Wollongong Recycling

Kembla Grange Waste Recovery Facility

Noise Assessment

April 2015

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Glossary

Term	Definition
EPA	Environmental Protection Authority
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dB(A)	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
ICNG	*Interim Construction Noise Guideline* (DECC, 2009).
INP	*Industrial Noise Policy* (EPA, 2000).
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
Noise sensitive receiver	An area or place potentially affected by noise which includes: • a residential dwelling. • an educational institution, library, childcare centre or kindergarten. • a hospital, surgery or other medical institution. • an active (e.g. sports field, golf course) or passive (e.g. national park) recreational area. • commercial or industrial premises. • a place of worship.
Rating background level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
RNP	*Road Noise Policy* (DECCW, 2011).

1. Introduction

1.1 Purpose of this report

Wollongong Recycling and Building Supplies Facility (Wollongong Recycling) proposes to construct and operate a waste recovery facility (WRF) at Kembla Grange (referred to in this report as 'the proposal'). This report has been prepared by GHD Pty Ltd (GHD) to provide an assessment of construction, operational and traffic noise impacts of the proposal. The noise assessment has been undertaken with consideration to the following documents:

- *Interim Construction Noise Guideline* (ICNG) (DECC 2009)
- *Industrial Noise Policy* (INP) (EPA 2000)
- *Road Noise Policy* (RNP) (DECCW 2012)

1.2 Proposal overview

Wollongong Recycling proposes to build and operate a Waste Recovery Facility (WRF) which includes:

- The processing of up to 230,000 tonnes per annum of building and demolition waste, including brick, concrete, soils, timber, general and solid waste.
- Waste storage and stockpile areas.
- Ancillary infrastructure including plant and equipment such as crushers, screens and front end loaders.
- The expansion of the footprint of storage areas on site, thereby providing a more functional operational arrangement.

1.3 Location of the proposal

The subject site is located at No. 50 Wyllie Rd, Kembla Grange, also identified as Lot 10 DP 878167, as shown in Figure 1. The site is located within the Lake Illawarra catchment and covers approximately 21.7 hectares in area. The area covered by the proposed development is approximately 4.68 hectares.

The site is located on the northern side of Wyllie Road and contains cleared areas used for building material storage and recycling material, while the remainder of the site across the northern and eastern section remains vegetated. However, the site has undergone significant disturbance associated with historical broad scale vegetation clearing and disturbance to the land surface within the south western section of the site due to the use of the site as a resource recovery facility.

The site is bounded to the north by an existing ridgeline. The ground is steeply sloping from the south-eastern entrance from Wyllie Rd at approximately +RL 44.0 AHD to a level platform located at the western part of the site at + RL 21.0 AHD. Within the site the landscape comprises the areas on the foot slopes of the Illawarra escarpment, local relief is approximately 30-100m and slope gradients are up to 25%.

The current building material storage and recycling facility was approved pursuant to DA 2009/1153 on 29 April 2010, with Modification 2009/1153/A issued on 17 July 2012, granting approval to an increase in the annual tonnage to 29,999 tonnes. The current facility includes a number of stockpile areas, a dam, workshop, site office and two shipping containers.

A site landscape plan of the proposal is shown in Figure 2.

Figure 1 Site location (Aerial: SIX Maps)

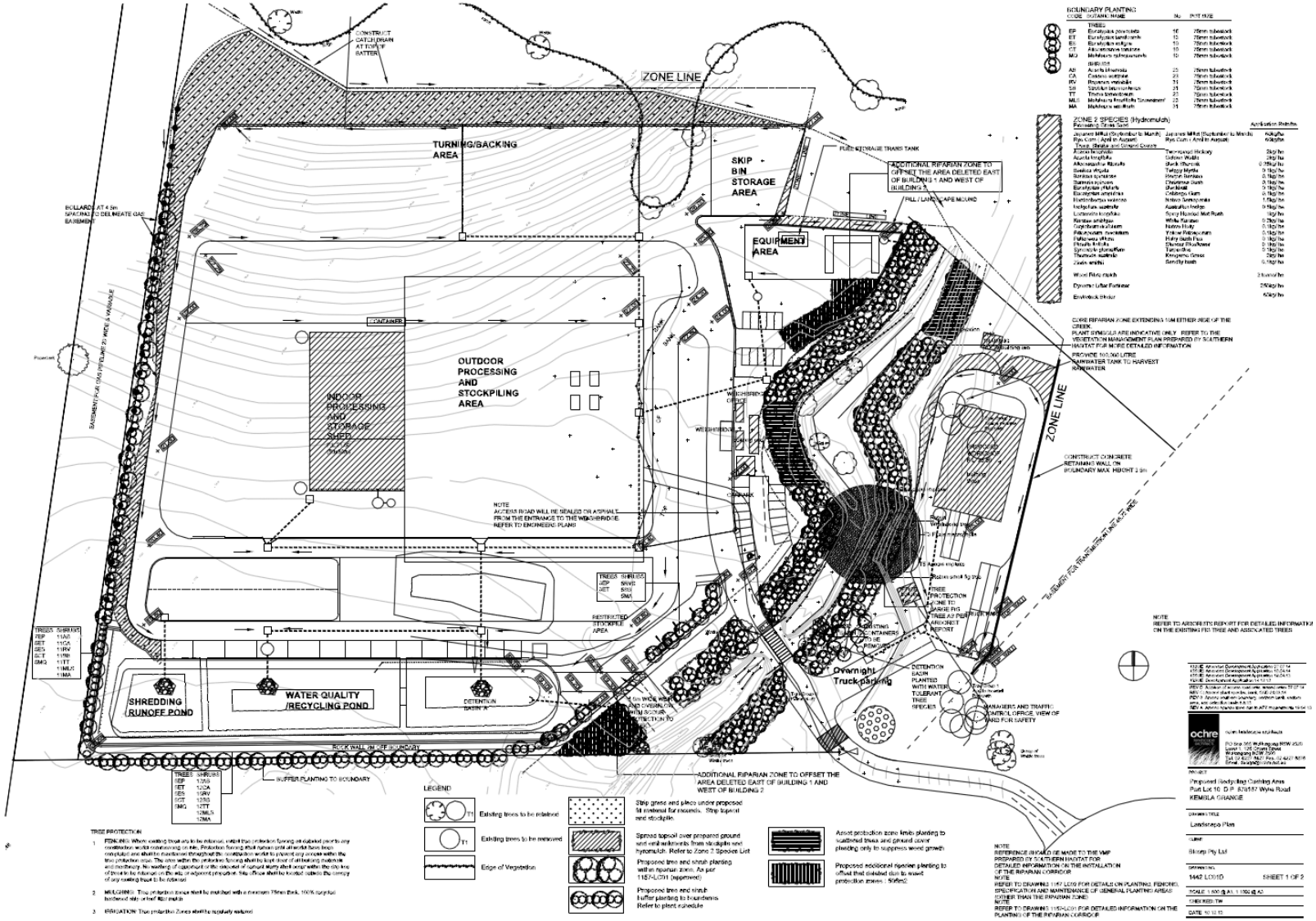


Figure 2 Site landscape plan

1.4 Scope

This noise assessment involved the following tasks:

- Key environmental noise catchment areas and noise sensitive receivers were identified from aerial imagery surrounding the site.
- Information provided by the client was reviewed to identify the likely principal noise sources from the WRF. A dataset of sound power levels was compiled for noise generating equipment at the site.
- Unattended noise monitoring was undertaken for a period of one week at two locations.
- Attended noise measurements were undertaken at the noise monitoring locations to supplement the unattended measurements and assess existing industrial noise levels in the area.
- Noise data was assessed and filtered to remove extraneous noise or adverse weather conditions.
- Noise monitoring data was used to establish operational and construction noise criteria based on the INP and the ICNG. Weather data over the monitoring period was obtained from the nearest Bureau of Meteorology Automated Weather Station (AWS) (Albion Park).
- Construction noise impacts were assessed with consideration of the ICNG and included:
  - Construction noise modelling to predict impacts at sensitive receivers.
  - Assessment of noise impacts against the construction noise criteria.
- Operational noise impacts were assessed with consideration to the INP and included:
  - One operational noise modelling scenario to predict the impacts at the sensitive receivers from the existing and proposed operations.
  - Assessment of impacts against the operational noise criteria.
- Where required, reasonable and feasible mitigation measures have been provided to reduce adverse construction and operational noise impacts at sensitive receivers.

1.5 Limitations

This report: has been prepared by GHD for Wollongong Recycling and may only be used and relied on by Wollongong Recycling for the purpose agreed between GHD and the Wollongong Recycling as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Wollongong Recycling arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Wollongong Recycling and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Existing environment

2.1 Sensitive receivers and land uses

Noise and vibration sensitive receivers are defined based on the type of occupancy and the activities performed in the land use. Sensitive noise and vibration receivers could include both existing and proposed:

- Residences
- Educational institutes
- Hospitals and medical facilities
- Places of worship
- Passive and active recreational areas such as parks, sporting fields, golf courses. Note that these recreational areas are only considered sensitive when they are in use or occupied
- Commercial or industrial premises

A water treatment facility is located to the west of the site, together with other heavy industrial uses such as 24 hour pipe coating operations, and steel manufacturing. Other uses sited to the west of the site include a substation and storage facilities and the Wollongong Waste and recovery Park (formerly known as the Whytes Gully Tip). To the east is the Macedonian Orthodox Church, vacant land, open space and the Wollongong Lawn Cemetery. Both adjacent uses are accessed via Wyllie Road.

To the north, buffered by bushland, is the residential neighbourhood of Farmborough Heights. The residences located to the north of the site are sited on an elevated rock shelf that is approximately 15-30 metres up slope above the proposed development site. The nearest residences are approximately 500 m from the proposed area of working. A vegetated buffer separates the closest residences to the north from the proposed development site.

To the south and south-west of the site is the Patrick Autocare Vehicle Storage Facility. Further to the south of the site opposite the Princes Highway is located residential housing of Kembla Grange, approximately 1000 m from the proposal.

Sensitive noise receivers surrounding the WRP are identified in Table 2-1 and shown in Figure 3.

Table 2-1 Noise sensitive receivers

Receiver	Location
Macedonian Orthodox Church	11 Wyllie Road, Kembla Grange
Houses on Fairloch Avenue, Farmborough Heights	Fairloch Avenue, Farmborough Heights
Kingston Lodge	14A Kingston Town Dr, Kembla Grange
Ian McLennan Park	Access off Wyllie Road
Patrick Autocare Vehicle Storage Facility	South and South-west of the site

Figure 3 Noise monitoring locations and sensitive receivers (AERIAL: Google Earth)

2.2 Background noise monitoring

Noise monitoring was undertaken from 17 February to 28 February at two locations near the proposed WRP (refer to Figure 3).

Noise monitoring was undertaken to determine background noise levels for the noise assessment. Monitoring was undertaken at locations which were secure from theft and vandalism and considered representative of the ambient environment in the vicinity of the proposal site.

The WRF operates during the day-time period, therefore to exclude noise emissions from the WRF (in accordance with the INP) the background noise measurements for the night-time period were used to conservatively establish the operational and construction noise criteria.

Noise monitoring was undertaken using two Rion NL52 environmental noise loggers programmed to accumulate L_{A90}, L_{A10} and L_{Aeq} noise descriptors continuously over the entire monitoring period. Equipment details are shown in Table 2-2. Prior to deployment, a calibration check was performed on the noise monitoring equipment using a sound level calibrator with a sound pressure level of 94 dB(A) at 1 kHz. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of ± 0.5 dB(A).

Table 2-2 Noise monitoring locations and equipment details

Location	Equipment details	Equipment settings	Site photo
Location 1: Boundary of site and church	Rion NL-52 Type 1 SN: 131631	A-weighted Fast time response 15 minute intervals Pre-cal: 94.1 dB(A) Post-cal: 94.0 dB(A)	
Location 2: 6 Bardess Crescent	Rion NL-52 Type 1 SN: 131629	A-weighted Fast time response 15 minute intervals Pre-cal: 94.1 dB(A) Post-cal: 94.0 dB(A)	

2.2.1 Unattended noise monitoring results

A summary of calculated background L_{A90} and ambient L_{Aeq} (day, evening and night) noise levels for the monitoring periods are provided in for Table 2-3 and Table 2-4 respectively. The noise data has been filtered in strict accordance with the *Industrial Noise Policy* Appendix B, excluding invalid data (when wind speeds were greater than 5 m/s or when rainfall occurred).

The number of valid data points is insufficient to establish the overall rating background and ambient levels during the day time period. However, this is considered acceptable as the WRF operations influence the noise levels during the day-time period and the night-time background noise levels have been used to establish the operational and construction noise criteria.

Daily charts of the monitoring results are presented in Appendix A. A detailed description of the acoustic terms can be found in the glossary at the start of this report.

Table 2-3 Site boundary summary of noise monitoring results, dB(A)

Date	Rating background level 90th percentile $L_{A90(15min)}$			Ambient noise levels, $L_{Aeq(period)}$		
	Day	Evening	Night	Day	Evening	Night
17/02/2014	-	40.4	36.2	-	46.1	43.1
18/02/2014	-	37.4	37.5	-	51.0	47.6
19/02/2014	-	39.3	-	-	50.3	-
20/02/2014	-	-	-	-	-	-
21/02/2014	-	41.9	-	-	49.9	-
22/02/2014	35.4	37.9	-	49.6	49.7	-
23/02/2014	-	37.1	34.7	-	46.7	43.0
24/02/2014	-	37.7	32.9	-	50.0	43.5
25/02/2014	-	-	33.5	-	-	40.9
26/02/2014	-	-	35.5	-	-	44.8
27/02/2014	43.8	39.4	34.2	49.7	48.5	44.7
28/02/2014	-			-		
Overall RBL and Leq	**-**	**38.6**	**34.7**	**-**	**49.3**	**44.7**

Note 1: '-'refers to invalid data that has been excluded from the data set due to adverse weather conditions

Table 2-4 6 Bardess Crescent summary of noise monitoring results, dB(A)

Date	Rating background level 90th percentile $L_{A90(15min)}$			Ambient noise levels, $L_{Aeq(period)}$		
	Day	Evening	Night	Day	Evening	Night
17/02/2014	-	31.6	32.1	-	43.2	42.9
18/02/2014	-	36.5	34.4	-	48.1	47.2
19/02/2014	-	34.5	-	-	44.5	-
20/02/2014	-	-	-	-	-	-
21/02/2014	-	33.7	-	-	50.7	-
22/02/2014	30.4	31.2	-	53.4	57.5	-
23/02/2014	-	32.0	31.6	-	53.7	49.4
24/02/2014	-	35.6	33.2	-	50.0	50.6
25/02/2014	-	-	35.2	-	-	49.3
26/02/2014	-	-	37.1	-	-	53.5
27/02/2014	32.7	32.5	32.9	50.3	52.6	52.3
28/02/2014	-			-		
Overall RBL and Leq	**-**	**33.1**	**33.2**	**-**	**52.1**	**50.3**

Note: '-'refers to invalid data that has been excluded from the data set due to adverse weather conditions

2.2.2 Attended noise monitoring results

Attended noise monitoring was also undertaken during site visits to supplement the unattended noise monitoring data.

Noise levels at the boundary of the site with the church were observed to include general industrial noise from the surrounding area, road traffic noise from Princes Highway and birds and insects.

Noise levels at Bardess Crescent were observed to consist of general suburban noise, birds and insects and also some noise from the native fern nursery. The noise monitoring site was adjacent the rail line however a large noise barrier is situated between the line and all of the houses in Farmborough Heights. This would mitigate train noise as well as other noise coming from industry in Kembla Grange including the proposal.

Attended monitoring charts are shown in Figure 5 and Figure 6 at the site boundary and Bardess Crescent respectively.

Attended noise monitoring was also undertaken of key noise generating activities onsite – the crusher and screen operating. The derived sound power levels from these activities are presented Table 2-5. A photo of the crusher and screen onsite during the noise monitoring is shown in Figure 4.

Table 2-5 Derived sound power levels from site measurements dB(A)

Source/ Hz	31.5	63	125	250	500	1000	2000	4000	8000	SWL
Terex 400S Crusher	72	95	100	101	109	110	108	103	92	115
Fintec 542 Screen	72	93	96	98	107	107	106	102	93	112

Figure 4 Crusher and screen located onsite

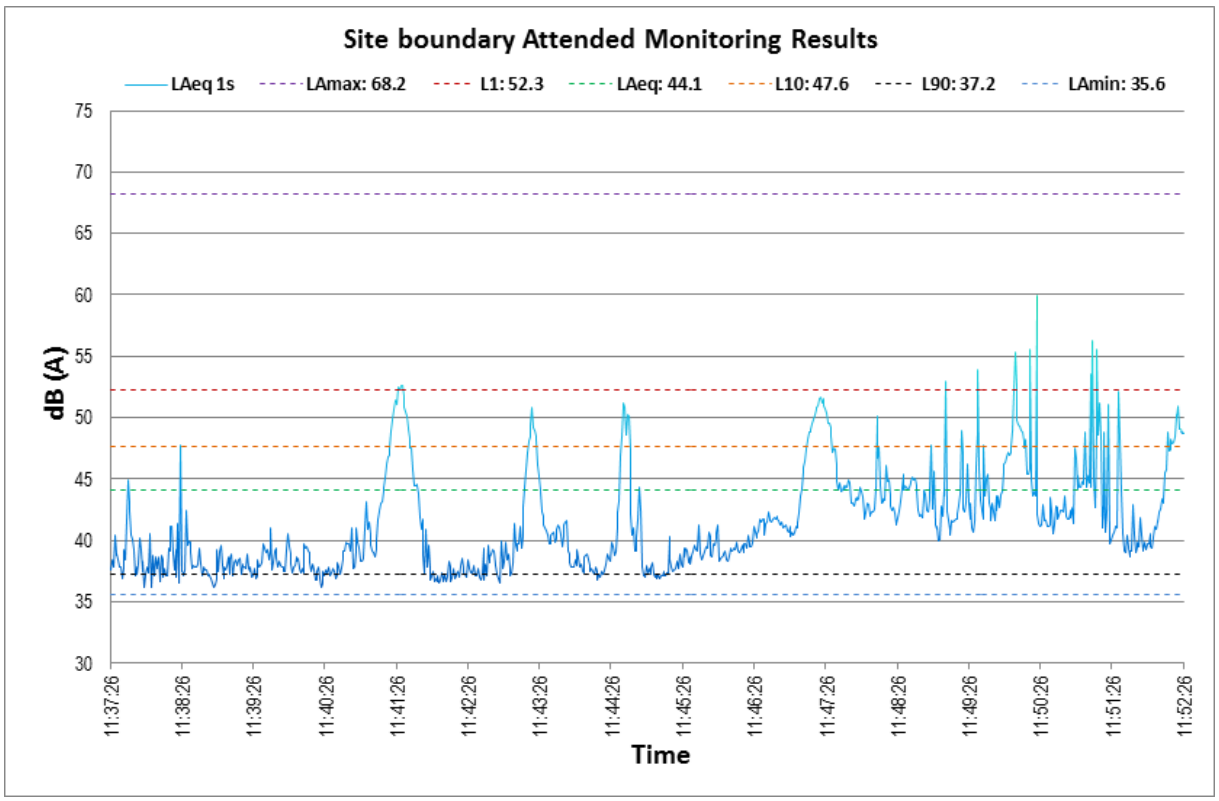


Figure 5 Attended monitoring results (Site boundary with Church)

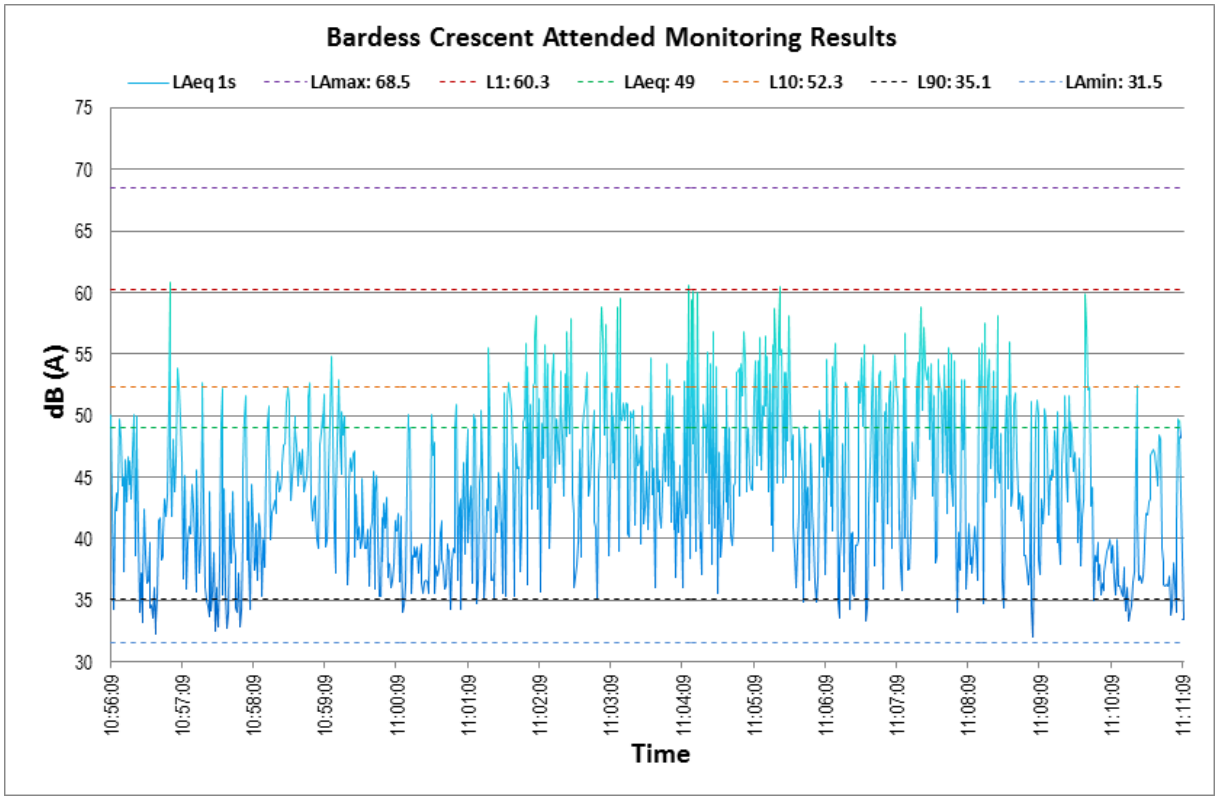


Figure 6 Attended monitoring results (6 Bardess Crescent)

3. Compliance criteria

The noise compliance criteria during operation and construction are presented in the following section. A summary of the noise criteria relevant to this proposal are summarised in 3.3.

3.1 Construction noise criteria

3.1.1 Construction noise management levels

The ICNG guideline recommends standard hours for construction activities as Monday to Friday: 7am to 6pm, Saturday: 8am to 1pm and no work on Sundays or public holidays. The ICNG acknowledges that the following activities have justification to be undertaken outside the recommended standard construction hours assuming that all reasonable and feasible mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses:

- The delivery of oversized plant or structures that police or other authorities determine to require special arrangements to transport along public roads.
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm.
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours.
- Works which maintain noise levels at receivers to below the noise management levels outside of the recommended standard construction hours.

Table 3-1 and Table 3-2 detail the ICNG construction noise management levels at sensitive land uses and residences, respectively.

Table 3-1 Construction noise management levels at sensitive land uses

Land use	Management level, $L_{Aeq(15min)}$ (when in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Industrial premises	External noise level 75 dB(A)
Offices and retail outlets	External noise level 70 dB(A)

Table 3-2 Construction noise management levels at residences

Time of day	Management level $L_{Aeq(15min)}$	How to apply
Recommended standard hours: • Monday to Friday 7am to 6pm • Saturday 8am to 1pm • No work on Sundays or public holidays	Noise affected Rating background level plus 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected Rating background level plus 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

3.2 Operational noise criteria

The INP provides guidance on the assessment of operational noise impacts. The guidelines include both intrusive and amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the total noise level from all sources near a receiver. The INP also provides guidance on sleep disturbance impacts.

The INP noise criteria are planning levels and are not mandatory limits required by legislation however the noise criteria will assist the determining authority to assess operational noise impacts. Where noise criteria are predicted to be exceeded, feasible and reasonable noise mitigation strategies should be considered. Feasible and reasonable noise mitigation measures should consider the economic, social and environmental costs and benefits of the development against the noise impacts.

The intrusive noise criteria controls the relative audibility of operational noise compared to the background level at residential receivers. The amenity criteria limits the total level of extraneous noise for all receiver types. Both sets of criteria are calculated and, in the case of continuous noise sources, the lower of the two in each time period normally apply. For noise sources with intermittent characteristics both noise criteria should be assessed independently.

3.2.1 Intrusive criteria

The intrusive criteria are determined by a 5 dB(A) addition to the measured (or adopted) background level with a minimum of 35 dB(A). The INP recommends that the intrusive noise criteria for the evening period should not exceed the daytime period and the night-time period should not exceed the evening period. The intrusive noise criteria are only applicable to residential receivers.

3.2.2 Amenity criteria

The amenity criteria are determined based on the overall acoustic characteristics of the receiver area, the receiver type and the existing level of industrial noise.

Residential receiver areas are characterised into ‘urban’, ‘suburban’, ‘rural’ or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic.

Amenity criteria are also provided for other sensitive land uses such as schools, hospitals, places of worship and recreational areas.

The amenity criteria aim to limit continual increases in noise levels from industrial noise sources and apply to all industrial noise sources at the receiver location, rather than just the noise source from the proposed development. To prevent cumulative noise level increases above the amenity criteria, the INP provides adjustments to the amenity criteria to set a target level for the proposed development. The applicable adjustment is scaled as per INP Table 2.2 and is based on the existing level of industrial noise at the receiver location. The INP amenity criteria are provided in Table 3-3.

Table 3-3 INP amenity criteria

Type of receiver	Noise amenity area	Time of day	Recommended $L_{Aeq(period)}$ noise level, dB(A)	
			Acceptable	Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban / industrial interface	Day	65	70
		Evening	55	60
		Night	50	55
School classroom	All	When in use (highest 1 hour period)	35 (internal)	40 (internal)
Hospital ward	All	When in use (highest 1 hour period)	35 (internal) 50 (external)	40 (internal) 55 (external)
Place of worship	All	When in use	40 (internal)	45 (internal)
Passive recreation	All	When in use	50	55
Active recreation	All	When in use	55	60
Commercial	All	When in use	65	70
Industrial	All	When in use	70	75

3.2.3 Meteorological conditions

Noise propagation can be enhanced by wind conditions and temperature inversions. The INP states:

"Where inversion conditions are predicted for at least 30% (or approximately 2 nights per week) of the total night time in winter, then inversion effects are considered to be significant and should be taken into account in the noise assessment.

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 per cent of the time or more in any assessment period (day, evening, night) in any season."

Therefore noise enhancing meteorological conditions should be included in the assessment unless it can be shown that they do not occur for 30% of the time during any seasonal period.

The noise modelling algorithm used takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.

3.2.4 Modifying factor adjustments

The INP requires that modifying factor adjustments are added to the measured or predicted noise levels if the noise sources contain tonal, low frequency, intermittent or impulsive characteristics, which have the potential to increase annoyance. The modifying factor adjustments are summarised in Table 3-4.

Table 3-4 INP modifying factor adjustments

Factor	Assessment/ measurement	When to apply	Correction[1,2]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz • 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive • 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.	5 dB(A)[2]
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more.	5 dB(A)[2]
Intermitte nt noise	Subjectively assessed	When the night-time noise level drops to that of the background noise level with a noticeable change in noise level of at least 5 dB(A).	5 dB(A)
Impulsive noise	A-weighted fast response and impulse response	If the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.	Apply the difference in measured noise levels as the correction up to a maximum of 5 dB(A)

Note 1: Where two or more modifying factors are present the maximum correction is limited to 10 dB(A).

Note 2: Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.

3.2.5 Sleep disturbance during operation

The INP application notes regarding sleep disturbance recommend that where the $L_{A1(1min)}$ or $L_{A(max)}$ exceeds the $L_{A90(15min)}$ by more than 15 dB(A) outside the bedroom window, a more detailed analysis is required.

The RNP provides further guidance, which indicates that:

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

3.3 Proposal specific criteria

3.3.1 Construction noise

The construction noise criteria for the proposed construction activities during recommended standard hours and outside of the recommended standard hours are provided in Table 3-5 for each sensitive receiver and are based on Table 3-1, Table 3-2 and the INP guidance on sleep disturbance.

Table 3-5 Proposal specific construction noise criteria, dB(A)[1]

Receiver	Construction noise management level, $L_{Aeq(15min)}$					Sleep disturbance criteria L_{Amax} (external)[2]
	During standard recommended hours		Outside of standard recommended hours[1]			
	7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday, no work on Sunday or public holidays		Day 7 am to 8 am and 1 pm to 6 pm Saturday, 8 am to 6 pm Sunday & Public Holidays	Evening 6 pm to 10 pm Monday to Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays	Night 10 pm to 7 am, Monday to Saturday; 10 pm to 8 am Sunday & Public Holidays
	Noise affected	Highly noise affected				
Macedonian Orthodox Church	55 (external)[2]	-	-	-	-	-
Houses on Fairloch Avenue, Farmborough Heights	43	75	38	38	38	48
Kingston lodge	45	75	40	40	40	50
Ian McLennan Park	60	-	-	-	-	-
Patrick Autocare Vehicle Storage Facility	65	-	-	--	-	-

Note 1: The WRF operates during the day-time period, therefore to exclude noise emissions from the WRF (in accordance with the INP) the background noise measurements for the night-time period were used to conservatively establish the construction noise criteria.

Note 2: Assuming open windows provide a 10 dB(A) reduction in noise from outside the building to inside the church.

3.3.2 Operational noise

The operational noise criteria at the residential receivers surrounding the proposal site are provided in Table 3-6 and are based on criteria discussed in Section 3.2. The noise criteria for Kingston lodge and other houses in this area have been developed using the noise monitoring data adjacent the church. However, background noise levels at Kingston Lodge would be higher due to the proximity to the Princes Highway; therefore the criterion is considered conservative.

Table 3-6 Proposal specific operational noise criteria

Receiver	Time period	Amenity criteria (acceptable noise level)[1] $L_{Aeq(period)}$	RBL[2], $L_{Aeq(15min)}$	Intrusive criteria, $L_{Aeq(15min)}$	Proposal specific noise criteria (external)	Sleep disturbance criteria L_{Amax} (external)
Macedonian Orthodox Church	When in use	50 (external)[3]	-	-	**50 $L_{Aeq(period)}$**	**-**
Houses on Fairloch Avenue, Farmborough Heights	Day	55	33	38	**38 $L_{Aeq(15mini)}$**	
	Evening	45	33	38	**38 $L_{Aeq(15min)}$**	
	Night	40	33	38	**38 $L_{Aeq(15min)}$**	48 L_{Amax}
Kingston lodge	Day	55	35	40	**40 $L_{Aeq(15min)}$**	
	Evening	45	35	40	**40 $L_{Aeq(15min)}$**	
	Night	40	35	40	**40 $L_{Aeq(15min)}$**	50 L_{Amax}
Ian McLennan Park	When in use	50	-	-	**50 $L_{Aeq(period)}$**	**-**
Patrick Autocare Vehicle Storage Facility	When in use	65	-	-	**65 $L_{Aeq(period)}$**	**-**

Note 1: With consideration to the INP 'noise amenity area' classification, the residential receivers surrounding the site have been classified as 'suburban'.

Note 2: The WRF operates during the day-time period, therefore to exclude noise emissions from the WRF (in accordance with the INP) the background noise measurements for the night-time period were used to conservatively establish the intrusive noise criteria.

Note 3: Assuming open windows provide a 10 dB(A) reduction in noise from outside the building to inside the church.

4. Construction noise impact assessment

4.1 Construction noise

The construction noise impact assessment is based on previous noise impact assessments for similar sites in NSW. Construction of the proposal is expected to take 12 to 18 months to complete.

4.1.1 Construction overview

The construction workforce is likely to range from about five to 10 people during the earthworks phase and peak at 25 people, when major concrete pours are occurring. There would probably be on average 10 to 15 people on site for the duration of construction works.

Construction working hours would be undertaken during the standard construction hours, as specified in the ICNG.

4.1.2 Construction noise sources

Noise activities associated with construction are expected to include earth compaction and grading, road works and general construction works. Construction would be limited to standard construction hours.

The typical construction equipment likely to be the main noise sources are shown in Table 4-1 with the corresponding noise level. Noise levels of construction equipment have been obtained from Australian Standard, *AS 2436 – 2010 'Guide to Noise Control on Construction, Maintenance and Demolition Sites'* and other available data. The equipment used to construct the proposal would be confirmed during the pre-construction phase.

Table 4-1 Typical construction equipment noise levels, dB(A)

Construction equipment	Sound power level (dB(A))	Source
Dump truck	117	AS2436 Table A1
Dozer	108	AS2436 Table A1
Excavator	107	AS2436 Table A1
Front end loader	113	AS2436 Table A1
Grader	110	AS2436 Table A1
Roller / compactors	113	AS2436 Table A1
Crane	105	AS2436 Table A1
Forklift	106	AS2436 Table A1

4.1.3 Modelling methodology

For each construction activity, the potential noise impacts on the surrounding sensitive receivers have been predicted. Noise modelling was undertaken using CadnaA v4.4 and the *ISO 9613-2, 'Acoustics – Attenuation of sound during propagation outdoors'* algorithm. Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

The following assumptions and calculation parameters were used in the noise model:

- Land was modelled assuming a mixture of hard and soft ground with a ground absorption coefficient of 0.5.

- The noise model was used to predict noise levels during a typical worst case 15 minute period of operation where all equipment is running at full power.
- Atmospheric absorption was based on an average temperature of 20 °C and an average humidity of 70%.
- Foliage to the north of the site has been included in the noise model at a height of 3 m.
- The noise barrier between the rail corridor and Fairloch Avenue has been modelled as 3 m high. This is considered conservative as the noise barrier is higher than this.
- The algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.
- Noise sensitive receivers were modelled at a height of 1.5 m at the most-affected point within 30 m of the receiver. For two-storey residential dwellings, the first floor was modelled at a height of 4.5 m at the building facade.

4.1.4 Predicted construction noise levels

Predicted construction noise levels at sensitive receivers during standard construction hours are provided in Table 4-2. The results indicate that all noise sensitive receivers are predicted to be below the construction noise affected management levels

The noise mitigation measures detailed in Section 6.1 would be implemented where feasible and reasonable.

Table 4-2 Predicted construction noise levels, dB(A)

Receiver	Criteria during recommend standard construction hours	Predicted level
Macedonian Orthodox Church	55	30
Residences on Fairloch Avenue, Farmborough Heights (Ground floor)	43	38
Residences on Fairloch Avenue, Farmborough Heights (First floor)	43	39
Kingston Lodge	45	37
Ian McLennan Park	60	41
Patrick Autocare Vehicle Storage Facility	65	60

5. Operational noise impact assessment

5.1 Operational noise

5.1.1 Noise generating equipment

Operational noise sources on site are expected to be the WRF building, C&D drop-off area, and vehicles on the site. Noise data has been sourced from attended equipment measurements undertaken at the existing facility, a similar facility as part of the *Kimbriki Resource Recovery Project Noise Assessment* (GHD, January 2011), *Bulls Hill Noise Impact Assessment* (Don Fox Planning, 2001), AS *2436 – 2010 'Guide to Noise Control on Construction, Maintenance and Demolition Sites'* and British Standards *BS5228-2009 Code of practice for noise and vibration control on construction and open sites Part 1: Noise*.

A summary of expected equipment and noise levels on site are provided in Table 5-1. All equipment is expected to be operational during the opening hours (6am to 6pm Monday to Saturday, 8am to 4pm Sundays and no work on Public Holidays).

Table 5-1 Existing landfill noise sources, dB(A)

Equipment	Sound power level (dB(A))	Source
Bulldozer	108	AS2436 Table A1
Dump truck	107	BS 5228, Table C2#30
Excavator	107	AS2436 Table A1
Loader backhoe	96	BS 5228, Table C2#8
Truck	107	AS2436 Table A1
Crusher	115	Site measurement
Screen	112	Site measurement
C&D dropoff area	103	Kimbriki
WRF building	Day-time operations: 90 (Internal)	Kimbriki
Heavy vehicle on weighbridge	104	Kimbriki

5.1.2 Modelling methodology

To assess compliance with the noise criteria, noise predictions were undertaken for the WRF. Noise modelling was undertaken using CadnaA v4.4 and the *ISO 9613-2, 'Acoustics – Attenuation of sound during propagation outdoors'* algorithm. Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

The following assumptions and calculation parameters were used in the noise model:

- Land was modelled assuming a mixture of hard and soft ground with a ground absorption coefficient of 0. 5.
- The noise model was used to predict noise levels during a typical worst case 15 minute period of operation where all equipment is running at full power.

- Atmospheric absorption was based on an average temperature of 20 °C and an average humidity of 70%.
- Site operations were assessed against the night-time operational noise criteria as site operations will begin at 6am.
- The algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.
- Foliage to the north of the site has been included in the noise model at a height of 3 m.
- The noise barrier between the rail corridor and Fairloch Avenue has been modelled as 3 m high. This is considered conservative as the noise barrier is higher than this.
- The WRF building sound power level has been based on noise levels used in the *Kimbriki Resource Recovery Project Noise Assessment.*
- The WRF building has been modelled with a noise reduction index R_w of 26 to account for the attenuation of noise from inside to outside of the building. This is typical of galvanised steel sheets.
- The WRF building is enclosed however a 10 m opening has been assumed on the eastern side of the building.
- One operational scenario has been modelled: general operation including operation of the existing crusher and screen.

5.1.3 Modifying factor adjustments

The noise modelling undertaken is considered worst-case with all machinery assumed to be operating simultaneously for the entire time period.

Site operations are not anticipated to have tonal or low frequency components.

The site does create intermittent noise however the INP states that a correction is only applied to the night time period. Site operations during the 6am to 7am period fall into the night time period. However, this time period is characterised by increasing noise levels and is a night to day time 'shoulder period' as per the INP.

Hence, no modifying adjustments have been applied.

5.1.4 Predicted operational noise levels

The predicted noise levels for site operations during the night-time period are shown in Table 5-2 and a noise contour plot is shown in Figure 7. The predicted noise levels include a G class stability condition and 3 m/s north-westerly winds during the night-time period.

Table 5-2 Predicted day time operational noise levels, dB(A)

Receiver	Noise criteria	Predicted level
Macedonian Orthodox Church	55	32
Residences on Fairloch Avenue, Farmborough Heights (Ground floor)	38	37
Residences on Fairloch Avenue, Farmborough Heights (First floor)	38	38
Kingston Lodge	40	36

Receiver	Noise criteria	Predicted level
Ian McLennan Park	60	39
Patrick Autocare Vehicle Storage Facility	65	60

5.1.5 Assessment of operational noise levels

The predicted existing night time noise levels at all receivers comply with the most stringent night time noise criteria. Due to the topography of the site predicted noise levels at Farmborough Heights and the nearby Macedonian Orthodox Church are well within the criteria. Predicted noise levels during operation at Kingston Lodge and other receivers in Kembla Grange are also below the criteria.

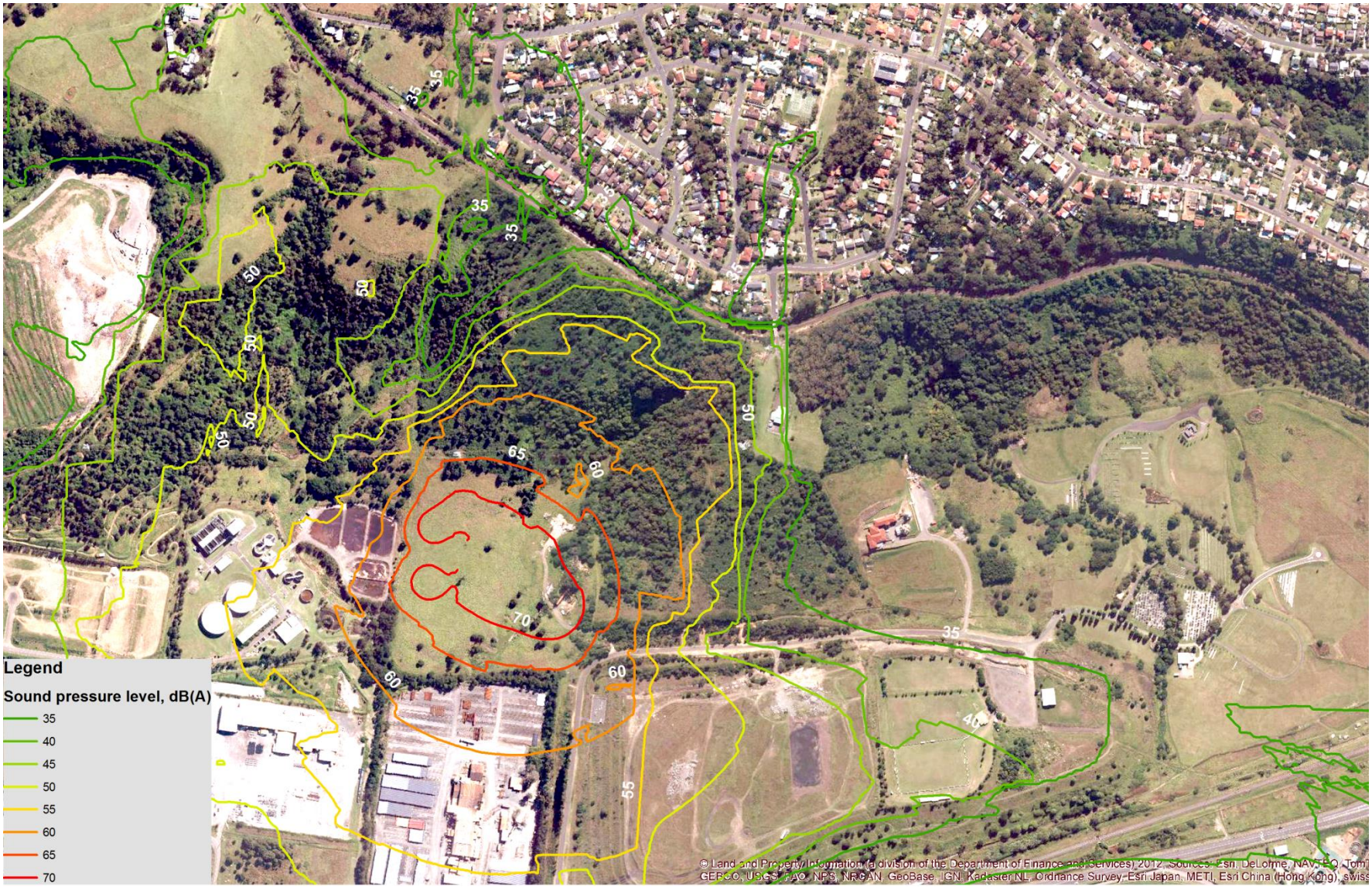


Figure 7 Predicted operational noise contours (Aerial: SIX Maps)

6. Mitigation measures

6.1 Construction mitigation measures

The modelling results indicate that the construction noise management levels will not be exceeded at any receivers. Construction noise impacts will be limited to during the standard construction hours. The following general noise mitigation measures are suggested to mitigate construction noise impacts:

- All engine covers should be kept closed while equipment is operating.
- As far as possible, materials dropping heights into or out of trucks should be minimised.
- Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes should be eliminated, where practicable.
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made.
- All equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.
- The constructor would provide a phone number at the site entrance detailing the site contact so that noise complaints can be received and addressed in a timely manner.
- Upon receipt of a noise complaint, monitoring would be undertaken and reported as soon as possible. If exceedances are detected, the situation would be reviewed in order to identify means to attempt to reduce the impact to acceptable levels.
- All site workers would be sensitised to the potential for noise impacts on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities. This would include:
  - Avoid the use of loud radios.
  - Avoid shouting and slamming doors.
  - Where practical, machines would be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods.
  - Keep truck drivers informed of designated vehicle routes, parking locations and delivery hours.
  - Minimise reversing.
  - Avoid dropping materials from height and avoid metal to metal contact on material.
  - All engine covers would be kept closed while equipment is operating.

6.2 Operational mitigation measures

The modelling results indicate that the operational noise criteria will not be exceeded at any sensitive receiver. Once the design for the WRF facility has been finalised, a review should be undertaken to check that noise levels do not exceed the assumed levels in this assessment.

Based on the information provided in this assessment, specific operational mitigation measures are not required. General mitigation measures are provided in section 6.1.

7. Conclusion

This report was prepared to assess potential noise impacts associated with construction and operation of the Kembla Grange Waste Recovery Facility. Baseline noise levels were measured at two sensitive receiver locations within the study area. The results of baseline noise measurements, combined with construction and operational information were used to predict potential impacts on key sensitive receivers.

Construction activities during recommended standard hours are not predicted to exceed the noise affected construction noise management levels at nearby sensitive receivers. Recommended noise mitigation measures would be implemented where feasible and reasonable.

Operational noise from the WRF is predicted to comply with the INP at the surrounding sensitive receivers during daytime and night time operations.

Once the design for the WRF facility has been finalised, a review should be undertaken to check that noise levels do not exceed the assumed levels in this assessment

The proposal would be acceptable from an acoustic perspective assuming the recommended mitigation measures are implemented.

8. References

AS 1055 Description and Measurement of Environmental Noise, Australian Standards, 1997

AS 2436 Guide to noise and vibration control on construction, demolition and maintenance sites, Australian Standards, 2010

BS 5228.2 Code of Practice for noise and vibration control on construction and open sites: Part 2 Vibration, British Standards, 2009.

Bulls Hill Noise Impact Assessment, Don Fox Planning, 2001

Industrial Noise Policy, EPA, 2000

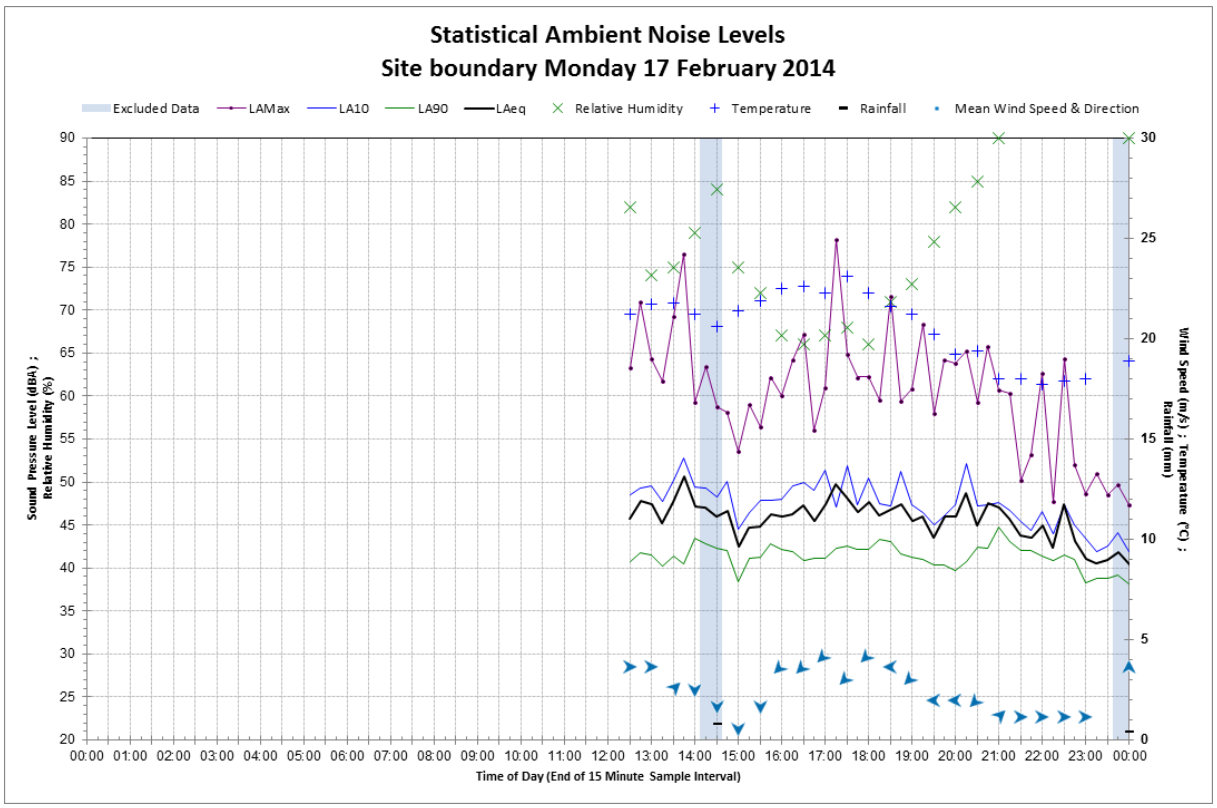
Kembla Grange Waste Recovery Centre EIS – Part A, TCG, 2013

Kimbriki Resource Recovery Project Noise Assessment, GHD, 2011

Road Noise Policy, DECCW, 2011

Appendices

Appendix A – Noise monitoring charts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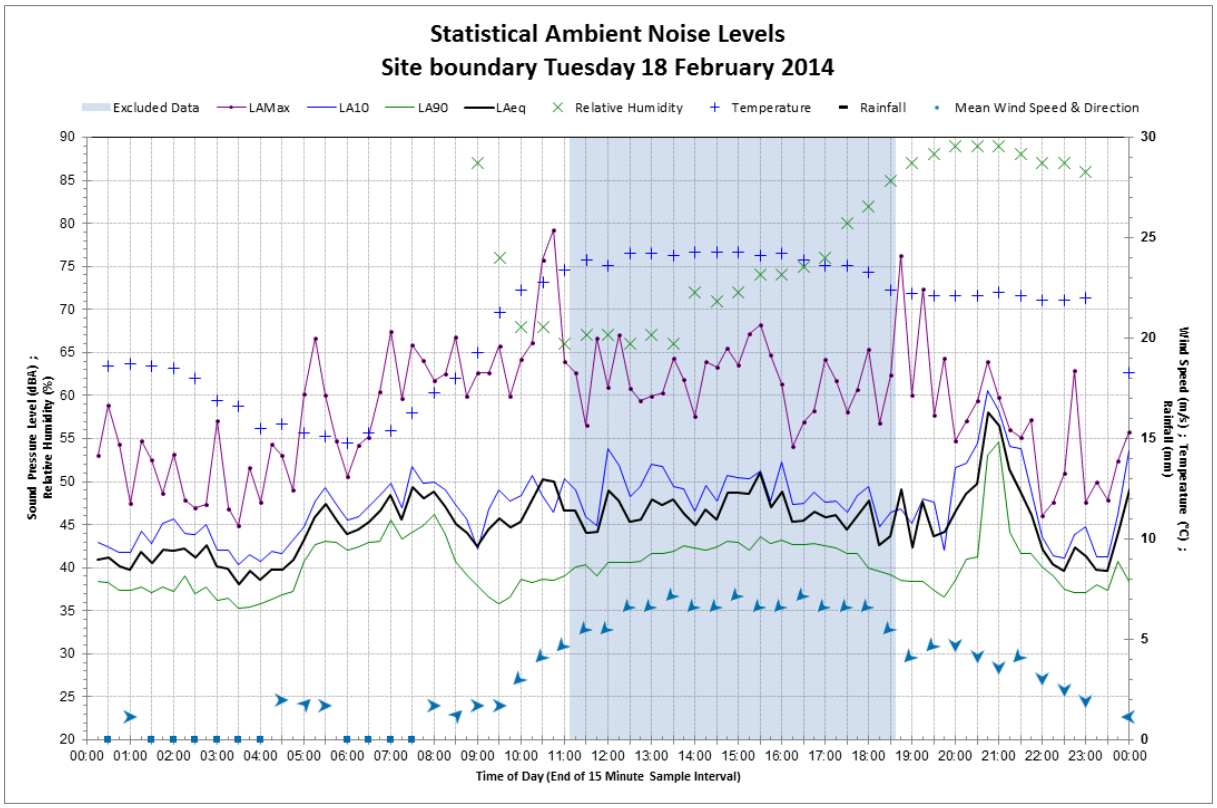
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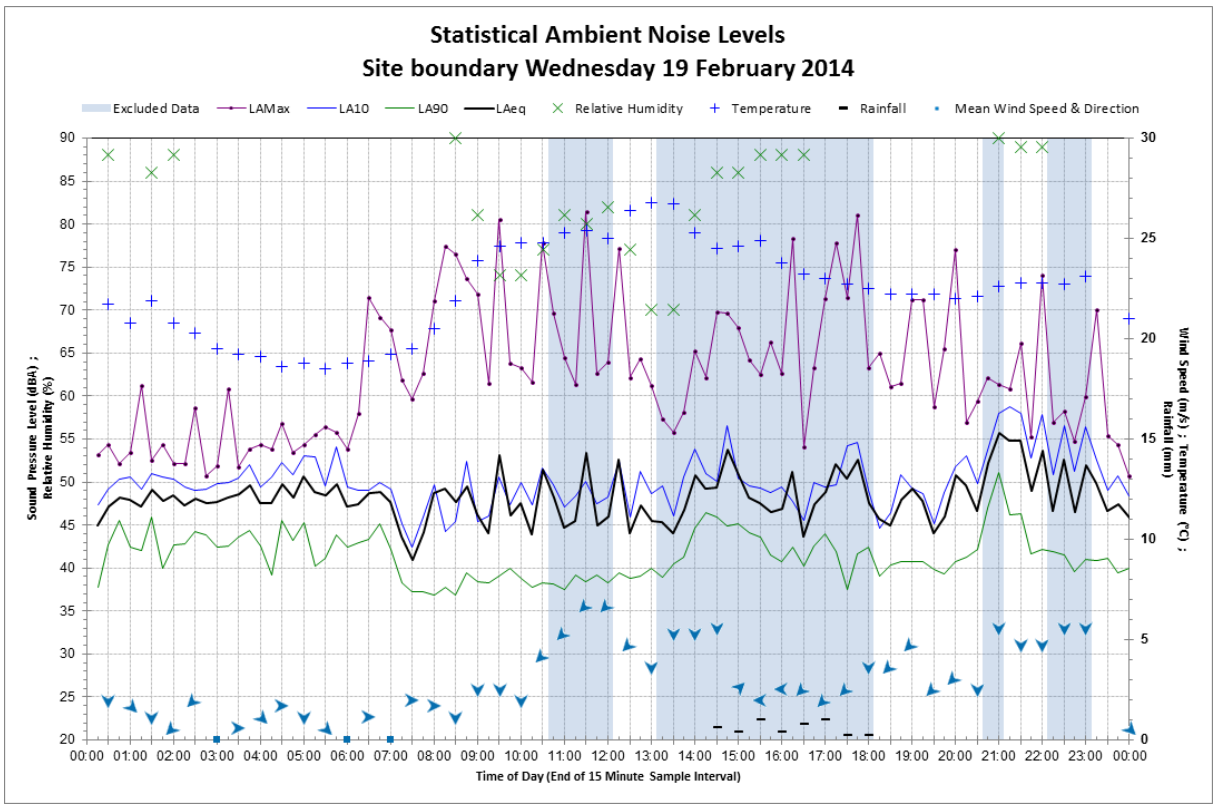
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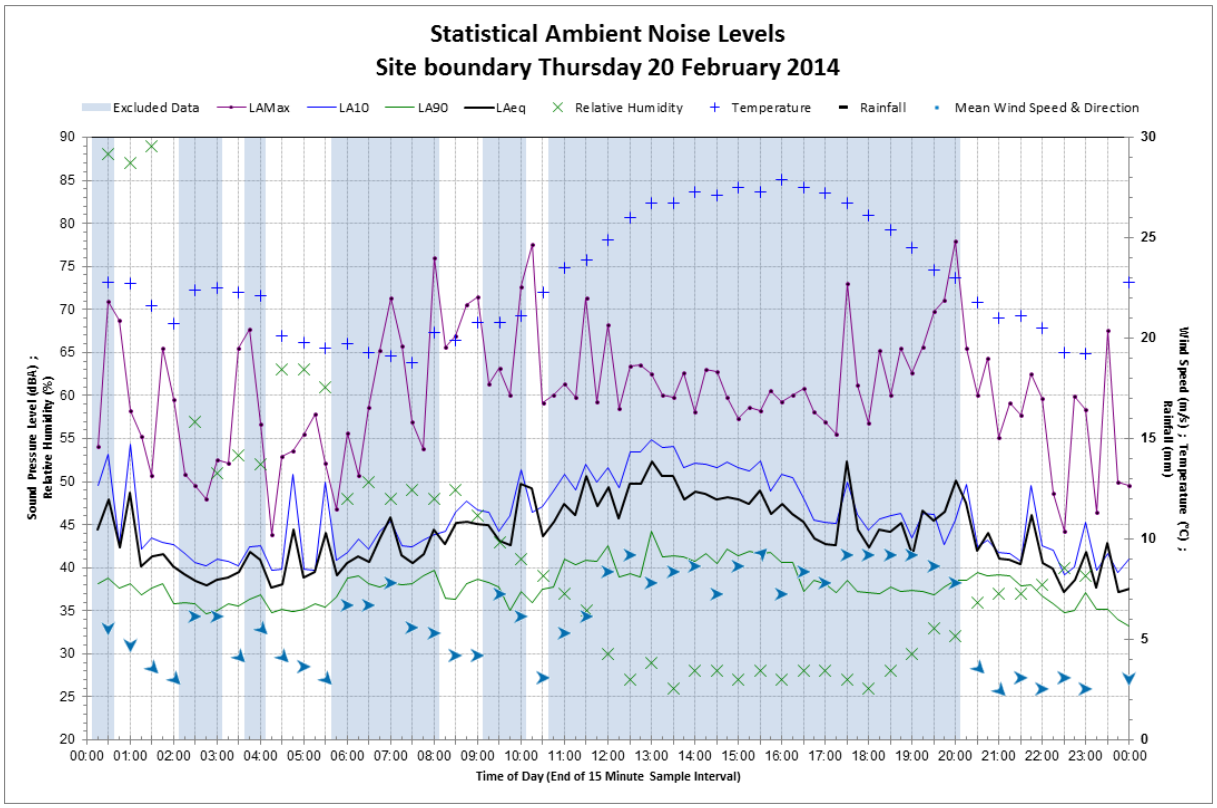
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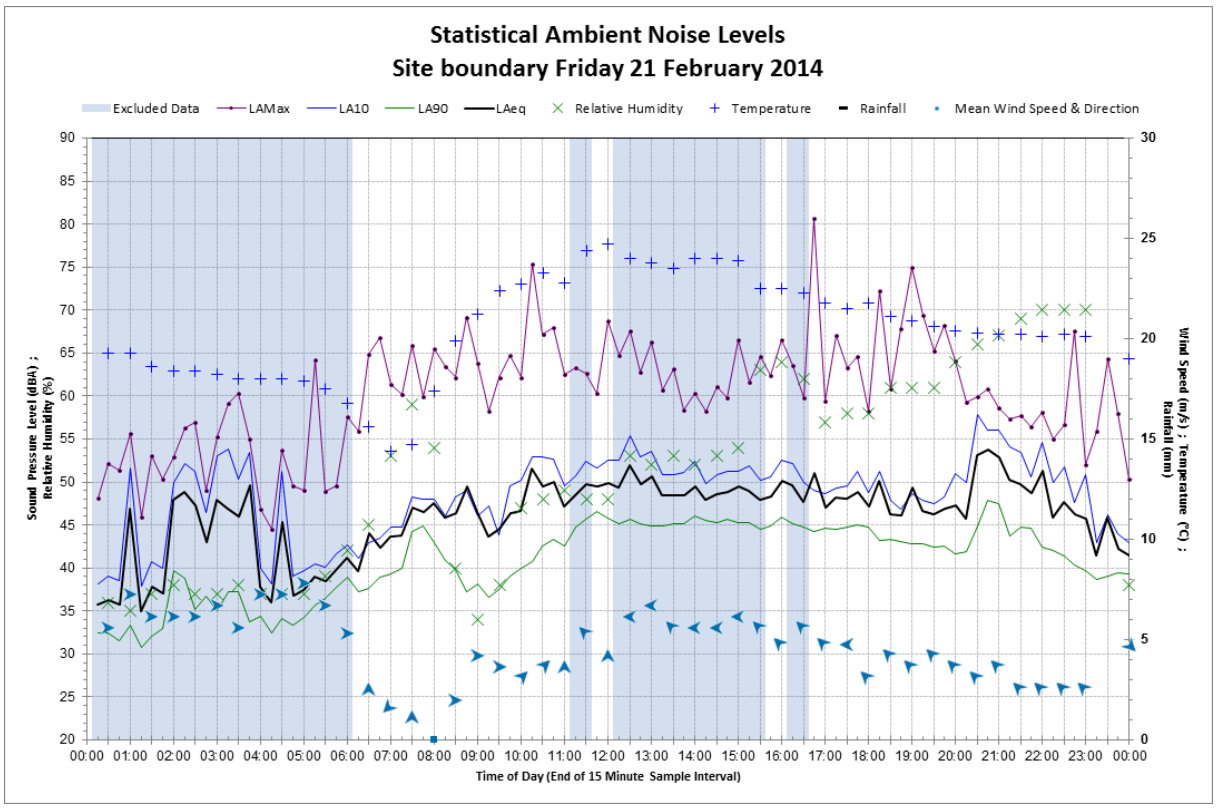
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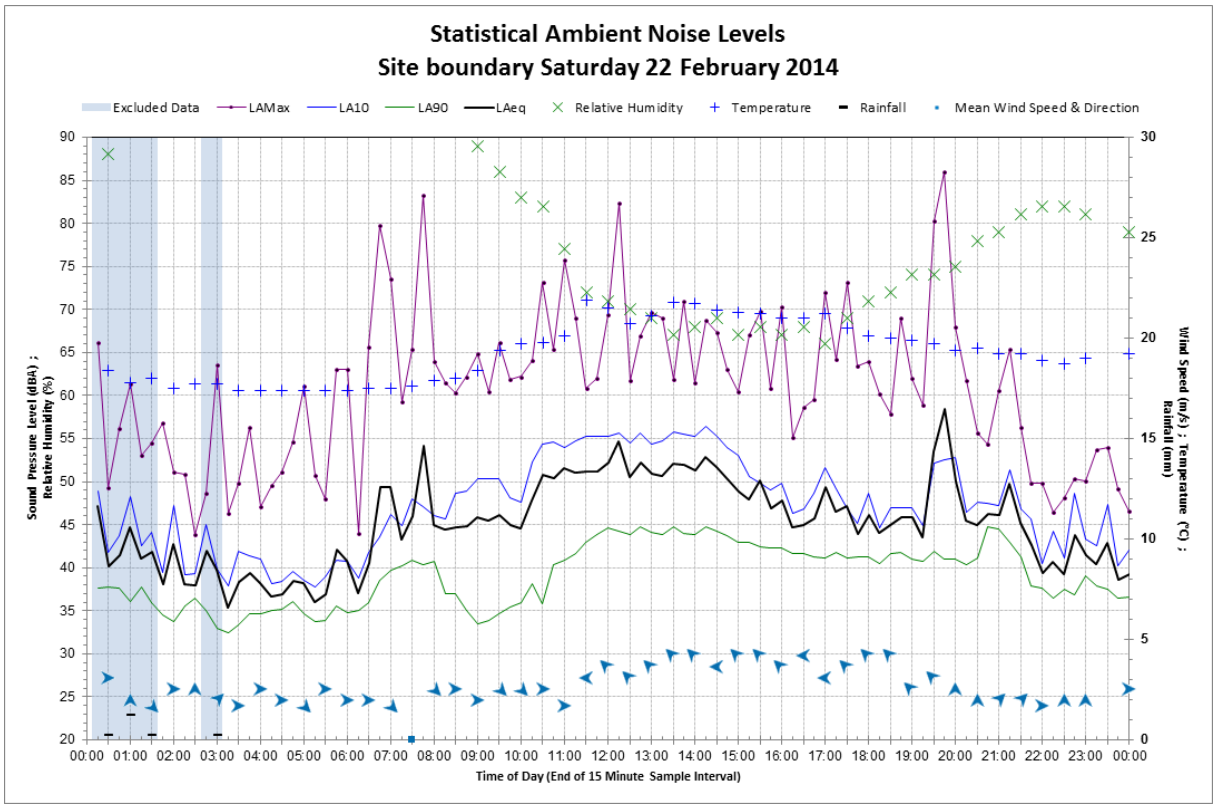
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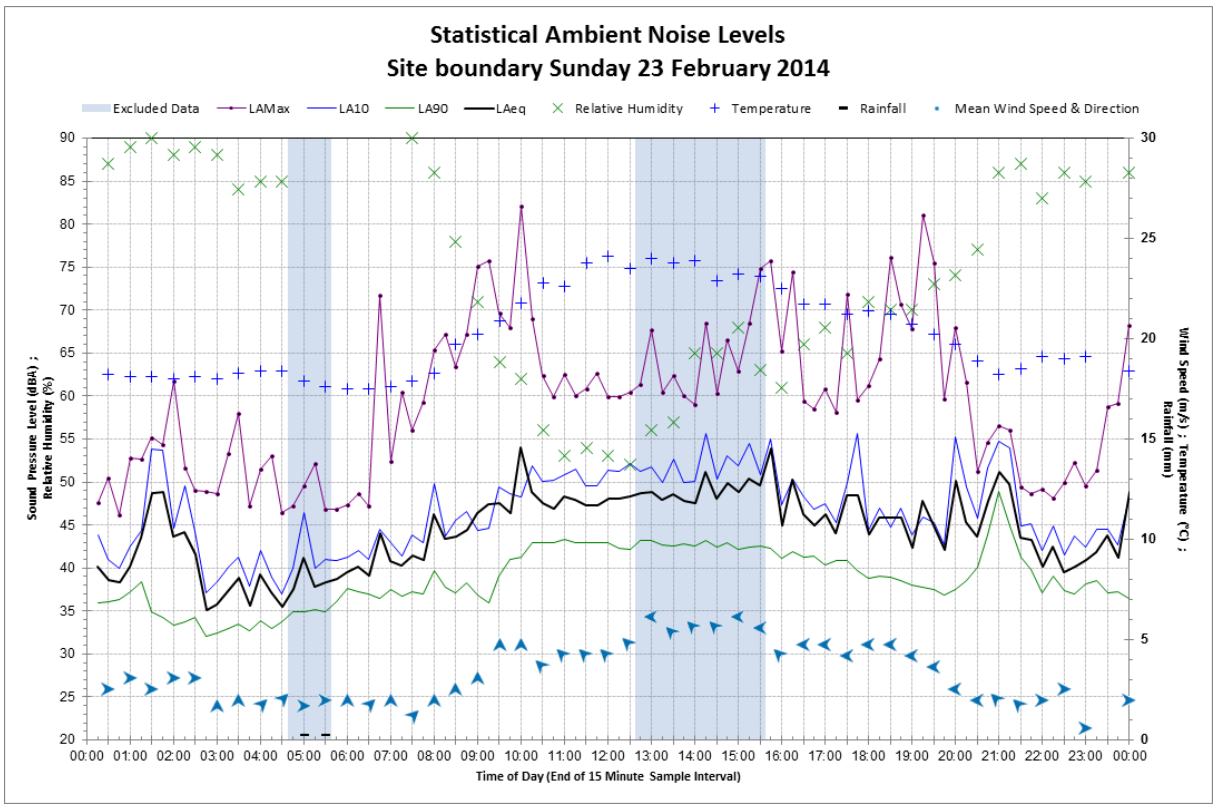
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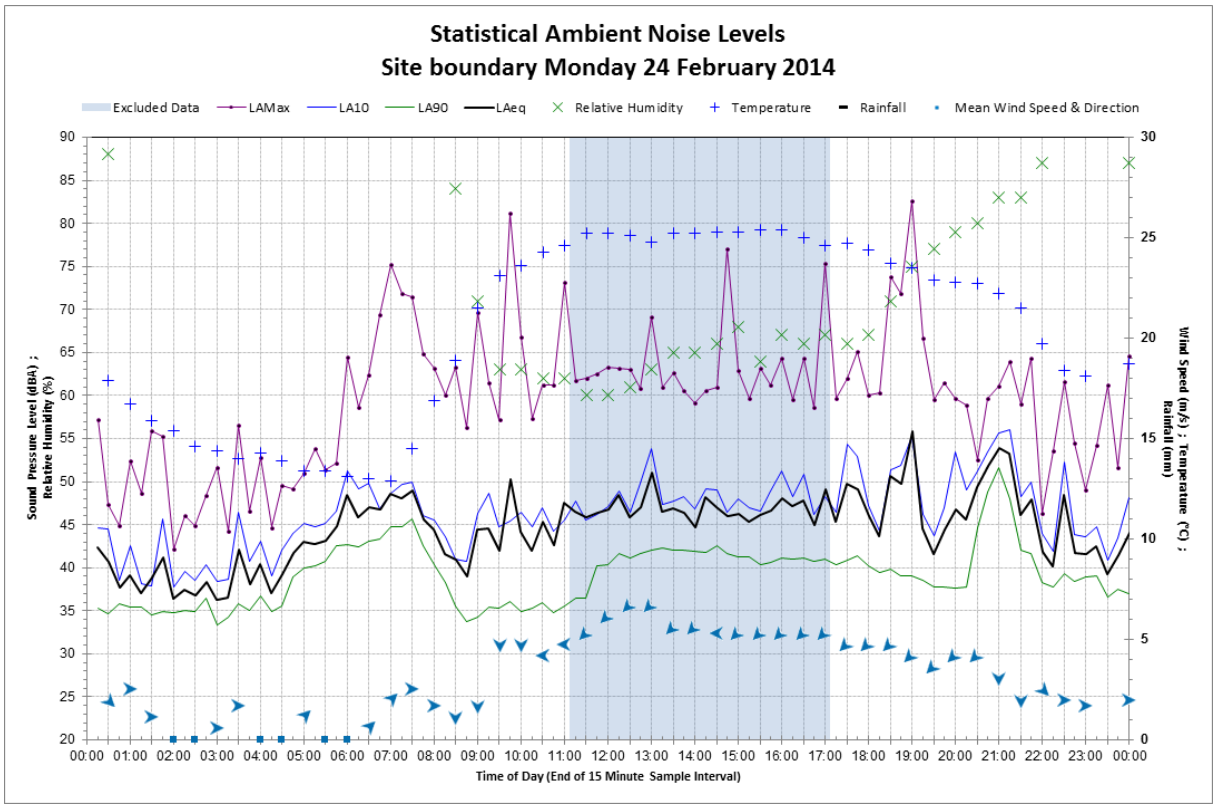
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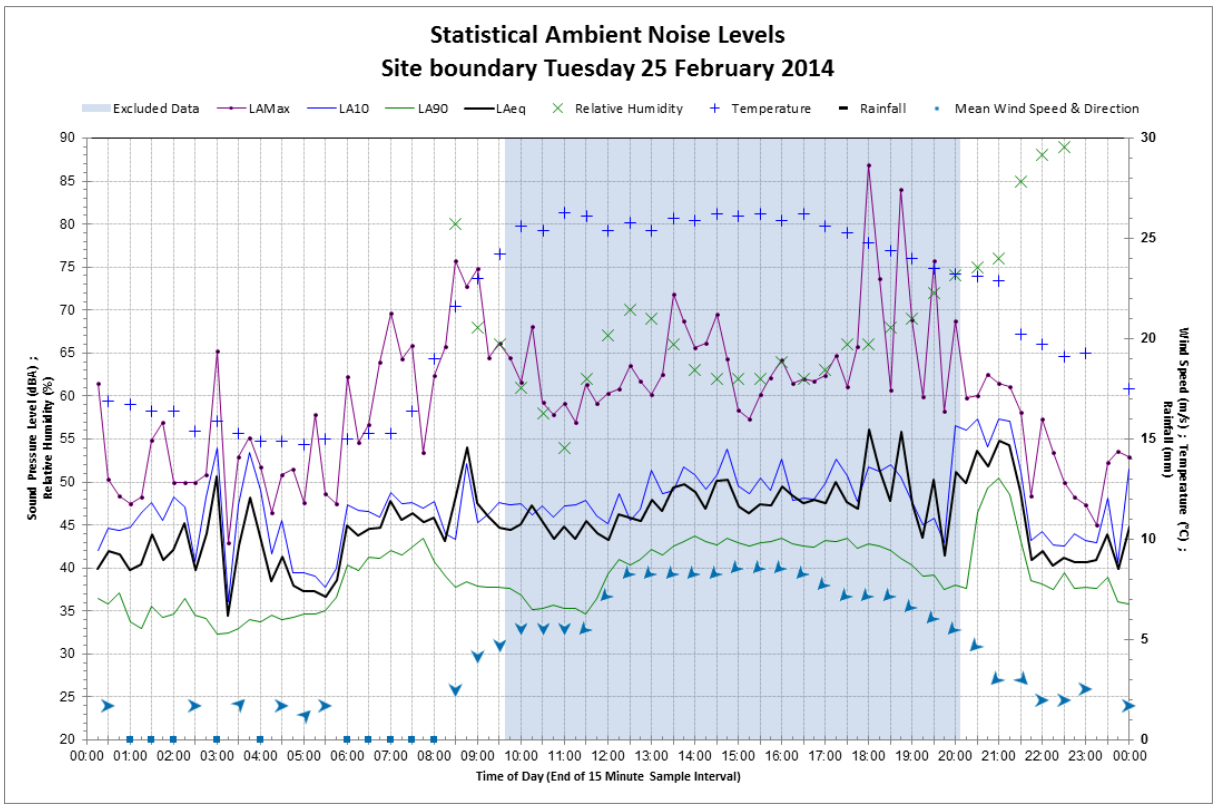
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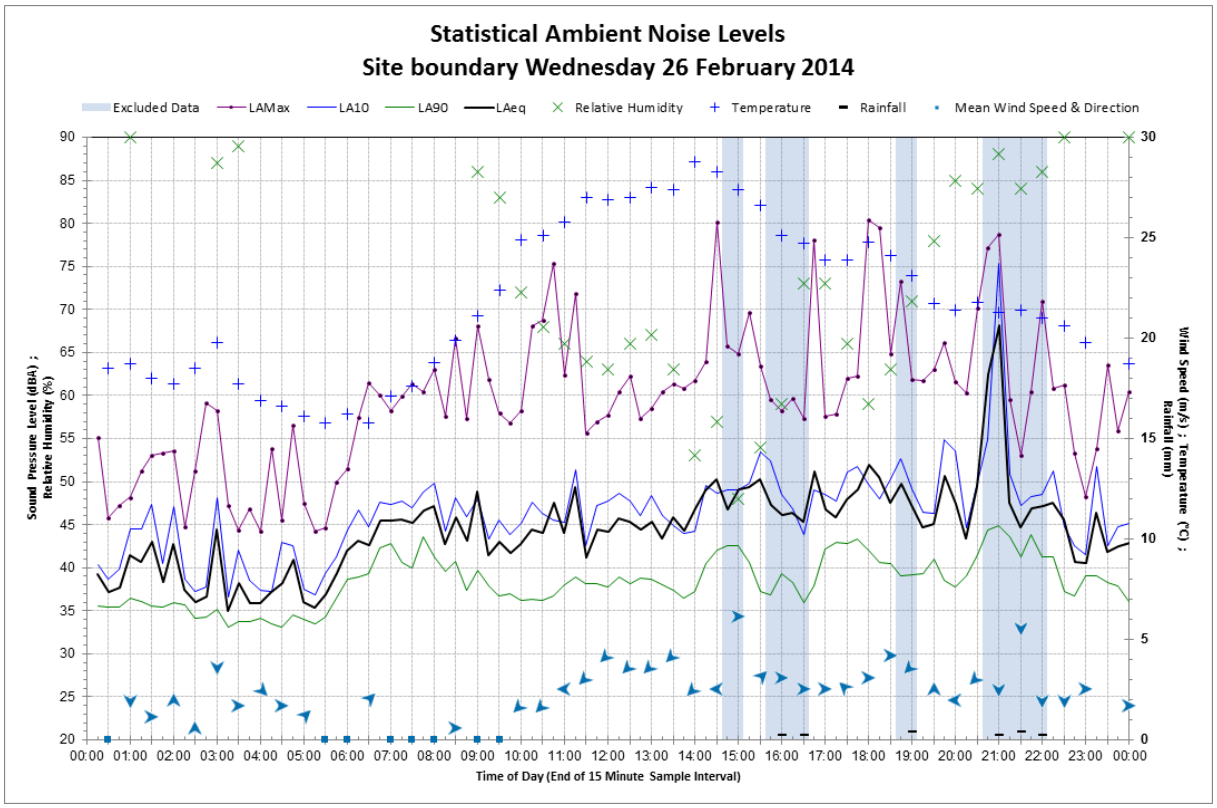
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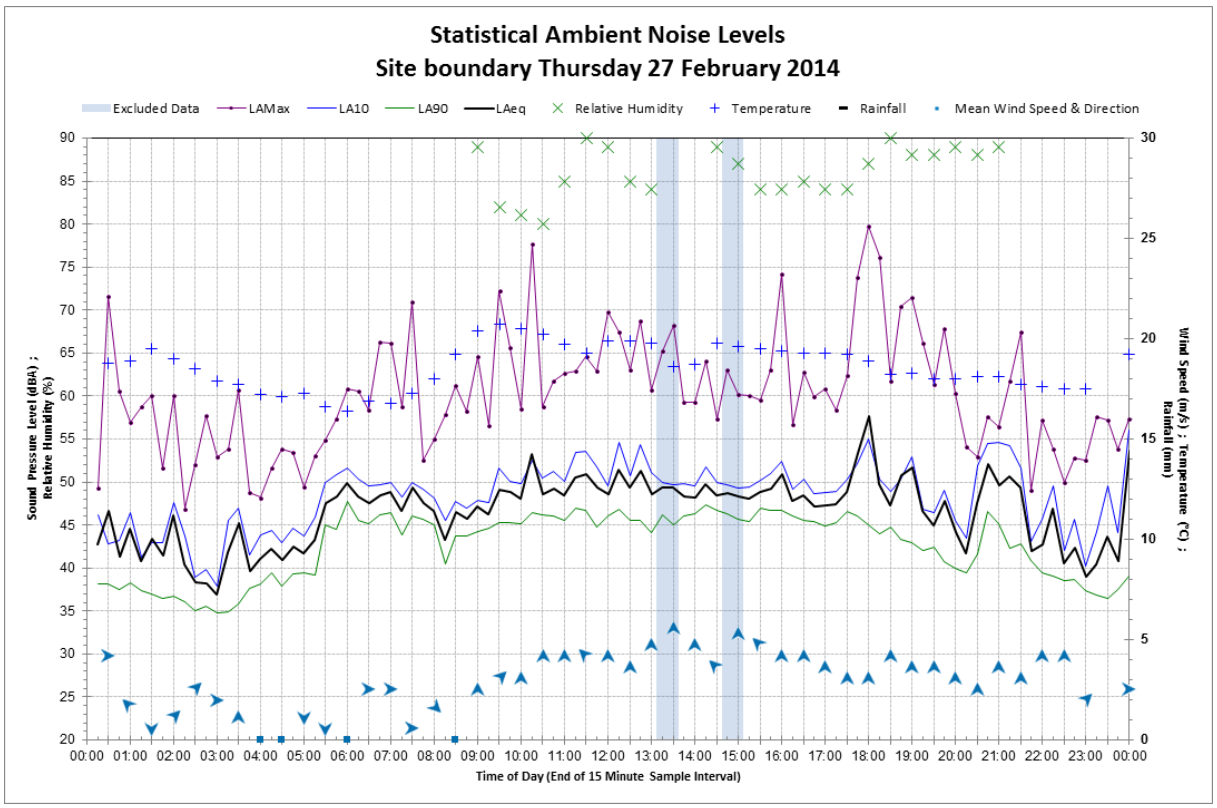
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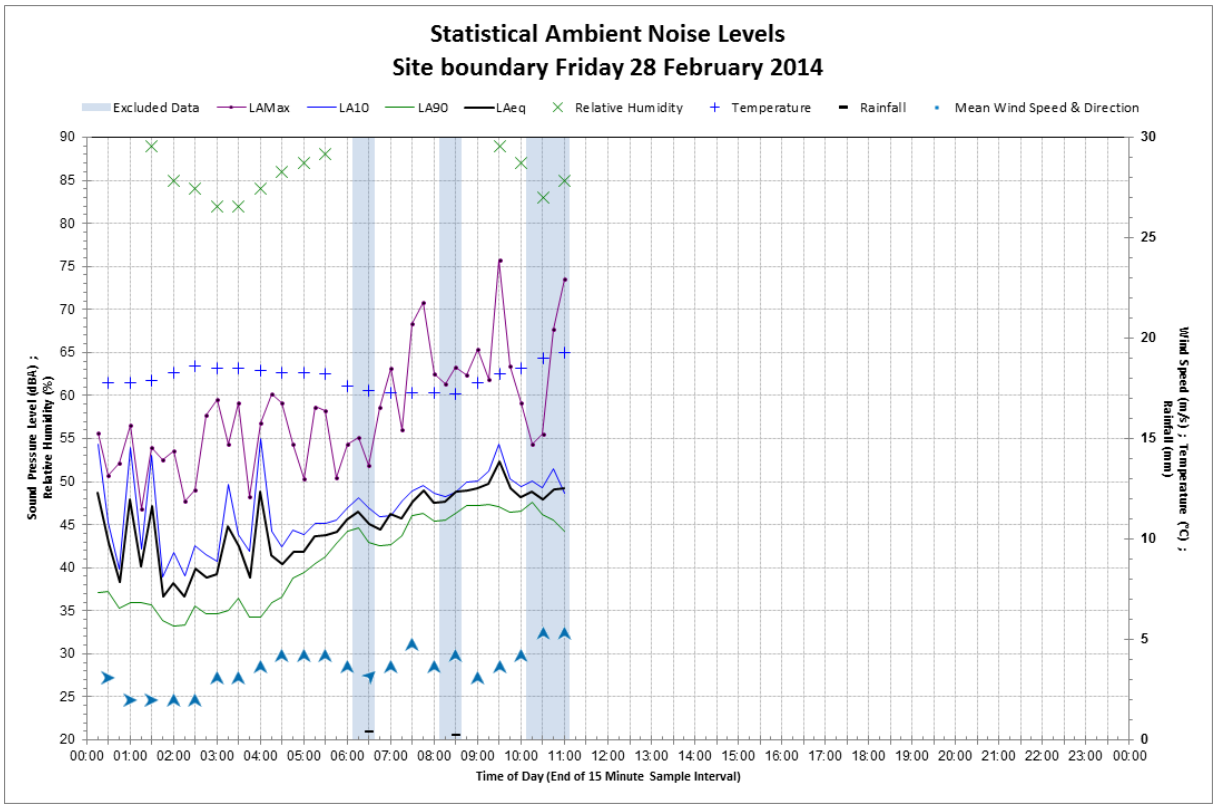
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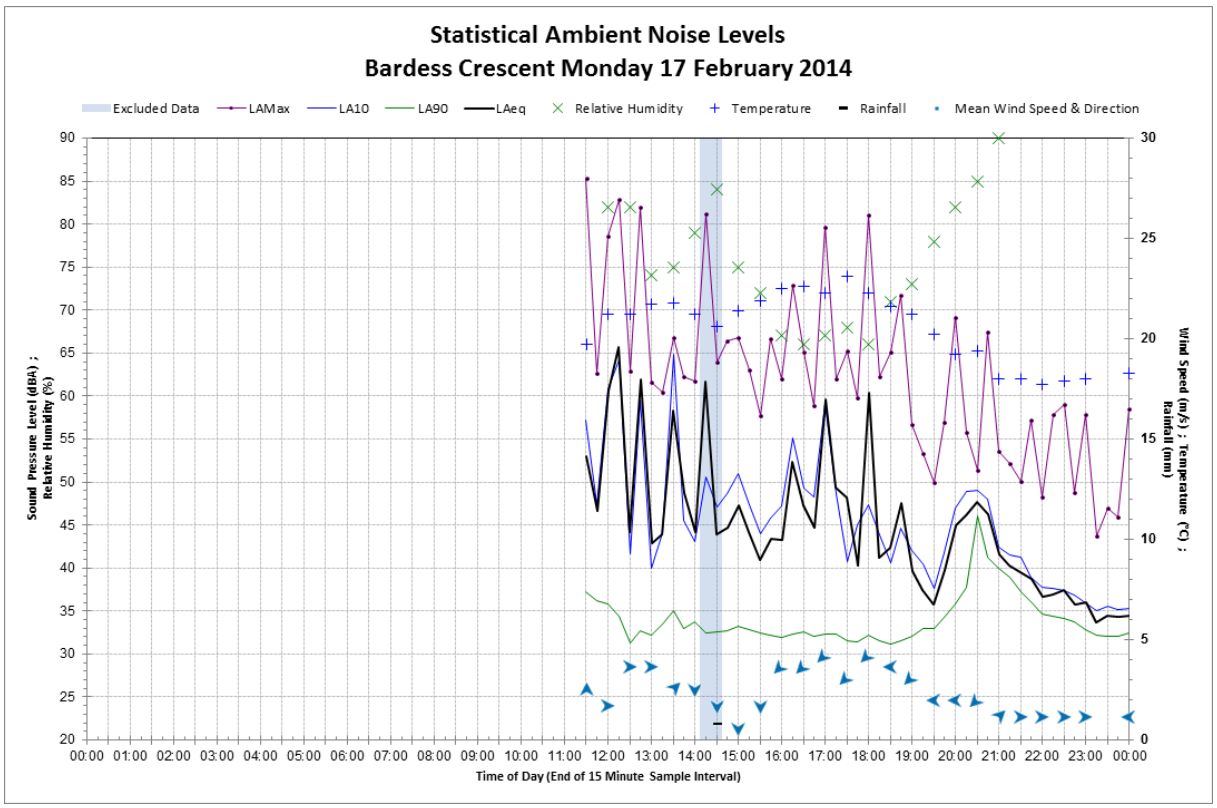
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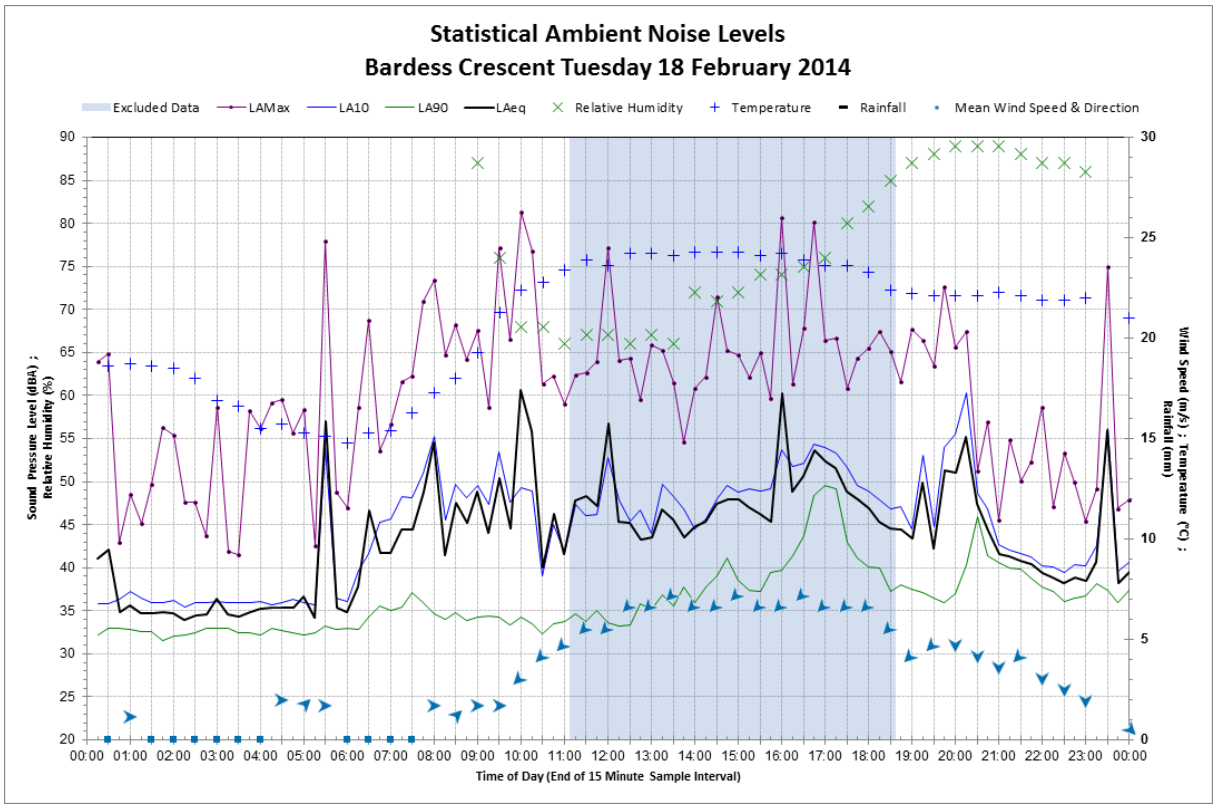
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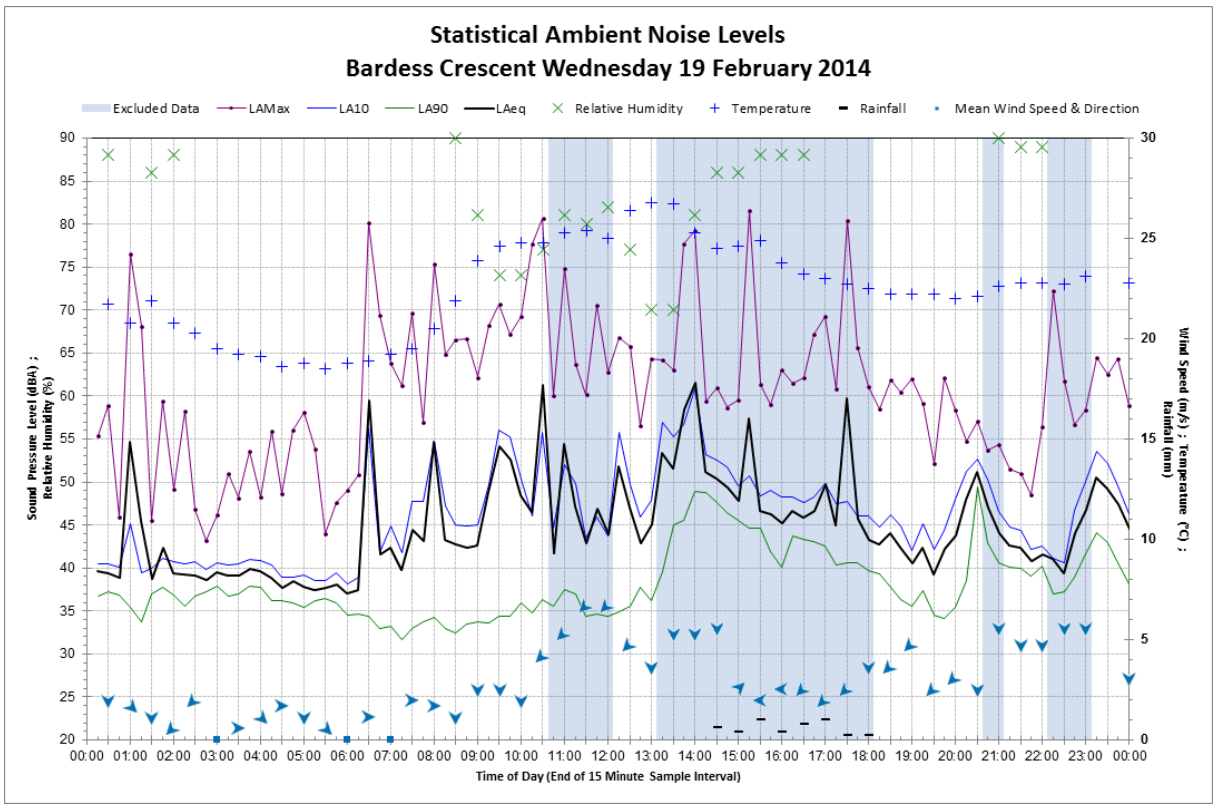
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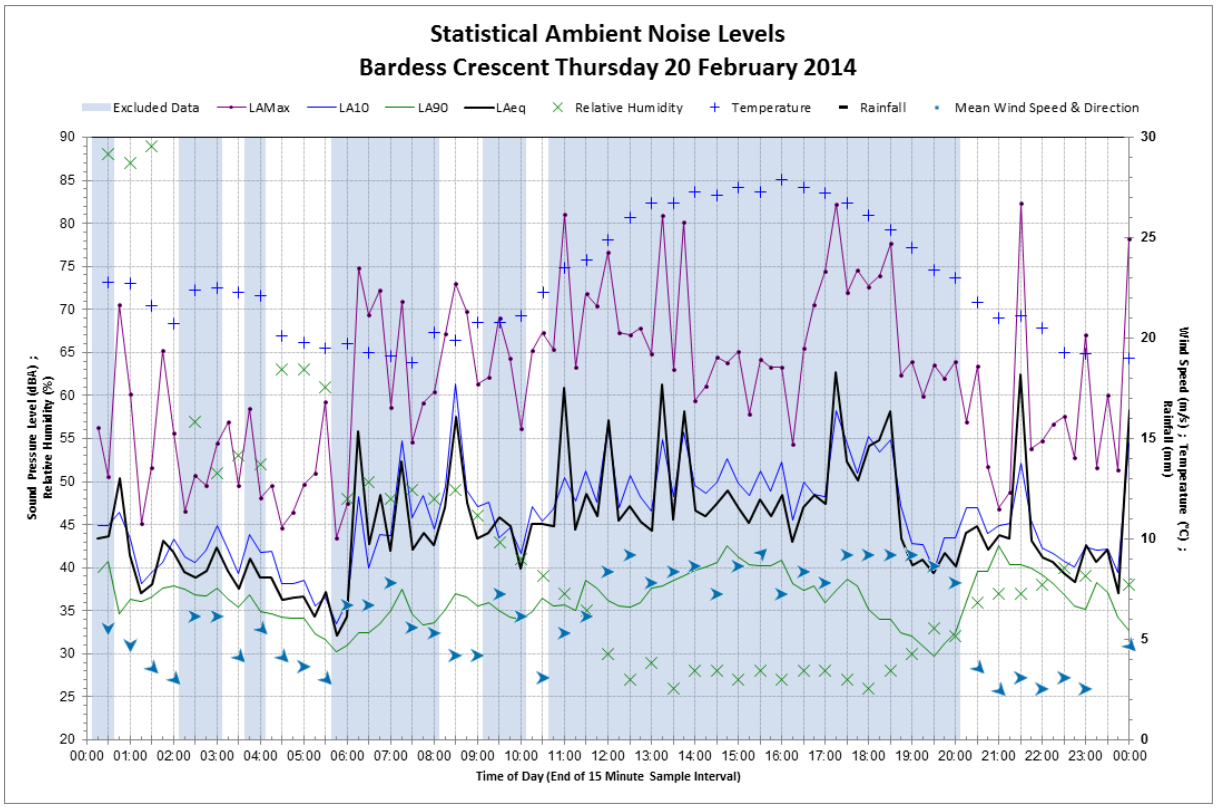
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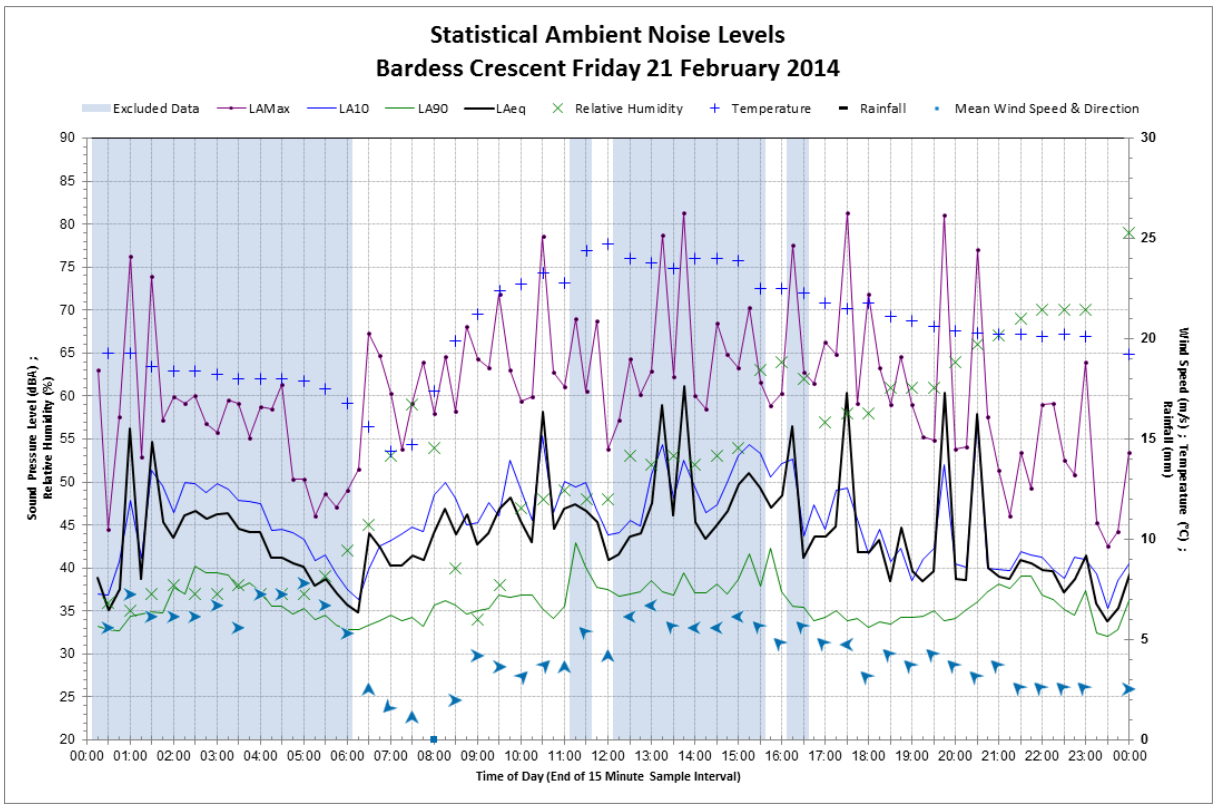
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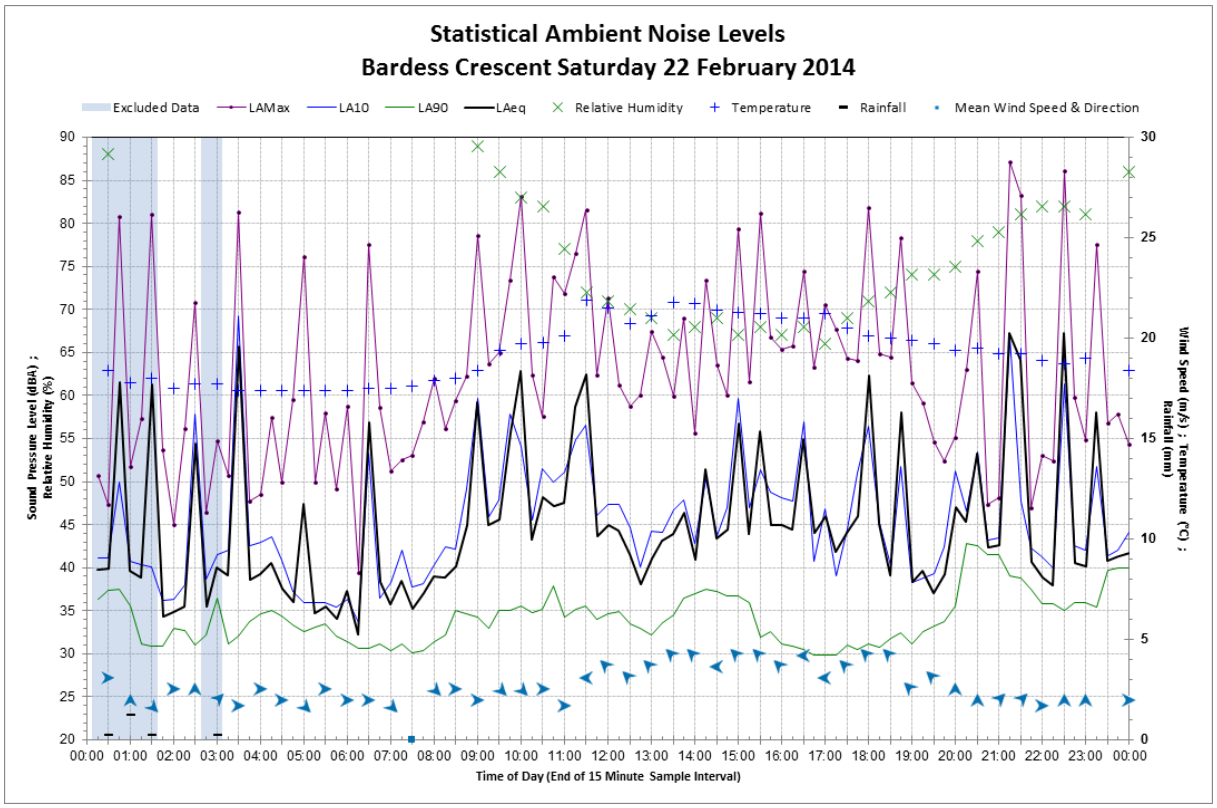
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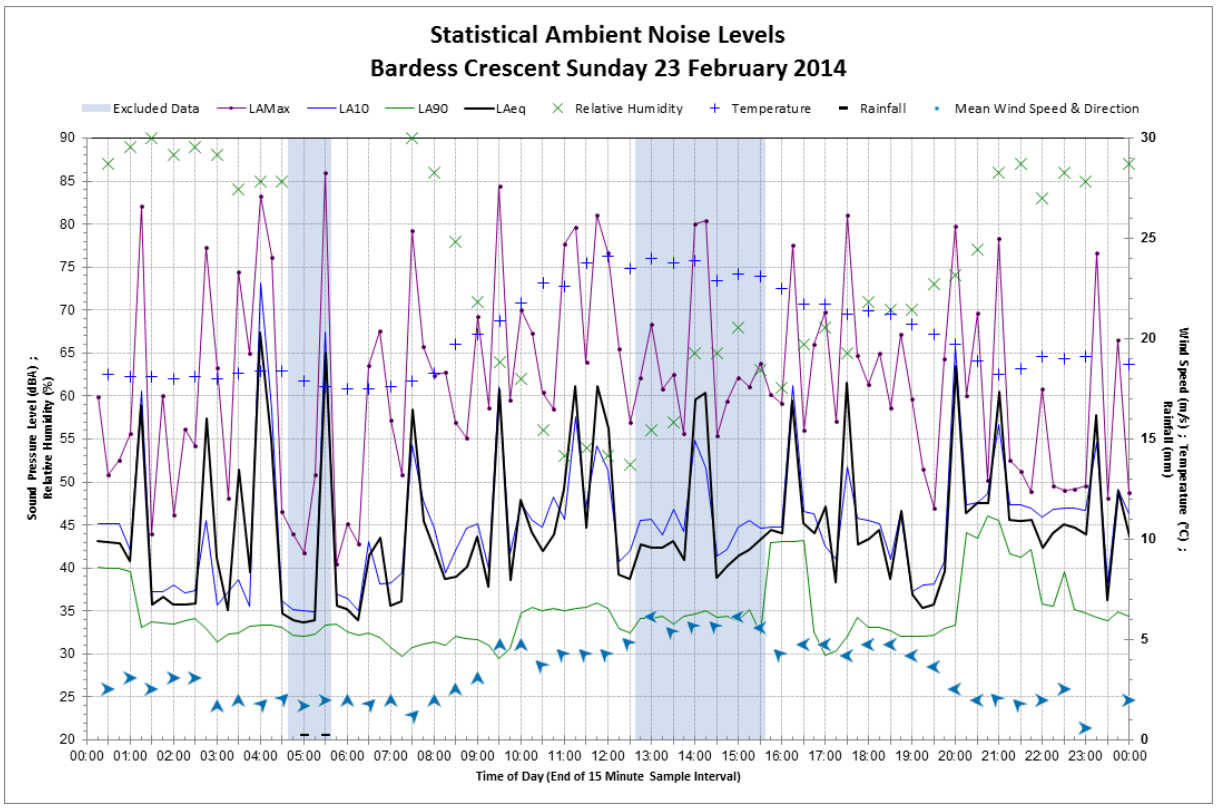
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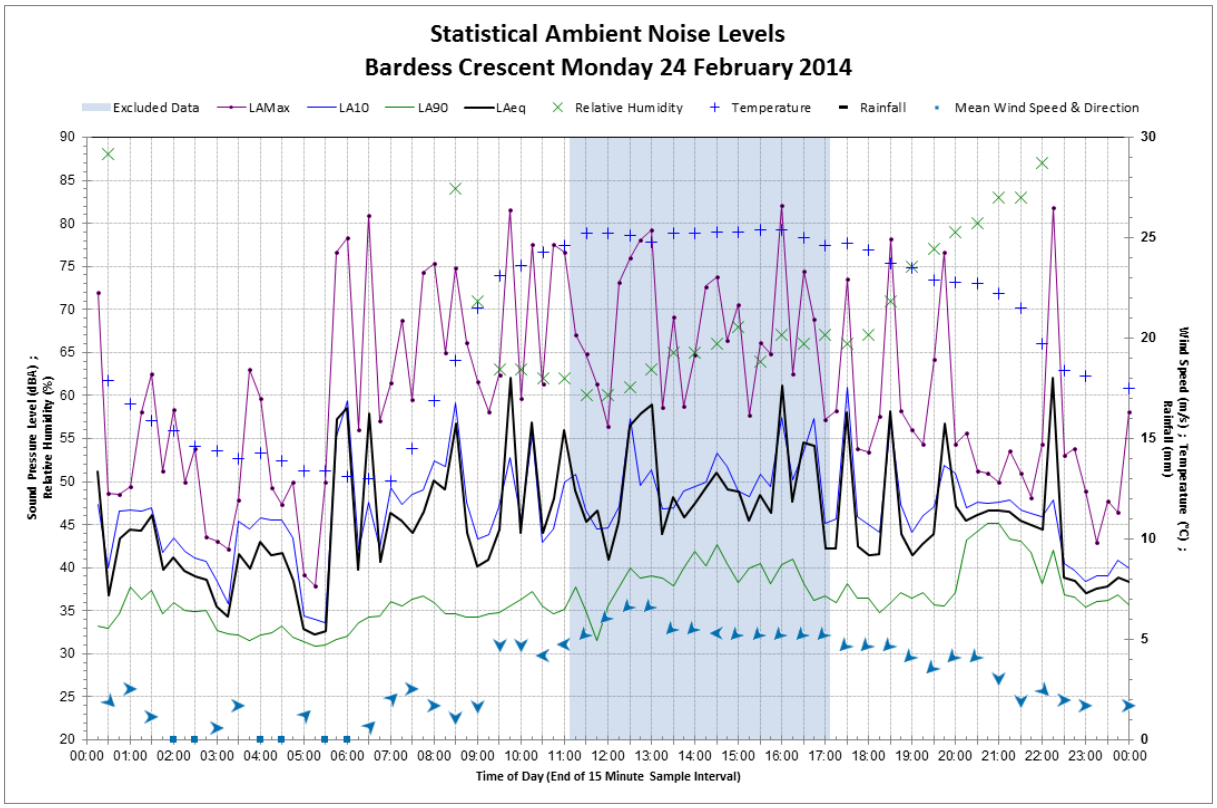
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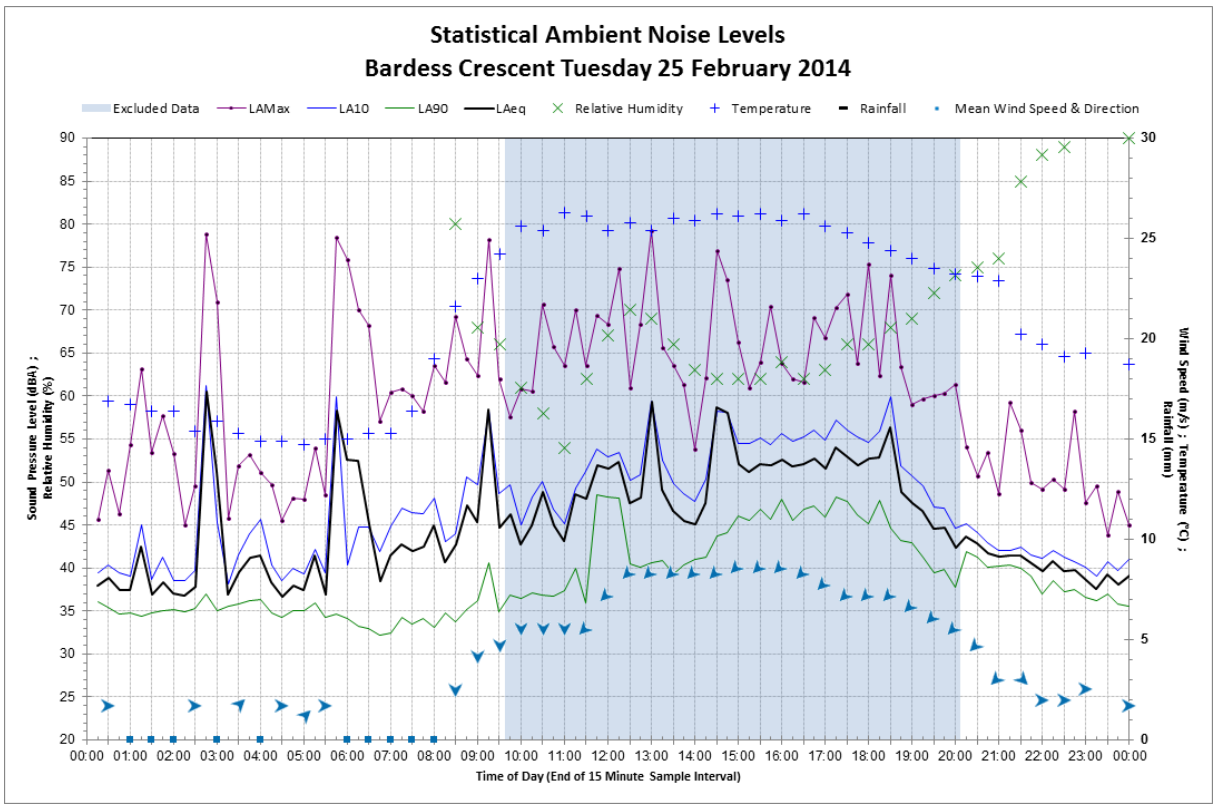
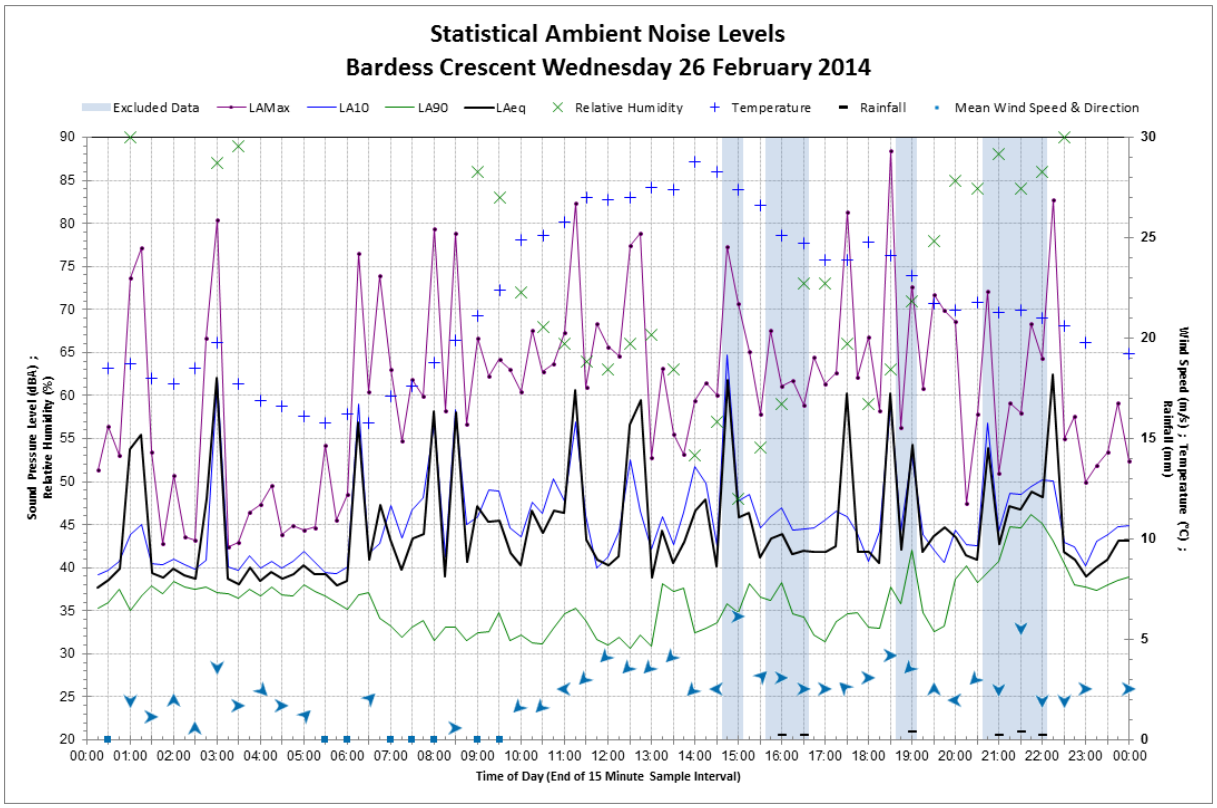
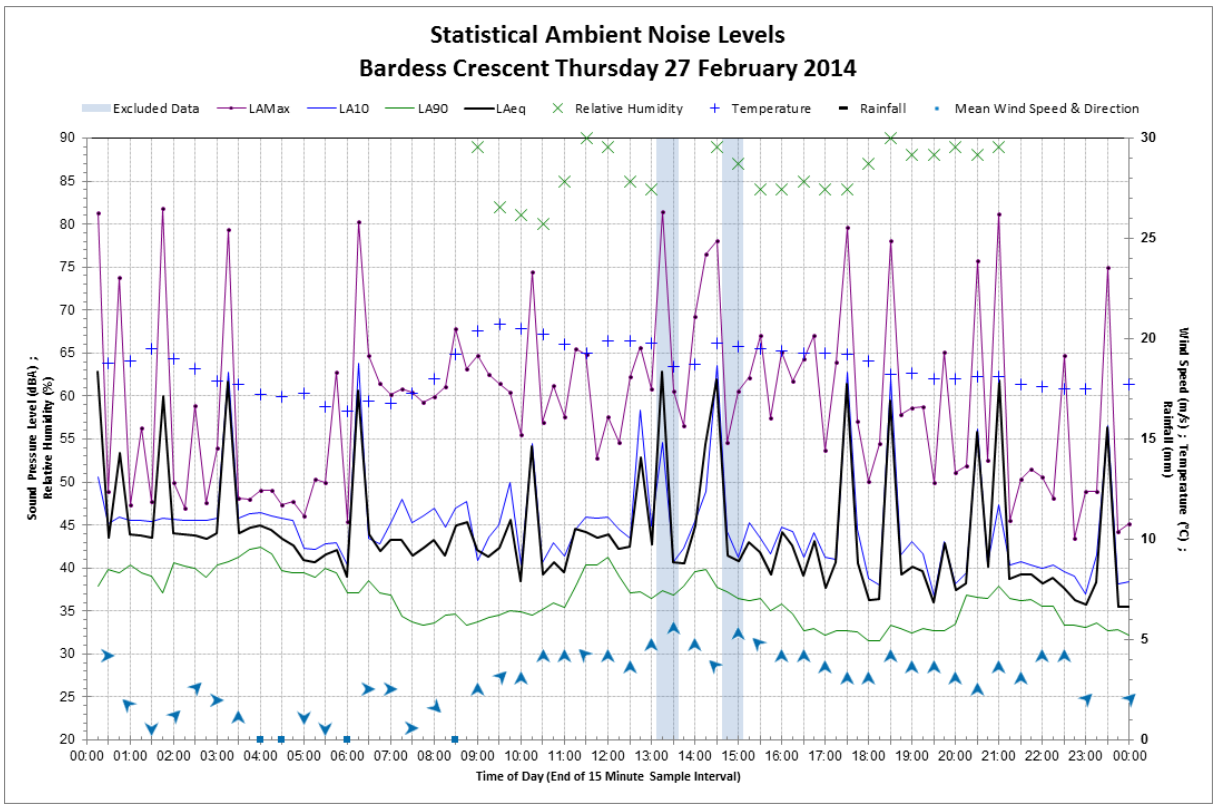
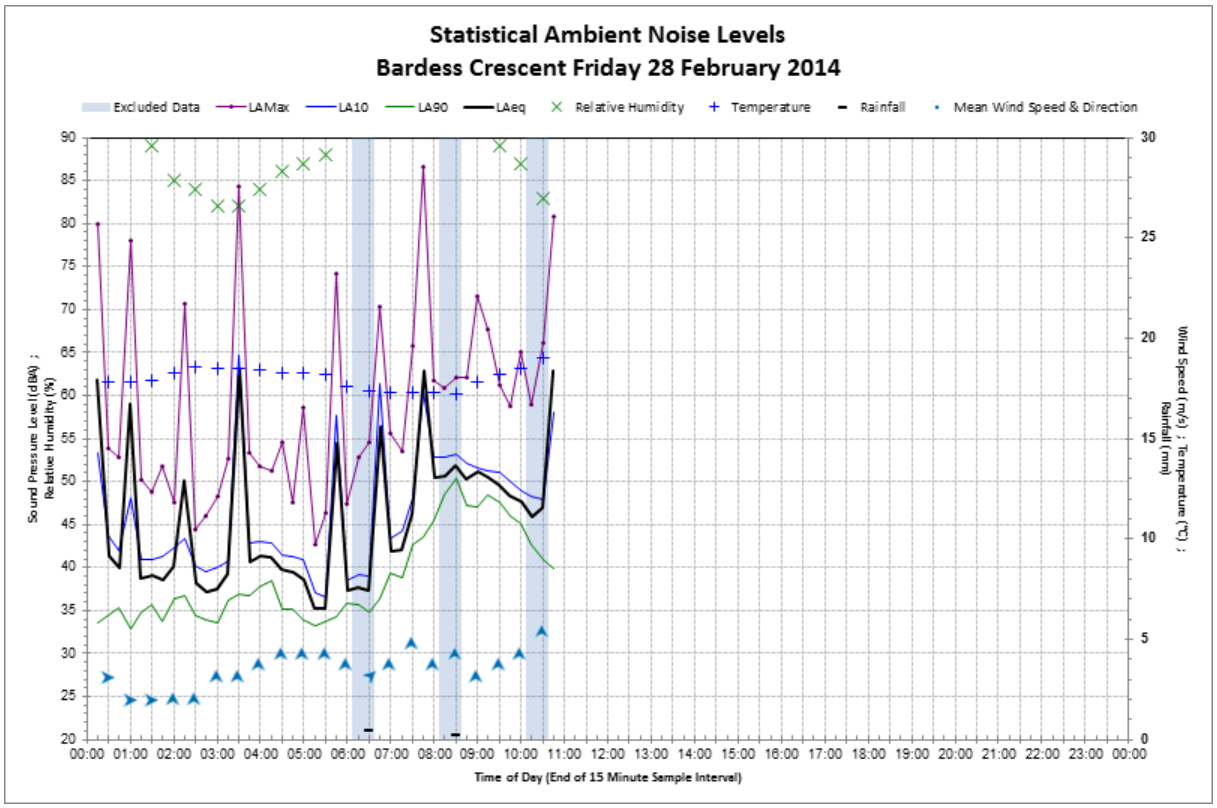
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Bardess Crescent Tuesday 25 February 2014
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Bardess Crescent Wednesday 26 February 2014
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Bardess Crescent Thursday 27 February 2014
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Bardess Crescent Friday 28 February 2014
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

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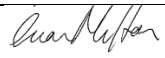
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	P Pandey	E Smith		E Milton		14/04/2014
1	P Pandey	E Smith		E Milton		20/06/2014
2	P Pandey	E Smith		E Milton		23/06/2014
3	E Smith	E Smith		E Milton		10/7/2014
4	P Pandey	E Milton		E Milton		15/04/2015

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