

Pentland floating offshore wind farm

Volume 3: Appendix A.16.8

Visibility Frequency Data



APPENDIX 16.8 VISIBILITY FREQUENCY DATA

1.1 Frequency and likelihood of visual effects – weather conditions

The judgements made in the Seascape, Landscape and Visual Impact Assessment (SLVIA) (Offshore EIA (Volume 2): Chapter 16) are based on optimum 'very good' to 'excellent' visibility of the Pentland Floating Offshore Wind Farm Array ('the Offshore Development'). Visibility is categorised in the SLVIA in accordance with Met Office definitions as follows:

- > Very Poor Less than 1,000 metres
- > Poor Between 1,001 and 4,000 metres
- > Medium Between 4,001 and 10,000 metres
- > Good Between 10,001 and 20,000 metres
- > Very Good Between 20,001 and 40,000 metres
- > Excellent Greater than 40,000 metres

This assumption is assessed as the worst-case scenario in the SLVIA, but in reality, the degree and extent of visual effects arising from the Offshore Development will be influenced by the prevailing weather and visibility conditions. Viewing conditions and visibility have been found, during field work, to vary in the SLVIA Study Area. The varied clarity or otherwise of the atmosphere will reduce the number of days upon which views of the Offshore Development will be available from the coastline and hinterland, and is likely to inhibit clear views, rendering the wind turbines more visually recessive within the wider seascape. The effects of the Offshore Development will vary according to the weather and prevailing visibility. This means that effects that are assessed to be significant in the SLVIA under very good or excellent visibility conditions, may be not significant under moderate, poor or very poor visibility conditions.

A description of visibility frequency is provided in the Offshore EIA (Volume 2): Chapter 16: SLVIA, using Meteorological Terminal Air Report (METAR) visibility data from the nearest Met Office station that records visibility, to highlight potential trends in the visibility conditions of the Offshore Study Area. The nearest Met Office is at Wick Airport. Both Landscape Institute with the Institute of Environmental Management and Assessment (2013) Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA3) (8.15) and NatureScot guidance (NatureScot, 2017, para 39) refer to use of this Met Office visibility data to assess typical visibility conditions within an area.

Visibility sensors measure the meteorological optical range which is defined as the length of atmosphere over which a beam of light travels before its luminous flux is reduced to 5% of its original value. The use of light within the visible spectrum allows the sensor to most accurately simulate human perception of visibility. Reasonably accurate measurements are possible over a range of visibility extending from a few tens of metres to a few tens of kilometres.

Although there are limitations to how this data can be applied to judgements about wind farm visibility, the 'visibility' data provides some understanding and evidence basis for evaluating the actual visibility of the wind turbines against their background.

The maximum optical range of visibility was measured every hour over a ten-year period (Jan 2012 to December 2021) at the Wick Airport Met Office Station. A table illustrating the percentage of the frequency of maximum optical range that occurs at different ranges is presented in Table 1.1-1.

Given that the sensor picks up the maximum distance over a 360-degree swept arc, it is likely that the longest distances are picked up over the landward part of the arc where the relative humidity is lower, rather than out to sea. The data is, therefore, likely to overestimate the range of visibility in a seaward direction due to its generally higher relative humidity.

Table 1.1-2 and Figure 1.1-1 show the percentage of visibility frequency at different ranges by season. Notably the categories of visibility; poor, moderate, good, very good and excellent, represent bands of distance with an increasing range, for example 'poor' represents a range of 1 km (<1 km), while 'very good' represents a range of 20 km (20 to 40 km). This explains why the frequency shown increases with each category.

'Very poor' and 'poor' visibility, although low in frequency, is most likely to occur in the summer and least likely to occur in the winter. 'Excellent' visibility is most likely to occur also in the winter and least likely to occur in the spring. Then for the 'good' and 'very good' categories, there are no pronounced variations, other than 'good' visibility is marginally more likely to occur in winter and 'very good' more marginally likely to occur in autumn.

If the percentage of visibility frequency is added together for the 'very poor', 'poor' and 'moderate' categories, that is when visibility is less than 10 km, this amounts to 14.16%. With the Offshore Development situated between 7 and 10 km from the closest surrounding coastlines, this means that it will not be visible for approximately 1 in every 10 days. From the more distant coastlines and hinterlands, the frequency with which the Offshore Development will not be visible will increase, such that beyond a range of 20 km it will only be visible approximately 1 in every 3 days.

Table 1.1-1 Frequency of Visibility at Different Ranges as a Percentage

Visibility (metres)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ALL OBS	Visibility Range	Visibility Definition	Visibility over 10 years %
< 1000	0.27	0.43	0.42	2.04	3.43	3.39	5.99	2.75	2.43	0.44	0.20	0.15	1.83	< 1km	Very Poor	1.83
1000 to 1999	0.26	0.32	0.28	0.53	1.08	1.31	1.73	1.15	0.70	0.26	0.21	0.23	0.67	1 to 4km	Poor	2.63
2000 to 2999	0.40	0.61	0.48	0.48	0.79	1.40	1.34	1.20	0.93	0.79	0.91	0.42	0.82			
3000 to 3999	0.86	0.74	0.85	0.90	1.25	1.42	1.77	1.52	1.31	1.28	1.23	0.46	1.14			
4000 to 4999	1.05	0.75	1.00	1.04	1.51	1.51	1.83	1.46	1.63	1.51	1.42	0.84	1.30	4 to 10km	Moderate	9.70
5000 to 5999	0.98	0.80	1.05	1.19	1.39	1.65	1.35	1.72	1.78	1.35	1.78	0.67	1.32			
6000 to 6999	1.16	1.11	1.24	1.79	1.82	1.89	1.35	1.78	2.04	1.86	2.20	1.03	1.61			
7000 to 7999	1.51	1.16	1.57	2.31	1.91	1.86	1.75	1.75	2.06	1.95	2.19	1.04	1.75			
8000 to 8999	1.71	1.33	2.03	2.24	1.94	2.05	1.65	1.86	2.07	1.79	1.98	1.23	1.82			
9000 to 9999	1.82	1.69	2.23	2.03	2.14	1.80	1.75	1.85	1.96	1.58	2.02	1.85	1.89			
10000 to 10999	1.67	2.07	2.23	2.72	2.51	2.03	1.49	1.72	1.61	1.95	1.83	1.67	1.95			
11000 to 11999	1.91	2.09	2.15	2.03	2.34	1.97	1.58	1.50	1.68	1.86	1.84	1.52	1.87			
12000 to 12999	1.94	2.20	1.88	2.14	2.28	1.93	1.66	1.60	1.49	1.93	1.56	2.23	1.90			
13000 to 13999	2.14	2.06	1.85	1.76	2.40	2.18	1.77	1.63	1.78	1.99	1.66	1.77	1.91			
14000 to 14999	2.40	2.38	2.08	1.90	2.18	2.25	1.80	1.40	1.89	1.87	1.62	1.93	1.97			
15000 to 15999	2.18	2.65	2.27	2.03	2.18	2.08	1.73	1.52	1.78	1.64	1.69	2.00	1.97			
16000 to 16999	2.44	2.52	1.87	2.04	1.97	2.57	1.59	1.63	1.60	2.11	1.45	1.79	1.96			
17000 to 17999	2.41	2.10	1.93	1.66	2.05	2.28	1.69	1.71	1.70	1.64	1.53	1.98	1.89			
18000 to 18999	2.93	2.17	2.27	1.90	2.20	2.01	1.76	1.50	1.63	1.67	1.77	2.28	2.01			
19000 to 19999	2.89	2.30	2.58	2.17	2.24	2.12	1.56	1.63	2.14	2.29	2.02	2.31	2.19			
20000 to 20999	3.07	2.47	2.23	2.51	2.15	2.16	1.42	1.82	2.14	1.76	2.40	2.62	2.23	20 to 40km	Very good	44.82
21000 to 21999	2.88	2.47	2.33	2.60	1.93	2.01	1.97	1.82	2.09	2.01	2.36	2.85	2.27			
22000 to 22999	2.65	2.36	2.90	2.60	2.28	2.54	1.93	1.87	1.85	2.46	2.56	2.65	2.39			
23000 to 23999	2.42	2.73	3.06	2.65	2.50	2.81	1.97	2.23	1.86	2.55	2.36	2.82	2.49			
24000 to 24999	2.48	2.96	2.76	2.94	2.34	2.42	2.22	2.75	2.27	2.56	2.51	2.62	2.56			
25000 to 25999	2.14	3.42	3.21	2.77	2.61	2.42	2.19	2.27	2.21	2.55	2.52	2.71	2.57			
26000 to 26999	2.07	3.34	2.48	2.80	2.14	2.88	2.26	2.59	2.36	2.51	2.70	3.21	2.60			

Visibility (metres)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ALL OBS	Visibility Range	Visibility Definition	Visibility over 10 years %
27000 to 27999	2.36	2.70	2.70	2.74	2.49	2.35	2.05	2.11	2.17	2.91	2.61	3.06	2.52			
28000 to 28999	2.11	2.46	2.81	2.55	2.41	2.54	2.32	2.33	2.21	2.52	2.44	3.12	2.48			
29000 to 29999	2.10	2.88	3.18	2.96	2.18	2.47	2.28	2.54	2.49	2.84	2.48	2.81	2.59			
30000 to 34999	9.02	11.39	11.29	11.48	11.03	11.61	12.45	11.14	11.47	11.49	10.72	10.73	11.14			
35000 to 39999	7.74	7.28	8.29	8.80	8.81	8.52	10.65	10.45	10.53	10.02	9.02	7.40	8.98			
40000 to 44999	6.90	6.52	6.20	6.64	6.81	6.20	8.01	8.61	8.94	7.56	7.58	6.86	7.26	>40km	Excellent	21.42
45000 to 49999	8.68	7.66	7.12	5.68	6.08	5.61	6.55	8.46	7.70	7.58	7.65	8.12	7.26			
50000 to 59999	10.46	7.89	7.20	5.40	4.60	3.77	4.57	5.97	5.40	6.81	8.27	10.59	6.77			
60000 to 69999	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.08	0.09	0.67	0.34	0.11			
>= 70000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.01	0.06	0.11	0.02			
ALL OBS	100	100	100	100	100	100	100	100	100	100	100	100	100			

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Table 1.1-2 Table showing percentage of visibility frequency at different ranges by season

% Visibility Frequency (10 years)		Spring	Summer	Autumn	Winter
Visibility Range	Visibility Definition	%	%	%	%
> 1km	Very Poor	0.47	1.03	0.26	0.07
1 - 4km	Poor	0.53	1.09	0.65	0.35
4 - 10km	Moderate	2.41	2.63	2.84	1.81
10 - 20km	Good	5.06	4.59	4.57	5.38
20 - 40km	Very Good	10.89	11.28	11.55	11.10
> 40km	Excellent	4.42	4.94	5.87	6.19
		23.8	25.6	25.8	24.9

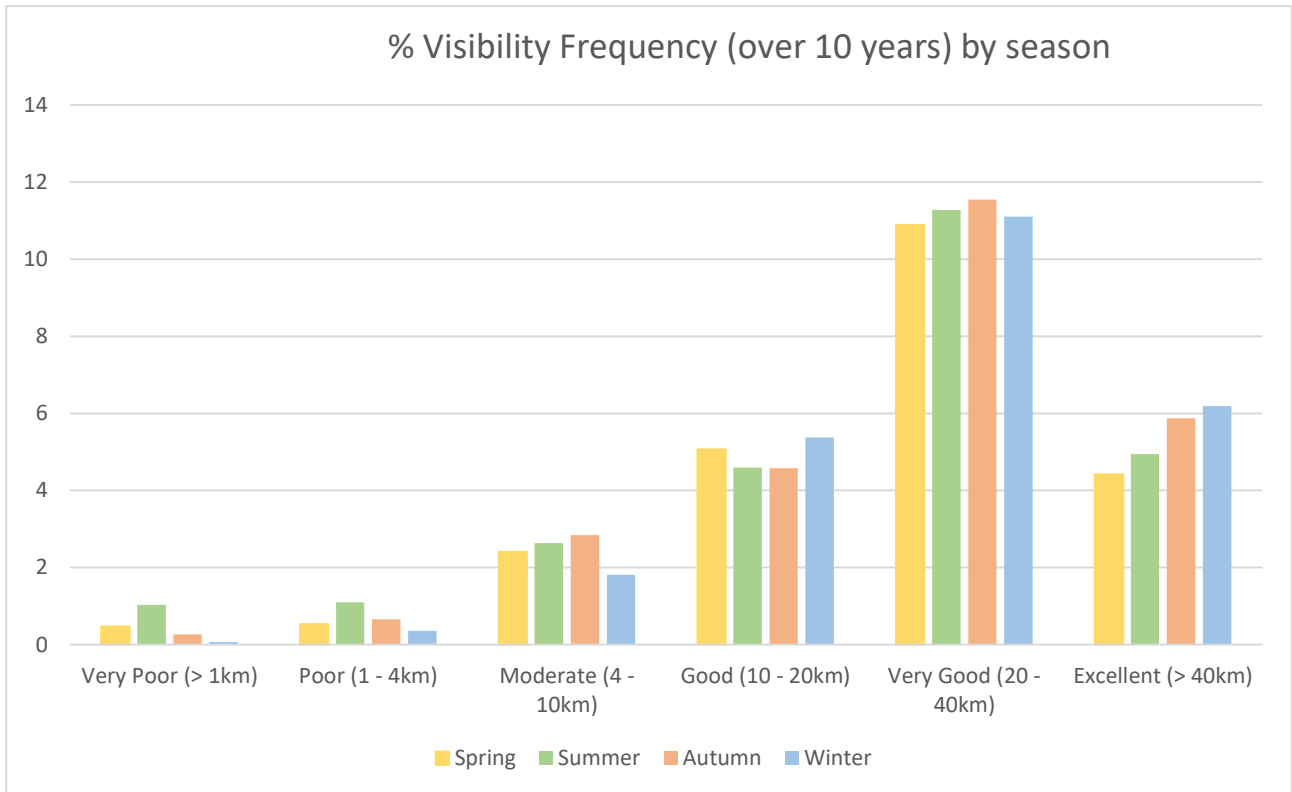


Figure 1.1-1 Chart showing percentage of visibility frequency at different ranges by season