MARSHALL DAY Acoustics

35 HAMS ROAD AND 151-229 ANGLESEA ROAD, SUBDIVISION

Road traffic and rail noise assessment

Rp 001 R04 2013193ML

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Project: **35 HAMS ROAD AND 151-229 ANGLESEA ROAD, SUBDIVISION**

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1.0 INTRODUCTION

SMEC Urban Pty Ltd has commissioned Marshall Day Acoustics to provide an assessment of noise levels for a proposed residential subdivision at 35 Hams Road and 151-229 Anglesea Road, Waurn Ponds.

A glossary of acoustic terms and symbols is provided in Appendix A.

2.0 SITE DESCRIPTION

The site is located at 35 Hams Road and 151-229 Anglesea Road, Waurn Ponds and is bounded by:

- Hams Road to the north
- Geelong/Warrnambool railway line to the south
- Powercor Waurn Ponds Terminal Station and Ghazeepore Road to the east
- Geelong Ring Road to Anglesea to the west.

A site development concept plan is presented in Appendix B.

3.0 CRITERIA

3.1 Road traffic noise

VicRoads' *Traffic Noise Reduction Policy* recommends traffic noise level objectives that are used by VicRoads when building new roads or upgrading existing roads. In addition, VicRoads has developed guidelines for noise mitigation at residential developments near major roads. These guidelines recommend that developers undertake some combination of the following:

- Erect traffic noise barriers of sufficient height and suitable construction in order to reduce external noise levels to 63dB $L_{A10(18h)}$ or less at the worst-affected dwellings
- Provide sound insulation treatment to residential dwellings sufficient to achieve compliance with the recommended internal noise levels specified in Australian Standard 2107-2000 *Acoustics - Recommended design sound levels and reverberation times for building interiors.*

Australian Standard 2107-2000 *Acoustics - Recommended design sound levels and reverberation times for building interiors* (AS2107) provides recommendations for acceptable internal noise levels. Table 1 shows the recommended internal noise levels stated in AS2107 for "houses and apartments near major roads."

Table 1: AS2107 recommended internal noise levels, dB L_{Aeq}

Area	Recommended internal noise level	
	Satisfactory	Maximum
Living areas	35	45
Sleeping areas	30	40
Work/utility areas	35	45
Apartment common areas (e.g.; lobbies)	45	55

Compliance with the "satisfactory" level is preferred, but compliance with the "maximum" noise level is acceptable.

Australian Standard 3671-1989 *Acoustics – Road traffic noise intrusion* (AS3617) provides recommended minimum façade constructions based on measured road traffic noise levels. Four categories of construction, determined by the amount of traffic noise reduction (TNR) expected, are identified. Table 2 details the AS3671 construction categories:

Table 2: AS3671 construction categories

Category	Description	Expected TNR – dB (A)
1	Standard construction; openings, including open windows and doors may comprise up to 10% of the exposed façade.	10
2	Standard construction, except for lightweight elements such as fibrous cement, metal cladding or all-glass façades. Windows, doors and other openings must be closed.	25
3	Special construction, windows, doors and other openings must be closed.	25-35
4	Specialist acoustic advice should be sought	>35

3.2 Railway noise

The *Victorian Passenger Rail Infrastructure Noise Policy* was released in April 2013. Section 5 of the policy sets out the conditions under which transport bodies must apply the policy.

The policy sets 'investigation thresholds' for the assessment of noise. These are noise levels, which if exceeded, indicate that noise mitigation should be considered. It states that:

> *In considering changing land use near an existing passenger rail corridor, transport bodies and planning authorities should consider the receivers set out in Table B in Attachment 2. Transport bodies and planning authorities should consider whether the noise level produced at these receivers will exceed the investigation thresholds for the periods specified in Table B in Attachment 2.* [Table B of Attachment 2 is reproduced below as Table 3 in this report.]

If an assessment shows the investigation thresholds are not exceeded, noise impacts should be considered a secondary matter. This means no further action need be considered under this policy.

The investigation thresholds are defined in terms of:

- $L_{Aeq,16h}$ – equivalent continuous daytime (0600-2200) noise level
- $L_{Aeq,8h}$ – equivalent continuous night-time (2200-0600) noise level
- L_{Amax} – maximum noise level.

Investigation thresholds for the redevelopment of land near existing rail infrastructure are presented in Table 3.

Table 3: Investigation thresholds for changing allowable land use near an existing rail corridor

Time	Type of receiver	Investigation thresholds		
Daytime (0600-2200)	Residential dwellings including aged person homes, hospitals, motels, caravan parks, and other buildings where people sleep. Noise sensitive community buildings including schools, kindergartens, libraries	65dB $L_{Aeq,16h}$	or	85dB L_{Amax}
Night-time (2200-0600)	Residential dwellings including aged person homes, hospitals, motels, caravan parks, and other buildings where people sleep.	60dB $L_{Aeq,8h}$	or	85dB L_{Amax}

The investigation thresholds are not design criteria. However, should the investigation thresholds be exceeded, then the following internal design criteria are recommended for residences adjacent to the Geelong/Warrnambool railway:

- Bedrooms: 55dB L_{Amax}
- Other living areas: 60dB L_{Amax}

These limits are based on a precedent set in the Victorian Civil and Administrative Tribunal (VCAT) regarding acceptable internal noise levels for residences adjacent to railway lines (Reference No. P2470/2003). In this case, a decision to grant a permit was made on the basis that the noise level of trains was not to exceed 55dB L_{Amax} in bedrooms and 60dB L_{Amax} in living areas. These levels were based on the commonly-used criteria for sleep disturbance taken from a document entitled *NSW Road Noise Policy* which was published in 2011 by the NSW Department of Environment, Climate Change and Water (DECCW - now known as the NSW Office of Environment and Heritage).

The NSW document included a comparison between several sleep disturbance criteria and concluded the following:

- Maximum internal noise levels below 50-55dB L_{Amax} are unlikely to cause awakening reactions
- One or two noise events per night, with maximum internal noise levels of 65-70dB L_{Amax} are not likely to affect health and wellbeing significantly.

Since 2003, there have been two VCAT decisions which have recommended an internal noise limit of 50dB L_{Amax} in bedrooms. However, there is no compelling case for the lower criterion as the decisions were not based on objective evidence presented to the Tribunal and are, in our opinion, unnecessarily restrictive. 55dB L_{Amax} is very close to the threshold of onset for noise-related sleep disturbance, and there is almost no significant difference (<1%) in reported levels of sleep disturbance between 55dB L_{Amax} and 50dB L_{Amax}.

This criteria (55dB L_{Amax}) has now been accepted by Public Transport Victoria (PTV) in a letter dated 18 October 2012, in relation to a residential development in Braybrook. Further details can be provided if requested.

4.0 NOISE MEASUREMENTS

Noise levels were measured using four Rion NL-31 precision integrating sound level meters fitted with weatherproof windshields. The microphones were mounted on poles at a height of 1.5m above local ground level. Measurement locations are shown in Appendix C.

Measurements were obtained using the 'F' response time and A-weighting frequency network. The equipment was calibrated before and after the survey using a Rion NC-74 sound calibrator to generate a calibration level of 94.0 dB at 1 kHz. No significant calibration drifts were observed.

Consecutive measurements of $L_{Amax, F}$, $L_{Aeq, T}$, $L_{A10, T}$, $L_{A90, T}$ and $L_{Amin, F}$ noise levels were obtained between 1100 hrs on Monday 24 June 2013 and 1215 hrs on Friday 28 June 2013.

There was a power failure at the noise monitor installed to the Geelong Ring Road side of the site on Tuesday 25 June 2013; however there is sufficient data available prior to this time in order to provide an indication of the noise exposure at this location.

4.1 Road traffic noise – Geelong Ring Road

Traffic noise monitoring was conducted in accordance with Appendix C of VicRoads Road Design Note RDN 06-01 *Interpretation and Application of VicRoads Traffic Noise Reduction Policy 2005*.

The noise monitor was located at approximately 60m from the edge of the Geelong Ring Road kerb at the west end of the site under freefield conditions. The current concept plan shows that the boundary of the nearest proposed buildings are approximately 35m from the road. Therefore, the measured levels require a distance correction in order to be indicative of the noise that would be experienced at the facade of the new dwellings under existing conditions. The measurement location is shown in Appendix C.

The prevailing noise environment when MDA consultants returned to site to collect the monitor was noted to be dominated by traffic on Geelong Ring Road.

The measured noise levels for comparison to the Vicroads criteria are presented in Table 4 and data for comparison with AS2107 are presented in Table 6. A photograph of the noise monitor in situ is presented as Figure 1.

Figure 1: Noise monitor at the west of the Hams Road site

Table 4: Measured noise levels at the west of the Hams Road site

	Measured noise level dB $L_{A10, 18hr}$
Monday, 24 June 2013	50
Tuesday, 25 June 2013	-*
Wednesday, 26 June 2013	-*
Thursday, 27 June 2013	-*
Friday, 28 June 2013	-*

* - Power failure at the noise monitor

4.2 Road traffic noise – Hams Road

The noise monitor was located at approximately 350m from the edge of the Geelong Ring Road kerb at the north end of the site under freefield conditions. The measurement location was approximately equidistant from Geelong Ring Road to the east and Ghazeepore Road to the west and is shown in Appendix C.

The prevailing noise environment when MDA consultants returned to site to collect the monitor was noted to be dominated by traffic on Geelong Ring Road.

The measured noise levels are presented in Table 6. A photograph of the noise monitor in situ is presented as Figure 2.

Figure 2: Noise monitor at the north of the Hams Road site

4.3 Road traffic noise – Ghazeepore Road

The noise monitor was located at approximately 9m from the edge of the Ghazeepore Road kerb at the east end of the site under freefield conditions. The measurement location is shown in Appendix C.

The prevailing noise environment when MDA consultants returned to site to collect the monitor was noted to be dominated by traffic on Ghazeepore Road and the Powercor Waurn Ponds Terminal Station.

The measured noise levels for comparison to the Vicroads criteria are presented in Table 5 and data for comparison with AS2107 are presented in Table 6. A photograph of the noise monitor in situ is presented as Figure 3.

Table 5: Measured noise levels at the east of the Hams Road site

	Measured noise level
	dB $L_{A10, 18hr}$
Monday, 24 June 2013	-*
Tuesday, 25 June 2013	63
Wednesday, 26 June 2013	64
Thursday, 27 June 2013	63
Friday, 28 June 2013	-*
Average	63

* - Incomplete period

Figure 3: Noise monitor at the east of the Hams Road site

Table 6: Measured noise levels at subject site, dB L_{Aeq}

	Highest Day dB $L_{Aeq,1h}$			Highest Night dB $L_{Aeq,1h}$		
	Geelong Ring Road	Hams Road	Ghazeepore Road	Geelong Ring Road	Hams Road	Ghazeepore Road
Monday, 24 June 2013	50	52	65	45	49	60
Tuesday, 25 June 2013	-*	54	67	-*	54	61
Wednesday, 26 June 2013	-*	56	67	-*	52	60
Thursday, 27 June 2013	-*	59	66	-*	53	60
Friday, 28 June 2013	-*	57	66	-*	-	-
Average	50	56	66	45	52	61

* - Power failure at the noise monitor

4.4 Railway noise

Noise from trains on the Geelong/Warrnambool railway line was measured on the southern site boundary of the Hams Road site.

The prevailing noise environment when MDA consultants returned to site to collect the monitor was noted to be dominated by traffic on Ghazeepore Road and Geelong Ring Road.

The noise monitor was located at approximately 30m from the centreline of the track under freefield conditions. The current concept plan shows that the boundary of the nearest proposed buildings are approximately 30m from the railway. Therefore, the measured levels are considered to be indicative of the noise that would be experienced at the facade of the new dwellings under existing conditions.

The measured noise levels are presented in Table 7. A photograph of the noise monitor in situ is presented as Figure 4.

Figure 4: Noise monitor at the south of the Hams Road site

Table 7: Measured noise levels at the south of the Hams Road site

	Highest Day		Highest Night	
	dB $L_{Aeq,1h}$	dB $L_{Amax,F}$	dB $L_{Aeq,1h}$	dB $L_{Amax,F}$
Monday, 24 June 2013	61	92	45	63
Tuesday, 25 June 2013	68	105*	52	64
Wednesday, 26 June 2013	63	93	49	63
Thursday, 27 June 2013	65	96	47	61
Friday, 28 June 2013	63	92	-	-
Average	64	96	49	63

* - This measurement is not considered to be representative of a typical train pass-by and therefore has not been included in the assessment

4.5 Weather conditions

Weather conditions throughout the survey period have been taken from Bureau of Metrology (BOM) observations performed at Geelong Racecourse, which is located approximately 9km from the subject site. Data measured at times when the weather conditions did not comply with the criteria set out in VicRoads Road Design Note RDN 06-01 have been discarded.

Weather data are presented in Appendix D.

5.0 FUTURE TRAFFIC FLOWS

It is customary when designing road traffic noise mitigation to consider the impact of traffic growth for 10 years following the date of this report.

5.1 Geelong Ring Road

According to data available on VicRoads' website, traffic volumes on this section of Geelong Ring Road (formerly Anglesea Road) increased by an average of 5% per annum between 2002 and 2012. If this level of traffic increase was to continue, then the traffic noise level in 2023 is predicted to be 2dB higher than at present.

Therefore, 52dB $L_{A10,\ 18hr}$ and 52dB $L_{Aeq,\ 1hr}$ have been taken as the future daytime external noise levels at this location and 47dB $L_{Aeq,\ 1hr}$ has been taken for the night.

5.2 Hams Road

Vicroads does not provide data for Hams Road. It is a local road serving dwellings on the surrounding roads and it has been assumed, due to the areas potential for redevelopment that road traffic noise will increase by an average of 5% per annum over the next 10 years. In which case the traffic noise level in 2023 is predicted to be 2dB higher than at present.

Therefore 58dB $L_{Aeq,\ 1hr}$ has been taken as the future daytime external noise levels at this location and 54dB $L_{Aeq,\ 1hr}$ has been taken for the night.

5.3 Ghazeepore Road

Vicroads does not provide data for Ghazeepore Road. It is a local road serving dwellings on the surrounding roads and it has been assumed, due to the areas potential for redevelopment that road traffic noise will increase by an average of 5% per annum over the next 10 years. In which case the traffic noise level in 2023 is predicted to be 2dB higher than at present.

Therefore, 65dB $L_{A10,\ 18hr}$ and 68dB $L_{Aeq,\ 1hr}$ have been taken as the future daytime external noise levels at this location and 63dB $L_{Aeq,\ 1hr}$ has been taken for the night.

6.0 RECOMMENDATIONS

Based on compliance with the recommended criteria, the following noise mitigation measures are proposed.

6.1 Road traffic noise – Geelong Ring Road

From the concept plan, it is estimated that the nearest boundary of future dwellings at the eastern end of the site will be 30m from the near side of Geelong Ring Road. The building façades will be set back from the boundary, however, the exact setback distance is unknown at this stage and therefore the assessment has been undertaken at the boundary. The measured noise levels have therefore been distance corrected in order to be representative of the likely noise exposure of a building located 30m from the road. The distance correction has added 4.7dB to the measured levels.

6.1.1 Vicroads Policy

Noise levels due to road traffic at the nearest building façade to Geelong Ring Road are likely to be in the region of 57dB $L_{A10,\ 18hr}$. This is below the Vicroads policy noise level detailed in Section 3.1 and it is considered therefore that no special treatment is required to the Geelong Ring Road boundary of the site.

6.1.2 AS2107

Noise levels due to road traffic are likely to be in the region of 57dB $L_{Aeq,\ 1hr}$ during the daytime and 51dB $L_{Aeq,\ 1hr}$ during the night. Dwellings at this location are considered to be Category 2 according to AS3671.

It is considered therefore that no special treatment, other than to construct the dwellings according to Category 2 of AS3671, is required to residences facing Geelong Ring Road in order to meet the internal noise level criteria of AS2107.

6.2 Road traffic noise – Hams Road

From the concept plan, it is estimated that the boundary of future dwellings at the northern end of the site will be adjacent to the kerb of Hams Road. The building façades will be set back from the boundary, however, the exact setback distance is unknown at this stage and therefore the assessment has been undertaken at the boundary. The measured noise levels have been taken as being representative of the likely noise exposure of a building located next to the road.

Measured noise levels corrected for future traffic growth are 58dB $L_{Aeq,\ 1hr}$ for the daytime and 54dB $L_{Aeq,\ 1hr}$ for the night. Dwellings at this location are considered to be Category 2 according to AS3671.

It is considered therefore that no special treatment, other than to construct the dwellings according to Category 2 of AS3671, is required to residences facing Hams Road in order to meet the internal noise level criteria of AS2107.

6.3 Road traffic noise – Ghazeepore Road

From the concept plan, it is estimated that the boundary of future dwellings at the eastern end of the site will be adjacent to the kerb of Ghazeepore Road. The building façades will be set back from the boundary, however, the exact setback distance is unknown at this stage and therefore the assessment has been undertaken at the boundary. The measured noise levels have been taken as being representative of the likely noise exposure of a building located next to the road.

6.3.1 Vicroads Policy

Noise levels due to road traffic at the nearest building façade to Ghazeepore Road are likely to be in the region of 65dB $L_{A10,\ 18hr}$. This is above the Vicroads policy noise level detailed in Section 3.1 and it is considered therefore that special treatment is required to the Ghazeepore Road boundary of the site.

Vicroads policy applies at the ground floor of a property adjacent to a road, therefore it is considered that the construction of a solid fence of suitable construction, such as masonry or 18mm plywood, and height, approximately 2.4m high around the boundary of the properties adjacent to Ghazeepore Road should be sufficient in order to reduce noise levels to below the Vicroads policy.

Other barrier constructions are acceptable. Proposed barrier details should be reviewed by a suitably qualified acoustic engineer to ensure that it will provide sufficient noise attenuation as to achieve the external noise criteria detailed in Section 3.1.

6.3.2 AS2107

Measured noise levels corrected for future traffic growth are 68dB $L_{Aeq,\ 1hr}$ for the daytime and 63dB $L_{Aeq,\ 1hr}$ for the night. Dwellings at this location are considered to be Category 3 according to AS3671.

It is considered therefore that special treatment is required in order to meet the internal noise level criteria of AS2107.

Details of the proposed dwelling constructions are not available at this stage. Treatment for the proposed dwellings is based on a typical two storey construction and is recommended for the north, south and east facing facades of dwellings adjacent to Ghazeepore Road:

- Construct buildings on the eastern boundary of the site from masonry, such as 110mm brick, with upgraded glazing, such as 10.38mm laminate single glazing or double glazing, to the north, south and east facades of dwellings adjacent to the road.
- Other constructions are acceptable. Proposed building details should be reviewed by a suitably qualified acoustic engineer to ensure that they provide sufficient noise insulation as to achieve the internal noise criteria detailed in Table 1.

6.4 Railway noise

6.4.1 Passenger services

Analysis of the timetable for the Geelong/Warrnambool line indicates that there are no scheduled passenger services during the night-time period on the section of line that passes the Hams Road site.

From the concept plan, it is estimated that the boundary of future dwellings at the southern end of the site will be 30m from the near side rail of the railway. The building façades will be set back from the boundary, however, the exact setback distance is unknown at this stage and therefore the assessment has been undertaken at the boundary. The measured noise levels have been taken as being representative of the likely noise exposure of a building located 30m from the near side rail.

The maximum noise level due to a passenger train pass-by has been measured as 98dB L_{Amax} during the daytime. This is above the investigation threshold of 85dB L_{Amax} shown in Table 3 and therefore railway noise mitigation is required along the southern site boundary.

Section 7 of the *Victorian Passenger Rail Infrastructure Noise Policy* gives two alternative paths of investigation regarding the mitigation of railway noise.

> *"1) Options that would avoid exposure to rail noise of the receivers (for example, places where people sleep) through the way land is used, for example:*
> *a) specifying the types of land use in proximity to rail infrastructure*
> *b) requiring set-back from the rail reserve*
> *c) encouraging the location of non-sensitive receivers (for example, commercial uses) in proximity to the rail corridor.*
>
> *2) Options that would reduce or mitigate the exposure to rail noise of the receivers through building and architectural treatments, for example:*
> *a) requiring developers to consider building orientation, placement on site and design of floor plans*
> *b) use of building materials including double-glazing that can help reduce or mitigate internal noise in a building.*
>
> *Note that options involving rail infrastructure design features are not applicable to a change in land use near an existing passenger rail corridor."*

Details of the proposed dwellings are not available at this stage. Therefore the following acoustic treatment is based on meeting the daytime internal noise criteria, as detailed in Section 3.2, for a typical two storey construction:

- Construct buildings on the southern boundary of the site from masonry, such as 110mm brick, with upgraded glazing, such as 10.38mm laminate single glazing or double glazing, to the south, east and west facades of dwellings adjacent to the railway.
- Orientate buildings such that noise sensitive areas, such as bedrooms and lounge rooms, do not have windows to the south facade of the building.

- Other constructions are acceptable. Proposed building details should be reviewed by a suitably qualified acoustic engineer to ensure that they provide sufficient noise insulation as to achieve the internal noise criteria detailed in Section 3.2.

6.4.2 Freight services

This section of track is part of the main interstate line from Melbourne to Adelaide and as such sees heavy freight traffic. Analysis of the timetable for the Geelong/Warrnambool line against the measured noise levels indicates that there could be up to three freight train pass-bys each day at present. The pass-bys appear to happen each day in the morning between approximately 0900 and 1100hrs and in the evenings between approximately 2030 and 2200hrs.

The *Victorian Passenger Rail Infrastructure Noise Policy* does not apply to freight services, and therefore the internal noise criteria detailed in Section 3.2 is considered to be applicable.

The maximum noise level due to a freight train pass-by has been measured as 93dB L_{Amax} during the daytime. It is considered that the recommendations for acoustic treatment to mitigate noise from passenger services, as discussed in Section 6.4.1 above, should be sufficient to mitigate noise from freight services.

7.0 CONCLUSION

Marshall Day Acoustics has measured road traffic and rail noise at the proposed development site at 35 Hams Road and 151-229 Anglesea Road, Waurn Ponds. Measured road traffic noise levels have been assessed according to the Vicroads requirements for developers.

Noise mitigation measures are required in order to meet Vicroads policy to properties adjacent to Ghazeepore Road. Furthermore, the facade and glazing of dwellings facing Ghazeepore Road will need to be upgraded, and reviewed by a suitably qualified acoustic consultant, in order to achieve the requirements of AS2107 for sleeping and living areas.

Measured rail noise levels have been assessed according to the *Victorian Passenger Rail Infrastructure Policy.* Existing maximum noise levels at the nearest proposed façades are likely to exceed the Policy threshold of 85dB L_{Amax} during the daytime.

Therefore specific acoustic treatments will required to future properties along the southern boundary of the development site in order to control railway noise. Such treatments will need to be selected in consultation with a suitably qualified acoustic engineer.

No specific acoustic treatment is required to dwelling facades facing Geelong Ring Road and Hams Road.

APPENDIX A GLOSSARY OF TERMINOLOGY

Decibels	There is a million to one ratio between the lowest to the highest tolerable sound pressure. Noise is therefore measured using a logarithmic scale, to account for this wide range, called the decibel (dB). Noise is defined as unwanted sound and the range of audible sound varies from around 0 dB to 140 dB
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
L_{A90}	This is the noise level exceeded for 90% of the measurement period and provides a measurement of the quieter 'lull' periods in between noise events. It is often referred to as the background noise level.
L_{A10}	The A-weighted noise level equalled or exceeded for 10% of the measurement period. This is commonly referred to as the average maximum noise level.
Octave Band	A range of frequencies where the highest frequency included is twice the lowest frequency. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.

APPENDIX B SITE DEVELOPMENT PLAN

APPENDIX C NOISE MONITORING LOCATIONS

APPENDIX D WEATHER DATA

Date/Time EST June	Temp °C	App Temp °C	Wind					Rain since 9 am mm
			Dir	Spd km/h	Gust km/h	Spd kts	Gust kts	
24/09:00am	6.8	5.5	SSW	2	2	1	1	0
24/09:30am	8.6	7.7	SSW	2	4	1	2	0
24/10:00am	9.6	8.6	SSW	4	7	2	4	0
24/10:30am	11.2	9.2	ESE	11	17	6	9	0
24/11:00am	12.1	10.1	E	11	22	6	12	0
24/11:30am	12.8	10.3	ESE	13	20	7	11	0
24/12:00pm	13.2	10.6	ESE	13	24	7	13	0
24/12:30pm	13.2	10.6	ESE	13	20	7	11	0
24/01:00pm	13.2	10.9	SE	11	19	6	10	0
24/01:30pm	13.5	10.9	SE	13	17	7	9	0
24/02:00pm	13.4	11.2	SE	11	17	6	9	0
24/02:30pm	13.8	11.1	ESE	13	24	7	13	0
24/03:00pm	13.8	10.6	ESE	15	28	8	15	0
24/03:30pm	13.5	11.1	ESE	11	17	6	9	0
24/04:00pm	13.2	11.3	SE	9	15	5	8	0
24/04:30pm	12.8	11.2	SE	7	11	4	6	0
24/05:00pm	12.2	10.8	ESE	6	9	3	5	0
24/05:30pm	11.4	10.4	SE	4	6	2	3	0
24/06:00pm	10.3	8.9	S	6	7	3	4	0
24/06:30pm	10	8.4	SSE	7	9	4	5	0
24/07:00pm	10.3	8.3	SE	9	13	5	7	0
24/07:30pm	9.9	8.3	SSE	6	9	3	5	0
24/08:00pm	9.8	8	SSE	7	11	4	6	0
24/08:30pm	8.8	7.1	S	6	7	3	4	0
24/09:00pm	10.2	8.2	SE	9	13	5	7	0
24/09:30pm	10.1	8.4	SE	7	9	4	5	0
24/10:00pm	10.6	9.1	SE	7	13	4	7	0
24/10:30pm	11	9.5	SE	7	15	4	8	0
24/11:00pm	10.8	9	SE	9	17	5	9	0
24/11:30pm	10.6	8.8	SE	9	13	5	7	0
25/12:00am	10.4	8.5	SSE	9	13	5	7	0
25/12:30am	10.5	8.7	SE	9	15	5	8	0
25/01:00am	9.9	8.3	SE	7	11	4	6	0
25/01:30am	9.8	8.3	SE	6	9	3	5	0
25/02:00am	9.9	7.9	SSE	9	11	5	6	0
25/02:30am	10	8.4	SSE	7	9	4	5	0
25/03:00am	10	8.1	SSE	9	13	5	7	0
25/03:30am	9.7	8.1	SSE	7	11	4	6	0
25/04:00am	9.9	8.3	SE	7	11	4	6	0
25/04:30am	9.8	8.4	SE	6	9	3	5	0
25/05:00am	10.1	8.5	SE	7	13	4	7	0
25/05:30am	9.9	8.3	SSE	7	13	4	7	0
25/06:00am	9.5	8	SSE	6	9	3	5	0
25/06:30am	9.2	7.6	SSE	6	7	3	4	0
25/07:00am	9.3	7.7	SSE	6	7	3	4	0
25/07:30am	9.4	7.8	SSE	6	9	3	5	0
25/08:00am	9.9	7.9	SSE	9	11	5	6	0
25/08:30am	10.3	8.8	SSE	7	11	4	6	0
25/09:00am	11.3	9.9	SE	7	11	4	6	0
25/09:30am	12.3	10.4	ESE	9	17	5	9	0
25/10:00am	12.6	9.7	ESE	13	22	7	12	0
25/10:30am	13.1	9.8	ESE	15	24	8	13	0
25/11:00am	13.4	9.5	ESE	17	26	9	14	0
25/11:30am	13.8	10.2	ESE	15	28	8	15	0
25/12:00pm	14.4	10.6	ESE	15	26	8	14	0
25/12:30pm	14.1	9.9	ESE	17	32	9	17	0
25/01:00pm	14.5	10.8	ESE	15	30	8	16	0
25/01:30pm	14.3	10.2	SE	17	28	9	15	0
25/02:00pm	13.9	10.1	ESE	15	24	8	13	0
25/02:30pm	14.1	10.3	ESE	15	22	8	12	0
25/03:00pm	14.4	10.6	SE	15	22	8	12	0
25/03:30pm	14.2	10.4	SE	15	22	8	12	0

Date/Time EST June	Temp °C	App Temp °C	Wind					Rain since 9 am mm
			Dir	Spd km/h	Gust km/h	Spd kts	Gust kts	
25/04:00pm	13.7	10.3	SE	13	20	7	11	0
25/04:30pm	13.2	10.3	SE	11	17	6	9	0
25/05:00pm	12.4	9.8	SE	9	15	5	8	0
25/05:30pm	11.7	9.4	SE	9	15	5	8	0
25/06:00pm	11.1	8.7	SE	9	15	5	8	0
25/06:30pm	11.1	8.1	SE	11	17	6	9	0
25/07:00pm	10.5	8.4	SE	6	9	3	5	0
25/07:30pm	10.1	8	SSE	6	9	3	5	0
25/08:00pm	9.4	7.3	SSE	6	9	3	5	0
25/08:30pm	9.6	7.6	SSE	6	9	3	5	0
25/09:00pm	10.4	8.3	ESE	7	15	4	8	0
25/09:30pm	10.4	8	ESE	9	19	5	10	0
25/10:00pm	10.6	8.2	ESE	9	15	5	8	0
25/10:30pm	10.2	8.4	ESE	6	11	3	6	0
25/11:00pm	9.8	8	ESE	7	17	4	9	0
25/11:30pm	9.1	7.9	E	4	7	2	4	0
26/12:00am	8.6	7.6	E	2	6	1	3	0
26/12:30am	8.3	7.3	E	2	6	1	3	0
26/01:00am	6.8	5.8	CALM	0	0	0	0	0
26/01:30am	6	4.9	CALM	0	0	0	0	0
26/02:00am	5.8	4.6	CALM	0	0	0	0	0
26/02:30am	5.3	4	CALM	0	0	0	0	0
26/03:00am	5	3.3	NNW	2	4	1	2	0
26/03:30am	5.6	3.3	NNW	6	7	3	4	0
26/04:00am	4.8	2.7	NW	4	7	2	4	0
26/04:30am	4.1	2.3	WNW	2	4	1	2	0
26/05:00am	4.2	2	WNW	4	6	2	3	0
26/05:30am	4.3	2.1	WNW	4	4	2	2	0
26/06:00am	4.4	2.2	WNW	4	4	2	2	0
26/06:30am	3.5	1.6	WNW	2	4	1	2	0.2
26/07:00am	3.5	1.2	WNW	4	4	2	2	0.2
26/07:30am	3.3	1.3	WNW	2	4	1	2	0.2
26/08:00am	3.6	1.7	NW	2	4	1	2	0.2
26/08:30am	3.3	1.3	NW	2	4	1	2	0.2
26/09:00am	4.9	3.2	WNW	2	4	1	2	0.2
26/09:30am	6.7	4	NW	9	13	5	7	0
26/10:00am	7.9	5.8	NNW	7	9	4	5	0
26/10:30am	9.2	7.3	NW	6	7	3	4	0
26/11:00am	10.6	8.8	WNW	6	7	3	4	0
26/11:30am	11.6	9.7	NNW	6	9	3	5	0
26/12:00pm	12.6	10.7	NNW	6	9	3	5	0
26/12:30pm	12.9	10.9	N	7	11	4	6	0
26/01:00pm	14.3	12.9	NW	4	9	2	5	0
26/01:30pm	13.9	12.4	N	6	9	3	5	0
26/02:00pm	13.5	11.9	NNE	6	7	3	4	0
26/02:30pm	14	12.3	NNE	7	9	4	5	0
26/03:00pm	14.3	12.7	NNE	6	7	3	4	0
26/03:30pm	14.5	13.2	NNE	4	7	2	4	0
26/04:00pm	14	12.4	NNE	6	7	3	4	0
26/04:30pm	13.4	12.1	NNE	4	6	2	3	0
26/05:00pm	12.5	11.9	CALM	0	0	0	0	0
26/05:30pm	10.1	8.9	SSW	4	6	2	3	0
26/06:00pm	9.9	9.2	S	2	4	1	2	0
26/06:30pm	8.5	7.5	S	2	4	1	2	0
26/07:00pm	8.3	7.3	SSW	2	4	1	2	0
26/07:30pm	8.2	7.5	CALM	0	0	0	0	0
26/08:00pm	7.5	6.7	CALM	0	0	0	0	0
26/08:30pm	6.6	5.6	CALM	0	4	0	2	0
26/09:00pm	6	4.9	CALM	0	0	0	0	0
26/09:30pm	5.7	4.5	CALM	0	0	0	0	0
26/10:00pm	5.2	3.6	WNW	2	6	1	3	0
26/10:30pm	5.3	3.3	WNW	4	6	2	3	0
26/11:00pm	5.8	3.5	NNW	6	6	3	3	0
26/11:30pm	5.5	3.5	WNW	4	6	2	3	0

Date/Time EST June	Temp °C	App Temp °C	Wind					Rain since 9 am mm
			Dir	Spd km/h	Gust km/h	Spd kts	Gust kts	
27/12:00am	5	2.9	WNW	4	6	2	3	0
27/12:30am	5	2.9	WNW	4	4	2	2	0
27/01:00am	4.5	2.7	WNW	2	4	1	2	0
27/01:30am	3.6	1.3	WNW	4	6	2	3	0
27/02:00am	3.7	1.4	N	4	6	2	3	0
27/02:30am	3.6	1.7	NW	2	6	1	3	0
27/03:00am	4.3	1.7	N	6	9	3	5	0
27/03:30am	3.5	1.9	CALM	0	0	0	0	0
27/04:00am	2.7	1	CALM	0	0	0	0	0
27/04:30am	2.4	0.6	CALM	0	0	0	0	0
27/05:00am	2.3	0.2	N	2	4	1	2	0
27/05:30am	2.9	0.1	NNW	6	7	3	4	0
27/06:00am	4.2	1	N	9	11	5	6	0
27/06:30am	3.7	1.4	N	4	6	2	3	0
27/07:00am	4.2	1.6	N	6	7	3	4	0
27/07:30am	3.7	1	NW	6	7	3	4	0
27/08:00am	4.5	2.3	NNW	4	6	2	3	0
27/08:30am	5	3.3	NNW	2	6	1	3	0
27/09:00am	5.8	4.3	NNW	2	2	1	1	0
27/09:30am	6.5	5.5	CALM	0	0	0	0	0
27/10:00am	7.6	6.8	CALM	0	0	0	0	0
27/10:30am	8.8	7.6	N	2	4	1	2	0
27/11:00am	10	8	N	6	9	3	5	0
27/11:30am	12.1	10.1	NE	7	11	4	6	0
27/12:00pm	12.4	10.6	NE	6	7	3	4	0
27/12:30pm	13.7	11.9	NNE	7	9	4	5	0
27/01:00pm	14.4	12.6	NE	7	11	4	6	0
27/01:30pm	14.9	12.7	NE	9	13	5	7	0
27/02:00pm	15.7	14	NE	7	9	4	5	0
27/02:30pm	15.1	13.3	ENE	7	13	4	7	0
27/03:00pm	15.8	13.5	ENE	9	15	5	8	0
27/03:30pm	15.5	12.8	ENE	11	15	6	8	0
27/04:00pm	15.6	13.6	ENE	7	11	4	6	0
27/04:30pm	15.3	13.5	NE	6	9	3	5	0
27/05:00pm	14.4	12.6	NE	6	7	3	4	0
27/05:30pm	12.4	11.8	CALM	0	0	0	0	0
27/06:00pm	11.4	11	CALM	0	0	0	0	0
27/06:30pm	11.1	10.6	CALM	0	7	0	4	0
27/07:00pm	9.4	8.4	NNE	2	2	1	1	0
27/07:30pm	9.3	8.5	N	2	4	1	2	0
27/08:00pm	8.7	7	NW	6	6	3	3	0
27/08:30pm	7.9	7.1	CALM	0	0	0	0	0
27/09:00pm	8.6	6.9	N	4	4	2	2	0
27/09:30pm	9.5	7.5	NW	6	7	3	4	0
27/10:00pm	9.6	7.6	NW	6	9	3	5	0
27/10:30pm	9.4	7.3	NW	6	7	3	4	0
27/11:00pm	9.3	7.1	NNW	6	9	3	5	0
27/11:30pm	9	6.8	WNW	6	7	3	4	0
28/12:00am	8	6.6	WNW	2	4	1	2	0
28/12:30am	6.6	5.6	CALM	0	0	0	0	0
28/01:00am	6.9	4.8	NW	6	7	3	4	0
28/01:30am	5.5	3.5	W	4	4	2	2	0
28/02:00am	5.6	3.6	NNW	4	4	2	2	0
28/02:30am	4.8	3.1	NNW	2	4	1	2	0
28/03:00am	5.3	2.9	NW	6	7	3	4	0
28/03:30am	5.5	3.5	NW	4	4	2	2	0
28/04:00am	4.8	3.1	N	2	4	1	2	0
28/04:30am	4.1	1.9	N	4	4	2	2	0
28/05:00am	4	1.4	NW	6	7	3	4	0
28/05:30am	3.8	1.5	NW	4	6	2	3	0
28/06:00am	4	2.1	NW	2	4	1	2	0
28/06:30am	3.9	1.6	WNW	4	6	2	3	0
28/07:00am	4.1	1.9	NNW	4	4	2	2	0
28/07:30am	4.1	2.3	N	2	6	1	3	0

Date/Time EST June	Temp °C	App Temp °C	Wind					Rain since 9 am mm
			Dir	Spd km/h	Gust km/h	Spd kts	Gust kts	
28/08:00am	4.1	2.3	NNE	2	6	1	3	0
28/08:30am	5.4	3.4	WNW	4	7	2	4	0
28/09:00am	7	5.7	NNW	2	4	1	2	0
28/09:30am	8.3	6.5	WNW	6	7	3	4	0
28/10:00am	8.8	8.2	CALM	0	2	0	1	0
28/10:30am	11.6	10.6	WNW	4	6	2	3	0
28/11:00am	13.4	12.6	NW	4	6	2	3	0
28/11:30am	15.3	15.5	N	2	4	1	2	0
28/12:00pm	16	15.6	NNE	4	6	2	3	0
28/12:30pm	15.7	14.9	NNE	6	9	3	5	0
28/01:00pm	15.5	14.5	NNE	6	7	3	4	0
28/01:30pm	16	15.1	NE	4	7	2	4	0
28/02:00pm	15.8	14.4	NNE	6	7	3	4	0
28/02:30pm	17.4	16.6	WNW	4	4	2	2	0
28/03:00pm	15.7	14.4	SSE	6	9	3	5	0
28/03:30pm	15.7	14.4	S	7	9	4	5	0
28/04:00pm	15.4	14.2	SE	6	7	3	4	0