TECHNICAL APPENDIX 8.1: TECHNICAL METHODOLOGIES FOR VISUAL REPRESENTATION

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1. Technical Appendix 8.1: Technical Methodologies for Visual Representation

1.1 Introduction

1.1.1 The following is a detailed methodology for production of technical outputs contributing to the Landscape and Visual Impact Assessment (LVIA).

1.1.2 The LVIA of the Proposed Varied Development is informed by several technical models and drawings. The methods for producing these are described below.

1.1.3 It should be remembered that,

"visualisations, whether they are hand drawn sketches, photographs or photomontages, can never exactly match what is experienced in reality. They should, however, provide a representation of the proposal that is accurate enough for the potential impacts to be fully understood" (SNH, 2017g: para 96, p22) and that *"visualisations in themselves can never provide the full picture in term of potential impacts; they only inform the appraisal process by which judgements are made"* (SNH, 2017g; para 98, p22).

1.1.4 Viewpoint (VP) photography has been undertaken by ASH design + assessment Ltd (ASH), and Creative Sides Photography. All editing and modelling has been completed by ASH.

Turbine Specifications

1.1.5 The turbines considered in the assessment of the Proposed Varied Development were modelled in accordance with the dimensions stated in **Chapter 2: Design Iteration & Proposed Varied Development** as follows:

- Hub Height: up to 149m
- Rotor Diameter: 162m
- Overall Tip Height: 230m.

1.1.6 The location of each turbine included in the visualisations is detailed in Table 1.1.1.

Table 1.1.1: Proposed Varied Development – Turbine Locations

Turbine Number	Ordnance Survey (OS) Grid Coordinates	Base Elevation (m AOD)	Turbine Number	Ordnance Survey (OS) Grid Coordinates	Base Elevation (m AOD)
T01	821692 238401	520	T09	820040 239315	470
T02	820992 238367	512	T10	820831 239569	467
T03	821833 238945	527	T11	821306 238945	530
T04	821334 239499	496	T12	821464 240026	522
T05	821951 239556	538	T15	820823 240119	500
T06	822170 238277	527	T16	820102 239848	444
T07	820686 238746	496	T17	821190 240450	493
T08	820250 238776	502			

Current Guidance

1.1.7 The main guidance documents which have informed the technical methodologies used to undertake this LVIA and prepare the supporting drawings and visualisations are as follows:

- Scottish Natural Heritage (SNH), (2017), Visual Representation of Wind Farms (Version 2.2) (SNH, 2017g) (the NatureScot[1], 2017 Guidance).
- The Highland Council (THC), (2016), Visualisation Standards for Wind Energy Developments (THC, 2016) (the THC, 2016 Guidance).

1.1.8 The Landscape Institute also provides technical guidance on visualisation production (below). While the guidance prepared by NatureScot and THC are the most relevant for the Proposed Varied Development, this document is also a useful reference guide:

- The Landscape Institute, (2019), TGN 06/19 Visual Representation of Development Proposals.

1.1.9 Two sets of photomontages and wirelines have been prepared to support the LVIA:

- One set to accord with the NatureScot, 2017 Guidance, included as Volume 3A of the EIA Report; and
- One set to accord with the THC, 2016 Guidance, included as Volume 3B of the EIA Report.

1.1.10 Location plans for both sets of photomontages and wirelines are also provided. These plans also illustrate the field of view for each set of photomontages. It should be noted that the illustrated field of view fans for the THC 2016 Guidance, single frame images are representative of the field of view of these images but do not take account of permissible offsets in the angle of view.

1.2 Zone of Theoretical Visibility (ZTV) Production

1.2.1 Zone of Theoretical Visibility (ZTV) diagrams have been prepared using Esri ArcGIS, Version 10.8 (ArcGIS) and Esri ArcGIS Pro 3.5.2 and an Ordnance Survey (OS) Terrain 5 digital terrain model (DTM) to illustrate the potential visibility of the wind farm. The ZTVs have been prepared based on a viewer height of 2m above ground level in line with the NatureScot, 2017 Guidance, with earth curvature and light refraction set to 0.075.

1.2.2 Terrain 5 is a grid of heightened points with regular five metre post spacing. The software uses this information to create a virtual, three-dimensional, bare ground model which is representative of the earth's surface. It does not take into account elements above the ground such as buildings or trees. Therefore, while the ZTV indicates areas of potential visibility of the Proposed Varied Development, in reality, not all locations within the ZTV would necessarily afford a view of it. Nevertheless, the ZTV is a valuable tool in both landscape character and visual impact appraisal.

1.2.3 Terrain 5 is a product which is updated by OS on a quarterly basis. The terrain model was created using data available in 2025 and supplied to ASH by SSE Renewables.

[1] In 2020, Scottish Natural Heritage (SNH) rebranded as NatureScot. However when referencing guidance published by the organisation before this date, SNH has continued to be referred to as this was the name under which the guidance was published at that time.

1.2.4 ZTV diagrams produced as part of the cumulative landscape and visual assessment (CLVIA) have also been prepared using ArcGIS and the OS Terrain 5 data. Cumulative ZTVs have been produced with a radius of 40 km for turbines below 150 meters and 45 km for turbines above 150 meters.

1.3 Photography

1.3.1 Photographs have been taken using a full frame sensor (equivalent to a 35mm film frame), digital single lens reflex (DSLR) cameras. Cameras used include:

- Canon EOS 5D Mark II with Canon EF 50mm f/1.4 USM lens;
- Sony A7RIII ILCE-7RM3 with Canon 50mm f/1.2 lens; and
- Sony ILCE-7RM3 with Sony 50mm f/1.2 Sony DT50mm lens.

1.3.2 The details of the camera and lens used for each VP are included on the relevant photograph or photomontage.

1.3.3 Lenses were fitted with a Polarising filter and/or Neutral Grad filter where appropriate to maximise the quality of light balance and photography at source and minimise the need for computer enhancement.

1.3.4 The VP photographs were taken in landscape format by a camera attached to a tripod and rotating panoramic head unit (set to 20° intervals for daytime photographs) with a levelling base in order to maintain a stable platform for photography work, and to ensure an even overlap for successive panorama images. Photography was taken at a height of 1.5m above ground level.

1.3.5 On arrival at each VP location, a global positioning system (GPS) navigation device was switched on and allowed to acquire satellite positions. This device will identify its location, to the nearest metre, using a 12 figure OS grid reference, e.g. 252294 925050 or NC 52294 25050. In order to increase the accuracy of readings, the grid reference was not recorded until all other work at the VP was completed and the GPS device had been switched on for several minutes. This passage of time allows the GPS device to increase the accuracy of readings through repeated, automated measurements. All GPS readings taken were to a maximum of ±5 m accuracy.

1.3.6 Night-time baseline photography was taken at twilight (approximately thirty minutes after sunset). The appearance of existing lights (street lighting, domestic lighting, etc.) within the photographs is considered to be an accurate representation of the conditions.

1.3.7 While at a VP, the landscape architect or photographer recorded the grid reference, ground level and camera viewing height along with a brief description of the nature of view, weather conditions and visibility. The camera embeds details of the date, time, camera make and model, the lens focal length, shutter speed, f-number and ISO speed rating as metadata in each photograph file. A photograph of the tripod position was also taken.

1.3.8 Baseline photographs were then downloaded and combined to create 360° baseline panoramic images in cylindrical projection using PTGui software. Where applicable these were converted to planar projection using Hugin – Panorama Stitcher software (Hugin). All single frame images conform to the fields of view characteristic of the lenses they represent (50mm or 75mm).

1.3.9 As detailed in **Table 1.3.1** below, some adjustments were made using Adobe Photoshop CC 26.3.0 (Photoshop) to the baseline photographs. For example, to alter the brightness and/or contrast; to enhance the depiction of the existing turbines when they were not clear in the original photograph; and/or to remove and re-montage back in operational cumulative turbines to face the VP in line with best practice guidance.

Table 1.3.1: Viewpoint Photography

VP	OS Grid Coordinates	Date and Time	Weather Conditions	Notes
VP1	235061, 818397	11/09/2020 15:16	Around 30% cloud cover, slight haze.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP2 - Daytime	241975, 816565	24/09/2020 16:57	Overcast.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged. To ensure visibility of the Proposed Development turbines, a pitch angle of +3° has been applied to the baseline photo and cumulative wireline (**Figures 8.10.2.1 to 8.10.2.2**) and +1° to the wireline and photomontage (**Figures 8.10.3 and 8.10.4**)
VP2 - Nighttime	241967, 816572	25/09/25 19:45	Clear sky with a few scattered clouds.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP3	245699, 822202	03/04/2021 11:42	Blue sky with light winds. Haze in distant views.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP3 - Nighttime	245699, 822202	03/04/2021 11:42	Blue sky with light winds. Haze in distant views.	The daytime photograph for this VP has been manipulated to approximate night-time conditions, due to health and safety risks associated with undertaking hilltop photography at night.
VP5 - Daytime	244964, 810542	24/08/2020 14:08	Around 80% cloud cover, bright with sunny spells. Clear views in distance.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.

VP	OS Grid Coordinates	Date and Time	Weather Conditions	Notes
VP5 - Nighttime	244963, 810542	24/09/25 19:44	Around 35% cloud cover, clear views in distance.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP6	244256 810363	24/08/20 20 14:54	Around 40% cloud cover, bright with sunny spells and light winds.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP7	249743, 817317	23/09/20 20 11:55	Around 50% cloud cover, bright and sunny.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP8	258073, 832121	31/05/20 21 07:42	Around 40% cloud cover, calm with slight early morning haze.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP10	256110, 839075	24/08/20 20 07:49	Sunny, around 50% cloud cover, light wind. Some haze in distant views.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP12	222752, 821610	01/09/20 20 14:44	Clouds in views to south, but views towards site sunny with patchwork of clouds and blue sky, some haze in distant views.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP14	224543, 807880	06/09/20 20 16:52	Around 50% cloud cover, bright and sunny. Haze in distant views.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP15	239054, 797974	23/09/20 20 16:16	Around 40% cloud cover, excellent visibility with slight haze in valley. No wind.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP17	259368, 832474	23/09/20 20 10:20	Around 40% cloud cover, bright and sunny. Some haze in distance.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.

VP	OS Grid Coordinates	Date and Time	Weather Conditions	Notes
VP20	218283, 823945	01/04/2021 18:44	Blue sky with light winds.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP21	219449, 828285	17/09/2020 18:22	Around 30% cloud cover, haze in distant views.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP21	219449, 828285	17/09/2020 18:22	Around 30% cloud cover, haze in distant views.	The daytime photograph for this VP has been manipulated to approximate night-time conditions, due to health and safety risks associated with undertaking hilltop photography at night
VP26	221488, 809497	24/09/2020 15:31	Overcast.	Minor enhancement to brightness and contrast and existing visible cumulative baseline windturbines, removed and re-montaged. To ensure visibility of cumulative baseline turbines, a pitch angle of +4° has been applied to the baseline photo and cumulative wireline (**Figures 8.34.2.1 to 8.34.2.2**). No pitch angle has been applied to the wireline and photomontage (**Figures 8.34.3 and 8.34.4**).

1.4 Wireline Preparation

1.4.1 Wirelines of the Proposed Varied Development turbines and cumulative development turbines as required, were created for all viewpoints using ReSoft WindFarm software (ReSoft) using the specified turbine model (see paragraph 1.1.5) and Terrain 5 DTM (see section 1.2. Where appropriate, wirelines were converted to planar projection using Hugin. The turbines in the wirelines are shown to face the viewer with the turbine tip pointing directly vertical.

1.4.2 To help understand the relationship of the Proposed Varied Development to the operational Bhlaraidh Wind Farm, turbines for this development are shown on all 53.5° NatureScot, 2017 Guidance and 65.5° THC, 2016 Guidance compliant wirelines of the Proposed Varied Development where visible, in a dark grey colour.

1.4.3 The DTM shown in the wirelines is drawn as a mesh seen in perspective. In some instances, this can result in more distant parts of the view merging into a solid colour as the grid lines get closer together. To counteract this, an adaptive grid is used. The adaptive grid doubles the grid spacing every 2km from the viewpoint. This ensures a

simple, readable image is maintained. However, because of the limitations of the project size in Resoft, the terrain model cannot extend to infinity and is restricted to around 40km from the viewpoint. For this reason, the full backdrop and horizon line visible in photographs is not always represented in the wireline view. Wirelines should therefore always be viewed in combination with baseline photographs and photomontages.

1.4.4 Similar to the limitations of the ZTV, these visualisations provide an indication of the Proposed Varied Development's potential appearance but do not take account of screening elements such as buildings, trees or minor variations in topography.

1.5 Photomontage Preparation & Rendering

1.5.1 Photomontage visualisations were created using the wirelines and baseline panoramic photograph images described above. Turbines were rendered in Resoft and exported to Photoshop, using the wireline to position these accurately into the photograph. Tracks and other structures including the on-site substation and LiDAR positions were added where these would be visible using 3d georeferenced models and 43d Topos R2 which accurately places these features in the view. Final touch-up rendering to create a realistic image was applied in photoshop.

1.5.2 As with the wirelines, the turbines in the photomontages are shown to face the viewer directly. However, the turbine blades, are shown at random rotations to provide a greater sense of realism. However, where this would result in a blade not being visible due to foreground screening, the rotation of the affected turbine has been adjusted accordingly to ensure visibility.

1.5.3 The appearance of turbine lighting in the photomontages is based on experience of similar intensity turbine lighting in similar conditions and is considered to be an accurate representation.

1.6 Viewing Instructions

1.6.1 The graphic material used in this assessment is for illustrative purposes only and should not be considered completely representative of what the human eye will see. While visualisations can give a reasonable impression of the scale and distance to the Proposed Varied Development, they cannot show exactly what they will look like in reality. This is due to various factors, including the resolution of the image; and the static nature of visualisations which cannot convey movement of the turbine blades and changing light/shadows, weather and seasonality etc. As such, visualisations are best viewed at the viewpoint location to appreciate the wider context.

1.6.2 All visualisations, whether prepared in accordance with NatureScot or THC guidance should be printed at the specified size and viewed flat at a comfortable arm's length. The graphic below has been extracted from the THC, 2016 Guidance to illustrate how single frame images prepared in accordance with the THC guidance should be viewed.

The image should be viewed at a comfortable arm's length (approximately 500mm) and viewed normally with both eyes. The page should obscure any foreground not visible within the photomontage itself. This enables the photomontage to be directly compared within the wider context of the real landscape.

Plate 1.6.1: Viewing Instructions for Single Frame Visualisations, Extracted from the THC, 2016 Guidance

1.6.3 If visualisations are viewed on a computer screen, rather than printed at the specified size, they should be enlarged to the full screen height to give a realistic impression. Use of devices with smaller screens, such as tablets, should be avoided for viewing visualisations.

1.6.4 It should be noted that, that the THC, 2016 Guidance 75mm focal length photomontage and the NatureScot, 2017 Guidance 53.5° field of view images, when printed at the correct size, illustrate an image greater than actual size if held at a comfortable arms length. This is intended to counteract the effects of a loss of relative perspective when viewing a flat image. It is important to note that these visualisations are provided for illustrative purposes to support the LVIA and are presented in a format to conform with the NatureScot, 2017 and THC, 2016 Guidance. Whilst they provide a helpful tool for assessment purposes, the judgements of landscape and visual effects reported in the LVIA are not reached wholly on the basis of these images, but through the landscape architect's professional experience and understanding of how the Proposed Varied Development would appear in the field.