

Appendix 8.17

Aviation Lighting Assessment

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Glossary

Term	Definition
Baseline Studies	Work done to determine and describe the environmental conditions against which any future changes can be measured or predicted and assessed.
Characteristics	Elements, or combination of elements, which make a contribution to distinctive seascape/landscape character.
Designated Seascape/Landscape	Areas of seascape/landscape, identified as being of importance at international, national, regional or local levels, either defined by statue or identified in development plans or other documents.
Development	Any proposal that results in a change to the seascape/landscape and /or visual environment.
Direct Effect	An effect that is directly attributable to the proposed development
Elements	Individual parts which make up the landscape, such as for example, trees, hedges and buildings.
Environmental Statement	A document reporting the findings of the Environmental Impact Assessment (EIA) and produced in accordance with the EIA Regulations.
Indirect Effects	Effects that result indirectly from the proposed development as a consequence of the direct effects, often occurring away from the site. This may be separated by distance or in time from the source of the effects.
Key Characteristics	Those combinations of elements which are particularly important to the existing character of the seascape/landscape and help to give an area a particularly distinctive sense of place.
Land Use	What land is used for, based on broad categories of functional land cover, such as agricultural, forestry, urban.
Landform	The shape and form of the land surface, which has resulted from combinations of geology, geomorphology, slope, elevation and physical process.
Landscape	An area, as perceived by people, the character of which is the result of the action and interaction of natural and/or human factors.
Landscape Character	A distinct, recognisable and consistent pattern of elements in the landscape that makes the landscape different from another, rather than better or worse.
Landscape Character Areas	These are single unique areas which are the discrete geographical areas of a particular landscape type.
Landscape Effects	Effects on the landscape as a resource in its own right.
Landscape Receptors	Defined aspects of the landscape resource that have the potential to be affected by the proposed development.
lux	Is the unit of illuminance in the International System of Units (SI). It is defined in terms of lumen s per meter squared (lm / m 2).
Magnitude (of effect)	A term that combines judgements about the size and scale of the effect, the extent of the area which it occurs and whether it is short or long term in duration.

Term	Definition
Photomontage	A visualisation which superimposes an image of the proposed development upon a photograph or series of photographs.
Quality	A measure of the physical state of the seascape/landscape. It may include the extent to which typical character is represented in individual areas, the intactness of the seascape/landscape and the condition of individual elements.
Scoping	The process of identifying the issues to be addressed by an Environmental Impact Assessment.
Seascape	Landscapes with views of the coast or sea, and coasts and adjacent marine environments with cultural, historical and archaeological links with each other.
Seascape Character	A distinct, recognisable and consistent pattern of elements in the seascape that makes the seascape different from another, rather than better or worse.
Seascape Character Areas	These are single unique areas which are the discrete geographical areas of a particular seascape type.
Seascape Landscape Character Assessment	The process of identifying and describing variation in the character of the seascape and landscape and using this information to assist in managing change in the seascape/landscape. It seeks to explain the unique combination of elements and features that make seascape/landscape distinctive. The process results in the production of a Seascape Landscape Character Assessment.
Sensitivity	A term applied to specific receptors, combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value related to that response.
Significance	A measure of the importance of the environmental effect, defined by significance criteria specific to the environmental topic.
Susceptibility	The ability of a defined seascape/landscape or visual receptor to accommodate the specific proposed development without undue negative consequences.
The proposed development	Y Bryn Wind Farm development.
Tranquillity	A state of calm and quietude associated with peace, considered to be a significant asset of the landscape.
Visual Amenity	The overall pleasantness of the views people enjoy of their surroundings, which provides an attractive visual setting or backdrop for the enjoyment of the activities of the people loving, working, recreating, visiting or travelling through an area.
Visual Effects	Effects on specific views and on the general visual amenity experienced by people.
Visual Receptors	Individuals and/or defined groups of people who have the potential to be affected by the proposed development.
Value	The relative value that is attached to seascape/landscapes by society. A seascape/landscape may be valued by different stakeholders for a variety of reasons.
Visualisation	A computer simulation, photomontage or other technique illustrating the proposed appearance of the development.
Zone of Theoretical Visibility	A map, showing areas of land within which, the proposed development is theoretically visible.

List of Abbreviations

Abbreviation	Description
ANO	Air Navigation Order
AONB	Area of Outstanding Natural Beauty
BBNP	Bannau Brycheiniog National Park
BOAT	Byway Open to All Traffic
ca	Candela
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CMLI	Chartered Member of the Landscape Institute
CRoW	Countryside and Rights of Way
ES	Environmental Statement
GLVIA	Guidelines for Landscape and Visual Impact Assessment
ICAO	International Civil Aviation Organisation
ILP	Institute of Lighting Professionals
km	Kilometre
LCA	Landscape Character Area
LPA	Local Planning Authority
NRW	Natural Resource Wales
OS	Ordnance Survey
SLA	Special Landscape Area
SLVIA	Seascape, Landscape and Visual Impact Assessment
ZTV	Zone of Theoretical Visibility

A8.17 AVIATION LIGHTING ASSESSMENT

Introduction

- A8.17.1 This appendix assesses the potential effects associated with wind turbine aviation lighting on seascape, landscape, and visual amenity for the proposed Y Bryn Wind Farm (also referred to as the proposed development).
- A8.17.2 The night-time assessment has been undertaken by Chartered Members of the Landscape Institute (CMLI) from Natural Power, experienced in undertaking night-time assessments of aviation lights on wind turbines. Supporting night-time visualisations from a selected number of agreed viewpoints and lighting intensity Zone of Theoretical Visibility (ZTV) mapping have also been produced by Natural Power.
- A8.17.3 This appendix of the Environmental Statement (ES) should be read in conjunction with the following chapters and appendices:
- Chapter 5: Project Description;
 - Chapter 8: Seascape, Landscape & Visual Impact Assessment (SLVIA);
 - Appendix 8.1: Seascape, Landscape & Visual Impact Assessment Methodology;
 - Chapter 15: Aviation & Existing Infrastructure; and
 - Appendix 15: Aviation & Existing Infrastructure.
- A8.17.4 This Appendix is supported by the SLVIA figures shown in Volume 2 and night-time specific ZTVs and visualisations as follows:
- Figures 8.48a – l: Viewpoint 4: Brynna Road, Cwmafan;
 - Figures 8.50a – h: Viewpoint 6: Mumbles Hill, Swansea;
 - Figures 8.64a – h: Viewpoint 20: Pen Parcau Bettws;
 - Figures 8.65a – h: Viewpoint 21: Sam Helen, Aberdulais;
 - Figures 8.68a – h: Viewpoint 24: Wales Coast Path, Kenfig Burrows;
 - Figure 8.82: Theoretical Visibility of Aviation Lighting by Intensity – Overview;
 - Figure 8.83a: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 1;
 - Figure 8.83b: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 2;
 - Figure 8.83c: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 3;
 - Figure 8.83d: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 4;
 - Figure 8.83e: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 5;
 - Figure 8.83f: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 6;
 - Figure 8.83g: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 7;
 - Figure 8.83h: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 9;
 - Figure 8.83i: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 11;
 - Figure 8.83j: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 12;

- Figure 8.83j: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 16;
- Figure 8.83l: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 17;
- Figure 8.83m: Theoretical Visibility of Aviation Lighting by Intensity – Turbine 18;
- Figure 8.84: Predicted Light Pollution within 45 kilometres (km);
- Figure 8.85: Predicted Light Pollution within 15 km; and
- Figure 8.86: Predicted Light Pollution in Areas of Theoretical Visibility of Aviation Lighting.

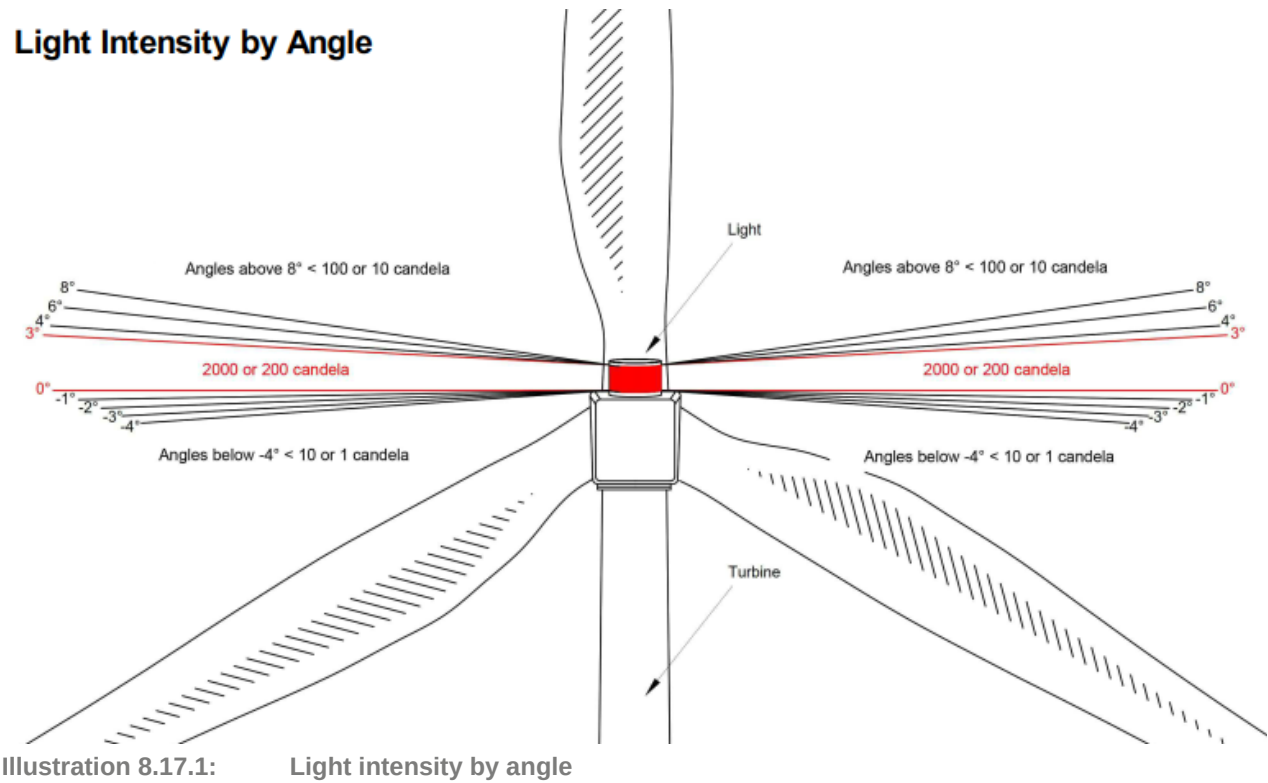
Regulatory Background

- A8.17.5 The regulatory background for aviation lighting on wind turbines is set out in Section 15.2 of Chapter 15: Aviation and Existing Infrastructure.
- A8.17.6 Civil Aviation Authority (CAA) policy on wind turbines is set out in Civil Aviation Publication (CAP) 764. This contains the CAA's position on the impacts of wind turbines on radar, radio navigation aids, physical obstacle hazards to aircraft and turbulence; describes a range of mitigations that may be applied; and outlines the process of assessing the aviation impacts of wind energy developments in the planning system. The current edition of CAP 764 is dated 2016. A revised version has been drafted and is expected to be published in 2023.
- A8.17.7 CAA policy on the requirements for lighting of onshore wind turbines with blade tip heights of 150 m or more is set out in a Policy Statement published in June 2017. This expands on the requirements set out in Air Navigation Order (ANO) Article 222. The main requirements are as follows:
- a medium intensity (2000 candela (ca)) steady red light on the nacelle of each turbine;
 - low intensity (32 ca) lights at the midpoint on the turbine tower;
 - lights to be switched on and off by an appropriate control device such as a timer; and
 - 2000 ca lights may be dimmed to 10% of peak intensity (i.e., to an intensity of 200 ca) when the meteorological visibility exceeds 5 km.

Proposed Lighting Scheme

- A8.17.8 The proposed development comprises 18 wind turbines with a range of blade tip heights between 206 m and 250 m and would therefore require lighting under Article 222 of the ANO, 2016.
- A8.17.9 The International Civil Aviation Authority (ICAO) sets out in Annex 14 the technical specification requirements for medium intensity obstacle lights and CAA Policy Statement details the recommended minimum intensity lighting settings for 2000 ca lights and 200 ca (lights being capable of being dimmed to 10% of peak intensity when the lowest visibility as measured at suitable points around the wind farm by visibility measuring devices exceeds 5 km), at different vertical angles of elevation, relative to the lighting horizontal plane.
- A8.17.10 Illustration 8.17.1 provides a diagrammatic interpretation of the potential light intensity from a medium-intensity aviation light (based on a L864-LXS-C) to be mounted on the turbine nacelle and an illustration of the likely light intensity in poor visibility <5 km (2000 ca) and clear visibility >5 km

(200 ca). The precise model of aviation lighting is not known at the time of application, but the illustration provides some context on the intensity of lighting predicted.



A8.17.11 Table A8.17.1 sets out the details of the lighting intensity at varying vertical angles of elevation in tabular form and demonstrates the relationship between elevation and lighting intensity.

Table A8.17.1: Maximum candela at varying vertical angles

Vertical angle of lighting from nacelle	Approximate maximum ca	Approximate ca at 10% (clear weather conditions)
3° to 4°	2000 – 1400	200 – 140
0° to 3°	2000	200
0° to -1°	2000 – 750	200 – 75
-1° to -2°	750 – 80	75 – 8
-2° to -3°	80 – 40	8 – 4
-3° to -4°	40 – 10	4 – 1

A8.17.12 A specialist aviation consultant (Aviatica) commissioned by the applicant has reviewed the proposed turbine layout and developed a reduced lighting scheme through consultation with aviation operators using the night low level airspace and with approval from the CAA (see Chapter 15) and summarised:

- a 2000 candela steady red light on the nacelles of Turbines 1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 16, 17 and 18;
- the 2000 candela lights will be dimmed to 10% of peak intensity when the visibility exceeds 5 km;
- the 2000 candela lights will only be switched on between the hours of sunset + 30 minutes and sunrise - 30 minutes;
- it is the intention of the Applicant to install an aircraft proximity-activated lighting system on the proposed development. This will only switch the lights on when an aircraft is detected within CAA-specified horizontal and vertical distances from the wind farm. An assessment of the frequency with which such a system would switch the lights on is contained in Appendix 15.1. A CAA policy on the technical criteria and regulatory provisions for proximity-activated lighting is expected to be published in 2023;
- an infra-red light (not visible to the unaided human eye) on all turbines; and
- no provision of mid-tower 32 candela lighting.

Methodology

A8.17.13 This assessment has been prepared in accordance with the methodology set out in Appendix 8.1: Seascape Landscape & Visual Impact Assessment Methodology. The assessment also takes cognisance of the principles contained within the *Guidelines for Landscape and Visual Impact Assessment, Third Edition* (GLVIA3).¹

A8.17.14 GLVIA 3 (para 6.12, page 103) provides the following guidance on the assessment of lighting effects:

‘For some types of development, the visual effects of lighting may be an issue. In these cases, it may be important effects of lighting and these effects need to be taken into account in generating the 3D model of the scheme. Quantitative assessment of illumination levels, and incorporation into models relevant to visual effects assessment, will require input from lighting engineers, but the visual effects assessment will also need to include qualitative assessments of the effects of the predicted light levels on night-time visibility.’

A8.17.15 It should be noted, this assessment concentrates on the potential effects from aviation lights on seascape, landscape, and visual amenity only. The assessment of night-time effects is informed by quantitative measurement of light levels but relies on the professional judgement of the CMLIs undertaking the assessment. This appendix should be read in conjunction with Chapter 15, Appendix 15.1 and 15.2 which address separately the regulatory and technical aspects of aviation lighting.

A8.17.16 Aviation lighting will be operated when light levels fall below 500 lux typically the period of time between sunset and sunrise covering twilight and night-time, as well as periods of poor visibility. Hours of darkness vary depending on a variety of reasons, such as the moon phase or the time of year with less hours of darkness around the summer solstice, and longer hours around the winter

¹ Landscape Institute., Institute of Environmental Management. (2013) *Guidelines for Landscape and Visual Amenity Assessment, Third Edition*. London. Routledge.

solstice. During this time, there will be periods during twilight where the whole development will be visible alongside the aviation lights, to darkness when the turbines would be less obvious, and the lights would be the main component visible. This assessment assumes the worst-case scenario of twilight when both the proposed turbines and aviation lights are visible and features within the surrounding landscape can be perceived.

A8.17.17 In line with Professor Best's Report detailed in Appendix 15.2 this assessment assumes the worst-case scenario will be clear conditions when the light is set at its reduced intensity setting of 200 ca, as it is considered this is when the aviation lights will be most visible, light intensity will be at its greatest, and visual receptors are likely to be outside.

A8.17.18 Guidance published by the Institute of Lighting Professionals (ILP) has also been considered in this assessment, in particular, two documents:

- *Guidance on Undertaking Environmental Lighting Impact Assessments* (Institution of Lighting Professionals, 2013);² and
- *Guidance Note 01/21 The Reduction of Obtrusive Light* (Institution of Lighting Professionals, 2021).³

A8.17.19 These documents provide useful guidance in the undertaking of night-time assessment as well as providing some context of the different types of light pollution encountered as follows:

'Obtrusive light, whether it keeps you awake through a bedroom window, impedes your view of the night sky or adversely affects the performance of an adjacent lighting installation, is a form of pollution. It may also be a nuisance in law and can be substantially mitigated without detriment to the requirements of the task.

Skyglow, the brightening of the sky, **Glare**, the uncomfortable brightness of a light source when viewed against a darker background, **Light spill** the spilling of light beyond the boundary of the area being lit and **Light intrusion** ('Nuisance') are all forms of obtrusive light which may cause nuisance to others, or adversely affect fauna & flora as well as waste money and energy.' (ILI, 2021)³.

Source: ILI, 2021

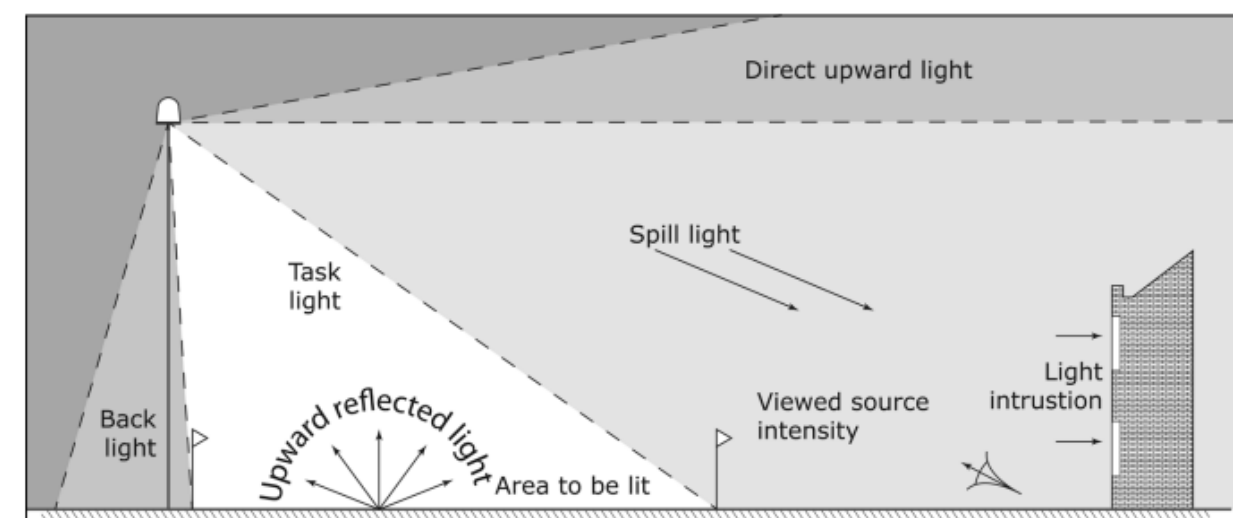


Illustration 8.17.2: Types of obtrusive light (Figure 1 from ILI, 2021)

Zone of Theoretical Mapping

A8.17.20 A series of ZTV maps have been produced to support the assessment (see Figures 8.82 and 8.83a – m). The ZTVs provide an illustration of potential light intensities from the aviation lights, both as an overview, and individually for each lit turbine.

Night-time Photography

A8.17.21 Night-time baseline photography was undertaken in accordance with NatureScot guidance (2017)⁴ (standard industry guidance) from six agreed viewpoint locations and are representative of night-time effects.

A8.17.22 In line with NatureScot guidance, photography was captured as follows:

'We have found that approximately 30 minutes after sunset provides a reasonable balance between visibility of the landform and the apparent brightness of artificial lights, as both should be visible in the image. It is important that the photographs represent the levels of darkness as seen by the naked eye at the time and the camera exposure does not make the image appear artificially brighter than it is in reality. It can also be helpful to note the intensity of other lights in the area to enable comparison (e.g. television transmitters) as this can aid the assessment process.' (Para. 176).

A8.17.23 Night-time photography was undertaken between March and April 2022 and captured at dusk in clear atmospheric conditions and consistent with light levels below 500 lux. A number of 360° sweeps were undertaken during a period as darkness set in and sought to capture the presence of existing sources of artificial lighting.

² Institution of Lighting Professionals (2013) Professional Lighting Guide 04: Guidance on undertaking Environmental Lighting Impact Assessments. Institution of Lighting Professionals. Rugby.

³ Institution of Lighting Professionals (2021) Guidance Note GN01/21 The Reduction of Obtrusive Light. Institution of Lighting Professionals. Rugby.

⁴ Scottish Natural Heritage (2017) Visual Representation of Wind Farms, Guidance. [Online] Available at: <https://www.nature.scot/sites/default/files/2019-09/Guidance%20-%20Visual%20representation%20of%20wind%20farms%20-%20Feb%202017.pdf> [Accessed 17/12/2023]

Visualisations

A8.17.24 NatureScot (2017)⁴ sets out the following guidance for night-time visualisations:

‘It is difficult to illustrate turbine lighting well in visualisations, although some recent examples which use photographs taken in low light conditions (just before or after sunrise / sunset) have been more useful.’ (para. 174).

‘Where an illustration of lighting is required, a basic visualisation showing the existing view alongside an approximation of how the wind farm might look at night with aviation lighting may be useful. This is only likely to be required in particular situations where the wind farm is likely to be regularly viewed at night (e.g., from a settlement, transport route) or where there is a particular sensitivity to lighting (e.g. in or near a Dark Sky Park or Wild Land Area). Not all viewpoints will need to be illustrated in this way. The visualisation should use photographs taken in low light conditions, preferably when other artificial lighting (such as street lights and lights on buildings) are on, to show how the wind farm lighting will look compared to the existing baseline at night. It is only necessary to illustrate visible lighting, not infrared or other alternative lighting requirements.’ (para. 175).

A8.17.25 The photomontages do not take into account turbine blades passing in front of the aviation light intermittently which would cause a flickering effect when the aviation lights are switched on. The blades have been positioned in the photomontages to avoid any screening of the aviation lights by blades to represent the worst-case scenario.

A8.17.26 The photomontages also do not capture reflection of the light along the turbine blade when passing the vertical position.

A8.17.27 Visualisations have been produced by an experienced visualisation specialist and based on field observations during the site visit.

Consultation

A8.17.28 Natural Power, on behalf of the client, undertook consultation with Natural Resource Wales (NRW) and both local planning authorities (LPA) regarding the approach to the assessment of aviation lighting and proposed illustrative viewpoint locations (see Appendix 3 for copy of letters and NRW/LPA responses). Table 8.6.1 provides a summary of NRW comments specifically related to landscape and visual. Technical comments regarding the lighting scheme by NRW are addressed separately in Appendix 15.2 of Chapter 15: Aviation and Existing Infrastructure.

Table A8.17.2: Consultation responses

Consultee	Comments	Response
Natural Resource Wales (24/03/22)	<u>Viewpoints</u> <i>With regard to the proposed viewpoints for night-time photography and photomontages, Viewpoint 6 Mumbles Hill is appropriate for a viewpoint from the Gower Area of Outstanding Natural Beauty (AONB). We note that there appears to be greater visibility from parts of Clyne Common, however Viewpoint 6 would be easier to access and likely to include a greater number of viewers when lights would be visible.</i>	Noted, a night-time visualisation has been undertaken from Viewpoint 6: Mumbles Hill (see Figure 8.50h)
	<i>For completeness, we advise a night-time viewpoint from the Brecon Beacons National Park, which is an International Dark Sky Reserve (e.g., Viewpoint 9 Ogof Ffynnon-Ddu).</i>	Noted, a night-time viewpoint from Viewpoint 9: Ogof Ffynnon-Ddu was considered but was scoped out following analysis due to the distance involved.
Neath Port Talbot County Borough Council (23/05/2022)	<i>Simon White has read the letter from Natural Power’s Graeme Glencorse dated 11 February and looked at the pdf showing Y Bryn aviation lighting intensity ZTV. He has advised that based on the assurance that aviation lighting has negligible visibility/effect below 4 degrees from the horizontal and therefore is unlikely to affect Maesteg and Bryn and associated settlements, the approach to choosing the representative viewpoints from those selected for the LVIA generally seems reasonable with one caveat. The one additional viewpoint he had suggested in his LVIA scoping response which Soltys Brewster did not take forward, his viewpoint G at Croeserw, appears to be an elevated location likely to be affected by lighting at a closer range than the Bettws and Cwmafan viewpoints. He believes that the assessment should address the effects on this area at least in text, differentiating it from the effects on Caerau and Maesteg to the south.</i>	The Aviation Lighting Intensity ZTV (see Figure 8.83a-m) shows Croeserw would not receive theoretical visibility of aviation lighting and has therefore not been included.
Natural Resources Wales (25/05/2022)	<i>Requested that technical document would be assisted by illustrative examples of similar lighting effects from existing wind farms, if this were possible.</i>	Noted, aviation lighting assessments undertaken for Crystal Rig IV and Clash Gour Wind Farms in Scotland were provided.

Source: Natural Resources Wales (11th March 2022) Night-time Aviation Lighting Assessment Response.

Study Area

A8.17.29 Figure 8.84 shows that within the 45 km study area, the proposed development is located on the edge of an area where light pollution is at its brightest extending between the outskirts of Newport in the east, and Llanelli in the west. This is due to the high density of settlement and connecting

road network. Higher concentrations of light pollution are situated within the city centres of Cardiff and Swansea, and nearby Port Talbot steelworks 2.5 km to the southwest. In the surrounding area to the north of the coastline, light pollution levels reduce due to a decrease in settlement density which is mainly confined to the valleys. To the north and southwest of the proposed development, the skies become darker on account of the upland landscape to the north, and the sea to the south west where there is a noticeable decrease in light pollution approximately 25 km from the proposed development.

A8.17.30 Similar to the SLVIA and consistent with the technical information set out in Appendix 15.1 and 15.2, this assessment focusses on a detailed study area of 15 km from the proposed development, as it is considered that within this area it is most likely that significant effects could occur as a result of the proposed aviation lights.

Baseline Conditions

A8.17.31 Figure 8.85 shows that levels of light pollution vary considerably within the 15 km study area. Dark skies mapping indicate that the darkest skies are located in the north of the study area where built development decreases and the landscape predominantly comprises agricultural land, forestry, and moorland.

A8.17.32 A series of interconnecting valleys cross the 15 km study area where linear settlements and vehicles traveling on roads increase light pollution. To the south along the coastline, the density of development increases substantially and includes heavy industry where light spill and obtrusive lights can be experienced along with skyglow which covers much of South Wales.

A8.17.33 Light pollution gradually reduces to the north covering Bannau Brycheiniog and Black Mountains, and the Gower AONB to the west, although it should be noted that levels are recorded at the medium to higher ranges on the periphery of these two national level designations.

A8.17.34 At the time of assessment, there are no other operational, consented or sites at application stage that require aviation lighting in 15 km from the proposed development.

Seascape Character Types

A8.17.35 Within the 15 km detailed study area, a total of 8 Seascape Character Types are located:

- 7. Pwlldu Head to Mumbles;
- 8. Swansea Bay – west;
- 9. Swansea Bay – east;
- 10. Neath Estuary;
- 11. Margam to Porthcawl;
- 12. Porthcawl;
- 16. Mid Swansea Bay; and
- 21. Glamorgan Coastal Waters & Nash Sand.

A8.17.36 The light pollution map shown on Figure 8.85 illustrates that the seascape is heavily influenced by light pollution extending from Ogmore-by-Sea in the east, around Swansea Bay to Swansea in the

west. This includes light reflection on the sea surface from illuminated coastal development as well as various marinas and industrial use jetties. A high level of ship activity also contributes to light pollution with ships ranging between small pleasure craft to larger commercial shipping that frequent various points along the coastline, as well as passing through Swansea Bay. At night-time, the operational and navigation lights of ship traffic can be experienced at varying intensities.

Sensitivity of Seascape Receptors

A8.17.37 None of the seascapes are valued for their levels of darkness, there may be some local importance due to their visual and cultural features and value is considered to be medium. Susceptibility is considered to be low on account that receptors are tolerant to the addition of turbine lights in an area where there is a considerable amount of light pollution. Overall sensitivity is considered to be medium.

Landscape Character Types

A8.17.38 Within the 15 km detailed study area, there is a complex arrangement of 93 Landscape Character Areas (LCAs) broadly comprising industrial and settled landscapes towards the coastline, narrow valleys separated by narrow ridges and hills which gradually broaden northwards.

Sensitivity of Landscape Receptors

A8.17.39 None of the landscapes are valued for their levels of darkness and value is generally considered low; however, those LCA located to the north and northeast have a higher sensitivity of medium due to the limited extent of development located within the LCT to provides artificial lighting at night-time. Susceptibility is also considered to be low on account of the influence of artificial lighting from nearby residential and industrial areas in each of the LCAs.

Representative Night-time Viewpoints

A8.17.40 A series of viewpoints from the SLVIA were agreed with NRW to represent the potential effects of aviation lighting. Four of these are located within the detailed 15 km study area, and one beyond 15 km to represent sensitive receptors in the Gower AONB and are as follows (to note, these viewpoint positions are the same that were used for the daytime assessment noted in SLVIA):

Table A8.17.3: Representative Aviation Lighting Assessment viewpoints

Viewpoint		Easting	Northing	Distance from Nearest Turbine (km)	Direction to the Proposed Development
4	Brynna Road, Cwmafan	277547	192500	4.29	E
6	Mumbles Hill, Swansea	262781	187443	18.18	N-E
20	Pen Parcau, Bettws	289785	187496	6.84	N-W
21	Sarn Helen, Aberdulais	279972	202684	9.56	S-E
24	Wales Coast Path, Kenfig Burrows	279807	181080	7.85	N

Source: Natural Power

Representative Viewpoint Baseline

A8.17.41 The following provides a summary of the visual baseline of each representative viewpoint.

Viewpoint 4: Brynna Road, Cwmafan

A8.17.42 This viewpoint is located on Brynna Road in the north of Cwmafan, 4.3 km to the west of the proposed development. The viewpoint is representative of residents whose main views are orientated towards the proposed development.

Sensitivity of Visual Receptors

A8.17.43 Receptors are not located within a designated landscape or at a location that is valued for its view at night-time; however, the value of the viewpoint is high as it represents the views of people in residential properties. The susceptibility to change is also assessed as high as residents may be particularly responsive to aviation lights on wind turbines. Sensitivity of visual receptors is assessed as very high.

Existing View

A8.17.44 This viewpoint is located within an area that is artificially lit by street lights and includes further lighting from nearby properties as well moving vehicles along nearby roads. In addition, part of Port Talbot steel works is visible between Mynydd Dinas and Mynydd Emroch to the south-west.

Viewpoint 6: Mumbles Hill, Swansea

A8.17.45 This viewpoint is located on the eastern side of Mumbles Hill 18.1 km to the south west of the proposed development.

Sensitivity of Visual Receptors

A8.17.46 This viewpoint is located within the Gower AONB and on the Wales Coast Path where views along the coastline are of importance, although it is recognised that the eastern part of the AONB is heavily influenced by artificial light pollution from nearby settlements and coastal development around Swansea Bay compared to elsewhere in the AONB. The value of the view from this viewpoint towards the proposed development is assessed as high as the predominant receptor types are predicted to be a low number of walkers using the public footpath, where the levels of darkness may not be the primary reason, but extensive views of Swansea Bay lit up during hours of darkness. The susceptibility to change of visual receptors is also considered to be high as walkers' attention will be focussed on the views of the surrounding landscape.

A8.17.47 Receptors are within a nationally designated landscape that includes walkers using a designated long-distance footpath. The majority of receptors are at a location that is valued for its views and undertaking an activity related to the landscape and therefore will be responsive to aviation lighting and the proposed development. Sensitivity of visual receptors is assessed as very high.

Existing View

A8.17.48 From this elevated location on Mumbles Hill, the view is dominated by the large expanse of open water, which at night-time, includes the reflections from urban development which traces the coastline of Swansea Bay, as well as marinas and industrial jetties. The viewpoint location is located in an area that is less built up resulting in slightly darker skies that contrast with the lit urban development surrounding Swansea Bay. This includes residential buildings, roads, commercial buildings, and industrial complexes such as Port Talbot steel works. This is back clothed by steep-sided hill sides often covered by coniferous forestry. Ships can also be observed at night-time

bringing materials to the integrated steel works, as well as other commercial shipping in the adjacent seascape.

Viewpoint 20: Pen Parcau, Bettws

A8.17.49 This viewpoint is located on the north-western periphery of Bettws 6.8 km to the south-east of the proposed development and represents residential receptors.

Sensitivity of Visual Receptors

A8.17.50 Receptors are not located within a designated landscape or at a location that is valued for its view at night-time; however, the value of the viewpoint is high as it represents the views of people in residential properties. The susceptibility to change is also assessed as high as residents may be particularly responsive to aviation lights on wind turbines. Sensitivity of visual receptors is assessed as very high.

Existing View

A8.17.51 This viewpoint is located within an area that is artificially lit by street lights and includes further lighting from nearby properties as well as moving vehicles. Other settlements can be observed beyond Bettws as a result of light pollution which form focal points as a result of which contrast with the surrounding rising landform, woodland and coniferous forestry which form darker elements within the view.

Viewpoint 21: Sarn Helen, Aberdulais

A8.17.52 This viewpoint is located on the Roman Road west of Abergarwed, 9.5 km to the north-west of the proposed development.

Sensitivity of Visual Receptors

A8.17.53 From this viewpoint location, which is situated within the Dulais Valley Special Landscape Area (SLA) there are panoramic views across the surrounding landscape where wind farm developments are an established feature of views. It is not located on a public footpath; however, it is within open access land as noted on Ordnance Survey (OS) maps and on a Byway Open to All Traffic (BOAT), which follows the route of Sarn Helen, Roman Road.

A8.17.54 The value of the viewpoint is high as it represents the views of people travelling along the route. The susceptibility to change is also assessed as high as receptors may be particularly responsive to aviation lights on wind turbines. Sensitivity of visual receptors is assessed as very high.

Existing View

A8.17.55 This view is from an upland area comprising Mynydd Blaenafon, Mynydd Fforch-dwm, Mynydd Canol, Mynydd Blaen-nant-du and Mynydd Nant-y-bar, with a communications mast located upon the summit of Foel Fynyddau. Light pollution tends to be limited to settlements and roads within the Vale of Neath to the east and south, although the source of light is not always visible due to screening by landform. To the south, there are views across the urban development of Britton Ferry, to Baglan Bay and the Bristol Channel beyond which results in artificial light in the mid-ground extending away from the viewpoint location. Further south-west there are views across the floodplain of the River Neath, towards Llandarcy, Swansea Docks which is extensively lit at night backdropped by Kilvey Hill and Mumble Head. This steeply wooded sides of the lower section of

the Neath Valley can be seen together with lights of the village of Cilfrew. To the north there are long distance views to the upland landscape and the undulating ridgelines to the mountains within Bannau Brycheiniog National Park (BBNP) where artificial lighting is very limited.

Viewpoint 24: Wales Coast Path, Kenfig Burrows

A8.17.56 This viewpoint is located on a footpath to the west of Kenfig / Cynffig, 7.8 km to the south of the proposed development and is representative of recreational receptors.

Sensitivity of Visual Receptors

A8.17.57 From this viewpoint, which is located within the Merthyr Mawr, Kenfig and Margam Burrows Landscape of Outstanding Historic Interest and the Kenfig Burrows SLA, views are generally contained by the adjacent dunes and associated scrub vegetation. The value of the view is assessed as medium to high. The predominant receptor types are predicted to be tourists within a designated landscape and open access land (CRoW Act) where the seascape and landscape may be the primary reason for their visit. The susceptibility to change of visual receptors is assessed as high.

A8.17.58 Views across Swansea Bay and to the steel works in Port Talbot are referenced in the SLA designation, however views towards the proposed development are not. The value of the view from this viewpoint towards the proposed development is assessed as medium to high.

A8.17.59 Receptors are within a nationally and locally designated landscape and therefore undertaking an activity related to the seascape/landscape. However, wind farm developments, mainly Mynydd Brombil Wind Farm, are an existing feature of some views, and receptors therefore may be able to accommodate some new visual elements of the type proposed. The sensitivity of visual receptors is assessed as very high.

Existing View

A8.17.60 Foreground views extend across the dune system of the burrows that includes rough grassland and scrub vegetation. To the east, artificial lighting is visible at the static caravans within Kenfig Pool Holiday Caravan Park, and the village of Kenfig. To the north-west, the steel works and other industrial development at Port Talbot and Margam and are significantly lit up at night-time.

Potential Impacts During Operational Phase

Aviation Lighting

A8.17.61 A study of the aviation lighting intensity undertaken by Professor Best of Edinburgh University has been prepared on the light propagation from the aviation warning lights on the Y Bryn Wind Farm and supplements this assessment (see Appendix 15.2).

Landscape Assessment

Seascape Assessment within 15 km

A8.17.62 Aviation lights of the reduced lighting scheme are predicted to be visible from the seascape within 15 km of the proposed development. Due to the viewing angle, this would be between -1° to -4° resulting in 75 – 1 candela during clear visibility, with the source intensity rating predicted to be

higher further away from the coastline, apparent brightness reducing significantly with distance (see Appendix 15.1). As described in the baseline, the seascape is heavily influenced by light pollution in the form of direct source of light from coastal development, light reflections from this on the sea, jetties, marinas, and ship traffic.

A8.17.63 The magnitude of impact would be small occupying a small part of the hinterland and experienced within the context of direct light from Port Talbot (including the steel works) as well as skyglow, and with distance, would be less perceptible. The size and scale of the change on seascape characteristics would be low. The duration of change would be long-term and reversible. Magnitude of impact is considered to be low.

A8.17.64 Combined with medium sensitivity, the overall effect on seascape would be slight-moderate (not significant) on the seascape character area identified within 15 km of the proposed development.

Landscape Assessment within 15 km

A8.17.65 The addition of the aviation lights to the night-time baseline will further introduce artificial lighting. Figure 8.82 predicts where the reduced lighting scheme will be seen within 15 km of the proposed development. This typically shows a limited visual envelope where theoretical visibility will mainly occur along ridgelines many of which are covered by coniferous forest, thereby, reducing the extent further.

A8.17.66 From elevated areas within 10 km of the proposed development, aviation lights will be experienced at angles of 0° to 3° resulting in intensities of 200 ca to the north-east and east (see Figure 8.82). Light intensities would decrease with distance beyond 5 km becoming fainter equivalent to a car brake light at 5 km. This would generally be experienced from forested hills to the north-east, and open hill tops to the east and include the Mynydd Resolven, Craig y Llyn and Mynydd Ynyscorrwg, Llyfi and Garw Uplands and Forestry, and Myrdd Llangelwyr Uplands LCAs. The key characteristics of these three LCAs would obtain a low level of magnitude of impact on account of distance (between 3 – 13 km where the lights would be experienced in the context of a backdrop of skyglow emitting from the more settled and industrial coastline to the south, combined with extent of forestry. These LCAs have a medium sensitivity to change owing to the reduced artificial lighting within the LCAs and result in a moderate effect. This would not be significant on account of the lights being experienced in the context of considerable artificial lighting to the south.

A8.17.67 Elsewhere, on the lower slopes, angles would decrease from 0° to -4° resulting in light intensities of 200 to 1, the greater intensities being experienced from the higher elevations. This generally covers the upper to mid-slopes of narrow valleys where coniferous forestry would reduce the extent of theoretical visibility experienced.

Visual Assessment

Viewpoints

A8.17.68 A review of the ZTVs shown on Figures 8.83a-m was undertaken for each viewpoint located within 15 km study area and shown on Table A8.17.4 This considers light intensity during clear conditions when the proposed aviation light is visible beyond 5 km and represents worst-case scenario. It should be noted that the actual light perceived at each viewpoint location is likely to be less as a

result of distance from the proposed development (see Appendix 15.1). The review also does not take into account for some emitted light spilling onto the passing blades which would be visible from viewpoints in proximity to the proposed development as the base of the blade passes the vertical position.

Table A8.17.4: 200 ca light intensities at viewpoints located generally within 15 km

Viewpoint		Indicative Lighting Intensities (ca) at Viewpoints														
		Distance from Nearest Turbine (km)	Northern Cluster							Southern Cluster						
			1	2	3	4	5	6	7	9	11	12	16	17	18	
1	Evans Terrace, Caerau	1.88	-	-	-	-	-	4-1	-	8-4	8-4	-	8-4	-	-	
2	Maesteg Golf Course	1.22	-	-	-	-	-	-	-	-	-	-	-	-	-	
3	Bryn (Play area off Neath Road)	1.46	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	Brynna Road, Cwmafan	4.29	4-1	-	4-1	4-1	4-1	4-1	4-1	4-1	4-1	-	4-1	-	-	
5	Rhiwlas, Neath	9.74	8-4	-	8-4	8-4	8-4	75-8	-	-	-	-	-	-	-	
6	Mumbles Hill, Swansea	18.18	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	
8	Margam Park (Deer Park)	2.33	-	-	-	-	-	-	-	-	-	4-1	-	-	-	
10	St. Illtyd's Walk National Trail, near Cynonville	1.90	-	-	-	-	-	-	-	-	-	-	-	-	-	
11	Wales Coast Path, Ogmore-by-Sea	14.23	75-8	-	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	75-8	
13	Junction of Heol Gelli Lenor and Brynllwarch, Maesteg	2.15	-	-	-	-	-	-	-	-	-	4-1	-	4-1	4-1	
16	The Princess Margaret Way, Aberavon	7.12	-	-	-	-	-	8-4	8-4	4-1	8-4	4-1	4-1	4-1	4-1	
17	Margam Park	2.89	-	-	-	-	-	-	-	-	-	-	-	-	-	
19	Wales Coast Path, Rest Bay / Royal Porthcawl Golf Club,	10.13	-	-	-	-	-	8-4	8-4	8-4	8-4	8-4	8-4	8-4	8-4	
20	Pen Parcau, Bettws	6.84	75-8	75-8	75-8	8-4	8-4	8-4	75-8	8-4	8-4	75-8	8-4	75-8	75-8	
21	Sarn Helen, Aberdulais	9.56	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	20-0-75	
22	Baxter Terrace, Glyncorrwg	7.04	75-8	75-8	75-8	75-8	75-8	75-8	-	75-8	-	-	-	-	-	

Viewpoint		Indicative Lighting Intensities (ca) at Viewpoints														
		Distance from Nearest Turbine (km)	Northern Cluster							Southern Cluster						
			1	2	3	4	5	6	7	9	11	12	16	17	18	
23	Margam Park (Access Road)	3.29	-	-	-	-	-	-	-	-	-	-	-	-	-	
24	Wales Coast Path, Kenfig Burrows	7.85	-	-	-	-	-	8-4	8-4	8-4	4-1	8-4	4-1	8-4	4-1	
25	Bryn East, picnic area opposite Royal Oak PH	1.16	-	-	-	-	-	-	-	-	-	-	-	-	-	
26	Ogwr Ridgeway Walk near Y Bwlwarcau Hillfort	1.42	75-8	75-8	75-8	75-8	75-8	8-4	8-4	-	-	-	-	8-4	4-1	
27	Cemetery eastern edge of Maesteg	3.02	-	-	4-1	-	-	4-1	4-1	4-1	-	8-4	4-1	8-4	8-4	
28	Llangynwyd	2.61	8-4	8-4	8-4	4-1	4-1	4-1	4-1	-	-	-	-	4-1	-	

Source: Figures 8.451a – 8.72l

A8.17.69 Table A8.17.4 reflects the differences in elevation of the detailed study area comprising upland slopes, narrow valleys, and coastal landscapes. Viewpoints where lighting intensities are predicted to be the greatest (200 ca) are limited to viewpoint 21 which in reality would receive views at a lesser intensity due to distance. Elsewhere, the angle of view varies between 0 and -4° mainly covering the upper slopes of valleys, or further afield, the coastline. Viewpoints 2, 3, 10, 17, 23 and 25 are not predicted to receive theoretical visibility of the proposed aviation lights. This is due to the elevation being below -4° and proximity to the proposed development.

Representative Viewpoint Assessment 5

Viewpoint 4: Brynna Road, Cwmafan

Predicted View

A8.17.70 The effect of the proposed development is illustrated by the photograph, wirelines and photomontage on Figures 8.48a – 8.48l The aviation lighting intensity ZTVs show that of the 13 turbines mounted with aviation lights, 7 (turbines T03, T03, T04, T05,T06, T7, T09, T11 and T16) would be visible at light intensities of 4-1 ca during clear visibility. The aviation lights of turbine T01 would be screened by landform, Turbines T02, T12 T17 and T18 would not directly be seen due to the horizontal angle of view; however, the viewer would be aware of the light reflecting along the base of the blade as it passes the vertical position. The lighting on the turbines mentioned will be seen in the context of existing artificial light sources in this direction, including lights form nearby housing and those associated with moving vehicles.

Magnitude of Visual Impact

A8.17.71 Overall, the magnitude of visual impact at night associated with aviation lighting will be low as a result of 6 aviation lights occupying a small proportion of the overall view at a lower intensity. This would occur when light levels drop below 500 lux during night-time or periods of poor visibility and the scale and size of the change would be small and reversible. Magnitude of impact would be low.

Significance of Visual Effects

A8.17.72 The sensitivity of receptors is considered to be very high and the magnitude of impacts is predicted to be low and therefore the significance of effects on visual amenity are predicted to be moderate (not significant) due to the lights occupying a small part of the overall view at low intensities.

Viewpoint 6: Mumbles Hill, Swansea

Predicted View

A8.17.73 The ZTV (Figures 8.83a - m) and night-time visualisation (Figure 8.50h) show that all 13 turbines mounted with aviation lights would be visible from this location. The ZTV illustrates that this would be at light intensities of 75-8 ca, although at 18.1 km from the proposed development, the aviation lights would be viewed as faint red lights, equivalent of a car break light and seen within the context of light pollution around Swansea Bay including marina, industrial buildings, residential and commercial buildings and vehicles.

Magnitude of Visual Impact

A8.17.74 All 11 aviation lights would be visible but occupy a small part of the overall view seen from this location. The size and scale of the change would be small on account of the light intensity experienced as a result of distance from the proposed development which would be seen within the context of light pollution around Swansea Bay. This would occur when light levels drop below 500 lux during night-time or in periods of poor visibility. Magnitude of impact is predicted to be very low and would be long-term.

Significance of Visual Effects

A8.17.75 The sensitivity of receptors is considered to be very high and the magnitude very low and therefore the significance of effects on visual amenity are predicted to be moderate (not significant) due to the distance between the viewpoint location where the aviation lights would be faint and seen within the context of light pollution from Port Talbot steelworks and nearby settlements.

Viewpoint 20: Pen Parcau, Bettws

Predicted View

A8.17.76 The ZTV (Figures 8.83a-m) and night-time visualisation (Figure 8.64h) show that 12 of the 13 aviation lights would be visible from this location at varying light intensities of 4 – 75 ca at a distance of 6.8 km. Turbine 12 would be screened from view by the foreground ridgeline.

Magnitude of Visual Impact

A8.17.77 Overall, the magnitude of visual impact at night associated with aviation lighting will be low as a result of 7 aviation lights occupying a small proportion of the overall view at a lower intensity. This would occur when light levels drop below 500 lux during night-time or periods of poor visibility and the scale and size of the change would be small and reversible. Magnitude of impact would be low.

Significance of Visual Effects

A8.17.78 The sensitivity of receptors is considered to be very high, and the magnitude of impacts is predicted to be low and therefore the significance of effects on visual amenity are predicted to be moderate

(not significant) due to the small extent of the overall view affected and lower intensities of light predicted.

Viewpoint 21: Sarn Helen, Aberdulais

Predicted View

A8.17.79 The ZTV (Figures 8.83a-m) and night-time visualisation (Figure 8.65h) show that all 11 of the aviation lights mounted on turbines would be visible at light intensities of 200 – 75 ca during clear visibility at a distance of 9.5 km.

Magnitude of Visual Impact

A8.17.80 Overall, the magnitude of visual impact at night associated with aviation lighting will be low as a result of 13 aviation lights occupying a small proportion of the overall view at a lower intensity. This would occur when light levels drop below 500 lux during night-time or periods of poor visibility and the scale and size of the change would be small and reversible.

Significance of Visual Effects

A8.17.81 The sensitivity of receptors is considered to be very high and the magnitude of impacts is predicted to be low and therefore the significance of effects on visual amenity are predicted to be moderate (not significant) due to a combination of distance and the small extent of the overall view.

Viewpoint 24: Wales Coast Path, Kenfig Burrows

Predicted View

A8.17.82 The effect of the proposed development is illustrated by the night-time visualisation at Figure 8.68h. The wireline indicates that 8 of the 13 proposed lit turbines will potentially be visible from this location. These will be seen at a distance of 7.8 km at light intensities ranging between 8-1 ca during periods of clear visibility.

Magnitude of Visual Impact

A8.17.83 Overall, the magnitude of visual impact at night associated with aviation lighting will be low as a result of 7 aviation lights occupying a small proportion of the overall view at a lower intensity. This would occur when light levels drop below 500 lux during night-time or periods of poor visibility and the scale and size of the change would be small and reversible. Magnitude of impact would be very low.

Significance of Visual Effects

A8.17.84 The sensitivity of receptors is considered to be very high, and the magnitude of impact is predicted to be very low and therefore the significance of effects on visual amenity are predicted to be moderate (not significant) due to distance and the lowlight intensities predicted.

Conclusion

A8.17.85 This assessment concludes that there would be no significant effects for seascape, landscape and viewpoints within 15 km assessed. This is due to the existing baseline which is heavily influenced by artificial lighting due to the built nature of the landscape resulting in significant light pollution. The addition of the proposed development to this baseline scenario would result in further artificial

light; however, this would be controlled as described in Appendix 15.1 and 15.2 and would largely be experienced at light intensities equivalent of a car brake light, at 5 km decreasing in intensity with distance from the proposed development.