ANNEX 2: TECHNICAL METHODOLOGIES FOR VISUAL REPRESENTATION

1 Introduction

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

1.2 The LVIA of the Proposed Varied Development included in Chapter 4: Landscape and Visual Amenity (EIAR Volume 2) is informed by several technical models and drawings. The methods for producing these are described below.

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*"[1] 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*"[2].

1.4 Viewpoint photography was undertaken by either ASH design + assessment or Gray Caledonian Photography. All editing and modelling to inform the landscape visual impact appraisal has been undertaken by ASH design + assessment Ltd.

2 Turbine Locations

2.1 The turbines considered in this assessment of the Proposed Varied Development were modelled in accordance with the dimensions stated in Chapter 2: Description of Development (EIAR Volume 2) as follows:

- Hub Height: 119 m;
- Rotor Diameter: 162 m; and
- Overall Tip Height: 200 m.

2.2 The locations of the proposed turbines are as follows:

Table 4.1.1: Turbine Locations

Turbine No.	British National Grid Coordinates		Base Height (metres Above Ordnance Datum)
	Easting	Northing	
T1	280619	953031	148
T2	281155	952737	179
T4	280687	952437	155
T6	281205	952237	175
T8	280675	951871	155
T9	281141	951618	164
T10	280139	951650	138
T11	280653	951295	159
T13	280144	951050	146
T15	281058	950872	172
T17	280598	950707	164

[1] Scottish Natural Heritage, (2017), *Visual Representation of Wind Farms (Version 2.2)*. para 96, p22.
[2] Scottish Natural Heritage, (2017), *Visual Representation of Wind Farms (Version 2.2)*. para 98, p22.

Table 4.1.1: Turbine Locations			
T18	281049	950334	184
T19	280030	950461	149
T20	280413	950162	165
T22	279973	949829	152
T24	280781	949792	182
T26	280279	949361	180
T28	279786	949085	157
T29	279022	950112	161
T30	279413	949703	155
T33	279165	949159	166
T35	277397	949254	192
T36	278217	949225	193
T39	277866	949638	177
T41	277431	949983	191
T42	278375	949964	176
T43	278763	949581	177
T45	278263	950529	176
T46	278855	950613	155
T47	278555	951001	169
T49	277856	951064	177
T50	278264	951400	180
T52	277806	951652	170
T56	278297	951962	179
T57	278737	951687	162
T61	279119	952086	148
T69	278372	953507	160
T70	278683	953059	174
T72	279165	953538	132

3 Current Guidance

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) (the SNH, 2017 Guidance).[3]
- Visualisation Standards for Wind Energy Developments (the THC, 2016 Guidance).[4]

[3] Scottish Natural Heritage, (2017), *Visual Representation of Wind Farms (Version 2.2)*. *Routledge.*
[4] The Highland Council, (2016), *Visualisation Standards for Wind Energy Developments*.

3.2 The Landscape Institute recently published a revision to its visualisation technical guidance (below). While the guidance prepared by NatureScot[5] and THC are the most relevant for the Proposed Varied Development, this document is also a useful reference guide.

- TGN 06/19 Visual Representation of Development Proposals.[6]

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

- One set to accord with the SNH, 2017 Guidance[3], included as Volume 3b of the EIAR; and
- One set to accord with the THC, 2016 Guidance[4], included as Volume 3b of the EIAR.

3.4 Location plans for both sets of photomontages and wirelines are included in Volume 3b of the EIAR with the figures prepared in line with the THC, 2016 guidance[4].

4 ZTV Production

4.1 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 Proposed Varied Development. The ZTVs have been prepared based on a viewer height of 2 m above ground level in line with current guidance[3], with earth curvature and light refraction set to 0.075.

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 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.

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.

4.4 ZTV diagrams produced as part of the cumulative landscape and visual assessment (CLVIA) have also been prepared using ArcGIS (Version 10.3) and the OS Terrain 5 data. Cumulative ZTVs have been run up to 60 km from each cumulative site included in the CLVIA.

5 TrueViewVisuals

5.1 The mobile tablet application TrueViewVisuals (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 locate 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.

6 Photography

6.1 Photographs have been taken using one of two full frame sensor (equivalent to a 35 mm film frame), digital single lens reflex (DSLR) cameras: either a Canon EOS 5D Mark II or a Canon EOS 6D. Both of these cameras have been fitted with the Canon EF 50 mm f/1.4 USM lens (a 50 mm prime lens). 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.

[5] Scottish Natural Heritage (SNH) formally changed their name to NatureScot on 24 August 2020. Many of their documents referred to in this report were published prior to this date. As such reference is still made to SNH where appropriate.
[6] The Landscape Institute, (2019), *TGN 06/19 Visual Representation of Development Proposals*

6.2 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 and 15° intervals for night-time photography) 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.

6.3 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 ±5 m accuracy.

6.4 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.

6.5 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.

6.6 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 (50 mm or 75 mm).

6.7 As detailed in Table 4.1.2 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[3],[4].

Table 4.1.2: Viewpoint Photography

Viewpoint	British National Grid Coordinates	Date and Time of Photography	Weather Conditions	Notes
VP1	283185, 941167	26/08/19, 10:08	Good weather, some haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP2	292003, 937695	20/08/19, 11:20	Cloudy, slight haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP3 – Day-time	295343, 957116	26/07/19, 12:35	Good weather, bright with broken cloud, slight haze.	Minor enhancement to brightness and contrast and existing wind turbines visible,

Table 4.1.2: Viewpoint Photography				
				removed and re-montaged.
VP3 – Night-time	295343, 957116	26/07/19, 12:35 (Daytime photo manipulated)	Sharp with some cloud.	A night-time photo was not taken from this viewpoint. The baseline photo is a manipulated version of the day-time photograph. The light levels of day-time photography were manipulated to approximate night-time conditions captured in night-time photographs for VP4, VP5 and VP7.
VP4 – Day-time	291737, 964451	15/08/19, 09:57	Bright, sharp, some clouds.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP4 – Night-time	291980, 964461	08/10/19, 19:12	Sharp, high cloud.	Minor enhancement to brightness and contrast.
VP5 – Day-time	284158, 965040	15/08/19, 10:20	Bright, sharp, broken clouds.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP5 – Night-time	284166, 965031	10/10/19, 18:54	Sharp, high clouds.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP6	274862, 961925	15/08/19, 12:01	Bright, clear, some high cloud	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP7 – Day-time	269437, 957272	15/08/19, 12:31	Bright, sharp, broken clouds.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP7 – Night-time	269489, 957272	10/10/19, 18:57	Sharp, high cloud	Minor enhancement to brightness and contrast.

Table 4.1.2: Viewpoint Photography				
VP8	257961, 949822	23/07/19, 11:19	Bright, broken clouds, slight haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP9	267353, 928879	21/07/19, 9:57	Cloudy, some distant haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP10	294954, 960923	26/07/19, 09:30	Bright with some high cloud, some haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP10 – Night-time	294954, 960923	26/07/19, 09:30 (Daytime photo manipulated)	Bright with some high cloud, some haze.	A night-time photo was not taken from this viewpoint. The baseline photo is a manipulated version of the day-time photograph. The light levels of day-time photography were manipulated to approximate night-time conditions captured in night-time photographs for VP4, VP5 and VP7.
VP11	288982, 942360	15/08/19, 11:09	Bright, sharp, broken clouds.	Minor enhancement to brightness and contrast.
VP12	251844, 960034	15/08/19, 13:14	Bright, sharp, broken clouds.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP13	305958, 969490	10/10/19, 13:52	Bright, sharp, some high clouds.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP14	320519, 976504	10/10/19, 12:29	Cloudy with haze	Minor enhancement to brightness and contrast.

7 Wireline Preparation

7.1 Wirelines of the Proposed Varied Development's turbines and cumulative development turbines as required, were created for all viewpoints using ReSoft WindFarm software (ReSoft) using the specified turbine model (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.

7.2 To help understand the relationship of the Proposed Varied Development to the existing Strathy North wind farm, Strathy North turbines are shown on all 53.5° NatureScot compliant wirelines of the Proposed Varied Development where visible, in a dark grey colour.

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.

7.4 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.

8 Photomontage Preparation & Rendering

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.

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.

8.3 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.

Monochrome Images

8.4 Monochrome images have been produced to comply with the THC, 2016 Guidance[4] 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.

9 Viewing Instructions

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 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.

9.2 All visualisations, whether prepared in accordance with SNH guidance[3] or THC guidance[4] 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*'[4] to illustrate how single frame images prepared in accordance with the THC guidance should be viewed.

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.

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.