

**GH WindFarmer Noise Report  
Erection of 2no. Endurance E-3120 wind turbines at  
Backies Farm, Keith, Morayshire.  
21 November 2012**

## 1 Project: Backies - Turbine types

|                             |                  |                   |
|-----------------------------|------------------|-------------------|
| Turbine type                | Endurance E-3120 |                   |
| Diameter                    | 19.2             | m                 |
| Hub height                  | 24.8             | m                 |
| Number of blades            | 3                |                   |
| Air density for power curve | 1.225            | kg/m <sup>3</sup> |
| Power regulation            | Pitch            |                   |
| Cut-In windspeed            | 3.5              | m/s               |
| Cut-Out windspeed           | 25.0             | m/s               |



**Turbine noise options:**

Turbine produces tonal noise No  
 Noise in octave bands Yes

| Octave band (Hz) | Sound Power Level (dB(A)) |
|------------------|---------------------------|
| 31.5             | 0.00                      |
| 63.0             | 75.50                     |
| 125.0            | 84.00                     |
| 250.0            | 88.90                     |
| 500.0            | 87.70                     |
| 1000.0           | 88.50                     |
| 2000.0           | 91.40                     |
| 4000.0           | 88.90                     |
| 8000.0           | 75.70                     |

Table 1 - Sound Power Level for Endurance E-3120

Specify absolute sound power level No  
 Specify variation of sound power level with wind speed Yes

Reference height 10.00 m  
 Reference wind speed 10.00 m/s

| Wind speed (m/s) | Difference to Reference (dB(A)) |
|------------------|---------------------------------|
| 0.0              | -94.80                          |
| 1.0              | -94.80                          |
| 2.0              | -94.80                          |
| 3.0              | -7.80                           |
| 4.0              | -6.80                           |
| 5.0              | -6.60                           |
| 6.0              | -6.10                           |
| 7.0              | -5.20                           |
| 8.0              | -3.60                           |
| 9.0              | -1.80                           |
| 10.0             | 0.00                            |
| 11.0             | 1.10                            |
| 12.0             | 1.10                            |
| 13.0             | 1.10                            |
| 14.0             | 1.10                            |
| 15.0             | 1.10                            |
| 16.0             | 1.10                            |
| 17.0             | 1.10                            |
| 18.0             | 1.10                            |
| 19.0             | 1.10                            |
| 20.0             | 1.10                            |

Table 2 - Noise as a function of windspeed for Endurance E-3120

## 2 Project: Backies - Turbines Table

| Turbine ID | Turbine label         | Turbine type name | Hub height (m) | Rotor diameter (m) | Capacity (kW) |
|------------|-----------------------|-------------------|----------------|--------------------|---------------|
| 1          | Application turbine 1 | Endurance E-3120  | 24.8           | 19.2               | 50            |
| 2          | Application turbine 2 | Endurance E-3120  | 24.8           | 19.2               | 50            |

Table 3 - Turbines Table - Part 1

| Turbine ID | Eastings (m) | Northings (m) | Height of base (m) | Nearest turbine ID | Distance to nearest turbine (m) |
|------------|--------------|---------------|--------------------|--------------------|---------------------------------|
| 1          | 349785.0     | 858675.0      | 158                | 0                  | 0.0                             |
| 2          | 349816.0     | 858528.0      | 154                | 0                  | 0.0                             |

Table 4 - Turbines Table - Part 2

## 3 Workbook noise options

|   |                                   |
|---|-----------------------------------|
| Form of noise model to be used                            | Complex (ISO9613) General         |
| Ground Effect   | Porous Ground                     |
| Ground Effect   | ISO9613 General                   |
| Ground factor around turbines                             | 0.50                              |
| Ground factor everywhere else                             | 0.50                              |
| Meteorological correction factor Co                       | 0.00 dB                           |
| Other attenuations to be considered                       | 2.00 Db(conversion of descriptor) |
| Initial default noise limit to use when placing dwellings | 35.00 dB(A)                       |
| Relative to background noise                              | 0.00 dB(A)                        |
| Calculation grid spacing                                  | 10.00 m                           |
| Height above ground for noise mapping                     | 1.50 m                            |
| Use DTM height data                                       | Yes                               |
| Octave Spreading  | Yes                               |

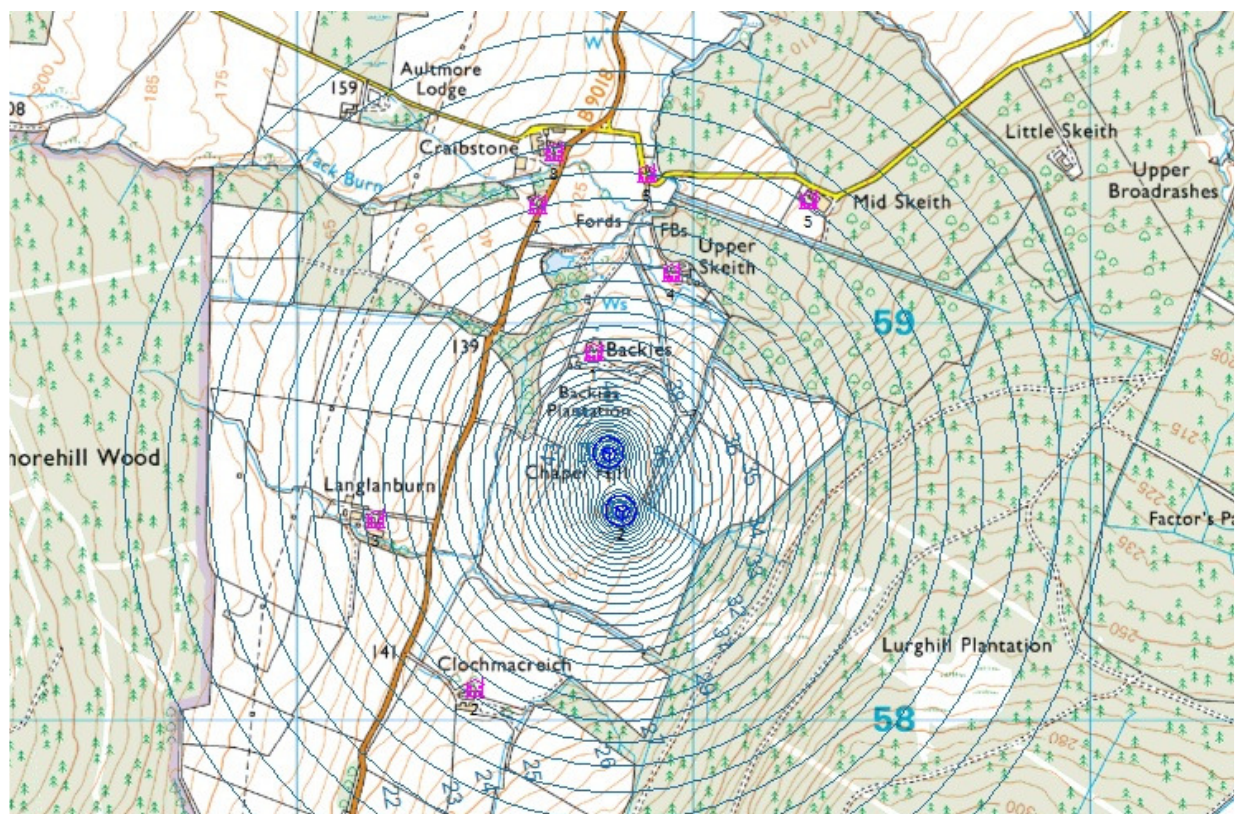
| Octave band (Hz) | Attenuation coefficient (dB/km) |
|------------------|---------------------------------|
| 31.5             | 0.00                            |
| 63.0             | 0.10                            |
| 125.0            | 0.40                            |
| 250.0            | 1.00                            |
| 500.0            | 1.90                            |
| 1000.0           | 3.70                            |
| 2000.0           | 9.70                            |
| 4000.0           | 32.80                           |
| 8000.0           | 117.00                          |

Table 5 - Atmospheric Attenuation for Octave Bands of Noise

## 4 Project: Backies - Dwellings

| Dwelling ID | Dwelling name                 | Distance to nearest turbine (m) | Eastings (m) | Northings (m) | Altitude (m) | Turbine exclusion radius (m) |
|-------------|-------------------------------|---------------------------------|--------------|---------------|--------------|------------------------------|
| 1           | BACKIES FARM                  | 259.1                           | 349745.0     | 858931.0      | 135.5        | 0.0                          |
| 2           | CLOCHMACREICH                 | 577.3                           | 349447.0     | 858084.0      | 154.8        | 0.0                          |
| 3           | LANGLANBURN                   | 611.1                           | 349196.0     | 858512.0      | 157.9        | 0.0                          |
| 4           | UPPER SKEITH                  | 482.6                           | 349943.0     | 859131.0      | 129.2        | 0.0                          |
| 5           | MID SKEITH                    | 814.8                           | 350288.0     | 859316.0      | 145.6        | 0.0                          |
| 6           | LOWER CRAIBSTONE COTTAGE      | 712.5                           | 349881.0     | 859381.0      | 115.4        | 0.0                          |
| 7           | CRAIBSTONE COTTAGES (NEAREST) | 651.4                           | 349605.0     | 859301.0      | 131.9        | 0.0                          |
| 8           | CRAIBSTONE FARM               | 774.4                           | 349647.0     | 859437.0      | 127.7        | 0.0                          |

Table 6 - Project: Backies - Dwellings



## 5 Project: Backies - Dwellings noise

| Dwelling ID | Noise prediction (dB(A)) | Noise limit type | Absolute noise limit (dB(A)) | Relative to background noise limit (dB(A)) | Background noise reference ID |
|-------------|--------------------------|------------------|------------------------------|--|-------------------------------|
| 1           | 34.94                    | Absolute         | 35.00                        | Not applicable                             | Not applicable                |
| 2           | 27.37                    | Absolute         | 35.00                        | Not applicable                             | Not applicable                |
| 3           | 27.49                    | Absolute         | 35.00                        | Not applicable                             | Not applicable                |
| 4           | 29.00                    | Absolute         | 35.00                        | Not applicable                             | Not applicable                |
| 5           | 23.82                    | Absolute         | 35.00                        | Not applicable                             | Not applicable                |
| 6           | 24.93                    | Absolute         | 35.00                        | Not applicable                             | Not applicable                |
| 7           | 25.83                    | Absolute         | 35.00                        | Not applicable                             | Not applicable                |
| 8           | 24.07                    | Absolute         | 35.00                        | Not applicable                             | Not applicable                |

Table 7 - Project: Backies - Dwellings noise

## 6 Summary

Noise Prediction Calculation carried out on WindFarmer (GL Garrad Hassan) Version 4.2.20.0 based on the Complex ISO9613-2:1996(E) General model, in accordance with ETSU-R-97. A copy of the methodology is included within these appendices.

Overall Sound Power Level to be used for turbine is weighted sound level (LW<sub>Aref</sub>) of 90.6 dB plus 1.6dB(A) uncertainty = 92.2dB(A) total for the Endurance E-3120. These levels are confirmed in the Hays Mackenzie Report HM:2300/R1 (6th April 2011) in table 5, page 9 and for uncertainty, table 7 on page 12 of the same report . This section also confirms that the above measurements result at a wind speed 8m/s.

In order to be in compliance with paragraph 25 of the executive summary of ETSU-R-97 (where it is confirmed that a 10m/s wind speed is to be tested), we have had to extrapolate an extra 3.7dB(A) (1.85dB(A) increase for every extra 1m/s – as per table 5, page 9 of the Hays Mackenzie Report. This gives us a final overall Sound Power Level of 95.9dB(A) – i.e. 90.6+1.6+3.7dB(A).

To allow this penalty to be used with the Complex (ISO9613) General method of calculation (which requires the sound to be attenuated as an octave spread) we have added the required 5.3dB to every Octave Sound Power value specified in the above test documents' octave table (Appendix G - Background Corrected One Third Octave Sound Power Levels – again found in the above Hayes Mckenzie Report) – which, when added, arrives at the overall Sound Power Level (SPL) of 95.9dB.

Please note we have included a ground attenuation factor of 0.5 (guidance published in the March/April 2009 IOA bulletin suggests that the ISO 9613 method for predicting noise from wind turbines gives a more accurate result when either hard ground G=0 or semi porous G=0.5 ground attenuation factors are used) – we have used a porous ground effect in the calculations above. We have included a satellite image of the site and surroundings in support of this confirmation of porous ground.

We confirm that all the above Sound Levels and calculations are dB(A)<sub>eq</sub>, and we have taken 2dB reduction in to account at all the dwellings for the conversion between the LA<sub>eq</sub> and LA<sub>90</sub>, 10min descriptors. This LA<sub>90</sub>, 10min descriptor is required to be in accordance with paragraph 14 of the executive summary of ETSU-R-97.

We have also included the Hays Mackenzie Report HM:2300/R1 (6th April 2011) .

PAN45 / ETSU-R-97 states that an acceptable sound pressure level received at the exterior of a neighbouring noise sensitive property must be no greater than 35dB during daylight hours.

From the above results, it is clear that we do not surpass these levels at any neighbouring properties.