APPENDIX 5.5: VISUALISATION METHODOLOGY

1.0 Introduction

1.1 The purpose of this methodology is to provide an understanding of how visualisations are produced and the correct way in which viewpoint visualisations should be viewed to enable the viewer to obtain a realistic impression of scale and distance.

1.2 Current good practice in the production of visualisations for wind energy development is set out in *Visual Representation of Wind Farms Version 2.1* (Scottish Natural Heritage 2014), which is endorsed by the Landscape Institute.

1.3 It should also be recognised that production of visualisations is only one component of a Landscape and Visual Impact Assessment (LVIA), which will consider a range of other factors when identifying and assessing changes to the landscape and to views. The use of visualisations is a useful aid when undertaking LVIA, but the assessment process is not dependent on them. LVIA may be undertaken without use of visualisations, although for major developments, including wind farms, the inclusion of visualisations is accepted practice.

2.0 Zone of Theoretical Visibility

2.1 The Zone of Theoretical Visibility of the Development is computer-generated using topographical relief data, usually referred to as a Digital Terrain Model (DTM).

2.2 Ordnance Survey OS Terrain 50 data was used to generate the ZTV. This consists of a series of spot levels at 5m intervals. The root-mean-square error (RMSE) of the DTM is 4m, i.e. the difference between the actual on-the-ground height of any particular location and the height as indicated by the DTM would be 4m or less, at worst

2.3 The ZTV was calculated using industry standard software (ReSoft WindFarm), taking account of the curvature of the earth's surface and light refraction. In order to offset any potential inaccuracies in the DTM data, the eye height of the viewer was set at 2m above ground level. The ZTV calculation did not use mathematically approximate methods.

2.4 The ZTVs were produced based on the bare-earth DTM only and do not reflect the presence of screening features such as vegetation, buildings, walls/fences and other

structures. As such, they represent a worst-case maximum of theoretical visibility only.

2.5 Given the nature of the Proposed Development, which comprises the repowering of an existing wind farm, and with the proposed new turbines differing only modestly from the existing turbines, the presentation of the hub and blade tip ZTVs varies from the approach that would typically be taken in regards to an undeveloped site.

2.6 Hub and blade tip ZTVs are displayed separately on A3 sheets, with colour banding used to distinguish between the visibility of the existing turbines, the adjacent Bryn-ffynnon turbine (which be unaffected by the Proposed Development), and the proposed new turbines. The colour banding used does not distinguish between the number of turbines visible. The ZTVs are presented at two separate scales, covering the entire 25km radius study area, and at greater details covering approximately 5km from the turbines. This is considered sufficient to gain an understanding of the changes in theoretical visibility of wind turbines that would result from the Proposed Development.

2.7 Cumulative ZTVs, illustrating the visibility of more than one development were calculated using the same method. Each individual scheme, or group of schemes, is displayed using a single colour only. Cumulative ZTVs illustrate theoretical visibility of turbine blade tips, unless otherwise stated. The cumulative ZTVs are presented on A3 sheets.

3.0 Photography

3.1 Refer to the LVIA (Chapter 5.0 of the Environmental Statement) for details of photographic viewpoint locations and the process by which these were selected.

3.2 All photography for this assessment was taken using a digital standard-reflex lens (DSLR) camera with a full-frame sensor, using a 50mm lens. The camera was mounted on a tripod to ensure a stable support and minimise camera shake. The camera was mounted on a panoramic tripod head with built-in spirit level, which allows for the rotation of the camera at fixed intervals around a fixed point in vertical alignment with the camera lens, thereby eliminating parallax error. The camera was levelled using an auto-leveller device. Camera height was 1.5m above the ground.

3.3 Photographs were taken over a full 360 degree sweep from each viewpoint location. The precise location of each photograph was recorded using a hand-held GPS

device, and an accompanying spreadsheet was completed recording information about the viewpoint.

4.0 Post Photographic Processing

4.1 The individual photos taken on-site were stitched together using the software package PTGui. The output was a single panoramic image. The specifications of the camera and camera lens used to take the photographs were inputted into the software to ensure the most accurate production of the final panoramic image.

5.0 Wireframes

5.1 Industry standard software (ReSoft WindFarm) was used for producing wireframes up to 360 degrees. Wireframes were constructed using a digital terrain model (DTM) of the bare earth surface (the Ordnance Survey Terrain 50 dataset) and the viewpoint data from the camera and photographs. The production of the wireframes made allowance for the curvature of the earth and assumes a viewpoint height of 2m above the Ordnance Survey datum as a conservative worst case, which took into account potential inaccuracies or discrepancies in the DTM data.

5.2 Wind turbine locations for a proposed development were defined to the nearest metre, using six-figure British National Grid co-ordinates. Hub heights, blade rotor diameter and other turbine dimensions were accurately modelled to correspond with the candidate turbine.

5.3 Based on the same input information as the wireframes and photomontages, a Google Earth file was used to double check that all viewpoint information corresponds with that which was recorded onsite. This also assisted in confirming site position and extracting marker reference points used in the subsequent alignment process of wireframes and photographs.

5.4 Turbine models were set to face the viewer with a turbine tip pointing directly skywards to illustrate theoretical worst case visibility in terms of maximum width and height. Turbines were numbered and labelled to be consistent with references elsewhere on other documents and plans.

5.5 For cumulative visualisations, the locations and dimensions for other wind turbines were also modelled as accurately as possible, based on available information regarding these turbines. The cumulative turbines were oriented in the same direction as those comprising the Proposed Development. As such, these may not

necessarily face the viewer, depending upon their location in relation to the viewpoint.

6.0 Photomontages

6.1 Photomontages are computer generated images, showing images of the proposed wind turbines superimposed upon the existing photography, with the aim of producing a visualisation that should give a realistic impression of how the Proposed Development would appear within the landscape.

6.2 Using Adobe Photoshop, the wireframe and panoramic photograph were matched together to form an overlay of wireframe on top of photograph. Accuracy was ensured by using the same GPS location recorded on site, and by matching prominent landforms and man-made objects (such as electricity pylons or telecommunication masts) as reference points where possible. This matching process indicated turbine position upon the photograph and was used later as a reference point for positioning the rendered turbine models.

6.3 Wind turbines were rendered using ReSoft WindFarm software with a light source set to replicate as closely as possible the lighting conditions seen within the photographs that they were superimposed upon. Certain lighting conditions may require the turbines to be over-emphasised to enable the viewer to properly identify the location of the turbines.

6.4 Typically, for a greater sense of realism each turbine blade set is randomly rotated in the image. However, if this results in an image within which a blade would not be visible, or would be marginally visible when superimposed upon the photographs, then it is manually adjusted to be more visible. In the case of the Proposed Development, the proposed turbines were set to face the same direction as the adjacent Bryn-ffynnon turbine.

6.5 Using Adobe Photoshop, the rendered turbines were superimposed within the panoramic photograph, aligning with the previously generated wireframe. Where all or part of any turbine would be obscured by intervening features in the landscape, the non-visible sections of the turbine were removed from the final image using a digital mask.

7.0 Presentation

7.1 Once the final viewpoint images have been produced, these were then cropped to match a series of templates that accord with the output and display format required by SNH. Typically, the following output is produced (Note Viewpoints 10-14 show a wireframe only, with no photographs, and hence only Items 1 and 2 have been produced for these viewpoints):

- 1. Baseline panorama and wireframe: Displayed on one or more A1 width pages, with each page illustrating a 90° horizontal field of view (each image displayed at 820mm by 130mm). This shows the existing context of the viewpoint. The image is shown in cylindrical projection. The accompanying wireframe shows all cumulative schemes visible in the same field of view. The decision of how many pages to use (i.e. whether to show a 90°, 180°, 270° or 360° field of view is determined by the assessor, and relates to the existing visual context and to the pattern of cumulative development. The horizontal extent of the single frame 50mm lens photograph centred on the Proposed Development site is indicated on the image, as is the extent of the extracted panorama used in relation to Item 3.
- 2. Wireframe: A wireframe produced in planar projection, using the same geometry and field of view as Item 3. The wireframe typically displays the proposed turbines only, with individual turbines numbered. The wireframe is displayed on an A1 width page;
- 3. A1 panorama: A photomontage of the Proposed Development, displayed on an A1 width page illustrating a 53.5° horizontal field of view and a 18.2° vertical field of view (image displayed at 260mm by 820mm). The image is shown in planar projection;

7.2 Items 1-3 are presented as series of Figures that accompany Chapter 5.0 of the Environmental Statement.

8.0 Viewing Instructions

8.1 It should be recognised that viewpoint visualisations can never provide an exact match to what is experienced in reality. Visualisations are tools in the assessment process but independent from it. They illustrate the likely change in view in the context of a specific date, time and weather conditions, that would be seen within a photograph and not as seen by the human eye. As such, visualisations need to be used in conjunction with site visits and should be considered in the context of the

totality of views experienced from the viewpoint and not just focussed on the proposed turbines.

8.2 All visualisations are prepared to be technically correct at a specific viewing distance that recreates the correct perspective geometry of the view available from the viewpoint. To accurately recreate this using the printed page is difficult, particularly as the flat page does not conform easily to the biconvex lens of the human eye. As such, and in accordance with SNH guidance, the photomontages displayed on Items 3 and 4 above should simply be **viewed held at a comfortable arm's length and with the page flat**.