green includes entrance walls, gate piers, and cast-iron gates. The boundary along the R407 comprises a rubblestone wall with alternate vertical and horizontal copes.	Castlesize	NIAH 1893
DL_19	Osberstown Hill	The GDL to Osberstown Hill house. The principal building remains extant; however, the Dublin-Cork (and others) railway line has replaced the northern boundary and the Sallins Bypass has removed a section of the eastern corner.	Osberstown	NIAH 1887
DL_20	Killashee House	The GDL to Killashee House. Largely developed include Killashee National School, and the majority of demesne features have been removed. The R448 is located within the western boundary of the demesne. Extant boundary features include established hedgerows and a ditch, and modern post and rail fencing. A section of roughly coursed rubble stone wall is extant to the south of the demesne, along with a later recessed entrance.	Killashee	NIAH 1980

3.4.3 Cultural Heritage

A total of 24 cultural heritage sites identified within the study area for Option D (Blue) from the sources identified in Section 2. These largely comprise extant post-medieval buildings and structures, including stone road bridges, vernacular housing and farm buildings, as well as cropmarks corresponding with post-medieval field systems. Summary information on these cultural heritage sites is presented in Table 3.12Table below and are shown on Figure B.1.4 (Appendix B.1).

Table 3.12: Cultural heritage sites identified within the study area for Option D (Blue)

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_01	694713 / 746280	Culcommon	Road Bridge	The stone parapet of a road bridge or culvert depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 2m to the east of Option D (Blue) (see Table 3.3 in Section 3.1.3 above).
CH_02	691765 / 745557	Warrenstown	House	'Jenkinstown House' depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) comprising the main house and a long range to north, approximately 65m to the north-west of Option D (Blue) (See Table 3.3 in Section 3.1.3 above).
CH_03	693262 / 745438	Jenkinstown	Public House	A public house depicted on historic mapping (Ordnance Survey 25", 1888-1913) immediately adjacent to the R156, approximately14m to the south-east of Option D (Blue) (See Table 3.3 in Section 3.1.3 above).
CH_04	691671 / 745333	Jenkinstown	Road Bridge	A stone road bridge that carries the R156 across a small watercourse - depicted on historic mapping as 'Jenkinstown Bridge' (Ordnance Survey 6", 1837 – 1842) (see Table 3.3 in Section 3.1.3 above).
CH_13	692931 / 739788	Moyglare	Police Station	A police station depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) and identified on later mapping as a 'constabulary barracks' (Ordnance Survey 25", 1888 - 1913). Located immediately to the north of Moyglare Road, overlooking the roadway.
CH_18	692330 / 737877	Laraghbryan East	Earthworks	Linear banks and ditches in a field to the north of Kilcock Road, identified from historic aerial photographs (see Table 3.6 in Section 3.2.3 above).
CH_19	691947 / 737649	Laraghbryan East	Bridge	The site of a possible bridge or crossing point over the River Lyreen, approximately 88m to the west of Option D (Blue), depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) (see Table 3.6 in Section 3.2.3 above).
CH_20	692218 / 736772	Newtown	Farm	A farm depicted on historic mapping (Ordnance Survey 6", 1837 – 1842); however, the current layout reflects that depicted on later mapping (Ordnance Survey 25", 1888 - 1913). The farm is located west of Rathcoffey Road, and immediately to the north of the M4 motorway, approximately 47m to the north of Option D (Blue).
CH_29	692955 / 732635	Windgates	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Located to the east of the R406, approximately 35m to the east of Option D (Blue), views are across the carriageway over arable fields. Modern farm buildings are located to the east and south.
CH_33	693077 / 731907	Barberstown Lower	Field boundaries	Linear and curvilinear cropmarks identified from aerial imagery. Some of these features correspond with historic field boundaries depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). Located immediately adjacent to the R406, approximately 20m to the east of Option D (Blue).
CH_34	692707 / 731744	Barberstown Upper	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913). Located to the west of the R406, approximately 20m to the west of Option D (Blue), views are across the carriageway towards arable fields. A gravel pit is located to the north.
CH_35	693259 / 731148	Barberstown	Field boundaries	Linear cropmarks identified from aerial imagery that correspond to field boundaries on historic mapping (Ordnance Survey 6", 1837 – 1842). Located approximately 42m to the south-east of Option D (Blue), immediately adjacent to the junction between the R406 and R403.

Reference Number	Location (Easting / Northing)	Townland	Site Type	Description
CH_36	692346 / 730958	Barberstown; Staffan; Bawnoges	Field boundaries	Linear cropmarks identified from aerial imagery including some which correspond with field boundaries depicted on historic mapping (Ordnance Survey 6", 1837 – 1842). However, these features are located near a cluster of SMR features which may comprise a barrow cemetery (including AY_21 and AY_22). In a field immediately to the south of the R403.
CH_38	688543 / 728782	Richardstown	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913). The house is set away from the R403, approximately 67m to the north-west of Option D (Blue), in agricultural land, with a clump of established trees to the immediate south-east.
CH_40	688493 / 727099	Blackhall	Field System	A series of linear and curvilinear cropmarks identified on aerial imagery to the south of the River Liffey. Interpreted as possible enclosures or a field system. No corresponding features were identified on historic mapping.
CH_45	688212 / 726113	Blackall	Lodge	A lodge depicted on historic mapping (Ordnance Survey 6", 1837 – 1842; Ordnance Survey 25", 1888 - 1913). Located on the R407 at the entrance to the Blackhall GDL (DL_16), approximately 16m to the east of Option D (Blue), adjacent to a treelined driveway.
CH_48	688707 / 724866	Blackhall	Farm	A farm complex depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 11m to the east of Option D (Blue) (see Table 3.9 in Section 3.3.3 above).
CH_50	688567 / 724291	Johninstown	Watch Tower	A watch tower depicted on historic mapping (Ordnance Survey 25", 1888 - 1913), approximately 70m to the north of Option D (Blue) (see Table 3.9 in Section 3.3.3 above).
CH_51	688232 / 719268	Jigginstown	Aqueduct	'Aquaduct' identified on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 22m to the north-east of Option D (Blue) (see Table 3.3 in Section 3.1.3 above).
CH_55	688073 / 716071	Killashee	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 13m to the east of Option D (Blue) (see Table 3.3 in Section 3.1.3 above).
CH_56	687962 / 715565	Oldtown	Farm	A farm depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 25m to the west of Option D (Blue) (see Table 3.3 in Section 3.1.3 above).
CH_57	687884 / 714478	Mylerstown	House	A single storey cottage depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 14m to the east of Option D (Blue) (see Table 3.3 in Section 3.1.3 above).
CH_58	687418 / 713423	Stephenstown South	House	A cottage depicted on historic mapping (Ordnance Survey 6", 1837 – 1842) located on the roadside, approximately 20m to the west of Option D (Blue) (see Table 3.3 in Section 3.1.3 above).
CH_59	687356 / 713137	Stephenstown South	House	A house depicted on historic mapping (Ordnance Survey 6", 1837 – 1842), approximately 23m to the west of Option D (Blue) (see Table 3.3 in Section 3.1.3 above).

Previous Excavations

The Excavations Bulletin and TII's Archaeological Excavation Reports were consulted to identify archaeological excavations that had been undertaken within the study area for Option D (Blue).

Archaeological testing undertaken in advance of the M7 motorway (Licence number: E004777) in Osberstown, Castlesize, Sallins, Waterstown, Barrettstown, and Bodenstown identified a number of sites of archaeological potential which were subsequently excavated.[43]

A further nine archaeological excavations were also identified (under Licence numbers: 15E0151, 06E0205, 05E0988, 03E1219, 06E0045 ext., 02E0419, 05E1334, 05E1334 ext., and 14E0452); however, these did not identify any archaeological remains or deposits of archaeological significance.

Five casual finds were also identified within the study area for Option D (Blue), and these comprise bronze pins and a fibula (1984: 5,6, and 1969:75) in Jigginstown and Naas West, artefacts (1935:544-8 R.I.A.) associated with a cemetery of pit burials (KD019-017; Recorded Monument) in Ploopluck, 'various archaeological finds' (E 412:1) in Crinstown, and a glazed medieval pot sheard (1979:13) in Jigginstown.

[43] https://excavations.ie/report/2017/Kildare/0026981/ [Accessed 05 November 2021].

4. References

Aerial Photographs

Cambridge University Collection of Aerial Photography (CUCAP): https://www.cambridgeairphotos.com/

CUCAP Number	Date	Subject
APE008	1966	Earthworks. Maynooth, Kildare, Ireland
BDU041	1970	Linear earthwork. Kilcock, 'The Pale', Kildare, Ireland

Historic Maps

The Down Survey of Ireland, 1656-1658, http://downsurvey.tcd.ie/index.html.

Noble and Keenan's map of Kildare, 1752, https://www.logainm.ie/Eolas/Data/Brainse/logainm.ie-map-j-noble-and-j-keenan-1752-grand-jury-kildare-south.jpg and https://www.logainm.ie/Eolas/Data/Brainse/logainm.ie-map-j-noble-and-j-keenan-1752-grand-jury-kildare-north.jpg.

Larkin's map of Meath, 1812, https://www.logainm.ie/Eolas/Data/Brainse/logainm.ie-map-william-larkin-1812-grand-jury-meath-sheet-06.jpg

Ordnance Survey, 6" to 1 mile, 1837 – 1842, https://geohive.maps.arcgis.com/apps/webappviewer/index.html?id=9def898f708b47f19a8d8b7088a100c4

Ordnance Survey, 25" to 1 mile, 1888-1913, https://geohive.maps.arcgis.com/apps/webappviewer/index.html?id=9def898f708b47f19a8d8b7088a100c4

Sources

Department of Arts, Heritage, Gaeltacht and the Islands (now Department of Culture, Heritage and Gaeltacht), 1999, *Framework and Principles for the Protection of the Archaeological Heritage*.

Department of Arts, Heritage and the Gaeltacht, 2011, *Architectural Heritage Protection Guidelines for Planning Authorities*.

Department of Culture, Heritage and the Gaeltacht, 2021, *National Inventory of Architectural Heritage Handbook*. Available online at: https://www.buildingsofireland.ie/app/uploads/2021/03/NIAH-Handbook-Edition-March-2021.pdf.

Department of Culture, Heritage and the Gaeltacht, n.d., *National Inventory of Architectural Heritage Historic Gardens and Designed Landscapes: Background*. Available online at: http://buildingsofireland.com/Surveys/Gardens/AShortHistory/.

Department of the Environment, Heritage and Local Government, 2004, *Irish Field Monuments.*

Department of the Environment, Heritage and Local Government and EirGrid, 2009, *Code of Practice between the Department of the Environment, Heritage and Local Government and EirGrid*.

Department of Housing, Local Government and Heritage, 2002a, *National Inventory of Architectural Heritage: Moortown (Celbridge ED), Kildare.* Available online at: https://www.buildingsofireland.ie/buildings-search/building/11901001/moortown-celbridge-ed-kildare [Accessed 25 October 2021].

Department of Housing, Local Government and Heritage, 2002b, *National Inventory of Architectural Heritage: Ballynagappagh (Clane ED), Kildare.* Available online at: https://www.buildingsofireland.ie/buildings-search/building/11901401/ballynagappagh-clane-ed-kildare [Accessed 25 October 2021].

EirGrid, 2015, *Cultural Heritage Guidelines for Electricity Transmission Projects.*

Jacobs (on behalf of EirGrid), 2021, *Kildare-Meath Grid Upgrade Environmental Constraints Report*. Available online at:
https://consult.eirgrid.ie/system/files/materials/2055/Environmental%20Constraints%20Report%20-%20Step%204A%20-%20KMGU.pdf.

Kildare County Council, 2017, *Kildare County Development Plan 2017 – 2023*.

Kildare.ie, n.d., *County Kildare History and Heritage: Jigginstown Castle, Naas, County Kildare*. Available online at: https://kildare.ie/Heritage/historic-sites/jigginstown-castle.asp [Accessed 25 November 2021].

Lyndon, J., 1973, *Ireland in the later Middle Ages*.

Meath County Council, 2021, *Meath County Development Plan 2021 – 2027*.

National Monuments Service, 2012, *Anglo-Norman castles*. Available online at: https://www.archaeology.ie/sites/default/files/media/publications/nms-farmers-journal-10.pdf [Accessed 25 October 2021].

UCD digital library, n.d.a, *Jigginstown Buildings*. Available online at: https://digital.ucd.ie/view-media/duchas:4819384/canvas?manifest=https://data.ucd.ie/api/img/manifests/duchas:4819384 [Accessed 04 November 2021].

UCD digital library, n.d.b, *Holy wells - in Leinster: St. Bride's well, near Kilcock*. Available online at: https://digital.ucd.ie/view/duchas:49398 [Accessed 04 November 2021].

Unknown, n.d., *Ireland's Holy Wells County-by-County: St. Brigid's Well*. Available online at: https://ihwcbc.omeka.net/items/show/416 [Accessed 12 November 2021].

Annex A. Inventory of Archaeology, Architectural Heritage and Cultural Heritage Constraints

Table A1: Inventory of Archaeological Constraints

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_01	ME049-014001	N/A	Calgath	Meath	Ritual site - holy well	689223 / 742511	Situated on a rise of a gentle S-facing slope at the centre of the mound (ME049-014----). The well is known as St Bride's Well and it was revered in the 19th century when it was described as having a diameter of 12 feet (c. 3.75m) (Cogan 1862-70, 2, 361). It was a small natural spring (diam. c. 1m) at the base of the stump of an ash tree in 1969 (SMR file) but is has been conserved in 2000 and is now a stone-lined well (diam. 0.85m; max. D 1.75m) with water approached by a path and steps from the N while the mound is less prominent. The well is surrounded by a paved path (Wth c. 1.5m) and within an enclosure (diam c. 5m) defined by a hedge and a picket fence, and there are two young trees outside the enclosure, one with rags. (French 2012, 33-4) Depicted on historic mapping as a large circular 'Mound' with 'Brides Well' located off centre towards the eastern limit of the mound. Later mapping depicts the well more centrally linked to a watercourse to the west. The mound is barely perceptible and is surrounded by a modern post and rail fence and low hedges, within a pasture field, west of the R125. The well is described as one of the hot wells in Meath and is said to have sprang up when St Brigid rested in the location that cured deafness and ear complaints. The well was described as 'situated on the side of a circular mound or hill, and an aged ash spreads its branches over it; the diameter of this well is twelve feet four inches'. A tree was located on the top of the low mound (1960s); however, this has since been removed.	19th century	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2011 [07 November 2021] 'St. Brigid's Well', Ireland's Holy Wells County-by-County. Available online: 2021, https://ihwcbc.omeka.net/items/show/416 [Accessed 12.11.2021] https://digital.ucd.ie/view/duchas:49398 [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_02	ME049-014	Recorded Monument	Calgath	Meath	Mound	689227 / 742510	Marked on the 1837 ed. of the OS 6-inch map as a small feature and described in gothic lettering as a 'Mound'. It was described as a circular mound (diam. 24m E-W, H 1.6m) truncated by ditch at S and with the holy well (ME049-014001-) at the centre (Moore 1987, 34), but the well has been conserved since 1985, and the mound is no longer prominent. Depicted on historic mapping as a large circular 'Mound' with 'Brides Well' located off centre towards the eastern limit of the mound. Later mapping depicts the well more centrally linked to a watercourse to the west. The mound is barely perceptible and is surrounded by a modern post and rail fence and low hedges, within a pasture field, west of the R125. A tree was located on the top of the low mound (1960s); however, this has since been removed.	Unknown	Record of Monuments and Places - County Meath (1996) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2011 [07 November 2021] https://digital.ucd.ie/view/duchas:49398 [07 November 2021]
AY_03	ME049-018	Recorded Monument	Calgath	Meath	Field system	689241 / 741855	Located on a gentle S-facing slope. Earthworks of relict field banks and drains covering an area of about 12 acres (c. 5 ha) are visible on aerial photographs (GSIAP: N 605, 606) and some later series. The banks (Wth c. 2m; H c. 0.3m) and ditches (Wth c. 1-2m; D c. 0.2m) create some irregular fields (dims c. 60m x c. 30m to c. 100m x c. 70m) which are covered in cultivation ridges confined to individual fields. There are some wide linear spaces (Wth c. 5-10m) between fields that might be roadways. The defining features are best preserved at the SW angle of the area and some modern houses impinge on it. Archaeological testing (04E0764) by S. Linnane at the S edge of the area produced no related material (excavations.ie 2004:1193). A field system is visible on digital globe aerial imagery as the earthwork banks and ditches, the remains of ridge and furrow, and linear features that may evidence possible tracks or roadways. The fields are irregular in shape and extend into the large field to the north.	Unknown	Record of Monuments and Places - County Meath (1996) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2011 [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							The field pattern does not correspond with that depicted on historic mapping.		
AY_04	ME049-021	Recorded Monument; Protected Structure	Rodanstown	Meath	Church	690574 / 741328	Situated on the W side of a small N-S fold in a fairly level landscape. At its suppression in 1540 the tithes of Kilclone and Balradan were amongst the possessions of St Peter's Augustinian abbey in Newtown Trim (ME036-049003-) (White 1940, 297). Ussher (1622) describes the church at Ballruddan as repaired although the chancel was ruined (Erlington 1847-64, 1, lxxix). According to the Dopping (1682-5) and Royal (1693) visitations the parish church of of St Rodan at Balroddan or Rodanstown was in good repair but there was no chancel. A font is listed and the graveyard was enclosed (Ellison 1972, 5). The saint could be St Ruadhán of Lorrha (TN004-010----), but there is no known connection. Lewis (1837, 2, 480) describes the church as an 'ancient plain edifice', but the present structure is likely to be 18th century in date. A church and oval graveyard is depicted on historic mapping on the bend immediately adjacent to the bend in the road through Rodanstown. The church is depicted as a rectangular building towards the centre of the graveyard, orientated north-west to south-east. The church and graveyard is shown surrounded by trees. Later mapping shows the church orientated west-east with a curved apse to the east. The church is identified as 'disused'. The current ruinous church is located towards the centre of the oval graveyard on the bend in the road. No remains of the medieval church are perceptible and the current structure appears to be a later.	Medieval	Record of Monuments and Places - County Meath (1996) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [07 November 2021]
AY_05	ME049-021001	N/A	Rodanstown	Meath	Graveyard	690573 / 741320	Situated on the W side of a small N-S fold in a level landscape. The site of the medieval parish church of Rodanstown (ME049-021----) is within an oval graveyard (dims c. 55m N-S; c. 45m E-W) defined by	Medieval	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							an earthen bank SE-W-NW and by a masonry wall NW-E-SE where it is skirted by a public road. The headstones date largely from c. 1750 to c. 1910 with some newer headstones from the 1970s. The font from this graveyard is now at Milltown (ME017-036----) near Kells. An oval graveyard is depicted on historic mapping, surrounded by trees. Later mapping continues to show the graveyard with the same extent. The boundary is defined by an earthen bank (possibly with stone facing in areas) and roughcast stone wall. The memorials and ruinous church within the graveyard date from the mid-18th century onwards.		Ordnance Survey 25", 1888-1913 Google StreetView 2019 [07 November 2021]
AY_06	ME049-021002	N/A	Rodanstown	Meath	Font	690580 / 741315	The font Rodanstown graveyard (ME049-021001-) mentioned by Cogan (1862-70, 2, 359) is now at Milltown (ME017-036----) near Kells. It is octagonal (ext. dim. 0.6m; H 0.5m) with chamfered under- panels and has a circular, flat-bottomed basin (int. diam. 0.46m; D 0.15m). The font stands on an octagonal base with a moulding at the top (H 0.28m) (Roe 1968, 113).	Post-medieval	Archaeological Survey of Ireland SMR
AY_07	KD005-024	N/A	Boycetown	Kildare	Excavation - miscellaneous	687822 / 740465	Archaeological monitoring (Licence no. 03E1554) was carried out in association with a proposed development of a warehousing facility and ancillary offices, along with associated services, infrastructure, storage and landscaping in an area measuring 13,937m2. Two small pits were observed in the northernmost field at the site. No diagnostic material was recovered from the northern pit. A small amount of burnt-bone fragments were recovered from the other. These have been retained for analysis. Nothing further of archaeological significance was recovered.	Unknown	Archaeological Survey of Ireland SMR https://excavations.ie/report/1970/Kildare/0000029/ [04 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_08	ME049A0 02001	N/A	Moyglare	Meath	Graveyard	692690 / 739763	Located on a level landscape with the W-E Rye Water, which forms the boundary with Co. Kildare, c. 200m to the S. The site of the parish church of Moyglare (ME049A-002----) is within a subrectangular graveyard (dims c. 65m E-W; c. 40-60m N-S) defined by masonry walls. According to the Dopping (1682-5) and Royal (1693) visitations the graveyard was 'well fenced' at that time (Ellison 1972, 4). A sub-rectangular graveyard is depicted on historic mapping. The extent of the graveyard remains unchanged. The boundary is defined by a low rubblestone wall, with vertical copes.	Post-medieval	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [07 November 2021]
AY_09	ME049A0 02	Recorded Monument	Moyglare	Meath	Church	692690 / 739742	Located on a level landscape with the W-E Rye Water, which forms the boundary with Co. Kildare, c. 200m to the S. A church at Mynclare (Moyglare) is listed in the ecclesiastical taxation (1302-06) of Pope Nicholas IV (Cal. doc. Ire., 5, 255). Ussher (1622) describes the church as in good repair but the chancel as ruined (Erlington 1847-64, 1, lxxvi). According to the Dopping (1682-5) and Royal (1693) visitations the parish church of Moyglare had been repaired, but the chancel was in ruins since 1641. The church was roofed with slates, the floor was clay and there was glass in the windows. In addition the graveyard was described as 'well fenced' (Ellison 1972, 4). This church continued in use until c. 1870 when St. Paul's church, a four bay Church of Ireland church with an attached spire, was built. This is now a private dwelling within a subrectangular graveyard (dims c. 65m E-W; c. 40-60m N-S) defined by masonry walls. There is no evidence of the medieval structure. No evidence of the medieval church is perceptible. The church depicted on historic mapping reflects the current post-medieval structure.	Post-medieval	Record of Monuments and Places - County Meath (1996) Google StreetView 2019 [07 November 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_10	KD005-036	N/A	Laraghbryan East	Kildare	Enclosure	692023 / 737926	Cropmark of circular-shaped enclosure (approx. diam. 44m) visible on Google earth aerial imagery. An ephemeral circular cropmark visible on Google aerial imagery in an arable field to the north of the R148. A number of similar cropmarks are perceptible in fields further north which may be associated with the site. No corresponding earthworks are perceptible on aerial photographs. Possible the location of 'Bryan's house site' ('lauragh' meaning the site of something, usually a building).	Unknown	Archaeological Survey of Ireland SMR https://www.cambridgeairphotos.com/location/ape008/ [04 November 2021] Joyce, P., W., (1887), The Origin and Historic of Irish Names of Places, Volume 1 (fifth edition). Dublin: M. H. Gill and Son.
AY_11	KD005-018	Recorded Monument	Crinstown	Kildare	Habitation site	691781 / 736833	In 1987, an archaeological excavation was conducted in conjunction with the construction of the Kilcock-Leixlip motorway bypass. According to Keeley (1991, 168), 'The site (was) identified from an aerial photograph … Evidence of medieval occupation was uncovered … represented by a cobbled area (dims. L c. 120m; Wth c. 120m). A habitation layer lay directly on the cobbles and consisted of a brown humic material with inclusions of fragmentary iron objects and a large amount of ceramic sherds … of both cooking and glazed wares with a dating range from the 13th-16th century.' Additional information is available on www.excavations.ie (search by townland), 'Two large ditches were also revealed. Ditch 'H' lay to the west of the cobbling and was 4m (max.) wide by 0.95m deep at subsoil level. Finds from this ditch reflect a similar date to those found associated with the cobbling. Ditch 'I' lay just east of the cobbling and was 2.65m (max.) wide by 0.85m deep at subsoil level. Five modern drains were also uncovered.'	Medieval	Record of Monuments and Places - County Kildare (1995) http://excavations.ie/report/1987/Kildare/0000733/ [04 November 2021]
AY_12	-	-	-	-	-	-	Number not used	-	-

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_13	KD010-001001	Recorded Monument; Register of Historic Monuments	Ballybrack (Balraheen Ed), Ballyloughan,Clonduff, Clonfert North, Clonfert South, Graiguepottle	Kildare	Linear earthwork	686721 / 735896	The area which would later be called 'The English Pale', from the Latin 'palus', a stake, and also possibly from the name of an earthen fortification at Calais in France (Lydon 1972, 261), originated in the 14th century when Norman settlers began fortifying their lands in counties Dublin, Kildare, Louth and Meath against attack by the native Irish. By 1435, ongoing attacks, probably primarily aimed at cattle theft (O'Riordáin 1971, 15), prompted the concept of an additional, linear defensive feature, the boundaries of which were defined in a 1488 Act of Parliament as extending, 'from Merrion inclusive to the waters of the Dodder, by the new ditch to Saggard, Rathcoole, Kilheel (Kilteel), Rathmore and Ballymore (Eustace), thence to the county of Kildare into Ballycutlan (Coghlanstown), Harristown and Naas, and so thence to Clane, Kilboyne, and Kilcock' (Mc Neill 1950, 250). In 1494, Parliament directed that, 'every inhabitant, earth tiller and occupier in said marches (borderlands), do build and make a double ditch six feet high above ground at one side or part which meareth next unto Irishmen between this and next Lammas (August 1st.), the said ditches to be kept up and repaired as long as they shall occupy said land.' However, Ellis (Ellis S. G. 'The emergence of the English Pale in Ireland' in Irish Historical Studies) points to a statute in Poyning's parliament in 1495 for 'ditches to be made aboute the Inglishe pale' as the first application of the term to Ireland. The Pale contracted eastwards in subsequent years and it is not certain if its original extent was ever completely ditched. By the seventeenth century, The Pale had ceased to have any real political or defensive significance. Only a few short sections have been positively identified in Co Kildare; in Kilteel Upper/Cupidstown near Rathmore (KD020-008-----), in Bishopsland just SW of Ballymore Eustace (KD029-039----), at	14th century	Record of Monuments and Places - County Kildare (1995) Kildare County Development Plan (2017 - 2023) Ordnance Survey 25", 1888-1913 https://www.cambridgeairphotos.com/location/bdu041/ [04 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							Castlebrown or Clongowes (KD010-021----/KD014-008----) and finally, the best preserved, semi-continuous portion which runs for c. 3365m through the townlands of Ballybrack, Ballyloughan, Clonduff, Clonfert South and Graiguepottle, c. 5km N of Clongowes (KD010-001----). There it is traceable from its E end in Clonfert South as a narrow (Wth 3.5m) metalled laneway between two probably recut fosses, running W (L c. 420m), and then veering NW (L c. 365m). [Archaeological test-trenching at one location along this section revealed possible medieval habitation evidence: KD010-001008-.] It then changes direction slightly to head NNW (L c. 660m) as a disused laneway (Wth 4.8m), slightly raised above surrounding field level, and running between two wide, deep fosses (Wth 3.8m; D 2.9m), forming the townland boundary between Clonfert South and Graiguepottle. It then turns sharply to head W (L c. 1085m) mainly as a functioning laneway (Wth 3.5m) between two deep fosses through Clonduff to a point where it appears to divide: one short section (L c. 155m) apparently continues W into Ballyloughan as a metalled laneway (Wth 3.5m) flanked by drains on either side, while the main section turns sharply S (L c. 680m) and continues as a fosse (Wth 2.5m; D 1m), the corresponding bank of which (noted in 1976, SMR file) has been levelled. Along this latter section it forms the townland boundary between Ballyloughan and Graiguepottle. Visible on several aerial photographs (CUCAP AVM 27-8, AHK 4, BDU 41). The monument is included on the Register of Historic Monuments. (Bradley 2011, 51-67) Depicted on historic mapping as a ditch or narrow trackway and identified as 'The Pale'. Aerial photographs show an ephemeral ditch feature aligned north-south running adjacent to the R407, alongside the current field boundary.		

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_14	KD010-006	Recorded Monument	Donaghstown	Kildare	Enclosure	691919 / 735233	Visible on aerial photographs (CUCAP ATA 29, BDU 42, 1967) as a long, narrow, slightly raised rectangular area (est. dims. L c. 80m NW-SE; Wth c. 20m NE-SW) with a rounded western end, truncated N-S to W of centre by a later road, subsequently disused and replaced by a realigned road to the W. The ground surface is uneven in this area, but the site limits are not readily discernable. A possible ringfort (KD010-005----) site lies c. 70m to the SE. No corresponding features on historic mapping. Aerial imagery (EirGrid Ortho photography) shows a pair of linear cropmarks, orientated roughly north-south, as well as a number of other cropmark features that correspond with a road and field boundaries depicted on historic mapping. A raised rectangular feature is perceptible on aerial photographs. The feature is possibly bisected by the former road and appears to curve west to east. A ringfort is located within the same field (KD010-005) to the south.	Unknown	Record of Monuments and Places - County Kildare (1995) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 https://www.cambridgeairphotos.com/location/bdu042/ [07 November 2021]
AY_15	KD010-066	N/A	Toolestown	Kildare	Ring-ditch	693401 / 734497	Cropmark of small circular-shaped enclosure (approx. diam. 8m) visible on Google earth aerial imagery. No corresponding features on historic mapping. A circular features is visible on Google aerial imagery, with a similar cropmark feature (AY_16) located to the west on the opposite side of the R406.	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_16	KD010-067	N/A	Toolestown	Kildare	Ring-ditch	693296 / 734447	Cropmark of small circular-shaped enclosure (approx. diam. 9m) visible on Google earth aerial imagery. No corresponding features on historic mapping. A circular features is visible on Google aerial imagery, with a similar cropmark feature (AY_15) located to the east on the opposite side of the R406.	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_17	KD010-028	Recorded Monument	Roosk	Kildare	Enclosure	691541 / 733297	On level pasture, formerly in tillage. Visible on aerial photographs (GSI N 468, 469) as the very faint cropmark of a fosse enclosing a large, circular area (est. diam. c. 120m). Not visible at ground. No corresponding features on historic mapping.	Unknown	Record of Monuments and Places - County Kildare (1995) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_18	KD010-070	N/A	Windgates	Kildare	Ring-ditch	693081 / 733087	Cropmark of circular-shaped ring-ditch (approx. diam. 8m) visible on Google earth aerial imagery. No corresponding features on historic mapping. Located in an arable field with another, larger cropmark of a circular enclosure (KD010-071) to the south-east. A linear features running north-south is also perceptible as a cropmark to the west of the feature on aerial imagery (EirGrid Ortho photography).	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_19	KD010-042	N/A	Barberstown Upper	Kildare	Enclosure	692654 / 731590	In tillage. Visible on a 1995 OSi Orthophoto and also on later Google earth and Bing satellite imagery as the cropmarks of two concentric fosses enclosing a circular area (estimated diameter c. 40m). A second, very faint cropmark c. 50m to the SE may be the remains of a ringbarrow. (pers. comm. D. Brennan, 30-03-2015). No corresponding features on historic mapping.	Unknown	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_20	KD010-022001	N/A	Barberstown	Kildare	Bawn	692674 / 731143	Some 6m S of a tower house (KD010-022001-) and separated from it by a later building, a short portion of wall (L 5.8m E-W; H 3.1m; T 1m) built of roughly coursed rubble masonry contains a blocked loop, and may be the remains of a bawn wall. A tall gate pier at its W end is not bonded to the wall and appears to be a later feature. No corresponding features on historic mapping.	Post-medieval	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_21	KD010-057	N/A	Barberstown	Kildare	Barrow - ditch barrow	692558 / 731133	One of a group of nine ditch-barrows (KD010-057----/065-) located in same field. Cropmark of circular-shaped enclosure/barrow (approx. diam. 13m) intersected at E by field boundary visible on Google earth aerial imagery. Bisected by a field boundary to the east. In an arable field with a cluster of circular cropmarks to the south-west. No corresponding features on historic mapping.	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_22	KD010-058	N/A	Barberstown	Kildare	Barrow - ditch barrow	692523 / 731116	One of a group of nine ditch-barrows (KD010-057----/065-) located in same field. Cropmark of circular-shaped enclosure/barrow (approx. diam. 10m) visible on Google earth aerial imagery. No corresponding features on historic mapping.	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_23	KD014-096	N/A	Longtown	Kildare	Ring-ditch	690299 / 730172	Cropmark of circular-shaped ring-ditch (approx. diam. 10m) visible on Google earth aerial imagery. No corresponding features on historic mapping.	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_24	KD014-001	Recorded Monument	Ballynagappagh (Clane Ed)	Kildare	Ringfort - rath	684904 / 729057	On a very gentle NW-facing pasture slope. A small, poorly preserved, circular area (diam. 24m) is defined by a low, earthen bank (Wth 2.6-3.8m; int. H 0.4-0.6m; ext. H 0.8-1m) NW-NE-SE, partly hedged as a field boundary NE-E-SE, and abutted externally along N by a landscaped garden. A possible entrance on the N side, noted in 1972 (SMR file), is no longer clearly identifiable. The interior slopes gently down to NW and contains a coppiced hazel stand. Depicted on historic mapping as a sub-circular area with a field boundary abutting its eastern extent. Later mapping shows an earthwork of the north-eastern section only, with an area delimited by a dashed line	AD 500 – 1169	Record of Monuments and Places - County Kildare (1995) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							and shown as tree-covered. Aerial imagery (EirGrid Ortho photography) shows the areas as overgrown with trees / vegetation.		
AY_25	KD014-059	N/A	Ladycastle Upper	Kildare	Enclosure	690311 / 727931	Digital Globe aerial photograph shows the cropmark of a curvilinear enclosure (approx. diam. 58m N-S) defined by a fosse. Cropmarks of plough-levelled field boundaries located 110m to SSE; chronological relationship uncertain. Some of these field boundaries are depicted on the 1838 ed. OS 6-inch map. These linear cropmarks may be the remains of a field system of post-1700 date. No corresponding features on historic mapping. A sub-circular cropmark is visible on aerial imagery (EirGrid Ortho photography) to the east of a field boundary, in an arable field.	Unknown	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_26	KD014-032; RPS B14-07	Recorded Monument; Protected Structure	Firmount East (Clane Ed)	Kildare	Mound	686334 / 726464	On a low N-S ridge in mixed tillage and pasture. The monument is a partially overgrown, circular, round-topped, earthen mound (diam. at base c. 22m; diam. at top c. 5.5m; H c. 4m) with gently sloping sides, which are crossed NE-SW by old cultivation ridges. Visible on a 2005 aerial photograph (OSi Orthophoto). A circular mound is depicted on historic mapping, surrounded by a square boundary of trees. Later mapping depicted the circular mound in a field, identified as a 'moat'. A low mound is visible from the L2002, topped with trees.	12th - 13th century	Record of Monuments and Places - County Kildare (1995) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [07 November 2021]
AY_27	KD014-054	N/A	Millicent Demesne	Kildare	Font (present location)	687361 / 725841	The present location of a font found in the wall of the church tower (KD014-026002-) in Clane village (see KD014-026010- for its original location), but moved to the church of 'St Michael and All Angles' (consecrated in 1883) in Millicent. A plain, square, granite font (dims. L 0.68m; Wth 0.68m) contains a	Medieval	Archaeological Survey of Ireland SMR

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							square basin (dims. L 0.49m; Wth 0.49m; D 0.16m). (Bradley et al. 1986, vol. 2, 145)		
AY_28	KD014-040	Recorded Monument	Castlesize	Kildare	Castle - unclassified	688611 / 724877	According to the OSL (Herity 2002, 46 (141)) '… it is said, there was formerly a Castle, of which, a vestige does not remain now'. On the landscaped grounds of Castlesize house, c. 150m E of the River Liffey. There was no trace of the castle visible in 1985 (SMR file). The site of a castle is identified on historic mapping in the demesne of Castlesize (DL_18). No features perceptible in this location on aerial imagery.	Unknown	Record of Monuments and Places - County Kildare (1995) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_29	KD014-041003	N/A	Bodenstown	Kildare	Font	689044 / 724810	In Bodenstown church (KD014-041001-). Two granite pieces appear to be part of the same, possibly 13th century baptismal font. One piece is square (dims. L 0.67m; Wth 0.67m) with a central, circular perforation (upper diam. 0.23m; base diam. 0.009m) and forms part of the base. The second, slightly larger piece (dims. L 0.8m; Wth 0.8m) contains a shallow basin which has small, opposing mortices. Sherlock (1899-1902, 298-9) explains that the opposing mortices on a very similar font (KD014-042002-) from Sherlockstown, c. 1 mile to the ESE, would have contained 'iron rivets leaded into the stone for the cover and lock required by the Constitution of Edward, Archbishop of Canterbury, in 1236' .	Medieval	Archaeological Survey of Ireland SMR
AY_30; AH_13	KD014-041001-; RPS B14-02	Protected Structure	Bodenstown	Kildare	Church	689044 / 724808	A roll dated 1352 records the 'church of Baledwenii/Baldewynii/Baldewynye' (Bodenstown) as belonging to the priory of Connell and it was still recorded as a possession in an Inquisition of 1606 (Price 1953, 200-01). According to Sherlock (1909-11, 223), '… church, chancel and books (were) in good order about the year 1612 when Bodenstown was held along with the vicarage of Clane by John Golborne, Bishop and Archdeacon of Kildare.' In the N sector of a	Medieval	Archaeological Survey of Ireland SMR Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							graveyard (KD014-041002-). A fairly poorly preserved, ivy-clad, rectangular structure (int. dims. L 16.4m E-W; Wth 6.6m N-S) comprises the N, S and W walls of a nave, standing to full height and built of roughly dressed, uncoursed limestone, and the grassed-over foundation wall line of the E gable wall. A slightly raised, grassed-over area (L c. 7m E-W) immediately to the E is the site of a probable chancel, which appears to lie slightly off-line, to the S of the line of the nave. The nave is entered through a nice, round-headed doorway (Wth 1.05m; H 1.68m), with beam-slot hole inside the N jamb, to the N of centre of the W gable wall, which is surmounted by a bellcote. The nave is lit by a round-headed window in the W gable wall and by two, narrow windows in the S wall; one round-headed and the other square-headed. The nave contains fragments of a font (KD014-041003-) and Wolfe Tone's grave abuts the S wall. (Killanin and Duignan 1967, 228-9) A church is depicted on historic mapping as a rectangular structure with a projecting porch to the west. The church is positioned in the centre of a sub-rectangular graveyard. Later mapping identified the church 'in ruins' and includes 'Wolfe Tone's Grave'. The building is depicted as three walls (north, west, and south) with a projecting bay to the south. The church is located within its associated enclosed graveyard (AY_31), south of the L2010. The structure comprises the ruinous western gable and sections of the north and south rubble stone elevations. The remains of the western porch also remain.		2009 [11 October 2021]
AY_31	KD014-041002	N/A	Bodenstown	Kildare	Graveyard	689044 / 724781	On the S side of a road, on the narrow summit of a short, low, N-S pasture ridge in an area of mixed tillage and pasture. An almost square area (dims. L c. 70m; Wth c. 70m) is enclosed by a stone wall and entered from the road along the N. Contains a church (KD014-	Post-medieval	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25",

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							041001-) in the N sector, with the main concentration of burials to its S. The oldest, legible grave markers date to the 19th century and stand to the E and W of the church. The E and W perimeter and S-third of the interior are planted with palm trees. A square graveyard surrounded by a low rubblestone wall, with trees also lining the boundary. Includes a ruinous church and 'Wolfe Tone's Grave'. The extent of the graveyard has changed from that depicted on historic mapping, with an extension to the south.		1888-1913 Google StreetView 2009 [11 October 2021]
AY_32	KD014-062	N/A	Castlesize	Kildare	Barrow - unclassified	688409 / 724218	Cropmark of circular-shaped enclosure (approx. diam. 12m) visible on Google maps aerial photograph. Visible as a dark circular area of earth on aerial imagery (EirGrid Ortho photography) to the north of the Sallins Bypass, in an arable field. Forms part of a group of possible barrows, including AY_33 and AY_34.	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_33	KD014-073	N/A	Castlesize	Kildare	Barrow - ditch barrow	688644 / 724200	Cropmark of circular shaped enclosure (approx. diam. 7m) visible on Google Earth imagery taken 28/06/2018. No corresponding features depicted on historic mapping. Located in an arable field to the south of the Sallins Bypass. Forms part of a group of possible barrows including AY_32 and AY_34.	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_34	KD014-076	N/A	Castlesize	Kildare	Barrow - ditch barrow	688590 / 724128	Cropmark of circular shaped enclosure (approx. diam. 9m) visible on Google Earth imagery taken 28/06/2018. No corresponding features depicted on historic mapping. Located in an arable field to the south of the Sallins Bypass, immediately to the west of a field boundary. Forms part of a group of possible barrows including AY_32 and AY_33.	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_35	KD014-074	N/A	Castlesize	Kildare	Enclosure - large enclosure	688419 / 724116	Cropmark of large circular shaped enclosure (approx. diam. 90m) with entrance gap at S bisected by road excavation trench visible on Google Earth imagery taken 28/06/2018. In an area of arable fields, bisected by Sallins Bypass. No corresponding features depicted on historic mapping.	Unknown	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_36	KD019-081	N/A	Osberstown	Kildare	Ring-ditch	687886 / 722860	Cropmark of circular-shaped area (approx. diam. 10m) visible on Google earth aerial imagery. No corresponding features depicted on historic mapping. A possible circular cropmark, of similar size and form is visible on aerial imager to the west, along with a number of linear features which correspond with historic field boundaries. A darks area of soil is visible on aerial imagery (EirGrid Ortho photography).	Bronze Age	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_37	KD019-068	N/A	Jigginstown	Kildare	Fulacht fia	686867 / 719323	In 2005, archaeological monitoring (Licence no. 05E0442: www.excavations.ie) of topsoil-stripping associated with the construction of the Millennium Park Western Link Road identified a fulacht fia on the edge of a natural peat basin. It was subsequently excavated (Licence no. 05E0524: www.excavations.ie). A low, probably originally U-shaped mound (dims. L 8m N-S; Wth 6.8m) was composed of burnt sandstone, charcoal and peaty clay. A shallow rectangular trough (dims. L 1.5m; Wth 1.2m; D 0.2m) at the N edge contained a stake hole in each corner, suggesting it once contained a wooden structure. Some 23 stake-holes were found immediately S of the trough, of which 13 formed the outline of an oval structure. Material from the mound yielded a radiocarbon date of 3869 6 52 BP (2480-2190 cal BC at 2 sigma), while material from the trough returned 3926 6 71 BP (2620-2190	Bronze Age	Archaeological Survey of Ireland SMR https://excavations.ie/report/2005/Kildare/0013779/ [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							cal BC at 2 sigma). A second fulacht fia (KD019-028----) lay c. 400m to the W.		
AY_38[44]	KD019-032	Preservation Order; Register of Historic Monuments	Jigginstown	Kildare	Gatehouse	687900 / 718970	It may be one of two castles (see KD019-034---- also) in the possession of Roland FitzEustace in 1486 (Tickell 1960, 368). On level pasture c. 35m W of 'Jigginstown Castle' (KD019-033001-), a very substantial 17th century building, and c. 90m NNE of 'Castle Rag' (KD019-034----), a small tower house. A now blocked-up and partially ivy-clad, plain, rubble-built arch (dims. Wth 4.55m E-W; H 3.5m) springs from a solid rectangular column (dims. L 2.1m N-S; Wth 1.3m) on the W and from a small, rectangular, three-storied, tower with a substantial base batter (H2.85m) on the E, which projects N (L 1.8m) from the face of the archway (dims. L 3.9m N-S; Wth 2.6m). The tower is entered through a narrow (Wth 0.7m) square-headed doorway at the S end of its W wall, just inside the arch. Immediately inside on the left (N), a short, narrow passageway leads N to a small embrasure (dims. L 1.15m E-W; Wth 0.9m) containing a now blocked loop, looking E. The embrasure is floored with large flags one of which at W is broken and under which a narrow (Wth 0.8m), partially rubble-filled, sub-floor passage running E and then turning to run S can be seen. A spiral stairs, lit by a double-splayed loop looking S, climbs anti-clockwise to first-floor level where a partially robbed doorway leads W to a wall-walk above the archway. The stairs rises towards a second-floor, but the steps are in an unstable condition. Externally, there is a small garderobe ope (dims. Wth 0.3m; H 0.4m) just above ground level (H 1m) near the N end of the E wall. The remains of a bawn wall runs S from the SW angle of the tower (dims. traceable L c. 6.1m; H 2.9m; T 0.8m) and contains a loop.	15th century	Preservation Orders (2019) Kildare County Development Plan 2017 - 2023 Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2021 [07 November 2021]

[44] Please note this constraint is located beyond 100m from the route option(s); however, has been included as it forms part of the Jigginstown Castle complex.

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							The remains of a tower immediately adjacent to the R445. Overgrown with matures trees in close proximity. A brick and rubblestone wall with substantial buttresses and a rectangular building with a slate roof are located immediately to the west. Forms part of the Jigginstown Castle complex. A belt of established trees and vegetation lines the eastern boundary of the complex. Depicted on historic mapping as part of two long ranges adjacent to the road. Later mapping shows the roofless tower, depicted in a similar style to Castle Rag, with a long attached range extending to the east.		
AY_39	KD019-033001	National Monument; Register of Historic Monuments	Jigginstown	Kildare	House - 17th century	687999 / 718963	A National Monument (No. 528) in State care. Built in the 1630's by Thomas Wentworth, Earl of Stafford, and Lord Deputy of Ireland (1633-7) as a summer residence for himself and as an intended (but never used) residence for King Charles 1. Possibly designed by John Allen, its completion date is uncertain, but by the time of the Civil Survey (1654-6) it was already in ruins (Simington 1952, 66). The Stafford Papers of c. 1665 describe the house as having been, 'A Noble Howse built in Siggenstown by my Lords your ffather which cost £20,000. It is a Double Brick howse all in length, free stone about the Windowes and some Collumes and pavem[en]ts of Marble. The ffront thereof 120 yards and it is the largest and most magnificent front that ever I saw to w[hi]ch proportions the Gardens answere in a Square having a sweet rivulett running through it: fromerly very beautiful in Walles Groves and Trees. But now theise are not only cutt down and defaced but a great [?] of the floores in the middle p[ar]ts of the Howse are fal[l]en downe.' An extremely long (L c. 100m E-W; Wth c. 18m) mainly brick-built, tall single-storey (with possible attic accommodation) over basement structure comprises a central block originally flanked by two slightly	17th century	National Monuments in State Care: Ownership & Guardianship - Kildare (2009) https://www.logainm.ie/Eolas/Data/Brainse/logainm.ie-map-j-noble-and-j-keenan-1752-grand-jury-kildare-south.jpg [09 November 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [07 November 2021] https://digital.ucd.ie/view-media/duchas:4952388/canvas?manifest=https://data.ucd.ie/api/img/manifests/duchas:4952

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							projecting (N) wings; the W one of which has been removed. A winged staircase near the E end of the N wall provided access to the main entry, and there were two rear doors; one centrally placed and the second near the W end of the S wall. The basement is walled with mortared stone, lit by mullioned windows and roofed with brick vaulting while the main floor is walled with brick and lit by large, timber framed windows. A central spine-wall (E-W) supported pitched roofs to each side. Massive brick chimney stacks rise from stone bases in the basement, and have wide fireplaces lined with very small red bricks. An ongoing conservation programme was informed by a detailed survey of the building and some archaeological excavation (Licence nos. 01E1109 and 02E1603: www.excavations.ie). Construction debris for the house overlay the truncated remains of a ploughed field, which overlay a number of features (not excavated) probably associated with medieval pottery found in the residual ploughsoil, suggestive of earlier, medieval settlement possibly associated with a spring now located in the basement of the house. One of two large box drains carrying water from the basement (and from the roof via internal downpipes) was found to have failed. During construction, part of the drain close to the house had been exhumed and a temporary sump cut and filled, and a new drain appears to have been quarried into the north-west corner of the basement. The building was originally fully floored, roofed, and plastered internally. Finds suggest the building was roofed with slate and glazed ridge tiles. Part of the formal gardens (KD019-033003-) survive to S and traces of a large, possibly associated enclosure (KD019-030002-) were noted in 1979 (SMR file). An earthen bank set against the S-side of the building, providing a terrace overlooking the garden, had a limekiln (KD019-033004-) built into it, and a midden (KD019-033005-) was also found.		388 [07 November 2021] https://digital.ucd.ie/view-media/duchas:4819384/canvas?manifest=https://data.ucd.ie/api/img/manifests/duchas:4819384 [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							(Vicars 1891-5, 19-24; Fitzgerald 1915-17, 491; Strath 1935-45, 343-7; Leask 1941, 148-9; Costello 1946, 422; Costello 1966-7, 268; Killanin and Duignan 1967, 384; Craig 1971, 50-8; Harbison 1975, 122; Bence-Jones 1978, 161; Meagher 1979-80, 118; Fenlon 2011, 207-223) The ruins of a large brick house immediately adjacent to the R445. Overgrown with some mature trees in proximity. A modern metal security fence surrounds the buildings and scaffolding has been erected around both east and west gable ends. Forms part of the Jigginstown Castle complex. A belt of established trees and vegetation lines the eastern boundary of the complex. Jigginstown is depicted on Noble & Keenan's Map of county Kildare (1752) as a crenelated structure. Depicted on historic mapping as a substantial rectangular range, immediately to the south of the road and identified as 'The Buildings (in ruins)' with a rectangular garden and 'Jigginstown House' to the south. Later mapping shows the layout of the roofless house, identified as 'Jigginstown Castle (in ruins)', with a sunken garden and the later house to the south. Belonged to the great family of 'Geraldines' and is dated back to the sixteenth century. It is believed that as there was no means of transport that a human chain of men stretched from Dublin to Naas and passed the stones for the building from man to man. In Kildare the story is still credited. In any castle the castle must have been a magnificent structure and a very large one judging by the ruins still left. It is still in a fairly good state of preservation. There are underground cellars under the ruins of all the apartments. There is also an underground tunnel which runs from Naas to Newbridge. Situated on the Newbridge Road is the Jigginstown buildings. It was built in the seventeenth century by		

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							the Earl of Stafford who was viceroy in Ireland. He built it so to have a mansion suitable for the king in case King Charles ever came on a visit to Ireland. He got the brick from Denmark. A legend tells us that he had his men lined from Dublin to Naas and they passed the bricks from one to another till they arrived at Jigginstown. It is about one hundred and fifty yards long. There are many underground cellars in it. Before it was finished the Lord Deputy was called over to England and was beheaded for making friends with the Irish. A legend tells us that in one of the cellars is a spring well which used to supply the house with water. It is said that there is gold buried there and that a black dog minds it. There is a tunnel leading to Killashee from Jigginstown.		
AY_40	KD019-033004	Preservation Order	Jigginstown	Kildare	Kiln - lime	688005 / 718954	An ongoing conservation programme at Jigginstown House (KD019-033001-) was informed by a detailed survey of the building and some archaeological excavation (Licence nos. 01E1109 and 02E1603: www.excavations.ie). An upcast bank was found, set against the south side of the building, providing a terrace overlooking the large sunken garden (KD019-033003-). A limekiln was built into the bank and was used, perhaps, to provide the lime needed for the internal plaster. No corresponding feature is depicted on historic mapping. Not visible on aerial imagery. Located in a bank to the south of the main building, in a grassed area, encroached on by a clump of mature trees. Forms part of the Jigginstown Castle complex. A belt of established trees and vegetation lines the eastern boundary of the complex.	17th century	Preservation Orders (2019) Kildare County Development Plan 2017 – 2023 https://excavations.ie/report/2002/Kildare/0008231/ [09 November 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_41	KD019-033005	N/A	Jigginstown	Kildare	Midden	688007 / 718953	An ongoing conservation programme at Jigginstown House (KD019-033001-) was informed by a detailed survey of the building and some archaeological	17th century	Archaeological Survey of Ireland SMR https://excavations.ie/r

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							excavation (Licence nos. 01E1109 and 02E1603: www.excavations.ie). A midden was found and contained window glass and kitchen waste, and suggested that the house was occupied before construction was complete.		eport/2002/Kildare/0008231/ [05 November 2021]
AY_42	KD019-033002	Preservation Order; Register of Historic Monuments	Jigginstown	Kildare	Enclosure	688013 / 718951	The E-half (NNE-E-SSE) of a very large, possibly oval enclosure (est. diam. c. 150m N-S) is defined by an inner, flat-bottomed fosse (Wth 3m; D 1.4m), a slight, outer earthen bank, and a second, narrower, outer fosse (Wth 1.5m; D 1.4m). A field wall running N-S over the visible S-limits of the fosses contains two wide, flat, relieving-arches in line with them. These features would appear to have enclosed Jigginstown House (KD019-033001-) and garden (KD019-033003-), together with Castle Rag (KD019-034----) a small tower house, and a medieval gatehouse (KD019-032----). While the fosses may have been partly defensive, they probably also served landscaping and drainage functions. Modern development works have removed some surface elements, but sub-surface features are likely to survive intact. In 1996, archaeological monitoring (Licence no. 96E132: www.excavations.ie) of the excavation of a gas-pipe trench (Wth 0.85m; D 0.95-1.3m) along the main road running E-W through the enclosed area in front of Jigginstown House revealed that the road level had been built up in relatively modern times with an infill deposit of stone and clay which produced modern pottery. The original ground surface, a light yellow clay, lay at 1.3m below existing ground level. No corresponding feature is depicted on historic mapping. An ephemeral earthwork is visible on an historic aerial photograph in a field to the north of the complex. The earthwork comprises two parallel linear features, with a possible bank, running east-west. A similar, equally	17th century	Preservation Orders (2019) Kildare County Development Plan 2017 - 2023 Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 https://www.cambridgeairphotos.com/location/asw018/ [07 November 2021] https://www.cambridgeairphotos.com/location/asw017/ [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							ephemeral feature is also located in a field to the east of the complex. Forms part of the Jigginstown Castle complex.		
AY_43	KD019-033003	Preservation Order; Register of Historic Monuments	Jigginstown	Kildare	Designed landscape - formal garden	688001 / 718921	The Stafford Papers of c. 1665 describe Jigginstown House (KD019-033001-) and gardens as having been, 'A Noble Howse built in Siggenstown by my Lords your ffather which cost £20,000. It is a Double Brick howse all in length, free stone about the Windowes and some Collumes and pavem[en]ts of Marble. The ffront thereof 120 yards and it is the largest and most magnificent front that ever I saw to w[hi]ch proportions the Gardens answere in a Square having a sweet rivulett running through it: fromerly very beautiful in Walles Groves and Trees. But now theise are not only cutt down and defaced but a great [?] of the floores in the middle p[ar]ts of the Howse are fal[l]en downe.' According to tradition, the gardens were formally laid out with terraces and fishponds (Bence-Jones 1978, 161). The majority of these features have apparently been levelled by modern road-making and the construction of the Grand Canal, but the remains of a sunken garden (dims. L c. 80m E-W; Wth c. 55m N-S) and gazebo survive to the S of the house. An ongoing conservation programme was informed by a detailed survey of the building and some archaeological excavation (Licence nos. 01E1109 and 02E1603: www.excavations.ie). An upcast bank was found, set against the south side of the building, providing a terrace overlooking the remains of the garden. The bank was built up late in the construction of the house and was built against scaffolding. A limekiln (KD019-033004-) was built into the bank. The terrace around the sunken garden was not completed, sloping away to the east and exposing the rough footings of the house. The bank was poorly surfaced with a narrow path. There was no indication of planting before the current	17th century	Preservation Orders (2019) Kildare County Development Plan 2017 - 2023 Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							standing trees (planted in the early-20th C). An associated enclosure (KD019-033002-) may have served defensive, drainage and landscaping functions. A rectangular area is depicted to the south of Jigginstown Castle, with Jigginstown House towards the centre on historic mapping. The area is tree-lined and includes a drive from the road, leading to the house, and a smaller square area with trees to the south of the house. Later mapping shows this area to be sunken, with dispersed trees within. Aerial imagery shows the areas as grassed with a clump of mature trees, and a trees lining the eastern boundary. Forms part of the Jigginstown Castle complex.		
AY_44[45]	KD019-034	Preservation Order; Register of Historic Monuments	Jigginstown	Kildare	Castle - tower house	687866 / 718878	It may be one of two castles (see KD019-032---- also) in the possession of Roland FitzEustace in 1486 (Tickell 1960, 368). Stands near the top of a short, very gentle, N-facing, pasture slope, c. 100m SSE of a gatehouse (KD019-032----) and c. 110m SSE of Jigginstown House (KD019-033001-). A really small, almost square (ext. dims. L 5.1m ENE-WSW; Wth 4.65m; int. dims. L 3.3m ENE-WSW; Wth 2.85m), two-storied structure with parapets and a slightly projecting (L 0.9m) stairs tower at the N-angle is built of rough, rubble, limestone masonry with large, well-dressed quoins (wall T. 0.9m). The walls are not battered but taper inwards slightly towards the top. Entered through a partially robbed-out doorway in the ENE wall, the ground floor is lit by a double-splayed loop in each of the four walls and roofed by a barrel-vault (E-W) bearing traces of wicker-centring, under which beam-slot holes mark the floor line of a loft, which is lit by narrow loops in the ENE and WSW walls. The very narrow spiral stairs (Wth 0.6m) is accessed through a	15th century	Preservation Orders (2019) Kildare County Development Plan 2017 - 2023 Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

[45] Please note this constraint is located beyond 100m from the route option(s); however, has been included as it forms part of the Jigginstown Castle complex.

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
							plain, square-headed doorway in the N corner and is lit between ground and first-floor levels by a loop looking ENE and, above, by a slightly larger rectangular window looking NNW, and between first-floor and parapet level by a rectangular window looking ENE and, above, a loop looking WNW. The first floor is entered through a plain square-headed doorway in the N corner. The floor is lit by two opposing, large, partially robbed-out, square-headed windows with traces of window seats in the ENE and WSW walls, and a blocked loop is visible in the SSE wall. A robbed-out fireplace with red brick mantle-supports in the NNW wall is serviced by a chimney which projects from the outer wall face, supported on two corbels. The battlement level is inaccessible, but lower courses of crenelations and gutters survive on the projecting parapet, and the stairs tower is also crenelated. (Vicars 1891-5, 58; Fitzgerald 1921, 388-91) 'Castle Rag' is depicted on historic mapping in an large field surrounded by dispersed trees to the west of Jigginstown House, and south-west of the other possible tower house (AY_38). Later mapping identifies the tower as 'in ruins' and depicts the building as roofless. The surrounding trees are also no longer depicted. The tower house is surrounded by a rubblestone wall, in a grassy field set back from the road. The tower remains visible from the R445, to the north; however, is screened from the east by a mature tree line. Forms part of the Jigginstown Castle complex.		
AY_45	KD024-038	N/A	Stephenstown South	Kildare	Redundant record	687392 / 713131	Included on the SMR (1988) as 'Potential site - aerial photo' but subsequently 'Delisted' from the RMP (1995). The evidence was not deemed sufficient to warrant accepting this as an archaeological monument.	N/A	Archaeological Survey of Ireland SMR

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Location / Coordinates	Description	Approx. Date	Sources
AY_46	KD024-050004	N/A	Dunnstown	Kildare	Enclosure	687302 / 712740	One of six, small subrectangular cropmarks (KD024-050001- to KD024-050006-) visible on an aerial photograph (GSI N 337-6). Located in level, well-drained pasture. No earthworks were visible at the time of visit, but there was heavy grass cover. No corresponding features on historic mapping. No above ground remains.	Unknown	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_47	KD024-050005	N/A	Dunnstown	Kildare	Enclosure	687328 / 712725	One of six, small subrectangular cropmarks (KD024-050001- to KD024-050006-) visible on an aerial photograph (GSI N 337-6). Located in level, well-drained pasture. No earthworks were visible at the time of visit, but there was heavy grass cover. No corresponding features on historic mapping. No above ground remains.	Unknown	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AY_48	KD024-050006	N/A	Dunnstown	Kildare	Enclosure	687335 / 712719	One of six, small subrectangular cropmarks (KD024-050001- to KD024-050006-) visible on an aerial photograph (GSI N 337-6). Located in level, well-drained pasture. No earthworks were visible at the time of visit, but there was heavy grass cover. No corresponding features on historic mapping. No above ground remains.	Unknown	Archaeological Survey of Ireland SMR Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

Table A2: Inventory of Architectural Heritage Constraints

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
AH_01	NIAH 14404905	N/A	Phepotstown	Meath	Country house	689355 / 744178	Detached five-bay two-storey country house also MH049-107), built c.1780. Recessed single-bay two-storey wing and outbuilding attached to east end. Hipped slate roof with rendered chimneystacks and cast-iron rainwater goods. Timber sash windows with limestone sills. Timber panelled door with cast-iron fanlight above, set in ashlar limestone door surround. Former gate lodge to site, with all openings now blocked. Rendered entrance piers with	1760 - 1800	https://www.buildingsofireland.ie/buildings-search/building/14404905/larch-hill-larch-hill-demesne-phepotstown-meath [Accessed 11 October 2021].

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							limestone wheel guards and cast-iron double gates. The modest form of this country house is enhanced by the retention of many original features and materials, such as the slate roofs and timber sash windows. The façade is enlivened by the delicate decorative fanlight. The house forms an interesting group with the other related buildings and structures, such as the outbuildings, walled garden and follies, which were built by Robert Watson and create a picturesque ferme ornee. The house is set within its demesne lands (DL_04) which includes a former gate lodge, mausoleum (MH049-105), and folly (NIAH 14404908), as well as rendered entrance piers with limestone wheel guards and cast-iron double gates. Tradition notes a previous owner believed he would return after death as a fox so constructed a fox-cover in the grounds.		Google StreetView 2019 [11 October 2021] https://digital.ucd.ie/view-media/duchas:4782508/canvas/duchas:4740627?manifest=https://data.ucd.ie/api/img/manifests/duchas:4782508 [Accessed 4 November 2021].
AH_02	RPS MH049-110	Protected Structure	Rodanstown	Meath	Church	690574 / 741328	Rodanstown Church A ruinous church set within an oval graveyard (AY_05), on the site of a medieval parish church. The stone structure comprises a roofless single storey, rectangular building with a large apse. The arched windows have been blocked up. The church is located in an elevated position, overlooking the bend in the road, surrounded by a number of memorials within the graveyard and enclosed by a low rough-cast wall. Views to the south and west limited by a mature belt of trees. A church is depicted on historic mapping as a rectangular building, orientated north-west to south-east; however, later mapping shows the curved apse, as well as the east-west orientation, of the current structure.	Post-medieval	Record of Protected Structures Google StreetView 2019 [11 October 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AH_03	RPS MH049-	Protected Structure	Moyglare	Meath	Church	692697 / 739762	Saint Paul's Church of Ireland Church Former church, built c.1870, with four-bay side elevations to nave, single-bay chancel to west, three-stage tower with ashlar limestone spire to north-east corner and entrance	1860 - 1880	https://www.buildingsofireland.ie/buildings-search/building/14404901/saint-pauls-

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
	112; NIAH 14404901						porch to south elevation. Now in use as a detached house. Pitched slate roofs with ridge cresting, limestone copings, limestone eaves dentils and cast-iron rainwater goods. Snecked and rock-faced limestone walls with buttresses and ashlar limestone quoins and dressings to openings. Cast-iron tracery to pointed window openings. Timber battened doors with strap hinges. Ashlar limestone piers with wrought-iron double gates and dressed limestone boundary walls. Graveyard to site. Saint Paul's Church, designed by Edward Mc Allister, is of an architectural form and design which is typical in many ways of church design in the late nineteenth and early twentieth centuries. The articulation of each section of the church into separate blocks is an interesting feature of this era. The tower, transepts, apse, vestry and porches are clearly identifiable forms from the exterior of the building. The treatment of the ashlar masonry is also representative of this time, with the rock-faced limestone contrasting with the ashlar limestone dressings, which add textural variation to the site. The carved stone gate piers, wrought-iron gates and carved stone grave markers enhance the setting of the church. A church is depicted on historic mapping within a roughly square graveyard. An additional building is also depicted to the north of the church. Later mapping shows this building in a square enclosure. The church is set within its associated graveyard, bounded by a low coursed rubble stone wall, with vertical copes. The church overlooks Moygale Road to the north, and fields to the south. While some mature trees are located within the boundary of the graveyard, views to and from the church are largely uninterrupted.		church-of-ireland-church-moyglare-meath [Accessed 11 October 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021]
AH_04	RPS B10-10; NIAH 11901005	Protected Structure	Donaghstown	Kildare	Church / chapel	690582 / 734759	Donaghstown Catholic Church Detached seven-bay double-height Gothic-style Catholic church, c.1870, comprising five-bay double-height nave with lancet-arch openings, single-bay three-stage engaged	1850 - 1890	http://www.buildingsofireland.ie/niah/search.jsp?type=record&county=KD&regno=11901005

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							corner tower to west on a square-plan with spire and two-bay double-height lower chancel to north-east gable end having single-bay single-storey sacristy projection to north-west. Gable-ended roof with slate (gabled to sacristy projection). Clay ridge tiles. Cut-stone coping to gables with trefoil motif. Cut-stone chimney stack to gable to sacristy projection. Cast-iron rainwater goods with decorative hoppers. Pyramidal roof to spire with slate (fish-scale pattern). Hammer-dressed snecked limestone walls. Stepped buttresses to corners. Lancet-arch window openings (paired to south-west gable end; tripartite to north-east gable end with hood moulding over). Cut-stone chamfered block-and-start surrounds. Fixed-pane leaded windows. Lancet-arch openings to tower. Louvered timber panels to top stage. Pointed-arch door opening. Cut-stone chamfered surround. Hood moulding over. Timber panelled doors. Full-height interior open into roof. Glazed timber panelled internal porch. Exposed timber roof construction on cut-stone corbels. Gothic style altar and reredos to chancel. Set back from road in own grounds. Lawns to site. Rubble stone boundary wall to site. Donaghstown Catholic Church is a fine example of a mid to late nineteenth-century Gothic style church, which retains much of its original aspect. Composed on a simple, almost single-cell plan the scale of the church and the plain treatment of the external elevations achieves an atmosphere of intimacy. Many original features and materials survive intact, including the early leaded fenestration and a slate roof. The interior is also of considerable interest with a chancel that contains fittings of artistic interest, while the exposed timber roof construction is of some technical/engineering merit. The church is attractively set within its own landscaped grounds and the soaring spire is a prominent landmark that articulates the skyline. Prominently located on a wedge-shaped site on the crossroads the church is of social and historic significance as the ecclesiastical centre for the		[Accessed 11 October 2021] Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							Catholic population in the locality. The church is depicted on historic mapping, labelled 'R.C. Church'. The church is located on a wedge of land on the junction between the R408 and L5037 and is bounded by a low coursed rubblestone wall, and landscaped grounds. Views from the church are across the carriageways towards fields to the south and west. Views north and east are limited by a hedgerow, established vegetation, and buildings.		
AH_05	RPS B10-09; NIAH 11901002	Protected Structure	Rathcoffey North	Kildare	Church / chapel	688134 / 732622	Catholic Church of the Sacred Heart Detached two-bay double-height Gothic-style Catholic church, c.1820, on a cruciform plan comprising single-bay double-height nave with single-bay double-height transepts to north and to south (with flights of external steps to first floors) and single-bay double-height polygonal apse to east having pair of single-bay single-storey projecting polygonal flanking porches. Gable-ended roofs with slate (polygonal roofs to apse and to porches). Clay ridge tiles. Stone cross finials to gables to transepts. Cast-iron rainwater goods with trefoil motif to brackets. Nap rendered walls. Painted. Pointed-arch window openings. Stone sills. Fixed-pane stained glass windows. Square-headed door openings. Timber panelled doors. Double-height interior. Timber pews. Balustraded timber galleries to first floor to transepts. Decorative Gothic-style marble altar. Set back from road in own landscaped grounds. Freestanding belfry, c.1860, to south on a square plan with iron bell and slate roof. Gateway, c.1820, to east comprising pair of rendered piers with pair of cast-iron inner piers having decorative cast-iron gates with quatrefoil motif and fleur-de-lis finials. The Catholic Church of the Sacred Heart is a fine example of an early nineteenth-century pre-Emancipation church. Of modest scale and simple plan, with little ornamentation to the elevations of the nave, the church achieves a curious effect by being set with an almost blank east end facing the	1800 - 1840	http://www.buildingsofireland.ie/niah/search.jsp?type=record&county=KD&regno=11901002 [Accessed 11 October 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							road - the combination of three polygonal bays (the apse and two porches) is an unusual feature. Also unusual are the flights of external stairs that access the galleries to the transepts, which allude to Italian models in their concept. The building retains many early or original features, including fenestration and slate roofs, while the interior is also of considerable interest including a marble altar that is of artistic importance. The church was patronised by a committee of local landlords, which emphasises the social and historic significance of the building as the ecclesiastical centre for the Catholic population in the region. Set within its own landscaped grounds, the church is an attractive feature in the area. The gates to the entrance are of considerable artistic merit and represent fine examples of early surviving cast-iron work. The church is depicted on historic mapping as a 'chapel', then later 'R.C. Church'. The church is set back from the R408 within its associated grounds, with views outward limited by established trees and vegetation.		
AH_06	RPS B10-14; NIAH 11901001	Protected Structure	Moortown (Ikeathy By)	Kildare	Thatched Dwelling	687159 / 732329	Detached five-bay single-storey lobby entry thatched house, extant 1837, on an L-shaped plan originally three-bay single-storey on a rectangular plan; single-bay (two-bay deep) single-storey projecting end bay with half-dormer attic (east). Pitched oat straw thatch roof, rope twist ridge with paired exposed stretchers having exposed scallops, rendered dwarf chimney stack on a T-shaped plan having concrete capping, and blind stretchers to eaves having blind scallops; pitched artificial slate roof (east) with ridge tiles, and cast-iron rainwater goods on roughcast eaves with cast-iron downpipes. Roughcast battered walls. Square-headed door opening with concrete threshold, and concealed dressings framing timber boarded door. Square-headed window openings with concrete sills, and concealed dressings framing one-over-one timber sash windows. Street fronted. A house identified as an integral component of the	1700 - 1837	Record of Protected Structures https://www.buildingsofireland.ie/buildings-search/building/11901401/ballynagappagh-clane-ed-kildare [Accessed 11 October 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							vernacular heritage of County Kildare by such attributes as the lobby entry plan form; the construction in unrefined local materials displaying a feint battered silhouette with sections of "daub" or mud suggested by an entry in the "House and Building Return" Form of the National Census (NA 1901; NA 1911); the disproportionate bias of solid to void in the massing; and the high pitched roof showing an oat straw thatch finish: meanwhile, aspects of the composition clearly illustrate the continued linear development or "improvement" of the house. Having been well maintained, the form and massing survive intact together with quantities of the original fabric, both to the exterior and to the interior, thus upholding much of the character or integrity of a house making a pleasing visual statement in a sylvan street scene. The house is depicted on historic mapping as a rectangular structure immediately adjacent to the road. Later mapping shows the house with other buildings to the east and south. The original single storey range has been joined with a later one and a half storey building to the east, and a single storey extension has been added to the west, with roughcast walls and a slate roof. Positioned immediately on Mooretown Drive, the house overlooks the road. While the view north is directly over the carriageway, views in other directions are screened by the surrounding established vegetation and trees, and other residential buildings.		
AH_07	RPS B10-17	Protected Structure	Barberstown Upper	Kildare	House	692708 / 731810	Greygates (house) Depicted on historic mapping as a rectangular building with projecting bays / extensions to the north, as well as a detached building. Located to the south-east of a gravel pit, in an enclosed plot. The house comprises a modest one and a half storey, five bay house, positioned perpendicular to the R406, of coursed rubble stone construction. Boundary of the plot remains extant; however, the outbuilding appears to have	Post-medieval	Record of Protected Structures Ordnance Survey 25", 1888-1913 Google StreetView 2017 [11 October 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							been replaced with a concrete structure and the projecting bays / extensions are no longer present.		
AH_08	RPS B10-12	Protected Structure	Barberstown	Kildare	House	692724 / 731299	Barberstown House Located on the roundabout junction between the R406 and R403, the house comprises a five bay, two-storey double pile building with an extension to the north gable. A complex of stone ranges arranged in a courtyard plan are located to the north. The principal view from the house is east, over the R406, across open fields. Views south and west (across a large lawn) are limited by established vegetation and mature tree lines. The current house appears to have replaced the 'L'-shaped 'Barberstown Cottage' depicted on historic mapping in the late 19th or early 20th century.	Post-medieval	Record of Protected Structures Google StreetView 2019 [11 October 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
AH_09	RPS B10-08	Protected Structure	Barberstown	Kildare	Castle	692669 / 731155	Barberstown Castle The castle is depicted on historic mapping with three accompanying ranges to the west, positioned in a courtyard plan, and a lodge to the east in laid out grounds. Later mapping shows the grounds sub-divided and further buildings in the complex. A 'castle' is also labelled in gothic text indicating the location of the preceding medieval structure. The tower house comprises a coursed rubble masonry structure with two square corner towers with battered bases. The castle, now a hotel, has been extended and modified. Baberstown Castle comprises a large country house complex, now a hotel, that has been extended and altered, and includes a medieval tower house (KD010-022) with an associated roughly coursed rubble bawn wall (AY_20). The complex is set within established landscaped grounds, with views in all directions limited by intervening vegetation, trees and buildings.	Post-medieval	Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2017 [11 October 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
AH_10	RPS B14-75	Protected Structure	Irishtown Lower	Kildare	House	690554 / 729463	Irishtown House Depicted on historic mapping, perpendicular to the drive, overlooking the River Liffey within its demesne lands (DL_12), with a ruined river bridge to the south. Later mapping shows the house with a substantial complex of buildings to the east, including a 'tank' and 'pump', a foot bridge is depicted to the south. The house comprises a double pile structure with two additional gable bays extending to the east and west. The view to the south is across the garden towards the river and north across pasture fields. The complex of buildings to the east remains; however, some of the ranges have been replaced with modern agricultural buildings. The river bridge and pigeon house remain extant to the south and west respectively.	Post-medieval	Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google aerial imagery [06 November 2021]
AH_11	RPS B14-36; NIAH 11901401	Protected Structure	Ballynagappagh	Kildare	Thatched House	685048 / 729269	Detached five-bay single-storey direct entry thatched farmhouse, extant 1837, on a rectangular plan with single-bay single-storey lean-to windbreak. Hipped oat straw thatch roof overhanging lean-to slate roof (windbreak), rope twist ridge with grouped exposed stretchers having exposed scallops, rendered dwarf chimney stacks supporting terracotta or yellow terracotta tapered pots, and blind stretchers to eaves having blind scallops. Roughcast battered walls on rendered plinth. Square-headed door opening with concealed dressings framing timber panelled door. Square-headed window openings with concrete or rendered sills, and concealed dressings framing one-over-one timber sash windows. Set perpendicular to road with roughcast piers (south) or roughcast cylindrical piers (north) having capping supporting flat iron double gates. A farmhouse identified as an important component of the vernacular heritage of County Kildare by such attributes as the alignment perpendicular to the road; the elongated rectilinear direct entry plan form; the construction in unrefined local material displaying a battered silhouette	1700 - 1837	Record of Protected Structures https://www.buildingsofireland.ie/buildings-search/building/11901401/ballynagappagh-clane-ed-kildare [Accessed 11 October 2021] Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							with sections of "daub" or mud suggested by an entry in the "House and Building Return" Form of the National Census (NA 1901; NA 1911); the disproportionate bias of solid to massing; and the high pitched roof showing an oat straw thatch finish. Having been well maintained, the form and massing survive intact together with substantial quantities of the original fabric, both to the exterior and to the interior, thus upholding the character or integrity of the composition. Furthermore, adjacent "tin roofed" outbuildings (----) continue to contribute positively to the group and setting values of a self-contained ensemble making a pleasing visual statement in a rural street scene. The house is depicted on historic mapping as a detached building, rectangular in plan, positioned roughly perpendicular to the road. The building is set within an irregular enclosure, with two other small ancillary buildings to the north-east and north. Later mapping shows further ranges added to the coplex, including a long rectangular range immediately to the north-east, and an 'L'-shaped range to the north. A single-storey range positioned perpendicular to the R408, with an adjacent range extant to the north-east (with later corrugated roof). A low rendered boundary wall (approximately 0.6km in length) bounds the road, with two sets of gatepiers to north-west. A small modern lean-to has been added to the building. Forms part of a working farmyard.		
AH_12	RPS B14-12	Protected Structure	Millicent Demesne	Kildare	Church and Lych Gate	687348 / 725849	Millicent Church and Lych Gate Located within Millicent House demesne (DL_17), the church comprises a Hiberno-Romanesque building. The church was consecrated in 1883. The church is not depicted on historic mapping dating to the mid-19th century; however, is shown on later mapping, with the lych gate to the south-west, surrounded by a rectangular graveyard. Located on a rise towards the centre of the parish of Clane,	1880s	Record of Protected Structures https://www.kildare.ie/ehistory/index.php/church-of-st-michael-and-all-angels-millicent-clane/ [Accessed 11 October 2021] Ordnance Survey 6",

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							the church comprises a cruciform plan building, orientated east-west, with short transepts and a central square tower (visible for some distance), a projecting porch is located to the south. The lych gate comprises a four bay, rectangular covering to the shallow stepped entrance, with transverse gables, and a gate mid-way. It has a slate pitched roof with decorative ridge pieces and bargeboards. The lych gate appears to have been restored in March 2011. The church is set within a rectangular treelined graveyard with an established hedgerow bounding the L2002.		1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021] Google StreetView 2011 [11 October 2021]
AH_13	RPS B14-02	Protected Structure	Bodenstown	Kildare	Church and graveyard	689044 / 724811	Bodenstown Medieval Church Ruins and Wolfe Tone's Grave A church and graveyard is depicted on historic mapping, adjacent to the road through Bodenstown to the west of the crossroads. The building is shown as a rectangular structure with a projecting porch to the west. Later mapping identified the church 'in ruins' and includes 'Wolfe Tone's Grave'. The building is depicted as three walls (north, west, and south) with a projecting bay to the south. The church is located within its associated enclosed graveyard (AY_31), south of the L2010. The structure comprises the ruinous western gable and sections of the north and south rubble stone elevations. The remains of the western porch also remain.	Medieval	Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2009 [11 October 2021]
AH_14	RPS B14-34	Protected Structure	Castlesize	Kildare	Gate lodge	688691 / 724806	Gate Lodge and entrance gates/walls to east of Castlesize House A lodge is depicted on historic mapping as a small rectangular building to the north of the driveway to Castlesize House (B14-13). Later mapping identifies the building as a 'lodge'. A single storey rendered lodge, with slate roof, building located within the Castlesize demesne (DL_18). Positioned on the driveway to the main house, the lodge is set behind a high stone boundary wall to the north of the entrance	Post-medieval	Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2018 [11 October 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							gates (off the R407), surrounded by mature trees and established vegetation.		
AH_15	RPS B14-27C	Protected Structure	Millicent Demesne	Kildare	House	687860 / 724793	Square plan two-storey house with (later?) conservatory and outbuilding. Millicent Estate Houses Located within Millicent Demesne (DL_17), a small rectangular building is depicted on historic mapping to the north of the drive to Millicent House (B14-26), to the west of a small bridge crossing a minor watercourse. Later mapping depicts the building as having a projecting bay on the northern elevation and two small projecting porches, and identifies it as a 'lodge'. The building comprises a square plan, two-storey house with a conservatory and outbuilding, both possibly of a later date. The house is surrounded by established gardens and woodland to the south-east. The principal elevation of the house is to the south-east, across a private access track. Millicent Road to the west is screened by an established boundary hedge.	Post-medieval	Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021]
AH_16	RPS (no reference)	Protected Structure	Jigginstown	Kildare	House	687993 / 718977	Jigginstown Castle and Environs Detached red brick country house (in ruins) c1630 A large rectangular building is depicted immediately to the south of the road through Jigginstown on historic mapping, with two smaller ranges to the west and 'Jigginstown House' to the south. Later mapping identified the castle as 'in ruins' and shows a tree-lined boundary between the building and the road. A sunken area is shown immediately to the south, and several other buildings are depicted in proximity. The castle is located immediately to the south of the R445. Local legend states men lined from Dublin to Naas and passed the bricks along the line to build the house, that there is gold buried beneath the house guarded by a black dog, and a tunnel leads from Jigginstown to Killashee.	Post-medieval	Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021] https://digital.ucd.ie/view-media/duchas:4819384/canvas?manifest=https://data.ucd.ie/api/img/manifests/duchas:4819384 [4 November

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
									2021] https://digital.ucd.ie/view-media/duchas:4952388/canvas?manifest=https://data.ucd.ie/api/img/manifests/duchas:4952388 [4 November 2021]
AH_17	RPS NS19-079	Protected Structure	Jigginstown	Kildare	Tower House (in ruins)	687866 / 718877	Castle Rag Depicted on historic mapping as a small square in plan tower house identified as 'Castle Rag'. Later mapping identifies the castle 'in ruins'. Set within a rubble stone walled enclosure, the square tower is ruinous. It comprises a three storey tower house with small rectangular windows on the north-east elevation. Set back from the R445, the tower house is surrounded by grass fields with modern housing to the south, and Jigginstown Castle to the north-west.	Post-medieval	Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2019 [11 October 2021]
AH_18	RPS NS19-115	Protected Structure	Bluebell	Kildare	Farm house	688798 / 717262	Bluebell Farm House Originally three-bay two-storey Victorian farm house The house is depicted on historic mapping as a rectangular range adjacent to the road between Bluebell and Broadfield. Later mapping shows a projecting bay to the east, and associated ranges to the south forming a yard. The house forms part of a working farmyard and is enclosed by a high rubblestone boundary wall. Views west are towards and across Kilcullen Road (both the former alignment and newer alignment); however, these are largely screened by the boundary wall.	Post-medieval	Record of Protected Structures Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView 2017 [11 October 2021]

Table A3: Inventory of Gardens and Designed landscapes

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
DL_01	N/A	N/A	Mullagh	Meath	Garden and Designed Landscape		Glebe House Demesne associated with Glebe House ('Paget Priory' on 25" OS mapping). Mature trees, hedges and low stone boundary wall with cast iron railings mark the boundary with the R156 and R126. Roughcast and painted gate piers (3) on junction with R125 / R126, with cast iron gate, leading to drive as depicted on historic mapping.	Post-medieval	Google StreetView (2021) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
DL_02	N/A	N/A	Jenkinstown	Meath	Garden and Designed Landscape		Jenkinstown House Demesne associated with Jenkinstown House. Mature trees and a ditch mark the boundary alongside the R156, a roughcast wall, with crenelated cope, square gate piers, and cast-iron gate are located at the entrance / drive.	Post-medieval	Google StreetView (2021) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
DL_03	NIAH 5151	N/A	Phepotstown	Meath	Garden and Designed Landscape		Phepotstown House Hedgerows and mature trees, roughcast walls and gate piers, with cast iron gates, leading onto drive / avenue. Wall continues along R125 with battened buttresses and unrendered sections. Mature woodland / hedges bound R125 until second entrance with sections of lower wall, cylindrical columns and decorative cast iron railings and gates onto drive.	Post-medieval	Google StreetView (2019 & 2021) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
DL_04	NIAH 5104	N/A	Phepotstown	Meath	Garden and Designed Landscape		Larch Hill House Buildings indicated, not named Established trees / hedgerows bound the R125, to gate entrance with lodge house (and additional ancillary building). Rendered walls and four square piers with cast iron gates which lead to a second set of piers beyond the lodge, along the drive. Low rubble stone wall runs from entrance to carriageway. Established boundary continues along R125, southern boundary established woodland belt. See also NIAH 14404905.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/5104/larch-hill-house-kilmore-co-meath Google StreetView (2019 & 2021) Ordnance Survey 6", 1837 – 1842

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
									Ordnance Survey 25”, 1888-1913
DL_05	N/A	N/A	Rodanstown	Meath	Garden and Designed Landscape		Rodanstown House Boundary of this demesne is still perceptible; however, features including the woodland / boundary trees and ‘L’-shaped range appear to have been removed. Modern agricultural buildings are located on the site with a range, positioned perpendicular to the road, still extant. Stone, roughcast and brick walls and low hedges bound the road, some of this boundary has been replaced with modern concrete blocks. Rendered gate piers and cast-iron gates lead onto drive to main house. Drive follows same alignment and garden wall remains extant.	Post-medieval	Ordnance Survey 6”, 1837 – 1842
DL_06	NIAH 5697	N/A	Calgath	Meath	Garden and Designed Landscape		Calgath House A significant number of modern agricultural buildings have been constructed on this site. Mature trees / low hedges to large roughly coursed rubblestone entrance wall / piers, iron gates with modern lanterns atop gate piers, leading to driveway. Along R125 wall replaced by a modern wooden fence, then continues as hedgerow.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/5697/calgath-house-co-meath Google StreetView (2019 & 2021) Ordnance Survey 6”, 1837 – 1842 Ordnance Survey 25”, 1888-1913
DL_07	NIAH 4983	N/A	Calgath	Meath	Garden and Designed Landscape		Brides Stream House Buildings indicated, not named Rendered entrance walls and gate piers, metal gate (modern replacement). Entrance appears to have been made narrower. R126 bounded by a low stone wall and ditch, with mature hedge / tree line. Southern entrance of bend in R125 comprises a semi-circular recessed entrance, with rendered stone wall, cast iron railings and cylindrical gate piers with cast iron gates. Driveway appears to be overgrown / disused. Second entrance comprises a rendered stone wall bounding the carriageway with a	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/4983/brides-stream-house-rodanstown-co-meath# Google StreetView (2019 & 2021) Ordnance Survey 6”, 1837 – 1842

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							recessed cast iron gate and square gatepiers. Wall continues along the R125 a short distance with two square piers towards the centre. Entrances either side of the lodge. Walling of the same character appears to run perpendicular to the southern entrance, along the edge of the demesne land.		Ordnance Survey 25", 1888-1913
DL_08	NIAH 5556	N/A	Dollardstown	Kildare	Garden and Designed Landscape		Dollardstown House Possibly wrong location.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/5556/dollardstown-house-co-kildare
DL_09	NIAH 1911	N/A	Dowdstown	Kildare	Garden and Designed Landscape		Dowdstown House Principal building remains extant; however, this demesne has been largely redeveloped.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1911/dowdstown-house-laraghbryan-co-kildare
DL_10	NIAH 1884	N/A	Painestown	Kildare	Garden and Designed Landscape		Painestown House Buildings indicated, area to west labelled Painestown. Fair amount of woodland from historic OS mapping no longer present. R407 bounded by established hedgerow and mature trees. Pair of small gatepiers and cast-iron gate, recessed from carriageway, leading on to driveway. Hedgerow continues and is replaced by a post and rail fence, with mature trees lining the carriageway. Later entrance further south.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1884/painestown-house-balraheen-co-kildare Google StreetView (2019 & 2021) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
DL_11	NIAH 1894	N/A	Rathcoffey Demesne	Kildare	Garden and Designed Landscape		Rathcoffey House Principal building remains; however, is ruinous. Boundary of demesne still perceptible; however, the area is largely agricultural, and fields have been consolidated. Round tree-topped earthwork feature still extant. Historic divisions (i.e. garden boundary, field divisions) visible as	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1894/rathcoffey-house-balraheen-co-kildare

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							cropmarks on aerial photographs. Drive off School Road still on same alignment, with stone entrance walls / gate piers (modern gate).		
DL_12	NIAH 1900	N/A	Ladycastle Lower; Irishtown Lower	Kildare	Garden and Designed Landscape		Irishtown House Principal building remains extant; however, a large portion of this demesne has been redeveloped into a golf course. Local access follows alignment of drive on historic mapping. A circular pigeon house is depicted on historic mapping, and remains extant to the west of the main house. Fields have been consolidated and trees removed. Some boundaries and avenues still perceptible. Includes an area of Ladycastle Lower, also much changed.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1900/irishtown-house-straffan-co-kildare Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
DL_13	N/A	N/A	Ladycastle Upper	Kildare	Garden and Designed Landscape		Ladycastle Large area of parkland depicted on historic mapping, south of the River Liffey. However, largely redeveloped as a golf course.	Post-medieval	Ordnance Survey 6", 1837 – 1842
DL_14	NIAH 1882	N/A	Firmount Demesne	Kildare	Garden and Designed Landscape		Firmount House Building indicated, area to north east labelled Firmount East Rendered wall with flat cope immediately adjacent to the L2002, includes small doorway towards north. Modern entrance has been added to north corner as access to new house. Small square building in south-east corner of walled garden (possible gazebo / dovecote). Later entrance also added to south of walled garden (although not replacing a section of the wall as above), leads to tree-lined avenue. L2002 bounded by modern post and rail fence, ditch and tree line. Second entrance completely replaced, with third and forth brick and stone entrances to modern housing. Hedgerow continues.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1882/firmount-house-clane-co-kildare Google StreetView (2019 & 2021) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
DL_15	NIAH 1883	N/A	Firmount East	Kildare	Garden and		Moatfield House Building indicated, not named Modern entrance in west corner. Ditch and established	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1883/moat

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
					Designed Landscape		hedgerow bound the L2002. Two new entrances (including post and rail fencing). Field entrance in same location as historic OS mapping (modern gate, possibly older posts). Recessed stone entrance, rubble stone wall with simple square gate piers and metal gates, drive leads up to house (B14-18) - wide tree-lined avenue. Lodge no longer extant. Low established hedge continues along L2002.		field-house-clane-co-kildare Google StreetView (2019 & 2021) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
DL_16	NIAH 1890	N/A	Blackhall	Kildare	Garden and Designed Landscape		Blackhall Main house and agricultural ranges remain extant. Layout of gardens and areas of trees / woodland also remain. Some subdivision of parkland and development; however, drives and belts of trees along boundary with R407 remain. Later ashlar entrance / gate piers adjacent to lodge. Entrance to main house set back from R407.	Post-medieval	Ordnance Survey 6", 1837 – 1842
DL_17	NIAH 1889	N/A	Millicent Demesne	Kildare	Garden and Designed Landscape		Millicent House Woodland and established hedgerow adjacent to carriageway leading to lych gate for church. Hedgerow continues with intermittent field accesses and mature trees, more recent accesses to properties, including section of rendered wall. Modern post and rail fence continues after housing, with a ditch and mature trees adjacent to road. Modern farm entrance on bend (roughcast single storey building depicted on historic OS (25") mapping. Hedgerow and ditch continue along road following farmyard, with sections of mature trees. Following Blundell's Bridge trees and hedge thin / have been removed. Ditch, hedgerows and trees continue beyond new house, however, are replaced by low privet and modern entrances and post and rail fencing further along Millicent Road. Large extant lodge, with rubble stone wall lined entrance and drive up to main house. Rubble stone wall continues along carriageway, some sections showing signs of repair. Replaced by post and rail fence for a section. Wall continues to entrance with second extant	Post-medieval	Google StreetView (2019 & 2021) Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							lodge, includes square ashlar gate piers and cast-iron gates, with drive leading to main house. Rubble stone wall continues from entrance, lining both sides of carriageway, to Millicent Bridge.		
DL_18	NIAH 1893	N/A	Castlesize	Kildare	Garden and Designed Landscape		Castlesize Some internal change; however, buildings and layout generally the same as depicted on historic mapping. Entrance opposite junction between the R407 and Castlesize Green includes entrance walls, gate piers, and cast-iron gates. Roughcast, with possible later sections. Boundary wall adjacent to R407 rubblestone construction with alternate vertical and horizontal copes, and second entrance, leading on to disused drive.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1893/castlesize-bodenstown-co-kildare Ordnance Survey 6", 1837 – 1842
DL_19	NIAH 1887	N/A	Osberstown	Kildare	Garden and Designed Landscape		Osberstown Hill Principal building and some agricultural ranges to the south remain extant. Largely the same layout as depicted on historic mapping; however, majority of parkland trees appear to have been removed. Roadside boundary is a modern post and rail fence. Driveway slightly altered (matches Ordnance Survey 25").	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1887/osberstown-hill-naas-co-kildare Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
DL_20	NIAH 1980	N/A	Killashee	Kildare	Garden and Designed Landscape		Killashee House Buildings indicated, labelled School, area labelled Killashee. R448 cuts through western limit of demesne land until Killashee School. Boundary established hedgerows and ditch, with field accesses and post and rail sections (modern). A section of roughly coursed rubble stone wall to south of demesne, with later recessed entrance on junction with local access.	Post-medieval	https://www.buildingsofireland.ie/buildings-search/site/1980/killashee-house-killashee-co-kildare#

Table A4: Inventory of Cultural heritage sites

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
CH_01	N/A	N/A	Culcommon	Meath	Road Bridge	694713 / 746280	The western coursed, squared, rubble stone parapet of a road bridge or culvert carrying a single lane carriageway over a small watercourse depicted on historic mapping. Half-round copes, rendered. Only one side (west) remains extant.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_02	N/A	N/A	Warrenstown	Meath	House	691765 / 745557	'Jenkinstown House' depicted on historic mapping comprising the main house and a long range to north (other buildings appear to have been replaced). Two-storey, three bay house, with gable stacks, rendered. Later extension added to north gable (one and a half storey). Agricultural range and walled yard appear to remain extant. Principal elevation of house is south-east facing, towards the R156; however, this is screened by a belt of established trees and vegetation.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_03	N/A	N/A	Jenkinstown	Meath	Public House	693262 / 745438	A public house depicted on historic mapping comprising a one and a half storey, roughcast immediately adjacent to the R156. Remains of a possibly earlier single storey range to south-east, now with corrugated roof, depicted on 6" OS mapping (without P.H.). One and a half storey roughcast building with two stacks and dormer windows. Modern single, storey additions, including a porch and entrance. Rendered wall adjacent to the carriageway (R156). Overlooks the R156.	Late 19th - early 20th century	Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_04	N/A	N/A	Jenkinstown	Meath	Road Bridge	691671 / 745333	A low rubble stone bridge that carries the R156 across a small watercourse. Depicted on historic mapping as 'Jenkinstown Bridge'. Low rubble stone parapets with wingwalls to east and north. Modern concrete wall added to south-east end of southern parapet.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_05	N/A	N/A	Phepotstown	Meath	House	689469 / 744597	'Phepotstown House' depicted on historic mapping comprising a farmhouse with an attached long range and	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							ancillary buildings. Principal elevation of farmhouse towards the R125 to the north.		various [07 November 2021]
CH_06	N/A	N/A	Martinstown	Meath	Road Bridge	689725 / 743478	A stone road bridge depicted on historic mapping comprising two low parapets with alternate horizontal and vertical copes on the R125. Roughly coursed masonry. Narrow footway along the inside of the south-western parapet. Some damage.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_07	N/A	N/A	Phepotstown; Calgath	Meath	Road Bridge	689372 / 743057	A stone road bridge depicted on historic mapping comprising two low stone parapets with rough vertical copes on the R125. Roughly coursed masonry.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_08	N/A	N/A	Rodanstown	Meath	Mill Dam	690331 / 742110	'Old Mill Dam' depicted on historic mapping, north of Rodanstown House. Located within two undeveloped agricultural fields adjacent to the road, no features associated with the mill were visible on aerial imagery.	Post-medieval	Ordnance Survey 6", 1837 – 1842
CH_09	N/A	N/A	Dolanstown	Meath	Lodge	690365 / 741843	A small single storey lodge building depicted on historic mapping and associated with Bridestream House. Located within an overgrown plot adjacent to entrance to the demesne (DL_07) with a farm entrance to south. Associated with Bridestream House.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_10	N/A	N/A	Dolanstown	Meath	Farm	689017 / 740938	A farm depicted on depicted on historic mapping. While some ranges remain extant, the complex has largely been replaced by more recent agricultural buildings.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							Rodanstown House - farm, some ranges still extant as depicted.		various [07 November 2021]
CH_11	N/A	N/A	Balfeaghan	Meath	House	689025 / 740886	A rendered two-storey, rendered with quoins, three bay, house depicted on historic mapping, with low walled garden to north. A number of modern farm buildings and sheds are located to the south-east, and the house is largely screened from the R158 (approximately 20m to the west).	Late 19th - early 20th century	Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_12	N/A	N/A	Balfeaghan; Boycetown	Meath; Kildare	Road Bridge	688018 / 740642	'Balfeaghan Bridge', depicted on historic mapping, carries the R158 across the River Rye and the Meath-Kildare county boundary. The bridge comprises a slightly humped stone structure with parallel parapets and vertical roughly hewn copes. Coursed rubble stone construction, some modern alterations.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_13	N/A	N/A	Moyglare	Meath	Police Station	692931 / 739788	A police station depicted on historic mapping and identified on later mapping as a 'constabulary barracks'. Located immediately to the north of Moyglare Road, overlooking the roadway.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_14	N/A	N/A	Commons West	Kildare	Racecours e	692931 / 739788	The site of Commons West racecourse depicted on historic mapping as a sub-circular circuit with some small buildings to the south. The form of the racecourse remains perceptible however, some modern development has occurred.	Post-medieval	Ordnance Survey 6", 1837 – 1842
CH_15	N/A	N/A	Commons South	Kildare	House	687572 / 739143	A small single storey vernacular building with a corrugated metal roof, with gable and central stacks. Depicted on historic mapping. Located within an overgrown roadside plot on the R407 and L5028.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
CH_16	N/A	N/A	Courtown Great	Kildare	Lodge	687151 / 738719	A single storey rendered lodge with two stacks and slate gabled roof. Adjacent to a lane leading to Courtown House. The lodge is depicted on historic mapping. Positioned adjacent to the lane, perpendicular to the R407.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_17	N/A	N/A	Portgloriam	Kildare	Agricultural building	686497 / 738292	An agricultural range depicted on historic mapping; later mapping identified the building as 'The Mount'. Positioned at an angle to the R407, away from the road, amongst a group of later agricultural buildings.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_18	N/A	N/A	Laraghbryan East	Kildare	Earthworks	692330 / 737877	Linear banks and ditches in a field to the north of Kilcock Road, identified from historic aerial photographs. Possibly associated with AY_10, or a nearby ecclesiastical site (KD005-021).	Unknown	https://www.cambridgeairphotos.com/location/ape008/ [Accessed 07.11.21].
CH_19	N/A	N/A	Laraghbryan East	Kildare	Bridge	691947 / 737649	A possible bridge or crossing point over the River Lyreen depicted on historic mapping. No corresponding features are visible on modern aerial imagery.	Unknown	Ordnance Survey 6", 1837 – 1842
CH_20	N/A	N/A	Newtown	Kildare	Farm	692218 / 736772	A farm depicted on historic mapping. The current layout reflects that depicted on later mapping. Located west of Rathcoffey Road, and immediately to the north of the M4 motorway.	Late 19th - early 20th century	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
CH_21	N/A	N/A	Crinstown	Kildare	Farm	691258 / 736597	A farm complex depicted on historic mapping, only the farmhouse remains extant. Only farmhouse remains extant. Comprises a three bay, two storey structure with gable stacks. Modern single storey porch.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_22	N/A	N/A	Donaghstown	Kildare	Bridge	691777 / 734898	A possible bridge or historic crossing over an unnamed watercourse depicted on historic mapping.	Post-medieval	Ordnance Survey 6", 1837 – 1842
CH_23	N/A	N/A	Donaghstown	Kildare	Building	691783 / 734648	A small rectangular building depicted on historic mapping. Positioned adjacent to the L5037. The plot is now densely wooded.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_24	N/A	N/A	Baltracey	Kildare	Road Bridge	687121 / 733948	A road bridge depicted on historic mapping. Crosses Baltracey River, carries R407. Squared rubble stone structure with parallel parapets with squared blocks as copes. Roughly coursed masonry construction. Overgrown.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_25	N/A	N/A	Bryanstown	Kildare	Enclosure	691356 / 733724	A series of cropmarks in an agricultural field identified from aerial imagery. Features include a small possible rectilinear enclosure near the eastern field boundary and two possible pits. No corresponding features were identified on historic mapping.	Unknown	EirGrid Ortho imagery
CH_26	N/A	N/A	Graiguesallagh	Kildare	Farm	689693 / 733526	A farm complex depicted on historic mapping. Current layout reflects the layout depicted on later mapping. Square plan house with long 'L'-shaped range to south/south-west. Single storey rubble stone house with later pitched porch, dormer windows. Slate roof with central brick stack. Decorative wooden boards below eaves. Part of range replaced with modern concrete building. Similar stone construction / slate roofs. Modern store to	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							south. A boundary wall of similar stone, rubble construction is located adjacent to the R408.		
CH_27	N/A	N/A	Smithstown	Kildare	Building	690854 / 733168	Farm buildings depicted on historic mapping. Two ranges remain extant, incorporated into other buildings, with later buildings forming part of the complex. Set back from a local road.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_28	N/A	N/A	Rathcoffey North	Kildare	House	689117 / 732739	A house depicted on historic mapping, with possible associated range to west (roadside). Later house located immediately to the south. Positioned adjacent to the R408 and L5046. Overgrown screening towards Proposed Development.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_29	N/A	N/A	Windgates	Kildare	House	692955 / 732635	A house depicted on historic mapping. Located to the east of the R406. Views across the carriageway towards arable fields. Modern farm buildings are located to the east and south.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_30	N/A	N/A	Rathcoffey North	Kildare	House	688156 / 732339	Roadside building, immediately overlooking R408. Depicted on historic mapping. Four bay, two storey house with single storey later extension to western gable. Rough cast central stack, with slate roof. Rubble stone construction. Two perpendicular ranges - demolished and new bungalows. Surrounding boundary wall of similar material. Later / modern rendering to principal facade / 1/2 rendered eastern gable.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_31	N/A	N/A	Rathcoffey South	Kildare	House	688190 / 732277	A five bay, two storey house with hipped roof and central stack depicted on historic mapping. Located off the L50351.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
									various [07 November 2021]
CH_32	N/A	N/A	Johninstown	Kildare	Building	690510 / 731928	A small rectangular building, possibly an agricultural range, depicted on historic mapping adjacent to the L5046.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_33	N/A	N/A	Barberstown Lower	Kildare	Field boundaries	693077 / 731907	Linear and curvilinear cropmarks identified from aerial imagery. Some of these features correspond with historic field boundaries depicted on historic mapping. In agricultural fields immediately adjacent to the R406.	Post-medieval	Ordnance Survey 6", 1837 – 1842
CH_34	N/A	N/A	Barberstown Upper	Kildare	House	692707 / 731744	A house depicted on historic mapping. Located to the west of the R406, views are across the carriageway towards arable fields. A gravel pit is located to the north.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_35	N/A	N/A	Barberstown	Kildare	Field boundaries	693259 / 731148	Linear cropmarks identified from aerial imagery that correspond to field boundaries on historic mapping. In agricultural fields immediately adjacent to the junction between the R406 and R403. In the same field as KD010-027.	Post-medieval	Ordnance Survey 6", 1837 – 1842
CH_36	N/A	N/A	Barberstown; Staffan; Bawnoges	Kildare	Field boundaries	692346 / 730958	Linear cropmarks identified from aerial imagery including some which correspond with field boundaries depicted on historic mapping. Located near a cluster of SMR features which may comprise a barrow cemetery (including AY_21 and AY_22). In a field immediately to the south of the R403.	Post-medieval	Ordnance Survey 6", 1837 – 1842

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
CH_37	N/A	N/A	Betaghstown	Kildare	House	685351 / 729626	A house on Betaghstown Cross Roads, depicted on historic mapping. Comprises a rendered two storey house, with single storey attached range and later additions. A low rendered boundary wall runs along the R408 and L1023.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_38	N/A	N/A	Richardstown	Kildare	House	688543 / 728782	House depicted on historic mapping. Set in agricultural land, with a clump of established trees to the immediate south-east. Set back from the R403.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_39	N/A	N/A	Firmount West	Kildare	Farm	685606 / 727306	Farm complex on Firmount Cross Roads depicted on historic mapping. Arranged in courtyard plan with later buildings and additions. The main house faces onto the R403, with the junction with the L2002 and a local road adjacent.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_40	N/A	N/A	Blackhall	Kildare	Field System	688493 / 727099	Linear and curvilinear cropmarks identified on aerial imagery to the south of the River Liffey. Interpreted as possible enclosures or a field system. No corresponding features were identified on historic mapping.	Unknown	
CH_41	N/A	N/A	Firmount West	Kildare	Field barn	685720 / 727075	Single storey field barn rendered with corrugated gable roof. Perpendicular to the L2002.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]

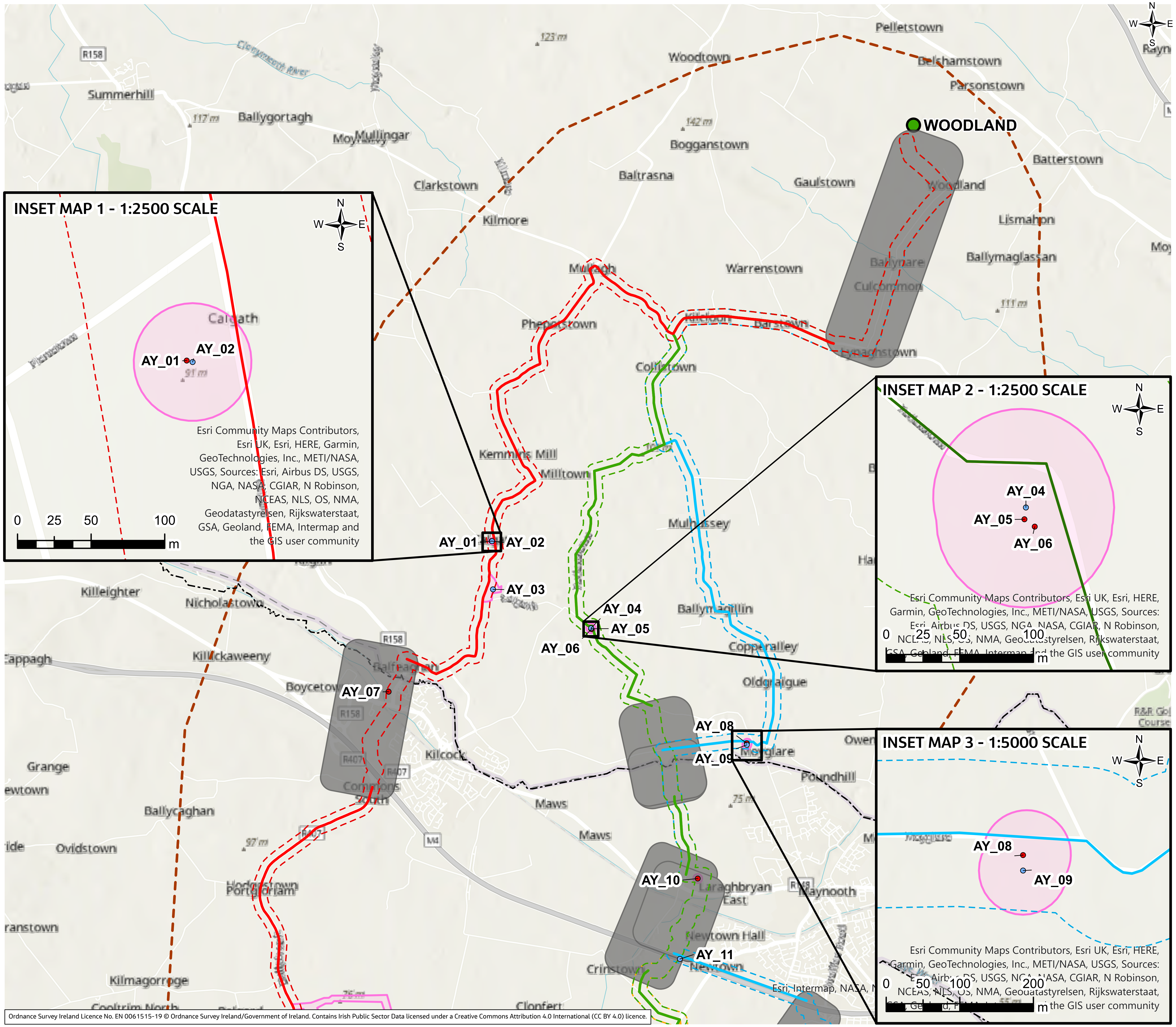
ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
CH_42	N/A	N/A	Firmount West	Kildare	Outbuilding	685788 / 726882	Single storey outbuilding depicted on historic mapping. Stone and rendered. Partially missing roof.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_43	N/A	N/A	Firmount Demesne	Kildare	House	685934 / 726668	A single storey roughcast house, with porch and central stack, slate roof, depicted on historic mapping. Later extensions / additions. Low stone boundary wall, rough cast with horizontal slab cope, two sets of gate piers, bounds the L2002.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_44	N/A	N/A	Littlerath	Kildare	Water feature	689320 / 726235	Sub-circular body of water with a small square building depicted on historic mapping. Later mapping identified the areas as a disused quarry. Immediately to the west of the L6003.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
CH_45	N/A	N/A	Blackall	Kildare	Lodge	688212 / 726113	A lodge depicted on historic mapping. On the R407 at the treelined driveway to the Blackhall GDL (DL_16).	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_46	N/A	N/A	Millicent South	Kildare	House	687359 / 725731	A house depicted on historic mapping, as a 'Vicarage'. Likely associated with Millicent Church and Lych Gate (AH_12). Single storey ranges, parallel to the north of a brick with first floor rendered house. Roadside range has a central brick stack, and gabled roof, of slate. The church tower is glimpsed from plot; however, otherwise the house	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							is largely screened by established trees and vegetation. The existing road already separates the house and church.		
CH_47	N/A	N/A	Ladyhill	Kildare	House	689213 / 725435	Two ranges depicted on historic mapping. Appear to have been incorporated into later house. Detached ranges no longer extant. Set back from the L6003.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_48	N/A	N/A	Blackhall	Kildare	Farm	688707 / 724866	A roadside farm complex depicted on historic mapping. Located adjacent to the R407.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_49	N/A	N/A	Bodenstown	Kildare	House	689127 / 724824	A small square roadside building depicted on historic mapping. 'L'-shaped range with another range further south. Identified as 'Bodenstown Cottage' on later mapping, depicted as a large building with two smaller rectangular ranges to the west. On the L2010.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913 Google StreetView various [07 November 2021]
CH_50	N/A	N/A	Johninstown	Kildare	Watch Tower	688567 / 724291	A watch tower depicted on historic mapping 'in ruins'. Not on First Edition Ordnance Survey mapping. Located in agricultural fields. Not visible on aerial imagery.	Late 19th - early 20th century	Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913
CH_51	N/A	N/A	Jigginstown	Kildare	Aqueduct	688232 / 719268	'Aquaduct' on historic mapping forming part of the Grand Canal.	Post-medieval	Ordnance Survey 6", 1837 – 1842
CH_52	N/A	N/A	Jigginstown	Kildare	Field boundaries	687422 / 718375	A linear feature comprising two, roughly parallel linears and smaller rectangular feature and possible cultivation marks identified from aerial imagery. Corresponds roughly to a field boundary on historic mapping, but not later mapping. Possibly a trackway. Field to the north includes a north-south linear and a circular feature north of the	Post-medieval	EirGrid Ortho imagery Ordnance Survey 6", 1837 – 1842 Ordnance Survey 25", 1888-1913

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							existing field boundary - no corresponding features on historic mapping.		
CH_53	N/A	N/A	Jigginstown	Kildare	Field boundaries	687650 / 718026	Linear cropmark interpreted as a former field boundary and perpendicular linear features interpreted as possible cultivation marks, identified from aerial imagery. Corresponds with a field boundary depicted on historic mapping.	Post-medieval	Ordnance Survey 6", 1837 – 1842
CH_54	N/A	N/A	Rathasker	Kildare	House	688148 / 717337	Small house depicted on historic mapping. On Rathasker Road.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_55	N/A	N/A	Killashee	Kildare	House	688073 / 716071	A house depicted on historic mapping. Six bay, one and a half storey rendered building, with gabled roof and stacks (gables and centre).	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_56	N/A	N/A	Oldtown	Kildare	Farm	687962 / 715565	Courtyard layout farm depicted on historic mapping with later ranges to the west. Two storey farmhouse, with gabled roof, gable stacks, and two-storey central wing. Single storey ranges and a stone roadside wall along the R448.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_57	N/A	N/A	Mylerstown	Kildare	House	687884 / 714478	A single storey cottage depicted on historic mapping with later additions. Three stacks (one later), slate roof, and gabled porch. Roadside location overlooking the R448.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]
CH_58	N/A	N/A	Stephenstown South	Kildare	House	687418 / 713423	Single storey half-thatched cottage, with high pitched roof. Depicted on historic mapping, including attached range which appears to have been removed (attached wall and return still extent). Subject to later additions and	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView

ID	Reference Number(s)	Legal Status	Townland	County	Site Type	Easting / Northing	Description	Date	Sources
							modification (double pile (later addition to south-west) with slate roof). Roadside location, with views across junction between R412, and R448.		various [07 November 2021]
CH_59	N/A	N/A	Stephenstown South	Kildare	House	687356 / 713137	A two-storey 'L'-shaped house depicted on historic mapping. Positioned on the R412.	Post-medieval	Ordnance Survey 6", 1837 – 1842 Google StreetView various [07 November 2021]

FIGURE B.1.1



Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- National Monument
- Preservation Order
- Recorded Monument
- Sites and Monuments Record (SMR)
- SMR Zone of Notification

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	Nov 2021	Draft issue	GB	GG	HC	FL

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Client

EIRGRID

Project

EirGrid Kildare-Meath Grid Upgrade

Drawing Title

Locations of Archaeological Monuments Within 100m of Option A (Red), Option B (Green), Option C (Orange) and Option D (Blue) (Sheet 1 of 3)

Drawing Status

DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
Jacobs No.	321084AH	
Client No.		
Drawing No.	321084AH-MAP-S4A-B.1.1	

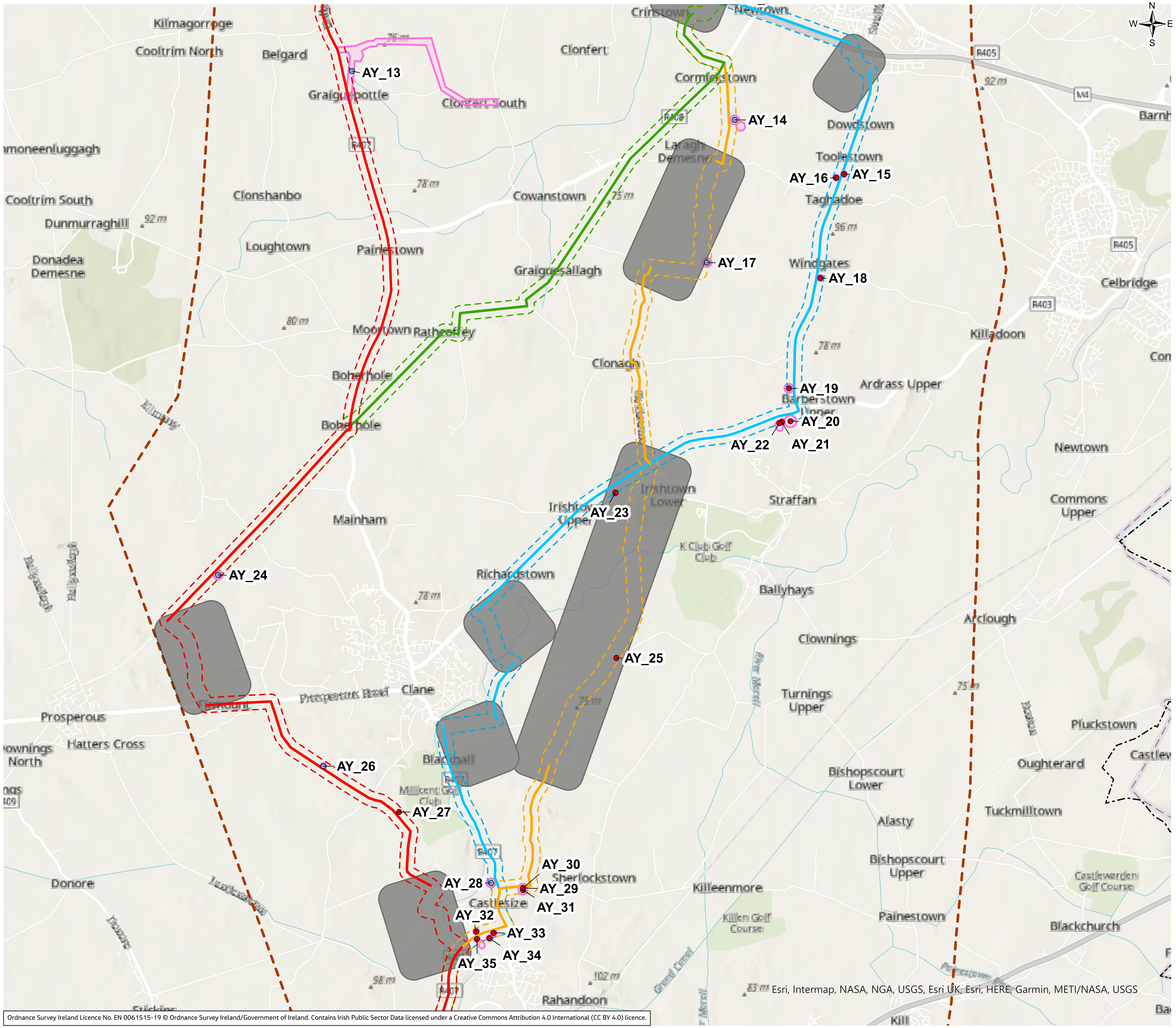

FIGURE B.1.1

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- National Monument
- Preservation Order
- Recorded Monument
- Sites and Monuments Record (SMR)
- SMR Zone of Notification

0 2 km

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Drawing Title
Locations of Archaeological Monuments Within 100m of Option A (Red), Option B (Green), Option C (Orange) and Option D (Blue) (Sheet 2 of 3)

Drawing Status
DRAFT

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Client No.		
Drawing No.	321084AH-MAP-S4A-B.1.1	

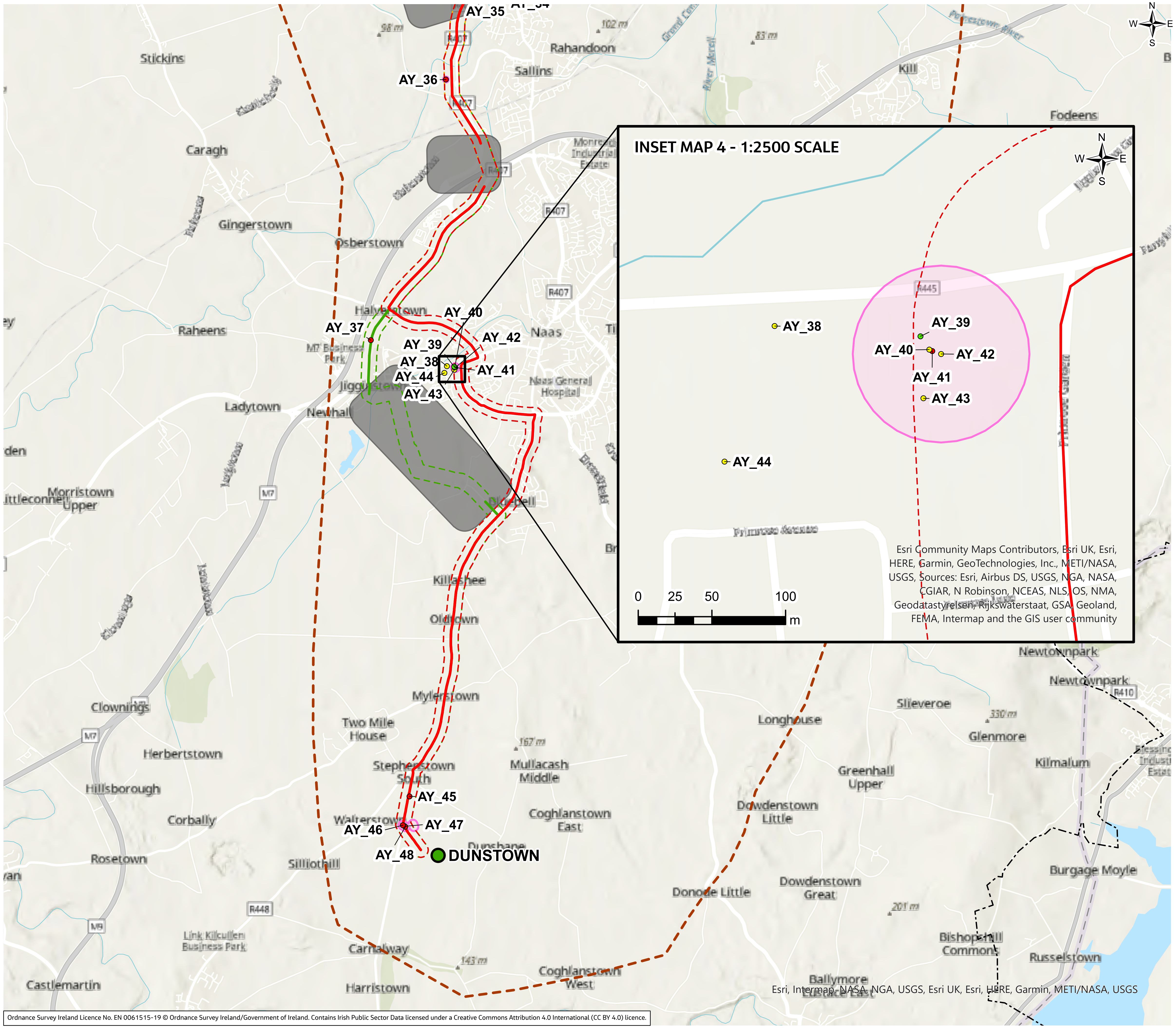

FIGURE B.1.1

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- National Monument
- Preservation Order
- Recorded Monument
- Sites and Monuments Record (SMR)
- SMR Zone of Notification

0 2 km

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EirGrid

Project

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Drawing Title

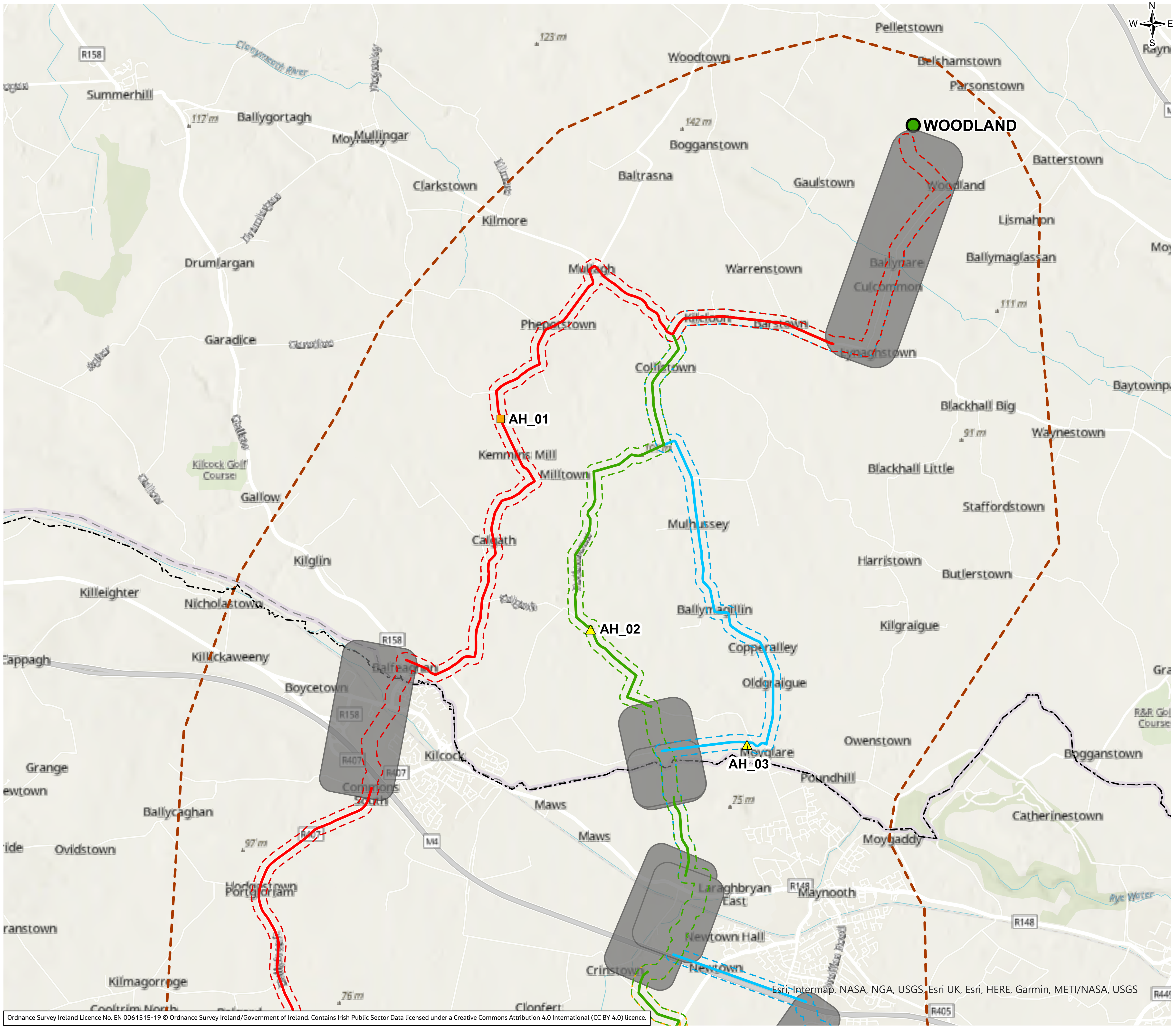
Locations of Archaeological Monuments
Within 100m of Option A (Red), Option B (Green),
Option C (Orange) and Option D (Blue)
(Sheet 3 of 3)

Drawing Status

DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
Jacobs No.	321084AH	
Client No.		
Drawing No.	321084AH-MAP-S4A-B.1.1	

FIGURE B.1.2



Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- National Inventory of Architectural Heritage (NIAH) - Regional
- Record of Protected Structures (RPS)

0 — 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
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Drawing Title

Locations of Architectural Heritage
Within 100m of Option A (Red), Option B (Green),
Option C (Orange) and Option D (Blue)

Drawing Status: DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
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Client No.		
Drawing No.	321084AH-MAP-S4A-B.1.2	

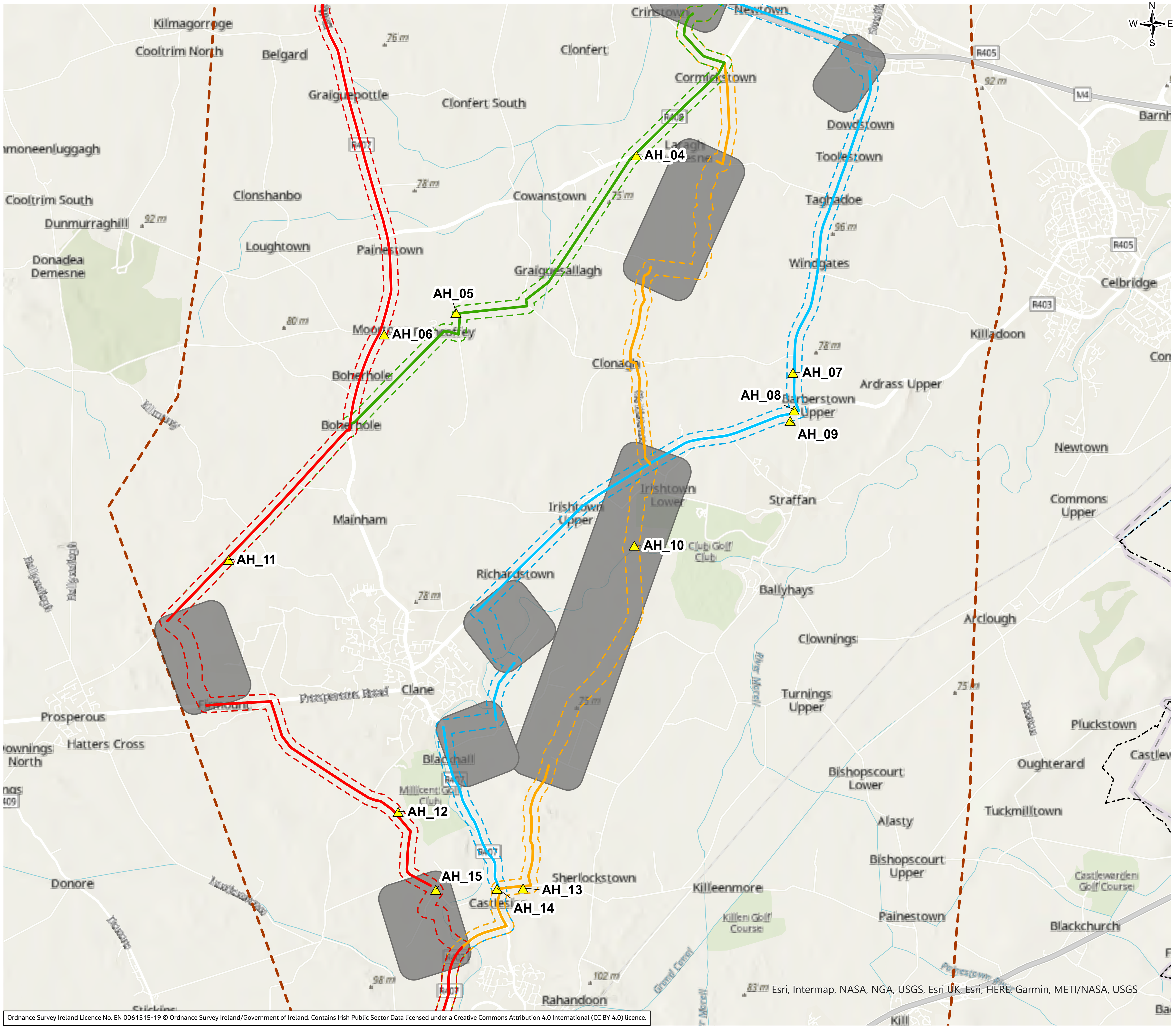

FIGURE B.1.2

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- Record of Protected Structures (RPS)

0 2 km

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Drawing Title

Locations of Architectural Heritage
Within 100m of Option A (Red), Option B (Green),
Option C (Orange) and Option D (Blue)

Drawing Status

DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
Jacobs No.	321084AH	
Client No.		
Drawing No.	321084AH-MAP-S4A-B.1.2	

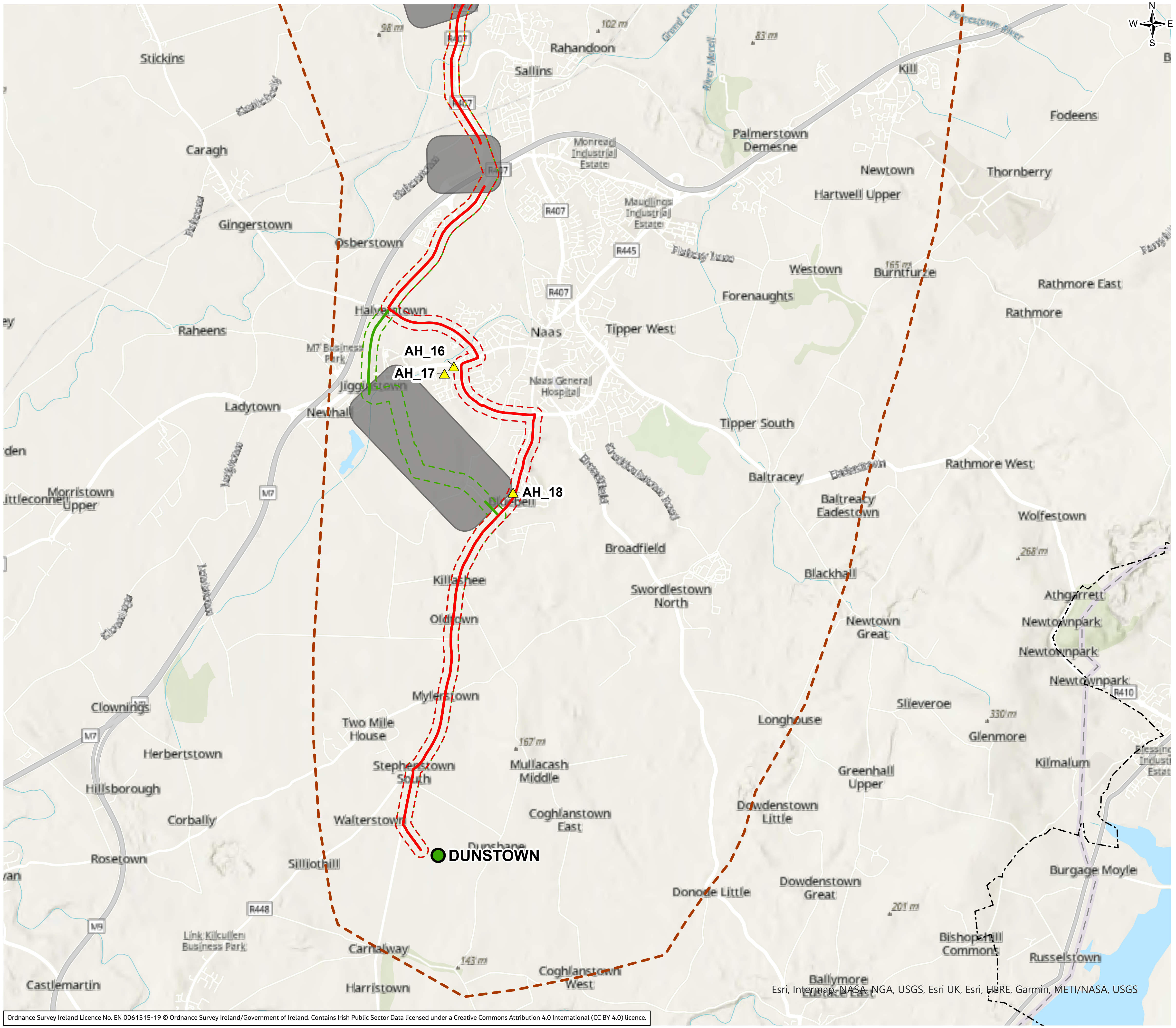

FIGURE B.1.2

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- Record of Protected Structures (RPS)

0 2 km

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Drawing Title

Locations of Architectural Heritage
Within 100m of Option A (Red), Option B (Green),
Option C (Orange) and Option D (Blue)

Drawing Status

DRAFT

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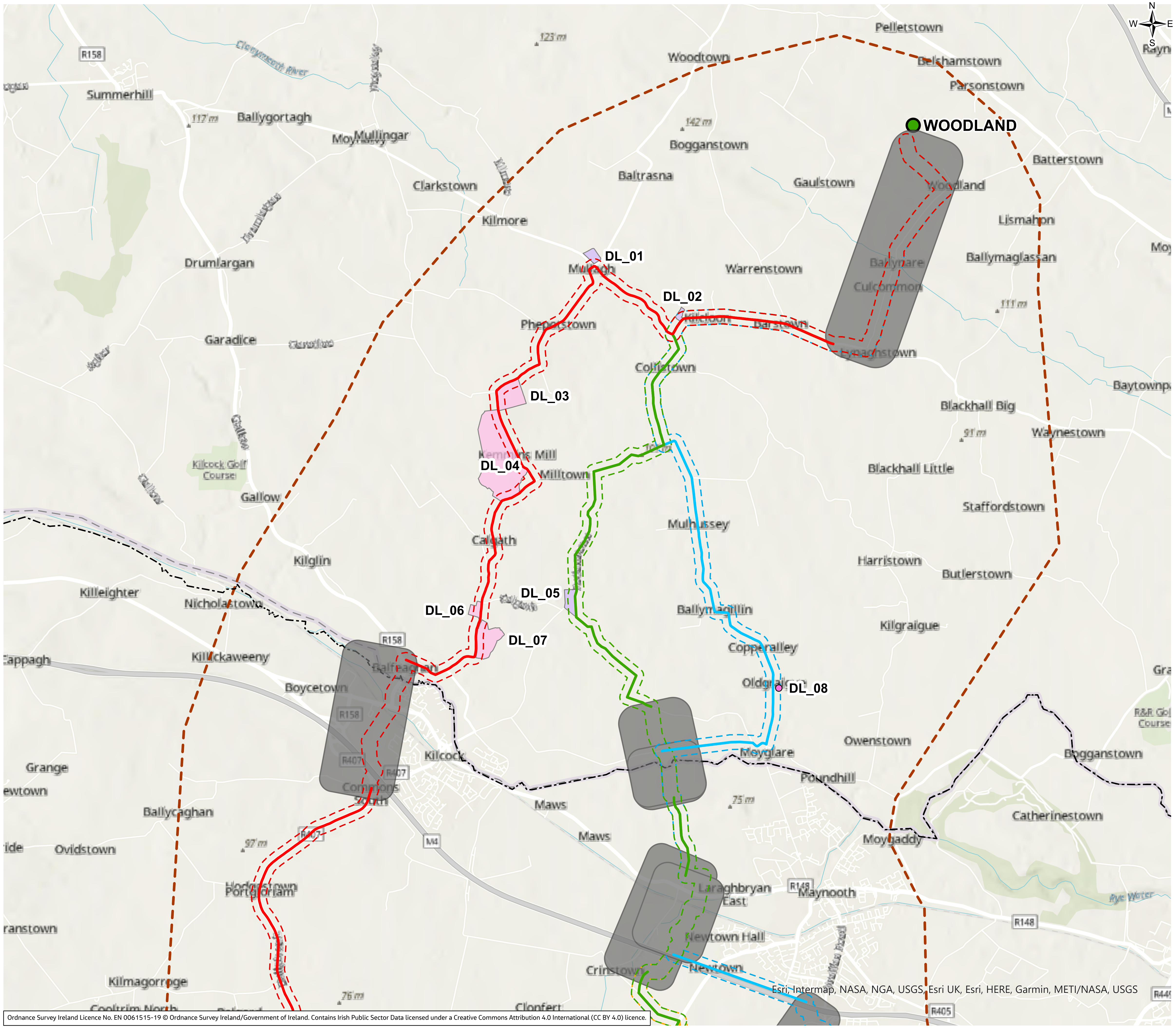

FIGURE B.1.3

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- Gardens and Designed Landscapes (GDL) Point (NIAH)
- Gardens and Designed Landscapes (GDL) Polygon (NIAH)
- Gardens and Designed Landscapes (GDL) Polygon (Historic Mapping)

0 2 km

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Client

EIRGRID

Project

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Drawing Title

Gardens and Designed Landscapes (GDLs) on the Survey of Historic Gardens and Designed Landscapes and Demesne Lands Identified from 6 inch to 1 mile First Edition Ordnance Survey Mapping (1837 – 1842)

Drawing Status

DRAFT

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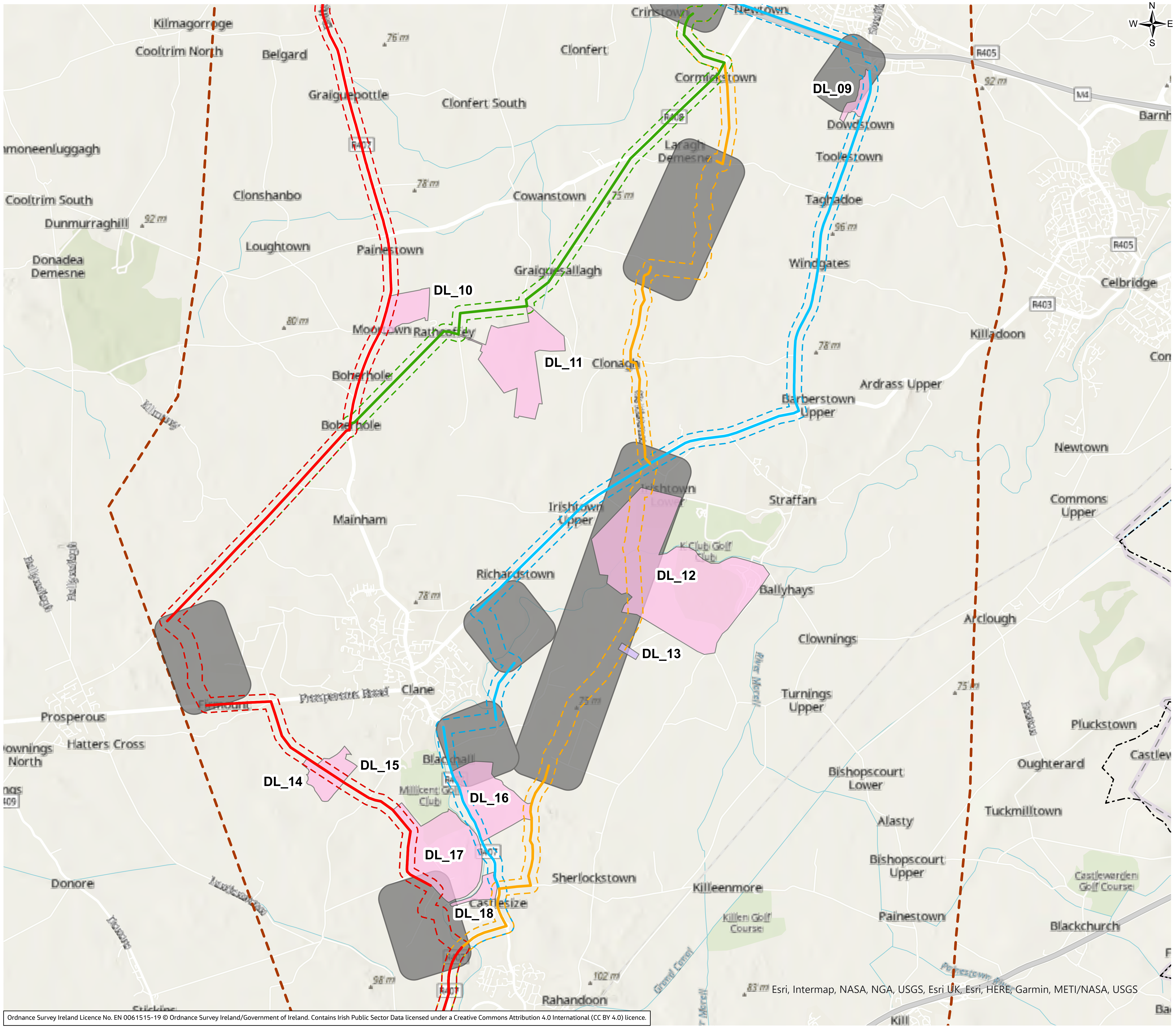

FIGURE B.1.3

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- Gardens and Designed Landscapes (GDL) Point (NIAH)
- Gardens and Designed Landscapes (GDL) Polygon (NIAH)
- Gardens and Designed Landscapes (GDL) Polygon (Historic Mapping)

0 2 km

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Drawing Title
Gardens and Designed Landscapes (GDLs) on the Survey of Historic Gardens and Designed Landscapes and Demesne Lands Identified from 6 inch to 1 mile First Edition Ordnance Survey Mapping (1837 – 1842)

Drawing Status
DRAFT

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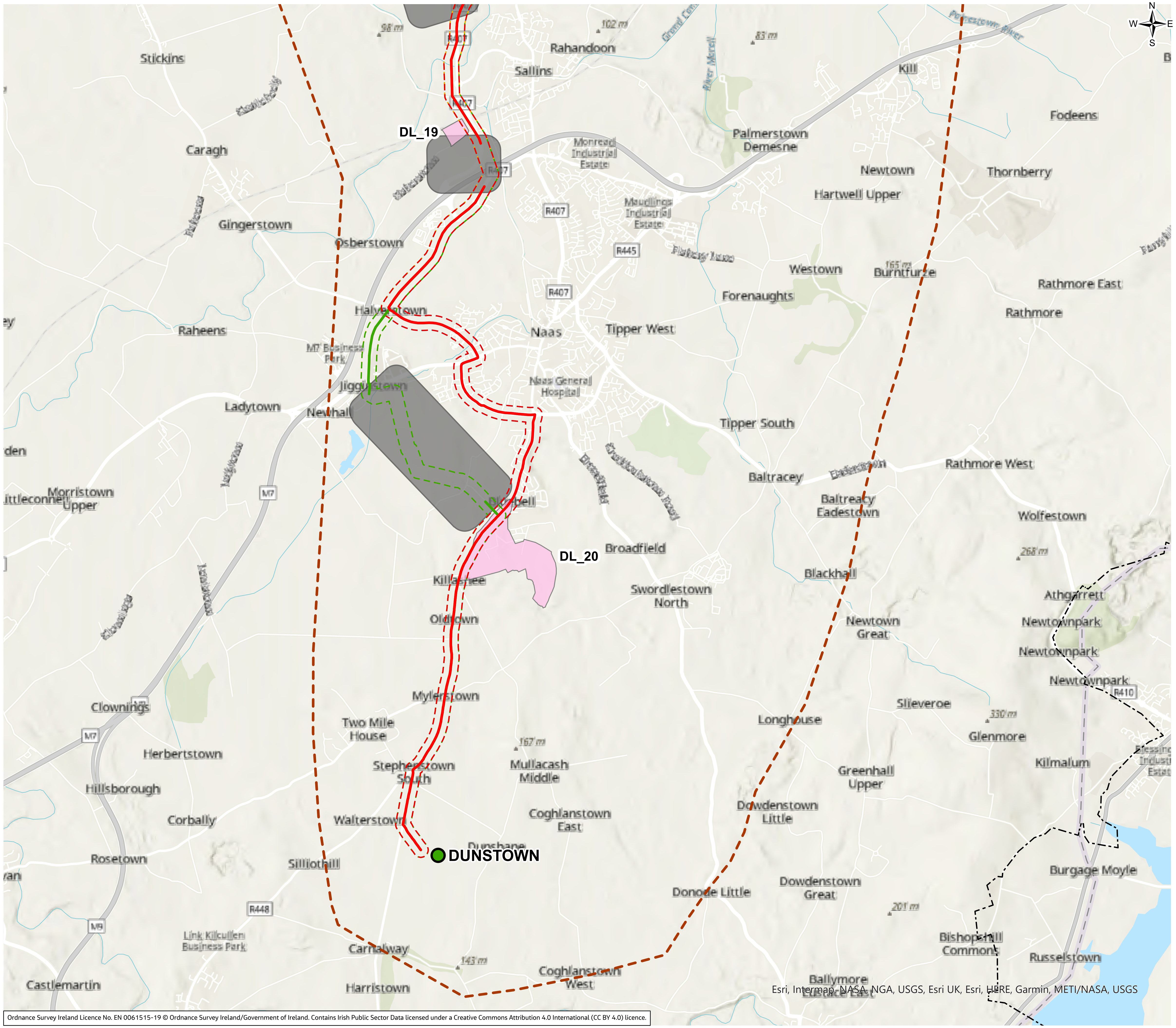

FIGURE B.1.3

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- Gardens and Designed Landscapes (GDL) Point (NIAH)
- Gardens and Designed Landscapes (GDL) Polygon (NIAH)
- Gardens and Designed Landscapes (GDL) Polygon (Historic Mapping)

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
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Drawing Title
Gardens and Designed Landscapes (GDLs) on the Survey of Historic Gardens and Designed Landscapes and Demesne Lands Identified from 6 inch to 1 mile First Edition Ordnance Survey Mapping (1837 – 1842)

Drawing Status
DRAFT

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Drawing No.	321084AH-MAP-S4A-B.1.3	

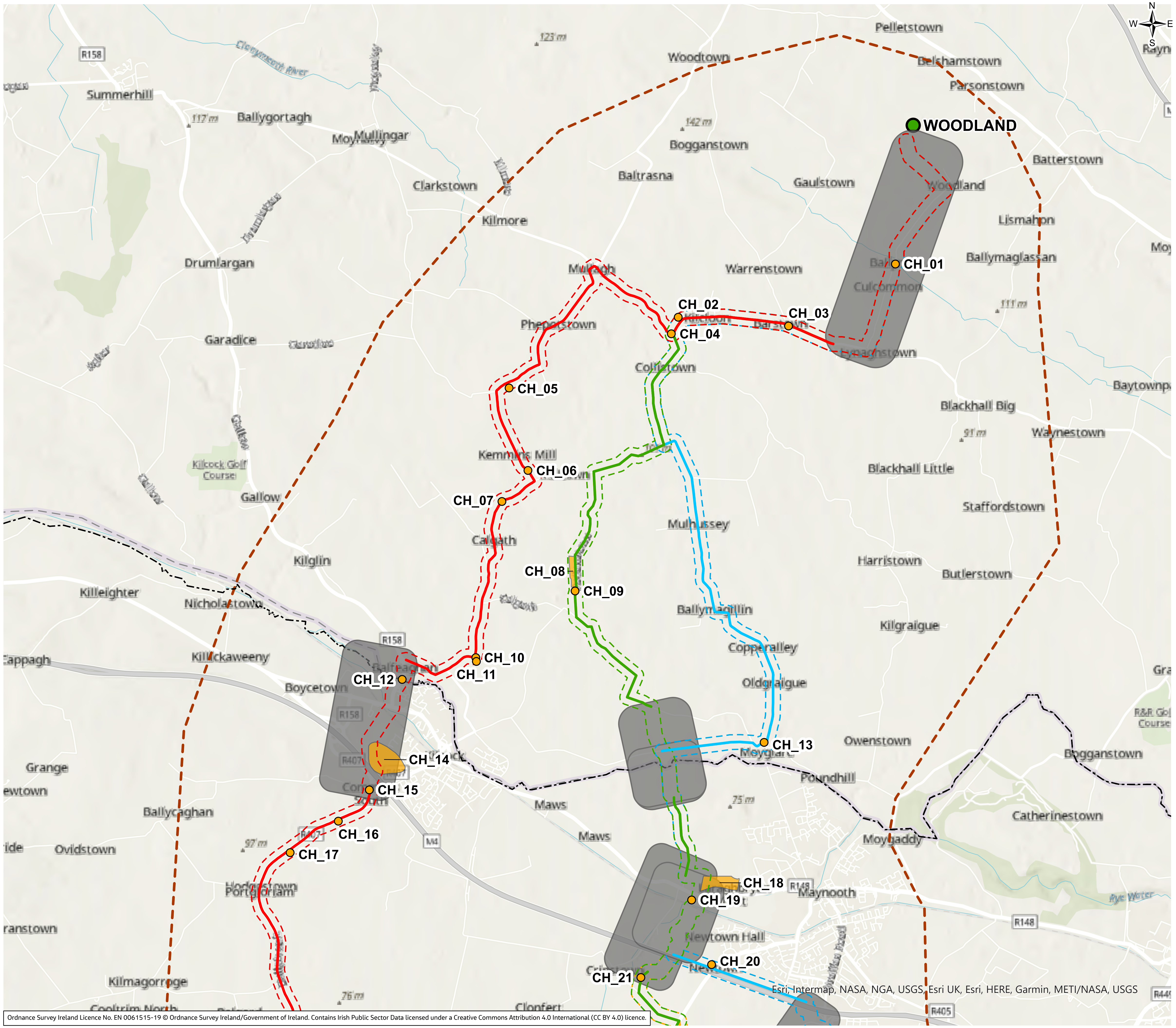

FIGURE B.1.4

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- Cultural Heritage Point
- Cultural Heritage Polygon

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
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Client

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Project

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Drawing Title

Locations of Cultural Heritage Sites
Within 100m of Option A (Red), Option B (Green),
Option C (Orange) and Option D (Blue)

Drawing Status

DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
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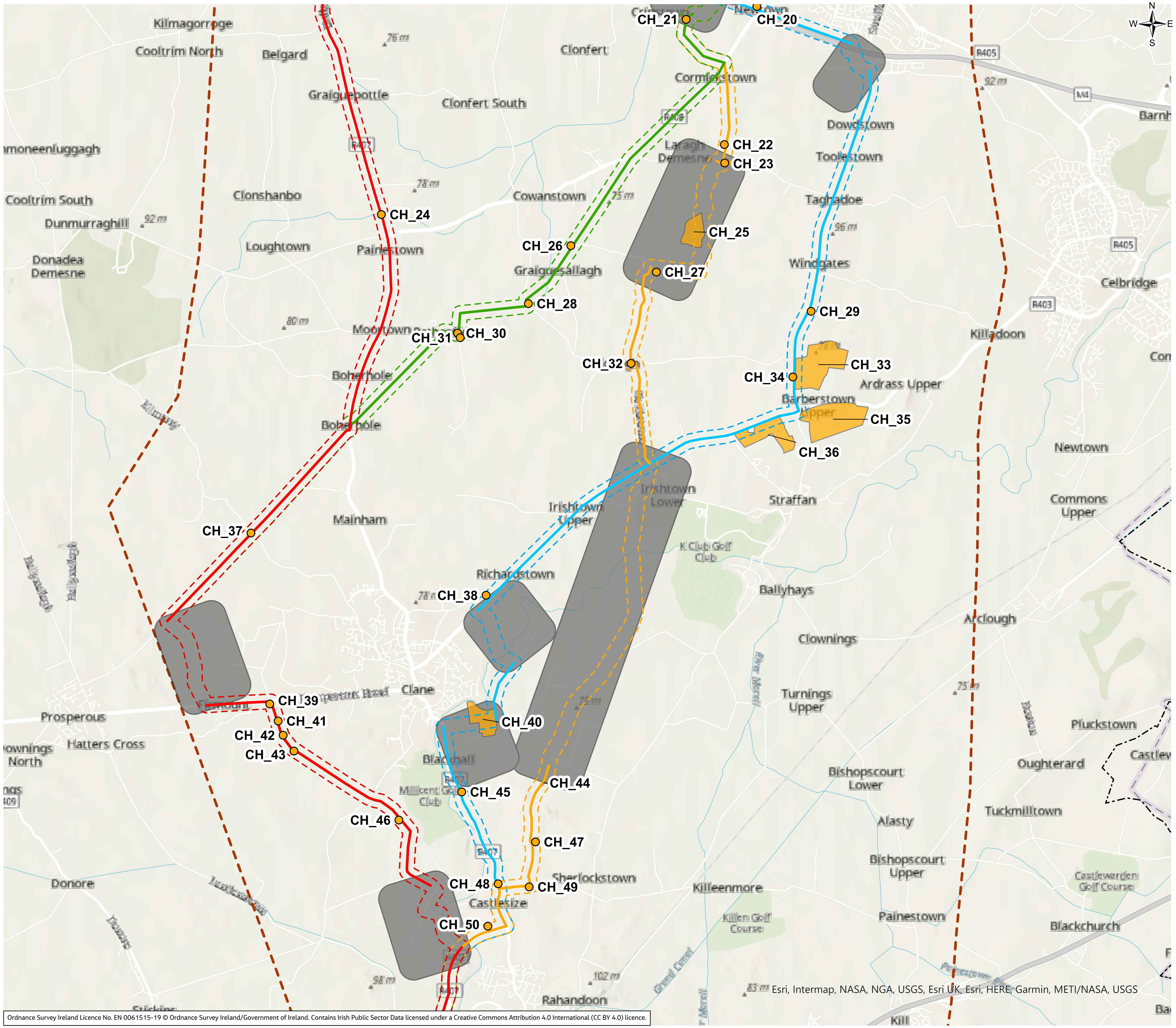
Client No.		
Drawing No.	321084AH-MAP-S4A-B.1.4	

FIGURE B.1.4



Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- Cultural Heritage Point
- Cultural Heritage Polygon

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
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Drawing Title

Locations of Cultural Heritage Sites
Within 100m of Option A (Red), Option B (Green),
Option C (Orange) and Option D (Blue)

Drawing Status: DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
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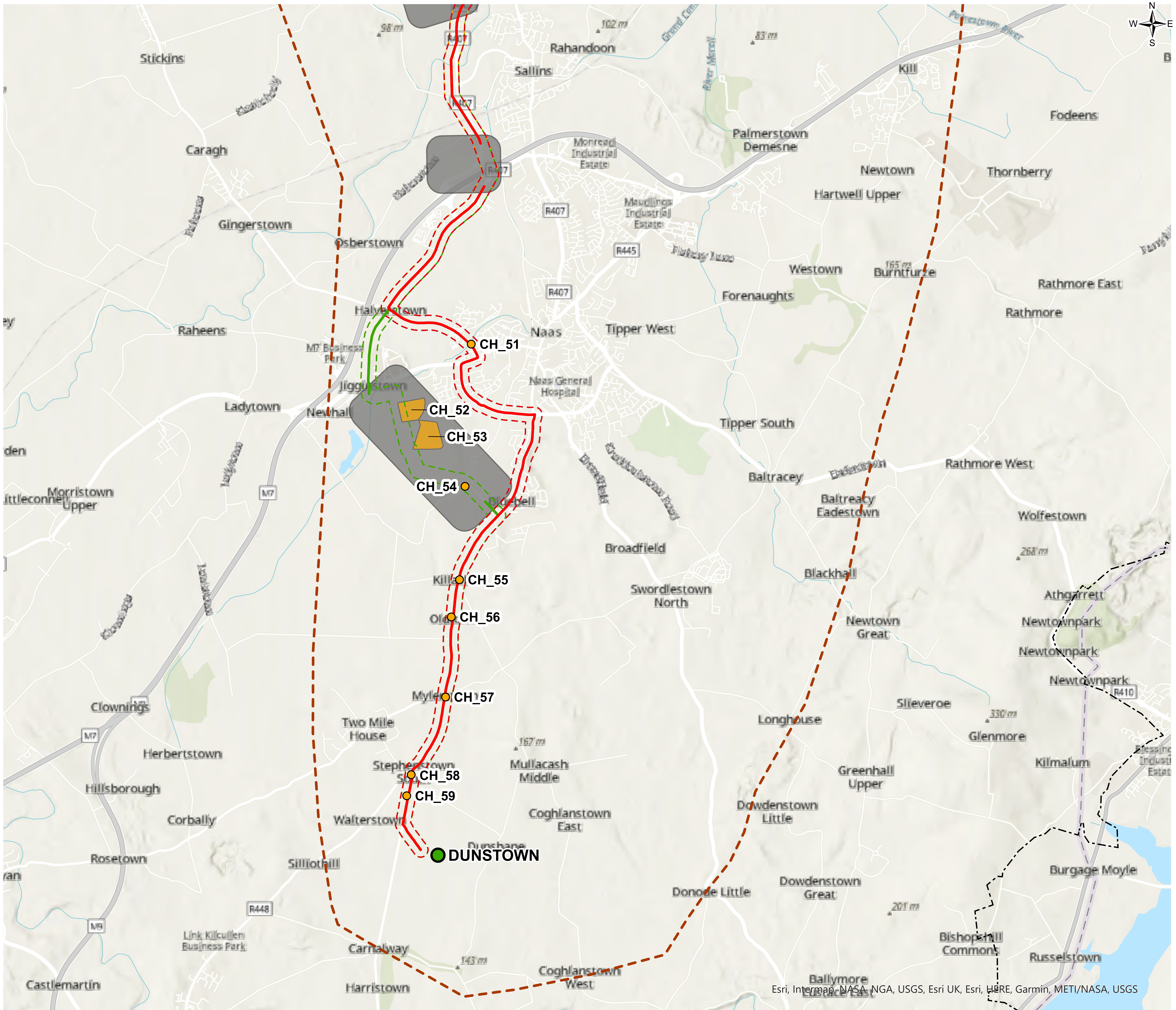
Client No.		
Drawing No.	321084AH-MAP-S4A-B.1.4	

FIGURE B.1.4



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Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- Cable Route Option A 100m Buffer
- Cable Route Option B 100m Buffer
- Cable Route Option C 100m Buffer
- Cable Route Option D 100m Buffer
- Cultural Heritage Point
- Cultural Heritage Polygon

0 2 km

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Drawing Title

Locations of Cultural Heritage Sites
Within 100m of Option A (Red), Option B (Green),
Option C (Orange) and Option D (Blue)

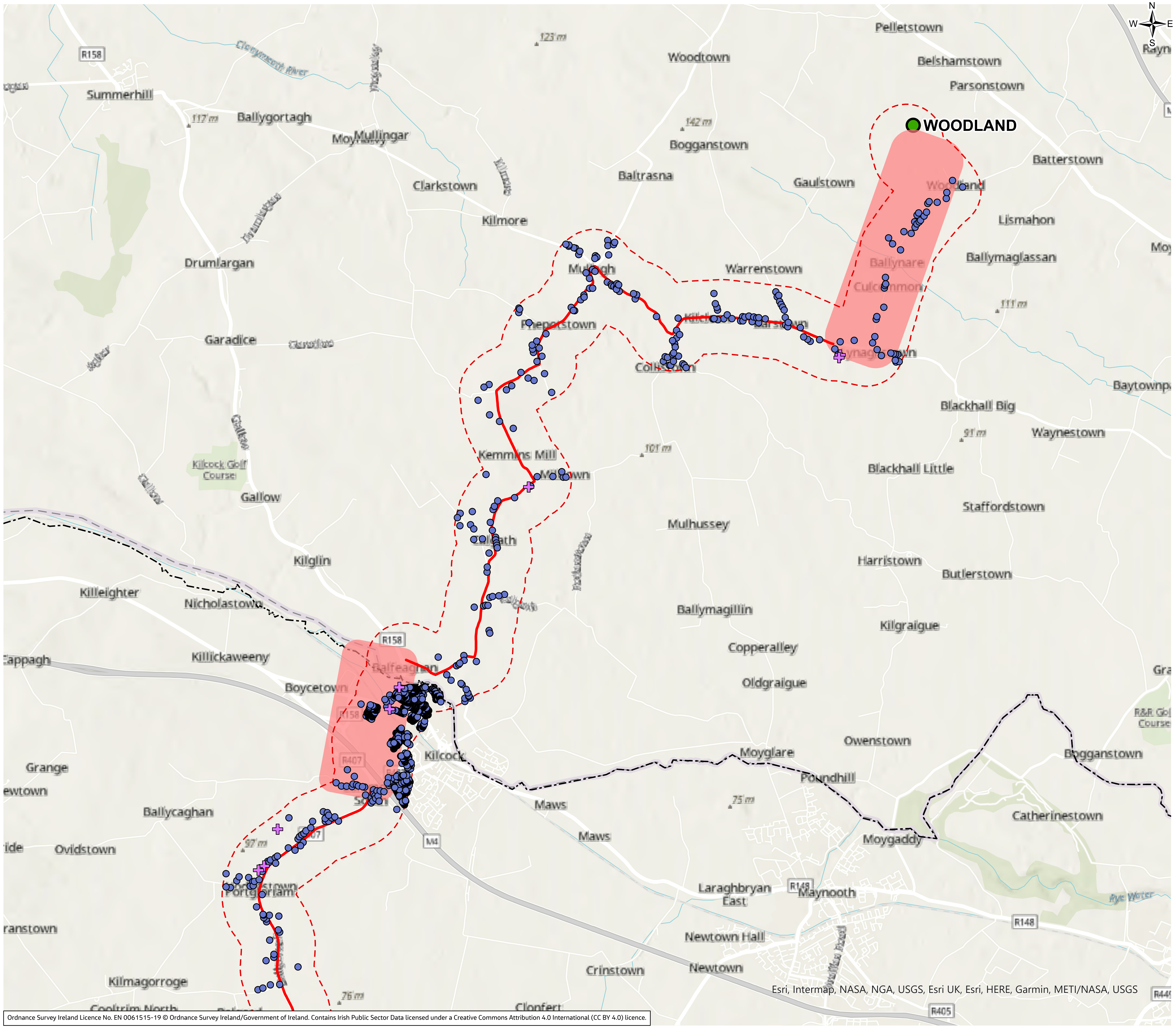
Drawing Status

DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
Jacobs No.	321084AH	
Client No.		
Drawing No.	321084AH-MAP-S4A-B.1.4	

Appendix C. 1 – Socio-Economic Figures

FIGURE C.1.1



Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Off Road Options Being Explored - Option A
- Cable Route Option A 500m Buffer
- Commercial/Retail Property
- Residential Property

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
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Drawing Title

Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option A (Red)
Sheet 1 of 3

Drawing Status

DRAFT

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Client No.		
Drawing No.	321084AH-MAP-S4A-C.1.1	

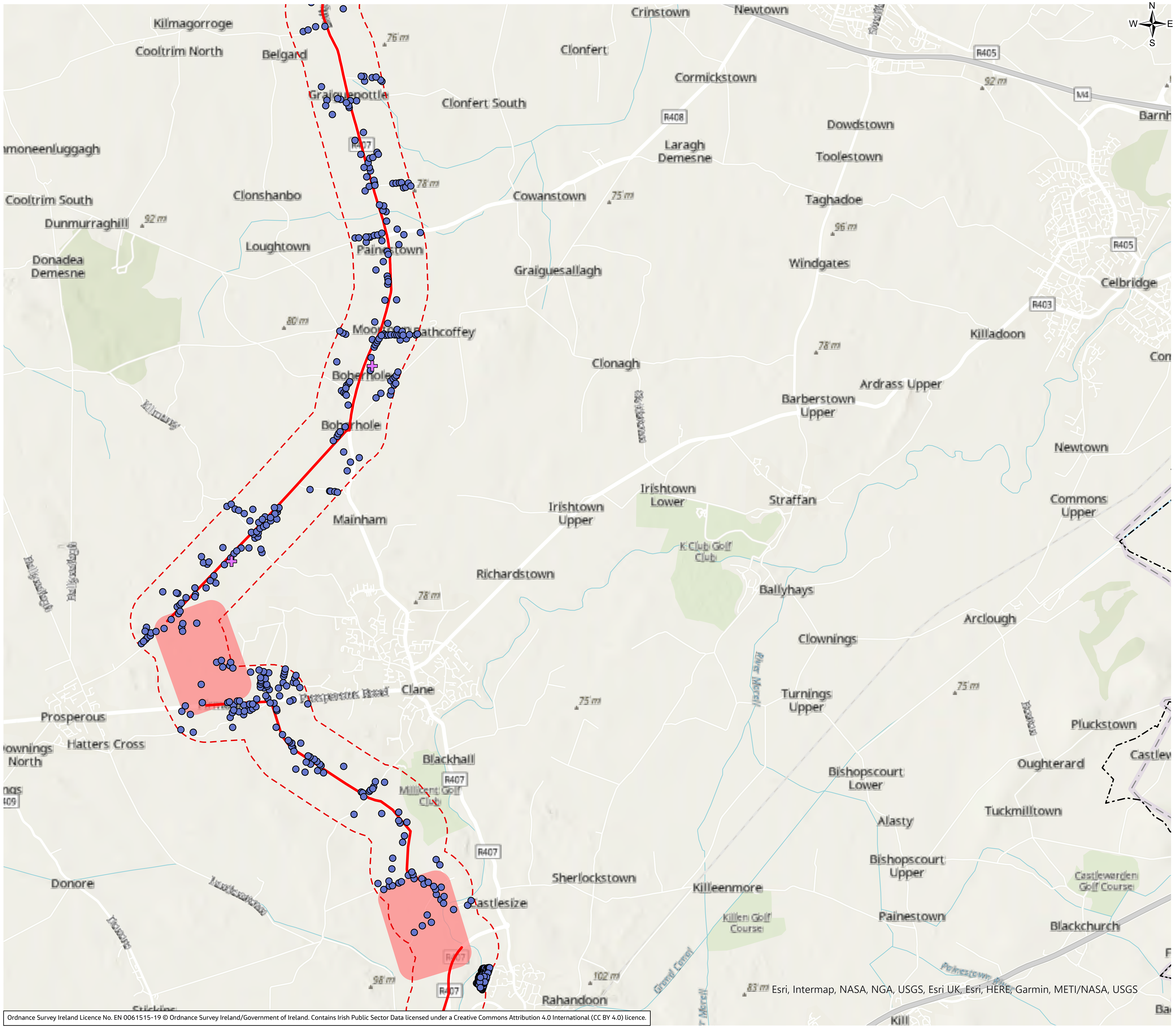

FIGURE C.1.1

Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Off Road Options Being Explored - Option A
- Cable Route Option A 500m Buffer
- Commercial/Retail Property
- Residential Property

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
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Drawing Title

Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option A (Red)
Sheet 2 of 3

Drawing Status: DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
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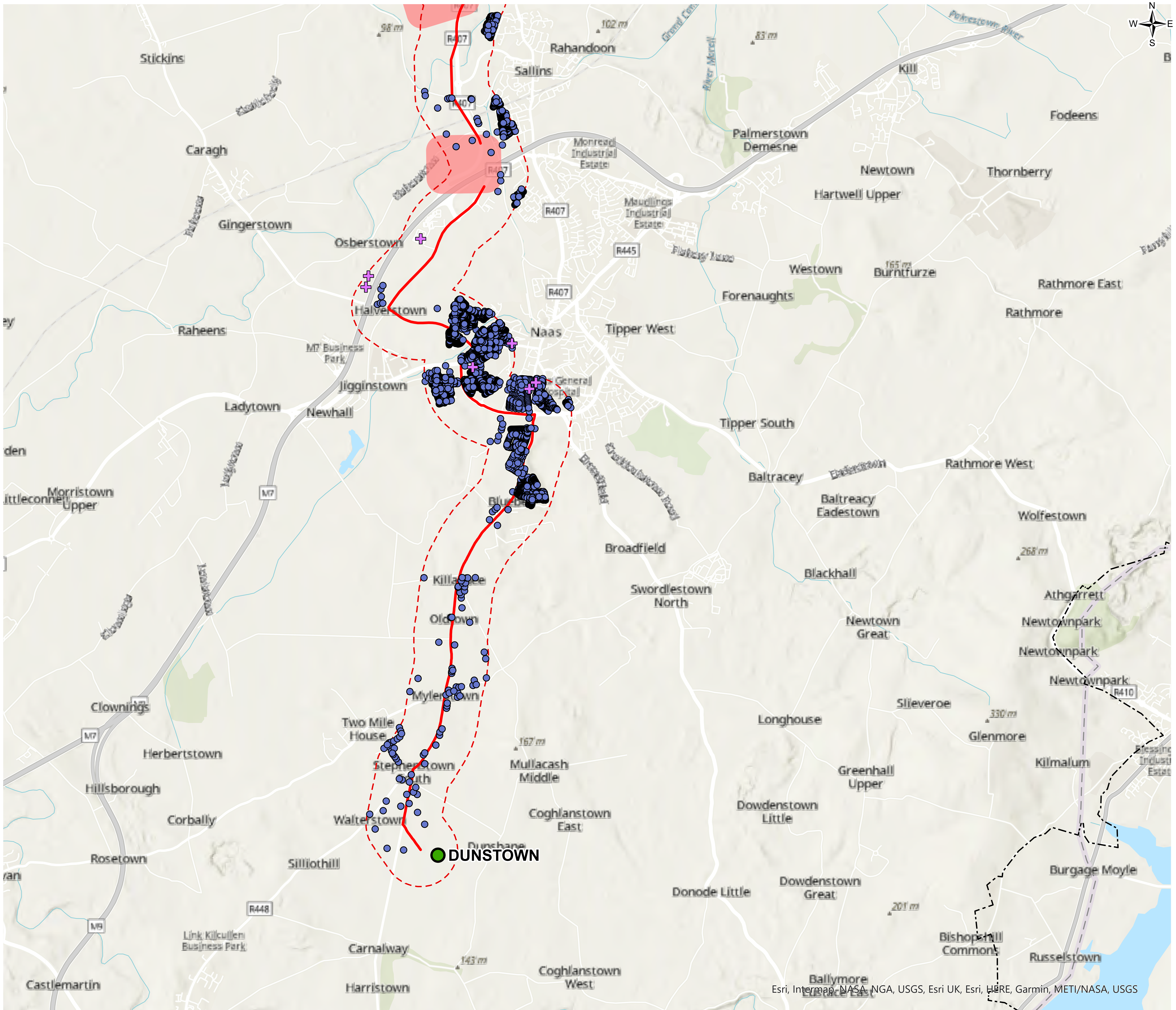
Client No.		
Drawing No.	321084AH-MAP-S4A-C.1.1	

FIGURE C.1.1



Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Off Road Options Being Explored - Option A
- Cable Route Option A 500m Buffer
- Commercial/Retail Property
- Residential Property

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	Dec 2021	Draft issue	GB	GM	GG	FL

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Drawing Title

Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option A (Red)
Sheet 3 of 3

Drawing Status

DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
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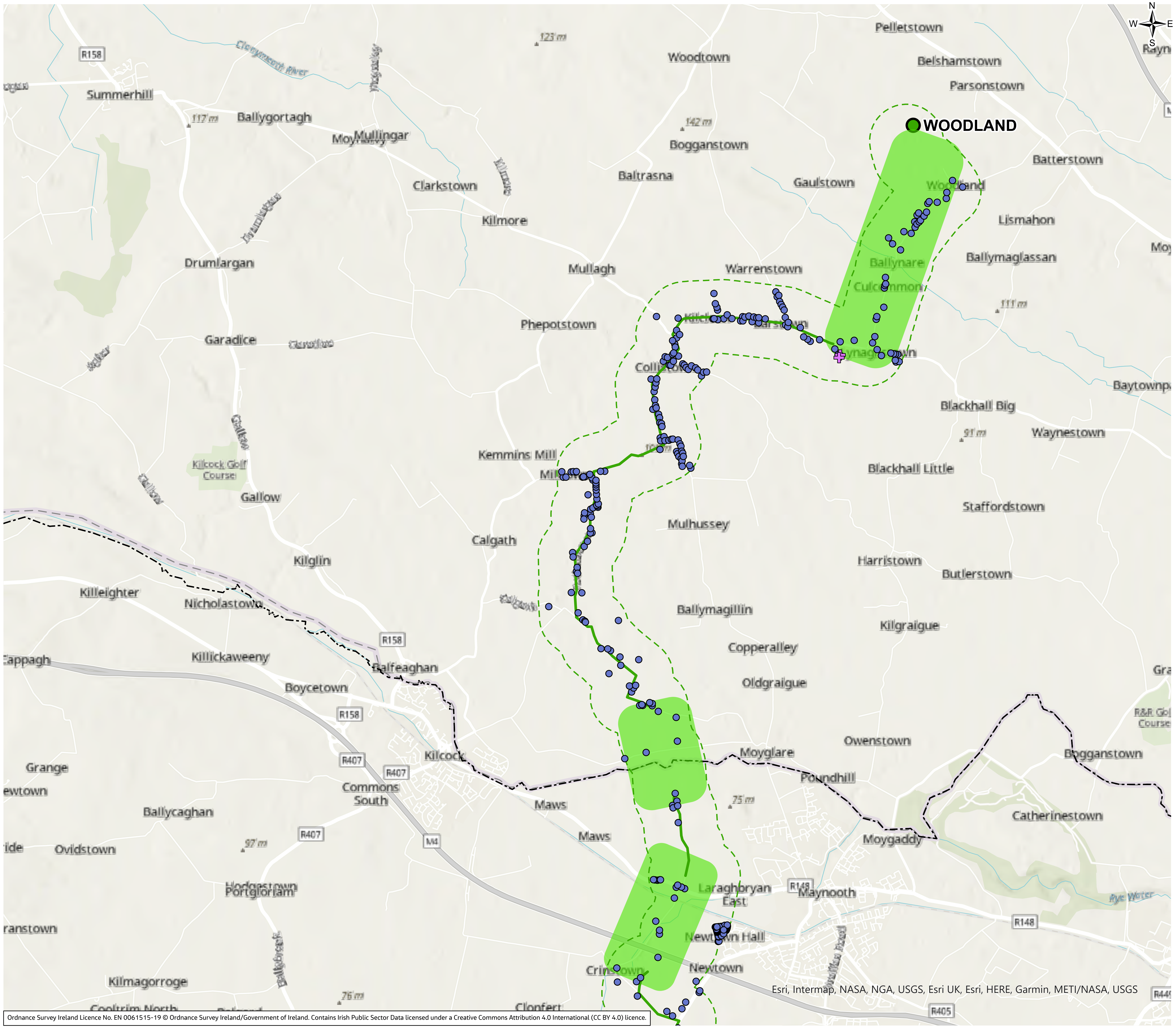

FIGURE C.1.2

Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option B (Green)
- Off Road Options Being Explored - Option B
- Cable Route Option B 500m Buffer
- Commercial/Retail Property
- Residential Property

0 2 km

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0	Dec 2021	Draft issue	GB	GM	GG	FL

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Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
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EIRGRID

Project

EirGrid Kildare-Meath Grid Upgrade

Drawing Title

Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option B (Green)
Sheet 1 of 3

Drawing Status

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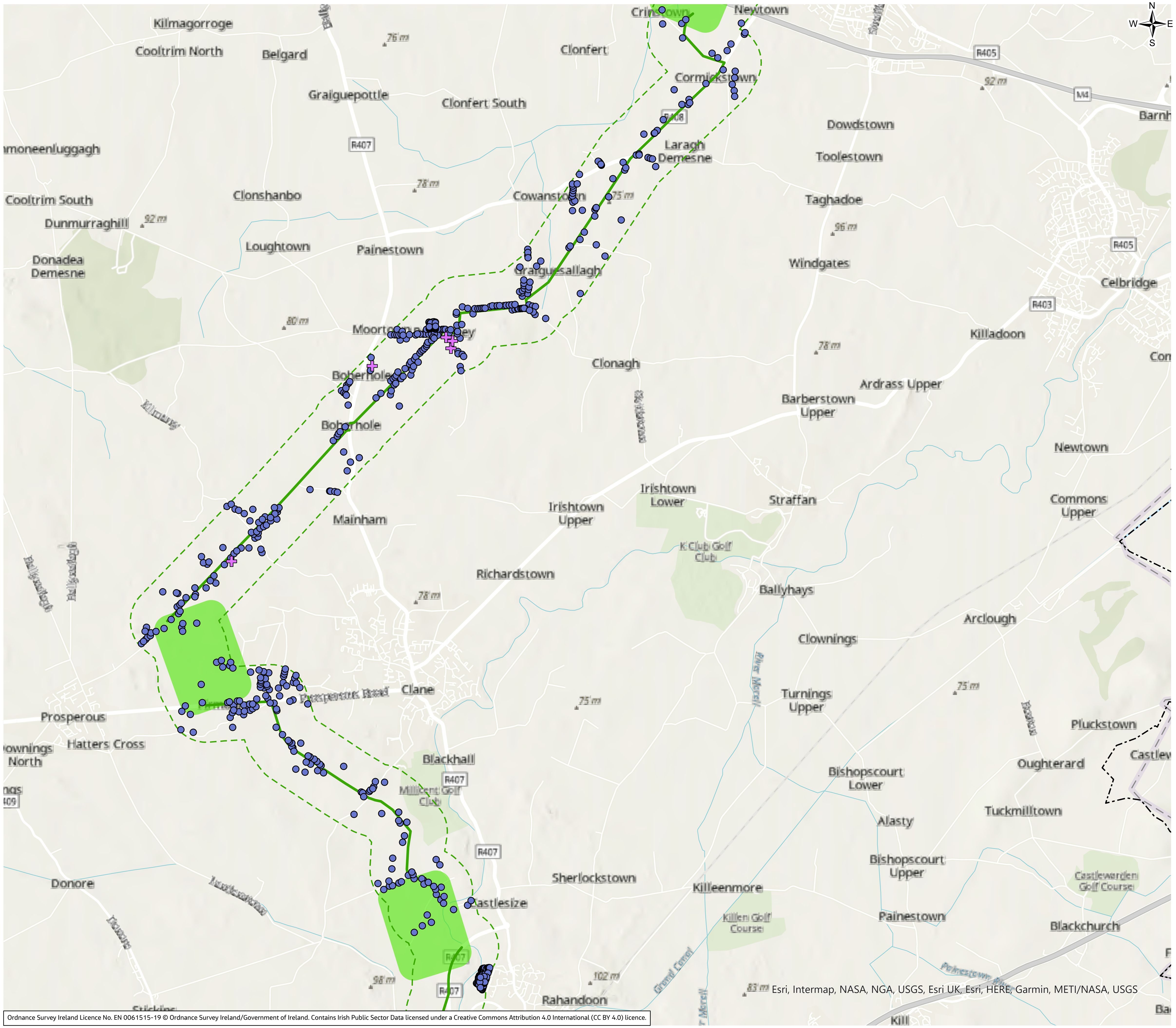

FIGURE C.1.2

Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option B (Green)
- Off Road Options Being Explored - Option B
- Cable Route Option B 500m Buffer
- Commercial/Retail Property
- Residential Property

0 2 km

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Drawing Title
Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option B (Green)
Sheet 2 of 3

Drawing Status
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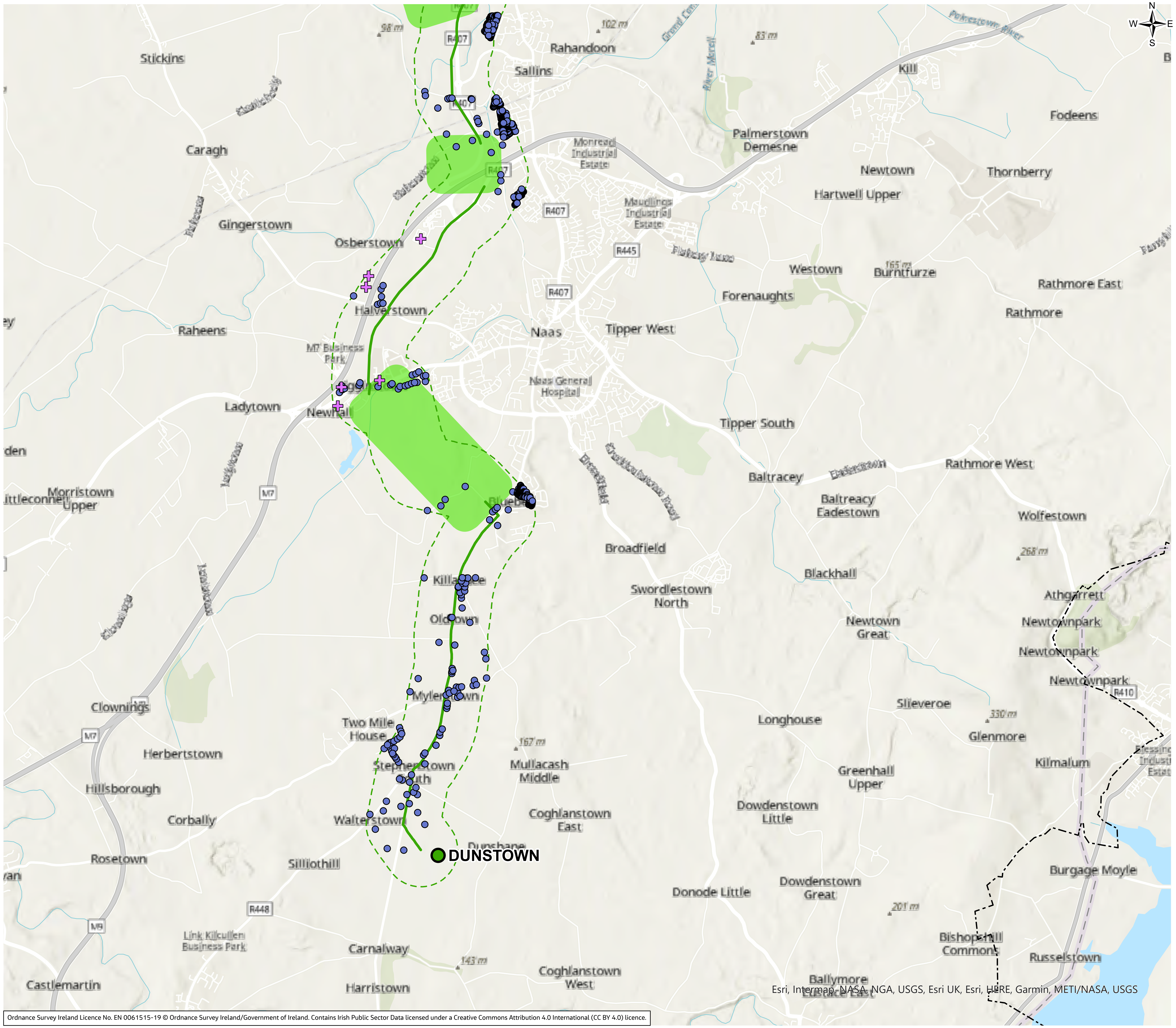

FIGURE C.1.2

Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option B (Green)
- Off Road Options Being Explored - Option B
- Cable Route Option B 500m Buffer
- Commercial/Retail Property
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Proposed Cable Route Option B (Green)
Sheet 3 of 3

Drawing Status

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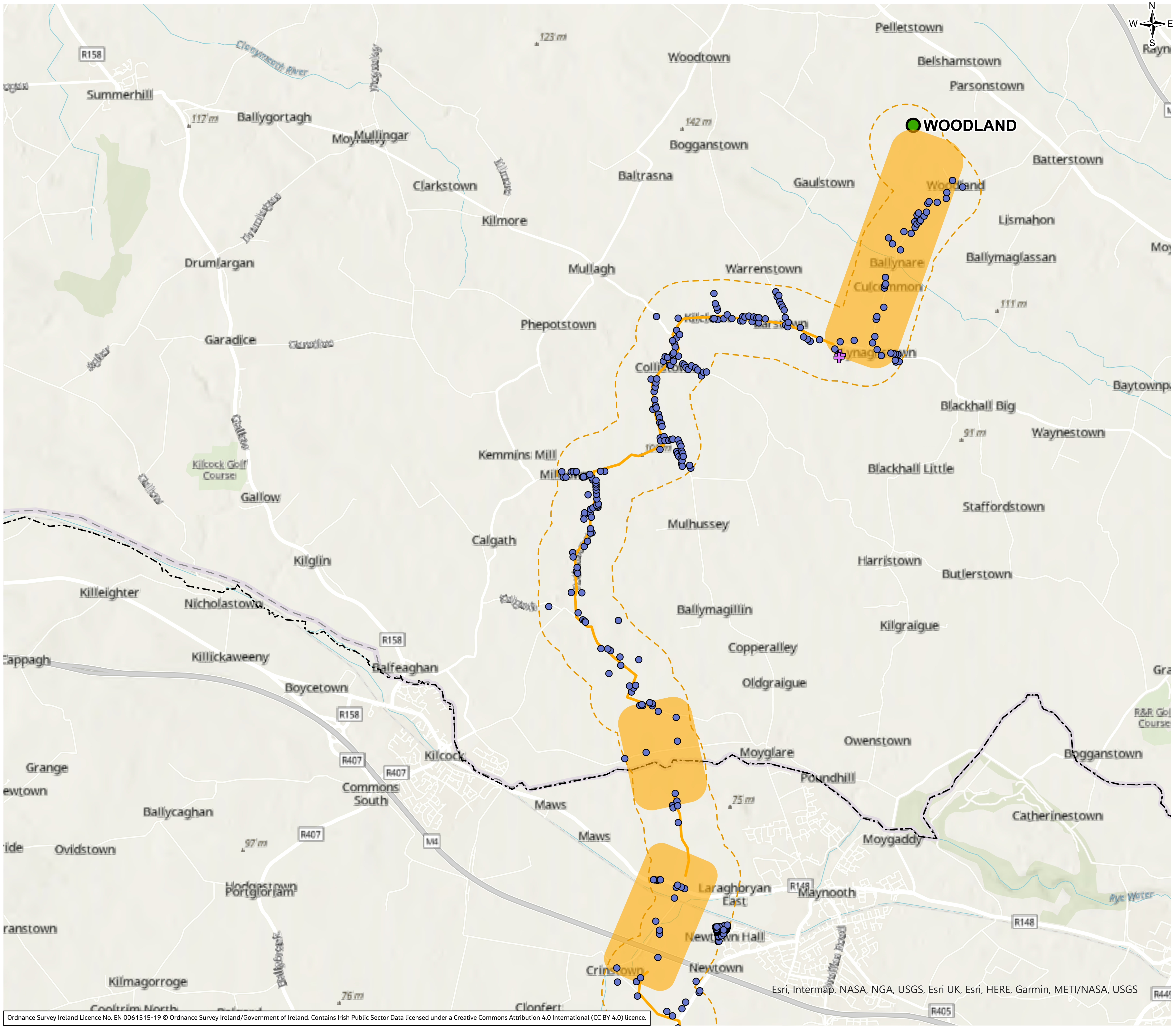

FIGURE C.1.3

Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option C (Orange)
- Off Road Options Being Explored - Option C
- Cable Route Option C 500m Buffer
- Commercial/Retail Property
- Residential Property

0 2 km

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Drawing Title

Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option C (Orange)
Sheet 1 of 3

Drawing Status

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Scale @ A3	1:50,000	DO NOT SCALE
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Client No.		
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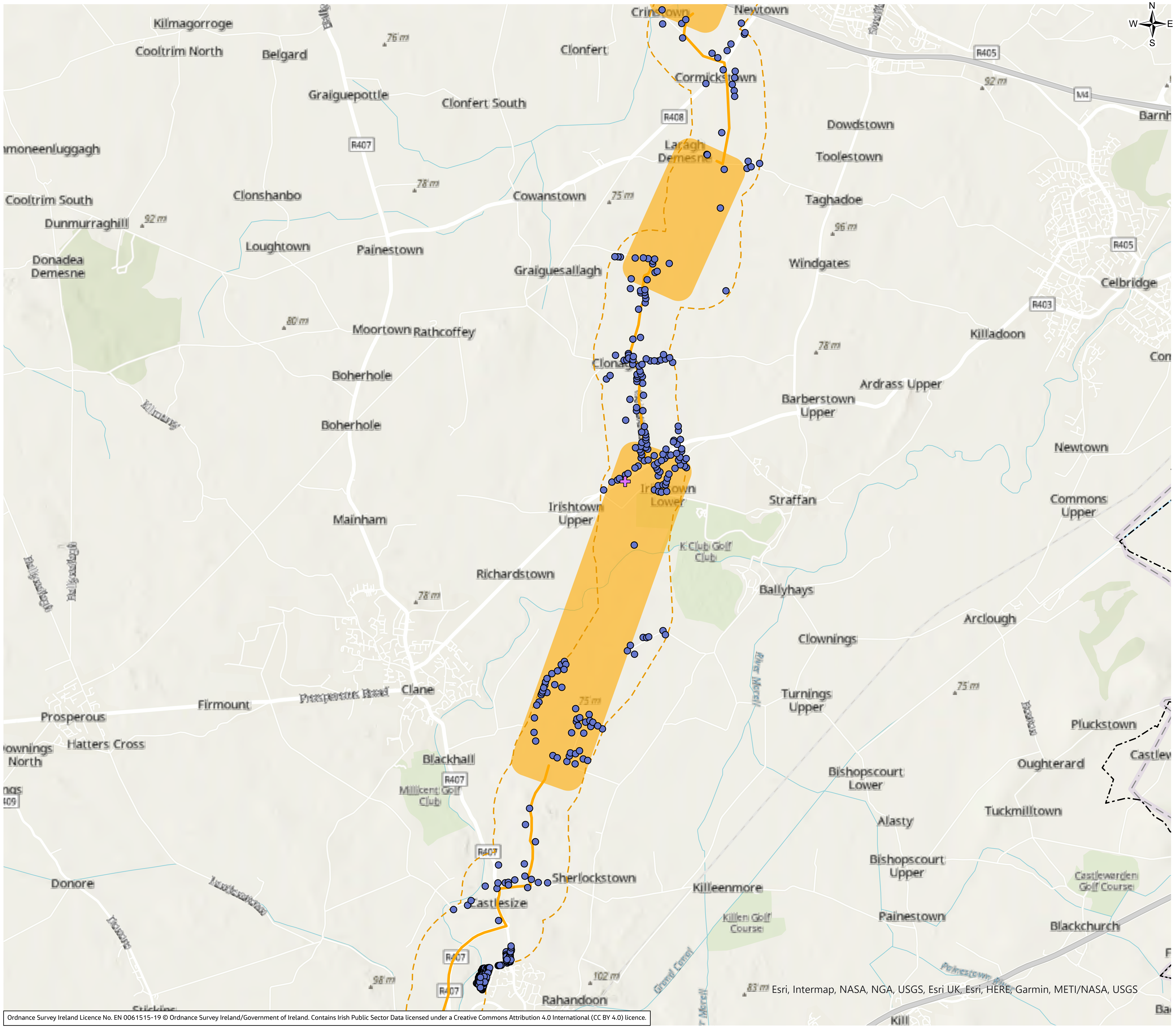
FIGURE C.1.3



Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option C (Orange)
- Off Road Options Being Explored - Option C
- Cable Route Option C 500m Buffer
- Commercial/Retail Property
- Residential Property

0 2 km

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Drawing Title
Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option C (Orange)
Sheet 2 of 3

Drawing Status
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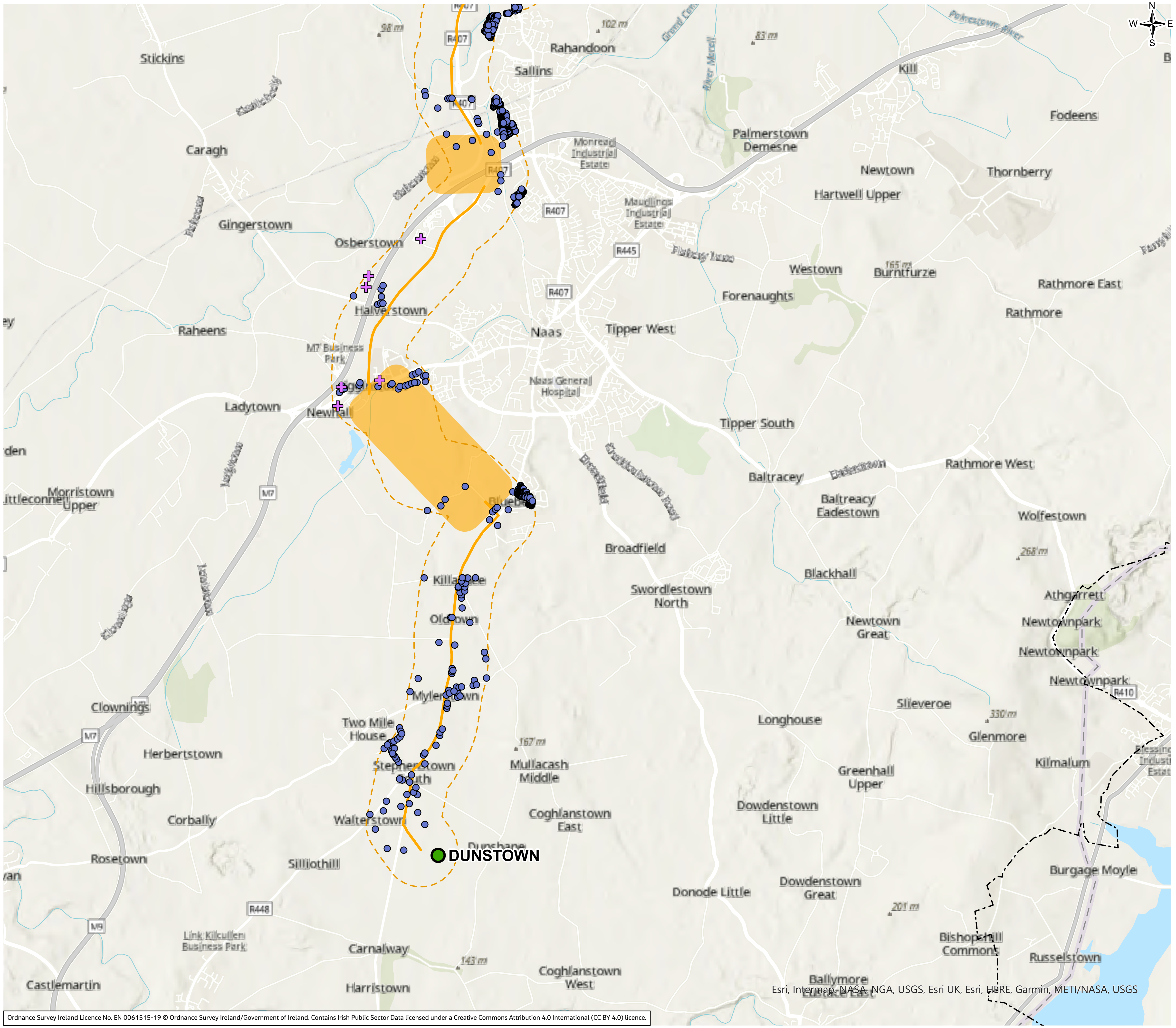

FIGURE C.1.3

Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option C (Orange)
- Off Road Options Being Explored - Option C
- Cable Route Option C 500m Buffer
- Commercial/Retail Property
- Residential Property

0 2 km

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Drawing Title: Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option C (Orange)
Sheet 3 of 3

Drawing Status: DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
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Client No.		
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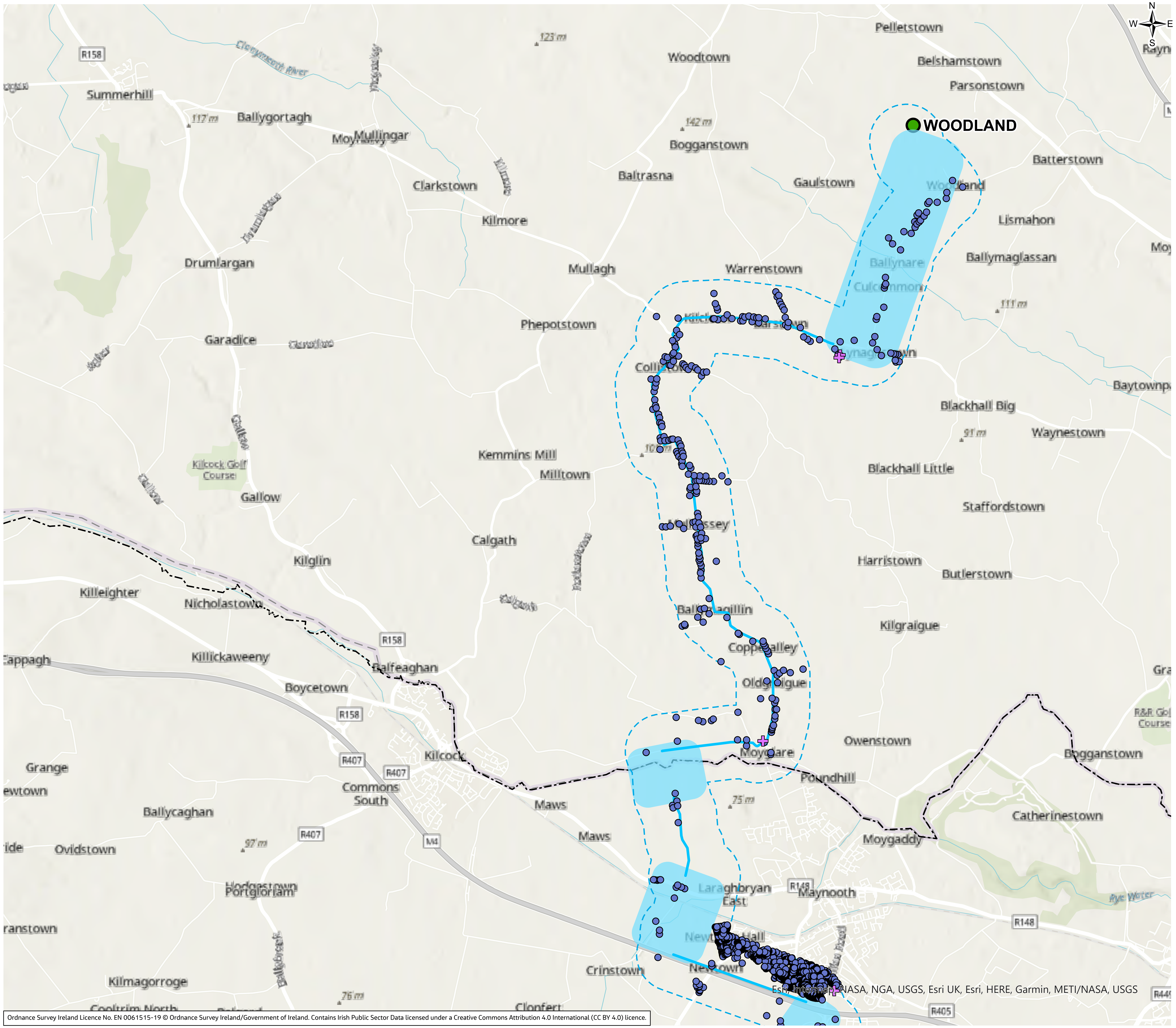
FIGURE C.1.4



Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option D (Blue)
- Off Road Options Being Explored - Option D
- Cable Route Option D 500m Buffer
- Commercial/Retail Property
- Residential Property

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Drawing Title

Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option D (Blue)
Sheet 1 of 3

Drawing Status

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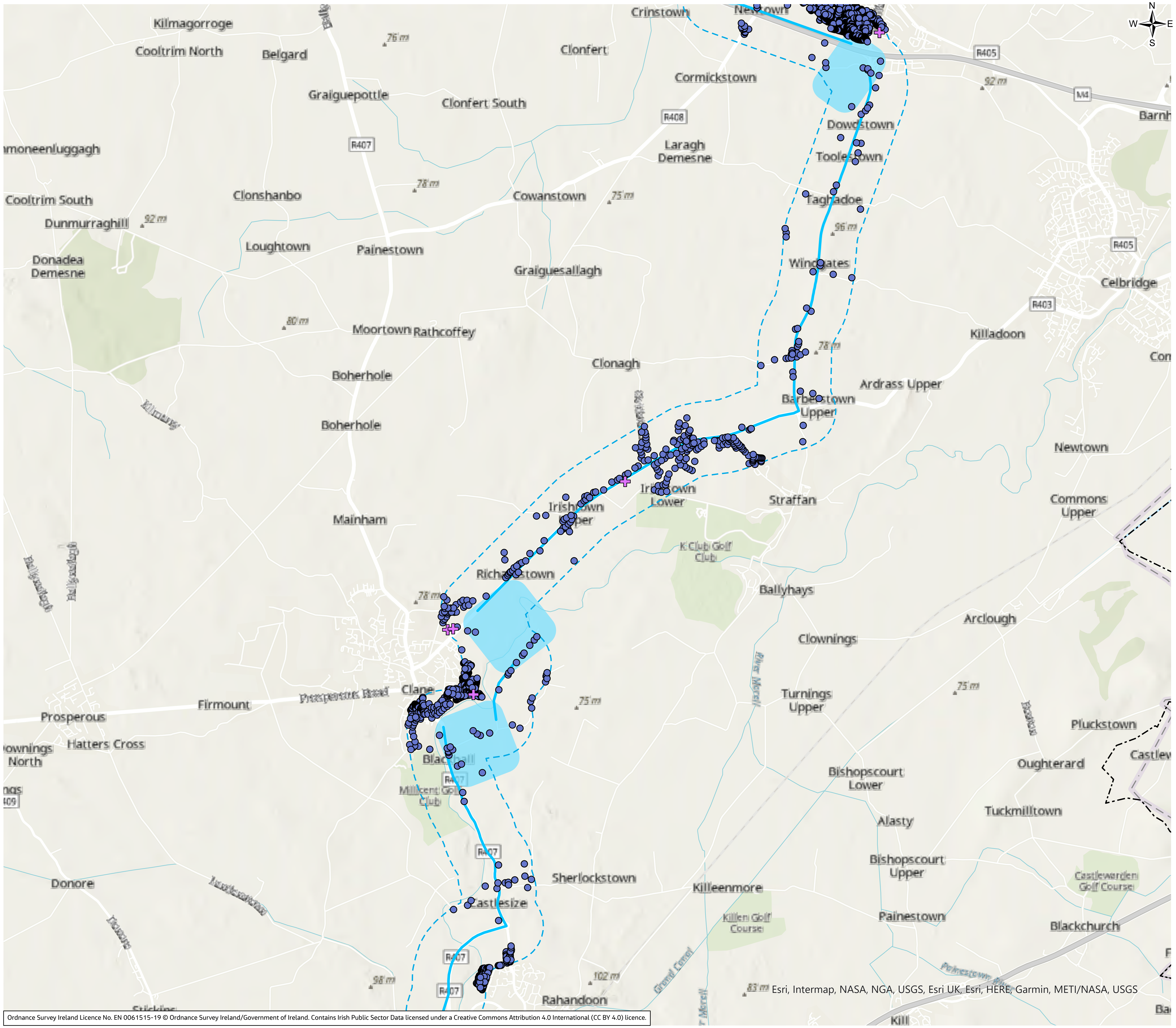

FIGURE C.1.4

Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option D (Blue)
- Off Road Options Being Explored - Option D
- Cable Route Option D 500m Buffer
- Commercial/Retail Property
- Residential Property

0 2 km

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Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option D (Blue)
Sheet 2 of 3

Drawing Status
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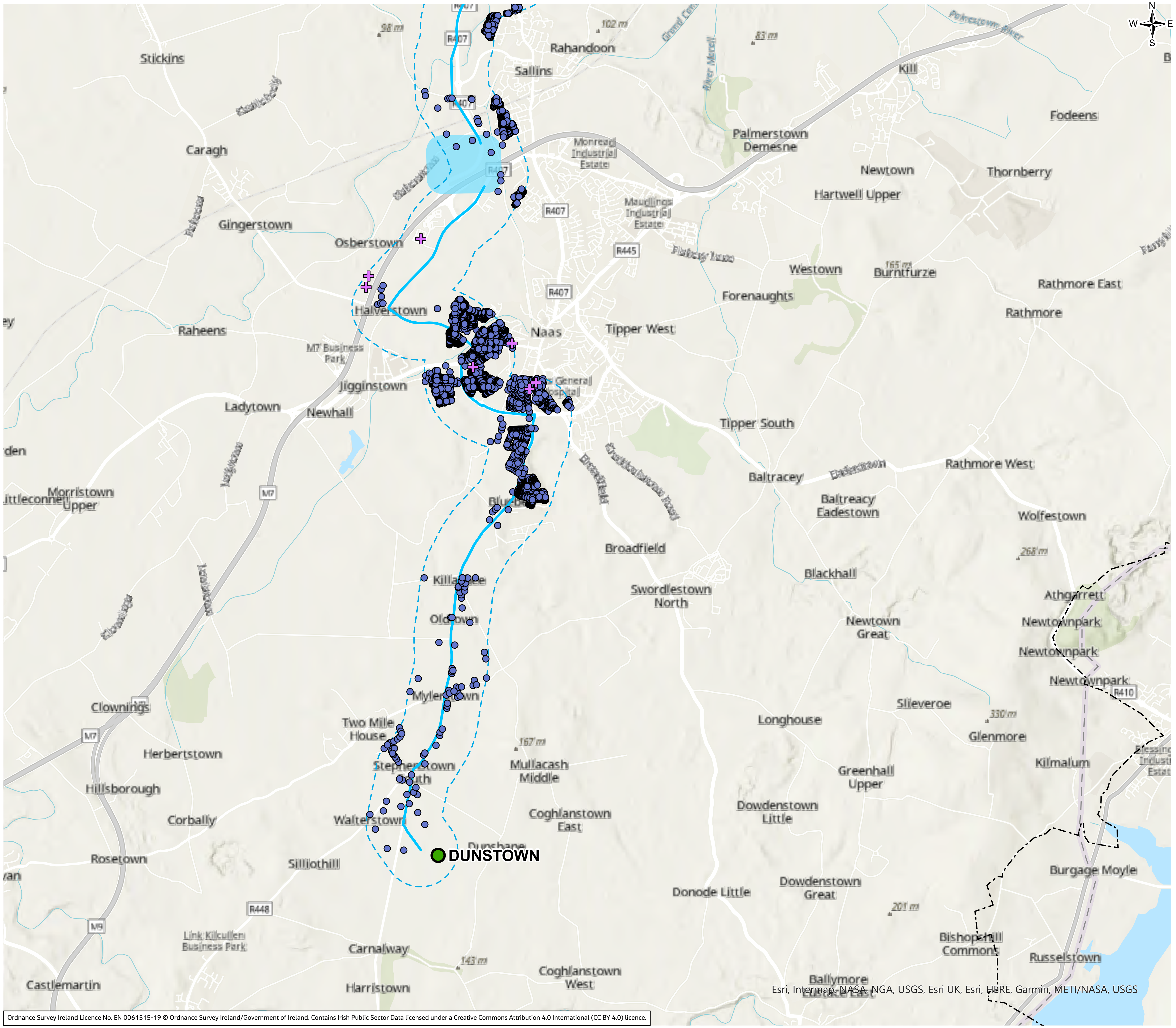

FIGURE C.1.4

Legend

- County Boundary
- 400kV Substation
- Proposed Cable Route - Option D (Blue)
- Off Road Options Being Explored - Option D
- Cable Route Option D 500m Buffer
- Commercial/Retail Property
- Residential Property

0 2 km

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Social Impact Assessment - Residential and Commercial Receptors
Proposed Cable Route Option D (Blue)
Sheet 3 of 3

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Drawing No.	321084AH-MAP-S4A-C.1.4	

Appendix D. 1 – Key Infrastructure

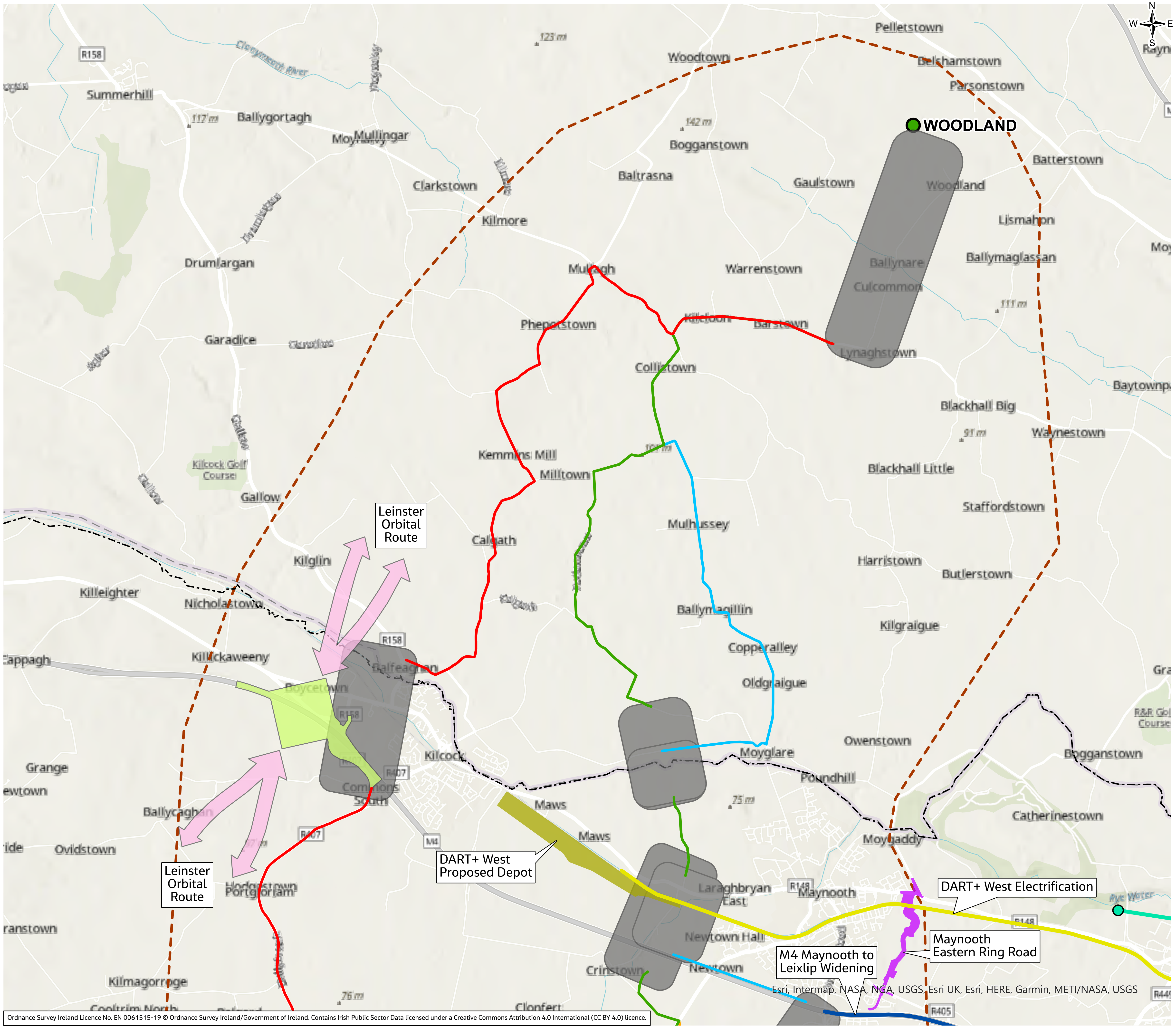

FIGURE D.1.1

Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored

Key Infrastructure

- Gas Network AGI (Above-Ground Installation)
- Gas Networks Ireland - Network Implementation Plan
- M4 Maynooth to Leixlip Widening
- DART+ West Electrification
- DART+ West Proposed Depot
- Leinster Orbital Route - Junction Protection Zone
- Leinster Orbital Route - Indicative Route Corridor
- Maynooth Eastern Ring Road

0 2 km

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Drawing Title
Key Infrastructure Map
Sheet 1 of 3

Drawing Status
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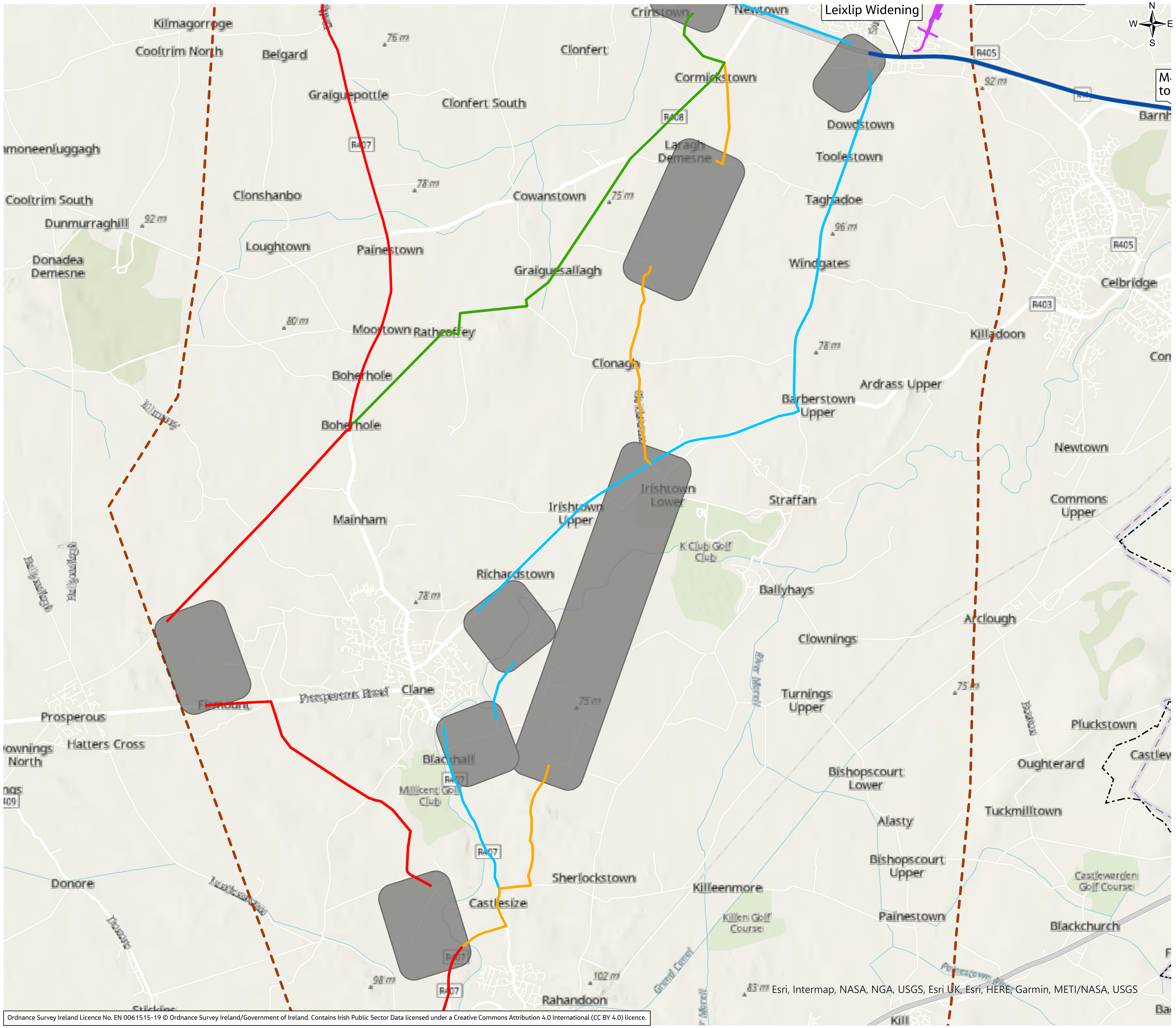

FIGURE D.1.1

Legend

- Study Area
- County Boundary
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored
- M4 Maynooth to Leixlip Widening
- Maynooth Eastern Ring Road

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Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
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Drawing Status: DRAFT

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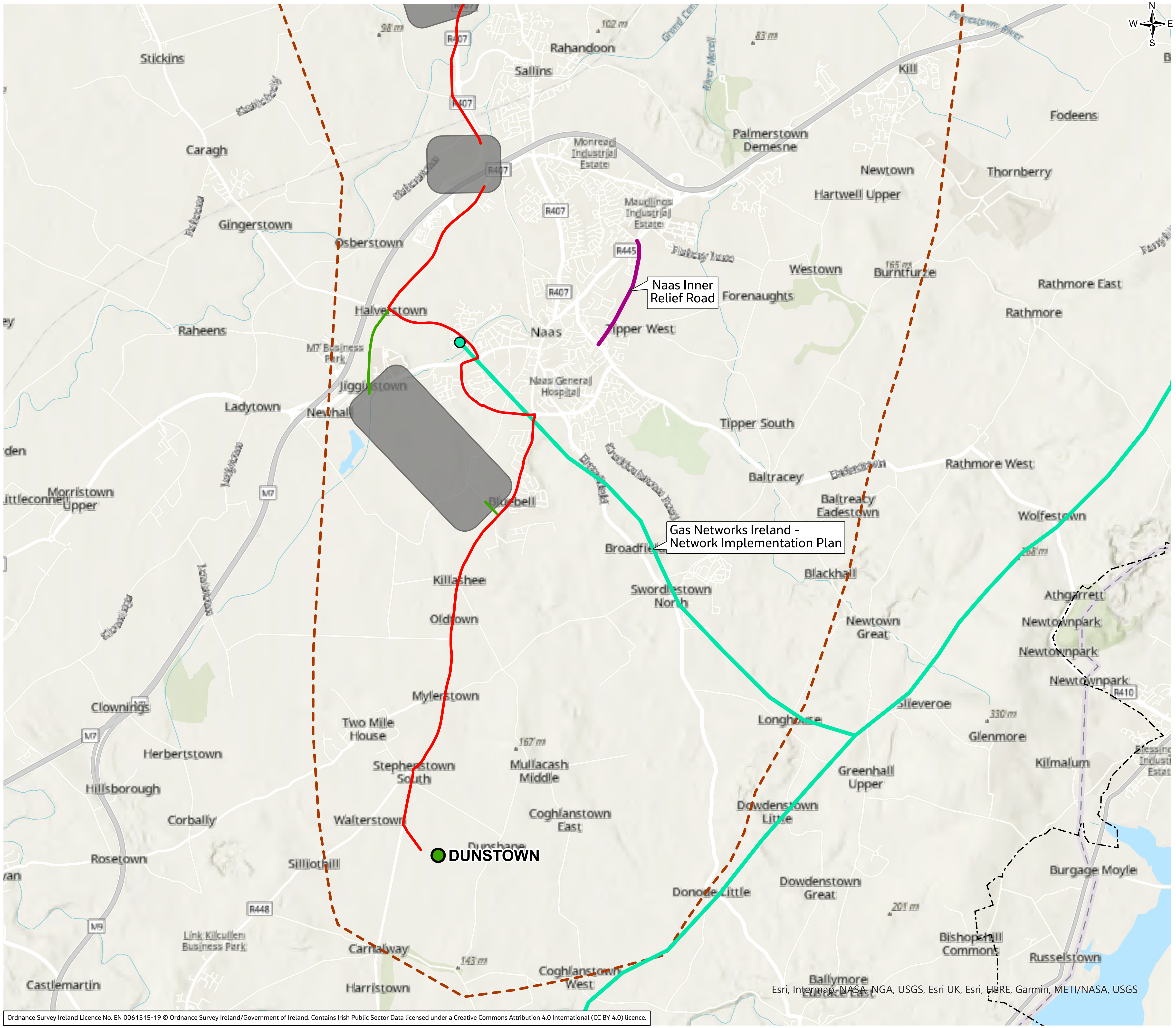
FIGURE D.1.1



Legend

- Study Area
- County Boundary
- 400kV Substation
- Proposed Cable Route - Option A (Red)
- Proposed Cable Route - Option B (Green)
- Proposed Cable Route - Option C (Orange)
- Proposed Cable Route - Option D (Blue)
- Off-Road Options Being Explored

Key Infrastructure

- Gas Network AGI (Above-Ground Installation)
- Gas Networks Ireland - Network Implementation Plan
- Naas Inner Relief Road

0 2 km

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Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
Tel: +353 1269 5666 Fax:+353 1269 5497
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Drawing Title: Key Infrastructure Map Sheet 3 of 3

Drawing Status: DRAFT

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Step 4B – Best Performing Route Option Report (June 2022)

Kildare- Meath Grid Upgrade

Step 4B Report – Route Options and Evaluation Report

June 2022

EirGrid

CP0966 Kildare Meath

Project No:	321084AH
Document Title:	Step 4B Report
Document No.:	KMGU-JAC-TN-0046
Revision:	Final
Document Status:	final
Date:	June 2022
Client Name:	EirGrid
Client No:	CP966
Project Manager:	Fay Lagan
Author:	Fay Lagan
File Name:	KMGU-JAC-TN-0046

Jacobs Engineering Ireland Limited

Merrion House,
Merrion Road,
D4, Dublin,
Tel: +353 1 269 5666

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
Final	14/06/22	Final	FL	GG	HS	NE

Contents

Executive Summary

What is this Report

EirGrid follows a six-step approach when they develop and implement solutions to any identified transmission network problem. The process and timescale of this project is shown in Figure A1-1 below. The Kildare-Meath Grid Upgrade project is currently at Step 4 – Where exactly should we build? To help identify the best location for the project, Step 4 has been divided into two sub-steps: Step 4A and Step 4B. Step 4A was completed in March 2022 and further details are on the project website[1]. This Step 4B Report presents a description of the proposed route. This report identifies what EirGrid considers to be the Best Performing Option[2] for the route of the underground cable. This report will be published and EirGrid will consider all feedback arising and will use this, and any further survey and analysis undertaken, to confirm the final route at Step 5.

Figure A1-1: EirGrid's six-step approach and timeline for the project

What is the Kildare-Meath Grid Upgrade Project?

The project will help transfer electricity to the east of the country and distribute it within the network in Meath, Kildare and Dublin. The project will add a high-capacity electricity connection between Dunstown substation in Kildare and Woodland substation in Meath. The need for the project remains robust and will provide integration of electricity generation and an increase in demand on the East coast.

The project is essential to meet the Government of Ireland's Climate Action Plan target of up to 80% renewable energy generation by 2030, this includes transporting electricity from offshore renewable sources. It will also help meet the growing demand for electricity in the East. This growth is due mainly to increased population and economic activity in the region.

A significant number of Ireland's electricity generators are in the south and south west, where many wind farms and some modern electricity generators are located. The power they generate needs to be transported to where it is needed. The power is mainly transported cross-country on the two existing 400 kV lines from Moneypoint station in Clare to Dunstown substation in Kildare and Woodland substation in Meath. The proposed Kildare-

[1] https://www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/
[2] The preferred route as shown in Step 4B. It is Option A (Red) from Step 4A with some minor changes.

Meath Grid Upgrade will connect these two lines, and this will strengthen the transmission network by improving reliability and security in the region.

What Happened at Step 4A (the previous step of the project)?

The design of the proposed route options at Step 4A were based on the following routing principles:

- Avoid motorways;
- Maximise the use of national, regional and local roads;
- Avoid town centres and industrial estates;
- Avoid going off-road, through private land and through agricultural land where possible;
- Avoid sensitive natural and built heritage locations;
- Minimise impact on communities where possible; and
- Minimise the overall length of the route.

These routing principles align with EirGrid's five key assessment criteria - Environmental; Socio-Economic; Technical; Economic; and Deliverability. By following the routing principles, improved route options were designed. The routing process was refined through a Route Section Assessment and an End-to-End Assessment. Further details are in the Step 4A Report[3].

Four route options were presented for public consultation between August and November 2021. The consultation process was promoted through on-site engagement in the project area, stakeholder engagement, public webinars, multi-channel advertisements and via the project website, and Community Forum meetings.

A Community Forum is established for each project that qualifies for an EirGrid Community Benefit scheme. The community forum for this project was established in July 2021. Each community forum develops a strategy for their specific community. A Community Forum does the following:

- Ensures communities are at the heart of the decision making over the project lifetime;
- Provides relevant input and key local knowledge to assist the project team in decision making;
- Works with community groups and organisations to build trust, identify local needs, grow partnerships and deliver on local projects;
- Provides governance and transparency around the implementation of Community Benefit;
- Receives regular updates from EirGrid team members on project delivery; and
- Advises EirGrid on the most effective approach to communicating feedback and key milestones to the wider community.

In March 2022, the Step 4A Report was published. This report described the process that has been completed during Step 4A and provided a comparative assessment of the four route options.

[3] https://www.eirgridgroup.com/site-files/library/EirGrid/KMGU-JAC-TN-0017-Step-4A-Report-08-03-2022-Compressed.pdf

Option A (Red) was selected as the Emerging Best Performing Option[4] as it scored more favourably in terms of Deliverability compared to the other options. Option A (Red) generally scored more favourably in four of the Deliverability topics compared to the other options – Design Complexity; Dependence on Other Projects; Permits and Wayleaves; and Implementation Timelines. Option A (Red) did score more highly than Options B and D and was equal to Option C for Traffic Disturbance because it has the most amount of in-road sections and potentially impacts more regional roads than the other options, which will increase traffic disturbance. While the potential traffic impacts will be temporary and restricted to the construction phase, in order to minimise the disturbance, traffic surveys will be undertaken to confirm this assumption. Other survey and design work will be completed to confirm the assumptions made on the required working area. In addition, localised route changes could be designed and assessed to minimise potential impacts further. Consultation will be undertaken with Meath and Kildare County Councils and other key stakeholders (such as Transport Infrastructure Ireland) to agree the approach to traffic management and avoid or reduce the potential impacts.

Option A (Red) also had less Socio-economic (community) impacts compared to other options. This is reinforced by the feedback received from respondents during the consultation period. Option A (Red) impacted the least amount of agricultural land and avoided concerns that the other options would have resulted in, such as, potential impacts to the settlement of Rathcoffey, and Ovidstown along the R403 and R406; and greater potential impacts to areas of amenity, such as Alexandra Bridge, near to Clane.

What Happened at Step 4B (the current step of the project)?

In Step 4A, Option A (Red) was re-examined to refine the route as far as possible to remove any wider areas (corridors) and to provide more certainty on the specific location. The five wider areas were shown in that way because these were off-road sections and further discussions were required with the affected landowners. Also, further surveys and design were needed to determine the best location for the cable route within these wider areas.

Option A (Red) from Step 4A provided a framework for the routing process at Step 4B. While it was explained in the Step 4A Report that route changes were a possibility because of further surveys and assessment, the project team sought to avoid significant changes. However, the Step 4B process had identified several areas where changes would result in an improved route. These changes are presented in Table A-1 and Table A-2 below. The changes were made for a number of reasons, such as reducing potential environmental impacts, or avoiding private lands. As a result, approximately 3% of the route (1.5km out of 51.4km[5]) has been moved from the route shown at Step 4A. The maximum movement of the cable route is 240m – this occurs on the approach to Dunstown substation where the route has moved 240m west from the location shown in Step 4A.

The one wider area that remains on the route is at the crossing point of the Grand Canal in Naas. Consultations with local stakeholders revealed that the area to the south of the canal is soft ground and is challenging in terms of ground conditions. A review of available geological data has not highlighted any significant constraints to construction in this area. However it was considered best to wait for the results of the ground investigations in this area and along the route. These results will inform the design and routing in this area.

[4] The preferred route shown in Step 4A. This was Option A (Red).
[5] At Step 4A, the cable route length was 51.4km.

Table A-1. Changes to Step 4A Wider Areas

Step 4A Wider areas	Step 4B Route	Reason for the Change at Step 4B (Best Performing Option)
 Woodland substation to R156		This is now an off-road section approximately 3km in length through agricultural land. The use of the local roads in this area were ruled out because of two road bridges. These bridges are too shallow for a trench to be dug into them. Diversions around the bridges were ruled out because of potential impacts to residential properties and farm buildings. (Further information on the options considered in this area is outlined in Chapter 3 of this report).
 West of Kilcock		This section includes a crossing of the Rye Water, Royal Canal, Dublin-Sligo railway, and the M4. The route in this section will be a mixture of in-road[6] along the R158 and R148, an off-road crossing of the Rye Water, and a crossing under the canal, railway, and the M4. From Commons West, the route travels to the south on the R407. (Further information on the options considered in this area is outlined in Chapter 3 of this report).
 East of Prosperous		This is an off-road section approximately 1.1 km in length through agricultural land. The section passes slightly to the west of the Study Area as previously shown, by approximately 220m. This decision was made in order to shorten the length of the cable route and to minimise potential impacts to landowners, hedgerows, and agricultural land. (Further information on the options considered in this area is outlined in Chapter 3 of this report).

[6] A section of the cable route that will be placed within an existing road. A trench will be dug in the road and the cable will be installed.

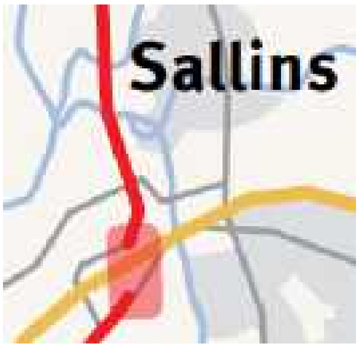
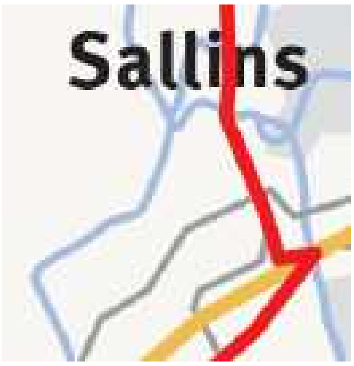
Step 4A Wider areas	Step 4B Route	Reason for the Change at Step 4B (Best Performing Option)
 North of Sallins		This section is a mixture of in-road sections and off-road crossing through agricultural land. It will also pass close to the River Liffey, and the design will help avoid impacts to the landscape and ecology. (Further information on the options considered in this area is outlined in Chapter 3 of this report).
 Crossing of the M7		This section is a mixture of in-road and off-road sections. The route comes off the Sallins Bypass and crosses over agricultural land. The route crosses under the M7 in the existing underpass (Osberstown Road). The route then connects to the R407 (Millennium Parkway). (Further information on the options considered in this area is outlined in Chapter 3 of this report).

Table A-2. Route Changes from Step 4A

Additional Areas of Changes	Reason for the Change at Step 4B
 Grand Canal Crossing in Naas	This is a new wider area at Step 4B. A wider area is included in this section because further surveys on ground conditions are needed before the route can be finalised. The Naas Sports Centre and adjacent residential properties will be avoided. The canal could be crossed along the R409 (New Caragh Road) or with a crossing under the canal. (Further information on the options considered in this area is outlined in Chapter 3 of this report).
 Approach to Dunstown substation	This is a change from the route shown at Step 4A. The route was changed in this section to avoid a road bridge which is too shallow for the cable trench. The cable will now travel south west along the R448 for a greater length than at Step 4A, before turning east to connect with the R412. This change reduces potential environmental and social impacts. (Further information on the options considered in this area is outlined in Chapter 3 of this report).

These changes have increased the length of the cable route from 51.4km to 52.6km – an increase of 1.2km. Within this 52.6km, there is also an increase of off-road length, from 6km to 7.9km.

This increase in off-road length is largely due to the changes at the Woodland substation, where the cable route is now off-road. As stated above, this is because local roads in the area were considered unsuitable because of two road bridges, which do not have sufficient depth for the cable trench. The increase in the overall length will increase the cost of the project. However, it was concluded that these route refinements were minor and did not change the assessment of Option A (Red) as presented in the Step 4A Report. It was concluded by the project team that Option A (Red) remained the Emerging Best Performing Option and that the route shown in this Step 4B Report is the Best Performing Option. It is possible that further changes will be required at Step 5, following further design, surveys, consultation, and assessment. However, these changes will be fully consulted upon with affected landowners, community forum, statutory bodies (such as Meath and Kildare County Councils), and details will be provided to the public through the EirGrid website and reports.

For the in-road sections the route is shown as the width of the road. Further design and assessment will refine the location of the cable within or adjacent to the road (e.g. in a footpath) at Step 5. For the off-road sections, the route is generally shown as up to a 40m wide strip. This width is mostly temporary construction areas and a smaller permanent easement above the cable, which will be required for future access and maintenance. The width of 40m is subject to ground conditions, severance issues, and other constraints. It may increase in size at watercourse crossings where additional land may be required for the proposed works. Additionally, in some locations along the in-road sections, an off-road crossing of a watercourse will be required. These areas are required where there is an existing bridge crossing of a watercourse. It is considered that those bridges would not have sufficient depth to accommodate a cable and so an off-road crossing is required.

Further design features will be added to the project at Step 5. These include jointing bays, passing bays, construction areas, access tracks, other associated works, and substation works. These works will be in the vicinity of the described route, however further surveys and assessment work is required before these elements can be designed. These elements will not affect the routing of the cable; however, they may result in additional temporary land requirements during the construction phase. Landowners will be consulted with directly to facilitate this.

A figure showing the Best Performing Option is presented in Appendix A of this report.

1. Introduction

1.1 Who is EirGrid?

EirGrid is responsible for a safe, secure and reliable supply of electricity – now and in the future. EirGrid develops, manages and operates the electricity transmission grid (the grid). This brings power from where it is generated to where it is needed throughout Ireland. EirGrid uses the grid to supply power to industry and businesses that use large amounts of electricity. The grid also powers the distribution network. This supplies the electricity used every day in homes, businesses, schools, hospitals and farms.

1.2 What is the Kildare Meath Grid Upgrade Project?

The project will help transfer electricity to the east of the country and distribute it within the network in Meath, Kildare and Dublin.

The project will add or upgrade a high-capacity electricity connection between Dunstown substation in Kildare and Woodland substation in Meath. The project is essential to meet the Government of Ireland's Climate Action Plan target of 80% renewable energy generation by 2030, which includes transporting electricity from offshore renewable sources. It will also help meet the growing demand for electricity in the East. This growth is due mainly to increased population and economic activity in the region.

A significant number of Ireland's electricity generators are in the south and southwest, where many wind farms and some modern electricity generators are located. The power they generate needs to be transported to where it is needed. The power is mainly transported cross-country on the two existing 400 kV lines from the Moneypoint station in Clare to the Dunstown substation in Kildare and Woodland substation in Meath (shown in **Figure 1-1**).

Figure 1-1: Cross-country 400 kV lines

To solve this emerging issue, EirGrid needs to strengthen the electricity network between Woodland and Dunstown substations to avoid capacity and voltage problems.

The project aims to strengthen the transmission network between Woodland and Dunstown substations – and EirGrid has assessed a number of technical solutions to do so. The project will have the following benefits:

- Competition - Apply downward pressure on the cost of electricity;
- Sustainability - Help facilitate Ireland's transition to a low carbon energy future;
- Security of Supply - Improve electricity supply for Ireland's electricity consumers;
- Economic - Contribute to the regional economy and support foreign direct investment; and
- Community - Deliver community benefit in the areas that facilitate the project infrastructure.

The need for the project has been established through a series of reports completed at Steps 1 to 4A (see **Figure 1-2** below for reference). These reports are available on the project website[7]. This series of studies identified the need for a new connection between Woodland and Dunstown substations and that an underground cable would be the best technology for this connection. The project is a high voltage (400 kV) underground cable between Woodland and Dunstown substations and the need for the project remains robust.

1.3 Purpose of this Report

EirGrid follow a six-step approach when they develop and implement the best performing solution option to any identified transmission network problem. This six-step approach is described in the document 'Have Your Say' published on EirGrid's website[8]. The six steps are shown at a high-level in **Figure 1-2**. Each step has a distinct purpose with defined deliverables and represents a lifecycle of a development from conception through to implementation and energisation.

Figure 1-2: EirGrid's six-step approach to developing the electricity grid

The project is currently in Step 4, where the project team, in consultation with stakeholders and the community, identifies exactly where the underground electricity connection will be built. The timeline for Step 4 can be seen in **Figure 1-3**.

[7] https://www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/
[8] https://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

Figure 1-3: EirGrid's six-step timeline for the project

In Step 1, EirGrid identified the need for the project.

In Step 2, EirGrid compiled a shortlist of best performing technical options, which went out for public consultation between November 2018 and February 2019. This included a mix of overhead line, underground cable and up voltage technologies. Four of those options were taken forward to Step 3 in April 2019.

In Step 3, EirGrid re-confirmed the need for the project and investigated and consulted on the shortlisted technology options to strengthen the electricity network between the Woodland and Dunstown substations. In April 2021, EirGrid identified the 400 kV underground cable option as the best performing option to progress for this project.

As part of Step 4, EirGrid has identified four potential underground cable route options and have consulted on these. The four proposed route options have been assessed against five key assessment criteria (see also **Figure 1-4** below):

- Environmental factors;
- Socio-economic factors – such as the local economy and local amenities;
- Technical aspects;
- Deliverability factors – such as timeline and potential risks; and
- Economic factors.

Figure 1-4: EirGrid's Five Assessment Criteria for Projects

Step 4 has been divided into two sub-steps: Step 4A and Step 4B. This Step 4B Report identifies what EirGrid, following technical assessments and substantive public and stakeholder engagement and consultation, considers to be the Best Performing Option for the route of the underground cable. This report will be published and EirGrid will consider all feedback arising. Comments on this report can be made to EirGrid (See Chapter 4 of this report for further details) and they will be reviewed and considered by the project team. If design changes are required these will be detailed in the Step 5 reports. The Best Performing Option will be the route option taken forward to the planning process and the design will be finalised at that time.

1.4 Structure of this Report

This report is structured as outlined in Table 1.1.

Table 1-1. Report Structure

Chapter	Overview
Executive Summary	A summary of this report.
Chapter 1 Introduction	An outline of the report, a description of the project; and information on the approach to its development.
Chapter 2 Summary of Project to Date	An overview of the works that have been completed on the project at Step 4A and at Step 4B.
Chapter 3 Description of the Best Performing Option	This chapter of the report provides a description of the current cable route and highlights any changes from Step 4A.
Chapter 4 Next Steps	Information on providing comments on this report to EirGrid, and an overview of what the project team will do next (Step 5).

1.5 Accompanying Reports

The following reports accompany this Step 4B Report:

- EirGrid. 2020. Cable Feasibility Report. Available at:

  https://www.eirgridgroup.com/site-files/library/EirGrid/Cable-Feasibility-Report.pdf

- EirGrid. 2021. Step 4A Environmental Constraints Report. Available at:

  https://consult.eirgrid.ie/system/files/materials/2055/Environmental%20Constraints%20Report%20-%20Step%204A%20-%20KMGU.pdf

- EirGrid. 2022. Consultation Summary Report.

  https://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

- EirGrid. 2022. Step 4A Report. Available at:

  https://www.eirgridgroup.com/site-files/library/EirGrid/KMGU-JAC-TN-0017-Step-4A-Report-08-03-2022-Compressed.pdf

2. Summary of Project to Date

2.1 Introduction

This chapter of the report provides an overview of the works that have been completed on the project at Step 4A. Further details are provided in the reports and mapping on the EirGrid website (see Chapter 1 of this report for the weblinks). This chapter also provides a description of the work that has been undertaken at Step 4B.

At Step 4A, Option A (Red) was presented as the Emerging Best Performing Option. This route option included five wider areas to allow for further refinement of the routing at Step 4B. That routing process has been completed and the majority of the wider areas have been removed and a route is provided. One wider area has been retained at the crossing of the Grand Canal (Corbally Section) in Naas. This is because ground investigations are required in this area to establish where and how the canal will be crossed within the wider area shown.

Figure 2-1 below provides a summary of the design process undertaken at Step 4A and 4B.

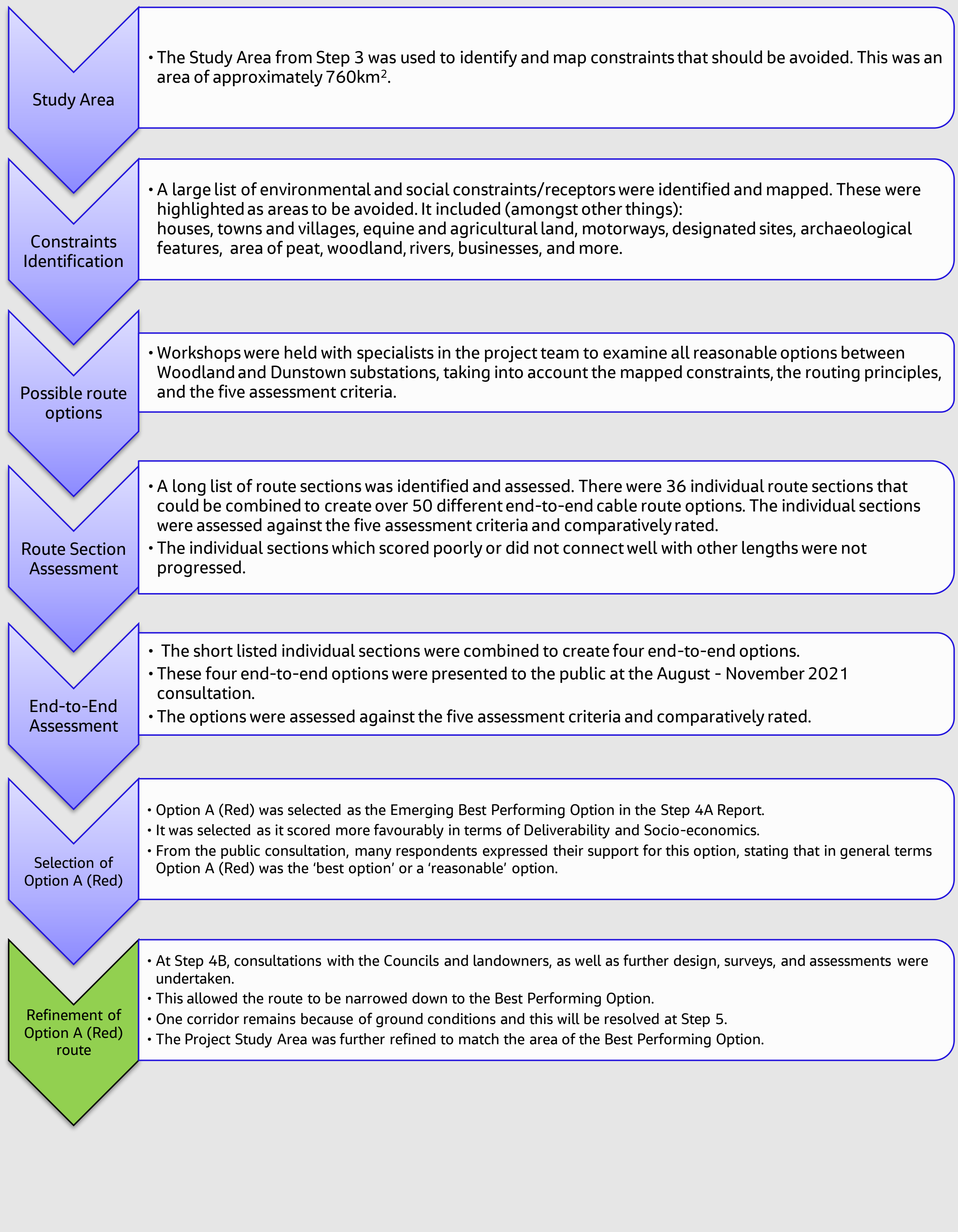


Figure 2-1: The Route Design Process for Step 4A and Step 4B

(Step 4A is shown in blue and Step 4B is shown in green)

2.2 Overview of Step 4A

In Step 4A, the project team re-examined the Study Area to design improved route options from the two feasible route options established during Step 3. The design of the proposed route options at Step 4A were based on the following routing principles:

- Avoid motorways;
- Maximise the use of national, regional and local roads;
- Avoid town centres and industrial estates;
- Avoid going off-road, through private land and through agricultural land where possible;
- Avoid sensitive natural and built heritage locations;
- Minimise impact on communities where possible; and
- Minimise the overall length of the route.

These routing principles align with EirGrid's five key assessment criteria - Environmental; Socio-Economic; Technical; Economic; and Deliverability. By following the routing principles, improved route options were designed. The routing process was refined through a Route Section Assessment and an End-to-End Assessment. This process culminated in four route options – as shown in **Figure 2-2**.

The four route options were presented for public consultation between August and November 2021.

The consultation process was promoted through Community Forum meetings, on-site engagement in the project area, stakeholder engagement, public webinars, multi-channel advertisements and via the project website.

A total of 108 responses were received during the public consultation. Consultation responses were received via an online portal (38), by email (nine) or by post (61). Public consultation has been an integral part of the project, with each response being considered in the routing of the project. A number of respondents expressed support for the overall project, highlighting that the project is needed, as it would bring economic benefits to the area by supporting job creation and by contributing to the development of a resilient energy network based on renewable energy sources. A number of respondents expressed support for the proposed route options generally following the road network, outlining that this would ensure ease of access for maintenance. A few of these responses outlined that the selection of roads should be determined by the amount of disruption on their use that the project would cause and emphasised that motorways should be avoided.

In March 2022, the Step 4A Report was published. This report described the process that has been completed during Step 4A, outlined the four route options, and provided a comparative assessment.

Option A (Red) was selected as the Emerging Best Performing Option as it scored more favourably in terms of Deliverability compared to the other options. It generally scored more favourably in four of the Deliverability topics compared to the other options – Design Complexity; Dependence on Other Projects; Permits and Wayleaves; and Implementation Timelines. Option A (Red) did score more highly than Options B and D and was equal to Option C for Traffic Disturbance because it has the most amount of road sections and potentially, impacts more regional roads than the other options, which will increase traffic disturbance. While the potential traffic impacts will be temporary and restricted to the construction phase, in order to minimise the disturbance, traffic surveys will be undertaken to confirm this assumption. Other survey and design work will be completed to confirm the assumptions made on the required working area. In addition, localised route changes could be designed and assessed to minimise potential impacts further. Consultation will be undertaken with Meath and Kildare County Councils (and Other key stakeholders such as Transport Infrastructure Ireland) to agree the approach to traffic management and avoid or reduce the potential impacts.

Option A (Red) also had fewer Socio-economic (community) impacts compared to other options. This is reinforced by the feedback received from respondents during the consultation period. Option A (Red) impacted the least amount of agricultural land and avoided concerns that the other options would have resulted in, such as potential impacts to the settlement of Rathcoffey, and Ovidstown along the R403 and R406; and greater potential impacts to areas of amenity, such as Alexandra Bridge, near to Clane.

Following the publication of the Step 4A Report, EirGrid held its eighth Community Forum and promoted the Emerging Best Performing Option for three weeks, including through local and regional press titles and radio including Kildare FM, the Meath Chronicle, Leinster Leader, Kildare Nationalist, and Liffey Champion, and on social media sites such as Facebook and Twitter. EirGrid corresponded with stakeholders throughout this period, including through emails, telephone calls, and information published on the EirGrid website to advise them of the Step 4A Report and the Emerging Best Performing Option.

EirGrid also engaged with a number of stakeholders through in-person information days and door-to-door site visits. Members of the EirGrid project team discussed the Step 4A Report and the Emerging Best Performing Option during these engagement days.

Between 29 March and 7 April 2022, EirGrid held six public information days in the following locations:

- The Grange, Sallins, Co. Kildare;
- Kilcock GAA Club, Co. Kildare;
- Two Mile House GAA Club, Co. Kildare;
- Blackhall Gaels GAA Club, Co. Meath;
- Naas Sports Centre, Co. Kildare; and
- Prosperous Parish Centre, Co. Kildare.

An Engagement Summary Report has been prepared which outlines the consultation responses since the publication of the Step 4A report and the Emerging Best Performing Option. This report is available on the project website[9]. Table 2-1 below provides a summary of key issues raised and how the project team have considered the comments.

Table 2-1. Post Step 4A Engagement Summary (2022)

Comment	Project Team Response
Potential disruption arising from the construction of the project, including lengthy roadworks and increased levels of traffic. The R125 should be closed because it is too narrow. The road between Mullagh and Kilcock should be closed and re-instated in better condition, meaning that the final route would have to be adjusted.	The Step 4A Report contained a multi-criteria assessment of the potential impacts at the construction phase, including traffic disruption. The construction phase impacts have been key considerations in the project to date and will be fully addressed in the Step 5 planning and environmental reports. Mitigation measures and traffic management will be included in those reports, following further consultation with key stakeholders like Meath and Kildare County Councils.
Land use - that the cable route would go through private land, could damage crops, and that land used may not be returned to	The routing principles have sought to avoid agricultural land as far as possible – roughly 15% of the total cable length is off-road (agricultural land). Agricultural liaison officers have met with the affected

[9] https://www.eirgridgroup.com/the-grid/projects/capital-project-966/related-documents/

Comment	Project Team Response
its original condition.	landowners and discussed potential impacts from the project, and they will continue to discuss the project going forward. Reinstatement will be resolved during the construction phase.
Potential sterilisation arising from easement.	The easement will be discussed with the affected landowners to minimise impacts as far as possible.
Overhanging trees on the 'Red Road' and that re-aligning the road could have potential adverse impacts on the Rath. The Red Road should be re-instated following completion of the project.	The Red Road will be avoided following routing at Step 4B.
Details requested with EirGrid's ecologist on planting.	Contacts are available and EirGrid are happy for any such discussions.
Potential impact to the 'North-South' Interconnector.	The Kildare Meath project does not cross the proposed North-South Interconnector and so there will be no impacts. Both are important project for Ireland's electrical grid.
Cycling routes are considered during construction.	Provision will be allowed for cyclists in the construction traffic management. Mitigation measures and traffic management will be included in the Step 5 reports, following further consultation with key stakeholders like Meath and Kildare County Councils.
Compensation is supplied for sterilisation from easement, per linear metre across farm land, and for crop loss and damages. That there should be arrangements to facilitate dairy farming, including milk and silage production.	Agricultural liaison officers have met with the affected landowners and discussed potential impacts from the project, and they will continue to discuss the project going forward.
More detailed maps should be provided so that residents can identify the proximity of the route in relation to their properties.	More detailed maps have been provided on the project website and in this Step 4B Report.
If the road is to be dug up, other utilities such as cables should also be placed underground.	EirGrid is consulting with key stakeholders like Meath and Kildare County Councils and utilities providers.
The route may run through their land and farms or be in close proximity to their residence.	Agricultural liaison officers have met with the affected landowners and discussed potential impacts from the project, and they will continue to discuss the project going forward. The cable route has tried to maximise the distance from all residential properties in-line with the routing principles.

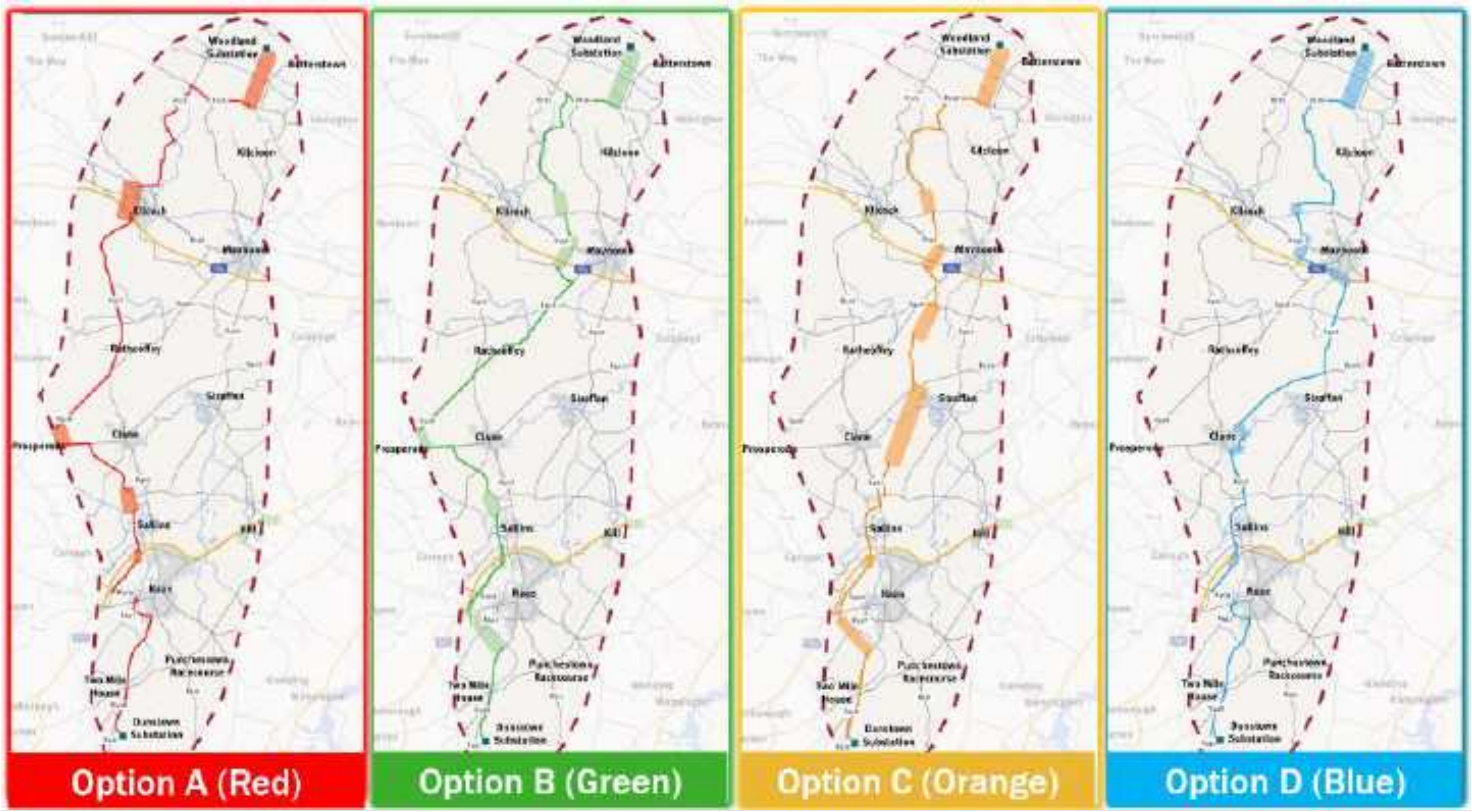


Figure 2-2: Shortlisted Options - shown in Step 4A Public Consultation (2021)

2.3 Approach to Step 4B

In Step 4B, Option A (Red) was re-examined to refine the route as far as possible to remove any wider areas (corridors) and to provide more certainty on the specific location. The five wider areas shown at Step 4A were shown in this way as these were off-road sections and further discussions were required with the affected landowners. Further surveys and design were needed to determine the best location for the cable route within these wider areas.

Option A (Red) from Step 4A provided a framework for the routing process at Step 4B. While it was explained in the Step 4A Report that route changes were a possibility because of further surveys and assessment, the project team sought to avoid significant changes. However, the Step 4B process had identified several areas where changes would result in an improved route. These changes are presented in Table 3-1 and Table 3-2 below. The changes were made for a number of reasons, such as reducing potential environmental impacts, reducing road closures, or avoiding private lands. As a result, approximately 3% of the route (1.5km out of 51.4km[10]) has been moved from the route shown at Step 4A. The maximum movement of the cable route is 240m – this occurs on the approach to Dunstown substation where the route has moved 240m west from the location shown in Step 4A.

The Step 4B process involved close cooperation between all members of the project team – agricultural liaison officers, and specialists in the fields of deliverability, technical, economic, environmental and socio-economic factors. This multi-disciplinary team, along with input from the stakeholders, landowners and the community ensured that the Best Performing Option would be selected through a consideration of all relevant issues.

Consultations were held with potentially affected landowners. This allowed landowner input into the potential routing and provided more information on ground conditions, environmental constraints, and farming practices that were considered in the routing process. At this time, further surveys and assessment were undertaken to determine how the route could be refined in order to avoid or reduce the potential environmental and social impacts, and to take account of technical issues. Issues such as the cable rating and the need to maintain the structural integrity of the cable (i.e. the cable must bend and not make 90° turns) have been factored into the routing. This process also included the technical assessment of the roads affected by the cable, for example, stone arch bridges in the existing roads may not be suitable for the digging of a cable trench. This is because the depth of the bridges below the roads are generally quite shallow. In these cases, off-road crossings adjacent to the bridges have been assessed to be the best solution, subject to the crossing methods including site-specific environmental mitigation. These locations are identified in Chapter 3 below.

Environmental and social considerations were addressed through aerial mapping, consultation with statutory bodies, field surveys, along with input from the landowners and the community, and discussions as a project team.

This process allowed for the consideration of all factors and for the project team to discuss potential routing options for the cable. The Step 4B Best Performing Option was chosen from this process and is detailed in Chapter 3 below.

The Project Study Area at Step 4A was roughly 340km^2 – a reduction of approximately 55% from the Step 3 Project Study Area, covering all four of the proposed route options. After the selection of Option A (Red) as the Emerging Best Performing Option, the Project Study Area was further refined to cover this area. The current Project Study Area is show in Figure 2.3. It covers an area of 137 km^2 – a reduction from the Step 4A area of approximately 60%. These refinements have allowed community engagement to be focused to the relevant area of the route.

[10] At Step 4A, the cable route length was 51.4km.

Figure 2-3: Step 4B Project Study Area

3. Description of the Best Performing Option

This chapter of the report provides a description of the Best Performing Option at Step 4B. The route described is based on the previous design and assessment work, surveys from Step 4A with updates at this Step, and consultations with the public, landowners, and statutory bodies. Further work will be undertaken as the project moves into Step 5 and this could result in some changes to the route as described. This could be because of new information from ground investigations, new constraints identified from environmental surveys or new details provided by the affected landowners. Any changes will be fully described in the Step 5 reports. The changes will be made because of technical, deliverability, or economic reasons, or to avoid or reduce potential impacts to the environment or to communities living along the cable route. Any changes will be fully described in the Step 5 reports.

3.1 Route Changes from Step 4A

The work that has been undertaken by the project team has allowed the refinement of the Emerging Best Performing Option that was shown at Step 4A. Option A (Red), as shown as Step 4A, had five wider areas and these are shown in Figure 2-2. It was necessary to show these wider areas as further design, assessment and consultation was required. In Step 4B, only one wider area remains – the crossing point of the Grand Canal in Naas. Consultations with local stakeholders revealed that the area to the south of the canal is soft ground and was described as challenging in terms of ground conditions. Geological data from Geological Survey Ireland[11] have been reviewed and no recorded significant constraints to construction in this area were identified. However, it was determined by the project team that it would be prudent to undertake further surveys at this location before identifying the crossing type. Ground investigations are proposed in this area and along the route. These results will allow the design in this area to be resolved at Step 5. Further details are provided in the text below with a summary of the key changes in Table 3.1 and Table 3.2.

Table 3-1. Changes to Step 4A Wider areas

Step 4A Wider Areas	Step 4B Route	Reason for the Change at Step 4B (Best Performing Option)
 Woodland Substation to R156		This is now an off-road section approximately 3km in length through agricultural land. The use of the local roads in this area were ruled out because of two stone arch road bridges on the Red Road. These bridges are too shallow for a trench to be dug into them (Further information on the options considered in this area is outlined below).

[11] https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

Step 4A Wider Areas	Step 4B Route	Reason for the Change at Step 4B **(Best Performing Option)**
 West of Kilcock		The route in this area will be a mixture of an in-road along the R158 and R148, an off-road crossing under the Rye Water, and crossing under the canal, railway, and the M4. From Commons South, the route travels to the south on the R407 (Further information on the options considered in this area is outlined below).
 East of Prosperous		This is an off-road section approximately 1.1 km in length through agricultural land. The section passes slightly to the west of the Study Area previously shown by approximately 220m. This decision was made in order to shorten the length of the cable route and to minimise potential impacts to landowners, hedgerows (through fewer hedge breaks), and agricultural land (Further information on the options considered in this area is outlined below).
 North of Sallins		This section is a mixture of in-road sections and off-road crossing through agricultural land. It will also pass close to the River Liffey, and the design will help avoid impacts to the landscape and ecology (Further information on the options considered in this area is outlined below).

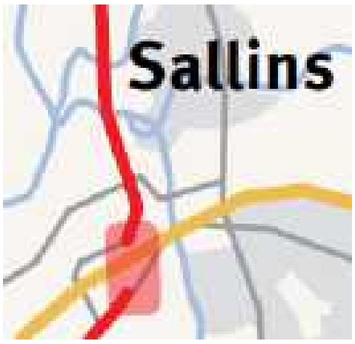
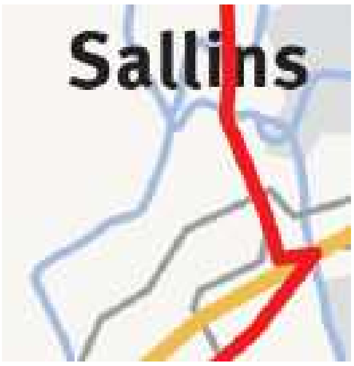
Step 4A Wider Areas	Step 4B Route	Reason for the Change at Step 4B (Best Performing Option)
 Crossing of the M7		This section is a mixture of in-road and off-road sections. The route comes off the Sallins Bypass and crosses over agricultural land. The route crosses under the M7 in the existing underpass (Osberstown Road). The route then connects to the R407 (Millennium Parkway) (Further information on the options considered in this area is outlined below).

Table 3-2. Route Changes from Step 4A

Additional Areas of Changes	Reason for the Change at Step 4B
 Grand Canal Crossing in Naas	This is a new wider area at Step 4B. A wider area is included in this section because further surveys on ground conditions are needed before the route can be finalised. The Naas Sports Centre and adjacent residential properties will be avoided. The canal could be crossed along the R409 (New Caragh Road) or with a crossing under the canal. (Further information on the options considered in this area is outlined in Chapter 3 of this report).
 Approach to Dunstown Substation	This is a change from the route shown at Step 4A. The route was changed in this section to avoid a road bridge which is too shallow for the cable trench. The cable will now travel south west along the R448 for a greater length, before turning east to connect with the R412. This change reduces potential environmental and social impacts. (Further information on the options considered in this area is outlined in Chapter 3 of this report).

3.2 Cable Details

The route shown in this report is based on a 2.1m wide trench (see Figure 3-1 below). It is possible that this width will be decreased when further technical assessments are completed at Step 5. However, 2.1m is the maximum width expected that could be used on this project and is used here as a reasonable "worst case". A narrower cable trench will mean less construction activities and less road closures. These issues will be addressed at Step 5. In some areas, e.g. at watercourse crossings, it may be necessary to widen the cable route to overcome physical constraints present.

For the on-road sections, the route is shown as the width of the road. Further design and assessment will refine the location of the route within or adjacent to the road (e.g. in a footpath) at Step 5. For the off-road sections, the route is generally shown as a 40m wide strip. The width of 40m is subject to ground conditions, severance issues, and other constraints. It may increase in size at watercourse crossings where additional land may be required for the proposed works (e.g. Horizontal Directional Drilling (HDD)). This 40m width is mostly temporary construction areas within this area will be a smaller permanent easement above the cable, which will be required for maintenance.

In some on-road sections, an off-road crossing of a watercourse will be required. These areas are described below and are needed at some existing bridge crossings of watercourses. At this time, it is considered that those bridges would not have sufficient depth to accommodate a cable and so an off-road crossing is required. The cable trench is typically 1.5m in depth and that can change because of ground conditions or the presence of constraints, such as other utilities. Stone arch bridges that carry roads over watercourses may not have sufficient depth for cable trenches such as the Kildare-Meath Grid Upgrade project. An on-site assessment of the bridges was made by technical experts. Where it was determined that it would not be possible to dig the trench into the bridge, alternative designs were considered.

Further design features will be added to the project at Step 5. These include jointing bays, passing bays, construction areas, access tracks, other associated works, and substation works. These works will be in the vicinity of the described route, however further surveys and assessment work are required before these elements can be designed. These elements will not affect the routing of the cable; however, they may result in additional land requirements and landowner engagement.

Jointing bays (underground chambers) will also be constructed along the cable routes and are used to join together ('joint') consecutive lengths of cable and to facilitate the cable pulling. Typically, jointing bay separation for a cable is between approximately 500m and 750m. To facilitate traffic management at locations where jointing bays are to be located within the carriageway, the use of temporary passing bays is proposed. These are strips of land at the edge of a public road on one side of a jointing bay (approximately 50-80m in length), that are temporarily cleared and laid with a hard surface in order to facilitate vehicle movements around the jointing bay, thereby avoiding or minimising the need for road closures. This will entail removing the top layer of ground to the side of the carriageway (including removal of hedges if present) and temporarily storing it locally to the site for reinstatement following the works. New hedges would be planted as part of re-instatement works.

Other traffic control measures will also be implemented as appropriate along the cable routes. These are likely to include road diversions, temporary closures and stop / go traffic management. All traffic management measures will be implemented in the context that the laying of cable is a linear construction process, which will be done in smaller sections along the cable route. This means that not all roads along the cable route will be disrupted at the same time during construction.

A number of crossings of watercourses, drainage ditches, utilities, railway lines and motorways will also be required along the cable route. These crossings will be designed at Step 5 but typical crossing techniques include cable bridge, open-cut trenching or by use of HDD. The specific detail of each crossing will be developed at Step 5 of the project but an overview of the techniques are:

- Cable bridge – a structure to pass cables over an area such as a watercourse. Measures are designed in to prevent unauthorised access to the structure;

- Open-cut trenching – an excavated area dug through fields where the cable is constructed. Where is it done through watercourses, the water flow is temporarily diverted with pipes around the area of work and the watercourse is then reinstated; and

- Horizontal Directional Drilling (HDD) – one of a number of trenchless techniques. A drilling rig launches a bore underground and it is guided in the desired direction. The cable is then laid in the drilled hole. There is no above ground works except for the start and end points of the hole.

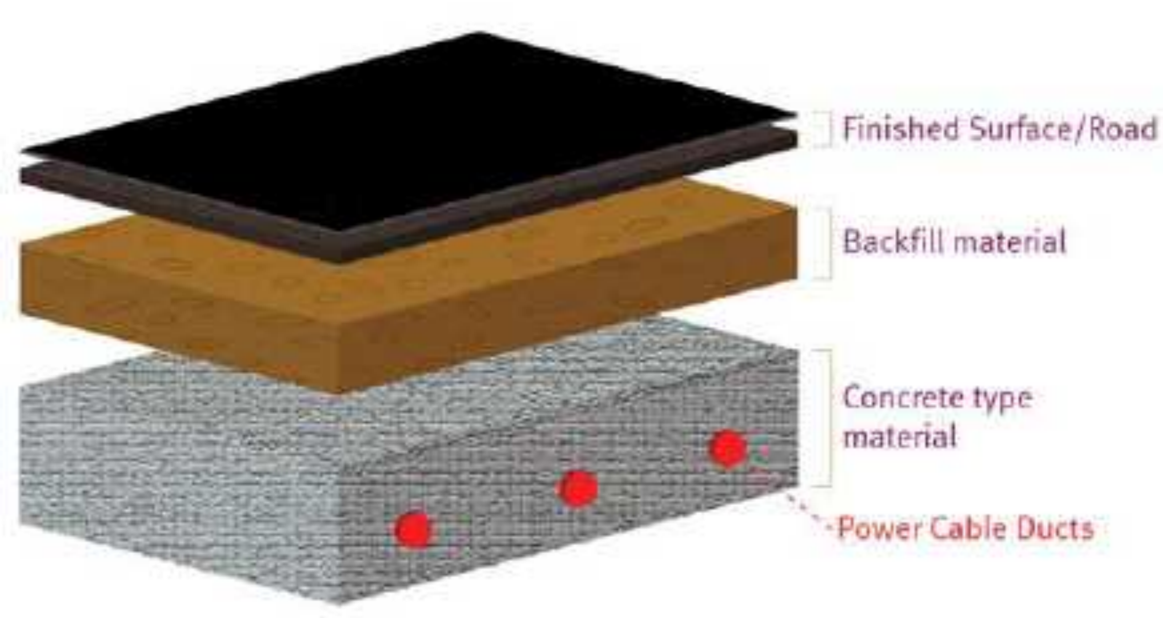


Figure 3-1: Indicative High-Voltage Alternating Current (HVAC) Cable Duct Arrangement (single conductor per phase solution)

The following sections of this chapter describe the Best Performing Option travelling from Woodland substation to Dunstown substation. For ease of reference the route has been broken into sections in this report. At the construction phase, the route may be progressed by multiple construction teams. This will be addressed in the Step 5 reports.

Please see Appendix A for a figure showing the Best Performing Option.

3.3 Woodland to R156

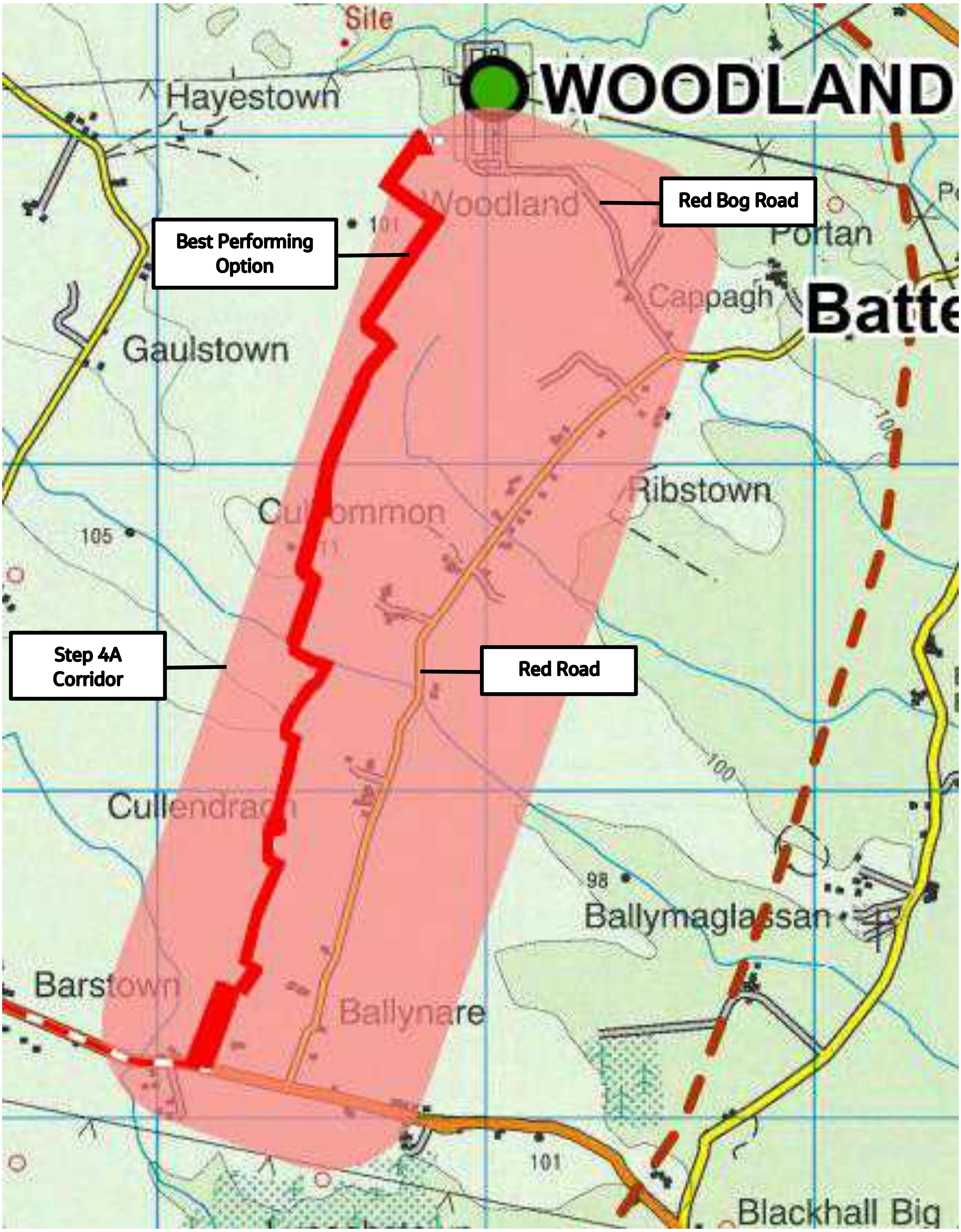


Figure 3-2: Woodland to R156

At Step 4A, a wider area was shown travelling from the substation in a south-westerly direction to the R156. At Step 4B, there were a number of routing options that were considered in-line with the routing principles for the project (See Chapter 2 of this report for further details). The option of an in-road section using the Red Bog Road and the Red Road to connect to the R156 was considered. However, this was ruled out because there are two existing in-road stone arch bridges, which were assessed to be unsuitable for trenching (See Section 3.2 for further details). Alternative design solutions (such as cable bridges) and off-road routes were considered in these areas; however, the area is constrained by residential properties and farm buildings adjacent to the bridges. Short off-road diversions at the bridges would have resulted in impacts to the properties and farm buildings and so this was ruled out.

These issues required the project team to identify an alternative off road route. This is in-line with the routing principles for the project, which aim to find the best overall option considering all issues. While there is a preference for on-road sections in the routing principles, that preference is to be considered on balance with all factors. In this case an off-road route was determined to be the Best Performing Option in this location.

Consultation with landowners between Woodland substation and the R156 helped to identify a viable route for the cable. Potential impacts to the affected area have been discussed and the route has sought to minimise the effects.

The route will cross approximately 17 hedgerows and treelines and there will be a crossing of the Dunboyne Stream_010[12]. There are field drains along hedgerows and treelines which require crossing. Where it is required, mitigation will be proposed to avoid or reduce the potential impacts in the Step 5 reports. There are no known archaeological features directly impacted by the proposed route. An assessment of the potential impacts of the proposed route was undertaken in the Step 4A Report for the project[13]; however further assessment will be undertaken at Step 5.

Part of the cable route is shown outside of the north west corner of the wider area. This is because of the field boundary in this area and the small area outside of the wider area has been included to avoid severance of this land.

As noted above, additional design features may be added at Step 5, but these will generally be accommodated within the area stated. In certain areas, it may be necessary to expand the temporary working area. This will be determined at Step 5.

[12] The watercourse will be known by a local name. This technical name is the Water Framework Directive (WFD) water body name assigned by the Environmental Protection Agency and these names for WFD water bodies are used in this report for consistency.
[13] http://www.eirgridgroup.com/site-files/library/EirGrid/KMGU-JAC-TN-0017-Step-4A-Report-08-03-2022-Compressed.pdf

3.4 R156 to Kilcock

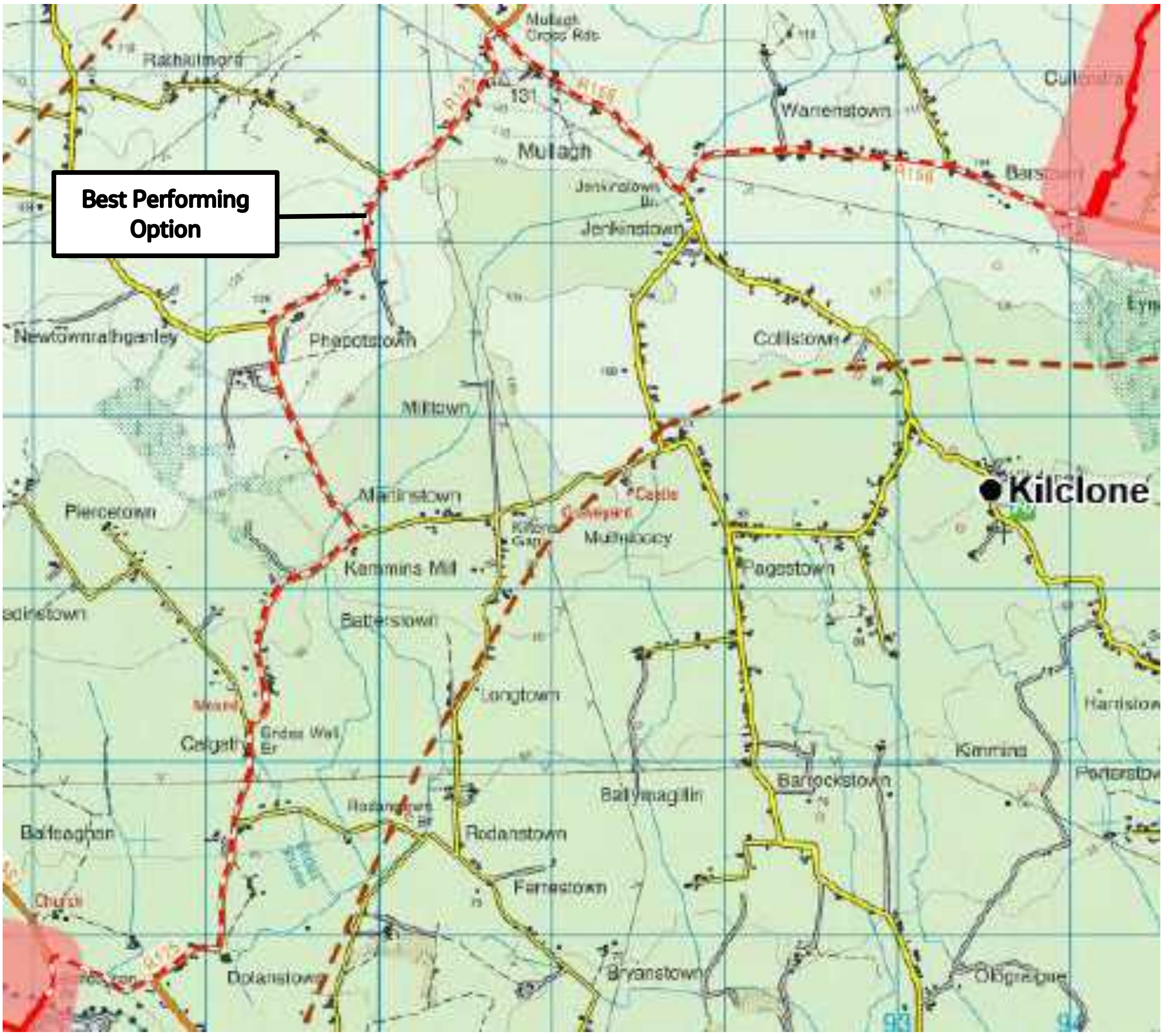


Figure 3-3: R156 to Kilcock

This section of the route (See **Figure 3-3**) is largely in-road with eight off-road sections for watercourse crossings. These are required where there is an existing stone bridge in the road. Technical assessments have determined that the bridges are unlikely to be suitable to accommodate the proposed cable because of the depth of the bridge. The crossing types at the stone arch bridges and other watercourses could be trenched or trenchless crossings, such as cable bridges or HDD. The crossing type will be resolved at Step 5 following further surveys, assessment, and consultations with affected landowners, Meath and Kildare County Councils and other key stakeholders (such as Inland Fisheries Ireland).

This section of the route joins the R156 close to the Barstown Industrial Estate. At the entrance to the Estate, there will be an off-road crossing of the Rye Water_030 water body. The route travels west along the R156 towards the townland of Jenkinstown. At the junction of the R156 and the Jenkinstown Road (a local road), there are water bodies including the Jenkinstown Stream_010 to the north and west of the junction. It is proposed to cross the water body to the south of the junction and then reconnect to the R156. A technical assessment was made and it was determined by the project team that the existing bridge was unsuitable for trenching. Options for off-road sections to the north and south of the junction were assessed. Because of field drains and the agricultural land to the north, it was determined that an off-road section to the south was the best option.

From this location, the route travels to the north west along the R156 towards the Mullagh crossroads. It was determined by the project team that the best option for the route was to continue in-road through the crossroads rather than passing over agricultural land and impacting the landowner to the south of the crossroads. From the crossroads, the route turns south west along the R125 towards Kilcock. It continues for several kilometres, passing the front entrance to the Larchill Arcadian Gardens. Potential mitigation measures may be designed, in consultation with the owners to avoid/reduce any potential impacts to access to this tourism and community asset. Along this section of the route there are additional off-road crossings of the Jenkinstown Stream_010 and its tributaries:

- Mullagh townland – Jenkinstown Stream_010 tributary;
- Phepotstown townland – Jenkinstown Stream_010;
- Phepotstown townland – Jenkinstown Stream_010; and
- Phepotstown townland – Jenkinstown Stream_010 tributary.

Continuing towards Kilcock, an off-road crossing will be provided for the Rye Water_020 water body in the townland of Calgath. Before the roundabout junction with the R158 in Balfeaghan, there will be another off-road crossing of the Rye Water_020.

3.5 West of Kilcock

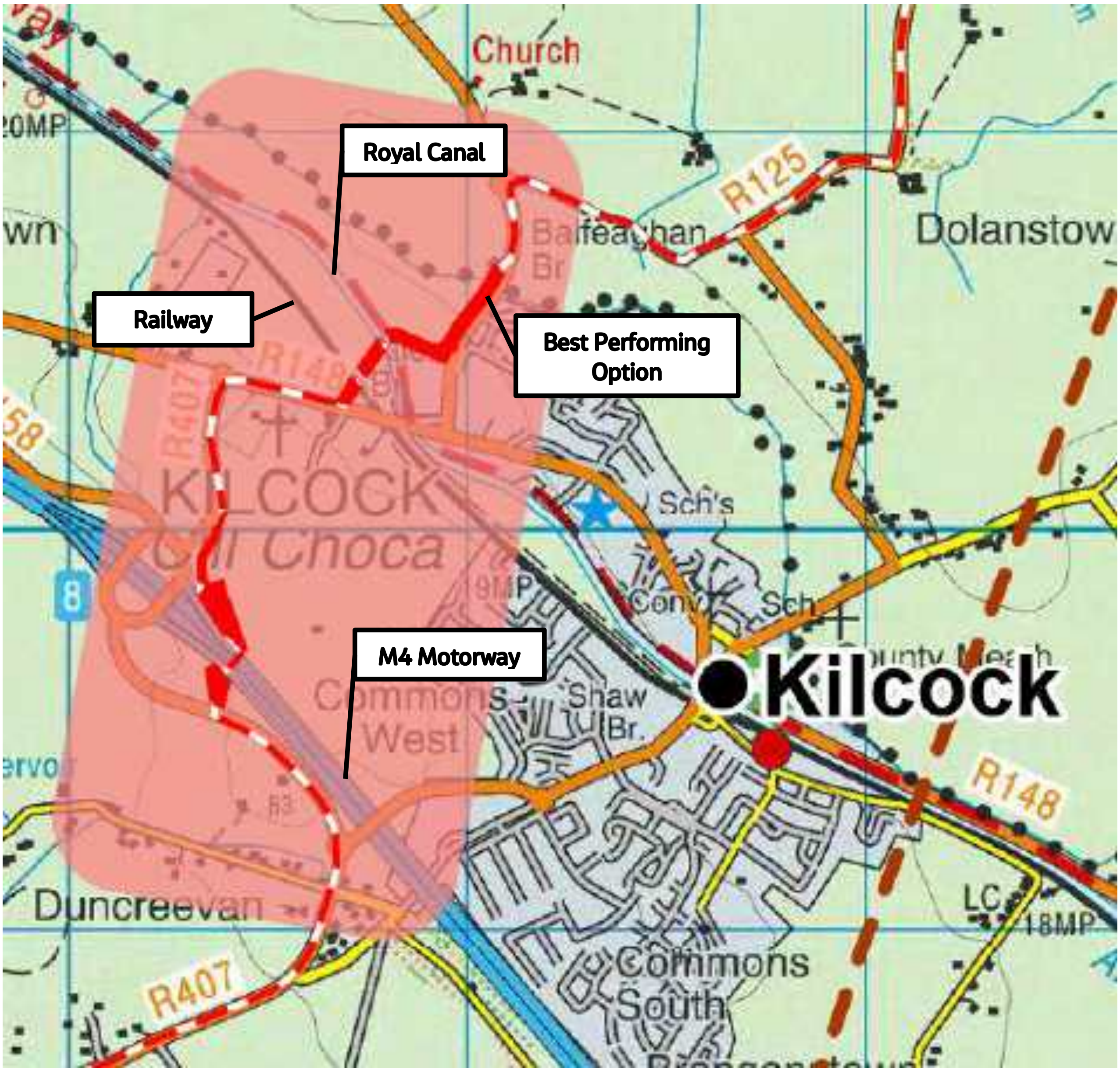


Figure 3-4: West of Kilcock

At Step 4A, the wider area was shown travelling to the west of Kilcock. This section of the route within the wider area is mostly off-road and will have several crossings – Rye Water_010; Royal Canal; Dublin-Sligo railway; and the M4 motorway. The route will travel south of the roundabout on the R158 until the Balfeaghan Bridge. This triple arch masonry bridge has been assessed to be unsuitable for a cable crossing and it will be avoided. The cable will pass to the west of the bridge and there will be a trenchless crossing of the Rye Water_010 water body. The crossing will be to west as the cable must travel to the south west to avoid Kilcock and to a location suitable for crossing the canal and railway. From the Rye Water_010 the route will cross land zoned for industrial development, which is currently agricultural land. A crossing (e.g. HDD) will be provided to pass under the Royal Canal and the Dublin-Sligo railway. The use of HDD will avoid any impacts to the users of the canal, its adjacent walkway, and to the railway line. From that location the route will travel along the R148, and then the R158 (M4 slip road) until another crossing (e.g. HDD) for the M4 Motorway. From here the route will travel south along the R407.

Alternative options were assessed in this area in order to optimise the route of the cable. In-line with the project's routing principles, a route through Kilcock was ruled out due to the potential temporary construction disruption to the town and its residents. The selected route parts from the R158 to the north of the Balfeaghan Bridge; however, continuing the route along the R158 was also assessed. This option would have resulted in disruption at the busy junction with the R148 to the east of Allen Bridge. Allen Bridge was assessed to be unsuitable for trenching following an on-site technical assessment and so a route along the bridge was also ruled out.

It would have been feasible to have a HDD crossing under the R158 and R148 junction but that was ruled out as the route would have passed under Mulligans Solid Fuel business and under the Royal Canal, and with additional restrictions on the working area due to residential properties in the area. This option was also ruled out as to continue south from this area would have crossed the Commons West area which is marked in the Kilcock Local Area Plan[14] for a mix of residential, amenity, and community and educational purposes.

The Best Performing Option in the Kilcock area was identified as having an off-road crossing of the Royal Canal and railway line, avoiding the junction of the R158 and R148. This was assessed to avoid impacts to Kilcock in terms of temporary traffic disruption during construction and to the residents that would have been adjacent to the proposed works. From that area, the route continues along the R148 to the west. Options to travel off-road to the south were ruled out because of the cemetery, existing residential properties, and proposed residential development on current agricultural land. It was determined that the route alongside the R158 (link road to the M4 Motorway) was the best route in this area. A crossing point to the east of the motorway junction (Junction 8) was identified. The area of the junction was avoided following consultations with Transport Infrastructure Ireland because of the volume of traffic using the junction and the likely traffic disruption during construction.

The Best Performing Option in this area was selected taking into consideration the other potential options, the potential impacts, and in-line with the routing principles for the project.

[14] Available at: https://kildarecoco.ie/AllServices/Planning/LocalAreaPlans/LocalAreaPlans/KilcockLocalAreaPlan2015-2021/Adopted%20Kilcock%20LAP%2020152021.pdf

3.6 Kilcock to Firmount Crossroads

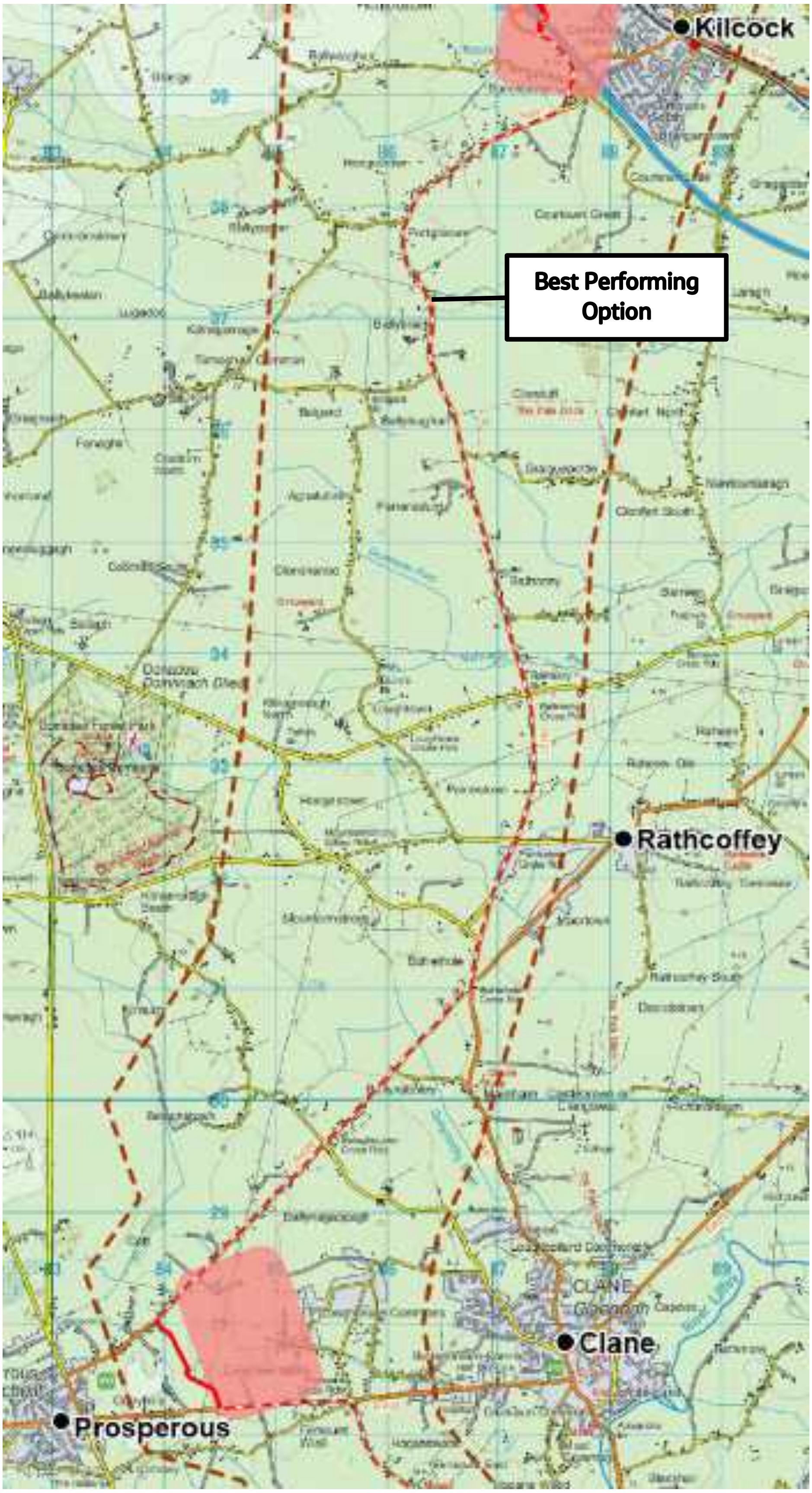


Figure 3-5: Kilcock to Firmount Crossroads

This section of the route is largely within the regional roads R407, R408, and R403. There is one off-road section which was shown as a wider area at Step 4A. The route travels south from the M4 motorway along the R407. There are many roadside residential properties and businesses, such as the Mountpleasant Nursing Home. The use of the regional road will help to minimise road closures because of the width of the road, which can largely accommodate the working area and traffic management/diversions will enable traffic to flow. The route travels along the R407 until the Boherhole Crossroads to the south west of Rathcoffey. At this location the route travels southwest along the R408 so to avoid Clane. Travelling along the R408, the route turns south before reaching Prosperous in the townland of Cott. This off-road section was shown as a wider area in Step 4A.

Following the surveys and consultations with landowners, it was determined that a better option could be found to the west of the Step 4A wider area. The route selected is approximately 220m outside of the Step 4A Study Area as shown in the Step 4A Report and during the public consultation. The reason for this change was to minimise potential impacts to agricultural land, which is one of the routing principles. By moving the off-road section to the west, its length was decreased by approximately 300m and the number of affected landowners decreased. The revised route also decreases the number of affected hedgerows and treelines from six to two. This also reduces the potential landscape and ecological impacts.

The off-road section connects to the R403 at the townland of Longtown North. It then travels east towards the Firmount Crossroads. The route then travels south on the Millicent Road (L2002).

There are nine off-road watercourse crossing in total along this section of the route. These are:

- Ballybrack townland – Lyreen_010 tributary;
- Ballyloughran townland – Lyreen_010 tributary;
- Ballyloughran townland – Lyreen_010 crossing;
- Baltracey townland – Lyreen_010 tributary;
- Baltracey townland – Lyreen_010 tributary;
- Baltracey townland – Clonshanbo_010;
- Ballynaboley townland – Kilmurry_010;
- Ballynaboley townland – Kilmurry_010 tributary; and
- Cott townland – Liffey_130 tributary.

3.7 Firmount Crossroads to Sallins Bypass

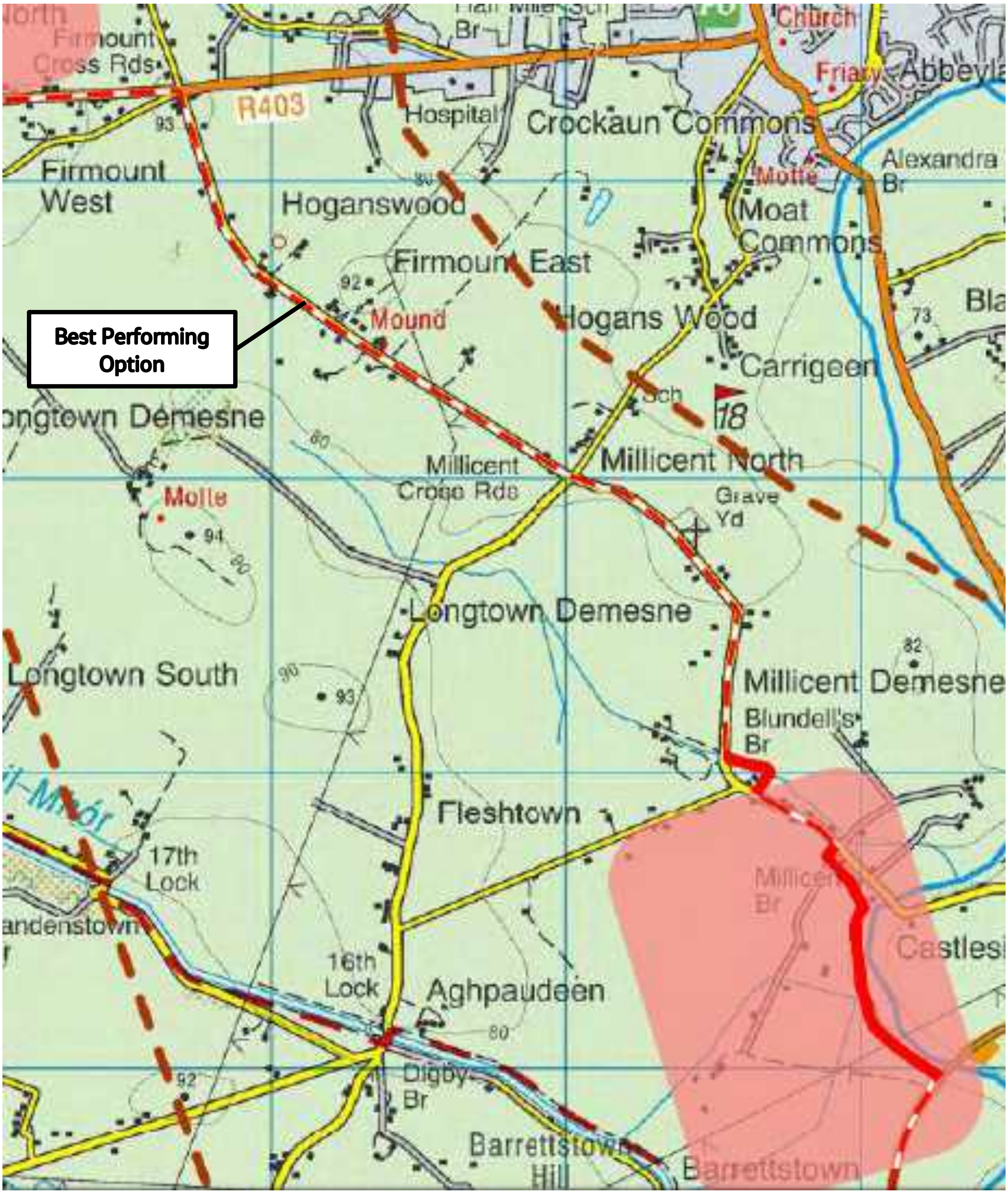


Figure 3-6: Firmount Crossroads to Sallins Bypass

This section of the route is a mix of in-road and off-road sections. The section travels to the south east along the Millicent Road (L2002). There are four roadside sites named on the Sites and Monument Record and five historic properties (these are not recorded as protected structures on the National Inventory of Architectural Heritage (NIAH)). None of these features will be directly impacted by the route. An assessment of any potential impacts to their setting will be undertaken at Step 5.

Between the Millicent Crossroads and Millicent Demesne, there is the roadside church of St. Michael and All Angels. The church will not be directly impacted; any potential impacts to access will be assessed at Step 5 and mitigation measures proposed, where required. Millicent Airfield is also in this area and further discussions will be held with the landowner and also with the Irish Aviation Authority.

There are three Garden and Designed Landscapes (demesnes) adjacent to the road – Firmount House, Moatfield House, and Millicent Demesne. There will be no direct impacts to Firmount or Moatfield, but the cable route will pass through the south west corner of Millicent Demesne. This is required to avoid Blundells Bridge. It has been assessed that the bridge is unsuitable to accommodate a cable crossing and so an off-road crossing of the Liffey_120 water body is required.

As outlined in Section 3.2 above, the cable trench is typically 1.5m in depth and that can change because of ground conditions or the presence of constraints, such as other utilities. Stone arch bridges that carry roads over watercourses generally do not have sufficient depth for cable trenches such as the Kildare-Meath Grid Upgrade project. An on-site assessment of the bridges was made by technical experts and it was determined that it would not be feasible to dig the trench into the bridge. Alternative options were considered, however the number of roadside properties and the bend in the Millicent Road at the bridge beside a junction meant that an off-road crossing to the north was the best option. Longer diversions to the west were explored however, these options would have increased the potential impacts to ecology, landscape, and agricultural land, in addition to being much more expensive and so were ruled out. A full assessment will be undertaken of the potential impacts to Millicent Demesne, residential amenity, and any other impacts at Step 5 and mitigation measures will be proposed to avoid/reduce any impacts.

After the Blundells Bridge off-road section, the route continues back on the Millicent Road until the junction of Millbank South Road. At this point the route enters the wider area that was shown at Step 4A. Here the route will travel off-road towards the Sallins Bypass. This section will avoid direct impacts to residential properties and their gardens and the River Liffey (Liffey_120) through the use of trenchless techniques (e.g. HDD). The route does not cross the River Liffey at this location but runs parallel to it for a distance. A design solution such as a HDD will allow the amenity of the gardens, the landscape of the River Liffey, and bankside ecology to be unaffected. Further assessment will be undertaken at Step 5. This area of the Liffey has an extensive floodplain in this area and an assessment of the flood risk, to and from the project, will be assessed at Step 5.

3.8 Sallins Bypass to M7 Motorway

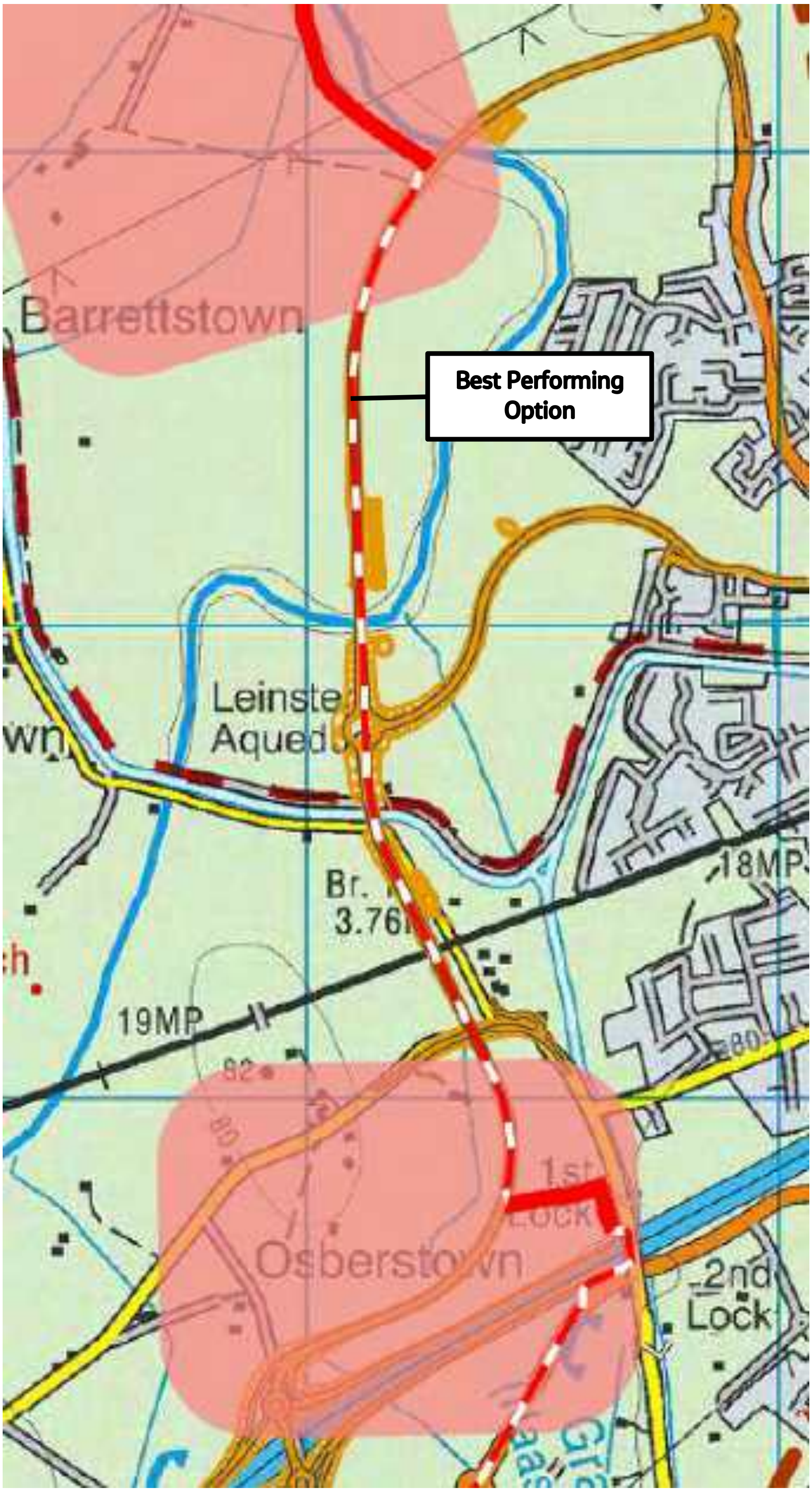


Figure 3-7: Sallins Bypass to M7 Motorway

This section of the route largely uses the recently constructed Sallins Bypass. The use of the road is in-line with routing principles in avoiding agricultural land and making use of roads, as far as possible. Consultations have been held with Kildare County Council on the use of the bypass. The route will seek to make use of the footpath that has been constructed on the eastern side of the road. The use of the footpath will minimise disruption to road users during the construction stage and temporary mitigation measures will be provided for cyclists, pedestrians, and other vulnerable road users. Its use will be subject to clarification on the presence of existing underground utilities in that area. The route will continue south to the bridge over the River Liffey (Liffey_120). A technical assessment has been undertaken and it has been determined that it will be possible to place the cable within the existing bridge structure. Further design and assessment will be undertaken to advance the design for Step 5. Additional consultation will be undertaken with Inland Fisheries Ireland (IFI), Kildare County Council, and other relevant stakeholders as required.

To the south of the River Liffey is the roundabout junction between the Sallins Bypass and the Sallins Link Road. To the east of the roundabout, a new public park is proposed to be constructed – Sallins Amenity Lands. A planning application for the park was submitted in January 2022 for the development of amenity and recreational facilities on 16.8ha of land. Further design and consultation are required to determine the best cable placement at the roundabout. The project team wish to avoid any potential impacts to the park; however, it may be possible to pass to the east of the roundabout without significantly impacting the park. Alternatively, the route could continue in-road through the roundabout. This will be resolved in Step 5 and fully assessed in the Step 5 reports.

Next along the route will be the crossings of the Grand Canal and the Dublin- Cork/Limerick railway. As with the Liffey bridge crossing, the project team has determined that the route can be incorporated into the existing bridge structure. Further design and consultation will be needed with Waterways Ireland, Irish Rail, and Kildare County Council and other relevant stakeholders as required.

The route will continue in the Sallins Bypass passing under the Osberstown Bridge (L2006). Before the Sallins Bypass turns west, the route will turn off the road and into agricultural land. This off-road crossing will connect the route to the Osberstown Road (L2006) and allow the route to pass under the M7 Motorway in the existing road. The use of the existing road will avoid the use of a crossing (e.g. HDD) for the M7 Motorway and will avoid disruption to development land to the west of this location.

Other options considered in this area included using the Osberstown Road to run the cable in-road parallel to the Grand Canal. This was ruled out following consultations with Waterways Ireland due to the potential impacts to the canal during construction. The use of the M7 Motorway Junction 9A was also ruled out following consultation with Transport Infrastructure Ireland due to the volume of traffic and the potential disruption to traffic flow during construction. Options to the east and west of the Sallins Bypass were considered but ruled out because of the presence of residential properties and the impact to agricultural land.

3.9 M7 Motorway to R448 (Naas section)

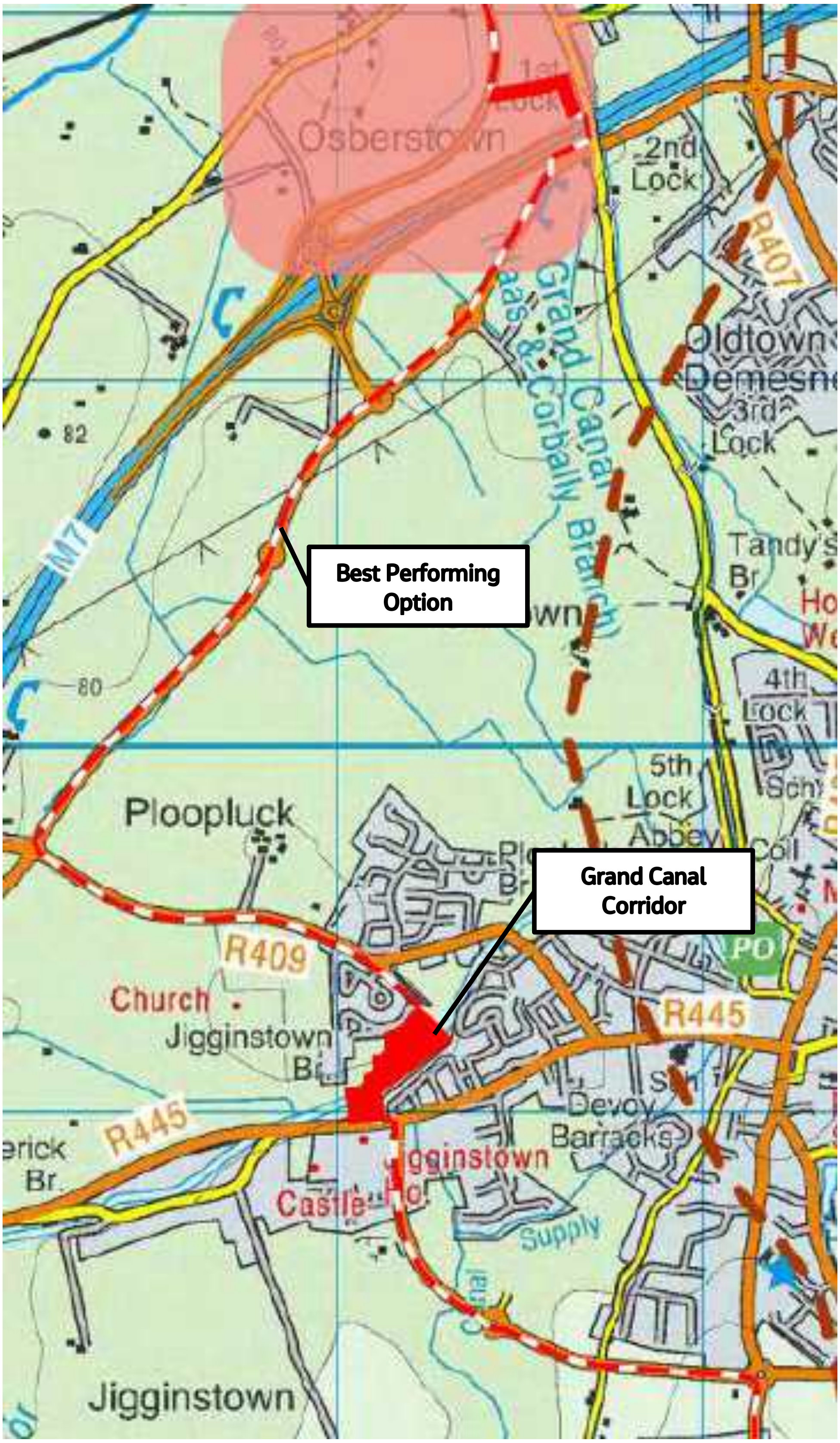


Figure 3-8: M7 Motorway to R448 (Naas section)

This section travels to the west of Naas town, largely using existing roads. Once under the M7 Motorway, the route will connect to the Millennium Parkway (also called the Western Distributor Road (R445)). The cable route will pass from the L2022 to the Millennium Parkway using the existing cycleway/footpath that connects the Parkway to the local road network. The use of the cycleway/footpaths will minimise temporary disruption to road users during construction. Temporary mitigation measures will be provided for cyclists, pedestrians, and other vulnerable road users.

As the route travels along the Millennium Parkway, it will continue in the existing cycleway/footpaths alongside the road. There are three roundabout junctions on this section of the Parkway. These roundabouts are entrances to Naas Community College, Kerry Group, Applegreen petrol station and other businesses. While the cable is planned to be in the cycleway/footpath, temporary traffic management will be required where the route crosses the approach to the roundabouts. This mitigation will minimise disruption to traffic flow in these areas.

At the junction of the R409 and Millennium Parkway, the route will travel to the east along the R409. This will take the route towards the Grand Canal Corbally Section.

This section of the route contains a wider area for the project. This is the only wider area remaining on the route and will be resolved at Step 5. The reason for the wider area is that ground investigations are required to determine the cable route at this location. Consultation with the public stakeholders has revealed that the land to the south of the canal is soft and could pose a challenge to any construction in this area. A review of available geological data from Geological Survey Ireland indicates that the area contains alluvium and glacial tills substrates and has moderate subsoil permeability. There are no recorded karst features in the area and the groundwater vulnerability is moderate in this area. These factors are not considered to be significant constraints to the construction of the cable. However, it has been determined by the project team that it would be prudent to undertake additional surveys in the area.

The ground investigations for the project will resolve where the crossing can be proposed and what type of crossing is possible. Naas Sports Centre and associated features, Naas Historic Trail, Grand Canal, Jigginstown Castle, House and associated features, and the residential properties in the area will be avoided and any potential impacts will be assessed at step 5. Mitigation measures will be proposed where required.

After the Grand Canal, the route will connect back into the road network through the R445 and the R447 (Southern Ring Road). The R447 has cycleways and footpath to the north and south of the carriageway. Like the Millennium Parkway, these could be utilised to minimise disruption to road users during the construction stage and temporary mitigation measures would be provided for cyclists, pedestrians, and other vulnerable road users. There is one watercourse crossed along this part of the route (Liffey_100). The crossing will be in the existing road network.

3.10 R448 to Dunstown Substation

Figure 3-9: R448 to Dunstown Substation

This section of the route makes use of the R448 (Kilcullen Road) which travels south from the R447 (Naas Southern Ring Road). The route will travel to the south away from Naas town, passing new housing developments off the R447 and new development at Killashee. This includes five schools, a hotel, and an Education and Training Board building. The project will not directly impact these; however, access will be disrupted during the construction works along the R448. Further mitigation measures and consultation will be required at Step 5.

To the south of Killashee, beyond the junction of the R448 and the L6044, there will be a crossing of an unnamed watercourse (tributary of the Liffey_110).

At the Sidegate Crossroads (junction of the R448 and R412), a change has been made to the route shown at Step 4A. Previously, the route travelled to the south east along the R412. However, this has been amended. From the Crossroads, the route now travels for an additional 420m along the R448, before turning east across agricultural land. This will cross an unnamed watercourse and then reconnect to the R412. This amendment to the route was made after the published option in Step 4A because of the presence of a stone arch bridge on the bypassed section of the R412. A technical assessment of the bridge determined that the bridge was not suitable for an in-road crossing. The presence of residential properties to the west and east of the bridge meant that an off-road crossing adjacent to the bridge was not possible. The bypassed section of the R412 was a common section to all four of the options presented at Step 4A and so the change has had no bearing on the option selection process.

The route travels along the R412 for a short length before entering the access road to the Dunstown substation where the route terminates.

3.11 Conclusions

The changes described above have increased the length of the cable route from 51.4km to 52.6km – an increase of 1.2km. Within this 52.6km, there is also an increase of off-road length, from 6km to 7.9km.

This increase in off-road length is largely due to the changes between the Woodland substation and the R156, where the cable route is now crossing agricultural land. As stated above, this is because local roads in the area were considered unsuitable because of two road bridges, which do not have sufficient depth for the cable trench. The increase in the overall length will slightly increase the cost of the project. However, it was concluded that these route refinements were minor and did not change the assessment of Option A (Red) as presented in the Step 4A Report. It was concluded by the project team that Option A (Red) remained the Emerging Best Performing Option and that the route shown in this Step 4B Report is the Best Performing Option. It is possible that further changes will be required at Step 5, following further design, surveys, consultation, and assessment. However, these changes will be fully consulted upon with affected landowners, community forum, statutory bodies (such as Meath and Kildare County Councils), and details will be provided to the public through the EirGrid website and reports.

4. Next Steps

The following actions will be completed on the project:

- This Step 4B Report will be published and any feedback considered by the project team and amendments will be made where it is considered appropriate;

- EirGrid will continue to meet with affected landowners, Community Forum, and other relevant communities and residents to discuss the project;

- EirGrid will continue to hold meetings with bodies such as Meath and Kildare County Councils, Transport Infrastructure Ireland, Inland Fisheries Ireland, Irish Rail, Waterways Ireland, and the utility providers such as Irish Water and Gas Networks Ireland. Initial meetings took place in Step 4A and these next meetings will be to examine the detail of the proposed route (e.g. the bridge crossings);

- EirGrid will engage with nature conservation stakeholders including local authority heritage officers, Inland Fisheries Ireland and National Parks and Wildlife Service. Matters to include agreement of watercourse crossing mitigation, and reinstatement principles, including use of commercial seed. EirGrid will incorporate biodiversity enhancement into the design to 'build back better', in consultation with relevant stakeholders;

- Confirmation of Strategic Infrastructure Status of the Project under the Planning and Development Act, 2000 (as amended) will be sought. Preplanning Consultation with An Bord Pleanála will commence;

- The project team will undertake a wide range of surveys to help to refine the design and location of the proposed cable. This will also include designing how the cable will be constructed and how traffic disturbance will be minimised through traffic management. The surveys include archaeology, ecology, agriculture, ground investigations, utilities surveys, hydrology, technical assessments, etc. These surveys may result in changes to the route shown in this report. This is a normal part of the design process – as further information is gathered and new issues are identified, changes may be made to the route (note these are expected on an exceptional basis);

- Further design work will be progressed at the substations to determine the works required to connect the proposed cable into the grid;

- The project team will prepare the planning submission (Step 5) for the project. This work will include planning and environmental reports, which will describe the final design of the project, outline the potential impacts, and identify the mitigation measures that will be put into place to avoid or reduce any impacts; and

- Further updates will be published by EirGrid on the project website: www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/

Comments on the project can be made to KildareMeath@eirgrid.com or to Eoghan O'Sullivan, EirGrid Community Liaison Officer: Phone: +353 (0)87 247 7732

Appendix A. Best Performing Option Figure

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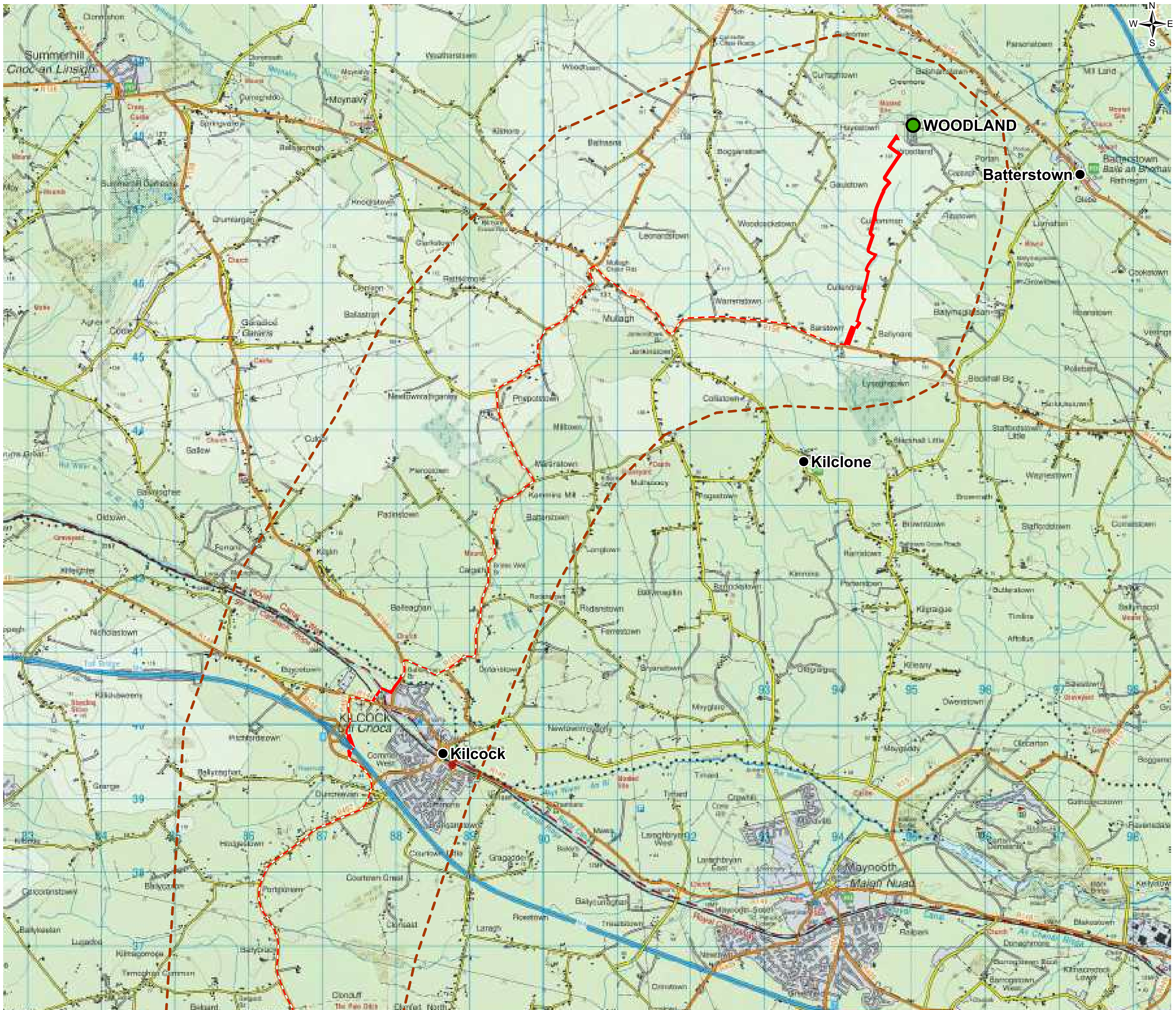

Legend

- 400kV Substation
- Study Area
- Proposed Cable Route - On-Road Section
- Proposed Cable Route - Off-Road Section

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	Jun 2022	Draft issue	GB	HS	FL	FL

Jacobs

Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
Tel: +353 1269 5666 Fax:+353 1269 5497
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Project

EirGrid Kildare-Meath Grid Upgrade

Drawing Title

Step 4B Report
Best Performing Option

Sheet 1 of 3

Drawing Status

DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
Jacobs No.	321084AH	
Client No.		
Drawing No.	321084AH-JAC-00-XX-DR-S4B-0001	

321084AH-JAC-00-XX-DR-S4B-0002

Legend

- 400kV Substation
- Study Area
- Proposed Cable Route - On-Road Section
- Proposed Cable Route - Off-Road Section

0 2 km

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	Jun 2022	Draft issue	GB	HS	FL	FL

Jacobs

Merrion House, Merrion Road, Dublin, D04 R2C5, Ireland.
Tel: +353 1269 5666 Fax:+353 1269 5497
www.jacobs.com

Client
EirGrid

Project
EirGrid Kildare-Meath Grid Upgrade

Drawing Title
Step 4B Report
Best Performing Option

Sheet 2 of 3

Drawing Status
DRAFT

Scale @ A3	1:50,000	DO NOT SCALE
Jacobs No.	321084AH	
Client No.		
Drawing No.	321084AH-JAC-00-XX-DR-S4B-0002	

321084AH-JAC-00-XX-DR-S4B-0003

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EIRGRID

Project

EirGrid Kildare-Meath Grid Upgrade

Drawing Title

Step 4B Report
Best Performing Option

Sheet 3 of 3

Drawing Status: DRAFT

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Jacobs No.	321084AH	
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Stakeholder Engagement Report (April 2023)

EirGrid

Kildare-Meath Grid Upgrade

CP966 | Summary of engagement with the public and stakeholders in steps 1-5

March 2023

Contents

01 Introduction

1.1. About this report

This report provides a summary of all public and stakeholder engagement carried out from Step 1 to Step 5 of the Kildare-Meath Grid Upgrade project.

1.2. About EirGrid

EirGrid is the state-owned operator of Ireland's electricity transmission grid. It is responsible for a safe, secure and reliable supply of electricity in Ireland. Since 2006, EirGrid has operated and developed the national high voltage electricity grid and wholesale market in Ireland. The grid moves wholesale power around the country, by bringing energy from generation station to heavy industry and high-tech users. The grid also supplies the distribution network operated by ESB Networks that powers every electricity customer in the country.

1.2.1. About the Kildare-Meath Grid Upgrade

The Kildare-Meath Grid Upgrade project (also known as Capital Project 966 or CP966) is intended to add a high-capacity underground electricity connection between the Dunstown substation near Two Mile House in Kildare and the Woodland substation near Batterstown in Meath.

The project is considered essential to meet the Government of Ireland's Climate Action Plan target up of 80% renewable energy generation by 2030, which includes transporting electricity from offshore renewable sources. It will also help meet the growing demand for electricity in the East of Ireland. This growth is due to increased population and economic activity in the region.

A significant number of Ireland's electricity generators are in the South and Southwest, where many wind farms and some modern electricity generators are located. The power they generate needs to be transported to where it is needed. The power is mainly transported cross-country on the two existing 400 kV lines from the Moneypoint station in Clare to the Dunstown substation near Two Mile House in Kildare and Woodland substation near Batterstown in Meath. The proposed Kildare-Meath project will connect these two lines, and this will strengthen the transmission network by improving reliability and security in the region.

For more information about the project, including the consultation brochure, visit the EirGrid website: www.eirgrid.ie/KildareMeath

02 Context

2.1. EirGrid's statutory role

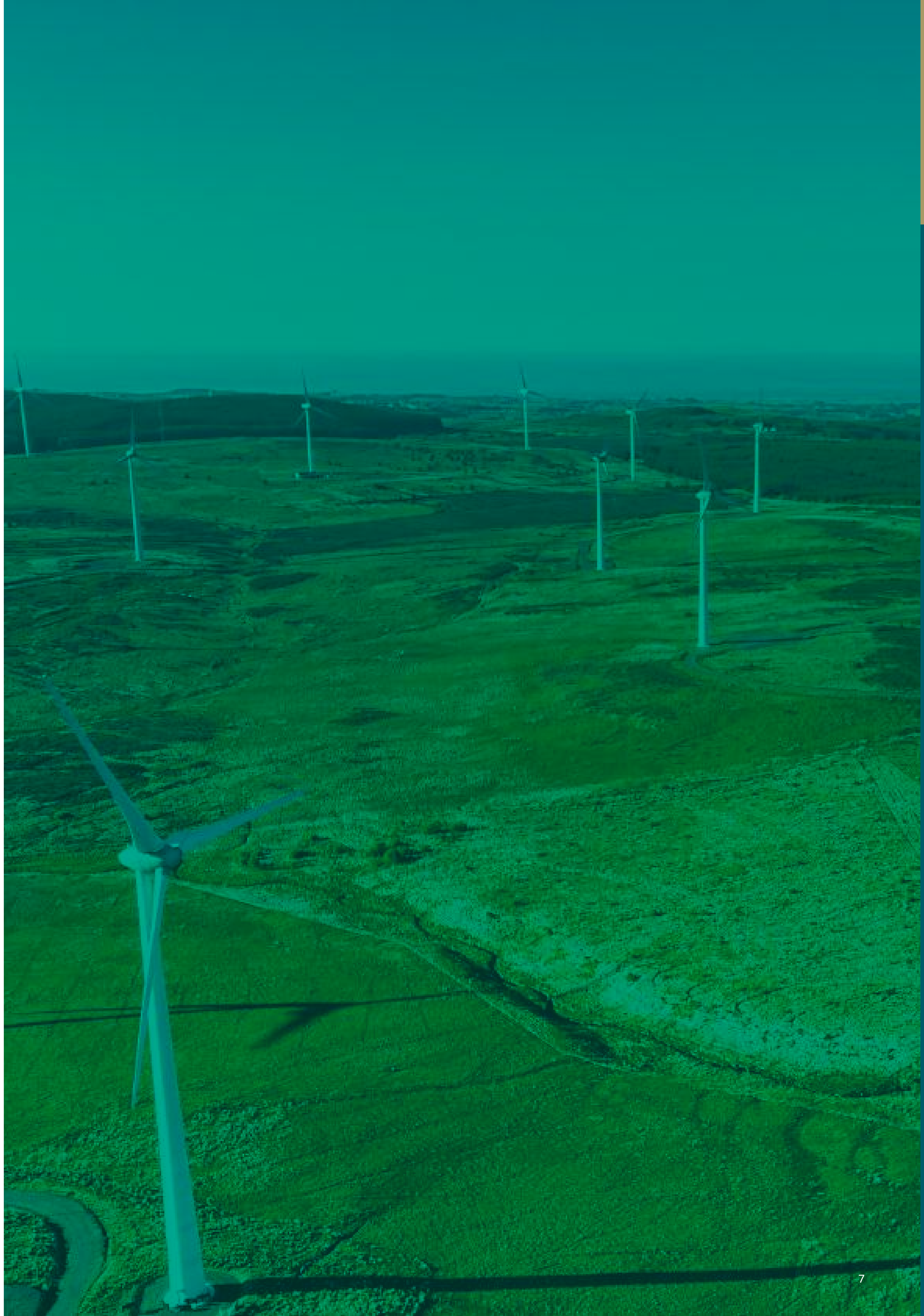
EirGrid is the national electricity Transmission System Operator (TSO) for Ireland. Their role and responsibilities are set out in Statutory Instrument No. 445 of 2000 (as amended); in particular, Article 8(1) (a) gives EirGrid, the exclusive statutory function:

"To operate and ensure the maintenance of and, if necessary, develop a safe, secure, reliable, economical, and efficient electricity transmission system, and to explore and develop opportunities for interconnection of its system with other systems, in all cases with a view to ensuring that all reasonable demands for electricity are met and having due regard for the environment."

Furthermore, as TSO, EirGrid are statutorily obliged to offer terms and enter into agreements, where appropriate and in accordance with regulatory direction, with those using and seeking to use the transmission system. Upon acceptance of connection offers by prospective network generators and demand users, they must develop the electricity transmission network to ensure it is suitable for those connections.

2.2. Regulatory targets

Part of EirGrid's responsibility is to develop the electricity transmission grid in accordance with the future needs of society. Careful analysis of different future energy scenarios specific to the area took place to establish that the transmission system is in compliance with the Transmission System Security Planning Standards (TSSPS).



2.3. EirGrid's approach to engagement

EirGrid follows a six-step approach to developing the grid. This is set out in full in EirGrid's Have your say document: http://www.eirgridgroup.com/newsroom/have-your-say-energy/

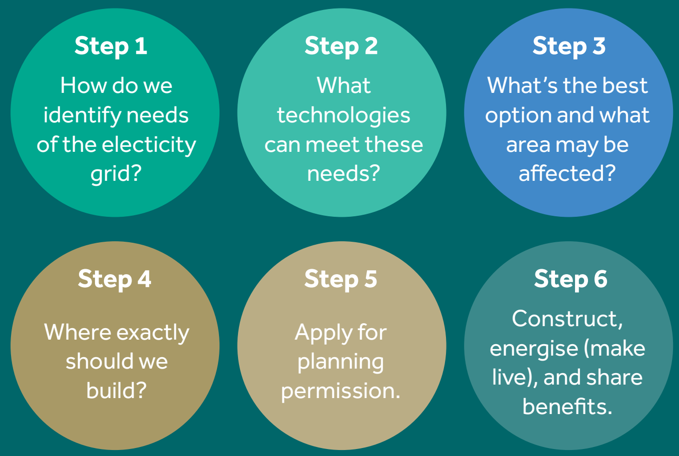


Figure 1: EirGrid's 6-Step approach to grid development

2.3.1. Steps 1-5 of the Kildare-Meath Grid Upgrade

In **Step 1**, EirGrid identified the need for the Kildare-Meath Grid Upgrade.

In **Step 2,** an initial list of 15 best performing technical options was compiled.

The options were a mix of overhead line, underground cable and up voltage technologies. Following a period of further detailed engagement with key stakeholders between November 2018 and February 2019 (see Section 3), four of these options were taken forward to **Step 3** in April 2019.

The options were:

- **Option 1**: To connect two existing 220 kV overhead lines and up-voltage to 400 kV;
- **Option 2**: To build a 400 kV overhead line;
- **Option 3**: To build a 220 kV underground cable;
- **Option 4**: To build a 400 kV underground cable.

EirGrid re-confirmed the need for the project at **Step 3** (i.e. What's the best option and what area may be affected) and investigated the shortlisted options to strengthen the electricity network between Dunstown and Woodland.

While investigating **Option 4**, to build a 400 kV underground cable, EirGrid identified that the cable would perform differently depending on how it was constructed. A fifth option was therefore added to cater for this variation in cable construction:

Option 5. To build a 400 kV underground cable using two new conductors in two separate routes.

EirGrid consulted on the shortlisted technology options to strengthen the electricity network and in April 2021 identified **Option 4**: to build a 400 kV underground cable as the best performing option to progress to **Step 4** (i.e. Where exactly we should build?)

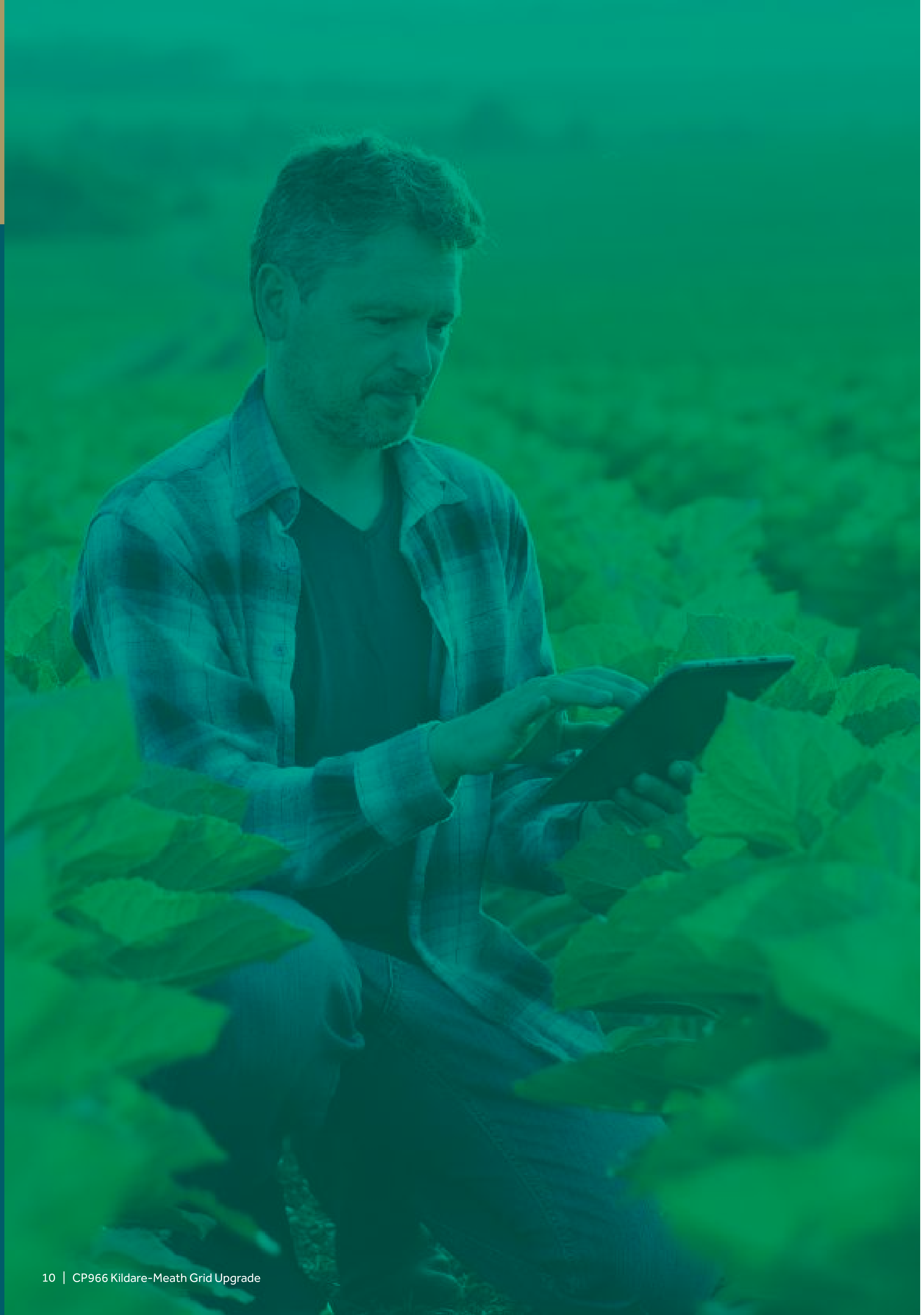
Four potential route options for the underground cables were identified and a 12-week public consultation was launched from August to November 2021. After considering the feedback received through the consultation process, EirGrid confirmed their Emerging Best Performing Route Option (EBPO) as Option A: The Red Option.

At the end of **Step 4,** EirGrid used a multi criteria assessment under the following five categories:

Figure 2: EirGrid's assessment categories

Following further engagement and technical studies, EirGrid confirmed the amendments to the route and announced their Best Performing Option (BPO) for the 400 kV underground cable. Five off-road sections required further engagement with affected landowners, and technical assessments were carried out to confirm the route within these wider areas.

The BPO has now been taken forward to the planning application process at **Step 5**. An interactive map can be viewed here: https://jacobs.maps.arcgis.com/apps/webappviewer/index.html?id=c6b4133f808042b0aaa0a66a81b16ec2



03 Public participation and stakeholder engagement

3.1. Introduction

EirGrid's approach to consultation and public participation is driven by their commitment to the six-step grid development process, as outlined in Section 2.3 above.

At each step, a series of activities were carried out in order to inform, engage and consult with stakeholders and facilitate their participation in the project development process.

3.2. Step 1 (2016-2018)

3.2.1. Project Actions

In Step 1 EirGrid identified and confirmed the need for Capital Project 966 through a process of analysis of future energy scenarios of the area. This identified two drivers for the need to further develop the transmission system.

1. Increased demand on the east coast due to natural growth;
2. Integration of generation in the South and South West as significant levels of new renewable generation was being connected there and would need to be transported.

In July 2017, EirGrid published the Needs Report - Capital Project 966: https://www.eirgridgroup.com/site-files/library/EirGrid/Step-1-Needs-Report-Capital-Project-966.pdf

This report described:

- The role of EirGrid, including the six-step engagement process;
- Regulatory targets and policy;
- The two drivers of the need for further development of the transmission system: increased demand on the east coast and the integration of generation in the South and South West;
- How the system is currently experiencing 'significant violations' with compliance with the Transmission System Security Planning Standards (TSSPS); and
- The plausible scale of solutions.

EirGrid had informal discussions with the regulator (CRU), Local Authorities, elected representatives, the EirGrid National Advisory Committee and Public Participation Networks (PPNs).

3.3. Step 2 (2018-2019)

3.3.1. Project Actions

In Step 2, EirGrid looked at a range of technical options that could meet the need they had identified. An initial long list of 15 solutions was created, which were then compared using two criteria - technical performance and economic performance. This led to the initial list being refined to the five best-performing options, using both overhead line and underground cable to link the two substations:

1. Dunstown to Woodland - Uprate of existing 220 kV overhead lines to 400 kV;
2. Dunstown to Woodland - New 400 kV overhead line;
3. Dunstown to Woodland - New 220 kV overhead line;
4. Dunstown to Woodland - New 220 kV underground cable;
5. Dunstown to Woodland - New 400 kV underground cable.

The five options were evaluated against a set of five criteria: technical, economic, environment, deliverability and socio-economic.

3.3.2. Stakeholder and Landowner Engagement

EirGrid identified the following strategic stakeholders, who were sent information about the project via email:

- Department of the Environment, Climate and Communications (DECC);
- Department of Business, Enterprise and Innovation;
- Kildare County Council;
- Meath County Council;
- Kildare Public Participation Network Officer;
- Meath Public Participation Network Officer;
- Kildare Elected Reps (Cllrs, TDs, Senators, MEPs);
- Meath Elected Reps (Cllrs, TDs, Senators, MEPs);
- Kildare Chamber of Commerce;
- Meath Chamber of Commerce;
- Eastern and Midlands Regional Assembly;
- Chambers Ireland;
- Industrial Development Authority (IDA);
- Irish Business and Employers Confederation (IBEC);
- Commission for Regulation of Utilities (CRU);
- Irish Farmers' Association (IFA);
- Equine industry.

3.3.2.1. Step 2 Phase A (March - June 2018)

In Phase A, the 15 initial options for meeting the need identified in Step 1 were evaluated and eventually narrowed to five options.

Stakeholder engagement activities included:

- In December 2017, following engagement with relevant stakeholders such as Government Departments, Meath and Kildare County Council, the IDA and the Eastern and Midlands Regional Assembly, EirGrid published Step 2 Part A Options Report - Capital Project 0966: This described:
  - the long list of options which had been identified to meet the need identified in Step 1,
  - the steps that would be followed to narrow this long list of options,
  - the details of how each option was evaluated and reduced to 5 options,
  - the next steps that would be required.
  - The report can be viewed here: https://www.eirgridgroup.com/site-files/library/EirGrid/Step-2-Part-A-Options-Report-Capital-Project-966.pdf
- In June 2018, the project team provided stakeholder updates regarding 'Identifying the need and solution options' for the project. These summarised:
  - the need case,
  - the six-step process,
  - project drivers,
  - the technologies involved,
  - the long list of 15 possible solutions,
  - how it was refined,
  - the refined list of 5 options,
  - how these would be evaluated,
  - next steps.

The information was shared with DECC, IDA Ireland, Kildare County Council, Eastern Midlands Regional Assembly Office and Meath County Council. All organisations ranged from broadly to very supportive of the project. The presentation can be viewed via the following link: https://www.eirgridgroup.com/site-files/library/EirGrid/CP966-Step-2-Stakeholder-Presentation.pdf

3.3.2.2. Step 2 Phase B (November 2018 – March 2019)

A 10-week engagement period took place from 23 November 2018 to 4 February 2019. This period covered a broad range of stakeholder engagement with the general public, local communities and their elected representatives. Stakeholders were given an opportunity to provide feedback in relation to the assessment carried out to date and the solutions to be brought forward for further consideration in Step 3. In preparation for, and alongside the engagement,

EirGrid:

- Issued press releases to local media in Kildare and Meath;
- Shared up-to-date photography with media outlets and for social media;
- Created a dedicated CP966 section on EirGrid's website;
- In Autumn 2018, published a brochure on CP966. Similar to the stakeholder presentations. This covered introducing EirGrid, the six-step process, the project, the technologies involved, how the initial list of 15 solutions had been narrowed to five, what the five remaining options were and what criteria would be used to evaluate them going forward. This brochure was distributed via the EirGrid website and can be viewed here: https://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Capital-966-Project-Brochure.pdf. In addition, hard copies were printed and made available to the public and stakeholders;
- Utilised social media platforms as a means of communicating information about the project, public events and feedback channels, (although not as a means of collecting feedback);
- Created a helpline with staff briefed to receive project-specific calls;
- Went door to door in Woodland with project updates to include introduction to the Kildare Meath Grid Upgrade;
- Published project related material on the project website, including reports and project brochures;
- Issued a press statement to the media;
- Communicated details of the project via stakeholder presentations to Kildare County Council and Ratoath Municipal District Meath County Council;
- Engaged with the Public Participation Networks in Kildare and Meath to provide information on the project to local community groups in the region.

3.3.2.3. Summary of feedback

In March 2019, EirGrid published an independent report Capital Project 966 -Engagement Report Step 2. This report can be viewed via the EirGrid website here: https://www.eirgridgroup.com/site-files/library/EirGrid/Capital-Project-966-Stakeholder-Engagement-Step-2-Report-(2).pdf

This summarised the background to the consultation and engagement actions undertaken by EirGrid so far as part of Step 2. It went on to summarise the written feedback received to the formal consultation.

Engagement at a glance:

Activity	Number
Strategic Stakeholder Emails	24
Press Adverts	7
Social Media	Facebook, Twitter, Linkedin
Stakeholder Briefings	9
Submissions	11

Strategic stakeholders who responded to the consultation agreed with the need case for infrastructure improvements, while some also expressed preferences for specific methods to deliver these improvements. A few preferred use of the existing network to carry out the improvements.

Most residents and strategic stakeholders who responded requested further information from the EirGrid project team about particular aspects of the project, or how the project as a whole would develop, on a range of topics including undergrounding, cables, communication, roads and the environment.

At the same time, EirGrid published Options Report - Part B - Capital Project 0966: https://www.eirgridgroup.com/site-files/library/EirGrid/Step-2-Part-B-Options-Report-Capital-project-966.pdf

This report followed on from the Part A Options Report which had been published in December 2017. It described how the five options identified in Part A had been evaluated and narrowed to four. This included an introduction to the need case identified in Step 1, the six-step process, the process and criteria for evaluating the five options, and the findings of this process.

EirGrid also published an updated brochure on the Kildare-Meath Grid Upgrade: https://www.eirgridgroup.com/site-files/library/EirGrid/Capital-Project-966-Brochure-Spring-2019.pdf

This described how, in the Step 2 consultation, most respondents had expressed a preference for either the underground option or the uprate option and discussed the uprate option in more detail. The brochure also communicated that the shortlist of five options had now been narrowed to four and described how this had been done. It went on to describe the next steps in the process.

3.4. Step 3 (2019-2020)

3.4.1. Project Actions

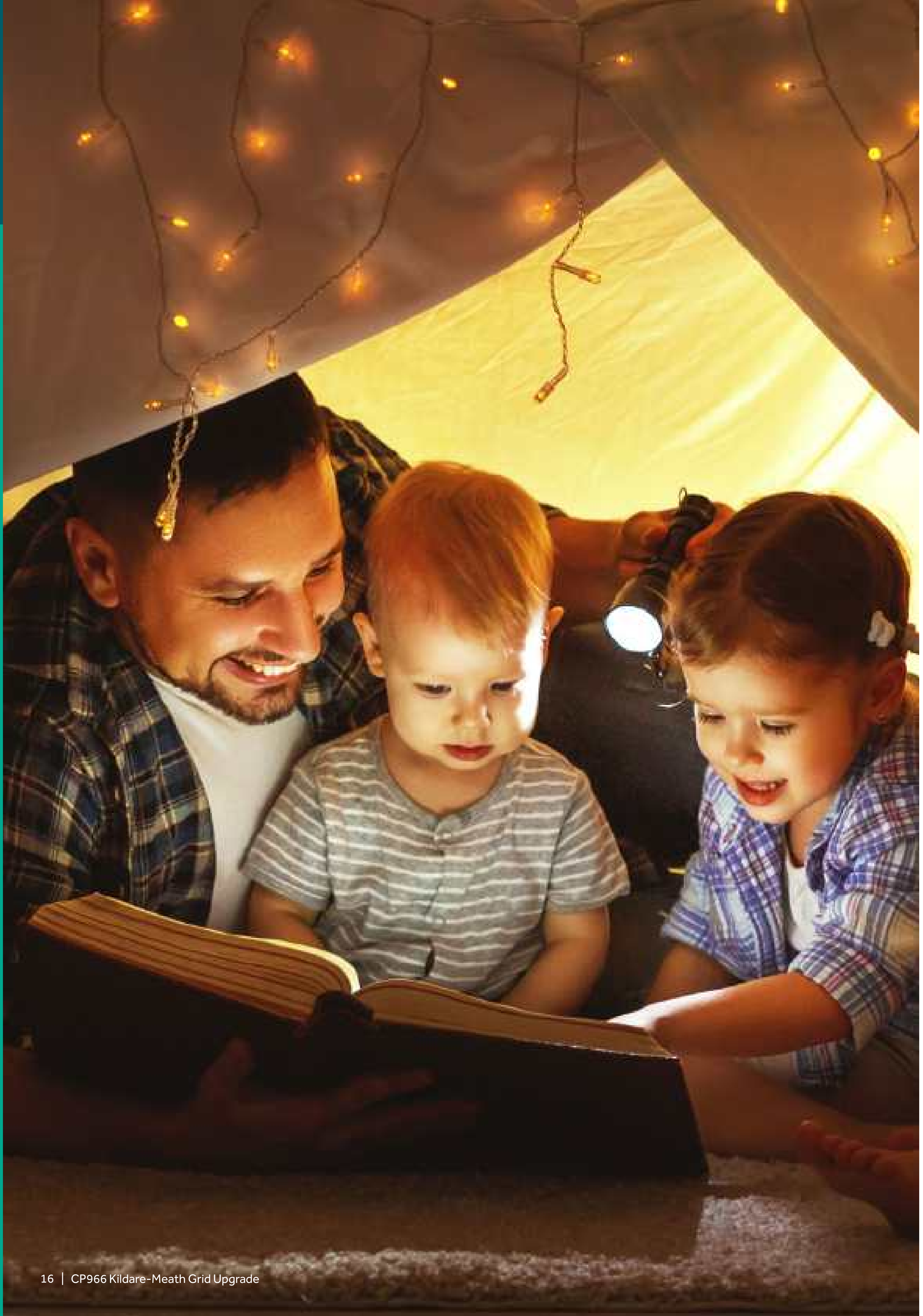
The shortlist of options to be evaluated in Step 3 that would address the need to upgrade the grid in the area are listed below.

Option 1: Dunstown to Woodland - Uprate of existing 220 kV overhead line to 400 kV;

Option 2: Dunstown to Woodland - New 400 kV overhead line;

Option 3: Dunstown to Woodland - New 220 kV underground cable;

Option 4: Dunstown to Woodland - New 400 kV underground cable.



EirGrid assessed these options against the five categories of a multiple criteria assessment, and as a result, EirGrid identified Option 1, which would use existing route corridors and infrastructure as much as possible to create a 400 kV overhead line, as the Emerging Best Performing Option (EBPO).

Option 4, which would involve building a new 400 kV underground cable, was identified as the emerging best performing alternative.

3.4.1. Stakeholder engagement

3.4.1.1. Information phase (20 July to 5 October 2020)

In the information phase, EirGrid informed and engaged with relevant regional and national stakeholders such as government Departments, Meath County Council, Kildare County Council, Elected Representatives, the IDA, the Eastern and Midlands Regional Assembly, Chambers of Commerce, Public Participation Networks and the Irish Farmers' Association.

This phase also included an information campaign in local newspapers and radio, video animation for social media awareness raising, the publication of investigative reports and technical assessments, an online interactive map and a webinar.

EirGrid also carried out door-to-door engagement within a two-mile radius of the substation at Woodland in the period.

Due to the challenges of the Covid 19 pandemic, EirGrid made additional efforts in reaching out to the public. Some of these activities included:

- Hosting public webinars;
- Advertising in local newspapers, on radio, bus stops, in some supermarkets and on social media;
- Developing a project micro-site (available at Kildare-Meath Grid Upgrade (https://storymaps.arcgis.com/stories/c7ec4696b65846feb1a384b85d39dde2);
- Hosting a virtual project exhibition (available at Eirgrid – Kildare-Meath (https://kildaremeath.consultation-online.com/);
- In-person meetings with our project liaison staff (as Covid-19 restrictions allowed);
- Ongoing engagement by phone and email.

3.4.1.2. Public consultation phase

Public consultation on the Emerging Best Performing Option took place between 6 October and 14 December 2020. The project questionnaire was distributed to all homes in the study area (approximately 57,000).

In total, this consultation received 178 responses. Responses to the consultation were submitted via an online form, by email and by post.

Response Channel	Response Volume
Online Responses	48
Hardcopy Responses	124
Letter / Email Responses	6
Meetings	9
Written feedback including queries on the project	11

Many respondents expressed support for Option 1. Dunstown to Woodland - Uprate of existing 220 kV overhead line to 400 kV, mainly because this option would make use of existing infrastructure. Many respondents also expressed support for Option 4. Dunstown to Woodland - New 400 kV underground cable, with a number saying that they prefer underground cables to overhead lines. A smaller number stated a preference for Options 2, 3 and 4.

The report in full can be read here: https://www.eirgridgroup.com/site-files/library/EirGrid/Kildare-Meath-Grid-Upgrade-Step3-Consultation-Final-report.pdf

3.5. Step 4 (2021-2022)

3.5.1. Project actions

At Step 4, EirGrid identified four potential underground cable route options, which were assessed against the five key assessment criteria (Environment, socio-economic, technical, deliverability and economic).

Step 4 was divided into two sub-steps: **Step 4A** and **Step 4B**. The Step 4A Report was published in March 2022 and presents an analysis of the proposed route options. It describes the process followed to identify the proposed route options and presents a comparative evaluation of those sites against the criteria. The report in full can be viewed at https://www.eirgridgroup.com/site-files/library/EirGrid/KMGU-JAC-TN-0017-Step-4A-Report-08-03-2022-Compressed.pdf

Option A (the Red Route) was selected as the Emerging Best Performing (EPBO) Option as it scored more favourably in terms of Deliverability compared to the other options.

In Step 4B, Option A was re-examined to refine the route as far as possible to remove any wider areas (corridors) and to provide more certainty on the specific location.

3.5.2. Stakeholder engagement

3.5.2.1. Information and Consultation phase

EirGrid undertook a phase of information-giving to promote the consultation phase with local stakeholders, starting in mid-August 2021, two weeks before the consultation opened, and continuing for the duration of the consultation period: 31 August to 22 November 2021.

In July 2021, a Community Forum was established for the project. The role of the forum was to offer advice to EirGrid on key project developments such as:

- how they communicate and engage with the public;
- what they need to consider in developing the project;
- how they can deliver meaningful community benefit to the area where infrastructure is hosted.

In May 2021 EirGrid appointed an Irish non-profit organisation called Development Perspectives as the called Development Perspectives as the independent chair of the Kildare-Meath Grid Upgrade Community Forum. An information evening was then held and that was followed a public nomination period where community groups were invited to express an interest in sitting on the forum. Kildare County Council and Meath County Council were also invited to nominate elected representatives onto the forum.

During the consultation phase, EirGrid carried out the following activities:

- Four Community Forum meetings;
- Onsite engagement with a Mobile Information Unit visiting nine towns and villages for one week: Batterstown, Kilcock, Maynooth, Straffan, Prosperous, Clane, Sallins, Naas and Two Mile House;
- Engagement (including meetings and/or written communications) with multiple stakeholders including:
  - Transport Infrastructure Ireland Kildare Meath Working Group,
  - Department of the Environment, Climate and Communications,
  - Local Authorities (Meath County Council, Kildare County Council, Maynooth Community Council),
  - Business stakeholders: Kildare Chamber, Meath Chamber, Enterprise Ireland, the ID,
  - Public Participation Networks: Kildare Partnership, Meath Partnership,
  - Elected representatives: including TDs from Meath East, Meath West, Kildare North and Kildare South, as well as Senators,
  - Kildare Councillors from Athy Municipal District, Kildare-Newbridge Municipal District, Celbridge-Leixlip Municipal District, Clane-Maynooth Municipal District, and Naas Municipal District,
  - Meath Councillors from Ashbourne Municipal District, Ratoath Municipal District, and Trim Municipal District,
  - Two Mile House Says No (battery objection group),
  - Irish Rail.
- Two public webinars, in September and October 2021;
- A media campaign in regional press and radio, social media (paid and organic), locally targeted advertising on digital screens and ad-boards, GAA pitch sponsorships (3-year agreements), a project website (https://www.eirgridgroup.com/the-grid/projects/capital-project-966/the-project/) and online consultation portal (https://consult.eirgrid.ie/consultation/kildare-meath-grid-upgrade-step-4-consultation-underground-cable-route-options)
- The distribution of a project information leaflet and freepost questionnaire to every home in the study area (approximately 42,800).

3.5.2.2. Post-consultation

Following the consultation, EirGrid published a Step 4 Engagement Report. This report details feedback received on the EBPO through community and stakeholder engagement. Positive comments included:

- The proposed Community Benefit Scheme;
- The use of an underground cable;
- That the cable would run on roads close to residential property, as its construction could potentially mean the upgrade of local roads;

- Satisfaction at the level of engagement publicity during the consultation process, including advertisements in regional newspapers.

Some stakeholder expressed concerns over disruption to local communities and businesses, particularly as a result of increased traffic movements.

Among the concerns raised were the following:

- Impacts on local amenities such as sports pitches;
- The importance of communication with those who would be impacted, as identified on the maps provided, and ensuring sufficient detail was contained within the maps;
- Potential safety issues arising from Electromagnetic Fields (EMF);
- Concerns over the project timeline.

The full report can be viewed here: https://www.eirgridgroup.com/site-files/library/EirGrid/Kildare-Meath-Step-4-Engagement-Report_FINAL-14-June-2022.pdf

EirGrid also published a Step 4B Report – Route Options and Evaluation Report in June 2022, which confirmed the Best Performing Route Option in detail. A period of engagement followed with landowners, the community forum, infrastructure owners and other key stakeholders in addition to environmental surveys and assessments.

The report can be viewed in full here: https://www.eirgridgroup.com/site-files/library/EirGrid/KMGU-JAC-TN-0048-STEP-4B-Final.pdf

EirGrid carried out door-to-door visits to community in and around Woodland following the announcement of Emerging Best Performing Option (EBPO). This included:

- Landowner engagement to agree access to lands for walkover surveys and ground investigation works;
- Ongoing landowner engagement to 'fine tune' routes through private lands;
- Engagement with other contractors and consultants to seek further information in relation to existing services within the roads;
- face to face engagement with all landowners;
- Meeting with non-impacted landowners to facilitate surveys on their lands;
- Ongoing engagement for additional elements associated with the cable route - passing bay locations for example.

3.6. Step 5

During Step 5 there has been ongoing engagement with a broad spectrum of stakeholders.

EirGrid undertook three Energy Citizen Roadshows within Counties Kildare and Meath. As part of a series of Energy Citizens Roadshow, these events were aimed at informing local communities on how the organisation plans to future-proof the electricity grid as well as providing information about microgeneration, home energy upgrades and retrofitting grants, and regional development issues. The roadshow concept was a follow on from the 2021 Shaping Our Electricity Future https://www.eirgridgroup.com/the-grid/shaping-our-electricity-f/ consultation programme during which EirGrid sought views and inputs from all sectors of society and industry about grid development.

The Kildare events were held in Naas and Maynooth, while the Meath event was hosted in Navan.

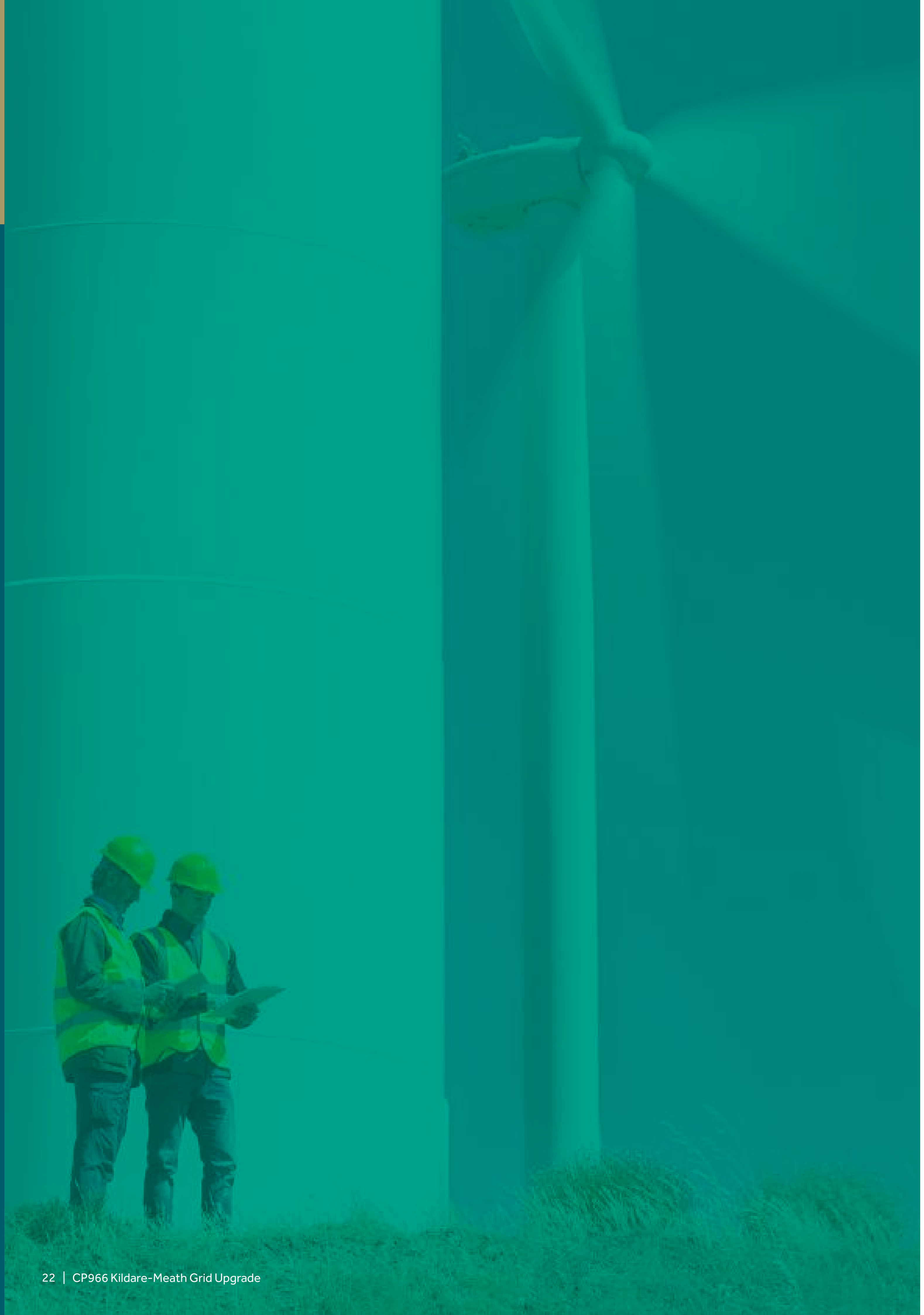
Publicising of these events took place in local print and radio outlets, and across social media channels (facebook, twitter, LinkedIn). In addition, these were publicised through the network of existing stakeholders within these two counties, such as the Public Participation Network, Chambers of Commerce, Local Elected Representatives, East Meath-North Dublin Community Forum and local stakeholders.

See appendix for associated advertising

In addition to the Energy Citizen Roadshows, EirGrid undertook local engagement as part of Engineers Week 2023, which took place from 4th to 10th March.

As part of the Engineers Ireland's STEPS programme, we visited Rathregan NS in Batterstown, Co Meath, to outline the creative and limitless world of engineering to these primary school students, and how engineering is at the heart of the work EirGrid does in developing the electricity grid. The visit consisted of an engineering-focused quiz, a practical engineering challenge were all students made a wind turbine and a presentation from one of EirGrid's senior engineers about engineering as a career.

The Engineers Ireland STEPS Programme is a non-profit outreach programme that promotes interest and awareness in engineering as a future career to students in all communities through a portfolio of projects.



04 Next steps and ongoing engagement

4.1. Next Steps

Having published the Preferred Route Corridor and Option Selection Report in Step 4, the planning and design development process commenced, which included undertaking surveys and investigations within the preferred route corridor, developing the route design, identifying the land take required, junction and access requirements and the completion of a planning and environmental consideration report. During this phase, the project team engaged with landowners and interested parties as part of the design development process.

Having developed the design, and concluded engagement with landowners and interested parties, a planning submission and statutory orders are now ready for publication. A statutory public consultation process will now be undertaken as part of the statutory approval process.

Any person or body may make a submission or observation in writing to the Board in relation to the application. Further information on making a submission / observation in writing to the Board and oral hearing procedures are available from the Board's website www.pleanala.ie. Further information on making a submission / observation in writing to the Board and oral hearing procedures are available from the Board's website www.pleanala.ie.

4.2. Ongoing Engagement

EirGrid will continue to engage with technical stakeholders, the Community Forum and the wider community throughout the planning process and thereafter.

From a technical stakeholder's perspective, members of the EirGrid team have held ongoing and frequent meetings with these stakeholders throughout the development of this project. Technical stakeholders include:

- Meath County Council
- Kildare County Council
- Transport Infrastructure Ireland
- Irish Rail
- Waterways Ireland
- Irish Water
- ESB
- National Parks & Wildlife Service
- Department of Transport
- Inland Fisheries Ireland
- National Monuments Services

Should planning permission be granted, the Community Forum will oversee the implementation of a Community Benefit Scheme with the support of the EirGrid Public Engagement team and an independent Community Fund Administrator.

The Community Forum will co-develop a community benefit strategy in conjunction with local stakeholders and will work with EirGrid to ensure the fund administrator aligns the benefit scheme to the strategy. The strategy will align with other local community plans, national policy and the Sustainable Development Goals.

The community benefit is spread across three funding streams including:

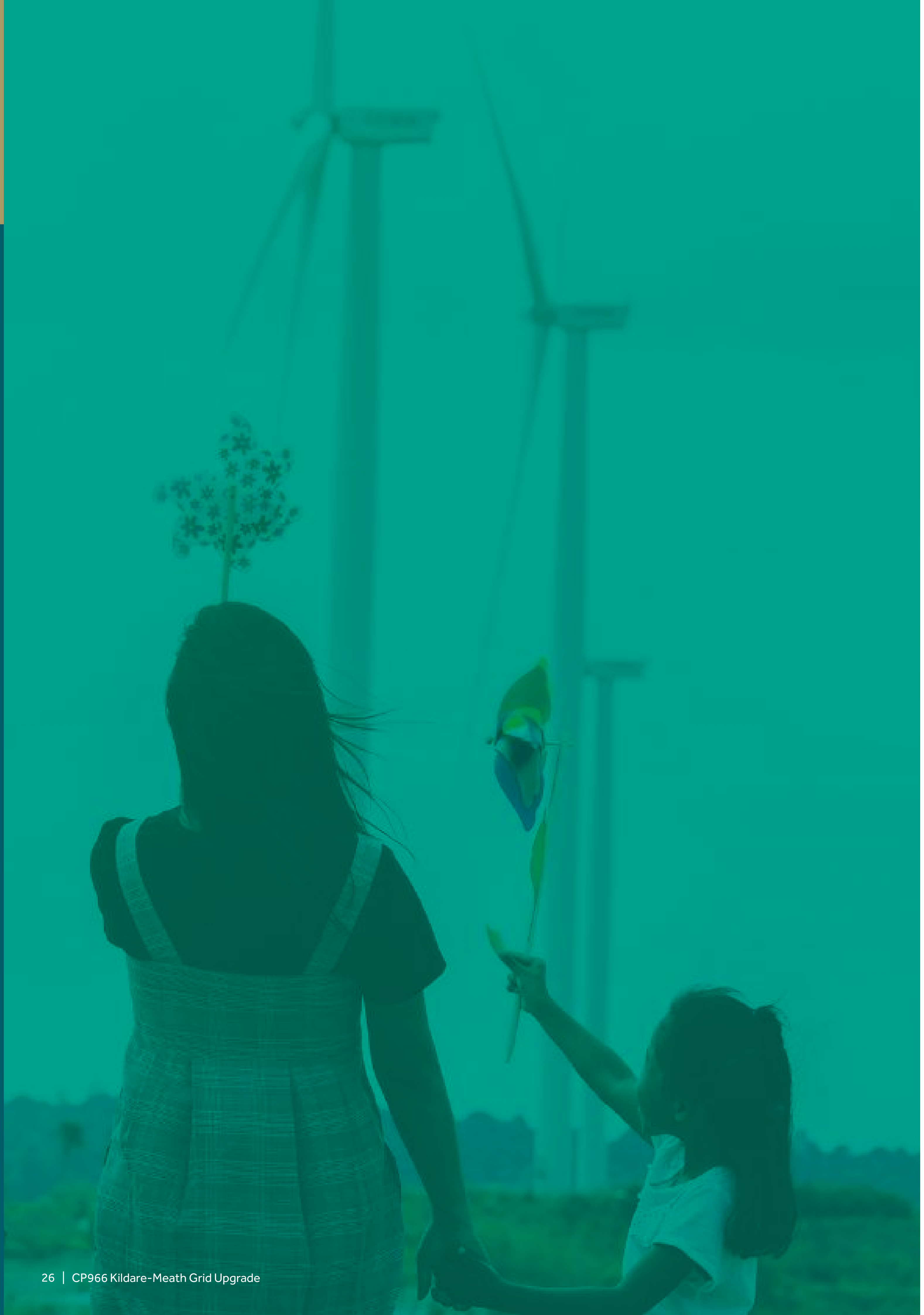
- Community - to reinforce community cohesion, wellbeing and education;
- Sustainability - to transform how communities think about, generate and use energy;
- Biodiversity - to leave the biodiversity of an area in a better condition than it was before we built a project.

The wider role of the Community Forum will be to:

- Ensure communities are at the heart of the decision making over the project lifetime;
- Provide relevant input and key local knowledge to assist the project team in decision making;
- Work with community groups and organisations to build trust, identify local needs, grow partnerships and deliver on local projects;
- Receive regular updates from EirGrid team members on project delivery;
- To advise EirGrid on the most effective approach to communicating feedback and key milestones to the wider community.

More information on the Community Forum is available here: https://www.eirgridgroup.com/the-grid/projects/capital-project-966/community-forum/

At Step 6, EirGrid will work with ESB Networks to minimise the impacts of construction and will engage with landowners and local communities on traffic management and access requirements.



05 Appendices

5.1. Appendix

Step 3 Project Information Leaflet

Your Kildare-Meath Grid Upgrade

We all know how much better an upgrade can make things. That's why EirGrid is planning to upgrade the Kildare-Meath Grid. It's vital if we are to have the power we need for our growing population and to ensure you have a safe, secure and sustainable supply of electricity for the future. It also means we can bring more renewable energy onto the grid, helping Ireland to reduce carbon emissions.

We're currently looking at five possible ways of doing this, with overhead or underground options. You can find out more at eirgrid.ie/KildareMeath

Come and meet us

In advance of our public consultation, which will run between September and November, our Mobile Information Unit will be visiting Kildare and Meath in the coming weeks and we'll be happy to answer your questions. Social distancing measures will, of course, be in place and you'll find all the dates, times and locations at eirgrid.ie/KildareMeath You can also call 01 677 1700 or email us at KildareMeath@eirgrid.com to learn more about the project.

EIRGRID

5.2. Appendix

Step 3 Consultation Response Form

5.2. Appendix

Step 3 Consultation Response Form

Personal Information

Name: ________________

Address: ________________

Eircode: ________________

Organisation (if any): ________________

Contact number: ________________

Contact Email: ________________

If interested, how would you like to receive further updates on this project?

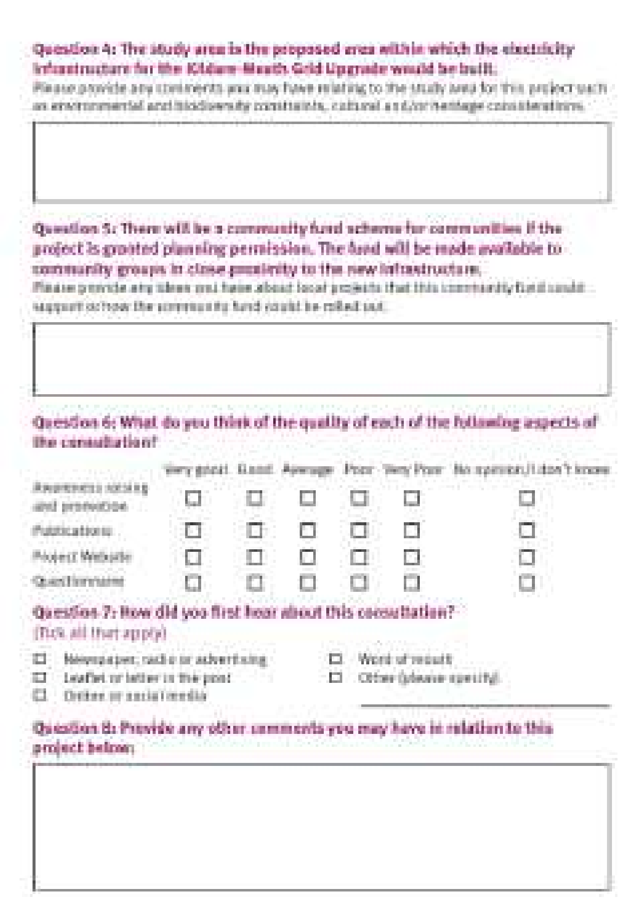
☐ Phone ☐ Email ☐ Post

Option 1 has been identified as the emerging best performing option. Based on assessments of the remaining options, we have identified Option 4 as the emerging best performing alternative.

Question 1: Please provide your comments in relation to Option 1: Connect two existing 220 kV overhead lines and upvoltage to 400 kV.

Question 2: Please provide your comments in relation to Option 4: Build a new 400 kV underground cable.

Question 3: Please provide your comments on the remaining 3 options (please indicate which of the options you are commenting on).



Question 4: The study area is the proposed area within which the electricity infrastructure for the Kildare-Meath Grid Upgrade would be built.

Please provide any comments you may have relating to the study area for this project such as environmental and biodiversity constraints, cultural and/or heritage considerations.

Question 5: There will be a community fund scheme for communities if the project is granted planning permission. The fund will be made available to community groups in close proximity to the new infrastructure.

Please provide any ideas you have about local projects that this community fund could support or how the community fund could be rolled out.

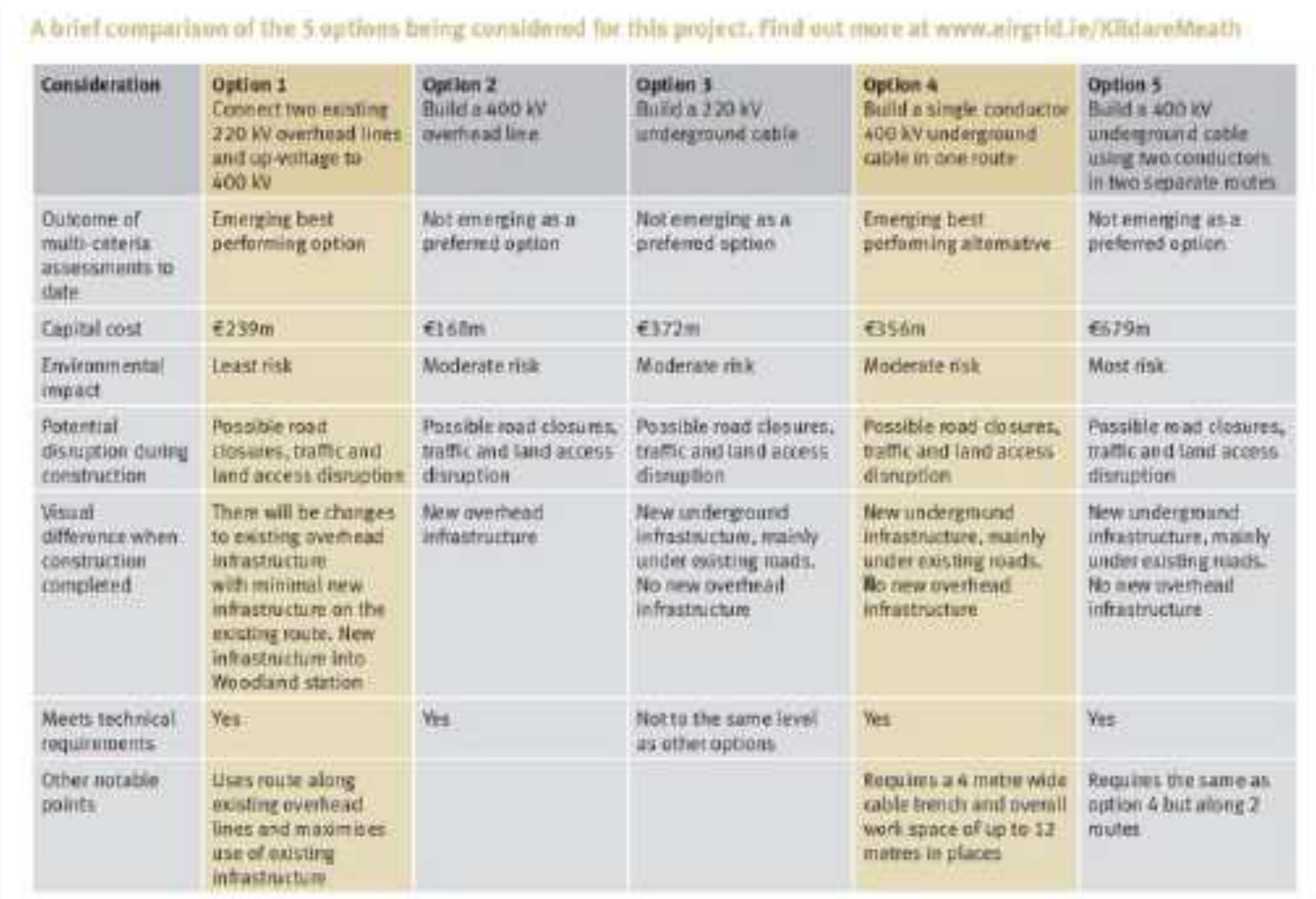
Question 6: What do you think of the quality of each of the following aspects of the consultation?

	Very good	Good	Average	Poor	Very Poor	No opinion/I don't know
Awareness raising and promotion	☐	☐	☐	☐	☐	☐
Publications	☐	☐	☐	☐	☐	☐
Project Website	☐	☐	☐	☐	☐	☐
Questionnaire	☐	☐	☐	☐	☐	☐

Question 7: How did you first hear about this consultation?
(Tick all that apply)

☐ Newspaper, radio or advertising
☐ Leaflet or letter in the post
☐ Online or social media
☐ Word of mouth
☐ Other (please specify)

Question 8: Provide any other comments you may have in relation to this project below:



A brief comparison of the 5 options being considered for this project. Find out more at www.eirgrid.ie/KildareMeath

Consideration	Option 1 Connect two existing 220 kV overhead lines and up-voltage to 400 kV	Option 2 Build a 400 kV overhead line	Option 3 Build a 220 kV underground cable	Option 4 Build a single conductor 400 kV underground cable in one route	Option 5 Build a 400 kV underground cable using two conductors in two separate routes
Outcome of multi-criteria assessments to date	Emerging best performing option	Not emerging as a preferred option	Not emerging as a preferred option	Emerging best performing alternative	Not emerging as a preferred option
Capital cost	€239m	€168m	€372m	€356m	€679m
Environmental impact	Least risk	Moderate risk	Moderate risk	Moderate risk	Most risk
Potential disruption during construction	Possible road closures, traffic and land access disruption	Possible road closures, traffic and land access disruption	Possible road closures, traffic and land access disruption	Possible road closures, traffic and land access disruption	Possible road closures, traffic and land access disruption
Visual difference when construction completed	There will be changes to existing overhead infrastructure with minimal new infrastructure on the existing route. New infrastructure into Woodland station	New overhead infrastructure	New underground infrastructure, mainly under existing roads. No new overhead infrastructure	New underground infrastructure, mainly under existing roads. No new overhead infrastructure	New underground infrastructure, mainly under existing roads. No new overhead infrastructure
Meets technical requirements	Yes	Yes	Not to the same level as other options	Yes	Yes
Other notable points	Uses route along existing overhead lines and maximises use of existing infrastructure			Requires a 4 metre wide cable trench and overall work space of up to 12 metres in places	Requires the same as option 4 but along 2 routes

5.3. Appendix

Step 4 Public Consultation Options A-D and Routes Considered Not

5.3.1. Option A – The Red Route

5.3.2. Option B – The Green Route

5.3.3. Option C – The Orange Route

5.3.4. Option D – The Blue Route

5.3.5. Routes Considered Not Progressed

5.4. Appendix 4

Step 4 Consultation Questionnaire

EIRGRID

Delivering a cleaner energy future

Kildare-Meath Grid Upgrade Consultation

31 August 2021 to 22 November 2021

Introduction

The Kildare-Meath Grid Upgrade will add a high-capacity underground electricity connection between Dunstown substation in Co. Kildare and Woodland substation in Co. Meath. The upgrade will help to more effectively transfer power to the east of the country and distribute it within the electricity network in Meath, Kildare and surrounding counties.

The project is essential to enable further development of renewable energy generation in line with Government policy ambitions of having at least 70% of electricity coming from renewable sources by 2030. This includes transporting electricity from offshore renewable sources.

The project will also help meet the growing demand for electricity in the east. This growth is due to increased economic activity and the planned connection of new large-scale IT industry and other industry infrastructure in Kildare, Meath and Dublin.

We want to hear what you have to say about the four underground cable route options for upgrading the electricity grid between Kildare and Meath.

Give your feedback

This leaflet contains some information about the project. We have included an indicative map to provide an overview of the options.

This leaflet also contains a freepost questionnaire. You can complete it, detach it and return it to us by freepost.

You can access more detailed information online at www.eirgrid.ie/KildareMeath. If you need further guidance or copies of any of our documents, please contact your EirGrid Community Liaison Officer Gráinne Duffy on: 085 887 4798 or KildareMeath@eirgrid.com.

We will consider feedback on all route options before deciding on what the best option is to take into the next step of this project.

Scan me for more information!

About this consultation

We are inviting you to give feedback on the four route options for the Kildare-Meath Grid Upgrade. We want to know what you think about each option. Is there anything else we should be taking account of? Have you any other feedback we should consider?

The consultation period is from 31 August to 22 November 2021. We encourage you to engage with us and have your say as early as possible during the consultation period.

Where can I find out more?

- Sign up to a webinar
- Arrange to speak to a team member directly
- Visit our consultation and information portal

All information relating to this project is available on our website: **www.eirgrid.ie/KildareMeath**. If you need further guidance or copies of any of our documents, please contact your Community Liaison Officer Gráinne Duffy on: **085 887 4798** or **KildareMeath@eirgrid.com**.

How can I have my say?

- Complete this questionnaire and submit it by freepost
- Submit your views online at: consult.eirgrid.ie
- Email your submission to us at: KildareMeath@eirgrid.com
- Write your own submission and freepost it back to us

Our freepost address is: **Kildare-Meath Grid Upgrade Consultation, EirGrid plc, Freepost FDN 5312, 160 Shelbourne Road, Ballsbridge, D04 FW28.**

About the options

We have developed four potential underground cable options for this project. We plan these using principles such as avoiding town and village centres, and maximising the use of local roads. We also consider constraints such as environmental impact, the width of roads and other services in the road such as water, gas and drainage. All routes start in Woodland substation and end in Dunstown substation. All routes cross the Royal Canal and the Grand Canal. Some routes will also need to cross watercourses, railway lines and motorways – however we would propose to drill under these. Please know that we will engage extensively with all relevant bodies, carry out all necessary studies and put in place all risk mitigations before starting these works.

Each option will require some of the cable to be off-road. Where off-road routing is unavoidable, we do not yet know what the exact route may be. For this reason, we highlight a corridor of space on the route map. The off-road section may pass through this corridor. We will determine this after discussing it with the landowners affected. We will avoid agricultural land as far as possible by carefully routing the cable.

5.4. Appendix 4

Step 4 Consultation Questionnaire

Personal Information:

Name: ____________________

Address: ____________________

EirCode: ____________________

Organisation (if any): ____________________

Contact number: ____________________

Contact Email: ____________________

If interested, how would you like to receive further updates on this project? (Tick all that apply)

☐ Phone ☐ Email ☐ Post

Data Protection and Privacy Statement

☐ I consent to EirGrid processing my data for the purposes of the Kildare-Meath Grid Upgrade project. All information provided to EirGrid will be held by EirGrid personnel and EirGrid's data processors only, for the purpose of engaging with me in the public consultation process. EirGrid's privacy statement is available at: *www.eirgrid.ie/privacy*

☐ I consent to EirGrid publishing my name with this submission. Otherwise this submission will be published anonymously.

(Optional) Questions about this Consultation Process

The questions in this section help us understand your views in relation to this consultation process and will help us best plan future engagement.

How did you hear about this consultation? (Tick all that apply)

☐ Member of the Community Forum
☐ An Elected Representative
☐ Newspaper, radio or advertising
☐ Leaflet or letter in the post
☐ Online or social media
☐ Word of mouth
☐ Other (please specify)

With which gender do you identify?

☐ Male ☐ Female ☐ Other ☐ Prefer not to say

Age?

☐ Under 18 ☐ 18-29 ☐ 30-39 ☐ 40-49
☐ 50-59 ☐ 60-64 ☐ 65+

Do you or anyone in your household have specific access needs that you would like us to be aware of?

Feedback Questions

Question 1: Please provide your comments in relation to each route option. Your comments may include route specific issues that you want us to be aware of or suggestions about alternative routing. Your comments may also express concerns or highlight opportunities.

Option A: Red Option

Option B: Green Option

Option C: Orange Option

Option D: Blue Option

Question 2: Please provide any other comments you have about the approach we have taken on this project.

Question 3: Are there regular or annual major events, festivals or similar in your local area that you would like us to be aware of as we plan the scheduling of this project?

At a glance view of the proposed route options

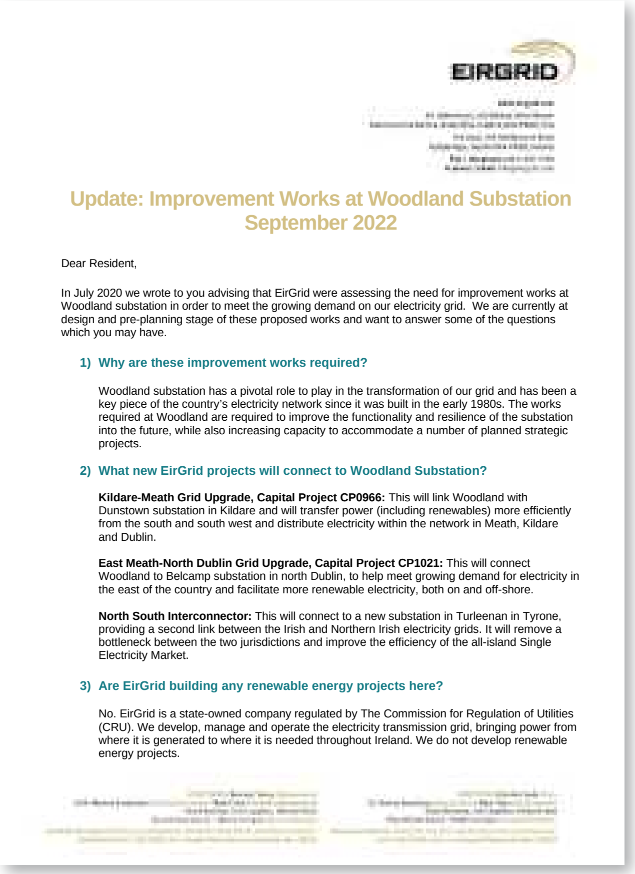
The following table provides an overview of the four underground cable options we are considering for this project. Find more detail online at eirgrid.ie/KildareMeath.

Please note that the route lengths referenced below are indicative only and will be finalised when a full and detailed route is agreed.

Option	Estimated overall length (km)	Estimated off-road sections (km)	Environmental impact	Social impact and potential disruption during construction	Meets technical requirements	Other notable points
Option A (Red)	51	5	Least risk	Low-moderate	Yes	Travels to the west of Kilcock village, longest route, but it affects the least amount of agricultural land of all options.
Option B (Green)	50	8	Low-moderate	Moderate-high	Yes	Travels through Rathcoffey and Moortown.
Option C (Orange)	47	13	Low-moderate	Moderate-high	Yes	Shortest cable but it affects the most agricultural land of all options.
Option D (Blue)	51	6	Least risk	Low-moderate	Yes	

5.5. Appendix 3

Step 4 Letter to residents living near Woodland Substation



Update: Improvement Works at Woodland Substation
September 2022

Dear Resident,

In July 2020 we wrote to you advising that EirGrid were assessing the need for improvement works at Woodland substation in order to meet the growing demand on our electricity grid. We are currently at design and pre-planning stage of these proposed works and want to answer some of the questions which you may have.

1) **Why are these improvement works required?**

Woodland substation has a pivotal role to play in the transformation of our grid and has been a key piece of the country's electricity network since it was built in the early 1980s. The works required at Woodland are required to improve the functionality and resilience of the substation into the future, while also increasing capacity to accommodate a number of planned strategic projects.

2) **What new EirGrid projects will connect to Woodland Substation?**

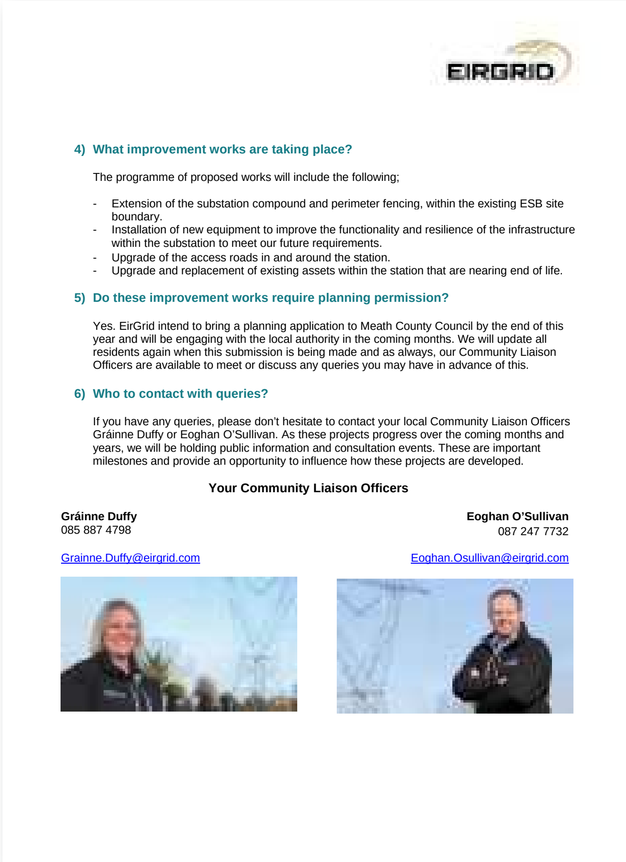
Kildare-Meath Grid Upgrade, Capital Project CP0966: This will link Woodland with Dunstown substation in Kildare and will transfer power (including renewables) more efficiently from the south and south west and distribute electricity within the network in Meath, Kildare and Dublin.

East Meath-North Dublin Grid Upgrade, Capital Project CP1021: This will connect Woodland to Belcamp substation in north Dublin, to help meet growing demand for electricity in the east of the country and facilitate more renewable electricity, both on and off-shore.

North South Interconnector: This will connect to a new substation in Turleenan in Tyrone, providing a second link between the Irish and Northern Irish electricity grids. It will remove a bottleneck between the two jurisdictions and improve the efficiency of the all-island Single Electricity Market.

3) **Are EirGrid building any renewable energy projects here?**

No. EirGrid is a state-owned company regulated by The Commission for Regulation of Utilities (CRU). We develop, manage and operate the electricity transmission grid, bringing power from where it is generated to where it is needed throughout Ireland. We do not develop renewable energy projects.



4) **What improvement works are taking place?**

The programme of proposed works will include the following;

- Extension of the substation compound and perimeter fencing, within the existing ESB site boundary.
- Installation of new equipment to improve the functionality and resilience of the infrastructure within the substation to meet our future requirements.
- Upgrade of the access roads in and around the station.
- Upgrade and replacement of existing assets within the station that are nearing end of life.

5) **Do these improvement works require planning permission?**

Yes. EirGrid intend to bring a planning application to Meath County Council by the end of this year and will be engaging with the local authority in the coming months. We will update all residents again when this submission is being made and as always, our Community Liaison Officers are available to meet or discuss any queries you may have in advance of this.

6) **Who to contact with queries?**

If you have any queries, please don't hesitate to contact your local Community Liaison Officers Gráinne Duffy or Eoghan O'Sullivan. As these projects progress over the coming months and years, we will be holding public information and consultation events. These are important milestones and provide an opportunity to influence how these projects are developed.

Your Community Liaison Officers

Gráinne Duffy
085 887 4798
Grainne.Duffy@eirgrid.com

Eoghan O'Sullivan
087 247 7732
Eoghan.Osullivan@eirgrid.com

5.6. Appendix 4

Step 4 Media Campaign Assets

EirGrid Kildare-Meath Grid Upgrade - Best performing route option video: https://www.youtube.com/watch?v=5E2MxpPlaXE

5.7. Appendix 4

Step 5 Media Campaign Assets

EirGrid