AtkinsRéalis

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EirGrid

Step 3 Report

EirGrid PLC

May 2025

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CP1226 Kildare Dublin Grid Reinforcement

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Abbreviations	
ABP	An Bord Pleanála
AIS	Air Insulated Switchgear
BPO	Best Performing Option
CENELEC	European Committee for Electrotechnical Standardisation
CP No.	Capital Project Identification Number
DCC	Dublin City Council
DLRCC	Dún Laoghaire-Rathdown County Council
DSO	Distribution System Operator
EPA	Environmental Protection Agency
ESB	Electricity Supply Board
FGD	Framework for Grid Development
GDA	Greater Dublin Area
GIS	Gas Insulated Switchgear
GSI	Geological Survey Ireland
Ha	Hectares
HV	High Voltage
IAA	Irish Aviation Authority
IFI	Inland Fisheries Ireland
KCC	Kildare County Council
kV	Kilovolt
MCA	Multi-Criteria Analysis
MVA	Megavolt-Amperes
MW	Megawatts
NHA	National Heritage Area
NIAH	National Inventory of Architectural Heritage
OEM	Original Equipment Manufacturer
OHL	Overhead Line
OSI	Ordinance Survey Ireland (now Tailte Éireann)
pNHA	proposed National Heritage Areas
SAC	Special Area of Conservation
SDCC	South Dublin County Council
SDZ	Strategic Development Zone
SLD	Single Line Diagram
SMR	Sites and Monuments Record

Abbreviations	
SPA	Special Protection Area
TSO	Transmission System Operator
UGC	Underground Cable
WCC	Wicklow County Council
WFD	Water Framework Directive
WSI	Wetland Surveys Ireland
ZoI	Zone of Influence

Glossary of Terms	
Bay	A connection point to a busbar and comprising switchgear and measurement equipment.
Capital Project Number	Each project has a Capital Project Number to help coordination between EirGrid and the Transmission Asset Owner (TAO), and for reporting purposes.
Circuit	A line or cable, including associated switchgear, which carries electrical power.
Demand	The amount of electrical power that is consumed by a customer and is measured in Megawatts (MW). In a general sense, the amount of power that must be transported from transmission network connected generation stations to meet all customers' electricity requirements.
Distribution System Operator (DSO)	In the electrical power business, a distribution system operator is the licensed entity responsible for: ▪ Operating and ensuring the maintenance and development of the distribution system in a given area (and its interconnections), if necessary and where applicable; and ▪ Ensuring the long-term ability of the system to meet reasonable demands for electrical power.
EirGrid	The independent statutory electricity Transmission System Operator in Ireland.
Grid	A network of high voltage lines and cables (400 kV, 275 kV, 220 kV and 110 kV) used to transmit bulk electricity supplies around Ireland. The terms grid, electricity transmission network, and transmission system are used interchangeably.
Loop-In Circuits	Loop-In Circuits are circuits used to connect a new substation by connecting or looping into an existing circuit.
Outage	Times when transmission infrastructure (i.e., lines, cables and transformers, etc.) will be out of service for maintenance or capital works.
Study Area	A geographic boundary defined such that it is appropriate to the scale of the proposed development, thereby facilitating the subsequent identification of the nature and extent of constraints within the proposed Study Area.
Sub-Study Area	A sub-study area is a subset of the Study Area, and is developed to identify suitable areas for locating potential substation sites.

Glossary of Terms	
Substation Zone	A substation zone is a subset of a sub-study area, and is developed to identify suitable areas for locating potential substation sites.
Substations	Contains the specialist equipment that allows the voltage of electricity to be transformed.
Switchgear	A combination of electrical equipment such as disconnects and/or circuit breakers used to isolate equipment in or near an electrical substation.
Transformer	An item of electrical equipment that allows electrical power to flow between typically two different voltage levels in an alternating current (AC) power system.
Transmission circuit	An overhead line, underground cable, or combination of both, used for the bulk movement of electrical energy from one node to another node within the electrical grid.
Transmission interface substation	A Transmission Interface Substation is a specific substation that serves as the critical point of connection between a Transmission System Operator (TSO) and a Distribution System Operator (DSO). This substation plays a vital role in managing the transfer of electrical power from the high-voltage transmission grid (operated by EirGrid as its role as the TSO) to the lower-voltage distribution network (operated by ESB as its role as the DSO). A Transmission Interface Substation is responsible for stepping down the voltage from transmission levels to distribution levels.
Transmission substation	A Transmission Substation is a substation within the high-voltage transmission network where electrical power is transformed, switched, and routed. It typically steps up or steps down voltage levels to facilitate efficient power transmission over long distances. Transmission substations are integral to the operation of the transmission grid, helping to control and protect the network, manage power flows, and ensure the reliable delivery of electricity across regions where it is needed.
Transmission System Operator (TSO)	In the electrical power business, a transmission system operator is the licensed entity responsible for the management of the flow of power on the electricity grid, moving high-voltage electricity around the country, from where it is produced to where it is used, supplying large energy users and the distribution network that powers homes and businesses.

1. Introduction

1.1 Who is EirGrid?

EirGrid PLC (hereafter referred to as EirGrid) is responsible for a safe, secure, and reliable supply of electricity in Ireland. EirGrid develops, manages, and operates the electricity transmission 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 Capital Project CP1226?

Kildare Dublin Grid Reinforcement (EirGrid Capital Project CP1226) is a proposed project to address the needs for additional transmission capacity and transmission interface substations in the East Kildare and South Dublin area. This project addresses the need for new infrastructure to accommodate the continued growth in electricity demand in the region, which is being driven by several sectors including residential housing, commercial and industrial development, and the electrification of heat and transportation. This project also facilitates the integration of both onshore and offshore renewable energy generation and the integration of interconnectors, located in the south and south-east of Ireland, to other countries.

The existing transmission system and transmission interface substations are at risk of reaching their capacity limits and as a result the existing infrastructure will not be capable to supply sufficient power to where it is needed. To address this need, new infrastructure is required to ensure a reliable, sustainable electricity supply to customers in the area.

A high-level project study area is identified in Figure 1-1.

The development of this project follows EirGrid's 6-Step approach to Grid Development (refer to Figure 1-2) which sets out the steps to be taken to identify and implement the best performing solution that meets the needs outlined above.

The Kildare Dublin Grid Reinforcement Project is currently in Step 3, with the objective of identifying a best performing technology solution and associated study area to meet the identified need.

This grid reinforcement will create opportunities by providing capacity to supply electricity to areas where it is needed in the future which will enable businesses, schools, hospitals, homes, and farms to prosper and grow. It will also facilitate the integration of renewable generation and interconnection.

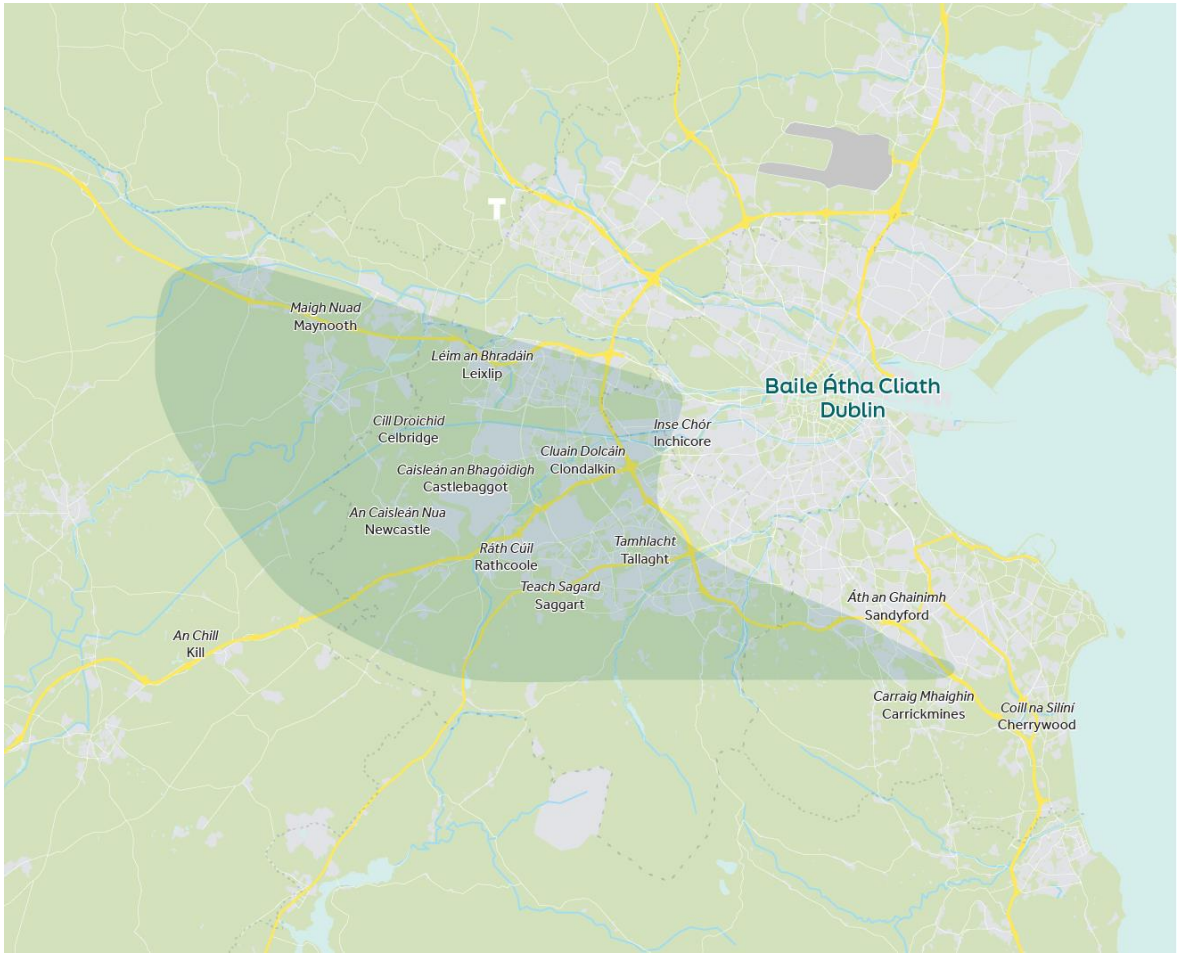

Figure 1-1 - Initial CP1226 Project Study Area Indicated in November 2024 Public Information Leaflet

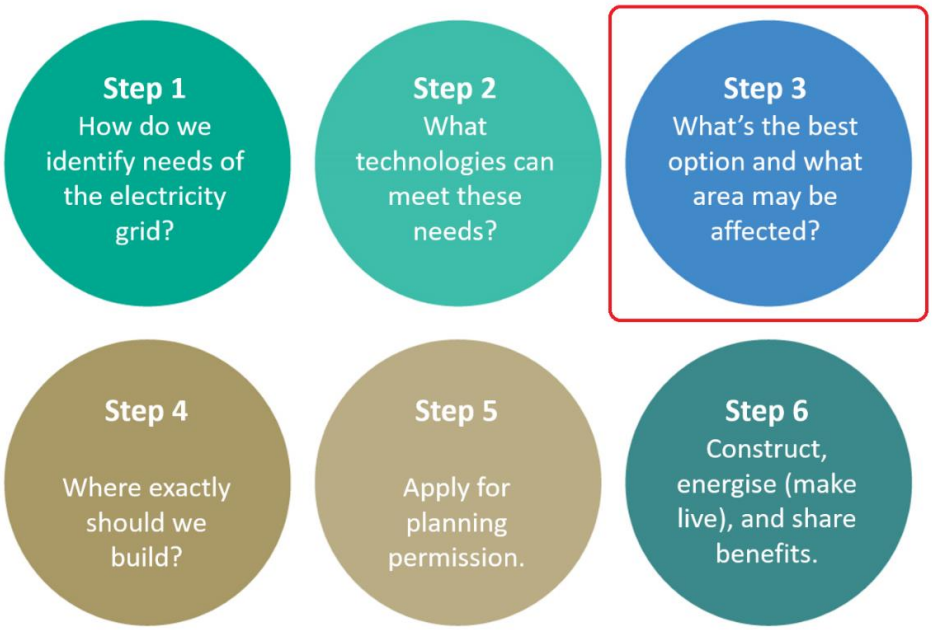

Figure 1-2 - EirGrid's 6-Step approach to Grid Development

2. Background to the Project

2.1 Need for Development

EirGrid, as the Transmission System Operator (TSO) of Ireland, and ESB Networks, as the Distribution System Operator (DSO) of Ireland, work collaboratively to ensure that the needs of transmission and distribution connected customers are met. This includes planning development of transmission interface substations.

The need identified is a shortage of capacity in the East Kildare and South Dublin part of the transmission system. The main drivers of the need are connection of demand, integration of renewable energy generation and integration of interconnection.

As part of feedback received from the 'Shaping Our Electricity Future' consultation, the DSO highlighted to EirGrid the emerging need for additional capacity at transmission interface substations in the greater Dublin area. The DSO applied for a number of new transmission interface substations in the Greater Dublin area, one of which is in West County Dublin. This new interface substation is needed to accommodate forecast growth of electricity demand in the distribution network. This projected demand growth is driven by a number of factors including residential, electrification of heat and transport, and growth in commercial sectors.

In addition, in order to meet the Government's renewable energy targets, significant amounts of both onshore and offshore renewable energy generation are needed. Similarly, interconnection to other countries is essential to meet the Government's renewable energy targets. These interconnectors can either export generation or import generation depending on the electricity market. There are new and planned interconnectors in the south and south-east of Ireland with connections to Great Britain and France. The East Kildare and South Dublin part of the transmission system will facilitate the transfer of the electricity from these renewable generators and interconnectors to where it is needed.

Given these drivers, the existing transmission system and transmission interface substations are at risk of reaching their capacity limits and as a result the existing infrastructure will not be capable to supply sufficient power to where it is needed. To address this need, new infrastructure is required.

2.2 Project Benefits

Figure 2-1 shows the benefits associated with the CP1226 project.

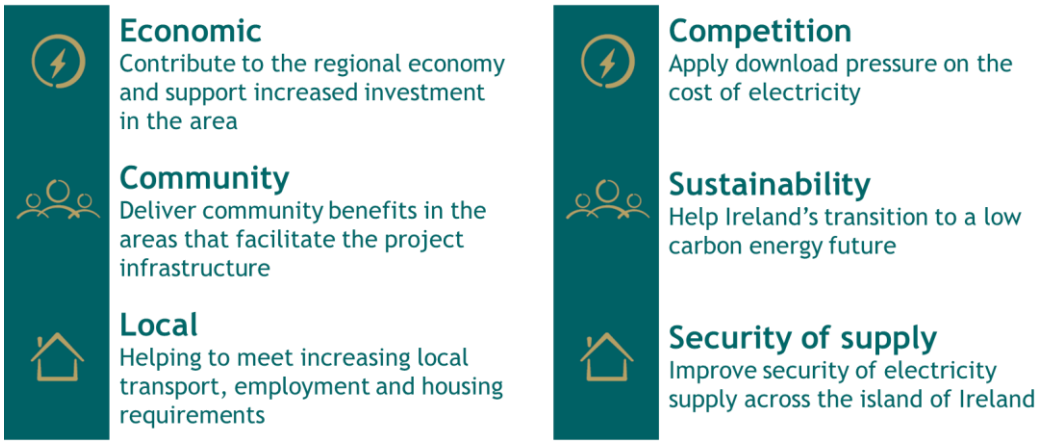

Figure 2-1 - CP1226 Project Benefits

2.3 New Infrastructure Identified in Step 2

The CP1226 infrastructure requirements that were identified by EirGrid during Step 2 and brought forward into Step 3 are as follows:

- New West Dublin 220/110 kV transmission interface substation, situated near West County Dublin;
- New South West Dublin 400/220/110 kV transmission interface substation, situated near South Dublin / East Kildare boundary, with new loop-in circuits from the proposed substation to the Carrickmines-Dunstown 220 kV circuit, the Dunstown-Maynooth 220 kV circuit, and nearby 110 kV circuits;
- New 400 kV transmission circuit (operated at 220 kV initially) between the existing Carrickmines 220 kV substation and the proposed South West Dublin 400 kV substation (with the abbreviation CKM-SWD);
- New 220 kV transmission circuit between the proposed South West Dublin 400 kV substation and the proposed West Dublin 220 kV substation (with the abbreviation SWD-WCD);
- New 220 kV transmission circuit between the existing Maynooth 220 kV substation and the proposed West Dublin 220 kV substation (with the abbreviation MAY-WCD); and
- New 220 kV transmission circuit between the proposed West Dublin 220 kV substation and either:
  - The existing Castlebagot 220 kV substation (with the abbreviation CBT-WCD); or
  - The existing Inchicore 220 kV substation (with the abbreviation INC-WCD).

It is noted that general substation names (i.e., ‘West Dublin’ and ‘South West Dublin’) are being used as placeholders in this report to help understanding and communication. When substation sites are confirmed, the substation names will be updated accordingly.

Notwithstanding the new infrastructure identified in Step 2 and outlined in the bullet points above, the transmission system in the Dublin region is facing further technical constraints and limitations in the future as the country and the economy are experiencing a period of rapid growth which in turn will have an impact on the transmission system. The growth has been accelerated by the Programme for Government 2025, ‘Securing Ireland's Future’. This outlines the Government's plans for economic growth and reform over the next five years and identifies key priorities for investment including offshore wind development, the rollout of new electricity interconnectors and ensuring the grid can support the transition to renewable energy while maintaining energy security.

Some of these technical constraints identified are high short-circuit levels in Dublin during certain operating scenarios and this has resulted in an imposed limit on how much generation can be accommodated in Dublin and this in turn may have implications on security of supply in the future if not addressed. EirGrid have published a briefing note regarding this technical limitation and are currently undertaking further studies to assess an appropriate solution. To address the high short-circuit levels in Dublin in the long term, new generation must connect at the 400 kV voltage level. As a result, the Kildare Dublin Grid Reinforcement project will need to be assessed to determine if additional future proofing is required. This may result in all or part of the of the Kildare Dublin Grid Reinforcement project being constructed to 400 kV standard. Until these studies are completed it is prudent to continue the project based on the current known infrastructure needs described in the bullet points above as the need to connect further demand in Dublin is acute. If the studies show that additional future proofing is needed, EirGrid will explain the decision and the impact.

2.4 Connection to Castlebagot or Inchicore

As indicated in Section 2.3, a new 220 kV transmission circuit is required between the proposed West Dublin 220 kV substation and either of the existing Castlebagot or Inchicore 220 kV substations. This transmission circuit is required to connect the proposed West Dublin 220 kV substation to the existing transmission network.

During the Step 3 process, EirGrid further investigated both options. The existing Castlebagot 220 kV substation does not have any available bays. The existing Inchicore 220 kV substation has 1no. available bay which is not currently allocated to a future project.

EirGrid concluded that the option of connecting to the existing Castlebagot 220 kV substation is not feasible for the following reasons:

1. The 220 kV GIS at Castlebagot will not be able to accommodate a standard additional sectionaliser and 4-bay arrangement extension (with the wing coupler moved to the end of the busbar);
2. Any alteration to the 220 kV GIS at Castlebagot will require a half-station outage to implement, and this cannot be sustained given the existing load at the substation; and
3. Cable access to Castlebagot is extremely difficult given all the existing 220 kV and 110 kV circuits connected to the substation.

A connection to Inchicore will be further investigated.

2.5 Project Description

The CP1226 project is described as follows:

- New West Dublin 220/110 kV transmission interface substation, situated near West County Dublin;
- New South West Dublin 400/220/110 kV transmission interface substation, situated near South Dublin / East Kildare boundary, with new loop-in circuits from the proposed substation to the Carrickmines-Dunstown 220 kV circuit, the Dunstown-Maynooth 220 kV circuit, and nearby 110 kV circuits;
- New 400 kV transmission circuit (operated at 220 kV initially) between the existing Carrickmines 220 kV substation and the proposed South West Dublin 400 kV substation (with the abbreviation CKM-SWD);
- New 220 kV transmission circuit between the proposed South West Dublin 400 kV substation and the proposed West Dublin 220 kV substation (with the abbreviation SWD-WCD);
- New 220 kV transmission circuit between the existing Maynooth 220 kV substation and the proposed West Dublin 220 kV substation (with the abbreviation MAY-WCD); and
- New 220 kV transmission circuit between the existing Inchicore 220 kV substation and the proposed West Dublin 220 kV substation (with the abbreviation INC-WCD).

3. Project Progression Through Step 3

The objective of Step 3 is to identify a best performing technology solution and associated study area to meet the identified need from Step 2. Figure 3-1 shows the process that was followed in Step 3, with a graphical representation provided in Figure 3-2. A high-level summary is outlined below with further detail discussed in this Chapter.

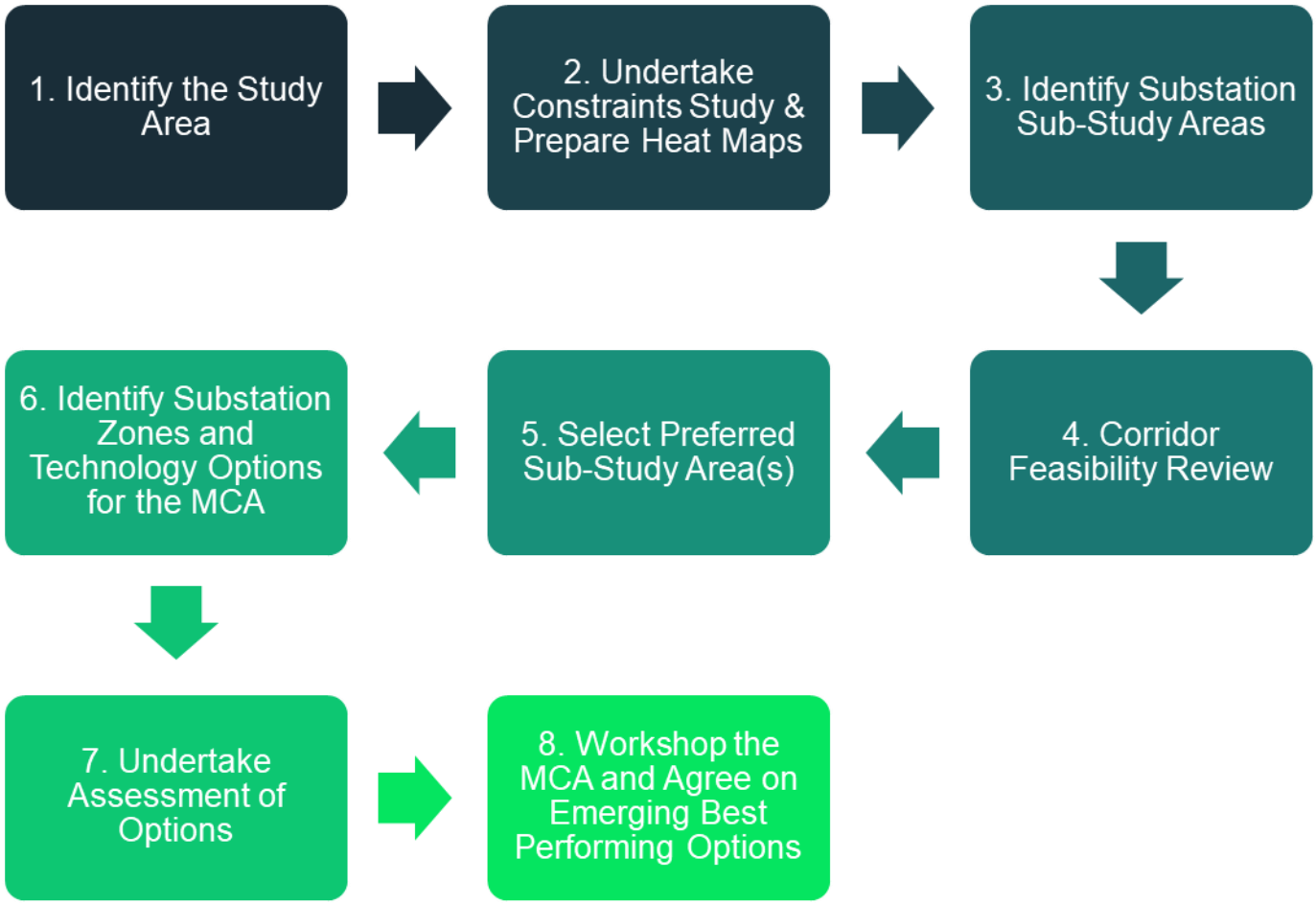

Figure 3-1 - Process Followed in Step 3

1. **Identify the Study Area:** The Study Area was defined such that it is appropriate to the scale of the proposed development thereby facilitating the subsequent identification of the nature and extent of constraints within the proposed Study Area.
2. **Undertake Constraints Study and Prepare Heat Maps:** Once the Study Area was defined, a constraints assessment was carried out. The identified constraints were then assigned a risk, and heat maps generated to graphically represent the constraints. The heat maps were used as a 'guide' to determine locations where the proposed infrastructure could be best positioned (when considering the constraints).
3. **Identify Substation Sub-Study Areas:** Given the greenfield nature of the Study Area, a phased approach to identify feasible sub-study areas for the location for the proposed substations was considered the most applicable. A wider net was cast to identify large sub-study areas where the substations could be positioned. Key technical, economic and deliverability guiding principles, together with the environmental and socio-economic constraints identified in the heat maps, were used to identify five (5no.) sub-study areas for the proposed West Dublin 220 kV substation and three (3no.) sub-study areas for the proposed South West Dublin 400 kV substation. These ranged in size from ± 345 ha to ± 1,825 ha. This process also included a high-level assessment of loop-in circuits

to the from the proposed South West Dublin 400 kV substation and the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV circuits.

4. **Corridor Feasibility Review:** A feasibility review for both OHL and UGC technologies was undertaken for all four (4no.) proposed circuits to ensure that a route can be found between the start points of the circuits and the sub-study areas for the proposed substations.
5. **Select Preferred Sub-Study Area(s):** Based on the initial high-level assessment carried out, four (4no.) of the five (5no.) sub-study areas for the proposed West Dublin 220 kV substation were selected for further assessment. All three (3no.) sub-study areas for the proposed South West Dublin 400 kV substation were selected for further assessment. The key guiding principles that informed this decision were the availability of suitable land and the connectivity to key existing electrical infrastructure.
6. **Identify Substation Zones and Technology Options for the Multi-Criteria Analysis (MCA):** Although the preferred sub-study areas had been identified, these areas were considerably larger than the actual size of land required for the proposed substations. The project team decided that substation zones (within the preferred sub-study areas) would be identified to allow a more detailed assessment to be undertaken. A total of three (3no.) substation zones were identified for the proposed West Dublin 220 kV substation, ranging in size from 150 ha to 345 ha. A total of four (4no.) substation zones were identified for the proposed South West Dublin 400 kV substation, ranging in size from 145 ha to 265 ha. The range in size of the substation zones provided flexibility for the identification of multiple substation sites which are suitable to accommodate the land take required for either substation technology option under consideration (i.e., gas-insulated switchgear and air-insulated switchgear).
7. **Undertake Assessment of Options:** Using the EirGrid Multi-Criteria Analysis Guidelines and the available constraints information, an assessment of both technologies (i.e., Air Insulated Switchgear and Gas Insulated Switchgear – further discussed in Section 3.6.1) was undertaken for each substation zone. The sub-criteria were scored from low to high risk and the overall performance for each option determined.
8. **Workshop the Multi-Criteria Analysis (MCA) and Agree the Emerging Best Performing Option(s):** The EirGrid Cross-Functional Team and the AtkinsRéalis team conducted an MCA workshop where the options were presented and the MCA scoring of each of the options discussed. The MCA workshop concluded with a decision on the Best Performing Options to proceed to Step 3 Public Consultation with.

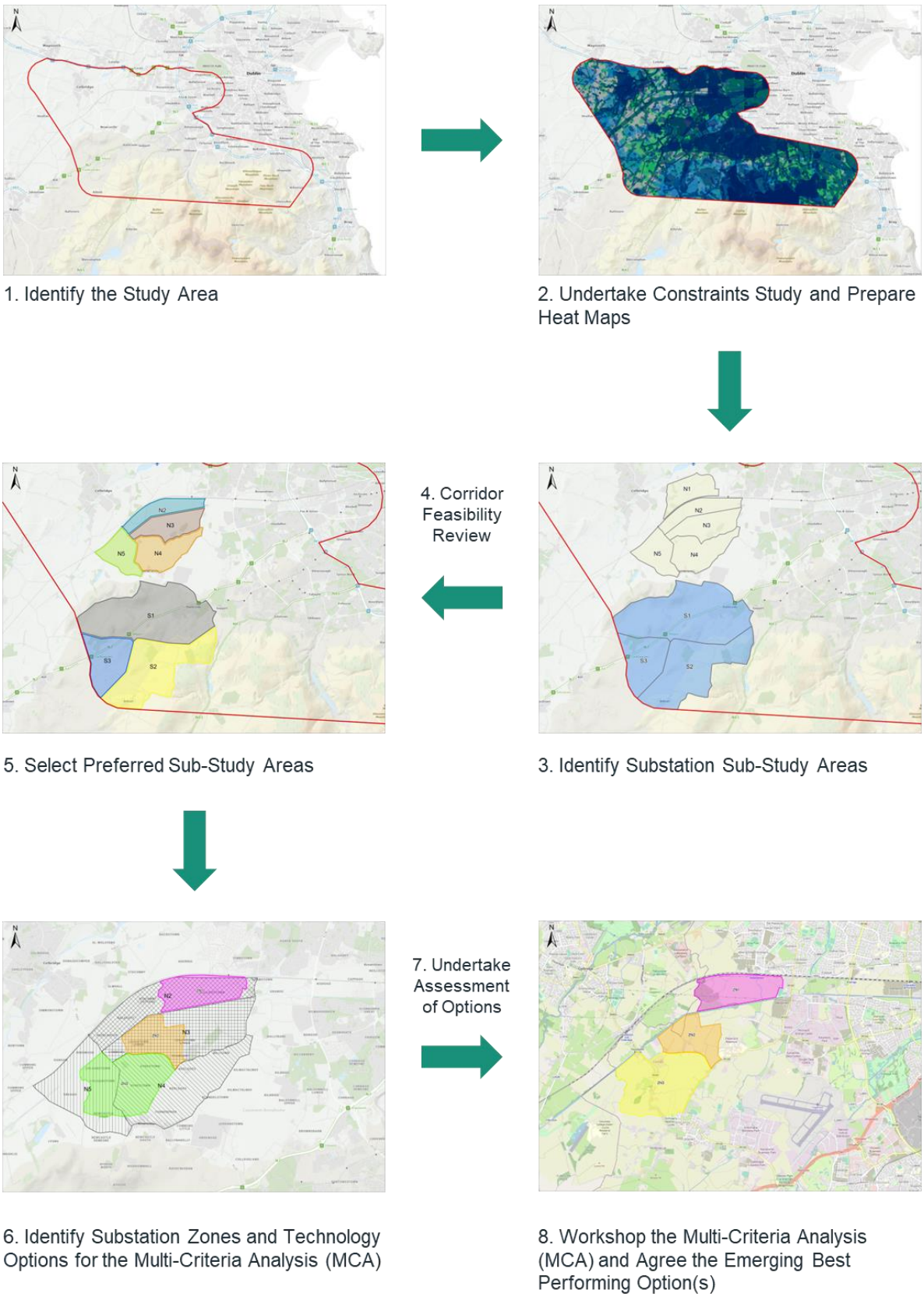

Figure 3-2 - Graphical Representation of the Process Followed in Step 3

3.1 Study Area

The Study Area was defined such that it was appropriate to the scale of the proposed development thereby facilitating the subsequent identification of the nature and extent of constraints within the proposed Study Area. The Study Area is presented in Figure 3-3.

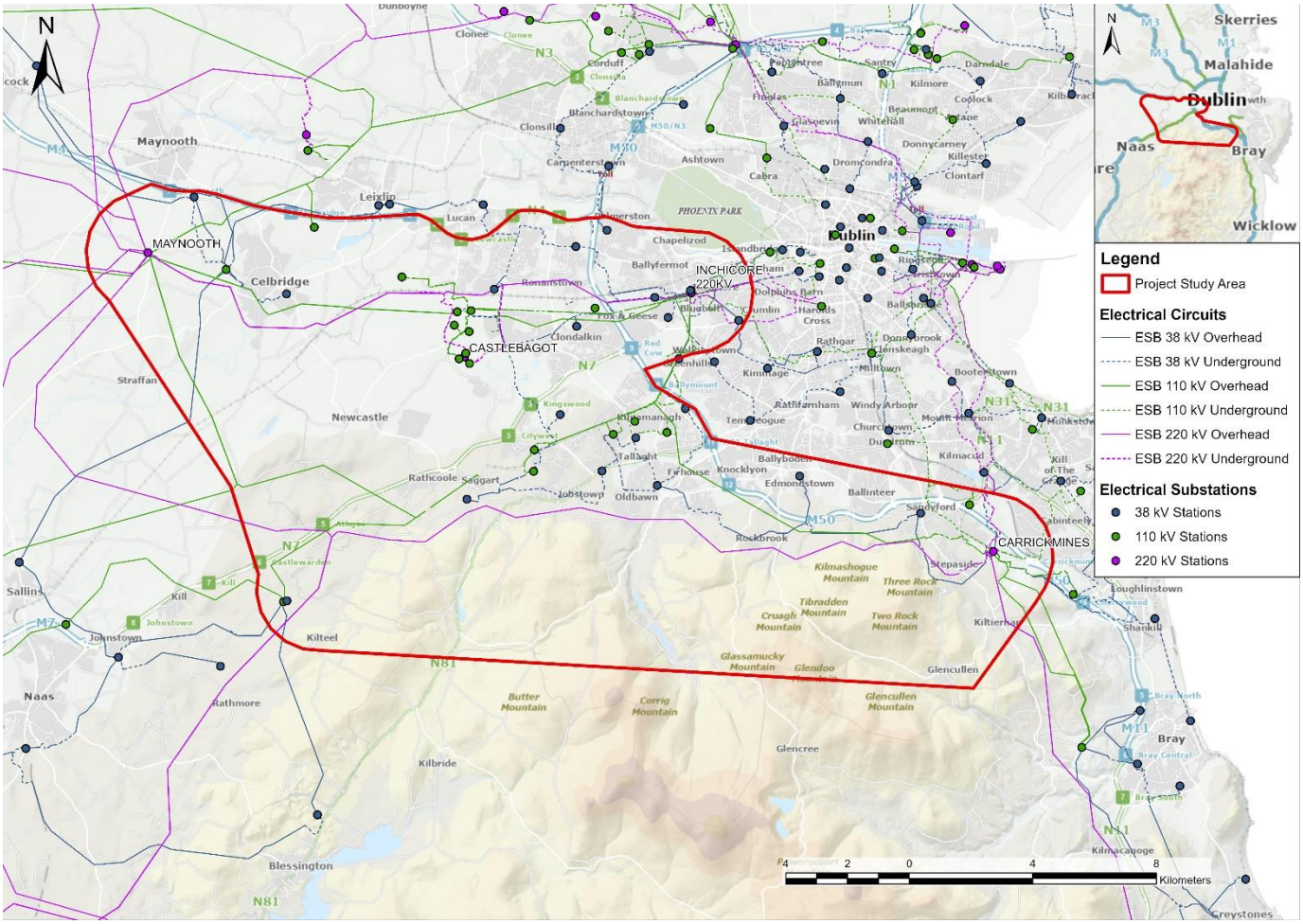

Figure 3-3 - CP1226 Step 3 Study Area

The identification of the Study Area was based primarily on a high-level assessment of the factors that present a significant constraint to the development of feasible solutions.

A desktop study, which was supplemented by site visits and windshield surveys, identified some key factors which influenced the identification of the Study Area from a technical development aspect:

- The existing 220 kV network routes for:
  - Dunstown-Carrickmines 220 kV OHL;
  - Dunstown-Maynooth 220 kV OHL;
  - Castlebaggot-Inchicore 220 kV OHL/UGC;
  - Castlebaggot-Maynooth 220 kV OHL/UGC; and
  - Inchicore-Maynooth 220 kV OHL/UGC.
- The proposed routes for EirGrid Powering Up Dublin;

- The EirGrid Dublin Cable Replacement Programme:
  - Carrickmines-Poolbeg 220 kV Cable Replacement (CP1146);
  - Inchicore-Poolbeg #1 220 kV Cable Replacement (CP1157); and
  - Inchicore-Poolbeg #2 220 kV Cable Replacement (CP1150).
- The preferred connection option for the Dublin Array project proposing to connect at Carrickmines 220 kV Substation and being developed by RWE;
- The motorway network e.g., M4, M7, M50;
- The rail network e.g., Heuston to Cork line, and Red and Green Luas Lines;
- Weston Airport (Civil), Leixlip and Casement Aerodrome (Military), Baldonnell;
- Significant towns and settlements such as Cellbridge, Inchicore, Ballyfermot, Clondalkin and Carrickmines;
- Consideration of OHL route options with the shortest and straightest possible routes; and
- Consideration of UGC route options including the use of public roads.

The proposed Study Area (see Figure 3-3) is situated within the boundaries of South Dublin County Council, Kildare County Council, Dublin City Council, Dún Laoghaire-Rathdown County Council and Wicklow County Council. The area to the north of the M4 Motorway / N4 National Road and the densely populated areas of Maynooth and Leixlip have not been included in the Study Area. The areas south of the R114 and R116 regional road are not considered to be feasible for either OHL or UGC for a variety of reasons, namely the mountainous nature of the terrain and significant areas of ecological sensitivity. To the west, the Project Study Area remains east of the village of Straffan.

3.2 Constraints Study and Heat Mapping

Once the Study Area had been defined, a constraints assessment was carried out. The following topics were included within the constraints assessment of the Study Area.

- Biodiversity, Flora and Fauna;
- Land, Soils and Geology;
- Material Assets;
- Noise and Vibration;
- Water;
- Air and Climate;
- Planning and Policy;
- Landscape and Visual;
- Settlements and Communities;
- Recreation, Amenity and Tourism;
- Cultural Heritage; and
- Aviation and Defence.

With the constraints identified, it was necessary to present the information in a manner that would inform the identification of potential substation sub-study areas and circuit grid route corridors. This was done by developing a series of illustrative heat maps which presented the aggregated individual constraints (and their associated risks) into areas of low to high risk. Maps were created for substation risk, OHL risk and UGC risk, and are shown in Figure 3-4, Figure 3-5, and Figure 3-6 respectively.

The constraints assessment is documented in the CP1226 Environmental Constraints Report.

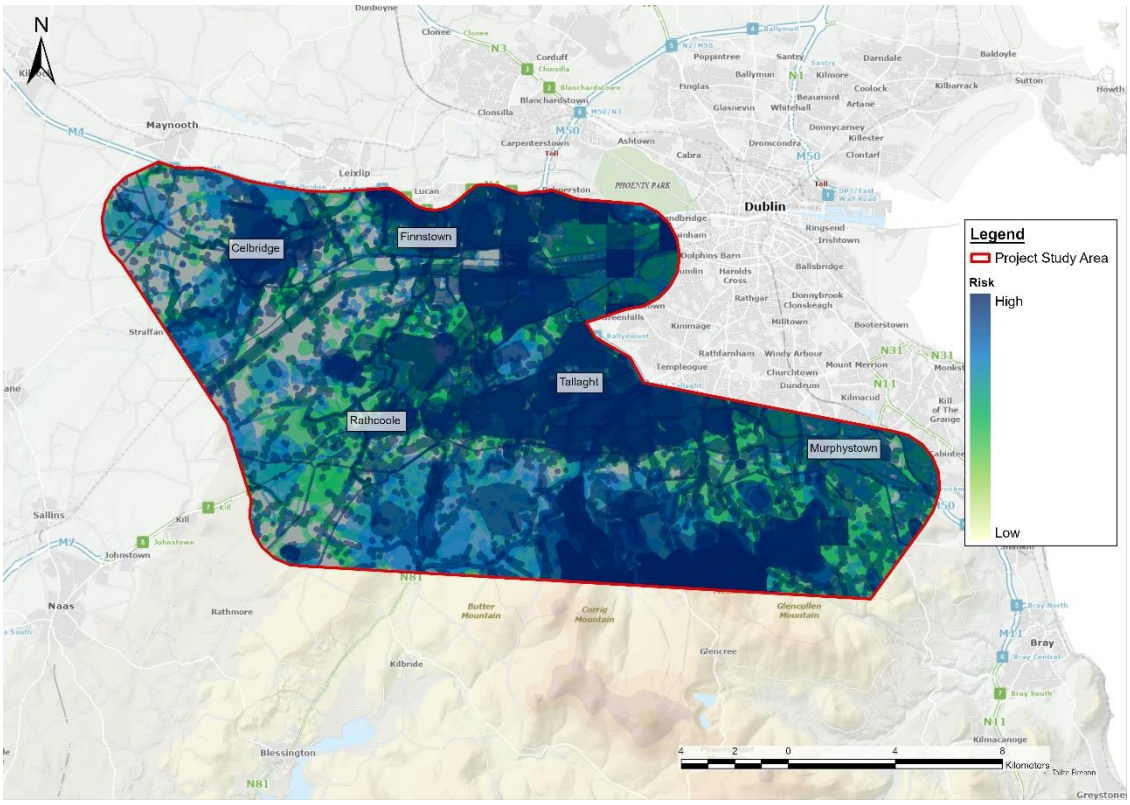

Figure 3-4 - CP1226 Substation Risk Heat Map

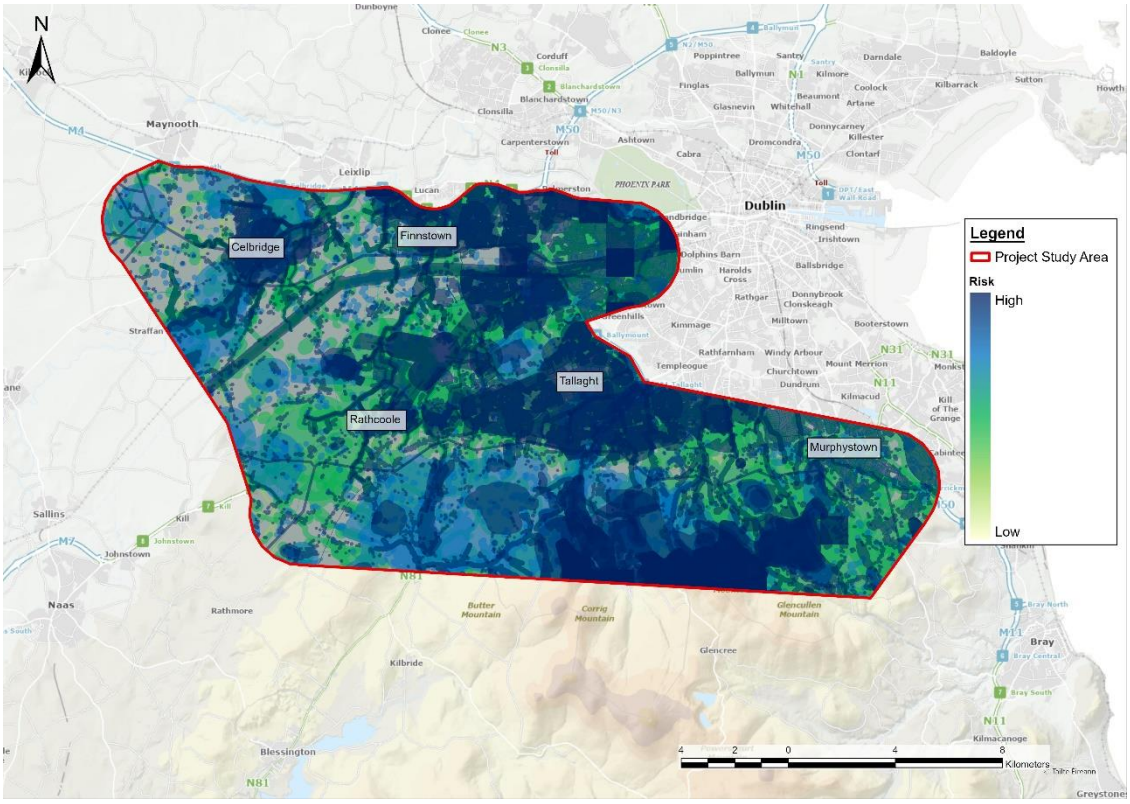

Figure 3-5 - CP1226 OHL Risk Heat Map

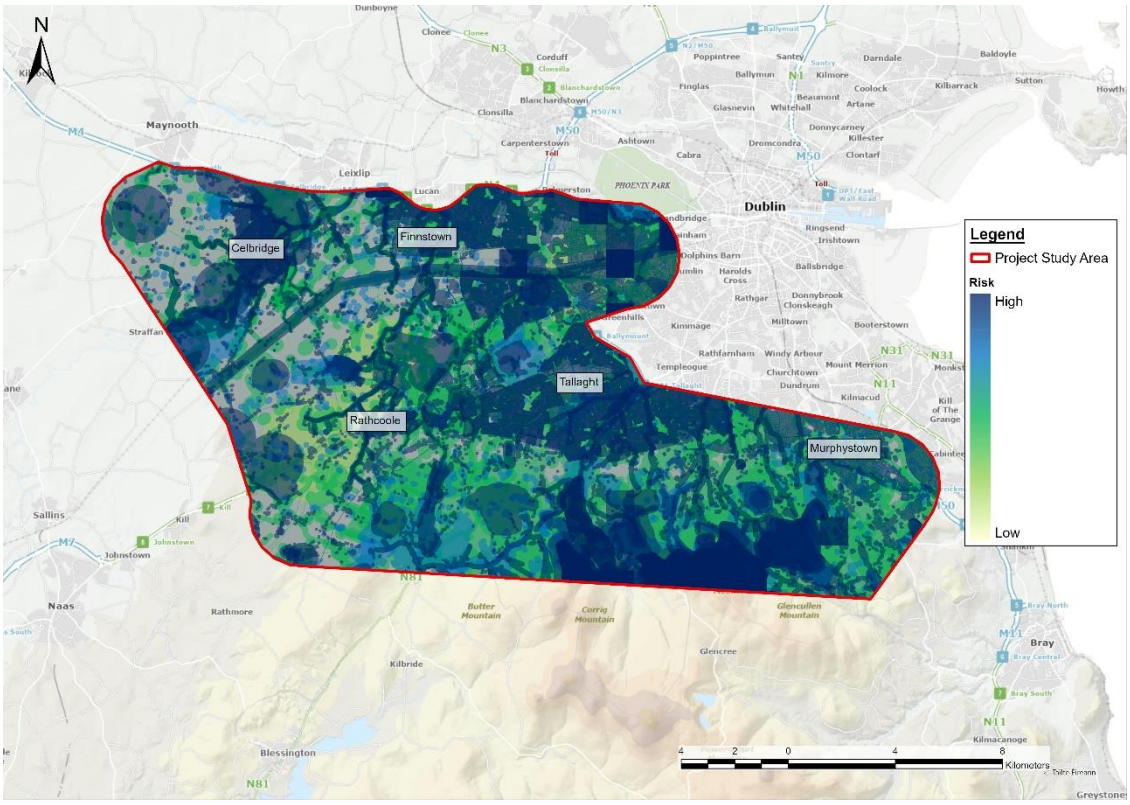

Figure 3-6 - CP1226 UGC Risk Heat Map

3.3 Substation Sub-Study Areas

3.3.1 Search Criteria

The proposed sub-study areas were developed to identify suitable areas for locating potential substation sites. The methods used to determine potential areas take into consideration the technical, economic and deliverability factors for the required loop-in points which may impact the project, as well as the environmental and socio-economic constraints associated with an area. The methods used for each substation are described in this Section.

West Dublin 220 kV substation (north-central section of the Study Area)

- Identify areas in west county Dublin located centrally between Maynooth, Inchicore and Castlebagot substations and the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV circuits;
- Avoidance of highly constrained areas such as built-up urban areas, e.g., Newcastle, Adamstown;
- Avoidance of large local amenity areas;
- Avoidance of areas with high risk ratings as identified in project constraint heat maps which could impact either the siting of a substation or the connecting OHL / UGC circuits;
- Limit study areas where possible outside of areas which may be zoned by local councils;
- Inclusion of areas large enough to accommodate substation sites suitable for both AIS and GIS technologies; and
- Avoid major elevation changes or areas with unsuitable ground conditions.

South West Dublin 400 kV substation (south-central section of the Study Area)

- Where possible, maintain a 2 km buffer to the existing Carrickmines-Dunstown / Dunstown-Maynooth double circuit 220 kV overhead line, to reduce the constraints involved with the length of required 220 kV loop-in double circuit;
- For construction feasibility and to reduce outage times it is preferred to loop-in to the single circuit structures of the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV overhead lines. However, due to other constraints and limitations on available land, looping into the double circuit sections may still be required;
- Avoidance of highly constrained areas such as built-up urban areas, e.g., Rathcoole, Newcastle;
- Avoidance of large local amenity areas;
- Avoidance of areas with high risk ratings as identified in project constraint heat maps which could impact either the siting of a substation or the connecting OHL / UGC circuits;
- Limit study areas where possible outside of areas which may be zoned by local councils;
- Inclusion of areas large enough to accommodate substation sites suitable for both AIS and GIS technologies; and
- Avoid major elevation changes or areas with unsuitable ground conditions.

3.3.2 Identified Sub-Study Areas

Based on the search criteria, five sub-study areas (N1 to N5) were identified for the proposed West Dublin 220 kV substation and three sub-study areas (S1 to S3) were identified for the proposed South West Dublin 400 kV substation. The identified sub-study areas are shown in Figure 3-7.

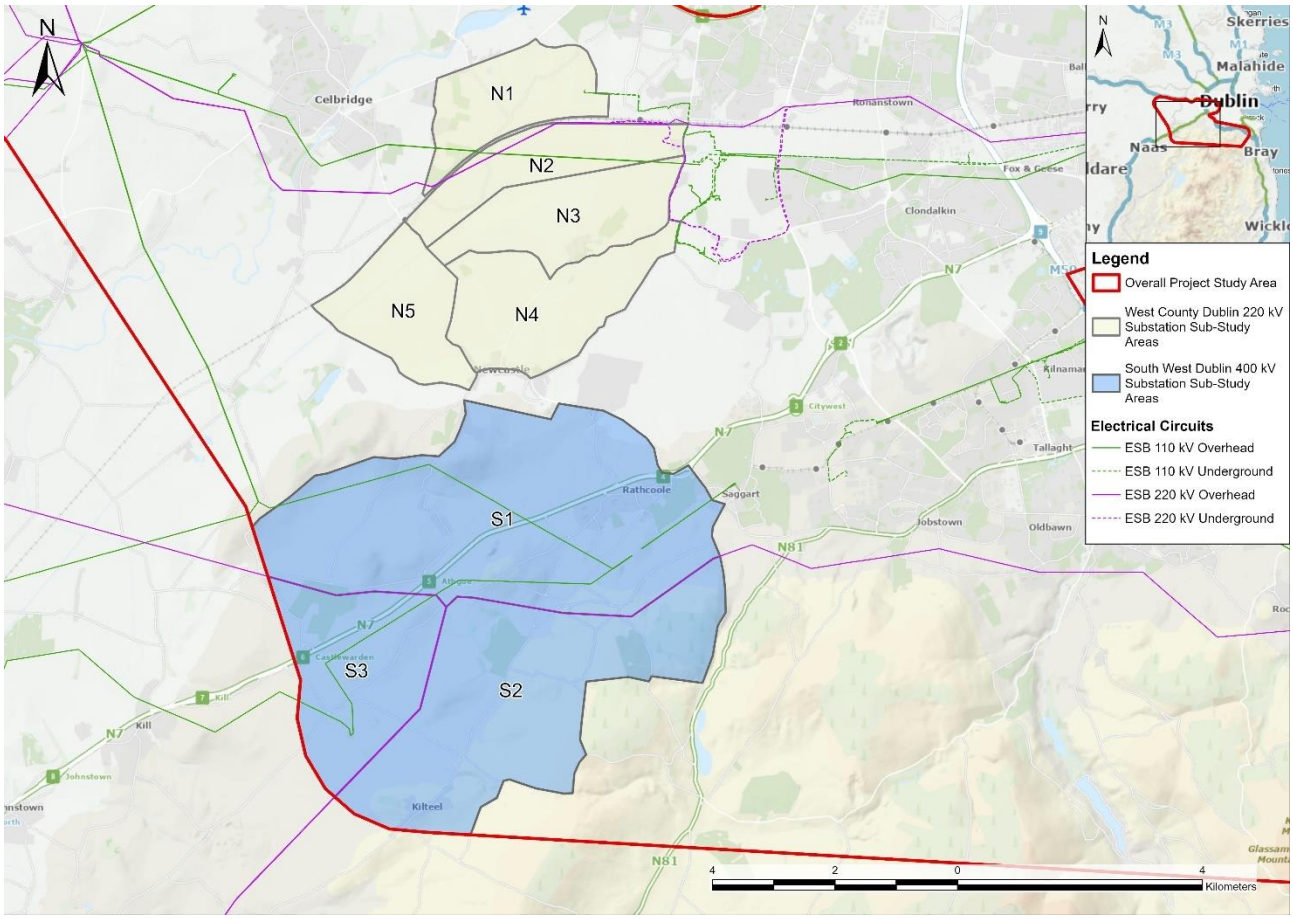

Figure 3-7 - Identified Sub-Study Areas

As discussed in Section 3.3.1, the heat maps were used to inform the identification of the sub-study areas; these are shown in Figure 3-8 and Figure 3-9.

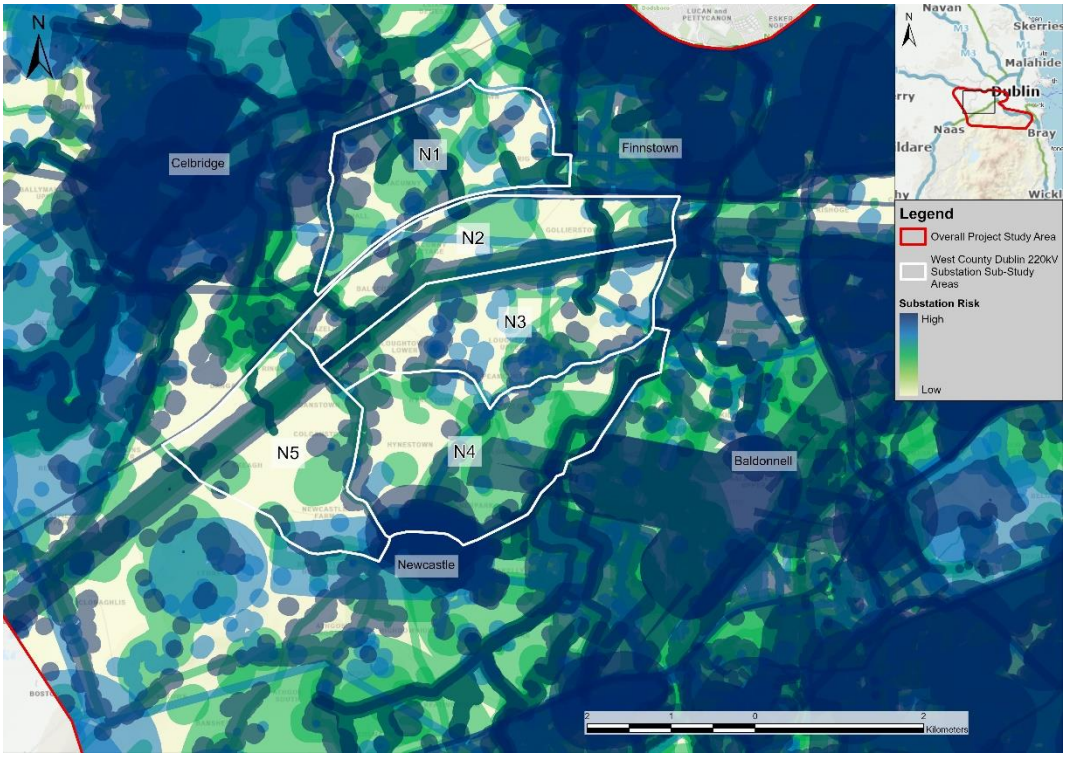

Figure 3-8 - Identified Sub-Study Areas for the West Dublin 220 kV Substation with the Substation Heat Map

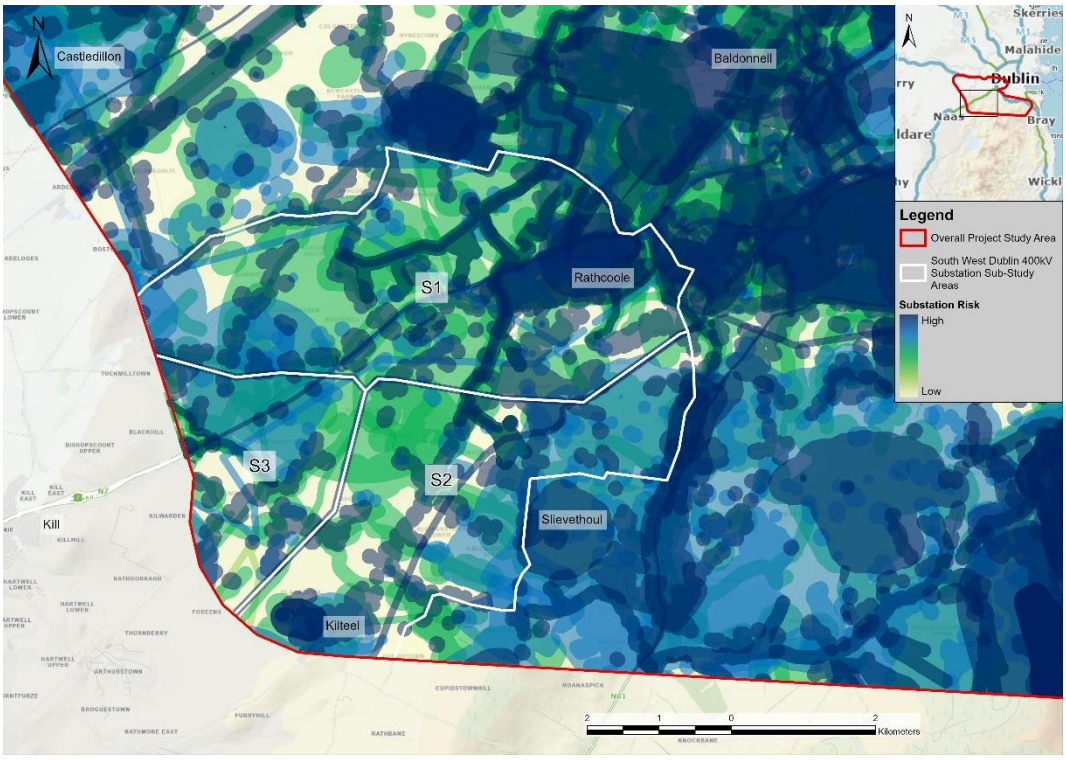

Figure 3-9 - Identified Sub-Study Areas for the South West Dublin 400 kV Substation with the Substation Heat Map

3.3.2.1 Identified Sub-Study Areas for the Proposed West Dublin 220 kV Substation

3.3.2.1.1 Sub-Study Area N1

- This sub-study area was assessed as it has several potential sites of lower constraint risk. Much of the area is rural in nature and zoned for agricultural use in the SDCC and KCC Development Plans. The area is located south of the R403 regional road, which was used as a boundary for this sub-study area. The built-up areas of Celbridge to the west, and Lucan to the east of the sub-study area have also been used as limits for the substation search area due to absence of available undeveloped lands in these areas.
- The area is primarily rural and there is potential to accommodate an AIS substation depending on the selection of a specific site.
- Based on the OHL and UGC constraint heat maps generated, the sub-study area has potential to accommodate both OHL and UGC grid connection options albeit within very limited access corridors due to the high-risk constraints of Weston Airport, the settlements of Celbridge and Lucan, and the Dublin-Cork railway line.

Table 3-1 illustrates positives and negatives associated with this sub-study area.

Table 3-1 - Positive and Negative Attributes of Sub-Study Area N1

Positive	Negative
By keeping the sub-study area to the north of the Dublin-Cork railway line, access routes to Inchicore 220 kV substation may be less constrained.	By keeping the sub-study area to the north of the Dublin-Cork railway line, access routes and connections to existing OHLs and OHLs connecting to Maynooth 220 kV substation, Castlebagot 220 kV substation and the proposed South West Dublin 400 kV substation will need to cross this high-risk constraint.
Primarily rural area with large private land folios which may have the potential to accommodate an AIS substation.	Substation not centrally located in the vicinity to existing/proposed 220 kV circuits and substations in the West Dublin area.
The heat map indicates pockets of potential areas which may be suitable for substation construction from an environmental perspective.	The sub-study area's proximity to Weston Airport may present an issue from an aviation safeguarding perspective and will require engagement with the relevant aviation authorities at consultation stage.
Area has a small number of watercourses which will help the process of siting a potential substation.	The existing road network connections heading east, west, and south of this sub-study area offer limited options for UGC connections to the other key substations in the CP1226 project.
The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may provide additional UGC routes south out of this study area.	The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may negatively impact some viable substation site options in this sub-study area.
No significant flood risk areas or areas of past flooding are indicated in this sub-study area.	The eastern side of this sub-study area will potentially be impacted by residential development projects which will limit access route options and push viable substation sites further west into the sub-study area.
Roads in this sub-study area are indicated as being free of other HV cable circuits from available data.	This sub-study area straddles the border between KCC and SDCC.

Positive	Negative
No designated environmental areas (SPA, SAC, NHA, pNHA, etc.) are present in the sub-study area.	Some medium pressure gas pipework is indicated in this sub-study area.
No substantial energy infrastructure projects have been found within the sub-study area (based on publicly available information and subject to detailed planning search at next stage of project).	The proposed 220 kV circuit linking the proposed West Dublin 220 kV substation to the proposed South West Dublin 400 kV substation would have to cross the Grand Canal and Dublin-Cork railway line.

3.3.2.1.2 Sub-Study Area N2

- This sub-study area was assessed as it has several potential sites of lower constraint risk. Much of the area is rural in nature and zoned for agricultural use in the SDCC and KCC Development Plans. The area consists of a strip of land between the Dublin-Cork railway line and the Grand Canal, which were used as boundaries for this sub-study area. The built-up areas of Celbridge to the west, and Lucan to the east of the sub-study area has also been used as a limit for the substation search area due to absence of available undeveloped lands in these built-up areas. The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may also affect substation siting and connection route options.
- The area is primarily rural and there is potential to accommodate an AIS substation depending on the selection of a specific site.
- Based on the OHL and UGC constraint heat maps generated, the sub-study area is more suited to UGC grid connection options due to the high-risk constraints of the Dublin-Cork railway line and the Grand Canal.

Table 3-2 illustrates positives and negatives associated with this sub-study area.

Table 3-2 - Positive and Negative Attributes of Sub-Study Area N2

Positive	Negative
By keeping the sub-study area to the south of the Dublin-Cork railway line, access routes to Maynooth 220 kV substation, Castlebagot 220 kV substation and the proposed South West Dublin 400 kV substation may be less constrained.	By keeping the sub-study area to the south of the Dublin-Cork railway line, access routes and connections to existing OHLs and OHLs connecting to Inchicore 220 kV substation will need to cross this high-risk constraint.
Primarily rural area with large private land folios which may have the potential to accommodate an AIS or GIS substation.	The southern edge of this sub-study area is delineated by the Grand Canal pNHA, which is a designated environmental area and a high-risk constraint.
Eastern sections of this sub-study area are centrally located in the vicinity of existing/proposed 220 kV circuits and substations in the West Dublin area.	Rail electrification project is indicated on ABP planning maps within the northern edge of the sub-study area. No other energy infrastructure projects indicated (based on publicly available information and subject to detailed planning search at next stage of project).
The heat map indicates pockets of potential areas which may be suitable for substation construction from an environmental perspective.	Several 110 kV and 220 kV UGCs are located within roads on the eastern side of this sub-study area. A rail electrification scheme may add further HV circuits to the existing road network.
The road network connections heading east, west, and south of this sub-study offer options for UGC connections to the other key substations in the CP1226 project.	This sub-study area straddles the border between KCC and SDCC.

Positive	Negative
The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may provide additional UGC routes south and north out of this study area.	The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may negatively impact some viable substation site options in this sub-study area.
Area has a small number of watercourses which will help the process of siting a potential substation.	Some medium pressure gas pipework is indicated in the R120 regional road on the eastern edge of this sub-study area.
The proposed 220 kV circuit linking the proposed West Dublin 220 kV substation to the proposed South West Dublin 400 kV substation would not have to cross the Dublin-Cork railway line.	Some areas of flood risk and areas of past flooding are indicated in the west of this sub-study area near Hazelhatch. Minor areas of flooding indicated around the Lucan Stream on the eastern part of the sub-study area.
	The proposed 220 kV circuit linking the proposed West Dublin 220 kV substation to the proposed South West Dublin 400 kV substation would have to cross the Grand Canal.

3.3.2.1.3 Sub-Study Area N3

- This sub-study area was assessed as it has several potential sites of lower constraint risk. Much of the area is rural in nature but zoned for enterprise and employment related uses in the SDCC Development Plan. The selected area is bounded on the north by the Grand Canal, and on the south by L-6053 and R-120 local and regional roads respectively. However, much of the sub-study area is occupied by the proposed Grange Castle Business Park Development, so potential substation options will need to adapt to the SDCC Development Plan. The proposed Western Dublin Orbital Route and New Nangor Road Extension shown on the SDCC Development Plan may also affect substation siting and connection route options.
- The area is primarily rural at present and there is potential to accommodate an AIS substation depending on the selection of a specific site.
- Based on the OHL and UGC constraint heat maps generated, the sub-study area is possibly more suited to UGC grid connection options due to the constraints of the Grand Canal to the north and Casement Aerodrome to the southeast.

Table 3-3 illustrates positives and negatives associated with this sub-study area.

Table 3-3 - Positive and Negative Attributes of Sub-Study Area N3

Positive	Negative
By keeping the sub-study area to the south of the Grand Canal, access routes to the proposed South West Dublin 400 kV substation may be less constrained.	By keeping the sub-study area to the south of the Grand Canal, access routes and connections to existing OHLs and OHLs connecting to Maynooth 220 kV substation, Inchicore 220 kV substation, and Castlebagot 220 kV substation will need to cross this high-risk constraint.
Primarily rural area with large private land folios which may have the potential to accommodate an AIS substation albeit industrial development planning in the	The northern edge of this sub-study area is delineated by the Grand Canal pNHA, which is a designated environmental area and a high-risk constraint.

Positive	Negative
western areas of this sub-study area may limit available options.	
Substation is centrally located in the vicinity to existing/proposed 220 kV circuits and substations in the West Dublin area.	Several 110 kV and 220 kV UGCs are located within roads on the eastern side of this sub-study area. Several planned and in-construction energy projects may add further HV cables to the existing road network.
The heat map indicates pockets of potential areas which may be suitable for substation construction from an environmental perspective.	The sub-study area's proximity to Casement Aerodrome (Baldonnell) may present an issue from an aviation safeguarding perspective and will require engagement with the relevant aviation and military authorities at consultation stage.
The existing road network connections heading east, west, and south of this sub-study offer options for UGC connections to the other key substations in the CP1226 project.	Several data centre and power generation projects are indicated on the eastern side of this sub-study area (based on publicly available information and subject to detailed planning search at next stage of project).
The proposed Western Dublin Orbital Route and New Nangor Road Extension shown on the SDCC Development Plan may provide additional UGC routes south, north, and east out of this study area.	The proposed Western Dublin Orbital Route and New Nangor Road Extension shown on the SDCC Development Plan may negatively impact some viable substation site options in this sub-study area.
Area has a small number of watercourses which will help the process of siting a potential substation.	Much of this sub-study area is occupied by the Grange Castle Business Park Development. High land values and constrained access routes for substation development can be expected.
The proposed 220 kV circuit linking the proposed West Dublin 220 kV substation to the proposed South West Dublin 400 kV substation would not have to cross the Grand Canal or Dublin-Cork railway line.	This sub-study area straddles the border between KCC and SDCC.
	Some medium pressure gas pipework is indicated in the R120 regional road on the eastern and southern edges of this sub-study area. There are also several medium pressure gas circuits indicated within the central parts of the sub-study area.
	Some areas of flood risk and areas of past flooding are indicated in the west of this sub-study area near Commons. Minor areas of flooding indicated around the Lucan Stream on the eastern part of the sub-study area.

3.3.2.1.4 Sub-Study Area N4

- This sub-study area was assessed as it has several potential sites of lower constraint risk. Much of the area is rural in nature and zoned for agricultural related uses in the SDCC Development Plan. The selected area is bounded on the north by the L-6053 and R-120 local and regional roads respectively, and on the south by L-6003 and R-405 local and regional roads. The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may also affect substation siting and connection route options.

- The area is primarily rural at present and there is potential to accommodate an AIS substation depending on the selection of a specific site.
- Based on the OHL and UGC constraint heat maps generated, the eastern parts of the sub-study area are possibly more suited to UGC grid connection options due to the presence of Casement Aerodrome to the immediate east of the sub-study area. Western areas of the sub-study area may be suitable for OHL development.

Table 3-4 illustrates positives and negatives associated with this sub-study area.

Table 3-4 - Positive and Negative Attributes of Sub-Study Area N4

Positive	Negative
Primarily rural area with large private land folios which may have the potential to accommodate an AIS substation.	The sub-study area's proximity to Casement Aerodrome (Baldonnell) may present an issue from an aviation safeguarding perspective and will require engagement with the relevant aviation and military authorities at consultation stage.
The heat map indicates pockets of potential areas which may be suitable for substation construction from an environmental perspective.	Several 110 kV and 220 kV UGCs are located within roads on the eastern side of this sub-study area. Several planned and in-construction energy projects may add further HV cables to the existing road network.
The existing road network connections heading east, west, and south of this sub-study offer limited options for UGC connections to the other key substations in the CP1226 project.	Several data centre and power generation projects are indicated just outside the eastern boundary of this sub-study area (based on publicly available information and subject to detailed planning search at next stage of project).
The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may provide additional UGC routes south and north out of this sub-study area.	The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may negatively impact some viable substation site options in this sub-study area.
Substation is centrally located in the vicinity to existing/proposed 220 kV circuits and substations in the West Dublin area.	Some medium pressure gas pipework is indicated in the R120 regional road in this sub-study area. There are also several medium and low-pressure gas circuits indicated within the southern parts of the sub-study area.
Area has a small number of watercourses which will help the process of siting a potential substation.	Areas of flood risk and areas of past flooding are indicated in the east of this sub-study area near Griffin River between Milltown and Newcastle.
No designated environmental areas (SPA, SAC, NHA, pNHA, etc.) are present in the sub-study area.	
This sub-study area is located within the administrative area of SDCC alone.	
The proposed 220 kV circuit linking the proposed West Dublin 220 kV substation to the proposed South West Dublin 400 kV substation would not have to cross the Grand Canal or Dublin-Cork railway line.	

3.3.2.1.5 Sub-Study Area N5

- This sub-study area was assessed as it has several potential sites of lower constraint risk albeit at greater distance from some of the desired connection points in the project brief, namely Castlebagot 220 kV substation and Inchicore 220 kV substation. Much of the area is rural in nature and zoned for agricultural related uses in the SDCC and KCC Development Plans. The selected area is bounded on the west by the Cork-Dublin railway line, on the east by the R-405 regional road, and on the south by the L-5064 local road. The western section of the sub-study area is also traversed SW-NE by the Grand Canal which is deemed a constraint.
- The area is primarily rural at present and there is potential to accommodate an AIS substation depending on the selection of a specific site.
- Based on the OHL and UGC constraint heat maps generated, the sub-study area has potential to accommodate both OHL and UGC grid connection options. OHL options will be limited to access corridors northeast and south due to the constraints associated with the settlement of Newcastle, and the Grand Canal.

Table 3-5 illustrates positives and negatives associated with this sub-study area.

Table 3-5 - Positive and Negative Attributes of Sub-Study Area N5

Positive	Negative
Primarily rural area with large private land folios which may have the potential to accommodate an AIS substation.	Substation not centrally located in the vicinity to existing/proposed 220 kV circuits and substations in the West Dublin area.
The heat map indicates pockets of potential areas which may be suitable for substation construction from an environmental perspective.	The sub-study area's location along the flight path to Casement Aerodrome (Baldonnell) may present an issue from an aviation safeguarding perspective and will require engagement with the relevant aviation and military authorities at consultation stage.
Area has a small number of watercourses which will help the process of siting a potential substation.	The road network connections heading east, west, and south of this sub-study offer limited options for UGC connections to the other key substations in the CP1226 project.
Roads in this sub-study area are indicated as being free of other HV cable circuits from available data.	This sub-study area straddles the border between KCC and SDCC.
No gas pipework is indicated in this sub-study area.	Some areas of flood risk and areas of past flooding are indicated in the north of this sub-study area near the Grand Canal.
No substantial energy infrastructure projects have been found within the sub-study area (based on publicly available information and subject to detailed planning search at next stage of project).	A designated environmental area (Grand Canal pNHA) cuts SW-NE across this full sub-study area, which is a high-risk constraint.
The proposed 220 kV circuit linking the proposed West Dublin 220 kV substation to the proposed South West Dublin 400 kV substation would not have to cross the Grand Canal or Dublin-Cork railway line.	

3.3.2.2 Identified Sub-Study Areas for the Proposed South West Dublin 400 kV Substation

3.3.2.2.1 Sub-Study Area S1

- This sub-study area was assessed as it has several potential sites of lower constraint risk. Much of the area is rural in nature and zoned for agricultural related uses in the SDCC and KCC Development Plans. This sub-study area is located north of the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHLs. It is bordered to the north by the L-6018, L-6001, R-120 local and regional roads. The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may also affect substation siting and connection route options.
- This area is primarily rural and there is potential to accommodate an AIS substation depending on the selection of a specific site.
- Based on the OHL and UGC constraint heat maps generated, the sub-study area has potential to accommodate both OHL and UGC grid connection options. OHL options will be limited to access corridors northwest, south and east due to the high-risk constraints associated with the settlements of Newcastle and Rathcoole.

Table 3-6 illustrates positives and negatives associated with this sub-study area.

Table 3-6 - Positive and Negative Attributes of Sub-Study Area S1

Positive	Negative
South-central sections of this sub-study area will provide ready access to both the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHLs.	The sub-study area's proximity to Casement Aerodrome (Baldonnell) may present an issue from an aviation safeguarding perspective and will require engagement with the relevant aviation and military authorities at consultation stage.
Primarily rural area with large private land folios which may have the potential to accommodate an AIS substation.	The N7 national road traverses this sub-study area SW-NE and is a medium risk constraint to route development.
The heat map indicates pockets of potential areas which may be suitable for substation construction from an environmental perspective.	The road network connections heading north and east out of this sub-study offer limited options for UGC connections to the other key substations in the CP1226 project.
The proposed Western Dublin Orbital Route shown on the SDCC Development Plan plan may provide additional UGC routes south and north out of this study area.	Local roads in the sub-study area are generally narrow in nature which will limit their usefulness for carrying multiple large HV circuits.
Area has a small number of watercourses which will help the process of siting a potential substation.	The proposed Western Dublin Orbital Route shown on the SDCC Development Plan may negatively impact some viable substation site options in this sub-study area.
Roads in this sub-study area are indicated as being free of other HV cable circuits from available data.	This sub-study area straddles the border between KCC and SDCC.
No designated environmental areas (SPA, SAC, NHA, pNHA, etc.) are present in the sub-study area.	A high-pressure gas pipeline is indicated running SW-NE close to and crossing into the southern section of this sub-study area. This pipe runs in parallel with the existing Carrickmines-Dunstown 220 kV OHL part of the way. Some medium pressure gas pipework is

Positive	Negative
	indicated in the N7 national road and R120 regional road in this sub-study area. There are also several medium and low-pressure gas circuits indicated within the central and eastern parts of the sub-study area.
No substantial energy infrastructure projects have been found within the sub-study area (based on publicly available information and subject to detailed planning search at next stage of project).	Areas of flood risk and areas of past flooding are indicated around several rivers on the east of this sub-study area.
The potential OHL connection to the proposed West Dublin 220 kV substation does not have to cross the existing 220 kV OHL circuits.	Limited number of 220 kV cable compound areas within the sub-study area for the loop-ins, with many dwellings / golf courses close to the existing 220 kV OHL circuits.
	N7 road crossing between loop-in 220 kV line and potential substation locations in the western section of this sub-study area.
	Potential 400 kV OHL may have to cross the Carrickmines-Dunstown 220 kV OHL.

3.3.2.2.2 Sub-Study Area S2

- This sub-study area was assessed as it has several potential sites of lower constraint risk. Much of the area is rural in nature and zoned for agricultural related uses in the SDCC and KCC Development Plans. This sub-study area is located south and east of the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHLs. It is bordered to the east by the L-6028, L-6031 and L-6035 local roads. Eastern areas of this sub-study area may be less suitable for substation development due to the hilly nature of the terrain.
- This area is primarily rural and there is potential to accommodate an AIS substation depending on the selection of a specific site.
- Based on the OHL and UGC constraint heat maps generated, the sub-study area has potential to accommodate both OHL and UGC grid connection options.

Table 3-7 illustrates positives and negatives associated with this sub-study area.

Table 3-7 - Positive and Negative Attributes of Sub-Study Area S2

Positive	Negative
Sections along the western edge of this sub-study area will provide ready access to the double circuit Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHLs.	By keeping the sub-study area to the south of the N7 national road, access connection routes to the proposed West Dublin 220 kV substation will need to cross this high-risk constraint.
Primarily rural area with large private land folios which may have the potential to accommodate an AIS substation.	The road network connections heading east and north out of this sub-study area offer very limited options for UGC connections to the other key substations in the CP1226 project.
The heat map indicates pockets of potential areas which may be suitable for substation construction from an environmental perspective.	Local roads in the sub-study area are generally narrow in nature with sections of steep incline due to the hilly

Positive	Negative
	terrain which will limit their usefulness for carrying large HV circuits.
Area has a small number of watercourses which will help the process of siting a potential substation.	This sub-study area straddles the border between KCC and SDCC.
Roads in this sub-study area are indicated as being free of other HV cable circuits from available data.	A high-pressure gas pipe is indicated running SW-NE through the central section of this sub-study area. This pipe runs in parallel with the existing Carrickmines - Dunstown 220 kV OHL in the NE section of this study area.
No substantial energy infrastructure projects have been found within the sub-study area (based on publicly available information and subject to detailed planning search at next stage of project).	Some areas of flood risk are indicated in the north of this sub-study area near Newtown Lower.
Several potential areas for 220 kV loop-in towers and cable compounds within large open farmland.	In the southwest of this sub-study area is a designated environmental area (Kilteel Wood pNHA, Native Woodland). On the eastern edge of the sub-study area is a designated environmental area (Slade of Saggart and Crookling Glen pNHA, Native Woodland).
	A potential 220 kV OHL circuit connection to the West Dublin 220 kV substation would have to cross the existing 220 kV OHL circuits.

3.3.2.2.3 Sub-Study Area S3

- This sub-study area was assessed as it has several potential sites of lower constraint risk. Much of the area is rural in nature and zoned for agricultural related uses in the SDCC and KCC Development Plans. This sub-study area is located south and west of the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHLs. Northern areas of this sub-study area may be less suitable for substation development due to passage of the N7 national road through the sub-study area along a SW-NE axis.
- This area is primarily rural and there is potential to accommodate an AIS substation depending on the selection of a specific site.
- Based on the OHL and UGC constraint heat maps generated, the sub-study area has potential to accommodate both OHL and UGC grid connection options.

Table 3-8 illustrates positives and negatives associated with this sub-study area.

Table 3-8 - Positive and Negative Attributes of Sub-Study Area S3

Positive	Negative
Sections along the eastern edge of this sub-study area will provide ready access to the double circuit, Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHLs.	By keeping the sub-study area to the south and west of the existing Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHLs, circuit options connecting to the proposed West Dublin 220 kV substation will need to cross these existing 220 kV OHLs.

Positive	Negative
Primarily rural area with large private land folios which may have the potential to accommodate an AIS substation.	The N7 national road traverses this sub-study area SW-NE and is a medium risk constraint to route development.
The heat map indicates pockets of potential areas which may be suitable for substation construction from an environmental perspective.	Local roads in the sub-study area are generally narrow in nature with which will limit their usefulness for carrying multiple large HV circuits.
Area has a small number of watercourses which will help the process of siting a potential substation.	The road network connections heading east and north out of this sub-study offer limited options for UGC connections to the other key substations in the CP1226 project.
Roads in this sub-study area are indicated as being free of other HV cable circuits from available data.	This sub-study area straddles the border between KCC and SDCC.
No designated environmental areas (SPA, SAC, NHA, pNHA, etc.) are present in the sub-study area.	Some areas of flood risk are indicated in the west of this sub-study area near Castlewarden.
No gas pipework is indicated in this sub-study area.	Potential 400 kV overhead line circuit will have to cross the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHLs.
No substantial energy infrastructure projects have been found within the sub-study area (based on publicly available information and subject to detailed planning search at next stage of project).	
Several potential areas for loop-in towers and cable compounds within large open farmland.	

3.3.3 Preferred Sub-Study Areas for Further Assessment

West Dublin 220 kV Substation

Following the initial assessment of the five (5no.) potential sub-study areas for locating the proposed West Dublin 220 kV substation, together with a high-level assessment of the circuits that are proposed to connect to the substation, it was recommended to bring forward Sub-Study Areas N2, N3, N4 and N5 for further assessment. All four (4no.) of these sub-study areas provide different advantages, as discussed in Section 3.3.2.1, and therefore warranted further detailed assessment. Sub-Study Area N1 was discounted predominantly due to the requirement for any circuits to the south or east to have to cross both the Dublin-Cork railway line and the Grand Canal.

The preferred sub-study areas are shown in Figure 3-10.

South West Dublin 400 kV Substation

Following the initial assessment of the three (3no.) potential sub-study areas for locating the proposed South West Dublin 400 kV substation, together with a high-level assessment of the circuits that are proposed to connect to the substation, it was recommended to bring forward all of the sub-study areas, i.e. Sub-Study Areas S1, S2 and S3 for further assessment. All three (3no.) of these sub-study areas provide different advantages, as discussed in Section 3.3.2.2, and therefore warranted further detailed assessment.

The preferred sub-study areas are shown in Figure 3-10.

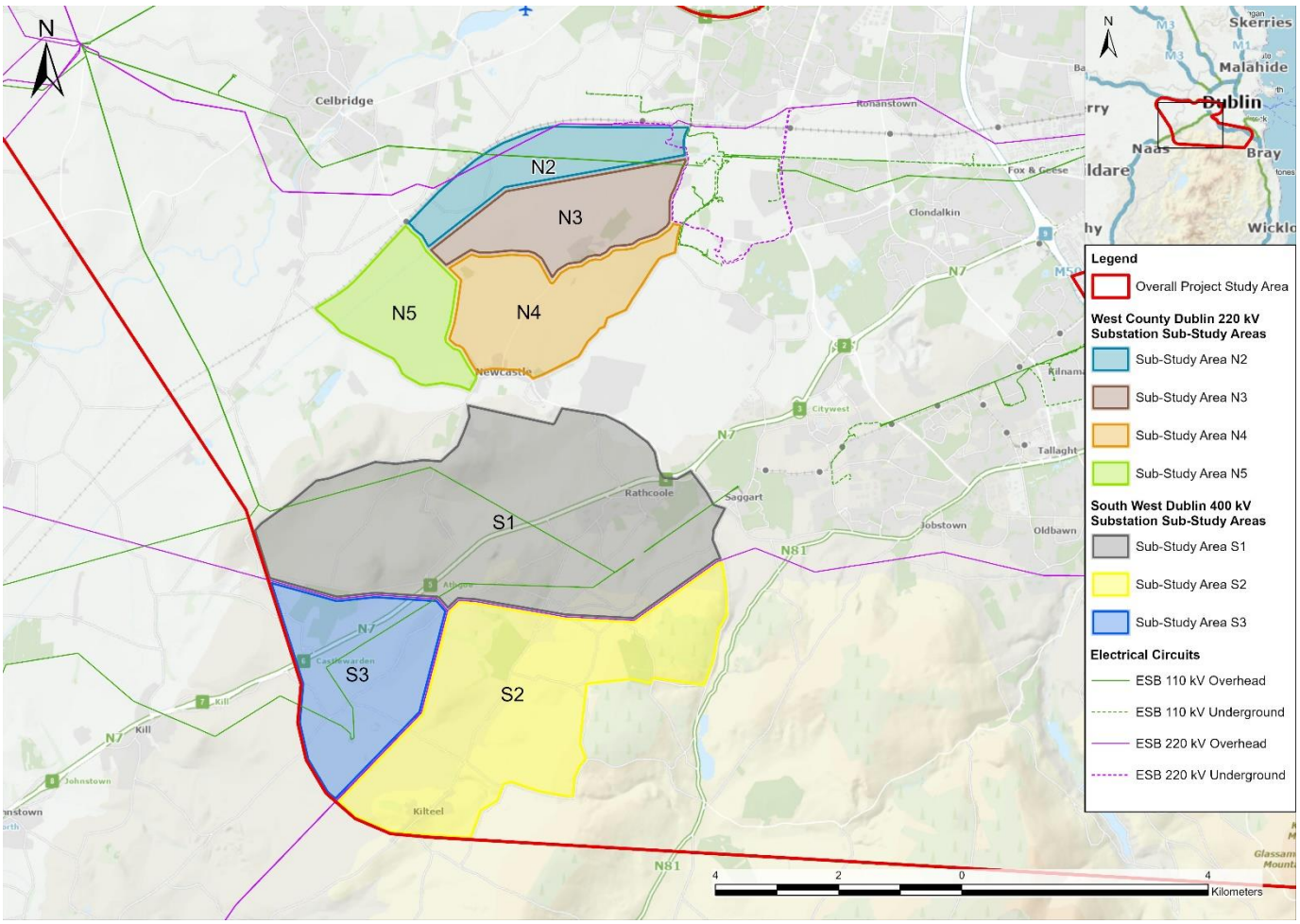

Figure 3-10 - Preferred Sub-Study Areas

3.4 Corridor Feasibility Review

A feasibility review for both OHL and UGC technologies was undertaken for all four (4no.) proposed circuits to ensure that a route can be found between the start points of the circuits and the sub-study areas for the proposed substations.

The review considered the heat maps produced as part of the constraints assessment and considered the viability of both OHL and UGC corridor options between the proposed substations. Further assessment of the potential circuit corridors and associated technologies will be undertaken in Step 4.

3.5 Identification of Substation Zones

The preferred sub-study areas are considerably larger than the actual size of land required for sites of the proposed substations. The project team decided that substation zones (within the preferred sub-study areas) would be identified to allow a more detailed assessment to be undertaken.

These substation zones were identified following analysis of constraint heat maps which take into consideration several different factors which may affect the siting of the proposed substations. These factors include, but are not limited to, technical performance, economic assessment, deliverability aspects, environmental aspects, and socio-economic aspects.

The substation zone boundaries have been defined by either existing constraints or linear features such as roads, rivers, county boundaries, etc. (as discussed further in this Section). However, depending on the availability of suitable land within a zone or along its boundary, it would be acceptable to modify/extend the zone if suitable land / sites are identified adjacent to the current boundaries.

3.5.1 Zones for the Proposed West Dublin 220 kV Substation

A total of three (3no.) substation zones were identified for the proposed West Dublin 220 kV substation, ranging in size from 150 ha to 345 ha. The zones, shown in Figure 3-11 and Figure 3-13, were sized to accommodate either substation technologies under consideration (i.e., gas-insulated switchgear and air-insulated switchgear). Figure 3-12 shows the zones in relation to the substation heat maps.

All substation zones were brought forward for further detailed assessment as part of the MCA process.

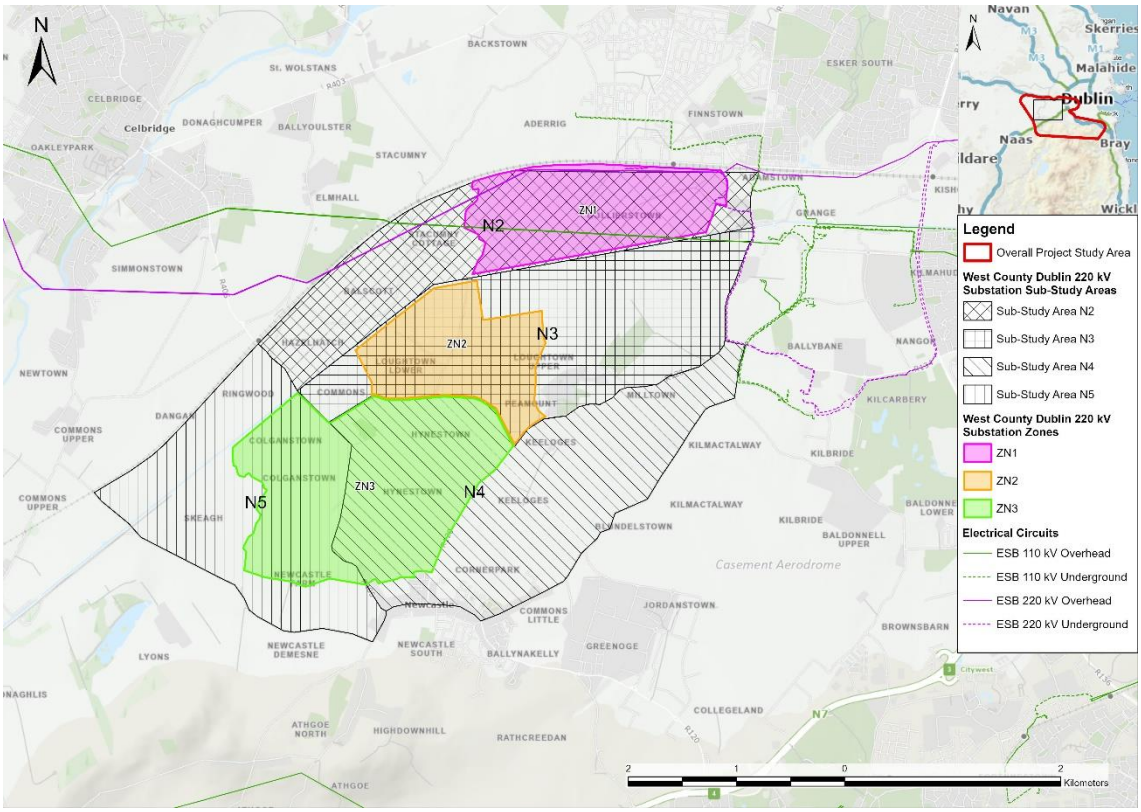

Figure 3-11 - West Dublin 220 kV Substation Zones (ZN1 to ZN3) Within the Preferred Sub-Study Areas

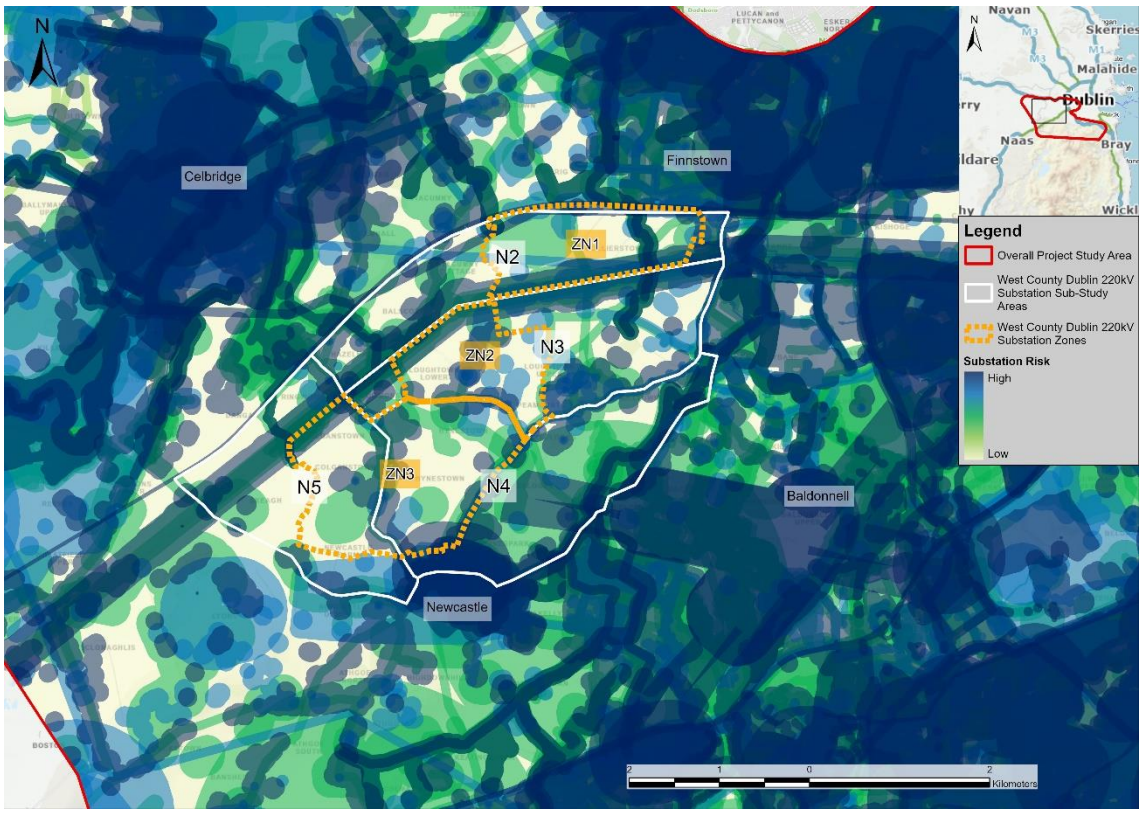

Figure 3-12 - West Dublin 220 kV Substation Zones (ZN1 to ZN3) Within the Preferred Sub-Study Areas, with the Substation Heat Map

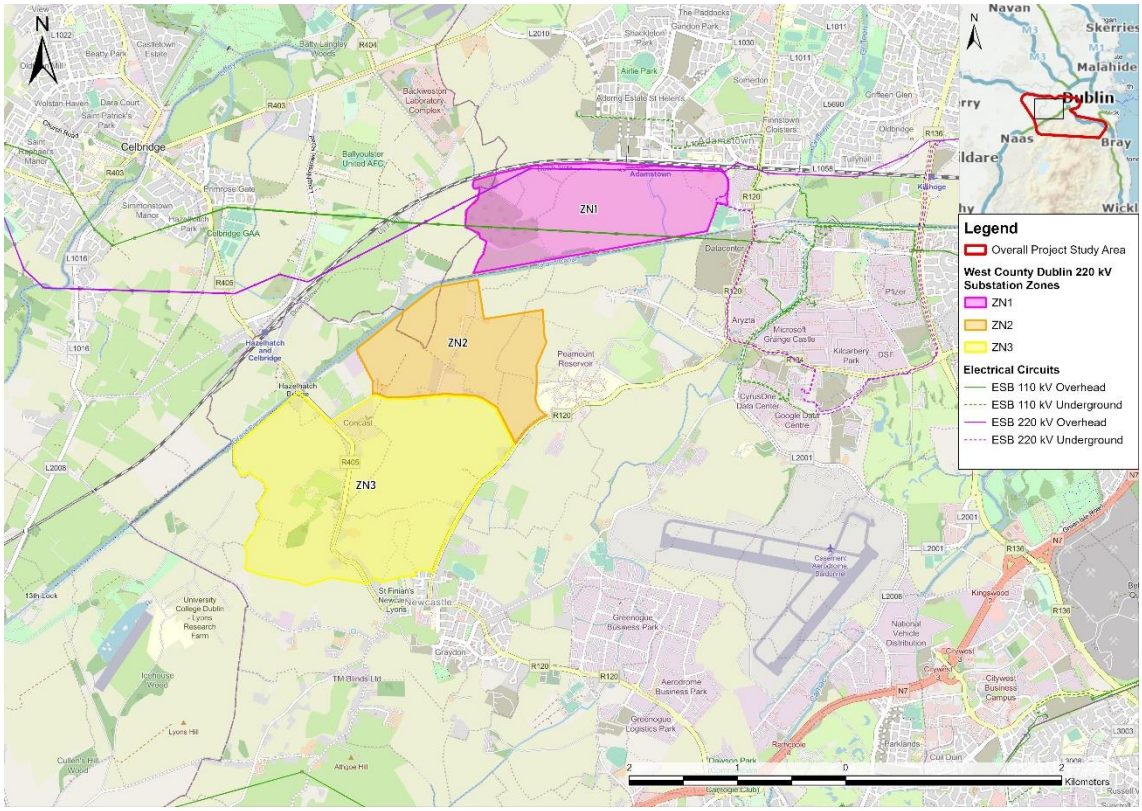

Figure 3-13 - West Dublin 220 kV Substation Zones (ZN1 to ZN3) - Detailed View (© OpenStreetMap)

3.5.1.1 Substation Zone ZN1

Substation Zone ZN1 is situated within Sub-Study Area N2. The boundaries of ZN1 are defined by the following constraints which are situated just outside of the proposed zone:

- To the north, the Dublin-Cork railway line.
- To the south, the Grand Canal.
- To the east, the Adamstown area with some businesses and the Lucan Sarsfields GAA Club.
- To the west, the Hillcrest area with some residential properties along Tubber Lane.

3.5.1.2 Substation Zone ZN2

Substation Zone ZN2 is situated within Sub-Study Area N3. The boundaries of ZN2 are defined by the following constraints which are situated just outside of the proposed zone:

- To the north and west, the Grand Canal.
- To the south, Loughtown Road.
- To the east, Peamount Hospital and the Grange Castle West Business Park (portions of which are under construction currently).

3.5.1.3 Substation Zone ZN3

Substation Zone ZN3 is situated within Sub-Study Areas N4 and N5. The boundaries of ZN3 are defined by the following constraints which are situated just outside of the proposed zone:

- To the north, Loughtown Road and Substation Zone ZN2.
- To the east, the R120 borders the zone.
- To the south / southeast, the area of Newcastle.
- To the west, Grand Canal and the area of Skeagh.

3.5.2 Zones for the Proposed South West Dublin 400 kV Substation

A total of four (4no.) substation zones were identified for the proposed South West Dublin 400 kV substation, ranging in size from 145 ha to 265 ha. The zones, shown in Figure 3-14 and Figure 3-16, were sized to accommodate either substation technologies under consideration (i.e., gas-insulated switchgear and air-insulated switchgear). Figure 3-15 shows the zones in relation to the substation heat maps.

All substation zones were brought forward for further detailed assessment as part of the MCA process.

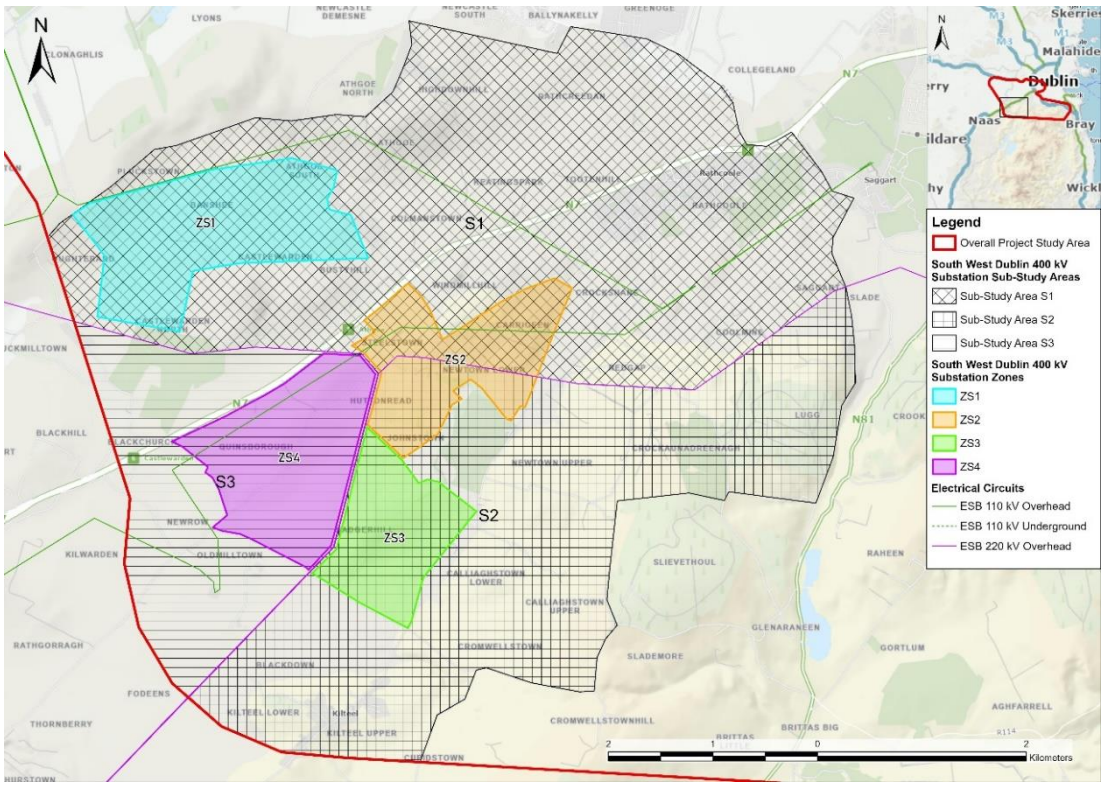

Figure 3-14 - South West Dublin 400 kV Substation Zones (ZS1 to ZS4) Within the Preferred Sub-Study Areas

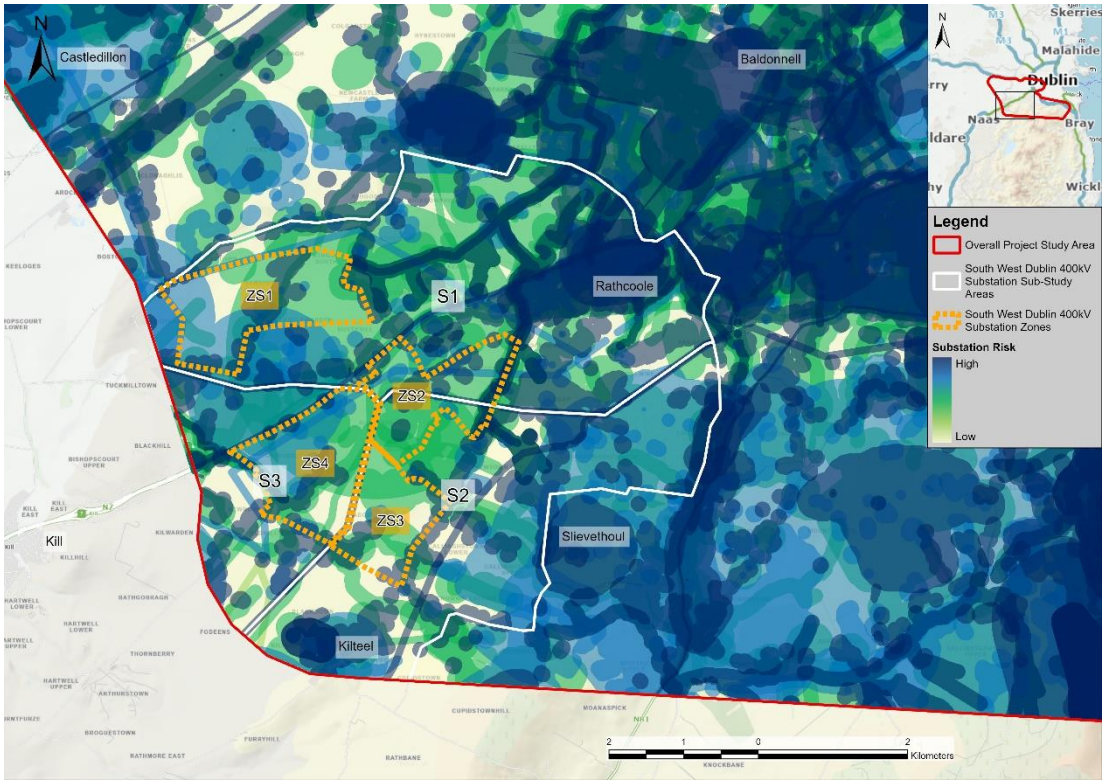

Figure 3-15 - South West Dublin 400 kV Substation Zones (ZS1 to ZS4) Within the Preferred Sub-Study Areas, with the Substation Heat Map

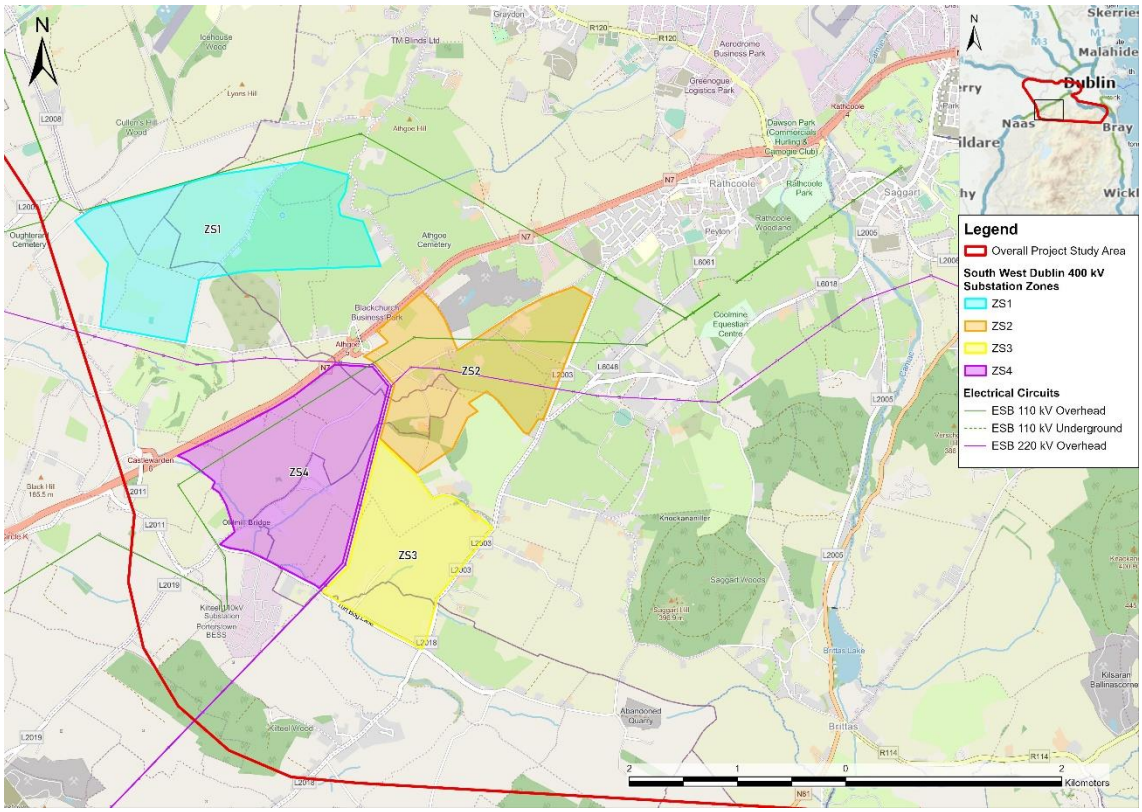

Figure 3-16 - South West Dublin 400 kV Substation Zones (ZS1 to ZS4) - Detailed View (© OpenStreetMap)

3.5.2.1 Substation Zone ZS1

Substation Zone ZS1 is situated within Sub-Study Area S1. The boundaries of ZS1 are defined by the following constraints which are situated just outside of the proposed zone:

- To the north, the existing Kilteel-Maynooth 110 kV OHL.
- To the south, the existing Dunstown-Maynooth 220 kV OHL and the Castlewarden Golf & Country Club.
- To the east, the residential properties along the L6001 local road.
- To the west, the area of Oughterard.

3.5.2.2 Substation Zone ZS2

Substation Zone ZS2 is situated within Sub-Study Areas S1 and S2. The boundaries of ZS2 are defined by the following constraints which are situated just outside of the proposed zone:

- To the north, and existing quarry situated within the area of Windmillhill.
- To the southeast, the Beech Park Golf Club.
- To the east, the Johnstown Road (L2003) borders the zone.
- To the west, the N7 and the existing Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHL double circuit.

3.5.2.3 Substation Zone ZS3

Substation Zone ZS3 is situated within Sub-Study Area S2. The boundaries of ZS3 are defined by the following constraints which are situated just outside of the proposed zone:

- To the north, Beech Park Golf Club and Zone ZS2.
- To the south, Turf Bog Lane borders the zone.
- To the east, the Johnstown Road (L2003) borders the zone.
- To the west, the existing Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHL double circuit.

3.5.2.4 Substation Zone ZS4

Substation Zone ZS4 is situated within Sub-Study Area S3. The boundaries of ZS4 are defined by the following constraints which are situated just outside of the proposed zone:

- To the north, Zone ZS2.
- To the northwest, the N7.
- To the south, Turf Bog Lane borders the zone.
- To the east, the existing Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHL double circuit.

3.6 Options under Consideration in Step 3

The objective of Step 3 is to identify a best performing technology solution and associated study area to meet the identified need from Step 2.

3.6.1 Substation Technologies Under Consideration

The following two substation technologies have been considered:

- GIS – A Gas Insulated Switchgear substation (GIS substation) normally uses sulphur hexafluoride gas (SF6 Gas) whose dielectric strength is higher than air, to provide the phase to ground insulation for the switchgear of an electrical substation (note, other suitable gases can also be utilised). This works whereby the conductors and contacts are insulated by pressurised SF6 gas meaning clearances required are smaller than that of AIS substations. The main advantage of the GIS substation is that this phase to phase spacing can be reduced significantly resulting in a substation with comparable load capability to an AIS substation but with a much smaller compound footprint. This is particularly advantageous in an urban environment where land size is at a premium. It also results in a smaller visual impact on a landscape as it can result in a significantly smaller footprint than its AIS counterpart. The main disadvantage of the GIS substation type is the reduction in scope of the substation for future connections, as equipment can be costly and difficult to source over the long term (usually all equipment necessary for future connections is procured and installed during initial substation commissioning). However, with GIS substations becoming a much more established technology globally, more standardisation has been introduced into manufacturing of the GIS equipment and therefore sourcing of any such required equipment has become less onerous and costly. As per EirGrid standards, GIS equipment are installed indoors within dedicated GIS buildings. Refer to Figure 3-17 for an example of a GIS substation.

  Note, recent EU legislation requires GIS substation switchgear to be F-gases free from 2028 (<145 kV) and 2032 (>145 kV).
- AIS – An Air Insulated Switchgear substation (AIS substation) uses atmospheric air as the phase to ground insulation for the switchgear of an electrical substation. The main advantage of the AIS substation is the scope of the substation for future offloading, for this reason AIS substations tend to be the most popular 400 kV substation type. The equipment of an AIS substation is easily sourced and has a short lead-time; this means that the required

future offloading does not need to be built immediately, unlike GIS where it must be considered with the initial build. The main disadvantage to the AIS substation is its overall size. At 400 kV level these substations can have a significant footprint and require sensitive locating in any rural environment. AIS are usually installed outdoor. Refer to Figure 3-18 for an example of an AIS substation.

A third hybrid option known as H-GIS, features a substation comprising of elements of both AIS and GIS technology. This allows the developer to potentially optimise a substation's use of available land whilst also optimising the systems performance and cost characteristics. This has not been considered in Step 3; however, it will be considered (if applicable) in Step 4.

Figure 3-17 - Example of substation with gas insulated switchgear (GIS) – Kilpaddoge 220 kV Substation

Figure 3-18 - Example of substation with air insulated switchgear (AIS) – Cashla 220 kV Substation

3.6.2 List of Options Considered for Step 3

3.6.2.1 Options Considered for the Proposed West Dublin 220 kV Substation

Given that suitability for AIS and GIS technologies was considered when identifying the substation zones, all three substation zones are therefore capable of siting an AIS or GIS substation. Allowing for an AIS and GIS option for each zone resulted in a total of six (6no.) options being identified to be assessed in accordance with the Step 3 MCA process:

- Substation zone north no. 1, AIS technology (ZN1-AIS)
- Substation zone north no. 1, GIS technology (ZN1-GIS)
- Substation zone north no. 2, AIS technology (ZN2-AIS)
- Substation zone north no. 2, GIS technology (ZN2-GIS)
- Substation zone north no. 3, AIS technology (ZN3-AIS)
- Substation zone north no. 3, GIS technology (ZN3-GIS)

3.6.2.2 Options Considered for the Proposed South West Dublin 400 kV Substation

Given that suitability for AIS and GIS technologies was considered when identifying the substation zones, all four substation zones are therefore capable of siting an AIS or GIS substation. Allowing for an AIS and GIS option for each zone resulted in a total of eight (8no.) options being identified to be assessed in accordance with the Step 3 MCA process:

- Substation zone south no. 1, AIS technology (ZS1-AIS)
- Substation zone south no. 1, GIS technology (ZS1-GIS)
- Substation zone south no. 2, AIS technology (ZS2-AIS)
- Substation zone south no. 2, GIS technology (ZS2-GIS)
- Substation zone south no. 3, AIS technology (ZS3-AIS)
- Substation zone south no. 3, GIS technology (ZS3-GIS)
- Substation zone south no. 4, AIS technology (ZS4-AIS)
- Substation zone south no. 4, GIS technology (ZS4-GIS)

The loop-ins from the proposed South West Dublin 400 kV substation to the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV circuits will be considered in further detail once the search area for the proposed South West Dublin 400 kV substation has been narrowed down to specific sites. This process will occur in Step 4 and will include an MCA assessment to identify the best performing technology (i.e., OHL or UGC) and corridor for the circuits.

3.7 MCA Process

To assist in identifying the best performing technology solution and associated study area, a Multi-Criteria Analysis (MCA) was carried out in accordance with the EirGrid Multi-Criteria Analysis Guidelines. The five main criteria considered in the MCA are:

- Technical Performance,
- Economic Performance,
- Deliverability Aspects,
- Environmental Aspects, and
- Socio-Economic Aspects.

Each of these criteria were broken down further into sub-criteria and a multi-criteria evaluation matrix was used to identify the best performing option(s) that will be brought forward to Step 4.

3.7.1 Technical Performance

- **Compliance with Safety Standards**: The project 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 System Reliability, Security Standards**: The project should comply with the reliability and security standard defined in the Transmission System Security and Planning Standards and the Operation Security Standards.
- **Average Failure Rates**: The average failure rates for the OHL or UGC can be calculated using, for example, estimated availability figures (unplanned outages/100km/year), Mean Time To Repair and the length of the line or cable. A more detailed calculation could also take into account failure rates of transformers, switchgear and other items.
- **Ease of Connectivity**: Ease of connecting planned and future circuits to the a substation.
- **Expansion / 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.
- **Repeatability**: This criterion examines whether this option can be readily repeated in the EirGrid network. For example, an OHL HVAC option is very repeatable, but a partially underground HVAC option is less repeatable as there can only be a certain amount of underground HVAC cable in each area of the network.
- **Technical Operational Risk**: “Technical Operational Risk” aims to capture the risk of operating different technologies on the network.
- **Geotechnical Conditions**: Considers the impact of known ground conditions (from GSI data or other available datasets), this would include depth to bedrock, likely water table depth, known areas of poor ground / marsh.

3.7.2 Economic Assessment

- **Project Implementation Costs**: Costs associated with the procurement, installation and commissioning of the grid development and therefore includes all the transmission equipment that forms part of the project’s scope.
- **Project Life-Cycle Costs**: These costs are incurred over the useful life of the reinforcement and include the on-going cost of ensuring that it remains viable for the evaluation period. Includes operating expenditure (OPEX), maintenance, replacement, cost of losses, decommissioning, etc.

- **Project Benefits**: Avoided costs and difference in constraint costs for example due to the lack of capacity to export a forecast volume of generation.
- **Cost to Single Energy Market (SEM)**: Cost to SEM from Development Unavailability (Reliability) i.e., the loss of energy due to unavailability.
- **Contingency Costs**: Estimate of unforeseeable expenditure that an individual option may incur.
- **Pre-Engineering Costs**: Costs associated with the design and specification, route evaluation and management of the statutory planning application, including contingencies for such activities.

3.7.3 Deliverability Aspects

- **Implementation Timelines**: Relative length of time until energisation (assess significant differences).
- **Project Plan Flexibility**: Does the project plan allow for some flexibility if issues arise during design and construction?
- **Dependence on other Projects**: Does the project depend on the completion of other projects?
- **Risk of Untried Technologies**: Has the technology been used by EirGrid and ESBN in the past?
- **Supply Chain Constraints**: Any constraints (e.g., small number of suppliers in Ireland or internationally) that would affect the procurement of materials or services to complete the project.
- **Permits & Wayleaves**: Various permissions and wayleaves required to proceed to construction.
- **Planning and other statutory requirements**: Considers the requirement for planning, foreshore licenses or other statutory requirements.
- **Land Availability**: Considers land availability for the construction of the substation or circuit, in addition to working space during construction.
- **Ease of Construction**: Considers elements such as working time constraints, outage impact, utility congestion, etc. and how that may impact the Contractor during construction.

3.7.4 Environmental Aspects

- **Biodiversity, Flora & Fauna:** Assessment of the impact on biodiversity, flora and fauna, which could include an ecological desktop study.
- **Soil impacts:** Impact on soil/subsoil geology, Irish geological heritage sites, and bedrock geology, etc.
- **Material Assets:** Impact on land use (forestry, farmland, bogs/peats, horticulture), homes, commercial and community properties, landfill sites, etc.
- **Noise & Vibration:** Vibrations and operational noise impact of lines and substations, taking into account sensitive receptors.
- **Water Impact:** Impact on river crossings, lakes, and groundwater based on established methodologies.
- **Air Quality Impact:** Construction dust and traffic assessment impact.
- **Planning Policy and Land Use:** Considers whether the site and/or route is consistent with the development plan.

3.7.5 Socio-Economic Aspects

- **Settlement & Communities:** The expected impact of a grid development option on towns, villages, and rural housing.
- **Recreation, Amenity & Tourism:** Impact on recreational activities (e.g., fishing, sports) and tourism during and after construction, that are not included in the other sub-criteria.
- **Landscape & Visual:** Assessment of landscape constraints and designations and the impact on visual amenity.
- **Cultural Heritage:** The impact on the recorded cultural heritage resource of a potential grid solution.

- **Aviation & Defence:** Impact on wireless services such as radars, radio communications, TV, flight paths, etc.

3.7.6 MCA Scoring Scale

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”. Table 3-9 shows the criteria performance/scoring scale used to illustrate each criteria parameter in a comparative assessment with other options.

Table 3-9 - Criteria Scoring Scale

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

High Risk (Dark Blue)	Moderate-High (Blue)	Moderate (Dark Green)	Moderate-Low (Green)	Low (Cream)

4. Multi-Criteria Analysis – West Dublin 220 kV Substation Options

The purpose of the MCA is to identify the emerging Best Performing Option/s (BPO) for the substation technology and substation zone. This chapter summarises the MCA that was carried out in Step 3 on the six (6no.) options for the proposed West Dublin 220 kV substation, with further details of the assessment of the options provided in the Technical Feasibility Study Report and the Environment and Socio-Economic MCA Scoring Report.

4.1 Emerging Best Performing Option/s (BPO) from the Multi-Criteria Analysis

Table 4-1 shows the overall performance for the 6no. options. Due to the extent of land associated with the substation zones (ZN1 to ZN3), ranging in size from 150 ha to 345 ha, the performance/scoring of a particular constraint will vary from High to Low depending on the location of the constraint within the zone. The approach to the scoring assessment has therefore looked at an 'aggregate' risk across the substation zone.

As a result of this aggregated approach to the scoring assessment, the scores for most of the criteria are Moderate, and with some criteria scored as Moderate-Low. Deliverability is mostly scored Moderate-High across the options, with Land Availability and Ease of Construction being the key drivers / sub-criteria. Ease of Connectivity, a sub-criteria assessed as part of the technical performance of the options, is another key driver.

Whilst there are differences between the performance of the options for certain criteria, when combining the criteria to determine the overall performance for all options, there is no distinguishable difference between the 6no. options under consideration as all score Moderate risk.

In the MCA Workshop, the EirGrid Cross-Functional Team and the project team decided that given the similar performance for both technologies and the zones, that all 6no. options will be brought forward to Step 4 for further assessment.

Table 4-1 - WCD 220 kV Substation MCA Scoring – Overall

Option	**ZN1-AIS**	**ZN1-GIS**	**ZN2-AIS**	**ZN2-GIS**	**ZN3-AIS**	**ZN3-GIS**
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Technical Performance						
Economic Assessment						
Deliverability Aspects						
Environmental Aspects						
Socio-Economic Aspects						
Overall Score						

4.2 Technical Performance

Table 4-2 shows a summary of the scores for the Technical Performance of each option.

Table 4-2 - WCD 220 kV Substation MCA Scoring – Technical Performance

Option	ZN1-AIS	ZN1-GIS	ZN2-AIS	ZN2-GIS	ZN3-AIS	ZN3-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Compliance with Safety Standards						
Compliance with System Reliability, Security Standards						
Average Failure Rates						
Ease of Connectivity						
Expansion/extendibility						
Repeatability						
Technology Operational Risk						
Geotechnical Conditions						
Overall Technical Score						

Zone ZN3's AIS option is found to score the marginally lower risk (Moderate-Low) compared to the other three zones on account of relatively better geotechnical conditions than the other zones. The other two zones and the GIS option for ZN3 are found to score Moderate risk.

AIS and GIS technologies have similar overall score for each zone from a Technical Performance point of view with the lower failure rates for GIS being offset by AIS's better extendibility and lower operation risk.

The evaluation of each option is made under each technical sub criterion and is elaborated further in the following sections.

4.2.1 Compliance with Safety Standards

As all options propose using tested and approved technology, they will comply with relevant safety standards such as those from the European Committee for Electrotechnical Standardisation (CENELEC). The materials used comply with IEC or CENELEC standards. All options are considered to score equally.

4.2.2 Compliance with System Reliability, Security Standards

As the substation SLD is the same for all options, they are all scored as compliant / stable in terms of network stability (i.e., Voltage, Frequency, EMT Limits, Thermal Limits, Short Circuit Levels, Phase Angle, etc.). The proposed substation SLD and layouts have made provision onsite for future compensation equipment including Shunt Reactors.

The busbar arrangement and layout complies with EirGrid substation standards and policy for busbar configuration. The AIS and GIS substation arrangements remain the same for all the considered zones and as such all options are considered to score equally.

4.2.3 Average Failure Rates

SLD are identified for all substation options under consideration so Failure Rates are predominantly driven by the chosen switchgear technology (AIS or GIS). Published failure rate statistics for GIS switchgear are less compared to AIS switchgear for 110 kV – 220 kV technology. The mean time to repair (MTTR) is approximately double for GIS equipment but overall, Availability Levels are found to be higher for GIS technology.

4.2.4 Ease of Connectivity

The substation layout has the provision for 24 no. individual circuit connections (12 x 220 kV, 12 x 110 kV) within the substation. The placement of the substation is critical in terms of ensuring there is adequate space and corridors / public road network in the vicinity surrounding the substation for ease of connection of all future UGC or OHL connections. Based on the quantity of connections required all options are scored with a baseline risk of Moderate before other factors are considered.

For zone ZN1, access to potential site locations is limited by the Cork-Dublin railway line and the Grand Canal to the north and south respectively, which will make the addition of future circuits more difficult. The Inchicore-Maynooth double circuit 220 kV OHL and Grange Castle-Maynooth double circuit 110 kV OHL also traverse the zone. Roads on the eastern side of the zone are occupied by 220 kV circuits connecting to Castlebagot 220 kV substation. The presence of Weston Airport 1.5 km north of this zone may limit OHL circuit options approaching the zone from the north and west.

Similarly, for ZN2, access to the potential site locations is limited by the Grand Canal to the north. The eastern side of this zone is situated next to the Grange Castle West Business Park Development (with some phases in design and others under construction) whose internal road network is due to carry a high volume of services, limiting available space for new HV UGC circuits. There is limited space available in the R120 and L6032 public roads to carry multiple HV UGCs.

For substation zone ZN3, the proximity of Casement Aerodrome may limit the addition of future HV OHLs to this substation zone. Access to the site location is limited by the Grand Canal to the west. The Grange Castle West Business Park Development is located to the northeast of this zone. Its internal road network is due to carry a high volume of services, limiting available space for new HV UGC circuits coming from this direction. There is limited space available in the R120, R405 and L6032 public roads to carry multiple HV UGCs.

4.2.5 Site Expansion/Extendibility

The proposed no. of line bays for the proposed West Dublin 220 kV substation has already made provision for future connection of potential circuits to the substation, so all options are deemed to start at low risk.

The initial build design has 6 no. spare 220 kV bays and 6 no. spare 110 kV bays for future connections. The design has also allocated space for 4 no. future bays on the 220 kV busbar and 4 no. future bays on the 110 kV busbar, including 1 no. common 220/110 kV transformer bay.

Further expansions are possible but for the GIS options there will be restrictions on expanding the GIS switchgear and building. The GIS technology options score a higher risk (in comparison to the AIS technology options) as they would be more onerous to extend, unless the GIS building specification has already made provision for additional space to accommodate additional bays (note, the 110 kV and 220 kV GIS buildings are already 16-bay standard EirGrid design).

The proposed layout for the AIS substation already has a very large footprint so it may be difficult to acquire additional adjacent land for future expansions, especially for ZN2 which is scored at a higher risk of Moderate-Low.

The ease of connecting future circuits into the substation via each zone is also assessed, whether by the existing road network for UGC or via likely land corridors for OHL.

4.2.6 Repeatability

AIS and GIS substations (up to 400 kV) are already used in the Irish Transmission system and no limits are envisaged regarding repeatability of such technology.

The connection circuits' technology is not yet known but the circuits lengths under consideration for the known 220 kV circuits (up to 13 km) would not be prohibitive for either UGC or OHL options. However, the possibility of laying multiple 220 kV UGC circuits alongside each other within the local road network, if it is used, could be prohibitive and limit future use of the roads for UGC circuits. As such zones ZN1 and ZN3 are scored at a higher risk.

4.2.7 Technical Operational Risk

AIS and GIS substation technologies are seen as a tried and tested technology on the EirGrid transmission network from 110 kV up to 400 kV. However, GIS equipment require specialist skills for the maintenance and repair of such equipment which may have to be sourced from the original equipment manufacturer (OEM) / outside of Ireland. As such there is higher technical operating risk associated with the GIS technology options.

4.2.8 Geotechnical Conditions

Until sites are available for consideration, only a high-level appraisal of the geotechnical conditions within a zone is possible. The ground conditions in all zones can be taken to be relatively flat and rural in nature, with suitable ground conditions for siting a substation without the need for major ground works. ZN1 and ZN2 are indicated as having areas of extreme groundwater vulnerability and therefore have been scored worse than ZN3 in this regard.

More specific site investigation will be required for assessment and selection of substation sites.

4.3 Economic Assessment

Table 4-3 shows a summary of the scores for the Economic Assessment of each option.

Table 4-3 - WCD 220 kV Substation MCA Scoring – Economic Assessment

Option	ZN1-AIS	ZN1-GIS	ZN2-AIS	ZN2-GIS	ZN3-AIS	ZN3-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Project Implementation Costs						
Project Life-Cycle Costs						
Project Benefits						
Cost to SEM						
Contingency Costs						
Pre-Engineering Costs						
Overall Economic Score						

From an economic perspective, all zones and technologies are scoring similarly. The larger land take required for the AIS substation design is offset by the high costs of equivalent GIS solutions.

Until substation sites have been identified for appraisal in Step 4, all zones are scored high risk for Contingency Costs due to the relatively high amount of uncertainty, i.e., lands costs, geotechnical conditions, required ground works, etc.

From an economic performance perspective, AIS technology is seen to perform similarly compared to GIS. Even though GIS technology would have higher procurement (Implementation) costs, these are more than offset by higher life-cycle costs and higher land costs for AIS.

An evaluation of each option is made under each economic sub criteria and is elaborated further in the following sections.

4.3.1 Project Implementation Costs

The baseline risk is scored Moderate before other factors are considered. Assuming no substantial difference in land procurement costs between the different zones, the project implementation costs will be driven predominantly by whether the substation technology is GIS or AIS and the length / technology of the required circuits. Until sites have been identified, costs associated with the substation construction works such as access roads, etc., are taken to be similar for all options.

GIS substations have a higher procurement cost compared to AIS and as such are scored as higher risk for this sub-criteria.

4.3.2 Project Life-Cycle Costs

Project life-cycle costs over the expected useful life of the electrical substation equipment (typical lifespan for transmissions assets in the range of 40 to 50 years) are expected to be similar for each zone.

Substation Maintenance Costs

Like any electrical equipment, AIS and GIS switchgear requires continuous maintenance to prolong the life of the equipment and both AIS and GIS switchgear are subject to EirGrid's maintenance policy / specifications. The incremental maintenance costs are those costs incurred to ensure that the appropriate level of reliability and availability in the new substation is maintained over its useful life. The annual service costs on both AIS and GIS are considered similar and the costs only vary when the switchgear requires a detailed service or inspection every 5+ years, where this will need the OEM's assistance.

Typical AIS Maintenance Requirements include, but are not limited to:

- Ongoing maintenance requirements, all equipment exposed to weather conditions; and
- Disconnect contacts must be cleaned regularly, operating mechanisms must be checked and maintained.

Typical GIS Maintenance Requirements include, but are not limited to:

- Arrangement of switchgear will play a significant role in how maintenance will be carried out;
- Considerable dismantling may be required if a main element fails; and
- OEM supervision (likely from Europe) will be required for any major service or fault repair.

In general, the Life-Cycle Costs of GIS substations are expected to be approximately 70-80% that of an equivalent AIS substation and thus are scored at lower risk in this assessment.

Cost of Transmission Losses

All options have the same SLD and connecting circuits working at high voltages (110 kV and 220 kV), and as such the cost of transmission losses can be taken to be the same for all options being evaluated (AIS or GIS).

Replacement Cost Including the Cost of Decommissioning

The typical lifespan for the electrical assets is in the range of 40 to 50 years and as such, no replacement or decommissioning costs are considered for these options.

4.3.3 Project Benefits

The benefit of a project can be measured by its ability to supply DSO/distribution demand in an area or the amount of generation that is not constrained due to 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 would be a result of annual market simulations carried out by EirGrid's energy market experts. The simulations optimise the generation dispatch required to meet the electricity demand while considering the power carrying capability of the transmission system and contingencies.

As the functionality of the substation will be the same for all options evaluated, there is no difference in the reduction in constraints and an associated annual savings for the various options. As such all options will be scored the same at Low risk.

4.3.4 Costs to SEM

As the substation SLD is the same for all options, a comparison can only be made on the Availability Levels associated with AIS and GIS switchgear. Availability Levels for AIS Switchgear are lower compared to GIS switchgear and thus have a higher cost impact to the SEM.

4.3.5 Contingency Costs

Contingency Costs would include an estimate of any unforeseeable expenditure that an individual option may incur, including but not limited to the following:

- Obstructions or delays to granting planning permission / license delays;
- CPO or extended negotiations with private landowners (of particular risk for the AIS options with its associated very large footprint);
- Volatile equipment procurement costs/lead-times; and
- Unstable ground conditions. As individual substation sites and associated ground conditions are unknown at this stage, all zones will be scored equally in this regard.

At this Step 3 of the project with only high-level budget estimates in place, contingency costs are estimated at 20% of the project implementation costs and all options score a baseline risk of Moderate-High.

4.3.6 Pre-Engineering Costs

Pre-Engineering Costs are those associated with the design and specification, route evaluation and management of the statutory planning application, which would be affected by the following (non-exhaustive) list of factors:

- Non-Standard equipment / system design & specification;
- Site / technology / grid corridor to comply with statutory body guidelines, etc.;
- Site / grid corridor within multiple planning authority boundaries;
- Large volume of existing utility diversions; and
- Large number of landowners / stakeholders.

As both technologies will employ standard EirGrid equipment and individual sites have not been identified yet in Step 3, the Pre-Engineering Costs are deemed to be equal for each Technology / Zone.

All zones are also likely to require interaction with SDCC regarding the land use and the Grange Castle West Business Park Development. Similarly, all zones are likely to require interaction with Waterways Ireland regarding crossing of the Grand Canal, and interaction with Irish Rail regarding the crossing of the Cork-Dublin railway line. Aviation safeguarding issues will also affect all zones to a certain extent and require engagement with the relevant authorities in that regard.

4.4 Deliverability Aspects

Table 4-4 shows a summary of the scores for the Deliverability Aspects of each option.

Table 4-4 - WCD 220 kV Substation MCA Scoring – Deliverability Aspects

Option	ZN1-AIS	ZN1-GIS	ZN2-AIS	ZN2-GIS	ZN3-AIS	ZN3-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Implementation Timelines						
Project Plan Flexibility						
Dependence on other Projects						
Risk of Untried Technologies						
Supply Chain Constraints						
Permits & Wayleaves						
Planning and other statutory requirements						
Land Availability						
Ease of Construction						
Overall Deliverability Score						

It is found that the GIS option for ZN2 scores overall better than alternative options due to the availability of publicly-owned lands with fewer constraints from an access and construction perspective.

Regarding Permits and Wayleaves, this is mainly influenced by the proximity of Casement Aerodrome's height restriction areas (impacting Zone ZN3) and to a lesser extent Weston Airport. Permission for crossings of the Irish Rail Cork-Dublin railway line and the Grand Canal will affect all substation zones to varying degrees and are also taken into account.

For planning purposes, all substation options will likely be considered for Strategic Infrastructure Development (SID), but zone ZN1 is at a higher risk on account of several additional constraints / potential zoning conflicts due to proximity to the Adamstown SDZ.

An evaluation of each option is made under each deliverability sub-criteria and is elaborated further in the following sections.

4.4.1 Implementation Timelines

No project delays are expected for any of the technology options evaluated for several reasons:

- EirGrid's 6-Step approach to Grid Development allocates adequate durations between project Stage Gates for proper planning and procurement of long lead time items;
- At this stage, no major obstacle or impediment to development is anticipated with any of the proposed substation zones; and
- Historically, procurement lead times for GIS substation equipment can be longer than that for equivalent AIS substation equipment but increased use/acceptance of GIS substations within the Irish and Global electrical markets and increased offerings from manufacturers globally has shortened procurement times.

At this Step 3 of the project, the chosen zone / technology is not seen to impact on overall project timeline and as such all zones / technology options will be scored equally.

The proposed West Dublin 220 kV substation development is likely to constitute SID under 'new transmission infrastructure facilitating the transmission of electricity from one substation to another', with an application submitted directly to An Bord Pleanála (ABP). The SID planning process is typically longer than a local authority planning application and may pose a risk to the overall project timeline.

4.4.2 Project Plan Flexibility

The Project Plan is set to be developed in Step 4, and as such this is not applicable to Step 3. All options will be scored equally as Moderate risk until the Project Plan is developed.

4.4.3 Dependence on other Projects

The Grange Castle West Business Park development is seen as an influential project because of the large volume of services anticipated in the road network to support it. This development and several other large industrial and commercial facilities will reduce the available grid connection corridors to the CP1226 project.

Proximity to the SDZs of Adamstown, Clonburris and City Edge are seen as lower drivers given that the substation zones and SDZs do not overlap, and the developments are more residential and commercial in nature, hence lower density of services in the road network.

As all substation zones are impacted by these developments, all zones will be scored equally at moderate-low risk.

4.4.4 Risk of Untried Technologies

AIS and GIS substation technologies are seen as a tried and tested technology on the EirGrid transmission network from 110 kV up to 400 kV.

GIS substation switchgear is legislated to be fluorinated greenhouse gas (F-gas) free from 2028 (<145 kV) and 2032 (>145 kV). This would be seen as industry emerging technology at TRL 9 (Technology Readiness Level), needing to be qualified against EirGrid/ESBN specifications.

AIS options will be scored equally at low risk. GIS options will be scored at Moderate risk.

4.4.5 Supply Chain Constraints

Both technologies AIS and GIS will employ standard EirGrid equipment, and all options will require procuring power transformers and compensating equipment such as shunt reactors. Transformers are currently experiencing very long lead times and the procurement of such equipment is usually on the critical path.

Historically, longer lead times and a more restrictive supply chain are also associated with GIS switchgear compared to AIS switchgear.

4.4.6 Permits and Wayleaves

All options presented will be new infrastructure and will require permits and wayleaves to some extent or another, which elevates the risk for all options. There is a public participation facet to the permitting which often increases the risk to the option and wayleaving requires extensive relationship building with individual landowners, the risk to the option is often in the time required to achieve wayleaving.

There is additional risk for substation structures and OHLs in zone ZN3 which is closer to Casement Aerodrome where height restriction limitations may restrict the development of tall structures such as OHL towers, substation GIS buildings, lightning masts, etc. Zones have been deliberately selected to avoid areas of height restrictions prohibitive of substation/OHLs, but permission will still be required from the IAA/AirNav Ireland/other relevant aviation authorities for any developments within designated height restriction zones.

All zones are bordered or require crossings of the Irish Rail Cork-Dublin railway line and the Grand Canal, both of which require careful, considered engineering design and consultation with the relevant authorities to allow permission for circuit crossings of their assets.

Constraints may also be imposed by the aviation authorities on the use of construction cranes / equipment above a certain height limit within these zones.

4.4.7 Planning and other Statutory requirements

The West Dublin 220 kV substation development is likely to constitute SID under ‘new transmission infrastructure facilitating the transmission of electricity from one substation to another’, with an application submitted directly to ABP. The requirements for EIA and AA are to be determined. SID determination has both positive and negative risks associated with it (i.e., positive that it is one planning authority, but also negative as the planning process is typically longer).

The lands in ZN1 and ZN3 are zoned as RU – Rural in the SDCC Development Plan 2022-2028. Lands in ZN2 are variously zoned RU – Rural, and EE – Enterprise and Employment. Uses which are neither ‘Permitted in Principle’ nor ‘Not Permitted’ will be assessed in terms of their contribution towards the achievement of the Zoning Objective and Vision and their compliance and consistency with the policies and objectives of the development plan.

Zone ZN1 is in proximity of the Adamstown and Clonburris SDZ and has hence been assessed as a higher risk from a planning perspective.

The Grand Canal pNHA forms the southern boundary of the zone ZN1 and the Grand Canal Greenway forms the northern boundary of zones ZN2 and ZN3.

The Cork-Dublin railway line is located along the northern and western boundary of ZN1. This was subject to a recent application to ABP (ABP-316199-23), for which a Railway Order for the DART+ South West project was granted. This could adversely affect connecting circuits.

4.4.8 Land Availability

At present it is expected that sites within each zone would need to be procured from private landowners. Private land prices in the vicinity of Dublin City are expected to be very high / volatile.

The AIS options for the proposed West Dublin 220 kV substation have a footprint approximately five times larger than the GIS option. As such the AIS technology options are scored at a higher risk than the GIS options as procurement of a site of such a large footprint will be more restrictive within all of the zones. The GIS option for zone ZN2 is scored at lower risk as publicly owned land parcels are available within the zone of sufficient size to accommodate the substation.

A relatively large area of space is allocated within the proposed substation layout for future circuits and this initial space can be used for a construction / storage compound during the initial phases of construction. Additional space around the substation will need to be considered for connecting the planned and future circuits. Additional space within the compound would also be required if it is deemed in future that connecting circuits require additional compensation equipment.

4.4.9 Ease of Construction

A relatively large area of space is allocated within the proposed West Dublin 220 kV substation layout for future circuits and this initial space can be used for a construction / storage compound during the initial phases of construction.

Individual sites have not been identified / assessed to date, but ground conditions and elevations within the zones are generally expected to be suitable for substation construction, e.g., limited amount of cut and fill ground works required.

All zones are rural, served by regional roads. Appropriate traffic management plans would need to be put in place for the construction phase but no special constraints on working time limitations are expected.

Zone ZN3 is near Casement Aerodrome and limits may be imposed on the use of construction cranes / equipment above a certain height limit.

4.5 Environmental Aspects

Table 4-5 shows a summary of the scores for the Environmental Aspects of each option.

Table 4-5 - WCD 220 kV Substation MCA Scoring – Environmental Aspects

Option	ZN1-AIS	ZN1-GIS	ZN2-AIS	ZN2-GIS	ZN3-AIS	ZN3-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Biodiversity, Flora & Fauna						
Land, Soils & Geology						
Material Assets						
Noise & Vibrations						
Water						
Air Quality Impact						
Planning & Policy						
Overall Environmental Score						

Zone ZN1 is the best performing zone from an environmental perspective, with both technology options scoring Moderate-Low risk. Zones ZN2 and ZN3 perform worse than ZN1, with both technology options scoring Moderate risk.

The scoring of risk associated with Environmental Aspects during Step 3 has been done at an 'aggregated' level (i.e., the average) considering the constraints identified throughout the entire zones. As a result, there are areas within the zones that may score at a higher risk, and those that may score at a lower risk. Once sites have been identified, a detailed risk assessment specific to the sites themselves (and the areas the sites influence) will be carried out.

There is little/no variance in the scores between the zones, which is due to the following:

- In identifying the extents of the zones, the identified constraints and associated heat maps were used to (as best as possible) discard High risk and 'no-go' areas; and
- The risk scores are aggregated, and as such there may be pockets of each zone that would score higher or lower risk, but overall the zones risk ratings are similar to one another when the risk is aggregated.

It is important to note that when considering Environmental Aspects, in particular the ecology elements, an Ecological Zone of Influence (ZoI) for the zones has been determined. This Ecological ZoI is larger than the zones themselves – further detail is provided in the Environment and Socio-Economic MCA Scoring Report.

An evaluation of each option is made under each environmental sub-criteria and is elaborated further in the following sections.

4.5.1 Biodiversity, Flora and Fauna

When scoring the risk associated with Biodiversity, Flora and Fauna, several factors have been considered and these are discussed below. Given the larger footprint of AIS substations, the AIS technology options are likely to have a larger impact on Biodiversity, Flora and Fauna. Therefore, the AIS technology options have all scored a higher risk when compared to the GIS technology options.

4.5.1.1 Impacts on Other Ecologically Important and/or Sensitive Habitats

For all 3no. zones, the following has been identified:

- Mix of improved grassland, dry grassland and cultivated land;
- Patches of wet grassland, which are bordered by scrub (for Zone ZN2, it is only found within the 500 m ZoI, not the zone itself);
- Hedgerows bisect the zones with few relatively short treelines (> 100m);
- Broadleaved Forest and Woodland, typically along the Grand Canal;
- Small areas of amenity grassland; and
- There are very few buildings located in the zone or within their ZoIs (with the exception of southeast area of Zone ZN3's 500 m ZoI in which the built-up area of Newcastle is situated).

2no. wetlands exist directly to the south of the boundary of Zone ZN1. These wetlands are B-rated and nationally important ecological value. Habitat mapping by ROD, carried out in 2016, indicates an ecologically sensitive area (ESA 6) exists along the Grand Canal to the south of Zone ZN1 particularly between Coolscaddaun and Gollierstown Bridge. Scrubland here is identified a key for ecological connectivity.

1no. wetland exists to the northwest of the boundary of Zone ZN2 – Grand Canal pNHA (KE22), and there are no wetlands in ZN3.

4.5.1.2 Impacts on Protected Areas

There are no Special Areas of Conservation (SACs), Special Protection Areas (SPAs) or National Heritage Areas (NHAs) in the zones and their associated 500 m ZoIs. However, the boundaries of the Grand Canal pNHA are along the perimeter of the zones.

The Grand Canal is a valuable natural, built and cultural heritage asset. The ecological value of the canal lies in the diversity of species it supports along its linear habitats including Annex II of the EU Habitats Directive species Otter and White-clawed Crayfish, Annex IV Bats species (Common Pipistrelle, Soprano Pipistrelle, Leisler's Bat, Daubenton's Bat and Brown Long-eared Bat), and flora and fauna of local importance.

The population of White-clawed Crayfish (Annex II) is likely of international importance. The Grand Canal provides extensive habitat for Otter (Annex II and IV) foraging and commuting. The Grand Canal also provides excellent foraging and commuting habitat for bats. The canal supports important habitats such as hedgerows, tall herbs, calcareous grassland, reef fringe, open water, scrub and woodland (ROD, 2016). The threatened Green Figwort, a species listed in the Irish Red Data Book, is recorded from several stations along the river within the site.

For all zones, there is hydrological connectivity to the Liffey Valley pNHA. Consequently, there is hydrological connectivity to the South Dublin Bay and River Tolka Estuary SPA, although it is remote and given the nature of the project the potential for impact is limited. The aquatic values of the Liffey Valley pNHA are with respect to salmonids.

4.5.1.3 Impacts on Sensitive Bird Species and/or Their Habitats

No I-WeBs or Ramsar sites identified in the zones and their associated 500 m ZoIs. Annex I bird species listed on the EU Birds Directive are found within the 500 m ZoI, as follows:

- Zone ZN1: 4no. Amber listed species – Red Kite, Barn Swallow, Mute Swan, Common Starling and Peregrine Falcon.
- Zone ZN2: 1no. Amber listed species – Barn Swallow.
- Zone ZN3: 1no. Red listed species – Barn Owl.

Findings from a field survey (Eire Ecology, 2024) were made available to AtkinsRéalis by SDCC with respect to a planning application for Grange Castle Media Park on lands located at Brownstown, Co. Dublin. The survey site in question overlaps with sites within ZN2.

The report by Eire Ecology (2024) aimed to:

- Identify species of birds and bats using the site.
- Examine feeding and commuting routes.
- Identify breeding species on and adjacent to the site.
- Identify how bird and bats species in the surroundings utilise the site.
- Potential impacts of birds and bats by the proposed development.
- Examine the site for its potential to hoist a badger set.

Surveys were conducted from November 2022 to March 2024 encompassing two wintering bird periods, a bird breeding season and bat active and wintering seasons.

Key findings with respect to birds were:

- Buzzard, Kestrel, Merlin, Sparrowhawk, Peregrine falcon and Long-eared owl were recorded within the South Dublin Co. Co. landholding. None were found to breed within the GC Media Park site however, buzzard was recorded breeding to the south of the site.
- Regarding Golden Plover, the Grange Castle Media Park site is less important for Golden plover than lands to the south of the application site. While flocks were noted circling over the northern area, they rarely interacted with this northern section of the site. As previously mentioned, the bird crop cover found on the northern field is not a favourably habitat for this species. The flock shows a particular affinity to fields just to the south of the site. Records within the subject site are considered of Regional Importance.
- Wintering surveys conducted in grasslands at Clonburris, 3.5km to the east did not find Golden Plover. This is unsurprising as the grasslands here are rank and typically over 7cm in sward height thus unfavourable for this species.

Bat results are discussed in Section 4.5.1.4.

4.5.1.4 Impacts on Protected Species Outside of Natura 2000 Sites

There are few differences between Zones ZN1, ZN2 and ZN3 in terms of recorded species listed on the EU Habitats Directive and no flora protection orders were recorded in the zones and their associated 500 m ZoIs. Although not recorded from NBDC records, Annex II species such as Otter and White-clawed Crayfish are known from the Grand Canal. The River Liffey is known to support Atlantic Salmon, Brown Trout, European Eel, Brook, River Lamprey and White-clawed Crayfish.

The following protected species, listed on the EU Habitats Directive, were identified:

- In Zone ZN1, 3no. Annex IV terrestrial mammals – Daubentons Bat, Lesser Noctule and Soprano Pipistrelle.
- In Zone ZN2, 1no. Annex V amphibian – Common Frog, 4no. Annex IV Terrestrial mammals – Daubentons Bat, Lesser Noctule, Soprano Pipistrelle and 1no. Annex V terrestrial mammal – Pine Marten.
- In Zone ZN3. 1no. Annex V amphibian – Common Frog, 3no. Annex IV terrestrial mammals – Daubentons Bat, Lesser Noctule and Soprano Pipistrelle.

Findings from a field survey (Eire Ecology, 2024) were made available to AtkinsRéalis by SDCC with respect to a planning application for Grange Castle Media Park on lands located at Brownstown, Co. Dublin. The survey site in question overlaps with sites within ZN2. Key results for bats were:

- Seven species of bat were positively identified during the various bat surveys: Common Pipistrelle (*Pipistrellus pipistrellus*), Soprano Pipistrelle (Pipistrellus pygmaeus), Nathusius Pipistrelle (*Pipistrellus Nauthusii*), Brown Long-eared bat (*Plecotus auritus*), Leisler's bat (*Nyctalus leisleri*), Natterer's Myotis (*Myotis Nattererii*), Daubenton's Myotis (*Myotis Daubentonii*). In addition, several unidentified Myotis bat species were recorded, these being either Whiskered, Natterers or Daubenton's bats.
- No evidence of a bat roost was found during any survey. Static surveys reveal the site is of limited value to bats however, the northern woodland provides a valuable screen for the Grand Canal where very high bat activity occurs. It is the surveyor's opinion that as long as this northern woodland is effectively screened (from lighting and disturbance) impact on the local bat population will be negligible.

4.5.1.5 Impacts on Ecological Networks, and/or Connectivity, and Green Infrastructure

The Grand Canal runs parallel to the boundary of Zones ZN1, ZN2 and ZN3. The Grand Canal is a key ecological corridor, acting as a major ecological and recreational link between the River Shannon in the midlands and Dublin City where the canal enters the sea. The Grand Canal Corridor forms a major point of interaction with other identified Strategic Corridors in this Strategy: the M50 Corridor, the Rural/Urban Fringe corridor, and the Liffey-to-Liffey Corridor, while further local links connect it to the other areas of the Liffey Valley Corridor. A key objective in the SDCC Development Plan is to *"preserve and enhance hedgerows to provide improved connectivity between the scrubland at Coolscuddan (north of Grangecastle West) and the Grand Canal Green Infrastructure Corridor"*. Impacts to hedgerows from substation development may impact this (amongst other) objectives.

Zones ZN1 and ZN2 fall within SDCC and KCC, whilst Zone ZN3 falls exclusively within SDCC. KCC Development Plan identified that the Grand Canal and River Liffey are key "stepping-stones" and that riparian corridors provide vital ecological linkages. No ecological networks have been explicitly mapped by either local authority. However, riparian corridors are recognised as key ecological corridors for connectivity and have been mapped by SDCC in their Development Plan. None of these riparian corridors are found in Zones ZN1, ZN2 or ZN3.

4.5.1.6 Impacts on Annex 1 Habitats Outside of Natura 2000 Sites

There are no known Annex I habitats found in the zones and their associated 500 m ZoIs. Alkaline fen is the closest Annex I habitat and is found in the Rye Water Valley/Carton SAC north of the zones. Furthermore, there is no hydrological connection to this Annex I habitat.

4.5.1.7 Impacts on Aquatic Environment

The Grand Canal runs parallel to the boundary of Zones ZN1, ZN2 and ZN3. The Grand Canal (IE_09_AWB_GCMLE) is classified as good water quality status.

There are 2no. EPA watercourses in Zone ZN1. Lucan stream has ‘poor’ water quality and is ‘at risk’ of failing to meet WFD objectives. Lucan Stream discharges into the River Liffey and the River Liffey pNHA (000128). The Coneyburrow_09 stream has ‘good’ water quality and is ‘at risk’ of failing to meet WFD objectives. The Coneyburrow discharges into Leixlip Reservoir. The OSI mapped drainage ditches within the zone connect to the EPA watercourse that is of 'poor' water quality. There are numerous small OSI lakes throughout the zone. The ecological value of the OSI drainage ditches and lakes is unknown. Several ponds are found within Zone ZN1 and in the 500 m ZoI particularly to the south of the zone along the Grand Canal. The River Liffey is regarded as the most important river in Dublin City for legally protected fish and endangered species. The River Liffey supports Atlantic Salmon, Brown Trout, the critically endangered European Eel, Brook and River Lamprey, and White-clawed crayfish. No fish survey data was available for either Lucan Stream or Coneyburrow09. Both streams discharge to the River Liffey. There are no WFD lakes here.

Zone ZN2 is in the Liffey (168) basin and the Casteltown-Kildare sub-catchment (IE_EA_09C500830). There are no EPA water courses in Zone ZN2. An OSI field drain is found in the central-eastern section of this zone and connectivity with other watercourses cannot be determined. Another OSI field drain runs parallel to the south-western boundary of Zone ZN2 within the 500 m ZoI and enters the Grand Canal. The ecological value of these field drains is unknown. Inspection of aerial imagery shows hedgerows and riparian vegetation associated with these field drains. No lakes, wetlands or ponds are found in this zone. There are no records of aquatic species listed on the EU Habitats Directive within this zone or the ZoI (NBDC, 2024).

There are no EPA watercourses in Zone ZN3. A series of field drains bisect the eastern section of Zone ZN3 and are connected to the Grand Canal. Their ecological value is unknown. A review of aerial imagery shows hedgerows and treelines are found along these drains. A pond is found just south of the zone’s boundary at Newcastle. There are no wetlands within this zone or the ZoI.

4.5.2 Land, Soils and Geology

As the footprint of the AIS technology is larger than the GIS technology, it is more likely to have a larger impact on Land, Soils and Geology. However, this is very dependent on the siting of the proposed West Dublin 220 kV substation and as such both technologies score equally across all zones.

Soils in Zones ZN1, ZN2 and ZN3 are predominantly poorly drained soils (mineral or organic) which by their nature, typically remain wet for prolonged periods each year and reach saturation during precipitation events. The bedrock consists of dark limestone and shale of the Lucan formation. Due to the reported presence of limestone in the region, there is the potential for unknown karst features to exist in all zones.

Land use in Zones ZN1 and ZN2 is predominantly agricultural with approximately two-thirds comprising cultivated land, improved grassland and dry grassland. This is one of the most substantial constraints here. In Zone ZN3, approximately two-thirds is cultivated land and almost one-third is improved grassland.

All options score Moderate-Low risk.

4.5.3 Material Assets

When scoring the risk associated with Material Assets, several factors have been considered and these are discussed below. All options scored Moderate-Low risk.

4.5.3.1 Forestry

All three zones contain small areas of broadleaved forest and woodland throughout the zones. Zone ZN1 and Zone ZN3 also contain small areas of broadleaved forest, and there are some tree lines in Zone ZN3.

4.5.3.2 Farmland

The majority of Zones ZN1, ZN2 and ZN3 are classified as cultivated land, improved grassland and dry grassland. As AIS substations have a larger footprint than GIS substations, the AIS technology is a greater risk to farmland.

4.5.3.3 Greenbelts/Open Spaces

None of the zones lie within greenbelts.

4.5.3.4 Bogs/Peats

Based on desktop sources, no peat has been identified in any of the zones.

4.5.3.5 Residential and Town Centres

There are no residential or town centres within Zones ZN1, ZN2 or ZN3, however, Newcastle North settlement lies within the southern portion of Zone ZN3 and there are numerous individual residences along the road network within this zone.

4.5.3.6 Commercial and Industrial

There are no EPA licenced facilities or SEVESO sites within the zones.

4.5.3.7 Built Services

There is 1no. 110 kV OHL, 1no. 220 kV OHL and 1no. 220 kV UGC in Zone ZN1. There are no EirGrid utilities within Zones ZN2 or ZN3 and no Gas Network facilities within any of the zones.

Once specific sites have been identified in Step 4, and potential routes for the circuits have been identified, further detailed assessment on built services will be undertaken – this includes water, sewer, surface water, telecommunications, etc.

4.5.4 Noise and Vibration

The risk of each option, associated with Noise and Vibration, is dependent on the siting of the proposed West Dublin 220 kV substation relative to sensitive noise receptors, and therefore further assessment is required in Step 4.

There are no noise sensitive receptors within Zone ZN1. However, the Grand Canal Way is immediately south of the boundary and Lucan Sarsfield's GAA club is adjacent to the eastern boundary. Both AIS and GIS options for Zone ZN1 score Moderate-Low risk.

There are several noise sensitive receptors within Zone ZN2 and adjacent to the zone including individual residences along the road network, Peamount Hospital and Peamount Church adjacent to the eastern boundary of the zone and

the Grand Canal Way adjacent to the western boundary of the zone. Both AIS and GIS options for Zone ZN2 score Moderate risk.

There are numerous noise sensitive receptors in Zone ZN3, Newcastle North settlement in the south and individual residences along the road network. The Grand Canal Way and Newcastle town are adjacent to the zone. Both AIS and GIS options for Zone ZN3 score Moderate risk.

4.5.5 Water

When scoring the risk associated with Water, several factors have been considered and these are discussed below. Given the larger footprint of AIS substations, the AIS technology options are likely to have a larger impact on Water sources. Therefore, the AIS technology options have all scored higher risk (Moderate) than the GIS technology options (Moderate-Low).

4.5.5.1 Watercourses and Waterbodies

There are 2no. EPA watercourses in Zone ZN1. Lucan stream has ‘poor’ water quality and is ‘at risk’ of failing to meet WFD objectives. Lucan Stream discharges into the River Liffey and the River Liffey pNHA (000128). The Coneyburrow_09 stream has ‘good’ water quality and is ‘at risk’ of failing to meet WFD objectives. The Coneyburrow discharges into Leixlip Reservoir. The OSI mapped drainage ditches within the zone connect to the EPA watercourse that is of 'poor' water quality. There are numerous small OSI lakes throughout the zone.

There are no EPA watercourses within Zone ZN2. There is 1no. OSI field drain and 2no. OSI streams (that connect to the Grand Canal) within the zone.

There are no EPA watercourses within the Zone ZN3. There are 6no. OSI streams (that connect to the Grand Canal) within the zone.

The Grand Canal (IE_09_AWB_GCMLE) runs parallel to boundary of Zones ZN1, ZN2 and ZN3, and is classified as having ‘good’ water quality.

Impacts on watercourses and waterbodies are site and design dependent and will be assessed in further detail once potential sites have been identified for the proposed West Dublin 220 kV substation, and mitigation measures will be explored.

4.5.5.2 Groundwater Bodies

Zones ZN1, ZN2 and ZN3 all lie within the Dublin groundwater body which is classified as having 'good' groundwater quality. The groundwater quality is 'under review' and therefore presumed 'at risk' of failing to meet WFD objectives.

4.5.5.3 Groundwater Vulnerability

Groundwater vulnerability is a key constraint across all zones. In Zones ZN1 and ZN2, groundwater vulnerability is predominantly classified as 'extreme' with a portion in the west classified as 'high' and areas of 'rock at or near surface or karst' throughout the zones.

The groundwater vulnerability in Zone ZN3 is predominantly moderate and therefore lower risk than Zones ZN1 and ZN2. However, there is a portion in the northeast and in the south of Zone ZN3 classified as 'high' and 'extreme' groundwater vulnerability with several small areas of 'rock at or near surface or karst' throughout the zone.

Impacts on groundwater vulnerability are site dependent and will be assessed in further detail once potential sites have been identified for the proposed West Dublin 220 kV substation, and mitigation measures will be explored.

4.5.5.4 Gravel Aquifer

No gravel aquifers were identified underlying any of the zones.

4.5.5.5 Groundwater Abstractions

There are no Public Supply Source Protection Areas, Group Scheme Preliminary Source Protection Areas, nor GSI-reported wells and springs within any of the zones.

4.5.5.6 Flood Risk

Flood risk is a constraint across all zones that needs future consideration. Zone ZN1 has areas of medium and high flooding probability to the east, associated with the Lucan Stream, and within the 500 m ZoI. There is also an area of medium and high probability of flooding in Zone ZN2 located in the southwest corner and within the ZoI associated with the Grand Canal. In Zone ZN3, there is an area of medium and high flooding probability located in the northwest along the Grand Canal and the ZoI.

4.5.6 Air Quality Impact

Sensitive receptors to air quality are hospitals, schools, creches, residential properties etc. There are numerous residential properties located along the road network in Zone ZN2 and Peamount Hospital is adjacent to the eastern boundary of the zone. Newcastle North settlement lies within Zone ZN3 and there are individual residences located along the road network within this zone. There are no sensitive receptors within Zone ZN1.

For the AIS options, the scores are Moderate-Low for Zones ZN2 and ZN3, and Low for Zone ZN1. All GIS options score one risk category higher due to the use of SF6 gas. Although recent changes in European Law have legislated that substation switchgear equipment needs to be F-gases free from 2028 (<145 kV) and 2032 (>145 kV), the score of Moderate risk for Zones ZN2 and ZN3, and Moderate-Low for Zone ZN1 remains as this stage.

4.5.7 Planning and Policy

The South Dublin County Council Development Plan (2023-2029) and Kildare County Council Development Plan (2022-2028) have been considered when scoring the Planning and Policy risk for the proposed West Dublin 220 kV substation zones. The alignment to Regional and National policies has also been considered and will form part of a Planning and Consent Strategy document which will be developed in future steps of the project. Table 4-6 shows a summary of key planning and policy requirements within and between the 3no. West Dublin 220 kV substation zones.

Table 4-6 - Summary of Key Planning and Policy Requirements Relating to the 3no. WDU Substation Zones

Category	Description	ZN1	ZN2	ZN3
Development Plan Policy	Relevant SDCC Development Plan (2023-2029) policies include: IE5 Objective 2 Undergrounding of Utilities; Policy IE6: Electricity Infrastructure; IE6 Objective 2 Electricity Transmission and Distribution Network.	✓	✓	✓
Development Plan Policy	Relevant polices of the KCC Development Plan (2022-2028) include: EC P2 Renewable Energy and associated grid infrastructure; EC P19 Electricity Transmission and Distribution Network; EC O67 Overhead Cables.	✓	✓	
	Zone Rural (RU) to protect and improve rural amenity and to provide for the development of agriculture. Public services, which includes all	✓	✓	✓

Category	Description	ZN1	ZN2	ZN3
Land use zoning	service installations necessarily required by electricity are permitted in principle.			
	Zoned Enterprise and employment (EE) which seeks to provide for enterprise and employment related uses. Public services, which includes all service installations necessarily required by electricity, are permitted in principle.	✓	✓	
	A small section to the north of the Grand Canal is zoned Open Space. Public Services are open for consideration in this zone.	✓		
	Part of this zone is located in the rural area of KCC, where the KCC Development Plan (2022–2028) applies.	✓	✓	
Aviation	Within the Inner Horizontal Surface of Casement Aerodrome where development may be permitted up to 45 m above the elevation datum of 131.6 m.	✓	✓	✓
	Within the Inner Horizontal Surface of Weston Airport where development may be permitted up to 45 m above the elevation datum of 91.3 m.	✓	✓	✓
	In the Weston Airport Conical Surface.	✓	✓	
	Part located within the Approach Surfaces and Take Off Surfaces of Casement Airport.			✓
	Part within the Casement Significant Noise Boundary.			✓
	Part of zone is in a location in which developments of up to 30 m in height above ground are unlikely to have significance in relation to aviation.	✓	✓	
Transport	Indicative Western Dublin Orbital Route traverses the central part of the area.	✓	✓	✓
	Indicative New Nangor Road Extension is located in the zone.	✓	✓	
	The Cork-Dublin railway was subject to a recent application to ABP (ABP-316199-23), for which a Railway Order for the DART+ South West project was granted.	✓		
Greenway	The Grand Canal Greenway. A small section to the north of the Grand Canal Greenway is zoned Open Space. Public Services are open for consideration in this zone.	✓	✓	
	The Grand Canal Greenway forms the western boundary.			✓
Green Infrastructure	Located within the Grand Canal and Rural Fringe Primary Green Infrastructure Corridors.	✓	✓	✓
	Part located in the Griffin River Link Secondary Green Infrastructure Corridor.			✓
Proposed Natural Heritage Area	Grand Canal proposed NHA.	✓		

EirGrid has commenced engagement with the respective local authorities (i.e., South Dublin County Council and Kildare County Council). Engagement is ongoing and feedback from the local authorities will be considered in future steps of the project.

4.6 Socio-Economic Aspects

Table 4-7 shows a summary of the scores for the Socio-Economic Aspects of each option.

Table 4-7 - WCD 220 kV Substation MCA Scoring – Socio-Economic Aspects

Option	ZN1-AIS	ZN1-GIS	ZN2-AIS	ZN2-GIS	ZN3-AIS	ZN3-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Landscape & Visual						
Settlement & Communities						
Recreation, Amenity & Tourism						
Cultural Heritage						
Aviation & Defence						
Overall Socio-Economic Score						

The scores were similar for Zones ZN2 and ZN3, with both AIS and GIS technology options scoring Moderate risk for both zones. Zone ZN1 scored more favourably (Moderate-Low risk) for both technology options. Cultural heritage is a consistent constraint across all zones and substation development could impact on the setting of archaeological monuments and sites, built heritage features, historic landscapes, protected structures, and architectural conservation areas. In addition, most of the zones are situated in the 'limestone farmland' landscape type (LCT) and this is considered a key constraint common to all zones.

The scoring of risk associated with Socio-Economic Aspects during Step 3 has been done at an 'aggregated' level considering the constraints identified throughout the entire zones. As a result, there are areas within the zones that may score at a higher risk, and those that may score at a lower risk. Once sites have been identified, a detailed risk assessment specific to the sites themselves (and the areas the sites influence) will be carried out.

There is little/no variance in the scores between the zones, which is due to the following:

- In identifying the extents of the zones, the identified constraints and associated heat maps were used to (as best as possible) discard High risk and 'no-go' areas; and
- The risk scores are aggregated, and as such there may be pockets of each zone that would score higher or lower risk, but overall the zones risk ratings are similar to one another when the risk is aggregated.

An evaluation of each option is made under each socio-economic sub-criteria and is elaborated further in the following sections.

4.6.1 Landscape and Visual

Socio-economic constraints are related to landscape impacts as there are predicted to be visual impacts to specific changes in the character of available views and the effects of those changes on visual receptors.

AIS technology is likely to have a greater impact than GIS technology across all zones. This is due to the larger size of AIS substation footprints (relative to GIS substation footprints), and that the equipment for AIS substations is typically stored outdoors (as opposed to GIS substations where the equipment is mostly indoors).

The majority of Zones ZN1, ZN2 and ZN3 lie within the SDCC 'limestone farmland' landscape character type (LCT) which is described as *"gently undulating low-lying (generally below 100m) with limestone bedrock, land use includes tillage and pasture and there is generally dispersed settlement pattern"*. This LCT is classified as medium sensitivity and medium to high value.

A small portion of Zone ZN2 lies within the KCC 'northern lowlands' landscape character area (LCA) and is classified as low sensitivity. The northern lowlands have the *"capacity to generally accommodate a wide range of uses without significant adverse effects on the appearance or character of the area"*. Major powerlines are ranked as *"most compatible"* for this LCA and there are restrictions in the KCC Development Plan for development of powerlines within 300 m of Principal Landscape Sensitivity Factors (e.g., peat bogs, ridgelines, waterbodies).

According to the SDCC Development Plan and KCC Development Plan, there are no protected views within any of the zones. As the zones are predominantly agricultural in nature with numerous individual residences along the road network, the visual receptors within the northern zones consist predominantly of local residents.

4.6.2 Settlement and Communities

Zone ZN1 is predominantly agricultural in nature and there are no residential properties or recreational facilities within the zone, which is why it scores Low risk. There are no towns and villages in Zone ZN2, however, there are individual residences along the road network and constraints for settlements and communities are expected. Zone ZN3 is predominantly agricultural with residential properties located along the road network. Both Zones ZN2 and ZN3 score Moderate-Low risk.

It is important to note that a Social Impact Assessment will be undertaken and there will be engagement with local communities towards the end of Step 3 and in future steps. The feedback from this engagement will be considered in this and future steps.

4.6.3 Recreation, Amenity and Tourism

There are no recreational or amenity facilities within Zones ZN1, ZN2 or ZN3, however, the Grand Canal Way borders all three zones and therefore a Moderate-Low risk is assigned as the baseline risk. The Lucan Sarsfields GAA Club is situated to the east of Zone ZN1, and therefore Zone ZN1 scores Moderate risk.

4.6.4 Cultural Heritage

The Cultural Heritage risk has been scored based on the presence of National Inventory of Architectural Heritage (NIAH) features, Sites and Monuments Record (SMR), Architectural Conservation Areas and County Record of Protected Structures. In general, due to its larger footprint, the AIS technology options are scored at a higher risk than the GIS technology options.

Cultural heritage is a constraint across all zones but there are fewer features overall in Zone ZN1. Table 4-8 shows the number of cultural heritage features that have been identified. Based on the number of features, the risks have

been scored accordingly. Zone ZN1 has been scored Moderate-Low for both technology options. For Zones ZN2 and ZN3, the AIS technology options score Moderate-High risk (due to a larger footprint), whereas the GIS technology options score Moderate risk.

As the risk assigned considers the entire zone, a site-specific risk will be assigned once potential sites are identified in Step 4.

Table 4-8 - Number of Cultural Heritage Features Identified per WCD Zone

Zone	ZN1	ZN2	ZN3
NIAH features		1	7
SMR features	2	6	1
Protected structures		1	3

4.6.5 Aviation and Defence

There is no airport infrastructure situated within any of the zones, however the proximity to Casement Aerodrome (Baldonnell) may present an issue from an aviation safeguarding perspective and will require engagement with the relevant aviation and military authorities at consultation stage. All options have been scored Moderate-Low risk.

5. Multi-Criteria Analysis – South West Dublin 400 kV Substation Options

The purpose of the MCA is to identify the emerging Best Performing Option/s (BPO) for the substation technology and substation zone. This chapter summarises the MCA that was carried out in Step 3 on the eight (8no.) options for the proposed South West 400 kV substation, with further details of the assessment of the options provided in the Technical Feasibility Study Report and the Environment and Socio-Economic MCA Scoring Report.

5.1 Emerging Best Performing Option/s (BPO) from the Multi-Criteria Analysis

Table 5-1 shows the overall performance for the 8no. options. Due to the extent of land associated with the substation zones (ZS1 to ZS4), ranging in size from 145 ha to 265 ha, the performance/scoring of a particular constraint will vary from High to Low depending on the location of the constraint within the zone. The approach to the scoring assessment has therefore looked at an 'aggregate' risk across the substation zone.

As a result of this aggregated approach to the scoring assessment, the scores for most of the criteria are Moderate, and with some criteria scored as Moderate-Low. Deliverability is scored Moderate-High across all options, with Land Availability and Ease of Construction being the key drivers / sub-criteria.

Whilst there are differences between the performance of the options for certain criteria, when combining the criteria to determine the overall performance for all options, there is no distinguishable difference between the 8no. options under consideration as all score Moderate risk.

In the MCA Workshop, the EirGrid Cross-Functional Team and the project team decided that given the similar performance for both technologies and the zones, that all 8no. options will be brought forward to Step 4 for further assessment.

Table 5-1 - SWD 400 kV Substation MCA Scoring - Overall

Option	ZS1-AIS	ZS1-GIS	ZS2-AIS	ZS2-GIS	ZS3-AIS	ZS3-GIS	ZS4-AIS	ZS4-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Technical Performance								
Economic Assessment								
Deliverability Aspects								
Environmental Aspects								
Socio-Economic Aspects								
Overall Score								

5.2 Technical Performance

Table 5-2 shows a summary of the scores for the Technical Performance of each option.

Table 5-2 - SWD 400 kV Substation MCA Scoring – Technical Performance

Option	ZS1-AIS	ZS1-GIS	ZS2-AIS	ZS2-GIS	ZS3-AIS	ZS3-GIS	ZS4-AIS	ZS4-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Compliance with Safety Standards								
Compliance with System Reliability, Security Standards								
Average Failure Rates								
Ease of Connectivity								
Expansion/extendibility								
Repeatability								
Technology Operational Risk								
Geotechnical Conditions								
Overall Technical Score								

Zones ZS1 and ZS2 are found to score the highest risk (Moderate) compared to the other two zones on account of relatively longer loop-in circuits for zone ZS1 and limited space for expansion/extendibility within ZS2. Zone ZS3 coupled with GIS technology is also found to score Moderate risk due to a combination of Moderate-High geotechnical risk for the zone and Moderate risk for GIS technology related to expansion constraints and ease of operation.

Zone ZS4 (GIS and AIS) and ZS3 AIS are found to have the lowest risk score on account of relatively good proximity to the existing double circuit 220 kV OHL, and better ground profile and available lands for siting a substation.

AIS technology is found to score marginally better for Technical Performance compared to GIS.

The evaluation of each option is made under each technical sub criterion and is elaborated further in the following sections.

5.2.1 Compliance with Safety Standards

As all options propose using tested and approved technology, they will comply with relevant safety standards such as those from the European Committee for Electrotechnical Standardisation (CENELEC). The materials used comply with IEC or CENELEC standards. All options are considered to score equally.

5.2.2 Compliance with System Reliability, Security Standards

As the substation SLD is the same for all options, they are all scored as compliant / stable in terms of network stability (i.e., Voltage, Frequency, EMT Limits, Thermal Limits, Short Circuit Levels, Phase Angle, etc.). The proposed substation SLD and layouts have made provision onsite for future compensation equipment including Shunt Reactors.

The busbar arrangement and layout complies with EirGrid substation standards and policy for busbar configuration. The AIS and GIS substation arrangements remain the same for all the considered zones and as such all options are considered to score equally.

It is noted that Zone ZS1 is further distant from the desired double circuit 220 kV OHL and thus will require longer loop-in circuits (either OHL or UGC). However, it is deemed that these longer circuits will not substantially alter the network stability.

5.2.3 Average Failure Rates

SLD are identified for all substation options under consideration so Failure Rates are predominantly driven by the chosen switchgear technology (AIS or GIS). Published failure rate statistics for GIS switchgear are less compared to AIS switchgear for 110 kV – 400 kV technology. The mean time to repair (MTTR) is approximately double for GIS equipment but overall, Availability Levels are found to be higher for GIS technology.

Slightly higher failure rate levels are considered for zone ZS1 due to the longer 220 kV loop-in circuits.

5.2.4 Ease of Connectivity

The proposed South West Dublin 400 kV substation has provision for 28 no. individual circuit connections (6x 400 kV, 10x 220 kV, 12x 110 kV) within the substation. The placement of the substation is important in terms of ensuring there is adequate space and corridors / public road network in the vicinity surrounding the substation for ease of connection for UGC or OHL connections. Based on the quantity of connections required all options are scored with a baseline risk of Moderate before other factors are considered.

ZS2 is considered the most constrained zone with access to potential site locations limited by the N7 multi-lane carriageway to the west of this zone, and the public road network consisting of mostly narrow local class roads which can carry a very limited number of HV UGCs. The active quarry immediately north of this zone and golf course to the south will also limit the approach directions to the zone. The 110 kV and 220 kV OHL circuits connecting from Kilteel 110 kV substation and Dunstown 400 kV substation bisect the zone east-west and may be a constraint to future OHL circuit routeing. However, it is noted that these lines would also loop-in into the new substation. This zone has been rated Moderate-High risk.

Other zones have been rated Moderate risk.

5.2.5 Site Expansion/Extendibility

The design for the proposed South West Dublin 400 kV substation (no. of line bays) has already made provision for future connection of potential circuits to the substation, so all options are deemed to start at low risk.

The current design has 6no. spare 400 kV bays, 4no. spare 220 kV bays and 9no. spare 110 kV bays for future connections (excluding transformer bays and known circuits). Further expansions are possible but for the GIS options there will be restrictions on expanding the GIS switchgear and building unless the initial (building) specification has made some allocation for future expansion of the switchgear.

As the substation footprint is considered very large it is considered a major obstacle to acquire additional adjacent lands for possible future expansions.

The ease of connecting future circuits into the substation via each zone is also assessed, whether by the existing road network for UGC or via likely land corridors for OHL.

Zone ZS2 is deemed to have insufficient available lands to site the 400 kV AIS substation design and has been rated high risk.

5.2.6 Repeatability

AIS and GIS substations (up to 400 kV) are already used in the Irish Transmission system and no limits are envisaged regarding repeatability of such technology.

The loop-in circuits' technology is not yet known but the circuit lengths under consideration for the 220 kV circuits (up to 3 km) would not be prohibitive for either UGC or OHL options. However, the possibility of laying multiple 220 kV UGC circuits alongside each other within the local road network, if it is used, could be prohibitive and limit future use of the roads for UGC circuits.

5.2.7 Technical Operational Risk

AIS and GIS substation technologies are seen as a tried and tested technology on the EirGrid transmission network from 110 kV up to 400 kV. However, GIS equipment require specialist skills for the maintenance and repair of such equipment which may have to be sourced from the original equipment manufacturer (OEM) / outside of Ireland. As such there is higher technical operating risk associated with the GIS technology options.

Longer loop-in circuits' length (associated with ZS1) increases the operational risk, especially for 220 kV UGC (higher risk of faults or damage requiring key skills to repair).

5.2.8 Geotechnical Conditions

Until sites are available for consideration, only a high-level appraisal of the geotechnical conditions within a zone is possible. The ground conditions in all zones can be taken to be rural in nature. Suitable ground conditions for siting a substation without the need for major ground works are present in Zones ZS1 and ZS4. Zones ZS2 and ZS3 are hillier in nature and may require more ground works to cut and fill the substation footprint. Zone ZS4 is deemed to have the lowest groundwater vulnerability of the zones assessed.

More specific site investigation will be required for assessment and selection of substation sites.

5.3 Economic Assessment

Table 5-3 shows a summary of the scores for the Economic Assessment of each option.

Table 5-3 - SWD 400 kV Substation MCA Scoring – Economic Assessment

Option	ZS1-AIS	ZS1-GIS	ZS2-AIS	ZS2-GIS	ZS3-AIS	ZS3-GIS	ZS4-AIS	ZS4-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Project Implementation Costs								
Project Life-Cycle Costs								
Project Benefits								
Cost to SEM								
Contingency Costs								
Pre-Engineering Costs								
Overall Economic Score								

Zone ZS1 is found to score the higher risk compared to the other three zones which are deemed Moderate-Low risk. Zones ZS2, ZS3 and ZS4 score lower due to the proximity of the zone to both Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHL circuits which need to be looped-in into the new substation.

Until substation sites have been identified for appraisal in Step 4, all zones are scored moderate-high risk for contingency costs due to the relatively high amount of uncertainty, i.e., lands costs, geotechnical conditions, required ground works, etc.

From an economic performance perspective, AIS technology is seen to perform marginally poorer compared to GIS. Even though GIS technology would have higher procurement (Implementation) costs, these are more than offset by higher life-cycle costs and higher land costs for AIS.

An evaluation of each option is made under each economic sub criteria and is elaborated further in the following sections.

5.3.1 Project Implementation Costs

The baseline risk is scored Moderate-Low before other factors are considered. Assuming no substantial difference in land procurement costs between the different zones, the project implementation costs will be driven predominantly by whether the substation technology is GIS or AIS and the length / technology of the required loop-in circuits with the 220 kV OHL. Until sites have been identified, costs associated with the actual substation construction works such as access roads, etc., are taken to be similar for all options.

GIS substations have a higher procurement cost compared AIS and as such are scored as higher risk for this sub-criterion.

Zone ZS1 is a greater distance from the OHL circuits compared to the other zones and as such are scored at a higher risk due to the increased costs of the required 220 kV loop-in circuits.

5.3.2 Project Life-Cycle Costs

Project life-cycle costs over the expected useful life of the electrical substation equipment (typical lifespan for transmissions assets in the range of 40 to 50 years) are expected to be similar for each zone.

Substation Maintenance Costs

Like any electrical equipment, AIS and GIS switchgear requires continuous maintenance to prolong the life of the equipment and both AIS and GIS switchgear are subject to EirGrid's maintenance policy / specifications. The incremental maintenance costs are those costs incurred to ensure that the appropriate level of reliability and availability in the new substation is maintained over its useful life. The annual service costs on both AIS and GIS are considered similar and the costs only vary when the switchgear requires a detailed service or inspection every 5+ years, where this will need the OEM's assistance.

Typical AIS Maintenance Requirements include, but are not limited to:

- Ongoing maintenance requirements, all equipment exposed to weather conditions; and
- Disconnect contacts must be cleaned regularly, operating mechanisms must be checked and maintained.

Typical GIS Maintenance Requirements include, but are not limited to:

- Arrangement of switchgear will play a significant role in how maintenance will be carried out;
- Considerable dismantling may be required if a main element fails; and
- OEM supervision (likely from Europe) will be required for any major service or fault repair.

In general, the Life-Cycle Costs of GIS substations are expected to be approximately 70-80% that of an equivalent AIS substation and thus are scored at lower risk in this assessment.

Loop-in Circuit Maintenance Costs

Four (4no.) 220 kV circuits will be required to loop-in the substation to the Carrickmines-Dunstown / Dunstown-Maynooth 220 kV OHL circuits (note if UGC are used for the loop-in circuits, multiple cables may be required to meet the equivalent OHL minimum seasonal ampacity rating). Zones further away from the circuit will include higher maintenance / fault correction costs on account of the longer circuit lengths / increased number of joint bays or towers. As such Zone ZS1, which is situated further from the double circuit sections of 220 kV OHL circuit, is scored at higher risk.

Cost of Transmission Losses

All options have the same SLD and connecting circuits working at high voltages (110 kV and 220 kV), and as such the cost of transmission losses can be taken to be the same for all options being evaluated (AIS or GIS).

For the loop-in circuits, transmission losses can be taken to be lower for UGC compared to OHL.

Replacement Cost Including the Cost of Decommissioning

The useful life for the electrical assets is in the range of 40 to 50 years and as such, no replacement or decommissioning costs are considered for these options.

5.3.3 Project Benefits

The benefit of a project can be measured by its ability to supply DSO/distribution demand in an area or the amount of generation that is not constrained due to 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 would be a result of annual market simulations carried out by EirGrid's energy market experts. The simulations optimise the generation dispatch required to meet the electricity demand while considering the power carrying capability of the transmission system and contingencies.

As the functionality of the substation will be the same for all options evaluated, there is no difference in the reduction in constraints and an associated annual savings for the various options. As such all options will be scored the same at Low risk.

5.3.4 Costs to SEM

As the substation SLD is the same for all options, a comparison can only be made on the Availability Levels associated with AIS and GIS switchgear. Availability Levels for AIS Switchgear are lower compared to GIS switchgear and thus have a higher cost impact to the SEM.

Zone ZS1 will have reduced Availability Levels due to the longer 220 kV loop-in circuits and as such are scored at higher risk.

5.3.5 Contingency Costs

Contingency Costs would include an estimate of any unforeseeable expenditure that an individual option may incur, including but not limited to the following:

- Obstructions or delays to granting planning permission / license delays;
- CPO or extended negotiations with private landowners (of particular risk for the AIS options with its associated very large footprint);
- Volatile equipment procurement costs/lead-times; and
- Unstable ground conditions. As individual substation sites and associated ground conditions are unknown at this stage, all zones will be scored equally in this regard.

At this Step 3 of the project with only high-level budget estimates in place, contingency costs are estimated at 20% of the project implementation costs and all options score a baseline risk of Moderate-High.

5.3.6 Pre-Engineering Costs

Pre-Engineering Costs are those associated with the design and specification, route evaluation and management of the statutory planning application, which would be affected by the following (non-exhaustive) list of factors:

- Non-Standard equipment / system design & specification;
- Site / technology / grid corridor to comply with statutory body guidelines, etc.;

- Site / grid corridor within multiple planning authority boundaries;
- Large volume of existing utility diversions; and
- Large number of landowners / stakeholders.

As both technologies will employ standard EirGrid equipment and individual sites have not been identified yet in Step 3, the Pre-Engineering Costs are deemed to be equal for each Technology / Zone.

5.4 Deliverability Aspects

Table 5-4 shows a summary of the scores for the Deliverability Aspects of each option.

Table 5-4 - SWD 400 kV Substation MCA Scoring – Deliverability Aspects

Option	ZS1-AIS	ZS1-GIS	ZS2-AIS	ZS2-GIS	ZS3-AIS	ZS3-GIS	ZS4-AIS	ZS4-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Implementation Timelines								
Project Plan Flexibility								
Dependence on other Projects								
Risk of Untried Technologies								
Supply Chain Constraints								
Permits & Wayleaves								
Planning and other statutory requirements								
Land Availability								
Ease of Construction								
Overall Deliverability Score								

It is found that AIS and GIS options score very similar within each zone. As the footprint for the proposed South West Dublin 400 kV substation is much larger than the proposed West Dublin 220 kV substation footprint, the risk on land availability and ease of construction is higher than for the northern zones.

The Ease of Construction for ZS2 is affected by the lack of available open space within the zone for siting of a substation footprint along with the necessary construction compounds, etc.

Regarding Permits and Wayleaves, this is mainly influenced by the required crossing of the multilane N7 roadway for connecting circuits which will affect all zones more or less equally.

For planning purposes, all proposed South West Dublin 400 kV substation options will likely be considered for Strategic Infrastructure Development (SID) with associated Moderate risk rating.

An evaluation of each option is made under each deliverability sub-criteria and is elaborated further in the following sections.

5.4.1 Implementation Timelines

No project delays are expected for any of the technology options evaluated for several reasons:

- EirGrid's 6-Step approach to Grid Development allocates adequate durations between project Stage Gates for proper planning and procurement of long lead time items;
- At this stage, no major obstacle or impediment to development is anticipated with any of the proposed substation zones; and
- Historically, procurement lead times for GIS substation equipment can be longer than that for equivalent AIS substation equipment but increased use/acceptance of GIS substations within the Irish and Global electrical markets and increased offerings from manufacturers globally has shortened procurement times,

At this step, the chosen zone / technology is not seen to impact on overall project timeline and as such all zones / technology options will be scored equally.

The proposed South West Dublin 400 kV substation development is likely to constitute SID under 'new transmission infrastructure facilitating the transmission of electricity from one substation to another', with an application submitted directly to An Bord Pleanála (ABP). The SID planning process is typically longer than a local authority planning application and may pose a risk to the overall project timeline.

5.4.2 Project Plan Flexibility

The Project Plan is set to be developed in Step 4, and as such this is not applicable to Step 3. All options will be scored equally as Moderate risk until the Project Plan is developed.

5.4.3 Dependence on other Projects

No dependence on other projects is anticipated at this stage and all zones are be scored equally at Low risk.

5.4.4 Risk of Untried Technologies

AIS and GIS substation technologies are seen as a tried and tested technology on the EirGrid transmission network from 110 kV up to 400 kV.

GIS substation switchgear is legislated to be F-gases free from 2028 (<145 kV) and 2032 (>145 kV). This would be seen as industry emerging technology at TRL 9 (Technology Readiness Level), needing to be qualified against EirGrid/ESBN specifications.

AIS options will be scored equally at Low risk. GIS options will be scored at Moderate risk.

5.4.5 Supply Chain Constraints

Both technologies AIS and GIS will employ standard EirGrid equipment, and all options will require procuring power transformers and compensating equipment such as shunt reactors. Transformers are currently experiencing very long lead times and the procurement of such equipment is usually on the critical path.

Historically, longer lead times and a more restrictive supply chain are also associated with GIS switchgear compared to AIS switchgear.

5.4.6 Permits and Wayleaves

All options presented will be new infrastructure and will require permits and wayleaves to some extent or another, which elevates the risk for all options. There is a public participation facet to the permitting which often increases the risk to the option and wayleaving requires extensive relationship building with individual landowners, the risk to the option is often in the time required to achieve wayleaving.

Consultation with TII is required for crossing of N7 for connecting circuits on all zones. Additionally, onwards connections to Carrickmines will likely require crossings of the M50 motorway. These consultations will be required on all zones.

Generally, OHL infrastructure tends to traverse private land and carries higher risk in attaining necessary wayleaves and permits. UGC circuits would require road opening licenses from the relevant authority.

5.4.7 Planning and other Statutory requirements

The proposed South West Dublin 400 kV substation development is likely to constitute SID under 'new transmission infrastructure facilitating the transmission of electricity from one substation to another', with an application submitted directly to ABP. The requirements for EIA and AA are to be determined. SID determination has both positive and negative risks associated with it (i.e., positive that it is one planning authority, but also negative as the planning process is typically longer).

All zones are zoned RA – Rural Area. All zones are within boundaries of two county councils, namely KCC and SDCC.

All zones are scored as Moderate risk.

5.4.8 Land Availability

At present it is expected that sites within each zone would need to be procured from private landowners. Private land prices in the East Kildare / South West Dublin vicinity are expected to be high in comparison to the rest of the country.

The AIS options for the proposed South West Dublin 400 kV substation have a footprint approximately four times larger than the GIS option. As such the AIS technology options are scored at a higher risk than the GIS options as procurement of a site of such a large footprint will be more restrictive within all of the zones.

A relatively large area of space is allocated within the proposed substation layout for future circuits and this initial space can be used for a construction / storage compound during the initial phases of construction. Additional space around the substation will need to be considered for connecting the planned and future circuits. Additional space within the compound would also be required if it is deemed in future that connecting circuits require additional compensation equipment.

5.4.9 Ease of Construction

A relatively large area of space is allocated within the proposed South West Dublin 400 kV substation layout for future circuits and this initial space can be used for a construction / storage compound during the initial phases of construction.

Individual sites have not been identified / assessed to date, but ground conditions and elevations within the Zones ZS1, ZS3 and ZS4 are generally expected to be suitable for substation construction, e.g., limited amount of cut and

fill ground works required. Zone ZS2 is deemed to be less suitable due to less favourable groundwater vulnerability (along the eastern boundary) and fewer areas of flat terrain profile.

All zones are rural, served by local roads. Appropriate traffic management plans would need to be put in place for the construction phase but constraints on working time limitations could be required to minimise disruption to local communities.

All options will require outages to loop-in the substation with the Carrickmines- Dunstown / Dunstown-Maynooth 220 kV OHLs.

5.5 Environmental Aspects

Table 5-5 shows a summary of the scores for the Environmental Aspects of each option.

Table 5-5 - SWD 400 kV Substation MCA Scoring – Environmental Aspects

Option	ZS1-AIS	ZS1-GIS	ZS2-AIS	ZS2-GIS	ZS3-AIS	ZS3-GIS	ZS4-AIS	ZS4-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Biodiversity, Flora & Fauna								
Land, Soils & Geology								
Material Assets								
Noise & Vibrations								
Water								
Air Quality Impact								
Planning & Policy								
Overall Environmental Score								

Zones ZS1 and ZS3 are the best performing zones from an environmental perspective, with both technology options scoring Moderate-Low risk. Zones ZS2 and ZS4 are the worst performing zones, with both technology options scoring Moderate risk – this is largely driven by the potential impact to water (i.e., probability of flooding, watercourses and waterbodies, and groundwater bodies).

The scoring of risk associated with Environmental Aspects during Step 3 has been done at an 'aggregated' level considering the constraints identified throughout the entire zones. As a result, there are areas within the zones that may score at a higher risk, and those that may score at a lower risk. Once sites have been identified, a detailed risk assessment specific to the sites themselves (and the areas the sites influence) will be carried out.

There is little/no variance in the scores between the zones, which is due to the following:

- In identifying the extents of the zones, the identified constraints and associated heat maps were used to (as best as possible) discard High risk and 'no-go' areas; and
- The risk scores are aggregated, and as such there may be pockets of each zone that would score higher or lower risk, but overall the zones risk ratings are similar to one another when the risk is aggregated.

It is important to note that when considering Environmental Aspects, in particular the ecology elements, an Ecological Zone of Influence (ZoI) for the zones has been determined. This Ecological ZoI is larger than the zones themselves – further detail is provided in the Environment and Socio-Economic MCA Scoring Report.

An evaluation of each option is made under each environmental sub-criteria and is elaborated further in the following sections.

5.5.1 Biodiversity, Flora and Fauna

When scoring the risk associated with Biodiversity, Flora and Fauna, several factors have been considered and these are discussed below. There are minimal risks within Zones ZS1, ZS2 and ZS3, and therefore they have scored Low risk for both technology options. ZS4 scores Moderate-Low risk for both technology options mainly due to the potential impact on protected species outside of Natura 2000 sites and potential impact on the aquatic environment.

5.5.1.1 Impacts on Other Ecologically Important and/or Sensitive Habitats

For all 4no. zones, the following has been identified:

- Mix of improved grassland, dry grassland and cultivated land;
- Patches of wet grassland, bordered by scrub, in varying extents;
- Hedgerows bisect the zones with few relatively short treelines (> 100m);
- Broadleaved Forest and Woodland, typically along the Grand Canal;
- Small areas of amenity grassland;
- There are very few buildings located in the zone or within their ZoIs; and
- The WSI records show no wetlands in the zones, with the exception of 1no. wetland at the northern boundary of Zone ZS2 in the ZoI. This wetland is rated as F with unknown ecological value – survey is required.

Although there is no bog identified within Zone ZS1, there are patches of "Blanket Bog[1]" within the 500 m ZoI just north of Castlewarden Golf Club (National Land Cover, 2018). Within Zone ZS4, there are small fragments of "Blanket Bog" located in the very southern border and central areas (National Land Cover, 2018).

Within Zone ZS2, 1no. mixed forest area is identified in the southern corner of the zone. Within Zone ZS4, a large standing area of mixed forest is located in the northeast corner in Beech Park Golf Club and in the east.

An area 17.7 ha of lacustrine sediments if located in the north-eastern corner of Zone ZS1. Wetland soil Alluvium of area 29.46 ha is located on the eastern border of Zone ZS2. There is an area of 10.66 ha of Alluvium located in the south, centre and east of Zone ZS3. There is an area of 26.20 ha of Alluvium located in the western corner of Zone ZS4, and an area of 10.66 ha in the southeast corner of Zone ZS4.

[1] The NLC (2018) manual states that “It is important to note that there are different interpretations of what constitutes a peatland and that this land cover type has seen large scale modification over time and in the landscape due to the uses of peatlands. Along with peat harvesting, many areas of peatland have been drained and either afforested with plantation forestry or converted to grassland. There is also evidence of encroachment of other land cover types in areas that are not actively managed. A peat ‘complex’ can therefore have many different land cover types present on-top of a peat soil”. NLC (2018) maps peat surfaces only, it does not map peat soils or label land cover which occurs on peat soils as e.g., ‘forest on peatland’.

5.5.1.2 Impacts on Protected Areas

For all 4no. zones, there are no Special Areas of Conservation (SACs), Special Protection Areas (SPAs), National Heritage Areas (NHAs) or proposed National Heritage Areas (pNHAs), within the zones are their associated 500 m ZoI. The closest SPA is the Poulaphouca Reservoir SPA (004063) which is located within 5 km to 7 km of each zone.

The register of WFD Protected Areas indicates no rivers or surface waters are hydrologically connected to any SAC habitats, SAC species or SPA habitats. There is hydrological connectivity to the Grand Canal pNHA and the Liffey Valley pNHA via watercourses here. Consequently, there is hydrological connectivity to the South Dublin Bay and River Tolka Estuary SPA, although it is remote and given the nature of the project the potential for impact is limited.

5.5.1.3 Impacts on Sensitive Bird Species and/or Their Habitats

No I-WeBs or Ramsar sites identified in the zones and their associated 500 m ZoIs. Annex I bird species listed on the EU Birds Directive are found within the zones and/or their associated 500 m ZoI, as follows:

- Zone ZS1: 1no. Annex I bird species – Yellowhammer, which is also a red-listed species on the Birds of Conservation Concern.
- Zone ZS2: none listed.
- Zone ZS3: none listed.
- Zone ZS4: 1no. Annex I bird species – Northern Lapwing.

5.5.1.4 Impacts on Protected Species Outside of Natura 2000 Sites

For all 4no. zones and their associated 500 m ZoIs, there are no flora protection orders recorded.

Zone ZS1 has 1no. Annex V terrestrial mammal listed on the EU Habitats Directive – Pine Marten. Zones ZS2 and ZS3 have no known Annex II, IV or V species listed in the EU Habitats Directive. Zone ZS4 has 4no. Annex IV terrestrial mammals listed – Brown Long-eared Bat, Daubentons Bat, Lesser Noctule, Soprano Pipistrelle, and 1no. Annex V terrestrial mammal listed – Pine Marten.

5.5.1.5 Impacts on Ecological Networks, and/or Connectivity, and Green Infrastructure

All zones span the SDCC and KCC boundaries.

The eastern section of ZS1 is situated in a primary green infrastructure corridor, as identified in the SDCC Development Plan.

For ZS2, the riparian corridor associated with the Tootenhill Stream falls within the zone and is listed as important green infrastructure in the SDCC Development Plan. This corridor is on the very margin of this zone and can be easily avoided with careful siting of a substation.

For ZS3 and ZS4, there are no riparian corridors listed and no green infrastructure identified in the relevant development plans.

5.5.1.6 Impacts on Annex 1 Habitats Outside of Natura 2000 Sites

There are no known Annex I habitats found in the zones and their associated 500 m ZoIs. Alpine and Sub-Alpine Heath (4060) is the closest known Annex I habitat and is found to the south-east of the zones.

There is no hydrological connectivity to any surface water dependent Annex I habitats outside of the zones.

Petrifying Springs are known to occur in other locations in South County Dublin but this data was not available at this point in time for mapping purposes.

5.5.1.7 Impacts on Aquatic Environment

Across all zones, the following is observed regarding the aquatic environment:

- No information was available from IFI on fish species present in EPA watercourses in the zones or their associated 500 m ZoI.
- There are no records of aquatic species listed on the EU Habitats Directive within the zones or their associated 500 m ZoI.
- The register of WFD protected areas indicates there are no WFD protected areas for SAC species, SAC habitats or SPA habitats within the zones or their associated 500 m ZoI.

The following is noted regarding the aquatic environment in Zone ZS1:

- Zone ZS1 is in the Liffey and Dublin Bay Catchment and the Liffey_SC_070 and Liffey_SC_090 Sub Catchment area.
- There are 2no. EPA watercourses in Zone ZS1 – Banshee (Morrell 040; waterbody code: IE_EA_09M010300) and the Pluckstown (Morrell 040; waterbody code: IE_EA_09M010300), both of which are classified as having moderate water quality status and at risk of failing to meet WFD objectives.
- Within the 500m ZoI is the Athgoe_North, (Liffey 170; waterbody code: IE_EA_09L012100) and Highdownhill (Liffey 170; waterbody code: IE_EA_09L012100) with poor water quality status and at risk of failing to meet WFD objectives.
- There is 1no. OSI mapped stream and 1no. OSI mapped drainage ditch connecting to the Banshee, and 4no. OSI mapped ponds to the east.
- There are no wetlands marked by Wetland Survey Ireland.

The following is noted regarding the aquatic environment in Zone ZS2:

- Zone ZS2 is in the Liffey and Dublin Bay catchment and the Liffey_SC_070 and Liffey_SC_090 Sub Catchment area.
- There are 6no. EPA watercourses in Zone ZS2 largely on the perimeter of the zone. Tootenhill Stream (Liffey 170; river waterbody code: IE_EA_09L012100) and Newtown_Lower09 (Liffey 170; river waterbody code: IE_EA_09L012100) are classified as having poor water quality and at risk of failing to meet WFD objectives.
- Kill East (Morell_040; river waterbody code: IE_EA_09M010300), Huttonread, (Morell 040; river waterbody code: IE_EA_09M010300) and Windmill Hill (Morrell 040; river waterbody code: IE_EA_09M010300) are classified as having moderate water quality and at risk of failing to meet WFD objectives.
- Keatings Park (Liffey_170; river waterbody code: IE_EA_09L012100) is in the 500m ZoI and is classified as having poor water quality and at risk of failing to meet WFD objectives.
- Castlewarden North (Morrell 040: river waterbody code: IE_EA_09M010300) and Athgoe South (Liffey 170; river waterbody code: IE_EA_09M010300) both have poor water quality and are at risk.
- There is 1no. OSI mapped stream and 4no. OSI mapped ponds.
- 1no. wetland is marked by Wetland Survey Ireland directly to the north of the boundary of Zone ZS2 in the 500m ZoI.

The following is noted regarding the aquatic environment in Zone ZS3:

- Zone ZS3 is in the Liffey and Dublin Bay catchment and the Liffey_SC_070 Sub Catchment area.
- There are 2no. EPA watercourses in Zone ZS3. Farmersvale (Morell 040; river waterbody code: IE_EA_09M010300) and Johnstown (Morell 040; river water body code:IE_EA_09M010300) bisects the south of this zone and are classified as having moderate water quality and at risk of failing to meet WFD objectives.
- In the 500 ZoI are Blackchurch (Morell 140; river waterbody code: IE_EA_09M01030), Kill East (Morell 140; river waterbody code: IE_EA_09M010300), Huttonread (Morell 040; river waterbody code: IE_EA_09M01030), Farmersvale (Morell 040; river waterbody code: IE_EA_09M010300) and Calliaghstown Lower (Morell 040; river waterbody code: IE_EA_09M010300) with moderate water quality and at risk of failing to meet WFD objectives.
- There is 1no. OSI mapped pond.
- There are no wetlands marked by Wetland Survey Ireland.

The following is noted regarding the aquatic environment in Zone ZS4:

- Zone ZS4 is in the Liffey and Dublin Bay catchment and the Liffey_SC_070 and Liffey_SC_090 Sub Catchment area.
- There are 3no. EPA watercourses in ZS4. Kill East (Morell 140; river waterbody code: IE_EA_09M010300), Blackchurch (Morell 140; river waterbody code: IE_EA_09M01030) and Newrow (Morell 140; river waterbody code: IE_EA_09M010300). These bisect the southern section of Zone ZS4 and all are classified as having moderate water quality and at risk of failing to meet WFD objectives.
- In the 500m ZoI are: Killhill (Painestown_010; river waterbody code: IE_EA_09P010400) which has poor water quality and is at risk and three watercourses with moderate water quality and classified as at risk: Castlewarden North (Morell 040; river waterbody code: IE_EA_09M010300), Castlewarden South (Morell 040; river waterbody code: IE_EA_09M010300) and Johnstown (Morell 040; river waterbody code: IE_EA_09M010300).
- There are 2no. OSI mapped streams, 2no. OSI mapped ponds, and 2no. OSI mapped field drains.
- There are no wetlands marked by Wetland Survey Ireland.

5.5.2 Land, Soils and Geology

As the footprint of the AIS technology is larger than the GIS technology, it is more likely to have a larger impact on Land, Soils and Geology. However, this is very dependent on the siting of the proposed South West Dublin 400 kV substation and as such both technologies score equally across all zones.

Zone ZS1 is underlain by poorly drained soils (mineral or organic) which, by their nature, typically remain wet for prolonged periods each year and reach saturation during precipitation events. However, soils beneath Zones ZS2, ZS3 and ZS4 are predominantly deep, well drained acidic (mineral) with areas of shallow, well drained, mineral alluvium and a small area of poorly drained soils, which by their nature, typically remain wet for prolonged period each year, reaching saturation during precipitation events.

The bedrock type in Zones ZS1, ZS2, ZS3 and ZS4 is calcareous greywacke siltstone and shale of the Carrighill Formation with greywacke and shale of the Tipperkevin Formation found in Zones ZS2, ZS3 and ZS4.

There is the potential for unknown karst features to exist within the zones. Landslide susceptibility is predominantly low across all 4no. zones.

Land use within Zones ZS1, ZS2, ZS3 and ZS4 is predominantly improved grassland with several areas of cultivated land and this is one of the most significant constraints here.

All options score Moderate-Low risk.

5.5.3 Material Assets

When scoring the risk associated with Material Assets, several factors have been considered and these are discussed below. All options scored Moderate-Low risk.

5.5.3.1 Forestry

All zones contain small areas of broadleaved forest and woodland, and treelines throughout the zone. Zones ZS3 and ZS4 also contain small areas of mixed forest and transitional forest.

5.5.3.2 Farmland

Land use within Zone ZS1 is predominantly classified as improved grassland with areas of cultivated land throughout. Zones ZS2, ZS3 and ZS4 are predominantly cultivated land and improved grassland. As AIS substations have a larger footprint than GIS substations, the AIS technology is therefore likely to have a more significant impact on farmland.

5.5.3.3 Greenbelts/Open Spaces

None of the zones lie within greenbelts.

5.5.3.4 Bogs/Peats

Based on desktop sources, no peat has been identified in Zones ZS1, ZS2 and ZS3. Zone ZS4 contains small areas of blanket bog within the zone.

5.5.3.5 Residential and Town Centres

There are no residential or town centres within the zones, however, there are individual residences along the road network.

5.5.3.6 Commercial and Industrial

There are no EPA licenced facilities or SEVESO sites within the zones, however, there is 1no. upper tier Seveso site (Dascher Ltd.) located approximately 60 m northwest of Zone ZS2.

5.5.3.7 Built Services

There is 1no. 110 kV OHL along the northern boundary of Zone ZS1, 1no. 110 kV OHL and 1no. 220 kV OHL running through Zone ZS2 and Zone ZS4.

Once specific sites have been identified in Step 4, and potential routes for the circuits have been identified, further detailed assessment on built services will be undertaken – this includes water, sewer, surface water, telecommunications, etc.

5.5.4 Noise and Vibration

The risk of each option, associated with Noise and Vibration, is dependent on the siting of the proposed South West Dublin 400 kV substation relative to sensitive noise receptors, and therefore further assessment is required in Step 4.

All zones contain individual residences along the road network, and are all scored Moderate-Low risk for both technology options.

5.5.5 Water

When scoring the risk associated with Water, several factors have been considered and these are discussed below. Zones ZS2 and ZS4 scored Moderate-High risk, largely due to probability of flooding, the risks associated with impacts on watercourses and waterbodies (highest in Zone ZS2), and the risks associated with impacts on groundwater bodies (highest in Zone ZS4). Zone ZS1 scored Moderate risk, and is the only zone with GSI-reported boreholes. Zone ZS3 had the least water-related risks, and scored Moderate-Low.

Whilst the larger footprint of AIS substations, in comparison to GIS substations, would suggest a larger impact on water sources, it did not warrant a different score (per zone) for the different technology options. The scores were driven by the risks identified in each zone, and would be common to both technology options.

5.5.5.1 Watercourses and Waterbodies

Potential impacts to watercourses/waterbodies is a key constraint for the South West Dublin 400 kV substation zones. There are 2no. EPA watercourses within ZS1. Both water courses are classified as having 'moderate' water quality and are 'at risk' of failing to meet WFD objectives. There are 6no. OSI mapped features within ZS1; 1no. stream, 1no. field drain and 4no. ponds. The OSI stream and field drain connect to the EPA Banshee stream.

There are 6no. EPA watercourses within ZS2. 3no. are classified as having 'poor' water quality and are 'at risk' of failing to meet WFD objectives and 3no. are classified as having 'moderate' water quality and are 'at risk' of failing to meet WFD objectives. There is 1no. OSI mapped stream and 4no. OSI mapped ponds within the zone.

There are 3no. EPA watercourses within ZS3 and ZS4, classified as having 'moderate' water quality and as 'at risk' of failing to meet WFD objectives. There is 1no. OSI mapped pond in ZS3 while there are 2no. OSI streams, 2no. OSI mapped drains and 2no. OSI mapped ponds within ZS4.

Impacts on watercourses and waterbodies are site and design dependent and will be assessed in further detail once potential sites have been identified for the proposed South West Dublin 400 kV substation, and mitigation measures will be explored.

5.5.5.2 Groundwater Bodies

Zones ZS1, ZS2, ZS3 and ZS4 lie within the Kilcullen groundwater body which has 'good' groundwater quality and is 'at risk' of failing to meet WFD objectives. Furthermore, the southern portion of Zone ZS4 lies within the Industrial Facility (P0325-01) groundwater body which has 'poor' groundwater quality and is 'at risk' of failing to meet WFD objectives.

5.5.5.3 Groundwater Vulnerability

Groundwater vulnerability is a key constraint across all zones. Groundwater vulnerability per zone is as follows:

- Zone ZS1: predominantly classified as 'moderate' with pockets of 'high' and 'extreme' in the north and south. A very small area exists in the south with 'rock at or near surface or karst'.
- Zone ZS2: predominantly classified as 'extreme' and 'high' with small areas classified as 'rock at or near surface or karst' and 'moderate' throughout the zone.
- Zone ZS3: predominantly classified as 'high' with areas classified as 'extreme' and 'rock at or near surface or karst' and 2no. small areas classified as 'moderate'.

- Zone ZS4: predominantly classified as 'high' and 'moderate' with areas of 'low', 'extreme' and rock at or near surface or karst' throughout the zone.

Impacts on groundwater vulnerability are site dependent and will be assessed in further detail once potential sites have been identified for the proposed South West Dublin 400 kV substation, and mitigation measures will be explored.

5.5.5.4 Gravel Aquifer

No gravel aquifers were identified underlying any of the zones.

5.5.5.5 Groundwater Abstractions

There are no Public Supply Source Protection Areas or Group Scheme Preliminary Source Protection Areas within any of the zones. Zone ZS1 contains 2no. GSI-reported boreholes within the zones; 1no. of agricultural and domestic use, and 1no. of unknown use.

5.5.5.6 Flood Risk

Within Zones ZN1 and ZN3, there is no probability of flooding identified by the OPW. Within Zone ZS2, areas of medium and high flooding probability exist along the eastern border of the zone and the 500 m ZoI. Flooding probability is associated with Tootenhill Stream (Waterbody code: IE_EA_09L012100). In ZS4, there is an area of medium and high flooding probability in the southwest associated with Kill_East stream (Waterbody code: IE_EA_09M010300).

5.5.6 Air Quality Impact

Sensitive receptors to air quality are hospitals, schools, creches, residential properties etc. There are individual residences located along the road network within all zones. Castlewarden Golf Club is adjacent to Zone ZS1, and Beech Park Golf Club is adjacent to Zones ZS2 and ZS3.

For the AIS options, the scores are Moderate-Low for all zones. All GIS options score one risk category higher (i.e., Moderate) due to the use of SF6 gas. Although recent changes in European Law have legislated that substation switchgear equipment needs to be F-gases free from 2028 (<145 kV) and 2032 (>145 kV), the score of Moderate risk for all GIS options remains as this stage.

5.5.7 Planning and Policy

The South Dublin County Council Development Plan (2023-2029) and Kildare County Council Development Plan (2022-2028) have been considered when scoring the Planning and Policy risk for the proposed South West Dublin 400 kV substation zones. The alignment to Regional and National policies has also been considered and will form part of a Planning and Consent Strategy document which will be developed in future steps of the project. Table 5-6 shows a summary of key planning and policy requirements within and between the 4no. South West Dublin 400 kV substation zones.

Table 5-6 - Summary of Key Planning and Policy Requirements Relating to the 4no. SWD Substation Zones

Category	Description	ZS1	ZS2	ZS3	ZS4
Development Plan Policy	Relevant policies of the South Dublin County Council Development Plan (2023-2029) include: IE5 Objective 2	✓	✓	✓	✓

Category	Description	ZS1	ZS2	ZS3	ZS4
	Undergrounding of Utilities; Policy IE6: Electricity Infrastructure; IE6 Objective 2 Electricity Transmission and Distribution Network.				
Development Plan Policy	Relevant polices of the Kildare County Council Development Plan (2022-2028) include: EC P2 Renewable Energy and associated grid infrastructure; EC P19 Electricity Transmission and Distribution Network; EC O67 Overhead Cables.	✓	✓	✓	✓
Development Plan Objectives	There are 2no. objectives for Traveller Accommodation in the area.		✓		
Land use zoning	Primarily located in an area zoned RU in the SDCC Development Plan (2022–2028), which seeks to protect and improve rural amenity and to provide for the development of agriculture. Public services, which includes all service installations necessarily required by electricity, are permitted in principle.	✓	✓	✓	✓
	Part located in the rural area of KCC, where the KCC Development Plan (2022-2028) applies. 2no. scenic routes (10 and 11) are located in the applicable Kildare rural area.	✓	✓	✓	✓
Aviation	Part located within the Conical Surface of Casement Aerodrome.	✓	✓	✓	✓
	Per Figure 12.1 of the SDCC Development Plan (2022-2028), part of the area is a location of Aviation Significance for any development.	✓	✓	✓	✓
	Part located within the Approach Surfaces, Take Off and Climb Surfaces, and Conical Surface of Casement Aerodrome.		✓	✓	✓
Transport	Local Objective SM6 applies - To improve the safety of the junction between the Kilteel Road (L2003) and Calliaghstown Lane (L6008).			✓	
Green Infrastructure	Part of the Griffeen Riparian Corridor and River Link (Secondary Green Infrastructure) traverses the area.	✓	✓		
	Part of the Rural Fringe Primary Green Infrastructure Corridor traverses the area.	✓	✓		

EirGrid has commenced engagement with the respective local authorities (i.e., South Dublin County Council and Kildare County Council). Engagement is ongoing and feedback from the local authorities will be considered in future steps of the project.

5.6 Socio-Economic Aspects

Table 5-7 shows a summary of the scores for the Socio-Economic Aspects of each option.

Table 5-7 - SWD 400 kV Substation MCA Scoring – Socio-Economic Aspects

Option	ZS1-AIS	ZS1-GIS	ZS2-AIS	ZS2-GIS	ZS3-AIS	ZS3-GIS	ZS4-AIS	ZS4-GIS
Technology Type	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**	**AIS**	**GIS**
Landscape & Visual								
Settlement & Communities								
Recreation, Amenity & Tourism								
Cultural Heritage								
Aviation & Defence								
Overall Socio-Economic Score								

Cultural heritage is a consistent constraint across all zones but scores higher for AIS technology. Substation development could potentially have adverse effects on the setting of archaeological monuments and sites, built heritage features, historic landscapes, protected structures and architectural conservation areas with the impacts expected to be greater in Zone ZS4.

Landscape and visual is identified as a key constraint in all zones and again AIS is expected to have greater impacts. Sections of Zones ZS1, ZS2 and ZS4 lie within the KCC 'Eastern Transition' Landscape Character Area which is classified as medium sensitivity and an area with *"the capacity to accommodate a range of uses without significant adverse effects on the appearance or character of the landscape having regards to localized sensitivity factor"*. Furthermore, all zones lie in the 'foothills' landscape character type (LCT) and the principles for development here will need to be considered.

The GIS technology options scored at a lower risk than the AIS technology options (Moderate-Low vs. Moderate). This is mainly due to the larger footprint size associated with AIS substations when compared to GIS substations.

The scoring of risk associated with Socio-Economic Aspects during Step 3 has been done at an 'aggregated' level considering the constraints identified throughout the entire zones. As a result, there are areas within the zones that may score at a higher risk, and those that may score at a lower risk. Once sites have been identified, a detailed risk assessment specific to the sites themselves (and the areas the sites influence) will be carried out.

There is little/no variance in the scores between the zones, which is due to the following:

- In identifying the extents of the zones, the identified constraints and associated heat maps were used to (as best as possible) discard High risk and 'no-go' areas; and
- The risk scores are aggregated, and as such there may be pockets of each zone that would score higher or lower risk, but overall the zones risk ratings are similar to one another when the risk is aggregated.

An evaluation of each option is made under each socio-economic sub-criteria and is elaborated further in the following sections.

5.6.1 Landscape and Visual

Socio-economic constraints are related to landscape impacts as there are predicted to be visual impacts to specific changes in the character of available views and the effects of those changes on visual receptors.

AIS technology is likely to have a greater impact than GIS technology across all zones. This is due to the larger size of AIS substation footprints (relative to GIS substation footprints), and that the equipment for AIS substations is typically stored outdoors (as opposed to GIS substations where the equipment is mostly indoors).

All zones lie within the SDCC 'foothills' landscape character type (LCT) which is described as *"bedrock is largely sedimentary sandstones, shales and greywackes. These foothills rise well above 150m. Landcover increasingly rough pasture with coniferous plantations at hilltops. Recreation use with forest walks"*. This LCT is classified as medium to high sensitivity and high value.

Furthermore, Zones ZS1, ZS2 and ZS4 also lie within the KCC 'Eastern Transition' Landscape Character Area which is classified as medium sensitivity. This is an area with *"the capacity to accommodate a range of uses without significant adverse effects on the appearance or character of the landscape having regards to localized sensitivity factor"*.

5.6.2 Settlement and Communities

There are no large residential settlements or commercial/industrial settlements within the zones. However, there are several small residential settlements located along the road networks. For these reasons, all zones and options are scored Moderate-Low risk.

It is important to note that a Social Impact Assessment will be undertaken and there will be engagement with local communities towards the end of Step 3 and in future steps. The feedback from this engagement will be considered in this and future steps.

5.6.3 Recreation, Amenity and Tourism

Zone ZS1 is scored Moderate-Low risk, for both technology options, as the Castlewarden Golf Club is adjacent to the zone.

Zone ZS2 and ZS3 are scored Moderate-Low risk, for both technology options, as the Beech Park Golf Club is adjacent to the zones.

5.6.4 Cultural Heritage

The Cultural Heritage risk has been scored based on the presence and number of National Inventory of Architectural Heritage (NIAH) features, Sites and Monuments Record (SMR), Architectural Conservation Areas and County Record of Protected Structures (Table 5-8) and the risks have been scored accordingly. In general, due to its larger footprint, the AIS technology options are scored at a higher risk than the GIS technology options.

For Zones ZS1, ZS2 and ZS3, the AIS technology options score Moderate risk (due to a larger footprint) whereas the GIS technology options score Moderate-Low risk. For Zone ZS4, due to the higher number of features identified, ZS4 scores Moderate-High for the AIS technology option and Moderate for the GIS technology option.

As the risk assigned considers the entire zone, a site-specific risk will be assigned once potential sites are identified in Step 4.

Table 5-8 - Number of Cultural Heritage Features Identified per SWD Zone

Zone	ZS1	ZS2	ZS3	ZS4
NIAH features	3	1	1	1
SMR features	2	1	2	8
Protected structures	0	0	1	0

5.6.5 Aviation and Defence

There is no airport infrastructure situated within any of the zones, however, the proximity to Casement Aerodrome (Baldonnell) may present an issue from an aviation safeguarding perspective and will require engagement with the relevant aviation and military authorities at consultation stage. All options have been scored Moderate-Low risk.

6. Conclusion

This report has assessed the 6no. options for the proposed West Dublin 220 kV substation and the 8no. options for the proposed South West Dublin 400 kV substation. Both proposed substations form part of the CP1226 Kildare Dublin Grid Reinforcement project. The assessments were carried out via a Multi-Criteria Analysis (MCA) process in line with EirGrid's MCA Guidelines. The evaluation considered technical performance, economic assessment, deliverability aspects, environmental aspects, and socio-economic aspects.

A feasibility review for both OHL and UGC technologies was undertaken for all four (4no.) proposed circuits to ensure that a route can be found between the start points of the circuits and the sub-study areas for the proposed substations. The review considered the heat maps produced as part of the constraints assessment and considered the viability of both OHL and UGC corridor options between the proposed substations. Further assessment of the potential circuit corridors and associated technologies will be undertaken in Step 4.

6.1 West Dublin 220 kV Substation

Due to the extent of land associated with the substation zones (ZN1 to ZN3), ranging in size from 150 ha to 345 ha, the performance/scoring of a particular constraint will vary from High to Low depending on the location of the constraint within the zone. The approach to the scoring assessment has therefore looked at an 'aggregate' risk across the substation zone.

As a result of this aggregated approach to the scoring assessment, the scores for most of the criteria are Moderate, and with some criteria scored as Moderate-Low. Deliverability is mostly scored Moderate-High across the options, with Land Availability and Ease of Construction being the key drivers / sub-criteria. Ease of Connectivity, a sub-criteria assessed as part of the technical performance of the options, is another key driver.

Whilst there are differences between the performance of the options for certain criteria, when combining the criteria to determine the overall performance for all options, there is no distinguishable difference between the 6no. options under consideration as all score Moderate risk.

In the MCA Workshop, the EirGrid Cross-Functional Team and the project team decided that given the similar performance for both technologies and the zones, that all 6no. options will be brought forward as Emerging Best Performing Options to Step 4 for further assessment. These 6no. options include an AIS and GIS technology in each of the 3no. zones (i.e., ZN1, ZN2 and ZN3) shown in Figure 6-1.

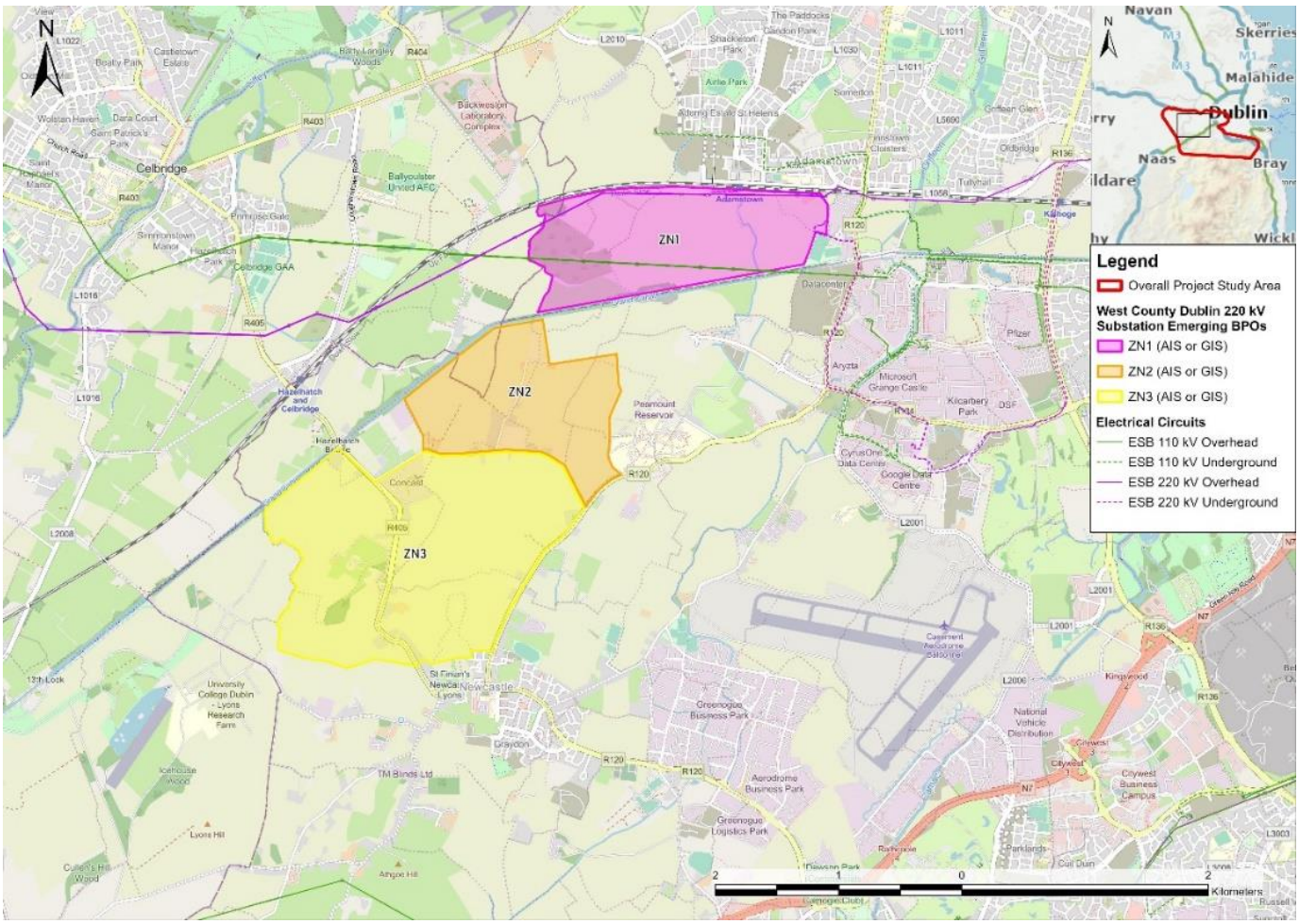

Figure 6-1 - West Dublin 220 kV Substation Emerging BPOs for Consideration in Step 4 (© OpenStreetMap)

6.2 South West Dublin 400 kV Substation

Due to the extent of land associated with the substation zones (ZS1 to ZS4), ranging in size from 145 ha to 265 ha, the performance/scoring of a particular constraint will vary from High to Low depending on the location of the constraint within the zone. The approach to the scoring assessment has therefore looked at an 'aggregate' risk across the substation zone.

As a result of this aggregated approach to the scoring assessment, the scores for most of the criteria are Moderate, and with some criteria scored as Moderate-Low. Deliverability is scored Moderate-High across all options, with Land Availability and Ease of Construction being the key drivers / sub-criteria.

Whilst there are differences between the performance of the options for certain criteria, when combining the criteria to determine the overall performance for all options, there is no distinguishable difference between the 8no. options under consideration as all score Moderate risk.

In the MCA Workshop, the EirGrid Cross-Functional Team and the project team decided that given the similar performance for both technologies and the zones, that all 8no. options will be brought forward as Emerging Best Performing Options to Step 4 for further assessment. These 8no. options include an AIS and GIS technology in each of the 4no. zones (i.e., ZS1, ZS2, ZS3 and ZS4) shown in Figure 6-2.

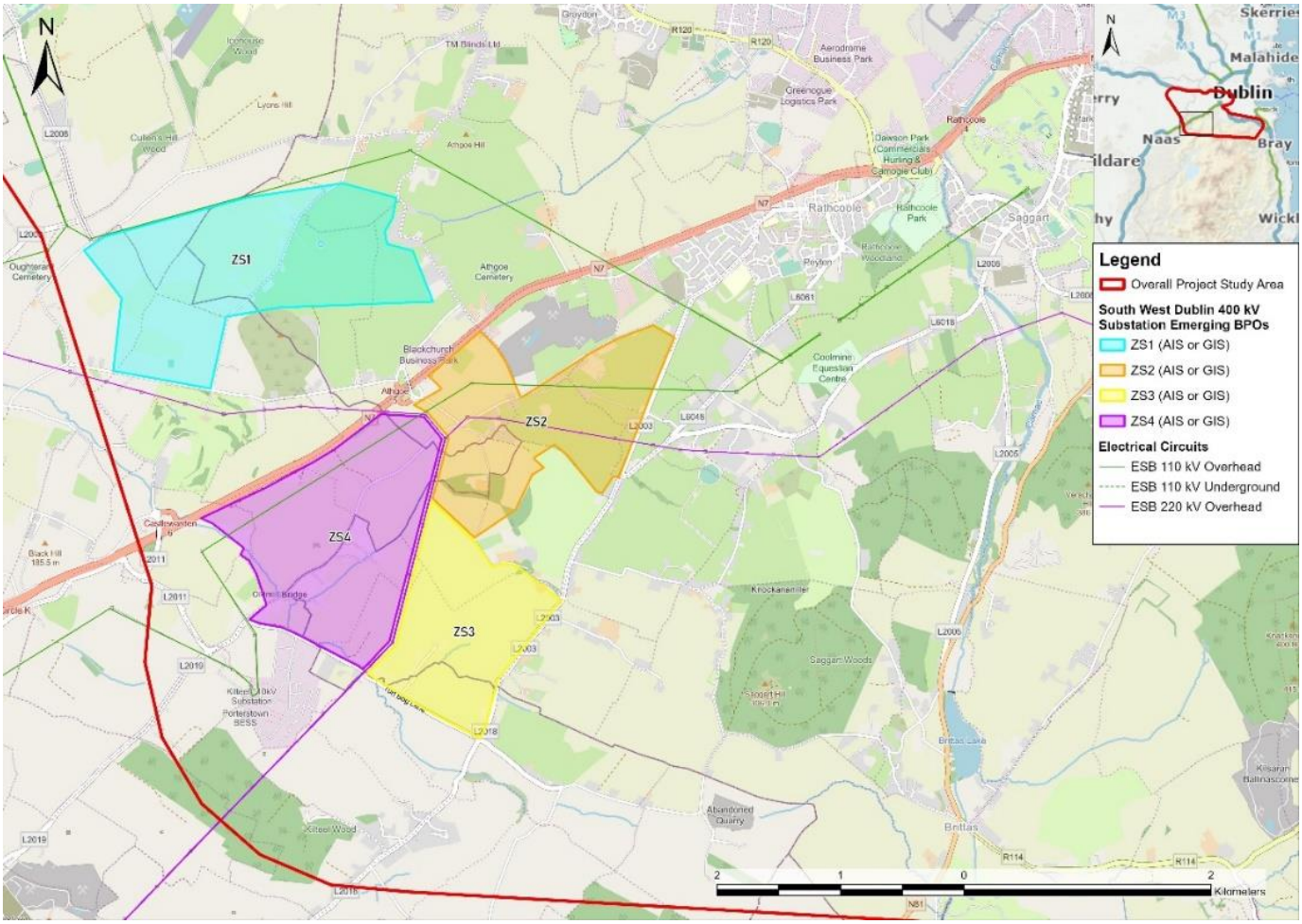

Figure 6-2 - South West Dublin 400 kV Substation Emerging BPOs for Consideration in Step 4 (© OpenStreetMap)

7. Next Steps

This report, the CP1226 Step 3 Report, will be published and presented to the public through a public consultation process, led by EirGrid. The feedback from the public consultation will be documented by EirGrid and considered by the project team in the future steps of the project.

EirGrid has commenced engagement with key stakeholders and this process will continue in parallel with the public consultation process, and into future steps of the project.

For the selection of the preferred substation technology and site for the proposed substations, the identification of suitable sites is required. EirGrid has commenced landowner engagement to identify landowners who are interested in selling suitable land to EirGrid, and this engagement will also continue in parallel with the public consultation process, and into future steps of the project.

Once potential sites are identified for the proposed substations, a further assessment will be carried out in Step 4 to reduce the number of potential sites to 2-3no. sites. Once the number of sites has been reduced, further assessment on the connecting circuits can be carried out. This assessment will include a review of the technologies (i.e., OHL, UGC or hybrid) for the circuits, as well as potential corridors/routes for the circuits.

These substation site and circuit corridor options will then undergo a detailed MCA assessment in Step 4 to identify an Emerging Best Option (EBO), which will be subject to further public consultation in Step 4.

The assessments in future steps will be aided by site visits, site walkover surveys, and if applicable, site investigations. These may include, but are not limited to, the following:

- Topographical surveys;
- Ground investigations, including test pits and boreholes;
- Ground penetrating radar (GPR) surveys;
- Slit trench surveys;
- Ground resistivity measurements;
- Soil contamination testing; and
- Ecological and environmental site investigations.

During the future steps, the following reports will be prepared:

- Social Impact Assessment;
- Planning and Consent Strategy;
- Screening for Appropriate Assessment and Screening for Environmental Impact Assessment;
- Step 4 Report; and
- Step 5 Report.

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