

Technical Appendix 4.8: Aviation Lighting Impact Assessment

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1.1 Introduction

- 1.1.1 The lighting of wind turbines is a developing topic. It is evident that the onshore renewables industry is committed to finding a long-term solution to minimising effects arising from visible aviation lighting, potentially through the introduction of radar or transponder activated lighting systems, or other advanced technological solutions. Until a technical solution is adopted, proposals for turbines with a maximum tip height of 150 m or greater require aviation lighting that necessitates the preparation of a suitable proportionate assessment of potential significant landscape and visual effects, especially where developments are located in remote rural locations where there may be few artificial light sources and where darkness may be a valued aspect of night-time visual amenity.
- 1.1.2 Daytime visualisations have been provided for all viewpoints. Four representative visualisations have been provided to illustrate the effects of aviation lighting on the Proposed Development during the hours of darkness for Viewpoints 4, 9, 22 and 25 (see **Figures 4.26h: Viewpoint 4: Yell. Ulsta Shetland Ferry Terminal, Figures 4.31h: Viewpoint 9: Vantage Point by Houb of Scatsta, Figures 4.44h: Viewpoint 22: Ollaberry and Figures 4.47h: Viewpoint 25: Toft (EIA Report Volume 3b)**). Turbines to be lit are highlighted in blue numbering and numbered on all wirelines including the night photography wirelines (see **Figures 4.26h: Viewpoint 4: Yell. Ulsta Shetland Ferry Terminal, Figures 4.31h: Viewpoint 9: Vantage Point by Houb of Scatsta, Figures 4.44h: Viewpoint 22: Ollaberry and Figures 4.47h: Viewpoint 25: Toft (EIA Report Volume 3b) (EIA Report Volume 3b)**). These turbines are shown lit in the photomontages during the hours of darkness.
- 1.1.3 The Proposed Development is a renewable energy development comprised of up to eight wind turbines, a Battery Energy Storage System (BESS) and associated infrastructure adjacent to Sullom Voe Oil Terminal (SVT) and the Shetland Gas Plant in Shetland, Scotland. The assessment is based on the Proposed Development as described in **Chapter 2: Proposed Development (EIAR Volume 2)**.

1.2 Regulatory Requirements

- 1.2.1 Article 222 (1) of the Civil Aviation Authority’s (CAA) Air Navigation Order 2016 and Regulations (ANO) states an: *“en-route obstacle’ means any building, structure or erection, the height of which is 150 metres or more above ground level, but it does not include a building, structure or erection:*
- which is in the vicinity of a licensed aerodrome; and*
 - to which section 47 of the Civil Aviation Act 1982 (warning of presence of obstructions near licensed aerodromes) applies.”*
- 1.2.2 These provisions mean that structures of 150 m or more in the UK are routinely lit with medium intensity (2,000 candela) steady red lights.
- 1.2.3 ANO Article 222 also contains provisions allowing for exemptions from its lighting requirements. Article 222 (6) provides that: *“A permission may be granted for the purposes of this article for a particular case or class of cases or generally.”*
- 1.2.4 While Article 222 (7) states: *“This article does not apply to any en-route obstacle for which the CAA has granted a permission to the person in charge permitting that person not to fit and display lights in accordance with this article.”*
- 1.2.5 The Proposed Development’s turbines would have a maximum blade tip height of up to 200 m above ground level. Therefore, they would normally be subject to the lighting requirements set out in Article 222 (1). However, the provisions in the CAA Policy Statement that the intermediate-level lights are only required to be low intensity (32 candela) and that the intensity of the 2,000 candela light may be

reduced to 10% of its peak intensity, *“if the horizontal meteorological visibility in all directions from every wind turbine generator in a group is more than 5 km.”*

- 1.2.6 The technical specifications for medium intensity obstacle lights are set out in International Civil Aviation Organisation (ICAO) Code - Annex 14 Table 6-3 and, for European Union Aviation Safety Agency (EASA) member states such as the UK, in Table Q-3 of CS-ADR-DSN. The ICAO and EASA specifications are identical.
- 1.2.7 The ICAO and EASA specifications for lighting do not use the term *“minimum peak intensity”* set out in paragraph 4.g. of the CAA Policy Statement. The required and recommended intensity settings for 2,000 candela lights are illustrated in **Figure 4.8.1: Aviation Lighting ZTV** and summarised as follows:
- Minimum average intensity between 0 and +3 degrees is 2,000 candela;
 - Between 0 and -1 degrees intensity would reduce from 2,000 to 750 candela;
 - Between -1 and -2 degrees intensity would reduce to from 750 to 80 candela;
 - Between -2 and -3 degrees intensity would reduce from 80 to 40 candela; and
 - Between -3 and -4 degrees intensity would reduce from 40 to 0 candela.
- 1.2.8 The implications of this for visibility of the lights from key viewpoints is that, depending upon the angle of receptors relative to the turbine lights, the intensity of light would vary, along with its perceived brightness. For example, for a light with a maximum intensity of 2,000 candela, views from below -3 degrees would see the light source as below 40 candela, a considerable reduction in perceived brightness from the maximum intensity, and if receptors view the light from below -4 degrees there would, theoretically be no direct view of the light. However, depending upon the specification and design of the light, some light reflection off the back of turbine blades may be discernible.
- 1.2.9 In conditions where horizontal meteorological visibility exceeds a 5 km radius from the position of the light, significant reductions in light intensity would be experienced, as lighting intensity would be reduced to 10% of the maximum intensity, as summarised below.
- Minimum average intensity at 10% between 0 and +3 degrees would be 200 candela;
 - Between 0 and -1 degrees intensity would reduce from 200 to 75 candela;
 - Between -1 and -2 degrees intensity would reduce to from 75 to 8 candela;
 - Between -2 and -3 degrees intensity would reduce from 8 to 4 candela; and
 - Between -3 and -4 degrees intensity would reduce from 4 to 0 candela.
- 1.2.10 Consequently, receptors located over 5 km from the turbines would only ever experience clear visibility to lights at these reduced intensities. In conditions of meteorological visibility less than 5 km the perceived brightness of turbine lights, whilst possibly still visible, are likely to be reduced by such conditions also. Additionally, when combined with local sources of light such as that at SVT, Sella Ness industrial area, Scatsta airstrip, ferry terminals at Toft and Ulsta and the settled landscapes at Brae, Mossbank, Voe and Vidlin the impact of the turbine lighting on such distant receptor locations may be limited further.

1.3 Assessment Methodology

Guidance

- 1.3.1 The following assessment takes cognisance of NatureScot’s Guidance on Aviation Lighting Impact Assessment and is consistent with the broader LVIA methodology provided in **Technical Appendix**

4.1: Seascape, Landscape and Visual Assessment Methodology (EIA Report Volume 4). In accordance with NatureScot guidance, the assessment comprises the following steps:

- Step 1: A definition of the lighting proposals for the Proposed Development;
- Step 2: A description of the baseline landscape and visual context; and
- Step 3: An assessment of the effect of the Proposed Development's aviation lighting on the landscape and visual resource.

1.3.2 The assessment is supported by an Aviation Lighting zone of theoretical visibility (ZTV) (**Figure 4.8.1: Aviation Lighting ZTV**) and night-time visualisations for the following viewpoints in **EIAR Volume 3b**:

- Viewpoint 4: Yell, Ulsta Ferry Terminal (**Figures 4.26g-h: Viewpoint 4: Yell. Ulsta Shetland Ferry Terminal (EIAR Volume 3b)**);
- Viewpoint 9: Vantage Point by Houb of Scatsta (**Figures 4.31g-h: Viewpoint 9: Vantage Point by Houb of Scatsta (EIAR Volume 3b)**);
- Viewpoint 22: Ollaberry (**Figures 4.44g-h: Viewpoint 22: Ollaberry (EIAR Volume 3b)**); and
- Viewpoint 25: Toft (**Figures 4.47g-h: Viewpoint 25: Toft (EIAR Volume 3b)**).

1.3.3 The Aviation Lighting Impact Assessment is based on 2,000 cd lights on the nacelle of each proposed turbine and 32 cd lights at mid-tower level on each proposed turbine. The night-time visualisations shown on **Figures 4.26g-h, 4.31g-h, 4.44g-h** and **4.47g-h** do not show the mid-tower lights as they are of low intensity. However, the assessment takes account of these lights in the overall judgements on magnitude of change and significance of effect.

1.4 Step 1: Lighting Proposals

Lighting Proposals

1.4.1 Aviation lights would be fitted on the nacelles of all eight turbines and would be located at around 114 m above ground level. At the request of the Maritime and Coastguard Agency Sumburgh Search and Rescue Helicopter Unit, infra-red lighting would also be installed on the nacelles of all eight turbines. Infra-red lighting would not be visible to the naked eye and is therefore not considered further in this assessment.

Mitigation

1.4.2 There are principally five current sources of potential mitigation in respect of aviation lighting on turbines, comprising four technological (in addition to one inherent) which have been introduced and accepted to varying degrees by aviation authorities in countries around the world (including by the United States Federal Aviation Authority ('FAA'), German Federal Aviation Office ('LBA'), and the Netherlands Aerospace Centre ('NAC')):

- The reduction in lighting intensity during periods of meteorological visibility in excess of 5 km (as discussed previously);
- The inherent reduction in apparent light intensity from source and size of light when viewed over distance.
- The reduction in lighting intensity for receptors at different elevations relative to source, as a result of design of the lights;
- The design of the lights to avoid illumination of turbine nacelles, towers, and blades;
- The lighting of only certain turbines along the perimeter of the wind farm, thereby limiting the number of lights visible at any given location, as outlined previously; and

- Use of a transponder or radar activated lighting solution. Such a system would mean that lights would only be activated by 'nearby' aircraft and could therefore only be on for a small proportion of time.

Reduced Lighting Intensity Over Distance

1.4.3 As observed during field reconnaissance, the perceived brightness and size of the light source, as experienced at different locations, would vary according to distance and atmospheric conditions. The intensity and brightness of the visible light, whilst constant in actuality, reduces as distance increases, due primarily to a reduction in the size of the lights surface and light energy reaching receptors. Clearly, any water droplets or air borne particles compounds this effect, partially or entirely obscuring the light source.

Reduced Lighting Intensity by Relative Elevation

1.4.4 **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** illustrates the intensity of turbine lights at different locations across the LVIA Study Area taking account of the angle at which they are seen from receptor locations. The figure indicates that the greatest intensity and brightness experienced would occur at elevated locations and areas of open sea which are infrequently visited after dark, whilst considerable reductions in intensity and brightness would be witnessed from low lying locations close by to the turbines, at primary visual receptor locations.

Lighting Design

1.4.5 The degree of mitigation achieved through careful design of lights is crucial. Lights on the side of towers can be designed to minimise illumination of the tower and it is assumed that tower lights are required for the Proposed Development. Similarly, the incorporation of light caps and collars can restrict up-lighting effects and the degree of downlighting and illumination of the nacelle of the turbine. In the case of the Proposed Development the assessment is based on directional intensity reduction only and not the presence of caps or collars on the lights.

Radar/Transponder Activated Lights

1.4.6 There is some uncertainty as to the availability and practicality of using radar/transponder activation at the Proposed Development. Further examination/consideration of the frequency and duration of any lighting activation may be needed in order to better understand the likely effects of radar/transponder activated lights. Depending upon the frequency and regularity of light activation this could prove more intrusive than lights that are on constantly during the hours of darkness. For avoidance of doubt, the current assessment has assumed no radar activation.

1.4.7 Light intensity would vary according to the manufacturer of the lights. As a manufacturer has not yet been selected the assumptions on light intensity reduction are based on the recommended intensity settings described in Section 1.2. The visualisations shown on **Figures 4.26h: Viewpoint 4: Yell. Ulsta Shetland Ferry Terminal, Figures 4.31h: Viewpoint 9: Vantage Point by Houb of Scatsta, Figures 4.44h: Viewpoint 22: Ollaberry and Figures 4.47h: Viewpoint 25: Toft (EIA Report Volume 3b) (EIA Report Volume 3b)** show worst case scenario with 2,000 candela lights without directional intensity mitigation.

1.5 Step 2: Baseline Context

Landscape and Coastal Character

1.5.1 **Technical Appendix 4.2: Landscape Character Types Sensitivity Assessment (EIA Report Volume 4)** describes the landscape character types (LCTs) considered elsewhere in the SLVIA and describes the sensitivity of each landscape to the type to the Proposed Development. **Figures 4.7a:**

Landscape Character Types and **4.7b: Landscape Character Types with Tip ZTV (EIA Report Volume 3a)** show the location the LCTs.

NatureScot’s character descriptions do not discuss night character. Whilst a number of landscape characteristics may be evident during periods of low ambient light levels (including dusk), it is also the case that perceived brightness of turbine lights would be lessened during such times of day, the greatest potential for significant effects would occur after dark. Of the ‘daytime’ characteristics described it is the wild and remote characteristics that are of the most relevance to the assessment of aviation lighting, especially in respect of elevated uplands, including:

- LCT 349: Major Uplands;
- LCT 350: Peatland and Moorland;
- LCT 351: Undulating Moorland with Lochs; and
- LCT 355: Coastal Edge.

- 1.5.2 These landscapes are essentially dark, largely uninhabited, with some areas relatively difficult to access with limited incidence of artificial lighting with the exception of some scattered farmsteads and dwellings on lower slopes and/or where roads bisect these LCTs. The operational Viking Wind Farm has lights on some of the perimeter turbines with the closest of these to the Proposed Development being approximately 15 km to the south. The most notable existing source of artificial light is SVT which strongly influences the locality and influences the perceived undeveloped character of the landscape in longer distance views where lights are directly visible or where ‘sky glow’ is discernible.
- 1.5.3 Key receptors within these LCTs comprise hill walkers who may value the dark and remote nature of such locations.
- 1.5.4 Contrasting with the upland landscapes there are settled and farmed landscapes of the coastal areas. LCT 354 Farmed and Settled Voes and Sounds lies to the east and west of the Proposed Development and includes the sparsely settled area at Brough and Toft ferry terminal in the east and SVT in the west. LCT 354 also occurs to the west of Sullom Voe, between Haggrister and Sullom Voe and between North Gluss and Ollaberry. LCT 354 occurs in the southwest of Yell between West Sandwick and Ness of Copister and at Burravoe in the southeast. LCT 353 Farmed and Settled Lowlands and Coast is also characterised by settlement and some development although it is more rural in character than some areas of LCT 354.
- 1.5.5 **Technical Appendix 4.3: Coastal Character Areas Sensitivity(EIA Report Volume 4)** describes the coastal character areas (CCA) considered elsewhere in the SLVIA and describes the sensitivity of each coastal character area to the Proposed Development. **Figures 4.8a: Coastal Character Areas and 4.8b: Coastal Character Areas with Tip ZTV (EIA Report Volume 3a)** show the location of CCAs.
- 1.5.6 The Shetland Coastal Character Assessment (SCCA)¹ describes light from coastal towns and villages, various lighthouses, navigational lights and buoys along the Shetland coast. The reflections on the water from the lights of towns and villages along the shoreline “are a valuable component of the coastal experience within Shetland.” The SCCA advises that “new developments must be sensitive to the night time light conditions along coastline and avoid altering the desired rural ambiance that is enjoyed by both local residents and visitors.”
- 1.5.7 CCA 26: Sullom Voe is strongly influenced by lighting at SVT, Sella Ness and Scatsta airfield. Lights on the proposed turbines are less likely to contrast with the baseline situation in CCA 26. CCA 3: Lunna Ness and CCA 27: Yell Sound are more likely to be affected by lights on the proposed turbines as these CCAs both include areas of undeveloped coast where remoteness and seclusion may be experienced

albeit in the context of navigational lights in the sea and movement of vessels in Sullom Voe and ferries at Toft and Vidlin.

Landscape Designations and Classifications

Shetland NSA

- 1.5.8 **Technical Appendix 4.6: Shetland National Scenic Area Special Landscape Qualities Assessment (EIA Report Volume 4)** describes and assesses the effects of the Proposed Development on Special Landscape Qualities (SLQ) of Shetland NSA. The special qualities of the NSA are listed and it was agreed with NatureScot that four SLQ should be assessed in detail.
- 1.5.9 The NSA is largely undeveloped apart from occasional aquaculture development, scattered settlement and roads. Large scale development is absent and there are limited sources of artificial light in the NSA. SVT is a notable source of artificial light and influences views from the North Roe NSA Area.

Local Landscape Areas

- 1.5.10 The SLVIA has focussed on four Local Landscape Areas (LLA):
 - LLA 12 Lunna Ness and Lunning;
 - LLA 2 Nibon and Mangaster;
 - LLA 1 Ronas Hill; and
 - LLA 17 West Sandwick and Gloup Holm.
- 1.5.11 All four of these SLA are largely undeveloped and predominantly rural areas with areas of farmland and settlement on the coast and uninhabited interior uplands or moorland. Large scale development is absent and there are limited sources of artificial light in these areas. SVT is not visible from LLA 12 but the effects of sky glow are visible above intervening landform. SVT is visible from the three remaining LLA and influences the experience of the LLA to a degree and night-time views. The key characteristics and designated features of LLA of most relevance to the assessment of aviation lighting are:
 - LLA 12 – “Long, narrow and remote headland of Lunna Ness.”
 - LLA 2 - “Sense of remoteness and wildness.”
 - LLA 1 – “Largely empty, uninhabited hills and moors” and “wide views across the whole of Shetland.”
 - LLA 17 – “Highly isolated, long stretches of coastline increasing in exposure to the north; Impressive wide views of great depth across Yell Sound to the rocky hills of Northmavine and views along the sound take in an attractive assemblage of water and layers of low, interlocking coastal hills rising to the rounded Ronas Hill behind.”
- 1.5.12 These key characteristics point to a largely dark landscape where artificial light sources are rare. However, views of SVT influence views and the experience of these characteristics to a degree.
- Wild Land Area 42 Ronas Hill and North Roe
- 1.5.13 A wild land assessment has not been undertaken but wildness qualities have been a consideration in the evaluation of sensitivity of landscape character types to the Proposed Development. The effects of lighting on landscape character and perceived qualities of wildness and remoteness are considered in the section on landscape character in this Technical Appendix.
- Visual Amenity
- 1.5.14 The main receptors and sources of artificial light within the landscape include residents of dwellings as well as road users.

¹ University of the Highlands and Islands. (2021) Shetland Coastal Character Assessment

- 1.5.15 The study area is sparsely populated and there are no large settlements although there are smaller nucleated settlements such as Mossbank and Brae and coastal areas with scattered settlement. Artificial light sources are present in settlements and at ferry terminals such as Toft and Ulsta and at SVT and these areas contrast with the darker secluded valleys and uplands. Residential receptors with potential to experience significant effects of aviation lighting are those within approximately 10 km since light intensity decreases with distance. The main settlements and settled areas closest to the Proposed Development (within 10 km) are:
- Mossbank: a village 2.7 km to the east south east;
 - Scatsta, Graven and Garth: a settled area 3 km to the south west;
 - Haggrister to Sullom: as settled area 6.5 km to the south west;
 - Ollaberry and North Gluss: a settled area 5 km to the west and north west;
 - Lunna peninsula: a settled area 9 km to the east south east;
 - Ulsta, Copister and West Yell: a settled area 5-8 km to the east and north east; and
 - Burravoe, Yell: a village and settled area 9.5 km to the east north east.
- 1.5.16 In the villages and settled areas there are a number of artificial light sources including interior lighting, street lighting and vehicle lights in addition to lights at SVT, Sella Ness and Scatsta airfield. There are also lights at Toft and Ulsta ferry terminals and navigational lights in the intervening stretches of sea between settled areas and the Site.
- 1.5.17 SVT is a notable source of artificial light. There are a number of light sources of varying intensity across the area occupied by SVT. These are mainly point sources of light such as security lighting and operational lighting during hours of darkness. The flare stacks at SVT make a notable contribution to sky glow that is visible even when the flares are not directly visible. The sky glow arising from SVT and flare stacks results in a modified night-time baseline where the perception of dark skies is reduced at and around SVT.
- 1.5.18 The perception of both receptor and light sources is conditioned, in part, by whether dwellings have internal blinds or curtains (effectively screening views out from the property and views of internal lights) and whether there are any external lights at properties or settlements.
- 1.5.19 The prominence of the lighting associated with settlements and dwellings can be exacerbated by its contrast with the otherwise essentially dark context in which they are viewed, especially where they are backdropped by darkened landforms of voes or dark expanses of sea.
- Key roads that are both receptor locations and sources of artificial light after dark comprise:
- The A968 on Shetland Mainland it is a relatively busy road that is lit where it passes through small settlements. On Yell traffic is less frequent although it is the main route north through the island to the ferry terminal at Gutcher;
 - The B9076 is lit at the junction with the A970 at Brae where lights of the proposed turbines would not be visible. It is unlit for the remainder of the route but strongly influenced by lighting at Scatsta airfield, Sella Ness and SVT with the short stretch to the west of Mossbank unlit with limited existing lighting influences;
 - The B9079 to the south west of Ollaberry is elevated and unlit; and
 - The B9081 between Ulsta and Burravoe is lit at Ulsta and unlit at Burravoe although influenced by lights in the settled areas between these two locations.
- 1.5.20 Vehicles moving on roads can be noticeable features in what is otherwise a largely dark landscape, they are low-lying and intermittent sources of impact.
- 1.5.21 The experience of the night seascape, landscape and views from vehicles is affected by dashboard lights and headlight beams, thereby lessening the perceived darkness of the adjacent landscape. The

perception of road users is also transitory, and of limited duration in comparison to that of residents of dwellings. Views across voes and open expanses of sea are influenced by navigational lights and the lights of coastal settlements. The 'sky glow' of SVT also influences the perception of dark skies.

- 1.5.22 Much of the Study Area comprises of uninhabited uplands typically devoid of artificial lighting. However, the number and frequency of visual receptors present in these areas is likely to be relatively low and generally restricted to small number of wild campers.

1.6 Step 3: Aviation Lighting Effects on Landscape and Visual Resource

Visibility and Intensity of Lights

- 1.6.1 According to the ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** the greatest theoretical light intensity and perceived brightness would be experienced within 5 km on largely uninhabited north facing slopes in an area to the south of Graven and east of Hill of Swinister and above Firths Voe. There would also be an area of higher intensity lighting on uninhabited moorland to the west of Mossbank.
- 1.6.2 At distances of greater than 5 km, the maximum intensity of light that would be experienced in clear meteorological conditions would be 200 candela. The ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** indicates greater theoretical light intensity and perceived brightness mainly from the following elevated locations at the following locations:
- Ronas Hill summit, south and east facing slopes approximately 9-12 km from the Proposed Development;
 - Summits and north facing slopes of hills between Hill of Oxnabool and Button Hills approximately 5-8.5 km to the south of the Proposed Development; and
 - Hill tops and west facing slopes in the south of Yell at distances of 6-15 km.
- 1.6.3 Several of these locations are over 10 km from the Proposed Development and therefore subject to further mitigation due to distance. At greater distances aviation lights would appear as small points of light within generally expansive views. It is also the case that these receptor locations are infrequently visited after dark.
- 1.6.4 From elevated locations from north east through north to west, the Proposed Development may be seen in the context of SVT, Sella Ness and Scatsta airfield which combine to create a concentrated source of artificial light immediately to the west of the Proposed Development. In this context the Proposed Development's lighting would not be wholly uncharacteristic of the night landscape and views.
- 1.6.5 Lower lying positions, in contrast, would be subject to limited or no views of turbine lights and lower degrees of brightness and intensity, turbine lights often being obscured by intervening topography.
- 1.6.6 Much of the area within 20 km of the Proposed Development would not be affected by the Proposed Developments turbine lighting due to the screening effect of intervening topography, as evidenced by **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit**.
- ### Effects on Landscape and Coastal Character
- 1.6.7 As mentioned in **Section 1.5**, LCTs with wild and remote characteristics are likely to be affected by the proposed turbine lights and in particular elevated upland areas where human habitation is limited or absent and the influence of existing artificial lights sources may be limited.

LCT 350 Peatland and Moorland

- 1.6.8 The western part of the host unit of LCT 350 Peatland and Moorland is occupied by part of SVT which includes sources of artificial light and flare stacks. The Calback Ness unit to the west of the host unit and immediately north of SVT is also influenced by the terminal as are the Gluss Ayre and Scatsta units to the west and south west respectively. Lights on the proposed turbines would be noticeable from these units. The lights would be of a different type to most of those visible and would be seen low on the horizon.
- 1.6.9 Lights would also be noticeable from a large unit of LCT 350 in the south of Yell. In this unit the “*wild character*” is more strongly evident than in the smaller units closer to settled and developed areas. The proposed lights would be perceived as distant objects, low on the skyline and seen in the context of the lights along the coast at Toft and the sky glow from existing lights at SVT.
- The magnitude of change on units of LCT 350 would be Slight. The residual effect on this receptor of Medium/Low to Medium sensitivity would be **Minor to Moderate/Minor** and **Not Significant**.

LCT 349 Major Uplands

- 1.6.10 The ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** indicates theoretical visibility of lights mainly from the southern unit and from the Ronas Hill unit to the north west of the Proposed Development. Both these units are largely uninhabited and it is the key characteristics of “*exposed high land with panoramic views...*” that would be affected by lights on the proposed turbines. The proposed lights would be within 5 km of the northern part of the southern LCT unit and would potentially be visible operating at up to 2,000 candela. The lights would be noticeable but not uncharacteristic of views from the LCT unit. From the Ronas Hill unit the lights would be seen at distances of 8.5 km or more and light intensity would be up to 200 candela.
- 1.6.11 From both these units the lights would be perceived as a new artificial source of light. The landscape from which the lights would be viewed includes very limited artificial sources of light. Artificial sources of light are visible in the baseline from both these units with SVT and Sella Ness industrial area having a noticeable influence. The proposed lights would be noticeable but not uncharacteristic of views from these LCT units.
- 1.6.12 The magnitude of change on the southern unit of LCT 349 would be Moderate/Slight. The residual effect on this receptor of High/Medium sensitivity would be **Moderate** and **Not Significant** in the southern unit. The magnitude of change on the Ronas Hill unit would be Slight and the residual effect on this receptor of High/Medium sensitivity would be **Moderate/Minor** and **Not Significant**.

LCT 351 Undulating Moorland with Lochs

- 1.6.13 The ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** indicates theoretical visibility of lights from the three units of this LCT within 10 km of the Proposed Development. The LCT is largely uninhabited with few man-made structures and remoter areas have a wild character. The North Roe and Burriland areas are uninhabited areas of rough moorland and lochs from which visibility of the proposed lights would be limited. These two areas are influenced to a degree by existing sources of artificial light at SVT.
- 1.6.14 The Lunning peninsula unit is a small area that coincides with higher ground on Lunna Ness. Intervening landform screens SVT from view although the sky glow from lights at the terminal is noticeable.
- 1.6.15 At the North Roe and Burriland units, lights on the proposed turbines would be seen at intensities of 200 candela or less. The proposed lights would be noticeable but not uncharacteristic of views from these LCT units. At the Lunna peninsula LCT unit the proposed lights would be seen low on the horizon. Lights on SVT would not be visible but the sky glow created by them would be discernible. The lights of settlement at Mossbank have a limited influence on landscape character.

- 1.6.16 The magnitude of change on these three units of LCT 351 would be Slight. The residual effect on this receptor of High/Medium sensitivity would be **Moderate/Minor** and **Not Significant**.

LCT 355 Coastal Edge

- 1.6.17 The daytime assessment described in **Chapter 4: Seascape, Landscape and Visual Amenity (EIAR Chapter 2)** identified four units that would be affected: two in the North Roe area and two on the west coast of Yell. Existing sources of artificial light at SVT are visible from all four of these units. Lights of settlements and navigation buoys also influence views from these units and the experience of wild character.
- 1.6.18 The proposed lights would be noticeable but not uncharacteristic of views from these LCT units. The lights would be visible at intensities of 200 candela or less and would influence views and wild character of the LCT units to a degree. However, the presence of existing sources of light in the direction of the Proposed Development and the lower intensity of the proposed lights and intervening distance mean that the magnitude of change would be Slight. The residual effect on this receptor of High/Medium sensitivity would be **Moderate/Minor** and **Not Significant**.

Costal Character Areas

- 1.6.19 CCA 3, 26 and 27 are all influenced by existing sources of artificial light at SVT particularly in the north of CCA 26 and south of CCA 27. The northern and western parts of CCA 3 are influenced by lights at Mossbank and Burravoe on Yell in addition to sky glow arising from SVT. There are lighthouses and lights on navigation buoys in addition to Toft and Ulsta ferry terminals and the lights of settlements along the coastline. These existing sources of light are found mainly within 5 km of the Proposed Development where the proposed turbine lights could be seen at up to 750 candela as shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit**. Beyond 5 km or during clear visibility when the proposed lights are operating in dimming mode, the proposed lights would be seen at intensities of between 75-200 candela.
- 1.6.20 The proposed lights would be noticeable but not uncharacteristic of views from these three CCA. The magnitude of change on these three CCA would be up to Slight. The residual effect would be **Moderate** and **Not Significant**.

Effects on Landscape Designations and Classifications*Shetland NSA*

- 1.6.21 **Technical Appendix 4.6: Shetland National Scenic Area Special Landscape Qualities Assessment (EIAR Volume 4)** explains that views of the Proposed Development would be distant and interrupted by landform from the Muckle Roe and Eshaness NSA Areas with greater potential for impacts from the eastern part of the North Roe NSA Area. The assessment concluded that there would be **Moderate** and **Significant** residual effects on SLQ2 “*coastal views both close and distant*” from part of the North Roe NSA Area. The Moderate and Significant effects relate to the way in which SLQ2 is experienced during daylight hours. At night views in the direction of the Proposed Development would be influenced by lighting at SVT where there are multiple sources of artificial light of different colours and intensities. This creates a dense area of artificial lighting sources recognisable from a distance as direct views of the lights are experienced as an area of ‘sky glow’ in the area above SVT. The distance from North Roe NSA Area to the Proposed Development is 11 km. Therefore, if visible, lights on the Proposed Development would likely be operating at reduced intensity of 200 candela. While the lights would be noticeable they would be low on the horizon and would not be uncharacteristic of baseline views in the direction of the Proposed Development. The magnitude of change would be Slight and the residual effect would be **Moderate** and **Not Significant** on SLQ2.

- 1.6.22 The ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** shows no visibility of proposed lights from the western part of the Eshaness NSA Area and very limited visibility in the east at Hillswick. There would be very limited visibility of lights at the Muckle Roe NSA Area. The magnitude of change on SLQ2 would therefore be Negligible and the residual effect would be **Minor** and **Not Significant** at Muckle Roe and Eshaness.
- 1.6.23 Lights on the proposed turbines also have the potential to affect SLQ6 “*a sense of remoteness, solitude and tranquillity*”. The daylight assessment concluded that effects would be Moderate and **Not Significant** in the North Roe NSA Area and Minor and **Not Significant** for Eshaness and Muckle Roe NSA Areas. In the North Roe NSA Area lights would be more noticeable from elevated locations in the eastern part of the NSA Area. Where visible the lights would be operating at 200 candela and would be seen as additional to the existing light sources at SVT. While the Proposed Development would increase the amount of artificial light sources visible from the North Roe NSA Area, this would not substantially diminish the experience of tranquillity in this part of the NSA. The magnitude of change would be Slight and the residual effect would be **Moderate** and **Not Significant** on SLQ6. At Eshaness and Muckle Roe, due to intervening distance and landform, the influence of lights on the proposed turbines would be very limited. The magnitude of change on SLQ6 would be Negligible and the residual effect would be **Minor** and **Not Significant** at Muckle Roe and Eshaness.

Local Landscape Areas

- 1.6.24 **Technical Appendix 4.5: Designations and Classifications Sensitivity Assessment (EIAR Volume 4)** lists the key characteristics of the four LLAs assessed in this SLVIA. The daytime effects on key characteristics of the LLA indicates that there would be **Moderate** and **Not Significant** effects on LLA 12 Lunna Ness and Lunning, LLA 2 Nibon and Mangaster and LLA 1 Ronas Hill. Daytime effects on LLA 17 West Sandwick to Gloup Holm would be **Moderate/Minor** and **Not Significant**. The LLA key characteristics and descriptions do not refer to dark skies or night-time views. However, lights on the proposed turbines could affect views from the LLA and the experience of remoteness, isolation and wildness referred to in the descriptions of each LLA.
- 1.6.25 The ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** indicates that, where visible, lights on the proposed turbines would be perceived as operating at intensities of approximately 75-200 candela. In practice this means that the intensity of the lights would be reduced due to the angle from horizontal, and the actual intensity could be up to 200 candela but this would vary due to atmospheric conditions affecting visual clarity.
- 1.6.26 The assessment of effects on the LCT that coincide with these four LLAs indicates that the magnitude of change would be up to Slight and residual effects would be Moderate/Minor. The assessment of LCT focussed on those key characteristics where views are mentioned as important and where the experience of remoteness, wildness or tranquillity is evident. These characteristics or qualities are also evident in the four LLAs and views from and across each LLA are a consideration. Views towards LLA 1 are also important as one of the key characteristics is about the landmark status of Ronas Hill.
- 1.6.27 The key characteristics of the four LLAs do not mention the influence of dark skies or indicate that night-time views are integral to an appreciation of the scenic qualities of each LLA. The four LLA are influenced to a degree by existing artificial sources of light and particularly the presence of SVT where lights are visible from LLA 1, LLA 2 and LLA 17 and sky glow is visible from LLA 12.
- 1.6.28 Given the key characteristics of the four LLAs and accounting for the analysis of night-time effects reported for the underlying LCT, the magnitude of change resulting from the proposed lights is considered to be Slight and the residual effect would be **Moderate** and **Not Significant** on each LLA.

Visual Effects

Settlements and settled areas

- 1.6.29 Given the assessment of effects reported in the main SLVIA in **Chapter 4: Seascape, Landscape and Visual Amenity (EIAR Volume 2)**, this section focusses on those settlements and settled areas within 10 km of the Proposed Development. As indicated on the ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** visibility of lights would occur mainly within 5 km of the Proposed Development. The settlements and settled areas within 5 km affected would be:
- Mossbank;
 - Scatsta, Graven and Garth.
- 1.6.30 Most of Mossbank would not experience visibility of the proposed lights due to screening by landform. A small area in the north of Mossbank would be affected. Viewpoint 21 (**Figure 4.43a-f: Viewpoint 21: Mossbank (EIAR Volume 3b)**) shows the predicted daytime view and indicates that all eight nacelles and therefore all lights would potentially be visible. Existing artificial sources of light are present in views from Mossbank. These sources include streetlights, security lights on houses, interior house lights, navigation lights and flare stacks and sky glow at SVT.
- 1.6.31 The Proposed Development would introduce a different type of light source which would appear low on the horizon and above the dark landform of the Site. The lights would contrast with the dark backdrop to a degree and would be seen as a cluster of lights in a small part of the view. The main view across and along Yell Sound would not be affected.
- 1.6.32 The proposed lights would be a noticeable influence on night-time views from public places in the northern part of Mossbank. **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** indicates that the lights would be perceived at an intensity of up to 750 candela. The lights would appear relatively bright although the contrast with baseline would be reduced to a degree by streetlights in Mossbank and by sky glow from SVT.
- 1.6.33 The magnitude of change for receptors in a small part of Mossbank would be Moderate/Slight. The residual effect on these receptors of High sensitivity would be **Moderate** and **Significant**.
- 1.6.34 At Scatsta, Graven and Garth existing sources of artificial light at SVT, Sella Ness and Scatsta airfield have a notable influence on night-time views. Viewpoint 9 (**Figure 4.31g-h: Viewpoint 9: Vantage Point by Houb of Scatsta (EIAR Volume 3b)**) shows that lights on the proposed turbines would be visible amongst existing light sources and would be seen at lower intensity than existing light sources.
- 1.6.35 Given the influence of existing light sources, the contrast of the proposed lights with baseline is lessened and the proposed lights would have a limited influence on views. The magnitude of change would be Slight/Negligible. The residual effect on this receptor of High sensitivity would be **Moderate/Minor** and **Not Significant**.
- 1.6.36 At distances of greater than 5 km, where visible the proposed lights are likely to be operating at 10% of maximum intensity. They could also be operating at full intensity but in conditions of poor visibility whereby perceived intensity would be reduced e.g. due to intervening cloud. Settlements are small with few or no streetlights and sources of artificial light are limited although SVT is a notable feature.
- 1.6.37 Viewpoint 22 (**Figure 4.44g-h: Viewpoint 22: Ollaberry (EIAR Volume 3b)**) is situated at Ollaberry and shows that all eight of the proposed lights would be seen above the skyline adjacent to SVT. The contrast with baseline at the receptors location would be reduced by intervening distance and lights would not be uncharacteristic of baseline views in the direction of the Site due to the presence of SVT. The magnitude of change would be Slight. The residual effect on this receptor of High sensitivity would be **Moderate** and **Not Significant**.

- 1.6.38 The effects reported for Ollaberry would be typical of those experienced from settled areas on the west side of Yell Sound. Views are influenced by SVT. Consequently lights would not be uncharacteristic of views despite the limited presence of artificial light sources at the receptor location in these rural settled areas.
- 1.6.39 At Ulsta, Copister and West Yell, the influence of SVT would reduce the contrast of the proposed lighting with the baseline. At Ulsta (see Viewpoint 4, **Figure 4.26g-h: Viewpoint 4: Yell. Ulsta Shetland Ferry Terminal (EIAR Volume 3b)**) the proposed lights would be seen above the skyline and above the dark landform and against the backdrop of night sky. A flare stack and some distant light sources are visible and have a limited influence on views. The proposed lights would be noticeable new feature of views. The magnitude of change would be Moderate/Slight. The residual effect on this receptor of High sensitivity would be **Moderate** and **Significant** at Ulsta and Copister. At West Yell the magnitude of change would reduce to Slight due to the influence of SVT and the residual effect would be **Moderate** and **Not Significant**.
- 1.6.40 At Burravoe on Yell, there are existing light sources in the village in the form of streetlights and security lights on dwellings and public buildings. There would be oblique views of the proposed lights from the village and vicinity. Viewpoint 19 (see **Figure 4.41a-f: Viewpoint 19: Yell. B9081, west of Loch of Littlester (EIAR Volume 3b)**) shows a daytime view to the west of the village and indicates that all eight lights would be discernible. Views from the village would be restricted to a degree by landform which would reduce visibility of existing light sources along the coastline. At Burravoe the magnitude of change would reduce to Slight due to the oblique angle of views and the residual effect would be **Moderate** and **Not Significant**.

Residents within 2 km of the Proposed Development

- 1.6.41 **Technical Appendix 4.7: Residential Visual Amenity Assessment (EIAR Volume 4)** describes the residential visual amenity assessment of all residential properties within 2 km of the nearest proposed turbine. The assessment describes daytime effects. It is assumed that residents indoors would have curtains or blinds closed at night and therefore unlikely to see the proposed lights from inside a dwelling. Residents may experience views of the proposed lights from gardens or driveways and from the public road used to access their property.
- 1.6.42 Where visible lights could be seen they would be operating at full intensity, as shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** lights would be seen only in the vicinity of Toft ferry terminal and to the north. Residents of the following properties may experience views of lights:
- P8 Quoy Lee;
 - P9 White House;
 - P10 Lighthouse; and
 - P11 Booth of Toft
- 1.6.43 The ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** indicates that lights may be perceived at intensities of up to 80 candela. Although the intensity of the lights would be limited, they would be noticeable new features in the night sky. The magnitude of change would be Moderate and the residual effect would be **Major/Moderate** and **Significant** at these four properties. It is likely that the residual effects would be experienced outside the dwelling in gardens or on driveways.

Roads

- 1.6.44 The road network in the Study Area is concentrated in incised straths and along the coast where views of lights on the Proposed Development would be restricted by the screening effect of intervening topography. There are occasional sections of road crossing higher ground from which more open views may be obtained. A large proportion of the transportation network would be unaffected by the Proposed

Development, as indicated in **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit**. Where lights are visible, they would appear slightly elevated and of a reduced brightness due to automatic dimming and directional intensity reduction. However, from some stretches of road within 5 km the proposed lights could be visible at greater intensities. The degree of contrast with baseline would be reduced for road users due to lights on the dashboard of vehicles, headlights of oncoming vehicles, and the tail lights and brake lights of other traffic.

A968

- 1.6.45 Analysis of the ZTV shown on **Figure 4.8.1: Aviation Lighting ZTV – All Turbines Lit** indicates that the greatest potential for direct views of the Proposed Development lights would be travelling northbound between Swinister and Toft within 5 km of the proposed lights. Where visible the magnitude of change would range between Moderate/Slight in the south near Swinister and Moderate at Toft. The residual effect would range between be **Moderate/Minor** and **Not Significant** near Swinister and **Moderate** and **Not Significant** at Toft.

- 1.6.46 The proposed lights would also be visible to southbound travellers on the A968 on Yell between West Yell and Ulsta. Viewpoint 4 (**Figure 4.26g-h: Viewpoint 4: Yell. Ulsta Shetland Ferry Terminal (EIAR Volume 3b)**) shows the predicted view from Ulsta ferry terminal and the closest point of the route on Yell to the Proposed Development and Viewpoint 18 (**Figure 4.40a-f: Viewpoint 18: Yell. A968/NCR1 (EIAR Volume 3b)**) shows a daytime view from the route near West Yell. At Ulsta the proposed lights would be a notable new feature and the magnitude of change would be Moderate/Slight. The residual effect on this receptor of Medium sensitivity would be **Moderate** and **Significant**. Further north along the route the effects would reduce with increasing distance and the lights would be perceived in the context of SVT which would be more noticeable from elevated parts of the route. The magnitude of change would be Slight and the residual effect would be **Moderate/Minor** and **Not Significant**.

A970

- 1.6.47 There would be intermittent views of short duration from the A970 and the magnitude of change would be Negligible. The residual effect would be **Negligible** and **Not Significant**.

B9076

- 1.6.48 The B9076 is already strongly influenced by existing sources of artificial light at Scatsta, Sella Ness and SVT. The contrast with baseline resulting from the Proposed Development would therefore be reduced. The magnitude of change would be Slight/Negligible and the residual effect on this receptor of Medium sensitivity would be **Minor** and **Not Significant**.

B9079

- 1.6.49 There would be views of the proposed lights from elevated parts of the route. The proposed lights would be seen in conjunction with SVT and the contrast with baseline would be somewhat reduced. The proposed lights would not be uncharacteristic of views and would be seen at an oblique angle to the direction of travel. The magnitude of change would be Moderate and the residual effect on this receptor of Medium sensitivity would be **Moderate** and **Not Significant**.

B9081

- 1.6.50 There would be views of the proposed lights from the eastern part of the route at Burravoe and in the west at Ulsta. At Burravoe the lights would be seen above intervening landform and would be uncharacteristic of views due to the limited influence of SVT along that stretch of the route. Approaching Ulsta the proposed lights would be more noticeable and appear in line of sight when driving southbound. At Burravoe the magnitude of change would be Slight and the residual effect would be **Moderate** and

Not Significant. Approaching Ulsta the magnitude of change would be Moderate/Slight. The residual effect on this receptor of Medium sensitivity would be **Moderate** and **Not Significant** at Ulsta.

1.7 Conclusions on the Effects of Lighting

- 1.7.1
- The topic of lighting effects is complex and highly nuanced. How the lights experienced would depend upon a range of factors from weather and visibility conditions, receptor elevation and distance relative to the Proposed Development, and whether receptors are moving or static.
- 1.7.2
- Lighting effects on landscape character and visual amenity are primarily concerned with effects on the darkness and remoteness of landscapes, and it is debatable whether landscape character can be appreciated in the dark. The visibility of the lights at the Proposed Development would primarily affect elevated upland landscapes which are largely uninhabited. The area immediately west of the Site is strongly influenced by existing lighting at SVT. West of Sullom Voe and on the west side of the voe and south of the Site are also influenced by existing sources of light at the terminal. In addition, there are sources of artificial lights at settlements such as Mossbank, ferry terminals at Toft and Ulsta, scattered dwellings and navigation buoys and lighthouses that characterise the coastal waters, headlands and voes. With increasing distance to the north and south east the influence of existing sources of lights diminishes and so too would the effects of lights on the Proposed Development due to automatic dimming and the effects of intervening distance reducing the contrast with baseline conditions.
- 1.7.3
- Views of the lights from lower lying landscapes, settlements and roads would be substantially restricted by intervening topography. Such landscapes also have a lesser degree of perceived remoteness, often containing existing light sources associated with established settlements, scattered farmsteads and dwellings as well as the headlights and interiors of vehicles. Effects in these landscapes would be confined mainly to road users in vehicles on the minor roads within 5 km of the Site where the lights would form notable elevated points of light and additional focal points in views. However, car dash-lights and headlights coupled with the transient nature of views from vehicles would lessen the magnitude of impacts arising from the turbine lights.

