Contents

2 Alternatives Considered

2.1 Introduction

This chapter presents the alternative aspects of the proposed development that were considered prior to deciding upon the final project design. Under the EIA Directive 2014/52/EU, amending Directive 2011/93/EU, the developer must provide a description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of environmental effects.

In the course of refining the Greenlink project, and the proposed development, which forms part of it, GIL and its technical team considered the following alternatives;

- Interconnector options,
- Route options for the high voltage direct current (HVDC) cable route on land,
- Sites for the converter station and landfall,
- Technologies for the cables and the converter station,
- Cable trench construction methods,
- Cable decommissioning methods, and
- Options for parking provision at Baginbun Beach.

These alternatives and an indication of the main reasons for GIL's choices, including a comparison of the environmental effects, are described below.

This chapter has been prepared by Simon Grennan and Dan Garvey of Arup, with input from GIL and its engineering consultants, WSP. A description of the authors' qualifications and experience is presented in **Appendix 1.1**.

2.2 Do-Nothing Alternative

If Greenlink is not developed, the current situation will continue unchanged. The existing interconnector between the Republic of Ireland and Great Britain, with a capacity of 500MW, and the Moyle Interconnector between Northern Ireland and Scotland, also with a capacity of 500MW, will be the only links between the electricity grids on the island of Ireland and Great Britain. The current constraints on the export of electricity when generation exceeds demand, and the import of electricity, when demand exceeds generation, will continue. Opportunities for increased security and diversity of electricity supply, support for low carbon generation, increased competition in the energy market in Ireland and the direct economic benefits, described in Section 1.4, will not arise.

As such, while the Do-Nothing Alternative avoids the short-term environmental disturbance associated with the proposed development of the Project, the Do-Nothing Alternative does involve indirect negative environmental impacts over the longer-term. The environmental effects of the Do-Nothing Alternative and the Project are considered and compared qualitatively under the most relevant topics, in **Table 2.1** below.

Table 2.1: Comparison of Environmental Effects of Do Nothing and Greenlink Alternatives

	Do-Nothing	Greenlink
Biodiversity	No direct effect. Long term indirect negative effects due to climate change disruption of habitats and species as low carbon technologies are not supported	Temporary disturbance to species and habitats during construction phase Long term indirect beneficial effects due to reduced carbon emissions slowing down climate change
Climate	No direct effect. Long term indirect negative effects - greater carbon emissions from fossil fuels, as excess power from low carbon generation cannot be exported to replace it	Minor temporary carbon emissions in construction phase. Long term beneficial effects as low carbon power generation supported, low carbon power will be exported rather than curtailed
Air Quality	No direct effect. Long term indirect negative effects - greater fossil fuel emissions, as excess power from low carbon generation cannot be exported to replace it	Minor temporary emissions in construction phase. Long term beneficial effects as low carbon power will be exported rather than curtailed, reducing emissions from fossil fuels
Natural Resources	No direct effect Long term indirect negative effects - greater fossil fuel consumption, as excess power from low carbon generation cannot be exported/imported to replace fossil fuel generation.	Minor temporary use of resources in equipment manufacture and construction phase. Long term indirect beneficial effects as low carbon power will be exported rather than curtailed, reducing use of fossil fuels

2.3 Interconnection Options

2.3.1 Connection Strategy

Ireland's location on the north western edge of Europe limits its options for economic interconnection. Great Britain lies between Ireland and continental Europe and represents a cost-effective stepping stone to European and Nordic energy markets.

Further interconnection with Great Britain provides the option to connect to European markets avoiding the need for lengthy and uneconomical direct cable routes. Connecting to Great Britain allows decreased capital costs for similar transmission capacity thereby providing additional security of supply to Irish consumers at lower cost.

The shorter connections via Great Britain are also subject to lower energy transmission losses and are less liable to accidental damage with associated interruptions and reduced security of supply.

The lower capital and operating costs, associated with using Great Britain as an interconnector stepping stone to continental Europe, directly translate into lower resource use for manufacturing cables, lower fuel use and emissions for construction and operation, and lower species and habitat disturbance and other environmental effects of construction and operation than for the longer interconnector. The main environmental effects of the options are compared qualitatively, in **Table 2.2** below.

Table 2.2: Comparison of Environmental Effects of Interconnector to Great Britain and Continental Europe

	Interconnector to Great Britain	Interconnector to Continental Europe
Natural Resources	Less use of natural resources in manufacture, construction and operation	Greater use of natural resources in manufacture, construction and operation
Air Quality	Less emissions to air in construction and operation	Greater emissions to air in construction
Biodiversity	Less disturbance to species and habitats during construction	Greater disturbance to species and habitats during construction

2.3.2 Connection Options in Ireland and Great Britain

In the project definition phase, the decision that the project would be an interconnector from Ireland to Great Britain, led to the consideration of the location for the link.

Since both the Irish and UK electricity markets have a uniform non-locational price, there was no market reason to choose one location over another for the link; once the power flows the benefits are accrued. The primary factor driving the choice of location of Greenlink was distance between the markets. A location which results in the shortest cable distance between the two markets will have the lowest losses and thus generate the most effective trades. A cable which is twice as long has twice the losses. Trades are only economic if the difference in prices between the markets exceeds the losses. The relevant distance is not between coastlines, but rather between feasible grid connection points. Practically this means existing 220kV or 400kV substations with more than 2 circuits connecting them. GIL ruled out 110kV substations in Ireland and

132kV substations in the United Kingdom on the basis that such substations cannot support 500MW of demand or generation.

There were three broad choices for the interconnector location: Northern Ireland - Scotland, Dublin - Liverpool (including Anglesey North Wales) and Wexford - Wales. Refer to **Figure 2.1**.

Figure 2.1: Alternative Interconnector Locations | not to scale [mapping: Bing Maps © Microsoft 2020]

A connection from Northern Ireland to Scotland would be the shortest distance. This is the reason for the location of the Moyle interconnector. GIL quickly ruled out building Greenlink parallel to the Moyle interconnector because, at the time the decision was made on where to locate Greenlink, there was not sufficient grid capacity in Scotland even to accept Moyle's flow in both directions. Refer to EirGrid Generation Capacity Statement (EirGrid 2016, Eirgrid 2019). Locating Greenlink at Moyle would result in power flowing in only one direction, thus halving the effectiveness of the project. In the intervening period, since the decision was made, Scotland has been building wind power generation and large sub-sea reinforcements to its grid, such as the Western bootstrap, but this capacity is going to be utilised by the increased wind generation. When the Greenlink decision was made, it was not certain that these reinforcements would proceed.

Moving southwards down the respective Ireland and Great Britain coastlines, the next obvious location was Dublin to Anglesey in North Wales. There is strong grid capacity onshore in both locations. However, an interconnector must operate as both generation and demand. Dublin has been experiencing a surge in demand through data centre growth.

Seeking a grid connection at Poolbeg, for example, for the generator mode of operation would be feasible and very welcome, but the demand mode of operation would be very problematic inside the Dublin region. Trades on the interconnector are driven by market forces, and so on occasion Great Britain prices would drive the interconnector to export 500MW at a time when Dublin was experiencing supply shortage. This in turn would drive EirGrid to limit trades at these sensitive times, thus limiting the public benefit and economic viability of Greenlink. On this basis, this connection option was discounted from further consideration.

Mid Wales is geographically close to the coastline running from Carrickmines to Rosslare. However, there is only a single 220kV circuit (Carrickmines to Great Island) in Ireland near that coastline. A single circuit is less likely to be able to provide for the full trading, for example if one part is offline for maintenance or fault. The 220kV circuit moves inland south of Arklow. In Wales there is no 400kV circuit near the west coast of Wales, other than at Anglesey and Pembroke. These factors ruled out a mid-Wales to Irish east coast connection.

The next feasible option was Pembroke in Wales to Great Island in Ireland. At Great Island, there are three 220kV circuits converging, as well as a number of 110kV lines. This makes it the most robust node on the network south of Dublin. Similarly, Pembroke in Wales has four 400kV circuits, again making it a very robust node on the network. Greenlink links these two points by the shortest feasible sub-sea cable route, allowing for the various constraints. Given there were no existing interconnectors at either Pembroke or Great Island, there was a high probability that the network could accommodate flows in both directions at all times, even if some circuits were out of service for fault or maintenance. This has been borne out by subsequent grid connection studies, and Greenlink now holds connection agreements from EirGrid and National Grid for 500MW of capacity at both substations.

As part of the site selection process, GIL also looked at options further south in Great Britain such as Devon, where there is a 400kV substation called Alverdiscott. This however is over twice the distance from Great Island, so GIL ruled it out on the grounds of both capital cost and operational losses, the combination of which would have negated any public benefit of the link.

As part of the site selection process GIL also ruled out other locations in Ireland such as Knockraha. This is an existing substation with multiple 220kV circuits, but it is more than 100km further west than Great Island, and just as for Alverdiscott, there would be no additional benefit to offset the significant extra capital cost and operational losses.

The environmental effects of the options are compared qualitatively, in **Table 2.3**.

Table 2.3: Comparison of Environmental Effects of Different Connection Locations

	Great Island - Pembroke	Northern Ireland - Scotland	Dublin - Anglesey	Great Island - Alverdiscott	Knockraha - Pembroke
Natural Resources	Greater length so more direct effects from construction; sufficient grid capacity and robust nodes on grid so full benefits of interconnection realised – reduced use of fuel for power generation etc	Shortest length so least direct effects from construction; but insufficient grid capacity so indirect effects –use of fuel for power generation etc - much greater	Greater length so more direct effects from construction; insufficient grid capacity so indirect effects –use of fuel for power generation etc - much greater	Much greater length so much more direct effects from construction; much greater length would increase power losses, which would reduce indirect benefits	Much greater length so much more direct effects from construction; much greater length would increase power losses, which would reduce indirect benefits
Air Quality	Greater length so more direct effects from construction; sufficient grid capacity and robust nodes on grid so full benefits of interconnection realised - reduced emissions from power generation etc	Shortest length so least direct effects from construction; but insufficient grid capacity so indirect effects - emissions from power generation etc - much greater	Greater length so more direct effects from construction; insufficient grid capacity so indirect effects - emissions from power generation etc - much greater	Much greater length so much more direct effects from construction; much greater length would increase power losses, which would reduce indirect benefits	Much greater length so much more direct effects from construction; much greater length would increase power losses, which would reduce indirect benefits
Climate	Greater length so more direct effects from construction; sufficient grid capacity and robust	Shortest length so least direct effects from construction; but insufficient grid capacity so indirect	Greater length so more direct effects from construction; insufficient grid capacity so indirect	Much greater length so much more direct effects from construction; much greater length would	Much greater length so much more direct effects from construction; much greater length would

	Great Island - Pembroke	Northern Ireland - Scotland	Dublin - Anglesey	Great Island - Alverdiscott	Knockraha - Pembroke
	nodes on grid so full benefits of interconnection realised - reduced emissions of greenhouse gases from power generation, support for renewable generation etc	effects - lack of support for renewable generation, etc – much greater	effects - lack of support for renewable generation, etc - much greater	increase power losses, which would reduce indirect benefits	increase power losses, which would reduce indirect benefits
Biodiversity	Greater length so more direct effects from construction	Shortest length so least direct effects from construction	Greater length so more direct effects from construction	Much greater length so much more direct effects from construction;	Much greater length so much more direct effects from construction;
Population	Sufficient grid capacity and robust nodes on grid so full benefits of interconnection realised – greater diversity of power sources and reduced reliance on one source, competition amongst suppliers leading to reduced costs, etc	Insufficient grid capacity so least benefits to consumers	Insufficient grid capacity so least benefits to consumers	Much greater length would increase power losses, which would reduce benefits to consumers	Much greater length would increase power losses, which would reduce benefits to consumers

2.4 Alternative Sites and Routes

2.4.1 Converter Station Site and Tail Station Site

Greenlink will connect into the existing Great Island 220kV substation in County Wexford.

In selecting the converter station site, the primary requirement was that the site would be close to the existing EirGrid Great Island substation which would be the connection point to the Irish transmission grid.

At an early stage in the development of the project, three possible locations for a converter station site were identified from a high-level desk study. These three locations are shown in **Figure 2.2**.

Figure 2.2: Three Possible Locations for Converter Station | not to scale [mapping: Bing Maps © Microsoft 2020]

Sites 1 and 2 were immediately north of the railway line and site 3 was south of the railway line, to the east of the Great Island substation.

More detailed study determined that sites 1 and 2 were crossed by three 220kV overhead powerlines, two 110kV overhead powerlines and a high-pressure gas pipeline. These features severely constrain the development of the land in this area. Rerouting some of these overhead lines and the gas pipeline, to free up land, was considered to be impracticable. To achieve a developable area of land, of sufficient size, the site would have to be much further north than the identified locations, further away from Great Island substation and closer to residential receptors and archaeological monuments. The proximity to residential properties and archaeological monuments were considered to be material constraints.

It was considered important that the converter station would be seen to be an extension of an existing developed area, rather than as an entirely new feature in the scenic rural landscape. The railway line was considered to form a natural boundary. A converter station north of the railway line would be seen as a new development and not as an extension of the existing development at Great Island. Sites north of the railway line were less preferred, for this reason.

The landfall site and cable route had not been chosen at that stage. However, it was anticipated that the most likely landfall would be on the Hook Head peninsula and the cable route would most likely approach Great Island from the south. Again, site 3 would be a better location, in this eventuality.

Once the site to the south of the railway was identified as preferred, in the high-level assessment, a number of characteristics of the site were examined to ensure that the site would be suitable for the converter station. These included:

- Ground conditions (i.e. dry/wet, suitable for heavy foundations);
- Topography;
- Feasibility of construction operation;
- Adjacent developments;
- Presences of hazards;
- Proximity to sensitive receptors;
- Environmental designations;
- Ease of road access, and
- Availability of land for purchase.

These characteristics of Site 3 were examined and no significant issues, which would make the site unsuitable, were identified. A sufficient area of land at the location was determined to be available for purchase. Consequently Site 3 was confirmed as the preferred site for the converter station. As the design evolved, the requirement for a tail station was identified. Site 3 was suitable for the location of this tail station, so no further alternative tail station locations were considered.

The environmental effects of the Converter station site options are compared qualitatively, in **Table 2.4**.

Table 2.4: Converter Station Site Options Comparison of Environmental effects

	Site 1	Site 2	Site 3
Constraints on development	Numerous high voltage overhead powerlines and gas pipeline constraining available land	Numerous high voltage overhead powerlines and gas pipeline constraining available land	No constraints identified
Cultural heritage including archaeological heritage	Potential indirect effect on known archaeological features on land further north	Potential indirect effect on known archaeological features on land further north	No impact on known archaeological features
Visual Impact	Visually separated from Great Island power plants and substation, creating significant new visual impact	Visually separated from Great Island power plants and substation, creating significant new visual impact	Visually part of the existing Great Island power station and substation, lessening visual impact
Natural resources, biodiversity	Potentially longer cable route would have greater impact on natural resources and biodiversity	Potentially longer cable route would have greater impact on natural resources and biodiversity	Potentially shorter cable route would have less impact on natural resources and biodiversity

2.4.2 Landfall Site

Following identification of Great Island substation as the connection point for Greenlink, an options study appraisal of the adjacent coastline was undertaken using a search area from approximately Brownstown Head, County Waterford to Bannow Beach, County Wexford. Ten potential landfall sites were selected based on their proximity to the Great Island substation. Refer to **Figure 2.3**.

The decision was taken early on to discount a route up the River Barrow estuary directly to Great Island for the following reasons:

- The River Barrow estuary adjacent to the Great Island substation forms part of the River Barrow and River Nore Special Area of Conservation (SAC). The site is important for the presence of a number of EU Habitats Directive Annex I listed habitats and well as Annex II listed species such as Freshwater Pearl Mussel, White-Clawed Crayfish, Salmon, Twaite shad, three lamprey species (sea, brook and river lamprey), the whorl snail *Vertigo moulinsiana* and otter. The River Barrow is the only site in the world for the hard water form of the Freshwater Pearl Mussel and one of only a few rivers in Ireland in which twaite shad spawn.
- Although there is a navigation channel through the estuary to the Port of Waterford in which water depths reach 10m, water depths across most of the estuary are typically 5m or less. Constraints in this area include:

- Navigation channels, dredged channels and designated anchor zones are avoided where possible when routeing a cable due to the risk posed to the cable from dredging and accidental anchoring. Additionally, the removal of a designated anchor zone and the disruption effects to commercial shipping that would be experienced during installation.
- Long stretches of shallow water depths are technically difficult from a cable installation perspective, requiring very slow-moving anchored barges. This can lead to increased levels of disruption, habitat disturbance and higher costs.
- In response to the scoping report, Port of Waterford identified significant issues with any route in the estuary to the west of Hook Head. Refer to Appendix 1.3.

Of the ten potentially suitable landfall locations, four were visited by Arup (onshore consultants) and eight were visited jointly by Arup and Intertek EWCS (offshore consultants). This ensured all sites had been visited and assessed. The ten sites identified were:

- Rathmoylan Cove,
- Boyce's Bay;
- Sandeel Bay;
- Carnivan Bay;
- Baginbun Beach;
- Dollar Bay;
- Booley Bay;
- Newtown Beach;
- Bannow Beach; and
- Cullenstown Beach.

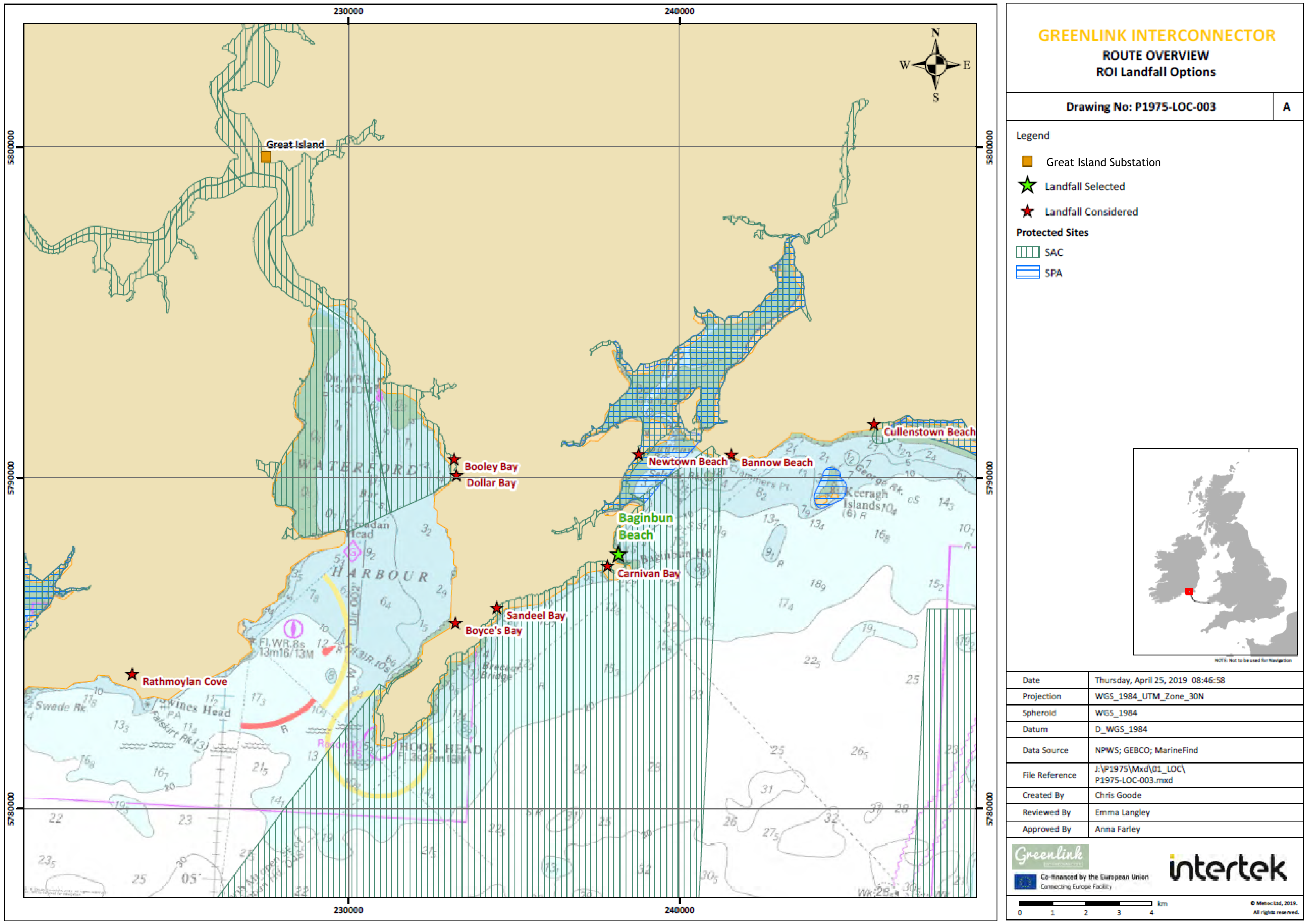

Figure 2.3: Potential landfall sites at Great Island, County Wexford (source: Intertek | not to scale)

In selecting the landfall site locations in Ireland, the proximity of the alternative landfall sites to the proposed converter station site was the primary consideration.

Several additional constraints were also assessed to identify the short-listed landfall sites. These were addressed using publicly available data and mapping.

Key constraints were subsequently used to identify the most suitable landfall sites (See **Table 2.5**). For each constraint, the sites were given a score out of 10 following a visit to each site location. A score of 10 being the most preferable and 0 the least preferable. The scores were averaged and a weighting applied according to the relative importance of each criterion.

Table 2.5: Constraints considered, and weighting used to identify suitable landfall sites

Constraint	Weighting
Vessel Access	16%
Beach composition – including nearshore seabed geology	14%
Ecological and other Environmental Constraints	10%
Amenity Impact	10%
Exposure – weather and currents	8%
Working / Site Area	8%
Obstructions & Existing Infrastructure	8%
Coastal Erosion	8%
Access to the Beach	6%
Cable engineering & protection requirements	6%
Overall cable length	6%

In **Table 2.5**, the constraints that are associated with environmental considerations are highlighted, and it is noted that the total weighting given to these constraints is 48%. A technical and environmental evaluation of the potential landfall sites was carried out (See **Table 2.6**), and the sites were visited. All but four options were ruled out. Baginbun Beach, Sandeel Bay, Boyce's Bay and Booley Bay remained as the short listed potential landfall sites.

Table 2.6: Weighted ranking assigned to potential landfall sites at Great Island. Preferred sites are marked in green

		Beaches - Scores out of 10										Beaches - Weighted Scores									
Description	Weighting	Baginbun Beach	Bannow Beach	Booley Bay	Boyce’ s Bay	Carnivan Bay	Cullenstown	Dollar Bay	Sandeel Bay	Rathmoylan Cove[1]	Newtown Beach[2]	Baginbun Beach	Bannow Beach	Booley Bay	Boyce’ s Bay	Carnivan Bay	Cullenstown	Dollar Bay	Sandeel Bay	Rathmoylan Cove	Newtown Beach
Vessel Access	16%	8	5	6	7	8	5	5	3			1.28	0.8	0.96	1.12	1.28	0.8	0.8	0.48		
Beach Composition - including nearshore seabed geology	14%	8	3	8	8	5	5	8	5			1.12	0.42	1.12	1.12	0.7	0.7	1.12	0.7		
Amenity Impact	10%	7	2	5	5	5	2	6	2			0.7	0.2	0.5	0.5	0.5	0.2	0.6	0.2		
Environmental Constraints	10%	4	7	3	6	2	7	3	2			0.4	0.7	0.3	0.6	0.2	0.7	0.3	0.2		
Exposure	8%	9	2	7	6	2	2	7	3			0.72	0.16	0.56	0.48	0.16	0.16	0.56	0.24		
Working/Site Area	8%	7	7	6	3	8	9	3	7			0.56	0.56	0.48	0.24	0.64	0.64	0.24	0.56		
Coastal Erosion	8%	7	4	7	7	2	4	7	6			0.56	0.32	0.56	0.56	0.16	0.16	0.56	0.48		
Obstructions & Existing Infrastructure	8%	8	6	7	7	7	5	7	6			0.64	0.48	0.56	0.56	0.56	0.56	0.56	0.48		

[1] Further assessment of Rathmoylan Cove was suspended as it was concluded that the overall onshore cable length would be prohibitively long

[2] Further assessment of Newtown Beach was suspended as it was concluded that either Carnivan Bay or Baginbun Beach would be clearly preferable. Newtown Beach is within the SPA, while Carnivan Bay and Baginbun are outside it.

		Beaches - Scores out of 10											Beaches - Weighted Scores									
Description	Weighting	Baginbun Beach	Bannow Beach	Booley Bay	Boyce' s Bay	Carnivan Bay	Cullenstown	Dollar Bay	Sandeel Bay	Rathmoylan Cove[1]	Newtown Beach[2]		Baginbun Beach	Bannow Beach	Booley Bay	Boyce' s Bay	Carnivan Bay	Cullenstown	Dollar Bay	Sandeel Bay	Rathmoylan Cove	Newtown Beach
Access to Beach	6%	5	4	9	8	7	4	5	7				0.3	0.24	0.54	0.48	0.42	0.42	0.3	0.42		
Cable Engineering & Protection Requirements	6%	6	3	6	6	7	9	6	6				0.36	0.18	0.36	0.36	0.42	0.42	0.36	0.36		
Overall Cable Length	6%	6	4	7	6	7	4	7	9				0.36	0.24	0.42	0.36	0.42	0.42	0.42	0.54		
	Total	**75**	**47**	**71**	**69**	**57**	**49**	**64**	**56**				**7.00**	**4.30**	**6.36**	**6.38**	**5.46**	**5.46**	**5.82**	**4.66**[3]		

[3] Refer to Table 2.3 relating to Sandeel Bay for the rationale for reinstating this location as a potential landfall site, even though the scoring was below other discounted locations.

Table 2.7 provides a summary of the considerations for the four options and the reason for the selection of Baginbun Beach as the preferred landfall.

Table 2.7: Summary of Four Short-listed Options

Name	Description	Decision
Baginbun Beach	Baginbun Beach is located to the north of Carnivan Bay on the Baginbun peninsula. It lies within the Hook Head Special Area of Conservation (SAC) but the cable would have less distance in the SAC than at alternative sites such as Sandeel Bay. The beach faces north east, has excellent access for vessels and the eastward facing aspect would protect the site from prevailing wind conditions. The gradient of the beach is flat (1.7˚) and the sediment is generally uniformly distributed coarse sand with occasional whole or partial shells. Notably, there was very little man-made debris. Offshore, lobster / crab pots were observed indicating fishing activity in the area. Surrounding the beach are heavily vegetated cliffs of moderate height (< 15 m) with only minor signs of erosion on the northern side of the beach. Height and apparent stability would suggest horizontal directional drilling (HDD) would be possible but would require appropriate geological assessment and survey of ground conditions for confirmation. An open cut trench landfall would leave a permanent visible scar on the cliff-face and would not be a preferred option. Consultation with the Foreshore Unit indicated that the beach has high amenity value especially during summer months. Although it is not a designated heritage site, the beach has historical importance as the site of an Anglo-Norman invasion in May 1170.	**Landfall Selected as Preferred Option** Following consultation with the National Parks & Wildlife Service (NPWS) (09 December 2015) it was concluded that installing a cable through a SAC could potentially be possible provided that works do not adversely affect the integrity of the protected site and its conservation objectives. Selection was based on the fact that it offered the shortest overall offshore cable route length and met the technical requirements for which other landfalls had lower weighted scores. Refer to Table 2.2 above. Selection as the preferred option was, however, dependent on the results of the cable route survey. The survey needed to demonstrate that the submarine cable route could be installed without significantly affecting the conservation objectives of Hook Head SAC. A sand channel with sufficient depth to achieve cable burial has been confirmed during the cable route survey, through the SAC to Baginbun Beach.

Name	Description	Decision
Boyce's Bay	This landfall location lies on the west coast of the Hook Peninsula, within the Port of Waterford harbour limits. The site is located outside the Hook Head SAC, but it falls within a proposed Natural Heritage Area (pNHA). The beach faces the south west making it an exposed site, given the prevailing south-westerly weather conditions. Due to the shallow waters and location of the 5 and 10 m depth contours, the types of vessel that can reach the bay may be restricted, increasing the chances of requiring anchored barges. The beach extends further north along the coastline for approximately 2km but a rock outcrop to the north of the site prevents vehicles from accessing the additional coastline and beach. The beach itself is gently sloping with evidence of a storm berm and seaweed debris on the upper reaches of the beach. The typical slope angle was 2.4° from the cliff to the water. The beach was approximately 200m wide, with approximately 157m of rock to the south of the beach. Fossils were observed on rock outcrops on the side of the bay. The surrounding cliffs and headland are high with one large derelict property at the top, close to the dairy farm; this is probably a heritage site and would require confirmation prior to establishing the location for a HDD point. The surrounding cliffs are densely vegetated with grasses and scrub but there are many indicators of instability and slope movement. Portions of the cliffs were identified as suitable for HDD up to the main track, pending further geotechnical assessments and ground investigation. An open cut trench landfall would leave a permanent visible scar on the cliff-face and would not be a preferred option.	**Landfall reserved as Second Preferred Option** Selected as an alternative for investigation in the case that the cable route survey identified substantial issues which would have resulted in a route to Baginbun Beach not being feasible. The Port of Waterford has expressed concerns that the proposed route to Boyce's Bay enters the shipping channel passing Hook headland. They have not granted permission for the route to extend into the central channel where there are potentially deeper Holocene sediments. Instead, their preference is for the cable to be routed as close to the headland as possible. A compromise, whereby the route follows the edge of a mapped outcrop to the east of the channel centre was proposed. However, this area may only have a veneer of sediment overlying rock which would likely result in external rock protection (e.g. rock berm) being required. The outcropping rock is likely to be Annex I Reef (Stony Reef) habitat and although not within the Hook Head SAC forms part of the wider habitat for which the site is designated. As well as increasing installation costs across the outcropping rock has the potential to significantly affect a sensitive habitat. The landfall was discounted in 2018 when the cable route survey confirmed a route into Baginbun Beach was feasible.

Name	Description	Decision
Booley Bay	Booley Bay is approximately 5km north of Boyce's Bay, within the Port of Waterford harbour limits. Like Boyce's Bay, the landfall faces the west and is moderately exposed to the prevailing south-westerly wind conditions. The beach is approximately 205m wide and 113m from the cliff to the water's edge shortly before low water. The beach is predominantly flat (0.2˚) with fine, water saturated sand. A storm berm was observed at the upper reaches of the beach. The surrounding headland is dominated by vegetated cliffs to the north and south, both sides demonstrated low levels of coastal erosion with minor evidence of disruption by landslides. Adjacent to the access road and track was a freshwater riverine input, surrounded by unmanaged vegetation. The river water flows directly onto the beach where the water flow is diverted along the upper reach of the beach to the southern rock outcrop where it is forced towards the sea by rocks. Options for installation would include HDD and open-cut trenching. It is likely that the flow of freshwater onto the beach would make keeping a trench open difficult and may risk exposure of the cable during adverse weather conditions.	**Landfall Discounted** Consultation with the Port of Waterford was undertaken on 09 March 2016. At the meeting the Harbour Master advised the Booley Bay landfall be dropped from further consideration. A 100m wide corridor (marked on Admiralty Chart) is dredged at Duncannon approximately 3-4 times a year, to stop the shipping channel from silting up. The offshore approach to the landfall would intersect this area risking both the port activities and the cable.

Name	Description	Decision
Sandeel Bay	Sandeel Bay is located to the south of the Baginbun peninsula on the east of the Hook peninsula. Lying within the Hook Head SAC, it is close to Hookless Village / Sandeel Bay Cottages, a popular holiday resort. The cliffs surrounding the beach are approximately 10 – 15m in height with small localised areas of erosion and landslip. There is a rock outcrop to the south of the bay. The beach gradient is shallow and demonstrates large amounts of seaweed and debris. There also appears to be sediment zonation indicative of sediment sorting associated with high-energy conditions. The site would not be suitable for open cut trenching due to the volume of rock and the seawall approaching the path. HDD may have been suitable but geotechnical data assessment would be required to confirm suitability.	**Landfall Discounted** Initially, the landfall was not considered a 'preferred' option as it is in both the SPA and the SAC. Following consultation with the National Parks & Wildlife Service (NPWS) (09 December 2015) it was concluded that installing a cable through a SAC could potentially be possible provided that works do not adversely affect the integrity of the protected site and its conservation objectives. In the interest of achieving the most direct offshore cable route, Sandeel Bay was reinstated as a potential landfall location, despite the relatively low score in assessment. It was subsequently de-selected when analysis of INFOMAR bathymetric data identified likely extensive reef habitat offshore, confirming any route to landfall would likely have significant effect on the conservation objectives of the SAC.

Baginbun Beach was ultimately selected as the single preferred landfall location as it offered the shortest overall cable route length, while avoiding significant adverse effects on the integrity of the Hook Head Special Area of Conservation.

Table 2.8 presents a comparison of the main potential environmental effects which were considered for each alternative landfall.

Table 2.8: Comparison of Environmental Effects of Short-listed Landfall Sites

	Baginbun Beach	Boyce's Bay	Booley Bay	Sandeel Bay
Biodiversity	Shortest offshore route so least disturbance of offshore biodiversity, no significant effect on conservation objectives of Hook Head SAC expected	Although outside the Hook Head SAC, a mapped rock outcrop on the route to this landfall, likely to be Annex 1 Reef (Stony Reef) habitat, likely to be affected	Site within River Barrow and River Nore SAC, potential effects on conservation objectives of SAC	Site within Hook Head SAC. With extensive reef habitat offshore, significant effect on conservation objectives likely
Archaeology and Cultural Heritage	Though not designated, beach has historical importance as used for Anglo-Norman invasion of 1170. HDD would avoid impact on beach	Potential impact on derelict property on cliff top, likely to be heritage site. The property would be avoided.	No archaeology or cultural heritage effects anticipated	No archaeology or cultural heritage effects anticipated
Population and Human Health	Beach has high amenity value; HDD would minimise disruption	Beach has medium amenity value; HDD would minimise disruption	Beach has medium amenity value; HDD would minimise disruption	Beach has low amenity value; HDD would minimise disruption
Natural Resources	No impact on shipping channel to Waterford Port. Overall cable length approximately equal to Boyce's Bay, though shortest offshore route, consumption of natural	Potential obstruction of shipping channel to Waterford Port during construction. External rock protection would be required. Overall cable length approximately equal to Baginbun Beach,	Potential obstruction of shipping channel to Waterford Port during construction and on regular maintenance dredging due to presence of cable. Overall cable length second	No impact on shipping channel to Waterford Port. Shortest overall cable length resulting in least resource use

	Baginbun Beach	Boyce's Bay	Booley Bay	Sandeel Bay
	resources greater than Sandeel Bay or Booley Bay	consumption of natural resources greater than Sandeel Bay or Booley Bay	shortest, consumption of natural resources less than Baginbun Beach or Boyce's Bay	

2.5 Onshore Routing

The landfall site and the converter station site define the two ends of the onshore cable route. Once these had been selected, the selection of the onshore cable route could proceed.

The objective of the onshore cable route selection process was to identify the optimum onshore cable route between Great Island converter station and Baginbun Beach, by achieving the right balance between environmental, technical, safety, and economic considerations.

2.5.1 Identification of Cable Route Options

Several feasible cable route options were identified which were then subjected to a comparative assessment against the route selection criteria. The following high-level route selection criteria within the study area were taken into consideration when identifying the feasible route options:

- The directness of the route;
- A preference for on-road route rather than cross-country route;
- The length of the route;
- A preference for wider roads, with straight alignment;
- The avoidance of nature conservation areas;
- The avoidance of protected structures/areas;
- The avoidance of towns and villages; and
- The avoidance of adverse social effects.

When considering feasible route options, cable routes that followed the public road network were preferred where possible. This preference avoids the requirement for extensive wayleave acquisition from numerous third-party landowners which would be required for long cross-country (off-road) routes, lessens the possibility of encountering unknown archaeological features, and also generally removes seasonal constraints on construction activities due to adverse weather. However, in certain areas, it was seen to be beneficial to route the cable cross-country, especially in the interest of reducing potential environmental effects and cable length. GIL’s strong preference was to avoid the requirement for compulsory acquisition orders for off-road construction, where possible.

2.5.2 Routing Criteria

The comparative assessment of the route options was undertaken against the following criteria, listed in **Table 2.9**.

Table 2.9: Criteria considered for route assessment

Criterion	Comments
Physical	
Geology/ground conditions	Very soft ground or rock affects the suitability for trench excavation/reinstatement. Impacts cost and duration of construction
Known contamination	Construction health, safety, and environmental risk. Impacts cost and duration of construction
Water table/flood risk	Very high-water table/flood risk impacts construction safety and cost of construction
Topography	Very steep slopes affect joint bay locations, cost, complexity and duration of construction
Physical characteristics of road	Road widths, presence of verge or hard shoulder. Impacts constructability and working methodology - availability of joint-bay locations, ability to install cables in verge, traffic management, requirement for lane/road closure.
Road surfacing - reinstatement	Cost of reinstatement of the surface
Services in road	Availability of space. Ability to avoid impact on other services. Diversion of services. Affects cost and duration of construction.
Road designations	Potential additional restriction on major/national roads
Traffic	Impact on other road users; seasonality of traffic volumes
Crossings - river	Very unlikely to be allowed an open cut crossing of environmentally designated rivers
Crossings - railway	Ability to cross railway. Obtain agreement with Irish Rail. Extremely unlikely to be allowed an open cut crossing of railway
Crossings – services transverse	Permissions to cross critical/sensitive services (cannot be interrupted) – major water, power, fibre. Possible temporary service/diversions required. Affects consents/notifications, cost and duration of construction
Environmental Issues	
Natura 2000/Habitats Directive (SPA, SAC)	Assess potential of impact and mitigation measures. Stakeholder engagement requirements
Habitats Directive annex 1 habitat or annex 2 species	Assess potential of impact and mitigation measures. Stakeholder engagement requirements
Natural heritage area (NHA)	Assess potential of impact and mitigation measures. Stakeholder engagement requirements
Other environmental designation e.g. National Park	Assess potential of impact and mitigation measures. Stakeholder engagement requirements

Criterion	Comments
National Monuments / Register of monuments and places	Assess potential of impact and mitigation measures. Stakeholder engagement requirements
Cultural heritage features: listed buildings / protected structures / conservation zones etc	Assess potential of impact and mitigation measures. Stakeholder engagement requirements
Designated scenic landscapes / visual impact / scenic views/scenic routes	Assess potential of impact and mitigation measures. Stakeholder engagement requirements
Other designations in County Development Plan/ local area plan	Assess potential of impact and mitigation measures. Stakeholder engagement requirements
Human activity	
Recreational amenities - e.g. beaches, walking paths etc	Potential nuisance or loss of amenity
Proximity to residences	Potential nuisance due to noise, dust, traffic and temporary disruption to access
Proximity to sensitive receptors - schools, hospitals, nursing homes, emergency services	Potential nuisance due to noise, dust, traffic and temporary disruption to access
Commercial premises - shops, tourism businesses, agricultural enterprises etc	Potential nuisance due to noise, dust, traffic and temporary disruption to access
Community assets/premises - churches, cemeteries, sports grounds	Potential nuisance due to noise, dust, traffic and temporary disruption to access
Engineering and economic	
Length	Impact on cost and duration of construction
Land acquisition	Impact on cost and risk/duration of wayleave acquisition

2.5.3 Route Identification

A number of route options were identified for the onshore cable route from the proposed converter station site at Great Island to the landfall site at Baginbun Beach. These route options are described below.

For ease of description of these routes, the route descriptions have been divided into two sections:

- from Great Island to the R733 at the village of Ramsgrange, and
- from the R733 at the village of Ramsgrange to Baginbun Beach.

All onshore cable routes pass close to the village of Ramsgrange. A straight-line route from the Great Island convertor station site to Baginbun Beach passes to the west of Ramsgrange village. When taking into account the technical and environmental constraints of crossing the Campile Estuary with the onshore cable route, a straight-line route from the likely crossing-point of the Campile Estuary to Baginbun Beach passes to the east of Ramsgrange village.

Figure 2.4 shows an overview of the route options, broken down into the two sections listed above.

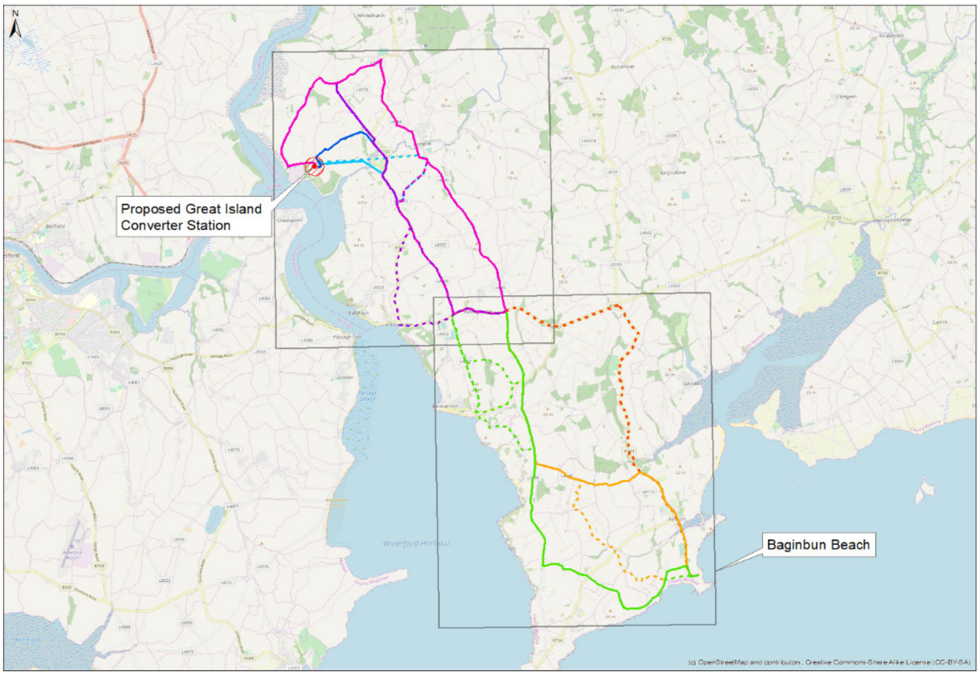

Figure 2.4: Overview of route options identified.

2.5.4 Great Island to Ramsgrange

Four primary route options (A-D) were identified from the converter station at Great Island to the R733 at Ramsgrange. These route options are described below, along with an alternative to each.

Route Option A

Route Option A (shown in **Figure 2.5**) exits the converter station site at Great Island onto the L4033 local road before turning north, crossing the railway line, and proceeding along the L4033 as far as the junction with the R733 regional road. The route may be required to divert onto private property in places along the L4033, due to a narrow causeway structure supporting the road. At the junction of L4033/R733, the route turns south, following the R733 before joining and following the L4035 towards Campile village. Due to the presence of a stone arch bridge over the river at Campile, the route deviates cross-country to the south of the L4035 before reaching Campile and crossing the Campile River Estuary to the west of Campile, upstream of the Barrow River Estuary pNHA and the River Barrow and River Nore SAC. The crossing of the estuary would be carried out by horizontal directional drilling (HDD).

The cable route joins the L4045 to the south of Campile, heads south along the L4045, through the L4034/L4045 junction, and continues on to the L4045/R733 junction east of Ramsgrange village. The total length of this route is approximately 14.2km.

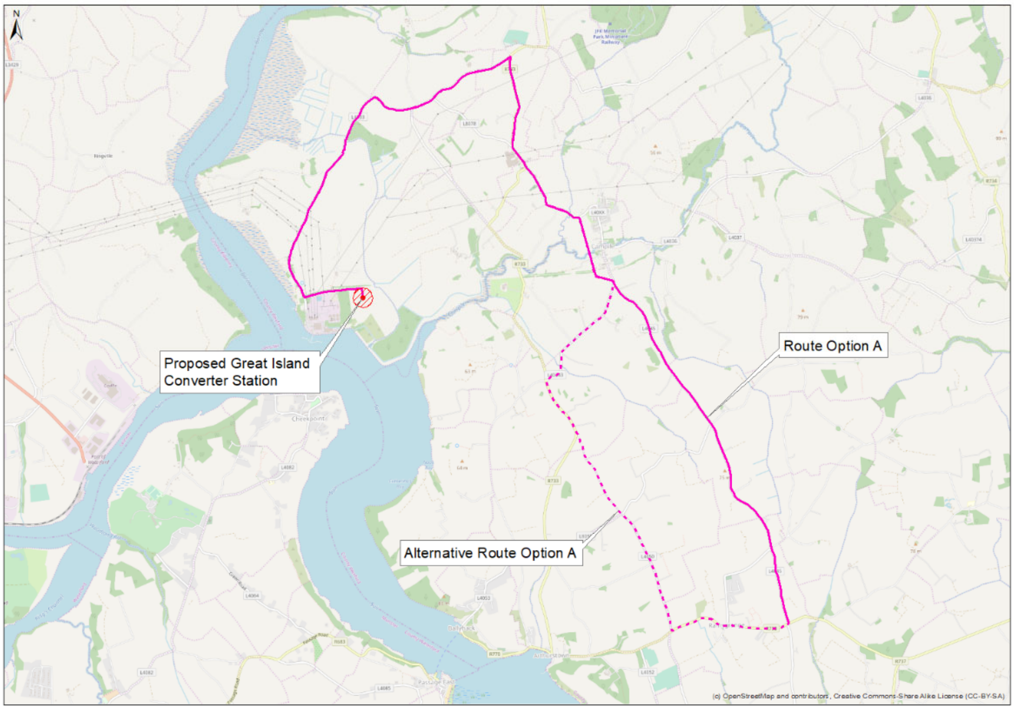

Figure 2.5: Route Option A and Alternative

Alternate Route Option A

Alternative Route Option A (also shown in **Figure 2.5**) follows the same route as Route Option A to the L4034/L4045 junction south of Campile village. However, from there it deviates south-west along the L4034 to meet the R733. The cable continues along the R733 to the junction of the R733/L4050, where it heads south along the L4050 before re-joining the R733 at Sutton's Cross, west of Ramsgrange village. From there, the route heads east through Ramsgrange to the junction of L4045/R733. The total length of the Alternative Route Option A is approximately 15.9km. Due to the additional cable length required, this variation was considered to be less advantageous than the original route and was discounted accordingly.

Additional alternatives to Route Option A, which deviated further east of Campile village while remaining on-road (as far as the R734), were discounted at an early stage because they deviated significantly from the direct route between Great Island and Baginbun Beach. These routes offered no significant advantage and were longer than Route Option A.

Route Option B

Route Option B, shown in **Figure 2.6**, exits the converter station site at Great Island onto the L4033 local road before turning north, crossing the railway tracks, and proceeding along the L4033 as far as the junction with the L8077 local road. The route may be required to divert onto private property in places along the L4033 due to a narrow causeway structure supporting the road. At the junction of L4033/L8077, the cable route turns south along the L8077 to meet the R733 regional road. Due to the presence of a stone-arch bridge on the R733 at the Campile Estuary, an off-road section through private property, is required to cross the estuary. The crossing of the estuary would be carried out by horizontal directional drilling (HDD). An option to cross the estuary by staying in the R733 road across the existing stone-arch bridge over the estuary was considered and ruled out due to the technical challenges of installing the cables in the stone-arch bridge. On south side of the estuary, the route re-joins the R733, passes underneath the railway tracks and continues to the first junction of the R733/L4050. Heading south on the L4050, the route meets up with the R733 again at Sutton's Cross before turning east through the village of Ramsgrange to the junction of L4045/R733. The total length of this route is approximately 13.4km.

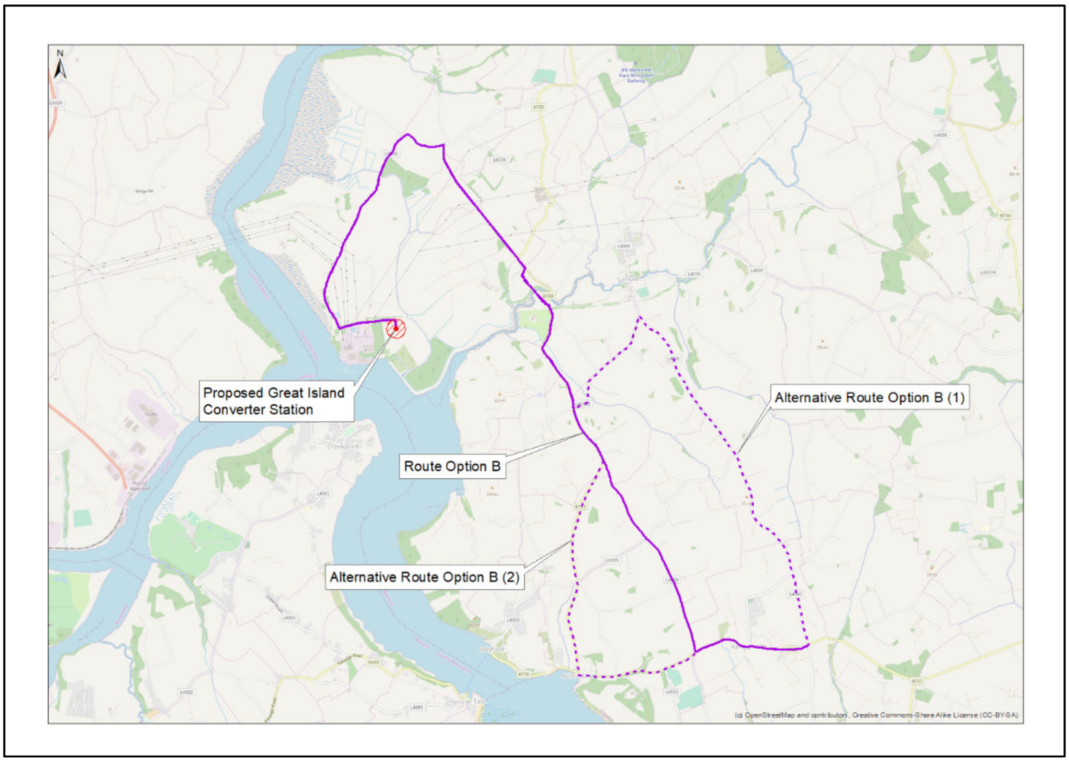

Figure 2.6: Route Option B and Alternative

Alternative Route Option B

A variation to Route Option B (shown in **Figure 2.6** as Alternative Route Option B (1)) follows the same route as far as the L4034/R733 junction, south of the Campile Estuary. From there, the alternative route turns northeast along the L4034 to the L4034/L4045 junction. The route then heads south on the L4045 to the junction of R733/L4045 east of Ramsgrange village.

The total length of this alternative is approximately 14.9km. While this variation avoids Ramsgrange village, it is 1.5km longer than Route Option B and therefore was considered to be less advantageous than the original route and was discounted accordingly.

A further alternative was considered (shown in **Figure 2.6** as Alternative Route Option B (2)) which follows the same route as Route Option B to the first junction of the R733/L4050 to the south of the Campile Estuary. At this point, instead of following the L4050 to Sutton's Cross, the route continues southwest on the R733, through Arthurstown, before heading east to Sutton's Cross. At Sutton's Cross, the route re-joins the original Route Option B and continues east through Ramsgrange to the R733/L4045 junction. This alternative is 1.5km greater in length than the original Route Option B and was therefore considered to be less advantageous than the original route and was discounted at an early stage accordingly.

Route Option C

Route Option C, shown in **Figure 2.7**, exits the convertor station site to the north via a cross-country route. The route crosses underneath the railway tracks to the north of the converter station site and continues north-east across private property towards the R733. Staying off-road, the route turns to the south, running parallel to the R733 across private property, and crosses the Campile River Estuary via HDD. An option to cross the estuary in the R733 road via the existing stone-arch bridge was considered but was ruled out due to the technical challenges of installing the cables in the stone-arch bridge. South of the estuary, the route re-joins the R733, passes underneath the railway tracks and continues until it reaches the first R733/L4050 junction of the R733/L4050, where it heads south on the L4050 and meets up with the R733 again at Sutton's Cross, west of Ramsgrange. From Sutton's Cross, the route turns east, through the village of Ramsgrange, to the L4045/R733 junction. The total length of this route is approximately 9.3km.

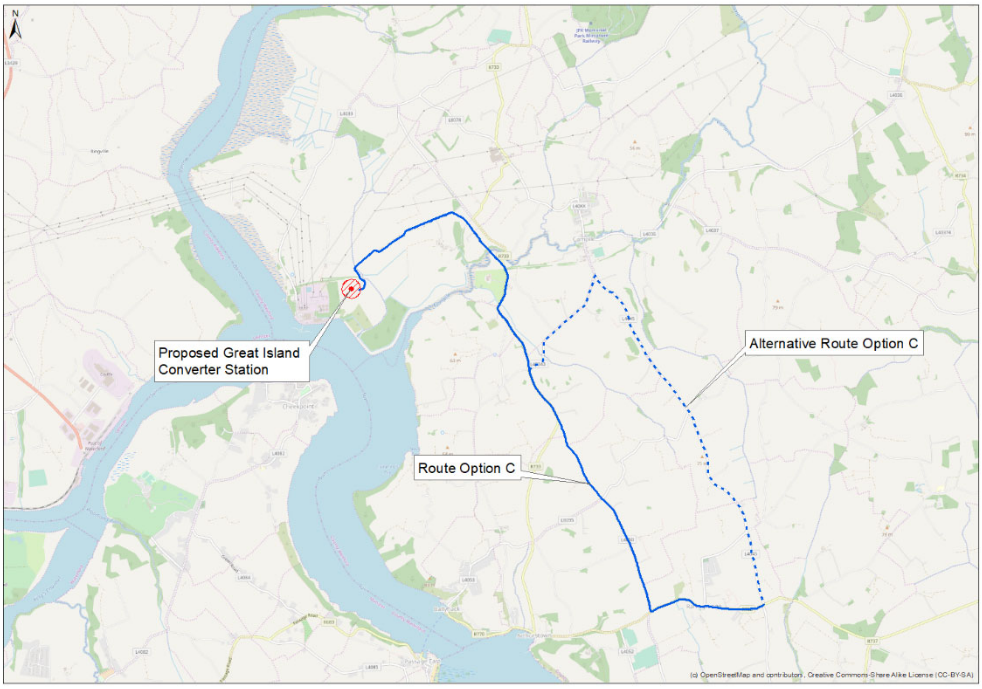

Figure 2.7: Route Option C and Alternative

Alternative Route Option C

Alternative Route Option C (also shown in **Figure 2.7**) follows the same route as Route Option C, as far as the L4034/R733 junction, south of the Campile Estuary. From there, the alternative route heads northeast along the L4034 to the L4034/L4045 junction where it turns south on the L4045 to R733/L4045 junction. The total length of Alternative Route Option C is 10.8km. While this variation avoids Ramsgrange village, it is 1.5km longer than Route Option C and was therefore considered to be less advantageous than the original route and was discounted accordingly.

Route Option D

Route Option D, shown in **Figure 2.8**, exits the convertor station site to the east via a cross-country route. The route heads due east from the converter station site, across private property, running parallel and to the south of the existing railway line before crossing the Campile River Estuary by HDD to the south-west of Dunbrody Abbey. Passing to the south of Dunbrody Abbey, the route joins the R733 and continues along this road until it reaches the first junction of the R733/L4050. It then heads south on the L4050, before re-joining the R733 at Sutton’s Cross, before continuing east through the village of Ramsgrange to the junction of L4045/R733. The total length of this route is approximately 8.0km.

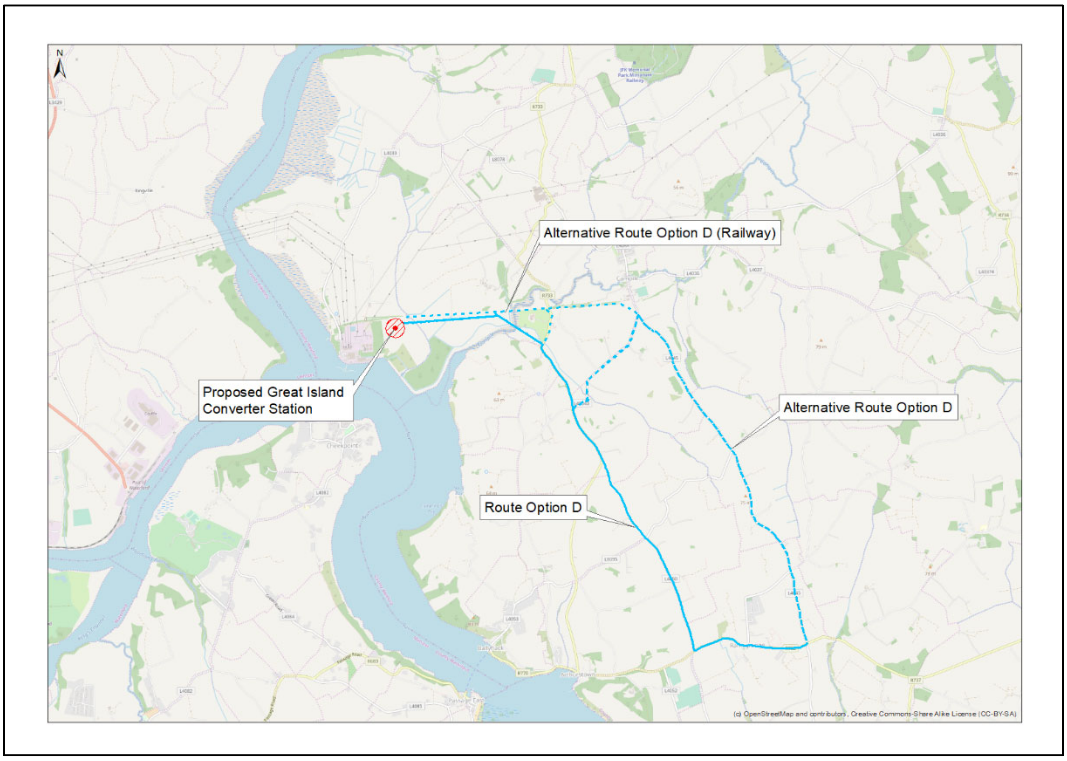

Figure 2.8: Route Option D and Alternative

Alternative Route Option D

Alternative Route Option D (also shown in **Figure 2.8**) follows the same route as far as the L4034/R733 junction south of the Campile Estuary. From there the alternative route to turn northeast along the L4034 as far as the L4034/L4045 junction before turning south on the L4045 to junction of R733/L4045 as before. The total length of this Alternative Route Option D is 9.5km. While this variation avoids Ramsgrange village, it is 1.5km greater in length and therefore was considered to be less advantageous than the original route and was discounted accordingly.

A further variation to Route Option D was considered which would exit the convertor station site to the north and run along the existing railway line, within the existing railway embankment, instead of running cross-country to the south of the railway line. This alternative route could run along the railway line as far as:

- **i.** before the Campile River Estuary railway viaduct;
- **ii.** the R733, or;
- **iii.** the village of Campile.

These alternatives routing along the railway line were discounted at an early stage as the railway line, while disused, has not been abandoned, and therefore the construction requirements would be the same as if the line was in active use. This would require the cables to be installed at a significant depth below the level of the railway tracks so as to make construction impractical.

Assessment of Route Options A to D

The constraints comparison for each of Route Options A to D, including their alternatives, are summarised in **Table 2.10** below. Based on this assessment, Route Option C has emerged as the preferred option for this section of the route. Route Option C is significantly shorter than the Options A or B, and Option D is not preferred as a compulsory acquisition order would be required to obtain a wayleave for the cross-country section of the route. In coming to this conclusion, GIL engaged with landowners early in the design stage, minimising negative effects on local populations.

Table 1.10: Comparison of Great Island to Ramsgrange Route Options, Including Comparison of Environmental Effects

Criteria	Route Option A	Alternative Option A	Route Option B	Alternative Option B	Route Option C	Alternative Option C	Route Option D	Alternative Option D
Ground conditions	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints	Route crosses reclaimed land on cross-country route near Great Island	Route crosses reclaimed land on cross-country route near Great Island	Route crosses reclaimed land on cross-country route near Great Island	Route crosses reclaimed land on cross-country route near Great Island
Road characteristics	Narrow road route near Great Island	Narrow road route near Great Island	Narrow road route near Great Island	Narrow road route near Great Island	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints
Services, Utility Constraints, Material Assets	HV/MV/LV ESB Gas mains Water mains Telecoms	HV/MV/LV ESB Gas mains Water mains Telecoms	HV/MV/LV ESB Gas mains Water mains Telecoms	HV/MV/LV ESB Gas mains Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms
Traffic	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads
Significant River Crossings	Crosses the Campile Estuary via HDD	Crosses the Campile Estuary via HDD	Crosses the Campile Estuary via HDD	Crosses the Campile Estuary via HDD	Crosses the Campile Estuary via HDD	Crosses the Campile Estuary via HDD	Crosses the Campile Estuary via HDD	Crosses the Campile Estuary via HDD
Rail Crossings	Once on-road on the L4033; and once off-road south of Campile village	Once on-road on the L4033; and once off-road south of Campile village	Once on-road on the L4033; and once on-road at Dunbrody	Once on-road on the L4033; and once on-road at Dunbrody	Once on-road north of Great Island converter station; and once on-road at Dunbrody	Once on-road north of Great Island converter station; and once on-road at Dunbrody	None	None
Environmental issues and biodiversity	Crosses upstream of Barrow River Estuary pNHA,	Crosses upstream of Barrow River Estuary pNHA,	Crosses Barrow River Estuary pNHA and River Barrow and	Crosses Barrow River Estuary pNHA and River Barrow and	Crosses Barrow River Estuary pNHA and River Barrow and	Crosses Barrow River Estuary pNHA and River Barrow and	Crosses Barrow River Estuary pNHA and River Barrow and	Crosses Barrow River Estuary pNHA and River Barrow and

Criteria	Route Option A	Alternative Option A	Route Option B	Alternative Option B	Route Option C	Alternative Option C	Route Option D	Alternative Option D
	River Barrow and River Nore SAC - less potential risk of impact	River Barrow and River Nore SAC - less potential risk of impact	River Nore SAC - potential risk of impact	River Nore SAC - potential risk of impact	River Nore SAC - potential risk of impact	River Nore SAC - potential risk of impact	River Nore SAC - potential risk of impact	River Nore SAC - potential risk of impact
Cultural Heritage, Archaeology	None	None	Close to Dunbrody Abbey - potential for impact	Close to Dunbrody Abbey - potential for impact	Close to Dunbrody Abbey - potential for impact	Close to Dunbrody Abbey - potential for impact	Close to Dunbrody Abbey - potential for impact	Close to Dunbrody Abbey - potential for impact
Natural Resources	Greater length of cable, use of materials	Greatest length of cable, use of materials	Greater length of cable, use of materials	Greater length of cable, use of materials	Less length of cable, use of materials	Less length of cable, use of materials	Least length of cable, use of materials	Less length of cable, use of materials
Human activity/ Social Constraints, Population, Amenity, Material Assets	Campile - potential for impact	Campile, Ramsgrange - potential for impact	Dunbrody Abbey, Ramsgrange - potential for impact	Dunbrody Abbey- potential for impact	Dunbrody Abbey, Ramsgrange - potential for impact	Dunbrody Abbey - potential for impact	Dunbrody Abbey, Ramsgrange - potential for impact	Dunbrody Abbey- risk of potential impact
Length	14.2km	15.9km	13.4km	14.9km	9.3km	10.8km	8.0km	9.5km
Land Acquisition	Required at Campile estuary	Required at Campile estuary	Required at Campile estuary	Required at Campile estuary	Required for cross-country route and Campile estuary	Required for cross-country route and Campile estuary	Required for cross-country route and Campile estuary but not possible without compulsory acquisition order	Required for cross-country route and Campile estuary but not possible without acquisition purchase order

2.5.5 Ramsgrange to Baginbun Beach

Three primary route options were identified from Ramsgrange to Baginbun Beach. The route options originate from either Sutton's Cross or the junction of L4045/R733. The route length for each option is given, along with the combined total route length when combined with the preferred Route Option C. These route options, along with a number of individual alternatives are described below.

Route Option E

Route Option E, shown in green on **Figure 2.9**, starts at Sutton's Cross at the junction between L4050/R733 to the west of Ramsgrange. The route runs west through the village of Ramsgrange to the junction of L4045/R733 where it turns south along the L4045, passing through the junction of the L4045/R737, and on to a junction with an unnamed local road at the Templar's Inn at Templetown. At the Templar's Inn, the route turns south-east and continues along the unnamed local road, crossing the R734 at Graigue Little, before continuing along the local coast road through Graigue Great and Carnivan until it meets the main road between Fethard and Baginbun Beach at a junction in Yoletown, just north of Baginbun Beach. The route then heads south on the road towards Baginbun until it reaches the field proposed for the HDD compound for the landfall at Baginbun Beach. The total length of this route is approximately 14.8km (or 22.6km when combined with Route Option C).

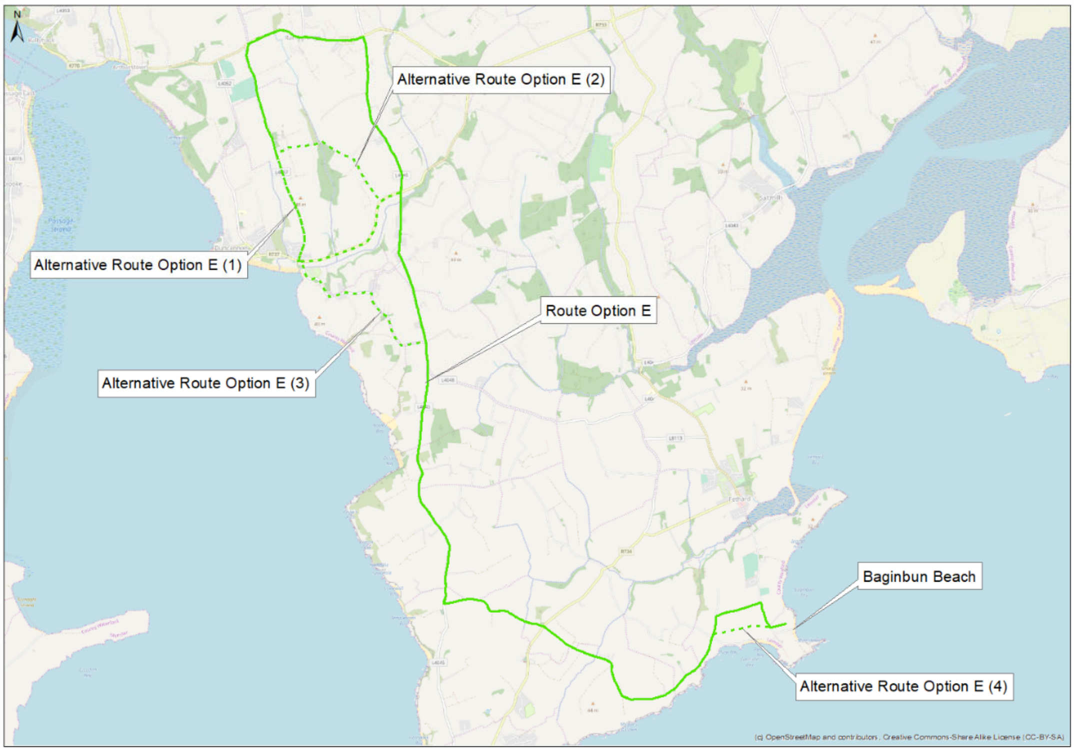

Figure 2.9: Route Option E and variations.

Three variations to Route Option E were also considered (also shown in **Figure 2.9**).

Alternative 1 to Route Option E

The first Alternative Route Option E starts at Sutton's Cross but instead of going east through Ramsgrange, it heads south along the L4051 until it joins the R737 near Duncannon. The route turns east along the R737 until it re-joins the original Route Option E at the junction of L4045/R737. From here it follows the remainder of the original Route Option E to Baginbun Beach. The total length of this Alternative Route Option E is approximately 15.9km. While this variation avoids Ramsgrange village, it is 1km greater in length and therefore was considered to be less advantageous than the original route and was discounted accordingly.

Alternative 2 to Route Option E

The second Alternative Route Option E starts at Sutton's Cross and heads south along the L4051. Approximately halfway along the L4051, the route turns east on an unnamed local road through Clonsharragh until it joins the R737 and turns east along the R737 until it re-joins the original Route Option E at the junction of L4045/R737. From here it follows the remainder of the original Route Option E to Baginbun Beach. The total length of this Alternative Route Option E is approximately 14.7km. While this variation avoids Ramsgrange village and is marginally shorter in length than the original Route Option E, it was considered to be less advantageous than the original route due to the technical constraint of routing along the narrow unnamed road through Clonsharragh between the L4051 and R737 and was discounted accordingly. The narrow width of this road, and crossing the bridge across a narrow river gully, make the route less preferable than the original route.

Alternative 3 to Route Option E

The third Alternative Route Option E starts a Sutton's Cross and heads south along the L4051 until it joins the R737 near Duncannon. The route turns east along the R737 for a short distance until turning south on an unnamed local road, across a river, and along the unnamed local road until it re-joins the original Route Option E approximately 2km south of the junction of L4045/R737. From here it follows the remainder of the original Route Option E to Baginbun Beach. The total length of this Alternative Route Option E is approximately 14.5km. While this variation avoids Ramsgrange village and is approximately 300m shorter in length than the original Route Option E, it was considered to be less advantageous than the original route due to the technical constraint of crossing the stone-arch bridge over the river to the south of Duncannon and was discounted accordingly. There is insufficient depth to the deck of the stone-arch bridge to allow the cables to be installed across the bridge, therefore the river will have to be crossed off-road, most likely by HDD. The river at this location is part of the River Barrow and River Nore Special Area of Conservation (SAC) and Duncannon Sandhills proposed Natural Heritage Area (pNHA). The shoreline to the west of the road is also part of the SAC and pNHA and there is a mobile home holiday park to the east of the road, immediately south of the river. To the south of the river crossing, the unnamed road is populated with dwellings and the alignment of the road has a greater number of bends than the original route, which are a disadvantage when installing the cables.

Alternative 4 to Route Option E

The fourth Alternative Route Option E follows the same route as the original Route Option E but crosses a section of privately-owned land off-road just before reaches the field proposed for the HDD compound for the landfall at Baginbun Beach. The total length of this Alternative Route Option E is approximately 14.4km. While this variation is approximately 400m shorter in length than the original Route Option E, it was considered to be less advantageous than the original route as the private property involved is owned by numerous parties giving rise to the risk of not obtaining landowner consent, and was discounted accordingly.

Route Option F

Route Option F (shown in orange on **Figure 2.10**) starts at the junction of L4045/R733 to the east of Ramsgrange and proceeds south along the L4045, passing through the junction of the L4045/R737, and on to a junction with the L4048 local road at Ballinruan. At this junction, the route heads west on the L4048 until it reaches the R734/L4048 intersection where it turns south-east on the R734 through the village of Fethard and on to the field proposed for the HDD compound for the landfall at Baginbun Beach. The route through Fethard requires a crossing of the causeway across the estuary to the south of the village. This crossing is considered to be challenging from a technical and environmental perspective. This route is approximately 11.3km in length.

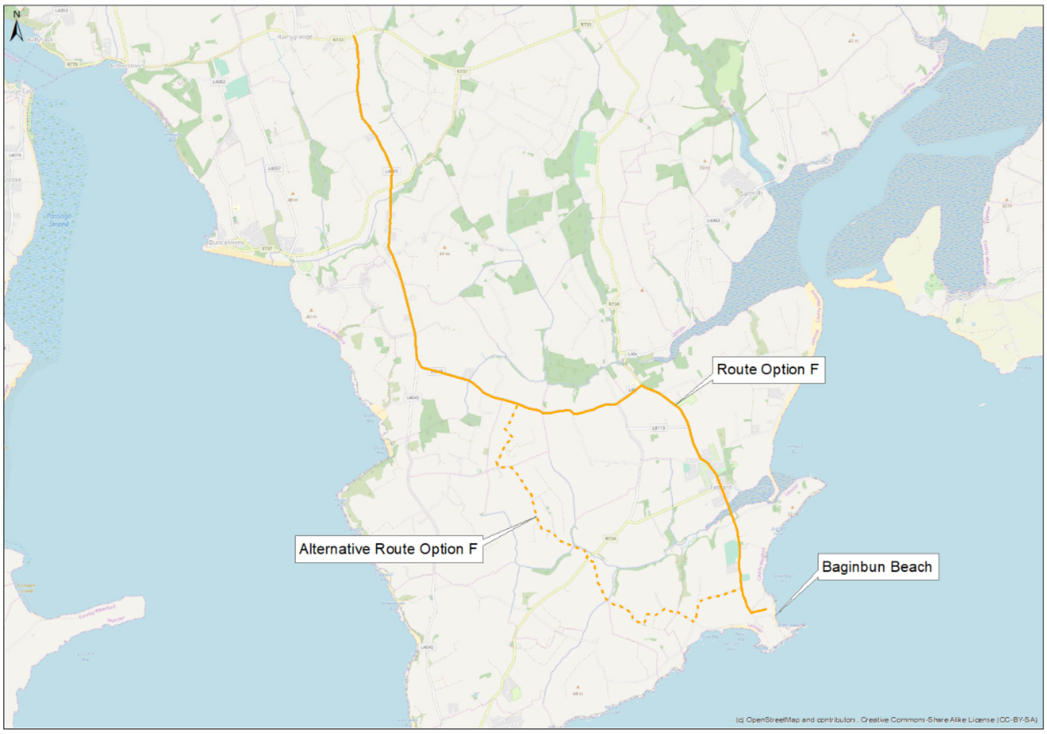

Figure 2.10: Route Option F and variations.

A variation to Route Option F was also considered (also shown in **Figure 2.10**) which follows the same route as far as the junction with the L4048 local road at Ballinruan. At this junction the route turns east along the L4048 as before, but then, at Knockanduff, the route turns south onto an unnamed local road through Haytown and Air Hill before crossing the R734 onto another unnamed local road and passing through Lambstown before joining the local coast road at Carnivan. At Carnivan, the route turns north-east along the coast road until it meets the main road between Fethard and Baginbun Beach at a junction in Yoletown, just north of Baginbun Beach. The route then heads south along the road towards Baginbun Beach until it reaches the field proposed for the HDD compound for the landfall at Baginbun Beach. The total length of this route is approximately 12.2km. While this variation avoids Fethard village, it is 0.9km greater in length and traverses narrower roads with alignments that have a greater number of bends than the original route that are a disadvantage when installing the cables, therefore the variation was considered to be less advantageous than the original route and was discounted accordingly.

Route Option G

Route Option G (shown in dark orange on **Figure 2.11**) starts at the junction of L4045/R733 to the east of Ramsgrange and proceeds south-east along the R733 to Ballininy Cross Roads, where it turns south on the R734 and through the village of Fethard until it reaches the field proposed for the HDD compound for the landfall at Baginbun Beach. The route through Fethard requires a crossing of the causeway across the estuary to the south of the village.

This crossing is considered to be challenging from a technical and environmental perspective. The total length of this route is approximately 12.5km.

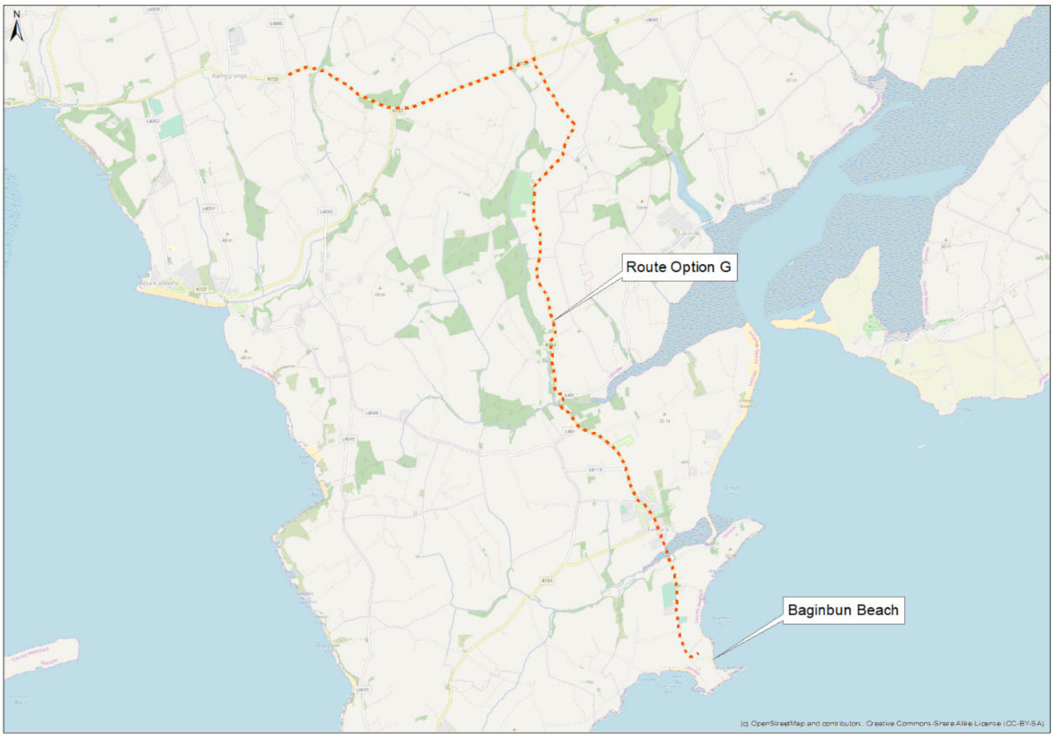

Figure 2.11: Route Option G.

Assessment of Route Options E to G

The constraints comparison for each of Route Options E to G, including their alternatives, are summarised in **Table 2.11** below. Based on this assessment, Route Option E has emerged as the preferred option for this section of the route. Route Options F and G are not preferred as they pose a significant challenge to cross the Bannow Bay Estuary. The Alternatives to Route Option E and F are not preferred due to the technical and environmental challenges they pose compared to Route Option E.

Although this Route Option E is the longest of the routes considered, the reduced social and environmental impacts and lesser technical challenges of the route make it preferable over the other route options.

The combined preferred Route Options C and E are shown in **Figure 2.12.**

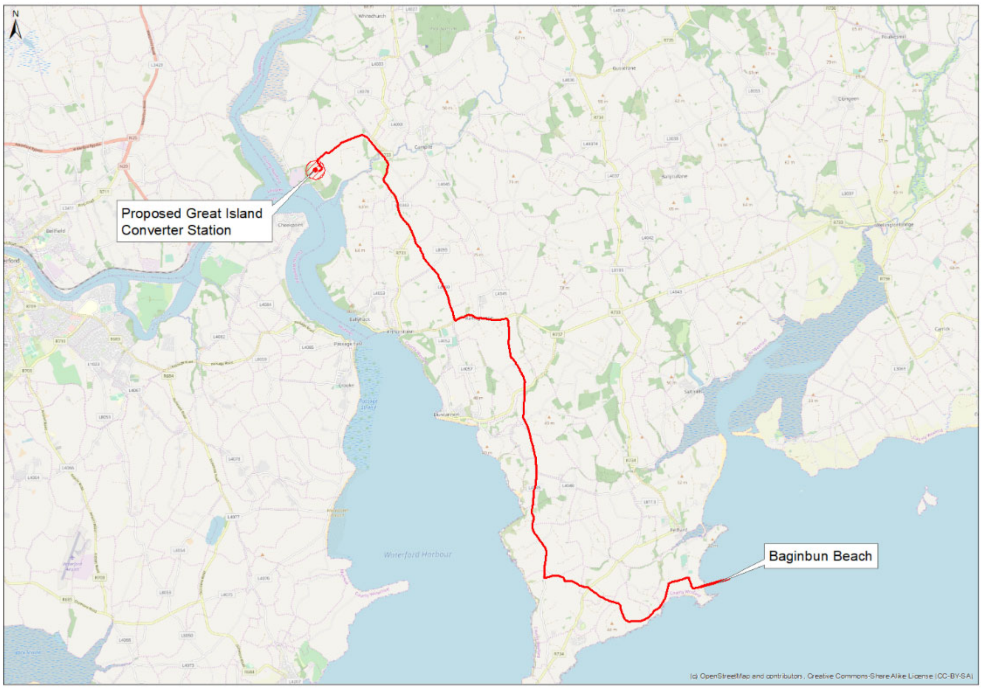

Figure 2.12: Combined preferred Route Options C and E.

Table 2.11: Comparison of Ramsgrange to Baginbun Beach Route Options, Including Comparison of Environmental Effects

	Route Option E	Alternative 1 to Route Option E	Alternative 2 to Route Option E	Alternative 3 to Route Option E	Alternative 4 to Route Option E	Route Option F	Alternative Route Option F	Route Option G
Ground conditions	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints	No noteworthy constraints
Road characteristics	No noteworthy constraints	No noteworthy constraints	Narrow road along alternative route	Less favourable alignment along alternative route	No noteworthy constraints	No noteworthy constraints	Narrow road and less favourable alignment along alternative route	No noteworthy constraints
Services, Utility Constraints, Material Assets	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms	MV/LV ESB Water mains Telecoms
Traffic	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads	Regional and local roads

	Route Option E	Alternative 1 to Route Option E	Alternative 2 to Route Option E	Alternative 3 to Route Option E	Alternative 4 to Route Option E	Route Option F	Alternative Route Option F	Route Option G
Significant River Crossings	None	None	One on alternative route-potential for impact on water body	One on alternative route- potential for impact on water body	None	Bannow Bay Estuary - potential for impact on water body	None	Bannow Bay Estuary - potential for impact on water body
Rail Crossings	None	None	None	None	None	None	None	None
Environmental issues and Biodiversity	Adjacent to but not in Hook Head pNHA/SAC	Crosses Duncannon Sandhills pNHA / River Barrow and River Nore SAC. Adjacent to but not in Hook Head pNHA/SAC	Adjacent to but not Hook Head pNHA/SAC	Crosses Duncannon Sandhills pNHA / River Barrow and River Nore SAC. Adjacent to but not in Hook Head pNHA/SAC	Adjacent to but not in Hook Head pNHA/SAC	Crosses Bannow Bay pNHA/SAC/SPA - potential for impact on designated site	Adjacent to but not in Hook Head pNHA/SAC	Crosses Bannow Bay pNHA/SAC/SPA - potential for impact on designated site
Cultural Heritage, Archaeology	None	None	None	None	None	None	None	None

	Route Option E	Alternative 1 to Route Option E	Alternative 2 to Route Option E	Alternative 3 to Route Option E	Alternative 4 to Route Option E	Route Option F	Alternative Route Option F	Route Option G
Natural Resources	greater use of natural resources	greatest use of natural resources	greater use of natural resources	greater use of natural resources	greater use of natural resources	least use of natural resources	less use of natural resources	less use of natural resources
Human Activity/ Social Constraints, Population, Amenity, Material Assets	Ramsgrange - potential for impact	None	None	None	Ramsgrange - potential for impact	Fethard - potential for impact	None	Fethard - potential for impact
Length	14.8km[1]	15.9km[1]	14.7km[1]	14.5km[1]	14.4km[1]	11.3km[2]	12.2km[2]	12.6km[2]
Total Combined Length with Route Option C	22.6km	23.7km	22.5km	22.3km	22.2km	20.6km	21.5km	21.9km

	Route Option E	Alternative 1 to Route Option E	Alternative 2 to Route Option E	Alternative 3 to Route Option E	Alternative 4 to Route Option E	Route Option F	Alternative Route Option F	Route Option G
Land Acquisition	None	None	Likely to be required for off-road river crossing on alternative route	Likely to be required for off-road river crossing on alternative route	Required for off-road section	Likely to be required for crossing Bannow Bay Estuary	None	Likely to be required for crossing Bannow Bay Estuary

2.6 Interconnector Capacity

The Greenlink capacity was selected at a nominal capacity of 500MW. This is based on the maximum permitted infeed loss in Ireland being 500MW. All components on a power system such as overhead lines, cables and generators, are prone to failure. Since supply must always be equal to demand on the power system, the transmission system operator must carry reserves that can ramp up very quickly (a few seconds at most) immediately following the sudden loss of a generator, or a line from a generator. Power stations come in many different unit sizes, generally the larger are more efficient. The best solution is for most of the power stations to have a similar unit size, and then the one "block" of reserve serves to support any combination of power plant dispatch. Currently the infeed loss limit is set by EirGrid to 500MW, matching most CCGT plant which are 450-480MW and the East-West Interconnector (EWIC) at 500MW. EirGrid thus holds 450-500MW of reserves depending on EWIC's dispatch. Consequently, the nominal rating of the Greenlink Interconnector is 500MW. A different capacity was not considered.

2.7 Interconnector Technology Options

2.7.1 High Voltage Direct Current (HVDC) or High Voltage Alternating Current (HVAC)

Both the Irish and the British national electrical transmission systems use HVAC to transmit electricity across country and use HVDC where electricity is transmitted long distances across the sea. The options considered for cable technology for Greenlink were HVAC and HVDC. HVDC technology was chosen for the interconnector over HVAC technology for the following reasons:

- Long lengths of HVAC cable transmission require electrical compensation (using large shunt reactors) installed, typically every 50km along the cable route. For Greenlink these would be required at four locations (two offshore and one each at the respective converter stations). The two offshore platforms would be significantly expensive and environmentally challenging.
- Long length of HVDC cable transmission requires no electrical compensation.
- HVAC requires 3 separate cables as compared to HVDC which requires 2 cables to transmit the same level of power reducing the level of environmental impact in respect to HDD and trenching both on land in subsea.
- HVDC facilitates power transmission over long distances with higher efficiency and lower losses than HVAC; and
- HVDC allows the interconnection of power systems of different grid systems that are asynchronous from a voltage and/ or frequency perspective.

Refer also to Section 2.3.5 below, which addressed converter technology.

Refer also to the description of converter station technology options in **Section 2.4.4** below.

Because HVDC is a more efficient mechanism for transmitting electricity over long distances, there is a clear environmental benefit in using this technology to maximise the value of electricity generation, whether this is primarily sourced from fossil fuel sources or renewable technologies. The environmental effects of the options are compared qualitatively, in **Table 2.12** below.

Table 2.12: Comparison of Environmental Effects of HVAC and HVDC Interconnector Technology

	HVDC	HVAC
Natural Resources	Greater efficiency and reduced transmission losses results in less use of fuel for power generation, less use of materials for construction of generation sources and large shunt reactors, as fewer new sources needed	Greater transmission losses result in greater use of fuel for power generation, greater use of materials for construction of generation sources and large shunt reactors, as more new sources needed
Air Quality	Greater efficiency and reduced transmission losses results in less emissions from power generation and construction of generation sources	Greater transmission losses result in greater emissions from power generation and construction of generation sources
Climate	Greater efficiency and reduced transmission losses results in less carbon emissions from power generation and construction of generation sources	Greater transmission losses result in greater carbon emissions from power generation and construction of new generation sources
Biodiversity	Greater efficiency and reduced transmission losses results in less disturbance to biodiversity as fewer new generation sources required	Greater transmission losses result in greater disturbance to biodiversity as more new generation sources required

2.7.2 Cable Technologies

The transmission of HVDC uses either one of two cable types. Both are fundamentally the same except they use a different conductor i) copper or ii) aluminium and/or insulation, i) Mass Impregnated (MI) insulation or ii) XLPE insulation.

The environmental effects of the options are essentially the same. XLPE insulated cables were chosen to be used for both the HVDC and HVAC circuits. The successful EPC (Engineer Procure Construct) contractor will choose its final preferred cable type using XLPE insulation.

2.7.3 Interconnector configuration

HVDC interconnectors are commonly designed using three different electrical topologies; (i) monopole, (ii) bipole with earth return or (iii) bipole with a metallic return.

Early in the project development GIL made a design decision to select a monopole topology. This was on the basis that a bipole topology with earth return would not be acceptable since on occasions the return electrical current could pass through the ground and seabed. The impact of the return electrical current on marine organisms is not fully understood and current practice in Europe does not allow for this. Alternatively, Greenlink could have decided upon a bipole topology with a metallic return. The advantage of the bipole with metallic return configuration is that there is a 50% redundancy, i.e. in the event of a malfunction of one HVDC cable or a converter valve the converter can still operate at half power.

However, this redundancy is obtained with the use of a third HVDC cable and extra converter HV switchgear. Noting that the Interconnector link will have a guaranteed high level of reliability, the extra cost of 188km of DC cable and switchgear and potential additional environmental effects cannot be justified.

The environmental effects of the options are compared qualitatively, in **Table 2.13** below.

Table 2.13: Comparison of Different Interconnector Configurations

	Monopole	Bipole with earth return	Bipole with metallic return
Natural Resources	Less use of resources, 2 cables required; no redundancy in event of malfunction	Less use of resources, 2 cables required; greater reliability as redundancy in event of malfunction	Greater use of resources, 3 cables required; greater reliability as redundancy in event of malfunction
Air Quality	Fewer emissions during manufacture and installation of 2 cables	Fewer emissions during manufacture and installation of 2 cables	More emissions during manufacture and installation of 3 cables
Biodiversity	Less impact as 2 cables to be installed, impacts fully understood	Potential significant, and not fully understood, impacts	More impact as 3 cables to be installed, impacts fully understood

2.7.4 Converter Technology

Further to **Section 2.7.1** above, HVDC technology primarily is based on either Line Commutating Converter (LCC) or Voltage Source Converter (VSC) technology. Greenlink will use VSC technology which, when compared to LCC technology, will require less reinforcement to the alternating current grid at the connection point, as well as allowing very rapid change of flow direction and reactive power, which is valuable to system operators when managing grid stability and in providing ancillary/system services. The environmental effects of the options are compared qualitatively, in **Table 2.14** below.

Table 2.14: Comparison of Environmental Effects of VSC and LCC Converter Technology

	VSC	LCC
Natural Resources	Less reinforcement of the AC grid will result in less consumption of materials for additional equipment	Greater reinforcement of the AC grid will result in more consumption of materials for additional equipment
Air Quality	Less reinforcement of the AC grid will result in less emissions from the manufacture and installation of new equipment	Greater reinforcement of the AC grid will result in greater emissions from the manufacture and installation of new equipment

	VSC	LCC
Climate	Less reinforcement of the AC grid will result in less carbon emissions from the manufacture and installation of new equipment	Greater reinforcement of the AC grid will result in less carbon emissions from the manufacture and installation of new equipment

2.7.5 Converter Station Configurations

Two converter station configurations are proposed in the planning application and described in **Chapter 3** *Proposed Development*. The two configurations reflect the different designs of the EPC (Engineer Procure Construct) contractors tendering for the Greenlink construction contract. The successful contractor will choose its preferred configuration.

The environmental effects of the two designs are essentially the same.

2.7.6 Tail Station

To connect into the Ireland Grid, EirGrid requires Greenlink to locate a new substation, the tail station, beside the converter station. A 220kV HVAC cable will connect from this tail station to the existing 220kV Great Island substation. The tail station will be transferred to Electricity Supply Board (ESB) once commissioned.

Gas insulated switchgear (GIS) and air insulated switchgear (AIS) were considered for the tail station. The GIS, which will be housed in a building, was chosen. GIS will have a footprint which is up to 30% smaller than AIS. It will have a visual impact and will require less construction activity than AIS. The environmental effects of the options are compared qualitatively, in **Table 2.15** below.

Table 2.15: Comparison of Environmental Effects of AIS and GIS Substation Technologies

	AIS	GIS
Land and soils	Larger footprint, more disturbance	30% smaller footprint, disturbance
Biodiversity	Greater disturbance of species and habitats due to larger footprint	Less disturbance of species and habitats due to smaller footprint
Natural Resources	Greater construction activity	Less construction activity
Visual Impact	Greater visual impact	Less visual impact

2.7.7 Trench Construction Options

GIL's preferred option for the cable installation is to excavate a trench to the required depth, install the cable and backfill the trench with the appropriate material. This 'open cut' option minimises the construction time, numbers of construction personnel and use of resources per metre of cable installed. However, at certain locations, open cut could involve too much disturbance of sensitive habitat or disruption to features at grade such as railways or motorways, or amenities such as Baginbun Beach. At two locations on the HVDC cable route, the landfall at Baginbun Beach and the Campile estuary, horizontal directional drill (HDD) will be used to install the cable. At the two locations where a railway crosses the route, the railway is carried overhead on a bridge and the cable can be installed in the road underneath. Consequently, HDD is not likely to be required at these locations. Mini HDD is the preferred method for crossing the existing transmission gas pipeline at Great Island and the Kilmannock Stream. If the preferred construction methodology of mini-HDD is not used, an open cut methodology will be used.

The environmental effects of the options are compared qualitatively, in **Table 2.16** below.

Table 2.16: Comparison of Environmental Effects of Open Cut and HDD Cable Installation

	HDD	Open Cut
Biodiversity	Avoids disturbance at ground level	Disturbs the surface along the footprint of the trench
Amenity features	Avoids disturbance of surface and exclusion of people from amenity	Disturbs surface, people excluded for health and safety reasons
Natural Resources	Requires greater input of resources, power, construction equipment per metre	Less use of natural resources, power, construction equipment per metre
Emissions to air	Greater emissions per metre	Fewer emissions per metre
Construction personnel	More personnel required per metre with consequent greater requirement for facilities, traffic, etc	Fewer personnel required per metre with consequent reduced requirement for facilities, traffic, etc

2.8 Decommissioning Options

In relation to decommissioning the cables, GIL's proposal is that the cables, ducting and duct surround will be left in place. Removal of the cables would require excavation of the trench at frequent intervals, cutting of the cables, setting up a winch and extracting the cables. The recovered cable would be cut into lengths short enough to fit on a truck. This operation would cause disruption to residents and traffic, emissions of noise and dust, generation of waste and consumption of energy. Leaving the cables in place would avoid the disruption and the other impacts, mentioned above, but the recovery of the cable materials would not be possible.

The environmental effects of the options are compared qualitatively, in **Table 2.17** below.

Table 2.17: Comparison of Environmental Effects of Cable Decommissioning Options

	Leave Cables in Place	Remove Cables
Population	No disruption to residents and road users	Disruption to residents and road users
Traffic	No traffic effects	Additional traffic, disruption to traffic when works underway
Noise	No noise emissions	Noise emissions from works
Emissions to air	No emissions to air	Emissions to air from works
Natural Resources	No consumption of fuel, etc; no recovery of cable materials	Consumption of resources for works; recovery of cable materials

2.9 Car Parking Options

During the consultations with Wexford County Council, Greenlink agreed to construct car-parking facilities near Baginbun Beach as an element of community gain contributed by the project. Greenlink will purchase a strip of land on the northern side of the approach road to the beach, which will allow the road to be widened to an overall width of 12m.

The various parking configurations, which were considered, are described below.

2.9.1 Perpendicular Parking (One Side)

Perpendicular parking was considered for one side of the road only. The benefit to this layout was the number of car parking spaces it would provide. However, a concern with this layout would be the ad hoc parallel parking of vehicles on the opposite side of the road (in the absence of designated parking spots). This would reduce space available for the manoeuvring of vehicles out of designated spaces, reduce the space required for two cars to pass comfortably and also lead to the blocking of access points to private lands.

2.9.2 Parallel Parking (One Side)

Parallel parking was considered for one side of the road only. However, due to the small number of spaces this would provide and also the ad hoc parking that would take place on the opposite site of the road (reducing the ability for two cars to pass comfortably on the road and reducing space for pedestrians), this alternative was discounted.

2.9.3 Parallel Parking (Both Sides)

Parallel parking was considered for both sides of the road. Many advantages were identified for this configuration. It provides ample parking spaces, it also allows for the safe manoeuvring of vehicles and maintaining a space in which two cars could pass comfortably.

This option proved to be the safest option while also providing ample parking spaces and was therefore the preferred option.

The environmental effects of the options are compared qualitatively, in **Table 2.18** below.

Table 2.18: Comparison of Environmental Effects of Parallel Parking Options

	Perpendicular Parking on One Side	Parallel Parking One Side	Parallel Parking Both Sides
Safety of pedestrians and road users	Risk of ad hoc parking on other side reducing space for pedestrians and for 2 cars to pass	Risk of ad hoc parking on other side reducing space for pedestrians and for 2 cars to pass	Safest option, provides space for pedestrians and for 2 cars to pass
Material assets	Greatest number of parking spaces, risk of ad hoc parking on other side obstructing traffic and pedestrians	Fewest parking spaces, risk of ad hoc parking on other side obstructing traffic and pedestrians	Adequate parking spaces, free movement of traffic and pedestrians
Land take	mid-range land take of agricultural land	Least land take of agricultural land	Greatest land take of agricultural land

2.10 Alternatives relating to community gain in Ramsgrange

The design of the pedestrian amenity improvements at Ramsgrange was developed in consultation with Wexford County Council. It quickly emerged that the provision of footpaths and associated street lighting was the preferred design, which would give rise to minimal adverse environmental effects. The inclusion of speed control signage at the western side of Ramsgrange was also considered to be appropriate. No alternative designs were given further consideration.

2.11 Alternatives relating to delivery of abnormal loads

The routes for delivery of abnormal loads to the site will be selected by the construction contractor, having regard to accessibility, commercial issues, and construction programme. **Section 6.5.1.7** of **Chapter 6** Traffic and Transportation describes the potential delivery routes, from Belview Port in Kilkenny, and Rosslare Port in Wexford, and also by sea through the SSE Power Station site. Preference will be given to technically-feasible shorter delivery routes, which would not only reduce transportation costs, but also reduce emissions of noise and vehicle exhaust associated with the transportation activity.

2.12 References

European Commission (2014) *Directive 2014/52/Eu Of The European Parliament And Of The Council Of 16 April 2014 Amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment*

EirGrid (2016) *All-Island Generation Capacity Statement 2016 - 2025*

EirGrid (2019) *All-Island Generation Capacity Statement 2019 - 2028*