

## **APPENDIX 15**

# **ENVIRONMENTAL APPRAISAL OF THE 220kV HVAC PARTIAL UNDERGROUND SECTION OPTIONS**

# ENVIRONMENTAL APPRAISAL OF THE 220kV HVAC PARTIAL UNDERGROUND SECTION OPTIONS

## 1. INTRODUCTION

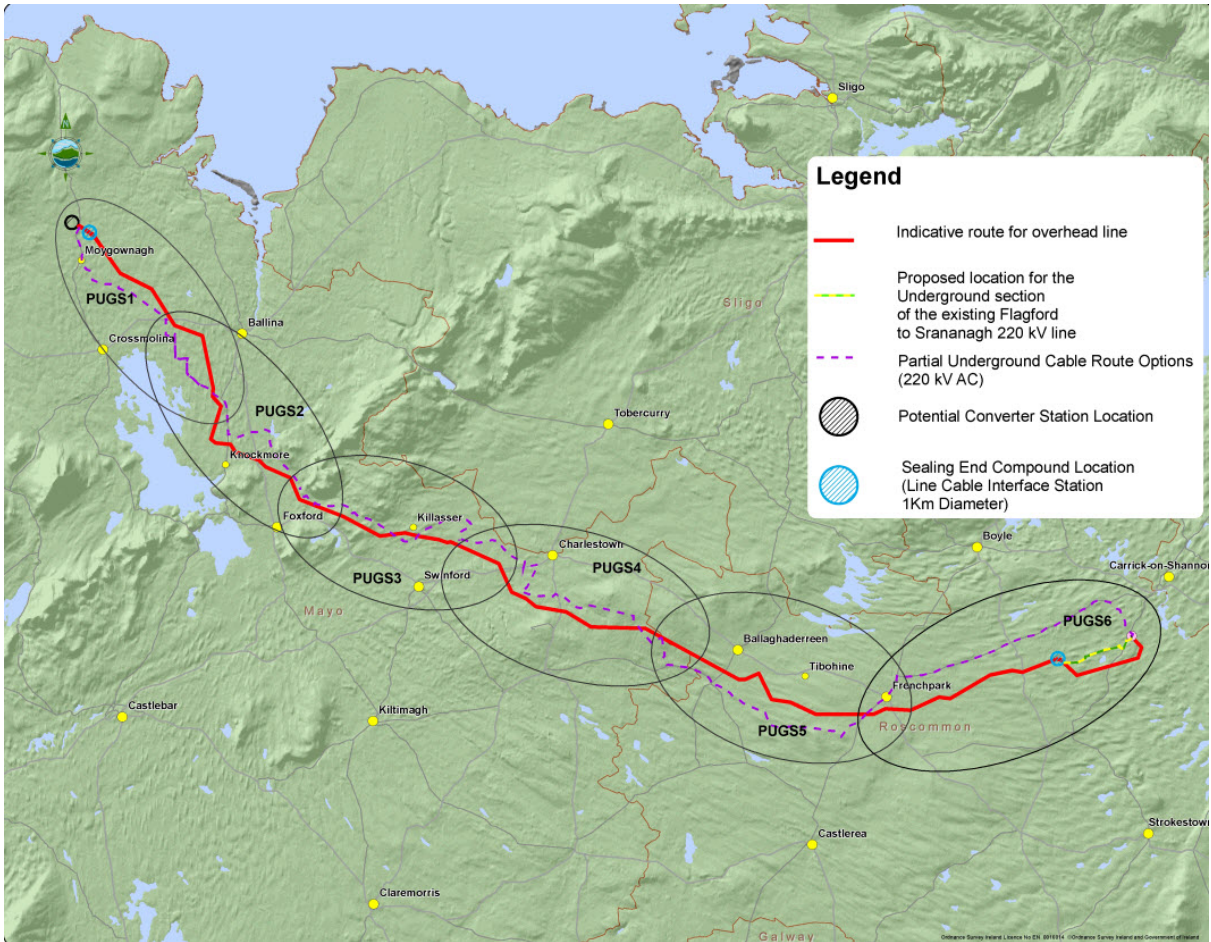
A preliminary appraisal was undertaken of an identified indicative 220kV OHL route (which largely follows the same route as the proposed 400kV OHL) with the purpose of proposing a 220kV solution for Grid West which would include the additional option of a 220kV underground cable section, up to 20km long somewhere along its route.

To facilitate this investigation, the entire route has been appraised by splitting it into six sections approximately 20km in length. The base case 220kV and 400kV HVAC OHL options both include approximately 105km of new OHL and 8km of UGC on the approach to Flagford.

The environmental, technical and economic effect of the end to end solution will vary depending on the ultimate amount of UGC installed. The UGC installed can vary from the base case which includes 8km to the maximum additional 22km of potential undergrounding.

The six partial underground sections (PUGS) are shown in Figure 1 below (in sequence from west to east) and include:

- Partial Underground Section 1, PUGS1, which runs from Moygownagh, to Ballyderg, north-west of Corroy;
- Partial Underground Section 2, PUGS2, which runs from south of the N59 (west of Ballina) to the area north-east of Foxford (Boherhalla);
- Partial Underground Section 3, PUGS3, which runs from north-east of Foxford to north-east of Swinford (Tumgesh);
- Partial Underground Section 4, PUGS4, which runs from north-east of Swinford to south-east of Charlestown, on the Mayo/Roscommon county boundary, near Ardkill;
- Partial Underground Section 5, PUGS5, which runs south-east of Charlestown to an area on the R361 regional road, south-west of Frenchpark; and
- Partial Underground Section 6, PUGS6, which runs from south-west of Frenchpark to Flagford.

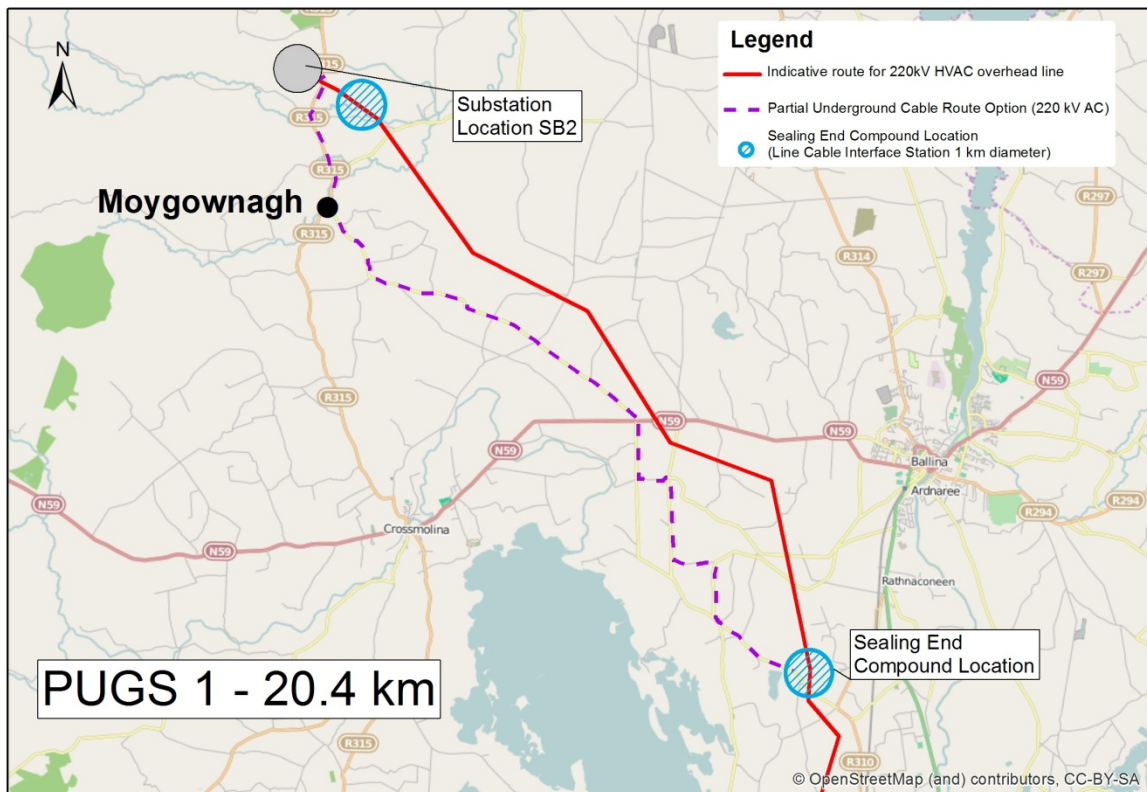


Appendix 15 Figure 1 Map of Partial UGC Sections Appraised

## 2. DESCRIPTION OF PARTIAL UGC SECTIONS

### Partial Underground Section 1 (PUGS 1):

Partial Underground Section 1 runs from the proposed substation location SB2, approximately 2.5km north of the village of Moygownagh, across the N59 Ballina to Crossmolina road, to a sealing end compound in the townland of Ballyderg, approximately 1km north west of the village of Corroy. The route is shown as a magenta dashed line in Figure 2 below and is approximately 20.4km in length.



Appendix 15 Figure 2 PUGS1

### Partial Underground Section 2 (PUGS 2):

Partial Underground Section 2 runs from a sealing end compound just south of the N59 to a second sealing end compound in the townland of Boherhallagh, approximately 3km north east of Foxford, as shown in Figure 3 below. This section is approximately 19.5km in length and incorporates a crossing of the river Moy and the N26 Foxford to Ballina national road<sup>1</sup>.



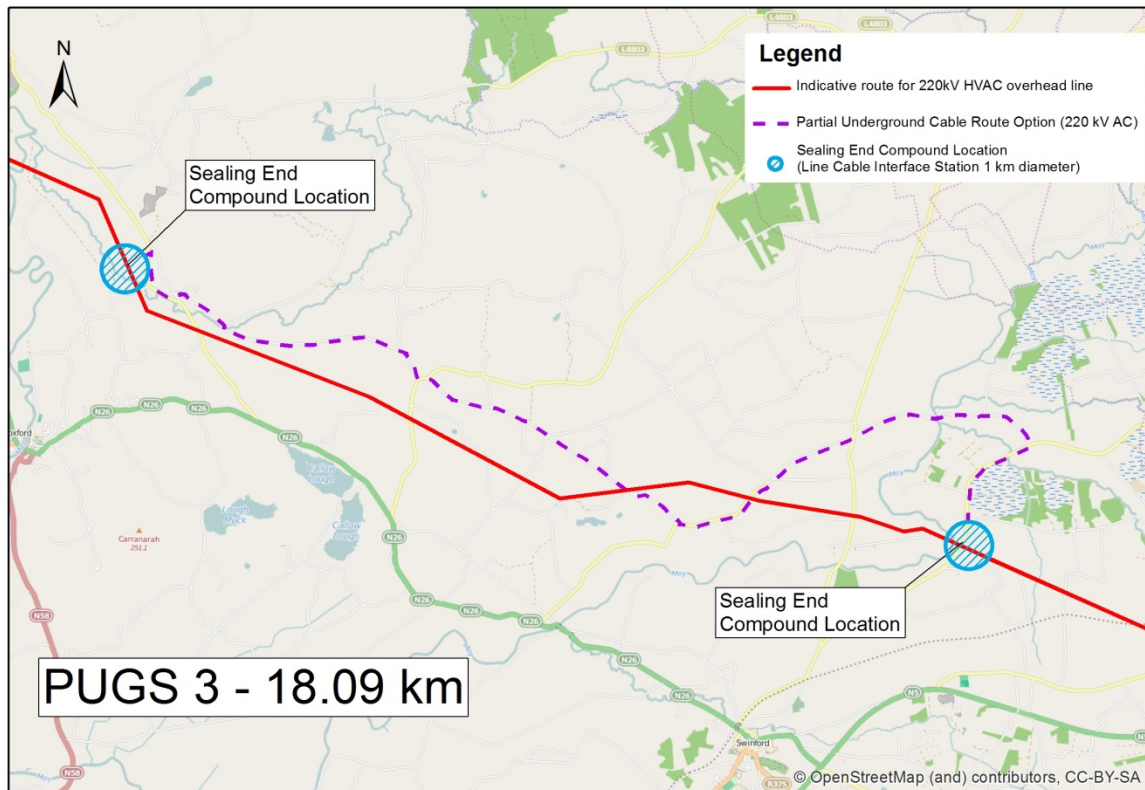
Appendix 15 Figure 3 PUGS 2

<sup>1</sup>Note: for PUGS2 there are two proposed sealing end compounds at each end of the underground cable section where there is a transition back to the overhead line. This could be in addition to the sealing end compounds at North Mayo (Moynagh) and Flagford.



### Partial Underground Section 3 (PUGS 3):

Partial Underground Section 3 runs from a sealing end compound north east of Foxford (the terminus of PUGS 2) to a second sealing end compound north east of Swinford in the townland of Tumgesh, as shown in Figure 4 below. This section is approximately 18.09km in length and incorporates a crossing of the river Moy<sup>2</sup>.

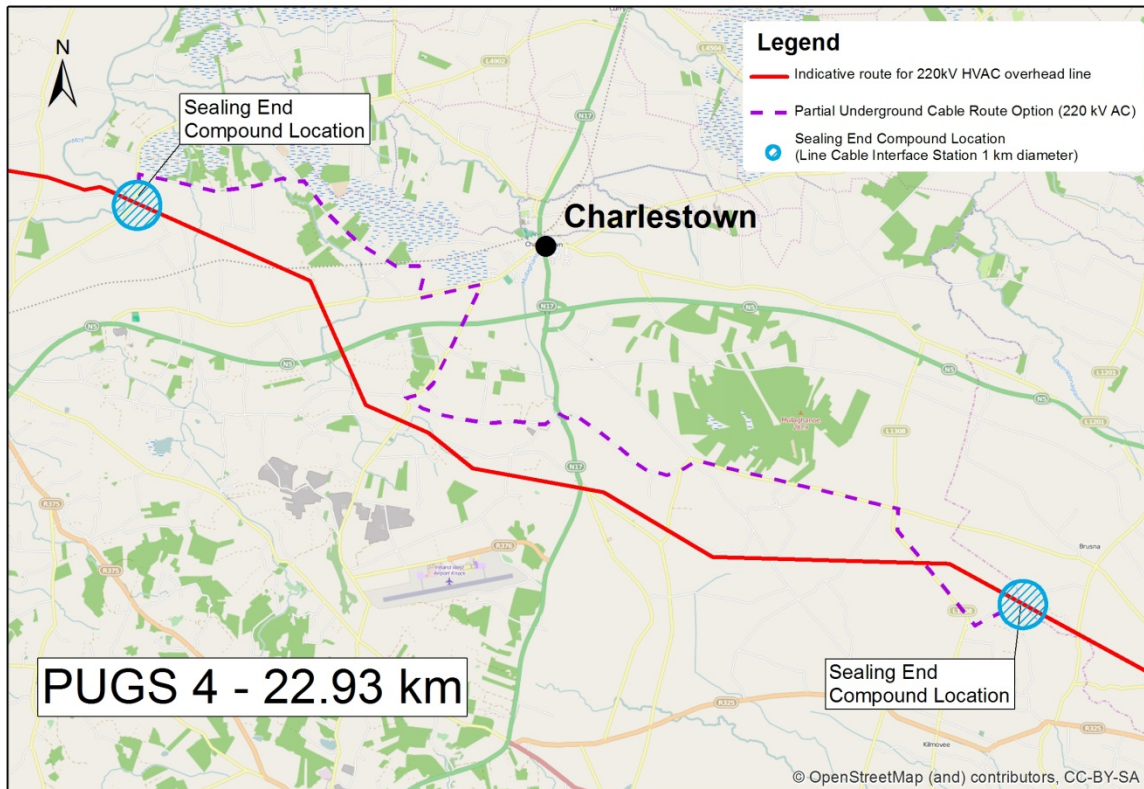


Appendix 15 Figure 4 PUGS 3

<sup>2</sup>Note: for PUGS3 there are two proposed sealing end compounds at each end of the underground cable section where there is a transition back to the overhead line. This could be in addition to the sealing end compounds at North Mayo (Moynagh) and Flagford.

**Partial Underground Section 4 (PUGS 4):**

Partial Underground Section 4 runs between a sealing end compound in Tumgesh, west of Charlestown to a second sealing end compound south east of Charlestown on the Mayo/Roscommon county boundary, as shown in Figure 5 below. This section does not follow the identified preferred route of the HVDC cable, but follows local public roads roughly parallel to the overhead line route corridor. The section is approximately 22.93km in length and includes crossings of the N5 and N17 national roads<sup>3</sup>.

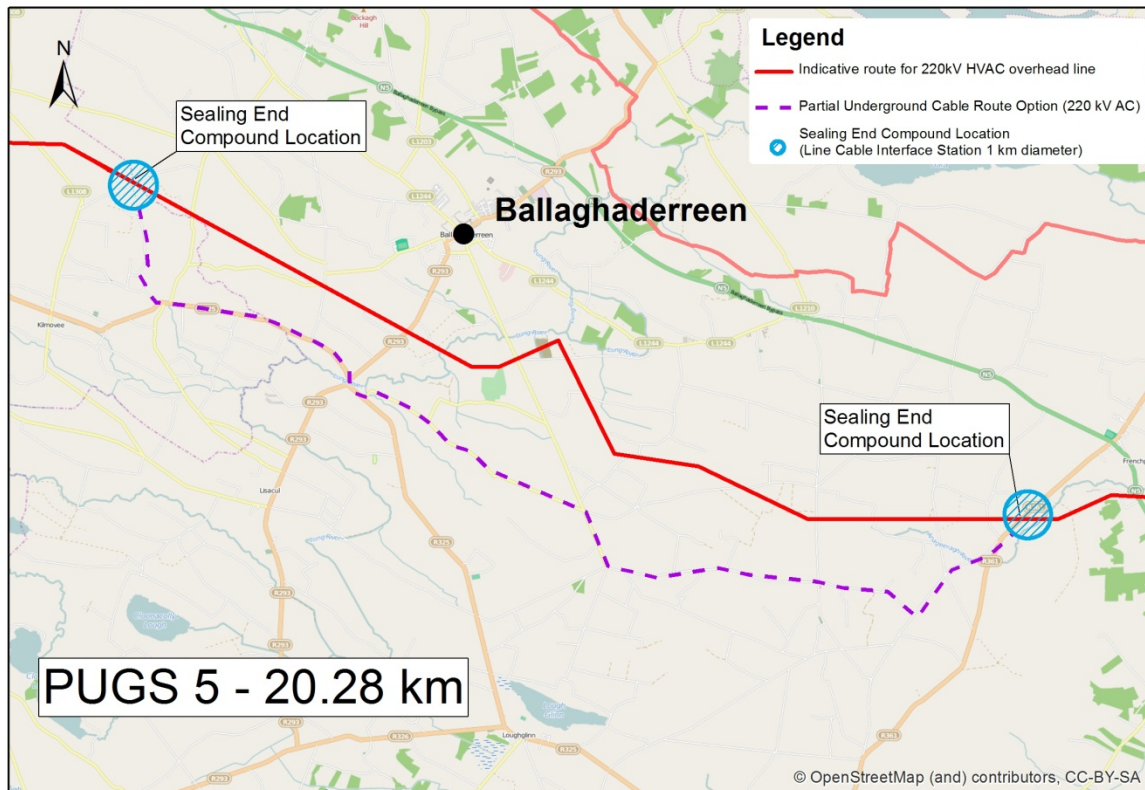


**Appendix 15 Figure 5 PUGS 4**

<sup>3</sup>Note: for PUGS4 there are two proposed sealing end compounds at each end of the underground cable section where there is a transition back to the overhead line. This could be in addition to the sealing end compounds at North Mayo (Moygownagh) and Flagford.

**Partial Underground Section 5 (PUGS 5):**

Partial Underground Section 5 runs from a sealing end compound at the terminus of PUGS 4, west of Ballaghaderreen, to a second sealing end compound adjacent to the R361 regional road, south west of Frenchpark, as shown in Figure 6 below. This section is approximately 20.28km in length and includes a crossing of the Lung River, south of Ballaghaderreen<sup>4</sup>.



**Appendix 15 Figure 6 PUGS 5**

<sup>4</sup>Note: for PUGS5 there are two proposed sealing end compounds at each end of the underground cable section where there is a transition back to the overhead line. This could be in addition to the sealing end compounds at North Mayo (Moygownagh) and Flagford.



**Partial Underground Section 6 (PUGS 6):**

Partial Underground Section 6 runs from sealing end compound located to the south-west of Frenchpark to a terminal substation near Flagford, as shown in Figure 7 below. This section is approximately 24.77km long and runs for most of its length along the R361 and R370 regional roads, including a section through the village of Frenchpark itself. It should be noted that in Figure 7 the dashed magenta line denotes the route of the underground cable section if it were decided to incorporate as much cable as possible at Flagford. The dashed red line indicates the route of the approximately 8km of underground cable that would bring the 220kV connection to Flagford if it were decided not to utilise the full cable allowance in this area.



Appendix 15 Figure 7 PUGS 6

### **3. ENVIRONMENTAL**

#### **3.1 ENVIRONMENTAL APPRAISAL OF PARTIAL UGC SECTIONS (1-6)**

This section sets out an appraisal of the zones identified in Section 1, with a view to identifying constraints within each that will benefit from the positive effect of a partial UGC section.

In assessing, for the purposes of this report, where a 20km underground cable section could be placed, the indicative overhead line was appraised to identify the most constrained OHL section. It should be noted that the OHL corridor contains no critical constraints that would impact on the selection of this preferred route corridor for the OHL option.

The appraisal may be used to inform the selection of an UGC section within the 220kV OHL route option.

#### **3.2 OVERHEAD LINE CORRIDOR SECTION APPRAISAL PARAMETERS**

The OHL route corridor sections corresponding to each of the six partial UGC sections were appraised under the following headings:

- Biodiversity, Flora and Fauna
- Water
- Soils and Geology
- Landscape/Visual
- Cultural Heritage
- Settlement/Communities
- Air Quality
- Climatic Factors
- Material Assets
- Recreation and Tourism
- Traffic and Noise

The impacts examined also include for substations and sealing-end compounds, as relevant, along the routes. Although Partial Underground Sections (PUGS) PUGS 1 and 6 will only contain one sealing end compound, compared to two sealing end compounds for PUGS 2, 3, 4 and 5, the additional construction works and operational impact for the extra sealing end compound is not regarded as significant as the works will be very localised and the compound will be of such a scale that it can be easily screened using landscaping measures. Therefore, the stations associated with the options have not influenced the appraisal of the PUGS options herein.

### 3.2.1 Biodiversity, Flora and Fauna

Partial Underground Options	SAC (ha) (within 1km corridor)	SAC (km) Length Crossed by Current OHL	SPA (ha)
PUGS 1	0	0	0
PUGS 2	94.6	0.3	0
PUGS 3	63.9	0.3	0
PUGS 4	33.7	0.5	0
PUGS 5	0	0	0
PUGS 6	0	0	0

**Appendix 15 Table 1 Biodiversity, Flora and Fauna PUGS 1-6**

#### 3.2.1.1 Discussion

All sections of the overhead corridor were appraised with respect to Natura 2000 locations i.e. the area of Special Areas of Conservation (SAC) within each corridor section, the length of SAC crossed by the indicative overhead line and the area of Special Protection Areas (SPA) within each corridor section. Table 1. above details the results of the appraisal.

As shown, there are no areas of designated SPA within the overhead route corridor. PUGS1, 5 and 6 contain no areas of designated SAC. The length of SAC crossed by the current OHL is similar for PUGS 2, 3 and 4. The area of SAC within PUGS 2, 3 and 4 ranges from 94.6km to 63.9km and 33.7km respectively.

It is important to note that the proposed underground section within PUGS 2 includes a section of approximately 272m in the River Moy SAC. There may be potential impacts associated with directional drilling in this area during the construction phase of an underground cable. This potential impact has been identified by the National Parks and Wildlife Service (NPWS). However, best practice construction methodologies will mitigate the impacts. Also, as the majority of the works in this partial underground section will take place along existing roads, the short term impact on the localised area of the River Moy SAC is outweighed by the benefit of avoiding an overhead route through a section of the corridor that contains approximately 95ha of SAC (including a 300m crossing of the River Moy SAC).

### 3.2.2 Water

Partial Underground Options	Water (River Crossings on Current Indicative OHL (Sept. '14))
PUGS 1	15
PUGS 2	11
PUGS 3	8
PUGS 4	15
PUGS 5	5
PUGS 6	12

**Appendix 15 Table 2 Water PUGS 1-6**

#### 3.2.2.1 Discussion

With respect to water, each section was reviewed to identify the number of river crossings on the current indicative overhead line route. The table above details the results of the appraisal.

As shown, there is a range of results from one overhead section to another. PUGS 1 and PUGS 4 have the highest number of river crossings compared to the lowest number of river crossings which were recorded in PUGS 5 (5 river crossings).

### 3.2.3 Soils and Geology

Partial Underground Options	Peat (Ha) within OHL Corridor
PUGS 1	535.8
PUGS 2	484.5
PUGS 3	211.6
PUGS 4	679.3
PUGS 5	897
PUGS 6	730.3

**Appendix 15 Table 3 Soils and Geology PUGS 1-6**

#### 3.2.3.1 Discussion

In order to evaluate the impact on Geology from the overhead route corridor, the overhead corridor was assessed with respect to the area of peat within each corridor section. The table above details the results of the appraisal.

As shown, there is a range of results from one overhead section to another. The area of peat within each section varies from approximately 212 ha (PUGS 3) to 897ha (PUGS 5).



### 3.2.4 Landscape/Visual

Partial Underground Options	Landscape (ha) (Designated Landscape Areas & Areas of Outstanding/Exceptional Natural Beauty)	Landscape -Places of Interest & Visitor Attraction	Landscape -Walking and Driving Routes
PUGS 1	0	0	0
PUGS 2	0	1 (River Moy)	1
PUGS 3	0	1 (River Moy)	3
PUGS 4	0	0	0
PUGS 5	0	0	2
PUGS 6	0	1	2

**Appendix 15 Table 4 Landscape PUGS 1-6**

#### 3.2.4.1 Discussion

All sections of the overhead corridor were appraised with respect to the area of designated Landscape areas within each corridor section. In addition, each section was reviewed to identify places of interest and visitor attraction and also walking and driving routes. The table above details the results of the appraisal.

As shown, there are no areas of designated landscape areas or recorded areas of outstanding or exceptional natural beauty within the overhead route corridor, as these areas have been avoided as part of the route selection process and identification of the emerging preferred overhead route corridor. There was only one place of interest identified within the corridor and that was in PUGS 6. It is noted that the River Moy is located in PUGS 2 and 3. Walking and driving routes were identified in PUGS 2, 3, 5 and 6.

### 3.2.5 Cultural Heritage

Partial Underground Options	Sites and Monument Record (+ Religious Sites)
PUGS 1	21
PUGS 2	18
PUGS 3	96 (2)
PUGS 4	20
PUGS 5	22
PUGS 6	28

**Appendix 15 Table 5 Archaeology PUGS 1-6**

#### 3.2.5.1 Discussion

All sections of the overhead corridor were appraised with respect to the number of archaeological features recorded within each corridor section. Archaeological features included locations

identified in the sites and monuments records and also recorded religious sites. The table above details the results of the appraisal.

In summary, the sections of the overhead route corridor identified as PUGS 1, 2, 4 and 5 contained a similar number of archaeological features ranging from 18-22 sites. PUGS 6 recorded 28 sites. However, the most constrained section was identified as PUGS3, which includes 96 archaeological sites and monuments and 2 religious sites.

### 3.2.6 Settlement/Communities

Partial Underground Options	No. of Houses within the 1km OH Corridor*	No. of Houses within 200m of the Current Indicative OHL (Sept. '14)
PUGS 1	114	28
PUGS 2	218	56
PUGS 3	146	30
PUGS 4	190	50
PUGS 5	130	32
PUGS 6	73	19

\* GeoDirectory Q2 2014

#### Appendix 15 Table 6 Settlements PUGS 1-6

##### 3.2.6.1 Discussion

According to the Quarter 2 2014 data sourced from the national GeoDirectory and included in the Table above, the section of the overhead corridor identified as PUGS 2 has the highest number of houses within the 1km wide overhead route corridor and within 200m of the current indicative overhead line. PUGS 4 has the next highest number, while the sections with the lowest number of settlement include PUGS 1 and PUGS 6. PUGS 3 and PUGS 5 had a similar number of houses within the overhead route corridor and within a 200m distance of the current overhead indicative line.

### 3.2.7 Air Quality

#### 3.2.7.1 Discussion

Air Quality for the OHL and identified underground cable section options should be considered with respect to construction and operational impacts.

The potential air quality impacts of the construction phase should be considered as no emissions or air quality impacts are anticipated during the operational phase of the development. Potential impacts during the construction phase include:

- Impacts of dust during the construction phase of the development; and
- Impacts of vehicle and plant emissions during the construction phases of the development.

The overhead line section of the 220kV option will consist of a number of small scale construction sites, each in operation for a short length of time. While there will be a large number of such sites, they will be spread out along the length of the proposed development, and construction can be scheduled in such a way as to reduce the duration and intensity of construction activities and vehicle movements on the road network.

Overall, the effect on local air quality and amenity of the proposed works at the tower sites and substations would be negligible for the overhead line option. Construction related traffic is also expected to be small in scale, well below 200 vehicles per day (the threshold set by European Protection UK), at each site, and as such would not be capable of causing a significant adverse effect on local air quality at receptors located along site access roads.

The underground cable section will consist of a series of construction sites, which will follow the route of the existing road network. This is likely to take it close to a number of sensitive receptors along the route, and therefore increase their exposure to dust and air pollutants.

The UGC route also has the potential to cause disruption to traffic along roads affected by construction, and change traffic flows along roads in the vicinity. However, as the background levels of pollutants are very low, it is unlikely that such disruption would significantly contribute to pollutant levels in the vicinity of the construction works, and is therefore unlikely to lead to an exceedance of the air quality standards.

### *3.2.8 Climatic Factors*

#### *3.2.8.1 Discussion*

With respect to Climatic Factors, the 220kV option will offer an improvement in energy infrastructure which will facilitate the expansion and incorporation of renewable energy generation into the national grid. This will have positive impacts on Ireland achieving its EU targets with respect to reducing greenhouse gas emissions and expanding energy production from renewable sources.

Construction traffic associated with the OHL and UGC section would contribute to existing traffic levels on the surrounding road network. However, these will be very short lived and are not predicted to be of sufficient numbers to adversely affect climate. In addition, the construction traffic in each PUGS section will be of a similar nature and no PUGS section is anticipated to result in a more significant traffic impact than another.

### *3.2.9 Material Assets*

#### *3.2.9.1 Discussion*

The potential impact on Material Assets from both an UGC and an OHL option is detailed in the IEP Report, Sections 5.6.10 and 6.4.10 respectively. As there is no significant difference between the 220kV and 400kV OHL options or between the HVDC UGC route and the proposed PUGS routes, there will be no considerable difference between the impacts of each PUGS option on Material Assets.

Partial Underground Options	Length of OHL Line (km)
PUGS 1	17.9
PUGS 2	18.4
PUGS 3	13.8
PUGS 4	18.1
PUGS 5	17.9
PUGS 6	15

**Appendix 15 Table 7** Lengths of OHL corresponding to PUGS 1-6

The assessment of the overhead route corridor, detailed in the Table above, included a review of the length of overhead line on the current route corresponding to each of the underground sections, PUGS 1 to 6.

As shown, there is a range of results from one overhead section to another. The length of the overhead line varies within a range of approximately 4.6km. The shortest line route, and therefore the shortest overhead line potential “environmental footprint”, is located in PUGS 3 (13.8km) and the longest line route, and longest potential “environmental footprint” is located in PUGS 2 (18.4km).

### 3.2.10 Recreation and Tourism

#### 3.2.10.1 Discussion

As landscape is one of the primary considerations with respect to tourism value, a project specific methodology was developed for identifying the landscape constraints within the Grid West Study area and the indicative OHL route was selected based on the identification and avoidance, where possible, of these constraints.

The potential impact on recreation and tourism from both an UGC and an OHL option are detailed in the IEP Report, Sections 5.6.11 and 6.4.11 respectively. For the partial underground option, there will be no significant difference between the works that will take place at each PUGS section option and along the remaining OHL for these PUGS options. Therefore, the impacts on recreation and tourism (primarily visual for the OHL option and traffic-related for the UGC option), will be similar.

Both Roscommon and Mayo have areas of valuable angling tourism. The construction of a partial underground section will involve construction of the cable along local roads (primarily) which may result in surface water runoff and disturbance to nearby drainage ditches and streams. Directional drilling is also proposed in order to route the cable across a number of water courses located along the route, as described in the “*Underground Route Options Preliminary Evaluation Report*” (July 2014) in Appendix 8. Careful mitigation will be required during the construction phase to ensure that surface or groundwater runoff from the construction works, possibly



containing a high volume of suspended solids and/or contaminants, does not enter any water course untreated and potentially impact on the quality of the salmonid waters along or in proximity to the route.

However, in addition to the above, PUGS 2 and 3 also include crossings of the River Moy. The River Moy is a valuable location for angling in County Mayo. If a partial underground section is selected in these areas, the visual impact and potential impact of locating physical structures in prime fishing areas will be mitigated. The reduction of this impact needs to be balanced with the potential impact from directional drilling under the River Moy that may impact on water quality in the overlying surface waters and, indirectly, affect the fish populations downstream of the construction works.

### *3.2.11 Traffic and Noise*

#### *3.2.11.1 Discussion*

The potential impact from traffic from both an UGC and an OHL option are detailed in the IPE Report, Sections 5.6.12 and 6.4.12 respectively. Noise impacts for the UGC and OHL options are dealt with in Sections 5.6.13 and 6.4.13 respectively. For the partial underground option, there will be no significant difference between the works that will take place at each PUGS section option and along the remaining OHL for these PUGS options. Therefore, the impacts on both traffic and noise will be similar.

For the OHL, access and temporary works will be required to accommodate the construction of the towers in fields, forest and peatlands. An increase in traffic may be experienced in the local area due to construction vehicles accessing the site and rolling closures of local roads may be required to facilitate access for larger vehicles; however overall traffic impact is expected to be relatively low as construction will be largely off-road.

The preferred 220kV OHL base case design also incorporates the undergrounding along a public road of approximately 8km into the existing Flagford Substation. Road closures will be required along the proposed route of the 220kV UGC to the existing Flagford Substation with disruption to traffic along the R386 south of Carrick-on-Shannon.

For the UGC section, significant disruption to traffic is expected at this location during installation of the cable. Where the cable is routed along an existing road, it is envisaged that phased traffic management provisions or full road closures will be required in order to accommodate construction work.

Locations requiring Horizontal Directional Drilling (HDD), for example the River Moy UGC route crossing, works will require sufficient access and surrounding areas will experience an increase in traffic from construction vehicles. This impact will be temporary in effect.

Post installation and for the lifetime of the asset, weekly surveys along the cable route are anticipated. These will be carried out to monitor any construction activities in the vicinity of the

cable to ensure that no damage occurs to what would be a vital infrastructural asset. However, it is not envisaged that these surveys will have a significant impact on traffic.

Construction noise and vibration impacts are by their nature temporary. This is particularly so for linear infrastructure schemes such as this, where intensive works on the OHL and UGC options in close proximity to sensitive receptors will be short term, as construction progresses along the route(s). However, resulting short-term noise levels can be high, depending on the activities being carried out and the plant employed.

Vibration impacts are unlikely to be significant for most construction activities. However, specific activities such as piling (as ground conditions dictate) and ground compaction in proximity to sensitive receptors can result in disturbance to residents.

Any potential operational noise impacts will be long-term and any identified significant impacts should be mitigated, if possible, at the design stage. Noise impacts may result from operation of the substations and from the overhead lines but vibration impacts during operation will not be significant. Operational noise from the cable is not a consideration for the underground section. Operational noise may also result from scheduled or emergency maintenance/repairs but will be temporary in effect.

#### *3.2.12 Assessment of Most Constrained Corresponding Overhead Line Corridor Section*

If the 220kV Partial underground option is developed further, the PUGS corresponding to the overhead line corridor section that is most constrained compared to the remainder of the corridor is the section that would be deemed to be the most appropriate for consideration of an underground option, as this area would gain the most benefits from an underground cable.

Further studies and consultation would be required before any such section of underground cable could be presented for statutory planning consent.

Again, however, it is reiterated that the fully OHL options along this route (400kV and 220kV) have been deemed to be acceptable from an environmental perspective, such that further consideration is merited.

## 4. TECHNICAL

### 4.1 ASSESSMENT PARAMETERS

The six possible partial underground sections can be divided into two categories; those that terminate in one of the remote end substations (PUGS 1 and 6), and those with a partial underground section mid-way along the 220kV circuit route (PUGS 2, 3, 4 and 5). The cable sections at the remote station ends of Flagford and Moygownagh will necessitate one sealing end compound each. In the case of the additional partial underground sections that terminate at a remote end substation (PUGS 1 and 6), the total number of sealing end compounds will remain at two. In the case of the additional partial underground sections mid-way along the 220kV circuit route (PUGS 2, 3, 4 and 5), the total number of sealing end compounds will increase to four.

A technical assessment was carried out on the two categories of partial underground sections. The following were deemed to be the most relevant assessment parameters since the other parameters are generally the same or similar for any of the PUGS options:

- Reliability and Security; and
- Risk of Untried Technology.

Partial Underground Options	Reliability and Security	Risk of Untried Technology
PUGS 1 & 6	2 sealing end compounds	Similar to existing partial underground applications on Irish Transmission System
PUGS 2, 3, 4 & 5	4 sealing end compounds	First application on Irish Transmission System

**Appendix 15 Table 8      Technical PUGS 1-6**

## 4.2 DISCUSSION

The technical assessment of the partial underground sections relates primarily to the technical impact of a partial underground section mid-way along the circuit route. This application will double the number of sealing end compounds compared to a partial underground section that terminates at one or other of the remote end substations. As described in Section 7.2.2 of the IEP Report, the addition of sealing end compounds significantly increases the component count and complexity of control and protection schemes. As a result, the increase in sealing end compounds increases the inherent risk of failure.

## 4.3 CONCLUSIONS

Evaluation Matrix	PUGS 1	PUGS 2	PUGS 3	PUGS 4	PUGS 5	PUGS 6
Reliability and Security						
Risk or Untried Technology						

Less Preferred

More Preferred



**Appendix 15 Table 9 Technical Matrix**

Following a technical assessment, PUGS 1 and PUGS 6 have the least technical impact on the Transmission System.

If the 220kV HVAC OHL option with additional UGC sections is ultimately chosen for the Grid West Project, further studies and consultation would be required before any partially undergrounded solution is presented for statutory planning consent.



## 5. ECONOMIC

The project implementation costs refer to the costs associated with the procurement, installation and commissioning of the development and therefore includes all the transmission equipment that form part of the development's scope. The 220kV HVAC OHL option cost will vary from the base case which includes 8km of undergrounding to the maximum additional 22km of potential undergrounding.

The estimated project implementation cost for each of the sections appraised is as follows:

Partial Underground Options	Length of OHL Line (km)	Length of UGC Cable (km)	220kV UGC Total (€M)
PUGS 1	17.9	20.40	49.33
PUGS 2	18.4	19.50	47.15
PUGS 3	13.8	18.09	43.74
PUGS 4	18.1	22.93	55.45
PUGS 5	17.9	20.28	49.04
PUGS 6	15	24.77	59.90

**Appendix 15 Table 10 Summary of Project Implementation Costs for each the 220kV PUGS option.**