



FCC Environment

# Residential and Leisure Development, Pen Y Bont, Chirk

Site Suitability Noise Report

Project No: 661712-01(01)

MAY 18

**RSK**

# RSK GENERAL NOTES

---

**Project No.:** 661712

**Title:** Residential and Leisure Development, Pen Y Bont, Chirk – Site Suitability Noise Report

**Client:** FCC Environment

**Date:** 30 May 2018

**Office:** Manchester

**Status:** FINAL

**Author** Ceri Jones  
Graduate  
Consultant

Acoustic

**Reviewer** Matt Wilson  
Senior Acoustic Consultant

Signature

Date: 30 May 2018



30 May 2018

## Project manager

Signature

Date: 30 May 2018

RSK Environment Ltd (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

No part of this report may be copied or duplicated without the express permission of RSK and the party for whom it was prepared.

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Group plc.

# ACOUSTIC GLOSSARY

---

## ***L<sub>p</sub> - Sound Pressure Level***

The basic unit of sound measurement is the sound pressure level, which is measured on a logarithmic scale and expressed in decibels (dB). The logarithmic scale makes it easier to manage the large range of audible sound pressures, and also more closely represents the way the human ear responds to differences in sound pressure:

$$L_p = 20 \log_{10} (p/p_0)$$

where  $p$  = RMS (root mean square) sound pressure; and

$p_0$  = reference sound pressure  $2 \times 10^{-5}$  Pa.

## ***Frequency Weighting Networks***

Frequency weighting networks, which are generally built into sound level meters, attenuate the signal at some frequencies and amplify it at others. The A-weighting network approximately corresponds to human frequency response to sound. Sound levels measured with the A-weighting network are expressed in dB(A). Other weighting networks also exist, such as C-weighting which is nearly linear (i.e. unweighted) and other more specialised weighting networks. Variables such as  $L_p$  and  $L_{eq}$  that can be measured using such weightings are expressed as  $L_{pA}$  /  $L_{pC}$ ,  $L_{Aeq}$  /  $L_{Ceq}$  etc.

## ***Time Weighting***

Sound level meters use various averaging times for the measurement of RMS sound pressure level. The most commonly used are fast (0.125 s averaging time), slow (1 s averaging time) and impulse (0.035 s averaging time). Variables that are measured with time weightings are expressed as  $L_{AFmax}$  etc.

## ***L<sub>Aeq</sub> – Equivalent Continuous Sound Pressure Level***

Sound levels tend to fluctuate, and as such an 'instantaneous' measurement like sound pressure level cannot fully describe many real-world situations. A summation can be made of the measured sound energy over a certain period, and a notional steady level can be calculated which would contain the same total energy as the fluctuating sound. This notional level is termed the equivalent continuous sound level  $L_{eq}$ .  $L_{eq}$  can be determined over any time period, which is indicated as  $L_{eq,T}$  where T is the time period (e.g.  $L_{eq,24h}$ ).

In mathematical terms, for  $n$  discrete sound level measurements,  $L_{eq}$  is given by:

$$L_{eq,T} = 10 \log_{10} (t_1 \times 10^{L_1/10} + t_2 \times 10^{L_2/10} + \dots t_n \times 10^{L_n/10})/T$$

where  $t_1$  = time at level  $L_1$  dB;

$t_2$  = time at level  $L_2$  dB etc.

and T = total time

## ***L<sub>max</sub> - Maximum Sound Pressure Level or Maximum Noise Level***

This is the maximum RMS sound pressure level occurring within a specified period. The time weighting is usually specified, such as in  $L_{Fmax}$ .

## ***L<sub>N</sub> - Percentile or Statistical Levels***

Sometimes it is useful to calculate the level which is exceeded for a certain percent of a total period. Background noise is often defined as the A-weighted sound pressure level exceeded for 90% of the specified period T, expressed  $L_{90,T}$ . Road traffic noise is often characterised in terms of  $L_{A10,18}$

# CONTENTS

---

|                                                                                                                                   |           |
|-----------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>1 INTRODUCTION .....</b>                                                                                                       | <b>1</b>  |
| 1.1 Instruction .....                                                                                                             | 1         |
| 1.2 Objectives .....                                                                                                              | 1         |
| <b>2 GUIDANCE.....</b>                                                                                                            | <b>2</b>  |
| 2.1 BS 7445: 'Description and measurement of environmental .....                                                                  | 2         |
| 2.2 ISO 9613-2: 1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation' ..... | 2         |
| 2.3 Technical Advice Note (Wales) 11, Noise – October 1997 .....                                                                  | 2         |
| 2.4 Local Guidance and Consultation.....                                                                                          | 4         |
| <b>3 SITE DESCRIPTION .....</b>                                                                                                   | <b>5</b>  |
| 3.1 Site Location and Project Description.....                                                                                    | 5         |
| 3.2 Existing Noise Environment.....                                                                                               | 5         |
| <b>4 NOISE SURVEY METHODOLOGY .....</b>                                                                                           | <b>7</b>  |
| 4.1 Measurement Details.....                                                                                                      | 7         |
| 4.2 Noise Monitoring Locations .....                                                                                              | 7         |
| 4.3 Equipment.....                                                                                                                | 9         |
| 4.4 Noise Monitoring Meteorological Conditions .....                                                                              | 9         |
| <b>5 NOISE SURVEY RESULTS .....</b>                                                                                               | <b>10</b> |
| <b>6 ASSESSMENT .....</b>                                                                                                         | <b>12</b> |
| 6.1 TAN 11 Assessment.....                                                                                                        | 12        |
| <b>7 CONCLUSION.....</b>                                                                                                          | <b>14</b> |
| <b>8 REFERENCES .....</b>                                                                                                         | <b>15</b> |
| <b>APPENDIX A - NOISE MEASUREMENT DATA .....</b>                                                                                  | <b>16</b> |

# 1 INTRODUCTION

---

## 1.1 Instruction

RSK Environment Ltd has undertaken a site suitability noise assessment for a potential residential and leisure development in Pen Y Bont, Chirk. The assessment is based on noise measurements gathered on and around site in January 2018. From this, an assessment of site suitability has been undertaken based on guidance from Planning Guidance (Wales) Technical Advice Note 11, Noise: October 1997 (TAN 11<sup>1</sup>).

The site for the proposed development requires a site suitability assessment to determine the impact of the existing ambient noise environment on future site users.

## 1.2 Objectives

The aim of this noise assessment is detailed below:

- Identify any prominent noise sources that may impact on future residents of the proposed development; and
- Quantify and report the noise environment across the site to determine the suitability of the site for the proposed residential and leisure development.

As the development only includes residential and leisure units, it has been assumed that there will not be additional fixed plant associated with the proposed buildings.

---

<sup>1</sup> Technical Advice Noise (Wales) 11, Noise, 1997.

## 2 GUIDANCE

---

The following documents have been used in the noise assessment process for the proposed development.

### 2.1 BS 7445: 'Description and measurement of environmental

The three-part standard BS 7445 provides the framework within which environmental noise should be quantified. Part 1 (2003) provides a guide to quantities and procedures and Part 2 (1991) provides a guide to the acquisition of data pertinent to land use. Part 3 (1991) provides a guide to the application of noise limits.

The standard also refers to BS EN 61672-1: 2013 'Electroacoustics. Sound Level Meters Specifications', which prescribes the equipment necessary for such measurements. Whilst BS 7445 does not prescribe the meteorological conditions under which noise measurements should or should not be taken, it does (part 2, paragraph 5.4.3.3) recommend that in order:

*"...to facilitate the comparison of results (measurements of noise from different sources), it may be necessary to carry out measurements under selected meteorological conditions which are reproducible and correspond to quite stable propagation conditions."*

These conditions include:

- wind speed not exceeding 5 m/s (measured at a height of 3 to 11 m above the ground);
- no strong temperature inversions near the ground; and
- no heavy precipitation.

### 2.2 ISO 9613-2: 1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'

ISO 9613 details a methodology for propagation of sound outdoors, in order to predict the levels of environmental noise at a distance from a number of sources. The methodology predicts a long-term average A-weighted sound pressure level (SPL), which encompasses a wide variety of environmental conditions.

### 2.3 Technical Advice Note (Wales) 11, Noise – October 1997

TAN 11 details the procedure to be followed when assessing the suitability of a site for prospective residential developments.

The results from the noise assessment (taking into account both daytime and night time levels) must fall into one of the following Noise Exposure Categories (NEC's).

**Table 2-1: TAN 11 Noise Exposure Categories**

| NOISE EXPOSURE CATEGORIES |                                                                                                                                                                                                                                                                             |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A</b>                  | Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.                                                                                         |
| <b>B</b>                  | Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.                                                                                                             |
| <b>C</b>                  | Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise. |
| <b>D</b>                  | Planning permission should normally be refused.                                                                                                                                                                                                                             |

Recommended noise levels are given for the four NEC's for various noise sources; these include road traffic, rail traffic, air traffic and also mixed sources which refers to any combination of road, rail, air and industrial noise sources. The mixed source values are based on the lowest numerical values of the single source limits in the table. The mixed source NECs should only be used where no individual noise source is dominant.

Table 2-2 below specifies the recommended noise levels for each noise source.

**Table 2-2: TAN 11 Noise Exposure Category Criteria**

| RECOMMENDED NOISE EXPOSURE CATEGORIES FOR NEW DWELLINGS NEAR EXISTING NOISE SOURCES                           |                          |                         |       |       |     |
|---------------------------------------------------------------------------------------------------------------|--------------------------|-------------------------|-------|-------|-----|
| Noise Levels <sup>(1)</sup> corresponding to the Noise Exposure Categories for New Dwellings $L_{Aeq,T}$ [dB] |                          |                         |       |       |     |
| Noise Source & Time Period                                                                                    |                          | Noise Exposure Category |       |       |     |
|                                                                                                               |                          | A                       | B     | C     | D   |
| Road traffic                                                                                                  | 0700-2300                | <55                     | 55-63 | 63-72 | >72 |
|                                                                                                               | 2300-0700 <sup>(2)</sup> | <45                     | 45-57 | 57-66 | >66 |
| Rail traffic                                                                                                  | 0700-2300                | <55                     | 55-66 | 66-74 | >74 |
|                                                                                                               | 2300-0700 <sup>(2)</sup> | <45                     | 45-59 | 59-66 | >66 |
| Air traffic <sup>(3)</sup>                                                                                    | 0700-2300                | <57                     | 57-66 | 66-72 | >72 |
|                                                                                                               | 2300-0700 <sup>(2)</sup> | <48                     | 48-57 | 57-66 | >66 |
| Mixed sources <sup>(4)</sup>                                                                                  | 0700-2300                | <55                     | 55-63 | 63-72 | >72 |
|                                                                                                               | 2300-0700 <sup>(2)</sup> | <45                     | 45-57 | 57-66 | >66 |
| Notes                                                                                                         |                          |                         |       |       |     |

<sup>(1)</sup> **Noise levels:** the noise level(s) ( $L_{Aeq,T}$ ) used when deciding the NEC of a site should be representatives of typical conditions.

<sup>(2)</sup> **Night-time noise levels (2300-0700):** sites where individual noise events regularly exceed  $82dBL_{Amax}$  (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the  $L_{Aeq,8H}$  (except where the  $L_{Aeq,8H}$  already puts the site in NEC D).

<sup>(3)</sup> **Aircraft noise:** daytime values accord with the contour values adopted by the Department of Transport which relate to levels measured 1.2m above open ground. For the same amount of noise energy, contour values can be up to 2 dB(A) higher than those of other sources because of ground reflection effects.

<sup>(4)</sup> **Mixed sources:** this refers to any combination of road, rail, air and industrial noise sources. The "mixed source" values are based on the lowest numerical values of the single source limits in the table. The "mixed source" NECs should only be used where no individual noise source is dominant.

To check if any individual noise source is dominant (for the purposes of this assessment) the noise level from the individual sources should be determined and then combined by decibel addition (remembering first to subtract 2 dB(A) from any aircraft noise contour values). If the level of any one source then lies within 2 dB(A) of the calculated combined value, that source should be taken as the dominant one and the site assessed against the appropriate NEC for that source, rather than using the "mixed source" NECs. If the dominant source is industrial noise see paragraph B17 of Annex B.

If the contribution of the individual noise sources to the overall noise level cannot be determined by measurement and/or calculation, then the overall measured level should be used and the site assessed against the NECs for "mixed sources".

## 2.4 Local Guidance and Consultation

Wrexham County Borough Council's Environmental Health Department was consulted in January 2018 regarding the methodology and acoustic criteria to be adopted for the assessment. The noise monitoring strategy and assessment methodology using TAN 11 criteria were agreed with the Environmental Health Department prior to the undertaking of the monitoring work.

## **3 SITE DESCRIPTION**

---

### **3.1 Site Location and Project Description**

The proposed development is on open agricultural land, accessed from the B5605 between Pentre and Newbridge at Pen Y Bont, 5km north of Chirk, North Wales. The site is adjacent to a former landfill site operated by FCC Environment to the west and the River Dee to the east. The southern portion of the site is currently occupied by Border Tachograph Services, however this will be removed as part of the proposals.

Immediately to the west of the site boundary, within the area of the former landfill site, sits an existing landfill gas generator. To the immediate north of the site entrance are a small number of existing residential dwellings.

The site is linear in nature and comprises two main development areas: the existing Tachograph site which will be redeveloped for permanent residential units; and the open agricultural land which will be developed for leisure uses including eco-lodges, traditional camping and a reception with associated cafe.

The development proposals are shown in Figure 3.1

### **3.2 Existing Noise Environment**

The existing noise environment is comprised predominantly of the B5605 and the River Dee 15m to the east of the pasture fields.

Other sources within the noise environment comprise of distant road traffic on the A483 and an environmental compound with landfill gas generator to the north of the site, which will remain operational upon completion of the development. The proposed development plan, shown in Figure 3.1 includes an acoustic barrier located between the existing landfill gas generation plant and the proposed residential units.

An existing Tachograph service area for heavy goods vehicles, currently occupies a portion of the proposed development site. This will not form part of the future development, however noise associated with the area was noted during the survey.

Figure 3.1 Development Proposal



## 4 NOISE SURVEY METHODOLOGY

### 4.1 Measurement Details

Attended measurements were taken in seven locations (NL01 – NL07) to determine the noise environment around the site. The measurements were undertaken on Thursday 11 January 2018 and Monday 15 January 2018 and encompassed short-term measurements over a 15 minute period.

One long term unattended noise meter (NL08) was installed to determine the existing baseline noise levels on the site. It was installed to the south of the proposed housing development area, near the access point to the development in close proximity to B5605. The unattended measurements were taken between Thursday 11 January 2018 and Monday 15 January 2018.

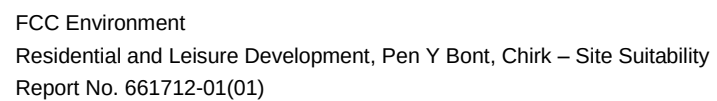
### 4.2 Noise Monitoring Locations

Noise monitoring locations including distances to audible noise sources during each measurement are presented in Table 4.1 below.

**Table 4.1 Noise Monitoring Locations**

| Noise Monitoring ID | Noise Monitoring Location                                                                                           | Audible Noise Source                                   |
|---------------------|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| NL01 (attended)     | Positioned on the access road from the B5605                                                                        | B5605/ Tachograph Service when operational             |
| NL02 (attended)     | Positioned at the boundary of the proposed housing development area, to the east of the site                        | Substation, B5605, Tachograph Service when operational |
| NL03 (attended)     | Positioned at the north east corner of the middle pasture field of the proposed development to the east of the site | River Dee/ A483/ B5605                                 |
| NL04 (attended)     | Positioned at the north east corner of the north pasture field of proposed development to the east of the site      | River Dee, A483                                        |
| NL05 (attended)     | Positioned to the south west of the landfill gas generator                                                          | Substation                                             |
| NL06 (attended)     | Positioned to the south east of the landfill gas generator                                                          | Substation                                             |
| NL07 (attended)     | To the north of the Tachograph building                                                                             | Tachograph (currently on site)                         |
| NL08 (Unattended)   | Positioned to the south of the site, set back from the access road                                                  | B5605, Tachograph Service when operational             |

Noise monitoring locations are presented in Figure 4.1 below.



## 4.3 Equipment

**Table 4.2 – Noise Monitoring Equipment**

| Equipment                 | Type       | Serial number | Calibration drift<br>dB [A] |
|---------------------------|------------|---------------|-----------------------------|
| Class 1 Sound Level Meter | Rion NL-52 | 00453834      | 0                           |
| Class 1 Sound Level Meter | Rion NL-52 | 0775938       | 0                           |
| Acoustic Calibrator       | Rion NC-74 | 3478202       | 0                           |

All measurements were undertaken in free field conditions with the microphone positioned away from reflecting surfaces and at 1.5 m above the ground height to the requirements of BS7445-1:2003 '*Description and measurement of environmental noise. Guide to quantities and procedures*'.

The sound level meters used conform to the requirements of BS EN 61672-1: 2013 '*Electroacoustics. Sound level meter, Specifications*'. The calibrator used conforms to the requirements of BS EN 60942: 2003 '*Electroacoustics, Sound calibrators*'. The equipment used has a calibration history that is traceable to a certified calibration institution under BS EN 61672-1.

## 4.4 Noise Monitoring Meteorological Conditions

During the installation of the unattended noise monitoring equipment and during the attended measurements taken on 11 January 2018, the temperature was on average 4 °C and sunny; the wind was predominantly in the north westerly direction during the survey. The average wind speed was below 5m/s and is therefore considered appropriate for the noise survey.

Upon collection of the unattended noise monitoring equipment and completion of attended measurements on 15 January 2018, the temperature was approx. 7 °C and the sky was clear, however, it had previously been raining and there were slight gusts of wind predominantly in the northern direction.

In addition, archive weather data has been obtained from [www.wunderground.com](http://www.wunderground.com), station ID: ICHIRK2, 3.7km from the site. The weather data during the unattended survey is presented in Table 4.3.

**Table 4.3 – Average Weather Data - Unattended Noise Survey**

| Date       | Average<br>Temperature / °C | Average Wind<br>Speed / m/s | Wind Direction | Precipitation /<br>mm |
|------------|-----------------------------|-----------------------------|----------------|-----------------------|
| 11/01/2018 | 4                           | <2                          | WNW            | 0.3                   |
| 12/01/2018 | 3                           | <2                          | ENE            | 0                     |
| 13/01/2018 | 5                           | <2                          | S              | 0                     |
| 14/01/2018 | 5                           | <2                          | S              | 0.3                   |

## 5 NOISE SURVEY RESULTS

The dominant noise source over the site was generally attributable to the local road network. At monitoring positions NL01 and NL07, the operation of the existing Tachograph service area was dominant when in use and contributed to the ambient noise level.

The results of the survey are reproduced in Appendix A and summarised in **Table 5.1** below:

**Table 5.1 Attended Noise Measurement Results**

| Location ID | Date       | Start | Duration (hh:mm) | L <sub>Aeq, T</sub> dB | L <sub>Amax, T</sub> dB | L <sub>A90, T</sub> dB | L <sub>A10, T</sub> dB |
|-------------|------------|-------|------------------|------------------------|-------------------------|------------------------|------------------------|
| NL01        | 11/01/2018 | 13:10 | 00:15            | 58.1                   | 81.2                    | 44.1                   | 59.7                   |
|             | 11/01/2018 | 13:39 | 00:15            | 55.1                   | 79.6                    | 41.7                   | 55.6                   |
| NL02        | 11/01/2018 | 13:17 | 00:15            | 52.6                   | 64.7                    | 49.7                   | 54.8                   |
|             | 11/01/2018 | 13:58 | 00:15            | 46.7                   | 56.8                    | 43.7                   | 49.4                   |
| NL03        | 15/01/2018 | 12:55 | 00:15            | 48.0                   | 70.1                    | 46.2                   | 49.2                   |
|             | 15/01/2018 | 13:31 | 00:15            | 48.2                   | 59.9                    | 47.2                   | 49.1                   |
| NL04        | 15/01/2018 | 13:13 | 00:15            | 49.1                   | 66.1                    | 48.1                   | 50.2                   |
|             | 15/01/2018 | 14:03 | 00:15            | 49.9                   | 62.6                    | 48.3                   | 51.2                   |
| NL05        | 11/01/2018 | 13:48 | 00:15            | 48.9                   | 60.0                    | 47.6                   | 50.0                   |
| NL06        | 15/01/2018 | 14:51 | 00:15            | 45.8                   | 65.6                    | 43.5                   | 47.2                   |
| NL07        | 11/01/2018 | 13:29 | 00:15            | 66.7                   | 71.3                    | 65.3                   | 67.7                   |

*Levels indicated in yellow are raised due to Tachograph Service operations*

**Table 5.2 Unattended Noise Measurement Results**

| Location ID | Date                      | Time Period | Start Time | Duration (hh:mm) | L <sub>Aeq,T</sub> dB | L <sub>AFmax,T</sub> dB | L <sub>A90,T</sub> dB | L <sub>A10,T</sub> dB |
|-------------|---------------------------|-------------|------------|------------------|-----------------------|-------------------------|-----------------------|-----------------------|
| NL08        | 11/01/2018                | Day         | 07:00      | 16:00            | 48.6                  | 82.9                    | 41.6                  | 48.1                  |
|             | 12/01/2018                | Day         | 07:00      | 16:00            | 50.9                  | 76.1                    | 46.4                  | 51.6                  |
|             | 13/01/2018                | Day         | 07:00      | 16:00            | 50.6                  | 81.8                    | 46.6                  | 51.7                  |
|             | 14/01/2018                | Day         | 07:00      | 16:00            | 47.8                  | 90.6                    | 44.1                  | 49.2                  |
|             | <b>Daytime Summary</b>    |             |            |                  | <b>49.7</b>           | <b>90.6</b>             | <b>44.7</b>           | <b>50.2</b>           |
|             | 11/01/2018                | Night       | 23:00      | 08:00            | 42.8                  | 59.1                    | 39.7                  | 44.3                  |
|             | 12/01/2018                | Night       | 23:00      | 08:00            | 44.8                  | 60.4                    | 41                    | 47.3                  |
|             | 13/01/2018                | Night       | 23:00      | 08:00            | 42.2                  | 60.8                    | 38.6                  | 44.6                  |
|             | 14/01/2018                | Night       | 23:00      | 08:00            | 45.0                  | 75.1                    | 41.2                  | 47.0                  |
|             | <b>Night-time Summary</b> |             |            |                  | <b>43.9</b>           | <b>75.1</b>             | <b>40.1</b>           | <b>45.8</b>           |

## 6 ASSESSMENT

### 6.1 TAN 11 Assessment

From the noise survey, the measurements have been assessed against TAN 11 requirements and the noise environment has been taken into consideration.

Whilst on site, the dominant noise sources comprised of road traffic noise from the B5605 road and A483 road, the compound and substation to the north of the site and also the River Dee to the east. Due to having both traffic noise and landfill gas generator noise across the site, the mixed noise source criteria have been used for the assessment.

It should be noted that the infrastructure currently on site (Tachograph Services) will be removed prior to the commencement of works for the development. The noise measurements affected by this source should not be taken as an accurate representation of the noise environment post construction (NL01 and NL07). This should also not be a determining factor when granting planning permission.

The Noise Exposure Categories and assessment are presented below in Table 53.

**Table 5.3 NEC criteria for mixed sources**

| Monitoring location | Daytime Level | NEC | Night time Level | NEC |
|---------------------|---------------|-----|------------------|-----|
| NL01                | 58.1          | B   | -                | -   |
|                     | 55.1          | B   | -                | -   |
| NL02                | 52.6          | A   | -                | -   |
|                     | 46.7          | A   | -                | -   |
| NL03                | 48.0          | A   | -                | -   |
|                     | 48.2          | A   | -                | -   |
| NL04                | 49.1          | A   | -                | -   |
|                     | 49.9          | A   | -                | -   |
| NL05                | 48.9          | A   | -                | -   |
| NL06                | 45.8          | A   | -                | -   |
| NL07                | 66.7          | C   | -                | -   |
| NL08                | 49.7          | A   | 43.9             | A   |

*Levels indicated in yellow are raised due to Tachograph Service operations*

From the measured results, the daytime attended noise levels measured on site were all within the daytime 'Category A' (<55dB  $L_{Aeq,16h}$ ) criteria, with the exclusion of NL01 and NL07. As noted above, NL01 and NL07 were affected by the Tachograph service and should not be taken as an accurate representation of the future noise environment on site.

At NL05 and NL06, the gas generator was audible. It is not considered to be significant during daytime hours as evident from the attended measurements, but as the generator operates 24 hours a day, there is potential that the levels at night will exceed 45dB  $L_{Aeq,8h}$  and hence it would potentially put the northern section of the residential area into

NEC B; as such appropriate mitigation measures may be required. The developer is proposing to introduce a noise attenuation wall adjacent to the noise source, and assuming this provides a 5-10dB(A) attenuation, the closest proposed residential receptor should be adequately protected.

Further analysis of the proposed barrier should be undertaken at detailed design stage with reference to BS4142:2014, *Methods for rating and assessing industrial and commercial sounds*.

The average noise levels during the daytime from the longer term unattended meter (NL08) were also below 55dB  $L_{Aeq,16h}$ , therefore falling within NEC A.

During the night-time the average levels from the longer term unattended meter (NL08) were below 45dB  $L_{Aeq,8h}$ , therefore placing it within NEC A.

Following the noise survey that has been undertaken, the site is considered to be suitable for the proposed residential and leisure uses. Conditions should be applied in order to mitigate industrial noise from the landfill gas generator.

## 7 CONCLUSION

---

RSK has undertaken a noise survey and site suitability assessment for a proposed residential and leisure development at Pen Y Bont, Chirk. Noise measurements were taken at locations to best represent the ambient noise levels at proposed receptor locations.

Based on the results from both attended and unattended noise monitoring, when taking into consideration the mixed noise source category stated in TAN 11, the levels across site generally falls into Noise Exposure Category A.

Where the measured daytime noise level is within NEC B and NEC C, the measurement has been affected by noise sources which will be removed from the site prior to the proposed development taking place.

The existing landfill gas generator has been identified as a potential source of night time noise, placing the closest residential properties into NEC B. Mitigation measures including a noise barrier are proposed in the application to address this, however, consideration to industrial noise should be given when the barrier is designed to ensure likelihood of complaints is reduced.

It is considered that the site is suitable for the proposed residential and leisure uses. Conditions should be applied in order to mitigate industrial noise from the landfill gas generator.

## 8 REFERENCES

---

1. BS 7445-1:2003 'Description and measurement of environmental noise. Guide to quantities and procedures'
2. BS EN 61672-1: 2013 'Electroacoustics. Sound Level Meters. Specifications'
3. ISO 9613-2: 1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'
4. Technical Advance Note – Wales, Noise (1997)

# APPENDIX A - NOISE MEASUREMENT DATA

## A.1 Hourly Summary Long Term monitoring

| Hourly summary |          |                          |                          |                       |                       |
|----------------|----------|--------------------------|--------------------------|-----------------------|-----------------------|
| Date           | Time     | L <sub>Aeq,1h</sub> (dB) | L <sub>AF,max</sub> (dB) | L <sub>A90</sub> (dB) | L <sub>A10</sub> (dB) |
| 11/01/2018     | 14:50:56 | 56.2                     | 82.9                     | 41.3                  | 52.8                  |
| 11/01/2018     | 15:05:56 | 46.6                     | 64.2                     | 42.5                  | 48.1                  |
| 11/01/2018     | 15:20:56 | 46.5                     | 54.4                     | 42.5                  | 50.8                  |
| 11/01/2018     | 15:35:56 | 55.7                     | 68.4                     | 43.8                  | 62.0                  |
| 11/01/2018     | 15:50:56 | 57.4                     | 69.4                     | 42.8                  | 64.1                  |
| 11/01/2018     | 16:05:56 | 48.7                     | 63.8                     | 42.0                  | 51.4                  |
| 11/01/2018     | 16:20:56 | 50.3                     | 62.8                     | 46.9                  | 51.2                  |
| 11/01/2018     | 16:35:56 | 45.7                     | 57.0                     | 42.6                  | 48.2                  |
| 11/01/2018     | 16:50:56 | 46.4                     | 67.1                     | 41.9                  | 48.0                  |
| 11/01/2018     | 17:05:56 | 47.3                     | 66.3                     | 41.3                  | 47.9                  |
| 11/01/2018     | 17:20:56 | 44.6                     | 56.8                     | 41.6                  | 47.4                  |
| 11/01/2018     | 17:35:56 | 45.8                     | 61.2                     | 42.1                  | 48.3                  |
| 11/01/2018     | 17:50:56 | 44.3                     | 54.5                     | 41.2                  | 46.9                  |
| 11/01/2018     | 18:05:56 | 45.2                     | 61.1                     | 42.3                  | 46.9                  |
| 11/01/2018     | 18:20:56 | 44.6                     | 57.5                     | 41.8                  | 47.1                  |
| 11/01/2018     | 18:35:56 | 43.9                     | 54.0                     | 41.2                  | 46.0                  |
| 11/01/2018     | 18:50:56 | 42.1                     | 51.2                     | 39.2                  | 44.5                  |
| 11/01/2018     | 19:05:56 | 48.1                     | 63.9                     | 40.6                  | 48.1                  |
| 11/01/2018     | 19:20:56 | 44.2                     | 59.0                     | 40.8                  | 46.5                  |
| 11/01/2018     | 19:35:56 | 44.7                     | 59.4                     | 40.8                  | 47.1                  |
| 11/01/2018     | 19:50:56 | 44.3                     | 53.0                     | 41.9                  | 46.1                  |
| 11/01/2018     | 20:05:56 | 45.5                     | 63.5                     | 41.4                  | 47.7                  |
| 11/01/2018     | 20:20:56 | 44.5                     | 54.0                     | 40.4                  | 47.3                  |
| 11/01/2018     | 20:35:56 | 43.6                     | 54.8                     | 41.4                  | 45.1                  |
| 11/01/2018     | 20:50:56 | 44.4                     | 53.3                     | 41.9                  | 46.3                  |
| 11/01/2018     | 21:05:56 | 44.3                     | 54.1                     | 42.3                  | 45.9                  |
| 11/01/2018     | 21:20:56 | 44.3                     | 55.0                     | 41.8                  | 46.5                  |
| 11/01/2018     | 21:35:56 | 44.2                     | 61.9                     | 39.7                  | 46.2                  |
| 11/01/2018     | 21:50:56 | 42.6                     | 53.7                     | 39.9                  | 44.7                  |
| 11/01/2018     | 22:05:56 | 42.5                     | 51.2                     | 40.7                  | 44.1                  |
| 11/01/2018     | 22:20:56 | 42.6                     | 53.6                     | 40.6                  | 44.1                  |
| 11/01/2018     | 22:35:56 | 43.0                     | 54.1                     | 40.7                  | 45.0                  |
| 11/01/2018     | 22:50:56 | 43.1                     | 53.9                     | 40.5                  | 45.2                  |
| 11/01/2018     | 23:05:56 | 42.5                     | 52.2                     | 40.0                  | 44.7                  |
| 11/01/2018     | 23:20:56 | 40.6                     | 48.7                     | 39.0                  | 42.1                  |
| 11/01/2018     | 23:35:56 | 42.0                     | 51.3                     | 38.8                  | 44.3                  |
| 11/01/2018     | 23:50:56 | 40.2                     | 51.2                     | 38.1                  | 42.0                  |

| Hourly summary |          |      |      |      |      |
|----------------|----------|------|------|------|------|
| 12/01/2018     | 00:05:56 | 41.3 | 55.2 | 37.8 | 43.9 |
| 12/01/2018     | 00:20:56 | 43.4 | 58.3 | 37.9 | 46.2 |
| 12/01/2018     | 00:35:56 | 39.6 | 50.6 | 37.8 | 41.6 |
| 12/01/2018     | 00:50:56 | 40.1 | 48.9 | 38.5 | 41.4 |
| 12/01/2018     | 01:05:56 | 39.6 | 51.1 | 37.8 | 40.9 |
| 12/01/2018     | 01:20:56 | 40.6 | 48.7 | 39.5 | 41.8 |
| 12/01/2018     | 01:35:56 | 40.5 | 44.7 | 39.3 | 41.5 |
| 12/01/2018     | 01:50:56 | 40.2 | 44.4 | 39.4 | 41.1 |
| 12/01/2018     | 02:05:56 | 40.5 | 51.5 | 39.6 | 41.3 |
| 12/01/2018     | 02:20:56 | 40.7 | 56.0 | 39.3 | 41.6 |
| 12/01/2018     | 02:35:56 | 41.9 | 56.8 | 39.6 | 44.1 |
| 12/01/2018     | 02:50:56 | 43.4 | 55.3 | 39.5 | 46.4 |
| 12/01/2018     | 03:05:56 | 44.5 | 56.6 | 40.0 | 48.1 |
| 12/01/2018     | 03:20:56 | 42.6 | 56.1 | 38.9 | 45.3 |
| 12/01/2018     | 03:35:56 | 43.7 | 58.3 | 38.2 | 47.2 |
| 12/01/2018     | 03:50:56 | 41.2 | 49.9 | 38.9 | 43.3 |
| 12/01/2018     | 04:05:56 | 41.4 | 56.3 | 38.6 | 43.7 |
| 12/01/2018     | 04:20:56 | 40.4 | 56.6 | 37.4 | 42.5 |
| 12/01/2018     | 04:35:56 | 40.5 | 49.9 | 37.6 | 42.7 |
| 12/01/2018     | 04:50:56 | 41.0 | 50.7 | 38.1 | 43.3 |
| 12/01/2018     | 05:05:56 | 43.0 | 53.2 | 40.2 | 45.3 |
| 12/01/2018     | 05:20:56 | 43.3 | 52.6 | 40.6 | 45.6 |
| 12/01/2018     | 05:35:56 | 44.6 | 58.3 | 41.7 | 46.8 |
| 12/01/2018     | 05:50:56 | 45.1 | 56.2 | 42.1 | 47.5 |
| 12/01/2018     | 06:05:56 | 45.8 | 55.0 | 43.6 | 47.7 |
| 12/01/2018     | 06:20:56 | 46.5 | 59.1 | 43.6 | 48.6 |
| 12/01/2018     | 06:35:56 | 46.8 | 58.0 | 44.3 | 48.5 |
| 12/01/2018     | 06:50:56 | 45.8 | 57.6 | 43.3 | 47.8 |
| 12/01/2018     | 07:05:56 | 46.8 | 53.9 | 44.5 | 48.8 |
| 12/01/2018     | 07:20:56 | 47.0 | 59.6 | 44.6 | 49.0 |
| 12/01/2018     | 07:35:56 | 48.1 | 61.2 | 45.7 | 50.0 |
| 12/01/2018     | 07:50:56 | 52.4 | 71.2 | 46.0 | 54.8 |
| 12/01/2018     | 08:05:56 | 49.6 | 66.8 | 45.3 | 51.3 |
| 12/01/2018     | 08:20:56 | 46.8 | 54.3 | 44.8 | 48.6 |
| 12/01/2018     | 08:35:56 | 47.7 | 57.8 | 45.5 | 49.6 |
| 12/01/2018     | 08:50:56 | 53.7 | 69.7 | 46.9 | 54.2 |
| 12/01/2018     | 09:05:56 | 48.6 | 64.2 | 44.7 | 50.5 |
| 12/01/2018     | 09:20:56 | 54.3 | 64.2 | 44.6 | 62.2 |
| 12/01/2018     | 09:35:56 | 54.9 | 66.6 | 44.9 | 53.7 |
| 12/01/2018     | 09:50:56 | 46.0 | 58.5 | 44.4 | 47.3 |
| 12/01/2018     | 10:05:56 | 52.8 | 72.0 | 45.7 | 52.9 |
| 12/01/2018     | 10:20:56 | 50.7 | 69.5 | 45.9 | 50.6 |

| Hourly summary |          |      |      |      |      |
|----------------|----------|------|------|------|------|
| 12/01/2018     | 10:35:56 | 51.4 | 64.2 | 47.4 | 55.4 |
| 12/01/2018     | 10:50:56 | 49.5 | 70.1 | 46.8 | 50.5 |
| 12/01/2018     | 11:05:56 | 48.8 | 60.8 | 47.3 | 50.1 |
| 12/01/2018     | 11:20:56 | 51.8 | 62.3 | 48.0 | 52.6 |
| 12/01/2018     | 11:35:56 | 51.5 | 65.8 | 48.2 | 52.8 |
| 12/01/2018     | 11:50:56 | 51.1 | 70.6 | 47.1 | 53.1 |
| 12/01/2018     | 12:05:56 | 50.7 | 69.9 | 47.8 | 51.6 |
| 12/01/2018     | 12:20:56 | 52.5 | 70.3 | 50.0 | 52.3 |
| 12/01/2018     | 12:35:56 | 51.6 | 57.9 | 50.5 | 52.8 |
| 12/01/2018     | 12:50:56 | 53.3 | 66.7 | 50.2 | 53.2 |
| 12/01/2018     | 13:05:56 | 57.0 | 65.9 | 47.3 | 63.0 |
| 12/01/2018     | 13:20:56 | 50.2 | 61.9 | 47.1 | 52.0 |
| 12/01/2018     | 13:35:56 | 49.6 | 58.4 | 46.9 | 51.5 |
| 12/01/2018     | 13:50:56 | 48.7 | 59.6 | 46.1 | 50.2 |
| 12/01/2018     | 14:05:56 | 58.3 | 70.1 | 48.1 | 63.6 |
| 12/01/2018     | 14:20:56 | 52.4 | 68.2 | 47.9 | 53.9 |
| 12/01/2018     | 14:35:56 | 51.2 | 68.6 | 47.5 | 51.3 |
| 12/01/2018     | 14:50:56 | 49.0 | 58.0 | 46.9 | 50.5 |
| 12/01/2018     | 15:05:56 | 48.9 | 73.8 | 46.2 | 50.0 |
| 12/01/2018     | 15:20:56 | 47.4 | 55.7 | 45.1 | 49.0 |
| 12/01/2018     | 15:35:56 | 47.9 | 56.9 | 46.1 | 49.5 |
| 12/01/2018     | 15:50:56 | 53.8 | 68.2 | 46.5 | 55.6 |
| 12/01/2018     | 16:05:56 | 53.5 | 68.0 | 51.9 | 53.9 |
| 12/01/2018     | 16:20:56 | 54.0 | 70.8 | 47.7 | 56.2 |
| 12/01/2018     | 16:35:56 | 52.6 | 76.1 | 47.9 | 50.9 |
| 12/01/2018     | 16:50:56 | 48.5 | 57.2 | 46.9 | 49.9 |
| 12/01/2018     | 17:05:56 | 48.3 | 54.8 | 47.1 | 49.6 |
| 12/01/2018     | 17:20:56 | 47.9 | 56.4 | 46.5 | 49.3 |
| 12/01/2018     | 17:35:56 | 47.8 | 61.8 | 46.3 | 49.0 |
| 12/01/2018     | 17:50:56 | 50.0 | 59.3 | 48.0 | 51.7 |
| 12/01/2018     | 18:05:56 | 49.5 | 54.9 | 48.0 | 50.8 |
| 12/01/2018     | 18:20:56 | 48.4 | 55.8 | 47.1 | 49.6 |
| 12/01/2018     | 18:35:56 | 48.5 | 62.8 | 46.8 | 49.9 |
| 12/01/2018     | 18:50:56 | 47.8 | 54.4 | 46.0 | 49.5 |
| 12/01/2018     | 19:05:56 | 48.3 | 56.7 | 46.3 | 49.7 |
| 12/01/2018     | 19:20:56 | 49.4 | 56.8 | 46.8 | 51.0 |
| 12/01/2018     | 19:35:56 | 49.6 | 56.6 | 46.9 | 51.6 |
| 12/01/2018     | 19:50:56 | 49.6 | 60.8 | 46.3 | 51.7 |
| 12/01/2018     | 20:05:56 | 49.6 | 56.6 | 46.6 | 51.7 |
| 12/01/2018     | 20:20:56 | 49.1 | 60.4 | 46.6 | 51.0 |
| 12/01/2018     | 20:35:56 | 48.6 | 58.1 | 45.7 | 50.6 |
| 12/01/2018     | 20:50:56 | 48.2 | 61.4 | 45.2 | 50.5 |

| Hourly summary |          |      |      |      |      |
|----------------|----------|------|------|------|------|
| 12/01/2018     | 21:05:56 | 48.7 | 56.4 | 44.7 | 51.2 |
| 12/01/2018     | 21:20:56 | 48.2 | 54.9 | 44.8 | 50.5 |
| 12/01/2018     | 21:35:56 | 48.3 | 58.6 | 44.9 | 50.6 |
| 12/01/2018     | 21:50:56 | 46.8 | 56.0 | 43.6 | 49.2 |
| 12/01/2018     | 22:05:56 | 46.8 | 61.5 | 43.1 | 49.1 |
| 12/01/2018     | 22:20:56 | 46.1 | 54.6 | 42.0 | 49.0 |
| 12/01/2018     | 22:35:56 | 46.5 | 62.8 | 42.0 | 49.3 |
| 12/01/2018     | 22:50:56 | 46.7 | 62.2 | 42.4 | 49.6 |
| 12/01/2018     | 23:05:56 | 47.4 | 56.9 | 43.0 | 50.3 |
| 12/01/2018     | 23:20:56 | 45.9 | 56.4 | 42.7 | 48.4 |
| 12/01/2018     | 23:35:56 | 46.2 | 58.6 | 42.6 | 48.8 |
| 12/01/2018     | 23:50:56 | 44.9 | 59.9 | 41.3 | 47.8 |
| 13/01/2018     | 00:05:56 | 45.2 | 59.1 | 41.4 | 48.1 |
| 13/01/2018     | 00:20:56 | 44.8 | 57.8 | 40.5 | 47.6 |
| 13/01/2018     | 00:35:56 | 43.9 | 54.8 | 39.7 | 47.0 |
| 13/01/2018     | 00:50:56 | 43.2 | 55.9 | 40.4 | 45.8 |
| 13/01/2018     | 01:05:56 | 43.8 | 56.5 | 40.5 | 46.3 |
| 13/01/2018     | 01:20:56 | 42.9 | 55.7 | 40.0 | 45.3 |
| 13/01/2018     | 01:35:56 | 44.0 | 57.8 | 40.4 | 46.9 |
| 13/01/2018     | 01:50:56 | 42.6 | 54.6 | 39.7 | 45.1 |
| 13/01/2018     | 02:05:56 | 43.4 | 56.7 | 40.0 | 46.3 |
| 13/01/2018     | 02:20:56 | 43.9 | 55.7 | 39.6 | 46.9 |
| 13/01/2018     | 02:35:56 | 42.1 | 54.4 | 39.0 | 44.6 |
| 13/01/2018     | 02:50:56 | 43.1 | 56.5 | 40.0 | 45.7 |
| 13/01/2018     | 03:05:56 | 43.0 | 60.4 | 39.9 | 45.0 |
| 13/01/2018     | 03:20:56 | 43.5 | 55.8 | 40.0 | 46.4 |
| 13/01/2018     | 03:35:56 | 42.9 | 55.9 | 40.1 | 45.3 |
| 13/01/2018     | 03:50:56 | 43.0 | 54.3 | 40.1 | 45.7 |
| 13/01/2018     | 04:05:56 | 43.1 | 54.7 | 40.1 | 45.8 |
| 13/01/2018     | 04:20:56 | 44.0 | 58.3 | 40.7 | 46.8 |
| 13/01/2018     | 04:35:56 | 44.6 | 54.8 | 40.7 | 47.6 |
| 13/01/2018     | 04:50:56 | 44.8 | 59.0 | 41.0 | 47.7 |
| 13/01/2018     | 05:05:56 | 45.1 | 58.3 | 40.8 | 48.0 |
| 13/01/2018     | 05:20:56 | 45.4 | 56.4 | 41.3 | 48.3 |
| 13/01/2018     | 05:35:56 | 46.5 | 58.1 | 42.8 | 49.2 |
| 13/01/2018     | 05:50:56 | 45.5 | 58.3 | 41.8 | 48.1 |
| 13/01/2018     | 06:05:56 | 46.6 | 57.0 | 42.9 | 49.3 |
| 13/01/2018     | 06:20:56 | 46.7 | 59.5 | 42.7 | 49.3 |
| 13/01/2018     | 06:35:56 | 47.2 | 59.2 | 43.6 | 49.6 |
| 13/01/2018     | 06:50:56 | 47.0 | 60.1 | 43.5 | 49.4 |
| 13/01/2018     | 07:05:56 | 48.7 | 59.6 | 45.0 | 51.0 |
| 13/01/2018     | 07:20:56 | 48.3 | 58.8 | 45.0 | 50.7 |

| Hourly summary |          |      |      |      |      |
|----------------|----------|------|------|------|------|
| 13/01/2018     | 07:35:56 | 49.0 | 59.6 | 45.5 | 51.1 |
| 13/01/2018     | 07:50:56 | 48.6 | 63.2 | 45.7 | 50.4 |
| 13/01/2018     | 08:05:56 | 49.4 | 58.4 | 46.7 | 51.4 |
| 13/01/2018     | 08:20:56 | 49.7 | 60.2 | 46.6 | 51.8 |
| 13/01/2018     | 08:35:56 | 53.6 | 67.7 | 48.1 | 57.6 |
| 13/01/2018     | 08:50:56 | 49.7 | 58.3 | 46.9 | 51.9 |
| 13/01/2018     | 09:05:56 | 50.3 | 60.0 | 47.3 | 52.2 |
| 13/01/2018     | 09:20:56 | 50.2 | 66.2 | 46.7 | 52.4 |
| 13/01/2018     | 09:35:56 | 51.6 | 68.3 | 47.9 | 53.8 |
| 13/01/2018     | 09:50:56 | 52.9 | 74.2 | 48.4 | 53.2 |
| 13/01/2018     | 10:05:56 | 59.8 | 69.1 | 48.6 | 66.9 |
| 13/01/2018     | 10:20:56 | 50.0 | 57.4 | 47.9 | 51.7 |
| 13/01/2018     | 10:35:56 | 53.8 | 69.8 | 48.9 | 55.4 |
| 13/01/2018     | 10:50:56 | 51.3 | 75.4 | 48.3 | 52.1 |
| 13/01/2018     | 11:05:56 | 51.3 | 67.2 | 49.0 | 53.0 |
| 13/01/2018     | 11:20:56 | 50.8 | 58.8 | 48.8 | 52.5 |
| 13/01/2018     | 11:35:56 | 50.5 | 60.3 | 48.5 | 52.0 |
| 13/01/2018     | 11:50:56 | 51.2 | 60.0 | 49.0 | 52.9 |
| 13/01/2018     | 12:05:56 | 52.0 | 67.4 | 49.8 | 53.4 |
| 13/01/2018     | 12:20:56 | 52.5 | 70.3 | 49.8 | 53.5 |
| 13/01/2018     | 12:35:56 | 50.8 | 59.6 | 49.2 | 52.2 |
| 13/01/2018     | 12:50:56 | 51.1 | 65.0 | 48.9 | 52.8 |
| 13/01/2018     | 13:05:56 | 50.6 | 67.4 | 48.7 | 51.9 |
| 13/01/2018     | 13:20:56 | 51.3 | 65.2 | 48.3 | 52.8 |
| 13/01/2018     | 13:35:56 | 50.2 | 60.2 | 48.0 | 52.0 |
| 13/01/2018     | 13:50:56 | 50.0 | 61.7 | 47.7 | 51.8 |
| 13/01/2018     | 14:05:56 | 50.9 | 62.1 | 48.5 | 52.6 |
| 13/01/2018     | 14:20:56 | 50.9 | 66.3 | 47.6 | 52.1 |
| 13/01/2018     | 14:35:56 | 51.5 | 69.4 | 47.7 | 51.4 |
| 13/01/2018     | 14:50:56 | 49.8 | 56.0 | 47.5 | 51.6 |
| 13/01/2018     | 15:05:56 | 51.0 | 60.0 | 48.8 | 52.7 |
| 13/01/2018     | 15:20:56 | 50.7 | 58.9 | 48.8 | 52.3 |
| 13/01/2018     | 15:35:56 | 51.9 | 77.4 | 49.4 | 52.8 |
| 13/01/2018     | 15:50:56 | 50.9 | 59.6 | 48.9 | 52.5 |
| 13/01/2018     | 16:05:56 | 53.6 | 81.8 | 48.6 | 53.2 |
| 13/01/2018     | 16:20:56 | 50.4 | 59.6 | 48.4 | 52.1 |
| 13/01/2018     | 16:35:56 | 50.2 | 55.9 | 48.0 | 52.0 |
| 13/01/2018     | 16:50:56 | 50.3 | 59.0 | 47.8 | 52.1 |
| 13/01/2018     | 17:05:56 | 49.9 | 55.6 | 47.4 | 51.6 |
| 13/01/2018     | 17:20:56 | 49.8 | 56.8 | 47.4 | 51.6 |
| 13/01/2018     | 17:35:56 | 49.4 | 62.3 | 46.8 | 51.2 |
| 13/01/2018     | 17:50:56 | 48.6 | 61.0 | 46.0 | 50.6 |

| Hourly summary |          |      |      |      |      |
|----------------|----------|------|------|------|------|
| 13/01/2018     | 18:05:56 | 49.0 | 56.8 | 46.8 | 50.9 |
| 13/01/2018     | 18:20:56 | 48.6 | 58.6 | 46.3 | 50.4 |
| 13/01/2018     | 18:35:56 | 48.9 | 57.3 | 45.8 | 51.2 |
| 13/01/2018     | 18:50:56 | 48.8 | 61.1 | 45.6 | 51.1 |
| 13/01/2018     | 19:05:56 | 49.0 | 59.8 | 45.2 | 51.4 |
| 13/01/2018     | 19:20:56 | 48.4 | 57.1 | 45.7 | 50.4 |
| 13/01/2018     | 19:35:56 | 48.5 | 57.3 | 45.2 | 50.8 |
| 13/01/2018     | 19:50:56 | 48.5 | 58.6 | 45.5 | 50.7 |
| 13/01/2018     | 20:05:56 | 48.4 | 56.1 | 45.1 | 50.6 |
| 13/01/2018     | 20:20:56 | 47.3 | 57.4 | 43.2 | 49.9 |
| 13/01/2018     | 20:35:56 | 46.8 | 56.7 | 43.6 | 49.0 |
| 13/01/2018     | 20:50:56 | 46.8 | 54.1 | 43.6 | 49.1 |
| 13/01/2018     | 21:05:56 | 46.1 | 57.2 | 42.9 | 48.5 |
| 13/01/2018     | 21:20:56 | 45.5 | 53.9 | 41.9 | 48.2 |
| 13/01/2018     | 21:35:56 | 46.6 | 57.4 | 42.6 | 49.2 |
| 13/01/2018     | 21:50:56 | 46.2 | 57.5 | 42.5 | 48.7 |
| 13/01/2018     | 22:05:56 | 45.9 | 60.4 | 42.0 | 48.5 |
| 13/01/2018     | 22:20:56 | 45.2 | 56.1 | 41.5 | 47.6 |
| 13/01/2018     | 22:35:56 | 45.4 | 58.5 | 41.6 | 48.2 |
| 13/01/2018     | 22:50:56 | 44.9 | 56.8 | 40.8 | 47.8 |
| 13/01/2018     | 23:05:56 | 44.4 | 54.7 | 41.1 | 46.8 |
| 13/01/2018     | 23:20:56 | 45.0 | 54.2 | 41.4 | 47.8 |
| 13/01/2018     | 23:35:56 | 44.3 | 56.0 | 40.2 | 47.3 |
| 13/01/2018     | 23:50:56 | 44.0 | 54.8 | 39.7 | 46.7 |
| 14/01/2018     | 00:05:56 | 42.8 | 54.0 | 39.3 | 45.5 |
| 14/01/2018     | 00:20:56 | 42.6 | 57.9 | 39.2 | 45.0 |
| 14/01/2018     | 00:35:56 | 42.6 | 53.7 | 39.3 | 45.3 |
| 14/01/2018     | 00:50:56 | 42.8 | 58.0 | 39.2 | 45.2 |
| 14/01/2018     | 01:05:56 | 42.0 | 53.9 | 38.7 | 44.9 |
| 14/01/2018     | 01:20:56 | 42.2 | 53.1 | 38.5 | 45.1 |
| 14/01/2018     | 01:35:56 | 43.0 | 56.0 | 39.0 | 46.0 |
| 14/01/2018     | 01:50:56 | 42.7 | 55.5 | 38.6 | 45.6 |
| 14/01/2018     | 02:05:56 | 41.8 | 56.0 | 38.4 | 44.8 |
| 14/01/2018     | 02:20:56 | 40.8 | 57.1 | 38.0 | 43.1 |
| 14/01/2018     | 02:35:56 | 39.6 | 51.4 | 37.5 | 41.5 |
| 14/01/2018     | 02:50:56 | 41.0 | 53.7 | 38.0 | 43.9 |
| 14/01/2018     | 03:05:56 | 40.9 | 51.3 | 38.1 | 43.6 |
| 14/01/2018     | 03:20:56 | 39.9 | 53.1 | 37.6 | 42.2 |
| 14/01/2018     | 03:35:56 | 40.3 | 52.3 | 37.6 | 42.6 |
| 14/01/2018     | 03:50:56 | 40.5 | 51.8 | 37.6 | 42.9 |
| 14/01/2018     | 04:05:56 | 40.4 | 54.5 | 37.4 | 43.1 |
| 14/01/2018     | 04:20:56 | 41.4 | 57.1 | 37.8 | 44.3 |

| Hourly summary |          |      |      |      |      |
|----------------|----------|------|------|------|------|
| 14/01/2018     | 04:35:56 | 41.2 | 60.8 | 37.7 | 43.6 |
| 14/01/2018     | 04:50:56 | 41.5 | 53.1 | 37.9 | 44.3 |
| 14/01/2018     | 05:05:56 | 40.3 | 55.7 | 37.8 | 42.6 |
| 14/01/2018     | 05:20:56 | 42.1 | 52.4 | 38.6 | 44.9 |
| 14/01/2018     | 05:35:56 | 41.7 | 53.2 | 37.6 | 44.6 |
| 14/01/2018     | 05:50:56 | 41.2 | 52.3 | 38.1 | 43.7 |
| 14/01/2018     | 06:05:56 | 41.8 | 52.5 | 38.7 | 44.3 |
| 14/01/2018     | 06:20:56 | 41.6 | 53.3 | 38.6 | 44.1 |
| 14/01/2018     | 06:35:56 | 43.1 | 54.2 | 39.1 | 45.9 |
| 14/01/2018     | 06:50:56 | 42.9 | 55.2 | 39.4 | 45.4 |
| 14/01/2018     | 07:05:56 | 42.9 | 51.1 | 40.0 | 45.4 |
| 14/01/2018     | 07:20:56 | 43.9 | 63.6 | 40.3 | 45.7 |
| 14/01/2018     | 07:35:56 | 45.5 | 62.8 | 41.2 | 47.8 |
| 14/01/2018     | 07:50:56 | 48.1 | 73.6 | 41.5 | 47.2 |
| 14/01/2018     | 08:05:56 | 46.2 | 73.2 | 40.6 | 46.5 |
| 14/01/2018     | 08:20:56 | 46.7 | 69.6 | 41.1 | 47.9 |
| 14/01/2018     | 08:35:56 | 46.3 | 66.6 | 42.3 | 48.0 |
| 14/01/2018     | 08:50:56 | 46.0 | 59.5 | 42.7 | 48.0 |
| 14/01/2018     | 09:05:56 | 46.8 | 62.7 | 43.5 | 49.0 |
| 14/01/2018     | 09:20:56 | 50.0 | 72.5 | 44.4 | 50.7 |
| 14/01/2018     | 09:35:56 | 47.6 | 67.2 | 44.4 | 49.5 |
| 14/01/2018     | 09:50:56 | 47.5 | 62.0 | 44.6 | 49.6 |
| 14/01/2018     | 10:05:56 | 47.8 | 62.1 | 44.3 | 50.0 |
| 14/01/2018     | 10:20:56 | 48.0 | 61.7 | 44.4 | 50.2 |
| 14/01/2018     | 10:35:56 | 46.8 | 59.3 | 43.9 | 48.8 |
| 14/01/2018     | 10:50:56 | 46.6 | 55.5 | 43.6 | 49.0 |
| 14/01/2018     | 11:05:56 | 47.2 | 62.2 | 43.7 | 49.1 |
| 14/01/2018     | 11:20:56 | 47.6 | 63.6 | 43.2 | 49.7 |
| 14/01/2018     | 11:35:56 | 47.3 | 57.8 | 44.4 | 49.2 |
| 14/01/2018     | 11:50:56 | 47.7 | 57.8 | 45.1 | 49.7 |
| 14/01/2018     | 12:05:56 | 55.7 | 90.6 | 44.6 | 49.8 |
| 14/01/2018     | 12:20:56 | 47.9 | 57.9 | 44.6 | 50.3 |
| 14/01/2018     | 12:35:56 | 48.1 | 58.2 | 44.9 | 50.4 |
| 14/01/2018     | 12:50:56 | 47.8 | 57.1 | 45.5 | 49.7 |
| 14/01/2018     | 13:05:56 | 47.5 | 55.7 | 45.1 | 49.4 |
| 14/01/2018     | 13:20:56 | 48.4 | 57.8 | 46.2 | 50.3 |
| 14/01/2018     | 13:35:56 | 48.2 | 61.1 | 45.7 | 49.9 |
| 14/01/2018     | 13:50:56 | 49.7 | 62.5 | 47.0 | 51.4 |
| 14/01/2018     | 14:05:56 | 49.1 | 56.0 | 46.8 | 50.8 |
| 14/01/2018     | 14:20:56 | 48.6 | 56.3 | 46.7 | 50.1 |
| 14/01/2018     | 14:35:56 | 48.9 | 60.5 | 45.8 | 50.6 |
| 14/01/2018     | 14:50:56 | 49.0 | 60.6 | 47.0 | 50.5 |

| Hourly summary |          |      |      |      |      |
|----------------|----------|------|------|------|------|
| 14/01/2018     | 15:05:56 | 48.5 | 57.4 | 46.5 | 50.1 |
| 14/01/2018     | 15:20:56 | 48.2 | 60.3 | 45.9 | 49.8 |
| 14/01/2018     | 15:35:56 | 48.7 | 55.8 | 46.5 | 50.5 |
| 14/01/2018     | 15:50:56 | 48.0 | 66.6 | 45.2 | 49.5 |
| 14/01/2018     | 16:05:56 | 48.1 | 62.5 | 46.2 | 49.6 |
| 14/01/2018     | 16:20:56 | 48.1 | 57.5 | 46.3 | 49.5 |
| 14/01/2018     | 16:35:56 | 48.1 | 61.9 | 46.0 | 49.7 |
| 14/01/2018     | 16:50:56 | 47.5 | 53.6 | 45.4 | 49.3 |
| 14/01/2018     | 17:05:56 | 47.1 | 62.9 | 45.0 | 48.6 |
| 14/01/2018     | 17:20:56 | 48.3 | 56.2 | 45.9 | 50.1 |
| 14/01/2018     | 17:35:56 | 47.0 | 53.3 | 44.8 | 48.8 |
| 14/01/2018     | 17:50:56 | 47.9 | 55.8 | 44.9 | 50.0 |
| 14/01/2018     | 18:05:56 | 48.6 | 55.9 | 46.4 | 50.3 |
| 14/01/2018     | 18:20:56 | 48.3 | 54.5 | 45.5 | 50.1 |
| 14/01/2018     | 18:35:56 | 48.0 | 54.3 | 45.6 | 49.9 |
| 14/01/2018     | 18:50:56 | 48.0 | 61.7 | 44.9 | 50.2 |
| 14/01/2018     | 19:05:56 | 47.9 | 57.0 | 45.1 | 50.0 |
| 14/01/2018     | 19:20:56 | 47.7 | 55.8 | 45.1 | 49.5 |
| 14/01/2018     | 19:35:56 | 47.2 | 54.2 | 43.9 | 49.5 |
| 14/01/2018     | 19:50:56 | 47.2 | 53.7 | 44.2 | 49.5 |
| 14/01/2018     | 20:05:56 | 46.7 | 55.0 | 43.8 | 48.9 |
| 14/01/2018     | 20:20:56 | 45.9 | 55.9 | 43.0 | 48.1 |
| 14/01/2018     | 20:35:56 | 46.0 | 55.8 | 42.5 | 48.6 |
| 14/01/2018     | 20:50:56 | 46.7 | 58.0 | 43.4 | 49.1 |
| 14/01/2018     | 21:05:56 | 46.4 | 64.0 | 42.2 | 48.8 |
| 14/01/2018     | 21:20:56 | 45.9 | 56.8 | 42.6 | 48.2 |
| 14/01/2018     | 21:35:56 | 45.2 | 56.1 | 41.4 | 47.7 |
| 14/01/2018     | 21:50:56 | 44.2 | 53.4 | 40.7 | 46.7 |
| 14/01/2018     | 22:05:56 | 44.9 | 57.9 | 41.4 | 47.5 |
| 14/01/2018     | 22:20:56 | 44.9 | 54.0 | 41.7 | 47.5 |
| 14/01/2018     | 22:35:56 | 44.3 | 54.0 | 40.9 | 46.7 |
| 14/01/2018     | 22:50:56 | 47.1 | 56.6 | 42.0 | 50.2 |
| 14/01/2018     | 23:05:56 | 44.6 | 54.6 | 41.1 | 46.9 |
| 14/01/2018     | 23:20:56 | 45.1 | 57.2 | 42.2 | 47.5 |
| 14/01/2018     | 23:35:56 | 46.6 | 58.1 | 42.0 | 49.2 |
| 14/01/2018     | 23:50:56 | 46.0 | 58.9 | 41.5 | 49.4 |
| 15/01/2018     | 00:05:56 | 46.5 | 59.0 | 40.9 | 49.5 |
| 15/01/2018     | 00:20:56 | 43.1 | 54.8 | 40.7 | 45.3 |
| 15/01/2018     | 00:35:56 | 46.4 | 53.9 | 43.0 | 48.8 |
| 15/01/2018     | 00:50:56 | 44.3 | 56.5 | 41.0 | 47.0 |
| 15/01/2018     | 01:05:56 | 45.5 | 54.6 | 41.1 | 48.2 |
| 15/01/2018     | 01:20:56 | 45.5 | 54.0 | 41.9 | 48.6 |

| Hourly summary |          |      |      |      |      |
|----------------|----------|------|------|------|------|
| 15/01/2018     | 01:35:56 | 44.1 | 55.6 | 40.9 | 46.5 |
| 15/01/2018     | 01:50:56 | 42.2 | 52.8 | 40.4 | 43.7 |
| 15/01/2018     | 02:05:56 | 43.2 | 60.4 | 40.3 | 45.3 |
| 15/01/2018     | 02:20:56 | 46.6 | 57.0 | 41.7 | 50.1 |
| 15/01/2018     | 02:35:56 | 44.7 | 55.1 | 42.0 | 47.0 |
| 15/01/2018     | 02:50:56 | 43.2 | 55.4 | 40.8 | 45.2 |
| 15/01/2018     | 03:05:56 | 44.2 | 56.3 | 41.0 | 46.7 |
| 15/01/2018     | 03:20:56 | 43.2 | 53.6 | 40.1 | 45.6 |
| 15/01/2018     | 03:35:56 | 44.6 | 54.5 | 41.3 | 47.4 |
| 15/01/2018     | 03:50:56 | 43.6 | 54.0 | 40.7 | 45.7 |
| 15/01/2018     | 04:05:56 | 47.2 | 66.8 | 40.7 | 47.8 |
| 15/01/2018     | 04:20:56 | 43.4 | 57.0 | 40.8 | 45.3 |
| 15/01/2018     | 04:35:56 | 44.1 | 55.4 | 41.0 | 46.4 |
| 15/01/2018     | 04:50:56 | 43.5 | 59.5 | 39.7 | 46.0 |
| 15/01/2018     | 05:05:56 | 43.9 | 57.3 | 40.2 | 46.3 |
| 15/01/2018     | 05:20:56 | 45.0 | 57.4 | 40.7 | 47.5 |
| 15/01/2018     | 05:35:56 | 46.2 | 58.9 | 41.5 | 48.8 |
| 15/01/2018     | 05:50:56 | 44.4 | 60.2 | 40.8 | 45.6 |
| 15/01/2018     | 06:05:56 | 44.7 | 56.7 | 41.2 | 47.2 |
| 15/01/2018     | 06:20:56 | 44.8 | 57.4 | 41.7 | 46.6 |
| 15/01/2018     | 06:35:56 | 45.3 | 57.0 | 42.7 | 47.5 |
| 15/01/2018     | 06:50:56 | 46.9 | 75.1 | 42.2 | 46.6 |
| 15/01/2018     | 07:05:56 | 47.4 | 58.3 | 43.9 | 50.1 |
| 15/01/2018     | 07:20:56 | 46.7 | 57.1 | 43.9 | 48.9 |
| 15/01/2018     | 07:35:56 | 49.3 | 63.2 | 44.4 | 51.7 |
| 15/01/2018     | 07:50:56 | 54.6 | 71.0 | 44.6 | 54.3 |
| 15/01/2018     | 08:05:56 | 58.0 | 72.7 | 54.9 | 60.4 |
| 15/01/2018     | 08:20:56 | 57.7 | 67.6 | 54.4 | 60.5 |
| 15/01/2018     | 08:35:56 | 57.1 | 60.9 | 56.2 | 58.0 |
| 15/01/2018     | 08:50:56 | 57.3 | 68.6 | 52.1 | 59.0 |
| 15/01/2018     | 09:05:56 | 55.9 | 71.1 | 51.2 | 58.1 |
| 15/01/2018     | 09:20:56 | 55.4 | 67.9 | 44.7 | 59.4 |
| 15/01/2018     | 09:35:56 | 58.4 | 65.0 | 54.0 | 61.6 |
| 15/01/2018     | 09:50:56 | 58.0 | 70.7 | 50.7 | 58.4 |
| 15/01/2018     | 10:05:56 | 48.7 | 60.6 | 43.1 | 51.7 |
| 15/01/2018     | 10:20:56 | 56.2 | 75.6 | 43.0 | 55.1 |
| 15/01/2018     | 10:35:56 | 51.0 | 70.8 | 43.3 | 51.6 |
| 15/01/2018     | 10:50:56 | 56.9 | 69.4 | 44.9 | 63.0 |
| 15/01/2018     | 11:05:56 | 54.5 | 74.3 | 45.6 | 56.8 |