SP ENERGY NETWORKS

Glenmuckloch to ZV 400kV Strategic Optioneering Study

Strategic Options Report

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June 2019

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1 Introduction

The Need for and Background to the Project

1.1 The existing transmission grid infrastructure in the South of Scotland will in the next few years be operating at full capacity and will therefore no longer be able to accommodate the planned and potential new generation in the area. Therefore, SP Energy Networks (SPEN) is required to reinforce the network to facilitate future connections and ensure the network remains fit for purpose. To meet this requirement, SPEN is proposing a new 400kV[1] overhead transmission line to connect a new substation adjacent to the Glenmuckloch Pumped Storage Hydropower (PSH) substation to the existing 'ZV' route (Scotland to England 400kV interconnector), via a new 400/132kV substation located between Coalburn and Elvanfoot. The existing transmission network, including 'ZV' route and Coalburn and Elvanfoot substations, as well as the proposed location of the PSH substation is shown on **Figure 1.1**.

1.2 As a transmission licence holder for southern Scotland, SPEN[2] is required under Section 9(2) of the Electricity Act 1989 to:

- develop and maintain an efficient, co-ordinated and economical system of electricity transmission; and
- facilitate competition in the supply and generation of electricity.

1.3 SPEN is required in terms of its statutory and licence obligations to provide for new electricity generators wishing to connect to the transmission system in its licence area. SPEN is also obliged to make its transmission system available for these purposes and to ensure that the system is fit for purpose through appropriate reinforcements to accommodate the contracted capacity.

1.4 Schedule 9 of the Electricity Act 1989 imposes a statutory duty on SPEN to take account of the following factors in formulating proposals for the installation of overhead transmission lines:

"(a) to have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features or special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and

(b) to do what it reasonably can to mitigate any effects which the proposals would have on the natural beauty of the countryside or any such flora, fauna, features, sites, buildings or objects."

1.5 As a consequence, SPEN is committed to identifying electrical connections that meet the technical requirements of the electricity system, which are economically viable, and cause on balance, the least disturbance to both the environment and the people who live, work and enjoy recreation within it.

"In developing and maintaining a technically feasible and economically viable transmission and distribution system, SP Energy Networks (SPEN) is committed to causing on balance, the least disturbance to people and the environment."(Para 1.2, Page 1) [3]

1.6 To ensure SPEN takes account of the Schedule 9 requirements from the outset, LUC has been commissioned to undertake a Strategic Optioneering Study ('the Study'), to identify potential areas of search and/or areas of constraint, based on environmental and technical considerations,

[1] Final voltage of the overhead line will be determined prior to the preferred route being progressed to consultation (will be either 132kV or 400kV)

[2] SPEN owns and operates the electricity transmission and distribution networks in central and southern Scotland through its wholly-owned subsidiaries SP Transmission plc (SPT) and SP Distribution plc (SPD). SP Transmission plc is the holder of a transmission licence. The references below to SPEN in the context of statutory and licence duties and the application for section 37 consent below should be read as applying to SP Transmission plc

[3] Major Electrical Infrastructure Projects: Approach to Routeing and Environmental Impact Assessment (2015) SPEN

for the identification of potential corridors for the overhead line and siting areas for the substation.

1.7 The specific project requirements are defined in greater detail in **Section 2: Project Design Requirements** and have been considered during this study.

Purpose of the Report

1.8 The purpose of this high level Strategic Options Report is to identify potential substation siting areas and broad corridor options, based on technical and environmental considerations, and advise on the 'constraints' and 'opportunities' for each option. The report sets out the methodology and findings to identify and appraise the broad corridor and substation siting options for the proposed new infrastructure, which may also in inform the overall decisions in relation to wider network design and rationalisation of existing and ageing assets.

1.9 It is understood that SPEN will balance the initial findings regarding the environmental and technical feasibility of strategic corridor options identified through this study with other technical and economic reviews being progressed in parallel, to enable SPEN to progress a preferred option(s) to the routeing stage.

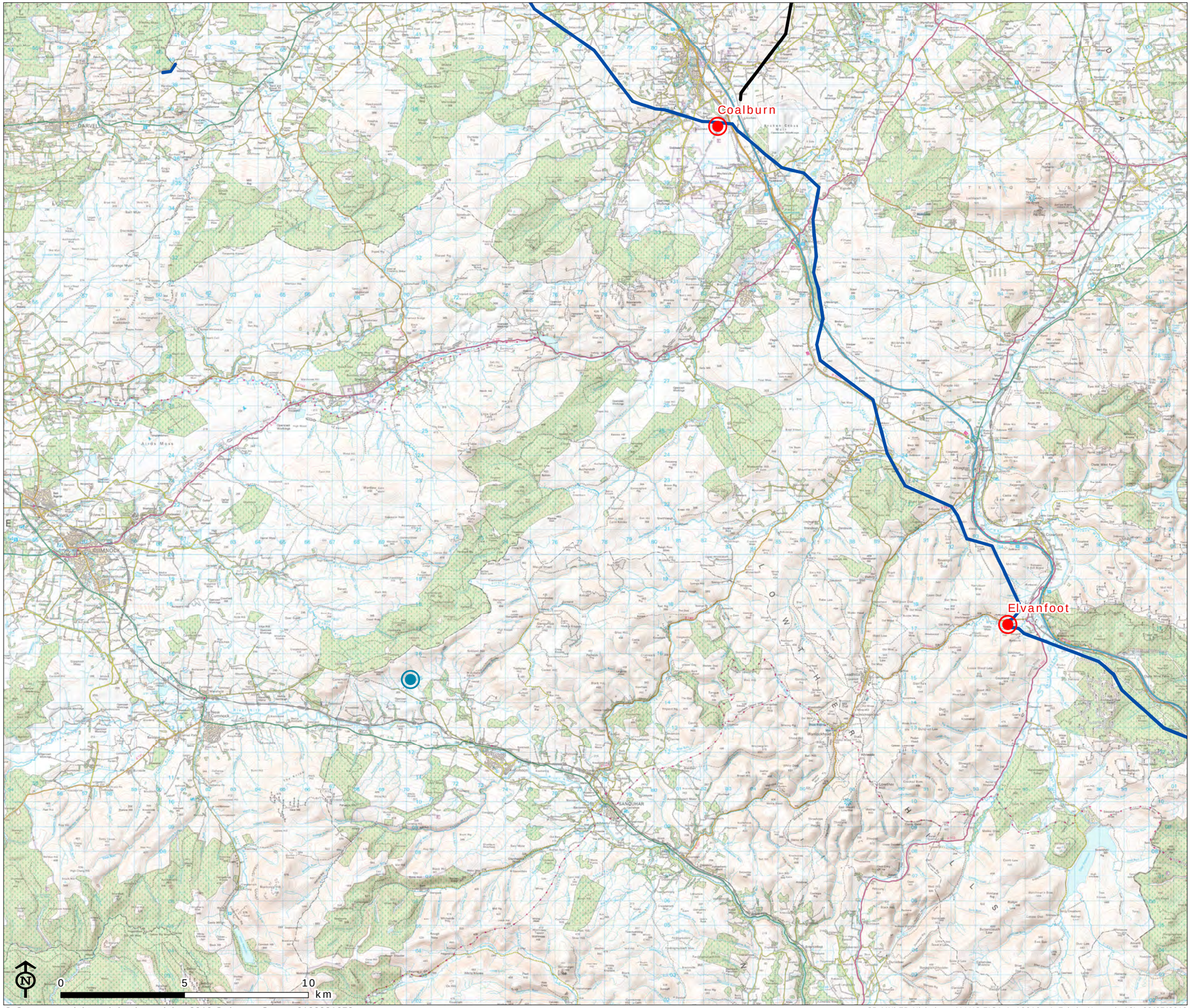
The Structure of the Report

1.10 This report is structured in the following Sections:

- **Section 1: Introduction**
- **Section 2: Project Design Requirements**
- **Section 3: Approach to the Strategic Optioneering Study**
- **Section 4: Strategic Optioneering Study Findings**
- **Section 5: Strategic Summary**

Glenmuckloch to ZV 400kV Optioneering Study

Figure 1.1: Existing Network



Substation

Proposed Glenmuckloch Substation

Transmission Network

132kV Overhead Line

400kV Overhead Line

Map Scale @A3: 1:150,000

CB:MNi EB:Nicholson_M LUC FIG1-1_10610_r1_ExistingNetwork_A3L 02/07/2019

Source: LUC, SPEN

2 Project Design Requirements

2.1 As outlined in **Section 1**, at this early stage in network design, SPEN has identified three distinct components of infrastructure required to deliver the proposed electricity network upgrade. Therefore it is understood that the technical design requirements for the project comprise the following key components:

- a new 400kV substation adjacent to the consented Glenmuckloch PSH substation, near Kirkconnel;
- a new 400kV substation located in the vicinity of the existing 'ZV' route (Scotland to England 400kV interconnector) between the existing Coalburn and Elvanfoot substations; and
- a new 400kV double circuit overhead line supported on L8 steel towers connecting the two substations.

2.2 It is acknowledged at the outset that the final design of the project will be dependent on the balance of environmental, technical and economic requirements. However, for the purposes of this study, it is assumed that the 400kV connection will be overhead lines supported on steel towers (L8). Photographs of the existing infrastructure in the locations outlined above are provided below.

Coalburn Substation and ZV Route from the B7078

ZV Route (400kV England-Scotland Interconnector) from the B7080 near Red Moss

Elvanfoot Substation and ZV Route from the B7040

2.3 For each of the three infrastructure components, the overhead line (OHL) infrastructure and substation infrastructure, and the requirements and implications in relation to existing infrastructure are outlined below.

Substation Requirements

2.4 The following technical requirements and initial design parameters of the proposed substations have been defined by SPEN to inform potential siting.

Glenmuckloch Substation

2.5 It is understood that the proposed Glenmuckloch Substation will be located in close proximity to the consented Glenmuckloch PSH substation.

ZV Route Substation

2.6 The minimum footprint area required for the substation is understood to be approximately 500m x 350m to accommodate 3 x 400/132kV transformers (approximately 175,000m^2 / 17.5 hectares). The substation is required to be located on the eastern side, and ideally within 500m, of the 'ZV' route. SPEN technical requirements are for the overhead line to terminate onto a sealing end tower on the western side of 'ZV' route and cable underneath into the new substation.

Overhead Line Connection Requirements

2.7 The overhead line would be supported by L8 lattice steel towers[4], which have six cross-arms (three on each side) and a standard average design height of 46m. The 'span length' between L8 towers averages 350m but can be increased if necessary if there is a requirement to span a larger distance.

2.8 At this stage it is understood that the overhead line will terminate onto a sealing end tower on the western side of 'ZV' route and cable beneath the existing ZV route into the new 400/132kV substation.

[4] Allowing for potential upgrade of the overhead line 400kV in the future, with limited physical changes to the infrastructure.

3 Approach to the Strategic Optioneering Study

Outline of Approach

3.1 The approach to the study has been undertaken in collaboration with SPEN, to agree the technical requirements and parameters of the project and develop an appropriate methodology informed by LUCs professional experience of similar projects.

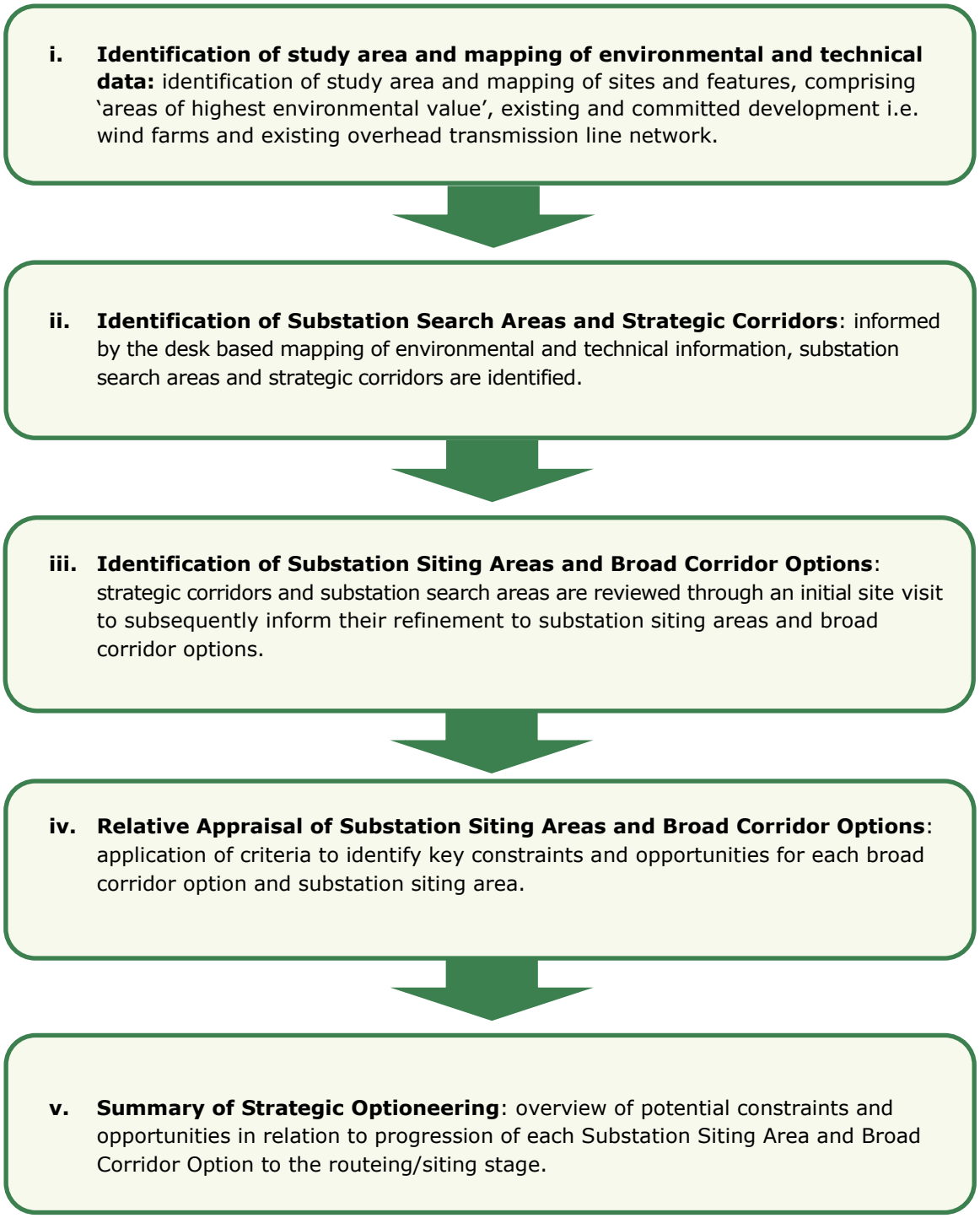
3.2 In order to identify and appraise broad corridor and substation siting options, it is important to recognise that the project requires an element of professional judgement, based on relevant expertise and previous experience whilst remaining transparent and robust throughout. On this basis, the approach to the study has been to utilise information gathered through desk based studies, supported by field work, to inform the professional judgement led strategic study.

3.3 It is also important to note that the scope of the study comprises environmental considerations only, with high level consideration of potential technical constraints taken into account at this preliminary strategic stage as advised by SPEN (technical constraints and considerations are outlined in more detail in **Section 4**).

3.4 The methodology comprises a number of key steps which are outlined in **Diagram 1** below. The steps are followed sequentially, with one step informing the next step, whilst also allowing for technical review/input at each stage to form an iterative process. Further detail for each step of the methodology is contained below, and the findings of each step are provided in **Section 4**.

3.5 Although recognising that this study relates to a high level strategic review of potential corridor options and substation siting options, the methodology is devised on the basis of the hierarchical principles contained within accepted good practice guidance for the routeing of high voltage lines and siting of substation infrastructure; the Holford Rules and Horlock Rules respectively, and in accordance with SPEN's own principles for routeing of Major Electrical Infrastructure Projects[3]. The Holford Rules and Horlock Rules are presented in **Appendix 1.**

Diagram 1: Strategic Optioneering Study Methodology



4 Strategic Optioneering Study Findings

4.1 This Section presents the findings of the Strategic Optioneering Study comprising the steps as presented in **Diagram 1** in **Section 3**.

> i. **Identification of study area and mapping of environmental and technical data:** identification of study area and mapping of sites and features, comprising 'areas of highest environmental value', existing and committed development i.e. wind farms and existing overhead transmission line network.

Identification of Overhead Line Study Area and Substation Study Area

4.2 The first step in the optioneering study process involved identification of the study areas, for both the overhead line and substations, predominantly for the purposes of gathering data specific to the project study areas. In identifying the study areas, it was important to ensure that these were large enough to accommodate all likely broad corridor options and substation siting areas reflecting SPENs technical design requirements.

4.3 To further inform the study areas:

- A preliminary check was carried out to identify the presence of internationally or nationally designated areas within, or immediately outside, the study area, to ensure that potential direct and/or indirect effects could be considered.
- A desk based review of the underlying landscape characteristics and topographic variances was used to identify the maximum area across which broad corridor options were likely to be identified, reflecting the likely maximum search area for the connection locations i.e. the substations.

4.4 The overhead line study area is shown on **Figure 4.1** and extends across three administrative boundaries, namely Dumfries and Galloway (DGC), East Ayrshire (EAC) and South Lanarkshire (SLC). Within the overhead line study area, a substation study area was identified for the new 400/132kV substation which reflected SPENs requirements to be located, where possible, within 500m[5], and to the east, of the existing ZV transmission line between the existing Coalburn and Elvanfoot substations. The substation study area is also shown on **Figure 4.1**.

4.5 The overhead line study area extends northwards from Enterkinfoot in Dumfries and Galloway at its southern extent, to Lesmahagow in South Lanarkshire at its northern extent. It also incorporates the settlements of Crawford, South Lanarkshire in the east and Cumnock, East Ayrshire in the west.

4.6 There is notable topographic variation across the overhead line study area, with the Lowther Hills, within the wider Southern Uplands representing the largest extent of uplands in the study area. Steep sided (≥ 22 degrees) slopes formed by smooth rounded hills and incised valleys, a distinctive characteristic of the Lowther Hills (732m AOD at the highest point of Green Lowther) are found across the south-eastern extents of the study area. Across the central part of the study area, topography is more consistent with large expanses of simple upland plateau, dissected by shallower upland river valleys flowing into the River Ayr and River Douglas to the north, and the River Nith to the south, south-west. Nevertheless notable hill summits within this area include Cairn Kinney (493m AOD), Cairn Table (593m AOD), Wardlaw Hill (497m AOD) and Kirkland Hill (507m AOD). The variable topography across the study area, as shown on **Figure 4.1**, may represent both potential opportunities and constraints to the routeing of overhead line

[5] At this stage wider study areas of 1km and 2km were also identified to inform the identification of substation search areas

infrastructure within the study area, from both a technical and landscape and visual perspective (in the context of the principles set out within the Holford Rules).

4.7 The landscape of the study area is defined by settled upland river valleys and expanses of generally sparsely inhabited upland. The landscape character types found across the study area are shown on **Figure 4.5a**. The main river valleys within the study area are occupied by the River Ayr to the north, the River Nith to the south and the Upper River Clyde to the east. Large expanses of simple Plateau Moorland are found to the north of the study area within South Lanarkshire and Easy Ayrshire, whilst the central and southern extents of the study area is characterised by the rounded and valley incised hills of the Southern Uplands. Large scale commercial forestry is present within areas of the Plateau Moorland LCT, and to a lesser extent the Southern Uplands LCT, of South Lanarkshire and East Ayrshire, whilst the landcover of other upland areas within the study area is generally defined by semi-improved grassland and moorland.

4.8 A proportion of the study area is afforded landscape designation and protection at a local level, with Special Landscape Areas (SLAs), Regional Scenic Areas (RSAs) and Sensitive Landscape Areas defined within the South Lanarkshire Council, Dumfries and Galloway Council and East Ayrshire Council administrate areas respectively, and are shown on **Figure 4.5a**. A large extent of the Upland River Valley of the River Ayr and River Nith, and Plateau Moorland LCT of East Ayrshire is designated as a Sensitive Landscape Area, and the Thornhill Uplands RSA in Dumfries and Galloway covers a large area of the Southern Uplands at the south of the study area. The designated landscapes of the Douglas Valley SLA, Leadhills and Lowther Hills SLA and Clyde Valley and Tinto SLA occupy a large proportion South Lanarkshire.

4.9 The population within the area is largely concentrated along the main transport routes throughout the study area, specifically the A70 along the Ayr Valley, the M74, A73 and A702 along the Clyde Valley and the A76 along the Nith Valley. The West Coast Main Line (WCML) railway line passes through the study area, running parallel with the M74 between Elvanfoot and Abington. The main arterial transport routes act as the main communication routes between the study area and urban hubs such as Glasgow, Dumfries and Carlisle. Population is generally sparse towards the centre of the study area where exposed upland moorland and forested areas are sparsely inhabited and less accessible, located further from the main transport routes.

4.10 Extensive areas of the study area are characterised by large scale wind farm development, most notably within the South Lanarkshire administrative boundary to the west, south-west of Coalburn substation. Existing (operational) wind farm developments area generally concentrated in upland areas of the Plateau Moorland LCTs of South Lanarkshire and East Ayrshire, whilst current pressure from committed (consented) and proposed wind farm development is concentrated in areas of the Southern Uplands LCTs of Dumfries and Galloway and East Ayrshire.

4.11 Mineral extraction of coal and, sand and gravel deposits are characteristic of substantial extents of the study area within South Lanarkshire and East Ayrshire, and to a lesser extent Dumfries of Galloway. Many areas of past extraction are currently at different stages of restoration, whilst some active operations area evident within East Ayrshire in the north-western extents of the study area.

Identification of Areas of Highest Environmental Value

4.12 Although recognising that this optioneering study is strategic in nature, principles contained within accepted good practice guidance for the routeing of high voltage overhead lines and siting of substations have been taken account of in identifying the 'areas of highest environmental value'[6] and to inform the identification and relative appraisal of broad corridors and substation siting areas. The guidance is referred to as the Holford and Horlock Rules, detailed in **Appendix 1**.

4.13 The SHETL clarification note b) of the Holford Rules states that areas of highest environmental value "*require to be established on a project-by-project basis considering Schedule 9 of the Electricity Act, 1989*". Consequently, areas identified to inform the strategic optioneering study

[6] For the purposes of this study, the term 'environmental' has been used in place of 'amenity' as used in the Holford Rules to reflect more recent thinking which also seeks to recognise the intrinsic value of such areas.

have been informed by the Holford Rules (Rules 1 and 2) and our experience and knowledge of the study area as well as routeing overhead lines and siting substations.

4.14 On this basis, the 'areas of highest environmental value' located within or just beyond the study area (and therefore could experience indirect effects), which are of such a geographical size to inform the identification of strategic corridors, comprise the following areas of natural and cultural heritage value designated at a national, European or international level:

- Special Protection Areas (SPA);
- Special Areas of Conservation (SAC);
- Sites of Special Scientific Interest (SSSI);
- Scheduled Monuments (SM) (where it is large in size and/or geographic location such that it may form a potential constraint to routeing);
- Gardens and Designed Landscapes (GDLs)[7].

4.15 Supplementary Note a) of the Rules relates to residential areas, stating "*avoid routeing close to residential areas as far as possible on grounds of general amenity*". In this study, settlements have been mapped and included as areas of highest environmental value. Settlements are defined as towns and villages identified within the relevant Local Development Plans (LDPs). Within the study area these comprise Cumnock, New Cumnock and Muirkirk in East Ayrshire; Sanquhar, Kirkconnel, Kelloholm and Wanlockhead in Dumfries and Galloway; and Leadhills, Crawfordjohn, Elvanfoot, Abington, Crawford, Lesmahagow, Coalburn, Rigside, Douglas, and Elvanfoot in South Lanarkshire.

4.16 The areas of highest environmental value located within the substation study area which have informed the identification of substation search (and siting) areas comprise those listed for the corridors[8], plus features which are of a smaller geographical size which could potentially be avoided during more detailed siting, comprising:

- Scheduled Monuments (SM);
- Listed Buildings (LBs);
- Ancient Woodland (AWI);
- Settlements (as defined on relevant LDPs); and
- Individual properties (in relation to residential amenity).

4.17 These areas of highest environmental value are shown on **Figure 4.2**.

Identification of Technical Considerations

4.18 At this stage, whilst not forming an 'avoid altogether where possible' constraint, the following technical considerations were mapped to inform the identification of strategic corridors and substation siting areas:

- Topography: areas of relatively higher ground;
- Slope Angle: slopes ≥ 22 degrees;
- Flood Risk zones (1/1000yr) for substations only;
- Wind farms and single wind turbines: operational, under construction and consented turbines were mapped with a 1.5x tip height radius buffer applied informed by a precautionary minimum separation distance between turbines and overhead lines; and
- Access: existing main transport routes comprising motorways, A and B roads as shown on the OS base maps.

[7] Located outwith the study area

[8] With the exception of the SPA which is not located within the substation study area

ii. **Identification of Substation Search Areas and Strategic Corridors**: informed by the desk based mapping of environmental and technical information, substation search areas and strategic corridors are identified.

Identification of Substation Search Areas and Strategic Corridor Options

4.19 The environmental and technical considerations were mapped and are shown on **Figure 4.2**. These were used to inform the desk based identification of substation search areas and strategic corridor options shown on **Figure 4.3**. It is important to note that the strategic corridor options as mapped, represent a schematic form of potential geographic areas for future routeing of an overhead line.

4.20 The substation search areas and strategic corridors were identified based on the desk based information, to focus the fieldwork and more detailed study, to effectively review and refine the strategic corridors to broad corridor options and the substation search areas to substation siting areas.

4.21 Although not mutually exclusive of one another, the identification of substation search areas took priority due to the more clearly defined technical requirements for this component of the project, as set out in **Section 2**. This then informed the identification of strategic corridors based upon connection to the most feasible substation search areas.

4.22 A number of 'areas of highest environmental value' with extensive geographical areas are present within the study area, namely the Muirkirk and North Lowther Uplands SPAs and SSSIs, which represent a key constraint to routeing (in accordance with Holford Rule 1) and had the greatest influence on the identification of strategic corridors.

4.23 In addition, Holford Rules 4 and 5, were considered from an early stage when determining the likely feasibility and suitability of potential strategic corridor options based on the principle that overhead line infrastructure is judged to be more widely visible from surrounding areas when located on higher ground, for example ridges and skylines and should instead to seek to identify opportunities for *'tree and hill backgrounds in preference to sky backgrounds'*, and prefer *'moderately open valleys with woods where the apparent height of towers will be reduced'.* This most notably included consideration of the presence of elevated/high ground (i.e. metres Above Ordnance Datum (AOD)), steep slope gradients (i.e. ≥ 22 degrees) and complex topography as illustrated on **Figure 4.2**.

4.24 The presence of wind farms provide an overview of areas of current and potential future wind energy development, however they do not form an avoid where possible constraint at this strategic stage.

4.25 Brief descriptions of each of the substation search areas and strategic corridor options are provided in **Table 4.2** and **Table 4.1** respectively below.

Table 4.1: Substation Search Areas

Substation Search Area	Description
Substation Search Area A	Substation search area extending east, south-east of the existing Coalburn substation and ZV route, encompassing an area of former open cast mineral extraction at Broken Cross Muir and agricultural land within the Douglas Water Valley east of the M74 corridor in South Lanarkshire.
Substation Search Area B	Substation search area extending east of ZV route between Douglas to the north and Abington to the south, and encompassing elevated moorland and rough grazing west of the M74 corridor within South Lanarkshire.
Substation Search Area C	Substation search area extending east, north-east of the existing Elvanfoot substation, between Crawford to the north and Elvanfoot to the south, situated in the Upper Clyde Valley in Dumfries and Galloway.

Table 4.2: Strategic Corridor Options

Strategic Corridor Option	Description
Strategic Corridor Option 1	Northern Strategic Corridor generally following the broad low lying Ayr Valley and avoiding the large central extent of the Muirkirk and North Lowther Uplands SPAs and SSSIs, and providing potential links to **Substation Search Areas A** or **B**.
Strategic Corridor Option 2	Western central Strategic Corridor generally crossing the unpopulated elevated ground of the Southern Ayrshire Plateau situated between the central extents of the Muirkirk and North Lowther Uplands SPAs and SSSIs, and providing potential links to **Substation Search Area B**.
Strategic Corridor Option 3	Eastern central Strategic Corridor passing south-east along the Nith Valley before crossing the north-western extents of the Lowther Hills region of the Southern Uplands, east of the North Lowther Uplands SPAs and SSSIs, and providing potential links to Substation Search **Area B** or **C**.
Strategic Corridor Option 4	Southern Strategic Corridor passing south-east along the Nith Valley before crossing the south-eastern extents of the Lowther Hills region of the Southern Uplands in the vicinity of the Mennock and Dalveen Passes, and providing potential links to **Substation Search Area C**.

iii. **Identification of Substation Siting Areas and Broad Corridors**: strategic corridors and substation search areas are reviewed through an initial site visit to subsequently inform their refinement to substation siting areas and broad corridor options.

Review of Substation Search Areas and Strategic Corridor Options

4.26 A review of the substation search areas and strategic corridor options was informed by initial fieldwork undertaken in March 2019[9], to subsequently inform their refinement to substation siting areas and broad corridor options.

Substation Search Areas

4.27 The substation search areas were subjected to a preliminary landscape and visual amenity review during fieldwork based on the following broad criteria:

- suitability to accommodate required footprint size of proposed substation;
- localised topography of potential location;
- openness and scale of the landscape;
- presence or absence of existing screening features;
- presence of sensitive landscape features;
- presence of settlements and residential properties;
- opportunities for implementation of screening;
- presence of existing substation and transmission line infrastructure.

4.28 Informed by desk based study and initial site observations during fieldwork each of the substation search areas identified, and shown on **Figure 4.3**, was judged to be suitable for the identification of substation siting areas.

Strategic Corridor Options

4.29 Given the nature of overhead transmission infrastructure the principal environmental considerations are likely to be associated with potential landscape and visual effects. It is generally accepted that the most effective way to limit adverse effects on landscape and visual amenity is by careful line routeing, led by landscape architects, based on professional judgement and informed by fieldwork and a detailed understanding of the underlying landscape and existing visual amenity.

4.30 Holford Rule 1 forms the basis for the identification of strategic corridor options. In addition, Holford Rule 4 and 5 identify that overhead line infrastructure is judged to be more widely visible from surrounding areas when located on higher ground, for example ridges and skylines and should instead to seek to identify opportunities for *'tree and hill backgrounds in preference to sky backgrounds'*, and prefer *'moderately open valleys with woods where the apparent height of towers will be reduced'*.

4.31 Informed by desk based study and initial site observations during fieldwork Strategic Corridor Options 1, 2 and 3 shown on **Figure 4.3** were each judged to be suitable for progression to the identification of potential broad corridor options stage.

4.32 However, the topography, landform and slope gradients (22 degrees) found within Strategic Corridor Option 4 as illustrated in **Figure 4.3**, were considered to provide few opportunities for routeing, limited to potential options passing through the valleys of the Mennock or Dalveen Passes which incise into and offer a scenic visual experience through the Lowther Hills. Options to cross the elevated summits and ridges of the Lowther Hills (i.e. crossing over ground of approximately 500-600m AOD) was also considered likely to result in extensive widespread visibility of transmission infrastructure across much of the immediate landscape of the Lowther

[9] Fieldwork undertaken in mixed weather conditions from publicly accessible locations only on Friday, 8th March 2019.

Hills, including the elevated settlements of Wanlockhead and Leadhills, with cultural heritage associations.

4.33 On the basis of the above, as Strategic Corridor Option 4 was considered to present substantial potential challenges to routeing OHL infrastructure of the type and scale proposed, relative to the other three strategic corridor options, it was not progressed to the broad corridor stage.

4.34 It should be noted that progression of the three strategic corridors to the next stage, does not preclude the identification of additional strategic corridor options in the event that exploration of routeing options within the identified strategic corridors is not possible due to constraints or sensitivities or technical requirements which may yet be unknown at this stage of the study.

Identification of Substation Siting Areas and Broad Corridor Options

4.35 Although not mutually exclusive of one another, and as for the approach taken to the identification of substation search areas, the identification of substation siting areas took priority in the first instance due to the clearly defined technical requirements for this component of the project, as set out in **Section 2**. This then allowed for focused identification of broad corridor options based upon connecting the substation siting areas identified.

Substation Siting Areas

4.36 As outlined above, the identified substation search areas were verified and refined during fieldwork undertaken in March 2019[9], to identify potential substation siting areas as shown on **Figure 4.4**.

4.37 Identification of the substation siting areas took account of the same environmental and technical considerations for substation search areas set out above, and sought to avoid areas of highest environmental value (Holford Rule 1) and with consideration of the key principles of appropriate substation siting detailed within the Holford Rules (Supplementary Notes on the Siting of Substations from the updated 2003 version of the Holford Rules, as detailed in **Appendix 1**) and Horlock Rules.

4.38 Three substation siting areas have been identified as shown on **Figure 4.4**. A written description of each substation siting area is detailed in **Table 4.3** below. Each substation siting area may have numerous opportunities for siting of a substation of the minimum footprint area required (understood to be approximately 175,000m^2 / 17.5 hectares) which is reflected in the approximate areas (in hectares) quoted in the table below.

Table 4.3: Substation Siting Areas

Substation Siting Area	Description
Substation Siting Area A (Approximate area: 336.6 hectares)	**Broken Cross Muir** The siting area is located to the east of the M74 near the Broken Cross Muir (former) opencast mine workings site. Surface disturbance associated with the mine workings is evident across the majority of the siting area, with land cover in the south-western to south-eastern extents of the area comprising blocks of coniferous forestry. The north-western corner of the site comprises improved pasture with the residential property of Annfield located along the unclassified road running parallel to the north-east of the M74. ZV route passes to the west, south-west of the siting area, running south, south-eastwards broadly in parallel with the M74 corridor.
Substation Siting Area B (Approximate area: 478.2 hectares)	**Red Moss** This siting area is located to the west of the M74 near Red Moss, spanning the length of the M74 from Wildshaw Hill to White Rig. Land cover comprises gently rolling rough grazing pasture with evidence of past and in-use mining works visible throughout the siting area. The southern extent of the siting area crosses the B7078

Substation Siting Area	Description
	to the north-west of Black Hill. ZV route runs broadly parallel with the western, south-western boundary of the siting area, crossing open moorland/rough grazing between the M74 to the east and B7078 to the west east of Red Moss.
Substation Siting Area C (Approximate area: 129.9 hectares)	**Elvanfoot** The siting area is located west of the main communications corridor of the M74 and west coast mainline railway near Elvanfoot. Extending east and north-eastwards of the existing Elvanfoot substation, land cover comprises rough grazing and gently rolling moorland. Collins Burn and Harry Burn cross the northern extents of the siting area and the lower reaches of Elvan Water crosses the southern extent of the siting area, before flowing into the River Clyde to the east. The farmstead at Elvanfoot Farm is located in the central part of the siting area, with additional residential properties clustered around the junction of the B7040 and A702 to the south and east of the siting area respectively. ZV route runs broadly parallel with the western boundary of the siting area, descending across open moorland/rough grazing from the north, north-west.

Broad Corridor Options

4.39 The desk based strategic corridors were also verified and refined during fieldwork undertaken in March 2019[9], to identify initial broad corridor options as shown on **Figure 4.4**. Each of the identified broad corridor options provides potential opportunities for and OHL connection between the proposed Glenmuckloch substation and one of the respective substation siting areas (e.g. A, B and C) located adjacent to ZV route.

4.40 In addition to the same principles as considered for the identification of the strategic corridor options (Holford Rules, 1, 4 and 5) set out above, Holford Rule 3 which states that, "*other things being equal, the most direct line should be chosen, with no sharp changes in direction*", is also taken account of in identifying broad corridor options.

4.41 It is important to note that the broad corridor option 'edges', as mapped, do not represent fixed boundaries to subsequent routeing opportunities, and the identification of these broad corridors was undertaken to identify the expansive geographic area within which the potential for future routeing of an overhead line, of the type proposed, was considered to be viable, relative to other geographic areas.

4.42 Six broad corridor options have been identified as shown on **Figure 4.5**. A written description of each broad corridor is detailed in **Table 4.4** below, described from west to east between the Glenmuckloch substation in the west to the relevant substation siting areas (describe in **Table 4.3** above) adjacent to ZV route in the east.

Table 4.4: Broad Corridor Options

Broad Corridor Option	Description
Broad Corridor 1a (Approximate length: 49.9km)	**North – Ayr Valley to Broken Cross Muir via Ayrshire Rim** Located in the north part of the study area, the broad corridor passes north from the Glenmuckloch substation towards the A70 before turning north-east to pass through Muirkirk towards the M74. The corridor includes areas of improved pasture and small blocks of forestry, crossing Glenmuir Water before turning north-east to follow the Ayr valley, where the corridor passes through improved pasture and a series of opencast mine workings. The corridor follows the Ayr Valley through the village of Muirkirk before

Broad Corridor Option	Description
	diverging further north at Glenbuck. The corridor passes north of the Nutberry wind farm through forestry before descending along the River Nethan into plateau farmland near Coalburn and the M74. **Broad Corridor 1a** provides potential continuous OHL options to **Substation Siting Area A**.
Broad Corridor 1b (Approximate length: 44.5km)	**North – Ayr Valley to Red Moss via Douglas Valley** Located in the north part of the study area, the broad corridor follows the same general alignment as Broad Corridor 1a for the majority of its length, diverging south-eastwards at Glenbuck following the Douglas Valley towards the M74. The corridor includes forestry, (existing and former) opencast mine workings, moorland and the Middle Muir and Andershaw wind farms, crossing Kennox Water near Kennox Hill. The corridor continues eastwards from Middle Muir, crossing Black Burn and Red Moss towards ZV route where it parallels the M74 and the B7078. **Broad Corridor 1b** provides potential continuous OHL options to **Substation Siting Area B**.
Broad Corridor 2a (Approximate length: 24.1km)	**Central – Southern Ayrshire Plateau to Red Moss via Glentaggart** Located in the central part of the study area, passing north-east from Glenmuckloch substation across the elevated plateau from Auchtitench Hill to Wedder Hill wit areas of commercial forestry. The corridor then crosses Kennox Water and heads east, passing (former) opencast mine workings, isolated farmsteads and properties at Glentaggart, areas of commercial forestry and the Middle Muir and Andershaw wind farms. The corridor continues eastwards from Middle Muir, crossing Black Burn and Red Moss towards ZV route where it parallels the M74 and the B7078. **Broad Corridor 2a** provides potential continuous OHL options to **Substation Siting Area B**.
Broad Corridor 2b (Approximate length: 33.9km)	**Central – Southern Ayrshire Plateau to Elvanfoot via Duneaton Water Valley** Located in the central part of the study area, the corridor follows the same general alignment as Broad Corridor 2a, diverging at Crawfordjohn to pass south-east towards Elvanfoot. The corridor crosses Duneaton Water and south-east of Crawfordjohn crosses Glengonnar Water before tracing the lower north-eastern contours of Ravengill Dod (538m AOD) and Harryburn Brae (499m AOD), generally following the corridor of the existing ZV route before descending towards the main communication corridor of the M74 and west coast mainline railway in the Upper Clyde Valley near Elvanfoot. **Broad Corridor 2b** provides potential continuous OHL options to **Substation Siting Area C**.
Broad Corridor 3a (Approximate length: 28.5km)	**South – Southern Uplands to Red Moss via Crawick Valley** Broad Corridor 3a is located in the southern part of the study area, passing south-east from the Glenmuckloch substation along the Nith Valley and includes blocks of forestry and grazing pasture on the upper Nithsdale slopes along the A76 corridor, passing to the north of the settlements of Kirkconnel, Kelloholm, Crawick and Sanquhar. The corridor diverges north-eastwards across the more complex topography of the Southern Uplands parallel with the upper Crawick valley to Conrig Hill (485m AOD) with areas of forestry, rough grazing and heathland.

Broad Corridor Option	Description
	Sharing the north-eastern extents of Broad Corridor 2a, the corridor crosses Duneaton Water to the south of Mountherrick Hill (427m AOD) before passing Crawfordjohn and descending into plateau farmland, before crossing Black Burn and Red Moss towards ZV route where it parallels the M74 and the B7078. **Broad Corridor 3a** provides potential continuous OHL options to **Substation Siting Area B**.
Broad Corridor 3b (Approximate length: 34.3km)	**South – Southern Uplands to Red Moss via Crawick Valley and Glengonnar** Broad Corridor 3b is located in the southern part of the study area and follows the same general alignment as Broad Corridor 3a, diverging at Crawfordjohn to pass south-east towards Elvanfoot. From the point of divergence, Broad Corridor 3b follows the same alignment as Broad Corridor 2b. The corridor crosses Duneaton Water and south-east of Crawfordjohn crosses Glengonnar Water before tracing the lower north-eastern contours of Ravengill Dod (538m AOD) and Harryburn Brae (499m AOD), generally following the corridor of the existing ZV route before descending towards the main communication corridor of the M74 and west coast mainline railway in the Upper Clyde Valley near Elvanfoot. **Broad Corridor 3b** provides potential continuous OHL options to **Substation Siting Area C**.

iv. Relative Appraisal of Broad Corridor Options and Substation Siting Areas: application of criteria to identify key constraints and opportunities for each broad corridor and substation siting area.

4.43 The broad corridor options and substation siting areas were subjected to a relative appraisal against a number of environmental and technical criteria to identify potential constraints and opportunities for future routeing/siting.

4.44 This process sought to:

- Continue to reflect SPENs technical design requirements;
- Continue to reflect SPENs overarching Approach to Routeing and EIA guidelines;
- Continue to reflect the Holford Rules for routeing overhead transmission lines and the Horlock Rules for siting substations (detailed in **Appendix 1**); and
- Draw out relative distinctions between the corridors and substation siting areas to enable constraints and opportunities of each to be identified.

4.45 The appraisal criteria and appraisal findings are set out below. The potential implications of 'pairing' each broad corridor with each substation siting area are also identified, on the basis of the interrelationship between the two infrastructure components.

Appraisal of Broad Corridor Options

4.46 Based on established practice for routeing overhead transmission lines, our knowledge of the study area and potential key issues for subsequent routeing and EIA, the following criteria were applied for the purposes of the appraisal:

- Length of broad corridor;
- Biodiversity;
- Landscape and visual amenity;
- Cultural heritage;
- Forestry;
- Land Use (committed development comprising wind farms and minerals extraction); and
- Technical Considerations (topography, slope and access).

4.47 The reasoning for the use of these criteria and an outline of the methodology for appraising each strategic corridor is set out below.

Length of Broad Corridor Option

4.48 Holford Rule 3 states that *"other things being equal choose the most direct line"*. Although this rule primarily relates to avoiding sharp changes in direction, and therefore the need for more visually intrusive angle towers, choosing the most direct line may result in fewer adverse effects than a longer less direct line (taking due cognisance of other constraints).

Biodiversity

4.49 The SPAs have formed avoid where possible constraints in accordance with Holford Rule 1. However, an ornithological 'trigger for consideration' zone of 2km from Muirkirk and North Lowther Uplands SPA (designated for breeding golden plover, hen harrier, merlin, peregrine and short-eared owl, and for non-breeding hen harrier) and SSSI (designated for the breeding bird assemblage and breeding hen harrier) is applied to reflect the core range of the majority of these species in relation to connectivity with the SPA as their breeding and foraging area (SNH Guidance Note: *Assessing Connectivity with Special Protection Areas (SPAs)* (2016)).

4.50 The ornithological 'trigger for consideration' zones are included as species constituting the qualifying features of these designated sites are likely to be reliant on habitats adjacent to, but outside, the designated site boundaries for foraging and, in some cases, for nesting. Hence, for individuals of these species, the presence of a route in the 'trigger for consideration zones' may present a risk of disturbance and collision, and the risk is considered to be proportionate to the length of the route option within this 'trigger for consideration zone'. The appraisal of strategic corridors highlights the constraint and opportunities for a potential route to avoid these 'trigger for consideration zones'.

4.51 In addition to the SPAs, other areas of "highest environmental amenity" comprising the SSSIs and SACs were identified and opportunities to avoid these and/or potential constraints to routeing identified. These are shown on **Figure 4.5b**.

Landscape and Visual Amenity

4.52 Consideration of landscape susceptibility to the type and scale of development proposed (400kV L8 steel lattice tower of an average 46m height, and large scale 400kV substation infrastructure) has informed the comparative appraisal of the broad corridor options and substation siting areas. The SNH digital map-based national Landscape Character Assessment (published in 2019)[10] has been used as the basis for determining the susceptibility of Landscape Character Types (LCTs) across the study area. This was supplemented by information contained within published landscape capacity studies and observations made during fieldwork to appraise the relative landscape' fit' of each broad corridor option. The LCTs found across the study area are shown on **Figure 4.5a**, and the findings of the landscape susceptibility appraisal are presented in **Appendix 2**.

4.53 There are no landscape designations comprising 'areas of highest environmental value' (Holford Rule 1) within the study area, which have informed the identification of broad corridor options. However, landscape areas of 'high' environmental value (Holford Rule 2), afforded landscape designation and protection at a local level, are found across a relatively large proportion of the study area, and are shown on **Figure 4.5a**. These areas comprise the following local landscape designations:

- East Ayrshire Sensitive Landscape Area[11];
- Douglas Valley Special Landscape Area (SLA), South Lanarkshire[12];
- Upper Clyde Valley SLA, South Lanarkshire[12];
- Leadhills and Lowther Hills SLA, South Lanarkshire[12];
- Thornhill Uplands Regional Scenic Area (RSA), Dumfries and Galloway[13].

4.54 These areas are designated as part of the Local Development Plan (LDP) process and therefore represent the landscapes of greatest scenic value within each of the administrative areas, and have therefore been included for consideration within the appraisal of broad corridor options. **Appendix 3** presents a consideration of key sensitivities in relation to overhead line and substation infrastructure of the type and scale proposed.

4.55 In relation to residential visual amenity, settlements in proximity to the broad corridor options and the potential for effects on views experienced from these settlements were considered. Further consideration will be given to minimising potential for effects on views from individual residential properties during routeing, however a general observation on the density and pattern of residential properties within each broad corridor is included in the appraisal.

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[10] https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/scottish-landscape-character-types-map-and-descriptions

[11] https://www.east-ayrshire.gov.uk/Resources/PDF/L/LDP-Sensitive-Landscape-Area-Background-Paper.pdf

[12] https://www.gov.scot/binaries/content/documents/govscot/publications/factsheet/2018/06/south-lanarkshire-council-planning-authority-core-documents/documents/renewable-energy/landscape-designations-report/landscape-designations-report/govscot%3Adocument

[13] https://www.dumgal.gov.uk/media/19851/LDP2-Regional-Scenic-Areas-technical-paper/pdf/Regional_Scenic_Areas_Technical_Paper.pdf?m=636827083977930000

4.56 The appraisal also reflects a preliminary landscape evaluation (based on a high level site visit). Observations during initial fieldwork have been considered at a strategic level as part of this appraisal, to gain an initial understanding of the potential constraints or opportunities associated with each broad corridor option. In arriving at a professional judgement, the following broad criteria were considered, informed by the principles of the Holford Rules[14]:

- topography and slope gradient;
- opportunity for backclothing;
- openness and scale of the landscape;
- presence or absence of screening features;
- presence of sensitive landscape features;
- presence of settlements and residential properties;
- presence of other transmission line infrastructure; and
- presence of wind farm developments/single wind turbines.

Cultural Heritage

4.57 Due to the geographic size/scale of cultural heritage features i.e. generally individual features/buildings and/or clusters, these are not considered to provide either a constraint or opportunity in relation to the broad corridor options as these are likely to be avoided during routeing. However, where a cultural heritage feature is large in size and/or geographic location such that it *may* form a potential constraint to routeing it is mapped and potential for direct and indirect (setting) effects considered. For this study this is considered to comprise the following:

- Muirkirk Scheduled Monument SM6640: remains of tar works, mines and structures east of Garpel Water;
- Leadhills Scheduled Monument SM5817: remains of lead mining and smelting; and
- Wanlockhead Scheduled Monument SM5597: remains of lead mining and smelting.

4.58 Reflecting with Holford Rule 2, Conservation Areas were identified within the broad corridor options. These areas formed potential constraints and opportunities to avoid/reduce, as far as practical, direct effects and indirect effects on the setting of designated features of cultural heritage interest were identified within the appraisal.

Forestry

4.59 Note b) of Holford Rule 5 states *'where possible follow open space and run alongside, not through woodland or commercial forestry, and consider opportunities for skirting edges of copses and woods.'* The presence of woodland, identified in the National Forest Inventory, Native Woodland Survey of Scotland and Ancient Woodland Inventory, within the broad corridor options and opportunities to avoid these, or likelihood of their forming a constraint during routeing, is identified during the appraisal.

Land Use

4.60 The presence of wind energy developments (wind farms and large scale single wind turbines mapped with a 1.5x tip height radius buffer applied), within the broad corridor options and opportunities to avoid these, or likelihood of their forming a constraint during routeing, is identified during the appraisal. Operational, under construction, consented along with additional but as yet undetermined wind energy developments (subject to valid applications, currently at appeal or subject of a valid scoping request) were included, where sufficient information was available at the time of the study.

[14] *The Holford Rules: guidelines for the routeing of new high Voltage overhead transmission lines* NGC (1992) and SHETL (2003)

4.61 Areas with committed minerals development comprising existing and operational extraction sites and allocated areas within the local Development plans for minerals extraction have been included in the appraisal.

Technical Considerations

4.62 The presence of areas of complex and/or elevated/high ground (topography and topographic variance), steep slopes (≥ 22 degrees) within the broad corridor options and opportunities to avoid these, or likelihood of their forming a constraint during routeing, is identified during the appraisal. Consideration is also given to the presence of existing transport infrastructure, comprising the public road network, in relation to constraints or opportunities to access the overhead lines during construction and operation.

Table 4.5: Appraisal of Broad Corridor Options

Appraisal Criteria	Sub-Criteria	Broad Corridor 1a	Broad Corridor 1b	Broad Corridor 2a	Broad Corridor 2b	Broad Corridor 3a	Broad Corridor 3b	Appraisal Summary - Criteria
Approximate length of broad corridor (km)	n/a	49.9km	44.5km	24.1km	33.9km	28.5km	34.3km	**Broad corridor 2a** is the shortest broad corridor.
Biodiversity	SPA with '2km trigger for ornithological consideration zone' (see **Figure 4.5b**)	These broad corridors pass within the 2km 'trigger for ornithological zone of consideration' at the Muirkirk and North Lowther Uplands SPA for the majority of their length, with the exception of the substation siting areas end.				Broad Corridors 3a and 3b pass the 2km 'trigger for ornithological consideration zone' close to Glenmuckloch substation, and partially with it towards the eastern end. In some areas along the corridor, it will be unavoidable to avoid this 'trigger for consideration zone'. However, there are opportunities to avoid it as the corridor moves towards the Substation Siting Areas.		**Broad Corridors 3a** and **3b** offer relatively greater opportunities to avoid the 2km 'trigger for ornithological consideration zone'.
	SSSI and SAC Sites (see **Figure 4.5b**)	The Coalburn Moss SSSI and SAC is likely to form a key constraint for Broad Corridor 1a, potentially preventing continuous connection via OHL and UGC with Substation Siting Area A. Routeing to avoid the SAC/SSSI is likely to be challenging.	The Red Moss SSSI and SAC is located within Broad Corridor 1b towards Substation Siting Area. B It is possible for this to be avoided during routeing.	Broad Corridors 2a and 2b encompass the Red Moss SSSI and SAC towards the Substation Siting Areas. It is possible for this to be avoided during routeing.		Broad Corridor 3a encompasses the Red Moss SSSI and SAC as it moves towards Substation Siting Area B It is possible for this to be avoided during routeing. This corridor also passes over the Upper Nithsdale Woods SAC and Back Woods SSSI. Routeing to avoid the SAC/SSSI is likely to be challenging.	Broad Corridor 3b encompasses the Upper Nithsdale Woods SAC and Back Wood SSSI. Routeing to avoid the SAC/SSSI is likely to be challenging.	**Broad Corridors 1b, 2a** and **2b** offer relatively better opportunities to avoid SSSI and SAC sites.
Landscape and visual amenity	Landscape Character and Susceptibility (See **Figure 4.5a**)	Sections of this corridor option pass through landscape character types (LCTs) judged to be of lower susceptibility (Plateau Moorland – Ayrshire and Plateau Moorlands – Glasgow & Clyde Valley), however the corridor crosses the Upland River Valleys – Ayrshire and Upland River Valley – Glasgow & Clyde Valley LCTs (medium susceptibility) near New Cumnock, Lugar, Muirkirk and Dalquhandy and the Plateau Farmland – Glasgow & Clyde Valley LCT (medium susceptibility) near Coalburn. Forestry north-west of Muirkirk and near Nutberry Hill may provide opportunities for backclothing and screening of the OHL during more detailed routeing phases.	As for Broad Corridor 1a, with the corridor crossing the Upland River Valley LCT (judged to be of medium susceptibility) for a longer section of the Ayr Valley and Douglas Valley. Forestry at Glentaggart may provide opportunities for backclothing and screening of the OHL during more detailed routeing phases.	The majority of this corridor option passes through LCTs judged to be of lower susceptibility (Southern Uplands with Forest, Plateau Moorland – Ayrshire and Plateau Moorlands Glasgow & Clyde Valley), with small portions of the corridor crossing the Upland River Valleys LCT (medium susceptibility) near Glespin and Crawfordjohn. LCTs judged to be of medium susceptibility can likely be avoided during more detailed routeing. Forestry may provide the opportunities for backclothing and screening for a large extent of the corridor during more detailed routeing phases.	As for Broad Corridor 2a, with the corridor option crossing into LCTs judged to be of medium susceptibility (Upland River Valleys, Southern Uplands and Upland Glen) from Crawfordjohn to Elvanfoot. Forestry to the south-east of Crawfordjohn may provide opportunities for backclothing and screening of the OHL during more detailed routeing phases.	The majority of this corridor option passes through LCTs judged to be of medium susceptibility (Upper Dale – Dumfries & Galloway, Southern Uplands – Glasgow & Clyde Valley, Upland River Valley – Glasgow & Clyde Valley) and higher susceptibility (Southern Uplands – Dumfries & Galloway) from Conrig Hill to Slough Hill. A small portion of the corridor passes through the Plateau Moorlands – Glasgow & Clyde Valley LCT (lower susceptibility) on approach to the M74.	As for Broad Corridor 3a, with the corridor option diverging away from the Plateau Moorlands – Glasgow & Clyde Valley LCT (lower susceptibility) and passing through the Upland River Valleys – Glasgow & Clyde Valley, Southern Uplands – Glasgow & Clyde Valley and Upland Glen – Glasgow & Clyde Valley LCTs (medium susceptibility) from Crawfordjohn to Elvanfoot. Forestry to the south-east of Crawfordjohn may provide some opportunities for backclothing and screening of the OHL during detailed routeing phases.	**Broad corridors 2a** and **2b** generally pass through LCTs judged to be of lower susceptibility, whilst avoiding LCTs of higher susceptibility to OHL development of the type and scale proposed.

Appraisal Criteria	Sub-Criteria	Broad Corridor 1a	Broad Corridor 1b	Broad Corridor 2a	Broad Corridor 2b	Broad Corridor 3a	Broad Corridor 3b	Appraisal Summary - Criteria
	Locally Designated Landscapes (See **Figure 4.5a**)	This corridor option passes through the East Ayrshire Sensitive Landscape Area near New Cumnock and to the south-west of Muirkirk, with views of the corridor possible from a large extent of the sensitive landscape area to the north and south of the corridor.	As for Broad Corridor 1a, with this corridor crossing into the southern extent of the Douglas Valley SLA and the northern extent of the Leadhills and Lowther Hills SLA. These SLAs can likely be avoided during more detailed routeing phases.	This corridor option passes through the southern extent of the Douglas Valley SLA and the northern extent of the Leadhills and Lowther Hills SLA. However, it is likely that these SLAs could be avoided during more detailed routeing phases.	As for Broad Corridor 2a, with a longer extent of the corridor passing through the Leadhills and Lowther Hills SLA, including parts of the SLA that are judged to be of medium susceptible to OHL development. This would be largely unavoidable during more detailed routeing phases.	This corridor option passes through the north-west corner of the Thornhill Uplands RSA, the north-western extent of the Leadhills and Lowther Hills SLA and the south-eastern corner of the Douglas Valley SLA. The Thornhill Uplands RSA and Douglas Valley SLA could likely be avoided during more detailed routeing phases, whilst routeing within the Leadhills and Lowther Hills SLA would be unavoidable. However, the corridor largely avoids the more sensitive upland glen areas of the Leadhills and Lowther Hills SLA.	As for Broad Corridor 3a, with a longer extent of the corridor passing through the Leadhills and Lowther Hills SLA, including parts of the SLA that are judged to be of higher susceptibility to OHL development. This would be largely unavoidable during more detailed routeing phases.	**Broad Corridor 2a** offers potential opportunities to avoid routeing through locally designated landscapes during more detailed routeing phases.
	Visual Amenity	This corridor option passes along the Upper Nith Valley with the potential for visibility from the A70 and residential properties along the road route. The corridor passes through the Ayr Valley, and visibility from the A70, the settlement of Muirkirk, and areas along the valley with a dense pattern of scattered residential properties is considered likely. This includes visual effects experienced from the River Ayr Way long-distance footpath and the network of core paths at Muirkirk. All broad corridor options end close to the M74 at the eastern extent of the study area, so visibility from this main communications corridor is considered unavoidable.	As for Broad Corridor 1a, with a longer section of the corridor following the A70 south-east towards Glespin. The corridor also crosses the B740, however visibility from this road route can likely be minimised during more detailed routeing phases. The corridor crosses National Cycle Network (NCN) Route 74 as it follows the B7078 near Red Moss.	This corridor passes relatively few isolated residences and promoted routes, crossing East Ayrshire core path 151 near Stony Hill and NCN Route 74 as it follows the B7078 near Red Moss. Forestry and rolling topography along this corridor option provides an opportunity for backclothing and screening of the OHL in views from settlements, recreational routes and transportation routes during more detailed routeing phases.	As for Broad Corridor 2a, although this corridor option passing additional core paths in the forestry south-east of Crawfordjohn, with potential for visibility from settlements located along the A74, including Abington, Crawford and Elvanfoot, and the west coast main line railway.	This corridor option passes through the relatively densely settled Upper Nith Valley, which includes the settlements of Kirkconnel and Sanquhar, and visibility from these settlements and the A76, B740 along the valley is considered likely. The Southern Upland Way run from Bogg to Wanlock Water within the corridor and the network of core paths connecting the long-distance footpath to nearby settlements and transportation routes. The corridor crosses NCN Route 74 as it follows the B7078 near Red Moss.	As for Broad Corridor 3a, with this corridor option passing additional core paths in the forestry south-east of Crawfordjohn, and with potential for visibility from settlements located along the A74, including Abington, Crawford and Elvanfoot, and the west coast main line railway.	**Broad Corridor 2a** has the best potential to minimise visual effects upon receptors relative to the other corridors, as it passes through an area of relatively sparse population, with forestry and topography offering opportunities for backclothing and screening OHL infrastructure.
	Residential Visual Amenity (See **Figure 4.5b**)	Beyond the settlements located within the corridor, scattered residential properties are located within farmland at the head of the	As for Broad Corridor 1a, with a longer section of the corridor following the A70 containing additional scattered residential	This corridor option includes very sparsely populated areas, with few isolated residential properties/farmsteads	As for Broad Corridor 2a, however this corridor option includes additional scattered residential properties south-east of	Scattered residential properties are found along the Upper Nith Valley close to the A76, whilst on crossing the Crawick	As for Broad Corridor 3a, however this corridor option includes additional residential properties south-east of Crawfordjohn and north-west	**Broad Corridor 2a** is the least populated broad corridor option, with a relatively small number of isolated

Appraisal Criteria	Sub-Criteria	Broad Corridor 1a	Broad Corridor 1b	Broad Corridor 2a	Broad Corridor 2b	Broad Corridor 3a	Broad Corridor 3b	Appraisal Summary - Criteria
		Nith Valley and along the A70 corridor within the Ayr Valley, whilst on approaching Coalburn, scattered residential properties are found along the valley of the River Nethan.	properties along the Ayr and Douglas Valleys before diverting south-east along the relatively unpopulated valley of Glespin Burn.	including those located at Cleughs, Auchendaff, Glentaggart, and Glespin.	Crawfordjohn and north-west of Elvanfoot, from which visibility is considered likely.	Valley, scattered residential properties are found along the B740, and along the valley of Duneaton Water on approaching and passing Crawfordjohn.	of Elvanfoot, from which visibility is considered likely.	residential properties/farmsteads located within the corridor.
Cultural heritage	Scheduled Monuments (see **Figure 4.5b**)	Broad Corridors 1a and 1b are in close proximity to the Muirkirk Tar Works Scheduled Monument (SM6640). It is likely that this can be avoided during routeing alignment however effects upon setting may have to be considered		There are no Scheduled Monuments within or in close proximity to these broad corridor options.		Broad Corridors 3a and 3b partly overlap the Wanlockhead Lead Mining Scheduled Monument (SM5597). It is likely that this can be avoided during routeing.		All corridors offer potential to avoid Scheduled Monuments.
	Conservation Areas (see **Figure 4.5b**)	There are no Conservation Areas within or in close proximity to these broad corridor options.				Broad Corridors 3a and 3b are located in close proximity to the Wanlockhead Conservation Area. It is likely that this can be avoided during routeing.		All corridors offer potential to avoid Conservation Areas.
Forestry	Commercial Woodland (NFI), Ancient Woodland (AWI) and Semi Natural Woodland (NWSS) (see **Figure 4.5b**)	Broad Corridor 1a and 1b have relatively large areas of commercial forestry surrounding the settlement of Muirkirk and towards the Substation Siting Areas. There are also several smaller, fragmented areas of semi-natural and ancient woodland sites throughout these broad corridor options. While it may be possible to avoid areas of semi natural and ancient woodland, routeing to avoid commercial forestry is likely to be challenging.		Broad Corridors 2a and 2b have large blocks of commercial woodland throughout the corridors which is likely to form a key constraint. Due to the extent of commercial woodland, it is likely that impacts upon forestry be unavoidable during routeing. There are small, fragmented areas of semi-natural and ancient woodland as the corridors move towards the Substation Siting Areas; however it is likely that these can be avoided through routeing.		Broad Corridors 3a and 3b have relatively fewer areas of commercial woodland. However there are large areas of commercial forestry as the corridors move towards the Substation Siting Areas. It may possible to avoid commercial woodland during routeing. There are a number of smaller areas of semi-natural and ancient woodland (including Upper Nithsdale SAC and Back Woods SSSI), whilst it is possible to avoid most of these woodland areas, routeing to avoid the associated SAC/SSSI is likely to be challenging.		All corridors are likely to be constrained by commercial forestry, with **Broad Corridor 2a** and **2b** unlikely to avoid forestry. **Broad Corridors 1a, 1b, 2a** and **2b** offer relatively greater opportunities to avoid areas of semi natural and native woodland.
Land Use	Existing, Committed and Potential Future Development (e.g. Mineral extraction, wind farms) (see **Figure 4.5b**)	This corridor option passes the Glenmuckloch and Lethans wind farms (consented) and the Cumberhead wind farm (in planning). The 'trigger for consideration' zones for wind farm turbines could be avoided during more detailed routeing phases. However, the corridor also includes the Hare Craig wind farm (scoping), and Should this potential development move forward, these turbines in combination with turbines at Cumberhead wind farm may cause a constraint during more detailed routeing phases. There are a number of mineral extraction sites within this corridor which may form	The geographical location of the wind farms and minerals sites at the Substation Siting Area are, in combination, likely to form a constraint to routeing, As for Broad Corridor 1a, with this corridor passing Glentaggart wind farm (in planning), Middle Muir and Andershaw wind farms (operational). The 'trigger for consideration' zones for turbines at these wind farms could be avoided during more detailed routeing phases. There are a number of mineral extraction sites within this corridor which may form a constraint to routeing.	This corridor option passes the Middle Muir (operational) and Andershaw (operational) wind farms near Crawfordjohn. The 'trigger for consideration' zones for turbines at these wind farms could be avoided during more detailed routeing phases. This corridor option passes the Glenmuckloch (consented) and Lethans (consented) wind farms, which are likely to cause a key constraint for the south-western extents of the corridor. The corridor also passes Penbreck (consented), Kennoxhead (consented), Glentaggart (in planning), and Kennoxhead Extension	As for Broad Corridor 2a, with this corridor option passing near the Harryburn wind farm (in planning). However, the 'trigger for consideration' zones for the turbines at this wind farm could be avoided during more detailed routeing phases. There are two large areas of mineral extraction sites within this corridor which may form a constraint to routeing.	This corridor option passes the Middle Muir (operational) and Andershaw (operational) wind farms. The 'trigger for consideration' zones for turbines at these wind farms could be avoided during more detailed routeing phases. This corridor option also passes the North Lowther Energy Initiative (in planning, currently at appeal) and Glentaggart (in planning) wind farms. Should these potential future developments move forward, the 'trigger for consideration' zones for wind farm turbines are likely to cause a potential constraint during more	As for Broad Corridor 3a, with this corridor option also passing near the Harryburn wind farm (in planning). However, the 'trigger for consideration' zones for the turbines at this wind farm could be avoided during more detailed routeing phases.	Potential mineral extraction may form a key issue to routeing within **Broad Corridors 1a** and **1b** and to a lesser extent **2a and 2b.** The presence and pattern of potential future wind farm development may form a key issue to routeing in **Broad Corridors 1a** and **1b,** and **2a** and **2b.**

Appraisal Criteria	Sub-Criteria	Broad Corridor 1a	Broad Corridor 1b	Broad Corridor 2a	Broad Corridor 2b	Broad Corridor 3a	Broad Corridor 3b	Appraisal Summary - Criteria
		a constraint to routeing.		(scoping) wind farms. Should these potential future developments move forward, the 'trigger for consideration' zones for wind farm turbines are likely to cause a potential constraint during more detailed routeing phases. There are two large areas of mineral extraction sites within this corridor which may form a constraint to routeing.		detailed routeing phases.		
Technical Considerations	Topography & Slope (≥ 22 degrees) Access (motorway, A and B roads) (see **Figure 4.5b**)	The majority of this broad corridor offers opportunities to avoid areas of steeper slopes, generally following the lower lying extents of the Ayr Valley. The northern extent of the corridor crosses steeper slopes and more elevated ground centred around Nutberry Hill (522m AOD). The majority of the southern and central sections of Broad Corridor 1a is in proximity to the A76, A70 and B743 with a relatively short part of the northern section being remote from the public road network (between Glenbuck and Coalburn - ~9km).	As for Broad Corridor 1a, with this corridor option crossing complex topography along the Douglas Valley near Shiel Hill (346m AOD) before crossing into the gently undulating plateau moorlands near Middle Muir. Broad Corridor 1b is in proximity to the existing public road network comprising the A76, A70, B743 and B740 along its length.	This broad corridor option generally passes through gently rolling plateau moorland with limited areas of steep slope, however the corridor passes into relatively more complex topography as it follows Kennox Water and crosses Glespin Burn. Areas of steep slopes and transition between varying topography can likely be avoided during more detailed routeing phases. The majority of Broad Corridor 2a is remote from the existing public road network (between Glenmuckloch PSH substation and Andershaw ~17km) from where it is in proximity to the B740.	As for Broad Corridor 2a, with this corridor option crossing complex incised terrain at Duneaton Water before passing into the rolling Southern Uplands near Drake Law and the steep upland glen along Glengonnar Water. The transition between these different topographies will require consideration and could cause a potential constraint during detailed routeing phases. The majority of Broad Corridor 2b is remote from the existing public road network (between Glenmuckloch PSH substation and Andershaw ~17km), from where it is in proximity to the B740, B797 and B7040.	This corridor option passes through the complex rolling topography of the Southern Uplands, with concentrated areas of steep slopes (≥ 22 degrees) near incised tributaries including Cog Burn, Glensalloch Burn and Wanlock Water. The northern extents of the corridor option descends into the lower lying valley at Duneaton Water before ascending into gently sloping plateau near Middle Muir. The transition between these different topographies will require consideration and could cause a potential constraint during detailed routeing phases. Broad Corridor 3a is in proximity to the existing road network comprising the A76, B740, and B7078.	As for Broad Corridor 3a, with this corridor option crossing complex incised terrain, with concentrated areas of steep slopes (≥ 22 degrees), at Duneaton Water before passing into the rolling Southern Uplands near Drake Law and the steep upland glen along Glengonnar Water. The transition between these different topographies will require consideration and could cause a potential constraint during detailed routeing phases. Broad Corridor 3b is in proximity to the existing road network comprising the A76, B740, B7040 and B797.	**Broad Corridor 2a** avoids the most complex topography and areas of most concentrated areas of steep slope (≥ 22 degrees) found within the study area. Although containing areas of relatively high ground (c.350-400m AOD), the corridor generally avoids transitions between areas of substantial topographical variance. However, Broad Corridor 2a is joint furthest (with Broad Corridor 2b) from the existing public road network for access.

Appraisal of Substation Siting Areas

4.64 Based on established practice for transmission substation/infrastructure siting, our knowledge of the study area and potential key issues for subsequent siting/design and EIA, the following criteria were applied to the appraisal:

- Biodiversity;
- Landscape and visual amenity;
- Cultural heritage;
- Flood Risk;
- Forestry;
- Land Use; and
- Other Technical Constraints.

4.65 The reasoning for the inclusion of these criteria and an outline of the methodology for appraising each substation siting area is set out below.

Biodiversity

4.66 SNH has published a series of maps and guidance documents relating to priority peatlands (Mapping of SNH Carbon Rich Soil, Deep Peat and Priority Peatlands (CPP) (July 2016). By dividing peatland habitat types into 4 broad 'classes', SNH has mapped those areas of Scotland of greatest value for carbon sequestration through peat formation. Class 1 and 2 peatlands are those which offer greatest restoration or carbon-sequestration potential. Whilst not avoided during the identification of substation siting areas, the presence/spatial extent of these areas and opportunities to avoid them during the detailed substation siting/design are identified.

Landscape and Visual Amenity

4.67 Consideration of landscape susceptibility to the type and scale of development proposed (large scale 400/132kV substation infrastructure) has informed the comparative appraisal of the substation siting areas. The SNH digital map-based national Landscape Character Assessment (published in 2019)[15] has been used as the basis for determining the susceptibility of Landscape Character Types (LCTs) across the study area. This was supplemented by information contained within published landscape capacity studies and observations made during fieldwork to appraise the relative landscape' fit' of each broad corridor option. The LCTs found across the study area are shown on **Figure 4.5a**, and the findings of the landscape susceptibility appraisal are presented in **Appendix 2**.

4.68 As there are no landscape designations comprising 'areas of highest environmental value', which have informed the identification of potential substation siting areas, landscape areas of 'high environmental/amenity value' (Holford Rule 2) and designated within local development plans have been included for consideration within the appraisal of substation siting areas. These include the local landscape designations, as detailed in **Appendix 3**.

4.69 Opportunities for potential backclothing or screening of terminal towers and substation during the detailed siting and design stages have also been identified.

4.70 Whilst it is recognised that proximity to properties is not an absolute constraint to substation siting, a 150m 'trigger for consideration' has been mapped around each residential property to identify potential constraints to substation siting/design.

[15] https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/scottish-landscape-character-types-map-and-descriptions

Cultural Heritage

4.71 Where a Scheduled Monument, Listed Building or Unscheduled Archaeology of National Importance, is located within or in proximity to a substation siting area, potential for direct and indirect effects on the setting of these cultural heritage assets are identified.

Flood Risk

4.72 In relation to potential conflicts with policy relating to flooding and to avoid potential increase to flood risk, as well as potential flooding of the substation, SEPA 1/1000yr flood zones are mapped. The presence of these flood zones forming a constraint to siting and/or opportunities to avoid the flood risk zones during detailed substation siting/design are identified.

Forestry

4.73 The presence of commercial, semi-natural and ancient woodland within the siting areas and opportunities to avoid loos of woodland during detailed siting and design are identified.

Land Use

4.74 Land Capability for Agriculture classes 1, 2 and 3.1 in Scotland are referred to as 'Best and Most Versatile' land (with regards to agricultural productivity), and are afforded protection from development. The presence of these land use classes within the substation siting areas was considered, however there are no areas of classes 1,2, and 3.1 located within the substation siting areas. Therefore these are not considered further in the appraisal.

4.75 The presence of existing or potential future development (e.g. mineral extraction or wind farm development) limiting opportunities for substation siting within the substation siting areas is considered, where this is known at the time of the study.

Other Technical Constraints

4.76 The presence of other technical constraints to substation siting are considered within the appraisal, including major above surface infrastructure and underground services such as the National Grid Gas Network and other major pipelines (e.g. major oil/ethylene pipelines) where the location of these is known at the time of the study. Consideration is also given to the presence of existing transport infrastructure, comprising the public road network, in relation to constraints or opportunities to access the substations during construction and operation.

Table 4.1: Appraisal of Substation Siting Areas

Appraisal Criteria	Sub-Criteria	Substation Siting Area A (Approximate area: 336.6 hectares)	Substation Siting Area B (Approximate area: 478.2 hectares)	Substation Siting Area C (Approximate area: 129.9 hectares)	Appraisal Summary - Criteria
Biodiversity	SNH Priority Peatland Habitats (Classes 1 and 2) (See **Figure 4.5c**)	There are no priority peatland habitats within the substation siting area.		There is a large area of Category 1 Carbon Peatland located within Substation Siting Area C. Opportunities to avoid this area are limited.	**Substation Siting Areas A** and **B** are not constrained by the presence of Priority Peatland Habitats.
Landscape and Visual Amenity	Landscape Character and Susceptibility (See **Figure 4.5a**)	This Siting area is located within the Plateau Farmland LCT – Glasgow & Clyde Valley LCT, which is judged to be of medium susceptibility. Forestry in the south-west and south-eastern extents of the siting area may provide some opportunities for screening, but the relatively flat landform provides little opportunity for topographical screening.	This Siting area is located within the Plateau Moorlands LCT – Glasgow & Clyde Valley LCT, which is judged to be of lower susceptibility. Rolling landform provides some opportunities for landform screening in views from LCTs judged to be of greater susceptibility within 2-3km of the siting area.	This Siting area is located within the Southern Uplands – Glasgow & Clyde Valley LCT, which is judged to be of medium susceptibility. While the topography of the siting area is relatively flat, the surrounding rolling foothills located to the north, north-west and south of the site provide opportunities for landform screening of the site.	**Substation Siting Area B** is located within an LCT judged to be of lower susceptibility to the type and scale of development proposed, and provides potential opportunities for screening of substation infrastructure.
	Locally Designated Landscapes (See **Figure 4.5a**)	This Siting area is not located within any locally designated landscapes. The area is located 0.7km north-west of the Douglas Valley SLA and whilst visibility from the peripheries of the SLA may be likely, the siting area will be seen in the context of existing development along the M74.	The southern extents of this siting area are located within the Leadhills and Lowther Hills SLA, with views of the siting area likely from this SLA due to the relatively flat topography. Views of the northern extents of the siting area are possible from the peripheries of the Douglas Valley SLA, however intervening features including vegetation and landform are likely to screen views from the wider SLA.	This Siting area is not located within any locally designated landscapes however it is directly adjacent to the north-east boundary of the Leadhills and Lowther Hills SLA. While there is potential for visibility of the siting area from the elevated summits within the SLA, visibility from the wider SLA is considered unlikely due to intervening topography surrounding the siting area.	**Substation Siting Areas A** and **C** are not located within areas of local landscape designation
	Visual Amenity	All Siting Areas are located adjacent to the existing ZV route and M74, with visibility likely from this main communications corridor, as well as NCN Route 74 which follows the B7078, A702 and B7076 parallel to the M74 throughout the study area. Visibility of this Siting Area is likely from the settlements of Douglas Water, Lesmahagow, Coalburn Hawksland, Brocketsbrae and Rigside, and the network of nearby core paths within the immediate vicinity. Use of existing forestry for screening of the substation may limit visibility from the settlements to the south-west to south-east of the siting area.	Given intervening features including topography and forestry, visibility of this siting area is considered unlikely from the nearby settlements of Douglas, and the majority of Crawfordjohn, however some visibility may be possible from the north-eastern extents of the settlement. However, visibility is likely from the B740 and B7078 which pass close to the siting area.	Visibility of this Siting Area is likely from the west coast main line railway, which runs roughly parallel to the M74, and the settlement of Elvanfoot to the south-east of the siting area. However, visibility of the siting area in longer-distance views from settlements along the A74, including the settlement of Crawford, are considered unlikely due to intervening topography.	**Substation Siting Areas B** and **C** offer the greatest potential to minimise visual effects upon receptors and offers relatively greater potential opportunities for screening of substation infrastructure.
	Residential Visual Amenity	A cluster of properties located 0.6km south-west of the siting area, scattered properties on Devonburn Road 0.6km north-west of the siting area.	Scattered residential properties are located along the B740 and B7080, and others located within the siting area and the immediate surrounding area, including those at Redshaw,	A number of residential properties are located to the south-east of the siting area, primarily comprising properties at Elvanfoot situated along the A702. Visibility may be possible from isolated	**Substation Siting Area B** is located in proximity to the fewest residential properties.

Appraisal Criteria	Sub-Criteria	Substation Siting Area A (Approximate area: 336.6 hectares)	Substation Siting Area B (Approximate area: 478.2 hectares)	Substation Siting Area C (Approximate area: 129.9 hectares)	Appraisal Summary - Criteria
			Thirstone Quarry, Blackburn, The Strand and Netherton Farm.	residential properties at North Shortcleugh and South Shortcleugh along the corridor of the B7040.	
Cultural Heritage	Scheduled Monuments (See **Figure 4.5c**)	There are no Scheduled Monuments within or in proximity to Substation Siting Area A.	Substation Siting Area B encompasses the Thirstone stone circle 1300m NNW of (SM5094). Whilst this could be avoided, effects on its setting may influence substation siting and design.	The Collins Burn, enclosure 750m NW of Elvanfoot Bridge (SM4527) are located within the Substation Siting Area as well as the Glengeith, settlement, bastle house and field system (SM4798) which is partially located within the southern extent of the Siting Area. Whilst these could be avoided, effects on the setting of these Scheduled Monuments may influence substation siting and design.	There are no Scheduled Monuments within **Substation Siting Area A.**
	Listed Buildings (See **Figure 4.5c**)	There are no Listed Buildings within the Substation Siting Area. There are three Category B listed buildings within the vicinity of the Substation Siting Area and effects on their setting may influence substation siting and design.	There are no listed buildings within the substation siting area.		There are no Listed Buildings within **Substation Siting Area B** and **C.**
Flood Risk	Flood Zones and Waterbodies (1/1000 year flood risk) (See **Figure 4.5c**)	There are a number of small areas of flood risk within the Substation Siting Area which may experience surface water flooding. These areas can be avoided through substation siting and design.	There are no areas of 1/1000yr within the Substation Siting Area.	In the south of Substation Siting Area C, there is a large area of 1/1000yr flood risk. This can be avoided through substation siting and design.	**Substation Siting Area B** has no areas of 1/1000yr flood risk.
Forestry	Commercial Woodland (NFI), Ancient Woodland (AWI) and Semi Natural Woodland (NWSS) (See **Figure 4.5c**)	There are areas of commercial woodland within the Substation Siting Area however there are opportunities to avoid these through substation siting and design.	There are no areas of commercial, ancient or semi natural woodland within Substation Siting Area B.	There are no areas of commercial woodland or ancient woodland within the Substation Siting Area. A small area of semi natural woodland is located within the south of the Siting Area however this can be avoided during substation siting and design	There is no woodland located within **Substation Siting Area B.**
Land Use	Existing, Committed and Potential Future Development (e.g. Mineral extraction, wind farms) (See **Figure 4.5c**)	The Substation Siting Area is located within the previously worked Broken Cross Muir opencast site. The proposed Broken Cross Wind Farm (scoping stage) is located within the Substation Siting Area. These areas of committed development could not be avoided at siting and design stage.	There are a number of past mineral workings sites located within the Substation Siting Area (from OS), in addition to an 'in-use' quarry located in the south-eastern portion of the site.	The existing Elvanfoot electricity substation, and National Grid gas substation is located in the south-west corner of the siting area.	Committed development will require to be considered at the detailed siting and design stage.
Technical Considerations	Topography & Slope (≥ 22 degrees) Access (motorway, A and B roads)	Past and current mineral extraction works have created some steep slopes in the south-eastern extents of the siting area.	The topography of this siting area is relatively flat in the central extents, and gently rolling, sloping upwards towards Wildshaw Hill (349m AOD) in	The topography of this siting area is relatively flat, with rolling topography beyond the north-west to south-west siting area boundary.	The topography of **Substation Siting Areas B** and **C** are relatively flat and both have good access opportunities.

Appraisal Criteria	Sub-Criteria	Substation Siting Area A (Approximate area: 336.6 hectares)	Substation Siting Area B (Approximate area: 478.2 hectares)	Substation Siting Area C (Approximate area: 129.9 hectares)	Appraisal Summary - Criteria
		The siting area is immediately adjacent to the north of the M74 and the B7078.	the north-western extents of the siting area. The siting area is located in between the M74 and the B7078.	The siting area includes sections of the A702 and B7040 and is in proximity to the M74.	
	Other Technical Constraints	No other technical constraints of relevance have been identified for these Substation Siting Areas.		The National Grid gas substation and gas pipeline network, and other Ethylene pipelines are located within this Substation Siting Area and may form a key constraint to substation siting, however some limited opportunities may exist to avoid these areas during substation siting and design.	**Substation Siting Area A** and **B** are unlikely to be constrained by other technical constraints known at this stage of the study.

Glenmuckloch to ZV 400kV Optioneering Study

Figure 4.1: Overhead Line Study Area and Substation Siting Study Area

Coalburn

Elvanfoot

Overhead Line Study Area

Substation

Proposed Glenmuckloch Substation

Substation Study Area

500m

1km

2km

Transmission Network

132kV Overhead Line

400kV Overhead Line

Topography

High

Low

0 5 10 km

Map Scale @A3: 1:150,000

CB:MNi EB:Nicholson_M LUC FIG4-1_10610_r1_StudyArea_A3L 02/07/2019

Source: OS, LUC, SPEN

Glenmuckloch to ZV 400kV Optioneering Study

Figure 4.2: Areas of Highest Environmental Value & Technical Constraints

- Overhead Line Study Area
- Substation
- Proposed Glenmuckloch Substation

Substation Study Area

- 500m
- 1km
- 2km

Technical Constraints

- 132kV Overhead Line
- 400kV Overhead Line
- Wind Turbine
- Turbine 1.5x tip height buffer
- Settlements
- Residential Property 150m Buffer*
- Slope > 22 degrees

Flood Risk Zone

- 1 in 1000 year Flood Risk Area*

Cultural Heritage

- Category B Listed Building*
- Garden and Designed Landscape
- Scheduled Monument

Natural Heritage

- Site of Special Scientific Interest (SSSI)
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Ancient Woodland Inventory (AWI)*

Topography (m)

- High
- Low

Source: OS, LUC, SPEN, SNH, SEPA

* within the Substation Study Area only

LUC

Map Scale @A0: 1:55,000

260000 270000 280000 290000 300000 310000

640000 630000 620000 610000

0 10 20 km

Glenmuckloch to ZV 400kV Optioneering Study

Figure 4.3: Strategic Corridor Options and Substation Search Areas

- Overhead Line Study Area
- Substation
- Proposed Glenmuckloch Substation

Substation Study Area

- 500m
- 1km
- 2km
- Strategic Corridor Options
- Substation Search Areas

Technical Constraints

- 132kV Overhead Line
- 400kV Overhead Line
- Wind Turbine
- Turbine 1.5x tip height buffer
- Settlements
- Residential Property 150m Buffer*

Source: OS, LUC, SPEN, SNH, SEPA

* within the Substation Study Area only

- Slope > 22 degrees

Flood Risk Zone

- 1 in 1000 year Flood Risk Area*

Cultural Heritage

- Category B Listed Building*
- Garden and Designed Landscape
- Scheduled Monument

Natural Heritage

- Site of Special Scientific Interest (SSSI)
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Ancient Woodland Inventory (AWI)*

Topography (m)

- High
- Low

LUC

Map Scale @A0: 1:55,000

0 10 20 km

Glenmuckloch to ZV 400kV Optioneering Study

Figure 4.4: Broad Corridor Options and Substation Siting Areas

- Overhead Line Study Area
- Substation
- Proposed Glenmuckloch Substation
- 132kV Overhead Line
- 400kV Overhead Line

Substation Study Area
- 500m
- 1km
- 2km
- Substation Siting Areas

Broad Corridor Options
- 1A
- 1B
- 2A
- 2B
- 3A
- 3B

Topography (m)
- High
- Low

Source: OS, LUC, SPEN

LUC

Map Scale @A0: 1:55,000

Coalburn
A
B
C
Elvanfoot
1A
1B
1A & 1B
1B, 2A, 2B & 3A
2A & 2B
2B & 3B
3A & 3B
NEWMILNS
DARVEL
CUMNOCK
SANQUHAR
CARSPHAIRN FOREST
Airds Moss
LOWTHER HILLS
260000
270000
280000
290000
300000
310000
640000
630000
620000
610000
0
10
20
km

Glenmuckloch to ZV 400kV Optioneering Study

Figure 4.5a: Landscape Character Types, Locally Designated Landscapes and Susceptibility

- Overhead Line Study Area
- Substation
- Proposed Glenmuckloch Substation
- 132kV Overhead Line
- 400kV Overhead Line
- Locally Designated Landscapes
- Substation Siting Areas

Broad Corridor Options

- 1A
- 1B
- 2A
- 2B
- 3A
- 3B

LCA Landscape Susceptibility

- Higher
- Medium
- Lower

Landscape Character Type (LCT)

- LCT
- 66: Agricultural Lowlands - Ayrshire
- 68: Lowland River Valleys - Ayrshire
- 69: Upland River Valleys - Ayrshire
- 74: Upland Basin - Ayrshire
- 78: Plateau Moorland - Ayrshire
- 81: Southern Uplands - Ayrshire
- 165: Upper Dale - Dumfries & Galloway
- 166: Upland Glens - Dumfries & Galloway
- 175: Foothills - Dumfries & Galloway
- 177: Southern Uplands - Dumfries & Galloway
- 178: Southern Uplands with Forest - Dumfries & Galloway
- 201: Plateau Farmland - Glasgow & Clyde Valley
- 207: Upland River Valley - Glasgow & Clyde Valley
- 208: Broad Valley Upland
- 209: Upland Glen - Glasgow & Clyde Valley
- 210: Undulating Farmland and Hills
- 213: Plateau Moorlands - Glasgow & Clyde Valley
- 217: Southern Uplands - Glasgow & Clyde Valley
- 218: Rounded Landmark Hills

Source: OS, LUC, SPEN

LUC

Map Scale @A0: 1:55,000

Coalburn

Elvanfoot

A

B

C

East Ayrshire Sensitive Landscape Area

Douglas Valley Special Landscape Area

Middle Clyde Valley Special Landscape Area

Upper Clyde Valley and Tinto Special Landscape Area

Lead Hills and Lowther Hills Special Landscape Area

Thornhill Uplands Regional Scenic Area

Moffat Hills Regional Scenic Area

Sensitive Landscape Area

NEWMILNS

DARVEL

CALSTON

CUMNOCK

SANQUHAR

CARSPHAIRN FOREST

260000 270000 280000 290000 300000 310000

640000 630000 620000 610000

0 10 20 km

Glenmuckloch to ZV 400kV Optioneering Study

Figure 4.5b: Other Environmental Considerations

- Overhead Line Study Area
- Substation
- Proposed Glenmuckloch Substation

Substation Study Area

- 500m
- 1km
- 2km
- Substation Siting Areas

Broad Corridor Options

- 1A
- 1B
- 2A
- 2B
- 3A
- 3B

Forestry

- National Forest Inventory
- Native Woodland Survey of Scotland
- Ancient Woodland Inventory (AWI)

Technical Constraints

- 132kV Overhead Line
- 400kV Overhead Line
- Mineral Site
- Slope > 22 degrees
- Residential Property 150m Buffer

Wind Farm Status

- Operational
- Under Construction
- Consented
- Application Submitted
- Design/Scoping
- Turbine 1.5x tip height buffer

Flood Risk Zone

- 1 in 1000 year Flood Risk Area*

Cultural Heritage

- Category B Listed Building*
- Scheduled Monument
- ConservationArea

Natural Heritage

- Site of Special Scientific Interest (SSSI)
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- SPA 2km Trigger for Consideration Buffer
- Peatland Category 1*

Source: OS, LUC, SPEN, SNH, SEPA, FCS

* within the Substation Study Area only

LUC

Map Scale @A0: 1:55,000

0 10 20 km

Glenmuckloch to ZV 400kV Optioneering Study

Figure 4.5c: Other Environmental Considerations - Substation Siting Areas

- Overhead Line Study Area
- Substation
- Substation Siting Areas

Broad Corridor Options

- 1A
- 1B
- 2A
- 2B
- 3A
- 3B

Technical Constraints

- 132kV Overhead Line
- 400kV Overhead Line
- Gas Pipeline
- Ethelyne Pipeline
- Slope > 22 degrees

Wind Farm Status

- Operational
- Consented
- Application Submitted
- Design/Scoping
- Turbine 1.5x tip height buffer

* within the Substation Study Area only

- Mineral Site
- Residential Property 150m Buffer

Cultural Heritage

- Category B Listed Building*
- Scheduled Monument
- ConservationArea

Natural Heritage

- Site of Special Scientific Interest (SSSI)
- Special Area of Conservation (SAC)
- SPA 2km Trigger for Consideration Buffer
- Special Protection Area (SPA)
- Peatland Category 1*

Flood Risk Zone

- 1 in 1000 year Flood Risk Area*

Forestry

- National Forest Inventory
- Native Woodland Survey of Scotland
- Ancient Woodland Inventory (AWI)

LUC

Source: LUC, SPEN, SNH, SEPA, FCS

Map Scale @A3: 1:62,000

0 2.5 5 km

North Lowther Energy Initiative (NLEI)

CB:MNi EB:Nicholson_M LUC FIG4-5c_10610_r2_OtherEnv_SSA_A3P 02/07/2019

5 Strategic Summary

v. **Summary of Strategic Optioneering and Appraisal**: overview of potential constraints and opportunities in relation to progression of each Substation Siting Area and Broad Corridor Option to the routeing/siting stage.

5.1 As set out in **Section 1**, this Section presents an overview of the potential constraints and opportunities in relation to progression of the substation siting areas and broad corridor options to the routeing and siting stage. The identification of potential constraints and opportunities is based on the findings of the desk and field based work undertaken to inform professional judgments made as part of the appraisal process. At this stage allocation of characteristics as either a 'constraint' or 'opportunity' is based on professional judgment using information gathered at this strategic scale and may be modified during later stages as more site specific information is gathered.

5.2 An overview of the potential constraints and opportunities for each substation siting area and broad corridor option is presented in **Table 5.1** and **Table 5.2** below.

Table 5.1: Substation Siting Areas

Substation Siting Area	Potential Opportunity	Potential Constraint
Substation Siting Area A	• No priority peatlands or designated sites (biodiversity) located within the Substation Siting Area • No scheduled monuments or listed buildings[16] (cultural heritage) • Woodland can be avoided (forestry) • Not located within area of landscape designation (locally designated landscapes) • Relatively small number of residential properties located within the immediate vicinity of the Substation Siting Area (residential visual amenity) • Good access opportunities (technical)	• Located within area of medium landscape susceptibility (landscape susceptibility) • Located in close proximity to B7078 and M74, including the route of the NCN 74 but with potential opportunities for screening (visual amenity) • Number of small flood risk areas in the Substation Siting Area (flood risk) • Presence of previously worked opencast mineral extraction and potential future wind farm development within Substation Siting Area (land use) • Variations in topography due to previous mineral workings (technical)
Substation Siting Area B	• No priority peatlands or designated sites (biodiversity) located within the Substation Siting Area • Located within area of lower landscape susceptibility (landscape susceptibility) • Substation siting area located relatively remote of residential properties (residential visual amenity) • No listed buildings (cultural heritage)	• South-eastern extent of Substation Siting Area located in Leadhills and Lowther Hills Special Landscape Area (locally designated landscapes) • Located in close proximity to M74 and B7078, including the route of the NCN 74 but with potential opportunities for mitigation (visual amenity) • Scheduled monument located in

[16] Three are located within the vicinity of the Substation Siting Area.

	• No flood risk areas in Substation Siting Area (flood risk) • Woodland can be avoided (forestry) • Relatively flat topography (land use) • Good access opportunities (technical)	Substation Siting Area (cultural heritage) • A number of previously worked mineral sites within the Substation Siting Area (land use)
Substation Siting Area C	• No listed buildings (cultural heritage) • Woodland can be avoided (forestry) • Relatively flat topography (technical) • Not located within area of landscape designation (locally designated landscapes) • Relatively small number of residential properties located within the immediate vicinity of the Substation Siting Area (residential visual amenity) • Good access opportunities (technical)	• Large area of priority peatland located within the Substation Siting Area (biodiversity) • Located within area of medium landscape susceptibility (landscape susceptibility) • A number of scheduled monuments are located within the Substation Siting Area (cultural heritage) • Flood risk area in Substation Siting Area (flood risk) • Presence of Elvanfoot substation within Substation Siting Area (land use)[17] • Presence of National Grid Gas substation and pipelines within Substation Siting Area (technical)

Table 5.2: Broad Corridor Options

Broad Corridor Option	Potential Opportunity	Potential Constraint
Broad Corridor 1a (Approximate length: 49.9km)	• Opportunities to avoid scheduled monuments and conservation areas (cultural heritage) • Opportunity to avoid ancient and semi-natural woodland (forestry) • Corridor includes landscapes of lower or medium susceptibility (landscape susceptibility) • The corridor generally follows the broad river valleys of the Upper Nith and Ayr Valley, before passing over higher but simple landform of the Plateau Moorlands, and generally displays limited topographic variance and complexity (topography) • Relatively good access options (technical)	• Presence of SAC and proximity to ornithological trigger for consideration zone of SPA (biodiversity) • Loss of commercial woodland (forestry) • Presence of minerals and wind farms (land use) • Corridor includes areas of the East Ayrshire Sensitive Landscape Area which could not be avoided through routeing (locally designated landscapes) • The presence of the settlements of New Cumnock and Muirkirk, and the A70 road corridor within the Ayr Valley (visual amenity) • The relatively dense distribution of residential properties within the Ayr Valley (residential visual amenity)
Broad Corridor 1b (Approximate length: 44.5km)	• Opportunities to avoid scheduled monuments and conservation areas (cultural heritage) • Opportunity to avoid ancient, semi-natural and commercial woodland (forestry) • Corridor includes landscapes of lower	• Presence of SAC and proximity to ornithological trigger for consideration zone of SPA (biodiversity) • Presence of minerals and wind farms (land use) • Corridor includes areas of the East Ayrshire Sensitive Landscape Area and

[17] May also be considered an opportunity.

	or medium susceptibility (landscape susceptibility) • The corridor follows the broad river valleys of the Upper Nith and Ayr Valley, before passing through the Douglas Valley and valley of Glespin Burn, and generally displays limited topographic variance and complexity (topography) • Relatively good access options (technical)	Douglas Valley SLA, however the latter could not be avoided through routeing (locally designated landscapes) • The presence of the settlements of New Cumnock and Muirkirk, and the A70 road corridor within the Ayr Valley (visual amenity) The relatively dense distribution of residential properties within the Ayr Valley (residential visual amenity)
Broad Corridor 2a (Approximate length: 24.1km)	• Opportunities to avoid scheduled monuments and conservation areas (cultural heritage) • Opportunity to avoid ancient and semi-natural woodland (forestry) • Corridor includes LCTs generally judged to be of lower susceptibility (landscape susceptibility) • Corridor includes presence of Douglas Valley SLA, however opportunities exist to avoid this through routeing (locally designated landscapes) • Corridor offers opportunities to avoid settlements and major communication routes (visual amenity) • The corridor contains a relatively small number of isolated residential properties/farmsteads (residential visual amenity) • The corridor crosses relatively high ground but generally displays limited topographic variance, and complexity (topography)	• Presence of SAC and proximity to ornithological trigger for consideration zone of SPA (biodiversity) • Potential loss of extensive areas of commercial woodland (forestry) • Presence of minerals and wind farms (land use) • Remote from access options along majority of its length (technical)
Broad Corridor 2b (Approximate length: 33.9km)	• Opportunities to avoid scheduled monuments and conservation areas (cultural heritage) • Opportunity to avoid ancient and semi-natural woodland (forestry) • Corridor includes LCTs generally judged to be of lower susceptibility, whilst avoiding landscapes of higher susceptibility (landscape susceptibility) • The corridor contains a relatively small number of isolated residential properties/farmsteads (residential visual amenity)	• Proximity to ornithological trigger for consideration zone of SPA (biodiversity). • Loss of extensive areas of commercial woodland (forestry) • Presence of minerals and wind farms (land use) • Corridor includes presence of Douglas Valley SLA and Leadhills and Lowther Hills SLA, the latter of which cannot be avoided through routeing (locally designated landscapes) • Corridor offers opportunities to avoid most settlements and major communication routes, but would pass the settlement of Crawfordjohn and Crawford (visual amenity) • The corridor crosses relatively high ground and generally displays limited topographic variance and complexity, however at its southern extent crosses more complex topography on

		approaching Elvanfoot (topography) • Remote from access options along majority of its length (technical)
Broad Corridor 3a (Approximate length: 28.5km)	• Opportunities to avoid ornithological trigger for consideration zone of SPA (biodiversity) • Opportunity to avoid ancient, semi-natural and commercial woodland (forestry) • Potential to avoid minerals and wind farms (land use) • Relatively good access options (technical)	• Presence of SAC/SSSI (biodiversity) • Proximity to scheduled monument and conservation area (cultural heritage) • Corridor generally includes landscapes judged to be of medium susceptibility, but also crosses the Southern Uplands LCT judged to be of higher landscape susceptibility (landscape susceptibility) • Corridor includes presence of Thornhill Uplands RSA and Leadhills and Lowther Hills SLA, the latter of which cannot be avoided through routeing (locally designated landscapes) • Corridor passes the settlements of Kirkconnel and Sanquhar within the Upper Nith Valley, and the regionally promoted Southern Upland Way (visual amenity) • Scattered properties are found along the Upper Nith Valley and the corridor of the B740, however the central extents of the corridor are generally sparsely populated (residential visual amenity) • Corridor crosses topography/ landform of relatively great complexity with concentrated areas of steep slope which would be challenging to routeing (topography)
Broad Corridor 3b (Approximate length: 34.3km)	• Opportunities to avoid ornithological trigger for consideration zone of SPA (biodiversity) • Opportunity to avoid ancient, semi-natural and commercial woodland (forestry) • Potential to avoid minerals and wind farms (land use) • Relatively good access options (technical)	• Presence of SAC/SSSI (biodiversity). • Proximity to scheduled monument and conservation area (cultural heritage) • Corridor generally includes landscapes judged to be of medium susceptibility, but also crosses the Southern Uplands LCT judged to be of higher landscape susceptibility (landscape susceptibility) • Corridor includes presence of Thornhill Uplands RSA and Leadhills and Lowther Hills SLA, the latter of which cannot be avoided through routeing (locally designated landscapes) • Corridor passes the settlements of Kirkconnel and Sanquhar within the Upper Nith Valley, and the regionally promoted Southern Upland Way (visual amenity) • Scattered properties are found along the Upper Nith Valley and the corridor of the B740, however the central extents of the corridor are generally sparsely populated (residential visual amenity) • Corridor crosses topography/ landform of relatively great complexity with concentrated areas of steep slope which

		would be challenging to routeing (topography)

Appendix 1
Holford Rules & Horlock Rules

The Holford Rules: Guidelines for the Routeing of New High Voltage Overhead Transmission Lines (with NGC 1992 and SHETL 2003 Notes)

It is generally accepted across the electricity industry that the guidelines developed by the late Lord Holford in 1959 for routeing overhead transmission lines, 'The Holford Rules', should continue to be employed as the basis for routeing high voltage overhead transmission lines. The Holford Rules were reviewed circa 1992 by the National Grid Company (NGC) Plc. (now National Grid Transmission (NGT)) as owner and operator of the electricity transmission network in England and Wales, with notes of clarification added to update the Rules.

A subsequent review of the Holford Rules (and NGC clarification notes) was undertaken by Scottish Hydro Electric Transmission Limited (SHETL) in 2003 to reflect Scottish circumstances. The principles of these guidelines for the routeing of new high voltage overhead transmission lines, with the NGC 1992 and SHETL 2003 notes have been considered within this Strategic Environmental Review. The Holford Rules are detailed below.

Rule 1

Avoid altogether, if possible, the major areas of highest amenity value, by so planning the general route of the line in the first place, even if the total mileage is somewhat increased in consequence.

Note on Rule 1

a) Investigate the possibility of alternative routes, avoiding altogether, if possible major areas of highest amenity value. The consideration of alternative routes must be an integral feature of environmental statements. If there is an existing transmission line through a major area of highest amenity value and the surrounding land use has to some extent adjusted to its presence, particularly in the case of commercial forestry, then effect of remaining on this route must be considered in terms of the effect of a new route avoiding the area.

b) Areas of highest amenity value require to be established on a project-by-project basis considering Schedule 9 to The Electricity Act 1989, Scottish Planning Policies, National Planning Policy Guidelines[18], Circulars and Planning Advice Notes and the spatial extent of areas identified.

Examples of areas of highest amenity value which should be considered are:

Special Area of Conservation (NPPG 14)[19]

Special Protection Area (NPPG 14)[20]

Ramsar Site (NPPG 14)[21]

National Scenic Areas (NPPG 14)[22]

National Parks (NPPG 14)[23]

National Nature Reserves (NPPG 14)[24]

Protected Coastal Zone Designations (NPPG 13)[25]

Sites of Special Scientific Interest (SSSI) (NPPG 14)[26]

Schedule of Ancient Monuments (NPPG 5)[27]

[18] The National Policy Guidelines ("NPPG") have been superseded by the Scottish Planning Policy ("SPP") published on the 23rd of June 2014. The reference to the relevant equivalent paragraph of the SPP are noted.
[19] Now noted in SPP paragraph 207.
[20] Now noted in SPP paragraph 207.
[21] Now noted in SPP paragraph 211.
[22] Now noted in SPP paragraph 212.
[23] Now noted in SPP paragraph 212.
[24] Now noted in SPP paragraph 212.
[25] Now noted in SPP paragraph 87.
[26] Now noted in SPP paragraphs 211-212.
[27] Now noted in SPP paragraph 145.

Listed Buildings (NPPG 18)[28]

Conservation Areas (NPPG 18)[29]

World Heritage Sites (a non-statutory designation) (NPPG 18)[30]

Historic Gardens and Designed Landscapes (a non-statutory designation) (NPPG 18)[31]

Rule 2

Avoid smaller areas of high amenity value, or scientific interest by deviation; provided that this can be done without using too many angle towers, i.e. the more massive structures which are used when lines change direction.

Note on Rule 2

a) Small areas of highest amenity value not included in Rule 1 as a result of their spatial extent should be identified along with other areas of regional or local high amenity value identified from development plans.

b) Impacts on the setting of historic buildings and other cultural heritage features should be minimised.

c) If there is an existing transmission line through an area of high amenity value and the surrounding landuses have to some extent adjusted to its presence, particularly in the case of commercial forestry, then the effect of remaining on this line must be considered in terms of the effect of a new route deviating around the area.

Rule 3

Other things being equal, choose the most direct line, with no sharp changes of direction and thus with few angle towers.

Note on Rule 3

a) Where possible choose inconspicuous locations for angle towers, terminal towers and sealing end compounds.

b) Too few angles on flat landscape can also lead to visual intrusion through very long straight lines of towers, particularly when seen nearly along the line.

Rule 4

Choose tree and hill backgrounds in preference to sky backgrounds, wherever possible; and when the line has to cross a ridge, secure this opaque background as long as possible and cross obliquely when a dip in the ridge provides an opportunity. Where it does not, cross directly, preferably between belts of trees.

Rule 5

Prefer moderately open valleys with woods where the apparent height of towers will be reduced, and views of the line will be broken by trees.

Notes on Rules 4 and 5

a) Utilise background and foreground features to reduce the apparent height and domination of towers from main viewpoints.

b) Minimise the exposure of numbers of towers on prominent ridges and skylines.

c) Where possible follow open space and run alongside, not through woodland or commercial forestry, and consider opportunities for skirting edges of copses and woods. Where there is no reasonable alternative to cutting through woodland or commercial forestry, the Forestry

[28] Now noted in SPP paragraph 141.
[29] Now noted in SPP paragraph 143.
[30] Now noted in SPP paragraph 147.
[31] Now noted in SPP paragraph 148.

Commission Guidelines should be followed (Forest Landscape Design Guidelines, second edition, The Forestry Commission 1994 and Forest Design Planning – A Guide to Good Practice, Simon Bell/The Forest Authority 1998).

d) Protect existing vegetation, including woodland and hedgerows, and safeguard visual and ecological links with the surrounding landscape.

Rule 6

In country which is flat and sparsely planted, keep the high voltage lines as far as possible independent of smaller lines, converging routes, distribution poles and other masts, wires and cables, so as to avoid a concatenation or 'wirescape'.

Note on Rule 6

a) In all locations minimise confusing appearance.

b) Arrange wherever practicable that parallel or closely related routes are planned with tower types, spans and conductors forming a coherent appearance. Where routes need to diverge allow, where practicable, sufficient separation to limit the impacts on properties and features between lines.

Rule 7

Approach urban areas through industrial zones, where they exist; and when pleasant residential and recreational land intervenes between the approach line and the substation, go carefully into the comparative costs of undergrounding, for lines other than those of the highest voltage.

Note on Rule 7

a) When a line needs to pass through a development area, route it so as to minimise as far as possible the effect on development.

b) Alignments should be chosen after consideration of impacts on the amenity of existing development and on proposals for new development.

c) When siting substations take account of the impacts of the terminal towers and line connections that will need to be made and take advantage of screening features such as ground form and vegetation.

Explanatory Note on Rule 7

The assumption made in Rule 7 is that the highest voltage line is overhead.

Supplementary Notes

a) Residential Areas

Avoid routeing close to residential areas as far as possible on grounds of general amenity.

b) Designations of Regional and Local Importance

Where possible choose routes which cause the least disturbance to Areas of Great Landscape Value and other similar designations of Regional or Local Importance.

c) Alternative Lattice Steel Tower Designs

In addition to adopting appropriate routeing, evaluate where appropriate the use of alternative lattice steel tower designs available where these would be advantageous visually, and where the extra cost can be justified. [*Note: SHETL have reviewed the visual and landscape arguments for the use of lattice steel towers in Scotland and summarised these in a document entitled Overhead Transmission Line Tower Study 2004*].

FURTHER NOTES ON CLARIFICATION TO THE HOLFORD RULES

Line Routeing and People

The Holford Rules focused on landscape amenity issues for the most part. However, line routeing practice has given greater importance to people, residential areas etc.

The following notes are intended to reflect this.

a) Avoid routeing close to residential areas as far as possible on grounds of general amenity.

b) In rural areas avoid as far as possible dominating isolated house, farms or other small-scale settlements.

c) Minimise the visual effect perceived by users of roads, and public rights of way, paying particular attention to the effects of recreational, tourist and other well used routes.

Supplementary Notes on the Siting of Substations

a) Respect areas of high amenity value (see Rule 1) and take advantage of the containment of natural features such as woodland, fitting in with the landscape character of the area.

b) Take advantage of ground form with the appropriate use of site layout and levels to avoid intrusion into surrounding areas.

c) Use space effectively to limit the area required for development, minimizing the impacts on existing land use and rights of way.

d) Alternative designs of substation may also be considered, e.g. 'enclosed', rather than 'open', where additional cost can be justified.

e) Consider the relationship of tower and substation structures with background and foreground features, to reduce the prominence of structures from main viewpoints.

f) When siting substations take account of the impacts of line connections that will need to be made.

APPENDIX A

INTERPRETATION OF THE HOLFORD RULES 1 AND 2 AND THE NOTES TO RULE 2 REGARDING THE SETTING OF A SCHEDULED ANCIENT MONUMENT OR A LISTED BUILDING

1 Interpretation of The Holford Rules 1 and 2

1.1 Introduction

Rules 1 refers to avoiding major areas of highest amenity value, Rule 2 refers to avoiding smaller areas of high amenity value. These rules therefore require identification of areas of amenity value in terms of highest and high, implying a hierarchy, and the extent of their size(s) or area(s) in terms of major and smaller areas.

The NGC Notes to these Rules identify at Rule 1(b) areas of highest amenity value and at Rule 2(a) and (b) of high amenity value that existed in England circa 1992.

1.2 Designations

Since 1949 a framework of statutory measures has been developed to safeguard areas of high landscape value and nature conservation interest. In addition to national designations, European Community Directives on nature conservation, most notably through Special Areas of Conservation under the Habitats and Species Directive (92/43/EC) and Special Protection Areas under the Conservation of Wild Birds Directive (79/409/EEC) have been implemented. Governments have also designated a number of Ramsar sites under the Ramsar Convention on wetlands of International Importance (CM6464). Scottish Office circulars 13/1991 and 6/1995 are relevant sources of information and guidance. In addition, a wide range of non-statutory landscape and nature conservation designations affect Scotland.

1.3 Amenity

The term 'Amenity' is not defined in The Holford Rules but has generally been interpreted as designated areas of scenic, landscape, nature conservation, scientific, architectural or historical interest.

This interpretation is supported by paragraph 3 of the Schedule 9 to the electricity Act 1989 (The Act). Paragraph 3 (1)(a) requires that in formulating any relevant proposals the licence holder must have regard to the desirability of preserving natural beauty, or conserving flora, fauna and geological or physiological features of special interest and of protecting sites, buildings, including structures and objects of architectural, historic or archaeological interest. Paragraph 3 (1)(b) requires the license holder to do what he reasonably can do to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any flora, fauna, features, sites, buildings or objects.

1.4 Hierarchy of Amenity Value

Rules 1 and 2 imply a hierarchy of amenity value from highest to high.

Schedule 9 to the Act gives no indication of hierarchy of value and there is no suggestion of a hierarchy of value in either NPPG5: Archaeology and Planning, NPPG 13: Coastal Planning, NPPG 14: Natural Heritage or NPPG 18: Planning and the Historic Environment. Nevertheless, designations give an indication of the level of importance of the interest to be safeguarded.

1.5 Major and Smaller Areas

Rules 1 and 2 imply consideration of the spatial extent of the area of amenity in the application of Rules 1 and 2.

1.6 Conclusion

Given that both the spatial extent in terms of major and smaller and the amenity value in terms of highest and high that must be considered in applying Rules 1 and 2, that no value in these terms is provided by either Schedule 9 to the Act, relevant Scottish Planning Policies or National Planning policy Guidelines, then these must be established on a project-by-project basis. Designations can be useful in giving an indication of the level of importance and thus value of the interest safeguarded. The note to The Holford Rules can thus only give examples of the designations which may be considered to be of the highest amenity value.

2. The setting of a Scheduled Ancient Monument or a Listed Building

The NGC note to Rule 2 refers to the setting of historic buildings and other cultural heritage features. NPPG 5: Archaeology and Planning refers to the setting of scheduled ancient monuments and NPPG 18: Planning and the Historic Environment refers to the setting Listed Buildings. None of these documents define setting.

APPENDIX B

ENVIRONMENTAL AND PLANNING DESIGNATIONS – EXAMPLES OF DESIGNATIONS TO BE TAKEN INTO ACCOUND IN THE ROUTEING OF NEW HIGH VOLTAGE TRANSMISSION LINES

Major Areas of Highest Amenity Value

1 In Scotland relevant national or international designations for major areas of highest amenity value include the following identified from Scottish Planning Policies and National Policy Guidelines[32]:

Special Areas of Conservation	(NPPG 14)
Special Protection Areas	(NPPG 14)
Ramsar Sites	(NPPG 14)
National Scenic Areas	(NPPG 14)

[32] See footnotes under Holford Rule 1 (note on Rule 1) for references update.

National Parks	(NPPG 14)
National Nature Reserves	(NPPG 14)
Protected Coastal Zone Designations	(NPPG 13)
Sites of Special Scientific Interest	(NPPG 14)
Scheduled Ancient Monuments	(NPPG 5)
Listed Buildings	(NPPG 18)
Conservation Areas	(NPPG 18)
World Heritage Sites	(NPPG 18)
Historic Gardens and Designated Landscapes	(NPPG 18)

Other Smaller Areas of High Amenity Value

2 There are other designations identified in development plans of local planning authorities which include areas of high amenity value:

Areas of Great Landscape Value

Regional Scenic Areas

Regional Parks

Country Parks

The nature of the landscape in these areas is such that some parts may also be sensitive to intrusion by high voltage overhead transmission lines but it is likely that less weight would be given to these areas than to National Scenic Areas and National Parks.

Flora and Fauna

3 Legislation sets out the procedure for designation of areas relating to flora, fauna and to geographical and physiogeographical features. Designations relevant to the routeing of transmission lines will include Special Area of Conservation, Special Protection Area, Sites of Special Scientific Interest, National Nature Reserves, Ramsar Sites and may also include local designations such as Local Nature Reserve.

Area of Historic, Archaeological or Architectural Value

4 Certain designations covering more limited areas are of relevance to the protection of views and the settings of towns, villages, buildings or historic, archaeological or architectural value. These designations include features which may be of exceptional interest. Of particular importance in this connection are:

Schedule of Ancient Monuments

Listed Buildings, especially Grade A and Grade B

Conservation Areas

Gardens and Designated Landscapes included in the Inventory of Gardens and Designated Landscapes of Scotland

Green Belts

5 Generally the purposes of Green Belts are not directly concerned with the quality of the landscape.

The Horlock Rules: NGC Substations and the Environment: Guidelines on Siting and Design (2006)

THE NATIONAL GRID COMPANY plc.
NGC SUBSTATIONS AND THE ENVIRONMENT: GUIDELINES ON SITING AND DESIGN

Section I INTRODUCTION

1 The National Grid Company plc.'s (NGC's) policy statement on the environment recognises the importance of giving due regard to protecting and enhancing the environment and taking into account the environmental effects of the Company's actions. The Company has statutory duties in relation to preservation of amenity under Schedule 9 of the Electricity Act 1989, and has published a Schedule 9 Statement setting out the manner in which it proposes to meet these duties.

2 NGC has a statutory duty under the Act to develop and maintain an efficient, co-ordinated and economical transmission system of electricity for England and Wales. New transmission lines, new substations, sealing end compounds, line entries, additions and extensions to existing substations may be required to provide new connections for customers or reinforcement of the national grid system arising from changes in the demand for and generation of electricity.

3 This document explains the approach NGC takes towards such developments (Section II) and contains Guidelines (Section III) to assist those responsible for siting and designing substations to mitigate the environmental effects of such developments and so meet the Company's policy. The document complements the Company's Holford Rules guidelines on the routeing of high voltage transmission lines and when appropriate should be used in conjunction with them.

4 The guidelines are to be used by NGC staff, their consultants, and contractors in the siting and design of new substations and extensions to substations. They reflect the criteria the company requires its staff, consultants and contractors to satisfy.

5 As recognised in its Schedule 9 Statement NGC places importance on consultation with statutory planning and amenity bodies over its proposals for new developments. NGC believes that the availability of these guidelines will assist in such discussions by referring to the main considerations relevant to substation siting, and will thereby assist in achieving the most appropriate siting and design solutions.

Section II NGC'S APPROACH TO DESIGN AND SITING OF SUBSTATIONS

Approach to the Environment

6 NGC's environmental policy recognises the importance of giving due regard to protecting and enhancing the environment and taking into account the effect on the environment of all the Company's actions. Following the principle of integrating environmental considerations into all its activities, NGC seeks to keep known adverse effects on the environment to a reasonably practicable minimum and, in accordance with its duties under Schedule 9 of the Electricity Act, the Company gives due regard to the preservation of amenity and takes reasonable steps to mitigate the effects of its relevant proposals. To achieve these aims the Company therefore has to balance technical, economic and environmental considerations to reach reasonably practicable development proposals.

7 The guidelines (Section III) deal with the amenity issues associated with the siting and design of new substations and major extensions or major modifications to existing substations. They cover a range of key issues from the time options are initially considered to final design, including form, silhouette and colour of the entire development in relation to the surrounding area, and also related issues such as overhead line entries, since these are dominant features in any substation.

Environmental Report

8 In order to achieve these objectives, the environmental effects of new substations and extensions or modifications to existing substations will be assessed and where appropriate an

environmental report prepared describing the effects and mitigative measures. Items to be considered are summarised in Appendix A.

Integrating Environmental Considerations into Power System Planning

9 The nature of transmission system planning is such that scheme proposals and options may go through various stages before it is finally decided to proceed with construction.

10 The purpose of each proposal for substation, sealing end compound or line entry development should be set out in a brief, and a range of system and siting options should be evaluated and documented as part of the selection of the preferred solution. In each case the effects of the overall development on the environment should be assessed, prior to a commitment to a particular site or design.

11 When it is clear a project is likely to proceed, an assessment should be made of any additional skills required to deal effectively with the range of environmental, land use, planning and design issues. Consideration should also be given to consultation as soon as reasonably possible with appropriate statutory planning and amenity bodies.

Liaison with other Electricity Companies

12 NGC will encourage and recommend other parties such as power generators or regional electricity companies to adopt these guidelines when working with NGC on proposals for substations, sealing end compounds or line entries.

Post Construction Review

13 Following completion of the project, a review should be undertaken to check that the necessary measures identified in the environmental report have been implemented.

Section III GUIDELINES

Overall System Options and Site Selection

1 In the development of system options including new substations, consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements for new developments against the consequential environmental effects in order to keep adverse effects to a reasonably practicable minimum.

Amenity, Cultural or Scientific Value of Sites

2 The siting of new NGC substations, sealing end compounds and line entries should as far as reasonably practicable seek to avoid altogether internationally and nationally designated areas of the highest amenity, cultural or scientific value by the overall planning of the system connections.

Notes:

1 Internationally and nationally designated areas of highest amenity, cultural or scientific value are:

National Parks;

Areas of Outstanding Natural Beauty; Heritage Coasts;

World Heritage Sites; Ramsar Sites;

Sites of Special Scientific Interest; National Nature Reserves; Special Protection Areas;

Special Areas of Conservation.

2 Care should be taken in relation to all historic sites with statutory protection e.g. Ancient Monuments, Battlefields and Listed Buildings.

3 Account should be taken of Government Planning Policy Guidance and established codes of practice.

4 Account should be taken of any development plan policies relevant to the siting or design of substations.

3 Areas of local amenity value, important existing habitats and landscape features including ancient woodland, historic hedgerows, surface and ground water sources and nature conservation areas should be protected as far as reasonably practicable.

Local Context, Land Use and Site Planning

4 The siting of substations, extensions and associated proposals should take advantage of the screening provided by land form and existing features and the potential use of site layout and levels to keep intrusion into surrounding areas to a reasonably practicable minimum.

Notes:

1 A preliminary study should be undertaken to identify the extent of land required to meet both operational and environmental needs.

In some instances it may be possible to site a substation partially or fully enclosed by existing woodlands.

Topographical information should be obtained at an early stage. In some cases a geotechnical survey may be required.

5 The proposals should keep the visual, noise and other environmental effects to a reasonably practicable minimum.

Notes:

1 Allow sufficient space for screening of views by mounding or planting.

2 Consider appropriate noise attenuation measures where necessary.

3 Use security measures which minimise visual intrusion from lighting.

4 Consider appropriate on-site water pollution prevention measures.

5 Consider adjoining uses and the amenity of local inhabitants.

6 The land use effects of the proposal should be considered when planning the siting of substations or extensions.

Notes:

1 Issues for consideration include potential sterilisation of nationally important land, e.g. Grade 1 agricultural land and sites of nationally scarce minerals.

2 Effects on land drainage.

Design

7 In the design of new substations or line entries, early consideration should be given to the options available for terminal towers, equipment, buildings and ancillary development appropriate to individual locations, seeking to keep effects to a reasonably practicable minimum.

Notes:

1 With outdoor equipment, a preference should be given normally to a low profile design with low height structures and silhouettes appropriate to the background.
2 Use lightweight narrow section materials for taller structures especially for gantries over about 6 metres in height.
3 Commission exterior design and colours appropriate to the surroundings.
4 Materials and colours for buildings, equipment and fencing should be chosen to harmonise with local surroundings.
5 Where possible avoid the use of prominent insulators by consideration of available colours appropriate to the background.

6 Where possible site buildings to act as visual screens for switchgear.

7 Ensure that the design of high voltage and low voltage substations is co-ordinated by early consultation between NGC and its customers.

8 Where there are particular technical or environmental constraints, it may be appropriate to consider the use of Gas Insulated Switchgear (GIS) equipment which occupies less space and is usually enclosed within a building.

9 Early consideration should be given to the routeing of utility service connections.

8 Space should be used effectively to limit the area required for development consistent with appropriate mitigation measures and to minimise the adverse effects on existing land use and rights of way, whilst also having regard to future extension of the substation.

Notes:

1 Assess the benefit of removing redundant substation equipment from existing sites where this would improve their appearance.

9 The design of access roads, perimeter fencing, earthshaping, planting and ancillary development should form an integral part of the site layout and design to fit in with the surroundings.

Line Entries

10 In open landscape especially, high voltage line entries should be kept, as far as possible, visually separate from low voltage lines and other overhead lines so as to avoid a confusing appearance.

11 The inter-relationship between towers and substation structures and background and foreground features should be studied to reduce the prominence of structures from main viewpoints. Where practicable the exposure of terminal towers on prominent ridges should be minimised by siting towers against a background of trees rather than open skylines.

END

APPENDIX A

NGC SUBSTATIONS – ENVIRONMENTAL REPORT

Introduction

All proposals for significant extensions of existing substations or for new substations and associated development should be the subject of an environmental appraisal and an environmental report should be produced. The project manager will be responsible for ensuring that an appropriate appraisal is undertaken and report prepared, with due regard to expert advice available to the team.

For a major development a scoping exercise should be undertaken with the contribution of appropriate skills to establish the range and depth of the appraisal. It will generally be appropriate at this stage to consider consultation with the local planning authority.

A clear distinction should be drawn between the preparation of an environmental report which will be undertaken in most cases and a full environmental statement (ES) which may on occasion be required under UK environmental assessment legislation, for example where the substation forms part of a major new power station for which an ES may be needed.

Recommended Content of Environmental Reports for Substations

Section 1

Information describing the project during construction, when operational and on de-commissioning including:-

1.1 Purpose and physical characteristics of the project, including details of access and transport arrangements and employment.

1.2 Land use requirements and other physical features of the project.

1.3 Operational features of the project and relevant measurements of emissions such as noise, vibration, light, heat and electric and magnetic fields.

1.4 Main alternative sites considered and reasons for final choice.

Section 2

Information describing the site and its environment including:-

2.1 Physical features such as

- Flora and fauna
- Soil: agricultural quality, geology
- Water courses including land drainage generally
- Climatic factors
- Historic heritage and archaeological sites
- Landscape and topography
- Local recreational uses
- Proximity of population and any other relevant environmental features.

2.2 The policy framework

The policy framework including all relevant statutory designations such as national nature reserves, sites of special scientific interest, national parks, areas of outstanding natural beauty, heritage coasts, special protection areas, special areas of conservation, regional parks, country parks, national forest parks, local nature reserves, areas affected by tree preservation orders, water protection zones, minerals protection zones, nitrate sensitive areas, conservation areas, listed buildings, scheduled ancient monuments, and designated areas of archaeological importance. It should also include references to Structure, Unitary and Local plan policies applying to the site and the surrounding area which are relevant to the proposed development as well as to any international designations.

Section 3

Assessment of effects on the surrounding area and landscape including:-

3.1 Visual effects, emissions during normal operation, noise, light, impact on local roads and transport.

3.2 Effects of the development on buildings, the architectural and historic heritage and archaeological features.

3.3 Loss of, and damage to flora, fauna and geology.

3.4 Land use/resource effects such as:

- quality and quantity of agricultural land to be taken

- sterilisation of mineral resources and alternative uses of the site.

3.5 Changes to hydrographic characteristics.

3.6 Air and Climate

3.7 Indirect matters such as traffic (road, rail, air, water) related to the development associated with the project, e.g. new roads, sewers, power lines, pipelines, telecommunications etc.

Section 4

Mitigation measures

4.1 Where significant adverse effects are identified, a description of the measures to be taken to avoid, reduce or remedy those effects, e.g.

a) site planning;

c) technical measures e.g. equipment selection, recycling of waste or redundant parts, pollution control and treatment, containment (e.g. shielding of transformers and bunding)

d) aesthetic and ecological measures e.g. mounding, design, colour, landscaping, tree planting measures to preserve particular habitats or create alternative habitats recording of archaeological sites measures to safeguard historic buildings or sites.

END

Appendix 2

Appraisal of Landscape Susceptibility to Overhead Electricity Transmission Infrastructure

Appraisal of Landscape Susceptibility to Overhead Electricity Transmission Infrastructure

Introduction

Landscape sensitivity is assessed with reference to the existing landscape characteristics and attributes of the landscape. Accordingly, the SNH digital map-based national Landscape Character Assessment (published in 2019)[33] has been used as the basis for determining the susceptibility of Landscape Character Types (LCTs) across the study area. This updated baseline dataset is based on a review of existing regional Landscape Character Assessments (LCAs) produced between 1994 and 1999 and includes updates to the original LCAs taking into account advances in digital technology, development of complementary datasets and changes in development patterns and pressures.

Within the study area, the original regional landscape character assessments include the following:

- Ayrshire Landscape Assessment (1998)[34];
- Dumfries and Galloway Landscape Assessment (1998)[35]; and
- Glasgow and Clyde Valley Character Assessment (1999)[36].

In addition to the above landscape character assessments, relevant landscape capacity studies which cover the extents of the study area were also reviewed. Although these studies relate to wind energy development (wind turbines), due to the vertical nature of transmission infrastructure and the relatively large geographical extents over which both of these types of infrastructure can affect landscape and visual receptors. Reference has been made to the assessed sensitivity[37] of each LCT from the following reports:

- East Ayrshire Landscape Wind Capacity Study (2018)[38];
- Dumfries and Galloway Wind Farm Landscape Capacity Study (2017)[39]; and
- South Lanarkshire Landscape Capacity Study for Wind Energy (2016)[40].

Appraisal of Landscape Susceptibility

Each of the SNH National LCTs (2019) identified within the defined study area is shown on **Figure 4.5a** has been evaluated (400kV L8 steel lattice tower of an average 46m height, and large scale 400/132kV substation infrastructure) and categorised as being of **higher**, **medium** or **lower** susceptibility. Indicators of the relative levels of landscape susceptibility to accommodate OHL development are detailed in the table below.

[33] https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/scottish-landscape-character-types-map-and-descriptions

[34] Land Use Consultants 1998. Ayrshire landscape assessment. Scottish Natural Heritage Review No 111.

[35] Land Use Consultants 1998. Dumfries and Galloway landscape assessment. Scottish Natural Heritage Review No 94.

[36] Land Use Consultants 1999. Glasgow and the Clyde Valley landscape assessment. Scottish Natural Heritage Review No 116. Note: Landscape character types for the South Lanarkshire area were updated in the South Lanarkshire Landscape Character Assessment (2010).

[37] 'Sensitivity' is defined here in accordance with the first component only of Paragraph 3.24 of GLVIA 3 namely: "the susceptibility of the receptor to the type of change arising from the specific proposal…"

[38] East Ayrshire Council (2018). East Ayrshire Local Development Plan, Non-statutory Planning Guidance. East Ayrshire Landscape Wind Capacity Study. Accessed online [https://www.east-ayrshire.gov.uk/Resources/PDF/L/Landscape-wind-capacity-study.pdf].

[39] Dumfries and Galloway Council (2017). Local Development Plan, Supplementary Guidance. Part 1 Wind Energy Development: Development Management Considerations, Appendix 'C' Dumfries & Galloway Wind Farm Landscape Capacity Study. Accessed online [https://www.dumgal.gov.uk/media/18596/Dumfries-and-Galloway-Wind-Farm-Land-Capacity-Study-Appendix-C/pdf/Wind_Energy_Appendix_C_Landscape_June_2017.pdf].

[40] South Lanarkshire Council (2016). South Lanarkshire Landscape Capacity Study for Wind Energy.

Indicators of Landscape Susceptibility

Susceptibility	Definition
Higher	Landscape character, existing land use, pattern, scale and attributes are vulnerable to being changed or lost resulting from the introduction of OHL / large scale substation development. Key perceptual and aesthetic characteristics are vulnerable to change or loss.
Medium	Landscape character, existing land use, pattern, scale and attributes able to accommodate some landscape change resulting from OHL / large scale substation development.
Lower	Landscape character, existing land use, pattern, scale and attributes are robust and tolerant of the change resulting from OHL / large scale substation development. The change could be accommodated without geographically extensive and/ or significant adverse effects on (or loss of) key perceptual, physical or aesthetic characteristics.

Characteristics Influencing Landscape Susceptibility

In determining landscape susceptibility, professional judgement is applied alongside an understanding of how the type of development proposed would affect, or fit with, the landscape, and the degree to which potentially adverse effects could be reduced. Analysis of the baseline information contained in the baseline landscape character assessments and landscape capacity studies, and the application of professional judgement which also draws on the principles set out in the Holford Rules and Horlock Rules, has informed an appraisal of the susceptibility of each LCT in the study area. This enables a judgement to be made on the landscape susceptibility of each LCT, which is presented graphically on **Figure 4.5a**, and supported by written observations on the key landscape characteristics.

For each LCT, the key characteristics have been analysed to inform an overall judgement on the susceptibility of each LCT to accommodate high voltage overhead line development of the type and scale proposed. The following table outlines the rationale for determining landscape susceptibility in relation to key landscape characteristics.

Characteristics Influencing Landscape Susceptibility to OHL Development

Criteria	Characteristics indicating a lower susceptibility to OHL / large scale substation development	Characteristics indicating a higher susceptibility to OHL / large scale substation development
Landform and Scale	• Flatter or gently undulating landscapes • Broad valley landscapes • Larger scale landscapes	• Steep, complex landscapes • Complex topography • Intimate scale landscapes
Landcover and Pattern	• Arable, pasture, rough grassland • Moorland • Simple patterns • Landcover which can recover quickly/ does not require complex engineering solutions	• Continuous woodland • Bog, peat, wetlands • Complex patterns • Landcover which recovers slowly/ requires complex engineering solutions
Manmade influence	• Industry, arable farming, presence of large built structures, disturbed areas • Landscapes which have experienced a higher level of human influence • More developed/ managed landscapes	• Remote landscapes • Areas with natural characteristics • Landscapes with little evidence of human influence

Criteria	Characteristics indicating a lower susceptibility to OHL / large scale substation development	Characteristics indicating a higher susceptibility to OHL / large scale substation development
Visual Experience	• Interrupted horizons • Simple skylines	• Uninterrupted horizons • Distinctive/ complex skylines
Settlement	• Industrial • Sparsely settled arable	• Residential • Dense patterns of isolated farmstead/ small scale settlements
Time Depth	• Landscapes which, through human influence, have experienced greater change at a faster pace of evolution (and which look likely to continue in this way)	• Landscapes which are more static, evolving at a slower pace (and which look likely to continue in this way)

Findings of Appraisal of Landscape Susceptibility

The following table presents LUC's appraisal of the landscape's relative susceptibility to OHL / large scale substation development of the type and scale proposed (400kV L8 steel lattice tower of an average 46m height, and large scale 400/132kV substation infrastructure) with reference to the Landscape Character Types (LCTs) within the study area.

Appraisal of landscape susceptibility to overhead line development

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
Agricultural Lowlands-Ayrshire LCT [66]	• **Complex landform**, gently increasing in height from the coastal fringe, dissected by many burns and streams draining to **incised main river valleys** to create an **undulating lowland landscape**. • Generally **small to medium scale landscape**. • **Landcover is predominantly pastoral**, with some arable on lower and better soils. • **Fields often regular in shape** and enclosed by beech or hawthorn hedges, with mature hedgerow trees giving the landscape a surprisingly wooded character. • Settlement pattern historic in origin based upon larger, more self-contained farmsteads set in a hinterland of fields. • Number of larger towns and villages with historic cores surrounded by more modern development. • **Several major road corridors creating a degree of conflict between the rural character** and presence of heavy traffic. • Dense network of often very rural minor roads. • **Varying landscape character** which ranges from very	Assessment of small-medium typology (30-50m) "*Turbines of this size would still appear large in relation to more complex rolling landform, small defined 'landmark' hills, farms and domestic buildings, small scale field enclosure pattern and woodlands although there is some limited scope to accommodate this typology in more open areas of less rolling landform and sparser settlement.* *This size of turbine (and particularly multiple turbines) could significantly intrude on the setting of small settlements and farms which are closely spaced across this landscape. Areas with a more 'semi-industrial' character and the sparsely settled upland fringes would be less sensitive* (pg. 25-28)."	Complex topography and smaller scale would indicate a higher susceptibility to OHL development. However, relatively simple field pattern and pastoral landcover would indicate a lower susceptibility to OHL development of the type and scale proposed. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.

[41] The judgements of sensitivity referenced are made in relation to the small-medium wind turbine typology, defined as 20-50m in vertical height and of a similar vertical scale to the typical vertical height of 400kV L8 lattice steel tower infrastructure proposed.

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	rural to more fragmented and developed landscapes on urban fringes. • Views tend to be dictated by the local topography and landcover.		
Lowland River Valleys – Ayrshire LCT [68]	• Series **of incised, narrow river valleys** bounded by **steep slopes** which cross the agricultural lowlands of Ayrshire. • **Complex skylines** formed by small interlocking hills within the southern valleys. • Pastoral farming character with hedgerow field boundaries and valley slopes which are **frequently wooded with stands of beech and semi-natural woodland**. • Settlement comparatively limited although there are a number of mills sited alongside rivers, often at bridging points. • **Rich woodland of the river valleys** often incorporated into designed landscapes. • **Intimate small scale landscapes** which often lie hidden within the wider agricultural lowlands. • Views tend to be enclosed, short distance and focused along the diverse river valley landscape. There are **open elevated views over the valleys from settlements and roads sited on upper slopes**.	Assessment of small-medium typology (30-50m) "*This typology could easily dominate the narrow floor of these valleys and appear to fill up more enclosed spaces. They would also dominate more complex small-scale landform features, farms and domestic buildings, small woodlands and enclosed fields.* *Turbines of this size would significantly detract from narrow incised and particularly contorted sections of these valleys (which can often be appreciated from elevated roads and settlement). They would also detract from more dramatic rocky gorges and the often complex interlocking landform of small knolly hills which occur on the top of containing side slopes and form prominent skylines* (pg. 37-38)."	The intimate scale landscape, continuous woodland, steep topography and complex skylines would indicate a **higher** susceptibility to OHL development. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **higher**.
Upland River Valleys – Ayrshire LCT [69]	• Varying river valley landform with **broad open sections which contrast with steeper valley slopes and narrow**, more enclosed valleys. • Characterised by **moorland vegetation**, with increasing amounts of **improved pasture on lower**	Assessment of small-medium typology (30-50m) "*Turbines of this size would still appear large in relation to more complex small-scale landform features, farms and domestic*	Steeper and more enclosed valleys and the pattern of isolated farmsteads in the Upper Nithsdale valley would indicate a higher susceptibility to OHL development. However, the relatively simple landcover, presence of

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	slopes and valley floors. • Confined landscape scale. • Together with adjacent moorlands, these valleys often provide the **focus for open-cast coal mining** activity. • A **focus for industrial settlement in all but the Upper Nithsdale valley, where settlement is scarce, confined to farmsteads** on the lower valley slopes. • Often act as a focus for transport routes. • Open views in the broad valley sections, changing to quite enclosed and intimate views within narrow sections.	*buildings and small woodlands. There is some limited scope to accommodate this typology in more sparsely settled and open upper hill slopes within the broader sections of these valleys.* *This typology could relate to simpler, more gently graded hill slopes and flatter areas. Steep hill slopes, more complex knolly landform, deeply incised valleys and occasional landmark hills would be more sensitive.* *Simple, more open areas of pasture and grass moorland would be less sensitive… there may be some scope to site turbines against a backdrop of rising hill slopes to minimise visual intrusion* (pg.47-49)."	manmade influence and broader valley sections would indicate a lower susceptibility to OHL development. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.
Upland Basin – Ayrshire LCT [74]	• Open basin at the foot of the Southern Uplands, partially enclosed by foothills and moorland plateau. • Comparatively elevated and exposed, reflected in the generally un-wooded character of the landscape. • Predominantly in **agricultural use**, with improved pastures enclosed by a mixture of hedges and drystone walls. • **Settlement of New Cumnock forms a highly visible feature** in the landscape. • Areas of **derelict or damaged land**, old railway lines, and pattern of development all comprise the legacy of the area's **industrial past**. Modern **opencast coal workings** also a component of the landscape. • An open, exposed landscape, with extensive views	Assessment of small-medium typology (30-50m): "*Turbines of this size would still appear large in relation to more complex small-scale landform features, farms and domestic buildings and small woodlands. There is some limited scope to accommodate this typology in more sparsely settled and open hill fringes.* *This typology could relate to simpler, gently graded hill slopes and flatter areas. Smaller landform features including low ridges and knolls would be more sensitive.* *Turbines of this height would detract from the more diverse areas of woodlands, lochs, and wetlands in the north-east. Simple,*	The presence of manmade influence and industrial development, and the relatively simple landform of hill slopes and flatter areas would indicate a lower susceptibility to OHL development. However, areas of more complex landform and small-scale development would indicate higher susceptibility. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	across the basin to the rising ground that encloses it.	*more open areas of pasture would be less sensitive…The absence of any sense of wildness reduces sensitivity* (pg. 69-71)."	
Plateau Moorland – Ayrshire LCT [78]	• Topography is **comparatively level** with **extensive plateaux** rising to soft contoured ridges. • Covered by **blanket bog, heather and grass moorland, with extensive mosses and peatland** forming an important component of this landscape type. • Frequent **extensive areas of coniferous forest** of uniform age which, in places, have significantly modified the original character of these areas in terms of colour, texture and views. • Largely undeveloped with a sparse network of roads. • **Wind farm development** on the north-eastern margins. • Open, exposed and **rather remote landscape**, wild in character, although this is lessened in places by the presence of wind turbines and associated infrastructure. • Views are open and medium to longer distance depending on undulations in the local topography.	Assessment of large typology (70-130m); no assessment provided for small-medium typology: "*Turbines located on less dramatic lower and more even skylines and/or set back into the core of these uplands would be likely to have less of an effect on these adjoining landscapes… This typology would fit with the more expansive scale of the interior of these uplands although they would dominate smaller scale buildings and woodlands on lower hill slopes and within valleys generally lying on the outer fringes of this upland plateau.* *The relatively simple land cover pattern of this landscape reduces sensitivity although turbines of this size would detract from more diverse small woodlands and stronger field enclosure pattern on settled lower hill slopes and valleys on the periphery of these uplands.* *This typology could exacerbate the fragmented and degraded nature of this landscape where it is disturbed by open cast mining if sited close-by workings… The largely unsettled and limited accessibility of this landscape reduces sensitivity* (pg. 92-94)."	The relatively simple landform, expansive scale and presence of manmade influence, including wind farms and coniferous forestry, would indicate a lower susceptibility to OHL development. However, remote qualities and areas of diverse landcover would indicate medium susceptibility to OHL development of the type and scale proposed. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **lower**.

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
Southern Uplands – Ayrshire LCT [81]	• **Steep, smooth slopes** rising to rounded summits. • Series of **distinctive valleys** cut into the uplands created by glacial erosion, with U-shaped cross sections, **precipitous side slopes, hanging valleys, waterfalls, crags and screes**. • Relatively **simple landcover**. • Heather-flecked grassland on summits. • Scarce semi-natural woodland is, limited to a few more sheltered glens, gullies and clefts. • Occasional forested areas and shelterbelts on lower side slopes leaving the domed peaks exposed. • **Absence of modern settlement** in these exposed uplands, it being concentrated in river valleys and the larger glens. • **Expansive, remote** and largely untamed landscape, most parts of the uplands are accessible on foot only. • Long distance and panoramic views encompass the settled Ayrshire lowlands to the north and west and remote Galloway Hills to the south and east	Assessment of large typology (70-130m); no assessment provided for small-medium typology due to "unsettled" landscape: "*The large scale of this open and unsettled landscape reduces sensitivity…The presence of well-defined and sometimes distinctly rugged 'landmark' hills increases sensitivity.* *There is an absence of pattern which would theoretically be less sensitive to wind farm development although the predominant openness of these uplands contrasts with the nearby densely forested Southern Uplands with Forest (20c) and Foothills with Forestry and Opencast Mining (17a) and additional development would compromise this quality.* *The presence of existing wind farm development also reduces sensitivity although cumulative effects are a key constraint* (pg. 107-108)."	Complex landform shaped by glacial activity, remote qualities and absence of modern/manmade features indicate a higher susceptibility to OHL development. However, relatively simple landcover and the presence of wind farm development would reduce susceptibility. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.
Upper Dale - Dumfries & Galloway LCT [165]	• **Wide valleys,** enclosed by high peaks and **moorland**. • **Open with long views**. • **Notable narrower section of Upper Nithsdale** between Thornhill and Mennock. • **Improved valley pastures** becoming rougher up the valley sides. • **Medium to large scale enclosures** with dry stone dykes.	Upper Nithsdale LCU assessment for small-medium turbines (20-50m): *"The more extensive areas of undulating landform and gentle side slopes offer some potential to accommodate this typology. However, the more complex landforms associated with glacial deposits, steeper gradients and the prominent outcrop hills are areas where the landscape is more sensitive to this typology.*	Due to the scale of the landscape, presence of manmade influence, including wind farm development, commercial forestry and mineral extraction, and relatively simple pattern of landcover, landscape susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	• Riparian woodlands along the main river and up tributary channels. • **Medium to large scale forests** on the valley sides and **extending over horizons** from higher ground. • **Large scale wind farm development** characteristic of some adjacent upland fringes and backdrop skylines. • Mining settlements and **remnants of industrial activity** such as mine ruins and bings.	*Turbines of this size located within the floor and lower slopes of the dale would also intrude on presently open views from roads and settlement although they would be less visually dominant if sited on upper side slopes and back-dropped by rising ground within broader sections of the valley* (pg. 136-139)."	

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
Upland Glens - Dumfries & Galloway LCT [166]	• **Deep u-shaped (and partially v-shaped) valleys** with steep sides and narrow flat valley floors. • Enclosed and often narrow, contained by **steep sides** which rise to form **irregular ridgelines**. • Features of **traditional upland farming**, with isolated farmsteads surrounded by trees, small to medium sized fields and enclosures with drystone dykes, fanks, stells and shelterbelts. • Rough grassland and moor above improved pastures. • Medium scale conifer forests (or parts of larger forests) on the glen sides. • Single track road access.	Assessment for small-medium turbines (20-50m) "*This typology could easily dominate the narrow floor of these valleys and appear to 'fill up' the more contained and enclosed spaces. The sense of 'depth' and often perceived towering scale of some of the more dramatic valleys located in the Southern uplands would be diminished by the presence of this typology. However, in places where the valley floor opens out, or widens at a confluence with a side valley, creating a more extensive sense of space, away from more dramatic steeply rising uplands, there is some potential to accommodate the lower range (possibly up to 35m) of this typology.* *The rhythm of the undulating and irregular ridges could be easily disrupted by turbines interrupting the skyline when viewed from the valley floor. The more sculptural and dramatic hill forms are particularly sensitive to disruption across the smoothly rolling summits and sheer-sided slopes, especially where the valleys are contained by the Southern Uplands* (pg. 150)."	Due to the steep and irregular landform, distinctive skylines and presence of small-scale settlement susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **higher.**
Foothills - Dumfries & Galloway LCT [175]	• Generally **undulating land** between 170 and 250 metres, with rounded peaks. Higher in the west, up to nearly 550 metres with **craggier peaks**. • Foothills dissected by **incised valleys**. • **Semi-improved pasture** enclosed in **medium-large fields** by stone walls. Grazed by sheep and cattle.	Nithsdale LCU assessment for small-medium turbines (20-50m) "*Turbines of this height would have a better relationship to the scale of the larger hills but would still dominate the narrow valleys, woodlands, individual trees and other small*	The gently undulating landform, larger scale of field pattern and relatively simple landcover would indicate a lower susceptibility to OHL development. However, areas of more complex incised landform and smaller-scale settlement would indicate a

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	Some rough pastures and heath on higher ground. • Trees in sheltered pockets with some copses on top of hills. • **Many scattered farmsteads and small settlements.** • Network of minor roads. • Numerous archaeological sites particularly Bronze Age funerary and ritual sites and Iron Age settlements and forts.	*landscape features which contribute to the often intimate scale of these foothills.* *This typology would also conflict with the intricate pattern of woodlands, fields and settlement becoming a dominant feature within a landscape where complex and diverse land cover patterns are finely balanced."*	higher susceptibility. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.
Southern Uplands - Dumfries & Galloway LCT [177]	• Large, smooth dome/conical shaped hills, predominantly grass-covered. • Open and exposed character except within incised valleys. • **Dramatically sculpted landforms** and awe-inspiring scale. • **Distinctive dark brown/purple colour of heather** on some of the higher areas. • **Pockets of woodland** in incised valleys. • Stone dykes occasionally define the lower limit. • Legacy of lead and other mining activity, with extensive archaeological remains around the former mining village of Wanlockhead. • **Wind farms locally characteristic, away from the more dramatic, scenic and sculptural slopes and skylines.**	Assessment for medium typology (50-80m): "*Turbines of this height could relate to this generally large scale landscape without dominating the height of hills.* *This typology would however impact on more complex irregular landform, which tends to occur close to deeply incised valleys… if sited within or close to these areas. Development sited on or close to the distinctive hills would detract from their prominence and the visual containment they often provide to lower more gently undulating plateaux.* *The simple land cover pattern would theoretically be less sensitive to wind farm development although the openness of these uplands contrasts with the densely forested Southern Uplands with Forest (19a) and turbines would compromise this quality* (pg. 331-332)."	The large scale and simple land use of the Southern Uplands would indicate a lower susceptibility to OHL development. However, distinctive skylines, sculptural slopes, diverse landcover pattern and areas of more complex topography would indicate a higher susceptibility. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **higher**.
Southern Uplands with Forest - Dumfries &	• Large, smooth dome-shaped hills with **large scale dark**	Assessment for medium typology (50-80m):	Due to the presence of manmade influence (e.g. wind farms), relatively

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
Galloway LCT [178]	**green forests on slopes and over lower summits**. • Predominantly **simple, gently rolling landform**. • Some areas of more complex and smaller-scale landscapes, with steep slopes enclosing heads of valleys and/or where uplands remain open. • Changing landscapes with **large scale forestry operations and wind farm development**. • Forested areas dominated by Sitka Spruce, interspersed with mixed conifers and broadleaf planting, and undergoing felling and replanting in large coupes. • **Wind farms** are a key characteristic in some areas. • **Expansive scale**.	"*This typology could also relate to the general expansiveness of this landscape although areas of more complex landform and incised valleys would still be sensitive.* *This typology could also relate to the predominantly gently undulating landform of this character type although pronounced open hill tops…should be avoided as well as areas of more complex landform and notably incised valleys.* *The uniformity of extensive forest cover reduces sensitivity to wind farm development* (pg. 349-350)."	simple landform, opportunities for backclothing and screening by commercial forestry, and the expansive scale of the landscape, susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **lower**.
Plateau Farmland - Glasgow & Clyde Valley LCT [201]	• Extensive, **open, flat or gently undulating landform**. • **Dominance of pastoral farming**, but with some mosses surviving. • Limited and declining tree cover. • **Visually prominent settlements and activities** such as mineral working. • Rural character of the Plateau Farmland has reduced as tree cover has declined and the visual influence of settlements, transport infrastructure and mineral working has increased.	An overall landscape character sensitivity rating of "Medium" is afforded due to the medium to large scale of landscape, undulating landform, "fairly simple field and tree belt pattern", presence of existing development (including electricity lines) and occasional wind turbines (pg. A27).	Settlement pattern is relatively dense within this LCT, suggesting a higher susceptibility, however due to the relatively simple landform, pastoral landcover and presence of manmade influence (e.g. wind farm development and electricity transmission infrastructure), and overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium.**
Upland River Valley - Glasgow & Clyde Valley LCT [207]	• A series of valleys formed along fault lines through the Plateau Moorlands and paired with valleys to the south and west in Ayrshire. • South-west to north-east orientation of the valleys. • **Strong contrast between the wooded and settled**	An overall landscape character sensitivity rating of "Medium/High" is afforded due to the small to medium scale, varying landform, somewhat irregular pattern, with a presence of existing electricity infrastructure and opencast mining (pg.	The smaller scale, presence of settlement, relatively irregular pattern and varying topography would indicate a higher susceptibility to OHL development. However, the presence of existing electricity infrastructure and

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	character of the valleys and the exposed enclosing uplands. • Transition from the **exposed upper reaches to more sheltered lowland areas**.	A28).	other manmade influence (e.g. wind farm development and mineral extraction) decreases susceptibility somewhat. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.
Broad Valley Upland LCT [208]	• **Medium to large scale** landscape comprising a **broad, flat bottomed, basin-like valley** enclosed by the rounded hills to the north and the Southern Uplands - Glasgow & Clyde Valley to the south. • **Distinctive pattern of tree cover** comprising shelterbelts on lower hill slopes and lines of mature trees along field boundaries. • **Medium to large agricultural field** in central areas. • **Scattered pattern of rural settlement**. • Important navigation route evidenced by Roman camps and a road, which significant modern transport routes follow. • Views predominantly focussed along the valley.	An overall landscape character sensitivity rating of "Medium/High" is afforded due to the "medium to occasionally large" scale, "rectilinear field pattern on valley floor broken by meandering river" and "generally high scenic quality" (pg. A29)	The medium/large scale of the landscape and broad characteristic of the landform would indicate a lower susceptibility to OHL development. However, the presence of continuous woodland would increase susceptibility. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.
Upland Glen - Glasgow & Clyde Valley LCT [209]	• **Glacially enlarged, smoothly contoured, U-shaped valleys** cutting into the upland mass of the Southern Upland. • Transition from **moorland vegetation** on upper slopes, through **rough grassland and pastures** on valley floor. • **Topography creates distinctive scenic vistas**. • Limited amounts of broadleaf woodland which tends to	An overall landscape character sensitivity rating of "Medium/High" is afforded due to the medium scale, steep sided valleys, "generally scenic upland character" (pg. A31). The presence of human influence including electricity infrastructure and wind turbines is noted.	The medium scale of landscape, relatively simple landcover pattern and presence of manmade influence would indicate a lower susceptibility to OHL development, however the distinctive skylines, steep valley sides and smaller scale of development within the glen floors would indicate a higher susceptibility.

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	be concentrated along the course of rivers, on steeper sheltered slopes and in gullies and side glens. • **Important corridors for communication and settlement**. • Scattering of the remains of later prehistoric settlement and pre-improvement agriculture along the valley sides. • Significant **cumulative impacts of transport infrastructure** in the glen of the River Clyde, with **large scale wind farm development** on the surrounding Southern Upland hills. • **Small scale, domesticated character of glen floors**, despite dominant transport infrastructure, which **contrasts with the enclosing uplands**.		Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.
Undulating Farmland and Hills LCT [210]	• A **varied landform** of rounded hills, ridges and undulating farmland. • Transition between Plateau Farmland to the north and the higher Southern Uplands - Glasgow & Clyde Valley and Plateau Moorlands - Glasgow & Clyde Valley to the south and west. • Farmland, mostly pastoral, with a **notable range of tree and woodland cover**. • **Distinctive pattern of shelterbelts and field boundaries** on lower hill slopes. • **Some areas of coniferous woodland, larger in the south of the area**. • Becoming generally higher and more open with poorer	(Rating for Foothills LCT[42]) An overall landscape character sensitivity rating of "Medium" is afforded due to the large to medium scale, "undulating to rolling hills", variable pattern and "low level of development" (pg. A29).	The complex topography and prominence of woodland cover would indicate a higher susceptibility to OHL development. However, the relatively sparse settlement pattern, simple pastoral pattern and presence of large scale coniferous woodland would indicate a lower susceptibility to OHL development. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium.**

[42] The South Lanarkshire Capacity Study for Wind Energy (2016) was based on the LCTs identified in the South Lanarkshire Landscape Character Assessment (2010), with this area identified as the Foothills LCT. The specific landscape characteristics that have influenced the landscape sensitivity assessment are consistent with the characteristics identified for the Undulating Farmland and Hills LCT [210] (SNH, 2019), thus the landscape sensitivity is considered to remain relevant.

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	pasture towards the south-west, although the highest hill, Black Mount is at the eastern reaches. • **Settlement is sparse** and mostly consists of scattered farmsteads and very occasional small villages. • Areas and features of historic and archaeological significance. • A **predominantly rural and pastoral character** that contrasts with the busier adjacent river valleys. • **Views to distinctive hills nearby**, the southern uplands beyond and, more closely, to adjacent wide upland river valleys.		
Plateau Moorlands - Glasgow & Clyde Valley LCT [213]	• **Large scale landform** • **Undulating hills and sloping ridges** in the western areas; a **more even plateau landform in the east**. • Distinctive upland character created by the combination of elevation, exposure, **smooth plateau landform, moorland vegetation**. • Predominant **lack of modern development**. • Extensive **wind turbine development**, including one of the largest wind farms in Scotland, Black Law. • **Sense of apparent naturalness and remoteness** which contrasts with the farmed and settled lowlands, although this has been **reduced in places by wind energy development**.	An overall landscape character sensitivity rating of "Medium/Low" is afforded due to the large scale, "predominantly undulating" landform and presence of wind farm and conifer plantation development (pg. A27).	Due to the large scale, relatively simple gently undulating landform, moorland landcover (with areas of extensive commercial forestry which offers opportunities for backclothing and screening of OHLs) and presence of manmade influence (e.g. wind farms and mineral extraction), susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **lower**.
Southern Uplands - Glasgow & Clyde Valley LCT [217]	• **Extensive, large-scale upland landscape** with strong but smooth relief. • Glacial carved and smoothed landforms, including u-shaped valleys, hanging valleys and corries.	An overall landscape character sensitivity rating of "Medium" is afforded due to the large scale, "rolling hills with glacial features", "fairly random pattern" and low level of development, however existing	The large scale of the landscape and existing presence of electricity infrastructure, wind farm development and key communications infrastructure (e.g. motorway and railway) would

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	• Extensive **mosaics of heath**, with a transition to rough grazing on lower tops or slopes. • Prominent isolated conifer forests and **old stands of Scots pine**. • **Largely undeveloped**, except for occasional upland farms, shielings and Clyde wind farm. • Important **travel and transmission lines pass through the area** are the A74, west coast mainline railway and **Scotland-England interconnector pylon line** • Significant archaeological sites, particularly from the Bronze and Iron Age periods. • **Prominent hill ranges** in views from many areas. • Wide ranging panoramic views from the hill summits.	electricity infrastructure and wind farm development is noted (pg. A31).	indicate a lower susceptibility to OHL development. However, the distinctive landform, complex landcover pattern and presence of woodland would indicate a higher susceptibility. Overall susceptibility to OHL / large scale substation development of the type and scale proposed is considered to be **medium**.
Rounded Landmark Hills LCT [218]	• High, rounded hills with a **distinctive landform**. • Glacially carved and smoothed landforms including shallow meltwater channels. • Highly prominent in views from many areas: Tinto is particularly striking as a landmark for the whole region. • **Mosaic of important habitat types** including dry heather moorland, heath and rough grazing • **Woodland in blocks** and shelterbelts on the lower slopes. • **Undeveloped**, except for occasional steadings and	(Rating for Prominent Isolated Hills[43]) An overall landscape character sensitivity rating of "Medium/High" is afforded due to the large scale, "no built development and little cultivation", "prominent steep landforms" "important scenic elements appearing relatively natural", and characteristic topography (pg. A30).	Due to the distinctive topography, diversity of landcover, presence of woodland and limited manmade influence, susceptibility to OHL / large scale development of the type and scale proposed is considered to be **higher**.

[43] The South Lanarkshire Capacity Study for Wind Energy (2016) was based on the LCTs identified in the South Lanarkshire Landscape Character Assessment (2010), with this area identified as the Prominent Isolated Hills LCT. The specific landscape characteristics that have influenced the landscape sensitivity assessment are consistent with the characteristics identified for the Rounded Landmark Hills LCT [218] (SNH, 2019), thus the landscape sensitivity is considered to remain relevant.

Landscape Character Type (LCT)	Key Characteristics	Landscape Sensitivity[41] findings (in relation to wind farms) from relevant landscape capacity studies	LUC Appraisal – Landscape Susceptibility to OHL / large scale substation development
	houses on lower ground. • Popular recreational area. • Wide-ranging panoramic views from the summits and higher ground.		

Appendix 3
Key Characteristics and Sensitivities of Locally Designated Landscapes

Key Characteristics and Sensitivities of Locally Designated Landscapes

Introduction

A relatively large proportion of the study area is defined by local landscape designation and afforded protection at a local planning policy level, as shown on **Figure 4.5a**. These areas include the following local landscape designations:

- East Ayrshire Sensitive Landscape Area[44];
- Douglas Valley Special Landscape Area (SLA), South Lanarkshire[45];
- Upper Clyde Valley SLA, South Lanarkshire[12];
- Leadhills and Lowther Hills SLA, South Lanarkshire[12];
- Thornhill Uplands Regional Scenic Area (RSA), Dumfries and Galloway[46].

These areas are designated as part of the Local Development Plan (LDP) process and therefore represent the landscapes of greatest scenic value within each of the administrative areas, and have therefore been included for consideration within the appraisal of broad corridor options.

The relative susceptibility of these designated areas to OHL development / large scale substation infrastructure is largely informed by the consideration of the landscape susceptibility of the underlying LCTs as detailed in **Appendix 2**. Nevertheless, the designation of these local landscapes is underpinned by the key characteristics/special qualities which may make them distinctive, unique or rare, and therefore consideration of how these could be affected by the introduction of OHL / large scale substation development of the type and scale proposed.

The following table presents a summary of the key characteristics of each of the locally designated landscapes found within the study area, consideration of the potential for these key characteristics to be affected by the introduction of OHL / large scale substation development of the type and scale proposed, and a summary of potential opportunities or challenges for routeing of OHL development / siting of large scale substation infrastructure within or in close proximity to these designated areas. However, no consideration of the overall susceptibility of these often large designated areas consisting of several different LCTs, therefore the

Key characteristics of designated landscapes

Locally Designated Landscape	Key Characteristics[47]	Key Sensitivities and potential opportunities/challenges
East Ayrshire Sensitive Landscape Area	Key Characteristics of LCAs within Sensitive Landscape Area and within Study Area: • Upland river valleys: "*The upland river valleys are **relatively broad valleys** and are strongly contained by more open expansive uplands, including the plateau moorlands. The upland river valleys contain **established settlements and small farm steadings** as well as **A Roads**.*" • Upland river valleys 'sensitivities': *"Whilst East Ayrshire*	Areas of the Sensitive Landscape Area covering Upland River Valleys demonstrate characteristics that are considered to be more susceptible to OHL / large scale substation development, including areas with established settlements and isolated farmsteads. However, relatively

[44] https://www.east-ayrshire.gov.uk/Resources/PDF/L/LDP-Sensitive-Landscape-Area-Background-Paper.pdf
[45] https://www.gov.scot/binaries/content/documents/govscot/publications/factsheet/2018/06/south-lanarkshire-council-planning-authority-core-documents/documents/renewable-energy/landscape-designations-report/landscape-designations-report/govscot%3Adocument
[46] https://www.dumgal.gov.uk/media/19851/LDP2-Regional-Scenic-Areas-technical-paper/pdf/Regional_Scenic_Areas_Technical_Paper.pdf?m=636827083977930000
[47] The key characteristics of each locally designated landscape may draw on reference to special landscape qualities defined within the documented descriptive information.

Locally Designated Landscape	Key Characteristics[47]	Key Sensitivities and potential opportunities/challenges
	contains several upland river valleys, it is the Doon Valley, as well as a small section of the Nith Valley, that is included within the Sensitive Landscape Area. • East Ayrshire Plateau Moorland: *"The Plateau Moorland forms an expansive upland plateau of **subtly rounded hills, shallow basins and gently graded lower slopes**. These are contrasted by **higher landmark hills, including Cairn Table and Blacklaw**, which have **steep slopes and defined ridge summits**. **Land cover is simple**, predominantly grass moorland with some **small areas of mixed woodlands**, **coniferous forestry and small pastures**. The landscape is relatively unsettled at its core and whilst there are **dispersed farms and houses** on the lower slopes at the transition with other landscape types, there are **noticeably no settlements within this landscape**."* • Plateau Moorland 'sensitivities': *"The plateau moorland is intrinsically a **wide open upland landscapes**. Its unique qualities are due to the **landmark hills** contained within the landscape, which form an important feature of **East Ayrshire's skyline**. The **open expansive nature** of the upland plateau contrasts dramatically to the rolling lowland landscape, and **contributes significantly to the diversity of the landscape** that can be experienced when travelling through East Ayrshire."*	small sections of the Nith and Ayr Valley are included within the Sensitive Landscape Area, which largely covers areas of Plateau Moorland within the study area. Areas of the Sensitive Landscape Area defined by the Plateau Moorland LCT demonstrate characteristics that are considered to be less susceptible to OHL / large scale substation development, including simple landcover, sparse settlement pattern and expansive scale. Landmark hills and views towards these hills are considered to be more susceptible due to the distinctive skylines these form.
Upper Clyde Valley SLA	*"The key qualities include:* • ***Scenic qualities of a meandering river in a broad semi-upland valley setting that contrasts with the enclosing hills of the Southern Uplands** and the prominent Tinto Hill;* • ***Cultural features include country houses set in designed policies, small settlements** and the historic burgh of Biggar in the valley and many **signs of prehistoric settlement in the hills**;* • *A n**etwork of mature policy woodlands and shelterbelts, a high quality water environment** and vast areas of heather moorland and rough grasslands;* • ***Frequently visited**, as it is traversed by major transport routes to the south and includes **popular hillwalking destinations such as Tinto Hill and Culter Fell**.*	The dense pattern of small scale settlements, distinctive skylines, and topographical contrast between valleys and the Southern Uplands provide challenges to routeing OHL / siting large scale substation infrastructure within this SLA.
Douglas Valley SLA	*"The significant of the Douglas Valley relates to a combination of scenic and cultural features:* • ***Scenic compositional qualities of a meandering upland river** passing through a **sheltered, mature pastoral landscape enclosed by moorland hills**;* • ***Cultural features include the designed landscape of Douglas Castle and the historic village of Douglas** together and their historic associations with the Douglas family, the Cameronians regiment and literary associations*	The complexity of topography and diverse landcover pattern, including areas of woodland and small scale settlement and scattered population, may provide challenges to routeing OHL / siting large scale substation infrastructure within this SLA.

Locally Designated Landscape	Key Characteristics[47]	Key Sensitivities and potential opportunities/challenges
	with Sir Walter Scott; • ***A network of mature policy woodlands and shelterbelts and a high quality of water environment****;* • *Frequently visited, as the M74 passed through the eastern end of the designated area and intersects with the* ***main east-west route of the A70 which passes along the valley****.* ***The village and castle are visitor destinations with well maintained footpaths through the designed landscape****."*	
Leadhills and Lowther Hills SLA	*"The significant of the Leadhills/Lowther Hills area arises from:* • *An extensive area of* ***high, smooth, rolling, hills and varied upland glens*** *with a* ***sense of emptiness engendered by a lack of extensive forestry or wind farm development****;* • ***Cultural features include the mining heritage surrounding Leadhills and remains of settlements on the sides of glens****;* • *Extensive areas of rough grassland and heather moorland vegetation;* • *The Southern Upland Way and other walking routes accessible via the M74 and main roads passing through to the west;* ***visitor attractions at Leadhills and fishing on the Daer reservoir****."*	Areas of relatively simple topography and landcover, including those within the Southern Uplands offer potential opportunities for routeing of OHL development / siting of large scale substation infrastructure. However, areas of more intimate landscape scale, including those within the upland glens, and the sense of remoteness/ uninterrupted skylines within the Southern Uplands may provide challenges to routeing OHL / siting large scale substation infrastructure within this SLA.
Thornhill Uplands RSA	• *"****Hills of Southern Uplands form large, smooth steep sided domes with complex spurs and ridges, dissected by numerous steeply sided clefts and several long, deep, U shaped Upland Glens****;* • *The uplands are patterned with a mosaic of rough grassland, bracken and rushes, combined with heather moorland on the higher areas;* • *There is relatively little tree cover though the forestry plantations to the west have encroached on the heads and sides of certain valleys.* • *Roads to the heads of the glens give access to i****solated farms****. Further south the valleys become wider and less steeply sided and start* ***coalescing to form Intimate Pastoral Valleys with scattered farms, hamlets and villages****.* • *The improved pastures of the valley sides are patterned with* ***drystone dykes, and interspersed by farm and streamside woodlands****.* • *The intervening Foothills and Upland Fringe form* ***open, sculptural ridges****, though conifer plantations on the uplands outwith the designated area sometimes lap over*	The complexity of topography and diverse landcover pattern may provide challenges to routeing OHL / siting large scale substation infrastructure within the RSA. These includes areas of the Upland Glens and Southern Uplands LCTs within the RSA, including views towards the Southern Uplands from adjacent areas.

Locally Designated Landscape	Key Characteristics[47]	Key Sensitivities and potential opportunities/challenges
	the southern horizons. • *The **main valley of the Nith has a varied character of strong contrasts**. In the north it forms a **steep wooded gorge, before opening out to the policy woodlands of Drumlanrig**."*	