Blair Hill Wind Farm

Technical Appendix 6.1 – Landscape and Visual Impact Assessment Glossary and Methodology

Author	LDA
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Glossary

Cumulative effects	The additional changes caused by a Proposed Development in conjunction with other similar developments or as the combined effect of a set of developments, taken together
Illustrative Viewpoint	A viewpoint chosen specifically to demonstrate a particular effect or specific issues, which might, for example, be the restricted visibility at certain locations
Landscape Character Areas	These are single unique areas which are the discrete geographical areas of a particular landscape type
Landscape Character Type	These are distinct types of landscape that are relatively homogeneous in character. They are generic in nature in that they may occur in different areas in different parts of the country, but wherever they occur they share broadly similar combinations of geology, topography, drainage patterns, vegetation, and historical land use, and settlement pattern, and perceptual and aesthetic attributes
Landscape effects	Effects on the landscape as a resource in its own right
Landscape character	A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse
Landscape quality (or condition)	A measure of the physical state of the landscape. It may include the extent to which typical character is represented in individual areas, the intactness of the landscape and the condition of individual elements.
Landscape receptors	Defined aspects of the landscape resource that have the potential to be affected by a proposal
Landscape value	The relative value that is attached to different landscapes by society. A landscape may be valued by different stakeholders for a whole variety of reasons.
Magnitude (of effect)	A term that combines judgements about the size and scale of the effect, the extent of the area over which it occurs, whether it is reversible or irreversible and whether it is short or long term, in duration
Mitigation	Measures which are proposed to prevent, reduce and where possible offset any significant adverse effects (or to avoid, reduce and if possible remedy identified effects)
Representative Viewpoint	A viewpoint selected to represent the experience of different types of visual receptor, where larger numbers of viewpoints cannot all be included individually and where the significant effects are unlikely to differ
Sensitivity	A term applied to specific receptors, combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value related to that receptor
Specific Viewpoint	A viewpoint because it is key and sometimes a promoted viewpoint within the landscape, including for example

	specific local visitor attractions, viewpoints in areas of particularly noteworthy visual and/or recreational amenity such as landscapes with statutory landscape designations, or viewpoints with particular cultural landscape associations
Susceptibility	The ability of a defined landscape or visual receptor to accommodate the specific Proposed Development without undue negative consequences
Visual amenity	The overall pleasantness of the views people enjoy of their surroundings, which provides an attractive visual setting or backdrop for the enjoyment of activities of people living, working, recreating, visiting or travelling through an area
Visual effect	Effects on specific views and on the general visual amenity experienced by people
Visual receptor	Individuals and/or defined groups of people who have the potential to be affected by a proposal
Zone of Theoretical Visibility (ZTV)	A map, usually digitally produced, showing areas of land within which a development is theoretically visible

1 Methodology

1.1 Introduction

1.1.1 This appendix contains additional detail regarding the assessment methodology, supplementing the information provided within the LVIA text. This appendix sets out a standard approach – specific matters in terms of the scope of assessment, study area and modifications to the standard approach for this assessment are set out within the LVIA.

1.1.2 The methodology has the following key stages, which are described in more detail in subsequent sections, as follows:

- Baseline – includes the gathering of documented information; agreement of the scope of the assessment with the EIA co-ordinator and planning authority; Site visits and initial reports to the EIA co-ordinator of issues that may need to be addressed within the design.
- Design – input into the design / review of initial design / layout / options and mitigation options.
- Assessment – includes an assessment of the landscape and visual effects of the scheme, requiring Site based work and the completion of a full report and supporting graphics.
- Cumulative Assessment – assesses the effects of the proposal in combination with other developments, where required.

1.1.3 For the Proposed Development, a Wild Land Area Assessment (WLAA) has also been undertaken as a standalone assessment to inform the LVIA. Whilst the Proposed Development is located outside the Merrick WLA, and therefore a WLAA is not required, the WLAA has been prepared to address concerns raised in response to the Scoping Opinion for the Proposed Development.

1.2 Baseline

1.2.1 The baseline study establishes the planning policy context, the scope of the assessment and the key receptors. It typically includes the following key activities:

1.2.2 A desk study of relevant current national and local planning policy, in respect of landscape and visual matters, for the Site and surrounding areas.

1.2.3 Agreement of the main study area radius with the local planning authority. A study area of 45km has been adopted for the assessment, with more detailed study areas listed below. These study areas were proposed in the formal scoping report (March 2023) and agreed in scoping responses from NatureScot and Dumfries and Galloway Council (DGC) as set out in section 6.3 of the LVIA chapter.

- 20 km for night-time effects;
- 15 km for detailed assessment of effects on landscape character (daytime);
- 45 km for cumulative effects; and
- 3 km for the residential visual amenity assessment.

1.2.4 A desk study of nationally and locally designated landscapes for the Site and surrounding areas.

1.2.5 A desk study of existing landscape character assessments and capacity and sensitivity studies for the Site and surrounding areas.

1.2.6 A desk study of historic landscape character assessments (where available) and other information sources required to gain an understanding of the contribution of heritage assets to the present day landscape.

1.2.7 Collation and evaluation of other indicators of local landscape value such as references in landscape character studies or parish plans, tourist information, local walking & cycling guides, references in art and literature.

1.2.8 The identification of valued character types, landscape elements and features which may be affected by the proposal, including rare landscape types.

1.2.9 Exchanging information with other consultants working on other assessment topics for the development as required to inform the assessment.

1.2.10 Draft Zone of Theoretical Visibility (ZTV) studies to assist in identifying potential viewpoints and indicate the potential visibility of the Proposed Development, and therefore scope of receptors likely to be affected. The methodology used in the preparation of ZTV studies is described below.

1.2.11 The identification of and agreement upon, through consultation, the scope of assessment for cumulative effects.

1.2.12 The identification of and agreement upon, through consultation, the number and location of representative and specific viewpoints within the study area.

1.2.13 The identification of the range of other visual receptors (e.g. people travelling along routes, or within open access land, settlements and residential properties) within the study area.

1.2.14 Site visits to become familiar with the Site and surrounding landscape; verify documented baseline; and to identify viewpoints and receptors.

1.2.15 Input to the design process.

1.2.16 The information gathered during the baseline assessment is drawn together and summarised in the baseline section of the report and reasoned judgements are made as to which receptors are likely to be significantly affected. Only these receptors are then taken forward for the detailed assessment of effects (ref. GLVIA 3rd edition, 2013, para 3.19).

1.3 Design

1.3.1 Beyond design changes to layouts, including number and size of turbines, opportunities for significant mitigation measures are inevitably limited due largely to the nature of the Proposed Development. The scale of development means that there are no real meaningful on-Site opportunities for incorporating mitigation measures for the main elements of the proposed scheme. However, within the evident constraints of the Proposed Development, mitigation measures have been considered and, wherever possible, incorporated into the evolving scheme in order to best address potential effects.

1.3.2 The design, siting and mitigation of potential effects of the access tracks, control buildings, and monitoring mast has also been considered.

1.3.3 The design process was resolved through a series of iterative design reviews which considered the full constraint data. These design options varied in the number of turbines and sizes, and were ultimately narrowed down to the final 14 turbine layout.

1.3.4 Details of the design considerations in respect of landscape and visual matters for this scheme are discussed within the assessment as part of the scheme description, which describes the proposed wind farm development, and any mitigation measures incorporated within the proposals to help reduce identified potential landscape and visual effects.

1.3.5 A summary of the design evolution and alternative considerations is included within Chapter 3 of the main EIAR.

1.4 Assessment

1.4.1 The assessment of effects includes further desk and Site based work, covering the following key activities:

- The preparation of a ZTV based on the finalised design for the development.
- The preparation of computer-generated wirelines showing the Proposed Development from the agreed representative viewpoints, and, potentially, selected residential properties.
- An assessment, based on both desk study and Site visits, of the sensitivity of identified receptors to the Proposed Development.
- An assessment, based on both desk study and Site visits, of the magnitude and significance of effects upon the landscape character, designated and recreational landscape and the existing visual environment arising from the Proposed Development.
- An informed professional judgements as to whether each identified effect is positive, neutral or adverse.
- A clear description of the effects identified, with supporting information setting out the rationale for judgements.
- Identification of which effects are judged to be significant based on the significance thresholds set out within the LVIA
- The production of photomontages from a selection of the agreed viewpoints showing the anticipated view following construction of the Proposed Development.

1.5 Site

1.5.1 The effect of physical changes to the Site are assessed in terms of the effects on the landscape fabric.

1.6 Landscape and Townscape Character Considerations

1.6.1 The European Landscape Convention (2000) provides the following definition:

"Landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors."

1.6.2 It notes also in Article 2 that landscape includes *"natural, rural, urban and peri-urban areas. It includes land, inland water and marine areas"*.

1.6.3 Landscape Character Assessment Guidance for England and Scotland (Scottish Natural Heritage and The Countryside Agency, 2002) defines landscape character as:

"a distinct and recognisable pattern of elements *that occur consistently in a particular type of landscape. Particular combinations of geology, landform, soils, vegetation, land use, field patterns and human settlement create character. Character makes each part of the landscape distinct, and gives each its particular sense of place.*"

1.6.4 The susceptibility of landscape character areas is judged based on both the attributes of the receiving environment and the characteristics of the Proposed Development as discussed under 'susceptibility' within the methodology section of the LVIA. Thus, the key characteristics of the landscape character types/areas are considered, along with scale, openness, topography; the absence of, or presence, nature and patterns of development, settlement, landcover, the contribution of heritage assets and historic landscape elements and patterns, and land uses in forming the character. The condition of the receiving landscape, i.e. the intactness of the existing character will also be relevant in determining susceptibility. The likelihood of material effects on the landscape character areas can be judged based on the scale and layout of the proposal and how this relates to the characteristics of the receiving landscape.

1.6.5 The introduction of any development into a landscape adds a new feature which can affect the 'sense of place' in its near vicinity, but with distance, the existing characteristics reassert themselves.

1.6.6 The baseline of the LVIA is informed by desk study of published landscape character assessments and field survey. The baseline helps to identify the key characteristics of the landscape. Page 45 of the Landscape Character Assessment Guidance for England and Scotland describes the function of key characteristics in landscape assessment, as follows:

"Key characteristics are those combinations of elements which help to give an area its distinctive sense of place. *They tend in many cases to be 'positive' characteristics but they may also, in some cases, be 'negative' features which nevertheless are important to the current character of the landscape. If the key characteristics which are identified were to change or be lost there would be significant consequences for the current character of the landscape. These would usually be negative but sometimes positive where some characteristics currently have a negative influence on the character (e.g. the effects of a busy road corridor). Key characteristics should therefore be the prime targets for monitoring change and for identifying landscape indicators.*"

1.6.7 It follows from the above that in order to assess whether landscape character is significantly affected by a development, it should be determined how each of the key characteristics would be affected. The judgement of magnitude therefore reflects the degree to which the key characteristics and elements which form those characteristics will be altered by the proposals.

1.7 Landscape value - considerations

1.7.1 Paragraph 5.19 of GLVIA states that *"A review of existing landscape designations is usually the starting point in understanding landscape value, but the value attached to undesignated landscapes also needs to be carefully considered and individual elements of the landscape- such as trees, buildings or hedgerows -may also have value. All need to be considered where relevant."*

1.7.2 Paragraph 5.20 of GLVIA indicates information which might indicate landscape value, including:

- Information about areas recognised by statute such as National Parks, Areas of Outstanding Natural Beauty;
- Information about Heritage Coasts, where relevant;
- Local planning documents for local landscape designations;
- Information on features such as Conservation Areas, listed buildings, historic or cultural sites;
- Art and literature, identifying value attached to particular areas or views; and
- Material on landscapes of local or community interest, such as local green spaces, village greens or allotments.

1.7.3 An assessment of landscape value is made based on the following factors outlined in Table 1 of the Landscape Institute's 'Technical Guidance Notes 02-21: Assessing landscape value outside national designations': natural heritage; cultural heritage; landscape condition; associations; distinctiveness; recreational; perceptual (scenic); perceptual (wildness and tranquillity); and functional.

1.7.4 In addition to the above list, consideration is given to any evidence that indicates whether the landscape has particular value to people that would suggest that it is of greater than Community value.

1.8 Viewpoints and Visual Receptors - considerations

1.8.1 A wide variety of visual receptors can reasonably be anticipated to be affected by the Proposed Development. Within the baseline assessment, the ZTV study and Site visits are used to determine which visual receptors are likely to be significantly affected and therefore merit detailed assessment. In line with guidance (GLVIA, 3rd Edition, 2013); both representative and specific viewpoints may be identified to inform the assessment. In general, the majority of viewpoints will be representative – representing the visual receptors at the distance and direction in which they are located and of the type(s) that would be present at that location. The representative viewpoints have generally been selected in locations where significant effects would be anticipated; though some may be selected outside of that zone – either to demonstrate the reduction of effects with distance; or to specifically ensure the representation of a particularly sensitive receptor. The types of visual receptors likely to be included with the assessment are:

- Users of walking routes or accessible landscapes including Public Rights of Way, National and Regional Trails and other long distance routes, Common Land, Open Access Land, permissive paths, land held in trust (e.g. Woodland Trust, National Trust) offering free public access, and other regularly used, permitted walking routes;
- Visitors to and residents of settlements;
- Visitors to specific valued viewpoints;
- Visitors to attractions or heritage assets for which landscape and views contribute to the experience; and
- Users of roads or identified scenic routes.

1.8.2 Visual receptors are grouped for assessment into areas which include all of the routes, public spaces and homes within that area. Groups are selected as follows:

- Based around settlements in order to describe effects on that that community – e.g. a settlement and routes radiating from that settlement; or
- An area of open countryside encompassing a number of routes, accessible spaces and individual dwellings; or
- An area of accessible landscape and the routes within and around it e.g. a country park; and
- such that effects within a single visual receptor group are similar enough to be readily described and assessed.

1.8.3 With the exception of specific viewpoints, each route, settlement or location will encompass a range of possible views, which might vary from no view of the development to very clear, close views. Therefore, effects are described in such a way as to identify where views towards the development are likely to arise and what the scale, duration and extent of those views are likely to be. In some cases, this will be further informed by a nearby viewpoint and in others it will be informed with reference to the ZTV, aerial photography and Site visits. Each of these individual effects are then considered together in order to reach a judgement of the effects on the visual receptors along that route, or in that place.

1.8.4 The representative viewpoints are used as 'samples' on which to base judgements of the scale of effects on visual receptors. The viewpoints represent multiple visual receptors, and duration and extent are judged when assessing impacts on the visual receptors.

1.8.5 For specific viewpoints (key and sometimes promoted viewpoints within the landscape), duration and extent are assessed, with extent reflecting the extent to which the development affects the valued qualities of the view from the specific viewpoint.

1.9 Nighttime assessment considerations

1.9.1 NatureScot's Guidance on Aviation Lighting Impact Assessment (NatureScot, 2024) indicates that there are many factors that influence the way in which aviation lighting is seen. The following paragraphs are of particular relevance:

"20 Many activities in the rural landscape at night involve some form of personal light for safety, unless the enjoyment of darkness is the basis for the activity, e.g. star gazing, and this will affect how other lights are perceived in the dark, due to the optical process called 'dark adaptation'[1]. An individual's eyesight can take time to adjust to darkness, and intensify, especially during dusk. On brighter nights people may however walk without torches and can also often just take time to stand and appreciate the night sky.

29 Different people (visual receptors) perceive and experience light in different ways, particularly at night. The observed illuminance (brightness or brilliance) of lights seen at night is influenced by a range of factors, and therefore observations are rarely experienced consistently. This is an important consideration in any assessment of effects arising from visible aviation lighting.

30 The effects of aviation lighting at night can vary depending on range of factors, which may include:

- *the number and perceived intensity of visible aviation lights*
- *the distance and angle of view to the lights*
- *the prevailing atmospheric conditions*

[1] The process by which our eyes switch from photopic (cone mediated) vision to scotopic (rod mediated) vision after moving from a lit area to a dark one. The switch over "zone" is known as mesopic vision.

- *the changing illumination that results from the different phases of the moon*
- *the saturation of darkness and seasonality changes*
- *the appearance of other baseline lighting in the landscape*

31 In perfectly clear weather, with excellent visibility, to a person, the same light located twice the distance away would appear a quarter as bright as the nearer light. Further attenuation of light due to intervening material (e.g. mist, dust, pollen etc.) will make more distant sources of light fainter than this, but as a rule of thumb it is a good first guide."

1.9.2 Section 2.10 below sets out considerations in relation to the sensitivity of visual receptors at night and section 2.13 sets out considerations in relation to the use of visualisations as a 'reasonable indicative illustration of the lighting effects'.

1.10 Nighttime Visual Receptor Sensitivity

1.10.1 Paragraphs 17-19 of NatureScot's Guidance on Aviation Lighting Impact Assessment sets out the differences between the sensitivity and susceptibility of visual receptors during the daytime and at night. They state:

"17 A night-time Aviation Lighting Impact Assessment is not the same as a more technical, and often quantitative, lighting assessment carried out by lighting engineers, lighting specialists or aviation specialists. It will normally be carried out by Chartered Landscape Architects, based on the principles set out within GLVIA3.

18 This type of assessment is different from the assessment of day-time impacts. The receptors to be assessed and their sensitivity to potential lighting impacts cannot necessarily be mapped across from the day-time assessment of a proposed development, but instead may require careful reconsideration to determine how sensitive receptors may be to lighting effects at night. For example, while residents are among the highest sensitivity visual receptors in a day-time assessment, the influence of baseline lighting at home, and in towns and villages, is likely to reduce sensitivity for those same receptors at night. Conversely, people visiting a recognised or designated Dark Sky Park at night are likely to have increased sensitivity as they seek to appreciate the night sky.

19 The significance of any impact at night will depend partly on the receptor and the magnitude of change to that receptor. In relation to visual receptors, sensitivity will be influenced by why and where they are in the landscape at night, as well as the activity being undertaken. For example, activities at night might include star/sky gazing/ photography, dog walking, hill walking, wild camping, adventure sports (mountain biking, running, climbing), fishing and farming/ estate management."

1.10.2 For this LVIA, the sensitivity of visual receptors at night is generally rated as follows:

- National value and High susceptibility – visitors to Dark Sky Parks where the main focus is the night sky.
- Local value and High susceptibility – visitors to dark sky discovery sites or public observatories where the main focus is the night sky.
- Community value and High susceptibility – wild campers, people engaged in night time activity such as bat watching, residents of notably dark areas (i.e. rural locations with no street lighting) in the streets around their homes or footpaths with demonstrable use at night, where the main focus is the night sky.
- National (or Local) value and Medium susceptibility – visitors to nationally important or well known local landmarks that are illuminated at night e.g. the Kelpies.
- Community value and Low susceptibility – residents in urban areas or semi-urban/rural areas in the streets around their homes, users of cycle routes and footpaths where street lighting/illumination is characteristic.

- Community value and Low susceptibility – drivers using local, unlit roads and train passengers.
- Limited value and Low susceptibility – users of main roads, illuminated minor roads and people at their place of work.

1.11 Positive / Neutral / Adverse - considerations

1.11.1 Whether an effect is Positive, Neutral or Adverse is identified based on professional judgement. GLVIA 3rd edition indicates at paragraph 2.15 that this is a "...particularly challenging" aspect of assessment, particularly in the context of a changing landscape and the need to address climate change. In the case of windfarms, much depends upon the attitudes and predispositions of the individual. As has been shown in a number of opinion surveys, the attitudes of the general public vary widely from those who think that windfarms blight the landscape to others who feel that they are a beautiful or positive addition, in some instances regardless of the natural beauty/ value of the landscape in question. In general terms there appears to be a majority view that is positive towards wind energy generation and its appearance in the countryside and this is particularly so once a windfarm is built in a particular location. A 2012 MORI poll indicated that 67% of people favour the use of wind energy in the UK, with only 8% opposed. Attitudes to the appearance of windfarms in the landscape indicated that 42% find this acceptable, with only 13% who do not. Based on this data, the argument that effects on the landscape and views should always be treated as adverse (on a 'worst case' or precautionary principle) seems to go against the majority opinion.

1.11.2 In examining visual effects, it is relevant to recognise this range of public opinion (and the likelihood that professionally qualified landscape architects may have differing positions) when discussing the effect upon views perceived by the public. However, it should be recognised that there is not an established policy position which aims to maintain unchanged views (similar to those for landscape character), visual effects may be described as being Neutral unless specific factors contribute to positive or adverse effects as identified within design guidance (Siting and Designing Windfarms in the Landscape, NatureScot, 2017) or local guidance.

1.11.3 Public opinion is also pertinent when considering effects on landscape receptors, as the way in which an individual regards wind turbines plays a part in their perceptual response to them within the landscape. If one regards them as industrial, alien structures, then it is understandable to perceive their influence as adverse. Likewise, those who have concerns regarding climate change may welcome turbines as a physical expression of action being taken. For those who derive particular value from associations with the past, the uncompromising modernity of wind turbines may be jarring within a familiar landscape, whilst for others, turbines may have positive associations with human progress. All of these responses are equally valid and will affect the perceptual aspects of landscape character. However, in keeping with the general planning policy presumption that distinctive character should not be altered and designated landscape should be protected from development, effects on landscape receptors are generally presumed to be Adverse.

1.12 Preparation and use of Visuals

1.12.1 The ZTVs are used to inform the field study assessment work, providing additional detail and accuracy to observations made on Site. Photomontages may also be produced in order to assist readers of the assessment in visualising the proposals, but are not used in reaching judgements of effect. The preparation of the ZTVs (and photomontages where applicable) is informed by the Landscape Institute's Technical Guidance Note 06/19 'Visual Representation of development proposals' and SNH 'Visual Representation of Wind Farms Best Practice Guidance' (both the 2007 and 2017 editions).

1.12.2 The following points should be borne in mind in respect of the ZTV study:

- Areas shown as having potential visibility may have visibility of the development obscured by local features such as trees, hedgerows, embankments or buildings.
- Since only the turbine hubs and blade tips have been modelled, this may be all that is visible – rather than the turbine tower. This is particularly true of areas near the edges of potential visibility.

1.12.3 The following points should be borne in mind in respect of visualisations, as identified in Annex A of the NatureScot Guidance (2017):

- "Visualisations of wind farms have a number of limitations which you should be aware of when using them to form a judgement on a wind farm proposal. These include:
- A visualisation can never show exactly what the wind farm will look like in reality due to factors such as: different lighting, weather and seasonal conditions which vary through time and the resolution of the image;
- The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate;
- A static image cannot convey turbine movement, or flicker or reflection from the sun on the turbine blades as they move;
- The viewpoints illustrated are representative of views in the area, but cannot represent visibility at all locations;
- To form the best impression of the impacts of the wind farm proposal these images are best viewed at the viewpoint location shown;
- The images must be printed at the right size to be viewed properly (260mm by 820mm);
- You should hold the images flat at a comfortable arm's length. If viewing these images on a wall or board at an exhibition, you should stand at arm's length from the image presented to gain the best impression.
- It is preferable to view printed images rather than view images on screen. If you do view images on screen you should do so using a normal PC screen with the image enlarged to the full screen height to give a realistic impression. Do not use a tablet or other device with a smaller screen to view the visualisations described in this guidance."

1.12.4 A detailed description of the methods by which ZTVs, wirelines and photomontages are prepared is included below.

1.13 Visualisations and ZTV Studies

ZTV Studies

1.13.1 ZTV studies are prepared using the ESRI ArcGIS Viewshed routine. This creates a raster image that indicates the visibility (or not) of the points modelled. Each turbine is analysed at both the blade tip and hub heights. LDA Design undertake two separate ZTV studies, with the first using a topographic model alone (often referred to as a Bareground ZTV), in accordance with NatureScot guidance. The second study is designed to include visual barriers from settlements and woodlands (with heights derived from NEXTMAP 25 surface mapping data). If significant deviations from these assumed heights are noted during Site visits, for example young or felled areas of woodland, or recent changes to built form, the features concerned will be adjusted within the model or the adoption of a digital surface model will be used to obtain actual heights for these barriers. In this instance this has not been required.

1.13.2 NextMAP 25 data has been used to derive the height of vegetation and built form for Figures 5.5-5.8, 5.10-5.11 and 5.13. Both the bare ground and visual barrier models are also designed to take into account both the curvature of the earth and light refraction using the curvature and refractivity equation published in the NatureScot guidance.

1.13.3 In accordance with NatureScot guidance LDA Design undertake all ZTV studies with observer heights of 2m.

1.13.4 The ZTV analysis begins at 1m from the observation feature (for example a wind turbine) and will work outwards in a grid of the set resolution (in this instance 25m2) until it reaches the end of the terrain map for the project.

1.13.5 For all plan production LDA Design will produce a ZTV that has a base and overlay of the 1:50,000 Ordnance Survey Raster mapping or better. The ZTV will be reproduced at a suitable scale on an A1 template to encompass the study area in accordance with NatureScot guidance (2017). For printing purposes all A1 figures will be produced at 600 dpi to allow interpretation of the base map.

Ground model accuracy

1.13.6 Depending on the project and level of detail required, different height datasets may be used. Below is listed the different data products and their specifications:

Table 6.1.3: Data products and their specifications

Product	Distance Between Points	Vertical RMSE Error
LiDAR	50cm – 2m	up to +/- 5cm
Photogrammetrically Derived Heights	2m – 5m	up to +/- 1.5m
Ordnance Survey OS terrain 5	5 m	up to +/- 2.5m
NextMap25 DTM	25 m	+/- 2.06m
Ordnance Survey OS terrain 50	50 m	+/- 4m

1.13.7 For most purposes, the NextMap25 data will be used, but in some cases, more detailed analysis of areas close to the Site or in relation to residential properties may be required, in which case, more detailed ZTVs using more detailed surface mapping products such as Photogrammetrically Derived Heights (from Getmapping or Bluesky), or LiDAR may be used. This has not been required for this assessment.

Visualisations

1.13.8 Visualisations are produced in 11 stages:

1. Photography is undertaken using a full frame digital SLR camera and 50mm lens. A tripod is used to take overlapping photographs which are joined together using an industry standard application to create a single panoramic image for each viewpoint. These are then saved at a fixed height and resolution to enable correct sizing when reproduced in the final images. The photographer also notes the GPS location of the viewpoint and takes bearings to visible landmarks whilst at the viewpoint.
2. Creation of a ground model and 3D mesh to illustrate that model. This is created using NextMap25 DTM point data (or occasionally other terrain datasets where required, such as Site-specific topographical data or Photogrammetrically Derived Heights) and ground modelling software.
3. The addition of the Proposed Development to the 3D model. The turbines are correctly proportioned to match the nacelle height and blade lengths proposed for the

development. They are also modelled to resemble the proposed turbine type. The turbines are then inserted into the 3D model at the proposed locations and elevations.

4. Wireline generation – The viewpoints are added within the 3D CAD model with each observer point being inserted at 1.5m above the modelled ground plane. The location of the landmarks identified by the photographer may also be included in the model. Before wireline generation, the turbines are rotated so that they face in the direction of the viewpoint from the centre of the Site, with blade tips upwards. The view from the viewpoint is then is then replicated using virtual cameras to create a series of single frame images, which also include bearing markers. For cumulative sites consented and operational sites shown in black and green respectively, sites in planning are shown in orange and sites in scoping/screening are shown in pink. As with the photographs, these single frame images are joined together using an industry standard application to create a single panoramic image for each viewpoint. These are then saved at a fixed height and resolution to ensure that they are the same size as the photographs.
5. Wireline matching – The photographs are matched to the wirelines using a combination of the visible topography, bearing markers and the landmarks that have been included in the 3D model.
6. These matched images then form the baseline panorama and are presented as determined by the 2017 NatureScot standards.
7. In order to produce the main wireline, a wireline is created in the same way as above, but without the cumulative sites. This image is then cropped both horizontally and vertically and re-projected (around the centre of the cropped image) using an image processing application to create a ‘planar projection’ as required by the 2017 NatureScot standards.
8. For the photomontage, an industry standard 3D rendering application is used to produce a rendered 3D view of the proposed turbines from the viewpoint. The rendering uses a pale grey colour (similar to that used for many turbines) and lighting conditions according to the date and time of the viewpoint photograph. The rendered turbines are then added to the photographs in the positions identified by the wireline (using an image processing application) to ensure accuracy. The images are then layered to ensure that the turbines appear in front of and behind the correct elements visible within the photograph, proposed felling is taken into account and the woodland is modified in photoshop to match the proposals. As for the main wireline, this matched image is then cropped and re-projected around the same centre as the main wireline, to create a ‘planar projection’ as required by the 2017 NatureScot standards. The proposed borrow pits are not modelled due to their temporary nature. The proposed substation and tracks are not modelled due to the general lack of visibility of these features.
9. Turbine order – turbines are listed as they are shown left-right within the view and labelled above the turbine. For the wireline this includes all turbines not screened by terrain (i.e. those visible on the wireline), and for the photomontage this includes all turbines not screened by intervening features (i.e. those visible on the photomontage).
10. Key to cumulative sites – for each viewpoint, information regarding the cumulative sites shown is shown on the baseline panorama. The sites are listed in the order they appear on the sheets with a distance to each of the sites.
11. In accordance with the guidance provided in Landscape Institute Technical Guidance Note 06/19, visualisations are prepared to the technical methodology set out in below. The photomontages prepared in support of the LVIA adhere to the Type 3 visualisation specification as surveyed locational accuracy is not generally necessary but image enlargement, to illustrate perceived scale, would be appropriate.

Table 6.1.4: Technical Methodology

Information	Technical Response
Photography	
Method used to establish the camera location	Aerial photography in ESRI ArcGIS along with GPS reading taken on Site
Likely level of accuracy of location	Better than 1m
If lenses other than 50mm have been used, explain why a different lens is appropriate	N/A
Written description of procedures for image capture and processing	See above
Make and type of Panoramic head and equipment used to level head	Manfrotto Levelling Head 338 and Manfrotto Panoramic Head MH057A5
If working outside the UK, geographic co-ordinate system (GCS) used	N/A
3D Model/Visualisation	
Source of topographic height data and its resolution	NextMap 25
How have the model and the camera locations been placed in the software?	Camera locations taken from photography viewpoint locations
Elements in the view used as target points to check the horizontal alignment	Existing buildings, infrastructure/road alignments, telegraph poles/street lighting/signage, field boundaries, DSM
Elements in the view used as target points to check the vertical alignment	Topography, existing buildings
3D Modelling / Rendering Software	Civil 3D / AutoCAD / 3DS Max / Rhino / V-Ray

Night Time Montage Methodology

1.13.9 Calibration photographs have been taken of the offshore demonstrator turbine at Methil in Fife which is fitted with 2000 candela nacelle lighting similar to that proposed. These photographs were taken from locations at a similar distance and ambient light level to those viewpoints being montaged and using similar camera equipment and exposure settings to the photographs used to produce the montages.

1.13.10 The model of the Proposed Development is rendered with turbine lighting shown in the correct locations, using industry standard software with realistic lighting reflecting the date and time of day the viewpoint photographs were taken at in order to give an impression of the ‘brightness’, colour relating to light on surfaces, and texture of surfaces at night. This rendered model is then fitted to the night time photographs using the wireframes created for the day time photomontage as a reference.

1.13.11 Finally, the proposals are rendered in a photo editing package to illustrate the proposals appearance based on existing lighting in the panoramas, the calibration photographs, foreground features in the view that would screen parts of the proposal and the render from the 3D model to give an accurate representation of the proposals. Red lights typically appear ‘less red’ in photographs than experienced with the naked eye so the proposed lighting shown in montages has been enhanced to present a colour that more closely resembles that which would be experienced in real life, whilst still reflecting the conditions during which the photography was undertaken.

1.13.12 As set out in Appendix 4 to NatureScot's Guidance on Aviation Lighting Impact Assessment (NatureScot, 2024), there are many factors that influence how we see lighting at night and visualisations are *"only a reasonable indicative illustration of the lighting effects"*. Paragraphs 15-20 of Appendix 4 state:

"There are several key aspects that influence what we can see at night, and how it compares to photographic evidence. The main ones are how dark-adapted our eyes are and the contrast between any individual light when compared to the surroundings. It is harder to see a light against a bright background or foreground simply because our eyes have limited contrast, and this is especially true in overall darker conditions. A camera has separate issues regarding the dynamic range it can acquire but typically these are not as limiting at night as the eye's limitations. This is one of the reasons that photography at twilight may show presence of light sources that our eyes simply cannot detect.

Evidence suggests that contrast affects most people in a similar way. Dark adaptation, by comparison, is something that varies greatly between individuals, with the main differences being due to diminishing dark response with age. In partly lit surroundings, dark adaptation never becomes complete. In unlit surroundings it can but requires from a few minutes up to half an hour to do so. Our eyes also develop greater blue sensitivity at night as they become dark adapted. A camera by comparison can be set to give a variety of colour responses (by variation of what is known as the white balance – i.e. what setting makes a sheet of white paper appear white under ambient lighting). As a result of these differences, twilight or night-time photographic images often bear a limited resemblance to what a person might see in the same circumstances. In addition, the perspective changes dramatically as the sky darkens. What may be visible in full dark may be completely invisible in twilight. There is no one simple visualisation technique that can capture the full effect.

The final aspect to consider in what a visualisation should represent, is whether it is as expected. In perfectly clear weather, with excellent visibility, to a person, the same light located twice the distance away would appear a quarter as bright as the nearer light. Any atmospheric opacity due to mist, dust, pollen etc. will make the more distant light fainter than this, but as a rule of thumb it is a good first guide. Another way to express this is to say how far away an aviation warning light at 200 cd would be compared to other more common red lights. The simplest of these to envisage in most locales is a car's rear brake lights since these are similarly red in colour. These vary slightly in intensity but are typically about 80 cd.

In recent times methods and techniques to illustrate how such lights may appear to the naked eye have been developed, often including the capture of baseline photography taken in low light conditions (just before sunrise/ or after sunset) to prepare photomontage visual representations in a similar format to those depicting day-time views of wind turbines.

Whilst multiple software packages and methods are available for use when modelling visible aviation lighting, it is important to note that digital visualisations prepared in such software cannot replicate the additional variable influence which distance (between the light and the viewpoint/observer) or atmospheric attenuation from aerosols or other influences can have on the observed illuminance (brightness or brilliance) of the lights. However, it is understood that the additional influence of these factors would typically lead to a further decrease in the perceived brightness or brilliance.

Because of these limitations, it is recommended that visualisations produced in support of a night-time Aviation Lighting Impact Assessment should be caveated as being only a reasonable indicative illustration of the lighting effects. Visualisations should, as far as *practicable, seek to represent the reasonable maximum case effects likely to arise so that these can be considered as part of the Environmental Impact Assessment (EIA) process (where such assessment is necessary). Where dimming mitigation is agreed with the CAA, photomontages need only illustrate 200 cd illumination."*