HEATHLAND WIND FARM

TECHNICAL APPENDIX A6.2

ZTV MAPPING AND VISUALISATION METHODOLOGY

JANUARY 2021

A6.2 ZTV MAPPING AND VISUALISATION METHODOLOGY

This appendix sets out the approach to the production of the visualisations which accompany the Heathland Wind Farm Landscape and Visual Impact Assessment (LVIA) and Cumulative Landscape and Visual Impact Assessment (CLVIA) set out in Chapter 6: Landscape and Visual Amenity, Volume 1 of the Environmental Impact Assessment Report (EIA Report). Figures referred to in this appendix are located in Volume 2b: LVIA Figures and Volume 2c: LVIA Visualisations.

The methodology for the production of visualisations was based on current good practice guidance from NaureScot (formerly SNH)[1] and the Landscape Institute[2]. Further information about the approach is provided below.

Paper Maps Used

- Ordnance Survey (OS) Maps:
  - Landranger 1:50,000 Scale (Sheets 65, 72); and
  - Explorer 1:25,000 Scale (Sheets 349, 343, 3440).
- *Online map search engines:*
  - Bing, mapping website (Online - Available at: www.bing.com/maps); and
  - Google, mapping website (Online - Available at: www.maps.google.com).

Data Used for Digital Terrain Modelling (DTM)

- OS Terrain® 5 mid-resolution height data (DTM) (5m grid spacing, 2.5 metres RMSE);
- Ordnance Survey 1:25,000 raster data (to provide detailed maps for viewpoint locations);
- Ordnance Survey 1:50,000 raster data (to show surface details such as roads, forest and settlement detail equivalent to the 1:50,000 scale Landranger maps); and
- Ordnance Survey 1:250,000 raster data (to provide a more general location map).

A6.2.1 ZONE OF THEORETICAL VISIBILITY (ZTV) MAPPING

Evaluation of the theoretical extent to which the wind farm would be visible across the Study Area was undertaken by establishing a ZTV using specific computer software designed to calculate the theoretical visibility of the proposed turbines within its surroundings. ESRI's ArcMap 10.5.1 software was used to generate the ZTV. The Spatial Analyst/Viewshed tool does not use mathematically approximate methods. This program calculates areas from which the turbine hubs and maximum blade tip height are potentially visible. This is performed on a 'bare ground' computer generated terrain model, which does not take account of potential screening by buildings or vegetation. It should be noted that the software uses raster[3] height data, but while it is displayed as continuous data (with each grid square referred to as a 'cell'), it assumes a single height value from the centre of that cell for the whole cell. Therefore, any height variations between centre points of cells will not be recognised.

The DTM used for the LVIA analysis is OS Terrain® 5 height data, obtained from Ordnance Survey in 2020. The root-mean-square error (RMSE) of this data is 2.5m. The DTM data is represented by 5x5m grids, which means that the software calculates the

[1] Scottish Natural Heritage (2017). Visual Representation of Wind Farms, Version 2.2.
[2] Landscape Institute (2019). Advice Note 01/11 Photography and photomontage in landscape and visual impact assessment.
[3] Raster data is a matrix of cells (or pixels) which contain a value representing information.

number of turbines visible from the centre point of each 5x5m grid/square area. This data was used to calculate visibility within the 45km Study Area. Visibility outwith the 45km buffer was based on the OS Terrain™ 50 height data (25m contour).

The DTM data has been not been altered (i.e. by the addition of local surface screening features) for the production of the ZTV. We have not identified any significant discrepancies between the used DTM and the actual topography around the Study Area. The effect of earth curvature and light refraction has been included in the ZTV analysis and a viewer height of 2m above ground level has been used. As it uses a 'bare ground' model, it is considered to over emphasise the extent of visibility of the Development and therefore represents a 'maximum potential visibility' scenario. The ZTV is used as a starting point in the assessment to provide an indication of theoretical visibility. This information is verified in the field so that the assessment conclusions represent the actual visibility of the proposals reasonably accurately.

The ZTV was calculated to show the potential number of turbines visible to maximum blade tip height (150m for T1-T3 and 180m for T4-T14) and maximum hub height (83.5m for T1-T3 and 101m for T4-T14). The ZTV calculated to blade tip height is shown on Figure 6.1.2a and Figure 6.1.2b, the hub height ZTV is shown in Figure 6.1.3a and Figure 6.1.3b. Subsequent figures which include the ZTV make use of the ZTV to maximum blade tip height.

To construct cumulative ZTVs (CZTVs) to illustrate the cumulative visibility of the Development in conjunction with other wind farms, the ZTV to tip height of each wind farm was generated (based on the tip height of each turbine to an applicable maximum radius in accordance with the current guidance (SNH, 2017)), and then combined with the Development ZTV (45km radius). The CZTVs are colour coded to distinguish between areas where the Development is predicted to be visible (either on its own, or in conjunction with other wind farms), and areas where other wind farms would be visible, but the Development would not.

A6.2.2 VIEWPOINT PHOTOGRAPHY

The methodology for photography is in accordance with guidance from Scottish Natural Heritage[4] and the Landscape Institute[5]. The focal lengths used are in accordance with recommendations contained in guidance and are stated on the figures. Photography was undertaken by LUC between October 2019 and September 2020. A Nikon D750 and a D700 full frame sensor digital single lens reflex (SLR) camera, with a fixed 50mm focal length lens, was used to undertake photography from all viewpoint locations.

A tripod with vertical and horizontal spirit levels was used to provide stability and to ensure a level set of adjoining images. The camera was orientated to take photographs in portrait format from Viewpoints 1 - 2, given their close proximity to the site, and in landscape format from Viewpoints 3 - 18. A panoramic head was used to ensure the camera rotated about the no-parallax point of the lens in order to eliminate parallax errors[6] between the successive images and enable accurate stitching of the images. The camera was moved through increments of 15° (degrees) for Viewpoints 1 – 2 and 24° for Viewpoints 3 – 18. The camera was rotated through a full 360° at each viewpoint. 24 photographs were taken for each 360° view in portrait format, and fifteen photographs for each 360° view in landscape format.

[4] Scottish Natural Heritage (2017). Visual Representation of Wind Farms, Version 2.2.
[5] Landscape Institute (2019). Advice Note 01/11 Photography and photomontage in landscape and visual impact assessment.
[6] Parallax is the difference in the position of objects when viewed along two different lines of sight. In the case of a camera this would occur if the rotation point of the lens was not constant and would result in stitching errors in the panorama.

The location of each viewpoint and information about the conditions was recorded in the field in accordance with NatureScot (SNH, 2017) and LI guidance (LI, 2019).

Weather conditions and visibility were considered an important aspect of the field visits for the photography. Where possible, visits were planned around clear days with good visibility. Viewpoint locations were visited at times of day to ensure, as far as possible, that the sun lit the scene from behind, or to one side of the photographer. South facing viewpoints can present problems particularly in winter when the sun is low in the sky. Photography opportunities facing into the sun were avoided where possible to prevent the wind turbines appearing as silhouettes. Adjustments to lighting of the turbines were made in the rendering software to make the turbines appear realistic in the view under the particular lighting and atmospheric conditions present at that time the photography was taken.

A6.2.3 VISUALISATIONS

A6.2.3.1 Photographic Stitching, Wirelines and Photomontages

Wirelines are computer generated line drawings which show outlines of the proposed turbines and the bare earth topography. Photomontages are computer generated images of the proposed development modelled into the actual baseline photography. Wirelines and photomontages are assessment tools and are not a substitute for site visits. They don't convey turbine movement and are representative of views but can't represent visibility at all locations.

Photographic stitching software PTGui© 11.19 has been used to stitch together the adjoining frames to create panoramic baseline photography. A selection of identical control points has been created within each of the adjoining frames to increase the level of accuracy when stitching the 360° panoramic photography.

The software package ReSoft© WindFarm version 4.2.5.3 was used to create a digital terrain model (DTM) from OS Terrain® 5 height data. The DTM includes the Site, viewpoint locations and all landform visible within the baseline photography. Turbine and viewpoint location coordinates were entered. Photomontages have been constructed to show the candidate turbine with the specified tip and hub height. A default viewer height of 1.5m above ground level has been set in the ReSoft© software, however on limited occasions this viewer height has been increased by a small increment to achieve a closer match between the terrain data and photographic landform content[7].

Wind farm layouts included within the cumulative assessment have been added to the ReSoft© WindFarm model.

The Panoramic baseline daytime photographic images were imported into ReSoft© WindFarm software. From each viewpoint the wireline views of the landform model with the proposed turbines were carefully adjusted to obtain a match. Fixed features on the ground, such as buildings and roads, were located in the model and used as markers to help with the alignment process where necessary. Each view was rendered taking account of the sunlight and the position of the sun in the sky at the time the photograph was taken. Blade angle and orientation adjustments were also made to represent a realistic situation.

The exported renders were imported into Adobe Photoshop© where they were aligned and composited with the baseline photography. Turbines or sections of turbines which were located behind foreground elements in the photograph were masked out (removed) to create the photomontage. Where visible, forest removal (including forestry which has/ will be removed between the day of photography and when the wind farm will

[7] An altered height above ground level was used for mountain summits where local topography did not match the wireframes due to data resolution.

theoretically be operational, in 2027) and infrastructure associated with the Development has been modelled into photomontages, within 5km.

Finally, where applicable, the images were converted from Cylindrical Projection to Planar Projection using PTGui© 11.19 software.

3ds Max software was used to render the turbines with the aviation lighting proposed for the development. These light sources were created to match the specifications provided by Wind Power Aviation Consultants (refer to Appendix A14.1 and Appendix A6.4) in terms of luminous intensity (candela units), colour and position. Real-time camera data was imported into the 3DS Max physical camera setups within the 3D models environment including F-stop and FOV (field of view) values. Depth of field (Bokeh) and vertical & horizontal lens shift data was also used to give additional accuracy to the placement of the views and enhance the depth and light level distortion from the required viewpoints. The sunlight and daylight system created within the software was set to accurately simulate the natural light still present at the date, time and geographical location of night-time photography. The turbines in the night views are orientated with the hub facing the viewer (and not obscured by turbine blades). This ensures that the images show the maximum visibility of lighting that is proposed to be installed on the hubs, along with any intermediate lighting that is required on the main structural columns.

As with the daytime images the exported renders were then composited with the baseline photographic view using Adobe Photoshop© software and converted from Cylindrical Projection to Planar Projection using PTGui© software.

A6.2.3.2 Figure Layout

The printed figures for the viewpoints produced in accordance with NatureScot requirements are presented in Volume 2b: LVIA Figures.

Adobe InDesign© software was used to present the figures. The dimensions for each image (printed height and field of view) are in accordance with NatureScot requirements. Photography information and viewing instructions are provided on each page where relevant.

The elongated A3/A1 width format pages for each viewpoint are set out as follows. This follows NatureScot visualisation standards:

- The first A3 page contains an OS 1:50,000 scale map showing the viewpoint location, direction of the 90˚ baseline photography, wireline views and 53.5˚ photomontage view. Wind turbine locations for the Development are also shown when visible in the map view;
- The following page contains 90˚ baseline photography and wireline to illustrate the wider landscape and visual context. These are shown in cylindrical projection and presented on an A1 width page. Additional pages in the same format are provided where relevant to illustrate wider cumulative visibility up to 360˚; and
- The subsequent two pages contain a 53.5˚ wireline and photomontage. These images are both shown in planar projection and presented on an A1 width page.