

**TECHNICAL APPENDIX 8.1: TECHNICAL METHODOLOGIES FOR VISUAL REPRESENTATION**

1.1. Introduction	1
1.2. Turbine Locations	1
1.3. Current Guidance	2
1.4. Zone of Theoretical Visibility (ZTV) Production	3
1.5. TrueViewVisuals	3
1.6. Photography	3
1.7. Wireline Preparation	8
1.8. Photomontage Preparation & Rendering	8
1.9. Viewing Instructions	9

# 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 Development included in Chapter 8 of this EIA Report (EIAR) 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”<sup>1</sup> 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”<sup>2</sup>.*

1.1.4 Viewpoint photography was undertaken by either ASH design + assessment or Creative Sides Photography. All editing and modelling to inform the LVIA has been undertaken by ASH design + assessment Ltd.

## 1.2 Turbine Locations

1.2.1 The turbines considered in this assessment of the Proposed Development were modelled in accordance with the following dimensions:

- Hub Height: 105m;
- Rotor Diameter: 150m; and
- Overall Tip Height: 180m.

1.2.2 The locations of the proposed turbines are as follows:

**Table 1: Turbine Locations**

Turbine No.	British National Grid Coordinates		Base Height (metres Above Ordnance Datum)
	Easting	Northing	
T1	238385	821688	518.76
T2	238364	821034	516.16
T3	238925	821693	535.61
T4	239380	821326	499.27
T5	239523	822070	535.34
T6	238277	822170	525.37
T7	238704	820694	498.37
T8	238771	820273	505.65

<sup>1</sup> Scottish Natural Heritage, (2017), *Visual Representation of Wind Farms (Version 2.2)*. para 96, p22.

<sup>2</sup> Scottish Natural Heritage, (2017), *Visual Representation of Wind Farms (Version 2.2)*. para 98, p22.

Turbine No.	British National Grid Coordinates		Base Height (metres Above Ordnance Datum)
	Easting	Northing	
T9	239348	820077	461.8
T10	239501	820920	475.27
T11	238876	821220	532.46
T12	239955	821460	515.14
T13	240789	821549	528.31
T14	240252	820478	450.03
T15	239933	820784	489.77
T16	239852	820120	442.03
T17	240372	821198	490.41
T18	240876	821077	495.61

### 1.3 Current Guidance

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

- Visual Representation of Wind Farms (Version 2.2) (SNH<sup>3</sup>, now NatureScot, 2017 Guidance).<sup>4</sup>
- Visualisation Standards for Wind Energy Developments (The Highland Council (THC), 2016 Guidance).<sup>5</sup>

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

- TGN 06/19 Visual Representation of Development Proposals.<sup>6</sup>

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

- One set to accord with the SNH, 2017 Guidance<sup>4</sup>, included as Volume 3a of the EIA; and
- One set to accord with the THC, 2016 Guidance<sup>5</sup>, included as Volume 3b of the EIA.

1.3.4 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.

<sup>3</sup> Scottish Natural Heritage (SNH) formally changed their name to NatureScot on 24 August 2020. Many of their documents referred to in this EIA report were published prior to this date. As such reference is still made to SNH where appropriate.

<sup>4</sup> Scottish Natural Heritage, (2017), *Visual Representation of Wind Farms (Version 2.2)*. Routledge.

<sup>5</sup> The Highland Council, (2016), *Visualisation Standards for Wind Energy Developments*.

<sup>6</sup> The Landscape Institute, (2019), *TGN 06/19 Visual Representation of Development Proposals*

## **1.4 Zone of Theoretical Visibility (ZTV) Production**

- 1.4.1 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 Proposed Development. The ZTVs have been prepared based on a viewer height of 2m above ground level in line with current guidance<sup>4</sup>, with earth curvature and light refraction set to 0.075.
- 1.4.2 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.
- 1.4.3 While Terrain 5 is a product which is updated by OS on a quarterly basis, the design and appraisal model was created using data available in 2019 and supplied to ASH by the Applicant. This terrain model has not been updated since that time. This prevents excessive reworking of models and allows for continuity during the appraisal process.
- 1.4.4 ZTV diagrams produced as part of the cumulative landscape and visual impact assessment (CLVIA) have also been prepared using ArcGIS (Version 10.3) and the OS Terrain 5 data. Cumulative ZTVs have been run for the full Terrain 5 data extent, so do not take account of the effects of distance on perception.

## **1.5 TrueViewVisuals**

- 1.5.1 The mobile tablet application TrueViewVisuals ([www.trueviewvisuals.com](http://www.trueviewvisuals.com)) was used to assist with the LVIA. TrueViewVisuals helps with gaining a thorough understanding of the potential visual impact of the turbines whilst in the field and can be used to microsite viewpoint photography accurately. While it enables an appreciation of the potential landscape and visual impacts during field assessment, it is not used for photomontages or other presentation purposes.

## **1.6 Photography**

- 1.6.1 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; and
  - Sony A7RIII ILCE-7RM3 with Canon 50mm f/1.2 lens.
- 1.6.2 The details of the camera and lens used for each VP are included on the relevant photograph or photomontage.
- 1.6.3 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.
- 1.6.4 The viewpoint photographs were taken in landscape format by a camera attached to a tripod and rotating panorama 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 1.5 m above ground level.

- 1.6.5 On arrival at each viewpoint (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 twelve 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  $\pm 5$  m accuracy.
- 1.6.6 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.
- 1.6.7 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 (50 mm or 75 mm).
- 1.6.8 As detailed in Table 2 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<sup>4,5</sup>.

**Table 2: Viewpoint Photography**

VP	British National Grid Coordinates	Date and Time of Photography	Weather Conditions	Notes
VP 1	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.
VP 2	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

VP	British National Grid Coordinates	Date and Time of Photography	Weather Conditions	Notes
				photomontage (Figures 8.10.3 and 8.10.4)
VP 3	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.
VP 4	252144, 830624	13/04/2021 08:13	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.
VP 5	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 6	244256 810363	24/08/2020 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.
VP 7	249743, 817317	23/09/2020 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.
VP 8	258073, 832121	31/05/2021 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.
VP 9	259879, 814376	31/05/2021 11:28	Around 30% cloud cover, bright and sunny with slight breeze. Some haze in distant views.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 10	256110, 839075	24/08/2020 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

VP	British National Grid Coordinates	Date and Time of Photography	Weather Conditions	Notes
				turbines, removed and re-montaged.
VP 11	224901, 828054	20/09/2020 16:44	High clouds and slight haze, especially to west. Excellent visibility.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 12	222752, 821610	01/09/2020 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.
VP 13	212993, 813884	18/09/2020 16:54	Around 50% cloud cover, haze in distant views.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 14	224543, 807880	06/09/2020 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.
VP 15	239054, 797974	23/09/2020 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.
VP 16	256145, 798766	30/05/2021 12:30	Around 70% cloud, sunny with light breeze. Haze in distance.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 17	259368, 832474	23/09/2020 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 18	247262, 846684	03/04/2021 07:46	Blue sky with light winds. Some haze in distant views.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind

VP	British National Grid Coordinates	Date and Time of Photography	Weather Conditions	Notes
				turbines, removed and re-montaged.
VP 19	214810, 822924	27/05/2021 20:46	Cloudy to west, but blue sky in direction of Proposed Development. Calm wind and good visibility.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 20	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.
VP 21	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.
VP 22	228902, 842603	29/09/2020 17:02	Around 70% cloud cover, especially in direction of Proposed Development. Haze in views south, not as marked to north.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 23	245032, 866581	24/04/2021 09:19	Blue sky, sunny with light wind. Some haze in distant views and valley.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 24	256730, 861462	08/10/2020 09:46	Around 25% cloud cover, bright and sunny.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 25	261234, 853906	08/10/2020 08:46	Around 20% cloud cover, sunny with slight breeze.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind turbines, removed and re-montaged.
VP 26	221488, 809497	24/09/2020 15:31	Overcast.	Minor enhancement to brightness and contrast and existing visible cumulative baseline wind



VP	British National Grid Coordinates	Date and Time of Photography	Weather Conditions	Notes
				turbines, 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)

## 1.7 Wireline Preparation

- 1.7.1 Wirelines of the Proposed Development's turbines and cumulative development turbines as required, were created for all viewpoints using ReSoft WindFarm software (ReSoft) using the specified turbine dimensions (see paragraph 2.1 above) and Terrain 5 DTM (see Section 4 above). 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.
- 1.7.2 To help understand the relationship of the Proposed Development to the Operational Development, Operational Development turbines are shown on all 53.5° NatureScot compliant wirelines of the Proposed Development, where visible, in a dark grey colour.
- 1.7.3 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 5 km 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 40 km 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.
- 1.7.4 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.

## 1.8 Photomontage Preparation & Rendering

- 1.8.1 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.

- 1.8.2 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***

- 1.8.3 Monochrome images have been produced to comply with the THC, 2016 Guidance<sup>5</sup> for all VPs where cumulative developments are visible within the 75 mm single frame image. Monochrome images have been created by converting the single frame colour image in Photoshop before adding the rendered turbines from ReSoft Windfarm as described above.

## **1.9 Viewing Instructions**

- 1.9.1 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.
- 1.9.2 All visualisations, whether prepared in accordance with SNH guidance<sup>4</sup> or THC guidance<sup>5</sup> 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's '*Visualisation Standards for Wind Energy Developments*'<sup>5</sup> to illustrate how single frame images prepared in accordance with the THC guidance should be viewed.
- 1.9.3 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.
- 1.9.4 It should be noted that the THC, 2016 Guidance 75mm focal length photomontage and the SNH, 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 arm's 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 SNH, 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 Development would appear in the field.



*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.*