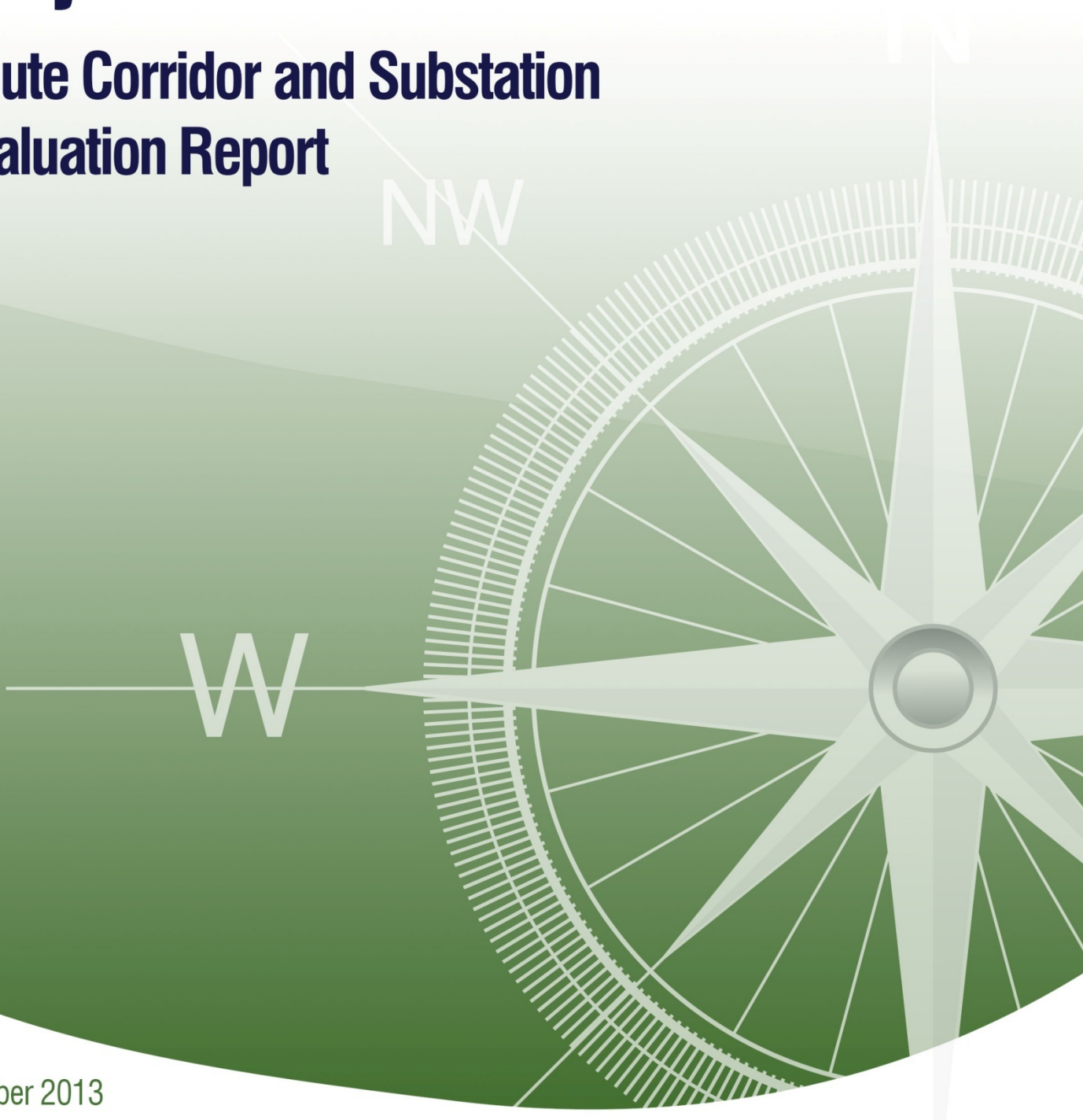
The Grid West Project

Route Corridor and Substation Evaluation Report



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TOBIN Consulting Engineers

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REPORT

PROJECT: **Grid West Project**

CLIENT:

EirGrid PLC
The Oval
160 Shelbourne Road
Ballsbridge
Dublin 4

COMPANY:

TOBIN Consulting Engineers
Block 10-4
Blanchardstown Corporate Park
Dublin 15

www.tobin.ie

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TOBIN Consulting Engineers							

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1 EXECUTIVE SUMMARY

Stage 1 of the the Grid West project incorporated the identification of a number of route corridor options which could accommodate a proposed 400kV line from the Bellacorick area of north Mayo to connect to the existing national electricity grid at existing substations in either Cashla, Co. Galway or Flagford, Co. Roscommon. Following publication of a Stage 1 Report, which incorporated the identification of a Least Constrained Corridor, all of the identified route corridors were the subject of extensive public consultation

The purpose of this Route Corridor and Substation Evaluation Report is to identify an Emerging Preferred Corridor and Substation locations for the Grid West project, taking into account all feedback received from stakeholders on the Stage 1 Report.

The submissions received on the Stage 1 Report were analysed by theme in a Workshop (Workshop No. 1) and this is discussed in Chapter 3 of this Report. While many of the submissions relate to the project overall, some are geographically and environmentally specific, both on the Least Constrained Route Corridor as identified in that report and on the other route corridor options. At this Workshop the Project Team validated the Least Constrained Route Corridor as continuing to be least constrained, having considered all submissions received.

Chapter 4 describes the route corridor evaluation process taking into account further site visits, review of aerial photography and the results of further environmental studies. It details how at a subsequent Workshop (Workshop No. 2) the Project Team maintained their position that the Least Constrained Route Corridor remained *least constrained*.

Chapter 5 includes a technical and environmental review of the substation options at Bellacorick and Flagford, based both on submissions received and on consideration of the routing options on the future extendibility of the substations. Particularly at Bellacorick, the western terminus of the Grid West project, routing options on the future extendability of the substation places significant constraints on the previously identified least constrained substation location (SB1). These constraints derive from accessibility of transmission circuits to and from the substation, not the location of the substation itself. These constraints need to be considered in the evaluation of the preferred substation location. Following considering of these constraints, it was found that the previously identified substation location SB2 in the Bellacorick area is the preferred substation location. Flagford has been confirmed as the eastern terminus of the Grid West project.

Chapter 6 reviews the proposed modifications to the Least Constrained Route Corridor which emerged resulting from analysis of submissions and relevant technical work. It also documents a review of the evaluation matrix applied to the modified Least Constrained Corridor. It confirms the *modified* Least Constrained Route Corridor as the Emerging Preferred Route Corridor following this evaluation exercise.

The Least Constrained Route Corridor was identified because it is least constrained overall, compared to the other corridor options, across all of the constraints considered. Some geographically specific

submissions were received expressing the view that areas close to particular sections within the Least Constrained Route Corridor are locally less constrained and that these should be examined. In identifying route corridors and in evaluating the Stage 1 Report consultation submissions, the project team has identified, from site visits, that there are areas of locally more dense constraint or 'pinch points', within all corridors, including the Least Constrained Route Corridor.

The EirGrid Roadmap clearly envisages a process of local modifications to make a corridor, which is already least constrained in an overall sense, even less constrained through refinement. This has been considered with the specialist team and the refinements and modifications which are proposed to the Least Constrained Route Corridor are discussed in Chapter 6.

Chapter 7 identifies the Emerging Preferred Route Corridor and Substation location for Bellacorick and Flagford substations.

2 INTRODUCTION

Grid25 is EirGrid's strategy to develop and upgrade the electricity transmission network from now until 2025. The Grid West project is the largest Grid25 project in the West, initially accounting for an estimated €240m of the investment earmarked for the region. By connecting the electricity generated by the region's huge renewable energy resources, the Grid West project will facilitate significant job creation and investment. It will contribute to national recovery and growth while at the same time allowing the region to attract inward investment which requires a strong reliable source of power.

This project will contribute to Ireland's national goal to achieve 40% of electricity consumption from renewable sources by 2020. These renewable resources include wind, wave and tidal energy. The existing transmission infrastructure in this region needs substantial investment and development to accommodate the West's increasing levels of renewable generation.

2.1 PURPOSE OF THIS REPORT

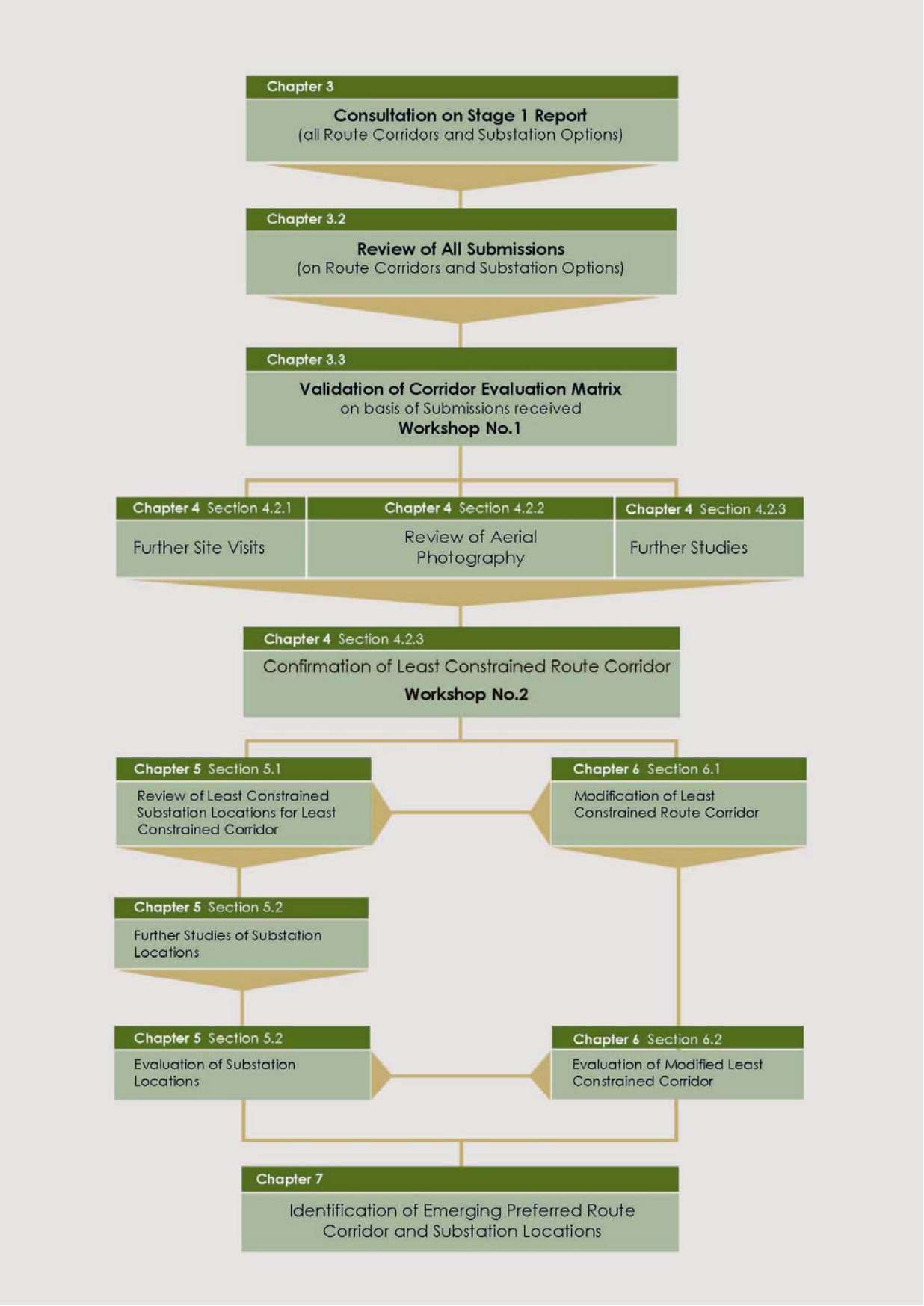
The purpose of the Route Corridor and Substation Evaluation Report is to identify an Emerging Preferred Corridor and Substation Locations for the Grid West project, taking into account all feedback received from stakeholders on the Stage 1 Report. As a project develops, additional information is received by the Project Team both from external sources and from design developments. It is important that this additional information is used to refine the project. Therefore, as this project progressed and further information was available to the Project Team, the following work was carried out:

- Documentation and mapping of features detailed in the stakeholder submissions (aided by aerial photography),
- Further site visits and
- Further more detailed studies.

All of the above work culminated in the identification of the Emerging Preferred Corridor and Substation Locations for the Grid West project.

The progression of the process from Consultation on the Stage 1 Report to confirmation of the Emerging Preferred Corridor is presented in Figure 2-1.

Figure 2-1 Progression of the process from Consultation on the Stage 1 Report



2.2 SUMMARY OF STAGE 1

Stage 1 commenced with defining a Study Area for the Grid West Project. Work then moved to mapping of more than eighty constraint datasets covering Ecology, Landscape, Geology, Water, Cultural Heritage, Settlements, Utilities & Infrastructure and Engineering Considerations. These included both statutorily designated lands under regulations implementing EU Directives and land uses defined by County Development Plans. These constraints were explained and analysed in the Grid West Constraints Report, which was published in August 2012.

Two separate periods of public consultation took place in reaching that waypoint; the first on the Study Area boundaries for the Project and the second on the Constraints Report itself. In essence, the public and the key statutory and non-statutory stakeholders were asked whether the proposed Study Area was adequately defined, given the stated objectives of the Project, and whether the developed datasets of Constraints were comprehensive, or needed to be augmented to include other constraining elements that should be taken into account in the process of corridor development and evaluation.

The feedback received from both of those public consultations then informed the process of identification of route corridors.

In Stage 1, the mapped constraints included both settlements and a large number of environmental datasets. The positioning of corridor options sought to avoid settlements and environmental constraints which were statutorily designated in order to achieve best positioning with respect to non statutory designated areas. This was done with the assistance of 'heat mapping', which identified heavily constrained 'hot spots' and less constrained 'cooler' areas within the Study Area. The Stage 1 Report describes in detail how sixteen route corridor options, composed of distinct groups of route corridors in the Bellacorick, Flagford and Cashla area, were positioned by the environmental and technical specialist team, aided by the 'heat mapping', in a strategy of avoidance of impact by best possible positioning of corridor options from the very beginning.

The Stage 1 Report set out in detail the evaluation criteria to be used in comparing route corridors and in determining the Least Constrained Corridor. It also set out the detailed evaluations, by each specialist, of each of the corridor elements, giving the reasoned opinion of that specialist in comparative analysis of each of the route corridors Refer to Appendix 6.2 "Route Corridor Evaluation Report" of the Stage 1 Report.

In this open, transparent and detailed presentation in the Stage 1 Report, all of the factors leading to the identification of route corridor B1/B2/B3/B9/F1/F3/F6/F7, from the Bellacorick substation area to the Flagford substation area, as the Least Constrained Route Corridor, were presented to the public and to all the key stakeholders. 'Least constrained' in the context of this Report should be considered to mean 'best fit' from a technical and environmental perspective. The Report presented the definitive view of the specialist team that route corridor B1/B2/B3/B9/F1/F3/F6/F7 was the Least Constrained Route Corridor and explained why, in its view, it was the overall least constrained of all the sixteen identified route corridor options.

Figure 2-2 Least Constrained Route Corridor

The Public Consultation Period on the Stage 1 Report, which included eight Open Days, commenced on March 5th 2013 and, while the period of focused consultation extended to April 16th 2013, submissions received after that date were also taken into account in the review and evaluation process in this Report.

Engagement by the public with the Project Team in that public consultation process was vigorous and very valuable. Almost 700 people attended the Open Days, and more than 1,100 submissions or contacts were recorded over the extended consultation period.

2.3 CONTEXT WITHIN THE EIRGRID ROADMAP

The Lead Consultant's Stage 1 Report ('the Stage 1 Report'), published in March 2013, marked the end of Stage 1 of the Grid West Project, as defined in EirGrid's Project Development and Consultation Roadmap (Plate 2-1). The Project is now in Stage 2, the Options Evaluation Stage, and this is the first Report in Stage 2 which details the process for route corridor and substation evaluation.

Plate 2-1 EirGrid Project Development & Consultation Roadmap

3 EVALUATION OF STAKEHOLDER FEEDBACK - STAGE 1 REPORT

Two levels of feedback on the Stage 1 Report are detailed in this Chapter; these include high level[1] analysis of feedback by theme which is presented in Section 3.2.1 and spatially specific[2] feedback which is detailed in Section 3.2.2.

3.1 CONSULTATION ON THE STAGE 1 REPORT

Information on the Stage 1 Report including identifying sixteen potential route corridors, amongst them the Least Constrained Route Corridor was published in March 2013. EirGrid undertook a six week period of public consultation to inform stakeholders and communities of the report and to seek feedback on the project.

A number of open days (eight in total) were held across the study area in order to facilitate direct access to information and personnel working on the Grid West project. These were held in:

- Athenry, County Galway
- Galway City
- Bangor Erris, Kiltane, County Mayo
- Ballina, County Mayo
- Swinford, County, Mayo
- Claremorris, County Mayo
- Ballaghaderreen, County Mayo
- Carrick-on-Shannon, County Leitrim

EirGrid also undertook a series of public communications initiatives to extensively engage with people and promote the Stage 1 Report, including:

- Update of Grid West project website with link to all relevant information;
- Publication of an updated project information brochure, in both English and Irish;
- Development and publication of a Guide to Stage 1 Report;
- Advertisements via local radio and newspapers;
- Issue of a press release to local media;
- Radio interviews with local radio conducted in and around the open days;
- Placement of prominent posters in towns where open days were scheduled to take place;
- Direct contact with all elected representatives and dedicated briefings in advance of open days; and
- The opening of the information centre at Castlebar for five days a week for the period of consultation.

EirGrid is committed to a comprehensive consultation process and to meaningful engagement with the general public and local community. All feedback received was very useful for the project team and played an important role in guiding the approach to consultation and highlighting individual issues of

[1] High level feedback means that the feedback is general eg, concerned about impact on the environment.
[2] Spatially specific feedback means that it relates to a geographic region, for example a town or townland.

significance, which were subsequently considered in the evaluation of the corridor matrix.

The Project Team continue to review feedback and submissions on the project and updated feedback is being continually considered and will form part of subsequent reports on public consultation over the next phase of the project. Some of the information received at this stage of the project will be more relevant at line design stage and will form part of considerations at this point.

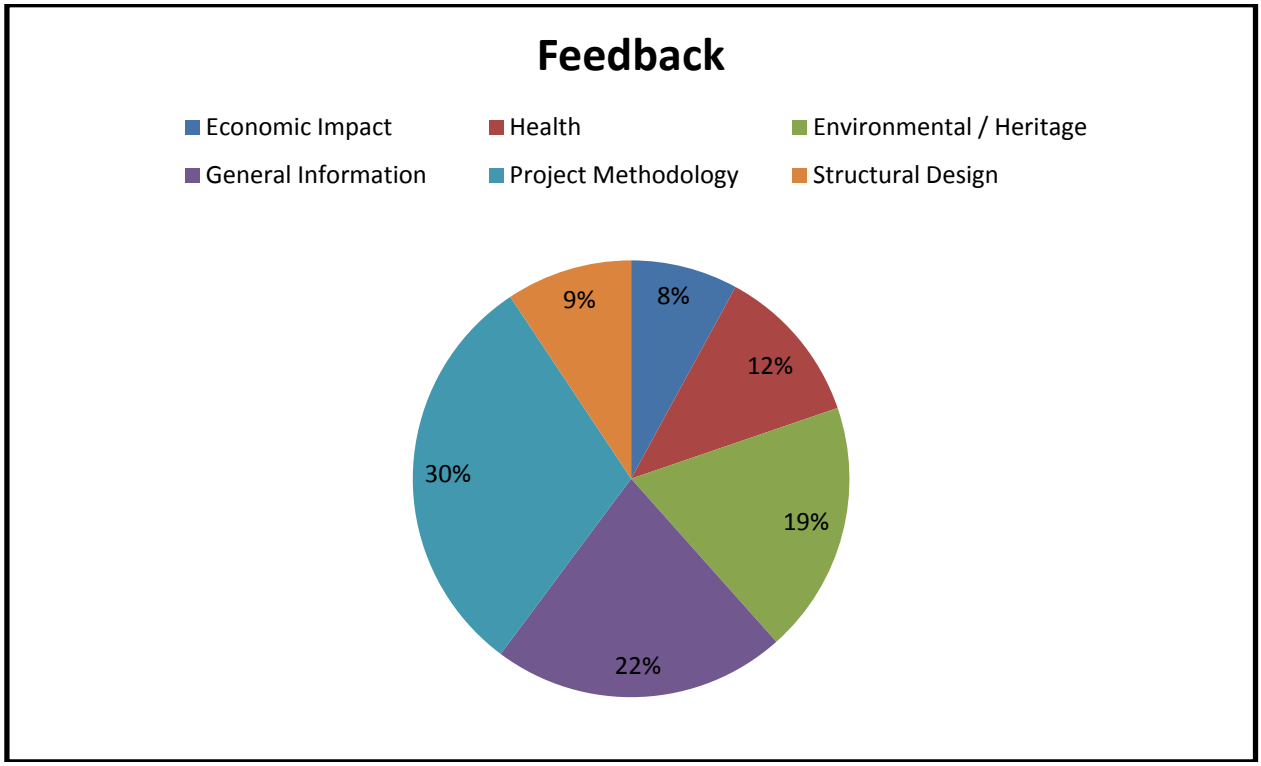
3.2 CLASSIFICATION & REVIEW OF CONSULTATION

The Project Team analysed all feedback and an overview of all feedback by theme is provided in the following table.

3.2.1 Feedback on Stage 1 Report by Theme

Figure 3-1 detailed the feedback on the Stage 1 Report by theme.

Figure 3-1 Feedback on Stage 1 Report

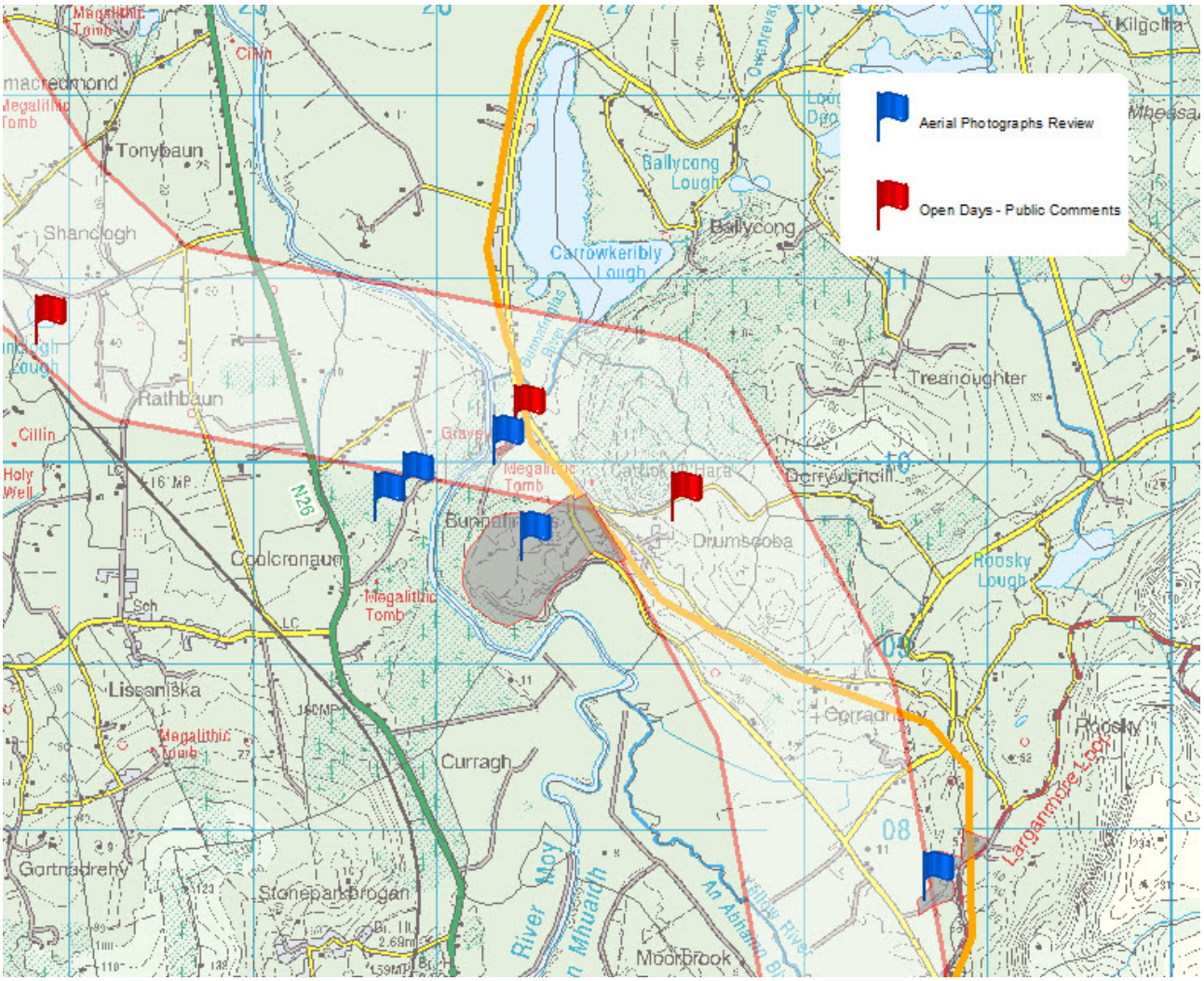


3.2.2 Spatially Specific Feedback on Stage 1 Report

All information gathered during the public consultation on the Stage 1 Report in Spring 2013 was appraised and its content examined. Those submissions which raised environmental or technical issues were then grouped into themes and reviewed in detail by each of the specialists on the Project Team, relevant to their area of expertise. Where the information was geographically specific in detail, this information was mapped and added to the Grid West Geographic Information System (GIS). For example Figure 3-2 shows geographic specific information from both technical and environmental

submissions received, indicated as a red flag and from a review of aerial photography, indicated as a blue flag.

Figure 3-2 Example Information Mapped in GIS



Approximately 1,100 submissions were reviewed. Of these, 189 related to environmental or technical constraints. In total, 68 of these submissions related to information which was spatially specific, i.e. the submission mentioned a specific area in which there was a constraint.This information was then mapped onto the Grid West GIS system. All of these submissions were appraised by each of the relevant Project Team specialists, to determine whether the submission added to what was already known. Where considered necessary or appropriate, further site visits were undertaken by the Project Team and specialists.

Of the 68 submissions which were spatially specific, approximately 50% of these related to submissions on the least constrained route corridor, while 50% related to information on the other route corridor options.

These submissions related to the following type of information:

- Proximity to Villages;
- Proximity to Settlement & Community Buildings; and
- Areas of Amenity - Golf courses, Playing pitches, Game Sanctuary, Camping Grounds, Walkways;
- Flooding risk areas;
- Turloughs, Lakes;
- Group Water Scheme Co-ops;
- Local Airfields, Knock Airport, Helicopter Pads;
- Cultural Heritage sites;
- Whooper Swan habitat, Breeding Bird Sites, Marsh Fritillary habitat, Wilderness Area;
- Locally Important Sites - Statues, Shrines, Queen Maeve's Grave, Sacred Hill (Shron Hill);
- Proximity to wind farms.

3.3 VALIDATION OF LEAST CONSTRAINED ROUTE CORRIDOR - WORKSHOP NO. 1

Two internal workshops were held within the Project Team in appraising the consultation submissions, in May and June 2013. Prior to the initial Workshop, written submissions from the public and stakeholders on all route corridors were examined for environmental and technical observations and, where submissions with specific geographic locators were received, these were mapped. The details of the submissions were therefore available to the different specialists for their consideration prior to the first Workshop. In addition, archaeological features, which had previously been available only as 'point' data[3], had been developed in the interim period since the Stage 1 Report into features of recognisable spatial extent.

At this Workshop, the characteristics of the Least Constrained Route Corridor, and its comparative position in the evaluation matrix, were reviewed in the context of the submissions received on all corridors. This validation included a formal confirmation by each of the Specialists, following their review of the submissions that the original matrices as set out in the Stage 1 Report remains unchanged, as set out in Table 3-1 and 3-2.

The evaluation of the Bellacorick group of route corridor options is presented schematically in a matrix format in Table 3-1.

[3] At the time of compiling the constraints data for the Grid West Project only point data was available in a digital format, however, more recently, data for RMP Zones has been made available for download on the www.archaeology.ie website. At this stage the RMP Zone data is incomplete and appears to be a work in progress. The only alternative source for this data is the original paper copies of the 6 inch OS RMP maps which were reviewed at the least constrained route corridor selection phase.

Table 3-1 Bellacorick Route Corridor Options Evaluation

Constraints	B1/B2/B3/B9	B1/B2/B4/B8/B11	B1/B5/B6/B9	B7/B11	B1/B5/B8/B11
Settlements					
Ecology					
Landscape					
Cultural Heritage					
Technical					
Geology					
Water					
Length of Line					

The evaluation of the Flagford group of route corridor options is presented schematically in a matrix format in Table 3-2.

Table 3-2 Flagford Route Corridor Options Evaluation

Constraints	F1/F2	F1/F3/F6/F7	B10/F4/F5/F6/F7	B10/F4/F8/F7
Settlements				
Ecology				
Landscape				
Cultural Heritage				
Technical				
Geology				
Water				
Length of Line				

Following this detailed review of the Least Constrained Route Corridor, the Project Team confirmed that while new information had come to light in the review of the consultation submissions, this information did not have a substantive effect on the comparative merit of the route corridors. This led the Project Team to consider that the Least Constrained Route Corridor, as identified in the Stage 1 Report, remained the *least constrained*.

The review has accordingly allowed the Project Team to validate the Least Constrained Route Corridor.

This initial Workshop noted that there were areas of locally more dense constraint, or 'pinch points', within the Least Constrained Route Corridor (notwithstanding the fact that it remains the least constrained corridor). Each specialist subsequently visited the Least Constrained Route Corridor to review the information detailed in the submissions, to examine the local options and circumstances at 'pinch points' and to consider localised modifications to the corridor which would improve it, from the viewpoint of each specialism, taking the views expressed in the submissions into account.

4 ROUTE CORRIDOR EVALUATION

As noted above, there are areas of locally more dense constraint, or 'pinch points', within all of the route corridors, including the Least Constrained Route Corridor. This is especially the case when it comes to settlements, given the density of one off housing in the Study Area, (Refer to Figure 4-1 below).

4.1 OPTIMISING WITH RESPECT TO SETTLEMENTS

In Stage 1, positioning of corridor options as far as possible from larger population centres was achieved by treating such settlements as primary constraints in the 'heat mapping' process.

Route corridors were identified, with the aid of 'heat mapping' all of the constraints, to avoid as many constraints as possible from the outset, by good positional design.

Despite the benefits of good positioning in this way, no corridor, including the Least Constrained Route Corridor, can completely succeed in avoiding all environmental constraints or rural settlement clusters.

The Geo-directory database was used to locate as precisely as possible each residence within the study area. Established by An Post and Ordnance Survey Ireland, Geo-directory identifies the precise address and location of every residential and commercial property in the State, assigning each property its own unique, verified address in a standardised format, and precise geographical location.

The Geo-directory data confirmed a significant dispersed pattern of settlement across the study area, with considerable spread of dwellings outside towns and smaller settlement nodes. The existence of such a spread of housing across the landscape constitutes a substantial constraint to grid development in general, and to identification of a preferred corridor for the Grid West project in particular.

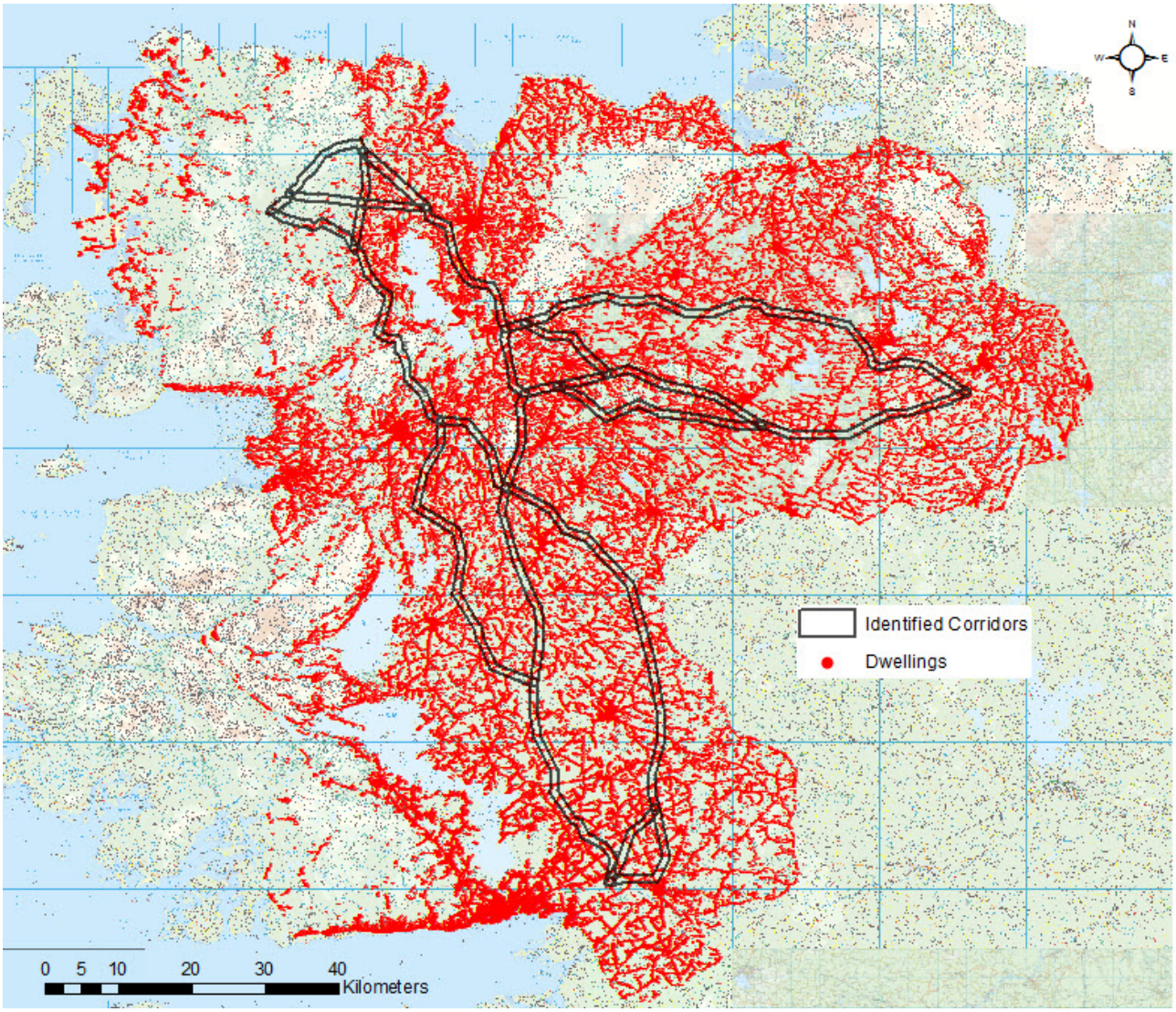
In this regard, Figure 4-1 shows the Geodirectory 'point' database of all rural residential housing throughout the Study Area. It must be clearly understood that this diagram incorporates no other environmental, infrastructural or technical constraint; it deals purely with settlement patterns.

With respect to routing transmission lines, on the grounds of general amenity, where possible overhead transmission lines will be routed to avoid residential areas. With respect to individual houses, the aim at route selection stage will be to achieve the maximum separation distance between existing dwellings and a planned line route, while also seeking to avoid, or minimise impact upon, other identified technical and environmental constraints. In this context, where possible, a lateral clearance of 50 metres from the centre of the proposed route to the nearest point of a dwelling will be sought. It should be noted that the 50 metre distance is only a routing aim and is not associated with distances that are required for electrical clearance.

Furthermore, it is clear that dwelling patterns in the West of Ireland are such that no corridor can avoid such a dispersed settlement pattern; the only large open areas on Figure 4-1 are lakes, mountains or

peatlands where, both technically and environmentally, it would be profoundly challenging to construct a new transmission line of the nature and extent planned for the Grid West project.

Figure 4-1 Rural Dwelling Patterns in the Grid West Study Area



4.2 REVIEW OF DATA FOR ROUTE CORRIDOR EVALUATION

Following a review of the submissions, it was concluded that the Least Constrained Route Corridor remains least constrained, at Workshop No.1.

Further work was completed in order to confirm the Least Constrained Route Corridor and to consider any requirements to modify this route corridor. This further work included:

- Further Site Visits;
- Detailed Review of Aerial Photography; and
- Further works to verify that the Least Constrained Route Corridor as modified can still accommodate a line route.

4.2.1 Further Site Visits

Further, more detailed site visits were completed by both the specialists and the route designers. These were focused along the Least Constrained Route Corridor and in particular at pinch points which had been identified from submissions received previously during the Stage 1 public consultation process, and considered during the Workshops with specialists.

These site visits allowed for:

- Verification of submissions from members of the public;
- Review of each road, rail and river crossing, where access was possible;
- Review of settlement patterns, especially ribbon developments, within the Least Constrained Route Corridor;
- Assessing the landscape for screening opportunities;
- Review of implementation issues e.g. ground conditions/ slopes/ peat/ access for construction; and
- Review of each "*pinch point*".

These site visits allowed the specialists to review and verify relevant information from stakeholder submissions and from the features identified following a review of the detailed aerial photography. These were then added to the Grid West GIS system.

4.2.2 Detailed Review of Aerial Photography

Detailed aerial photography was acquired and reviewed to allow additional features to be identified including:

- Quarries;
- Playing Pitches;
- Existing Graveyards;
- Equestrian Tracks;
- Walled Garden; and
- Tennis Courts.

The extent of these features was mapped and subsequently logged into the Grid West GIS system. For example Figure 3-2 above shows information identified during a review of aerial photography, indicated as a blue flag.

4.2.3 Further Studies

Further studies have been ongoing since March 2013 and were considered in confirming the Least Constrained Route Corridor. These studies include:

- Whooper Swan Studies;
- Breeding Bird Studies; and
- Marsh Fritillary Studies.

4.3 CONFIRMATION OF LEAST CONSTRAINED ROUTE CORRIDOR - WORKSHOP NO. 2

A second Workshop was held following the Project Team's site visits in order to review this additional work. The site visits allowed the Project Team to consider the significance of their observations and of features identified in the stakeholder submissions.

At the second Workshop, the Project Team maintained their position that the Least Constrained Route Corridor remained *least constrained*. The Least Constrained Route Corridor was confirmed based on the review of data from further site visits, detailed review of aerial photography and further studies.

At this Workshop the Project Team also reviewed the pinch points which were identified at the initial Workshop in order to improve further the confirmed Least Constrained Route Corridor. Section 6.1 provides details on the proposed modifications to the Least Constrained Route Corridor. These modifications would ultimately make the originally identified Least Constrained Route Corridor locally less constrained.

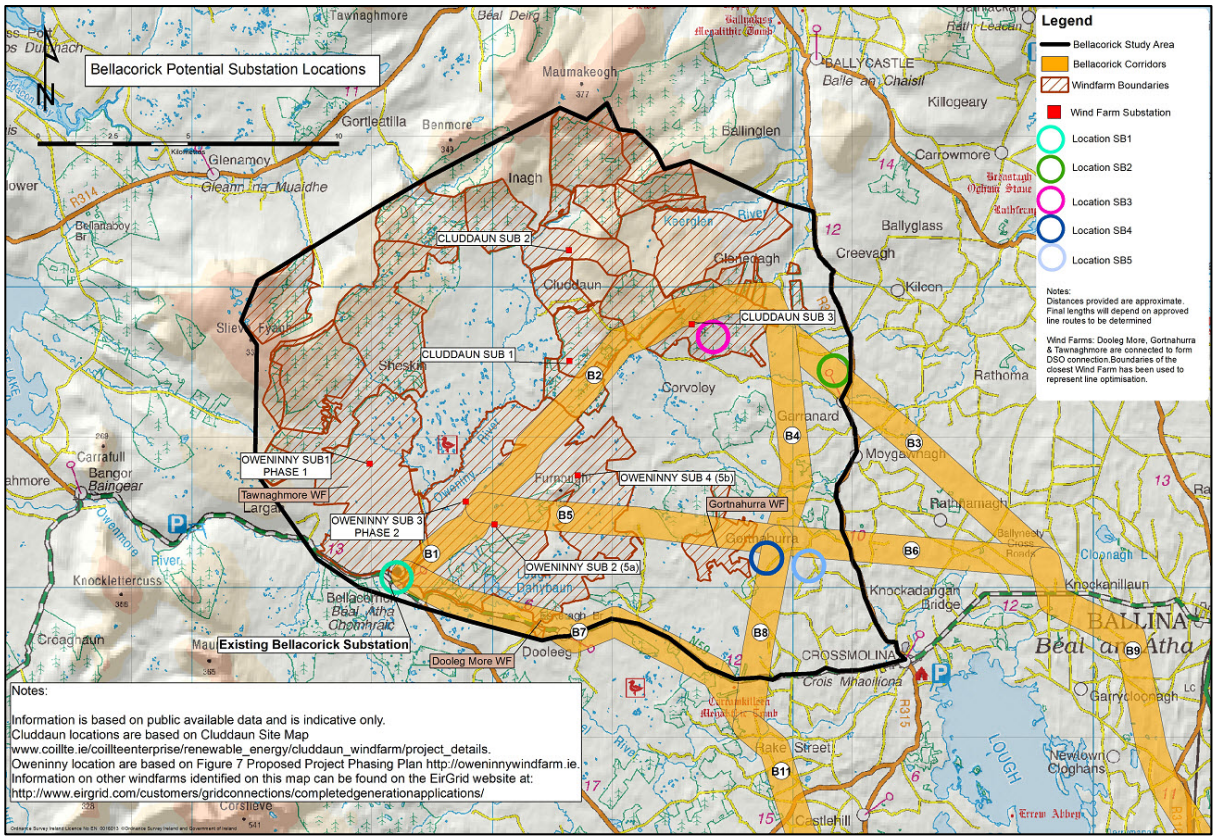
5 SUBSTATION LOCATION EVALUATION

5.1 LEAST CONSTRAINED SUBSTATION LOCATIONS

5.1.1 Bellacorick Substation Locations

The Stage 1 Report for the Grid West project identified five potential locations for the new 400kV/110kV substation in the Bellacorick area. These are illustrated in Figure 5-1 below.

Figure 5-1 Bellacorick Potential Substation Locations



In the Stage 1 Report, on evaluating these options against the criteria agreed for the Stage 1 Report, it was found that the location SB1 adjacent to the existing Bellacorick substation was the least constrained location, with the location SB2 the next least constrained location.

The Stage 1 Report did note that Location SB1 '*would only be suitable if a route for the 400kV line through the wind farms can be confirmed as acceptable under the EirGrid overhead line design standards*'. Since the publication of the Stage 1 Report, further more detailed studies have been undertaken, new information has been received, and further more specific site visits conducted. These have found that the options for routing overhead transmission lines into location SB1 are very limited, thus significantly limiting the extendibility of any future substation located at SB1.

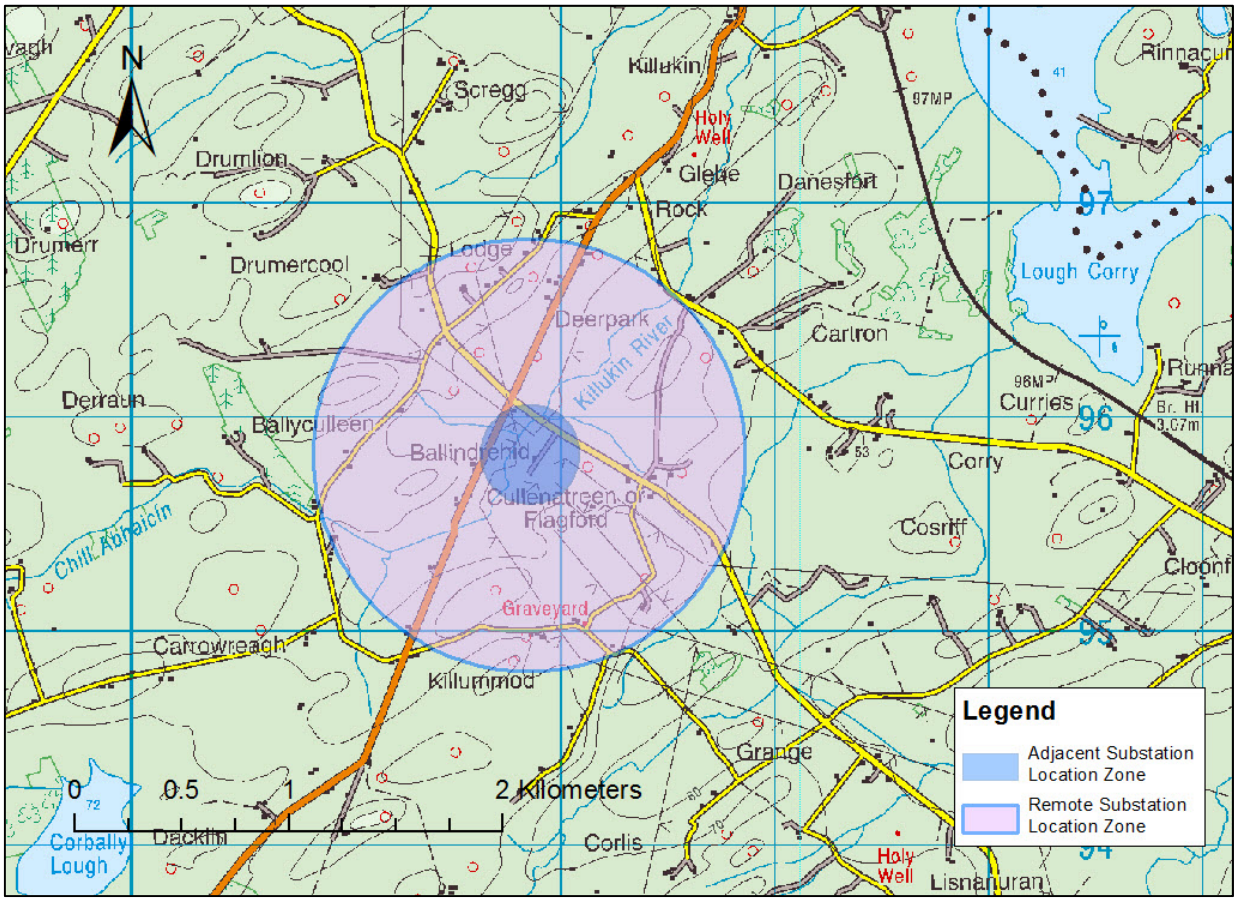
The new information thereby places significant constraints on SB1 as the western terminus of the Grid West project, regardless of the fact that there was clearly significant merit in originally identifying the existing substation at Bellacorick as a least constrained substation location. It is clear that these constraints derive from accessibility of transmission circuits to and from the substation, not the substation location itself.

5.1.2 Flagford Substation Location

In relation to the Flagford Substation, the Stage 1 Report identified two substation location zones, designated as the Adjacent Substation Location Zone and the Remote Substation Location Zone. The adjacent substation location zone was an area immediately around the existing substation, while the remote substation location zone was the area within the defined 1km radius study area, outside of the adjacent zone. The potential substation location zones are shown in Figure 5-2.

Specific substation sites will not be identified until more detailed site and technical investigations are carried out and until initial consultations are held with the landowners.

Figure 5-2 Flagford Substation Location Zones



5.1.3 Cashla Substation Locations

Following a review of all submissions from stakeholders, the re-evaluation process continued to support the selection of the route corridor to Flagford as the Least Constrained Route Corridor hence no further refinement has been undertaken for the existing Cashla substation location zone.

5.2 SUBSTATION LOCATION RE-EVALUATION

5.2.1 Bellacorick Substation Location

Since the publication of the Stage 1 Report a number of factors have influenced the re-evaluation of the potential least constrained substation locations in the Bellacorick area. This has required consideration of each of the Bellacorick substation locations, taking into account the constraints associated with the Least Constrained Route Corridor and the constraints associated with each of the substation locations.

Of the potential substation location zones in the Bellacorick area, only locations SB1, SB2 and SB3 are located on the Least Constrained Route Corridor. SB3 is in an area largely surrounded by the Cluddaun Wind Farm, which greatly restricts access for further transmission lines, both at 400kV and 110kV. It was also the third least constrained location after SB1 and SB2 and therefore is now not considered suitable for a new 400kV substation. Thus it was considered that substation location zones SB1 and SB2 should be subject to evaluation.

Since the publication of the Stage 1 Report, the developers of the Oweninny Wind Farm have submitted a planning application in which the positions of the proposed wind turbines have been defined. An appraisal of this layout has found that it would not be possible to route one 400kV overhead line through the Oweninny Wind Farm without the Developers agreeing to remove at least 5 wind turbines, with a further turbine having to be removed in the Cluddaun wind farm[4], in order to comply with the EirGrid policy of achieving at least a three times rotor diameter separation between the overhead line and the centre of the wind turbines. Even if this could be agreed, it is considered that it would be impractical to find a route for a second 400kV overhead line into the existing Bellacorick substation site within the Least Constrained Route Corridor (SB1). The extensive ecologically protected areas in the region greatly diminish the options for finding an alternative second 400kV line into Bellacorick location SB1 using an alternative route corridor.

Operating a single 400kV line to location SB1 would significantly limit the future expansion of the 400kV grid in the region and hence the capacity to accommodate future loads and/or generation. It is considered that this future expansion could only be accommodated by establishing a second 400kV substation to the east of the Bellacorick peat complex[5], possibly in the vicinity of location SB2. This would then result in a 400kV spur[6] feeder from the new substation to any substation at location SB1. While this would be electrically functional, it is not operationally desirable and would not normally be engineered into a project at the outset.

[4] Information has been received from the developers of Cluddaun wind farm on their proposed wind turbine locations.

[5] An extensive area of peat bog surrounding the village of Bellacorick, which is of significant ecological importance

[6] A 400kV spur is a section of 400kV transmission line, one end of which does not connect to another 400kV line

In the interim period, further information has also been obtained on the ground conditions and construction requirements through the peat complex and in particular through the wind farms. The wind farm developers have not positioned turbines in areas of deep and/or unstable peat or in environmentally sensitive areas. These more constrained locations will then most likely be the only areas which are available for routing an overhead transmission line. Construction will be difficult and costly in these areas, with potential adverse environmental impacts to the bog habitats.

The above indicates that, while SB1 in itself is the least constrained substation location against the range of criteria used for the evaluation in Stage 1, a number of key factors indicate that a location to the east of the Bellacorick peat complex may be preferred as this would eliminate the need to construct a 400kV overhead line across the Bellacorick peat complex and through the Oweninny and Cluddaun Wind Farms. A location to the east, for example at SB2, would also allow the future integration of a substation into the 400kV grid and allow for easier implementation of further 110kV connections.

However, a site to the east of Bellacorick at location SB2 would still have to be connected to the 110kV Gate 3 generation and also connect to the existing 110kV network at either the existing Bellacorick substation or at an alternative grid node meeting the connectivity requirements. A number of different options for implementing this 110kV connection have been identified but further technical studies are needed to firstly establish the technical viability of each option and then to identify the preferred option from those that are technically viable.

For the purpose of this report, the 110kV connections as set out in Table 5-1 are assumed to be feasible options for the required 110kV link from a 400kV substation at the SB2 location. These are also illustrated in Figure 5-3.

Table 5-1 110kV Circuits from SB2

From	To	Connection Type	Assumed route and configuration
SB2	Existing 110kV network	110kV underground and/or overhead line	See Table 5-4 below
SB2	Cluddaun Substation 3	Overhead 110kV	Overhead 110kV
SB2	Oweninny 5a (substation 3)	Underground[7] and overhead 110kV	110kV overhead line from SB2, underground through wind farms
SB2	Oweninny 5b (substation 4)	Underground and overhead 110kV	110kV overhead line from SB2, underground through wind farms
SB2	Distribution Network Operator (Gortnahurra)	Overhead line	Overhead line through farm land

[7] Underground section is required to cross the Oweninny wind farms. Coordination with wind farm developers may reduce the requirement for underground however current documentation indicate this as a requirement

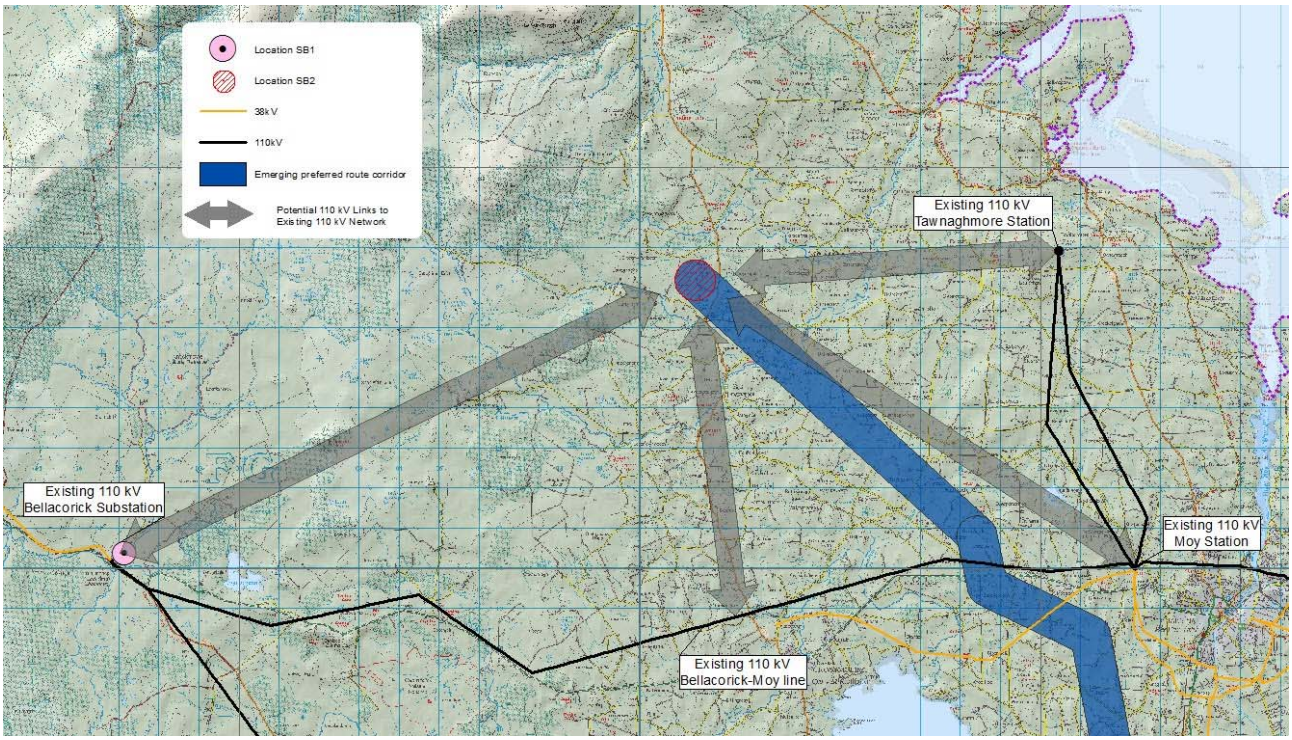
It has been assumed that these circuits would be run as 110kV overhead lines, implemented using EirGrid standard wood pole design in sections not affected by the wind farms. It has further been assumed that circuits that have to be routed through either Cluddaun or Oweninny wind farms would be implemented using underground cable, typically run in or alongside tracks established for the wind farms. However, these assumptions will need to be validated in the subsequent technical studies indicated above.

A number of different options are available for implementing the 110kV connection to the existing 110kV network. These are summarised in Table 5-2 and illustrated in Figure 5-3

Table 5-2 Options to Connect Substation at Location SB2 to Existing 110kV Network

No.	Connection Options	Details (assumed)
1	Direct connection from SB1 to SB2	Routed in route corridor B1/B2 between SB2 and the existing Bellacorick Substation, OHL from SB2 to Cluddaun and then underground cable
2	Loop in to existing Bellacorick-Moy 110kV overhead line	Cut into the existing Bellacorick to Moy 110kV overhead line at a point to the south of SB2 and then run a double circuit 110kV overhead line from the cut in point to SB2, generally in route corridor B4/B8
3	Direct connection from SB2 to Moy Substation	Implemented as an 110kV overhead line on wooden poles, running in route corridor B3, parallel to the proposed 400kV line as far as possible
4	Connection from SB2 to SB1, through Oweninny Substation No 3 (Oweninny 5a)	In addition to the Gate 3 wind farm connection from SB2, a additional 110kV underground cable would be installed from Oweninny Sub 3 to existing Bellacorick Substation
5	Connection from SB2 to SB1, through Oweninny Substation No 1	In addition to the wind farm grid connection to the existing Bellacorick substation, this would require an overhead /underground circuit from Oweninny Wind Farm Substation 1 to SB2, similar to the direct interconnection circuit (1) above
6	Direct connection from SB2 to existing Tawnaghmore Substation	Implemented as an 110kV overhead line on wooden poles, routed from SB2 to Tawnaghmore.

Figure 5-3 Potential 110kV Connection Options



For the evaluation of the Bellacorick Substation location, the above discussion sets out the key factors that needed to be considered. These are a result of further information received and further development work done on the project since the publication of the Stage 1 Report.

In summary there are three factors which determine the recommendation of this report:

- **Future Expansion:** A 400kV substation on a national electricity grid is a strategic element of grid infrastructure. Customers depend upon the reliability and security of the electricity connection offered by such a substation. Indeed this is a basic requirement of EirGrid's remit. For this reason, it is common practice for such substations to have at least two 400kV connections[8], so that in the event of a fault on one connection the substation continues to be connected to the grid through the other connection. It is therefore important that the site selected for any new 400kV substation can accommodate future expansion and connections, to meet system requirements. As discussed below, it would be difficult to find a route for the Grid West 400kV line and given the extent of the wind farms and protected areas around Bellacorick, it is considered highly unlikely that a route for a second 400kV line could be found into location SB1. Similar restrictions will apply to any further 110kV transmission lines.

[8] The Grid West project is the first stage in establishing a 400kV grid in the west of the country. It is reasonable to expect that as the system develops and further generation and/or load in the Co Mayo region needs to be connected to the grid, a second 400kV line into the area would be required in the future.

These factors seriously limit the future expansion of a new 400kV substation at SB1 and hence the capability of this substation to accommodate future requirements in the region. These restrictions are generally not applicable for a substation located within the SB2 location.

- **400kV Line Considerations**: It would be necessary for the 400kV transmission line from SB2 to SB1 to comprise an overhead line. System constraints on the Irish grid make it impractical to underground extended sections of 400kV transmission circuit. Furthermore, a substantial part of the route is through peat bog and the installation of a 400kV underground cable in these ground conditions increases the risk of early failure due to ground movements stressing the cable. Good practice would indicate avoiding the construction of a 400kV cable circuit through peat bog.

  For an overhead line, EirGrid policy requires that any high voltage overhead transmission line be routed at a distance of at least three times the rotor diameter away from any wind turbine. The proposed location of the turbines in the Oweninny wind farm would require at least 5 turbines to be removed or significantly repositioned if a route for an overhead line is to be established through Oweninny wind farm. Similarly at least one wind turbine would need to be removed or repositioned in the Cluddaun wind farm.

  The construction requirements for a 400kV overhead transmission line are an important consideration, particularly in areas of poor ground conditions, such as peat bog. The towers are large, heavy structures that require substantial foundations, with access being required for the heavy equipment and materials. This constructability is a major concern in the Bellacorick peatlands, where areas of deep and/or unstable peat will make this construction difficult and costly. These conditions are also likely to attract significant ecological issues. The fact that the wind farm developers have located their wind turbines such that only areas with the more difficult ground conditions are available for the transmission line exacerbates the construction difficulty.

- **110kV Circuit Considerations:** In general the same restrictions apply to the 110kV circuits as to the 400kV line. The three times rotor diameter protection standard applies equally to a 110kV overhead line, as do the restrictions on access created by the protected habitats.

  In general, the 110kV overhead lines would be implemented using the EirGrid standard wooden pole design. This design offers a reduced landscape and visual impact, as well as being simpler construct in bog conditions.

  It has been assumed that where underground circuits are required these would typically be constructed within or adjacent to tracks built for the wind farm developments. Where existing tracks do not provide suitable location for the installation of underground cable, additional civil works will be required. It may be possible to install greater lengths of 110kV underground cable without the same system risks presented by 400kV underground cable installations. However, there are still practical limits and detailed system studies are required to demonstrate that the

different options are compatible with system operational requirements, particularly in respect of technical matters such as harmonics and system over-voltages.

For the 110kV connection to the existing 110kV network, if the substation is located at SB1 then such connection would be achieved by connecting directly 'across the fence' between the new substation and the existing substation at Bellacorick. If the substation is established at SB2, a number of options are potentially available for the connection of SB2 to the 110kV network, as presented in Table 5-2 and Figure 5-3 above. While SB1 does have an advantage over SB2 in this respect, the availability of alternative options for this connection from SB2 serves to limit the disadvantage. This advantage also does not outweigh the major disadvantages of SB1 set out above.

The above evaluation indicates that, taking the capability for future expansion and the constructability of both the 400kV and 110kV transmission lines into account, Location SB2 is the preferred location for the 400kV Grid West Substation in the Bellacorick area.

5.2.2 Flagford Substation Locations

As was carried out for the Bellacorick substation location, further review of the constraints has been undertaken on the Flagford substation zone, taking into consideration the development work carried out on the Least Constrained Route Corridor and the refinement of that corridor.

This review considered the following:

- From a system operation, maintenance and engineering perspective there are distinct advantages in locating the new 400kV substation at Flagford adjacent to the existing substation, particularly on the eastern side of the existing substation. These advantages include:
    - Simplified 220kV interconnection between the new and existing substations will provide greater reliability, as a result of reduced equipment requirements and shorter connection lengths.
    - It will be simpler and cost less to meet increased capacity in the future.
    - Simplified protection arrangements, particularly for the 220kV interconnections between the existing and new substation.
- There are currently a total of 9 high voltage overhead lines entering the Flagford substation. As noted in the Stage 1 Report[9], the configuration of these is such that it would not be possible for the Grid West 400kV line to approach Flagford without crossing at least one 220kV line and 1 x 110kV line.
- It is difficult to cross a 220kV line because of the higher towers and greater clearances required. The best method of implementing this crossing is subject to further study. However at least one 220kV line crossing is required regardless of whether the new Flagford substation is located in either the adjacent to or the remote substation location zone and thus does not influence the selection of the preferred location zone.

[9] Stage 1 Report Volume 3, Appendix 7.1, Section 3.4

Taking the above considerations into account, the Flagford adjacent substation location zone is confirmed as the emerging preferred substation location zone.

6 ROUTE CORRIDOR MODIFICATIONS

6.1 MODIFICATION OF THE LEAST CONSTRAINED ROUTE CORRIDOR

In light of information collated from Open Days and a review of aerial photography (mapped as illustrated in Figure 3-2 above), and of the further more detailed studies carried out since the Open Days, the Project Team reviewed the Least Constrained Route Corridor and proposed a number of modifications to the Corridor. The areas affected include:

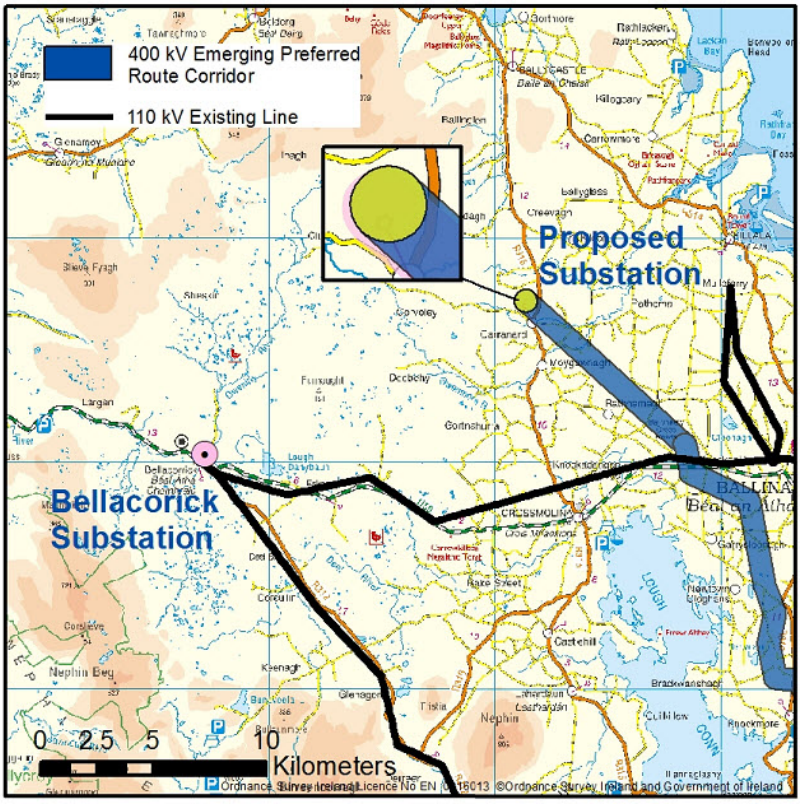
1. Bellacorick substation location;
2. Between Lough Conn and Carrowkeribly Lough; and
3. Between Swinford and Charlestown.

These proposed modifications were then assessed by the Project Team to ensure that any variations to the Least Constrained Route Corridor have no greater impact on settlements, environmental constraints and engineering implementation considerations than the previous Least Constrained Route Corridor.

6.1.1 Bellacorick Substation Location

The location of the 400kV substation in the Bellacorick area has been discussed in Section 5.2.1 of this Report. The emerging preferred location for this substation is at location SB2, an area to the east of Bellacorick, approximately 2.5km north of the village of Moygownagh, as illustrated in Figure 6-1.

Figure 6-1 Bellacorick Substation SB2 Location



The reasons for the selection of SB2 have been set out in Section 5.2.1 but can be summarised as:

- A substation at SB2 can be expanded in the future and there are potential routes for further connections at both 400kV and 110kV.
- It would not be necessary to route a 400kV overhead line through the Cluddaun and Oweninny Wind Farms, thus obviating the need for the Developers of these wind farms to omit at least six wind turbines in order to accommodate any proposed overhead transmission line.
- It will not be necessary to construct the 400kV overhead line (or any potential underground cable) in the difficult ground conditions in the peat bog, which also eliminates the ecological risks in doing this.

With the emerging preferred location for the substation in the Bellacorick area being at SB2, this has resulted in the 400kV route corridor terminating at SB2. A minor adjustment to the local alignment of the route corridor was also required so as to align the route corridor with the area of SB2. This was because the substation location zone was more constrained to the south, making it difficult to relocate the location zone. This resulted in the corridor being moved approximately 120m north.

Locating the western terminus of the Grid West line at SB2 means sections B1, B2 and part of B3 route corridors are not being considered for the 400kV line, resulting in this line being shorter in length by approximately 20km compared to the original proposal. This reduction in length significantly reduces the technical and engineering constraints associated with routing the 400kV line through the peat bog and also reduces the impact on the ecology and the landscape. Although these reductions have to be offset against the impact of the additional 110kV circuits, notwithstanding the fact that these may be undergrounded in whole or in part, as found in Section 5.2.1, this reduction in length results in a less constrained route corridor and substation location.

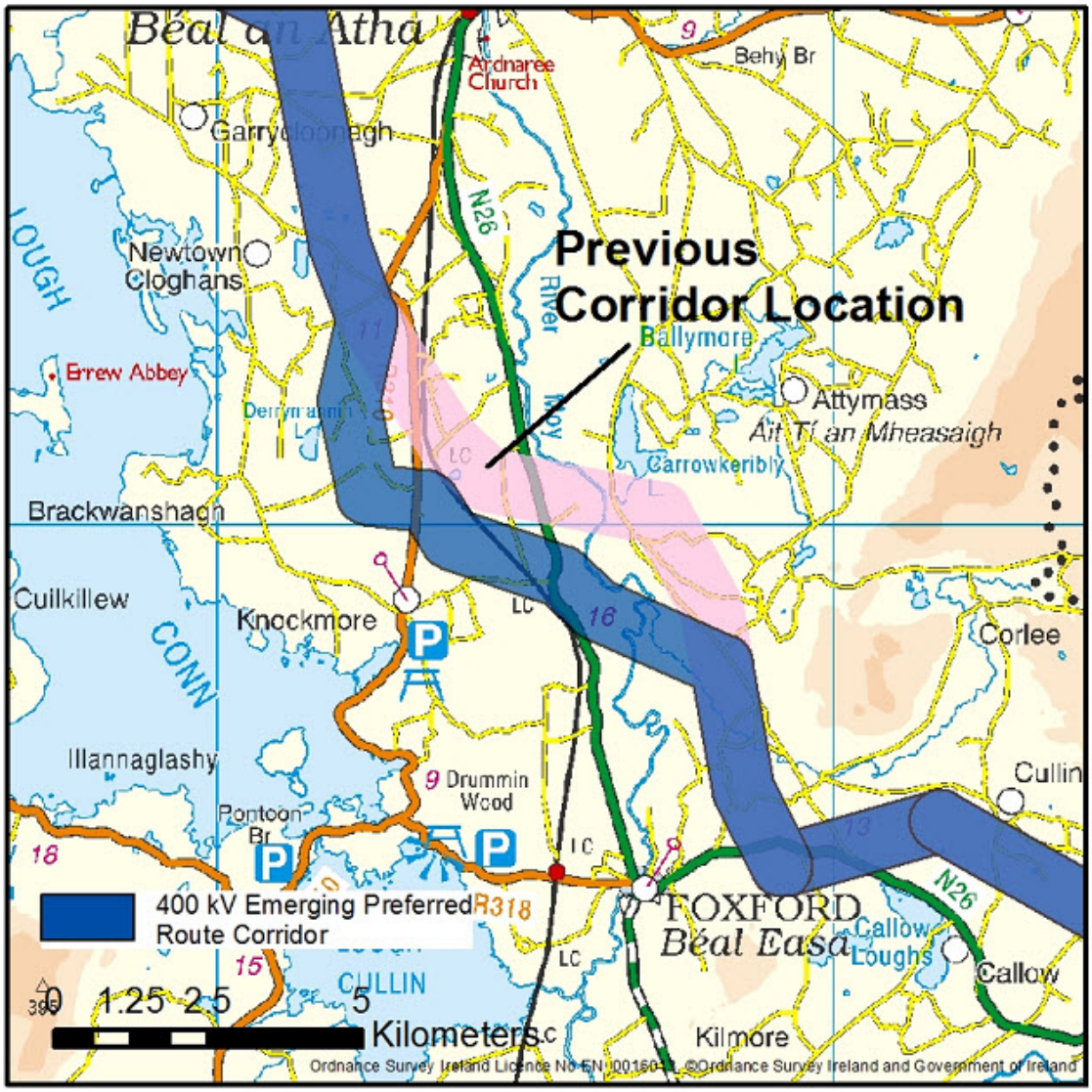
6.1.2 Pinch Point between Lough Conn and Carrowkeribly Lough

Following a review of the information detailed in Chapter 4 of this Report, it was considered that a localised modification to the route corridor at this location would make it locally less constrained. The constraints raised which brought about the need for this modification are as follows:

- Settlement Density and location of dispersed dwellings;
- River Moy crossing;
- Graveyard currently in use;
- More detailed mapping of the extent of quarries;
- More detailed habitat mapping
- Mature Woodland; and
- Whooper Swan studies.

Refer to Figure 6-2 which details the modification to the Least Constrained Route Corridor proposed between Lough Conn and Carrowkeribly Lough.

Figure 6-2 Pinch Point between Lough Conn and Carrowkeribly Lough



The modified Least Constrained Route Corridor is considered less constrained than the original Least Constrained Route Corridor, for the following reasons:

- There are fewer houses within this route corridor;
- The route corridor will cross lower lying land / terrain;
- It will minimise the impact to qualifying habitats and species;
- It avoids impact to a historic graveyard and recorded graveyard;
- It will avoid impact to the megalithic tomb located south of Carrowkeribly Lough; and
- It avoids the higher ground to the south east of Carrowkeribly Lough (near Drumscoba).

In addition, the classification of the quarries as a constraint has had a bearing on the corridor, which, in combination with the above, has resulted in a modification to the route corridor.

Modification to this Least Constrained Route Corridor includes localised repositioning this route corridor to the south west in order to avoid the constraints detailed above. Modifications at this location resulted in the route corridor being considered less constrained.

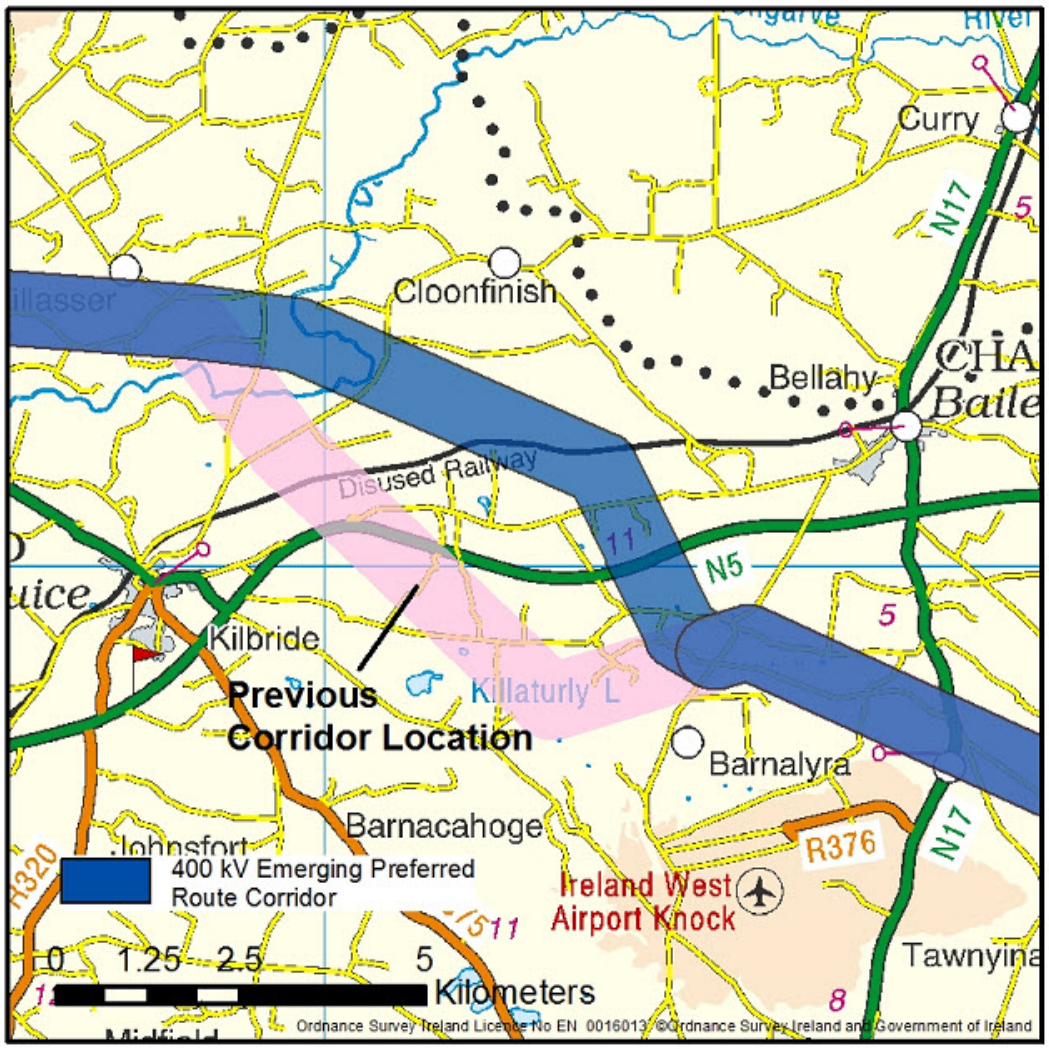
6.1.3 Pinch Point between Swinford and Charlestown

Following a review of the information detailed in Chapter 4 of this Report, it was considered that a modification to the route corridor at this location would make it locally less constrained. The constraints considered in making this modification were as follows:

- Settlement density and location of dispersed dwellings; and
- The extent of Stripe Medieval Field System, the full extent of which is now known.

Refer to Figure 6-3 which details the modification to the Least Constrained Route Corridor proposed between Swinford and Charlestown.

Figure 6-3 Pinch point between Swinford and Charlestown



The modified Least Constrained Route Corridor is considered less constrained than the original Least Constrained Route Corridor, for the following reasons:

- Notwithstanding that the modified route is slightly more constrained from an ecological and visual point of view, there are considerably fewer houses within this route corridor, which results in this route being less constrained; and
- It also avoids the extent of Stripe Medieval Field System for which further data has been received.

Modification to this Least Constrained Route Corridor includes repositioning this route corridor to the east in order to avoid the constraints detailed above. Modifications at this location resulted in the route corridor being considered less constrained.

6.2 EVALUATION OF MODIFIED LEAST CONSTRAINED ROUTE CORRIDOR

6.2.1 Bellacorick Route Corridor Option Review

The review of the Bellacorick group of route corridor options is presented schematically in a matrix format in Table 6-1; this matrix includes the modified least constrained route corridor. The modifications to this section of Least Constrained Route Corridor relate to both Bellacorick substation location and the section of corridor between Lough Conn and Carrowkeribly Lough.

Table 6-1 Bellacorick Route Corridor Options Re-evaluation

Constraints	B1/B2/B3/B9 (Originally Least Constrained Route Corridor)	B3/B9 (Modified Least Constrained Route Corridor)
Settlements		
Ecology		
Landscape		
Cultural Heritage		
Technical		
Geology		
Water		
Length of Line		

From Table 6-1 it is apparent that the Modified Least Constrained Route Corridor is considered the "least constrained", when compared to the other Bellacorick group of route corridor options, under five headings, namely Settlements, Landscape, Cultural Heritage, Technical and Length of Line.

When comparing the Bellacorick section of least constrained route corridor with the modified least constrained route corridor, it is apparent that:

- From a settlements perspective there are fewer houses within this route corridor;
- Given that sections B1, B2 and part of B3 route corridors are not being considered for 400kV line, the Bellacorick route corridor for a 400kV transmission line is shorter in length by approximately 20km;
- There is a lower ecological impact on the Bellacorick peat complex;
- The modified least constrained route corridor avoids impacting on a historic graveyard which is still in use at Bunnafinglas;
- It also avoids a megalithic tomb in the townland of Bunnafinglas; and
- It avoids higher ground south east of Carrowkeribly Lough (near Drumscoba).

6.2.2 Flagford Route Corridor Option Re-evaluation

The re-evaluation of the Flagford group of route corridor options is presented schematically in a matrix format in Table 6-2; this matrix includes the Modified Least Constrained Route Corridor.

The modifications to this section of Least Constrained Route Corridor relate to the corridor section between Swinford and Charlestown.

Table 6-2 Flagford Route Corridor Options Re-evaluation

Constraints	F1/F3/F6/F7 (Originally Least Constrained Route Corridor)	F1/F3/F6/F7 (Modified Least Constrained Route Corridor)
Settlements		
Ecology		
Landscape		
Cultural Heritage		
Technical		
Geology		
Water		
Length of Line		

When comparing the Flagford section of the Least Constrained Route Corridor with the Modified Least Constrained Route Corridor, it is apparent that:

- From a settlements perspective there are fewer houses within this modified route corridor; and
- There is less impact on archaeological features in this area within the modified route corridor.

7 IDENTIFICATION OF EMERGING PREFERRED ROUTE CORRIDOR & SUBSTATION LOCATION

7.1 CONFIRMATION OF EMERGING PREFERRED ROUTE CORRIDOR

Considering all of the further work which has taken place since March 2013, including a review of the feedback from Stage 1, the Project Team can confirm that the Modified Least Constrained Route Corridor is considered the Emerging Preferred Route Corridor.

Local modifications to the Emerging Preferred Route Corridor and Substation Locations for those identified in the Stage 1 Report are shown on Figure 7-1.

Figure 7-1 Emerging Preferred Route Corridor

7.2 CONFIRMATION OF EMERGING PREFERRED SUBSTATION LOCATIONS

7.2.1 Preferred Bellacorick Substation Location

Further studies have confirmed that the preferred substation location for the new 400kV/110kV substation in the Bellacorick area is the location zone designated SB2.

This location zone has been found to be the preferred zone for the following key reasons:

- A substation at SB2 can be expanded in the future and there are potential routes for further connections at both 400kV and 110kV.
- It would not be necessary to route a 400kV overhead line through the Cluddaun and Oweninny Wind Farms, thus obviating the need for the Developers of these wind farms to omit at least 6 wind turbines in order to accommodate the transmission line.
- It will not be necessary to construct the 400kV overhead line in the difficult ground conditions in the peat bog, which also eliminates the ecological risks in doing this.
- A number of different options for achieving the 110kV connection are possible. Further system studies are needed to prove that the required connectivity can be achieved by each option and then a selection will need to be made taking into account the other factors and in particular the phased construction of the wind farms.

7.2.2 Preferred Flagford Substation Location

Further studies have confirmed that the preferred substation location zone for the new 400kV/220kV substation in the Flagford area is the adjacent location zone.

8 CONCLUSION

This Report has found that the Least Constrained Route Corridor with some local modifications is considered the Emerging Preferred Corridor. It has also found that the Preferred Substation Location at the western end of the line is Substation Location SB2 and the Preferred Substation Location at the eastern end of the line is the adjacent location zone.

The Least Constrained Route Corridor, even when modified and nominated as the Emerging Preferred Corridor, still has constraints including residential clusters and environmental designations and features, which the Project Team will try to avoid to the greatest extent practicable in designing the indicative line route.

8.1 NEXT STEPS

EirGrid will announce details of the Emerging Preferred Route Corridor in October 2013. The next steps in the project will involve EirGrid contacting landowners within the Emerging Preferred Route Corridor to commence land surveys and to discuss a possible line route, substation and tower locations. This work is scheduled to take place from October 2013 to Spring 2014.

Following this consultation with landowners and further technical work, EirGrid will publish a Stage 2 Report, presenting all information in relation to an indicative line route for the 400kV circuit and associated 110kV connection line.

This report is expected to be published mid 2014, at which time the public, communities and other stakeholders will be given the opportunity to review the report and provide feedback on the indicative line route and locations identified.

No final line route has been decided for the Grid West project. All public, community and stakeholder input in respect of the indicative line route and substation and tower locations will be considered as part of final line design. It will form the basis for progression to Stage 3 (route confirmation) of EirGrid's Project Development and Consultation Roadmap, and which ultimately will inform preparation of a final planning application, which it is anticipated will be submitted to An Bord Pleanála in 2015.

GLOSSARY OF TERMS

Adjacent Substation Location Zone: is an area directly surrounding the existing substation site where development, for technical, environmental and planning purposes can be considered an extension of the existing site.

Constraint: A constraint is any physical, environmental, topographical, socio-economic or other condition that may affect the location, development and other aspects of a proposal.

Emerging Preferred Route Corridor is considered to be the corridor to offer the best balance between often competing technical, environmental, community and other criteria.

High level feedback means that the feedback is general e.g., concerned about impact on the environment.

Least Constrained Route Corridor is considered to be the corridor which best avoids the environmental and other constraints.

Remote Substation Location Zone: is an area within the substation study area, that excludes the adjacent substation locational zone, where the development, for technical, environmental and planning purposes can be considered for a new substation site linked (but not adjacent) to the existing substation site.

Spatially Specific feedback means that it relates to a geographic region, for example a town or townland.

Substation Location: A zone of land, typically 1 km in diameter, sited so as to avoid as many environmental constraints as possible, and within which a substation can later be positioned.

The Grid West Project

October 2013