

# Hornsea Offshore Wind Farm

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Project Two

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Environmental Statement  
Volume 6 – Onshore

**Annex 6.5.15**  
**Meteorological Data**

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SMart Wind Limited

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# 1 METEOROLOGICAL DATA

## 1.1 Acquisition of Meteorological Data

1.1.1 Visibility data for the study area has been provided by The Meteorological Office (Met Office) through the provision of a visibility frequency analysis report, which is based on hourly data over a ten year period beginning in January 2003. These visibility observations (which are reproduced below) were identified at Donna Nook meteorological station, situated at national grid reference (NGR) 5429E, 3996N.

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STATION: Donna Nook

NGR: 5429E 3996N

Altitude: 8 metres Above Mean  
Sea Level (A.M.S.L)

PERIOD: 2003 to 2012

**Table 1.1 Frequency Table.**

| Visibility (km) | Hourly data for the 10 year period January 2003 – January 2013 (detailed by month) |      |      |      |      |      |      |      |      |      |      |      | All Observations (OBS) |
|-----------------|--|------|------|------|------|------|------|------|------|------|------|------|------------------------|
|                 | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |                        |
| 0 to 4          | 690  | 1261 | 1265 | 882  | 343  | 570  | 476  | 444  | 460  | 735  | 945  | 1067 | 9138                   |
| 5 to 9          | 1170   | 1196 | 1064 | 1155 | 879  | 860  | 938  | 926  | 843  | 1111 | 1161 | 1347 | 12650                  |
| 10 to 14        | 1222   | 1026 | 1010 | 1190 | 1152 | 1224 | 1507 | 1409 | 1457 | 1127 | 1055 | 1070 | 14449                  |
| 15 to 19        | 1067   | 992  | 1050 | 1039 | 1176 | 1327 | 1919 | 1345 | 1332 | 1079 | 966  | 960  | 14252                  |
| 20 to 24        | 1117   | 861  | 949  | 978  | 1182 | 1376 | 1290 | 1351 | 1158 | 1036 | 1045 | 1176 | 13519                  |
| 25 to 29        | 838  | 621  | 796  | 794  | 1071 | 948  | 725  | 940  | 931  | 840  | 745  | 846  | 10095                  |
| 30 to 34        | 595  | 411  | 608  | 558  | 845  | 458  | 290  | 490  | 608  | 651  | 523  | 504  | 6541                   |
| 35 to 39        | 253  | 176  | 325  | 318  | 461  | 165  | 119  | 217  | 252  | 380  | 294  | 219  | 3179                   |
| 40 to 44        | 175  | 115  | 170  | 174  | 219  | 53   | 51   | 101  | 84   | 244  | 214  | 104  | 1704                   |
| 45 to 49        | 86   | 57   | 76   | 69   | 40   | 22   | 15   | 39   | 24   | 81   | 82   | 46   | 637                    |
| 50 to 59        | 94   | 49   | 45   | 30   | 10   | 7    | 0    | 23   | 2    | 43   | 49   | 51   | 403                    |
| >= 60           | 11   | 2    | 3    | 2    | 1    | 1    | 0    | 0    | 0    | 2    | 1    | 4    | 27                     |
|                 |  |      |      |      |      |      |      |      |      |      |      |      |                        |

1.1.2 In order for the acquired data to be of greater use to the assessment, a number of calculations were performed and are discussed in Sections 1.2 – 1.3. Calculations have been performed to give the worst case scenario (i.e. increased visibility) of the supplied Met Office visibility data.

|                  |      |      |      |      |      |      |      |      |      |      |      |      |       |
|------------------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| All Observations | 7318 | 6767 | 7361 | 7189 | 7379 | 7011 | 7330 | 7285 | 7151 | 7329 | 7080 | 7394 | 86594 |
|------------------|------|------|------|------|------|------|------|------|------|------|------|------|-------|

Table 1.2 Percentage Table.

| Visibility (km) | Month (%) |       |       |       |       |       |       |       |       |       |       |       | All OBS |
|-----------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
|                 | Jan       | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |         |
| 0 to 4          | 9.4       | 18.6  | 17.2  | 12.2  | 4.6   | 8.2   | 6.4   | 6.1   | 6.5   | 10.1  | 13.4  | 14.4  | 10.6    |
| 5 to 9          | 15.9      | 17.7  | 14.6  | 16.1  | 11.9  | 12.3  | 12.9  | 12.7  | 11.8  | 15.1  | 16.3  | 18.2  | 14.6    |
| 10 to 14        | 16.7      | 15.2  | 13.7  | 16.6  | 15.6  | 17.5  | 20.6  | 19.3  | 20.4  | 15.4  | 14.9  | 14.5  | 16.7    |
| 15 to 19        | 14.6      | 14.7  | 14.3  | 14.5  | 15.9  | 18.9  | 26.2  | 18.5  | 18.6  | 14.7  | 13.6  | 13    | 16.5    |
| 20 to 24        | 15.3      | 12.7  | 12.9  | 13.6  | 16    | 19.6  | 17.6  | 18.5  | 16.2  | 14.1  | 14.8  | 15.9  | 15.6    |
| 25 to 29        | 11.5      | 9.2   | 10.8  | 11    | 14.5  | 13.5  | 9.9   | 12.9  | 13    | 11.5  | 10.5  | 11.4  | 11.6    |
| 30 to 34        | 8.1       | 6.1   | 8.3   | 7.8   | 11.5  | 6.5   | 4     | 6.7   | 8.5   | 8.9   | 7.4   | 6.8   | 7.6     |
| 35 to 39        | 3.5       | 2.6   | 4.4   | 4.4   | 6.2   | 2.4   | 1.6   | 3     | 3.5   | 5.2   | 4.2   | 3     | 3.7     |
| 40 to 44        | 2.4       | 1.7   | 2.3   | 2.4   | 3     | 0.8   | 0.7   | 1.4   | 1.2   | 3.3   | 3     | 1.4   | 2.0     |
| 45 to 49        | 1.2       | 0.8   | 1     | 1     | 0.5   | 0.3   | 0.2   | 0.5   | 0.3   | 1.1   | 1.2   | 0.6   | 0.7     |
| 50 to 59        | 1.3       | 0.7   | 0.6   | 0.4   | 0.1   | 0.1   | 0     | 0.3   | 0     | 0.6   | 0.7   | 0.7   | 0.5     |
| >= 60           | 0.2       | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0.1   | 0.0     |
| All OBS         | 100.0     | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0   |

## 1.2 Average Monthly Distance of Visibility (%)

1.2.1 The minimum, maximum and average monthly distance of visibility (in km) for the ten year period, shown as a percentage in Table 4.12 of Volume 3 Chapter 5 Landscape and Visual Resources of the Environmental Statement, has been derived from

1.2.2 Table 1.2 of this Annex. These numbers show the percentage of each month, in which visibility up to a given distance may be possible. The total number of hours of visibility over a given distance per month was extrapolated and then cross-referenced against the total number of hourly data observations over a 10 year period (see Table 1.1). Where a discrepancy occurs between the number of hours in a given month and the actual number of observations, a value of 0 km visibility is assumed for those hours unaccounted for Table 1.3 of this Annex shows the difference between hours and

actual extrapolated observations. The table gives an indication of variance and the reliability of the calculation. There was a good data confidence over the ten year period. There were greater levels of unrecorded hourly observations during January and June through to August.

**Table 1.3 Difference Between Hours and Actual Extrapolated Observations.**

|                                      | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|--------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| <b>Number of hours</b>               | 7440 | 6792 | 7440 | 7200 | 7440 | 7200 | 7440 | 7440 | 7200 | 7440 | 7200 | 7440 |
| <b>Actual number of observations</b> | 7318 | 6767 | 7361 | 7189 | 7379 | 7011 | 7330 | 7285 | 7151 | 7329 | 7080 | 7394 |
| <b>Unaccounted hours</b>             | 122  | 25   | 79   | 11   | 61   | 189  | 110  | 155  | 49   | 111  | 120  | 46   |

**Table 1.4 Average Monthly Distance of Visibility (%).**

| Visibility (km) | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0               | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  |
| <= 4.99         | 98.4 | 99.6 | 98.9 | 99.8 | 99.2 | 97.4 | 98.5 | 97.9 | 99.3 | 98.5 | 98.3 | 99.4 |
| < = 9.99        | 89.1 | 81.1 | 81.9 | 87.6 | 94.6 | 89.5 | 92.1 | 91.9 | 92.9 | 88.6 | 85.2 | 85.0 |
| <= 14.99        | 73.4 | 63.5 | 67.6 | 71.6 | 82.8 | 77.5 | 79.5 | 79.5 | 81.2 | 73.7 | 69.1 | 66.9 |
| <= 19.99        | 56.9 | 48.4 | 54.1 | 55.0 | 67.3 | 60.5 | 59.3 | 60.6 | 61.0 | 58.5 | 54.4 | 52.6 |
| <= 24.99        | 42.6 | 33.7 | 39.9 | 40.6 | 51.5 | 42.1 | 33.5 | 42.5 | 42.5 | 44.0 | 41.0 | 39.7 |
| <= 29.99        | 27.6 | 21.1 | 27.2 | 27.0 | 35.6 | 23.0 | 16.1 | 24.3 | 26.4 | 30.1 | 26.5 | 23.8 |
| <= 34.99        | 16.3 | 11.9 | 16.5 | 16.0 | 21.2 | 9.8  | 6.4  | 11.7 | 13.5 | 18.8 | 16.2 | 12.5 |
| <= 39.99        | 8.3  | 5.9  | 8.3  | 8.2  | 9.8  | 3.4  | 2.5  | 5.1  | 5.0  | 10.1 | 8.9  | 5.7  |
| <= 44.99        | 4.9  | 3.3  | 4.0  | 3.8  | 3.6  | 1.2  | 0.9  | 2.2  | 1.5  | 5.0  | 4.8  | 2.8  |
| <= 49.99        | 2.6  | 1.6  | 1.7  | 1.4  | 0.7  | 0.4  | 0.2  | 0.8  | 0.4  | 1.7  | 1.8  | 1.4  |
| <= 59.99        | 1.4  | 0.8  | 0.6  | 0.4  | 0.1  | 0.1  | 0.0  | 0.3  | 0.0  | 0.6  | 0.7  | 0.7  |
| <= 60+          | 0.1  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.1  |

### 1.3 Fluctuating Distance of Visibility (km)

1.3.1 The fluctuating distances of visibility have been recorded under the worst case assumption that every observation within each 5 km visibility distance class interval is accorded the highest value within that class interval (i.e., an observation of 8 km visibility would fall within the 5 – 9.99 km visibility distance class interval, and would be given a value of 9.99 km). For any records of visibility distance where visibility

exceeded 60 km, such records were accorded a visibility distance of 75 km, as visibility over this distance is considered to be the most likely furthest extent of perceptible visibility. As with the average monthly distance of visibility, a value of 0 km visibility has been assumed for the unrecorded hourly observations see Table 1.4.



1.3.2 To calculate the average combined distance of visibility for any given month, the number of observations for each distance class interval within that month were multiplied by the greatest value of the respective distance class interval (see Table 1.6).

1.3.3 The combined distance figure for each distance class interval was then added together and then divided by the number of hours within that month.

1.3.4 The same process was carried out for each individual month to determine the fluctuation of visibility on a month by month basis.

$$\text{i.e., } \begin{array}{l} \text{Number of observations} \\ \text{(for the distance class} \\ \text{interval)} \end{array} \times \begin{array}{l} \text{Distance} \\ \text{(greatest value of class} \\ \text{interval)} \end{array} = \begin{array}{l} \text{Combined distance} \\ \text{(for the class interval)} \end{array}$$

**Table 1.5 Average Distance of Visibility Per Month (km).**

| Month         | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Distance (km) | 21.51 | 18.64 | 20.28 | 20.62 | 23.51 | 20.79 | 19.73 | 21.29 | 21.32 | 21.84 | 20.72 | 19.68 |

**Table 1.6 Combined Distance of Visibility (km) and Observations Per Month.**

| Distance category (km) | Month    |          |          |          |          |          |          |          |          |          |          |          |
|------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|                        | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
| 0                      | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        |
| 4.99                   | 3443.1   | 6292.39  | 6312.35  | 4401.18  | 1711.57  | 2844.3   | 2375.24  | 2215.56  | 2295.4   | 3667.65  | 4715.55  | 5324.33  |
| 9.99                   | 11688.3  | 11948.04 | 10629.36 | 11538.45 | 8781.21  | 8591.4   | 9370.62  | 9250.74  | 8421.57  | 11098.89 | 11598.39 | 13456.53 |
| 14.99                  | 18317.78 | 15379.74 | 15139.9  | 17838.1  | 17268.48 | 18347.76 | 22589.93 | 21120.91 | 21840.43 | 16893.73 | 15814.45 | 16039.3  |
| 19.99                  | 21329.33 | 19830.08 | 20989.5  | 20769.61 | 23508.24 | 26526.73 | 38360.81 | 26886.55 | 26626.68 | 21569.21 | 19310.34 | 19190.4  |
| 24.99                  | 27913.83 | 21516.39 | 23715.51 | 24440.22 | 29538.18 | 34386.24 | 32237.1  | 33761.49 | 28938.42 | 25889.64 | 26114.55 | 29388.24 |
| 29.99                  | 25131.62 | 18623.79 | 23872.04 | 23812.06 | 32119.29 | 28430.52 | 21742.75 | 28190.6  | 27920.69 | 25191.6  | 22342.55 | 25371.54 |
| 34.99                  | 20819.05 | 14380.89 | 21273.92 | 19524.42 | 29566.55 | 16025.42 | 10147.1  | 17145.1  | 21273.92 | 22778.49 | 18299.77 | 17634.96 |
| 39.99                  | 10117.47 | 7038.24  | 12996.75 | 12716.82 | 18435.39 | 6598.35  | 4758.81  | 8677.83  | 10077.48 | 15196.2  | 11757.06 | 8757.81  |
| 44.99                  | 7873.25  | 5173.85  | 7648.3   | 7828.26  | 9852.81  | 2384.47  | 2294.49  | 4543.99  | 3779.16  | 10977.56 | 9627.86  | 4678.96  |
| 49.99                  | 4299.14  | 2849.43  | 3799.24  | 3449.31  | 1999.6   | 1099.78  | 749.85   | 1949.61  | 1199.76  | 4049.19  | 4099.18  | 2299.54  |
| 59.99                  | 5639.06  | 2939.51  | 2699.55  | 1799.7   | 599.9    | 419.93   | 0        | 1379.77  | 119.98   | 2579.57  | 2939.51  | 3059.49  |
| 75                     | 825      | 150      | 225      | 150      | 75       | 75       | 0        | 0        | 0        | 150      | 75       | 300      |