# BURONGA
# PEAKING POWER PLANT
## NOISE & VIBRATION ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 07098
VERSION A

WILKINSON MURRAY

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**REPORT NO.** 07098
**VERSION** A

**OCTOBER 2007**

**PREPARED FOR**

URS AUSTRALIA PTY LIMITED
LEVEL 3, 116 MILLER STREET
NORTH SYDNEY NSW 2060

Wilkinson Murray Pty Limited
ABN 41 192 548 112 • Level 2, 123 Willoughby Road, Crows Nest NSW 2065, Australia • **Asian Office: Hong Kong**
**t** +61 2 9437 4611 • **f** +61 2 9437 4393 • **e** acoustics@wilkinsonmurray.com.au • **w** www.wilkinsonmurray.com.au

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# 1 INTRODUCTION

International Power (Australia) Pty Limited (IPRA) proposes to construct a peaking power plant at a site approximately 10km northeast of Buronga in the southwest of New South Wales.

The location of the site is shown in **Figure 3-1**.

Upon completion, the facility will comprise three gas turbine units, each rated at up to 50MW, to produce up to approximately 150MW in total. It will operate as a "peaking plant" which means the facility only operates during periods of high demand. The gas turbines are configured to operate independently or together (either in pairs or all three) as required by the demand. It is anticipated that the plant would operate on an as-required, intermittent basis for a total maximum period of up to 10% of any year.

Construction of the Peaking Power Plant would take approximately 6 months.

Wilkinson Murray (WM) has been engaged to conduct a noise and vibration assessment forming part of an Environmental Assessment (EA). This assessment considers the environmental noise and vibration aspects relating to the construction and operation of the Buronga Peaking Power Plant.

# 2 DESCRIPTION OF PROPOSAL, SITE & SURROUNDS

The proposed facility would comprise three distillate-fired gas turbines each nominally rated at up to 50MW subject to final plant selection. The electricity generated by the Buronga Peaking Power Plant would feed via step up transformers into the adjacent TransGrid 220kV switching station and then into the national grid HV system.

The gas turbines would be fuelled by distillate with up to 1,500 tonnes stored on site at any one time. The gas turbines would be capable of later conversion to gas firing should sufficient natural gas become commercially available in the future.

These units would be capable of operating either individually or in conjunction - either in pairs or all three together.

Given that the plant is proposed to operate as a "peaking plant", there would only be a limited number of hours that any of the gas turbines and generators would operate. However, this could occur during the night time period, although unlikely given that generally "peak demand" is likely to coincide with mornings or evenings. With respect to environmental noise impacts, the NSW Department of Environment and Climate Change (DECC) define night time as 10.00pm to 7.00am (except Sundays and Public Holidays where night time ends at 8.00am) and evening as 6.00pm to 10.00pm.

The proposed site is located in the Murray Basin in south-western NSW, approximately 10km northeast of the town of Buronga. The proposed site is located on the northern side of Arumpo Road immediately adjacent the existing 220kV TransGrid owned switching station. The site is situated approximately 2.5km northeast from the edge of Lake Gol Gol and lies approximately 9km north of the Murray River.

The plant would be located on Crown land (which is controlled by the Western Lands Commissioner) immediately adjacent to the TransGrid 220kV switching station.

The facility would occupy an area of approximately 4 hectares on a lot of approximately 200m by 200m at an elevation of approximately 48m AHD. It is bounded by Arumpo Road to the south east and the adjoining TransGrid 220kV switching station to the south west.

With respect to residential receivers, the closest single residence is located north of Lake Gol Gol approximately 3km southwest of the proposed site. Groups of residences are located at Mourquong some 7km south-west of the proposed site, and at Gol Gol North approximately 6km south of the proposed site. Table 2.1 presents the residential receivers in closest proximity to the proposed peaking power plant.

**Table 2.1 Residential Receivers**

| Receptor ID | Direction from Site | Distance from Site | Receptor |
|---|---|---|---|
| A | South West | 3km | Single Residence |
| B | SW | 7km | Mourquong |
| C | South | 6km | Gol Gol North |

# 3 EXISTING ACOUSTIC ENVIRONMENT

A review of aerial photographs by WM indicated that in terms of noise sources in the area there is Arumpo Road (with low traffic volumes – see **Section 8**) and the TransGrid switching station (fronts Arumpo Road) that may control the general ambient noise in the area.

The existing typical acoustic environment that is experienced by the closest residence (Receptor A in Figure 3-1) was measured and assessed so that noise criteria could be developed (noise criteria are addressed in Section 3.1.2 and Section 4 of this report). Noise logging was performed at this receiver which was considered by WM to provide typical background noise levels. The noise contribution at this receiver from the operation of the switching station was also assessed.

A single noise logger (ARL Model 215) was installed at the front boundary fence (approximately 4m from the house) of the nearest residence from Wednesday, 8 to Thursday, 16 August 2007.

The logger was set to monitor and store various noise descriptors every 15-minutes using the A-weighting and Fast response filters. This equipment is capable of remotely monitoring and storing noise level descriptors including $L_{A90}$ and $L_{Aeq}$ levels (see **Appendix A** for definitions) of the existing noise environment for later detailed analysis. The calibration was checked before and after the survey and no significant drift was noted.

The detailed measurement results are shown as charts in **Appendix B**.

**Figure 3-1 Locations of Affected Residences & Noise Monitoring Locations & Site**


Source © URS Australia Pty Limited

### 3.1.1 **Rating Background Levels**

From the background noise levels ($L_{A90}$) measured at the nearest residential receiver, the Rating Background Levels (RBLs) were determined using methodology as recommended by the *NSW Industrial Noise Policy INP*. The DECC considers the RBL to represent the background noise level. **Table 3-1** summarises the RBL derived from data collected during the unattended noise monitoring.

**Table 3-1 Rating Background Levels**

| Time Period (1) | Rating Background Level RBL (dBA) |
|---|---|
| Daytime | 26 |
| Evening | 26 |
| Night Time | 24 |

Note 1) The *INP* considers daytime (7.00am-6.00pm); evening (6.00pm-10.00pm); night time (10.00pm-7.00am). On Sundays and Public Holidays, daytime begins at 8.00am and night time ends at 8.00am.

As required by the *INP*, any effects due to adverse meteorological conditions (rain and wind greater than 5m/s at a height of 1.5m) have been excluded. To ascertain the typical weather conditions present while collecting noise data, meteorological data (15 minute data) from Mildura Airport was obtained from the Bureau of Meteorology (BoM) this being the closest available meteorological station.

This weather station is located approximately 21km from where noise data was collected and given that the surrounding area is relatively flat, the weather data it is considered representative. It must be noted that the wind data at this station (as with all BOM stations) is collected at a height of 10m above ground, whereas it is more appropriate to understand the wind speed at the height of the microphone (1.5m above ground) when assessing the impact wind may have on the noise data collected. With respect to adverse meteorological conditions occurring during the noise logging, there was no rain, however periods of high wind speed occurred and have been excluded (see **Appendix B**).

The *INP* also requires the exclusion of any extraneous noise that will influence the RBL. Where measured noise levels were clearly affected by extraneous noise, these periods were also excluded in calculating the RBL values shown in **Table 3-1**. The residence (along with many others in such rural situations) requires the use of a generator to produce electricity and as such the noise from the generator influenced the background levels. This primarily occurred during the evening period.

Notwithstanding this, the RBL values derived approached the noise floor of the noise logger and were all less than 30dBA. According to the *INP*, if the RBL derived from measured background levels is less than 30dBA, then it is set to 30dBA for assessment. Hence the RBL for all time periods is set to 30dBA for this assessment.

### 3.1.2 **Assessment of Current Industrial Noise Levels**

During the deployment of the noise logger no industrial noise was audible. The background noise level at the time (approximately 12:20pm to 12:45pm, Wednesday 8 August 2007) was typically <30dBA. This was based on an attended measurement using a Bruel & Kjaer Type 2215 Sound Level Meter.

# 4 NOISE CRITERIA

With respect to noise criteria, the NSW Department of Planning (DoP) has provided the environmental assessment requirements under Part 3A of the *Environmental Planning & Assessment Act* 1979 to be compliant with the *NSW Industrial Noise Policy (INP)* and Chapter 171 of the *Environmental Noise Control Manual (ENCM)*.

In considering the DoP and DECC requirements, together with previous experience on similar projects and expectations, the Buronga Peaking Power Plant development has been assessed in accordance with the following policy guidelines published by the DECC:

- *NSW Industrial Noise Policy (INP)*, dated January 2000 - (Industrial Noise)
- *Environmental Criteria for Road Traffic Noise (ECRTN),* dated May 1999 - (Traffic Noise)
- *Environmental Noise Control Manual (ENCM).* dated May 1999 - (Construction Noise)
- *Noise Guide for Local Government (NGLG).* dated June 2004 and - (Sleep Disturbance)
- *Assessing Vibration: A Technical Guideline (AVATG).* dated February 2006 - (Vibration)

## 4.1 Operational Noise Criteria

### 4.1.1 Continuous & Semi-Continuous Plant Noise

The *INP* is designed to assess "industrial noise", as is the case with this development using the more stringent of the following two approaches:

- Intrusive noise impacts in the short term for residences; and
- Amenity for particular land uses such as residences.

The intrusive goal is set 5dBA above the Rating Background Level (RBL) for each time period (daytime, evening or night time) of interest. The RBL's are derived from the measured $L_{A90}$ noise levels as per the DECC guidelines.

The amenity goal sets an upper limit to the total noise level ($L_{Aeq}$) in an area from all industrial noise. The criterion depends on the time of day, area classifications and the relationship of the total measured $L_{Aeq}$ (and contribution from existing industrial noise) to determine the Acceptable Noise Level (ANL) for the development.

The potentially affected area is classified as "Rural" by the *INP* (and the local LEP). Given this, the "acceptable" amenity levels ($L_{Aeq}$ dBA) which apply over the whole day, evening or night period are as follows and are applicable as there are no other significant "industrial" noise sources – the substation is not audible at the nearest residential receiver:

| | |
|---|---|
| Daytime | 50dBA |
| Evening | 45dBA |
| Night time | 40dBA |

The "maximum" amenity levels are 5dBA higher.

Where the noise source contains annoying characteristics, such as dominant low frequency content, adjustment factors as per the *INP* apply.

### 4.1.2 Sleep Disturbance

The assessment of the disturbance of ones' sleep is complex, but primarily due to the following factors:

- Absolute level (usually presented as the $L_{Amax}$ or $L_{A1(1minute)}$);
- The amount the absolute level "emerges" above the general background noise at the time of the event; and
- Number of events and time of occurrence.

Where there exists the possibility that instantaneous, short-duration, high-level noise events may occur during night time hours (10.00pm-7.00am), the DECC requires that consideration be given to the potential for disturbance of sleep within residences.

With reference to the *NGLG,* the primary assessment for whether or not ones' sleep will be disturbed by activities related to the operation of the peaking power plant is based on whether the $L_{A1(1minute)}$ noise level (often approximated as the $L_{Amax}$ noise level) from any instantaneous night time noise event (related to the operational activities of the power plant) will exceed the background noise level by more than 15dBA when measured external to a bedroom window.

This is a simple approach and the *NGLG* acknowledges that further research is needed to define a better relationship between noise levels and sleep disturbance, referring to the literature review contained within the *ECRTN*.

### 4.1.3 Summary of Operational Noise Criteria

**Table 4-1** provides a summary of the operational noise criteria applicable to this project.

**Table 4-1 Operational Noise Criteria**

| Residence | Time Period | Criteria (dBA) | | |
|---|---|---|---|---|
| | | Continuous Noise | | Intermittent Noise |
| | | Intrusive $L_{Aeq,15min}$ | Amenity $L_{Aeq,period}$ | Sleep Disturbance $L_{A1,1min}$ |
| 3km Southwest of the proposed site | Daytime | ***35*** | 50 | n/a |
| | Evening | | 45 | n/a |
| | Night Time | | 40 | ***45*** |

The relevant project specific noise levels are identified in bold italics.

Further to this, the *INP* requires where noise sources contain certain characteristics, such as tonality, impulsiveness, intermittency or dominate low frequency content, a modifying factor of +5dBA (to a maximum of +10dBA) should be applied because these type of noises typically cause greater annoyance to the community.

These modification factors take effect at the residential receiver and would typically be judged by measurement at the residential receiver where the measurement would be made up of both the plant noise and existing ambient noise environment as currently experienced by the residential receiver.

With regard to gas turbine power plants and the identified residences shown in Figure 3.1, there is a risk (considered by WM to be medium due to the limited existing low frequency noise ) that low frequency noise correction could apply if the noise mitigation is not correctly designed in the detail design process. Therefore these issues should be considered and form part of more detailed assessment if appropriate. In the event that the gas turbine supplier considers that their plant would result in a low frequency modification factor being applied at the residences, then the plant should be designed to meet a level of 5dBA below the criterion to account for low frequency noise.

### 4.2 Construction Noise Criteria

With respect to construction noise, the requirements outlined in Chapter 171 of the *ENCM* are usually applied and this approach is reproduced below.

***Level Restrictions***

*(i) Construction period of 4 weeks and under.*
*The $L_{10}$ level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).*

*(ii) Construction period greater than 4 weeks and not exceeding 26 weeks.*
*The $L_{10}$ level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A).*

***Time Restrictions***

| | |
|---|---|
| *Monday to Friday* | *7am–6pm* |
| *Saturday* | *7am–1pm (if inaudible at residential premises)* |
| | *8am–1pm (if audible at residential premises)* |

*No construction work to take place on Sundays or Public Holidays*

***Silencing***

*All possible steps should be taken to silence construction site equipment. It is particularly important that silenced equipment should be used on road or rail works where 24 hour operation is necessary.*

There is no suggested criterion for projects that are constructed over a longer period than 26 weeks. However, typical operational intrusive noise criteria are used, that is:

*The $L_{10}$ level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 5 dB(A).*

It is anticipated that construction will most likely take place from 7.00am to possibly up to 5.00 or 6.00pm during weekdays and 8.00am-1.00pm on Saturdays. Should the contractor wish to work outside these "standard" hours, they will need to apply to the relevant authorities for approval. Given this, the criteria in **Table 4-2** apply given the likelihood that construction will be greater than 26 weeks duration.

**Table 4-2 Criteria for Construction Noise – Daytime**

| Residence | Criteria $L_{A10,15min}$ (dBA) |
|---|---|
| | Monday-Saturday |
| 3km Southwest of the proposed site | 35 |

As per operational noise, where construction noise sources contain certain characteristics, such as tonality, impulsiveness, intermittency or dominate low frequency content, a modifying factor of +5dBA (to a maximum of +10dBA) should be applied.

# 5 NOISE PREDICTIONS

## 5.1 Introduction

For this assessment, noise predictions were made using the ENM modelling software. This is a point-to-point model that takes into account the attenuation factors, including distance, ground absorption, air absorption and the effects of meteorological conditions.

Influence of meteorological factors such as wind speed, wind direction and the presence of temperature inversions are influential when noise propagates over large distances of at least several hundred metres. In addition to increasing noise levels, these meteorological conditions significantly reduce the attenuating effect of intervening topography such as bunds (and barriers) since the sound waves follow a curved path that can go over such barriers.

## 5.2 Noise Model Inputs

### 5.2.1 Meteorological Conditions

Noise levels experienced by a receiver at relatively large distances (at least several hundred metres) from a source can vary considerably under different meteorological conditions, particularly in the evening and at night. Prevailing wind and air temperature gradients will change over the course of the night time period, and hence noise levels at receivers will change, even when the noise source level is constant.

The *INP* generally directs the use of a single set of meteorological data to use in the assessment of noise impacts; however Wilkinson Murray has adopted a more rigorous approach in past assessments where noise levels at all residences are calculated under a varied set of existing meteorological conditions. Measured statistical occurrences of these conditions over a period of at least one year, divided into seasons, are then applied to the results, and a $10^{th}$ percentile exceedence noise level calculated, which is then compared with relevant criteria. This approach is generally more representative than one using a single set of meteorological data as it accounts for the directional distribution of prevailing winds for each residence surrounding the proposal.

This alternative assessment procedure involves significantly greater computational complexity than the use of a single set of meteorological conditions, but provides a much more direct and comprehensible description of noise impacts at a receiver. This approach of using the $10^{th}$ percentile calculated noise level as a measure of noise impacts on residences has been considered acceptable by the DECC for previous similar assessments. This alternative procedure is considered appropriate for this project.

Hourly data for an entire year (2005) was processed for the site by URS using CSIRO's The Air Pollution Model (TAPM) assimilated with wind data from a meteorological station located within Mildura Airport. This data has been further processed by WM such that it could be used to model the effect that meteorological conditions around the site have on noise propagating from the site to the receivers.

The weather conditions that have been considered when calculating the noise levels for this project are summarised in the following section. **Appendix C** details the meteorological conditions modelled in order to perform a statistical analysis of the effect of meteorology.

It is to be noted that for the purposes of calculating the 10th percentile exceedence noise level during enhanced meteorological conditions such as wind (the INP requires assessment of winds of 3m/s or less), the occurrence of winds ≤0.5m/s and >3m/s have been combined. This is an acceptable approach because at wind speeds >3m/s there is likely to be noise generated by the wind itself and as such the noise level during these periods can be considered to be "equivalent" to the noise generated by calms. This assumption allows a calculation of the 10th percentile exceedence noise level.

**Acoustically Neutral Meteorological Conditions**

An acoustically neutral condition is considered to occur when the wind is calm (≤0.5m/s) and there are no temperature gradients present. After processing of the data provided by URS, the average temperature and relative humidity have been calculated as follows:

- Day Temperature and relative humidity of 19.5ºC and 54.3%
- Evening Temperature and relative humidity of 16.9ºC and 59.1%
- Night Temperature and relative humidity of 12.8ºC and 71.4%

These conditions have been modelled for both the operational and construction (day only) phases of the project.

**Meteorological Conditions that will enhance the Propagation of Noise**

During the night time period, the worst case noise levels are likely to be experienced during both temperature inversions and wind. Temperature inversions are rarely present (if so their occurrence is low) during the daytime or evening periods. Therefore, the most significant meteorological effect during the daytime and evening periods is wind.

These conditions have been modelled for the operational phase of the project. The data from URS was processed by WM and the occurrence of the following five wind speed categories; 0.75m/s, 1.25m/s, 1.75m/s, 2.25m/s and 2.75m/s (encompassing a 0.25m/s range either side) determined. At speeds of greater than 3m/s, enhancement of noise propagation does not occur as the wind also generates noise. For each of the aforementioned speeds, the occurrence of the wind direction at every 45 degrees (encompassing a 22.5 degree range either side) is also determined.

In particular during the night time period, the effect of wind is also modelled both with a temperature inversion of 3º/100m and without a temperature inversion. A temperature inversion has been determined by considering the stability class. A stability class between Class A and E is assigned no temperature inversion (0°/100m inversion), whereas a Class F is a 3°/100m temperature inversion.

Several conditions are considered for each season and each time period, as indicated in Appendix C.

The probability of occurrence for all the above-mentioned conditions have been calculated and the noise level that occurs 10% of the time for each DECC defined time period (day, evening and night) during each season is presented at each receiver and this is compared against the relevant operational criteria.

### 5.2.2 **Topography**

URS have supplied a 3D digital terrain map of the immediate surrounding area (relatively flat topography) and location of the main (noise producing) components of the Buronga Peaking Power Plant.

Given that the location of the nearest and most affected residence is approximately 3km away to the south west, a single receiver has been used for the point-to-point calculations.

The ground between sources and the receiver has been modelled as "soft ground".

# 6 ASSESSMENT OF ON-SITE OPERATIONAL NOISE

Given the potential that the Buronga Peaking Power Plant may operate at any time, it is appropriate to develop operating scenarios for all time periods. This section of the report assesses the potential noise impacting to the existing residences due to the actual operation of the facility. An assessment of the potential impact due to vehicle movements on Arumpo Road generated by the operation (as well as construction) of this facility is assessed in **Section 8** of this report.

## 6.1 Operational Activities

The facility is intended to operate as a peaking plant that will operate up to 10% of the time in any one year. The time the plant would operate would be during demand periods, likely be mornings or evenings. It may be that only one gas turbine or any other combination up to three gas turbines would operate simultaneously depending on load demand. Given this, it has been assumed that all equipment would operate at any time.

It is expected that during operations there will be the need for operators and maintenance staff to visit site during the day time. These movements are expected to be very low and result in negligible impacts compared to the noise emission from the plant.

## 6.2 Assigned Sound Power Levels

**Table 6-1** summarises details such as the overall noise emissions from the primary plant items associated with the Peaking Power Plant and the height of each source.

The noise levels used are from a compilation of data previously used by Wilkinson Murray together with data from various manufacturers, however are considered typical of a "standard" power plant.

**Table 6-1 Information Regarding Noise Emissions of Main Peaking Power Plant Equipment**

| Plant Item | Sound Power Level $L_{Aeq}$ (dBA) | Source Height (m) | Comments |
|---|---|---|---|
| Generator Transformer | 86 | 5 | Standard Design |
| Exhaust Stack | 81(1) | 13 | Directional - vertical |
| Air Intake | 98 | 9.5 | Directional - to the southwest |
| Gas Turbine & Generator Enclosure | 106 | 8 | Assumed the middle enclosure is shielded by the outer enclosures |

Note: 1) Sound power level reduced by nominally 5dBA (from 86 to 81dBA) to allow for directivity (conservatively assumed losses at 90 degrees to vertical discharge).

Only the larger and potentially noisier plant items have been modelled in detail. The only other noise source is the workshop, however given the limited noisy activities and the restricted daytime usage, the workshop is considered a low risk noise source and not considered any further.

It is assumed that any small or localised noise sources, such as that from the workshop, could, if required treated individually with screens / enclosures or lagging and the like. Correct vibration isolation will be necessary and is assumed.

### 6.3 Calculated Noise Levels to Closest Existing Residence – Unmitigated

The unmitigated noise levels at the closest residential receptor (Receptor A in **Figure 3.1**) have been calculated using the ENM modelling software and are summarised in **Table 6-2**. Levels for acoustically neutral conditions and the conditions that will enhance the propagation of noise are presented.

**Table 6-2 Summary of Calculated Noise Levels (Unmitigated) to Closest Existing Residence**

| Residence No. | Time Period | Calculated $L_{Aeq,15min}$ Noise Level (dBA) | | Noise Criteria $L_{Aeq,15min}$(dBA) |
|---|---|---|---|---|
| | | Meteorological Condition | | |
| | | Acoustically Neutral | Acoustically Enhanced | |
| 3km Southwest of the proposed site | Daytime | <20 | <20 | 35 |
| | Evening | | | |
| | Night Time | | 21 | |

Assuming that all three gas turbines are operational, the calculated noise levels for acoustically neutral conditions comfortably meet the criteria. At worst case a level of 21dBA has been calculated during the night time period in the event of meteorological conditions that enhance the noise from source to the nearest receiver.

It is important to note that it has been assumed that all plant will operate at any time. The levels will be up to 5dB lower should only one set of plant operate.

It is important to appreciate that based on the third octave data WM has assessed, the risk of a plant item having low energy or tonality (which could attract a 5dB penalty as per the *INP*) is considered to be "medium" when assessed at the receivers. However, the spectrum shape of similar items can be quite different, therefore needs to be considered as well as the overall noise level when a plant or mitigation selection is being assessed.

However, based on our modelling, even if the noise emitted from the plant did require a 5dB penalty, the noise level would be, at worst case some 26dBA (21+5). Nevertheless, it would be good design practice to ensure the design minimises noise that attract attention such as low frequency.

### 6.4 Assessment of the Potential for Sleep Disturbance

The potential for sleep disturbance within the residences will likely be greatest during the early morning hours (notionally 2.00-4.00am) when background noise levels are at their lowest.

Based on previous experience with similar power plants it is understood that there are no sources identified that will produce instantaneous, short-duration, high-level noise events. If a gas turbine begins (or ceases) operation in the early hours of the morning, this will not occur instantaneously but as a gradual process. Should a gas turbine be operating into the night or early morning period, the process is relatively steady state and free of instantaneous events.

Furthermore there is no reason for the site to be visited during the night-time period even it there is a need to operate the plant. Any repairs or maintenance would obviously be scheduled during the daytime period.

It can be concluded that the potential risk of activities associated with the development that may disturb the sleep of nearby residences is negligible.

# 7 CONSTRUCTION NOISE ASSESSMENT

This section of the report is a preliminary assessment of the potential impact of noise during construction. Given that the construction vehicles enter the site directly from Arumpo Road, the vehicles are considered to be part of the noise from the site and therefore assessed as construction noise (see **Section 8**). The works would typically involve the following over a period of approximately six months:

- General earthworks for the site establishment;
- Drainage, utility and internal road works;
- Construction of concrete foundation slabs;
- Construction / erection of the buildings;
- Landscaping; and
- Commissioning.

## 7.1 Construction Activities Involving Fixed & Mobile Plant

To predict the typical worst case noise levels at typical construction stages over the duration of the project, the following typical scenarios have been considered:

**Scenario 1**

A worst case period of time where activities including earthworks and construction of the internal road are anticipated to occur simultaneously.

**Scenario 2**

A worst case month where activities including, construction/erection of the buildings and landscaping are anticipated to occur simultaneously.

**Scenario 3**

This represents the activities occurring towards the end of the construction phase, associated with commissioning. This essentially is the noise that will be experienced during operation which has already been calculated.

## 7.2 Plant Items & Assigned Sound Power Levels

For the construction stage, WM have relied on other similar projects and provides in this report indicative likely plant (and quantity) to be used. The sound power level (SWL) of these plant items has been sourced from WM's extensive database of actual measured plant items under different usage.

**Table 7-1** summarises the typical, noisier plant used during each scenario together with its respective SWL and number of items. It is not a total of all plant used over the entire project duration but a typical summary of the main plant items during the two defined scenarios.

**Table 7-1 Equipment Numbers & $L_{Amax}$ Sound Power Levels**

| Plant / Equipment Item | $L_{Amax}$ Sound Power Level (dBA) | No. of Items Modelled | |
|---|---|---|---|
| | | Scenario 1 | Scenario 2 |
| Grader | 110 | 1 | 0 |
| Water Cart | 108 | 1 | 0 |
| 20 to 30t Excavator | 110 | 2 | 0 |
| D8 Dozer | 113 | 1 | 0 |
| Scraper | 115 | 2 | 0 |
| Roller | 112 | 0 | 0 |
| Crane | 103 | 0 | 1 |
| Concrete/Brick/Tile Saw | 105 | 0 | 1 |
| Concrete/Haul Truck | 112 | 4 | 2 |
| Concrete Pump | 108 | 0 | 0 |
| Compressor | 103 | 0 | 1 |
| General Power Tools | 95 | 0 | 3 |
| Jack Hammer | 90 | 0 | 0 |
| Portable Generator | 110 | 0 | 1 |

All equipment listed in **Table 7-1** would not be working at the maximum power levels simultaneously. Experience indicates that these maximum noise levels occur only rarely, and the $L_{A10}$ noise levels will be at least 7dBA below the maximum levels. For this reason, 7dBA was subtracted from the calculated "worst case" maximum noise levels to give an estimate of the typical $L_{A10}$ noise level from the site. Using the assumed plant items and their associated maximum sound power levels (with consideration given to the operational changes, intermittent processes and changes in distance of mobile plant), the combined $L_{A10}$ sound power levels for each scenario is:

Scenario 1 116dBA (123dBA-7dBA)
Scenario 2 111dBA (118dBA-7dBA)

For each scenario, three indicative locations (each of the same SWL) across the site have been modelled.

### 7.3 Calculated Noise Levels

**Table 7-2** summarises the calculated noise levels (unmitigated) at the closest existing residence (Receptor A) for acoustically neutral conditions and also considering the noise emission from the average vehicle movement along the access road within the site.

**Table 7-2 Calculated Construction Noise Levels at Existing Receivers**

| Residence No. | Calculated Noise Level $L_{A10,15min}$ (dBA) | | Noise Criteria $L_{A10,15min}$ (dBA) |
|---|---|---|---|
| | Scenario 1 | Scenario 2 | |
| 3km Southwest of the proposed site | <20 | | 35 |

**Table 7-2** shows that no exceedances have been predicted and that the noise criteria are met comfortably.

Once the contractor is selected, the plant, processes and duration will be better known and a Construction Noise Management Plan is to be developed so that our assumptions confirmed.

# 8 TRAFFIC NOISE ASSESSMENT

This section assesses the impact of increased noise potentially impacting residential receivers along Arumpo Road due to additional road traffic generated by the development during both the construction and operational phases of the project.

Assessment is based on the non-mandatory guidelines contained within the *Environmental Criteria for Road Traffic Noise (ECRTN)*.

## 8.1 Noise Criteria for Arumpo Road

To access the facility, all vehicular movements will travel along Arumpo Road (this is the only option) and then onto the site. Arumpo Road links the proposed site to the main towns in the area of Buronga, Mourquong and Mildura. This road is generally a two way, two lane road with a speed limit of 100km/hr.

In order to assign noise criteria, the functional category of the road is to be determined. In discussion with RTA, they consider the road to be a "minor arterial". This is considered by WM to be similar to a "sub-arterial" road using the *ECRTN*. Therefore, the applicable noise criteria are:

- day time (7.00am-10.00pm) $L_{Aeq,15hr}$ 60dBA level
- night time (10.00pm-7.00am) $L_{Aeq,9hr}$ 55dBA level

Further to these criteria, traffic generating developments are allowed an increase above these limits of 2dB, once all reasonable and feasible mitigation is considered. Given the fact that this is the only access, it seems appropriate to apply the 2dB limit.

## 8.2 Existing and Additional Road Traffic Volumes

The Roads and Traffic Authority (RTA) last conducted traffic counts for a complete week in November 2006 (RTA station 98.156 - Buronga – North of State Highway 22, Silver City Highway). These counts included directional and classification data for each hour over the week long period.

URS have provided an estimated number of typical daily movements during both the construction and operation phases.

**Table 8-1** summarises both the RTA and URS data. Given that vehicular movements are unlikely during the night time period, only the day time volumes are presented. Furthermore, it is assumed that equal movements enter and leave the site in both directions.

**Table 8-1 Road Traffic Volumes During the Daytime Period**

| Traffic Volumes | Vehicle Types | |
|---|---|---|
| | Light | Heavy |
| **Existing**[1] | 233 | 98 |
| **Predicted (Construction)**[2] | 13 | 4 |
| **Predicted (Operation)** | 2 | 11 (summer), 9 (winter) |

Note 1: Average of Monday to Saturday inclusive.
Note 2: Typical volumes over the majority of the time, there will be periods with both lower and higher traffic volumes.

To assess the change in traffic noise during the construction phase, the Federal Highways traffic noise prediction method (FHWA) has been used. A change of 1.3dB has been calculated, which is below the 2dB allowance.

During the operational phase, normal staff levels are expected to average one (1) full time person with up to two (2) more on an intermittent basis generating two (2) vehicle trips over the morning and evening periods. It is also probable that the operation of the proposed peaking power plant may be outside of peak travel hours due to the nature of the demand on the facility.

In addition, during the operational phase, water will be trucked to the site from the Buronga Sewerage Treatment Plant. It is estimated that water tanker frequency from the Treatment Plant at typical operational mode will be up to 30 trucks per week during summer (with evaporative cooling on) and up to 21 trucks per week in winter (with evaporative cooling off).

In addition, during the operational phase, distillate will be trucked to the site. It is estimated that distillate tanker frequency during typical operational mode will be up to 25 B-double trucks per week during summer and in winter.

Based on the above movements per day for heavy and light vehicles, the increase in noise from traffic during the operational phase is considered to be negligible (<0.5 dB).

# 9 VIBRATION ASSESSMENT

The impact due to vibration may be in the form of annoyance to the occupants of a particularly building for instance, or in some cases cause damage to structures including buildings. Usually the levels at which annoyance occurs is far less than the levels that may lead to structural damage of structures including buildings. Given this, it is more than reasonable to assume that compliance with criteria formulated to manage annoyance will more than likely result in compliance with any criteria formulated to assess structural damage.

This section provides a qualitative appreciation of the effect of vibration from both the construction and operation of the facility to the closest existing residence (Receptor A).

In terms of vibration sources identified during the construction stage, only vibratory rollers have been identified to possibly be used to establish the required RL of the site. Given that the nearest residential receiver is approximately 3km away from the closest area of works, the vibration levels would not be perceptible (significantly less than 0.15mm/s) and therefore not impact the residence.

Once operational, all rotating plant items of the Buronga Peaking Power Plant will be required to be correctly aligned and balanced. It is therefore unlikely that any vibration levels will be perceptible at the closest existing residence.

Given the low risk associated with vibration impacts a detailed vibration assessment is not deemed necessary. In making this judgment the DECC document *Assessing Vibration: A Technical Guideline, February 2006* has been consulted.

# 10 CONCLUSION

The construction, operational and traffic noise and vibration impacts due to the proposed Buronga Peaking Power Plant have been assessed in accordance with relevant Department of Environment & Climate Change policy documents.

Based on typical, generic noise level emissions of the major noise producing plant associated with 50MW power plants, no exceedances have been predicted to the closest existing residence, even in the scenario where the noise source contains annoying characteristics such that a 5dB penalty is required.

The potential of sleep disturbance from the operation of the development were found to be negligible.

Noise impacts due to extra traffic along Arumpo Road, during the construction and operation of the plant were found to be negligible.

No vibration impacts are envisaged to occur at the closest existing residence either during construction or operation of the plant.

A preliminary assessment of noise during the construction phase shows no exceedances at the closest existing residence (Receptor A). These levels are to be confirmed prior to commencement with the Contractor. A Construction Noise Management Plan should be developed to ensure a suitable program and that noise criteria are met.



| Version | Status | Date | Prepared by | Checked by |
|---|---|---|---|---|
| A | Draft | 17 October 2007 | Sam Demasi | John Wassermann |
| A | Final | 29 November 2007 | Sam Demasi | - |

# APPENDIX A

## GLOSSARY OF TERMS

# GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

**Maximum Noise Level ($L_{Amax}$) –** The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

**$L_{A1}$ –** The $L_{A1}$ level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the $L_{A1}$ level for 99% of the time.

**$L_{A10}$ –** The $L_{A10}$ level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the $L_{A10}$ level for 90% of the time. The $L_{A10}$ is a common noise descriptor for environmental noise and road traffic noise.

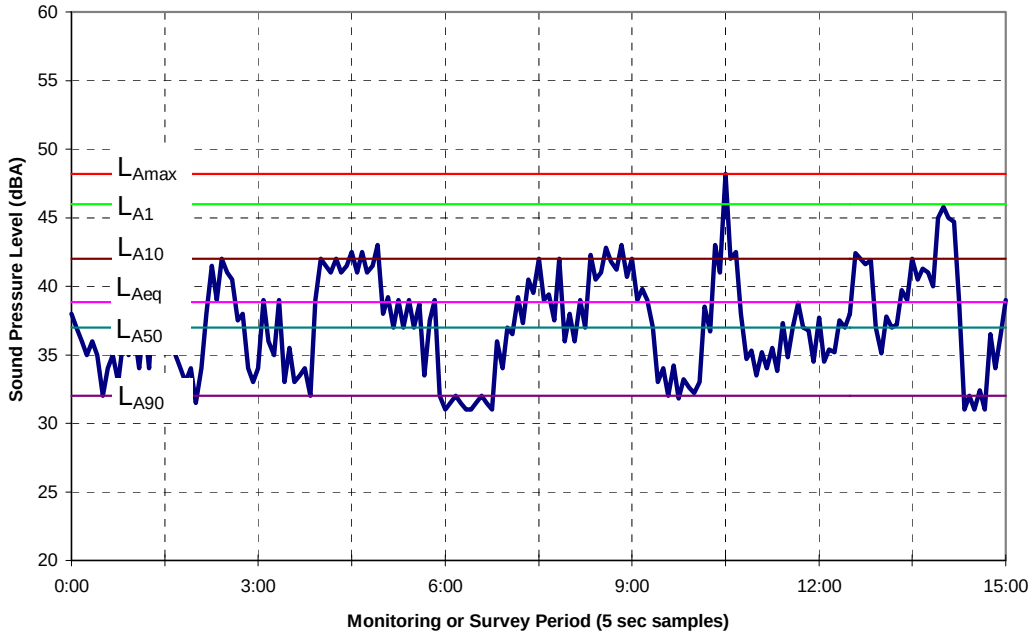
**$L_{Aeq}$ –** The equivalent continuous sound level ($L_{Aeq}$) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

**$L_{A50}$ –** The $L_{A50}$ level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the $L_{A50}$ level for 50% of the time.

**$L_{A90}$ –** The $L_{A90}$ level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the $L_{A90}$ level for 10% of the time. This measure is commonly referred to as the background noise level.

**ABL –** The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the $10^{th}$ percentile (lowest $10^{th}$ percent) background level ($L_{A90}$) for each period.

**RBL –** The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

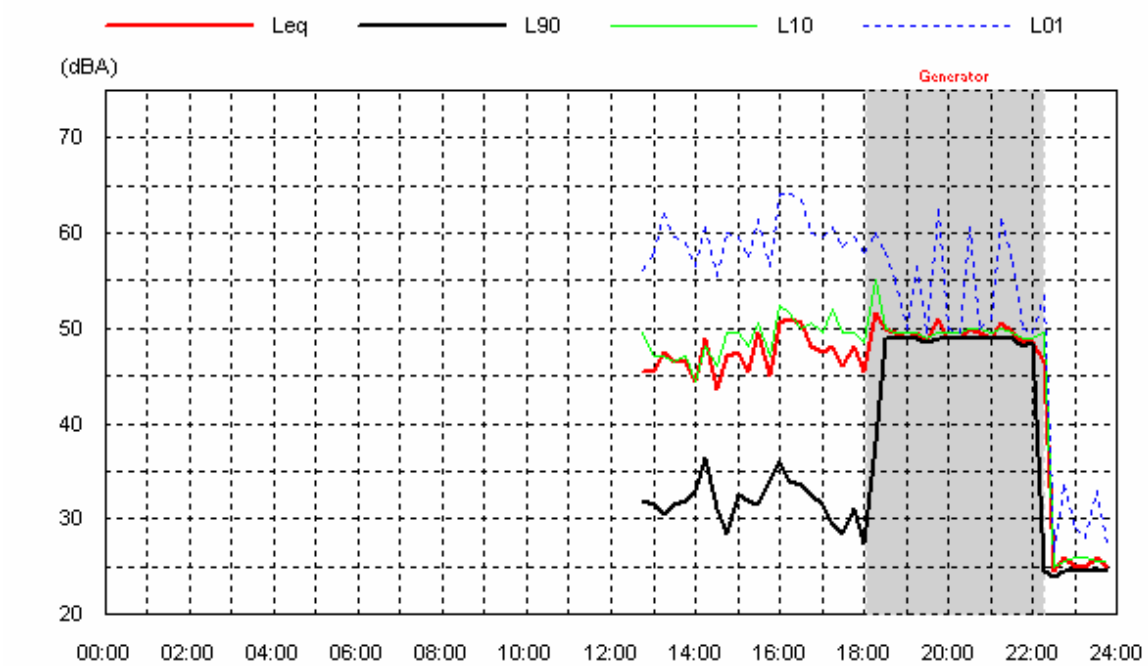

60
55
50
45
40
35
30
25
20
Sound Pressure Level (dBA)
LAmax
LA1
LA10
LAeq
LA50
LA90
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

# APPENDIX B

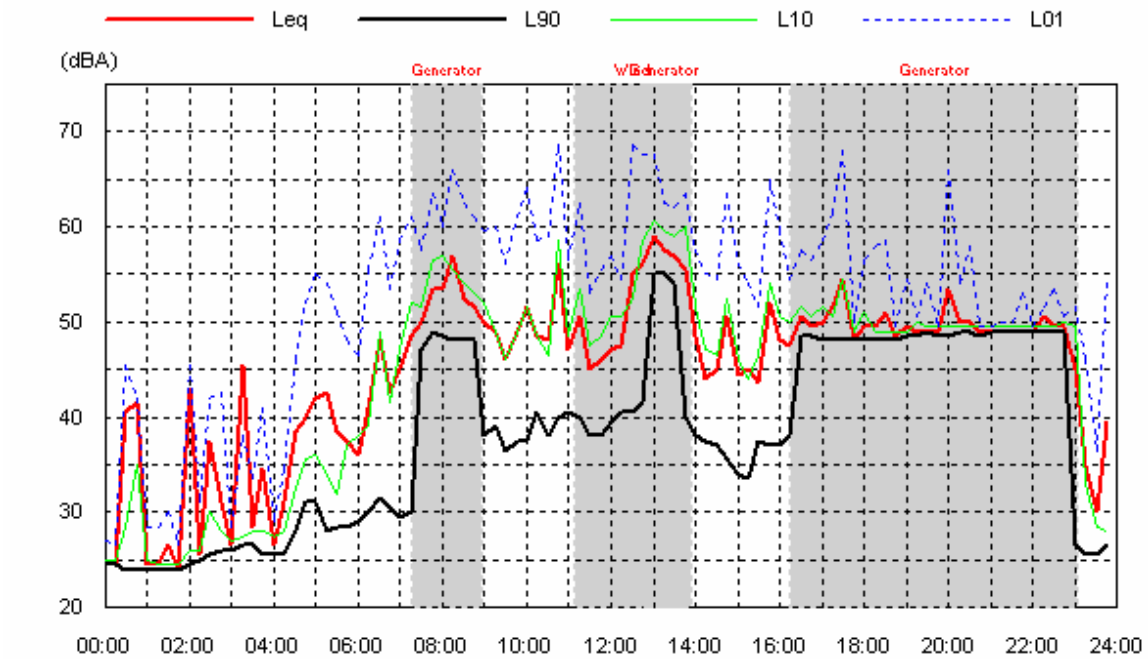
## NOISE MEASUREMENT RESULTS

Location: Nearest Residence (3km)
Data shaded: Generator; Wind

Wed 08 Aug 07

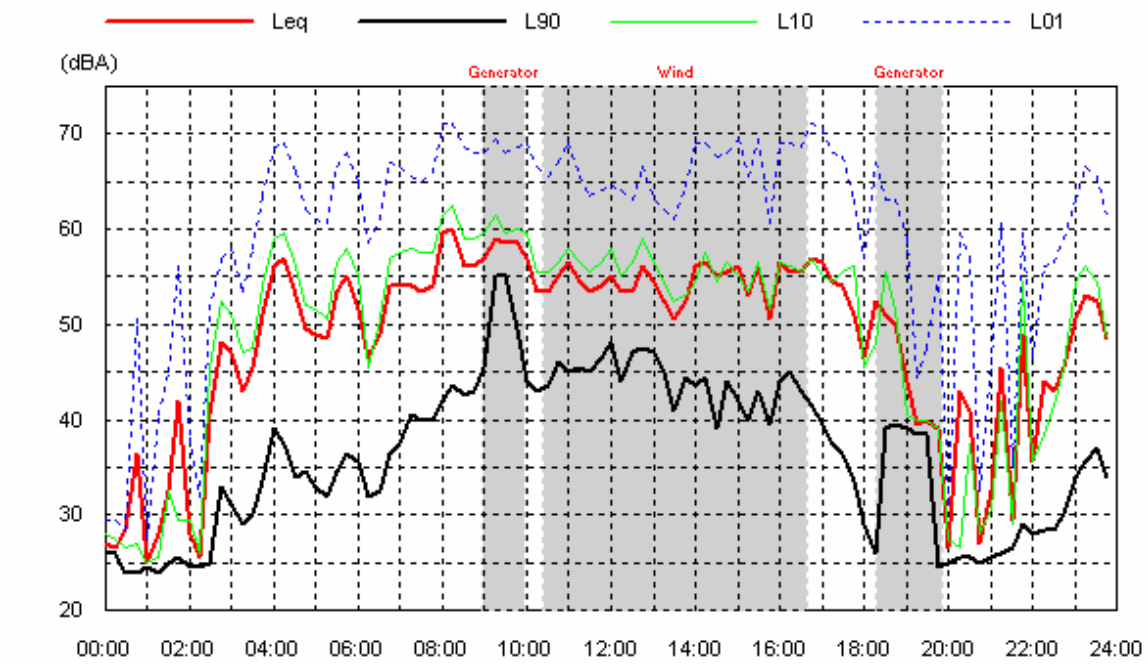



Thu 09 Aug 07

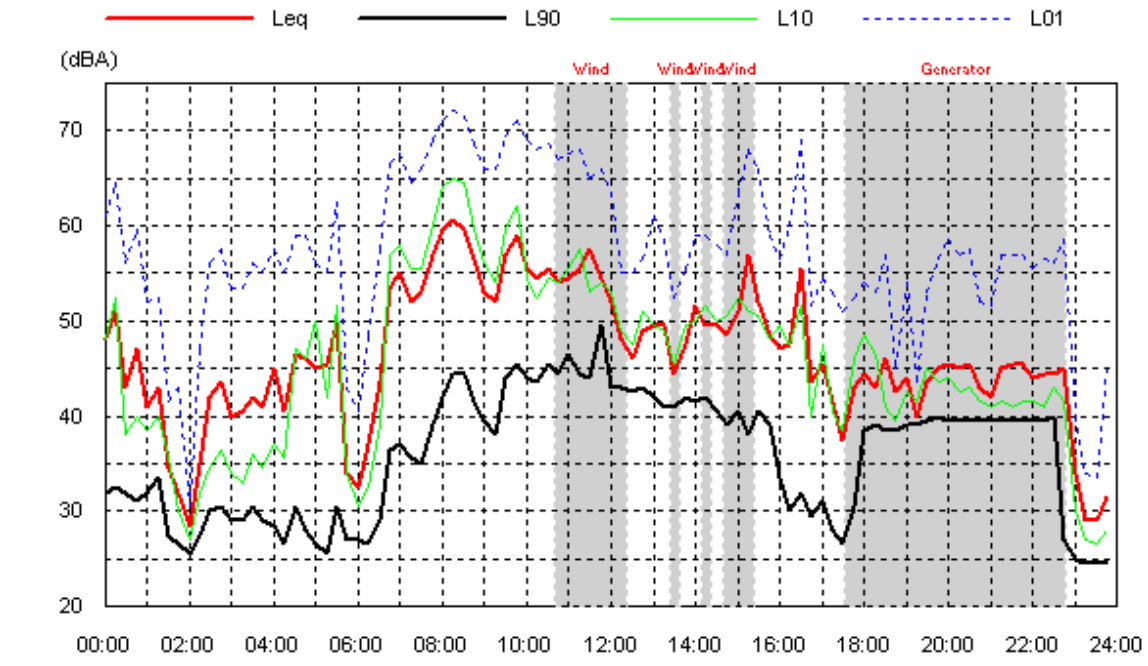


Location: Nearest Residence (3km)
Data shaded: Generator; Wind

Fri 10 Aug 07

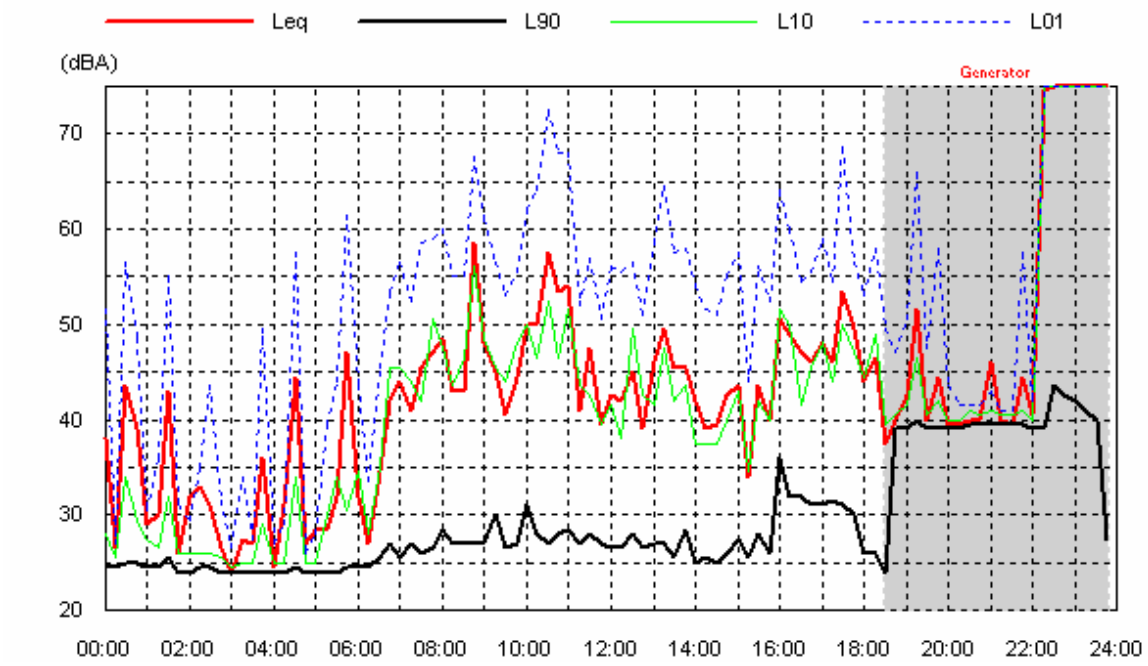



Sat 11 Aug 07

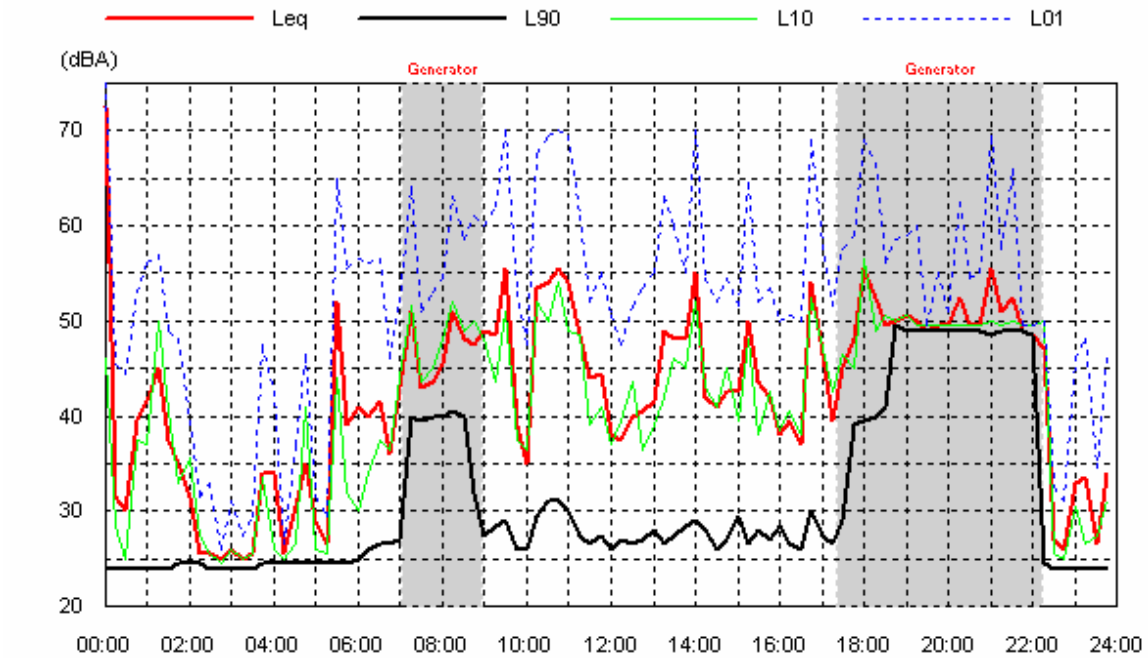


Location: Nearest Residence (3km)
Data shaded: Generator; Wind

Sun 12 Aug 07

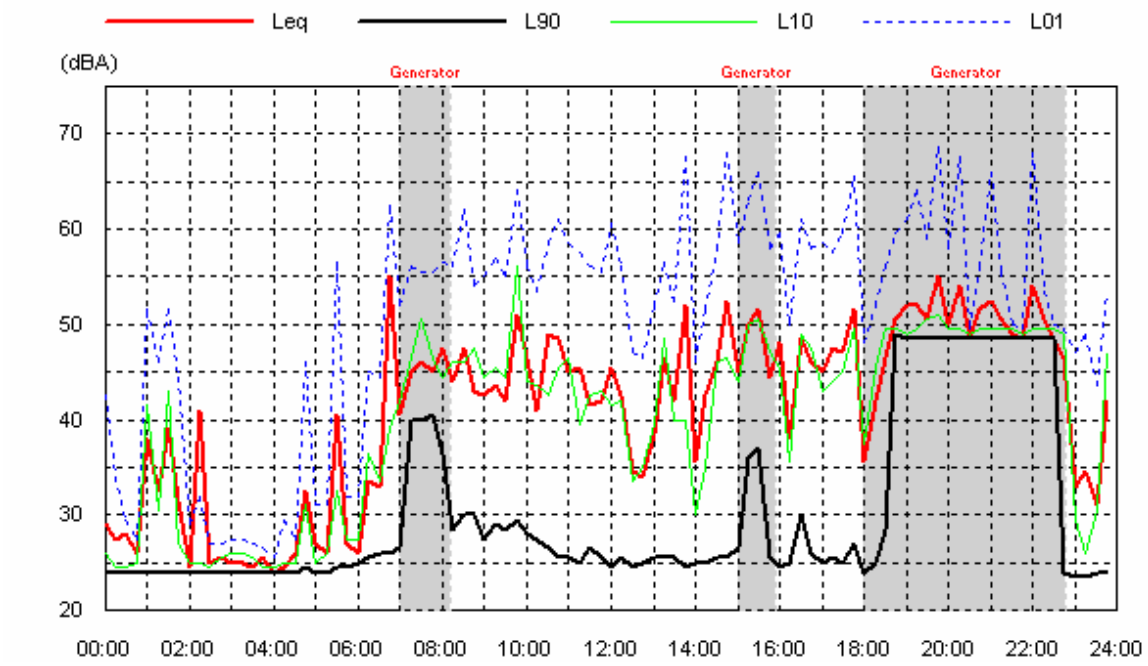



Mon 13 Aug 07

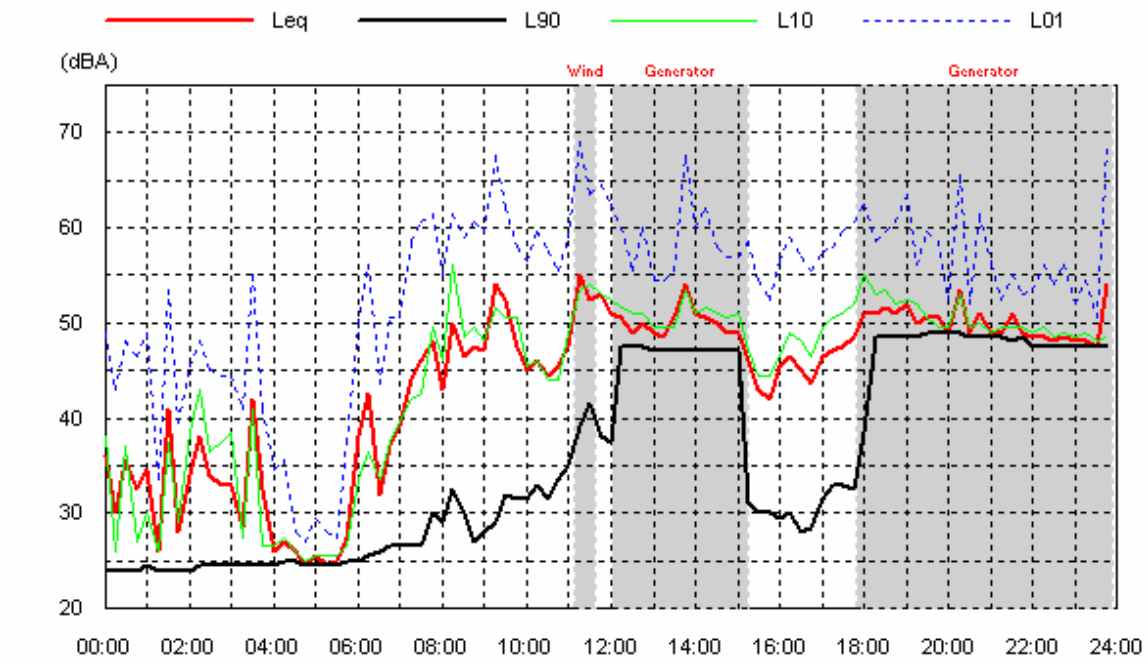


Location: Nearest Residence (3km)
Data shaded: Generator; Wind

Tue 14 Aug 07

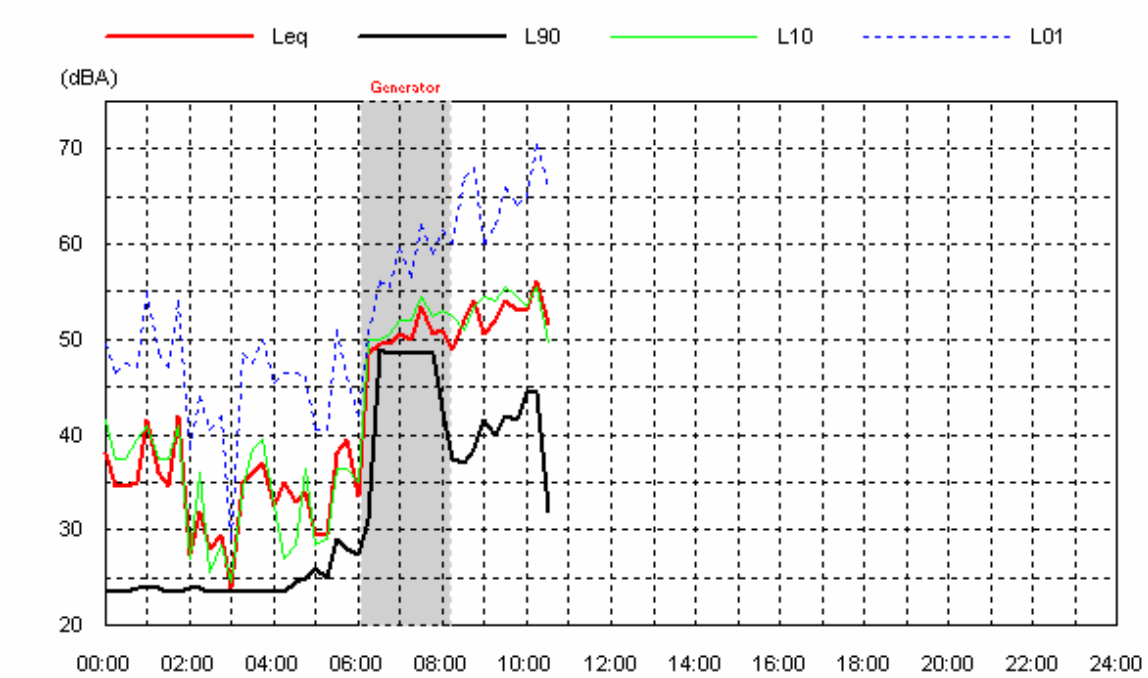



Wed 15 Aug 07



Location: Nearest Residence (3km)
Data shaded: Generator; Wind

Thu 16 Aug 07



# APPENDIX C

## SUMMARY OF METEOROLOGICAL CONDITIONS MODELLED

## AUTUMN – DAY

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 56.3 |
| 0 | 0.75 | 0 | 0.8 |
| 45 | 0.75 | 0 | 0.2 |
| 90 | 0.75 | 0 | 0.5 |
| 135 | 0.75 | 0 | 0.4 |
| 180 | 0.75 | 0 | 0.5 |
| 225 | 0.75 | 0 | 0.2 |
| 270 | 0.75 | 0 | 0.1 |
| 0 | 1.25 | 0 | 0.6 |
| 45 | 1.25 | 0 | 0.7 |
| 90 | 1.25 | 0 | 0.6 |
| 135 | 1.25 | 0 | 0.4 |
| 180 | 1.25 | 0 | 0.8 |
| 225 | 1.25 | 0 | 0.7 |
| 270 | 1.25 | 0 | 0.3 |
| 315 | 1.25 | 0 | 0.4 |
| 0 | 1.75 | 0 | 1.0 |
| 45 | 1.75 | 0 | 0.7 |
| 90 | 1.75 | 0 | 0.4 |
| 135 | 1.75 | 0 | 1.1 |
| 180 | 1.75 | 0 | 2.1 |
| 225 | 1.75 | 0 | 0.9 |
| 270 | 1.75 | 0 | 0.4 |
| 315 | 1.75 | 0 | 0.3 |
| 0 | 2.25 | 0 | 1.8 |
| 45 | 2.25 | 0 | 1.9 |
| 90 | 2.25 | 0 | 0.9 |
| 135 | 2.25 | 0 | 3.6 |
| 180 | 2.25 | 0 | 4.2 |
| 225 | 2.25 | 0 | 1.4 |
| 270 | 2.25 | 0 | 0.7 |
| 315 | 2.25 | 0 | 0.3 |
| 0 | 2.75 | 0 | 1.2 |
| 45 | 2.75 | 0 | 1.5 |
| 90 | 2.75 | 0 | 1.0 |
| 135 | 2.75 | 0 | 2.4 |
| 180 | 2.75 | 0 | 4.3 |
| 225 | 2.75 | 0 | 1.2 |
| 270 | 2.75 | 0 | 0.9 |
| 315 | 2.75 | 0 | 1.5 |
| 0 | 0 | 3 | 0.2 |
| 0 | 1.75 | 3 | 0.3 |
| 180 | 2.25 | 3 | 0.1 |
| 225 | 2.25 | 3 | 0.1 |
| 315 | 2.25 | 3 | 0.1 |
| 180 | 2.75 | 3 | 0.2 |
| 225 | 2.75 | 3 | 0.2 |

## AUTUMN - EVENING

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 23.9 |
| 0 | 0.75 | 0 | 0.3 |
| 45 | 0.75 | 0 | 0.8 |
| 90 | 0.75 | 0 | 0.8 |
| 135 | 0.75 | 0 | 0.3 |
| 180 | 0.75 | 0 | 0.3 |
| 270 | 0.75 | 0 | 0.5 |
| 90 | 1.25 | 0 | 0.3 |
| 315 | 1.25 | 0 | 0.3 |
| 180 | 1.75 | 0 | 0.8 |
| 225 | 1.75 | 0 | 0.3 |
| 45 | 2.25 | 0 | 0.5 |
| 90 | 2.25 | 0 | 0.3 |
| 135 | 2.25 | 0 | 0.5 |
| 180 | 2.25 | 0 | 4.3 |
| 225 | 2.25 | 0 | 2.7 |
| 270 | 2.25 | 0 | 0.8 |
| 180 | 2.75 | 0 | 1.1 |
| 225 | 2.75 | 0 | 0.5 |
| 0 | 0 | 3 | 7.3 |
| 90 | 0.75 | 3 | 0.3 |
| 135 | 0.75 | 3 | 0.3 |
| 0 | 1.25 | 3 | 0.3 |
| 45 | 1.25 | 3 | 1.6 |
| 90 | 1.25 | 3 | 0.5 |
| 135 | 1.25 | 3 | 0.8 |
| 180 | 1.25 | 3 | 0.8 |
| 225 | 1.25 | 3 | 0.3 |
| 0 | 1.75 | 3 | 0.5 |
| 45 | 1.75 | 3 | 1.9 |
| 90 | 1.75 | 3 | 1.4 |
| 135 | 1.75 | 3 | 1.6 |
| 180 | 1.75 | 3 | 2.2 |
| 225 | 1.75 | 3 | 1.4 |
| 270 | 1.75 | 3 | 0.8 |
| 0 | 2.25 | 3 | 1.6 |
| 45 | 2.25 | 3 | 3.0 |
| 90 | 2.25 | 3 | 1.9 |
| 135 | 2.25 | 3 | 3.0 |
| 180 | 2.25 | 3 | 9.5 |
| 225 | 2.25 | 3 | 5.2 |
| 270 | 2.25 | 3 | 1.4 |
| 315 | 2.25 | 3 | 0.3 |
| 45 | 2.75 | 3 | 2.2 |
| 90 | 2.75 | 3 | 1.4 |
| 135 | 2.75 | 3 | 1.9 |
| 180 | 2.75 | 3 | 4.1 |
| 225 | 2.75 | 3 | 2.2 |
| 270 | 2.75 | 3 | 1.1 |

**AUTUMN - NIGHT**

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 23.4 |
| 0 | 0.75 | 0 | 0.4 |
| 45 | 0.75 | 0 | 0.5 |
| 90 | 0.75 | 0 | 0.6 |
| 135 | 0.75 | 0 | 0.4 |
| 180 | 0.75 | 0 | 0.5 |
| 225 | 0.75 | 0 | 0.4 |
| 270 | 0.75 | 0 | 0.4 |
| 315 | 0.75 | 0 | 0.1 |
| 0 | 1.25 | 0 | 0.2 |
| 45 | 1.25 | 0 | 0.1 |
| 90 | 1.25 | 0 | 0.7 |
| 135 | 1.25 | 0 | 0.5 |
| 180 | 1.25 | 0 | 0.5 |
| 225 | 1.25 | 0 | 0.2 |
| 270 | 1.25 | 0 | 0.1 |
| 315 | 1.25 | 0 | 0.1 |
| 0 | 1.75 | 0 | 0.1 |
| 45 | 1.75 | 0 | 0.2 |
| 135 | 1.75 | 0 | 0.1 |
| 180 | 1.75 | 0 | 2.1 |
| 225 | 1.75 | 0 | 0.2 |
| 270 | 1.75 | 0 | 0.1 |
| 0 | 2.25 | 0 | 0.7 |
| 45 | 2.25 | 0 | 1.0 |
| 90 | 2.25 | 0 | 0.1 |
| 135 | 2.25 | 0 | 1.0 |
| 180 | 2.25 | 0 | 4.3 |
| 225 | 2.25 | 0 | 3.4 |
| 270 | 2.25 | 0 | 0.6 |
| 0 | 2.75 | 0 | 0.1 |
| 45 | 2.75 | 0 | 0.2 |
| 90 | 2.75 | 0 | 0.1 |
| 135 | 2.75 | 0 | 0.2 |
| 180 | 2.75 | 0 | 3.3 |
| 225 | 2.75 | 0 | 1.0 |
| 270 | 2.75 | 0 | 1.1 |
| 0 | 0 | 3 | 14.0 |
| 90 | 0.75 | 3 | 0.1 |
| 180 | 0.75 | 3 | 0.1 |
| 225 | 0.75 | 3 | 0.1 |
| 270 | 0.75 | 3 | 0.1 |
| 315 | 0.75 | 3 | 0.2 |
| 0 | 1.25 | 3 | 0.2 |
| 45 | 1.25 | 3 | 0.5 |
| 90 | 1.25 | 3 | 0.1 |
| 135 | 1.25 | 3 | 0.5 |
| 180 | 1.25 | 3 | 0.5 |
| 225 | 1.25 | 3 | 0.2 |
| 0 | 1.75 | 3 | 0.2 |
| 45 | 1.75 | 3 | 0.8 |
| 90 | 1.75 | 3 | 0.6 |
| 135 | 1.75 | 3 | 0.2 |
| 180 | 1.75 | 3 | 1.4 |
| 225 | 1.75 | 3 | 0.2 |
| 315 | 1.75 | 3 | 0.1 |
| 0 | 2.25 | 3 | 1.2 |
| 45 | 2.25 | 3 | 3.7 |
| 90 | 2.25 | 3 | 2.2 |
| 135 | 2.25 | 3 | 2.3 |
| 180 | 2.25 | 3 | 4.7 |
| 225 | 2.25 | 3 | 1.3 |
| 270 | 2.25 | 3 | 0.6 |
| 315 | 2.25 | 3 | 0.2 |
| 0 | 2.75 | 3 | 0.6 |
| 45 | 2.75 | 3 | 2.9 |
| 90 | 2.75 | 3 | 1.4 |
| 135 | 2.75 | 3 | 0.8 |
| 180 | 2.75 | 3 | 6.3 |
| 225 | 2.75 | 3 | 1.6 |
| 270 | 2.75 | 3 | 0.4 |

## SPRING - DAY

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 76.4 |
| 0 | 0.75 | 0 | 0.2 |
| 45 | 0.75 | 0 | 0.1 |
| 90 | 0.75 | 0 | 0.5 |
| 135 | 0.75 | 0 | 0.4 |
| 180 | 0.75 | 0 | 0.5 |
| 225 | 0.75 | 0 | 0.2 |
| 315 | 0.75 | 0 | 0.2 |
| 0 | 1.25 | 0 | 0.3 |
| 45 | 1.25 | 0 | 0.3 |
| 90 | 1.25 | 0 | 0.2 |
| 135 | 1.25 | 0 | 0.6 |
| 180 | 1.25 | 0 | 0.6 |
| 225 | 1.25 | 0 | 0.3 |
| 270 | 1.25 | 0 | 0.3 |
| 315 | 1.25 | 0 | 0.3 |
| 0 | 1.75 | 0 | 0.8 |
| 45 | 1.75 | 0 | 0.2 |
| 90 | 1.75 | 0 | 0.3 |
| 135 | 1.75 | 0 | 0.5 |
| 180 | 1.75 | 0 | 0.7 |
| 225 | 1.75 | 0 | 0.7 |
| 270 | 1.75 | 0 | 0.9 |
| 315 | 1.75 | 0 | 0.3 |
| 0 | 2.25 | 0 | 0.4 |
| 45 | 2.25 | 0 | 0.8 |
| 90 | 2.25 | 0 | 0.5 |
| 135 | 2.25 | 0 | 1.0 |
| 180 | 2.25 | 0 | 1.2 |
| 225 | 2.25 | 0 | 0.9 |
| 270 | 2.25 | 0 | 0.5 |
| 315 | 2.25 | 0 | 0.4 |
| 0 | 2.75 | 0 | 0.4 |
| 45 | 2.75 | 0 | 0.8 |
| 90 | 2.75 | 0 | 1.7 |
| 135 | 2.75 | 0 | 1.2 |
| 180 | 2.75 | 0 | 1.9 |
| 225 | 2.75 | 0 | 1.1 |
| 270 | 2.75 | 0 | 0.3 |
| 315 | 2.75 | 0 | 1.1 |

## SPRING - EVENING

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 47.0 |
| 0 | 0.75 | 0 | 0.3 |
| 45 | 0.75 | 0 | 0.3 |
| 90 | 0.75 | 0 | 0.8 |
| 135 | 0.75 | 0 | 1.4 |
| 225 | 0.75 | 0 | 0.3 |
| 315 | 0.75 | 0 | 0.3 |
| 45 | 1.25 | 0 | 0.3 |
| 90 | 1.25 | 0 | 0.5 |
| 225 | 1.25 | 0 | 0.3 |
| 270 | 1.25 | 0 | 0.5 |
| 315 | 1.25 | 0 | 0.3 |
| 45 | 1.75 | 0 | 0.3 |
| 180 | 1.75 | 0 | 0.5 |
| 225 | 1.75 | 0 | 0.3 |
| 270 | 1.75 | 0 | 0.8 |
| 315 | 1.75 | 0 | 0.3 |
| 45 | 2.25 | 0 | 0.5 |
| 90 | 2.25 | 0 | 0.5 |
| 135 | 2.25 | 0 | 0.3 |
| 180 | 2.25 | 0 | 0.8 |
| 225 | 2.25 | 0 | 0.8 |
| 270 | 2.25 | 0 | 1.9 |
| 315 | 2.25 | 0 | 0.3 |
| 0 | 2.75 | 0 | 0.5 |
| 90 | 2.75 | 0 | 0.3 |
| 135 | 2.75 | 0 | 0.3 |
| 180 | 2.75 | 0 | 0.3 |
| 315 | 2.75 | 0 | 0.5 |
| 0 | 0 | 3 | 11.8 |
| 135 | 0.75 | 3 | 0.3 |
| 0 | 1.25 | 3 | 0.3 |
| 45 | 1.25 | 3 | 0.8 |
| 90 | 1.25 | 3 | 0.3 |
| 135 | 1.25 | 3 | 0.3 |
| 180 | 1.25 | 3 | 0.5 |
| 225 | 1.25 | 3 | 0.3 |
| 315 | 1.25 | 3 | 0.3 |
| 45 | 1.75 | 3 | 0.5 |
| 135 | 1.75 | 3 | 0.3 |
| 180 | 1.75 | 3 | 0.5 |
| 225 | 1.75 | 3 | 0.3 |
| 270 | 1.75 | 3 | 0.5 |
| 0 | 2.25 | 3 | 0.8 |
| 45 | 2.25 | 3 | 1.4 |
| 90 | 2.25 | 3 | 1.4 |
| 135 | 2.25 | 3 | 0.8 |
| 180 | 2.25 | 3 | 1.9 |
| 225 | 2.25 | 3 | 2.5 |
| 270 | 2.25 | 3 | 1.1 |
| 315 | 2.25 | 3 | 0.5 |
| 0 | 2.75 | 3 | 1.6 |
| 45 | 2.75 | 3 | 0.8 |
| 90 | 2.75 | 3 | 2.2 |
| 135 | 2.75 | 3 | 1.4 |
| 180 | 2.75 | 3 | 1.6 |
| 225 | 2.75 | 3 | 1.4 |
| 270 | 2.75 | 3 | 1.6 |
| 315 | 2.75 | 3 | 0.3 |

**SPRING - NIGHT**

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 40.4 |
| 0 | 0.75 | 0 | 0.6 |
| 45 | 0.75 | 0 | 0.2 |
| 90 | 0.75 | 0 | 0.9 |
| 135 | 0.75 | 0 | 0.1 |
| 180 | 0.75 | 0 | 0.2 |
| 225 | 0.75 | 0 | 0.4 |
| 270 | 0.75 | 0 | 0.1 |
| 315 | 0.75 | 0 | 0.1 |
| 0 | 1.25 | 0 | 0.1 |
| 45 | 1.25 | 0 | 0.1 |
| 90 | 1.25 | 0 | 0.4 |
| 135 | 1.25 | 0 | 0.6 |
| 180 | 1.25 | 0 | 0.1 |
| 225 | 1.25 | 0 | 0.4 |
| 270 | 1.25 | 0 | 0.1 |
| 315 | 1.25 | 0 | 0.2 |
| 45 | 1.75 | 0 | 0.2 |
| 90 | 1.75 | 0 | 0.1 |
| 135 | 1.75 | 0 | 0.9 |
| 180 | 1.75 | 0 | 1.8 |
| 225 | 1.75 | 0 | 1.0 |
| 270 | 1.75 | 0 | 0.7 |
| 315 | 1.75 | 0 | 0.5 |
| 0 | 2.25 | 0 | 0.6 |
| 45 | 2.25 | 0 | 0.5 |
| 90 | 2.25 | 0 | 0.6 |
| 135 | 2.25 | 0 | 1.5 |
| 180 | 2.25 | 0 | 2.6 |
| 225 | 2.25 | 0 | 2.2 |
| 270 | 2.25 | 0 | 1.5 |
| 315 | 2.25 | 0 | 1.3 |
| 0 | 2.75 | 0 | 0.4 |
| 45 | 2.75 | 0 | 0.5 |
| 90 | 2.75 | 0 | 0.5 |
| 135 | 2.75 | 0 | 0.7 |
| 180 | 2.75 | 0 | 1.5 |
| 225 | 2.75 | 0 | 0.5 |
| 270 | 2.75 | 0 | 1.0 |
| 315 | 2.75 | 0 | 0.1 |
| 0 | 0 | 3 | 9.9 |
| 180 | 0.75 | 3 | 0.1 |
| 45 | 1.25 | 3 | 0.6 |
| 90 | 1.25 | 3 | 0.1 |
| 135 | 1.25 | 3 | 0.1 |
| 0 | 1.75 | 3 | 0.1 |
| 45 | 1.75 | 3 | 0.2 |
| 90 | 1.75 | 3 | 0.6 |
| 135 | 1.75 | 3 | 0.4 |
| 180 | 1.75 | 3 | 0.1 |
| 225 | 1.75 | 3 | 0.1 |
| 270 | 1.75 | 3 | 0.1 |
| 315 | 1.75 | 3 | 0.2 |

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | 2.25 | 3 | 0.7 |
| 45 | 2.25 | 3 | 1.6 |
| 90 | 2.25 | 3 | 1.5 |
| 135 | 2.25 | 3 | 2.0 |
| 180 | 2.25 | 3 | 2.4 |
| 225 | 2.25 | 3 | 1.0 |
| 270 | 2.25 | 3 | 1.0 |
| 315 | 2.25 | 3 | 0.4 |
| 0 | 2.75 | 3 | 0.5 |
| 45 | 2.75 | 3 | 2.3 |
| 90 | 2.75 | 3 | 2.0 |
| 135 | 2.75 | 3 | 0.9 |
| 180 | 2.75 | 3 | 3.1 |
| 225 | 2.75 | 3 | 0.7 |
| 270 | 2.75 | 3 | 0.7 |
| 315 | 2.75 | 3 | 0.2 |

**SUMMER - DAY**

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 80.6 |
| 45 | 0.75 | 0 | 0.2 |
| 90 | 0.75 | 0 | 0.3 |
| 135 | 0.75 | 0 | 0.1 |
| 180 | 0.75 | 0 | 0.3 |
| 270 | 0.75 | 0 | 0.1 |
| 315 | 0.75 | 0 | 0.1 |
| 0 | 1.25 | 0 | 0.1 |
| 45 | 1.25 | 0 | 0.2 |
| 90 | 1.25 | 0 | 0.2 |
| 135 | 1.25 | 0 | 0.2 |
| 180 | 1.25 | 0 | 0.3 |
| 225 | 1.25 | 0 | 0.1 |
| 315 | 1.25 | 0 | 0.3 |
| 0 | 1.75 | 0 | 0.4 |
| 45 | 1.75 | 0 | 0.3 |
| 90 | 1.75 | 0 | 0.7 |
| 135 | 1.75 | 0 | 0.9 |
| 180 | 1.75 | 0 | 0.9 |
| 225 | 1.75 | 0 | 0.2 |
| 270 | 1.75 | 0 | 0.3 |
| 315 | 1.75 | 0 | 0.3 |
| 0 | 2.25 | 0 | 0.7 |
| 45 | 2.25 | 0 | 0.7 |
| 90 | 2.25 | 0 | 0.6 |
| 135 | 2.25 | 0 | 1.7 |
| 180 | 2.25 | 0 | 0.7 |
| 225 | 2.25 | 0 | 1.0 |
| 270 | 2.25 | 0 | 1.1 |
| 315 | 2.25 | 0 | 0.6 |
| 0 | 2.75 | 0 | 0.6 |
| 45 | 2.75 | 0 | 0.6 |
| 90 | 2.75 | 0 | 0.3 |
| 135 | 2.75 | 0 | 0.3 |
| 180 | 2.75 | 0 | 1.3 |
| 225 | 2.75 | 0 | 0.7 |
| 270 | 2.75 | 0 | 1.3 |
| 315 | 2.75 | 0 | 0.5 |

**SUMMER - EVENING**

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 63.6 |
| 0 | 0.75 | 0 | 0.3 |
| 135 | 0.75 | 0 | 0.3 |
| 180 | 1.25 | 0 | 0.3 |
| 225 | 1.75 | 0 | 0.3 |
| 45 | 2.25 | 0 | 0.3 |
| 135 | 2.25 | 0 | 0.6 |
| 180 | 2.25 | 0 | 0.3 |
| 225 | 2.25 | 0 | 0.3 |
| 270 | 2.25 | 0 | 0.3 |
| 315 | 2.25 | 0 | 0.6 |
| 0 | 2.75 | 0 | 0.3 |
| 180 | 2.75 | 0 | 0.6 |
| 270 | 2.75 | 0 | 0.3 |
| 315 | 2.75 | 0 | 0.3 |
| 0 | 0 | 3 | 6.9 |
| 45 | 0.75 | 3 | 0.3 |
| 90 | 1.25 | 3 | 0.3 |
| 180 | 1.25 | 3 | 0.6 |
| 225 | 1.25 | 3 | 0.3 |
| 270 | 1.25 | 3 | 0.6 |
| 45 | 1.75 | 3 | 0.3 |
| 90 | 1.75 | 3 | 0.6 |
| 135 | 1.75 | 3 | 0.6 |
| 225 | 1.75 | 3 | 1.1 |
| 315 | 1.75 | 3 | 0.3 |
| 0 | 2.25 | 3 | 0.8 |
| 45 | 2.25 | 3 | 1.7 |
| 90 | 2.25 | 3 | 2.5 |
| 135 | 2.25 | 3 | 1.9 |
| 180 | 2.25 | 3 | 1.7 |
| 225 | 2.25 | 3 | 0.8 |
| 270 | 2.25 | 3 | 1.4 |
| 315 | 2.25 | 3 | 1.1 |
| 0 | 2.75 | 3 | 0.6 |
| 45 | 2.75 | 3 | 0.6 |
| 90 | 2.75 | 3 | 0.6 |
| 135 | 2.75 | 3 | 1.7 |
| 180 | 2.75 | 3 | 1.7 |
| 225 | 2.75 | 3 | 0.8 |
| 270 | 2.75 | 3 | 1.4 |
| 315 | 2.75 | 3 | 0.8 |

**SUMMER - NIGHT**

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 43.0 |
| 0 | 0.75 | 0 | 0.2 |
| 45 | 0.75 | 0 | 0.4 |
| 90 | 0.75 | 0 | 0.7 |
| 135 | 0.75 | 0 | 0.2 |
| 225 | 0.75 | 0 | 0.1 |
| 270 | 0.75 | 0 | 0.1 |
| 45 | 1.25 | 0 | 0.2 |
| 90 | 1.25 | 0 | 0.2 |
| 135 | 1.25 | 0 | 0.1 |
| 180 | 1.25 | 0 | 0.1 |
| 225 | 1.25 | 0 | 0.1 |
| 270 | 1.25 | 0 | 0.1 |
| 315 | 1.25 | 0 | 0.2 |
| 90 | 1.75 | 0 | 0.1 |
| 135 | 1.75 | 0 | 0.2 |
| 180 | 1.75 | 0 | 0.7 |
| 225 | 1.75 | 0 | 1.1 |
| 270 | 1.75 | 0 | 0.4 |
| 315 | 1.75 | 0 | 0.1 |
| 45 | 2.25 | 0 | 0.6 |
| 90 | 2.25 | 0 | 0.7 |
| 135 | 2.25 | 0 | 0.6 |
| 180 | 2.25 | 0 | 3.2 |
| 225 | 2.25 | 0 | 1.2 |
| 270 | 2.25 | 0 | 1.6 |
| 315 | 2.25 | 0 | 0.2 |
| 45 | 2.75 | 0 | 0.5 |
| 90 | 2.75 | 0 | 0.1 |
| 135 | 2.75 | 0 | 0.1 |
| 180 | 2.75 | 0 | 2.6 |
| 225 | 2.75 | 0 | 1.4 |
| 270 | 2.75 | 0 | 0.6 |
| 0 | 0 | 3 | 10.0 |
| 180 | 0.75 | 3 | 0.1 |
| 0 | 1.25 | 3 | 0.2 |
| 45 | 1.25 | 3 | 0.5 |
| 90 | 1.25 | 3 | 0.4 |
| 135 | 1.25 | 3 | 0.4 |
| 180 | 1.25 | 3 | 0.1 |
| 0 | 1.75 | 3 | 0.1 |
| 45 | 1.75 | 3 | 0.9 |
| 90 | 1.75 | 3 | 0.1 |
| 135 | 1.75 | 3 | 1.1 |
| 180 | 1.75 | 3 | 0.4 |
| 225 | 1.75 | 3 | 0.7 |
| 270 | 1.75 | 3 | 0.1 |
| 315 | 1.75 | 3 | 0.1 |
| 0 | 2.25 | 3 | 0.2 |
| 45 | 2.25 | 3 | 2.1 |
| 90 | 2.25 | 3 | 1.1 |
| 135 | 2.25 | 3 | 2.5 |
| 180 | 2.25 | 3 | 4.7 |
| 225 | 2.25 | 3 | 1.2 |
| 270 | 2.25 | 3 | 0.5 |
| 0 | 2.75 | 3 | 0.1 |
| 45 | 2.75 | 3 | 1.6 |
| 90 | 2.75 | 3 | 1.2 |
| 135 | 2.75 | 3 | 0.7 |
| 180 | 2.75 | 3 | 3.7 |
| 225 | 2.75 | 3 | 1.9 |
| 270 | 2.75 | 3 | 0.5 |
| 315 | 2.75 | 3 | 0.2 |

## WINTER - DAY

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 70.0 |
| 0 | 0.75 | 0 | 0.1 |
| 45 | 0.75 | 0 | 1.8 |
| 90 | 0.75 | 0 | 0.6 |
| 135 | 0.75 | 0 | 0.6 |
| 180 | 0.75 | 0 | 1.8 |
| 225 | 0.75 | 0 | 0.6 |
| 270 | 0.75 | 0 | 0.6 |
| 315 | 0.75 | 0 | 1.2 |
| 0 | 1.25 | 0 | 0.9 |
| 45 | 1.25 | 0 | 0.3 |
| 90 | 1.25 | 0 | 2.1 |
| 135 | 1.25 | 0 | 1.2 |
| 180 | 1.25 | 0 | 1.2 |
| 225 | 1.25 | 0 | 0.6 |
| 270 | 1.25 | 0 | 0.6 |
| 315 | 1.25 | 0 | 0.6 |
| 0 | 1.75 | 0 | 1.2 |
| 45 | 1.75 | 0 | 1.2 |
| 90 | 1.75 | 0 | 1.5 |
| 135 | 1.75 | 0 | 0.6 |
| 180 | 1.75 | 0 | 3.9 |
| 225 | 1.75 | 0 | 1.2 |
| 270 | 1.75 | 0 | 3.0 |
| 315 | 1.75 | 0 | 1.5 |
| 0 | 2.25 | 0 | 4.5 |
| 45 | 2.25 | 0 | 4.2 |
| 90 | 2.25 | 0 | 3.3 |
| 135 | 2.25 | 0 | 3.0 |
| 180 | 2.25 | 0 | 5.0 |
| 225 | 2.25 | 0 | 1.2 |
| 270 | 2.25 | 0 | 5.0 |
| 315 | 2.25 | 0 | 4.5 |
| 0 | 2.75 | 0 | 4.5 |
| 45 | 2.75 | 0 | 3.3 |
| 90 | 2.75 | 0 | 3.6 |
| 135 | 2.75 | 0 | 3.3 |
| 180 | 2.75 | 0 | 2.7 |
| 225 | 2.75 | 0 | 3.3 |
| 270 | 2.75 | 0 | 3.3 |
| 315 | 2.75 | 0 | 5.0 |
| 0 | 0 | 3 | 1.5 |
| 135 | 0.75 | 3 | 0.3 |
| 90 | 1.75 | 3 | 0.3 |
| 0 | 2.25 | 3 | 0.3 |
| 90 | 2.25 | 3 | 0.3 |
| 135 | 2.25 | 3 | 0.3 |
| 180 | 2.25 | 3 | 0.3 |
| 225 | 2.25 | 3 | 0.3 |
| 270 | 2.25 | 3 | 0.3 |
| 0 | 2.75 | 3 | 0.6 |
| 135 | 2.75 | 3 | 0.3 |
| 180 | 2.75 | 3 | 0.3 |
| 270 | 2.75 | 3 | 0.6 |
| 315 | 2.75 | 3 | 0.9 |
| 180 | 2.25 | 3 | 0.6 |
| 225 | 2.25 | 3 | 0.6 |
| 0 | 2.75 | 3 | 0.3 |
| 45 | 2.75 | 3 | 0.3 |
| 180 | 2.75 | 3 | 0.3 |
| 225 | 2.75 | 3 | 0.6 |
| 270 | 2.75 | 3 | 2.7 |
| 315 | 2.75 | 3 | 0.3 |

## WINTER - EVENING

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 22.2 |
| 0 | 0.75 | 0 | 0.7 |
| 45 | 0.75 | 0 | 0.4 |
| 90 | 0.75 | 0 | 0.2 |
| 135 | 0.75 | 0 | 0.2 |
| 270 | 0.75 | 0 | 0.2 |
| 315 | 0.75 | 0 | 0.2 |
| 0 | 1.25 | 0 | 0.5 |
| 45 | 1.25 | 0 | 0.4 |
| 90 | 1.25 | 0 | 0.2 |
| 135 | 1.25 | 0 | 0.2 |
| 180 | 1.25 | 0 | 0.4 |
| 225 | 1.25 | 0 | 0.7 |
| 270 | 1.25 | 0 | 0.2 |
| 315 | 1.25 | 0 | 0.4 |
| 90 | 1.75 | 0 | 0.2 |
| 180 | 1.75 | 0 | 0.4 |
| 225 | 1.75 | 0 | 0.5 |
| 270 | 1.75 | 0 | 0.9 |
| 0 | 2.25 | 0 | 0.9 |
| 45 | 2.25 | 0 | 0.4 |
| 90 | 2.25 | 0 | 0.2 |
| 135 | 2.25 | 0 | 0.2 |
| 180 | 2.25 | 0 | 0.2 |
| 225 | 2.25 | 0 | 1.3 |
| 270 | 2.25 | 0 | 3.1 |
| 315 | 2.25 | 0 | 0.4 |
| 0 | 2.75 | 0 | 0.5 |
| 45 | 2.75 | 0 | 0.4 |
| 90 | 2.75 | 0 | 0.5 |
| 135 | 2.75 | 0 | 0.5 |
| 180 | 2.75 | 0 | 0.5 |
| 225 | 2.75 | 0 | 1.1 |
| 270 | 2.75 | 0 | 0.2 |
| 315 | 2.75 | 0 | 0.2 |
| 0 | 0 | 3 | 5.4 |
| 180 | 0.75 | 3 | 0.2 |
| 0 | 1.25 | 3 | 0.2 |
| 45 | 1.25 | 3 | 0.5 |

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 180 | 1.25 | 3 | 0.4 |
| 0 | 1.75 | 3 | 0.5 |
| 45 | 1.75 | 3 | 1.1 |
| 90 | 1.75 | 3 | 0.2 |
| 135 | 1.75 | 3 | 0.2 |
| 180 | 1.75 | 3 | 0.4 |
| 225 | 1.75 | 3 | 0.2 |
| 270 | 1.75 | 3 | 0.2 |
| 0 | 2.25 | 3 | 2.0 |
| 45 | 2.25 | 3 | 1.6 |
| 90 | 2.25 | 3 | 1.3 |
| 135 | 2.25 | 3 | 1.3 |
| 180 | 2.25 | 3 | 1.3 |
| 225 | 2.25 | 3 | 1.8 |
| 270 | 2.25 | 3 | 0.5 |
| 315 | 2.25 | 3 | 0.2 |
| 0 | 2.75 | 3 | 1.3 |
| 45 | 2.75 | 3 | 0.7 |
| 90 | 2.75 | 3 | 0.7 |
| 135 | 2.75 | 3 | 1.8 |
| 180 | 2.75 | 3 | 0.5 |
| 225 | 2.75 | 3 | 0.5 |
| 270 | 2.75 | 3 | 1.3 |
| 315 | 2.75 | 3 | 0.9 |
| 45 | 2.25 | 3 | 0.4 |
| 90 | 2.25 | 3 | 0.7 |
| 180 | 2.25 | 3 | 0.9 |
| 225 | 2.25 | 3 | 2.9 |
| 270 | 2.25 | 3 | 4.7 |
| 315 | 2.25 | 3 | 2.4 |
| 0 | 2.75 | 3 | 1.6 |
| 90 | 2.75 | 3 | 0.7 |
| 135 | 2.75 | 3 | 0.2 |
| 180 | 2.75 | 3 | 2.2 |
| 225 | 2.75 | 3 | 3.6 |
| 270 | 2.75 | 3 | 8.9 |
| 315 | 2.75 | 3 | 4.3 |

## WINTER - NIGHT

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 0 | ≤0.5m/s & >3m/s | | 37.2 |
| 0 | 0.75 | 0 | 0.8 |
| 45 | 0.75 | 0 | 0.6 |
| 90 | 0.75 | 0 | 0.6 |
| 135 | 0.75 | 0 | 0.7 |
| 180 | 0.75 | 0 | 0.1 |
| 225 | 0.75 | 0 | 0.2 |
| 270 | 0.75 | 0 | 0.2 |
| 315 | 0.75 | 0 | 0.6 |
| 0 | 1.25 | 0 | 0.5 |
| 45 | 1.25 | 0 | 0.2 |
| 90 | 1.25 | 0 | 0.1 |
| 180 | 1.25 | 0 | 0.1 |
| 225 | 1.25 | 0 | 0.5 |
| 270 | 1.25 | 0 | 0.4 |
| 315 | 1.25 | 0 | 0.4 |
| 0 | 1.75 | 0 | 0.1 |
| 45 | 1.75 | 0 | 0.1 |
| 90 | 1.75 | 0 | 0.5 |
| 135 | 1.75 | 0 | 0.7 |
| 180 | 1.75 | 0 | 1.1 |
| 225 | 1.75 | 0 | 0.8 |
| 270 | 1.75 | 0 | 1.7 |
| 315 | 1.75 | 0 | 0.1 |
| 0 | 2.25 | 0 | 0.7 |
| 45 | 2.25 | 0 | 0.2 |
| 90 | 2.25 | 0 | 0.6 |
| 135 | 2.25 | 0 | 1.0 |
| 180 | 2.25 | 0 | 4.0 |
| 225 | 2.25 | 0 | 3.0 |
| 270 | 2.25 | 0 | 2.5 |
| 315 | 2.25 | 0 | 1.2 |
| 0 | 2.75 | 0 | 1.1 |
| 45 | 2.75 | 0 | 0.5 |
| 90 | 2.75 | 0 | 0.2 |
| 135 | 2.75 | 0 | 0.1 |
| 180 | 2.75 | 0 | 1.6 |
| 225 | 2.75 | 0 | 0.7 |
| 270 | 2.75 | 0 | 1.0 |
| 315 | 2.75 | 0 | 1.2 |
| 0 | 0 | 3 | 8.6 |
| 180 | 0.75 | 3 | 0.1 |
| 0 | 1.25 | 3 | 0.2 |
| 45 | 1.25 | 3 | 0.4 |
| 90 | 1.25 | 3 | 0.2 |
| 180 | 1.25 | 3 | 0.2 |
| 0 | 1.75 | 3 | 0.4 |
| 45 | 1.75 | 3 | 0.4 |
| 90 | 1.75 | 3 | 0.6 |
| 135 | 1.75 | 3 | 0.5 |
| 180 | 1.75 | 3 | 0.7 |
| 225 | 1.75 | 3 | 0.2 |
| 0 | 2.25 | 3 | 2.2 |

| Wind Dir | Wind Speed | Inv Strength | % Occurrence |
|---|---|---|---|
| 45 | 2.25 | 3 | 1.3 |
| 90 | 2.25 | 3 | 1.9 |
| 135 | 2.25 | 3 | 0.7 |
| 180 | 2.25 | 3 | 1.3 |
| 225 | 2.25 | 3 | 1.0 |
| 270 | 2.25 | 3 | 0.4 |
| 315 | 2.25 | 3 | 0.4 |
| 0 | 2.75 | 3 | 2.4 |
| 45 | 2.75 | 3 | 2.2 |
| 90 | 2.75 | 3 | 0.7 |
| 135 | 2.75 | 3 | 0.1 |
| 180 | 2.75 | 3 | 1.4 |
| 225 | 2.75 | 3 | 1.6 |
| 270 | 2.75 | 3 | 1.1 |
| 315 | 2.75 | 3 | 0.5 |