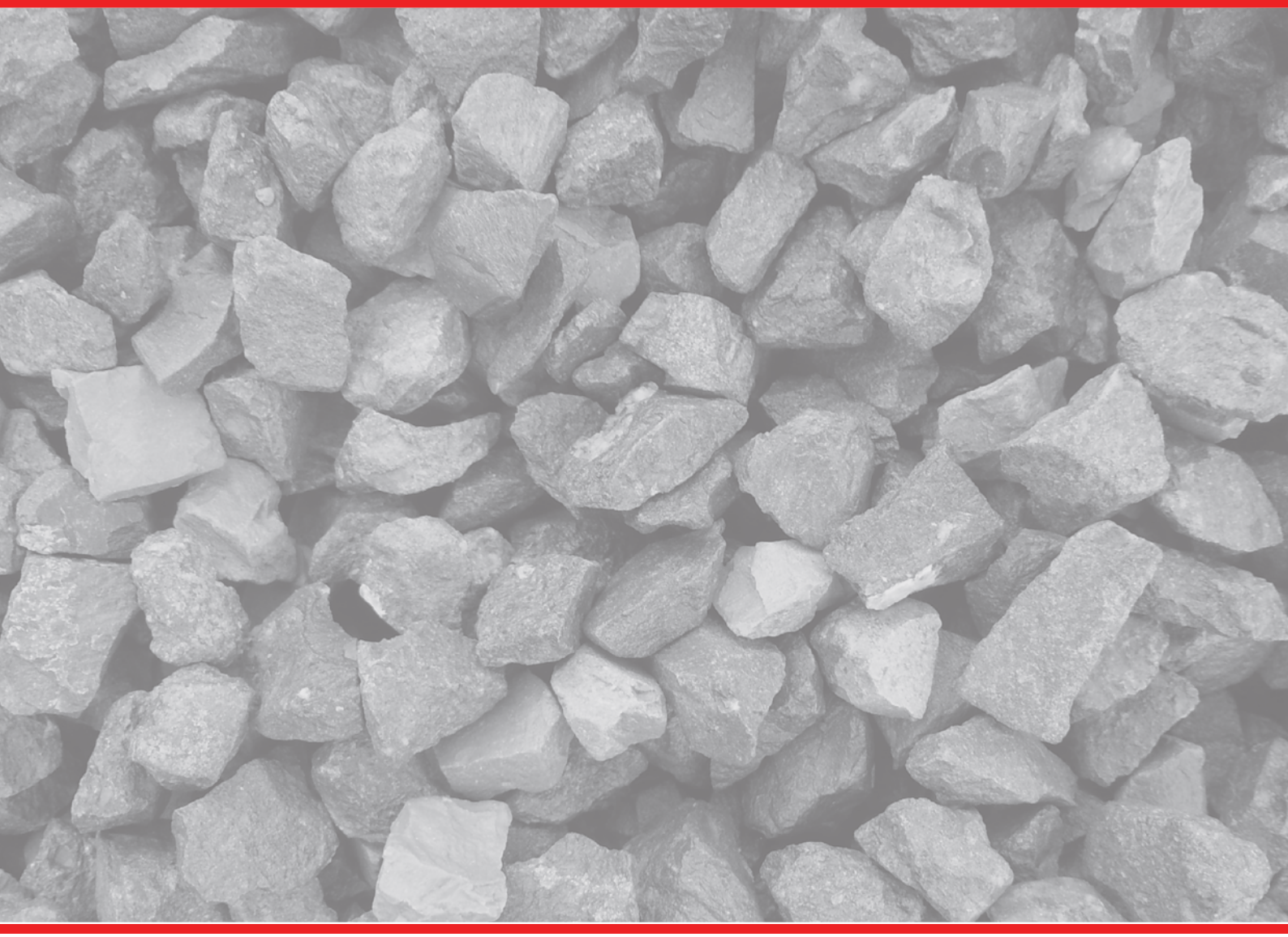
Appendix C

Noise and Blasting Impact Assessment



global environmental solutions

Jandra Quarry Intensification Project

Operation and Transportation Noise and Blasting Impact Assessment

Report Number 610.13023-R2

30 June 2014

Element Environment Pty Ltd
PO Box 1563
Warriewood NSW 2102

Version: Revision 1

Jandra Quarry Intensification Project

Operation and Transportation

Noise and Blasting Impact Assessment

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610.13023-R2	Revision 1	30 June 2014	Dianne Williams	Ryan Wakeling and Mark Blake	Dianne Williams

Executive Summary

SLR Consulting Australia Pty Ltd (SLR) was commissioned by Element Environment Pty Ltd on behalf of Holcim (Australia) Pty Ltd, to undertake a Noise and Blasting Impact Assessment (NBIA) for the proposed Jandra Quarry Intensification Project.

Holcim is seeking to modify the development consent to provide for the production and transportation of a maximum of 475,000 tonnes of finished quarry products per calendar year, with an approval period of 30 years.

The proposed changes to the approved operations that have the potential to result in noise and vibration impacts include:

- Extension of operating hours to include weekday evenings (6:00 am to 10:00 pm Monday to Friday) and from 6:00 am to 6:00 pm Saturday, including the return of trucks from Newcastle haul to midnight. Refuelling, servicing and maintenance will also be extended from 9:00 pm to 10:00 pm on Saturdays.

- Asphalt plant operating hours to allow for production on a 24 hour campaign basis.

- Addition of a mobile crusher to increase processing capacity.

- Increasing blasting frequency from approximately one blast per month to approximately two blasts per month.

- Construction of a new heavy vehicle access road to separate inbound heavy vehicles from outbound heavy and light vehicles.

- Expansion of the finished product stockpile area.

The nearest and potentially most affected noise sensitive receptor locations have been identified. Holcim owned residences are located within and immediately south of the development consent boundary. The closest private residence (R1) is located approximately 500 m north of the eastern most extent of the quarry extraction area and primary processing area and approximately 350 m north east of the overburden emplacement area.

Site visits, attended and unattended noise monitoring was conducted by SLR in order to quantify the existing acoustical environment at receptor locations and to measure noise from items of plant and equipment currently operated at the quarry.

Local meteorological conditions have been analysed and it has been determined that that the area is subject to noise enhancing conditions (light winds and temperature inversions). These conditions have been taken into consideration for quarry operations during the night-time period.

Data obtained during the background noise survey has been used to calculate environmental limits for noise from quarry operations in accordance with the NSW *Industrial Noise Policy* (INP) and for sleep disturbance.

Noise monitoring undertaken at a residence 40 m from the Pacific Highway (R3) has been used to quantify existing road traffic noise levels.

Executive Summary

A 3-D computer noise model has been prepared for each of the three proposed stages of the quarry's life, with the scenarios modelled to reflect 'worst case' operations and associated noise impacts at residential receptor locations. The model inputs include the local topography; sound power levels of quarry plant and equipment; ground contour information for future stages of the quarry's life as provided by Holcim and meteorological information.

One residential receptor location has been identified as being particularly susceptible to operational noise impacts from the proposed changes. No. 15418 Pacific Highway (R1) has a line of sight to both the asphalt plant and to upper eastern and southern benches of the quarry. An additional two receptors (R2, 112 Spicers Road and R6, 1677 The Lakes Way), to the east of the quarry, are predicted to be exposed to noise levels marginally (2 dBA) above the day time/evening criteria, when quarry activities are undertaken above RL 74, during Stage 3 of the quarry life. Marginal noise level increases of 1 dBA to 2 dBA are not noticeable by most people. Holcim will pursue negotiated agreements with all three property holders (R1, R2 and R6) regarding noise levels they will experience from the proposed intensification in production.

During the early morning shoulder period, when noise enhancing meteorological conditions can be expected and lower noise limits apply, levels of noise above the nominated criteria are predicted at a number of receptor locations. Recommendations have been provided in this report for managing the predicted noise levels by restricting operational activities during this time.

Additional controls to minimise noise and vibration impacts include:

- Use of broadband reversing beepers for all on site vehicles operated in the approved overburden emplacement area and on the upper southern and eastern benches during Stages 2 and 3.
- Reassignment of the on-site Holcim owned residence R10 to non-residential uses during Stage 2.

The increase in traffic noise associated with the proposed quarry intensification is predicted to be less than 2 dBA and in accordance with EPA guidelines, does not trigger the requirement for further investigation or controls.

Operational noise from the quarry is predicted to marginally exceed the INP sleep disturbance goals at two receptor locations, one private residence and one Holcim owned property. These levels will not occur at the private residence if the recommended operational restrictions for the early morning shoulder periods are implemented. The predicted levels at the Holcim owned property, while above the INP sleep disturbance goals, are well below the 60 to 65 dBA (external) sleep disturbance levels identified in the *Road Noise Policy*.

Guidance, in the form of recommended maximum instantaneous charges (MICs), has been provided for controlling airblast and ground vibration to residential receptor locations. It has also been recommended that all blasts are monitored at the closest / potentially most affected residence to establish compliance with the nominated criteria.

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1 INTRODUCTION

Element Environment commissioned SLR Consulting Australia Pty Ltd (SLR) to conduct a noise and blasting impact assessment for a proposed increase in production at Jandra Quarry operated by Holcim (Australia) Pty Ltd (Holcim).

This report presents the methodology, input data, assumptions and findings of a noise and vibration impact assessment performed for the proposed intensification in production.

1.1 Proposed Modification

Jandra Quarry is currently operating under development consent (DA231-10-99) with an approved extraction rate of 250,000 tonnes per calendar year. Holcim is seeking to modify the development consent to provide for the production and transportation of a maximum of 475,000 tonnes of finished quarry products per calendar year, with an approval period of 30 years (refer to the Environmental Assessment for a detailed description of the proposed modification).

The existing approved quarry pit design, as detailed in the 1999 EIS, has a depth limit of RL20 and (at the time) contained 16.5 million tonnes (Mt) of fresh rock. To date, Holcim has extracted and processed in the order of 3 Mt of this resource. It is not proposed to increase extraction of the overall resource and therefore no modification to the approved quarry pit disturbance area is proposed.

The proposed changes to the approved operations that have the potential to result in noise and vibration impacts include:

- Extension of operating hours to include weekday evenings (6:00 am to 10:00 pm Monday to Friday) and from 6:00 am to 6:00 pm Saturday, including the return of trucks from Newcastle haul to midnight. Refuelling, servicing and maintenance will also be extended from 9:00 pm to 10:00 pm on Saturdays.
- Asphalt plant operating hours to allow for production on a 24 hour campaign basis.
- Addition of a mobile crusher to increase processing capacity.
- Increasing blasting frequency from approximately one blast per month to approximately two blasts per month.
- Construction of a new heavy vehicle access road to separate inbound heavy vehicles from outbound heavy and light vehicles.
- Expansion of the finished product stockpile area.

No changes are proposed to the operating hours for drilling and blasting. These activities currently take place between 9:00 am and 5:00 pm Monday to Friday and 9:00 am to 3:00 pm Saturday. Blasting does not take place on public holidays.

Holcim has also revisited the four stage quarry development schedule presented in the EIS (ERM 1999) and have developed revised staging plans for extraction of the remaining resource over the next 30 years. Stage 1 involves expanding the quarry to the western extent of the approved extraction area and developing a new 15 metre high bench to increase the quarry depth to RL35. Stage 2 involves developing a final 15 metre high bench in the western section of the quarry to increase the quarry depth to the approval limit of RL20. This stage also includes the extension of the pit eastwards to a depth of RL35. Stage 3 involves expanding the quarry to the eastern extent of the approved extraction area and increasing the quarry depth to the approval limit of RL20. The site layouts for each stage are presented in **Figure 1**, **Figure 2** and **Figure 3**, respectively.

1.2 Noise Complaints Summary

The Environment Manager at Holcim reported that no environmental complaints relating to noise and blasting emissions at the Jandra Quarry were received during the period 1999 to 2014.

Figure 1 Site Layout – Stage 1

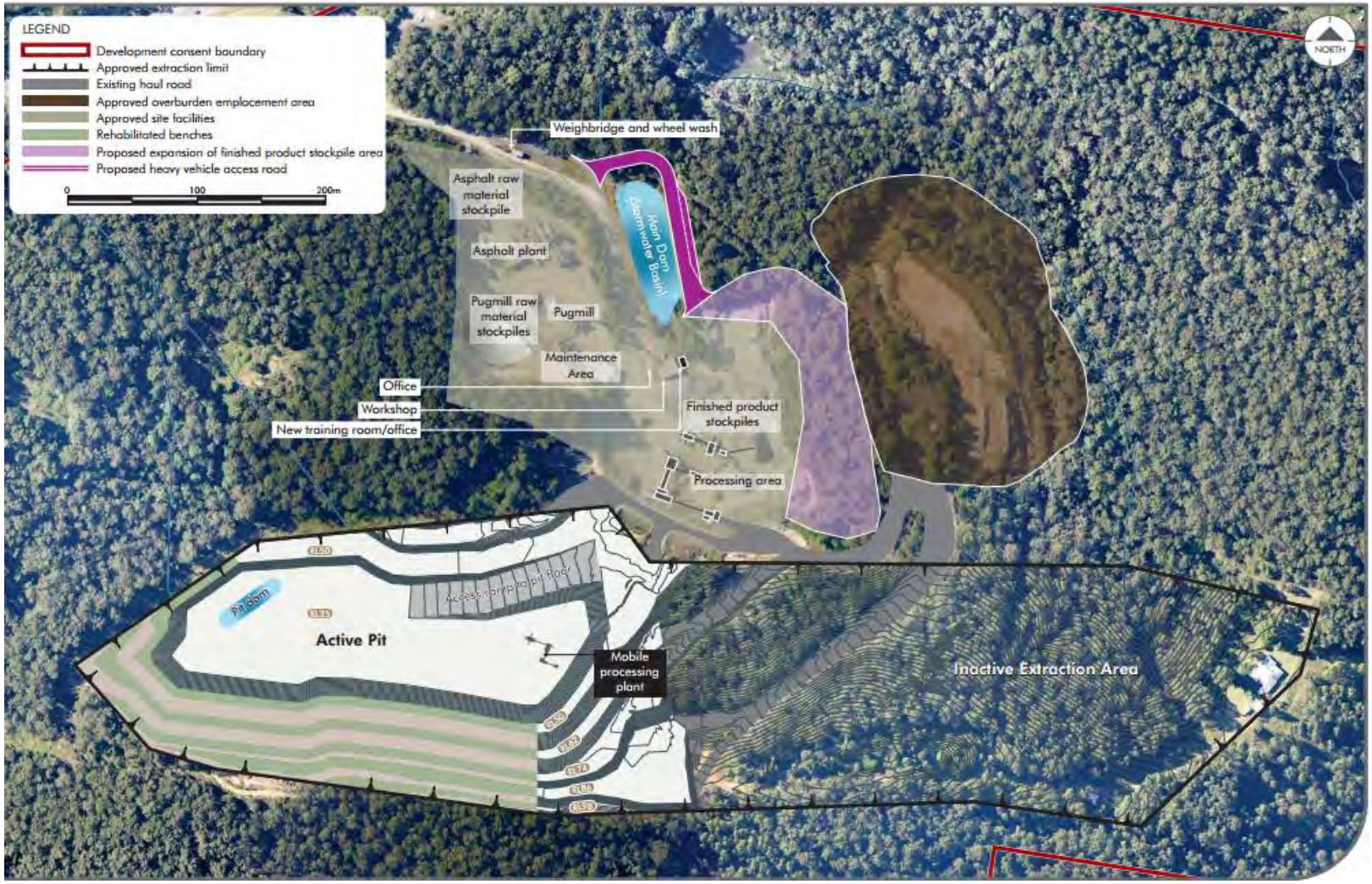


Figure 2 Site Layout – Stage 2

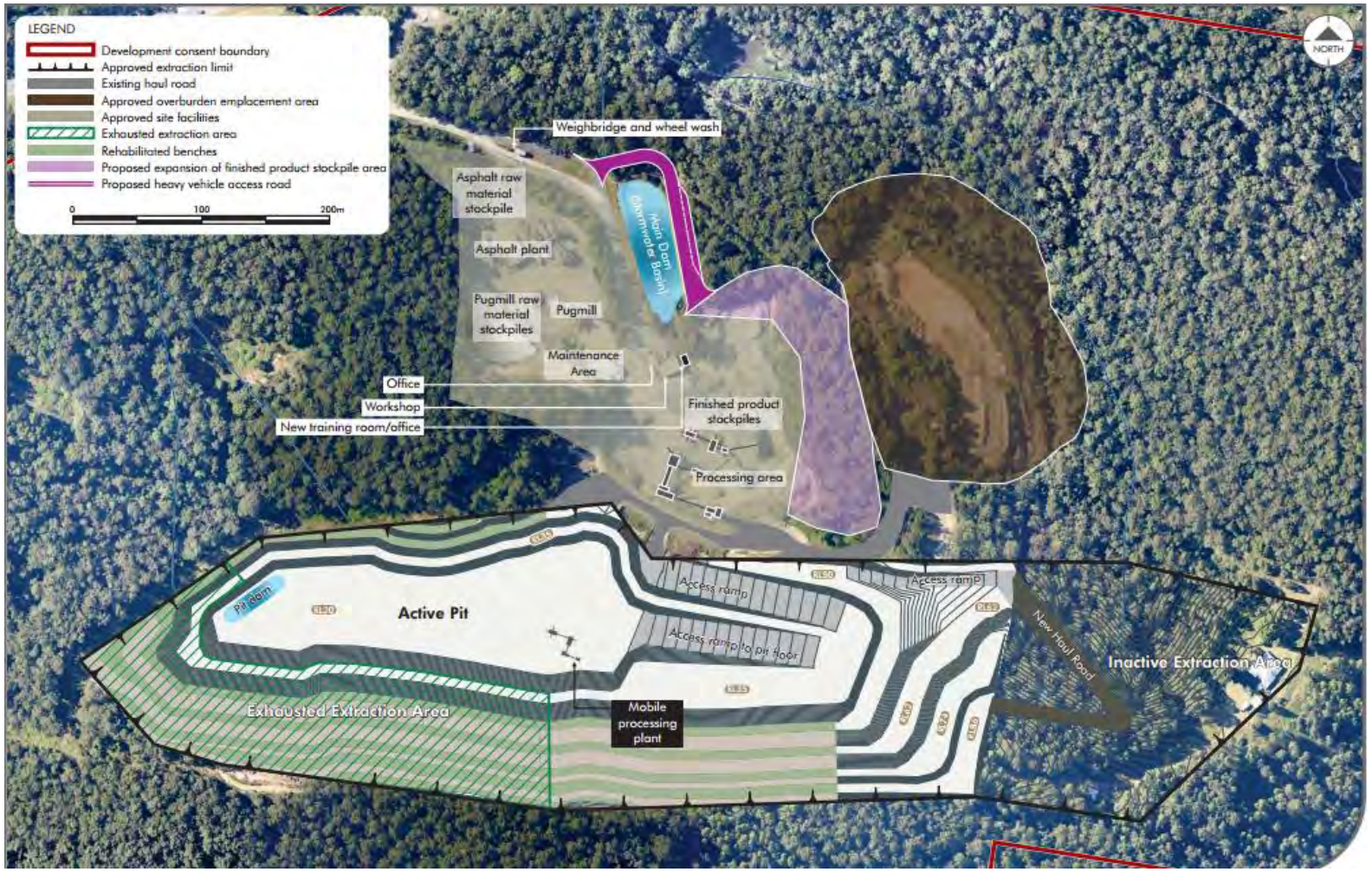
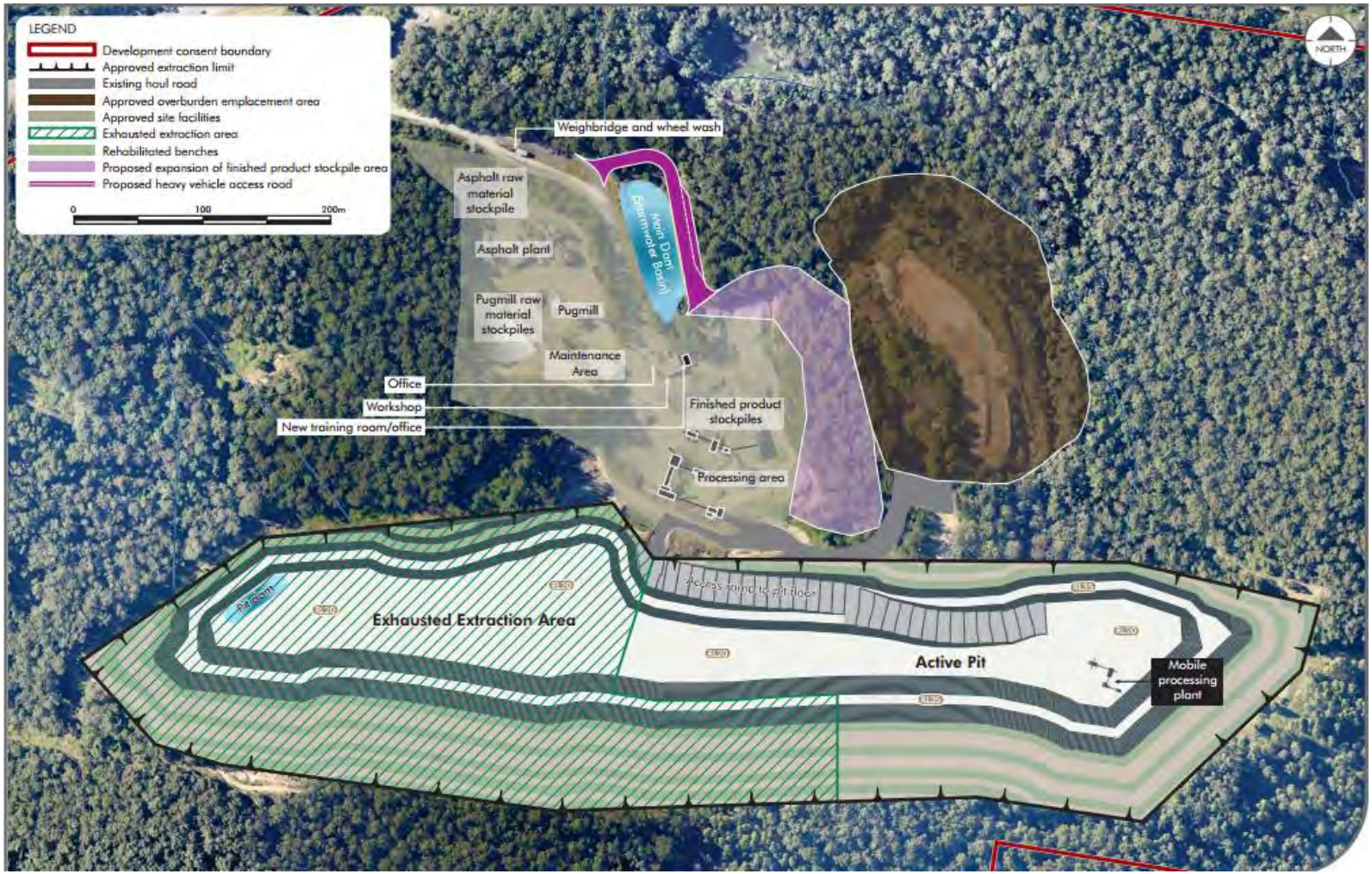


Figure 3 Site Layout – Stage 3



2 LOCAL AND REGIONAL SETTING

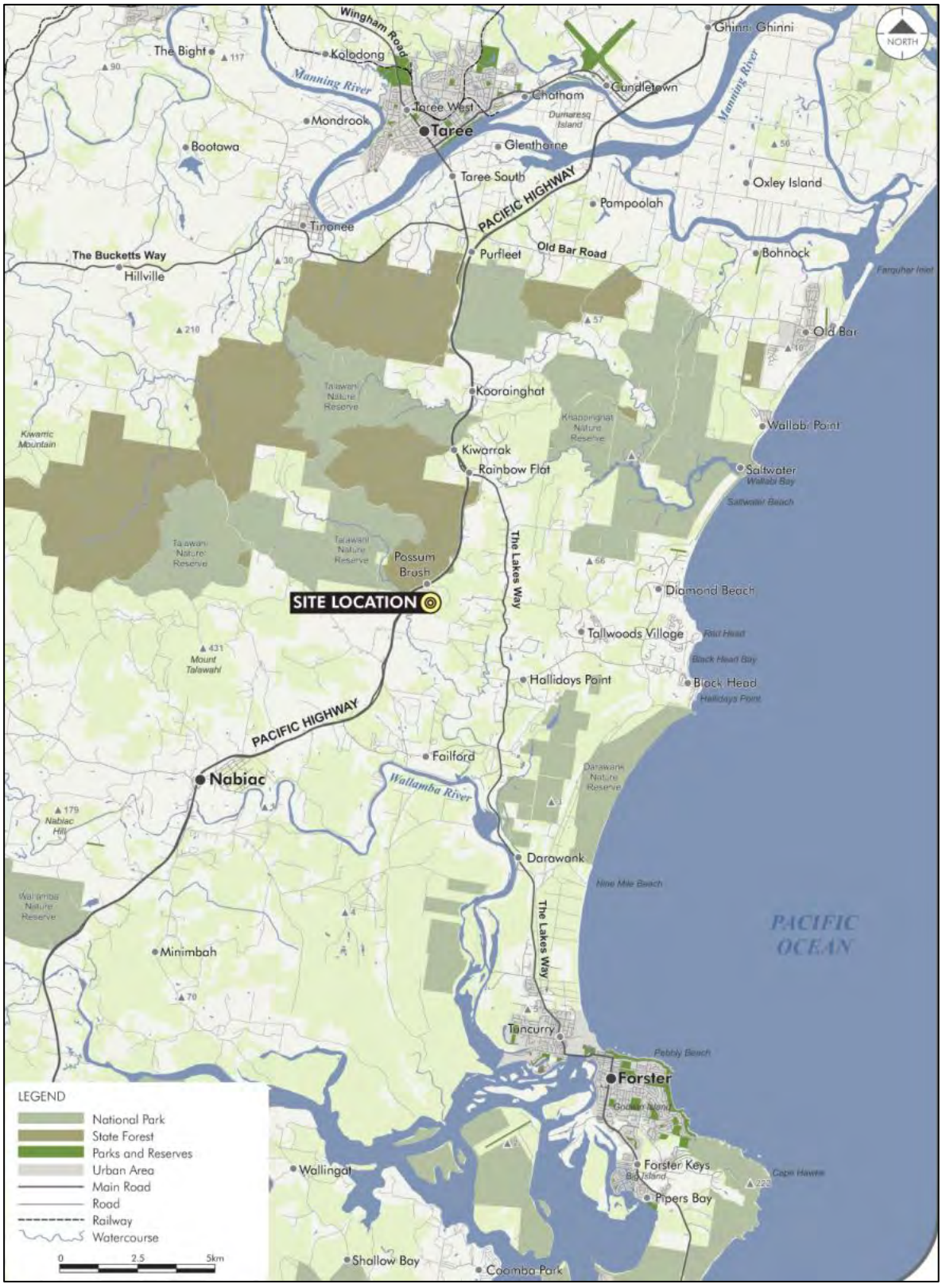
Jandra Quarry is a hard rock quarry located approximately 17 kilometres (km) south of Taree in the Greater Taree Local Government Area (LGA). The regional location of the Project is shown in **Figure 4**.

2.1 Topography and Land Use

The site is located on the Pacific Highway at Possum Brush, NSW. The closest town to the site is Nabiac, located approximately 10 km to the southwest of the site. The topography of the site and surrounding area is generally undulating with rolling hills and valleys. A contour map is provided in **Appendix D**.

Scattered residences are located to the northeast, east, southeast and southwest of the operational area of the site. The surrounding areas are predominantly cleared agricultural land on the lower slopes and moderate to heavy vegetated land on steeper areas. The lower slopes to the south and east of the site have been extensively cleared and are predominantly used for cattle grazing.

Figure 4 Regional Context



2.2 Nearest Sensitive Receptors

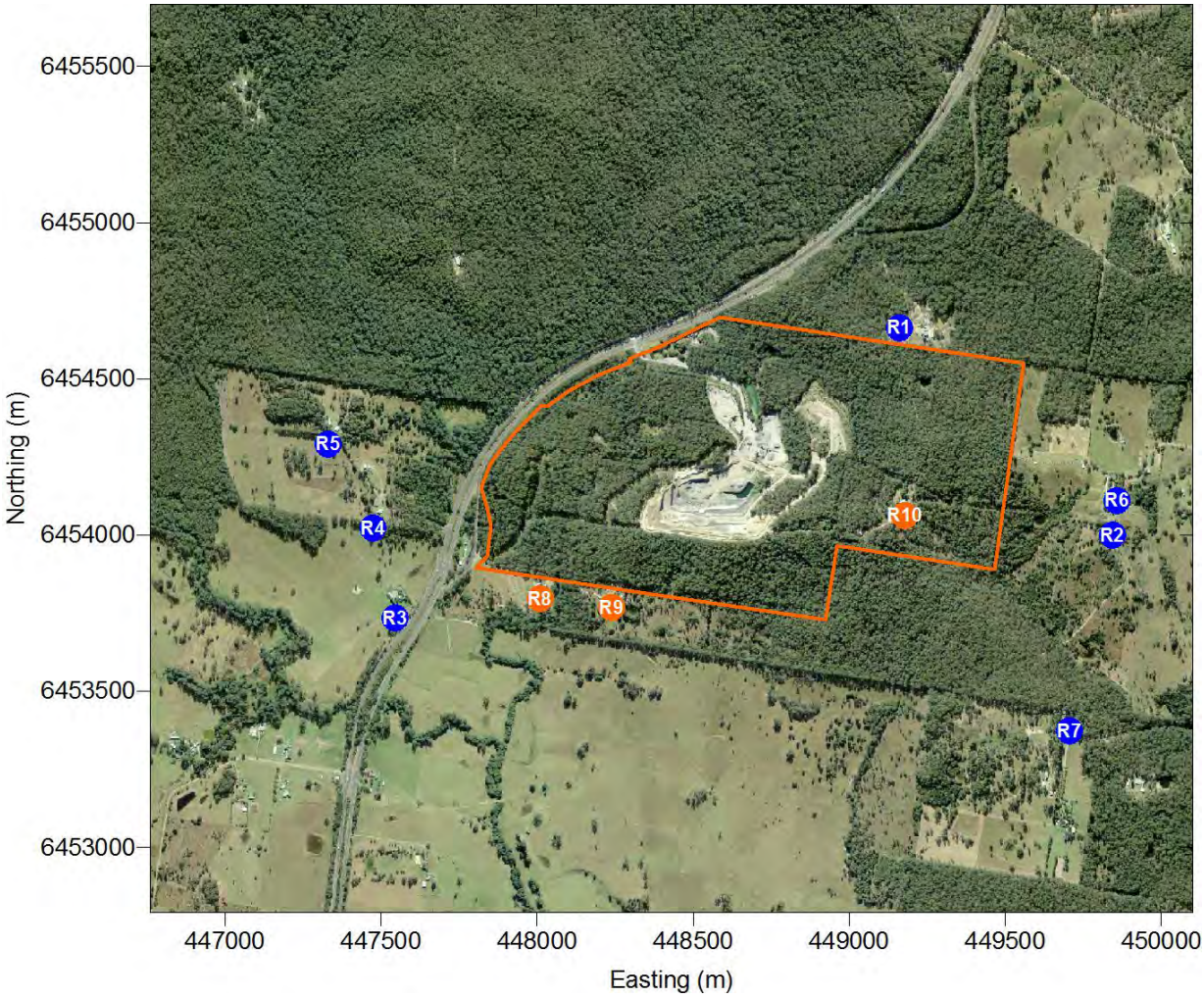
The Project is situated in a rural environment surrounded by numerous medium sized residential acreages to the north, east and west. Holcim owned residences are located immediately south of as well as within the development consent boundary. The nearest residences are identified in **Figure 5.**

Coordinates and distance from the development consent boundary are provided in **Table 1**.

Table 1 Noise sensitive receptor locations

Receptor ID	Address	Location		Distance (m) / Direction from Consent Boundary	Elevation (mAHD)
		Easting (m)	Northing (m)		
R1	15418 Pacific Highway, Possum Brush	449164	6454674	50, N	45
R2	112 Spicers Road, Rainbow Flat	449824	6454014	340, E	74
R3	15165 Pacific Highway, Possum Brush	447560	6453785	290, SW	18
R4	Lot 6 Pacific Highway, Possum Brush	447484	6454056	320, W	44
R5	15215 Pacific Highway, Possum Brush	447333	6454339	490, W	55
R6	1677 The Lakes Way, Rainbow Flat	449838	6454136	340, E	72
R7	136 Spicers Road, Rainbow Flat	449675	6453391	500, ESE	42
R8	Holcim owned residence	448005	6453843	30, S	12
R9	Holcim owned residence	448232	6453803	30, S	30
R10	Holcim owned residence	449172	6454104	Within boundary	79

Figure 5 Location of Nearest Sensitive Receptors



2.3 Existing Road Traffic Volumes

The existing road traffic volumes on the Pacific Highway immediately south of the Jandra Quarry access road are provided in **Table 2**. Traffic volumes are provided as a baseline for determining impacts of the changes in traffic volumes associated with the proposed quarry intensification.

Table 2 Pacific Highway south[1] of Jandra Quarry access road 5 day average and 7 day average traffic volumes and vehicle classification

Direction of Travel	5 Day Average (Weekday)			7 Day Average (ADT)		
	Light[2]	Heavy[3]	Total	Light[2]	Heavy[3]	Total
North	4075	1629	5704	4145	1392	5537
South	3897	1635	5532	4005	1475	5480
Total	7972	3264	11236	8150	2867	11017
Proportion of Total	70.9%	29.1%	100%	74.0%	26.0%	100%

Source: Jandra Quarry Traffic Impact Assessment (Transport and Urban Planning / TUP report), June 2014).

NOTE 1: Traffic flows for the Pacific Highway north of the access road are comparable.

NOTE 2: Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes

NOTE 3: Heavy Vehicles – Austroads 3-12 vehicle classifications

3 ACOUSTIC TERMINOLOGY

An explanation of noise level descriptors typically used for assessing the noise environment is provided below and conveyed pictorially in. **Figure 6**.

LAmax or LMax, (dBA) The maximum A-weighted noise level that occurs over a given measurement period.

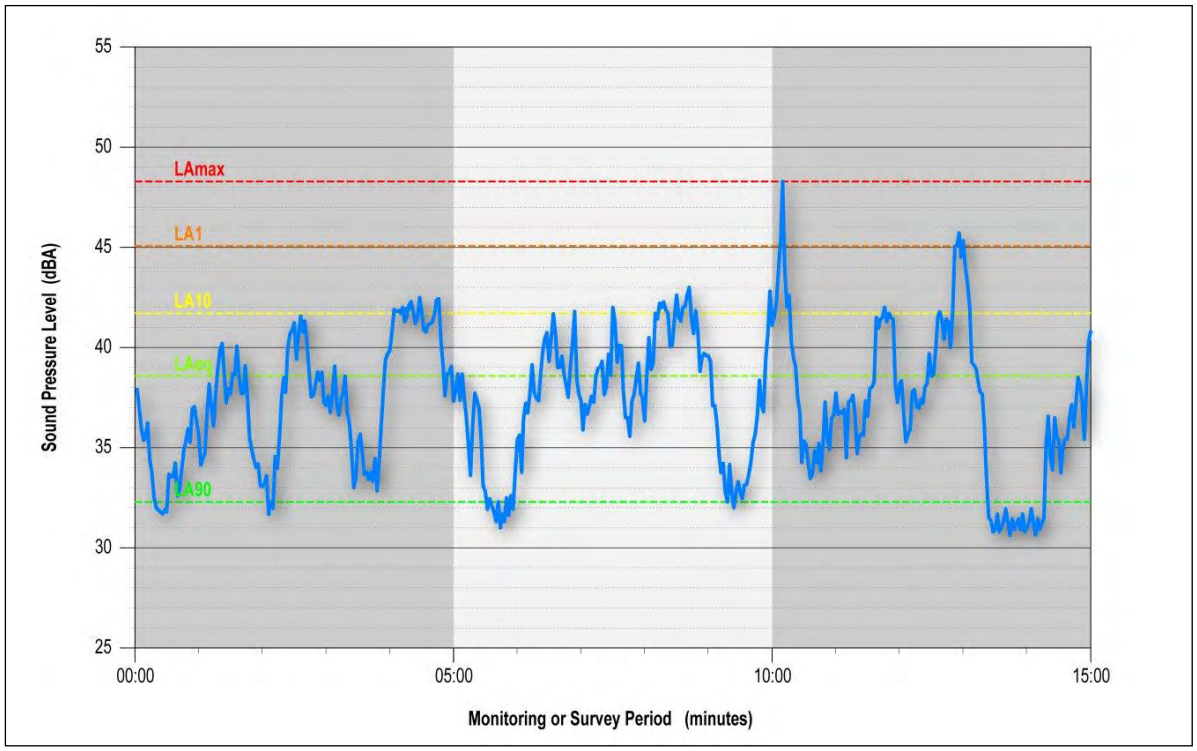
LA1 or L1 (dBA) The noise level exceeded for 1% of a measurement period. This parameter is often used to represent the typical maximum noise level in a given interval.

LA10 or L10 (dBA) The A-weighted sound pressure level exceeded 10% of a given measurement interval. The LA10 is often taken to represent the average maximum noise level.

LAeq or Leq (dBA) The A-weighted equivalent continuous sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement interval. The Leq can be loosely thought of as an 'average' level.

LA90 or L90 (dBA) The A-weighted sound pressure level exceeded 90% of a given measurement interval and is representative of the average minimum sound level. The LA90 is often used to describe the 'background' level.

Figure 6 Graphical Display of Typical Noise Indices



4 IMPACT ASSESSMENT PROCEDURES

All noise produced on site from quarry operations, including noise generated during construction of the proposed new heavy vehicle access road and the extension of the existing finished product stockpile area, is assessed as operational noise. As such, there is no specific construction noise assessment for this project.

4.1 Operational Noise

Responsibility for the control of noise emission in New South Wales is vested in Local Government and the Environmental Protection Authority (EPA). The Industrial Noise Policy (INP) was released in January 2000 and provides a framework and process for deriving noise criteria for consents and licences that will enable the EPA to regulate premises that are scheduled under the Protection of the Environment Operations Act, 1997.

The specific policy objectives are:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving project specific noise levels.
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from the premises scheduled under the Act.

4.1.1 Assessing Intrusiveness

For assessing intrusiveness, the background noise level must be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured background level (L_{A90}).

4.1.2 Assessing Amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. If present, the existing noise level from industry is measured. If it approaches the amenity criterion value, then noise from new industries needs to be designed so that the cumulative level does not significantly exceed the criterion.

The amenity criteria for rural residences are provided in **Table 3**.

Table 3 INP Amenity Criteria – Recommended L_{Aeq} noise levels from industrial noise sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
		Night	50	55

Note: Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am, On Sundays and Public Holidays, Daytime 8.00 am -6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

4.1.3 INP Project Specific Criteria

The INP Project Specific Noise levels are the more stringent of either the amenity or intrusive criteria. The INP states that these criteria have been selected to protect at least 90% of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

In those cases where the INP project specific assessment criteria are not achieved, it does not automatically follow that all people exposed to the noise would find the noise unacceptable. In subjective terms, exceedances of the INP project specific assessment criteria can be generally described as follows:

- Negligible noise level increase <1 dBA (Not noticeable by all people)
- Marginal noise level increase 1 dBA to 2 dB(A) (Not noticeable by most people)
- Moderate noise level increase 3 dBA to 5 dB(A) (Not noticeable by some people but may be noticeable by others)
- Appreciable noise level increase >5 dBA (Noticeable by most people)

In view of the foregoing, **Table 4** presents the methodology for assessing noise levels which may exceed the INP project specific noise assessment criteria.

Table 4 Noise impact assessment methodology

Assessment Criteria	Project Specific Criteria	Noise Management Zone	Noise Affectation Zone
Intrusive	Rating background level plus 5 dBA	≤ 5 dBA above project specific criteria	> 5 dBA above project specific criteria
Amenity	INP based on existing industrial level	≤ 5 dBA above project specific criteria	> 5 dBA above project specific criteria

For the purposes of assessing the potential noise impacts the project specific, management and affectation criteria are further defined in the following sections.

Project Specific Criteria

Most people in the broader community would generally consider exposure to noise levels corresponding to this zone acceptable.

Noise Management Zone

Depending on the degree of exceedance of the project specific criteria (1 dBA to 5 dBA) noise impacts could range from negligible to moderate. It is recommended that management procedures be implemented including:

- Prompt response to any community issues of concern.
- Noise monitoring on site and within the community.
- Refinement of on-site noise mitigation measures and plant operating procedures where practical.
- Consideration of acoustical mitigation at receivers.
- Consideration of negotiated agreements with property holders.

Noise Affectation Zone

Exposure to noise levels exceeding the project-specific criteria by more than 5 dBA may be considered unacceptable by some property holders and the INP recommends that the proponent explore the following.

- Discussions with relevant property holders to assess concerns and provide solutions.
- Implementation of acoustical mitigation at receivers.
- Negotiated agreements with property holders, where required.

4.2 INP Assessment of Prevailing Weather Conditions

4.2.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the noise source. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where the source to receiver wind component at speeds of up to 3 m/s occur for 30% or more of the time in any seasonal period (during the day, evening or night), then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

The INP Section 5.3 Wind Effects states:

> *"Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source to receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 percent of the time or more in any assessment period in any season."*

In order to determine the prevailing conditions for the subject site, weather data for the period 1 January to 3 December 2013 were obtained from a weather station at Taree Airport (Station Number 60141) operated by the Bureau of Meteorology. The data was analysed in order to determine the frequency of occurrence of winds of speeds up to 3 m/s in each season.

The results of the weather station analysis for daytime, evening and night-time winds are presented in **Table 5**, **Table 6** and **Table 7** respectively.

In each table, the wind directions and percentage occurrence are those dominant during each season.

Table 5 Seasonal frequency of occurrence wind speed intervals – Daytime

Period	Calm (<0.5 m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2.0 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	2.1%	NE±45	1.5%	4.2%	5.7%
Autumn	2.9%	W±45	3.9%	12.9%	16.8%
Winter	5.4%	W±45	7.4%	11.9%	19.3%
Spring	0.7%	W±45	2.6%	5.1%	7.7%

Table 6 Seasonal frequency of occurrence wind speed intervals - Evening

Period	Calm (<0.5 m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2.0 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	10.6%	ENE±45	6.7%	10.5%	17.1%
Autumn	25.4%	WNW±45	11.0%	12.2%	23.2%
Winter	25.5%	WNW±45	14.0%	15.0%	29.0%
Spring	18.3%	NE±45	8.7%	10.8%	19.5%

Table 7 Seasonal frequency of occurrence wind speed intervals - Night-time

Period	Calm (<0.5 m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2.0 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	26.2%	WNW±45	9.4%	13.4%	22.9%
Autumn	20.0%	WNW±45	18.5%	24.8%	43.3%
		W±45	16.2%	23.5%	39.8%
		NW±45	17.5%	19.1%	36.6%
Winter	20.5%	W±45	18.1%	19.2%	37.3%
		WNW±45	18.2%	18.3%	36.5%
		WSW±45	14.8%	16.3%	31.1%
Spring	25.9%	WNW±45	16.5%	14.6%	31.1%
		W±45	15.4%	15.6%	30.9%

The prevailing winds less than (or equal to) 3 m/s with a frequency of occurrence greater than (or equal to) 30% and considered to be relevant to the site in accordance with the INP are presented in **Table 8**, where the dominant conditions are underlined.

Table 8 Project prevailing wind conditions in accordance with NSW INP (2000)

Season	Winds ≤ 3 m/s with frequency of Occurrence ≥ 30%		
	Daytime	Evening	Night-time
Summer	Nil	Nil	Nil
Autumn	Nil	Nil	<u>WNW (43%), W (40%), NW (37%)</u>
Winter	Nil	Nil	<u>W (37%), WNW (37%), WSW (31%)</u>
Spring	Nil	Nil	<u>WNW (31%), W (31%)</u>

Results of the analysis provided in **Table 8** indicate that winds are not a feature of the environment during the day and evening periods, however occur regularly during the night time. Wind has therefore been considered in this noise assessment for the 6:00 am to 7:00 am shoulder period, during which time normal quarry activities occur, and for the entire night-time period, during which time asphalt production is proposed to occasionally take place.

4.2.2 Temperature Inversion

The NSW INP states that temperature inversions need only be considered for the night-time noise assessment period (10:00 pm to 7:00 am).

Meteorological data was available from the BoM AWS at Taree Airport to allow the determination of the percentage occurrence of temperature inversions during winter nights. The temperature inversion data was obtained for the year 2013.

The INP states:

> *"Temperature inversions occur during E, F and G stability categories. These three categories are considered to represent weak, moderate and strong inversions respectively. For noise-assessment purposes, only moderate and strong inversions are considered significant enough to require assessment."*
>
> *"In dispersion modelling, stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme there are six stability classes, A through to F. Class A relates to unstable conditions, such as might be found on a sunny day with light winds. Class F relates to stable conditions, such as those that occur when the sky is clear, the winds are light and an inversion is present. The intermediate classes B, C, D and E relate to intermediate dispersion conditions. A seventh class, G, has also been defined to accommodate extremely stable conditions such as might be found in arid rural areas."*

An analysis of the occurrence of each stability class has been conducted and is provided in **Table 9**.

Table 9 Atmospheric stability frequency of occurrence – Evening and Night-Time

Stability Class	Evening and Night-Time Frequency of Occurrence			
	Summer	**Autumn**	**Winter**	**Spring**
A	0.0%	0.0%	0.0%	0.0%
B	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%
D	43.2%	29.8%	27.7%	42.0%
E	10.5%	10.3%	12.4%	10.8%
F	19.8%	22.2%	24.4%	26.6%
G	26.5%	37.7%	35.4%	20.6%
F+G	46.3%	59.9%	59.9%	47.2%

Results of the analysis provided in **Table 9** indicate that temperature inversions are a feature of the area throughout the year during the evening and night periods. Temperature inversions have therefore been considered in this noise assessment for the 6:00 am to 7:00 am shoulder period and the evening period during which time normal quarry activities occur; and for the entire night period, during which time asphalt production is proposed to occasionally take place.

4.2.3 Drainage Flow Winds

The INP identifies that a default wind drainage value be applied where sources are situated at a higher altitude than receivers with no intervening topography.

The drainage-flow wind does not apply to this development as intervening topography exists between sources and receivers.

4.3 Off Site Road Traffic

Whilst operating on the project site, vehicle noise is as assessed as part of the general quarry operations using the procedure outline in **Section 4.1**. However, on public roads the vehicles are treated as 'traffic' rather than as part of the quarry operations, and different assessment criteria apply.

Road traffic criteria are provided in the *"NSW Road Noise Policy"* (RNP), which was released in March 2011. The policy sets out noise criteria applicable to particular types of projects, road category and land use for the purpose of defining traffic noise impacts. **Table 10** presents the criteria for residential land uses affected by noise from an arterial road such as the Pacific Highway. Noise levels provided in **Table 10** are external noise levels and refer only to road traffic noise.

Table 10 Road traffic noise assessment criteria for residential land uses (NSW RNP)

Road	Type of Project and Land Use	Total Traffic Noise Criteria[1,3]	Relative Increase Criteria[2,3]
Pacific Highway	Existing residences affected by additional traffic on existing freeways/arterial/subarterial road generated by land use development.	Daytime 60 $L_{Aeq(15hour)}$	Existing $L_{Aeq(15hour)}$[4] plus 12 dBA
		Night-time 55 $L_{Aeq(9hour)}$	Existing $L_{Aeq(9hour)}$ plus 12 dBA

Note 1: Total traffic noise level from non-project related and Project related traffic for comparison with the Criteria.
Note 2: Relative increase noise level generated by the Project for comparison with the Criteria.
Note 3: Daytime 0700 hrs to 2200 hrs, Night-time 2200 hrs to 0700 hrs.
Note 4: L_{Aeq} = equivalent continuous noise level.

In relation to situations where exceedances of the road traffic noise assessment criteria are predicted, the NSW Road Noise Policy relevantly provides:

> *Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.*
>
> *In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.*
>
> *…*
>
> *For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*

In practice, noise level increases of less than 2 dBA are generally achieved when the Project-related percentage increase to the existing light and heavy traffic is no greater than 60%.

4.4 Sleep Disturbance

The EPA's current approach to assessing potential sleep disturbance is to apply an initial screening criterion of background plus 15 dBA (as described in the Application Notes to the INP), and to undertake further detailed analysis if the screening criterion cannot be achieved. The sleep disturbance screening criterion applies outside bedroom windows during the night-time period.

Where the screening criterion cannot be met, the additional analysis should consider the number of potential sleep disturbance events during the night, the level of exceedance and noise from other events. It may also be appropriate to consider other guidelines including the EPA's RNP which contains additional guidance relating to the potential sleep disturbance impacts.

A review of research on sleep disturbance in the RNP indicates that in some circumstances, higher noise levels may occur without significant sleep disturbance. Based on studies into sleep disturbance, the RNP concludes that:

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

It is generally accepted that internal noise levels in a dwelling, with the windows open, are 10 dBA lower than external noise levels. Based on a worst case minimum attenuation, with windows open, of 10 dBA, the first conclusion above suggests that short term external noises of 60 dBA to 65 dBA are unlikely to cause awakening reactions. The second conclusion suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to affect health and wellbeing significantly.

4.5 Blast Emissions

4.5.1 Ground Vibration - Structural Damage

In terms of the most recent relevant blast vibration damage criteria, British Standard 7385:Part 2-1993 "*Evaluation and Measurement for Vibration in Buildings Part 2"* is a definitive standard against which the likelihood of building damage from ground vibration can be assessed. This is the Standard recommended in Australian Standard AS 2187: Part 2-2006 "*Explosives - Storage and Use - Part 2: Use of Explosives*" as the guideline values and assessment methods "*are applicable to Australian conditions*".

Although there is a lack of reliable data on the threshold of vibration-induced damage in buildings both in countries where national standards already exist and in the UK, BS 7385:Part 2 has been developed from an extensive review of UK data, relevant national and international documents and other published data. The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration which are considered in the standard include blasting (carried out during mineral extraction or construction excavation), demolition, piling, ground treatments (e.g. compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

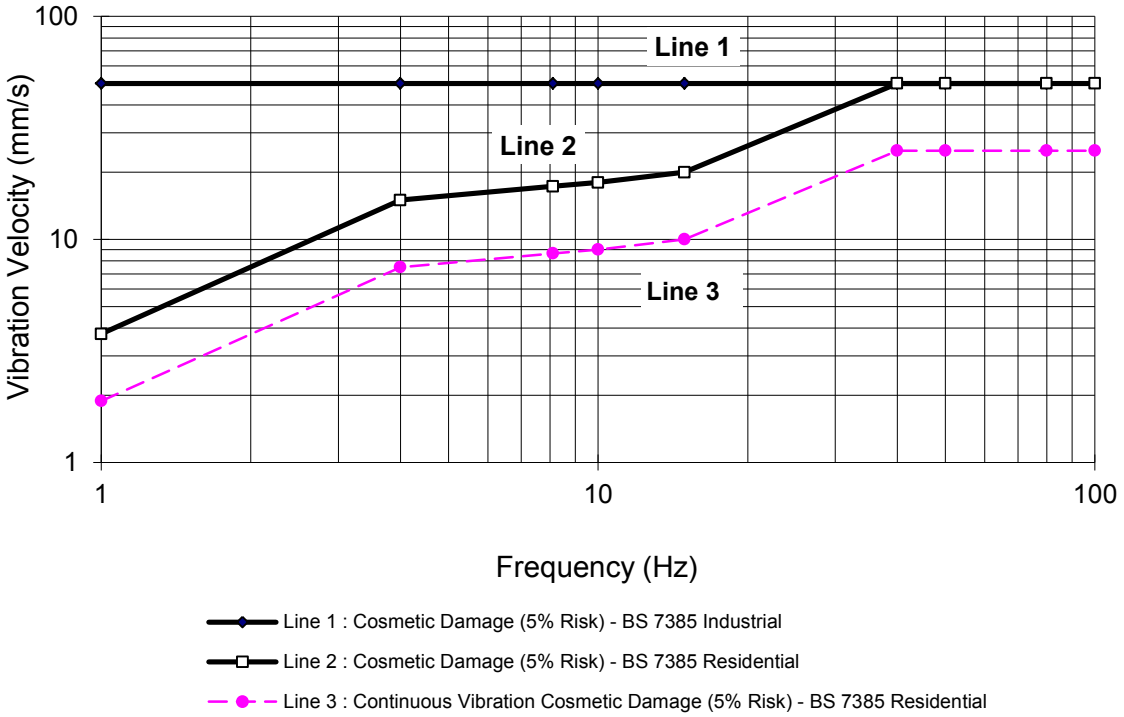
As the strain imposed on a building at the foundation level is proportional to the peak particle velocity, but is inversely proportional to the propagation velocity of the shear or compressional waves in the ground, this quantity (i.e. peak particle velocity) has been found to be the best single descriptor for correlating with case history data on the recurrence of vibration-induced damage.

The guide values from this standard for transient vibration judged to result in a minimal risk of cosmetic damage to residential buildings and industrial buildings are presented numerically in **Table 11** and graphically in **Figure 7**.

Table 11 Transient vibration guide values for cosmetic damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Figure 7 Graph of Transient Vibration Guide Values for Cosmetic Damage



In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for the building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in **Table 11** and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in **Table 11** should not be reduced for fatigue considerations.

It is noteworthy that extra to the guide values nominated in **Table 11**, the standard states that:

> *"Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK."*

Also that:

> *"A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive."*

4.5.2 Airblast - Structural Damage

Based largely on work carried out by the US Bureau of Mines, the US Office of Surface Mining has presented the following regulatory limits for airblast from blasting (depending on the low frequency limit of the measuring system):

Low Frequency Limit	Peak Airblast Level Limit
2 Hz or lower	132 dB Linear
6 Hz or lower	130 dB Linear

These levels are generally consistent with the level of 133 dB Linear nominated in AS 2187.2-2006.

The US criteria are structural damage limits based on relationship between the level of airblast and the probability of window breakage, and include a significant safety margin. It has been well documented that windows are the elements of residential buildings most at risk to damage from airblast from blasting.

While cracked plaster is the type of damage most frequently monitored in airblast complaints, research has shown that window panes fail before any other structural damage occurs (USBM, RI 8485-1980). The probabilities of damage to windows exposed to a single airblast event are as shown in **Table 12**.

Table 12 Probability of window damage from airblast

Airblast dB Linear	Level kPa	Probability of Damage	Effects and Comments
140	0.2	0.01%	"No damage" - windows rattle
150	0.6	0.5%	Very occasional failure
160	2.0	20%	Substantial failures
180	20.0	95%	Almost all fail

4.5.3 Human Comfort and Disturbance Considerations

The ground vibration and airblast levels which cause concern or discomfort to residents are significantly lower than the damage limits. Humans are far more sensitive to some types of vibration than is commonly realised. They can detect and possibly even be annoyed at vibration levels which are well below those causing any risk of damage to a building or its contents.

The criteria normally recommended for blasting in NSW, based on human discomfort, are contained in the EPA's Environmental Noise Control Manual (Chapter 154). However, for recent projects the EPA has advocated the use of the Australian and New Zealand Environment Council (ANZEC), *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration,* September 1990 (hereafter referred to as the ANZEC Guidelines).

The ANZEC Guidelines for the control of blasting impact at residences are as follows:

- The recommended maximum level for airblast is 115 dB Linear, Peak (115 $dBL_{,peak}$).
- The level of 115 dB Linear may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 120 dB Linear at any time.
- The recommended maximum level for ground vibration is 5 mm/s (peak particle velocity (ppv)).
- The ppv level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.
- Blasting should generally only be permitted during the hours of 9 am to 5 pm Monday to Saturday. Blasting should not take place on Sundays and public holidays.

5 EXISTING ACOUSTICAL ENVIRONMENT

Ambient noise monitoring surveys were undertaken at three residential locations to assist in the determination of INP noise limits and potential project impacts. The monitoring locations, R1, R2 and R3, are shown in **Figure 5**. Details of instrumentation are provided in **Table 13.**

Table 13 Instrumentation

Equipment	Receiver Location	Make and Model	Serial Number
Noise Logger	R1	ARL 316	16-306-039
	R2	ARL 316	16-203-509
	R3	ARL 316	16-301-473
Calibrator	All	SV30A	24713
Sound level meter	All	Bruel & Kjaer 2270	2679354

The background noise monitoring consisted of continuous, unattended noise logging and operator attended noise surveys. The operator attended noise surveys were used to identify noise sources and the character of noise in the area and to qualify unattended noise logging results.

5.1 Unattended Continuous Noise Monitoring

Unattended background noise monitoring was conducted between Wednesday 26 February and Sunday 9 March 2014 at the three residential receiver locations. Environmental noise loggers were used to continuously record noise levels at the respective monitoring locations over the survey period.

Within the periods selected as being representative of the background noise level, noise data during periods of any rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded.

The results of unattended noise monitoring are presented graphically in **Appendices A** to **C**. The data has been analysed in accordance with the relevant methodologies in the following sections.

5.1.1 Ambient and Rating Background Levels

Ambient and background noise data required for the determination of INP noise limits is presented in **Table 14**.

Table 14 Summary of existing L_{A90} Rating Background Levels (RBL's) and existing L_{Aeq} ambient noise levels - dBA re 20 µPa

Monitoring Location	$L_{A90(15minute)}$ Rating Background Noise Level (dBA)[1]			$L_{Aeq(period)}$ Existing Ambient Noise Level (dBA)[1]		
	Daytime 0700-1800 Hours	Evening 1800-2200 Hours	Night 2200-0700 Hours	Daytime 0700-1800 Hours	Evening 1800-2200 Hours	Night 2200-0700 Hours
R1	36	38	36	47	47	46
R2	34	33	42	47	52	54
R3	50	48	48	61	62	60

Note 1: The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level.

The L_{Aeq} is the equivalent continuous noise level defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Review of the data presented in **Table 14** indicates that the $L_{A90(15minute)}$ RBL's at the various monitoring locations ranged from 34 dBA to 50 dBA during the daytime, 33 dBA to 48 dBA during the evening and 36 dBA to 48 dBA during the night-time. The measured background noise levels are typical of those controlled by transportation noise contributions associated with the Pacific Highway.

5.1.2 Road Traffic Noise

The noise logging data collected at Receptor Location 3, approximately 40 m west of the Pacific Highway, has been used to quantify the existing ambient road traffic noise levels. A summary of the traffic noise levels recorded is contained within **Table 15.**

Table 15 Existing road traffic noise

Receptor	Road Traffic Noise (dBA $_{free\ field}$)			
	$L_{Aeq(15\ hour)}$	$L_{Aeq(1\ hour)}$ Day	$L_{Aeq(9\ hour)}$	$L_{Aeq(1hour)}$ Night
R3	62	64	60	61

It is noted that the existing road traffic noise levels at R3 exceed the RNP assessment levels of 60 $L_{Aeq(15\ hour)}$ and 55 $L_{Aeq(9\ hour)}$ provided in **Table 10**.

5.2 Operator-Attended Noise Surveys

Operator-attended noise surveys of 15 minutes duration were conducted at noise logger locations on 26 February 2014.

During the attended noise surveys the operator identified the character and duration of acoustically significant ambient noise sources. Wherever possible, the operator quantified local traffic flows and made a qualitative assessment of the prevailing weather conditions.

The operator-attended noise survey results are presented in **Table 16** for the daytime, evening and night-time periods respectively.

Table 16 $L_{Aeq(15minute)}$ Operator-attended noise survey results, 26 February 2014

Location	Date/ Time (Hours)	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission Sources
		L_{Aeq}	L_{A90}	L_{A10}	L_{A01}	L_{max}	
R1	2:54 pm (day)	44	41	47	49	51	Wind in trees: 46-48 L_{Amax} Pacific Hwy road traffic: 49-51 L_{Amax} Birds: 42-44 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.
	6:00 pm (evening)	43	37	46	51	55	Plane: 46-49 L_{Amax} Pacific Hwy road traffic: 35-43 L_{Amax} Birds: 43-55 L_{Amax} Insects: 35 L_{Amax} Dog barking: 45-49 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.
	10:25 pm (night)	46	41	49	52	55	Pacific Hwy road traffic: 46-55 L_{Amax} Wind in trees: 48-50 L_{Amax} Insects: 40-43 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.
R2	3:52 pm (day)	36	32	37	42	57	Wind in trees: 32-42 L_{Amax} Distant road traffic: 35-36 L_{Amax} Birds: 34-49 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.
	6:38 pm (evening)	42	33	42	49	73	Plane: 37-39 L_{Amax} Pacific Hwy road traffic: 38-39 L_{Amax} Operator: 73 L_{Amax} Birds: 38-59 L_{Amax} Insects: 33 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.
	11:04 pm (night)	48	39	52	55	57	Pacific Hwy road traffic: 44-52 L_{Amax} Insects: 40-57 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.
R3	4:55 pm (day)	60	50	63	68	72	Insects: 44 L_{Amax} Distant road traffic: 61-72 L_{Amax} Birds (aviary on residents' property: 57-64 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.
	7:14 pm (evening)	59	46	64	68	72	Pacific Hwy road traffic: 69-72 L_{Amax} Cow: 61 L_{Amax} Birds: 59-67 L_{Amax} Shot gun fire: 59-62 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.
	10:00 pm (night)	59	51	63	68	73	Pacific Hwy road traffic: 62-68 L_{Amax} Insects: 50-54 L_{Amax} Jandra Quarry not audible. No other industrial noise audible.

The operator-attended noise measurement results generally confirm the results obtained from the unattended noise loggers and support the use of the noise levels in being representative of the background noise environment at residences.

Appreciable differences between results of attended and unattended average, or L_{Aeq} measurements were, however, measured at R2 during the evening and night periods. Attended measurements of noise were 6 to 10 dBA lower than the unattended logging data for these periods.

Additionally, the night time background L_{A90} noise level at R2 was unusually high during both the attended and unattended noise measurements. Elevated noise at night is typically attributable to insects or mechanical plant such as air conditioning units, both of which can be seasonal noise sources.

Due to the possibility that data collected at R2 during the night period has been affected by seasonal sources, this data has not been used for determining night time noise limits.

5.3 Non-monitored Receptor Locations

Ambient noise was not monitored at receptor locations R4 to R10. For assessment purposes the existing acoustic environment at monitoring locations R1 and R2 has been assumed to be representative of the receptor locations indicated in **Table 17.**

Table 17 Acoustical environment at non-monitored receptor locations

Measurement location	Acoustically comparable receptor location	Basis
R1	R4, R5, R8 and R9	All receptors within 600 m of the Pacific Highway
R2	R6, R7 and R10	All receptors remote from the Pacific Highway

6 PROJECT SPECIFIC NOISE EMISSION CRITERIA

6.1 Operational Noise

The noise emission design criteria for the proposed development have been established with reference to the INP using the procedure outlined in **Section 4.1** of this report.

The resulting operational project specific noise criteria for the proposed development are shown in **bold** within **Table 18**.

Table 18 Project specific noise criteria

Location	Period	Intrusiveness Criteria $L_{Aeq(15minute)}$ (dBA)	EPA Acceptable Amenity Criteria $L_{Aeq(Period)}$ (dBA)	Project Specific Noise Criteria $L_{Aeq(15minute)}$ (dBA)
R1, R4, R5, R8 and R9	Day	41	50	**41**
	Evening	43	45	**41**[1]
	Night (6 am to 7 am)	41	40	**40**
R2, R6, R7 & R10	Day	39	50	**39**
	Evening	38	45	**38**
	Night (6 am to 7 am)	47	40	**38**[2]
R3	Day	55	51	**51**
	Evening	53	52	**51**[1]
	Night (6 am to 7 am)	53	50	**50**

NOTE 1: Adjustment made in accordance with the INP Application Notes.

NOTE 2: The evening limit has been adopted for these locations due to anomalies in the night time data collected at R2.

6.2 Off Site Road Traffic

Existing road traffic noise levels exceed the RNP assessment criteria at 11165 Pacific Highway (R3), and can be expected to exceed the identified limits at other residences within 40 m of the highway.

Due to the existing exceedance, the road traffic noise impacts of the quarry intensification have been assessed by comparing the predicted change in traffic noise with the threshold criterion of +2dBA.

6.3 Sleep Disturbance

The sleep disturbance noise emission design goals have been based on the minimum $L_{A90(15minute)}$ noise level recorded during the night period at each receptor location and are provided in **Table 19**.

Table 19 Sleep disturbance design goals

Location	$L_{A90(15min)}$ RBL (dBA)	Sleep Disturbance Noise Emission Design Goal ($L_{A1(1\ min)}$) (dBA)[1]
R1, R4, R5, R8 and R9	36	51
R2, R6, R7 & R10	33[2]	48
R3	48	63

NOTE 1: Sleep disturbance design goal, $L_{A1(1\ min)}$ = RBL + 15 dB.

NOTE 2: The evening RBL has been used as a basis for noise limits at these locations due to anomalies in the night time data collected at R2.

6.4 Blast Emissions

Design goals for blast emissions at all sensitive receptor locations are provided in **Table 20**.

Table 20 Blast emission limits

Attribute	Recommended Maximum Level	Comments
Airblast	115 $dBL_{(peak)}$	The level of 115 dBL may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 120 dBL at any time.
Ground vibration	5 mm/s peak particle velocity (ppv)	The ppv level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.

NOTE: Blasting should generally only be permitted during the hours of 9:00 am to 5:00 pm Monday to Friday and 9:00 am to 3:00 pm Saturday. Blasting is not to take place on Sundays and public holidays.

7 NOISE MODELLING

7.1 Methodology

In order to determine the acoustical impact of the proposed quarry intensification, a computer model incorporating all significant noise sources, the closest potentially affected residential properties, and the intervening terrain has been prepared.

The computer model was prepared using the SoundPLAN V7.2 Industrial Module which allows the use of various internationally recognised noise prediction algorithms. The CONCAWE algorithm, which is suitable for the assessment of large industrial plants, has been selected for this assessment because it also enables meteorological influences to be assessed.

Inputs to the computer noise model include the following:

- A 0.5 m topographic map for the general area and for those sections of the quarry not affected by the proposed changes.
- Contour information for the three stages of the quarry pit and overburden area provided by Holcim.
- Ground cover. A ground cover factor of 0.2, corresponding to reasonably 'hard' ground, has been applied to the quarry pit and processing area. The surrounding bushland has been modelled with a ground cover factor of 1, representative of 'soft' ground.
- Octave band sound power levels (SWLs) for all acoustically significant plant and equipment proposed to be used on site. This data was derived from:
  - On site measurements of noise of plant and equipment conducted by SLR at the Jandra Quarry.
  - The SLR extensive database of mine and quarry equipment noise levels.

  Further detail of noise source inputs are provided in **Section 7.2**.
- Fixed plant items have been modelled as point sources. Mobile plant items that can be expected to move throughout the site have been modelled as line sources, with the sound power distributed equally over the length of the line source.
- All plant has been assumed to operate 100% of the time. This assumption is in line with the INP 15 minute assessment interval. Whilst down time can be expected of some plant at times, there will be other periods where all plant operates concurrently for at least 15 minutes.
- Operational scenarios derived from information provided by Holcim and the project team, and approved by Holcim. Further detail of operational scenarios is provided in **Section 37**.
- Meteorological information. Predictions of noise under calm atmospheric conditions (CONCAWE Cat 4) have been conducted for all day operations. Temperature inversions and noise enhancing winds were identified as characteristic of the local environment during the night period (Refer to **Section 4.2**). For this reason noise during the night period has been modelled for both calm and worst case (CONCAWE Cat 6) meteorological conditions. Details of modelled meteorological conditions are provided in **Table 21**.

Table 21 Meteorological parameters for noise predictions

Meteorol-ogical Condition	Period	CONCAWE Category	Temper-ature	Humidity	Wind Speed	Wind Direction (degrees from north)	Pasquill Stability Class
Calm	All	4	20^0C	70%	N/A	N/A	D
Worst case	Night	6	10^0C	70%	2.5 m/s	Worst Case	F

7.2 Equipment Sound Power Levels

The L_{Aeq} sound power levels of plant and equipment from existing and proposed operations are given below in **Table 22**.

Table 22 Equipment sound power levels

Group	Plant and Equipment	L_{Aeq} Sound Power levels (dBA)	L_{Amax} Sound Power levels (dBA)	Source Height (m)
Mobile Equipment	Excavator	111	117	4
	Front end loader (FEL)	112	119	2
	Haul truck	108	116	2
	Water truck	108	113	2
	Drill rig	117	122	4
	Delivery trucks	101	109	2
Fixed Plant	Primary crusher	115	119	4
	Secondary crusher	118	120	4
	Screen 3	118	120	4
	Screen 4	118	120	4
	Pug mill	100	114	4
	Barmac	113	117	4
	Wash plant	113	117	4
Relocatable Plant	Asphalt plant	115	120	4
	Mobile processing plant	115	120	4
	Generators	99	103	1.5

7.3 Operational Scenarios

An estimated 'worst case' operational scenario has been modelled for each of the three stages of the project. The worst case scenario typically involves works on the uppermost benches of the quarry and is assumed to take place during the early phases of each stage of the quarry's life. The operational scenarios modelled are described in **Table 23**, **Table 24** and **Table 25**.

Each scenario has been modelled for neutral (CONCAWE Cat 4) meteorological conditions, as can be expected during the day period, and worst case (CONCAWE Cat 6) meteorological conditions, which will occur regularly during the night period.

Table 23 Stage 1 Operational scenario

Type	No	Equipment	Location / Bench	RL (m)	Activity
Mobile plant	1	Excavator	Stage 1 southern bench	74	Distributing OB[1] on benches to be rehabilitated
	1	FEL	Stage 1 southern bench	74	Loading OB
	1	Haul truck	Stage 1 southern bench	74 (start)	Hauling OB to AOBEA[2]
	1	FEL	Stage 1 northern bench	50	Loading shot rock
	1	Haul truck	Stage 1 northern bench	50 (start)	Hauling shot rock to processing plant
	1	Water truck	throughout site	various	Dust control
	1	Drill rig (daytime only)	southern bench	50	Drilling, pre-blast
Fixed plant	1	Primary feeder, crusher and screen	Processing area	44	Processing
	1	Secondary feeder , crusher and screen	Processing area	44	Processing
	1	Tertiary feeder, crusher and screen 3	Processing area	44	Processing
	1	Screen 4	Processing area	44	Processing
	1	Barmac	Processing area	44	Processing
	1	Wash plant	Processing area	44	Processing
Relocatable plant	1	Pugmill	Processing area	44	Processing
	1	Asphalt plant	Processing area	44	Processing
	1	Mobile processing plant	Stage 1 Active pit	50	Processing
	3	500 kVA generators	Active pit	50	Processing
Deliveries	3[3]	Truck deliveries	Between processing area and highway	44	Delivery

NOTE 1: Overburden

NOTE 2: Approved overburden emplacement area

NOTE 3: Three deliveries, or 6 delivery truck movements, have been modelled for the INP 15 minute assessment period.

Table 24 Stage 2 Operational scenario

Type	No	Equipment	Location / Bench	RL (m)	Activity
Mobile plant	1	Excavator	Stage 2 eastern bench	86	Removal of OB[1] from eastern extension of pit
	1	FEL	Stage 2 eastern bench	86	Loading OB from eastern extension of pit
	1	Haul truck	Stage 2 eastern bench	86 (start)	Hauling OB from pit extension to AOBEA[2]
	1	FEL	Stage 1 pit	35	Loading shot rock
	1	Haul truck	Stage 1 pit	35 (start)	Hauling shot rock to processing plant
	1	Water truck	Throughout site	various	Dust control
	1	Drill rig (daytime only)	Stage 2 south eastern bench	86	Drilling, pre-blast
Fixed plant	1	Primary feeder, crusher and screen	Processing area	44	Processing
	1	Secondary feeder , crusher and screen	Processing area	44	Processing
	1	Tertiary feeder, crusher and screen 3	Processing area	44	Processing
	1	Screen 4	Processing area	44	Processing
	1	Barmac	Processing area	44	Processing
	1	Wash plant	Processing area	44	Processing
Relocatable plant	1	Pugmill	Processing area	44	Processing
	1	Asphalt plant	Processing area	44	Processing
	1	Mobile processing plant	Stage 1 pit	35	Processing
	3	500 kVA generators	Stage 1 pit	35	Processing
Deliveries	3[3]	Truck deliveries	Between processing area and highway	44	Deliveries

NOTE 1: Overburden

NOTE 2: Approved overburden emplacement area

NOTE 3: Three deliveries, or 6 delivery truck movements, have been modelled for the INP 15 minute assessment period.

Table 25 Stage 3 Operational scenario

Type	No	Equipment	Location / Bench	RL (m)	Activity
Mobile plant	1	Excavator	Stage 3 eastern bench	74	Removal of OB[1] from eastern extension of pit
	1	FEL	Stage 3 eastern bench	74	Loading OB from eastern extension of pit
	1	Haul truck	Stage 3 south eastern bench	74 (start)	Hauling OB from pit extension to AOBEA[2]
	1	FEL	Stage 2 northern and southern bench	20	Loading shot rock
	1	Haul truck	Stage 2 northern bench	20 (start)	Hauling shot rock to processing plant
	1	Water truck	Throughout site	various	Dust control
	1	Drill rig (daytime only)	Stage 3 south eastern bench	74	Drilling, pre-blast
Fixed plant	1	Primary feeder, crusher and screen	Processing area	44	Processing
	1	Secondary feeder , crusher and screen	Processing area	44	Processing
	1	Tertiary feeder, crusher and screen 3	Processing area	44	Processing
	1	Screen 4	Processing area	44	Processing
	1	Barmac	Processing area	44	Processing
	1	Wash plant	Processing area	44	Processing
Relocatable plant	1	Pugmill	Processing area	44	Processing
	1	Asphalt plant	Processing area	44	Processing
	1	Mobile processing plant	Stage 2 pit	20	Processing
	3	500 kVA generators	Stage 2 pit	20	Processing
Deliveries	3[3]	Truck deliveries	Between processing area and highway	44	Delivery

NOTE 1: Overburden

NOTE 2: Approved overburden emplacement area

NOTE 3: Three deliveries, or 6 delivery truck movements, have been modelled for the INP 15 minute assessment period.

8 NOISE AND VIBRATION ASSESSMENTS

8.1 Operational Noise

Operational noise from the Project has been assessed against the INP criteria for the three scenarios described in **Section 7.3**. Overall noise levels have been calculated with and without asphalt production in progress, as asphalt production will not be a regular part of routine operations at Jandra Quarry. Predicted noise levels are provided in the following sections.

8.1.1 Stage 1

Normal Operations – No Asphalt Production

Predicted operational noise levels for Stage 1 are compared with project criteria in **Table 26**.

Table 26 Stage 1 Assessment without asphalt plant operating (exceedances shown in **bold)**

Receptor	**Day / Evening (dBA L_{eq})** 7 am to 10 pm		**Early morning shoulder (dBA L_{eq})** 6 am to 7 am		
	Project Criteria	Predicted level Neutral	Project criteria	Predicted level Neutral	Worst case
R1	41	41	40	**41**	**46**
R2	38	30	38	30	35
R3	51	<30	50	<30	30
R4	41	34	40	33	38
R5	41	40	40	38	**43**
R6	38	32	38	32	37
R7	38	<30	38	<30	<30
R8 (Holcim)	41	33	40	32	36
R9 (Holcim)	41	38	40	36	40
R10 (Holcim)	38	**44**	38	**43**	**47**

Calculated noise levels were above the project criteria at R1, R5 and R10 (Holcim owned residence).

Restricted Morning Shoulder Operations – No Asphalt Production

Noise levels at receptor locations during Stage 1 have been recalculated with restricted operations during the early morning shoulder period. During this time it has been assumed that the following restrictions will be in force:

- No works in the approved overburden emplacement area.
- No works above RL50.
- No operation of the mobile processing plant.

Results are provided in **Table 27**.

Table 27 Stage 1 Assessment without asphalt plant operating and with restricted morning shoulder operations[1] (exceedances shown in **bold)**

Receptor	Day / Evening (dBA L_{eq}) 7 am to 10 pm		Early morning shoulder (dBA L_{eq}) 6 am to 7 am		
	Project Criteria	Predicted level	Project criteria	Predicted level (restricted operations[1])	
		Neutral		Neutral	Worst case
R1	41	41	40	35	39
R2	38	30	38	<30	23
R3	51	<30	50	<30	<30
R4	41	34	40	31	36
R5	41	40	40	32	38
R6	38	32	38	31	36
R7	38	<30	38	21	<30
R8 (Holcim)	41	33	40	30	35
R9 (Holcim)	41	38	40	33	38
R10 (Holcim)	38	**44**	38	**42**	**46**

NOTE 1: Restrictions comprise: no works in AOBEA, no works above RL50 and no operation of the mobile processing plant.

Compliance with the project criteria is predicted at all residences that are not owned by Holcim provided that operations are restricted during the early morning shoulder period.

Normal Operations and Asphalt Production

Calculated noise levels at receptor locations during asphalt campaigns are provided in **Table 28**.

Table 28 Stage 1 Assessment with asphalt plant (exceedances shown in **bold)**

	Day / Evening (dBA L_{eq}) 7 am to 10 pm		Early morning shoulder (dBA L_{eq}) 6 am to 7 am			Night (dBA L_{eq}) 10 pm to 6 am	
	Project Criteria	Predicted level	Project criteria	Predicted level (restricted operations[1])		Predicted level (asphalt plant only)	
		Neutral		Neutral	Worst case	Neutral	Worst case
R1	41	**45**	40	**43**	**47**	**42**	**46**
R2	38	31	38	30	34	<30	<30
R3	51	<30	50	<30	<30	<30	<30
R4	41	36	40	35	40	33	39
R5	41	41	40	35	40	32	38
R6	38	32	38	31	36	<30	<30
R7	38	<30	38	<30	<30	<30	<30
R8 (Holcim)	41	33	40	31	35	<30	<30
R9 (Holcim)	41	38	40	34	38	<30	<30
R10 (Holcim)	38	**46**	38	**45**	**49**	**42**	**47**

NOTE 1: Restrictions comprise: no works in AOBEA, no works above RL50 and no operation of the mobile processing plant.

The predicted noise levels are up to 7 dBA above the project criteria at R1 while the asphalt plant is operating. Compliance with the project criteria is predicted at all other residences that are not owned by Holcim, provided that operations are restricted during the early morning shoulder period.

8.1.2 Stage 2

Normal Operations – No Asphalt Production

Predicted operational noise levels for Stage 2 are compared with project criteria in **Table 29**.

Table 29 Stage 2 Assessment, without asphalt plant (exceedances shown in **bold)**

Receptor	**Day / Evening (dBA L_{eq})** 7 am to 10 pm		**Early morning shoulder (dBA L_{eq})** 6 am to 7 am		
	Project Criteria	Predicted level Neutral	Project criteria evening/night	Predicted level Neutral	Predicted level Worst case
R1	41	**46**	40	**43**	**47**
R2	38	36	38	34	**39**
R3	51	>30	50	<30	29
R4	41	36	40	33	39
R5	41	37	40	36	**42**
R6	38	36	38	35	**40**
R7	38	>30	38	>30	30
R8 (Holcim)	41	31	40	30	35
R9 (Holcim)	41	34	40	34	38
R10 (Holcim)	38	**55**	38	**55**	**58**

Calculated noise levels were above the project criteria at R1 and R10 during the day/evening period, and R1, R5, R6 and R10 (Holcim owned residence) under worst case propagation conditions during the early morning shoulder period.

Restricted Morning Shoulder Operations – No Asphalt Production

Noise levels at receptor locations during Stage 2 have been recalculated with restricted operations during the early morning shoulder period. During this time it has been assumed that the following restrictions will be in force:

- No works in the approved overburden emplacement area.
- No works above RL50.
- No operation of the mobile processing plant.

Results are provided in **Table 30**.

Table 30 Stage 2 Assessment without asphalt plant operating and restricted morning shoulder operations[1] (exceedances shown in **bold)**

Receptor	Day / Evening (dBA L_{eq}) 7 am to 10 pm		Early morning shoulder (dBA L_{eq}) 6 am to 7 am		
	Project Criteria	Predicted level Neutral	Project criteria evening/night	Predicted level Neutral	Predicted level Worst case
R1	41	**46**	40	35	39
R2	38	36	38	<30	33
R3	51	>30	50	<30	<30
R4	41	36	40	<30	33
R5	41	37	40	>30	33
R6	38	36	38	>30	33
R7	38	>30	38	>30	<30
R8 (Holcim)	41	31	40	>30	34
R9 (Holcim)	41	34	40	33	37
R10 (Holcim)	38	**55**	38	**52**	**56**

NOTE 1: Restrictions comprise: no works in AOBEA, no works above RL50 and no operation of the mobile processing plant.

During Stage 2, with restricted operations during the early morning shoulder period, compliance with the project criteria is predicted at all residences that are not owned by Holcim. Calculated noise levels are 5 dBA above the criteria at R1 during the day/evening period.

Normal Operations and Asphalt Production

Calculated noise levels at receptor locations during asphalt campaigns are provided in **Table 31**.

Table 31 Stage 2 Assessment, with asphalt plant (exceedances shown in **bold)**

	Day / Evening (dBA L_{eq}) 7 am to 10 pm		Early morning shoulder (dBA L_{eq}) 6 am to 7 am			Night (dBA L_{eq}) 10 pm to 6 am	
	Project Criteria	Predicted level Neutral	Project criteria	Predicted level (restricted operations[1]) Neutral	Worst case	Predicted level (asphalt plant only) Neutral	Worst case
R1	41	**48**	40	**43**	**47**	**42**	**46**
R2	38	36	38	<30	34	<30	<30
R3	51	<30	50	<30	<30	<30	<30
R4	41	38	40	34	40	33	38
R5	41	38	40	33	39	32	37
R6	38	36	38	<30	34	<30	<30
R7	38	<30	38	<30	<30	<30	<30
R8 (Holcim)	41	31	40	30	34	<30	<30
R9 (Holcim)	41	34	40	33	37	<30	<30
R10 (Holcim)	38	**55**	38	**52**	**56**	**42**	**47**

NOTE 1: Restrictions comprise: no works in AOBEA, no works above RL50 and no operation of the mobile processing plant.

The predicted noise levels are up to 7 dBA above the project criteria at R1 while the asphalt plant is operating. Compliance with the project criteria is predicted at all other residences that are not owned by Holcim, provided that operations are restricted during the early morning shoulder period.

8.1.3 Stage 3

Normal Operations – No Asphalt Production

Predicted operational noise levels for Stage 3 are compared with project criteria in **Table 32**.

Table 32 Stage 3 Assessment without asphalt plant operating (exceedances shown in **bold)**

Receptor	Day / Evening (dBA L_{eq})		Early morning shoulder (dBA L_{eq}) 6 am to 7 am		
	Project Criteria	Predicted level Neutral	Project criteria evening/night	Predicted level Neutral	Worst case
R1	41	**46**[1]	40	**43**	**48**
R2	38	**40**[1]	38	**40**	**45**
R3	51	<30	50	<30	<30
R4	41	36	40	32	38
R5	41	37	40	34	40
R6	38	**40**[1]	38	**40**	**44**
R7	38	36	38	36	**41**
R8 (Holcim)	41	30	40	30	34
R9 (Holcim)	41	33	40	33	37
R10[2] (Holcim)	38	NA	38	NA	NA

NOTE 1: Dominant sources works at RL74.
NOTE 2: Site residence removed during Stage 3.

Calculated noise levels were above the project criteria at R1, R2 and R6 during the day/evening period, and R1, R2, R6 and R7 under worst case propagation conditions during the early morning shoulder period.

Restricted Morning Shoulder and Day/Evening Operations – No Asphalt Production

Noise levels at receptor locations during Stage 3 have been recalculated assuming no works at or above RL74 during the day/evening period and with restricted operations during the early morning shoulder period. During the early morning shoulder period it has been assumed that there will be:

- No works in the approved overburden emplacement area.
- No works above RL50.
- No operation of the mobile processing plant.

Results are provided in **Table 33**.

Table 33 Stage 3 Assessment without asphalt plant operating; restricted morning shoulder operations[1] and no works at or above RL74 during the day/evening[2] (exceedances shown in **bold)**

Receptor	Day / Evening (dBA L_{eq})		Early morning shoulder (dBA L_{eq}) 6 am to 7 am		
	Project Criteria	Predicted level[1] Neutral	Project criteria evening/night	Predicted level[2] Neutral	Worst case
R1	41	**45**	40	34	38
R2	38	33	38	<30	34
R3	51	<30	50	<30	<30
R4	41	33	40	<30	33
R5	41	35	40	<30	35
R6	38	35	38	<30	32
R7	38	<30	38	<30	<30
R8 (Holcim)	41	30	40	<30	33
R9 (Holcim)	41	33	40	32	36
R10[3] (Holcim)	38	NA	38	NA	NA

NOTE 1: No works at or above RL74.
NOTE 2: Restrictions comprise: no works in AOBEA, no works above RL50 and no operation of the mobile processing plant.
NOTE 3: Site residence removed during Stage 3.

The recalculated day/evening noise levels demonstrate that noise levels predicted for R2 and R6 in **Table 33** are due to works on the uppermost benches of the quarry and are unlikely to occur during works below RL74. However even with these restricted operations, noise levels at R1 are predicted to exceed the project criteria during the day/evening period.

Compliance with the project criteria is predicted for all receptor locations apart from R1 during the early morning shoulder period, assuming limited operations at this time.

Normal Operations and Asphalt Production

Calculated noise levels at receptor locations during asphalt campaigns are provided in **Table 34**.

Table 34 Stage 3 Assessment, with asphalt plant (exceedances shown in **bold)**

	Day / Evening (dBA L_{eq}) 7 am to 10 pm		Early morning shoulder (dBA L_{eq}) 6 am to 7 am			Night (dBA L_{eq}) 10 pm to 6 am	
	Project Criteria	Predicted level Neutral	Project criteria	Predicted level (restricted operations[1]) Neutral	Worst case	Predicted level (asphalt plant only) Neutral	Worst case
R1	41	**48**	40	**43**	**46**	**42**	**46**
R2	38	**40[2]**	38	<30	35	<30	<30
R3	51	<30	50	<30	<30	<30	<30
R4	41	36	40	34	40	33	39
R5	41	37	40	33	39	32	37
R6	38	**40[2]**	38	28	33	<30	<30
R7	38	36	38	<30	<30	<30	<30
R8 (Holcim)	41	30	40	<30	33	<30	<30

	Day / Evening (dBA L_{eq}) 7 am to 10 pm		**Early morning shoulder (dBA L_{eq})** 6 am to 7 am			**Night (dBA L_{eq})** 10 pm to 6 am	
	Project Criteria	Predicted level	Project criteria	Predicted level (restricted operations[1])		Predicted level (asphalt plant only)	
		Neutral		Neutral	Worst case	Neutral	Worst case
R9 (Holcim)	41	33	40	32	36	<30	<30
R10 (Holcim)	38	NA	38	NA	NA	NA	NA

NOTE 1: Restrictions comprise: no works in AOBEA, no works above RL50 and no operation of the mobile processing plant.

NOTE 2: Dominant contributing sources – works undertaken at RL74.

The predicted noise levels are up to 7 dBA above the project criteria during the daytime/evening period and up to 6 dBA above the project criteria during the morning shoulder and night periods at R1 while the asphalt plant is operating. Noise levels at R2 and R6 are 2 dBA above the daytime/evening criteria due to normal quarry works at RL74 and above, rather than due to operation of the asphalt plant. Compliance with the project criteria is predicted at all other residences provided that operations are restricted during the early morning shoulder period.

8.1.4 Summary

Restricted operations – No asphalt production

Compliance with the early morning shoulder project criteria is predicted at all receptor locations and for all stages of the quarry life, provided that operations are restricted during this time and the asphalt plant is not in production. The proposed restrictions include: no works in the approved overburden emplacement area; no works above RL50, and no operation of the mobile processing plant.

For the day/evening period:

- During Stage 1, compliance with the project criteria is predicted at all non-Holcim residences.
- During Stage 2, compliance with the project criteria is predicted at all non-Holcim residences apart from R1.
- During Stage 3, compliance is predicted at all non-Holcim residences apart from R1, R2 and R6. The predicted noise levels at R2 and R6 are above the criteria by a marginal amount (2 dBA) and are predicted to occur whilst works are at or above RL74. Works at lower benches are predicted to comply with the project daytime criteria at R2 and R6.

Normal operations – Including asphalt production

Noise from asphalt production predominantly affects R1 and R10 (Holcim owned residence) during all stages of the quarry development, as these receptor locations have a line of sight to the asphalt plant. The predicted levels at R1 are up to 7 dBA above the project criteria.

8.2 Off Site Road Traffic

The future change in road traffic noise attributable to the Project has been calculated using the CoRTN prediction algorithms and taking into consideration:

- The existing traffic movements on the Pacific Highway as provided in the Traffic Impact Assessment (TUP Report, June 2014).
- 186 heavy vehicle movements (93 inbound and 93 outbound) on any single day. This figure corresponds to the 85 percentile of the day movements as provided in the TUP report dated 24 June 2014.

- 100 heavy vehicle movements during the night period (after 10 pm and before 7:00 am). This figure corresponds to the predicted level of heavy vehicle movements at night during asphalt production campaigns.
- A 50% north south split of truck movements from the site.

The predicted changes in road traffic noise levels are:

- 0.3 dB during the day period
- 1.9 dB during the night period

The changes are below the threshold of +2 dBA and therefore no further investigations or controls have been considered.

8.3 Sleep Disturbance

Noise generated during the early morning shoulder period and during night time operation of the asphalt plant has the potential to cause sleep disturbance.

Predicted maximum noise levels at all receptor locations are compared with the project sleep disturbance criteria in **Table 35**.

Table 35 Sleep disturbance assessment (exceedances shown in **bold)**

Receptor	**Sleep Disturbance Noise Emission Design Goal (LA1(1minute)) dBA**	**Predicted level** Worst case meteorological conditions	**Noise source**
R1	51	**52**	Stage 3 - Haul truck on south bench, RL74
R2	48	47	Stage 3 – Excavator removing OB from south bench, RL74
R3	63	< 30	
R4	51	43	Asphalt plant (all stages)
R5	51	42	Asphalt plant (all stages)
R6	48	47	Stage 3 – Excavator removing OB from south bench, RL74
R7	48	45	Stage 3 – Excavator removing OB from south bench, RL74
R8 (Holcim)	51	< 30	
R9 (Holcim)	51	< 30	
R10 (Holcim)	48	**54**	Primary processing plant (all stages)

Table 35 indicates noise levels are above the project sleep disturbance criteria by 1 dBA at R1 and 4 dBA at R10 (Holcim owned residence) during worst case meteorological conditions. The noise levels are predicted to occur at R1 during works on the upper southern and eastern benches of the quarry (at or above RL74) during Stages 2 and 3, and at R10 during operation of the primary processing plant during all stages.

The proposed restricted operations during the early morning shoulder period will ensure that noise levels do not exceed sleep disturbance criteria at R1. The level predicted R10 (the Holcim owned residence) is above the INP design goals but well below the 60 to 65 dBA (external) sleep disturbance levels identified in the *Road Noise Policy*.

8.4 Blast Emissions

8.4.1 Proposed Blasting Practices

The proposed method of material extraction for the Project is by drill and blast techniques incorporating free-face blasting. A summary of indicative blast design details is presented in **Table 36**.

Table 36 Indicative blast design details

Parameter	Free-Face
Bench height	Up to 15 m
Sub-drill	0.5 m
Stemming (using 14 mm aggregate)	2.8 m
Blasthole diameter	89 mm
Blasthole inclination (to vertical)	10^{o}
Blasthole spacing	3.2 m
Burden	2.8 m
Maximum Instantaneous Charge (MIC)	137 kg (for 12 m bench)[1]

NOTE 1: Jandra Quarry do not propose to blast with MICs greater than 137 kg.

8.4.2 Blast Emission Levels

The blasting site laws developed from the blast emission data obtained from similar quarries in NSW have been used to assess the blasting impacts from the Project.

The ground vibration and airblast criteria advocated by the EPA and the ANZEC Guidelines cater for the inherent variation in emission levels from a given blast design, by allowing a five percent exceedance of a general criterion up to a (never to be exceeded) maximum. Correspondingly, the "5% exceedance" prediction formulae were generated in the blast emission site laws.

The resulting 5% site laws for ground vibration and airblast are:

Ground Vibration

$$PVS\ (mm/s)\ (5\%) = 150\ (SD)^{-0.91} \qquad \textit{(equation 1)}$$

Airblast

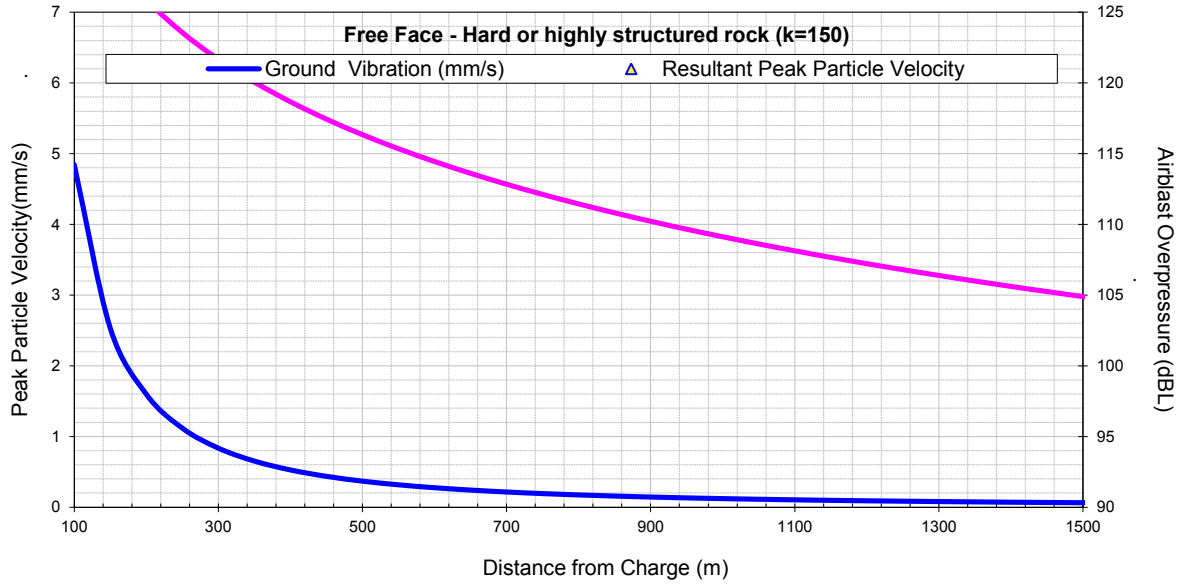
$$SPL\ (dBL)\ (5\%) = 152.7 - 18.8 \log (SD) \qquad \textit{(equation 2)}$$

where PVS (5%) and SPL (5%) are the levels of ground vibration (Peak Vector Sum - mm/s) and airblast (dB Linear) respectively, above which 5% of the total population (of data points) will lie, assuming that the population has the same statistical distribution as the underlying measured sample.

PVS = Peak Vector Sum ground vibration level (mm/s)
dB = Peak airblast level (dB Linear)
R = Distance between charge and receiver (m)
Q = Charge mass per delay (kg)

The relationship between distance and the peak vector sum (PVS) ground vibration and peak airblast from the quarry blasting are presented in **Table 5** respectively for a MIC of 137 kg (corresponding to firing a full 12 m bench).

Figure 8 Peak Vector Sum Ground Vibration and Airblast for an MIC of 137 kg



Calculations have been conducted to identify the maximum instantaneous charge (MIC) that allows the ANZEC Guidelines to be met at the closest non-Holcim owned residence. All Holcim owned residences will be evacuated during blasting in accordance with the Jandra Quarry blast management procedure. Results are provided in **Table 37**.

Table 37 Highest acceptable MIC (kg) to meet ANZEC Guidelines for human comfort

Stage	Bench	Closest receptor	Distance from blast (m)	Highest Acceptable MIC (kg) determined from:		Maximum acceptable MIC (kg)
				Ground Vibration	Peak Airblast	
1	North	R1	750	300	400	300
	South	R3	960	500	900	500
	East	R1	700	270	350	270
2	North	R1	570	180	185	180
	South	R1	650	240	280	240
	East	R1	640	230	260	230
3	North	R1	500	140	125	125
	South	R2	730	300	380	300
	East	R1	550	170	160	160

Jandra Quarry do not propose to use MICs greater than 137 kg. As such, compliance with the guidelines is predicted at all receptor locations, for all blasts and at all stages of the quarry life, apart from R1 during Stage 3. Blasts on the northern benches during this stage of the quarry expansion should be restricted to a MIC of 125 kg.

Provided that the guidelines in **Table 37** are met:

- The predicted levels of ground vibration at all nearby residences will comply with the ANZEC general human comfort criterion (of 5 mm/s) and consequently with the BS 7385 structural damage criterion of 15 mm/s (at 4 Hz);

- The predicted levels of peak airblast at all residences will comply with the ANZEC general human comfort criterion of 115 dB Linear; and
- The predicted levels of peak airblast will be well below the US Bureau of Mines damage limit of 132 dB Linear (2 Hz cut off) at all residences.

Notwithstanding the above, it is recommended that all blasts are monitored at the closest/potentially most affected residence in order to establish compliance with the nominated criteria and to progressively update the blast emissions site laws (ground vibration and airblast) in order to optimise future blast designs, based on actual site conditions. In this way, the site laws can be used to assist with the blast designs in order to ensure compliance with the ANZEC criteria at all nearby residences.

By adopting this approach, in conjunction with the inevitable future introduction of improved blasting products, it is anticipated that the blast emissions criteria can be met without imposing any unnecessary constraints on the blast designs throughout the life of the quarry.

9 NOISE AND VIBRATION MANAGEMENT AND MITIGATION

The following conceptual advice is provided for managing noise emissions from the Project.

9.1 Day / Evening Operations (excluding asphalt production)

Noise levels from quarry operations that are 5 dBA above the day / evening project criteria, which are not directly attributable to the asphalt plant, are predicted at R1 during Stages 2 and 3. The levels are due to works on the upper southern and eastern benches of the pit.

Noise levels from quarry operations that are a marginal 2 dBA above the day / evening project criteria, which are associated with works at or above RL74 in the southern and eastern part of the quarry pit, are predicted at R2 and R6 during Stage 3.

The predicted day / evening noise levels at R1, R2 and R6 fall inside the INP Noise Management Zone. As such the following management procedures may be investigated as an alternative to noise mitigation.

- Prompt response to any community issues of concern.
- Noise monitoring on site and within the community.
- Refinement of on-site noise mitigation measures and plant operating procedures where practical.
- Consideration of acoustical mitigation at receivers.
- Consideration of negotiated agreements with property holders.

Whilst the predicted noise levels do not meet the INP intrusiveness criteria, they are below the 45 dBA $L_{eq,15\ mins}$ amenity criterion at R2 and R6, and marginally (1 dBA) above the amenity criterion at R1.

Holcim intends to discuss the predicted noise levels with the property holders, and attempt to negotiate an agreement. This approach is considered appropriate given that the predicted noise levels are not greater than 5 dBA above the project criteria and are only predicted to occur when works are at or above RL74, in the southern and eastern extents of the pit, during Stages 2 and 3.

To minimise noise intrusion due to source tonality, it is recommended that broadband ‘quacker’ type reversing beepers are used on all site vehicles operated in the approved overburden emplacement area, and on the upper southern and eastern benches during Stages 2 and 3.

9.2 Early Morning Shoulder Period

The following restrictions are proposed for the early morning shoulder periods and are predicted to ensure compliance with the project criteria for all stages of the quarry’s life:

- No works in the quarry pit above RL 50
- No dumping or redistribution of overburden in the approved overburden emplacement area.
- No operation of the mobile processing plant.

9.3 Asphalt Plant

Noise from operation of the asphalt plant during campaigns is predicted to affect R1 and R10 (Holcim owned residence), with noise levels of up to 7 dBA above the project criteria predicted at R1. Holcim intend to pursue a negotiated agreement with the property holder of R1. Alternatively, compliance with the criterion could be achieved by constructing a noise barrier immediately east of the asphalt plant. The extent and height and location of the barrier can be determined during detailed noise control design.

9.4 On site residence (R10)

Compliance with the project noise and vibration criteria is not readily achieved at this location. This is a Holcim owned residence and acceptance of exposure to noise above the criteria would be a condition of occupancy. R10 falls within the footprint of the Stage 3 extraction area. When the extraction area reaches R10 this resident's lease agreement will be terminated and the residence will be demolished.

9.5 Blast Emissions

Blasting only takes place between 9:00 am and 5:00 pm Monday to Friday and 9:00 am to 3:00 pm Saturdays. Blasting does not occur on public holidays.

Occupants of Holcim owned residences are to be evacuated during blasts in accordance with the Jandra Quarry blast management procedure.

To control ground borne vibration and airblast to non-Holcim receptors, the MIC for blasts on the northern benches during Stage 3 should be restricted to 125 kg.

It is also recommended that all blasts are monitored at the closest non-Holcim residence in order to establish compliance with the nominated criteria and to progressively update the blast emissions site laws.

10 CONCLUSION

This report presents the results of findings of the potential impacts of construction and operation of the Jandra Quarry Intensification Project, located approximately 17 km south of Taree. The findings and recommendations of the assessment are summarised below.

Operational Noise

One residential receptor location was identified as particularly susceptible to operational noise impacts. R1 (15418 Pacific Highway), is approximately 500 m north of the quarry processing area and pit, and has a line of sight to both the asphalt plant and to upper eastern and southern benches of the quarry. An additional two receptors, R2 and R6, to the east of the quarry, are predicted to be exposed to noise levels marginally (2 dBA) above the project criteria during Stage 3 of the quarry life, as the quarry pit extends eastward. Holcim intend to pursue negotiated agreements with these three property holders regarding exceedances of the project noise criteria.

During the early morning shoulder period, when noise enhancing meteorological conditions can be expected and lower noise limits apply, noise levels above the project criteria are predicted at a number of receptor locations. Recommendations have been provided in this report for managing the predicted noise levels by restricting operation during this time.

The following additional controls are also proposed:

- Use of broadband reversing beepers for all on site vehicles operated in the approved overburden emplacement area, and on the upper southern and eastern benches during Stages 2 and 3.
- Reassignment of the on-site Holcim owned residence R10, to non-residential use during Stage 2.

It should be noted that the above assessment has been conducted for the hours of operation provided in **Section 1.1**; the equipment listed in **Table 22** and for operational scenarios presented **Table 23**, **Table 24** and **Table 25** of this report. Changes in equipment and/or practices from those on which this report is based, could result in changes to noise levels at residential receptor locations.

Road Traffic Noise

The calculated increase in road traffic noise is less than 2 dBA and does not trigger the requirement for further investigation or controls.

Sleep Disturbance

Operational noise from the quarry is predicted to marginally exceed project sleep disturbance criteria at R1 and R10 (Holcim owned residence). The level predicted at R1 will not occur if the operational restrictions proposed for the early morning shoulder period in **Section 9** are implemented. The predicted level at R10, while above the INP sleep disturbance goals, is well below the 60 to 65 dBA (external) sleep disturbance levels identified in the *Road Noise Policy*.

Blast Emissions

Guidance has been provided in **Section 8.4.2** for controlling airblast and ground vibration to residential receptor locations. Jandra Quarry do not propose to use MICs greater than 137 kg. As such, compliance with the guidelines is predicted at all receptor locations, for all blasts and at all stages of the quarry life, apart from R1 during Stage 3. Blasts on the northern benches during this stage of the quarry expansion should be restricted to a MIC of no greater than 125 kg to comply with blasting guidelines.

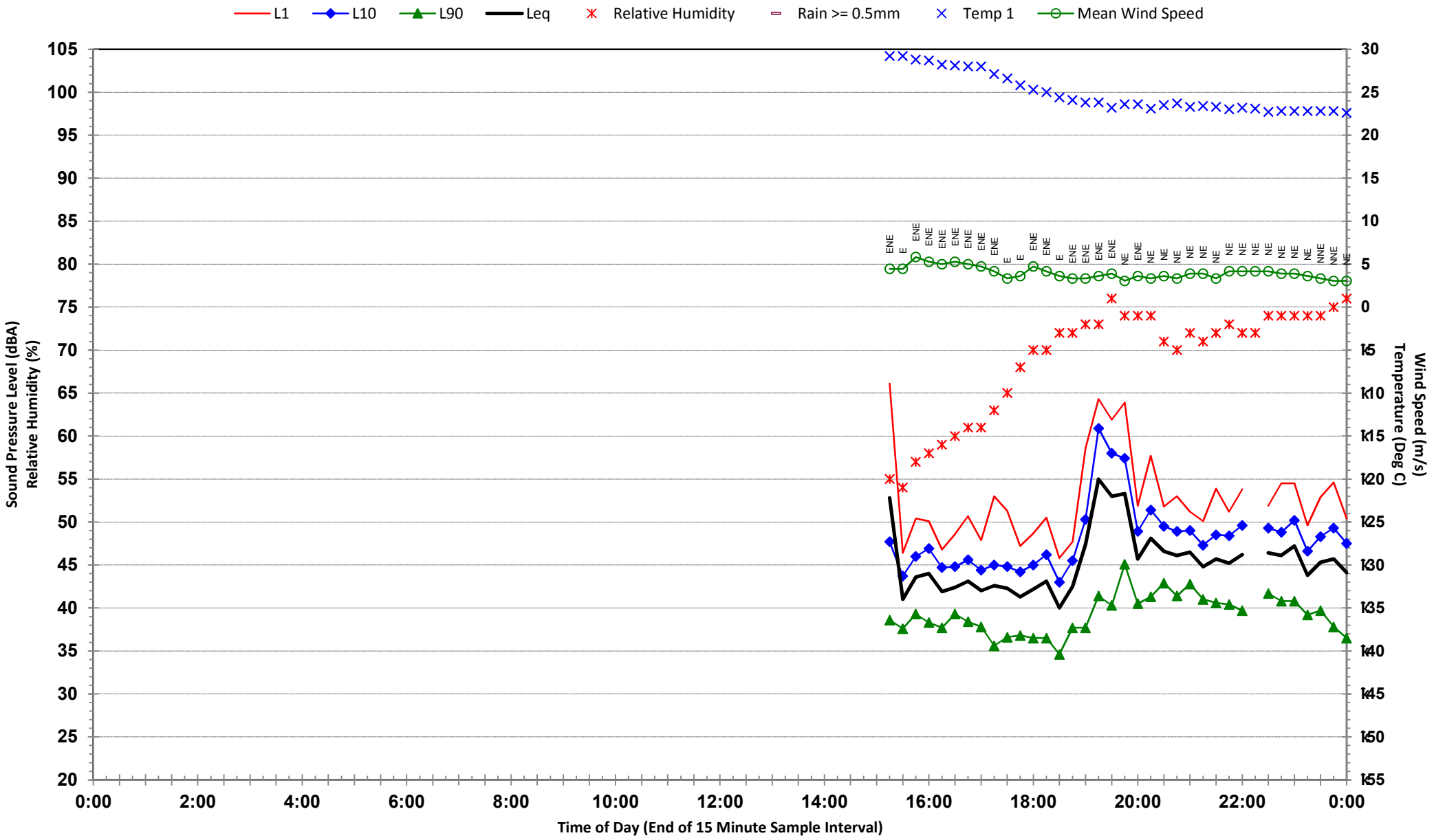
Unattended Noise Monitoring Results

Receptor Location 1: Loveday Residence

26 February to 5 March 2014

Statistical Ambient Noise Levels

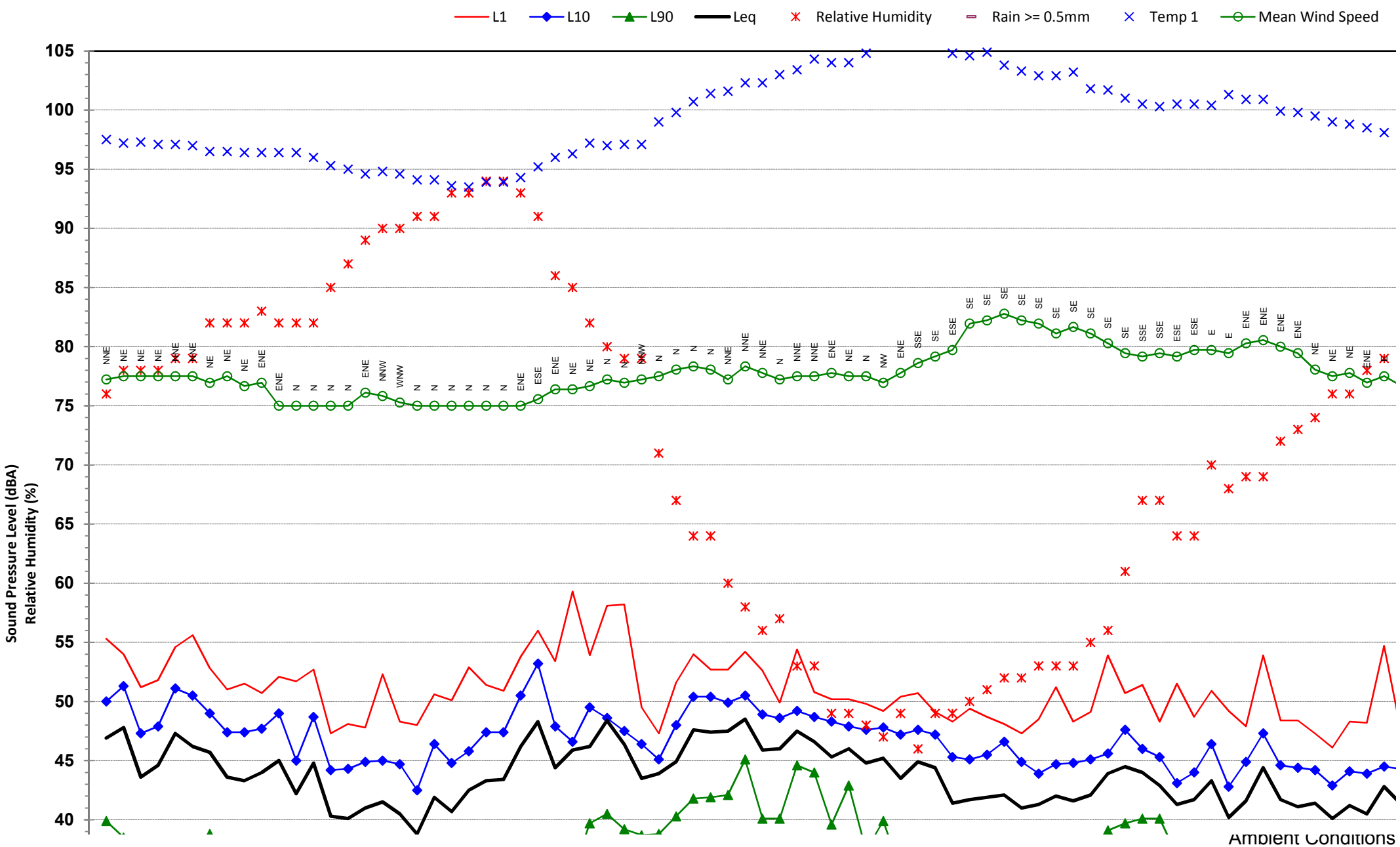
16-306-039 - Wednesday 26 February 2014



Ambient Conditions
Heggies Report 610.13023

Statistical Ambient Noise Levels

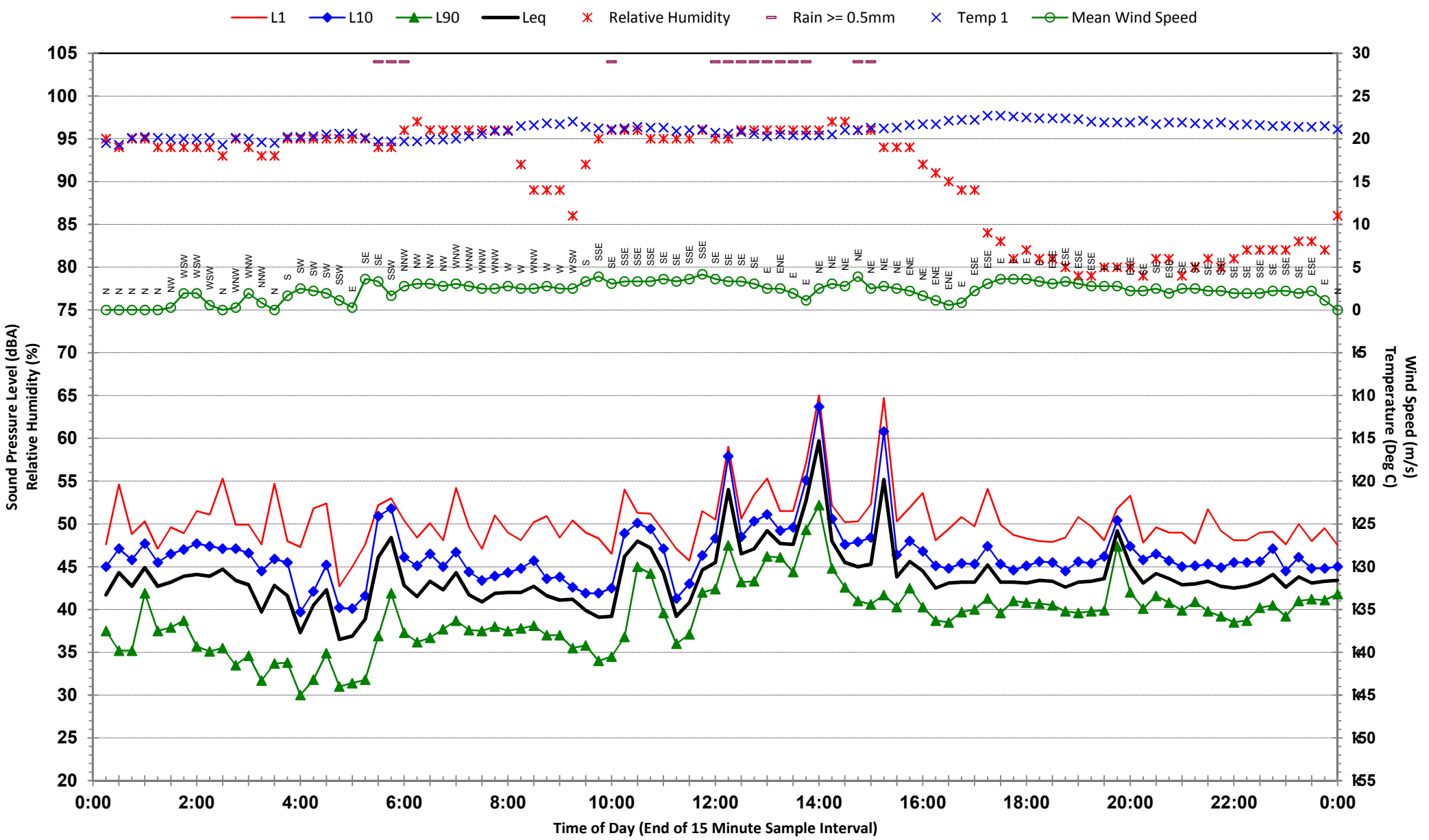
16-306-039 - Thursday 27 February 2014



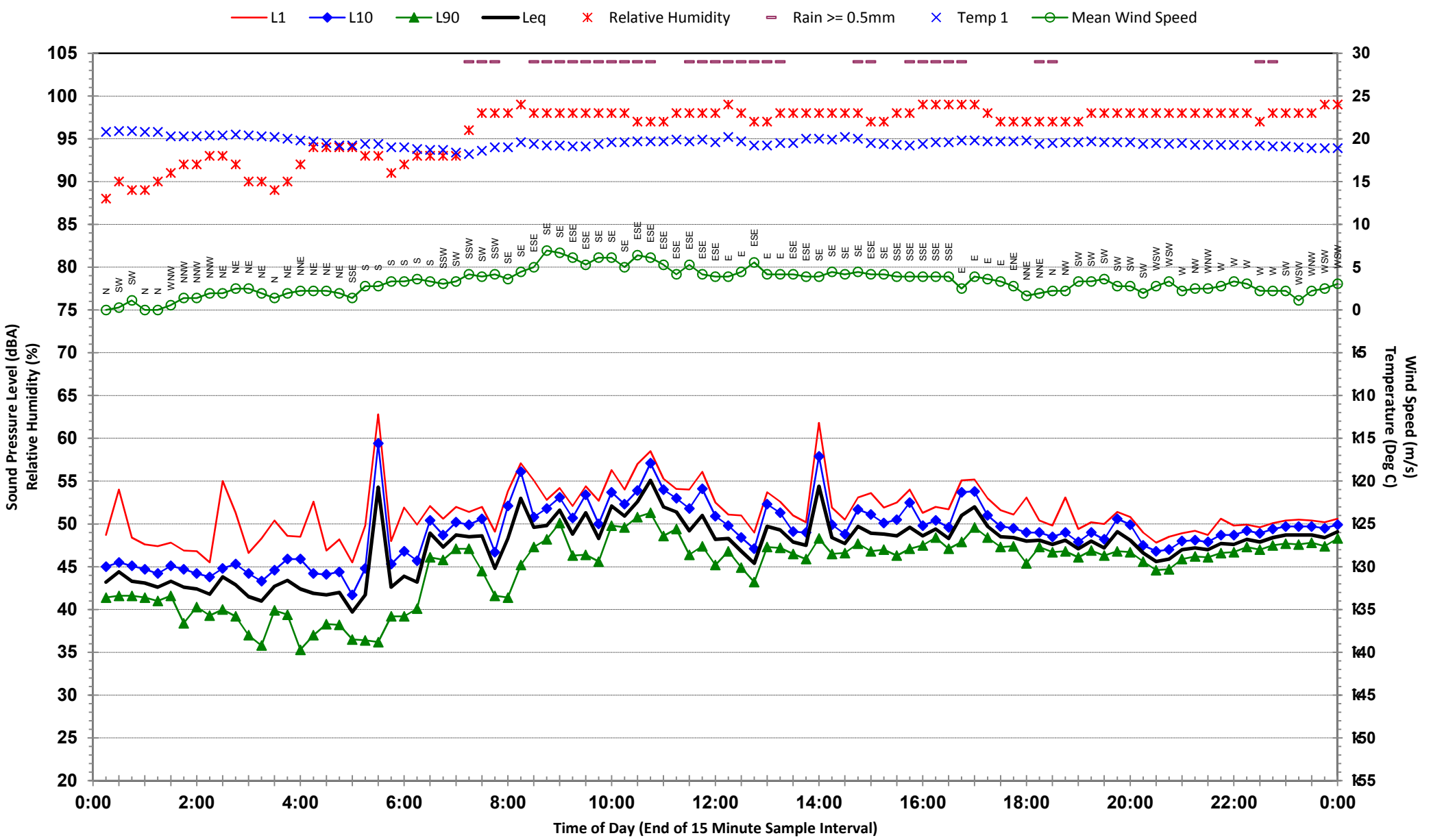
Ambient Conditions

Heggies Report 610.13023

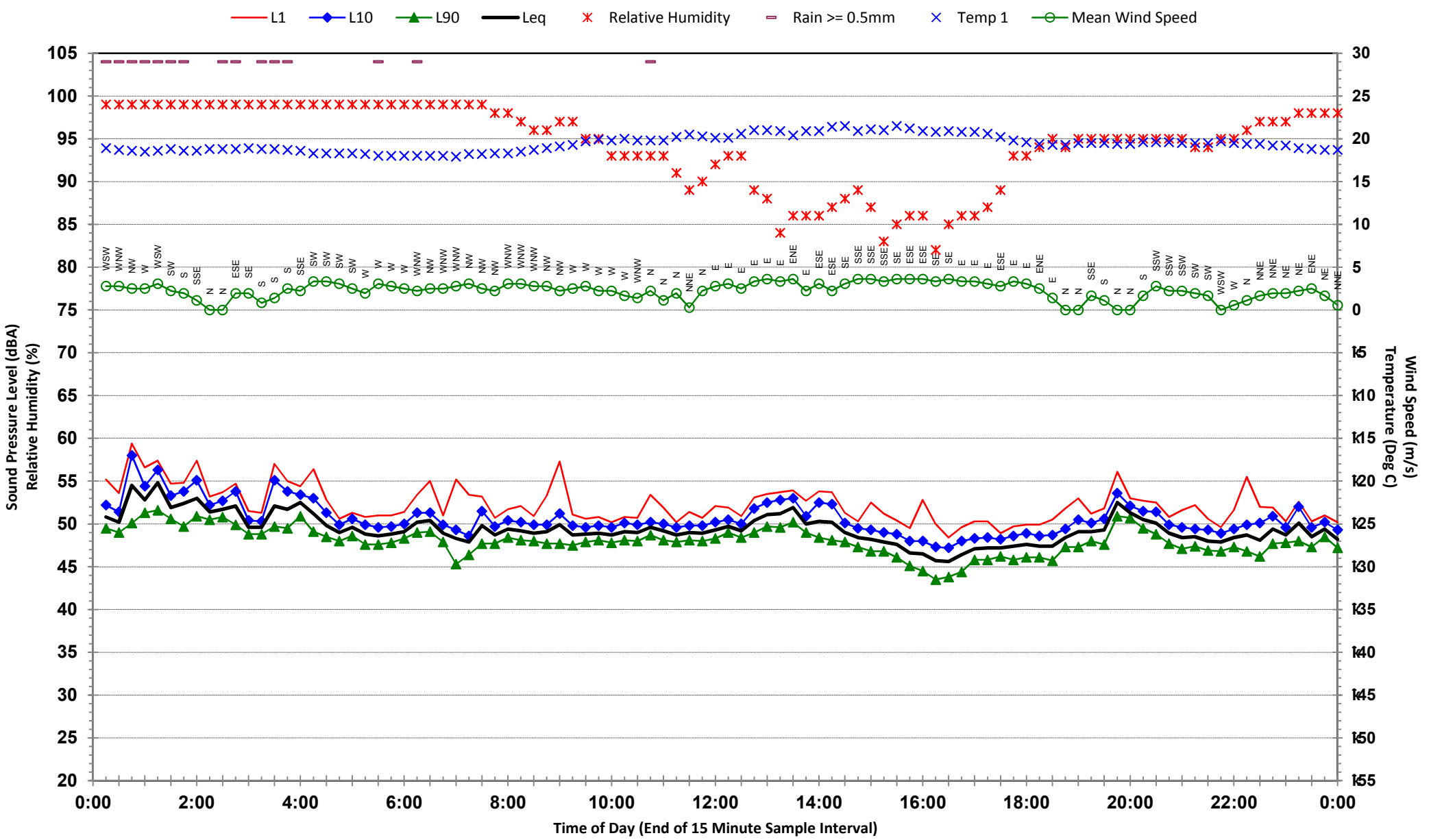
Statistical Ambient Noise Levels
16-306-039 - Friday 28 February 2014



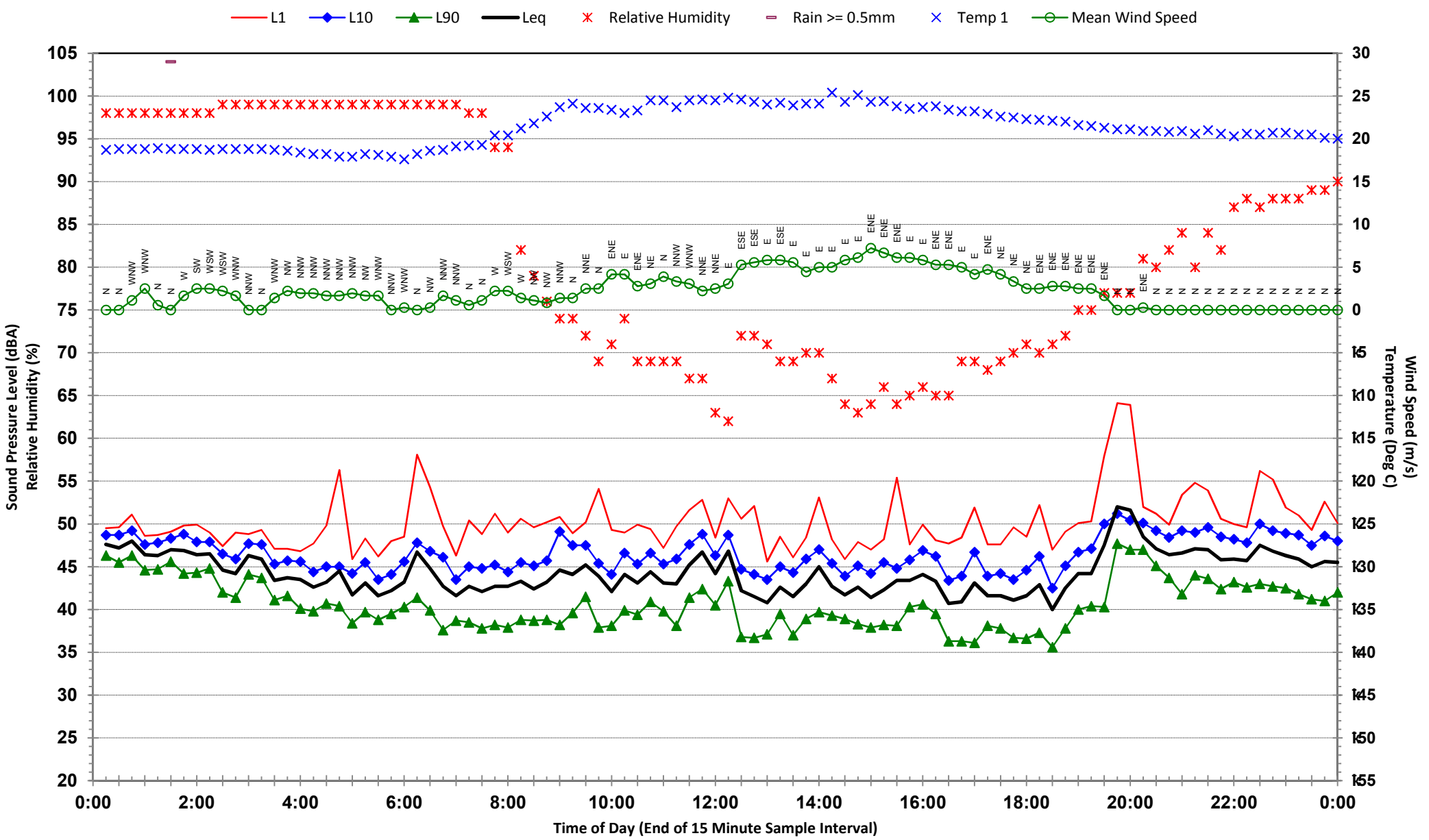
Statistical Ambient Noise Levels
16-306-039 - Saturday 1 March 2014



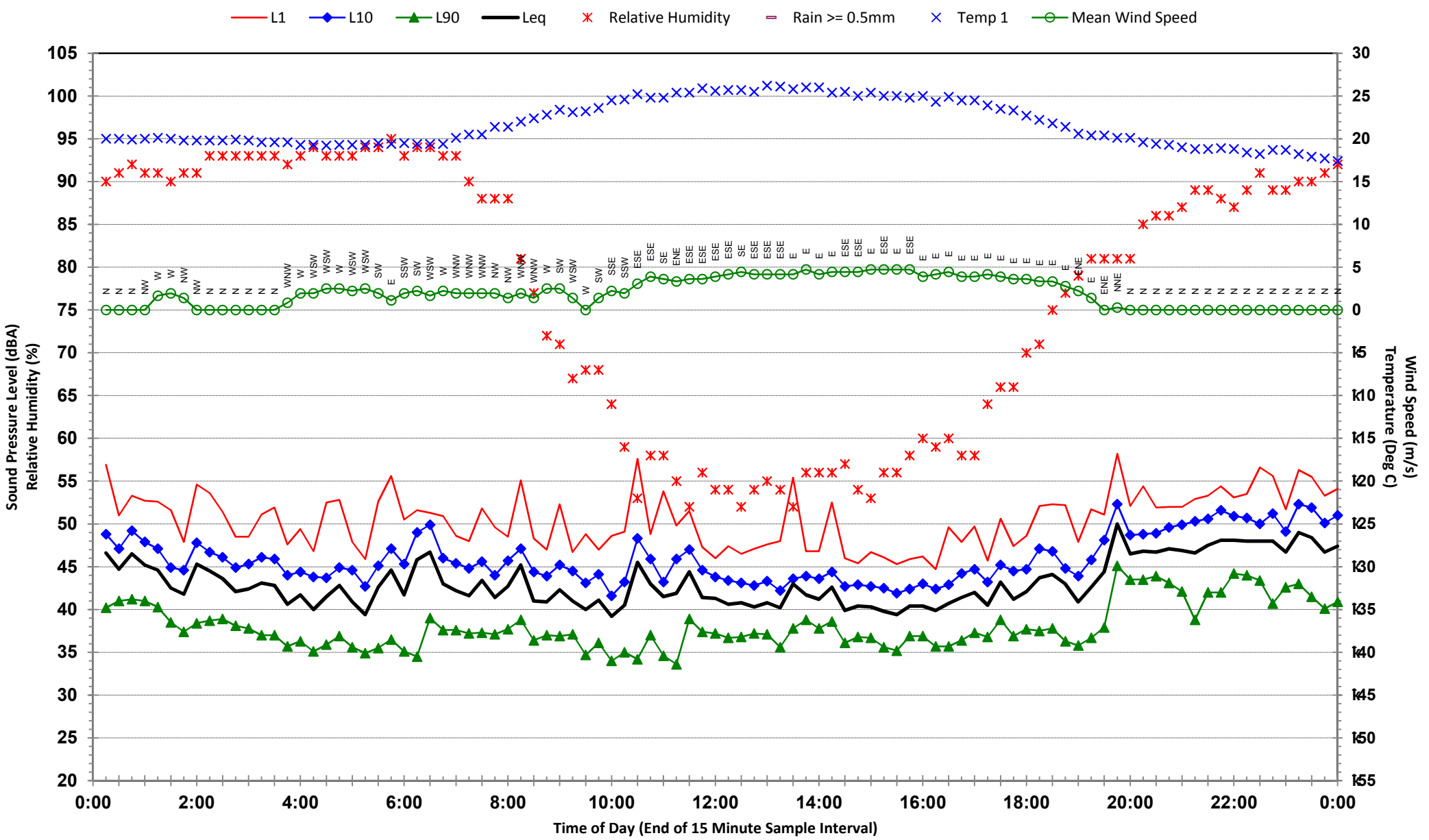
Statistical Ambient Noise Levels
16-306-039 - Sunday 2 March 2014



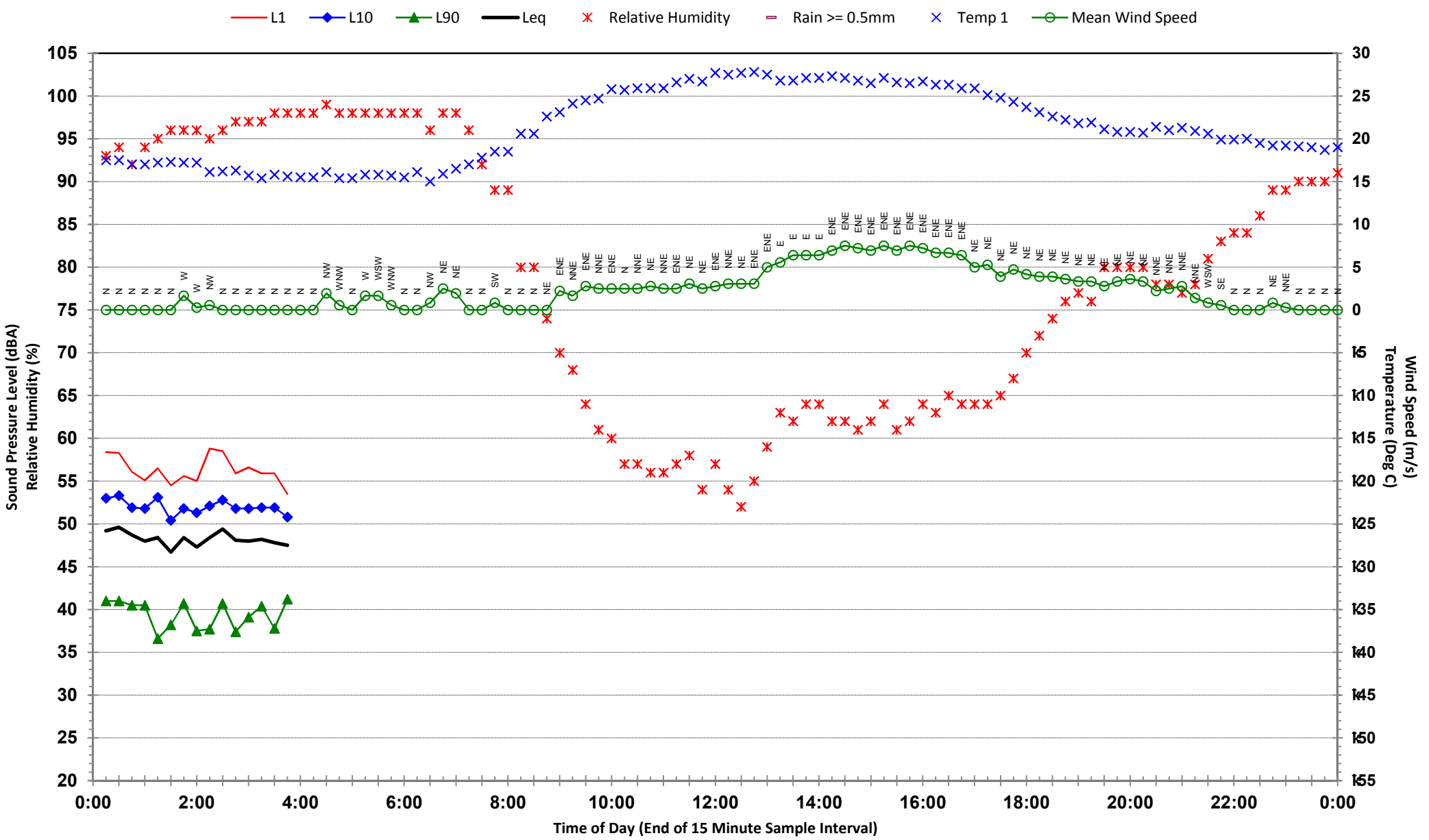
Statistical Ambient Noise Levels
16-306-039 - Monday 3 March 2014



Statistical Ambient Noise Levels
16-306-039 - Tuesday 4 March 2014



Statistical Ambient Noise Levels
16-306-039 - Wednesday 5 March 2014



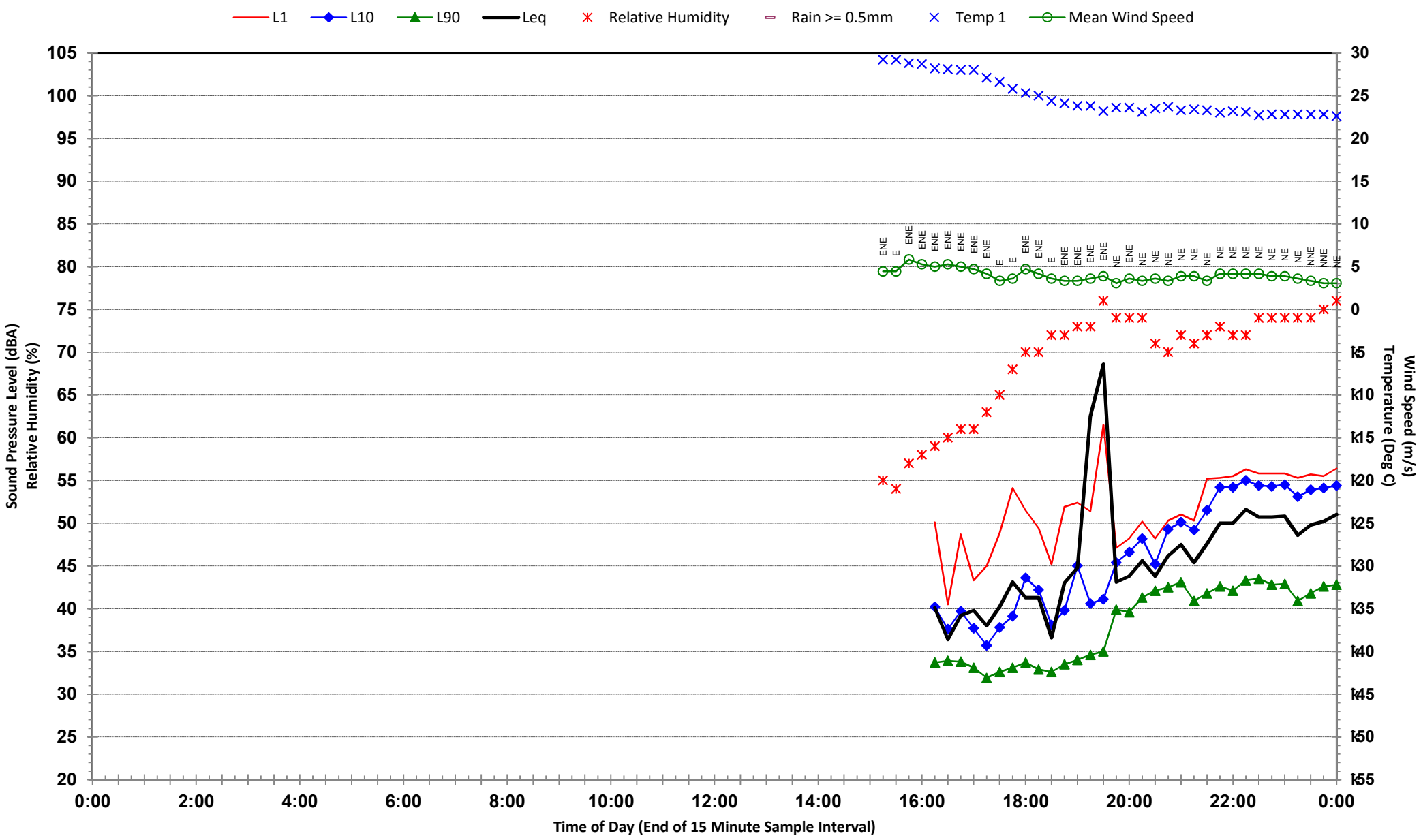
Unattended Noise Monitoring Results

Receptor Location 2: 112 Spicers Road, Rainbow Flat

26 February to 9 March 2014

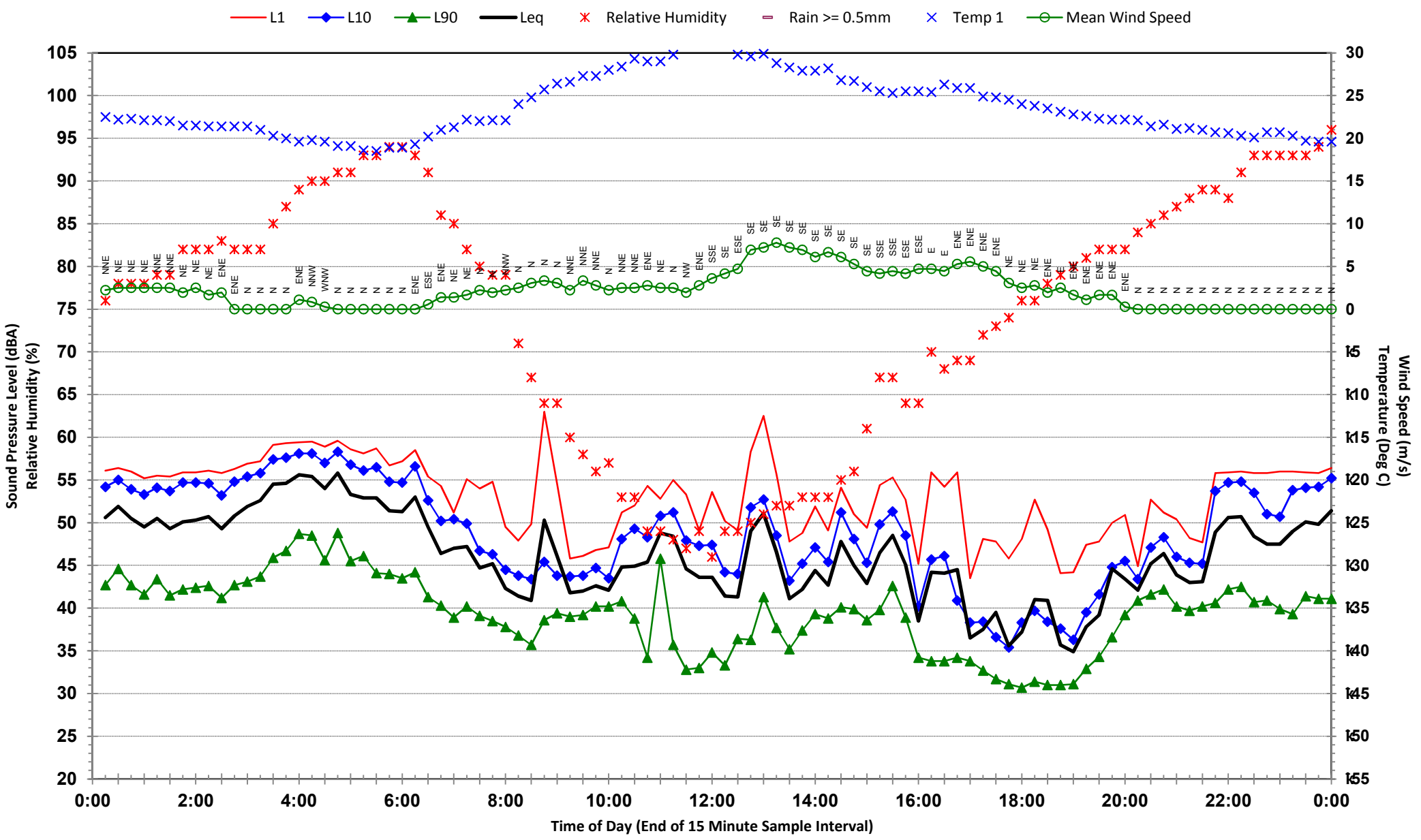
Statistical Ambient Noise Levels

16-203-509 - Wednesday 26 February 2014

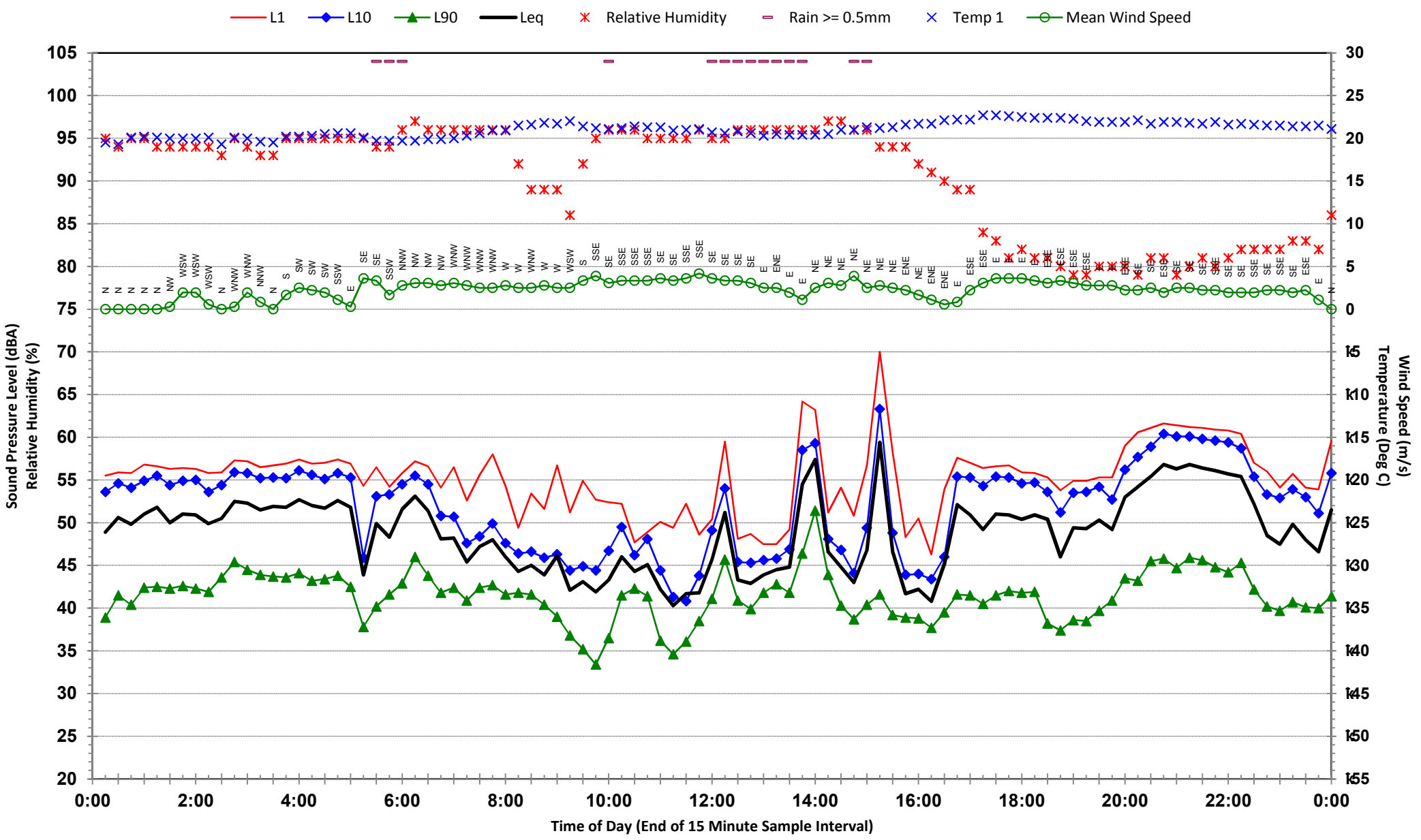


Ambient Conditions
Heggies Report 610.13023

Statistical Ambient Noise Levels
16-203-509 - Thursday 27 February 2014



Statistical Ambient Noise Levels
16-203-509 - Friday 28 February 2014



Statistical Ambient Noise Levels
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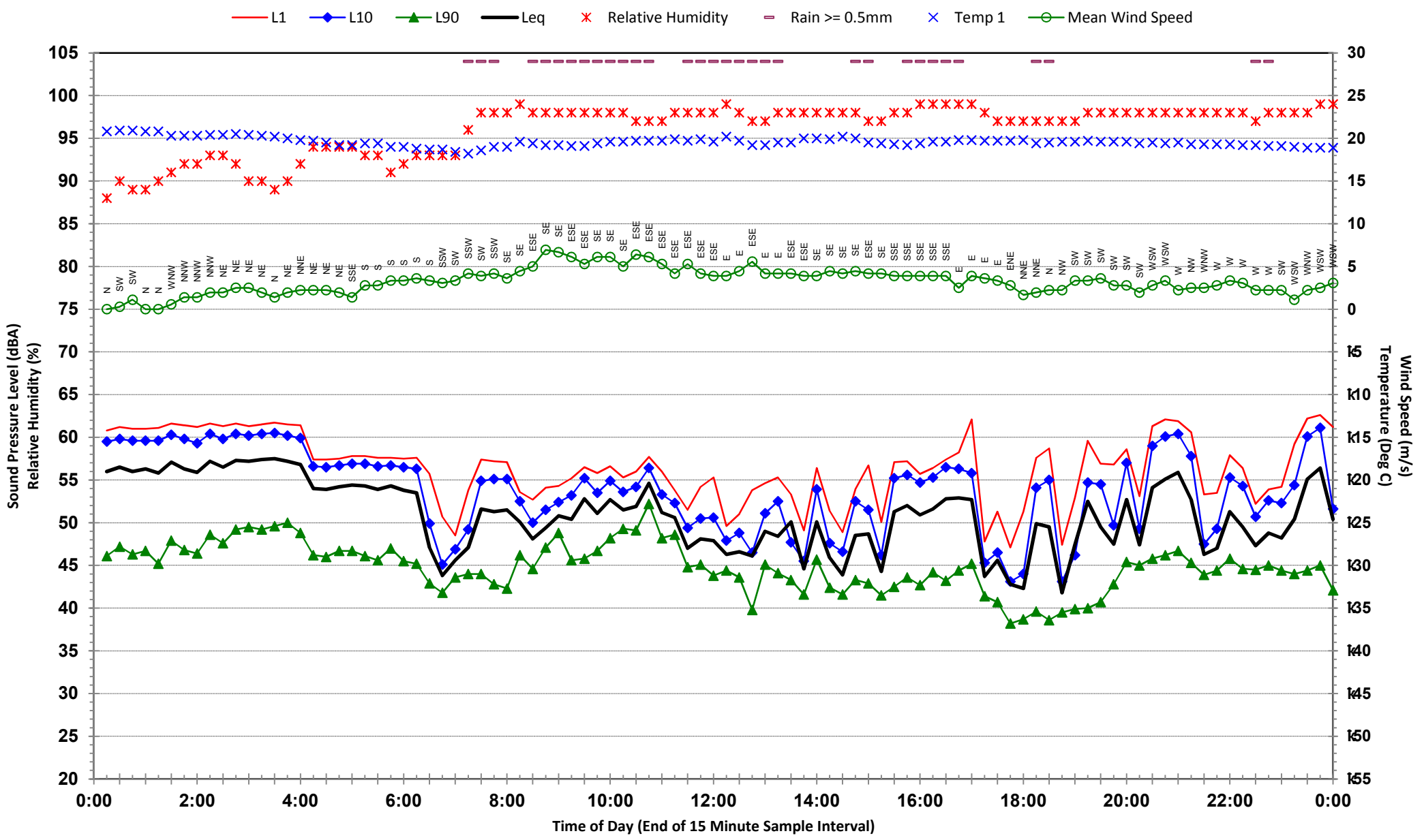
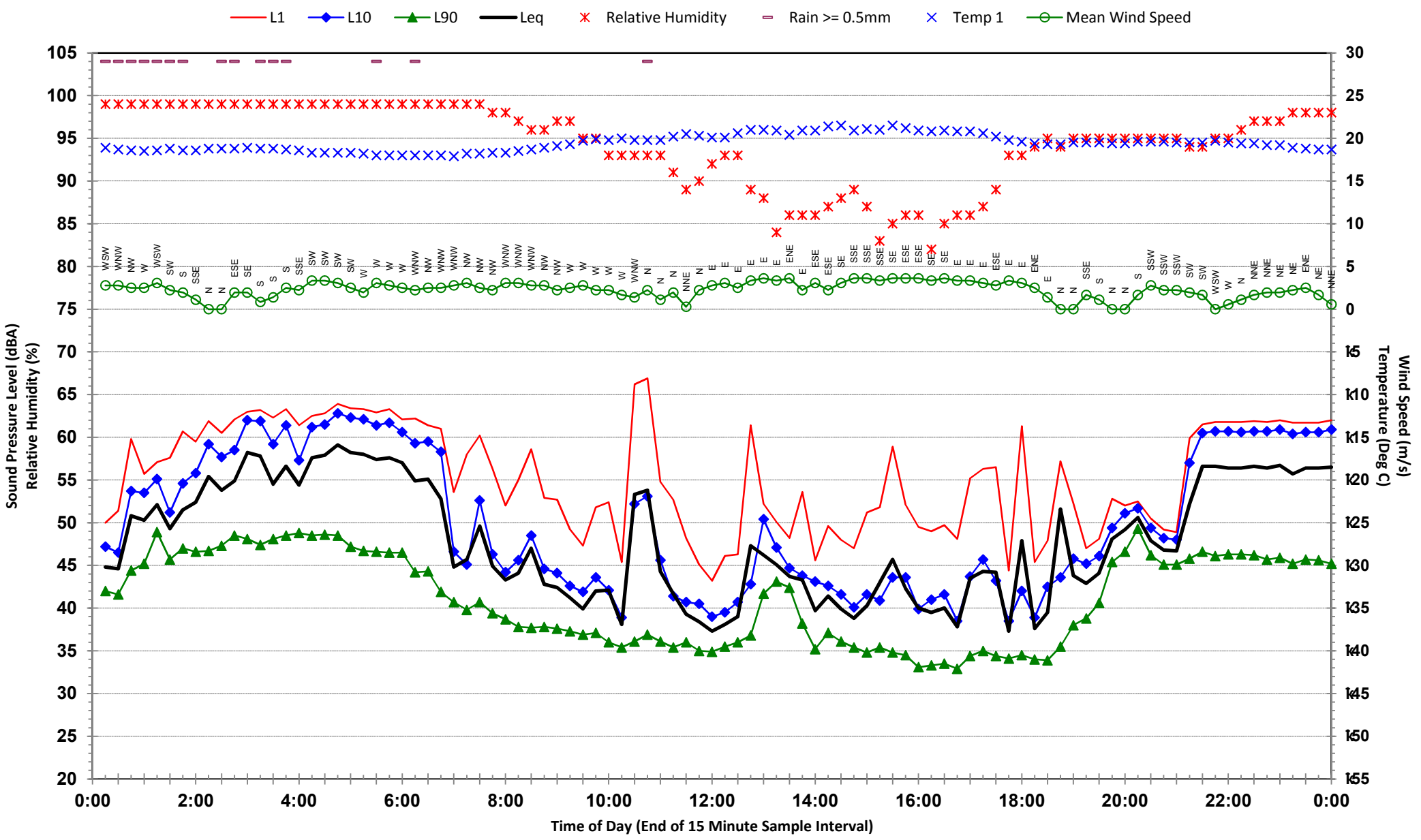
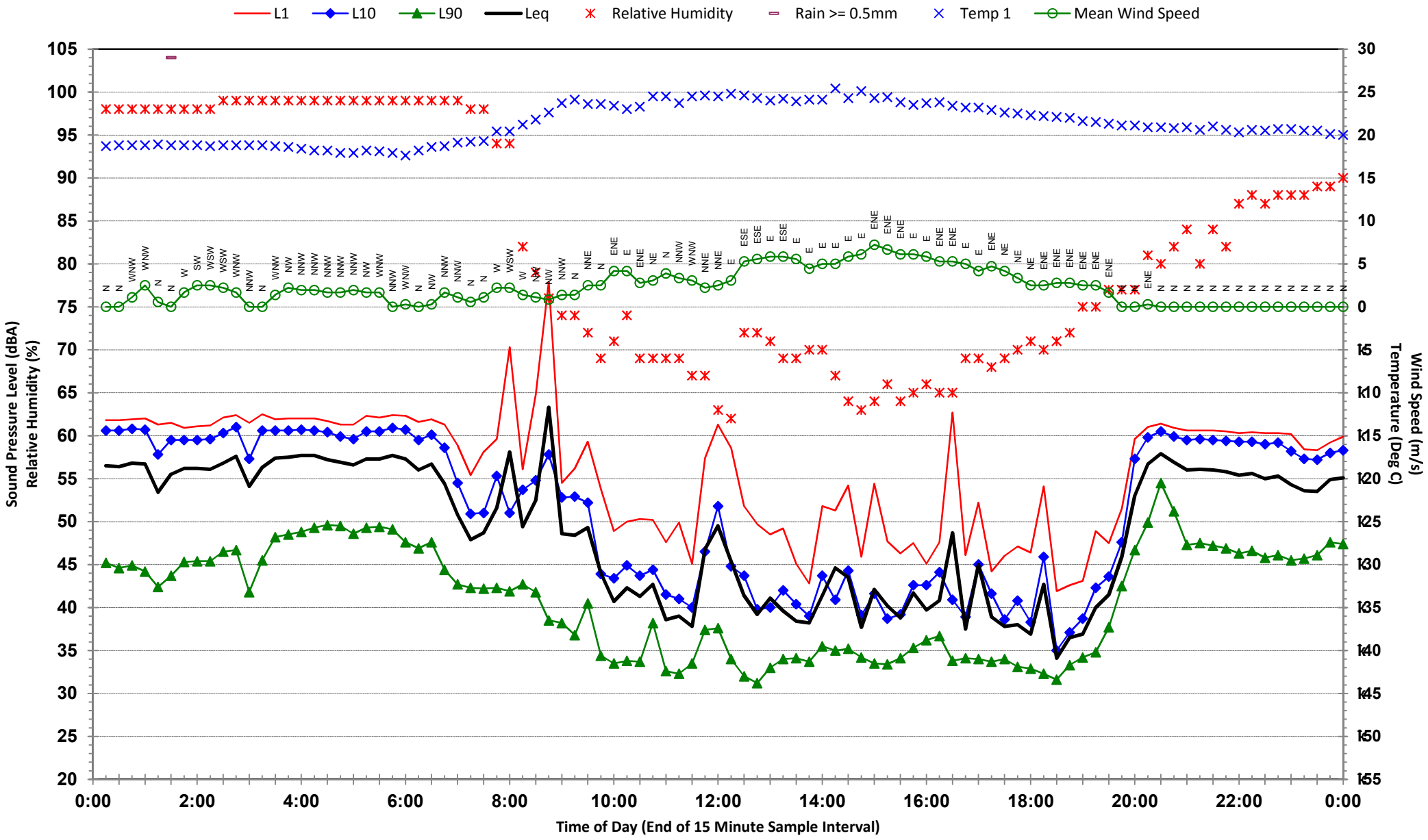


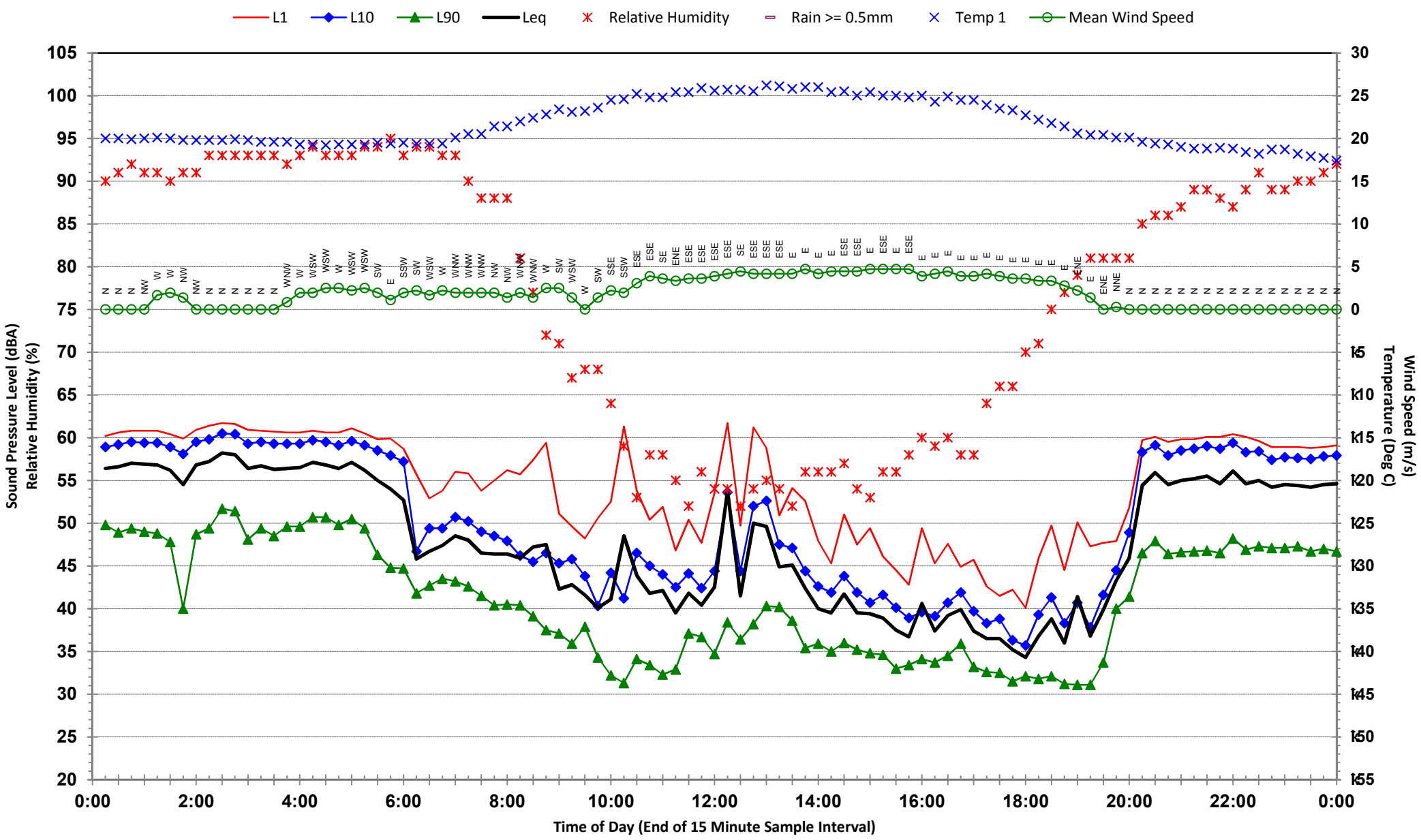
Statistical Ambient Noise Levels
16-203-509 - Sunday 2 March 2014



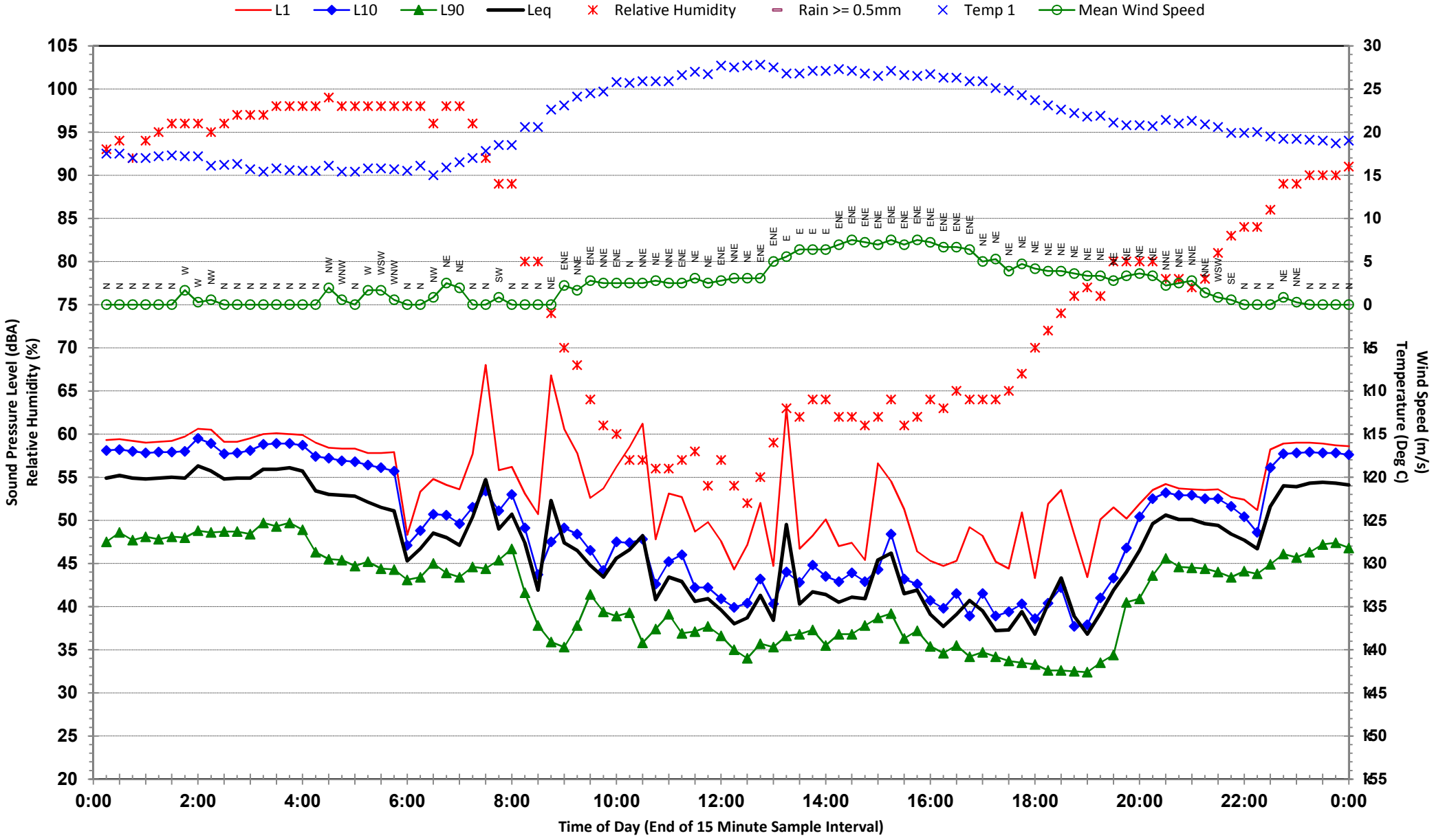
Statistical Ambient Noise Levels
16-203-509 - Monday 3 March 2014



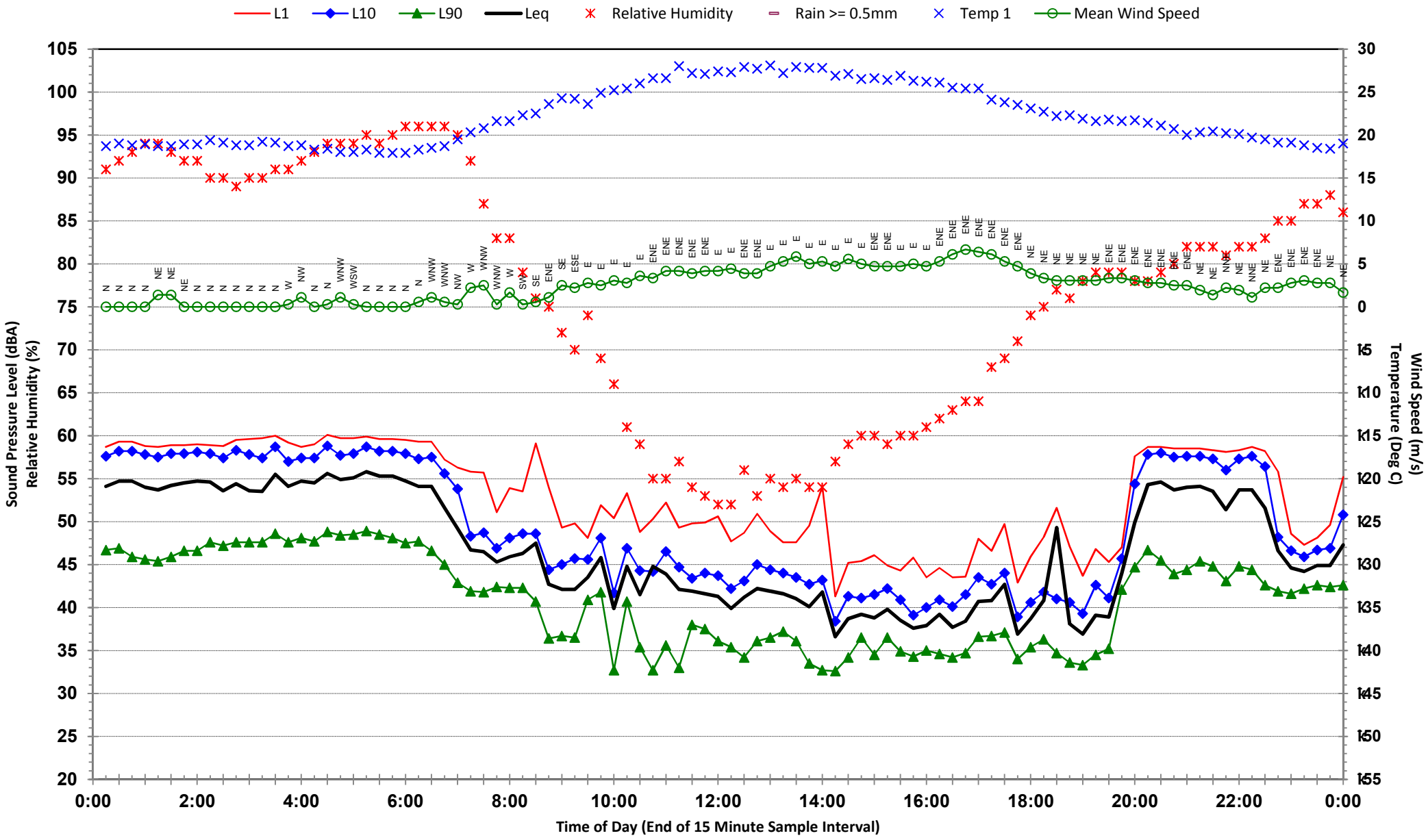
Statistical Ambient Noise Levels
16-203-509 - Tuesday 4 March 2014



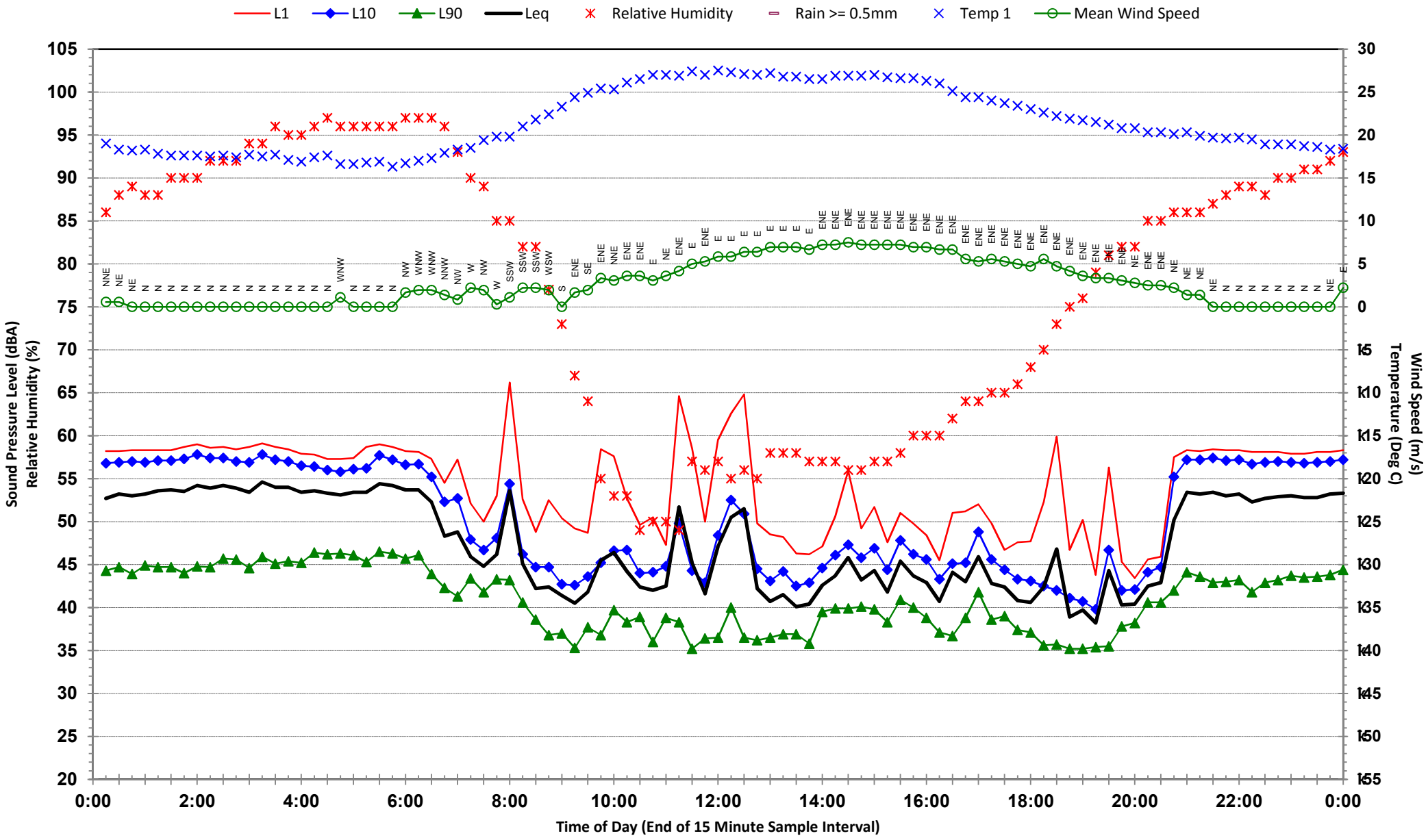
Statistical Ambient Noise Levels
16-203-509 - Wednesday 5 March 2014



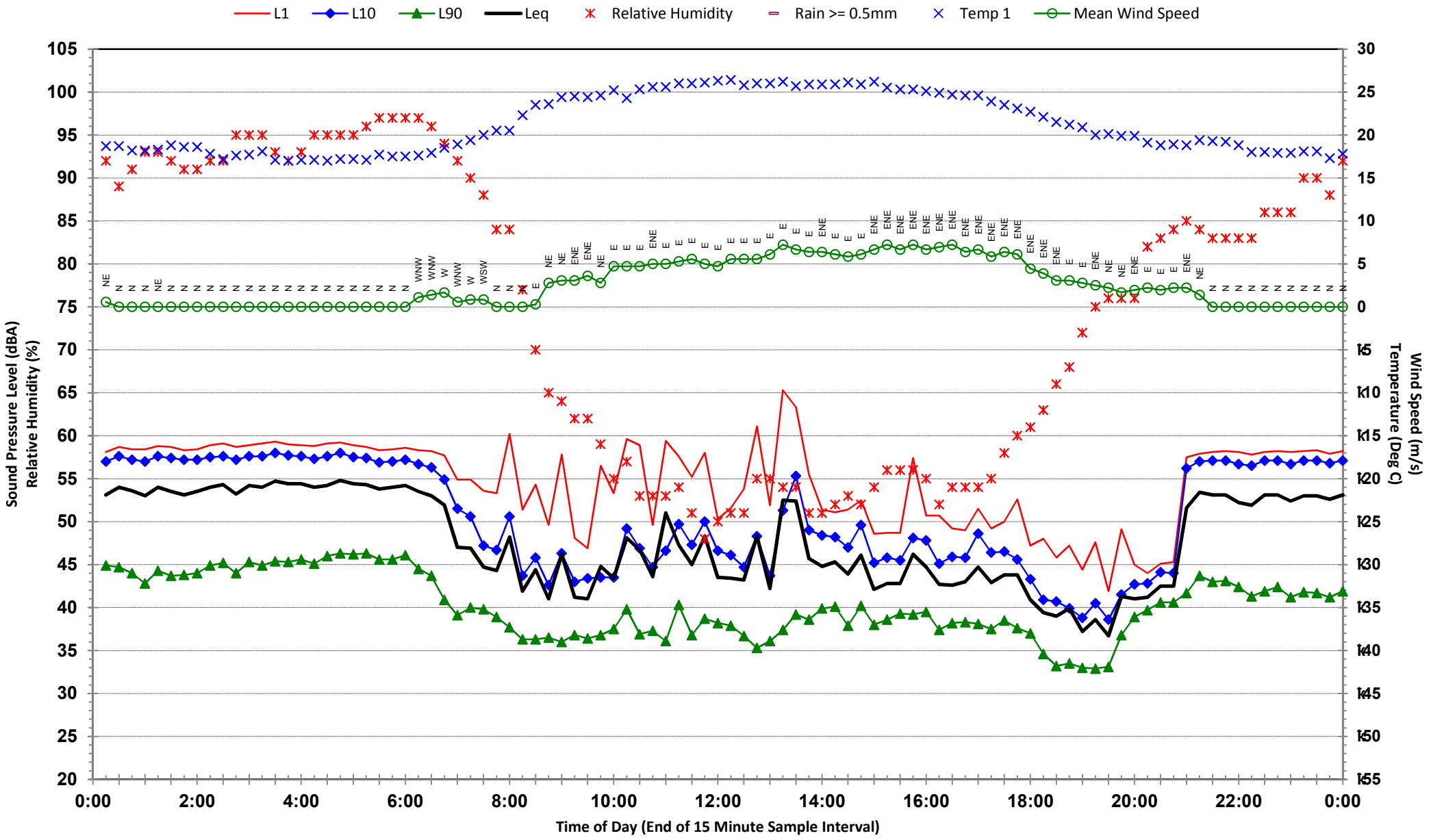
Statistical Ambient Noise Levels
16-203-509 - Thursday 6 March 2014



Statistical Ambient Noise Levels
16-203-509 - Friday 7 March 2014

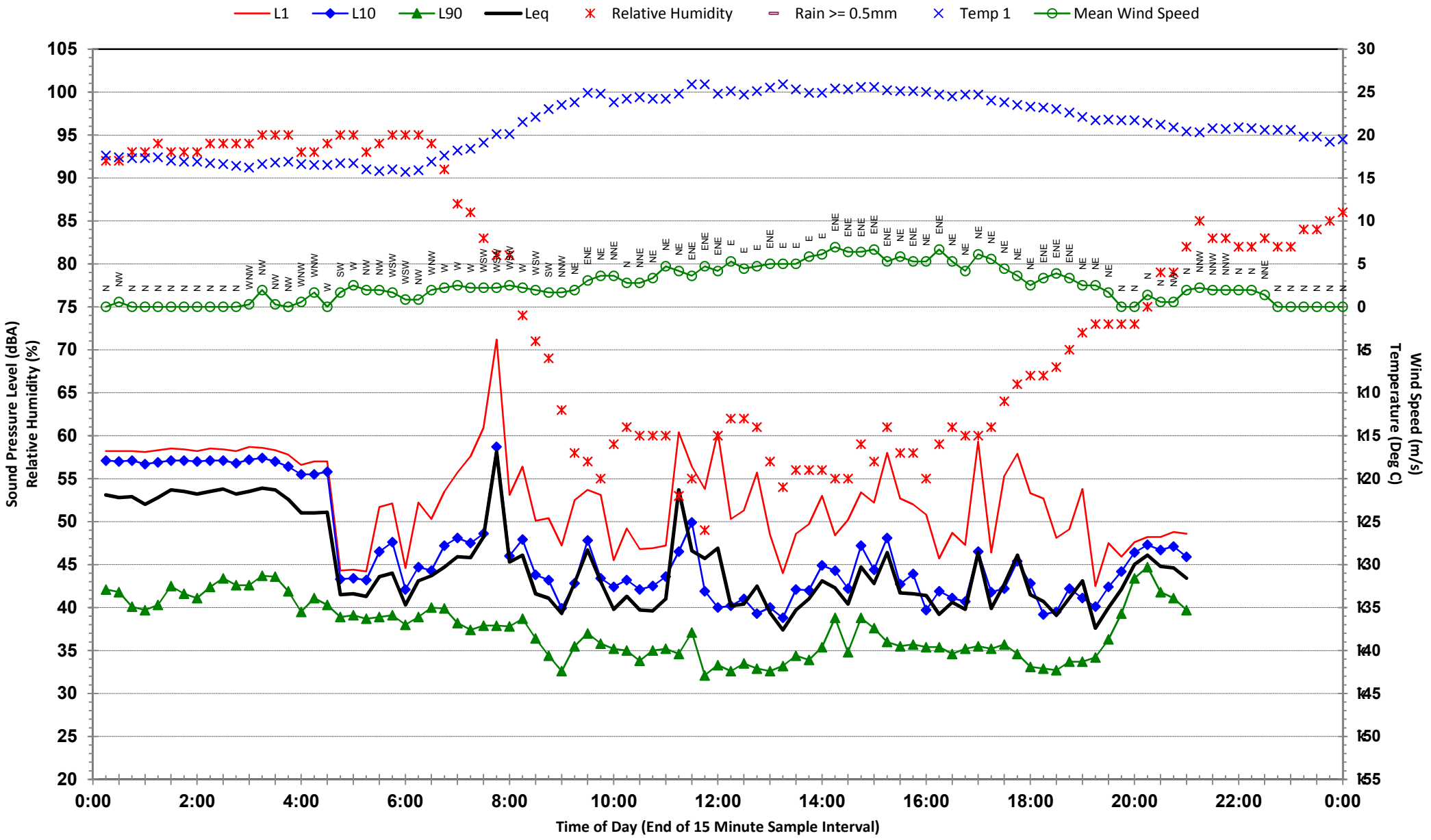


Statistical Ambient Noise Levels
16-203-509 - Saturday 8 March 2014



Ambient Conditions
Heggies Report 610.13023

Statistical Ambient Noise Levels
16-203-509 - Sunday 9 March 2014



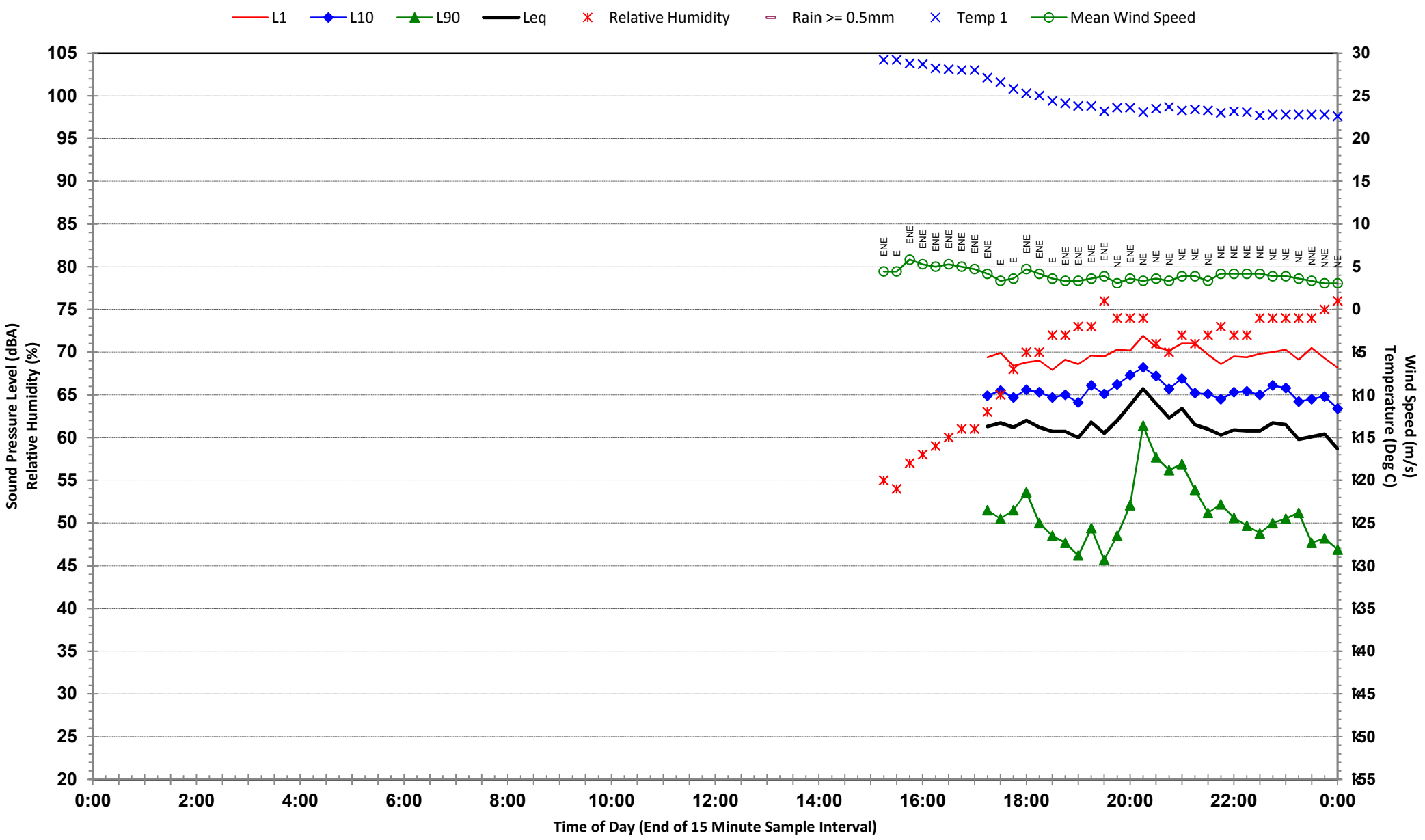
Unattended Noise Monitoring Results

Receptor Location 3: 15165 Pacific Highway, Possum Brush

26 February to 10 March 2014

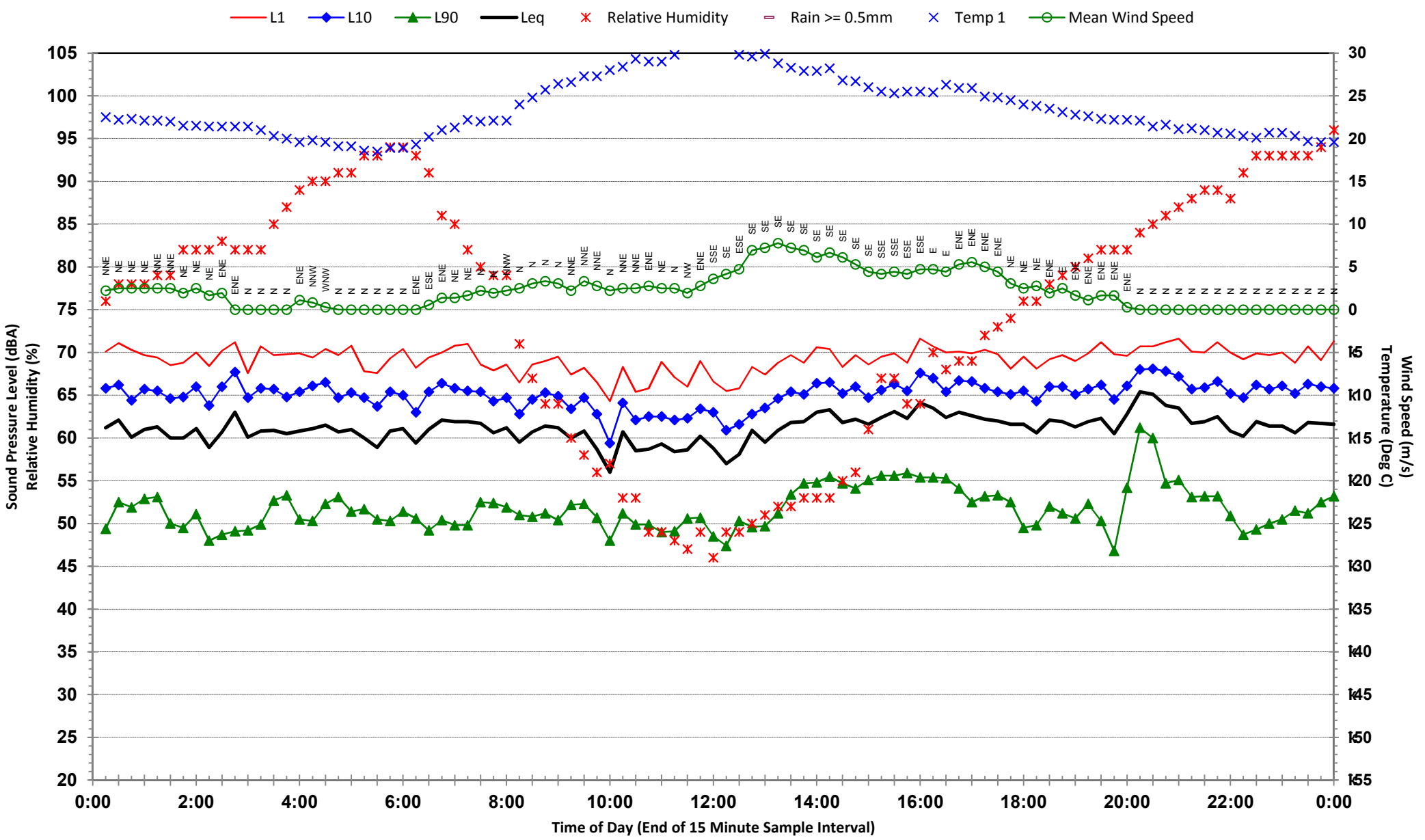
Statistical Ambient Noise Levels

16-301-473 - Wednesday 26 February 2014

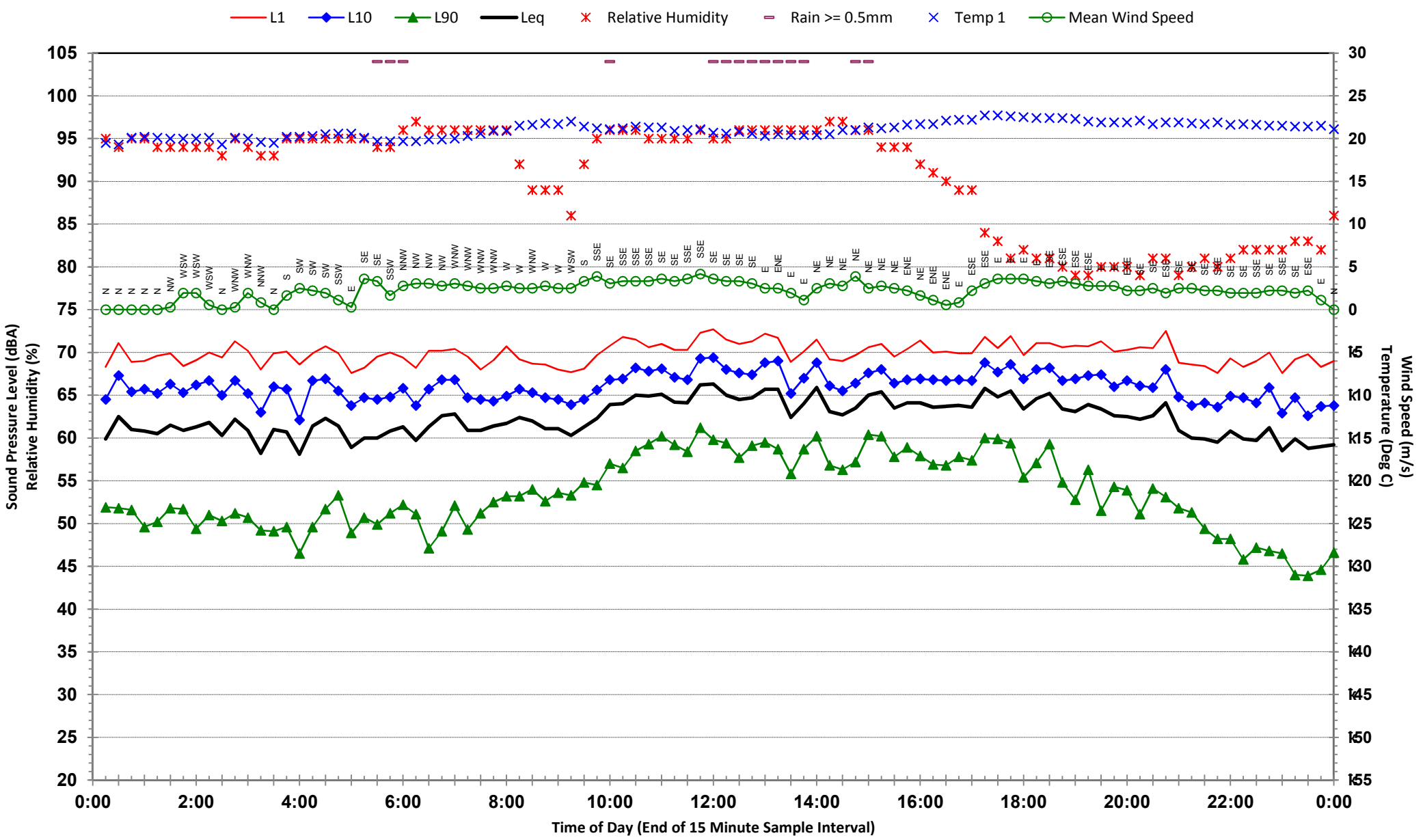


Ambient Conditions
Heggies Report 610.13023

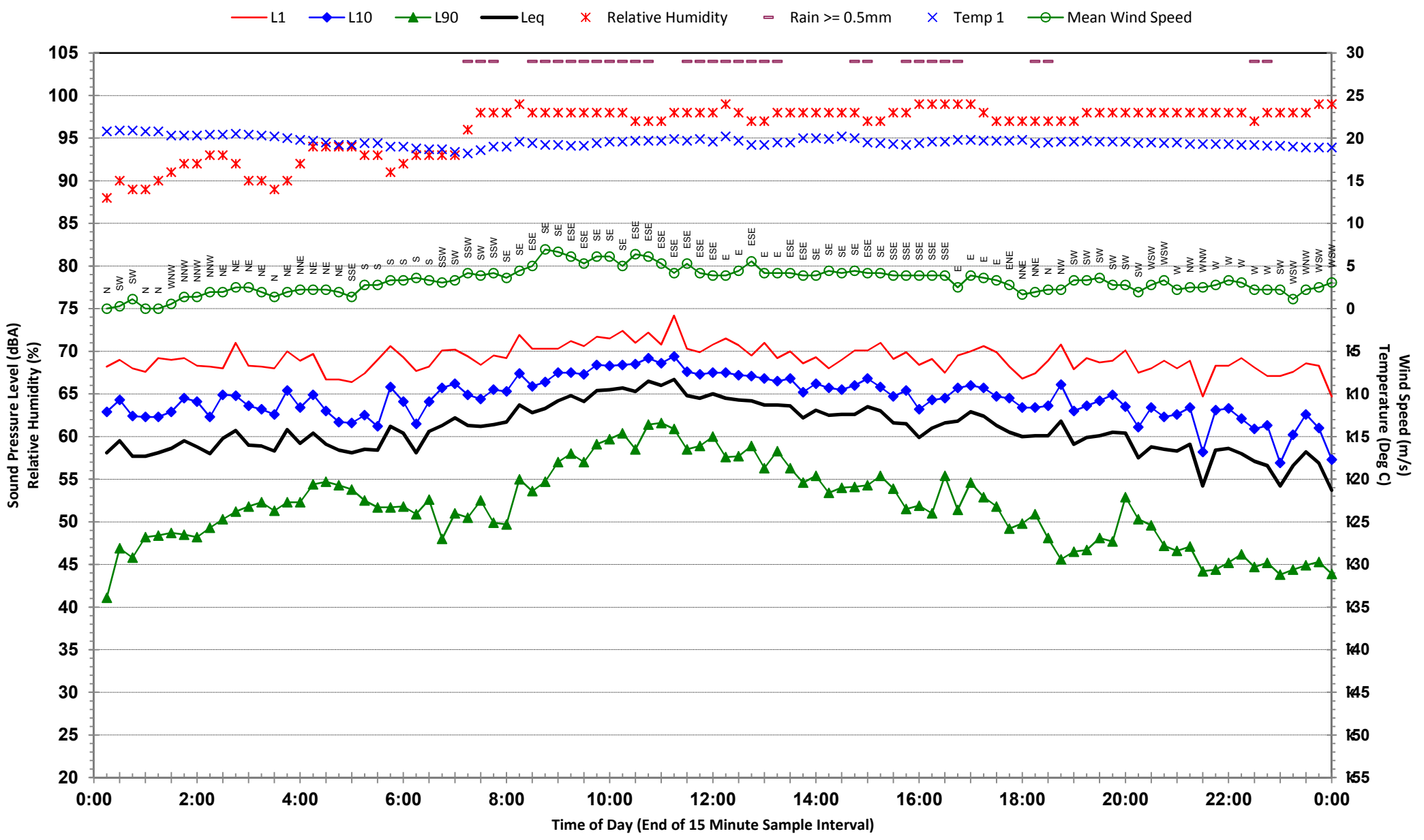
Statistical Ambient Noise Levels
16-301-473 - Thursday 27 February 2014



Statistical Ambient Noise Levels
16-301-473 - Friday 28 February 2014



Statistical Ambient Noise Levels
16-301-473 - Saturday 1 March 2014



Statistical Ambient Noise Levels
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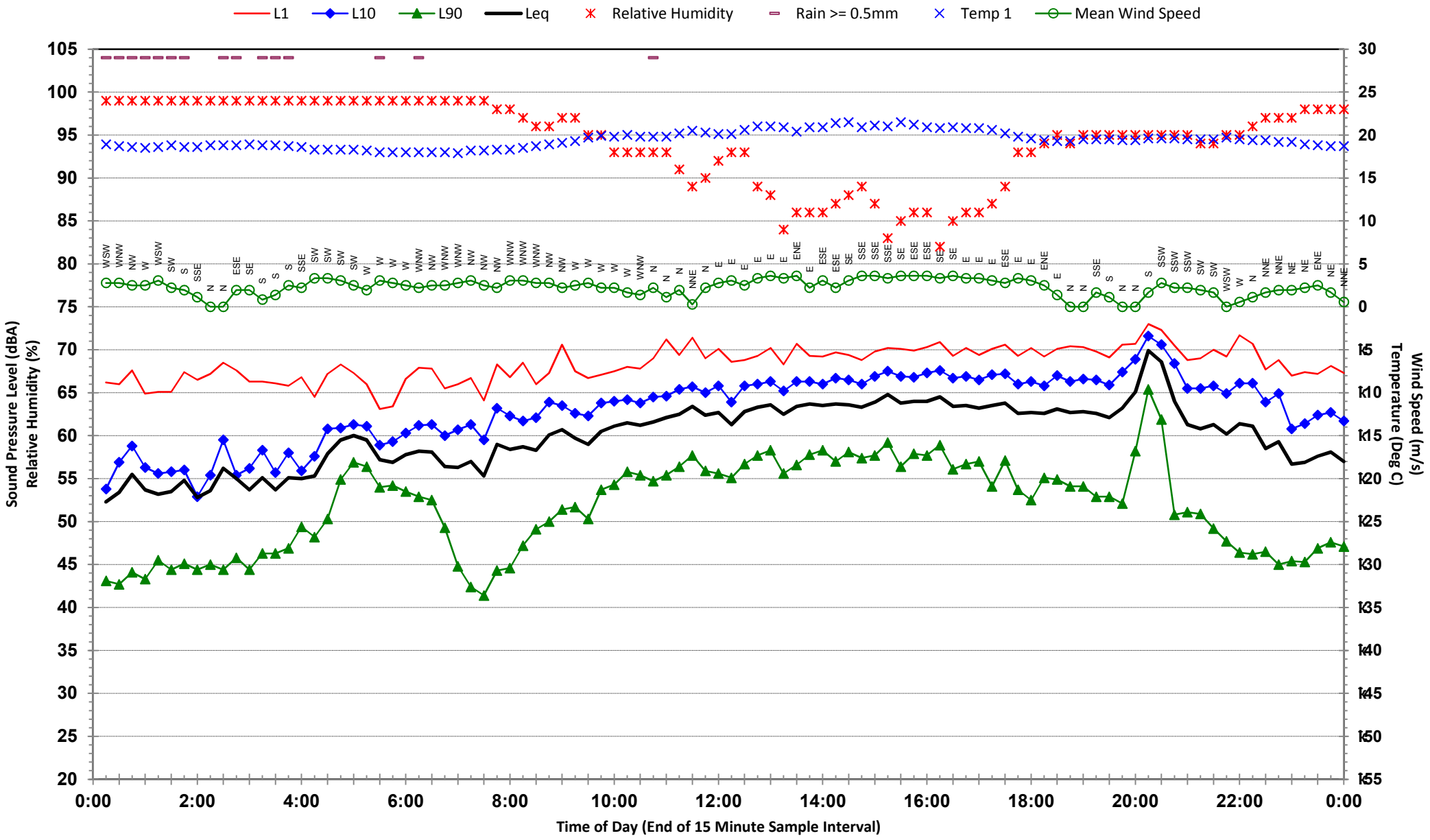
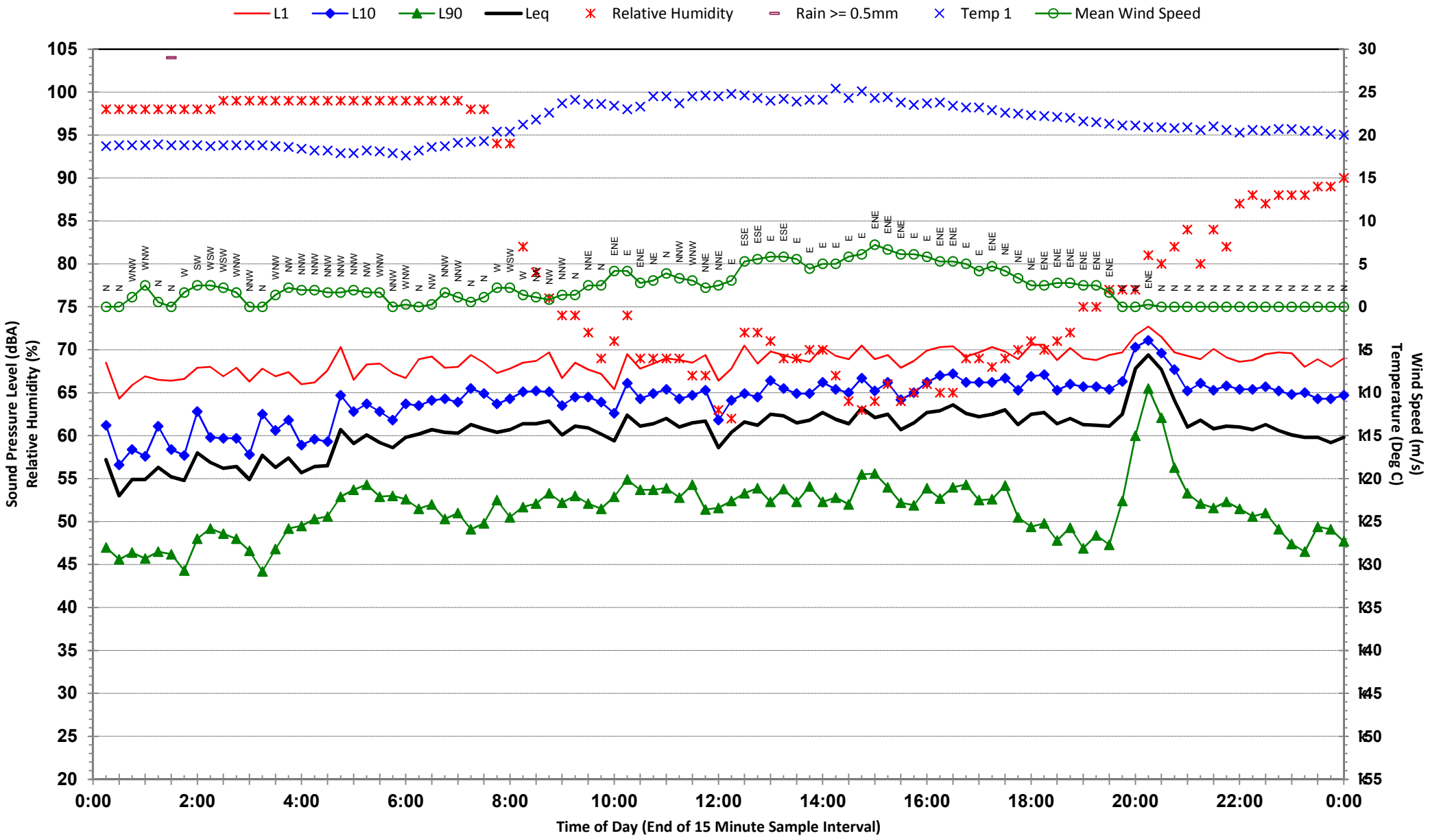
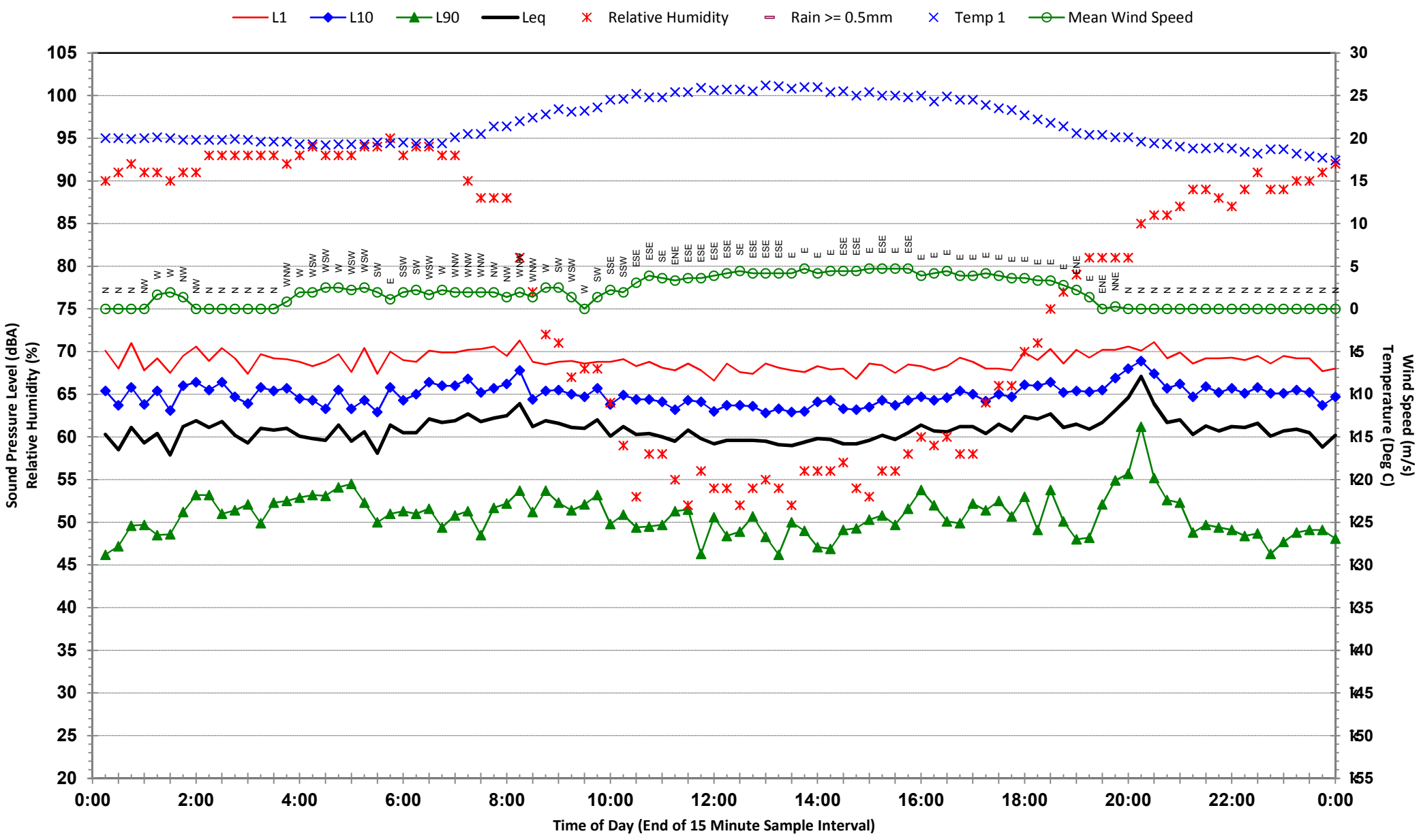


Statistical Ambient Noise Levels
16-301-473 - Monday 3 March 2014



Statistical Ambient Noise Levels
16-301-473 - Tuesday 4 March 2014



Statistical Ambient Noise Levels
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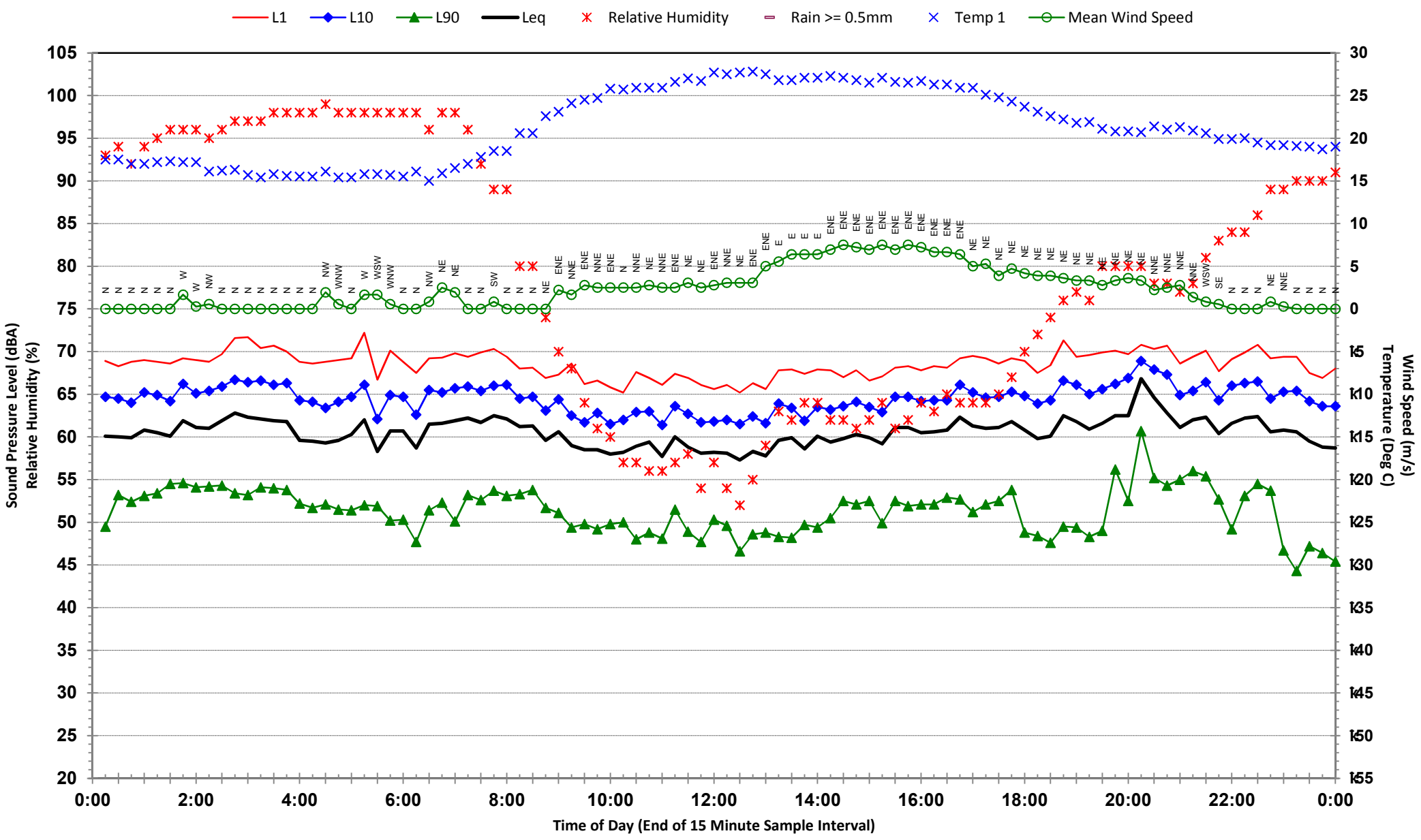

Statistical Ambient Noise Levels
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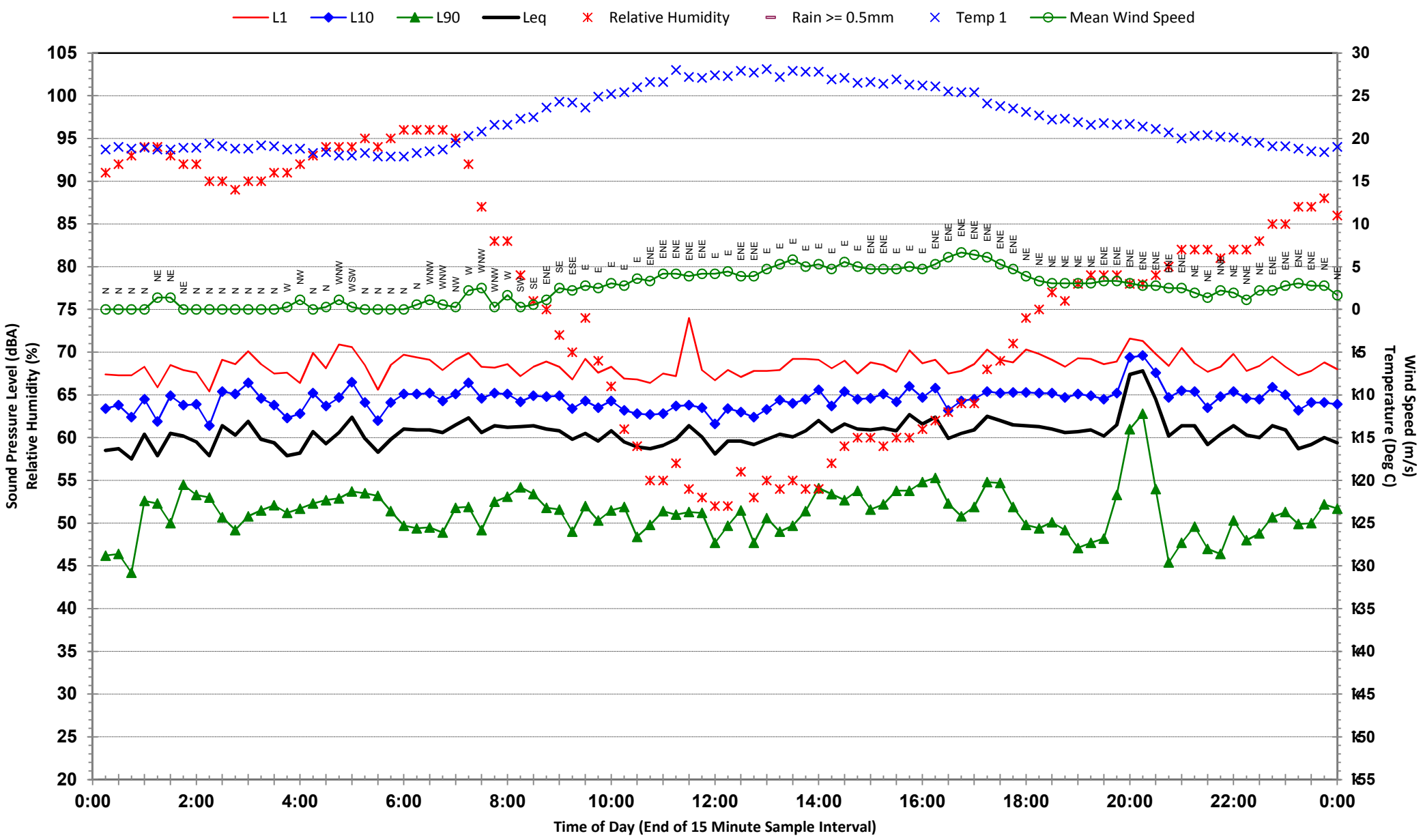

Statistical Ambient Noise Levels
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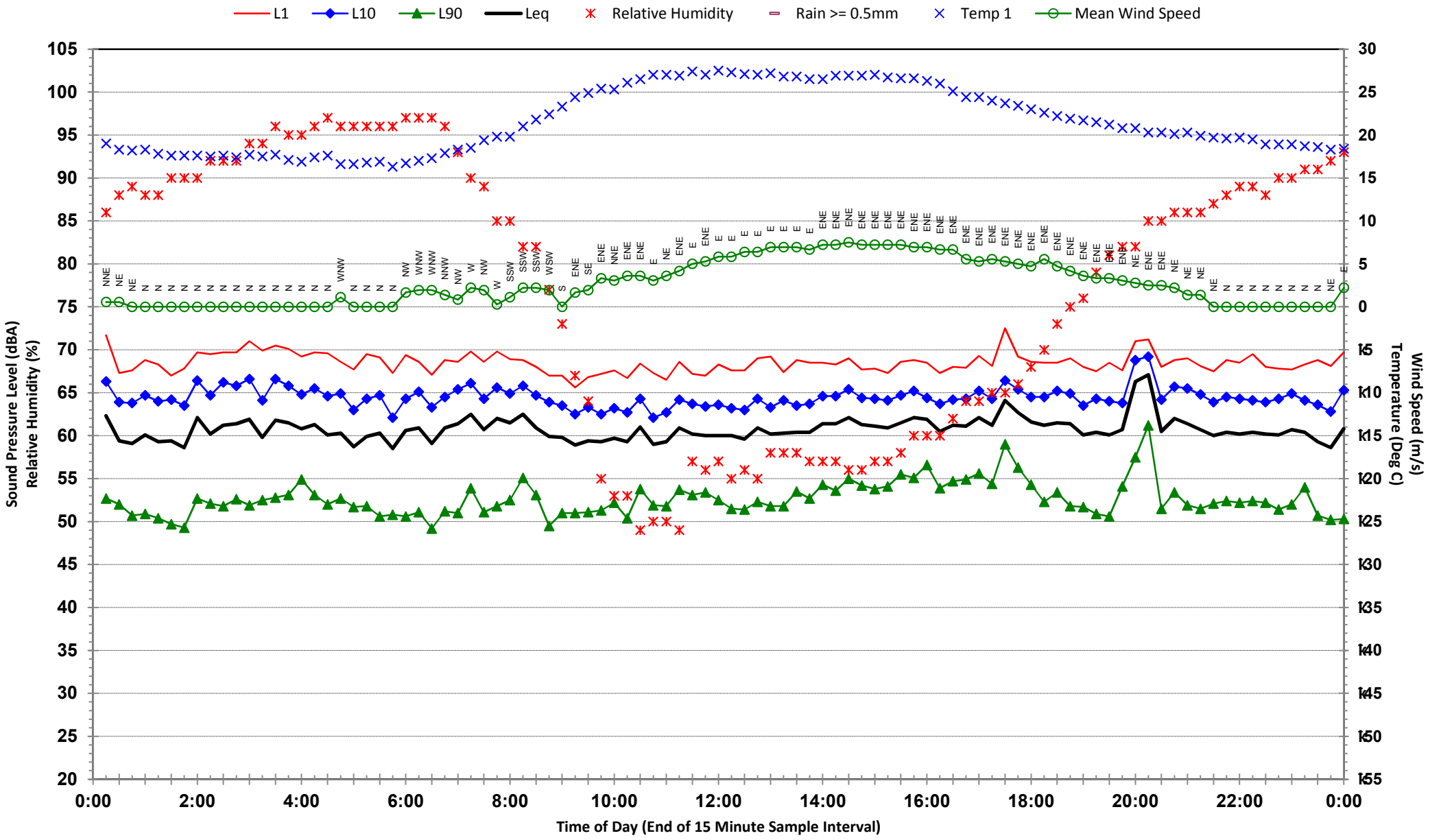

Statistical Ambient Noise Levels
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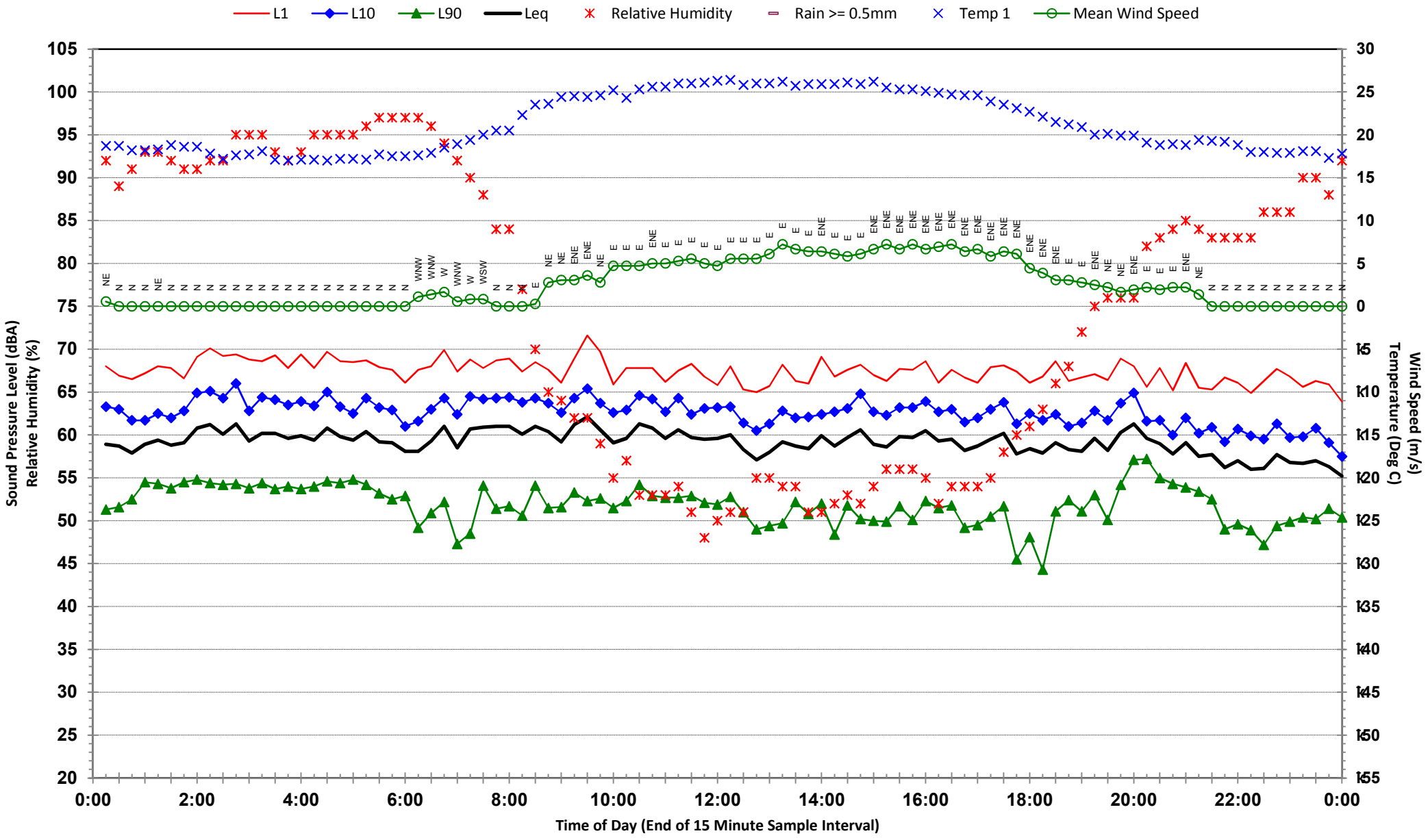
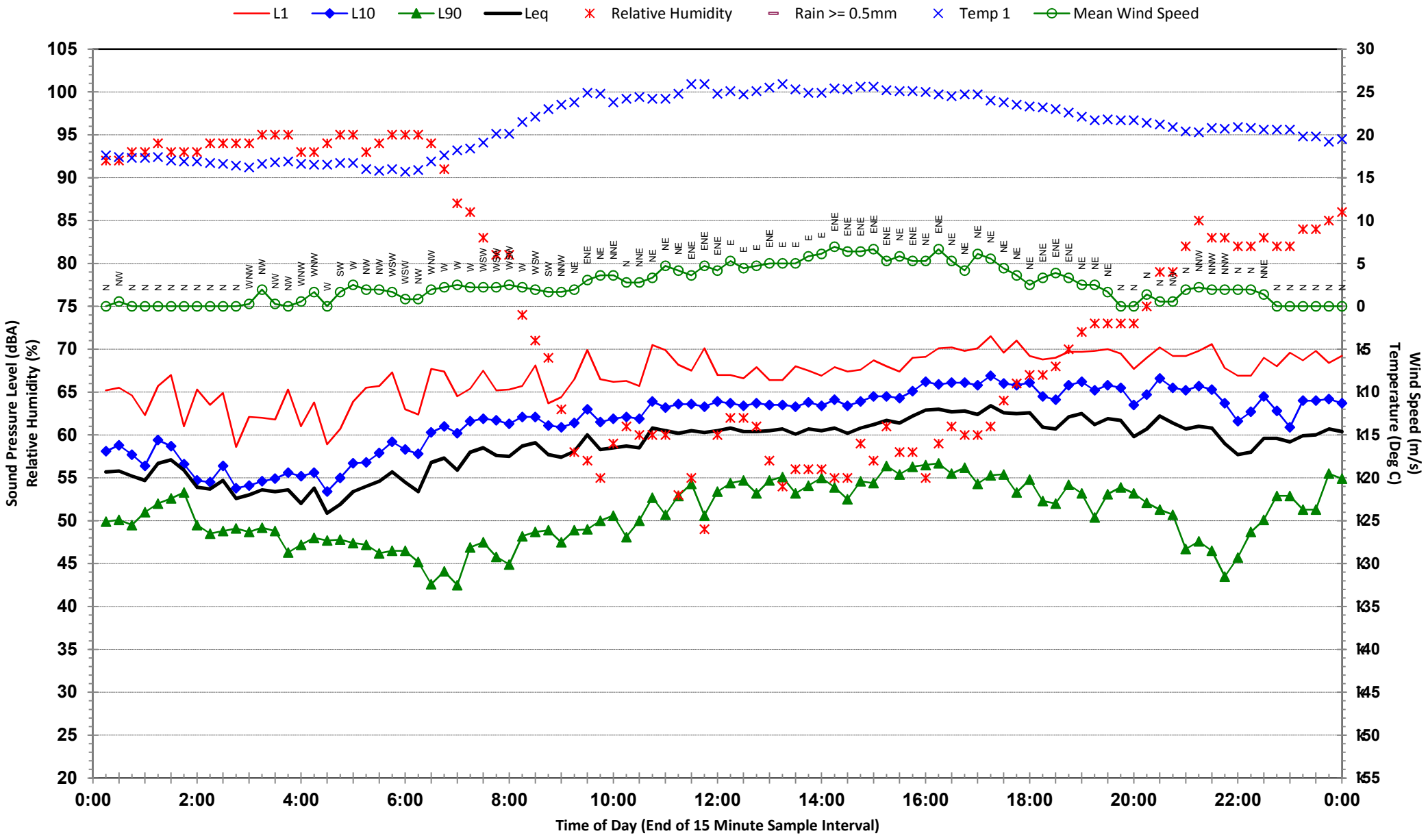


Ambient Conditions
Heggies Report 610.13023

Statistical Ambient Noise Levels
16-301-473 - Sunday 9 March 2014



Statistical Ambient Noise Levels
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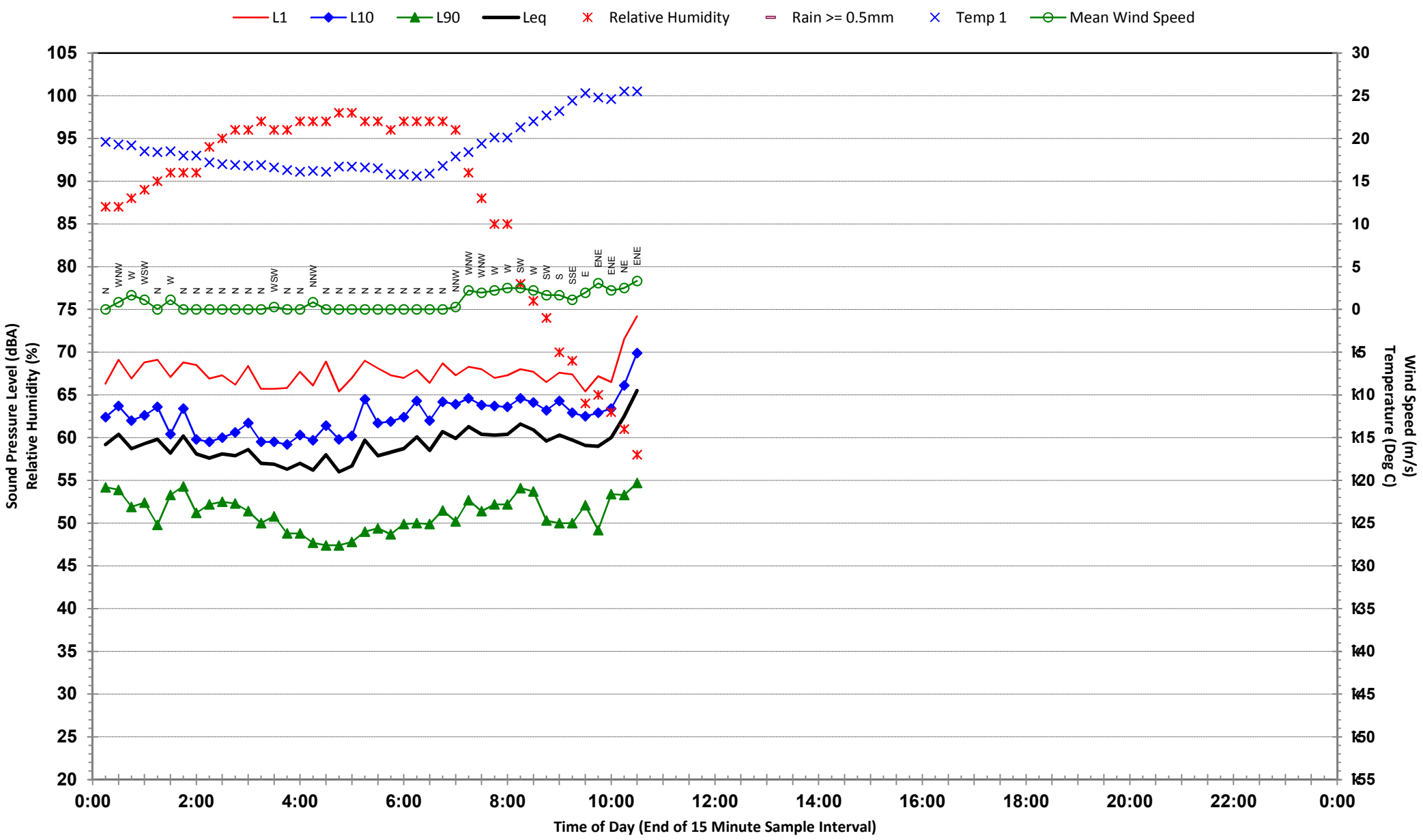
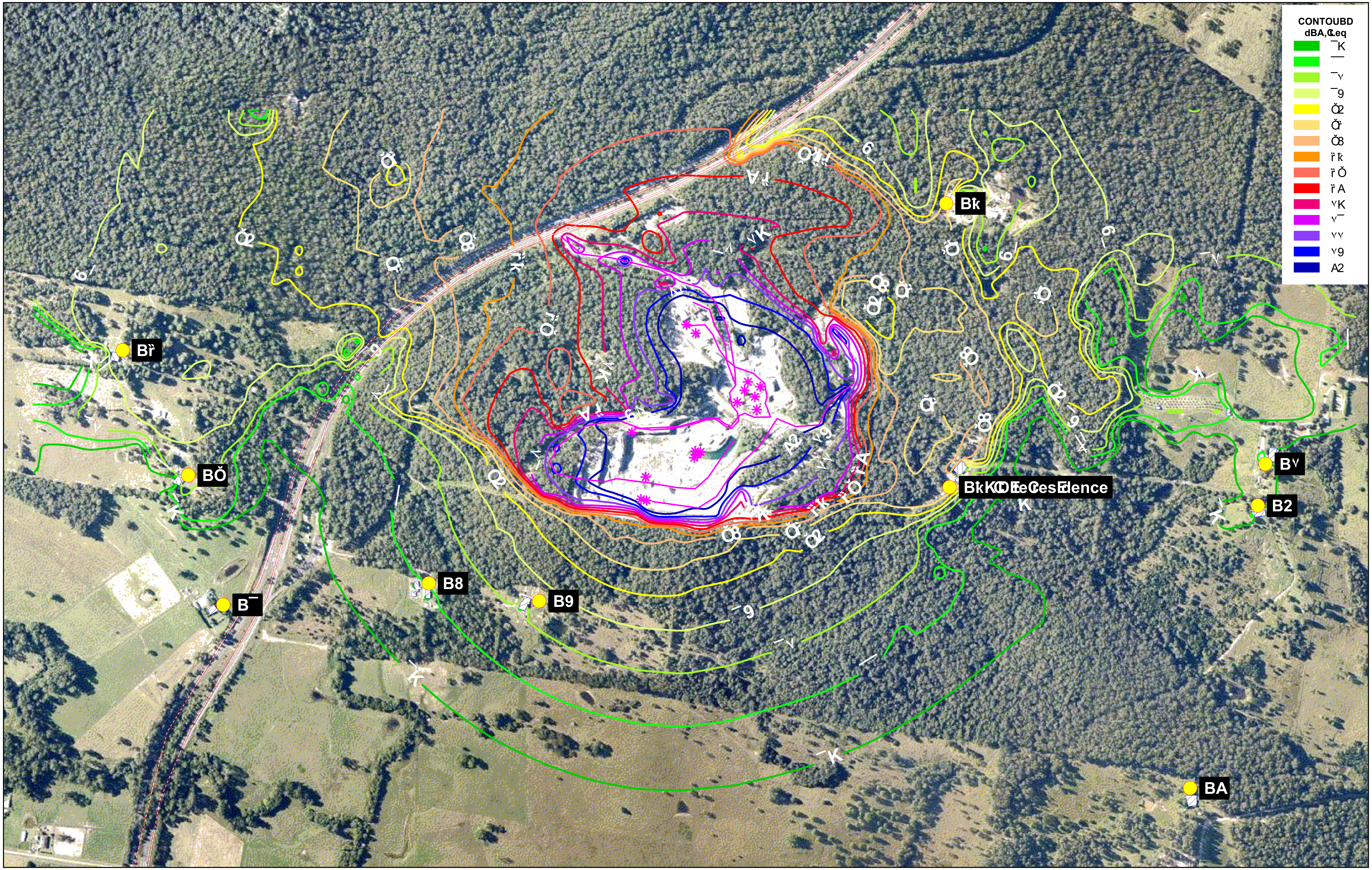


Grid Noise Maps



SLR

SCAL"

OB#ENTAT#ON

L"' EN C

PoinB so/ rce

5inFB so/ rce

MainB / i-din)

PoinB eceiver

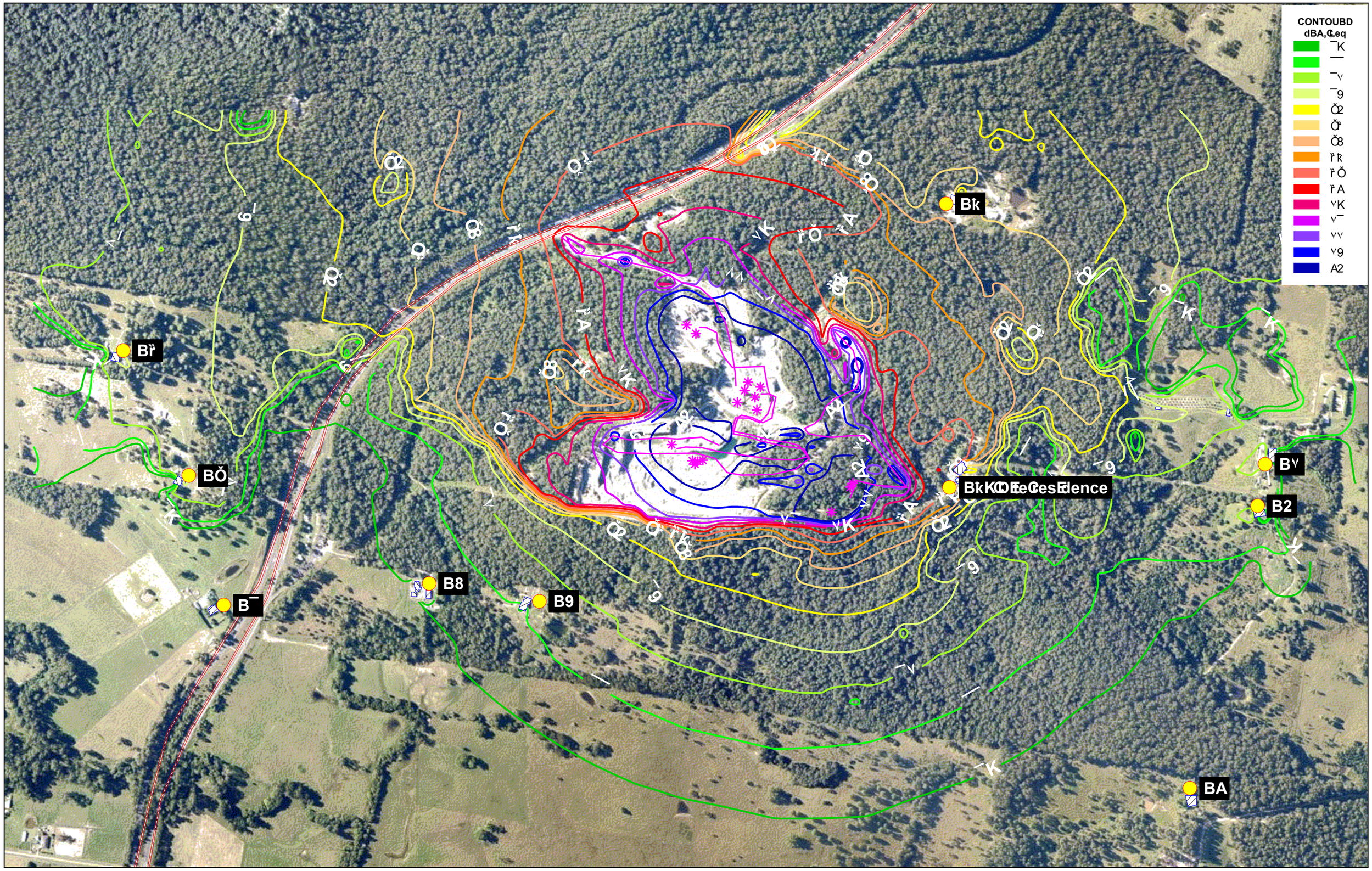
PRO(ECT	JandraB / Drry 2nE nsi3caE onB Pro'Fct
CL#ENT	+FmenE Environmen Pty 5Ed
ESCB#PT#ON	StD) FB 7C Dytime AI-F8/ i#menE o#FraE n)

PredictionB MeE od: CONCAWE

Pre#DredB y: CW

APPEN #$

MAP NO&



SLR

2B2NCO5NB89
5ANE CO:
NSW2K
AU69" AL2A
9:B'k2B9C2AB8KK
<:B'k2B9C2AB2KK

9hFBconEnBconBInFdB iBhinBis documenBnay . FB DsedBnBirdB Dt&
dDBDB5" BCon-/ -6n) BAustra DBPty 5BBloFs noB) / DranEFBFBDccuracy
o3Bny -/ ch3n3rmaBon!

SCAL"

K Al² A² k² K 22² KK A² O² K

OB#ENTAT#ON

L"' EN C

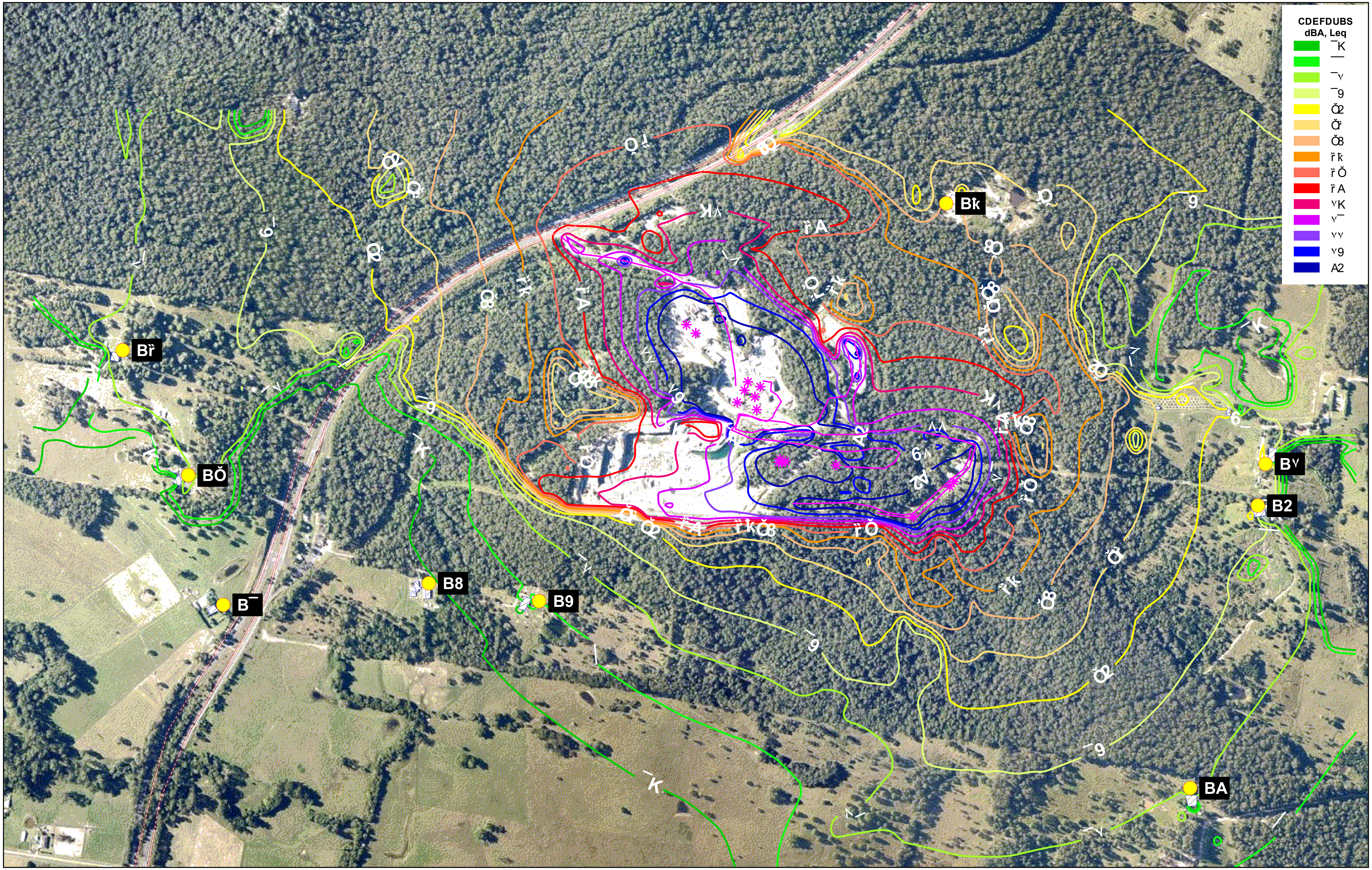
- PoinBso/ rce
- 5inFBso/ rce
- MainB / i-din)
- PoinBeceiver

PRO(ECT	JandraB / Drry 2nBEnsi3caBonBPro'Fct
CL#ENT	+FmenBEnvironmenBPty 5Bd
ESCB#PT#ON	StD) FB27BCDytime Al-BF8/ i#menBo#FraBn)

CDBF:B5/KV/2KrÖ	
Pro'FctBNo!:B'k2K1k K2	
" F#ortBNo!:B'k2K1k K2 $"r	
PredictionBMeBod:BCONCAWE CDBBÖ	
Pre#DredBy:BCW	
PredictionB(Fi) hEB2!K3	

APPEN #$

MAP NO&



SLR

SCALE

DBIENFAFIDE

N

LEGEND

PoinB so/ rce

5inFB o/ rce

MainB / i-din)

PoinB eceiver

PRD"ECF	JandraB / Drry 2nE nsi3caE on B Pro'Fct
CLIENF	+FmenEE EnvironmenE Pty 5Ed
DESCBIPTIDE	StD) FB 7CDytime AI-F8/ i#menE o#FraE n)

Prediction Method: CONCAWE

APPENDIX
D

MAP ED

SLR
2 LINCOLN ST
LANE COVE
NSW 2066
AUSTRALIA
T: 61 2 9427 8100
F: 61 2 9427 8200
www.slrconsulting.com

SCALE

0 37.5 75 150 225 300 375 450 m

ORIENTATION

N

LEGEND

- Point source
- Line source
- Main building
- Point receiver

PROJECT	Jandra Quarry Intensification Project
CLIENT	Element Environment Pty Ltd
DESCRIPTION	Elevation contours - 10 m spacing

Date: 18/06/2014
Project No.: 610.13023
Report No.: 610.13023-R1
Prepared By: DW

APPENDIX
D

MAP NO.
004