TECHNICAL APPENDIX 7.1: TECHNICAL METHODOLOGIES FOR VISUAL REPRESENTATION

1. Technical Appendix 7.1: 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 LVIA.

1.1.2 The Landscape and Visual Impact Assessment (LVIA) of the Proposed 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, 2017: 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, 2017; para 98, p22).

1.1.4 Viewpoint (VP) photography has been undertaken by ASH design + assessment Ltd (ASH), Gray Caledonian Photography and Karen Thorburn Photography. All editing and modelling has been completed by ASH.

Turbine Specifications

1.1.5 The turbines considered in the assessment of the Proposed Development were modelled in accordance with the dimensions stated in Chapter 3: Description of Development as follows:

- Hub Height: 80.9 m
- Rotor Diameter: 138 m
- Overall Tip Height: 150 m.

1.1.6 Although the specified turbine height for the application has a tip height of 149.9m, a 150m turbine has been used for all visualisations as a worst case.

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

Table 1.1.1: Proposed Development – Turbine Locations

Turbine Number	Ordnance Survey (OS) Grid Coordinates	Base Elevation (m AOD)
C1	NH 46783 04218	639
C2	NH 47321 04180	642
C3	NH 47972 03060	667
C4	NH 47289 02902	681
C5	NH 47084 03411	633
C6	NH 47759 04458	650
C7	NH 48149 04689	652
C8	NH 48433 05039	664

Turbine Number	Ordnance Survey (OS) Grid Coordinates	Base Elevation (m AOD)
C9	NH 48141 02548	720
C10	NH 47133 02313	694
C11	NH 46917 01717	695
C12	NH 47584 01964	702
C13	NH 46624 01159	701
C14	NH 46598 03094	639
C15	NH 46328 02556	683
C16	NH 46665 02253	683
C17	NH 46200 02005	693
C18	NH 46029 01215	703
C19	NH 47940 01628	703
C20	NH 47944 00942	731
C21	NH 48380 00690	721
C22	NH 48999 00802	699
C23	NH 48496 01189	716
C24	NH 48479 02007	720
C25	NH 49090 02015	723
C26	NH 49193 01495	682
C27	NH 49798 00871	715
C28	NH 49475 00443	727
C29	NH 55605 01455	748
C30	NH 56001 01903	709
C31	NH 56641 02276	736
C32	NH 57165 02794	742
C33	NH 56751 03157	713
C34	NH 57337 03339	751
C35	NH 57234 03946	739
C36	NH 56658 04129	738

Current Guidance

1.1.8 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, (2017), Visual Representation of Wind Farms (Version 2.2) (the SNH, 2017 Guidance).
- The Highland Council (THC), (2016), Visualisation Standards for Wind Energy Developments (the THC, 2016 Guidance).

1.1.9 The Landscape Institute recently published a revision to its visualisation technical guidance (below). While the guidance prepared by SNH and THC are the most relevant for the Proposed Development, this document is also a useful reference guide.

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

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

- One set to accord with the SNH, 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.

1.1.11 Location plans for both sets of photomontages and wirelines are included in Volume 3B of the EIA Report. These plans also illustrate the field of view for THC, 2016 Guidance panoramic and single frame montages. It should be noted that the illustrated field of view fans for 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 10.7 (ArcGIS) 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 current guidance (SNH, 2017), 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 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 While Terrain 5 is a product which is updated by OS on a quarterly basis, the terrain model was created using data available in 2019 and supplied to ASH by SSE. The terrain model has not been updated since that time. This prevents excessive reworking of models and allows for continuity during the appraisal process.

1.2.4 ZTV diagrams produced as part of the cumulative landscape and visual assessment (CLVIA) have also been prepared using ArcGIS and the same OS Terrain 5 data. Cumulative ZTVs have been run up to 40km from each cumulative site included in the CLVIA.

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
- Canon EOS 6D with Canon EF 50mm f/1.4 USM lens; and
- Nikon D810 with Sigma 50mm 1:2.8 prime 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) 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. 132807 925438 or NB 32807 25438. 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 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.

1.3.7 Baseline photographs were then downloaded and combined to create 360° baseline panoramic images in cylindrical projection using Kolor Autopano Pro 3 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).

1.3.8 As detailed in Table 1.3.1 below, some adjustments were made using Adobe Photoshop CC 2019 (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	NH 21906 25555	06/07/19, 11.51	Fine weather with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP2	NH 49330 24347	01/08/19, 16:39	Clear conditions with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible,

VP	OS Grid Coordinates	Date and Time	Weather Conditions	Notes
				removed and re-montaged.
VP3	NH 45889 22181	20/09/19, 15:18	Bright and sharp, very low winds.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP4	NH 59863 14300	03/10/19, 08:10	Bright, little to no haze, winds strengthening.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP5	NH 51675 09519	13/10/19, 10:13	Cloudy, some haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP6	NH 54356 07217	31/07/19, 08:27	Bright, somewhat cloudy.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP7	NH 41679 03397	30/07/19, 12:01	Bright with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP8	NH 63545 02427	28/06/19, 12:56	Excellent, clear sky	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP9	NN 56145 98766	25/08/19, 11.10	Bright, sharp, some clouds.	Minor enhancement to brightness and contrast.
VP10	NN 95300 99906	08/07/19, 11:35	Bright, clear, light haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP11	NN 47216 90352	22/06/19, 09:56	Bright but heavy clouds.	Minor enhancement to brightness and contrast and existing

VP	OS Grid Coordinates	Date and Time	Weather Conditions	Notes
				wind turbines visible, removed and re-montaged.
VP12	NN 53411 90479	21/09/19, 09:05	Crisp and clear, some blustery winds.	Minor enhancement to brightness and contrast.
VP13	NN 50441 81229	07/09/19, 11:24	Low wind, bright, little haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP14	NH 21165 02845	26/06/19, 14:01	Light wind, clear, great visibility.	Minor enhancement to brightness and contrast.
VP15	NN 36142 85969	07/07/19, 10:58	Bright, mainly dry, low winds.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP16	NN 42847 94138	31/10/19, 11:12	Bright, sharp, few clouds.	Minor enhancement to brightness and contrast.
VP17	NN 35029 96630	26/06/19, 11:07	Light wind, clear, great visibility.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP18	NN 55806 91384	21/09/19, 10:44	Fine weather, crisp and clear.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP19	NN 67701 82147	27/06/19, 09:49	Good weather, some haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP20	NH 53103 28638	02/08/19, 11:02	Cloudy, slight haze.	Minor enhancement to brightness and contrast.

1.4 Wireline Preparation

1.4.1 Wirelines of the Proposed 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 1.1.10). 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 Development to the existing Stronelairg Wind Farm, Stronelairg turbines are shown on all 53.5° SNH compliant wirelines of the Proposed 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 5km 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 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.

Monochrome images

1.5.3 Monochrome images have been produced to comply with the THC, 2016 Guidance for all VPs where other existing or proposed wind farms are visible within the 75mm single frame image. Monochome images have been created by converting the single frame colour image in Photoshop before adding the rendered turbines from ReSoft Windfarm as described above.

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 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 SNH 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.