VOLUME 4

Appendix E2
Airport ground-based noise and vibration

A C O U S T I C S   A N D   A I R

WESTERN SYDNEY AIRPORT EIS

ASSESSMENT OF GROUND-BASED OPERATIONAL NOISE

REPORT NO. 14168-1
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PREPARED FOR

GHD PTY LTD
LEVEL 15
133 CASTLEREAGH STREET
SYDNEY NSW 2000

WILKINSON MURRAY

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50 YEARS 1962–2012

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EXECUTIVE SUMMARY

This report assesses noise impacts on surrounding communities from ground-based operational activity at the proposed Western Sydney Airport. The assessment has been undertaken as part of the EIS for the proposal. Aircraft overflight noise, which includes aircraft take-off and reverse thrust noise, is addressed in a separate EIS technical report.

Existing Noise Environment

The existing noise environment of the study area was surveyed to determine background noise levels and establish noise criteria for the construction and operational phases of the proposal. The results obtained are shown in Table 2-1 of the report.

Assessment of Airport Ground-based Operational Noise

Criteria for operational noise have been set for night time (the most sensitive period) using the measured background noise levels. The following residential noise criteria have been adopted taking into account any intermittency of the noise in question.

- Engine ground running noise ($L_{Aeq,15min}$) 45 dBA
- Taxiing noise ($L_{Aeq,15min}$) 40 dBA

The assessment of the initial (Stage 1) airport development shows that a significant population could be expected to be affected by noise levels above these criteria during night time hours (10pm-7am) and under worst-case assumptions of a temperature inversion. This impact is summarised in Table 3-1 of the report.

Noise criteria were also established for other uses. The assessment shows that up to five educational institutions, three places of worship, two passive recreation areas and three active recreation areas would be affected by operational noise levels above the noise criteria.

There are limits to the extent that mitigation measures can be applied to reduce the impacts of ground-based operational noise. One noise generating operation is engine ground running which is a mandatory procedure for all aircraft returning into service after maintenance. Although a contributor to overall noise levels, engine running at high power would not occur often. The most effective form of mitigation is to ensure that engine runs on high power do not occur at night time, except for abnormal situations where run-up is required to allow early departure of an aircraft.

Run-up noise level reductions of up to 10 dBA (an effective halving of the perceived noise level) may be achieved by locating or constructing buildings, barriers or mounds around the run-up area.

The noise impact from taxiing is much lower as aircraft engines are at idle power settings and specific noise mitigation is less likely to be required.

Apart from these operational noises, other noise would be generated within the proposed airport by vehicle movements and mechanical plant. However, this type of noise will be much lower in level than the operational noise assessed.

Assessment of Construction Noise and Vibration

Noise levels have been calculated for the bulk earthworks stage of the proposed construction works, which is expected to be the noisiest stage. Noise levels have been calculated for the four proposed earthworks areas and the results are shown in contour form in Figure 4-1 to Figure 4-4 of this report for the worst meteorological conditions of a temperature inversion. Construction noise levels would be confined mostly to the airport site, but some impact to the west of the airport site near Luddenham and to the north-east around Badgerys Creek is expected. However, no residence will be affected by construction noise levels in excess of the acceptable standard in the Airports (Environment Protection) Regulations.

During construction, heavy and light vehicles are expected to use Elizabeth Drive for access to the construction site. However, the increase in road traffic noise levels on Elizabeth Drive during construction would not be significant. Vibration from construction is not likely to damage buildings.

Assessment of Operational Road Traffic Noise

During operation of the proposed airport, there would be an increase in road traffic in the area surrounding the airport site. Apart from the M12 motorway, the road traffic increases attributable to the operation of the proposed airport are not expected to result in significant noise level increases. Impacts associated with the development of the M12 and other local road upgrades and realignments are to be separately assessed by the NSW Government as part of the planning for these projects.

1 INTRODUCTION

1.1 Background

Planning investigations to identify a site for a second Sydney airport first commenced in 1946 with a number of comprehensive studies – including two previous environmental impact statements for a site at Badgerys Creek – having been completed over the last 30 years.

More recently, the *Joint Study on Aviation Capacity in the Sydney Region* (Department of Infrastructure and Transport, 2012) and *A Study of Wilton and RAAF Base Richmond for civil aviation operations* (Department of Infrastructure and Transport, 2013) led to the Australian Government announcement on 15 April 2014 that Badgerys Creek will be the site of a new airport for Western Sydney. The airport is proposed to be developed on approximately 1,700 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Construction could commence as early as 2016 with airport operations commencing in the mid-2020s.

The proposed airport would provide both domestic and international services with development staged in response to demand. The initial development of the proposed airport would include a single 3,700 metre runway coupled with landside and airside facilities, such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of up to 10 million passengers per year. While the proposed Stage 1 development does not currently include a rail service, planning for the proposed airport preserves flexibility for several possible rail alignments including a potential express service. A final alignment will be determined in consultation with the New South Wales Government with any enabling work required during Stage 1 subject to a separate approval and environmental assessment process.

In the longer term, approximately 40 years after operations commence and in accordance with relevant planning processes, the airport development could include parallel runways and additional passenger and transport facilities for around 82 million passenger movements per year. To maximise the potential of the site, the airport is proposed to operate on a 24-hour basis. Consistent with the practice at all federally leased airports, non-aeronautical commercial uses could be permitted on the airport site.

On 23 December 2014, a delegate of the Australian Government Minister for the Environment determined that the construction and operation of the airport would require assessment in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Guidelines for the content of an environmental impact statement (EIS) were issued in January 2015. Approval for the construction and operation of the proposed airport will be controlled by the *Airports Act 1996* (Cth) (Airports Act). The Airports Act provides for the preparation of an Airport Plan which will serve as the authorisation for the development of the proposed airport.

The Australian Government Department of Infrastructure and Regional Development is undertaking detailed planning and investigations for the proposed airport, including the development of an Airport Plan. The draft Airport Plan is the primary source of reference for, and companion document to, the EIS. The draft Airport Plan identifies a staged development of the proposed airport. It provides details of the initial development being authorised, referred to as Stage 1, as well as a long-term vision of the airport's development. This enables preliminary consideration of the implications of longer term airport operations. Any stages of airport development beyond Stage 1 would be managed in accordance with the existing process in the Airports Act. This includes a requirement that for major developments (as defined in the Airports Act), a major development plan be approved by the Australian Government Minister for Infrastructure and Regional Development following a referral under the EPBC Act.

The Airport Plan will be required to include any conditions notified by the Environment Minister following this EIS. Any subsequent approvals for future stages of the development will form part of the airport lessee company's responsibilities in accordance with the relevant legislation.

1.2 Terms of Reference

The Department of the Environment issued EIS guidelines in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* for the Western Sydney Airport proposal. Requirements of the EIS guidelines relevant to aircraft noise are as follows:

> *Impacts to the environment (as defined in section 528) should include but not be limited to the following:*
>
> *Aircraft noise and vibration impacts on everyday activities and on sensitive environmental receptors (all sensitive receptors within the community and natural environment). Discussion and quantification/modelling of aircraft noise impacts should include consideration of all potential flight paths, height of flights, noise exposure patterns, noise contours, the range of frequencies of the noise, cumulative exposure, peak noise, frequency of overflights and temporal variability of this (including long term trends), varying aircraft types, varying aircraft operating procedures, and variations in noise patterns due to seasonal and meteorological factors*

This report has been prepared in accordance with the EIS guidelines.

1.3 Scope of this Report

This report addresses the operational noise impacts associated with the following components of the proposed airport:

- ground running of aircraft engines;
- taxiing of aircraft; and
- road traffic changes in the surrounding area.

Apart from these operational noises, other noise would be generated within the proposed airport by vehicle movements and mechanical plant. However, this type of noise will be much lower in level than the operational noise assessed.

The use of auxiliary power units (APUs) on aircraft has not been assessed because it is assumed that power and pre-conditioned air would generally be supplied to aircraft at the terminal gates.

The report also addresses construction noise, including construction generated traffic and vibration.

Collectively, the activities assessed in this report are referred to as airport ground-based operational noise sources. Noise from aircraft departing and arriving, including whilst on the runway, is assessed in the Aircraft Overflight and Operational Noise Report.

Ground-based operational noise at airports is regulated by the Airports (Environment Protection) Regulations 1996. These regulations include specific limits for certain activities at certain times of the day and provide other more general principles to be applied by the airport environment officer at other times. All airports have specific procedures around ground noise and it is likely that these types of procedures would be applied to the proposed airport.

The following NSW noise policies have been referred to in assessing the impacts associated with ground-based noise sources, because these policies best address community reaction:

- NSW *Industrial Noise Policy (INP)*(R3);
- NSW *Road Noise Policy (RNP)*(R4).

In addition to the NSW *Road Noise Policy* which is applicable to construction as well as operational traffic, the construction noise assessment has also been undertaken with regard to the *Interim Construction Noise Guideline (ICNG)*(R8) (NSW Department of Environment and Climate Change, now NSW Environment Protection Authority, July 2009).

1.4 Report Structure

The remainder of this report is structured as follows:

Chapter 2 – presents a summary of the existing noise environment, including results of ambient noise monitoring.

Chapter 3 – presents the assessment of airport operational noise sources including ground running of aircraft engines and taxiing of aircraft

Chapter 4 – presents the assessment of construction noise and vibration sources, including construction traffic noise.

Chapter 5 – presents the assessment of airport-related road traffic.

Section 6 – presents the conclusions of the report.

2 EXISTING NOISE ENVIRONMENT

The various NSW noise policy documents considered in this report require knowledge of the existing noise environment, in particular, the background noise levels in the area surrounding the proposed airport. This sets the benchmark against which the potential impacts of constructing and operating the proposed Western Sydney Airport can be assessed. Accordingly, ambient, or background, noise levels have been measured at a number of locations. These measurements were carried out in accordance with AS1055: 1997[R12].

Noise measurements were carried out at 10 locations generally over the period Monday, 23 March to Thursday, 2 April 2015, although at some locations a shorter period [the minimum duration required by the *INP* (7 days)] was completed. The measurement locations are described in Table 2-1 and shown in Figure 2-1. The area is rural and rural-residential and the measurement locations reflect this environment. The locations were also chosen to represent potentially-affected development in the surrounding area.

The noise monitoring equipment used for these measurements consisted of environmental noise loggers set to A-weighted, fast response, and continuous monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment was calibrated before and after the survey to ensure the accuracy of observations. No significant drift in level was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. This is used for the assessment of sleep disturbance. The L_{A90} level is normally taken as the background noise level during the relevant period.

The results of measurements are shown in graphical form in Appendix A. From the measurement data, the Rating Background Level (RBL) as defined in the *INP* has been determined and shown in Table 2-1.

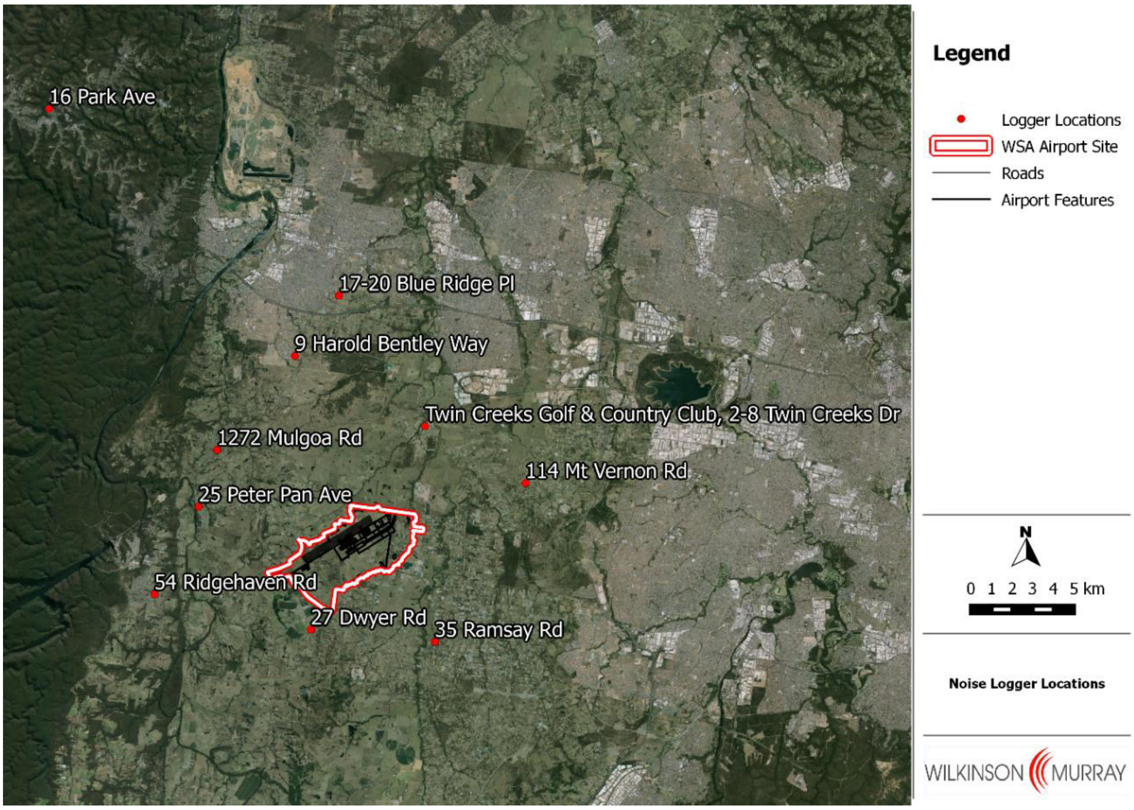
Table 2-1 Measured Background Noise Levels around the proposed Western Sydney Airport

Location	Measurement Duration	Rating Background Level (dBA)		
		Day (7am-6pm)	**Evening** (6pm-10pm)	**Night** (10pm-7am)
9 Harold Bentley Way, Glenmore Park	Monday 23/3/15 – Thursday 2/4/15	39	42	38
16 Park Avenue, Springwood	Wednesday 25/3/15 – Thursday 2/4/15	29	32	24
17 Blue Ridge Place, Orchard Hills	Monday 23/3/15 – Tuesday 31/3/15	34	38	36
25 Peter Pan Avenue, Wallacia	Monday 23/3/15 – Thursday 2/4/15	37	34	28
27 Dwyer Road, Bringelly	Monday 23/3/15 – Thursday 2/4/15	33	38	35
35 Ramsay Road, Rossmore	Friday 27/3/15 – Thursday 2/4/15	35	37	35
54 Ridgehaven Road, Silverdale	Thursday 26/3/15 – Thursday 2/4/15	36	36	31
114 Mount Vernon Road, Mount Vernon	Monday 23/3/15 – Thursday 2/4/15	34	35	33
120 Vincent Avenue, Mulgoa	Monday 23/3/15 – Tuesday 31/3/15	38	42	35
Twin Creeks Golf & Country Club (2 Twin Creeks Drive, Luddenham)	Thursday 26/3/15 – Thursday 2/4/15	34	38	33

The measurement periods are in accordance with the *INP*.

According to the *INP*, where the RBL has been measured as less than 30 dBA, it should be assumed to be 30 dBA for the purpose of setting noise criteria. This applies at the Springwood and Wallacia locations. The relevant RBL values across all locations therefore fall in the range 30-38 dBA for the night period.

Figure 2-1 Background Noise Measurement Locations



3 ASSESSMENT OF AIRPORT GROUND-BASED OPERATIONAL NOISE

This section addresses the potential impacts of ground-based noise from operations within the boundary of the proposed airport. It discusses general noise criteria which are applied to industrial noise in NSW as the basis for setting criteria for the relatively constant ground-based noise. It then sets specific noise criteria for the particular types of noise to be expected, based on industrial noise assessment procedures. It is important to recognise in setting these criteria that the character of noise from ground-based activities at an airport is different from the character of noise from many other developments, such as industrial developments.

The Airports (Environment Protection) Regulations provide a regulatory approach for ground-based operational noise. However, these regulations are not intended to provide a basis for the assessment of the impact caused by such noise and they do not set criteria for aircraft engine noise. As a result, it is necessary to identify other noise guidelines which could be used as a benchmark to reflect the potential response of members of the community to any ground-based operational noise. This analysis uses the *Industrial Noise Policy (INP)* [R3], which is published by the NSW Government. While the *INP* has no application to the regulation of Commonwealth leased airports, it provides a useful basis for assessing potential noise impacts in specific circumstances.

3.1 NSW *Industrial Noise Policy (INP)*

The *INP* [R3] provides guidance on the assessment of industrial noise and other noise of a similar character. It sets out noise criteria that are useful as a planning tool but recognises that the assessment of noise impact is complex and subjective, and should include consideration of other social and economic aspects of the development or activity.

The *INP* recommends that the $L_{Aeq,15min}$ noise level from an industrial development not exceed two noise criteria at residential locations, as measured outside:

- Intrusiveness criterion – this criterion is calculated as RBL +5 dB; and
- Amenity criterion – this criterion applies to the daytime period, evening period and night time period and is specified as an absolute level (i.e. it is not related to existing noise conditions).

In the area surrounding the airport, the intrusiveness criterion is the more stringent at all locations.

For ground-based operational noise the *INP* intrusiveness criterion would be the RBL (as shown in Table 2-1) + 5 dB. However, further consideration is necessary before finalising the airport-specific criteria for the different noise types.

3.1.1 Adapted *INP* Criteria for Residential Locations

The *INP* based intrusiveness noise criteria for residential land uses have been determined by adding 5 dB to the measured RBL levels.

The *INP* criteria are shown in Table 3-1 for generally continuous noise. However, adjustments need to be made where the noise is not continuous.

Table 3-1 *INP* Intrusiveness Noise Criteria for Residential Locations

Location	Measurement Duration	$L_{Aeq,15min}$ Noise Criteria (dBA)		
		Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
9 Harold Bentley Way, Glenmore Park	Monday 23/3/15 – Thursday 2/4/15	44	47	43
16 Park Avenue, Springwood	Wednesday 25/3/15 – Thursday 2/4/15	35	37	35
17 Blue Ridge Place, Orchard Hills	Monday 23/3/15 – Tuesday 31/3/15	39	43	41
25 Peter Pan Avenue, Wallacia	Monday 23/3/15 – Thursday 2/4/15	42	39	35
27 Dwyer Road, Bringelly	Monday 23/3/15 – Thursday 2/4/15	38	43	40
35 Ramsay Road, Rossmore	Friday 27/3/15 – Thursday 2/4/15	40	42	40
54 Ridgehaven Road, Silverdale	Thursday 26/3/15 – Thursday 2/4/15	41	41	36
114 Mount Vernon Road, Mount Vernon	Monday 23/3/15 – Thursday 2/4/15	39	40	38
120 Vincent Avenue, Mulgoa	Monday 23/3/15 – Tuesday31/3/15	43	47	40
Twin Creeks Golf & Country Club (2 Twin Creeks Drive, Luddenham)	Thursday 26/3/15 – Thursday 2/4/15	39	43	38

The night time noise criteria are the most important criteria for airport ground-based operational noise because ambient noise levels will generally be lower than those during the day and evening and the applicable noise criteria for a given noise-generating event will also be lower. These criteria vary according to the location and are in the range 35-43 dBA.

So that the noise contours included below in this report can be readily interpreted, it is preferable to adopt one criterion for all residences. By the time the proposed airport becomes operational, background noise levels in the general area are expected to have increased as a result of increased road traffic and associated development in the surrounding area. This would particularly be so for the lower background noise levels and would in turn raise the value of the appropriate noise criteria for the assessment of airport operational noise. For this reason, an overall noise criterion of 40 dBA can be taken as generally appropriate for residential locations at night. Whilst this general criterion will be conservative for some locations, it takes into account the uncertainty of future noise levels.

3.1.2 *INP* Noise Criteria for Other Receiver Types

The *INP* also recommends noise criteria for other receiver types potentially affected by ground-based noise from the proposed airport. Some of these criteria are for indoor noise levels and these have been converted to outdoor noise levels by adding 10 dB. This is equivalent to the attenuation that would be perceived indoors from an external noise source with windows partly open.

The external criteria for these other receiver types are shown in Table 3-2, and these apply during normal use, i.e. generally daytime only, but also at night in the case of hospital wards.

Table 3-2 Noise Criteria for Other Receiver Types

Type of Receiver	Recommended Maximum L_{Aeq} Noise Criterion (dBA)
School Classroom	50
Hospital Ward	55
Place of Worship	55
Passive Recreation Area	55
Active Recreation Area	60

3.1.3 Relevance of *INP* to Ground-Based Operational Noise

The *INP* criteria discussed above apply to relatively continuous noise such as that produced by taxiing. The following sections address the specific noise types in detail and set the appropriate noise criteria.

3.2 Noise Criteria for Engine Ground Running

Engine ground running noise would be intermittent and would most likely be subject to limitations during the night time period. In practice, ground running would not often occur during night time and high power running would not occur every night. When when it does occur, it would occur for only a short period.

For modelling purposes it has been assumed that high power run up would occur for less than 5 minutes in any night. Therefore, the night time residential criterion for this activity has been set using the industrial noise criterion as 5 dB over the general *INP* night time criterion for residential receivers; that is 45 dBA, in accordance with the *INP* duration adjustment. The criteria for other land uses have been set 5 dB over the levels referred to in Table 3-2.

Like other major airports in Australia, the proposed airport is expected to have restrictions in place on engine ground runs, including limitations on night time run up activity.

3.3 Noise Criteria for Taxiing

Taxiing would occur relatively continuously at the proposed airport during daytime, but it would be expected to be intermittent at night time as a result of the limited number of aircraft movements proposed. However, during the busiest 15-minute period at night time, taxiing would be expected to be relatively continuous.

Since the resulting noise from taxiing aircraft would be relatively continuous, but fluctuating during the worst-case 15-minute period, it may be assessed according to the general *INP* criteria. 40 dBA has been set as a relevant criterion for residential receivers subject to taxiing noise and the criteria in Table 3-2 have been adopted for other land uses (see Section 3.1.1). These criteria apply at night.

3.4 Summary of Airport-Specific Operational Noise Criteria

Table 3-3 summarises the operational noise criteria adopted.

Table 3-3 Summary of Airport-Specific Operational Noise Criteria

Operation	Receiver Type	Measure	Noise Criterion (dBA)
Engine ground running	Residential	$L_{Aeq,15min}$	45
	School	$L_{Aeq,15min}$	55
	Hospital	$L_{Aeq,15min}$	60
	Place of worship	$L_{Aeq,15min}$	60
	Passive recreation	$L_{Aeq,15min}$	60
	Active recreation	$L_{Aeq,15min}$	65
Taxiing	Residential	$L_{Aeq,15min}$	40
	School	$L_{Aeq,15min}$	50
	Hospital	$L_{Aeq,15min}$	55
	Place of worship	$L_{Aeq,15min}$	55
	Passive recreation	$L_{Aeq,15min}$	55
	Active recreation	$L_{Aeq,15min}$	60

The noise criteria in Table 3-3 apply during the night time for residential and hospital developments. For the other uses, they apply during the daytime. However, the levels expected from all operations based on the measure indicated in the table would be the same during night time as during the day time or evening, despite the fact that the intensity of operation would be greater during the day time and evening. This means that the levels calculated and reported below for night time operations can be considered appropriate for assessment for all receiver types.

3.5 Prediction Method

Ground-based operational noise levels have been predicted for the initial airport development and for the longer term development. The initial development is presently expected to occur around 2030 and is the focus of this assessment.

Noise levels were calculated using the CadnaA noise model which is considered to be equivalent to a temperature inversion. CadnaA is a widely used and highly accepted environmental noise model which allows calculation of noise levels from a series of noise sources into the surrounding area. It takes into account the noise level of the noise sources, distance attenuation, air absorption, ground effects, shielding by intervening buildings and topography, and the effects of specific weather conditions. In this case, the model prepared for prediction incorporated the topography surrounding the airport, the final landform of the airport and the buildings proposed to be constructed during the initial airport development and the longer term airport development. Concawe is a document that describes environmental noise calculation procedures, including methods of assessing the effects of different weather conditions. Its algorithms were incorporated within CadnaA.

The philosophy applied to the assessment of ground-based operational noise involves, as is normal practice, the assessment under typical worst-case conditions. This includes assessment of the worst 15-minute period in those cases where the noise level varies with time, and assessment under worst-case meteorological conditions. The worst-case meteorological conditions were taken to be the worst conditions from Concawe(R1), which is equivalent to a temperature inversion. It should also be noted that no allowance has been made for any potential reduction in aircraft noise levels over time and the predictions discussed are based on known aircraft noise levels.

3.5.1 Aircraft Engine Ground Running Noise for Initial Airport Development

It has been assumed that aircraft ground runs would occur at the location shown in Figure 3-1. The orientation of an aircraft during run-up would depend on the prevailing wind conditions, as described in section 3.3. Taking a conservative approach to allow for a range of orientations, it has been assumed for modelling purposes that the noise source would be omni-directional and a level of 151 dBA has been assumed, based on measurements of aircraft taking off.

For the worst-case meteorological condition assumption, that being a temperature inversion, the calculated noise contours are shown in Figure 3-2 for the initial development. These contours reflect an assumption that there would be shielding from a maintenance building near the ground running area. They are $L_{Aeq,15min}$ contours and are based on the assumption that, at the very most, no more than one run up on full power would occur during any night and only for a maximum of five minutes.

3.5.2 Taxiing Noise for Initial Airport Development

Taxiing noise has been predicted by modelling the worst-case 15-minute period likely to occur during the night time period, using CadnaA. Aircraft taxiing on the taxiways shown in Figure 3-1 have been assumed for the proposed initial airport development by applying a line source along each taxiway.

A sound power level (noise level at source) for each aircraft of 138 dBA has been assumed. This is the highest level measured for aircraft taxiing, based on measurements of a B777, B747, B737, B717 and A330 aircraft.

The $L_{Aeq,15min}$ noise levels were predicted for worst-case meteorological conditions and are shown in Figure 3-3.

Figure 3-1 Ground-Based Operational Noise Source Locations – 2030

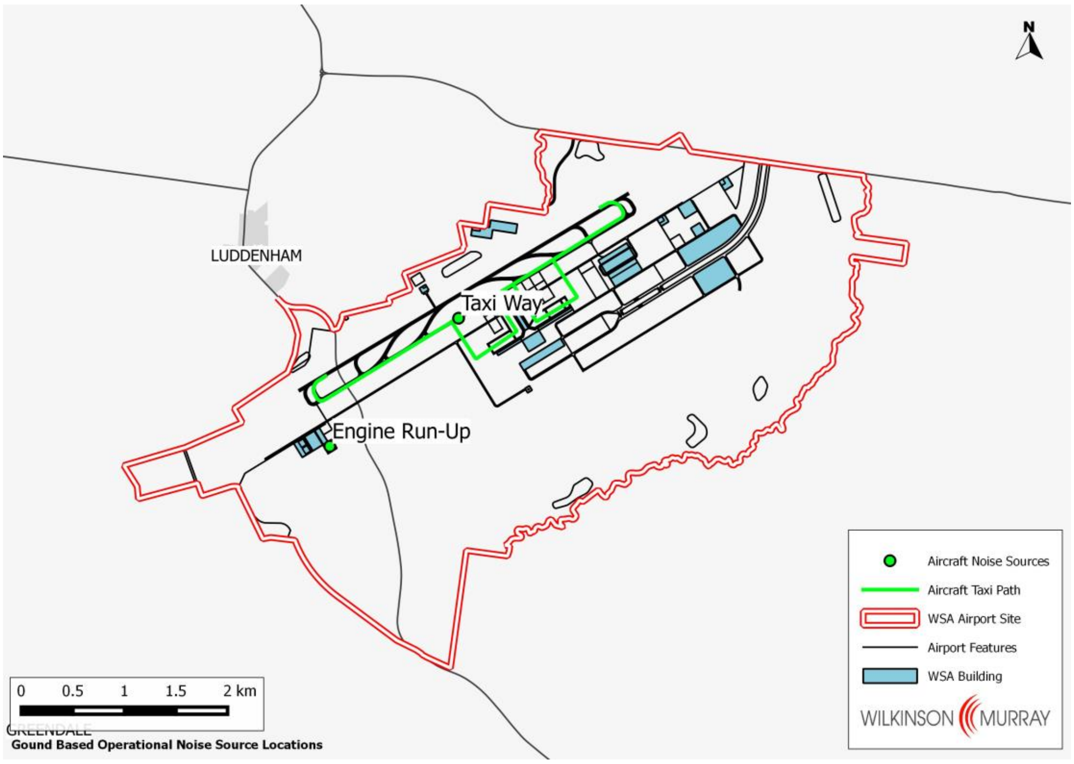


Figure 3-2 Worst-Case $L_{Aeq,15min}$ Engine Ground Running Noise Contours – 2030

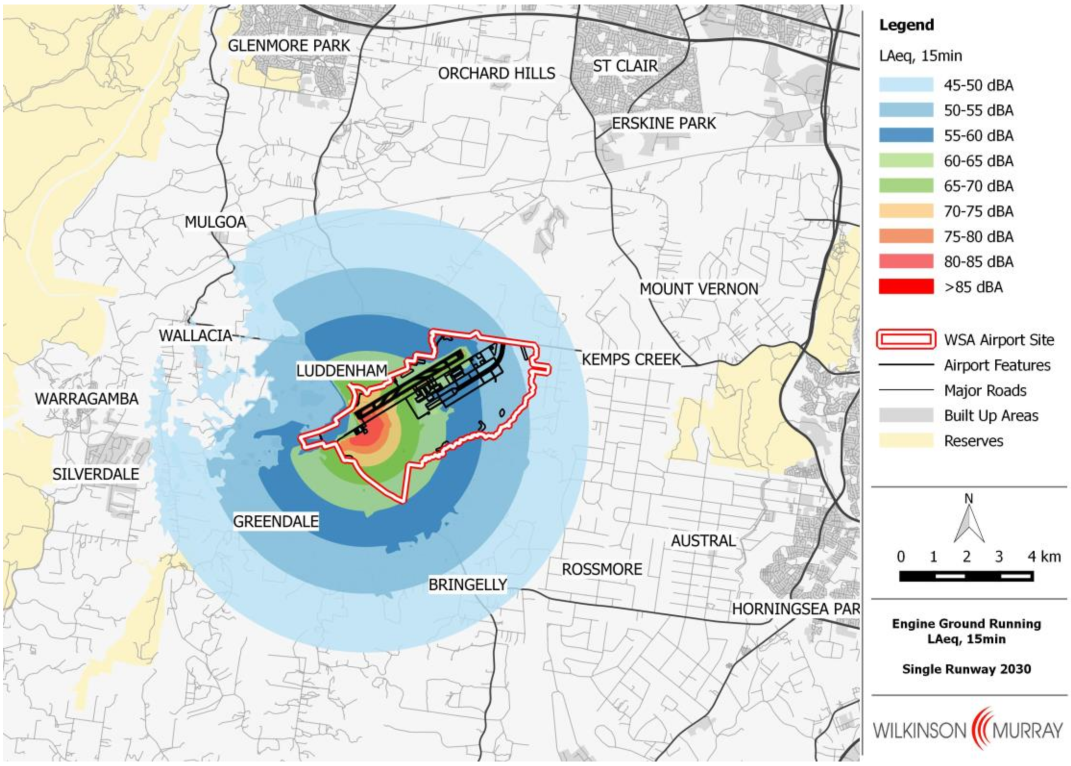
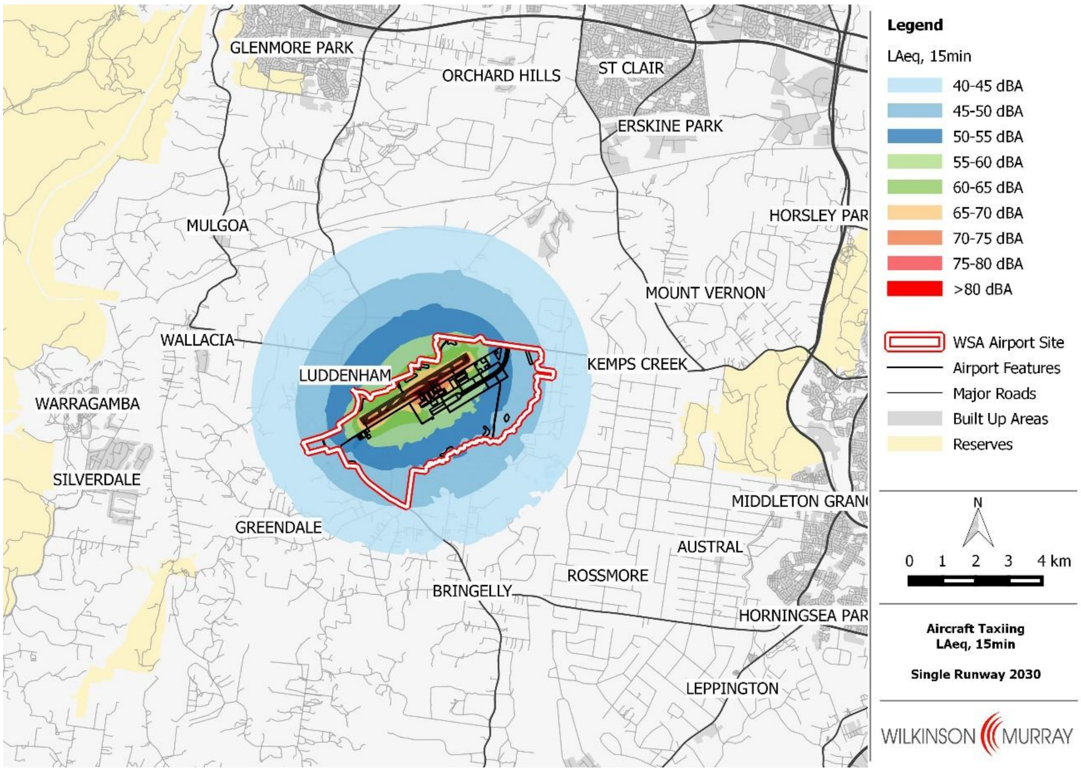


Figure 3-3 Worst-Case $L_{Aeq,15min}$ Taxiing Noise Contours – Night 2030



3.6 Assessment of Initial (Stage 1) Airport Development

Noise impact contours for engine ground running and aircraft taxiing are shown in Figure 3-2 and Figure 3-2, which depict the worst-case noise levels predicted to emanate from the proposed airport into adjacent areas in 2030.

Table 3-4 shows the estimated population that may be exposed to levels of ground-based operational noise above the residential criteria during the night time period in 2030 under worst-case conditions. Existing and forecast population estimates were developed by GHD, based on the September 2014 release of the NSW Bureau of Transport Statistics population forecasts. These forecasts take into account metropolitan planning development forecasts for future land use in Sydney as well as NSW Department of Planning and Environment population forecasts.

Table 3-4 Predicted Residential Noise Impact of Ground-Based Operational Noise under Worst-Case Conditions

Noise Type	Noise Criterion	Population Affected above Criterion
Engine Ground Running	45 dBA	7,258
Taxiing	40 dBA	3,117

Note: Population exposures are esitmates only

The impact of ground-based operational noise on other receiver types surrounding the airport is summarised in Table 3-5. This table shows the number of buildings and other land uses potentially affected by ground-based noise levels exceeding the criteria indicated in Table 3-2 above.

Table 3-5 Predicted Noise Impact of Ground-Based Operational Noise on Other Receiver Types under Worst-Case Conditions

Noise Type	Other Buildings and Land Uses Affected Above Criterion		
	Building or Land Use Type	Criterion	Number
Engine Ground Running	Educational Institutions	55 dBA	5
	Hospitals	60 dBA	0
	Place of Worship	60 dBA	2
	Passive Recreation	60 dBA	2
	Active Recreation	65 dBA	0
Taxiing	Educational Institutions	50 dBA	1
	Hospitals	55 dBA	0
	Place of Worship	55 dBA	0
	Passive Recreation	55 dBA	0
	Active Recreation	60 dBA	0

Note: Building numbers are based on information obtained in 2015, however datasets may be older. No verficiation of building types or uses has been undetaken.

As indicated in the contour plots and the tables above, under worst-case conditions and in the absence of operational controls (e.g. the restriction of certain operations such as engine ground running and use of reverse thrust at night), ground-based operational noise has the potential to extend over an area close to the airport site.

Under worst-case meteorological conditions, the impact from aircraft engine ground running at high power levels and taxiing has the potential to affect:

- Luddenham;
- Badgerys Creek;
- Bringelly;
- Wallacia; and
- Greendale.

The other uses likely to be affected by at least one of these noise types are shown in Table 3-6.

Table 3-6 Other Receiver Types Potentially Affected by One or More Operational Noise Types

Type of Use	Facilities
Education	Holy Family Catholic Primary & Church
	Luddenham Childcare Centre
	Schoolies at Mulgoa
	Luddenham Public School
	Mulgoa Pre School
Places of Worship	Holy Family Catholic Primary & Church
	St James Luddenham
	Luddenham Uniting Church
Passive Recreation	Freeburn Park, Luddenham
	Willmington Reserve, Luddenham
Active Recreation	Hubertus Country Club
	Sales Park, Luddenham
	Luddenham Showground
	Luddenham Raceway

3.7 Assessment of Longer Term Airport Development

The noise impacts discussed in Section 3.6 above relate to the proposed initial airport development of one runway in 2030. The longer term airport development is expected to involve the development of a second parallel runway some time before 2063. Such longer term development would be associated with a larger number of aircraft movements and more aircraft activity at the airport and consequently changed ground-based noise levels.

Ground-based noise levels have been predicted for the longer term airport development using the same methods as for the initial airport development. The noise source locations are shown in Figure 3-4 and the resulting contours are shown in Figure 3-5 and Figure 3-6.

Figure 3-4 Ground-Based Operational Noise Source Locations – 2063

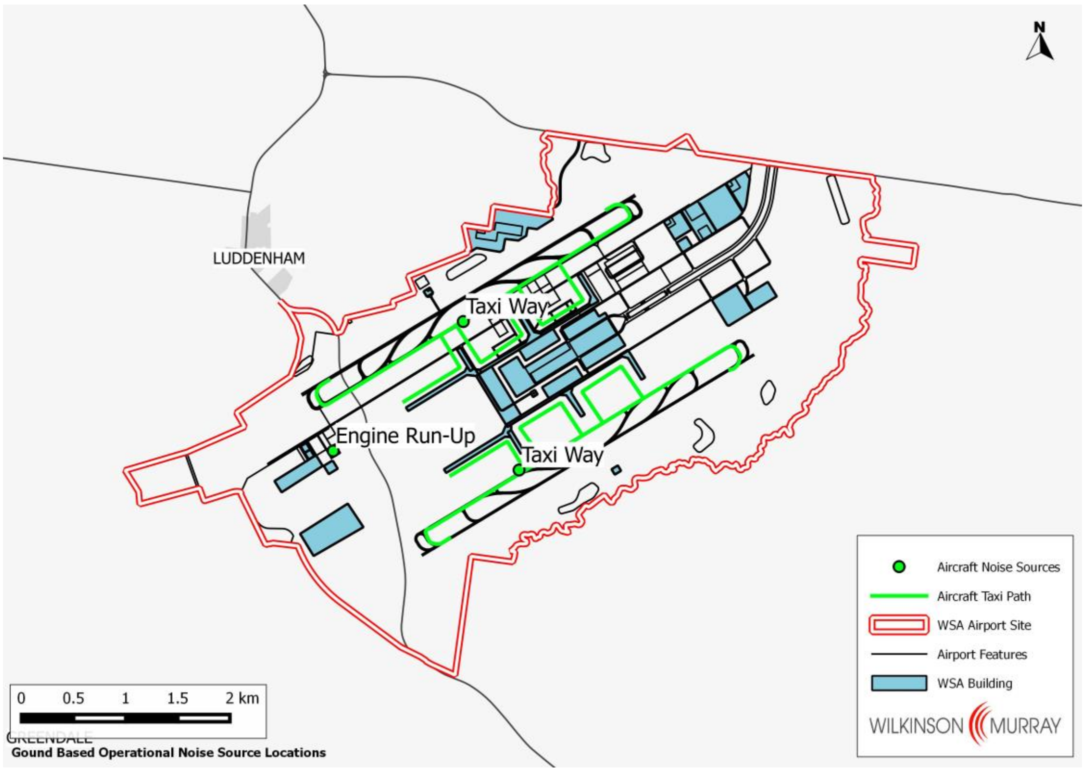


Figure 3-5 Worst-Case $L_{Aeq,15min}$ Engine Ground Running Noise Contours – 2063

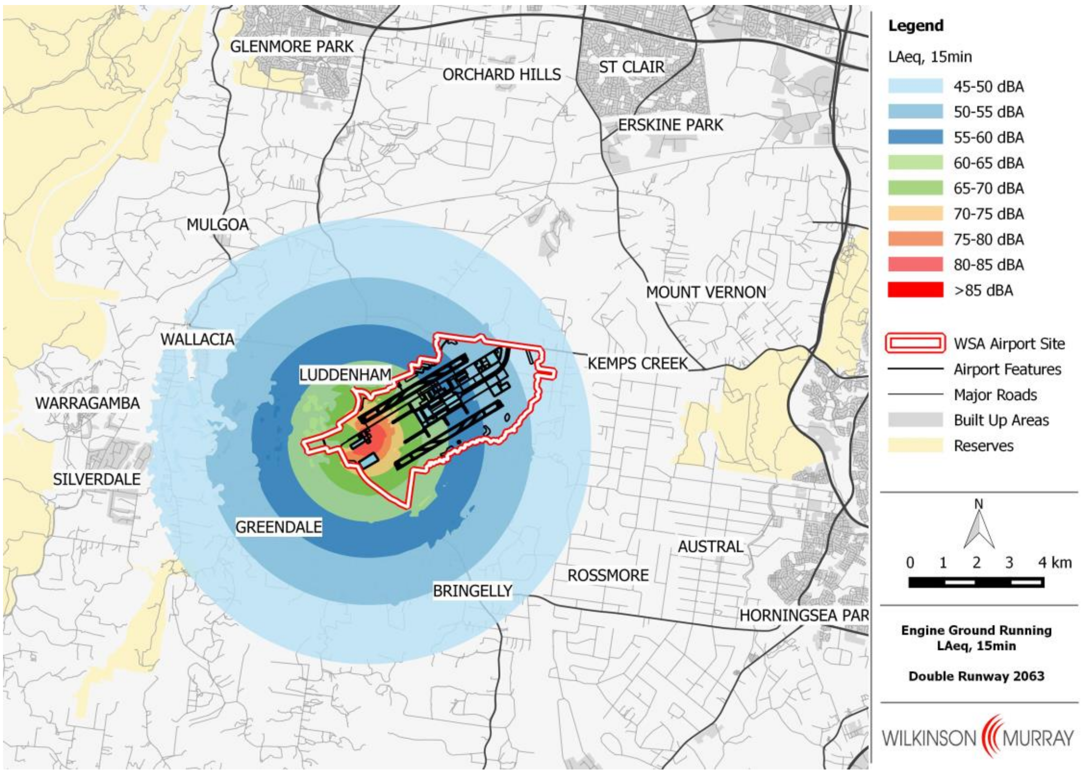
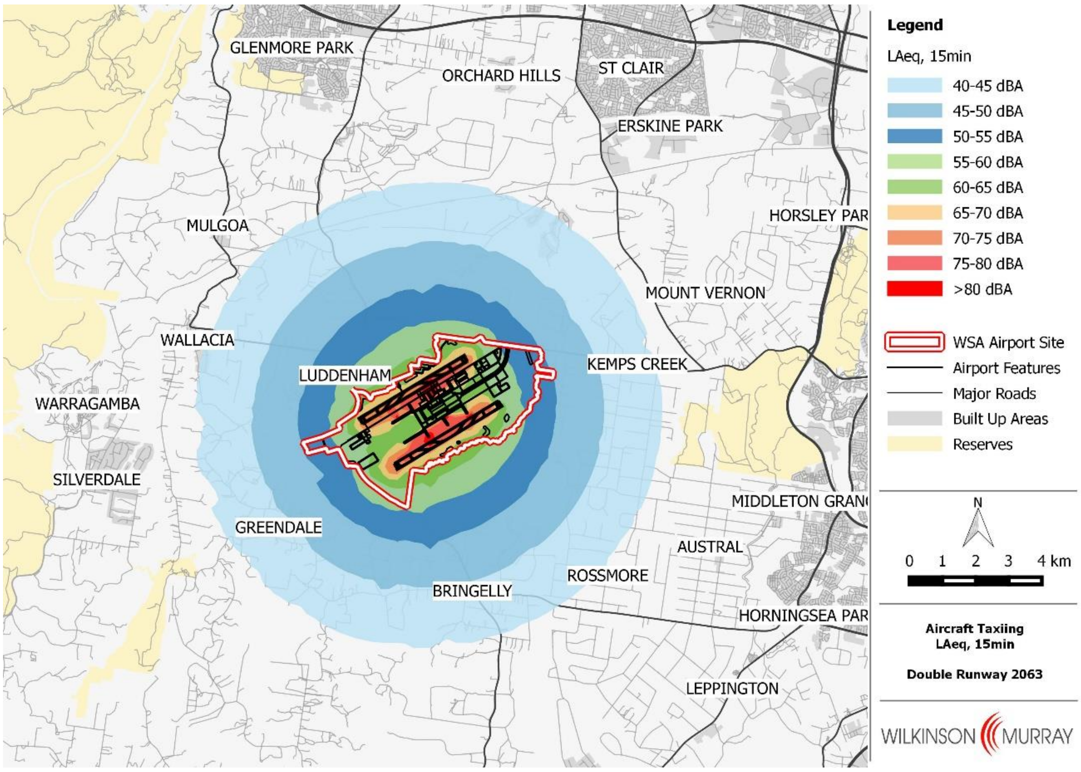


Figure 3-6 Worst-Case $L_{Aeq,15min}$ Taxiing Noise Contours – Night 2063



Engine ground running noise is not predicted to change substantially and will be generally shielded by buildings developed for the longer term development. The taxiing noise contours reflect the increased aircraft movements.

3.8 Mitigation of Ground-Based Operational Noise Impact

There are practical limits on the mitigation measures that can be applied to reduce the impact of ground-based operational noise sources and there are limited examples to assist in defining what is a practical strategy.

Engine ground running on high power would normally be carried out during daytime and night time. High power running at night time should be restricted to special circumstances where high power testing is required after maintenance activity prior to an aircraft taking off, as is the case for many major airports in Australia now. Restricting the amount of high power running at night time would substantially reduce the impact of ground running noise. It may also be practical to construct buildings, mounds or barriers near the run-up area to provide greater noise shielding, particularly on the northern side to shield the closest area of Luddenham. It is possible that reductions of around 10 dBA could be achieved with mounds or buildings at least 10 m high, but moderate residual impacts would still occur under worst-case meteorological conditions. There may also be a benefit in relocating the run up area further to the south-east to reduce the noise impact on Luddenham, but practical operational issues would need to be considered for this.

Aircraft taxiing noise would be relatively low in comparison to other noise associated with operation of the airport. There would be little that could be done to reduce noise levels emanating from the airport as a result of taxiing.

Many of the localities predicted to be affected by ground-based operational noise would also be affected by aircraft overflight noise. Luddenham is one such locality. It would be affected by typically 5-10 aircraft movements per day over 70 dBA (N70 5-10)[R11] from operation of the proposed initial airport development. Accordingly, a holistic approach is best adopted to the assessment and control of airport noise. One of the best methods of limiting any increase in impact over time is good planning around the airport site, including limiting residential development near the site.

The proposed use of ground power and pre-conditioned air for aircraft at the gates avoids the use of aircraft auxiliary power units and the associated noise.

4 ASSESSMENT OF AIRPORT CONSTRUCTION NOISE & VIBRATION

This section addresses the likely impact of airport construction noise and vibration on the surrounding area. The assessment is limited to construction within the airport site, given that construction outside, such as construction of new roads or realignment of roads, is not part of the proposed action and would be subject to separate approval processes by the relevant authorities.

Airport construction noise is governed by the Airports (Environment Protection) Regulations, but other noise criteria are also addressed in this section.

4.1 Relevant Criteria

4.1.1 NSW *Interim Construction Noise Guideline (ICNG)*[R8] and Construction Noise Criteria

The *ICNG* provides the method for management of noise levels emanating from construction sites in New South Wales. It recommends a process and noise management levels (NML) which can be used to assist in the process. Where it is predicted that the NML will be exceeded, specific action is recommended. For standard construction hours, it is recommended that all feasible and reasonable work practices be applied to meet the NML and that potentially impacted residents be informed of the nature of the work, the expected noise levels and duration, as well as contact details. Outside of standard hours, all feasible and reasonable work practices should be applied and, where the noise remains above the NML, there should be consultation with the affected community.

Standard construction hours are defined in the document as:

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm

For construction during standard construction hours, particularly daytime construction, the (noise affected) NML is background +10 dB for residential locations. For works outside of normal construction hours, the NML is background + 5 dB. The highly affected NML is set as 75 dBA. This is the acceptable standard set in the Airports (Environment Protection) Regulations for construction noise.

Airport construction works are proposed to occur primarily between 6.00am and 6.00pm, 6 days a week[R2]. Some work will be carried out outside these hours. Work between 6.00am and 7.00am and during Saturday afternoon (i.e. after 1.00pm) would fall outside of the standard hours within the NSW guidelines.

Based on the daytime background noise levels shown in Table 2-1, the daytime residential NML would be between 39 dBA and 49 dBA for standard hours. For assessment of construction noise, a NML of 45 dBA may reasonably be adopted for all residential receivers, for week-day construction. Equally, for weekend works and early morning works, an NML of 40 dBA may be adopted.

For other receiver types, the criteria NMLs are shown in Table 4-1.

Table 4-1 Noise Management Levels for Other Uses

Building Type / Use	NML (dBA)
Schools	55
Hospitals	55
Places of worship	55
Passive recreation	60

4.1.2 Vibration Criteria

Potential damage from vibration caused by construction of the proposed airport is addressed in this section. In Australia, the most stringent vibration standard, the German Standard DIN 4150-3: 1999(R5), is mostly used to protect buildings from vibration damage. This standard recommends guideline values which are frequency dependent. The lowest and most conservative values are normally adopted, as shown in Table 4-2.

Table 4-2 Vibration Damage Guideline Values (DIN 4150-3)

Type of Structure	Guideline Value, PCPV (mm/s)
Dwellings and buildings of similar design	5
Vibration sensitive buildings (heritage)	3

4.2 Construction Noise Sources

At this early stage in the airport planning process, only limited information is available about likely construction methods and equipment. The exact details of each construction stage would be established by the successful construction contractors. However, GHD 2015(R2) provides information to assist in predicting construction noise levels.

There are two basic stages of construction: bulk earthworks and aviation infrastructure construction. The bulk earthworks stage is expected to be the noisiest and Table 4-3 provides a summary of typical Sound Power Levels (at source) of the plant which may to be used during this stage.

Table 4-3 Typical Construction Sound Power Levels (SWL, Noise at Source)

Plant	SWL (dBA)
Caterpillar 657 Scraper	118
Caterpillar 825 Compactor	108
Caterpillar 966 Loader	114
Caterpillar D11 Bulldozer	120
Caterpillar D8 Bulldozer	110
30,000L Water Truck	103
200t Excavator	117
30t Excavator	105
Dump Truck	105
Moving Floor Truck	105
B-double Truck	105
Concrete Truck	105
16’ Grader	111
14’ Grader	109
Bobcat	103
Pad Foot Roller	104
Smooth Drum Roller	105
Multi-tyre Roller	100
Gravel Paver	109
Asphalt Paver	109
Paver Train	110
Concrete Cutting	115
Concrete Batch Plant	110
Asphalt Batch Plant	114

4.3 Construction Noise Scenarios and Predicted Levels

The bulk earthworks will generate the most noise during construction and the likely fleet of equipment is shown in Table 4-4, based on the GHD Construction Planning Report(R2).

Table 4-4 Construction Noise Scenario for Bulk Earthworks

Description	Equipment	Quantity
Bulk Earthworks • East Sector • North Sector • North West Sector • South West Sector	Caterpillar 657 Scrapper	16
	D11 Bulldozer	4
	200 t Excavator	3
	50 t Dump Truck	15
	Caterpillar 825 Compactor	3
	30,000 Water Cart	7
	16' Grader	7
	Pad Foot Roller	7
	Smooth Drum Roller	7

Bulk earthworks are expected to occur over four areas of the airport site at different times: North Sector, North West Sector, South West Sector and East Sector. For assessment purposes, the equipment shown in Table 4-4 has been assumed to operate in each sector at a time. The bulk earthworks in the East Sector are expected to take approximately nine months and in the other sectors one month each (according to the Construction Planning Report).

The CadnaA model was used to predict construction noise levels in the surrounding area. A Concawe worst weather condition has been modelled to represent a temperature inversion that may occur early in the morning in winter. A still isothermal weather condition has also been modelled to represent the rest of a typical day.

The four sets of construction noise contours generated are shown in Figure 4-1 to Figure 4-4 for a temperature inversion and Figure 4-5 to Figure 4-8 for isothermal conditions. There will be some construction noise impact for a limited period of time. The total effected population likely to be affected by noise levels above the NML during standard hours is shown in Table 4-5 and Table 4-6. No other uses will be affected by construction noise levels over the relevant NML.

Figure 4-1 East Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Temperature Inversion

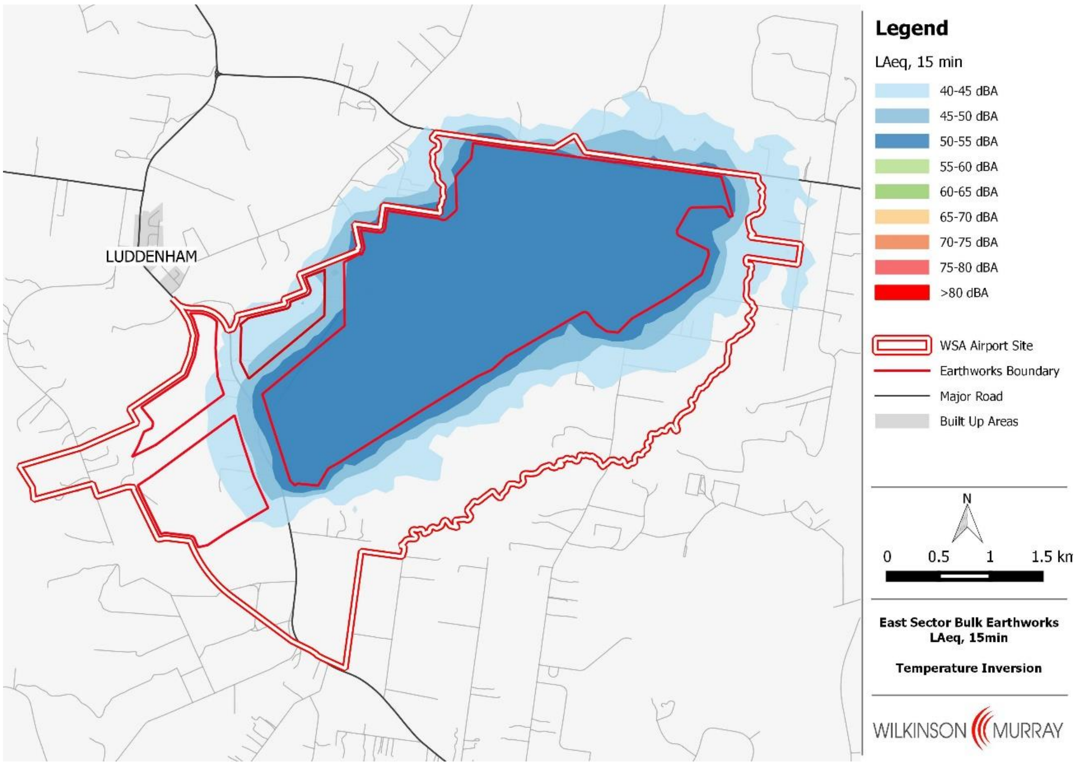


Figure 4-2 North Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Temperature Inversion

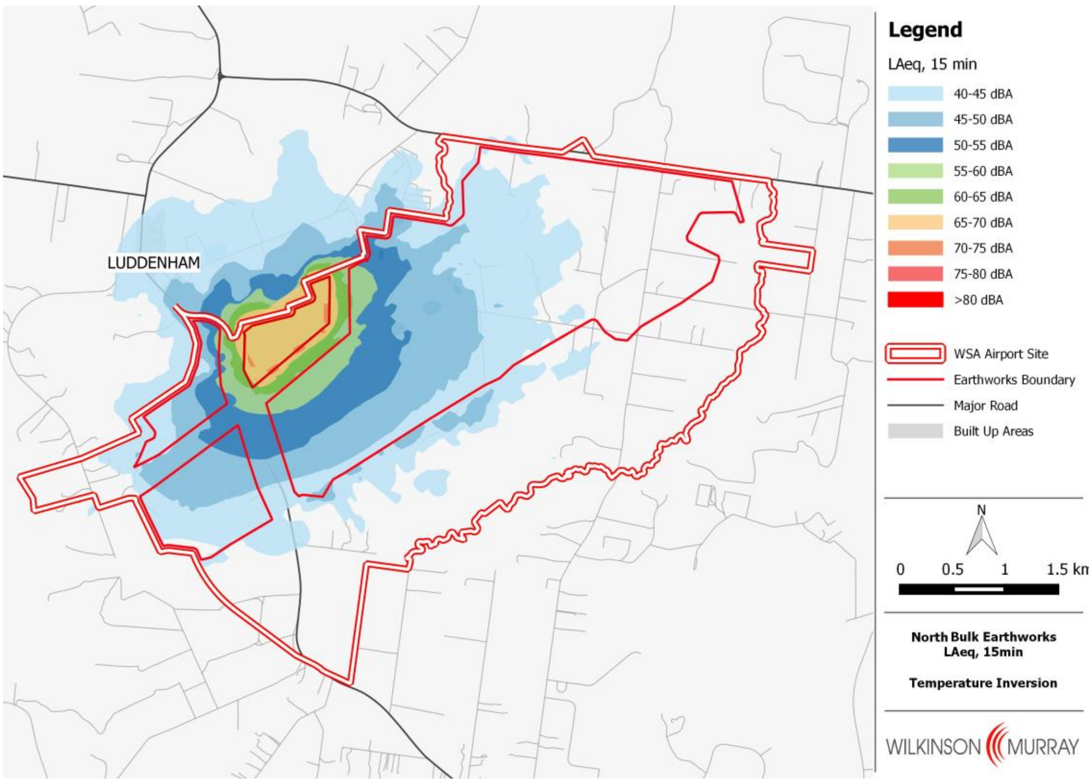


Figure 4-3 North West Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Temperature Inversion

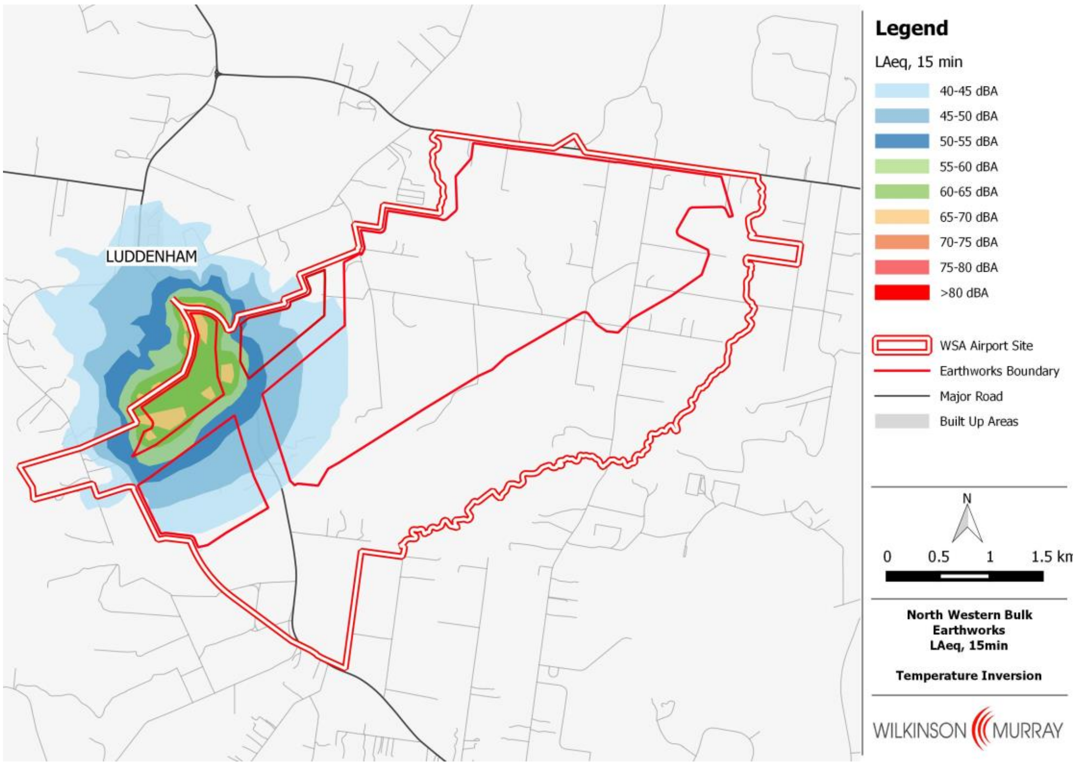


Figure 4-4 South West Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Temperature Inversion

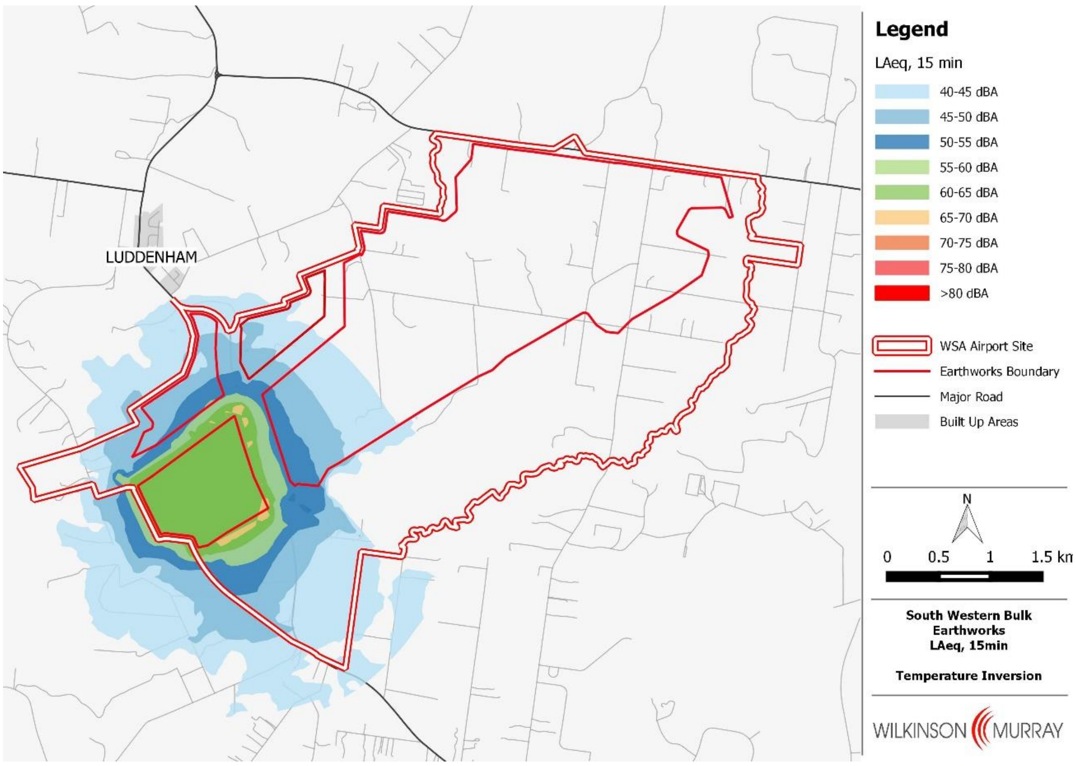


Figure 4-5 East Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Isothermal

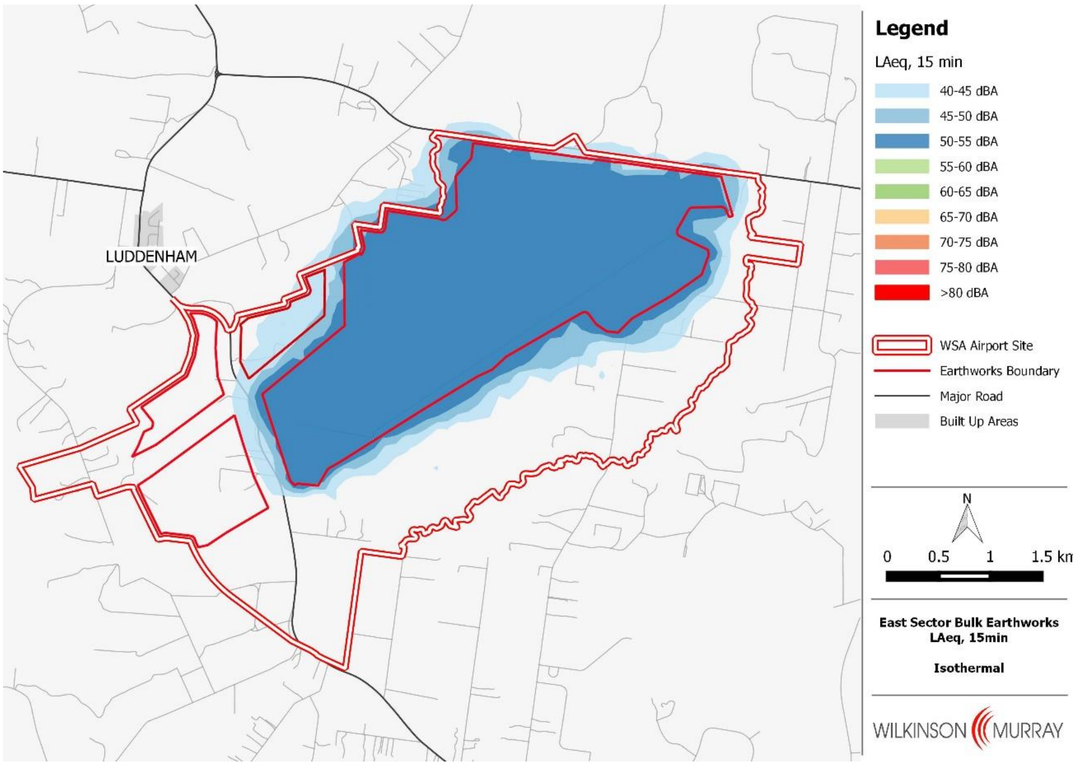


Figure 4-6 North Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Isothermal

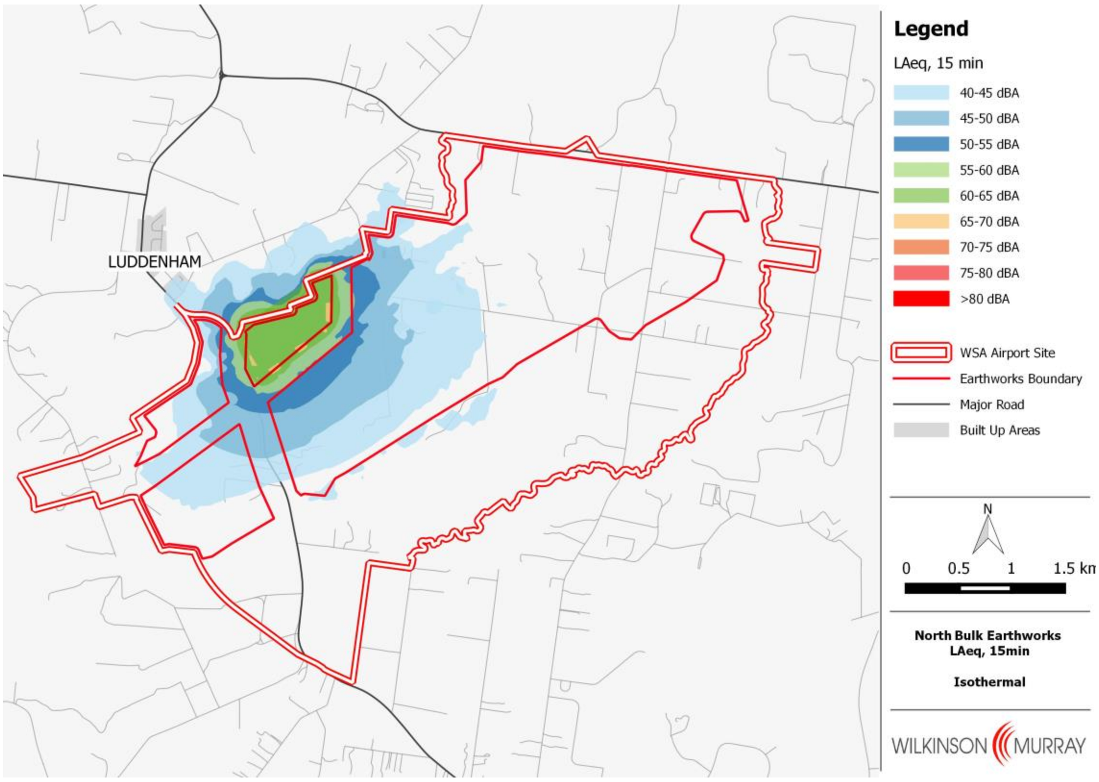


Figure 4-7 North West Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Isothermal

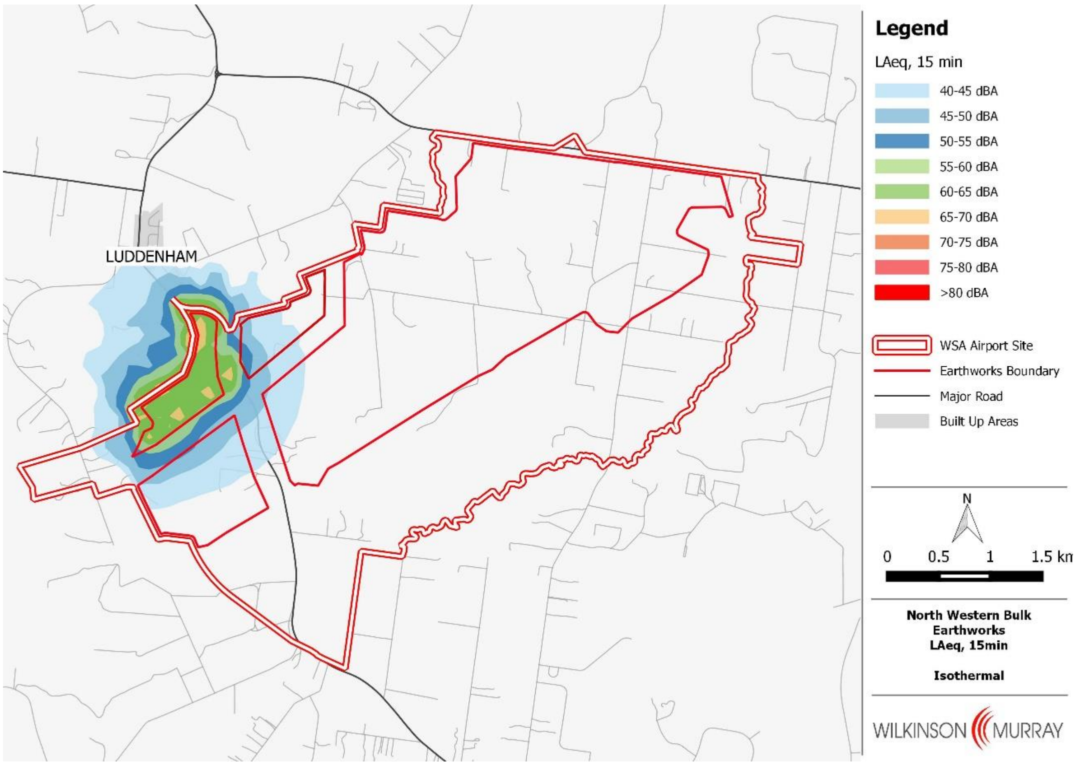


Figure 4-8 South West Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Isothermal

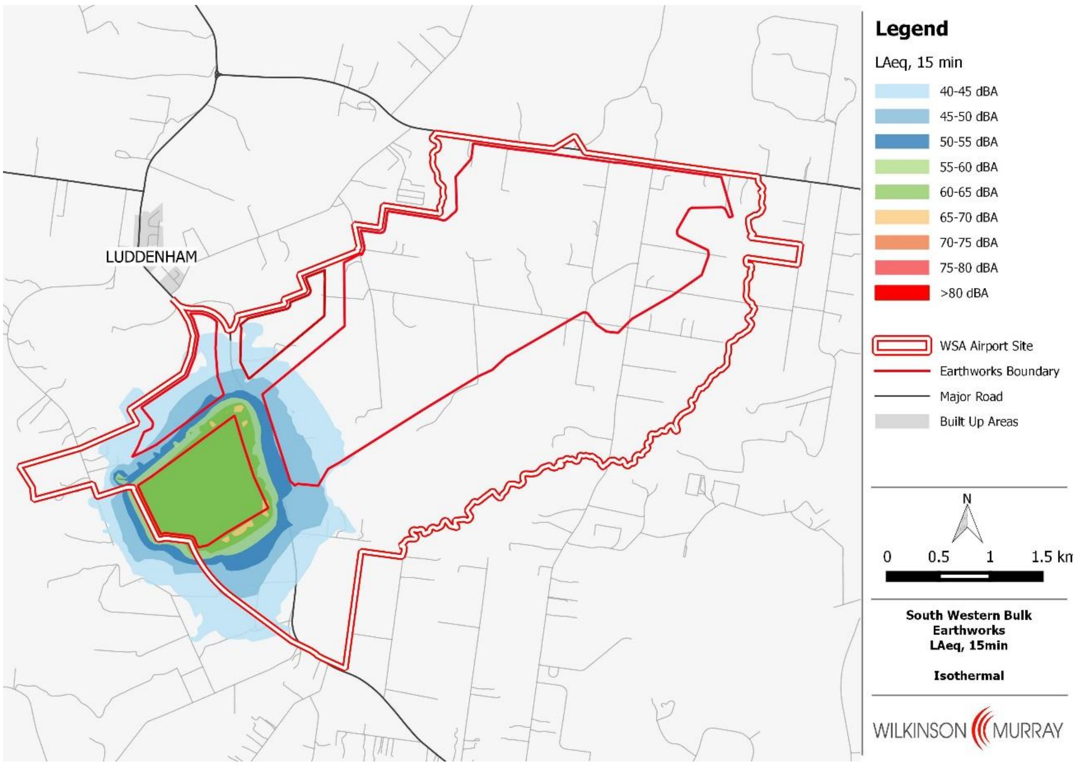


Table 4-5 Population affected by Levels above NML during Standard Construction Hours – Worst-Case of Temperature Inversion

Noise Type	Noise Criterion	Population affected above Criterion
East Sector	45 dBA	0
North	45 dBA	103
North West	45 dBA	199
South West	45 dBA	14

Note: Population exposures are esitmates only.

Table 4-6 Population affected by Levels above NML outside of Standard Construction Hours – Worst-Case of Temperature Inversion

Noise Type	Noise Criterion	Population affected above Criterion
East Sector	40 dBA	48
North	40 dBA	527
North West	40 dBA	531
South West	40 dBA	140

Note: Population exposures are esitmates only.

The impact of construction noise is not predicted to extend far beyond the airport boundary, largely because construction noise would be generated during daytime only, but sometimes during non-standard hours. The localities likely to be affected by construction noise are Luddenham and Badgerys Creek.

No residential receivers would be affected by construction noise levels above the acceptable standard in the Airports (Environment Protection) Regulations.

4.4 Construction Noise Mitigation Measures

Without mitigation, noise levels from construction activities have been predicted to exceed the nominated design criteria at numerous residential receivers and a number of other noise sensitive facilities. Therefore, noise control measures should be considered to ensure that construction noise levels are minimised at sensitive receivers.

A range of possible approaches to reducing the impact of construction noise is possible. It is proposed that these strategies be applied to areas of exceedance identified in the preceding section. The contractors responsible for the construction works should implement a *Construction Noise & Vibration Management Plan.* The Plan should provide for ongoing communication with potentially-affected residents and establish a complaint management and response system.

The plan should also address the following issues relating to construction noise impact management:

- construction hours (having regard to day of the week, work locations and distance to sensitive receivers);
- best practice noise levels for equipment (including use of noise compliant equipment, periodic compliance audit of equipment, use of clackers instead of reversing beepers etc.);
- operator training; and
- noise monitoring.

In practice, there is limited action that can be taken to reduce construction noise levels, but the impacts can often be reduced by management measures, such as restricting noisy activities outside of standard construction hours.

4.5 Construction Vibration Assessment

Vibration would be generated by the proposed construction works. As a very conservative approach, the lower guideline value applying to vibration sensitive buildings (3 mm/s) has been considered to test the risk of damage from construction vibration.

Figure 4-9 shows vibration levels previously measured on construction sites at a range of distances. The vibration levels from impact piling during the construction works would likely generate the highest vibration levels.

Figure 4-9 Previously Measured Vibration Levels

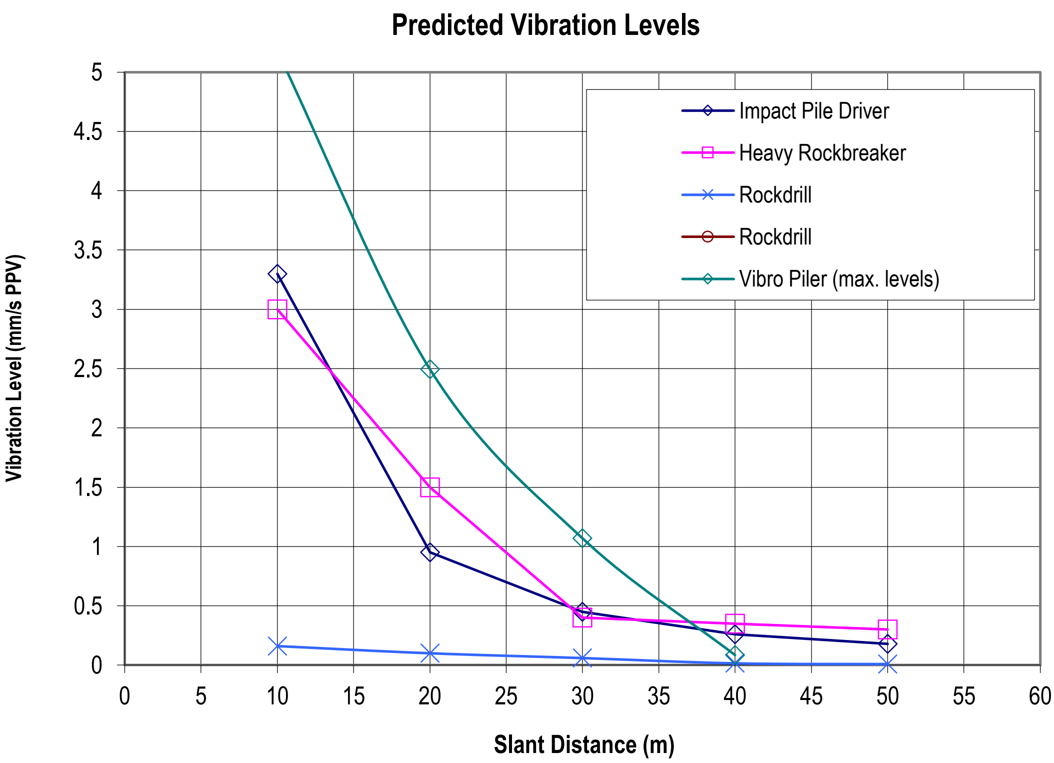


Figure 4-9 shows that the 3 mm/s value could be achieved even when using the piling method generating the highest vibration level at a distance of less than 20 m. Given that piling would occur well within the proposed airport boundary to construct the buildings, there would be no risk of damage to buildings from vibration outside of the proposed airport site.

Vibration may also be generated by the ripping of rock, but again the 3 mm/s guideline value is likely to be complied with inside the airport boundary and there is no risk of damage outside the airport boundary.

4.6 Construction Traffic Noise Assessment

The proposed construction works would require the use of the nearby road network for traffic to and from the construction site. Both heavy and light vehicles would need to access the site during this period. The number of movements of these vehicles during the busiest stage of construction is identified in GHD 2015(R2) and this information has been used to predict the change in road traffic noise due to construction. All construction traffic is expected to travel to the site via Elizabeth Drive.

The construction traffic noise levels have been calculated as described below in Section 5 and the calculated increases are shown in Table 4-7. These increases are based on the increase over the measured 2011 traffic flows and, therefore, the real impact would be expected to be less than predicted.

Table 4-7 Construction Traffic Noise Increases on Elizabeth Drive

Road	Section	L_{Aeq} Noise Level Increase (dB)	
		Day	Night
Elizabeth Dr	West of Mamre Rd	0.6	1.1
	West of Devonshire Rd	0.9	0.5
	West of Lawson Rd	0.9	0.6

Note: Analysis based on measured 2011 traffic and forecast construction traffic.

Along all sections of Elizabeth Drive the increase in noise level expected from construction traffic would be less than 2 dBA. Using the traffic noise criterion discussed in Section 5.2 below, it is concluded that this level of noise change resulting from the proposed construction works would not represent a perceptible noise increase.

5 ROAD TRAFFIC NOISE

The development of the proposed airport would result in increased airport-bound traffic. Planning for a proposed new M12 Motorway from the M7 to The Northern Road is being progressed by the NSW Government. When constructed, this motorway would provide the primary road link to the proposed airport. A detailed alignment for this motorway is not currently known.

Future road works would be the subject of separate approval processes by the relevant authorities undertaking these actions and the assessment of these is not covered in this document. However, a preliminary assessment of the general impact of the expected change in road traffic associated with operation of the proposed airport has been undertaken.

5.1 Relevant Criteria

Reference has been made to the NSW *Road Noise Policy* (*RNP*)(R4) to assess the effect of the proposed airport on road traffic noise in the area. The *RNP* recommends noise assessment criteria for residential and non-residential land uses affected by traffic generating developments. These criteria are more relevant to the assessment of new road infrastructure works, and they do not assist greatly in determining the impact of road traffic noise increases on existing roads due to the proposed airport and associated development.

In Section 3.4, the *RNP* document indicates that …. "*an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person*". It is this statement which is useful in assessing the significance of traffic noise level increases due to the proposed airport development.

5.2 Noise Impact of Traffic on Specific Roads

Road traffic projections for major roads in the vicinity of the airport have been provided by traffic planners for the year 2030 (GHD 2015a(R9)) with and without the airport. Noise levels at typical distances from these roads have been calculated using the *CoRTN*(R7) procedure which has allowed the increase in road traffic noise due to the proposed airport development to be forecast.

Table 5-1 shows the change in noise level expected as a result of the proposed airport on the major roads which the traffic report expects airport traffic to use. This table shows that there would be a decrease in road traffic noise on some roads which is due to anticipated development of the future M12 motorway. The highest noise level increase expected is less than 2 dB and accordingly, it is concluded that there would not likely be a perceptible noise increase resulting from road traffic as a result of the proposed airport development.

Table 5-1 Predicted Road Traffic Noise Level increases due to Airport Development (2030)

		Day	Night
Elizabeth Drive	West of Mamre Rd	0.8	0.5
	West of Devonshire Rd	1.3	0.8
	West of Lawson Rd	-0.4	-1.8
	West of Badgerys Creek Rd	1.6	0.0
	West of Luddenham Rd	1.3	-0.1
Luddenham Road	South of South Creek	-0.4	-0.6
	South of Twin Creeks Golf Club	-0.8	-1.4
Mamre Road	North of Elizabeth Dr	-0.1	-0.1
	North of Bakers Ln	0.5	0.4
	North of Banks Dr	0.0	0.0
The Northern Road	North of Homestead Rd	-0.4	-0.6
	South of Glenmore Pkwy	-0.6	-1.1
	North of Littlefields Rd	-0.9	-1.3
	North of Adams Rd	-0.6	-0.9
	North of Northern Rd	-0.1	-0.4
	North of Cobbitty Rd	-0.2	-0.3
	North of Camden Valley Way	-0.1	-0.2

Note: Source of traffic flows – GHD (2015).

6 CONCLUSIONS

Ground-based operational noise would be generated by aircraft engine ground running and taxiing. Predicted noise levels for these activities under assumed worst-case meteorological conditions are shown in contour form in Figure 3-2 and Figure 3-3 during the initial airport development.

Under worst-case conditions, engine running noise would affect a greater area around the airport compared to aircraft taxiing. Localities that may experience noise from engine runs based on the current conceptual layout includeeLuddenham, Badgerys Creek, Bringelly, Wallacia and Greendale. Residences in these localities would be affected by these noises along with schools and other educational institutions, places of worship, passive recreation and active recreation.

In reality, for any individual engine run not all of the above areas would be affected to the degree shown in Figure 3-2. This is because aircraft would be oriented in a particular direction during an engine run, usually facing into the prevailing wind, and noise would not be emitted equally in all directions as assumed by the modelling. High power engine runs during night time should be restricted to special circumstances where high power testing is required after maintenance activity prior to an aircraft taking off, as is the case for many major airports in Australia now. In addition, it may prove practicable to locate buildings, walls or earth mounds around the run up area. These structures could reduce noise levels by up to 10 dB.

Aircraft taxiing would generate relatively lower noise levels which are predicted to affect primarily Luddenham.

The design for the proposed airport is indicative, and the noise modelling resulting from that will be subject to further detailed design and assessment closer to the commencement of operations of the proposed airport. Some aspects of airport operations could be introduced to mitigate noise impacts on the community such as the establishment of ground running procedures.

It is important to note that the proposed airport has a lengthy construction period and current planning is for the airport to commence operations in about 2025. In this timeframe, technological improvements, including the upgrading of airline fleets, are expected to continue to reduce the industry's noise impacts on communities. These and other potential improvements will be considered in formal airport design and assessment processes in the future.

It is anticipated that a noise management strategy would be developed in consultation with appropriate stakeholders prior to the commencement of operations. This strategy would be developed in parallel with the detailed airport design to provide the local community and other important stakeholders with the chance to be consulted and fully informed of the final expected impacts before the airport commences operations.

Noise during the construction stage of the proposed airport would be confined primarily to within the airport boundary. However, some noise impact would occur outside of the airport boundary, particularly in the Luddenham and Badgerys Creek areas, but no residences would be affected by noise levels in excess of the acceptable criteria in the Airports (Environment Protection) Regulations. To minimise construction noise impacts, a *Construction Noise and Vibration Management Plan* should be developed by the construction contractors. This plan should address construction hours, equipment noise controls and complaint / response procedures.

Although heavy and light vehicles would need to access the proposed airport during the construction stage, the resulting increase in traffic noise would not be significant. Vibration generated by construction activities is considered unlikely to cause building damage outside of the site.

During operation of the proposed airport, road traffic noise level increases in the surrounding area are predicted to be insignificant. This is without considering the impact of the newly proposed M12 motorway and any road realignments which would be subject to separate applications and approvals by the relevant authorities.

7 REFERENCES

R1: Concawe, *The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities*, Concawe, May 1981

R2: GHD 2015, *Western Sydney Airport Environmental Impact Statement Construction Planning Report*, GHD, July 2015

R3: *INP*, NSW *Industrial Noise Policy*, NSW EPA, January 2000

R4: *RNP*, NSW *Road Noise Policy*, NSW EPA, March 2011

R5: DIN 4150-3, *Structural Vibration: Effects of Vibration on Structures*, May 1986

R6: AS2021: 2015, *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*, March 2015

R7: *CoRTN*, *Calculation of Road Traffic Noise*, UK Department of Transport, 1988

R8: *ICNG*, *Interim Construction Noise Guideline*, NSW EPA, July 2009

R9: GHD 2015a, *Western Sydney Airport Traffic Report*, GHD, 2015

R10: Transport for NSW, *Construction Noise Strategy*, 2012

R11: Wilkinson Murray Report No. 14168, *Western Sydney Airport EIS – Aircraft Overflight Noise*, August 2015

R12: Australian Standard 1055: 1997, *Acoustics – Description and Measurement of Environmental Noise,* Standards Association of Australia

GLOSSARY

ACOUSTICAL TERMINOLOGY

Most environments are affected by noise from a variety of sources. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are defined here.

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

A-Weighted Noise Level (dBA) – This is a value representing the loudness of a sound at a specific time, allowing for the differential response of the human ear to different sound frequencies.

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

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

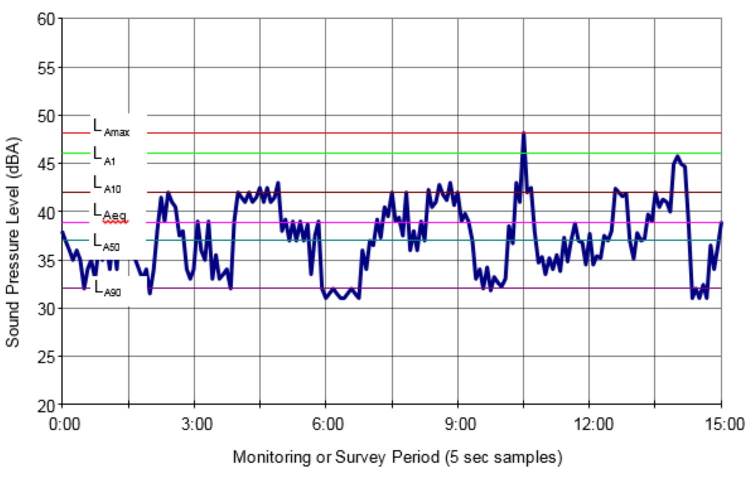
L_{A90} – The L_{A90} level is the A-weighted noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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

Maximum Noise Level (L_{Amax}) – L_{Amax} over a sample period is the maximum A-weighted noise level measured during the period.

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

Typical Graph of Sound Pressure Level vs Time



OTHER TERMINOLOGY

Aircraft Operation – In the context of this report, this refers to an aircraft arrival or departure.

Aircraft Engine Ground Running – Often after major engine maintenance, it is necessary to 'run-up' the engine for testing while the aircraft is on the ground. Whilst most of this occurs for engines running at idle or low power, it is often necessary to run the engine at full power for short periods of time.

Airport Site – The airport site is the total of all properties that may become part of Western Sydney Airport.

DIRD – The Australian Government Department of Infrastructure and Regional Development tasked with the detailed planning and investigation of the proposed Western Sydney Airport.

EIS – Environmental Impact Statement.

Initial Development – The first stage in the development of the Western Sydney Airport, including a single runway and associated infrastructure to handle up to approximately 10 million annual passenger movements, presently anticipated to occur in 2030. Also referred to as the Stage 1 development.

Longer Term Development – A longer term development at Western Sydney Airport could include dual runways and associated infrastructure to handle approximately 82 million annual passenger movements. The Western Sydney Airport EIS considers this patronage level could be reached around 2063.

Noise Management Levels – The Interim Construction Noise Guideline[R8] recommends Noise Management Levels (NMLs) which are to be used to manage construction noise levels at noise sensitive receivers. Where construction noise levels are predicted to be above the NMLs, the proponent should apply all feasible and reasonable work practices to meet the NMLs.

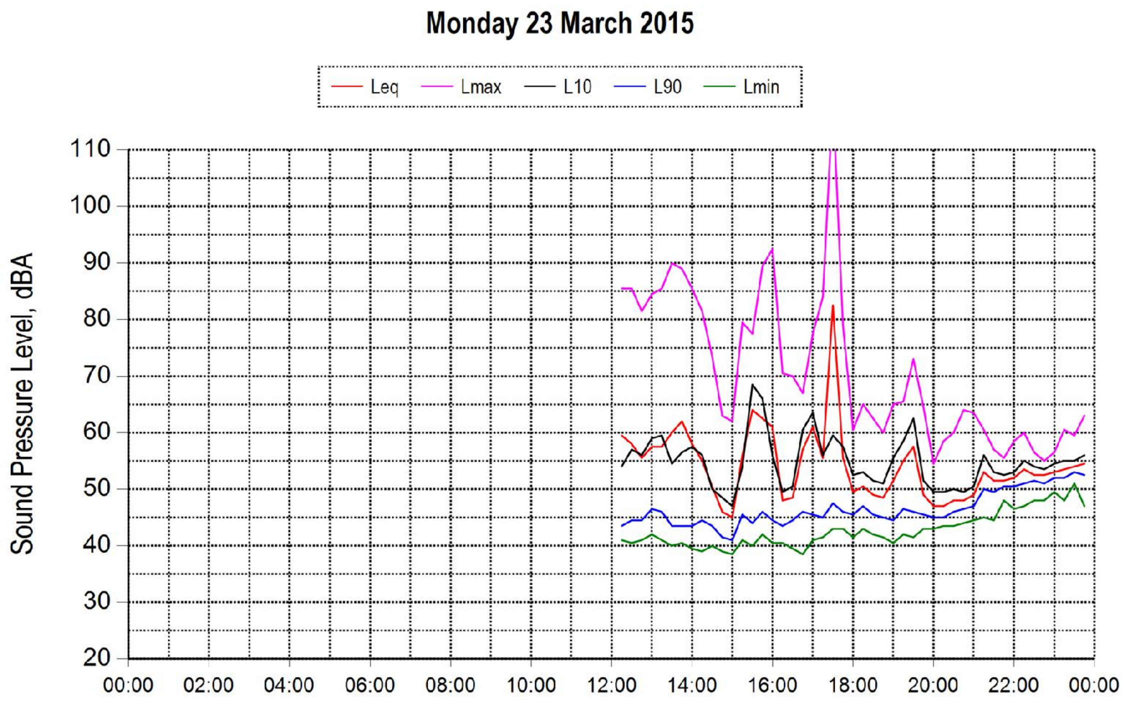
Taxiing – Aircraft at airports typically taxi from the terminals to the runway prior to take-off or from the runway to the terminal after landing. In calculating ground-based noise, taxiing noise has been calculated by modelling the movement of aircraft along the taxiways as shown on the designs for the initial development.

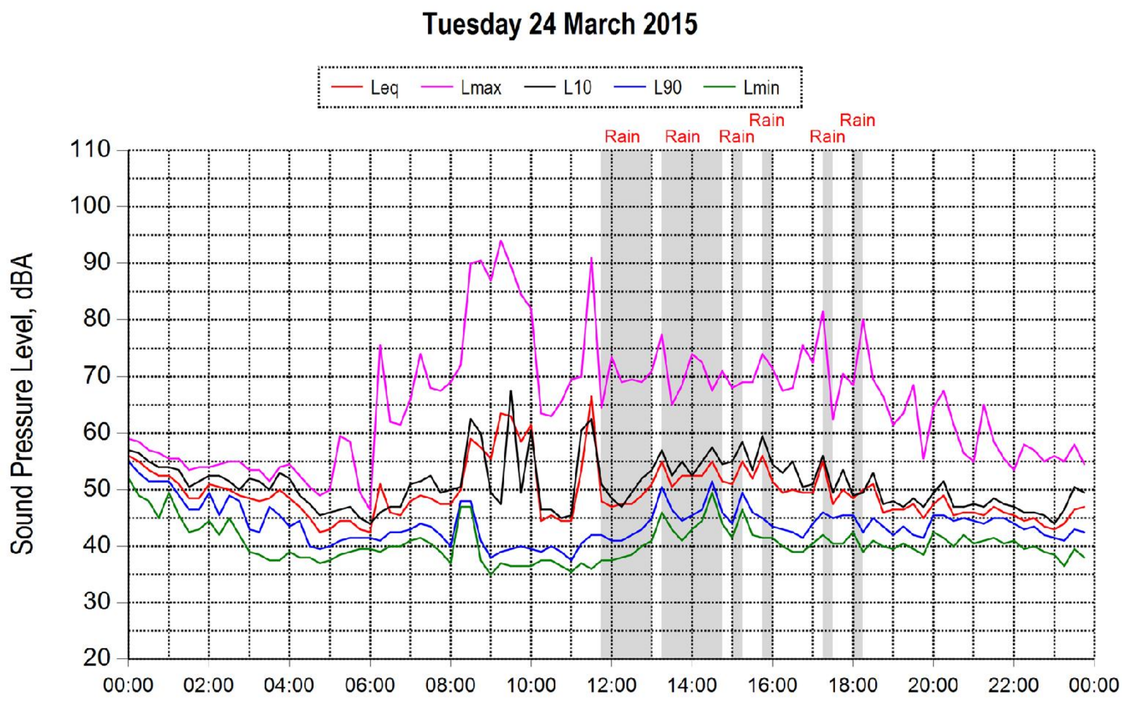
Western Sydney Airport (WSA) – The proposed airport at Badgerys Creek as assessed in the Western Sydney Airport environmental impact statement.

APPENDIX A

AMBIENT NOISE MEASUREMENTS

9 Harold Bentley Way, Glenmore Park





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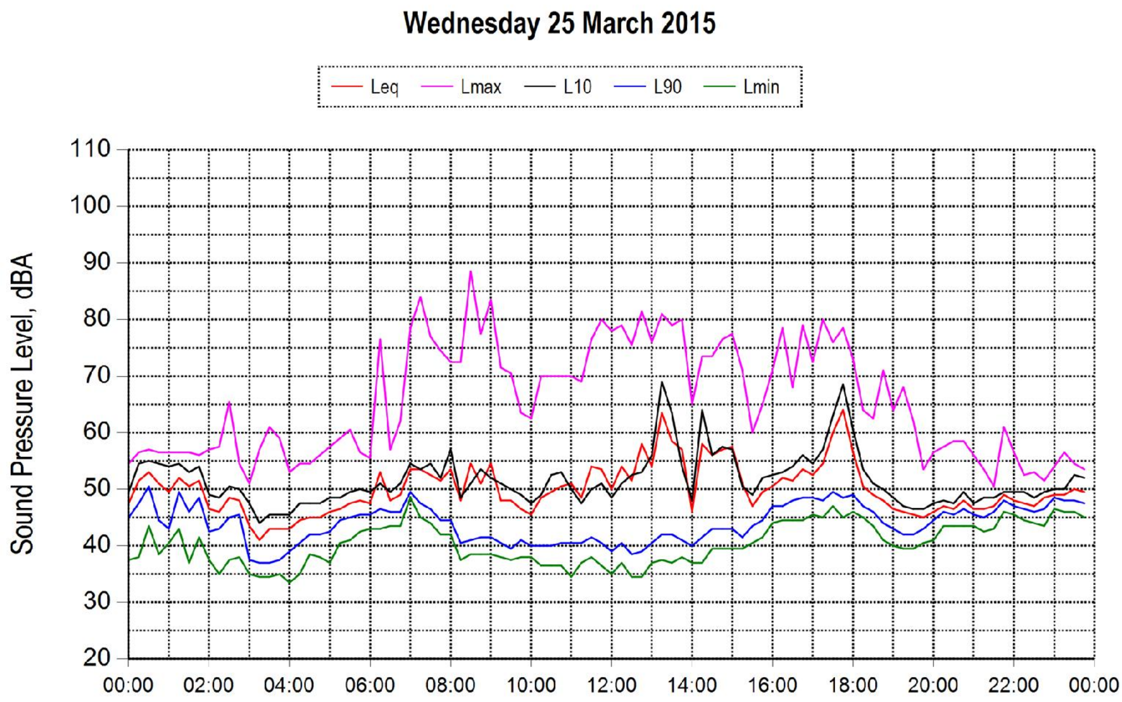

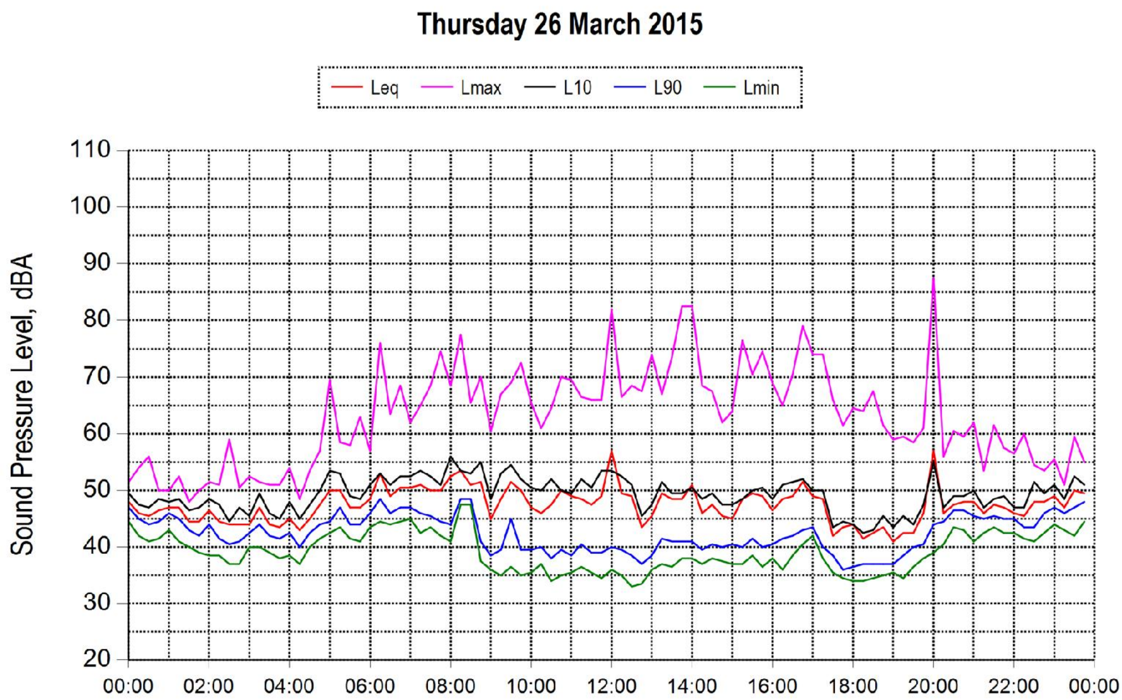

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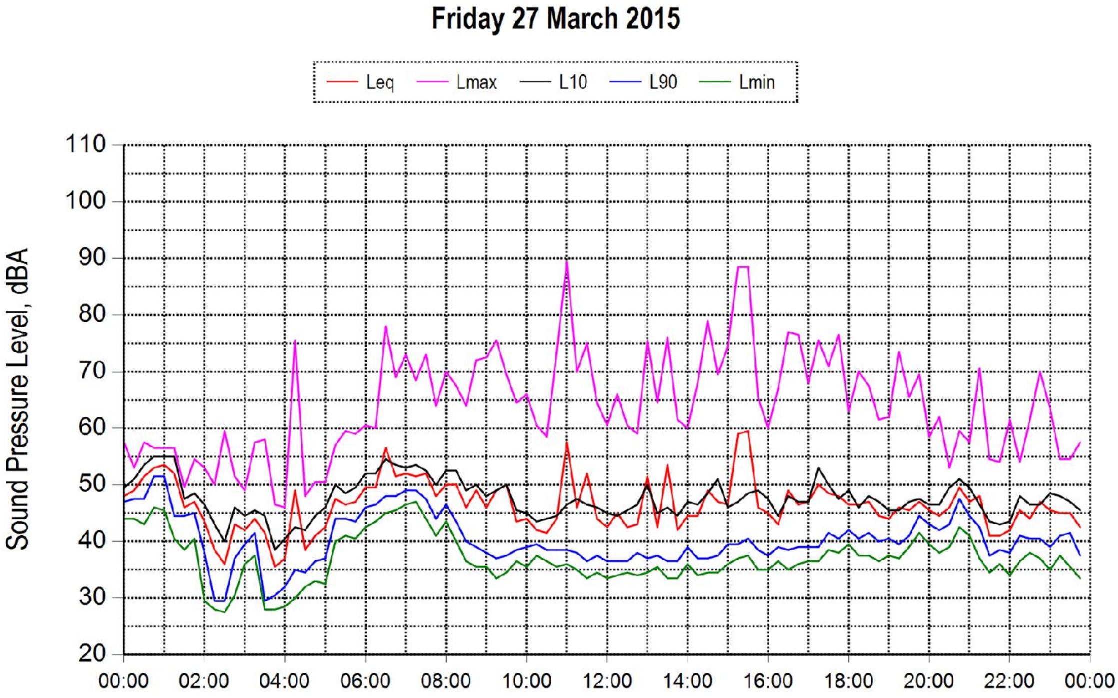

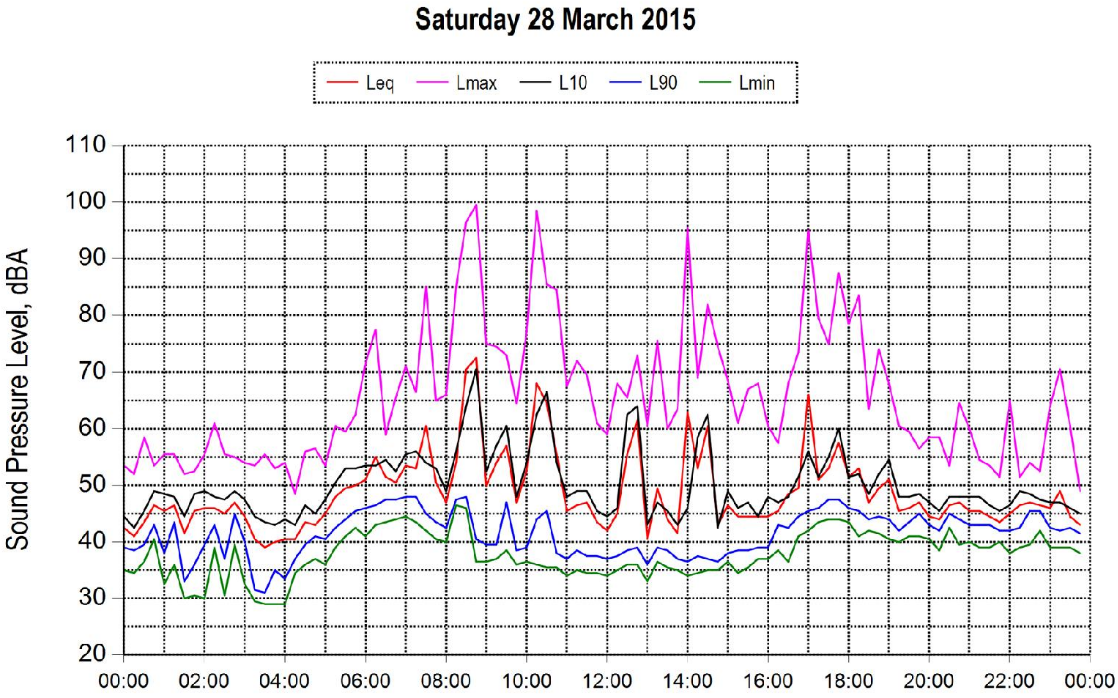

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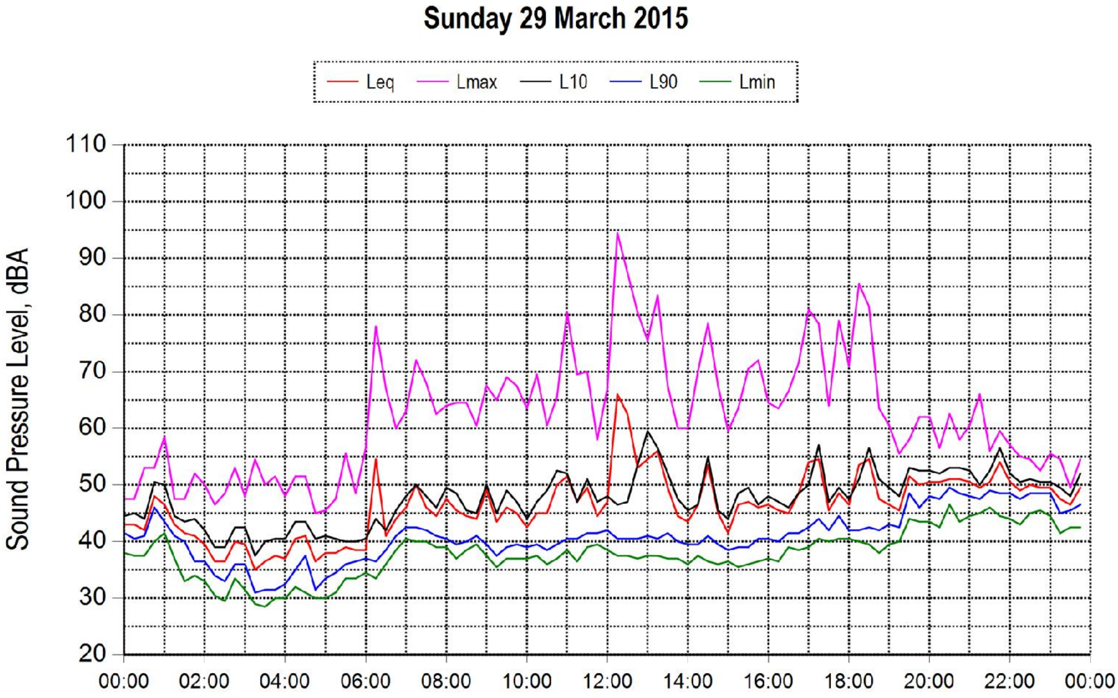

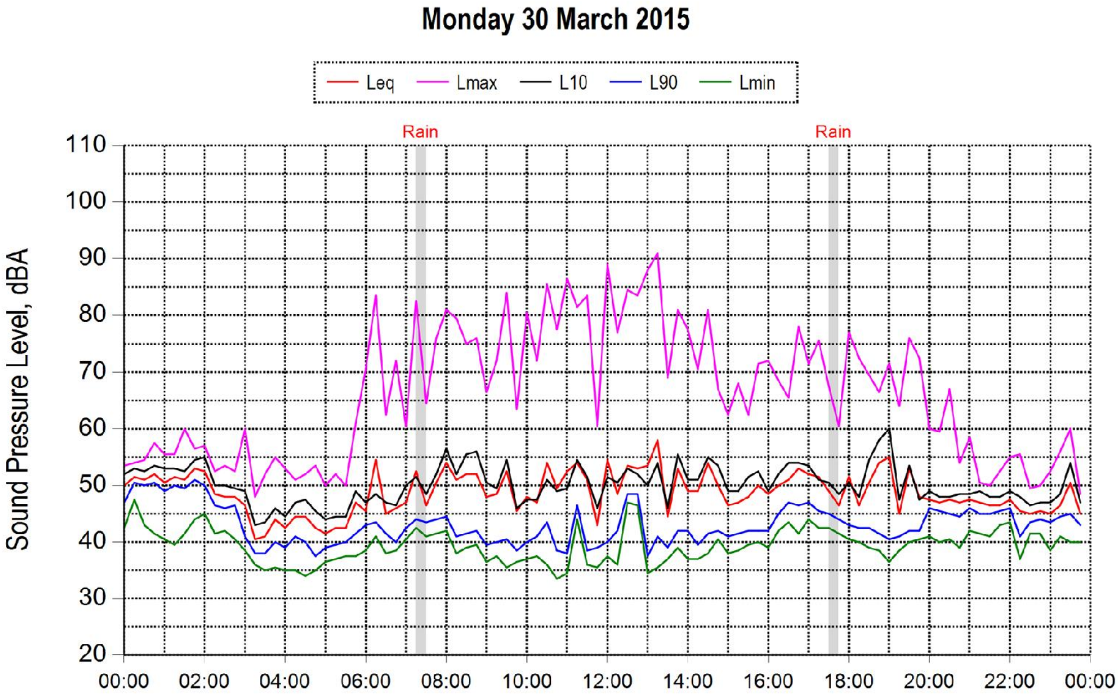

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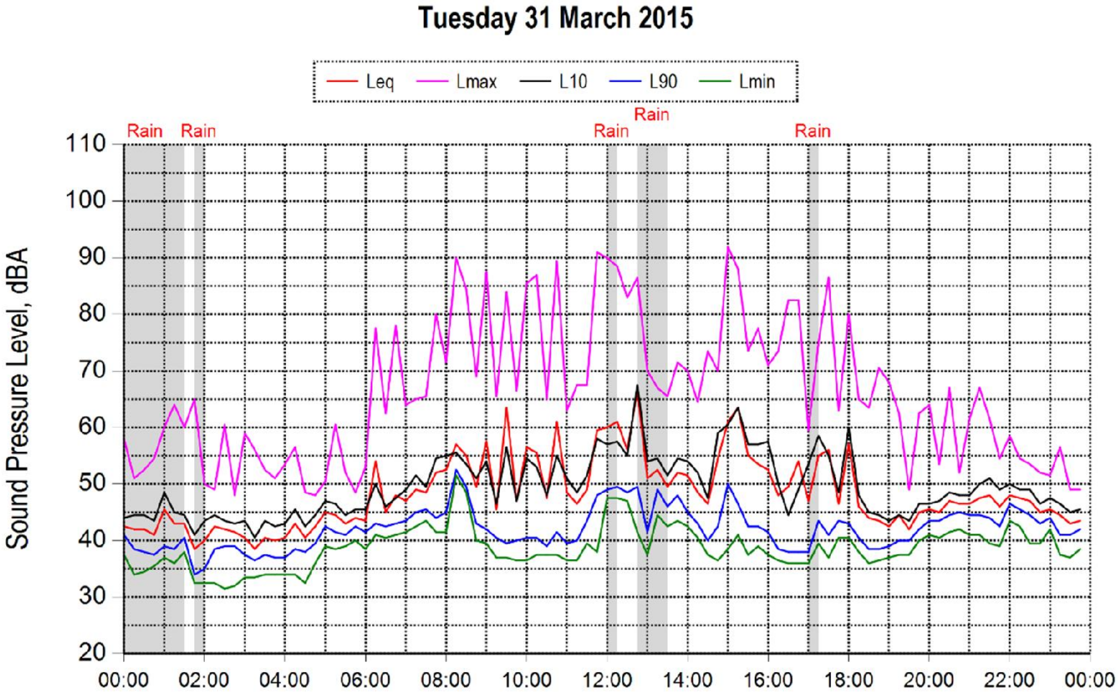

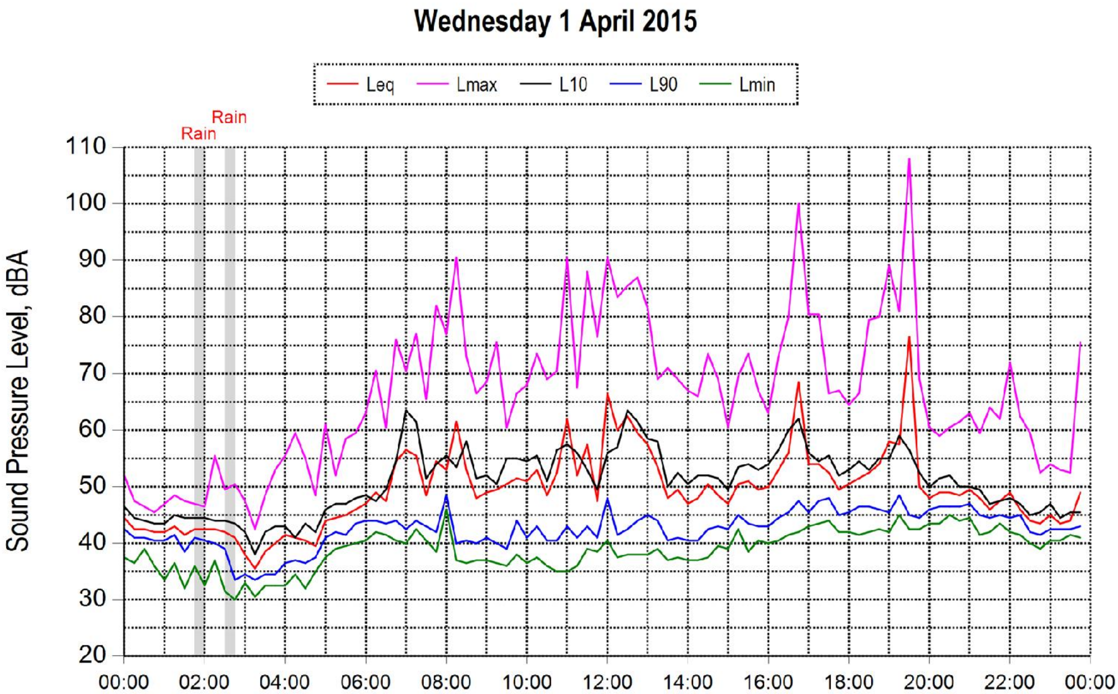

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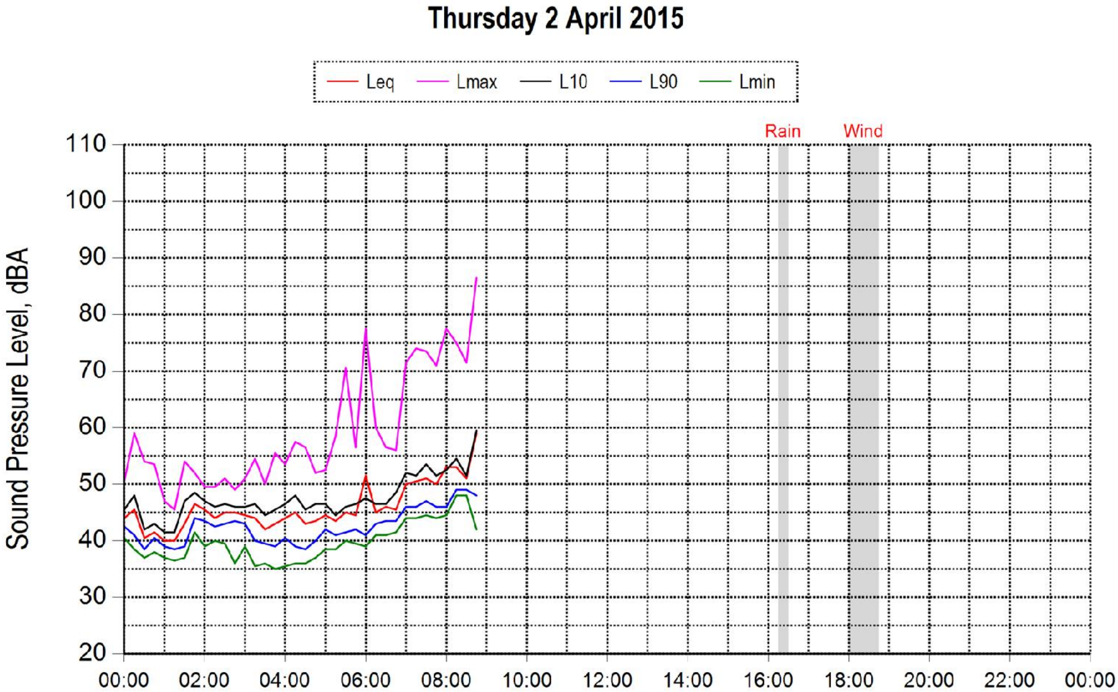
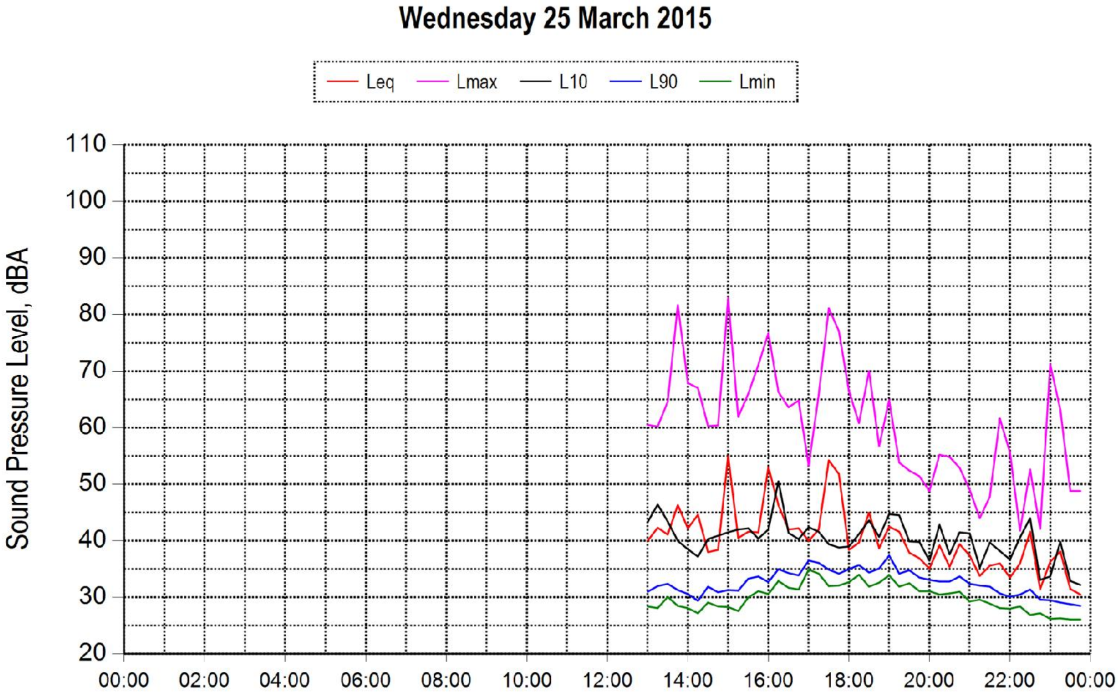
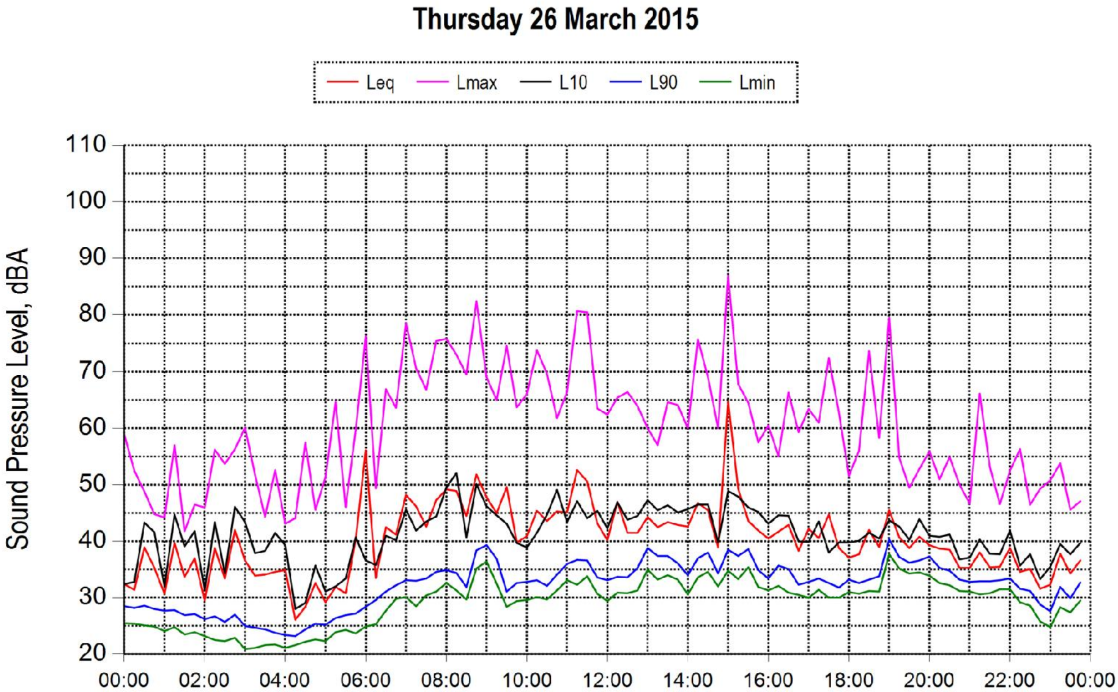


16 Park Avenue, Springwood





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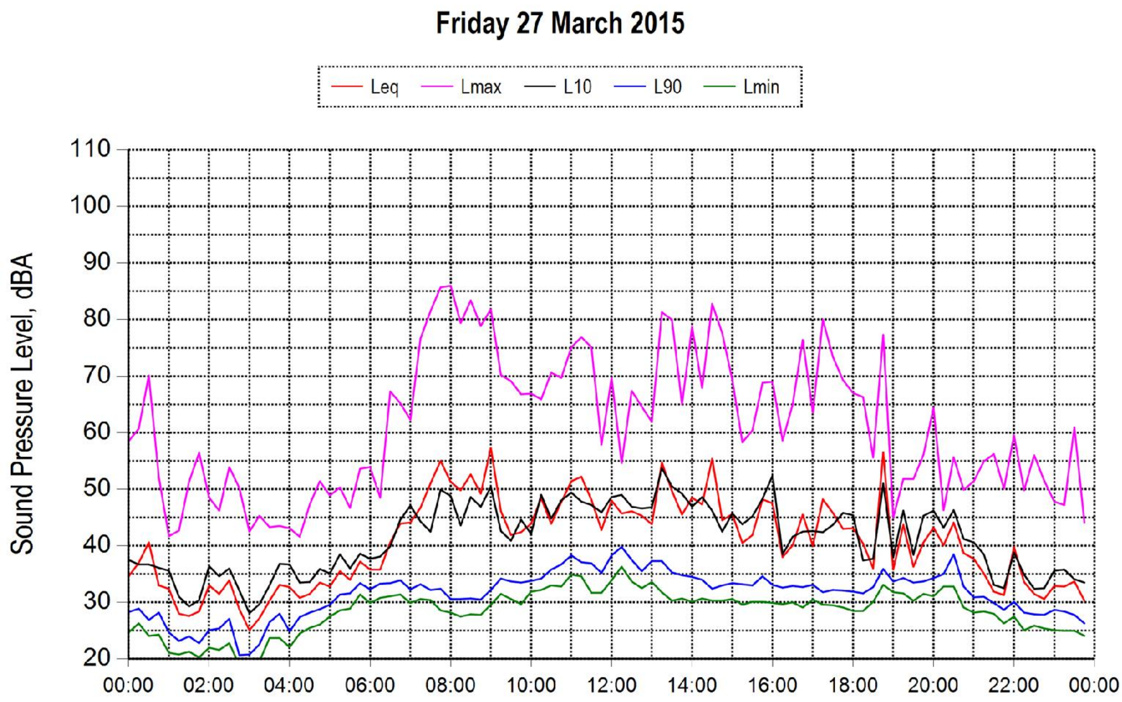

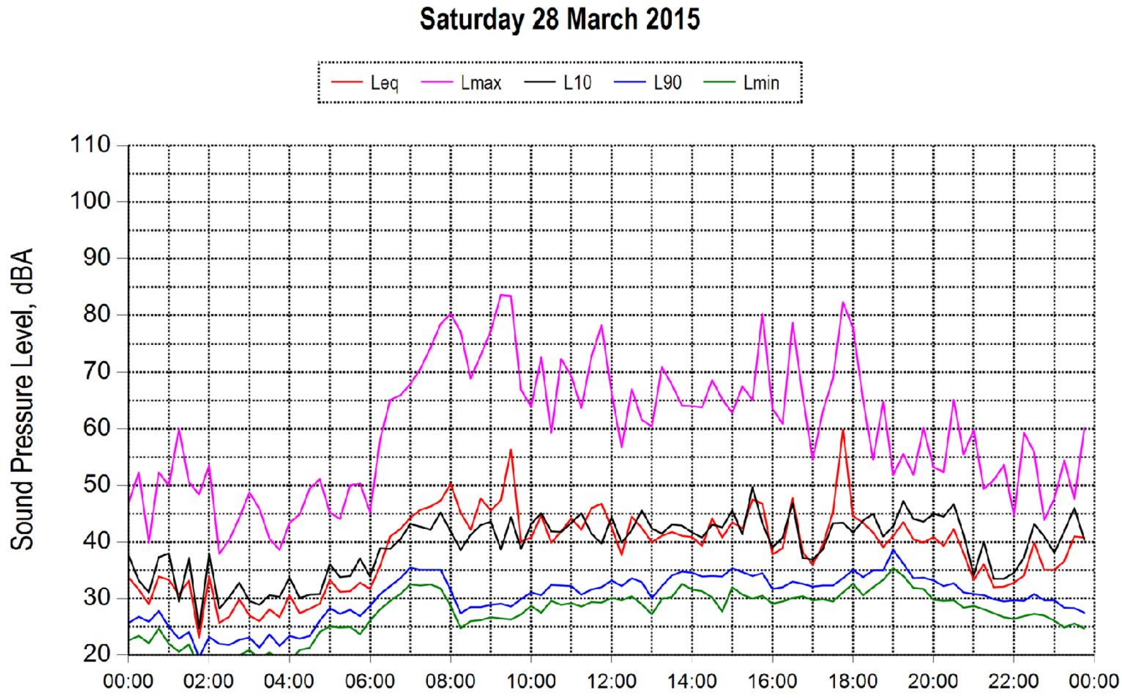

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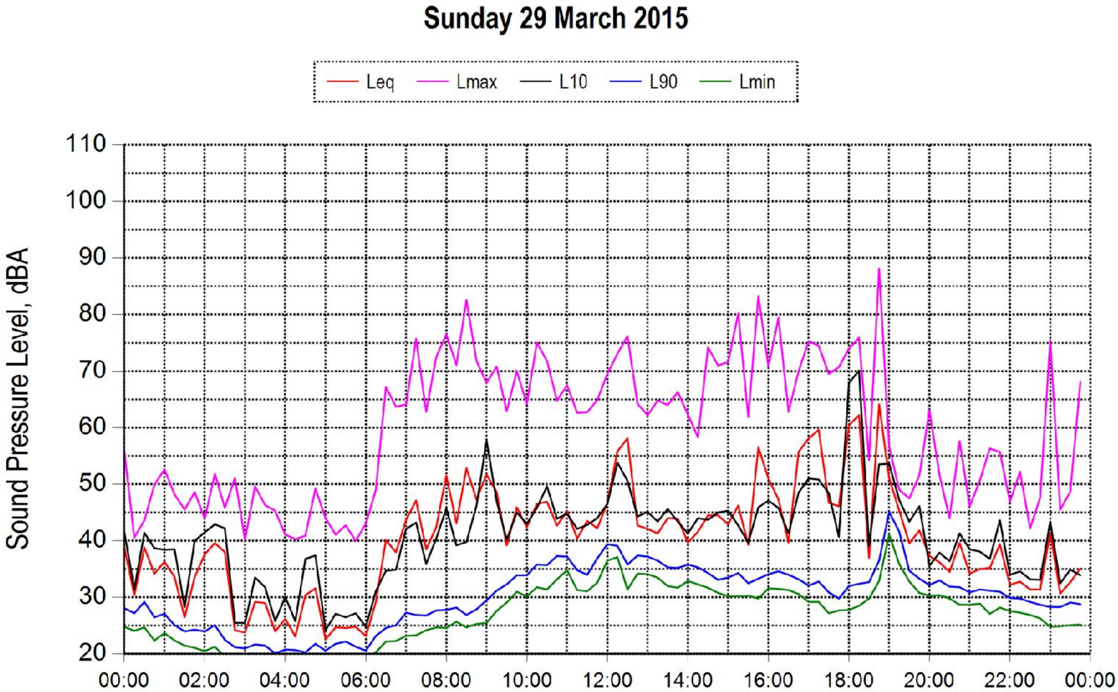

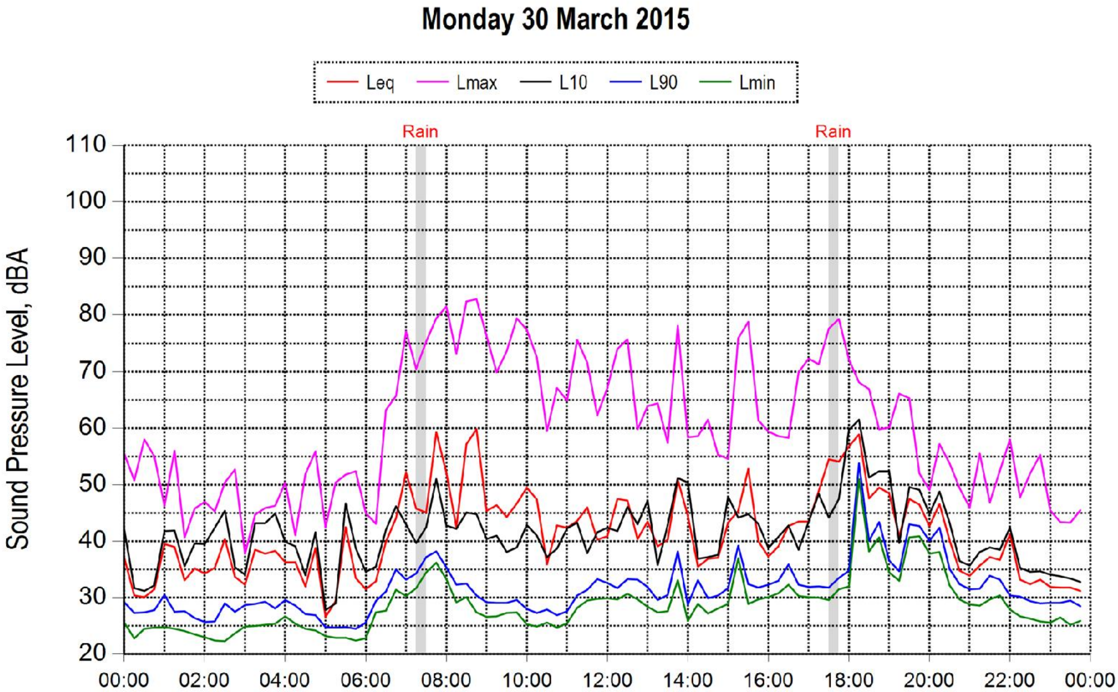

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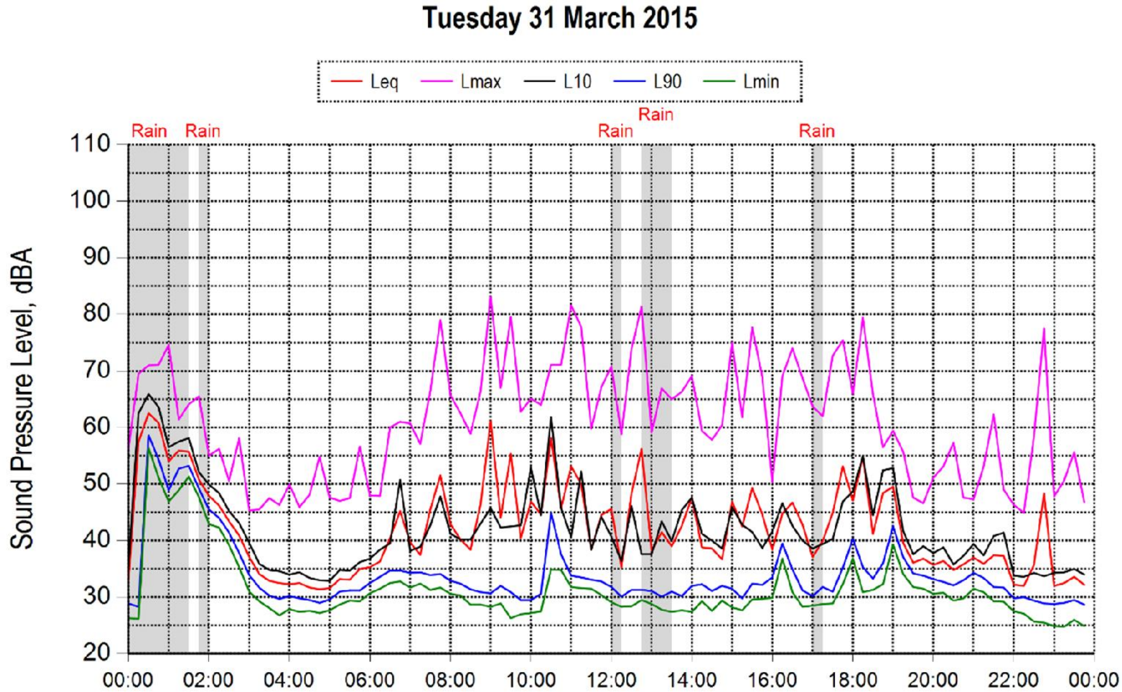

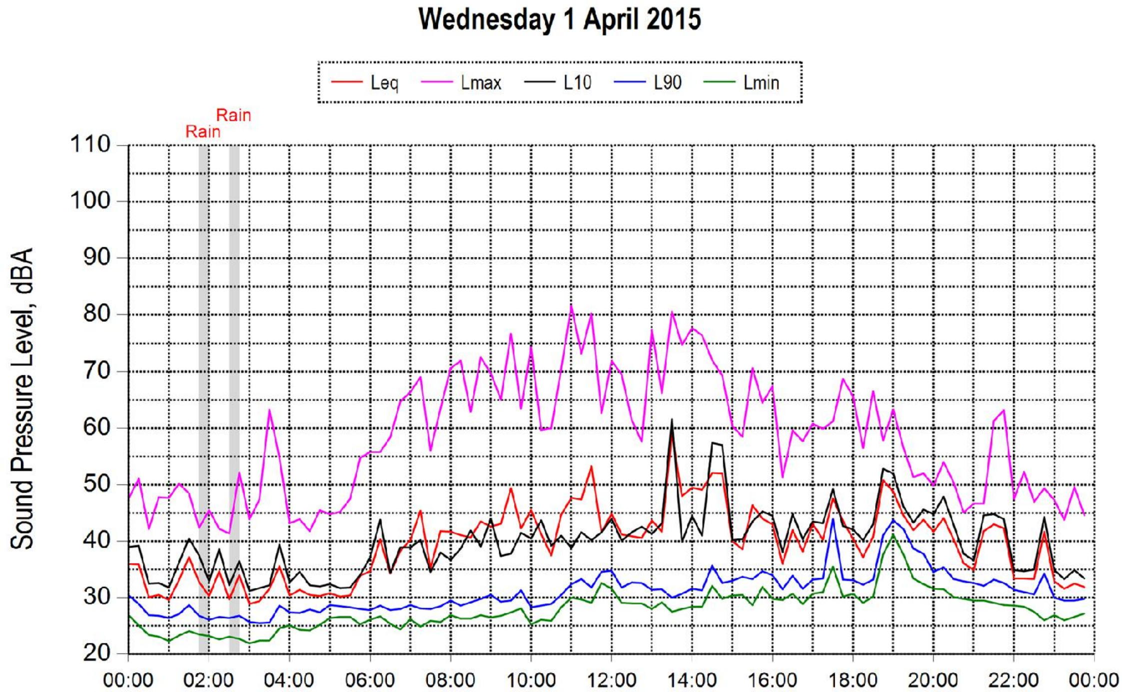

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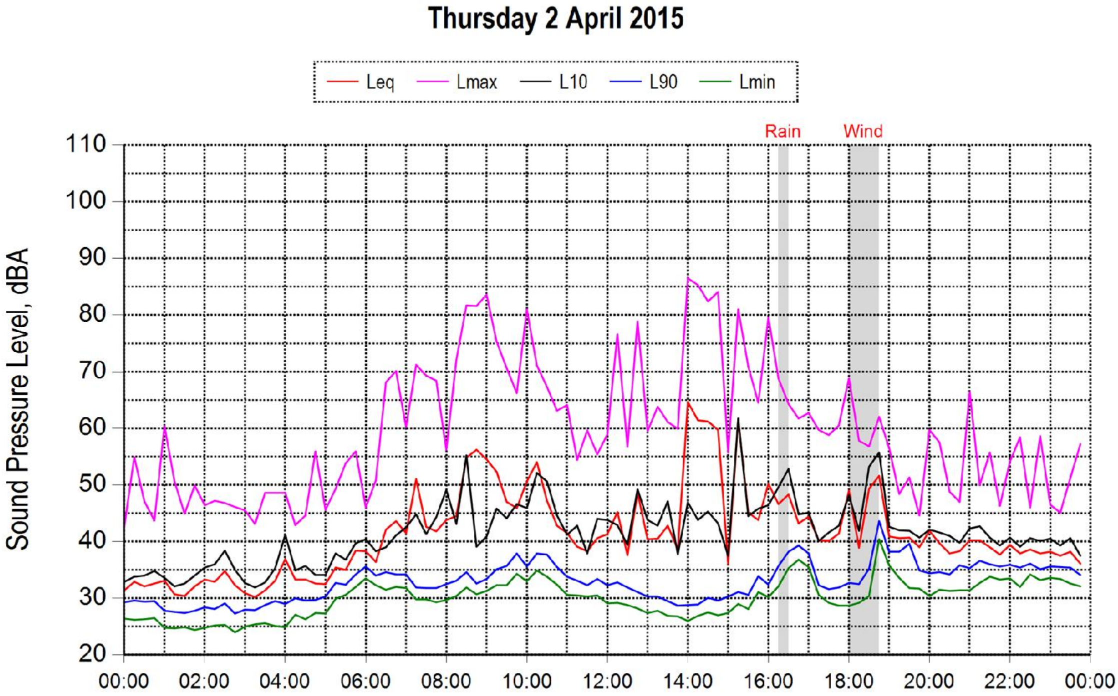
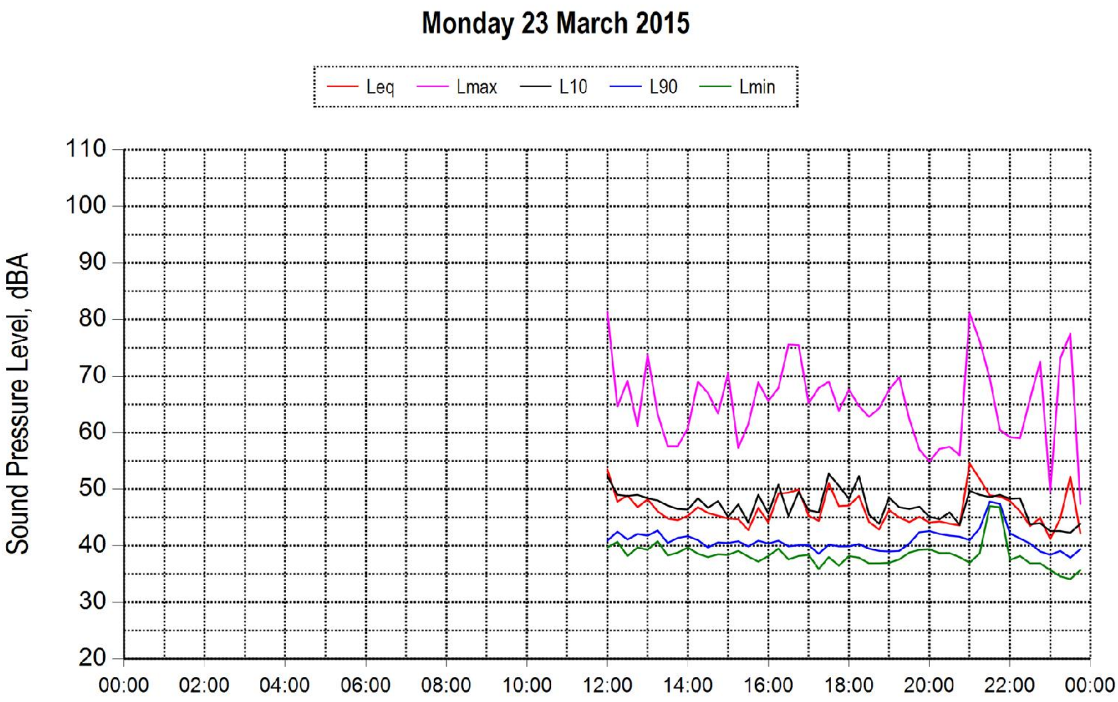
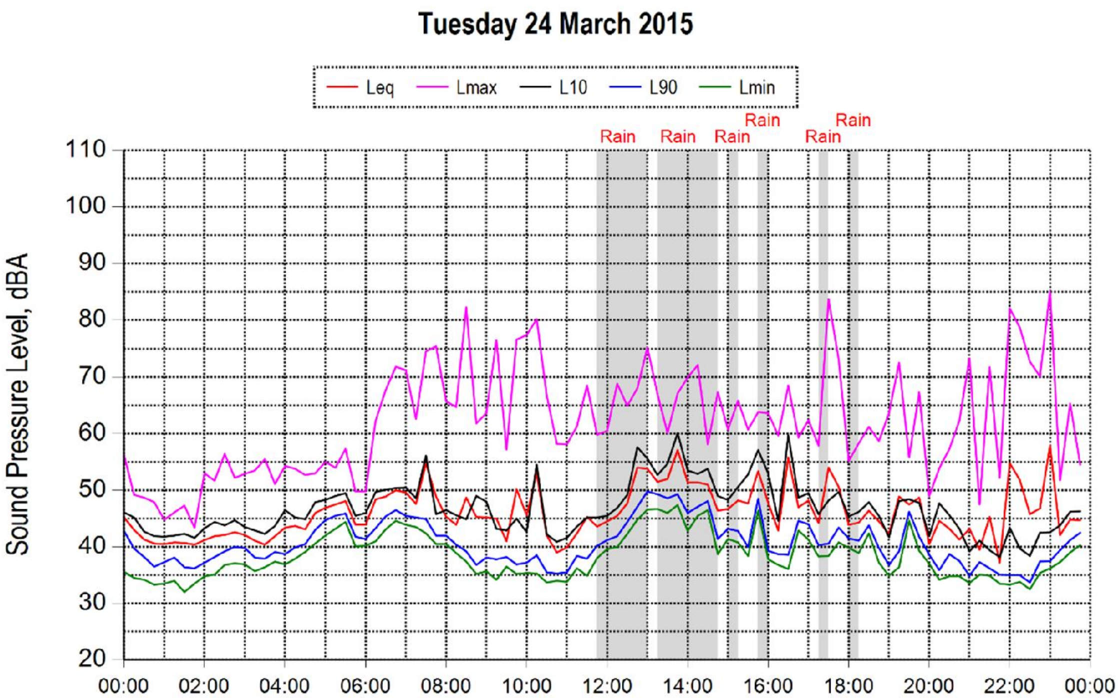


17 Blue Ridge Place, Orchard Hills





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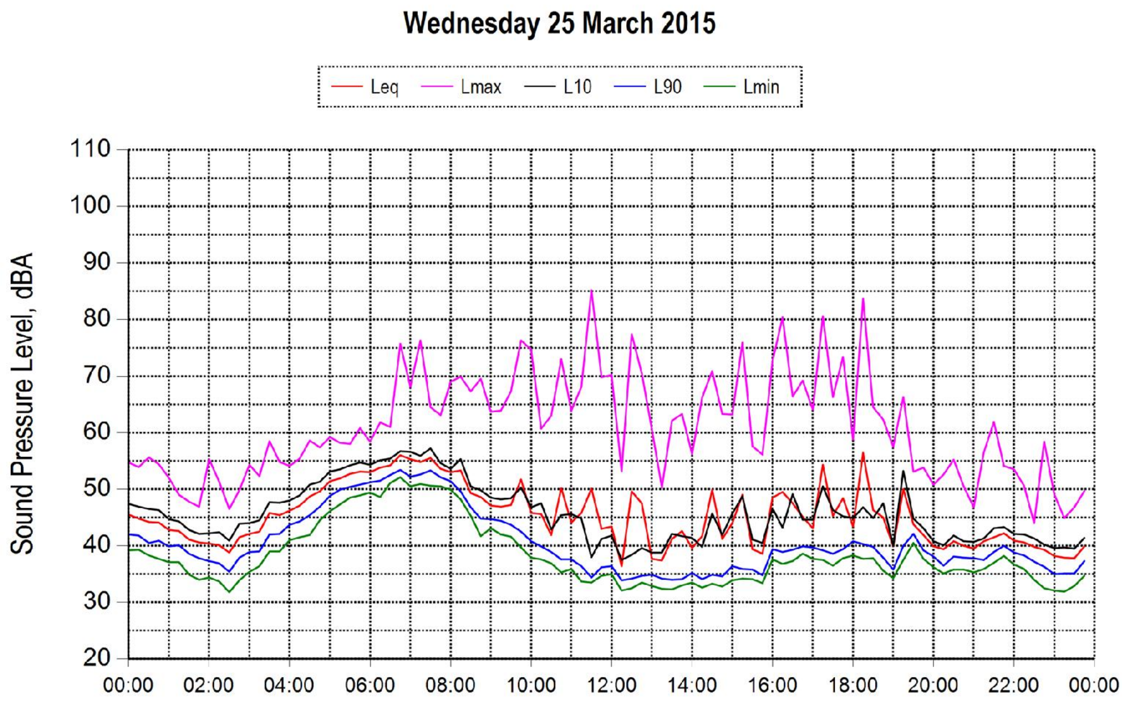

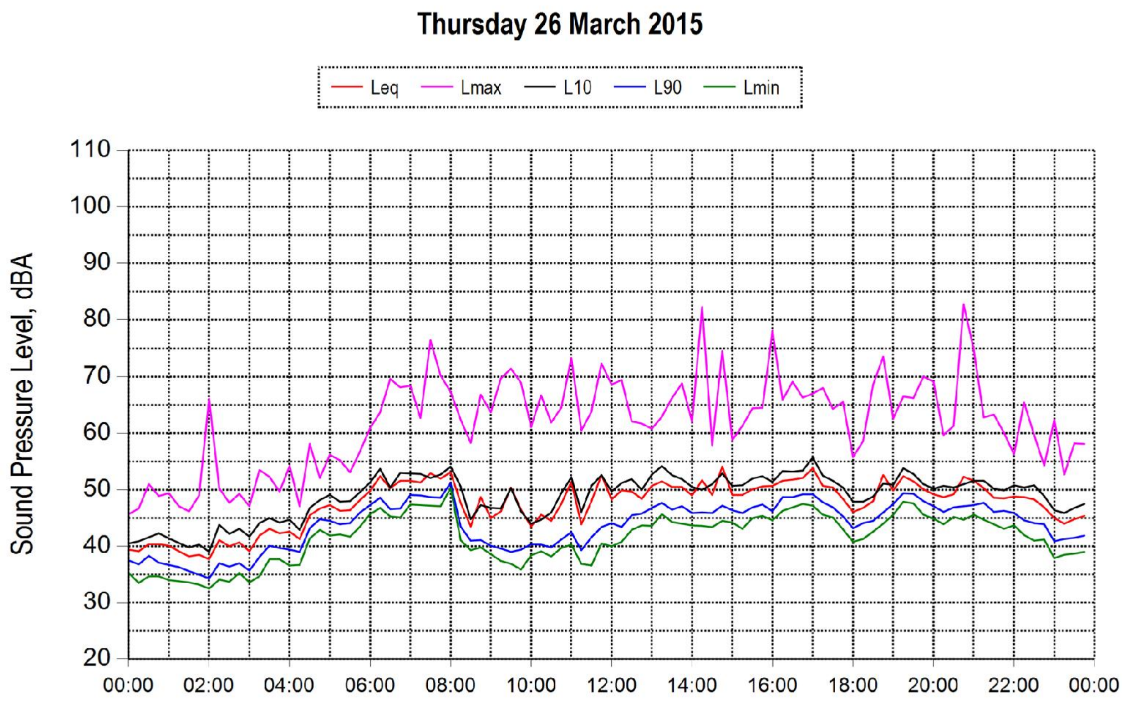

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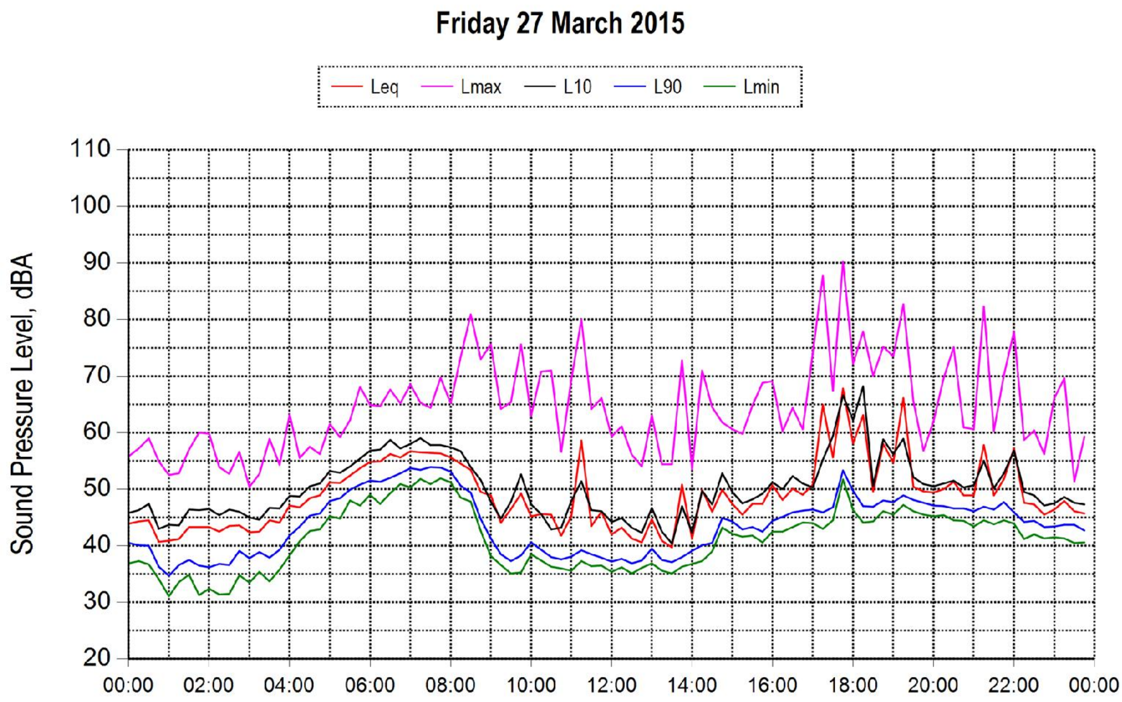

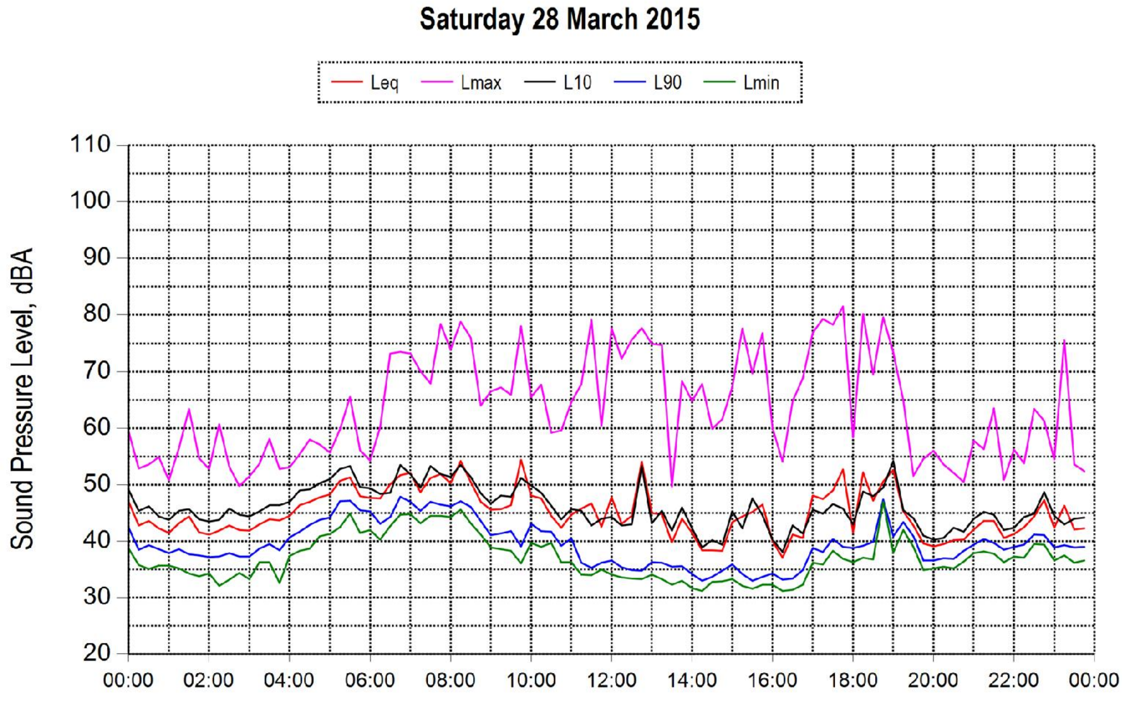

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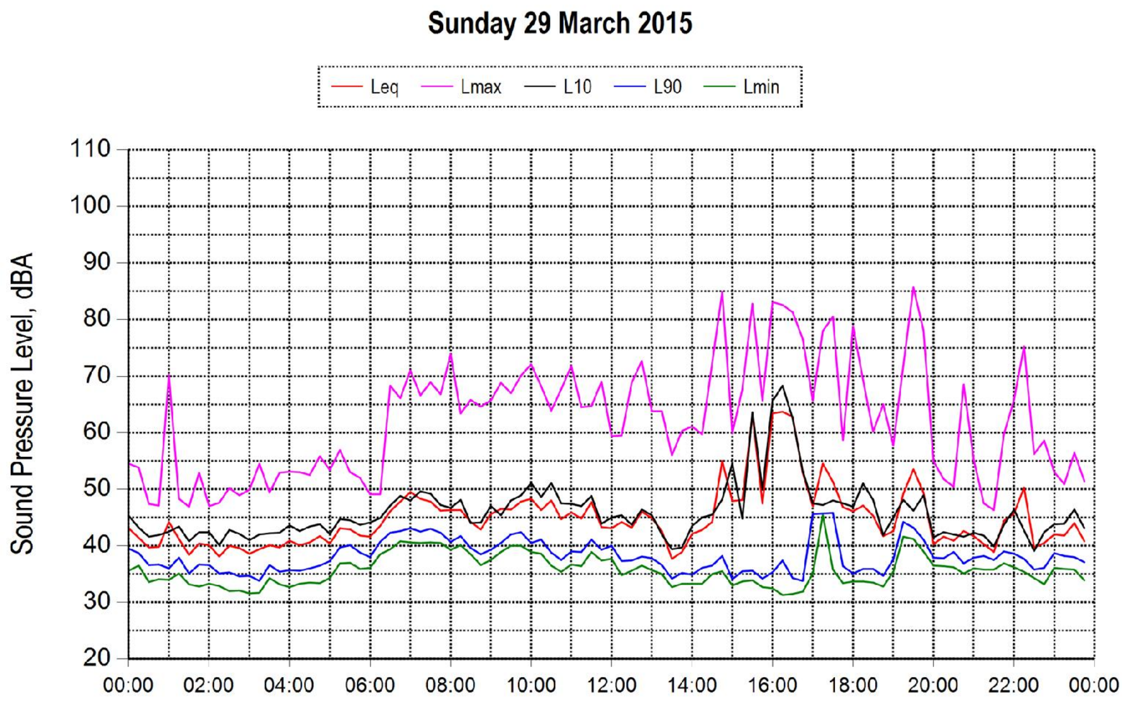

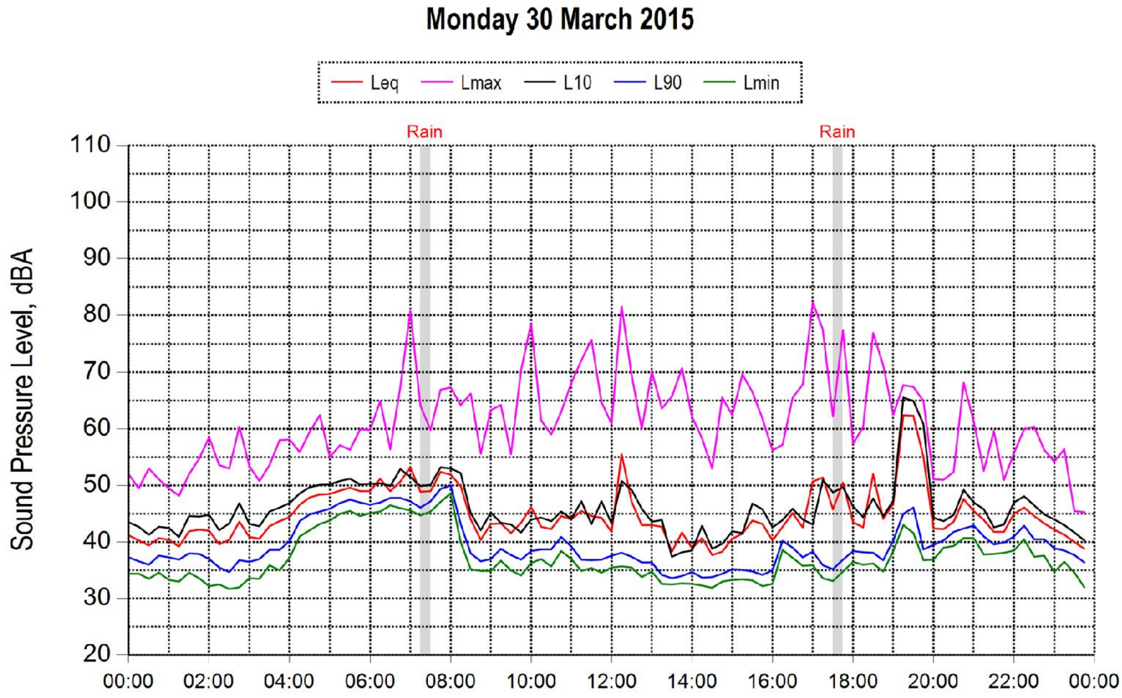

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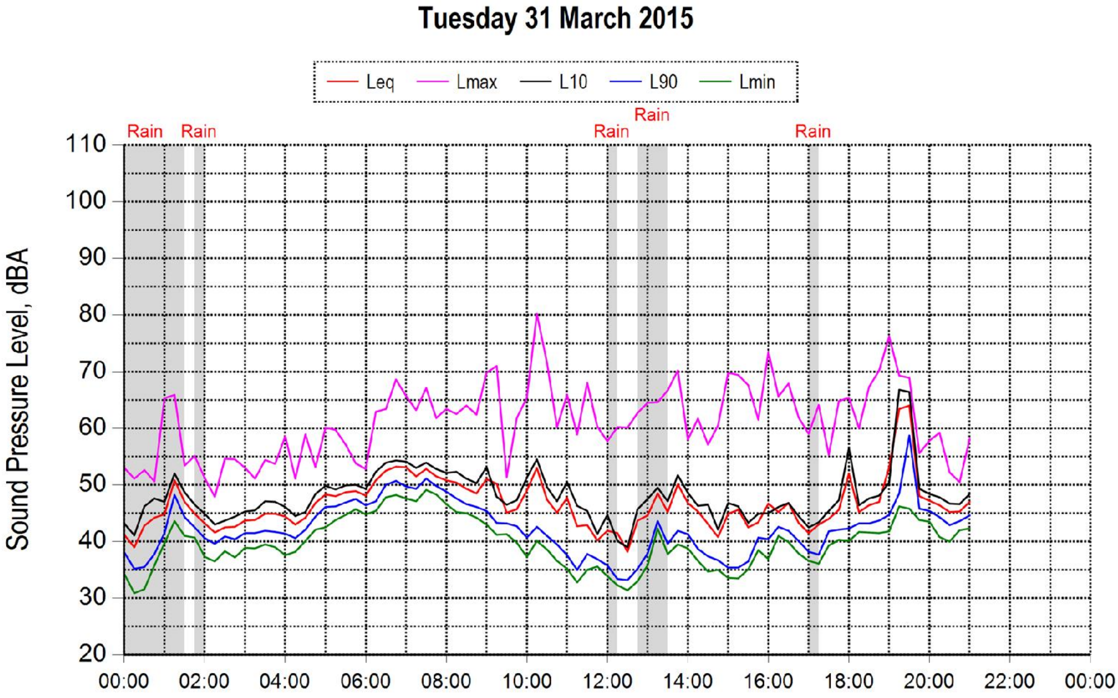
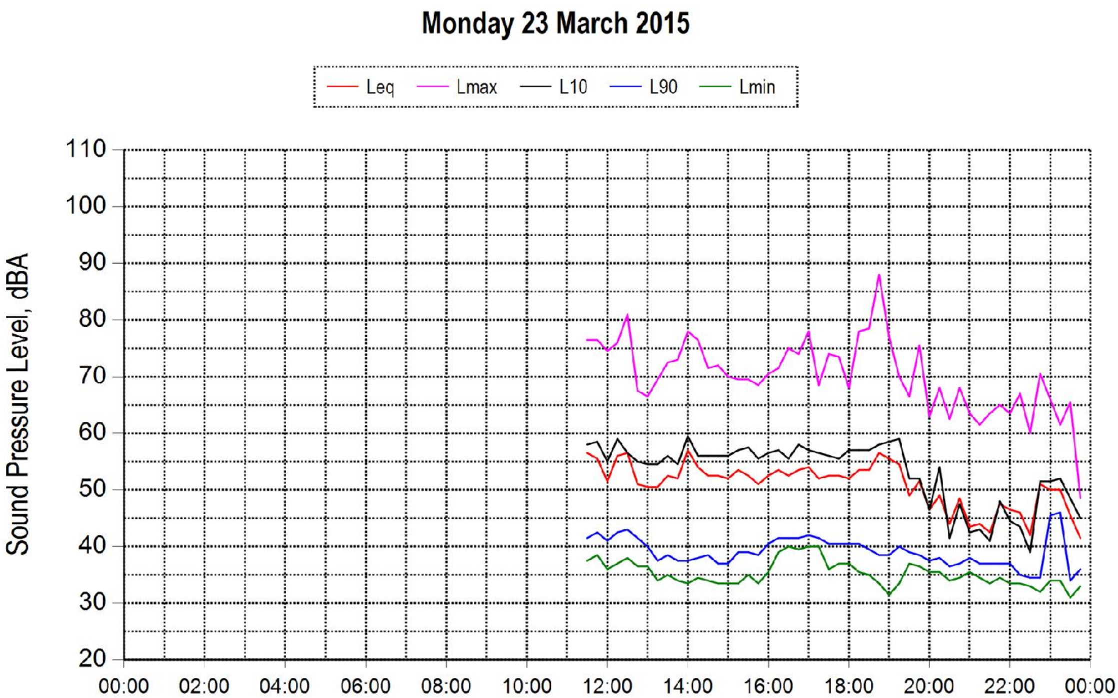
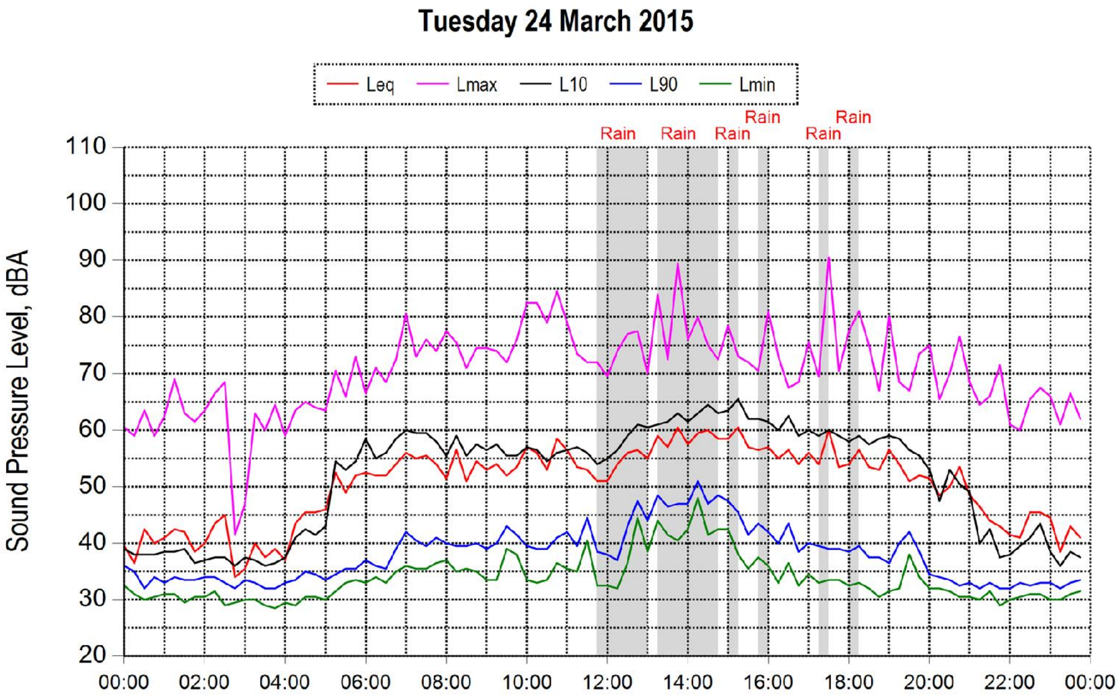


25 Peter Pan Avenue, Wallacia





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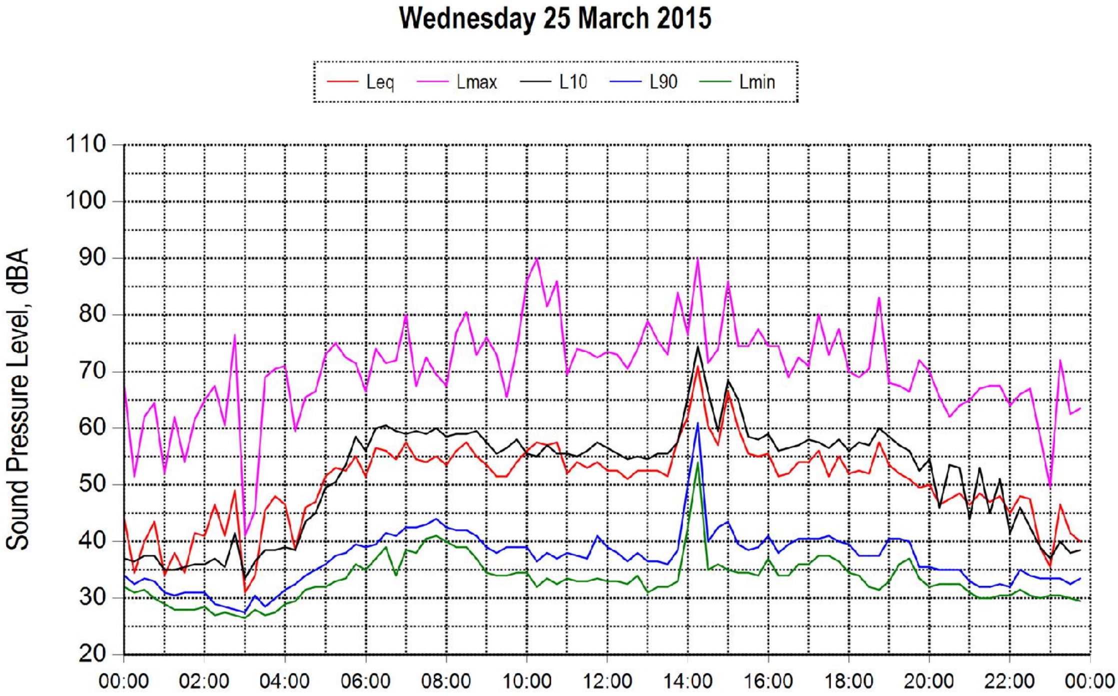

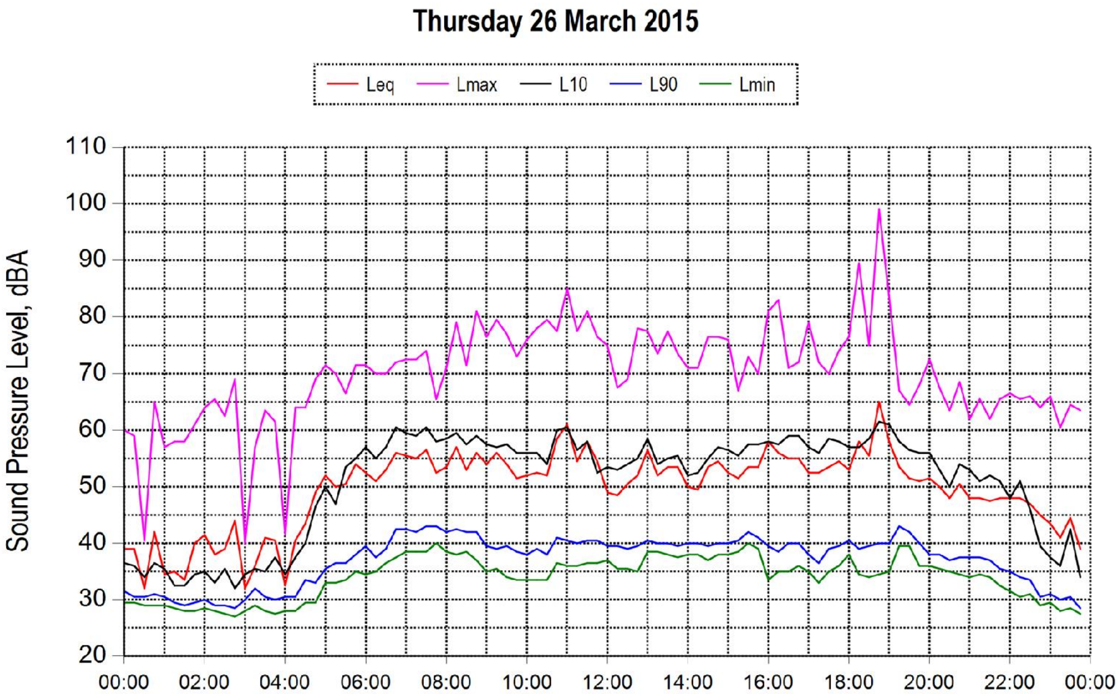

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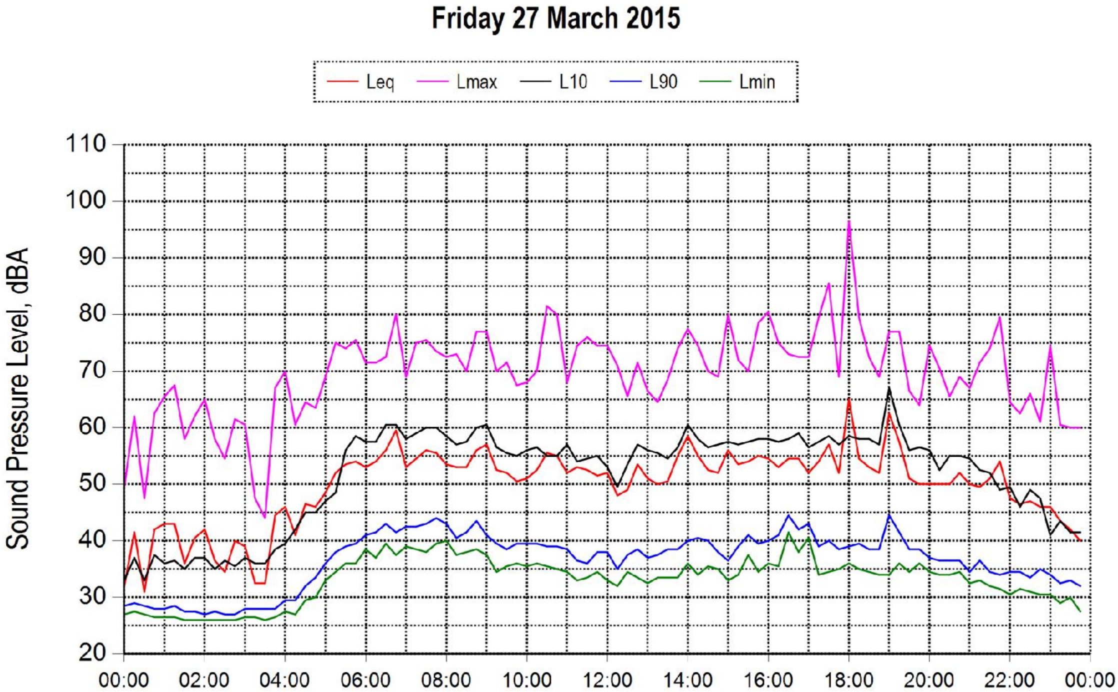

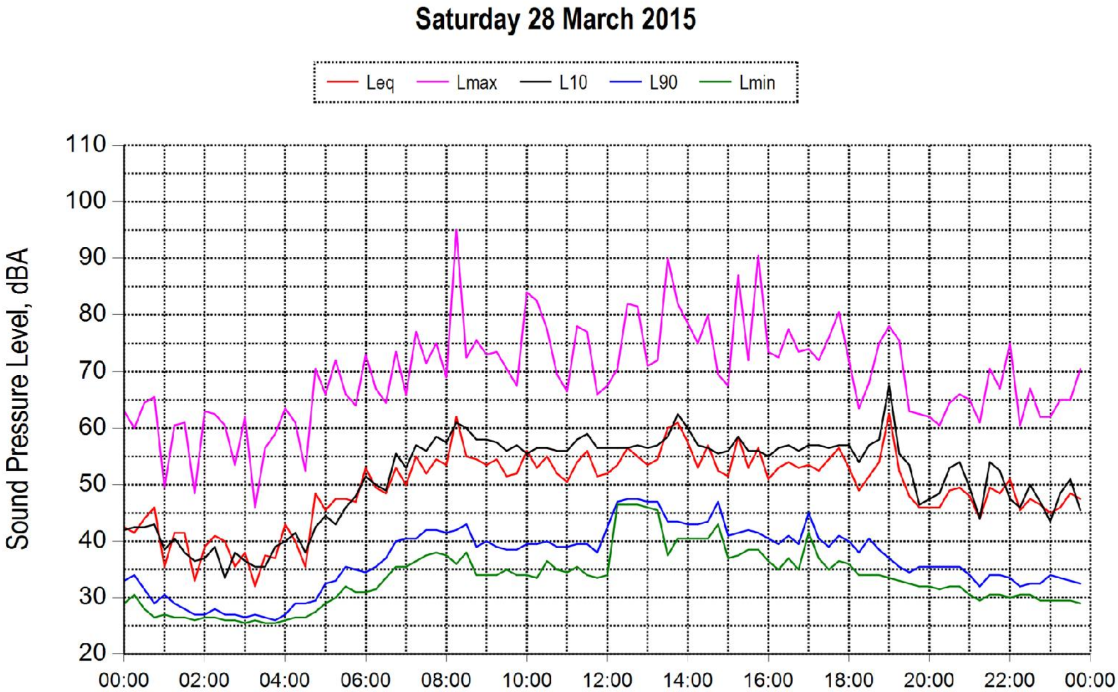

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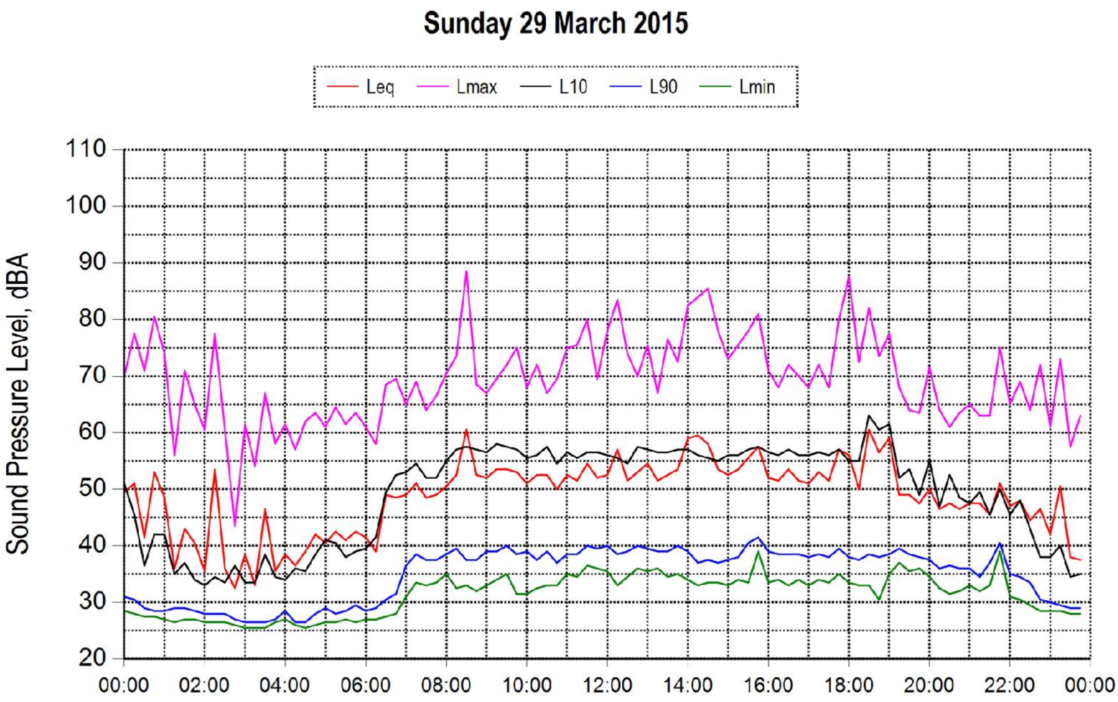

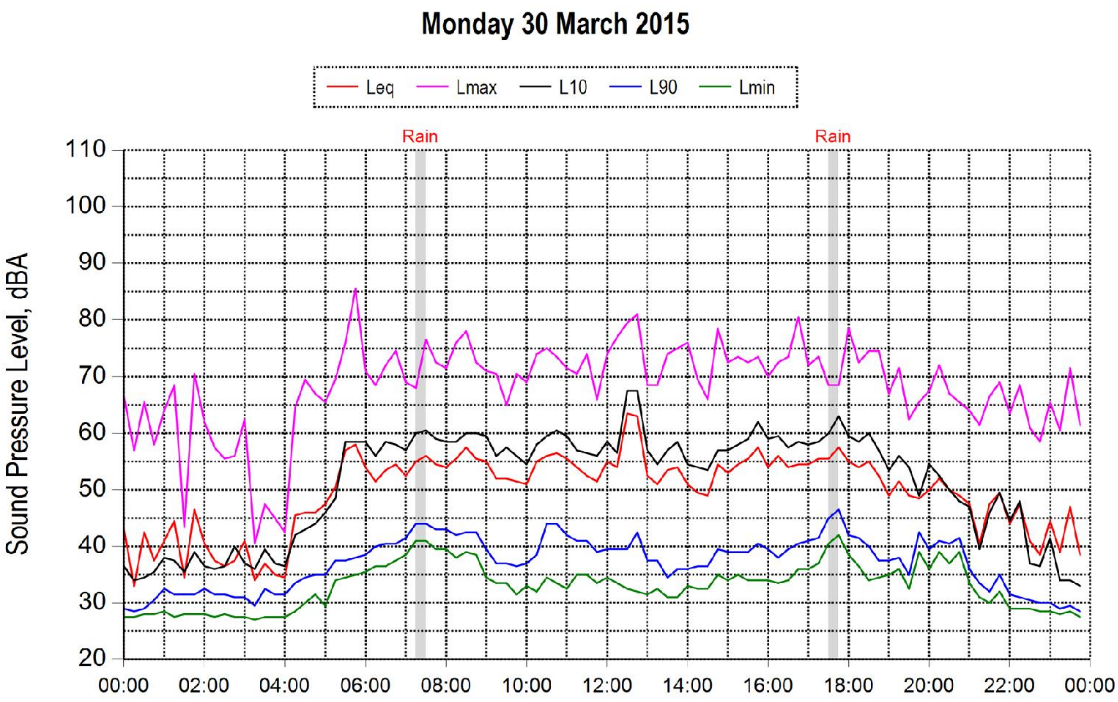

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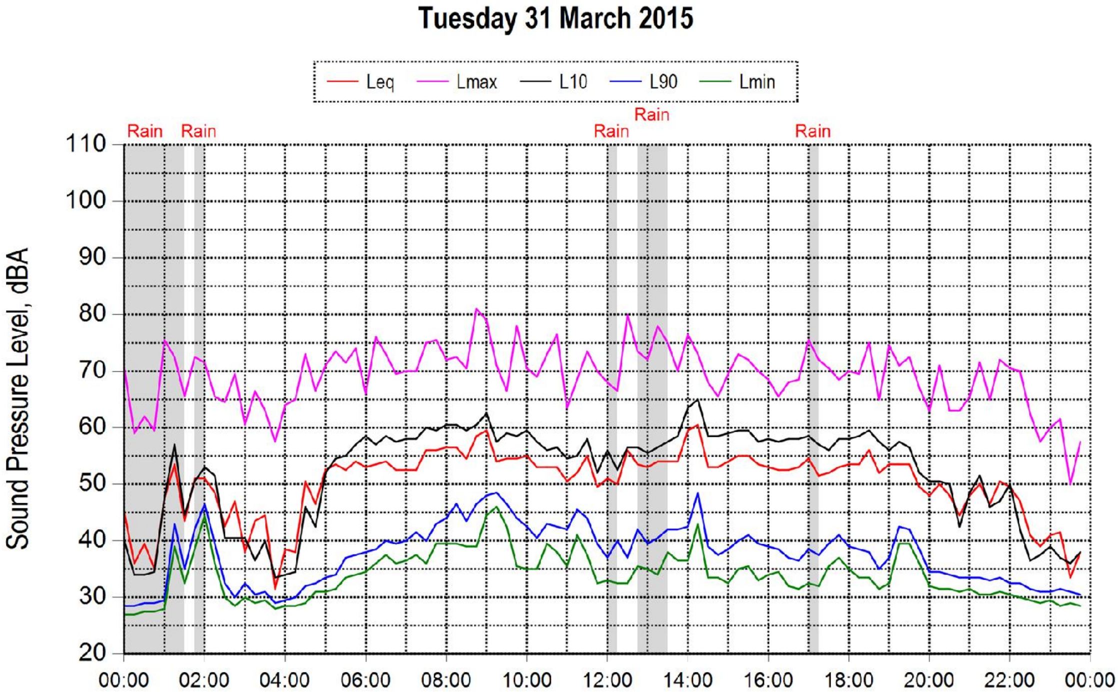

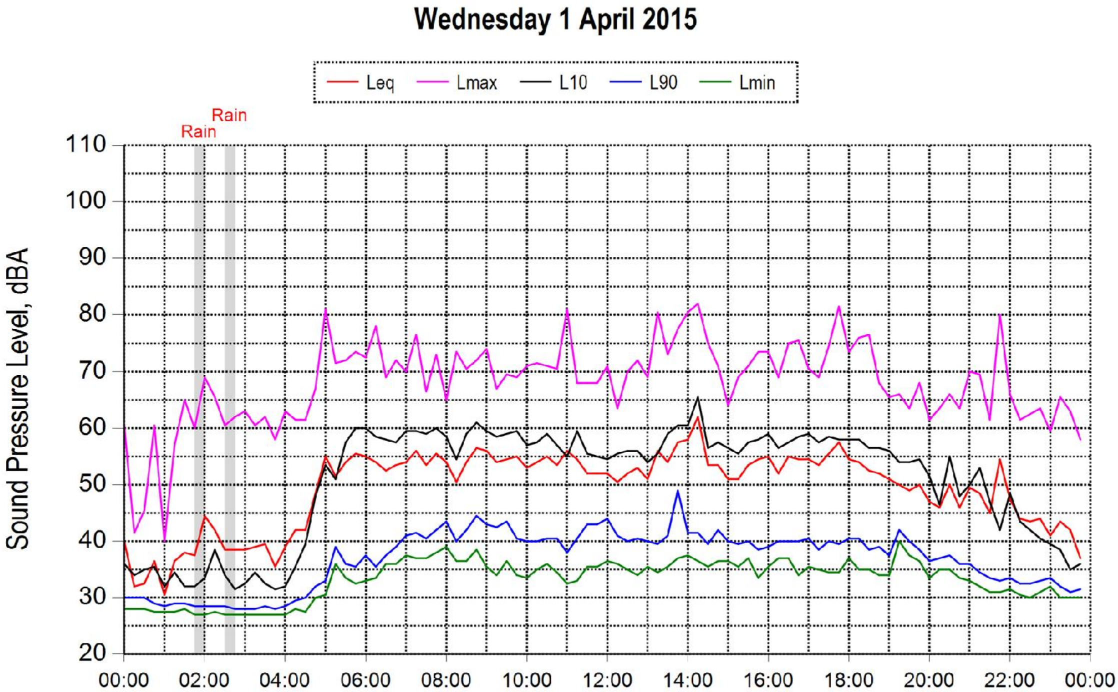

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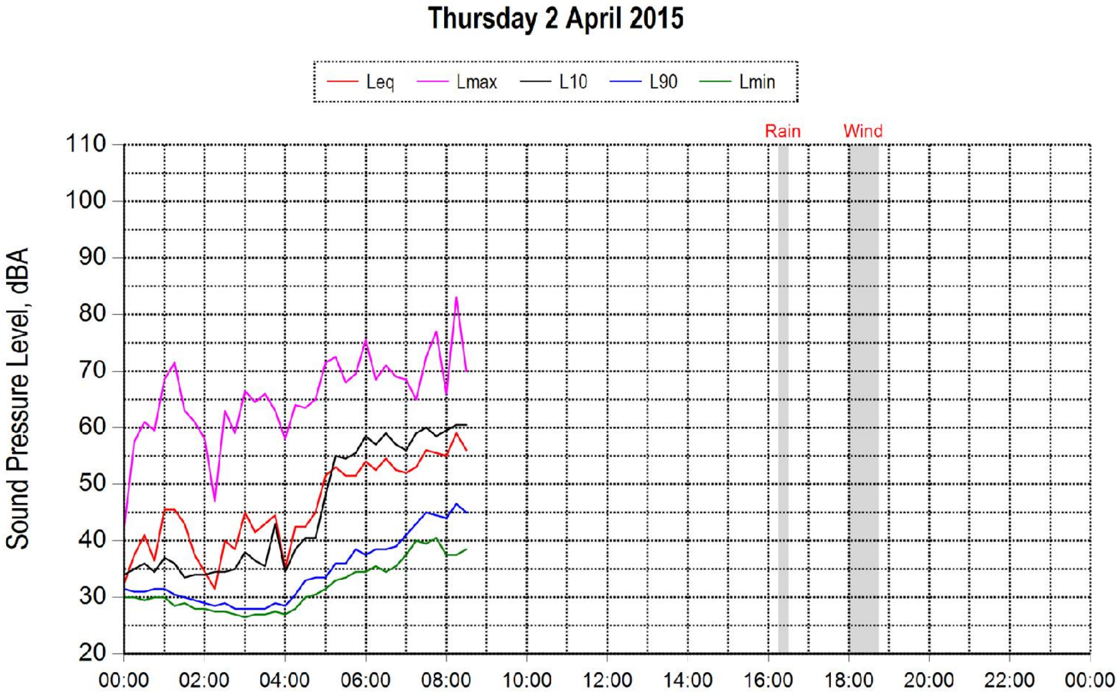
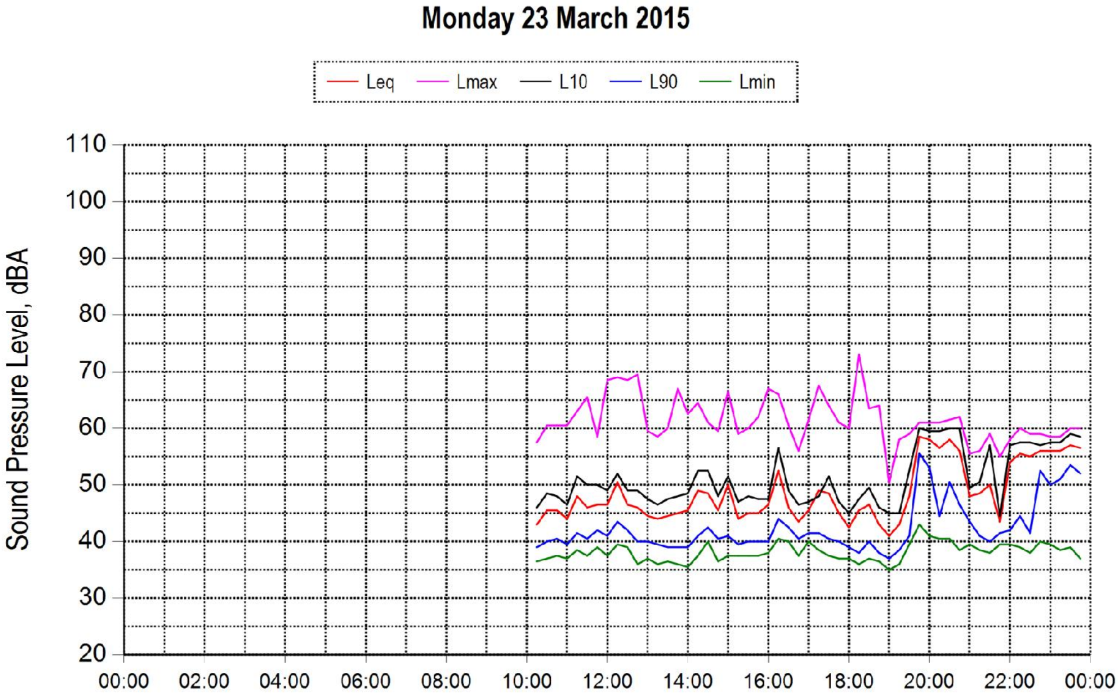
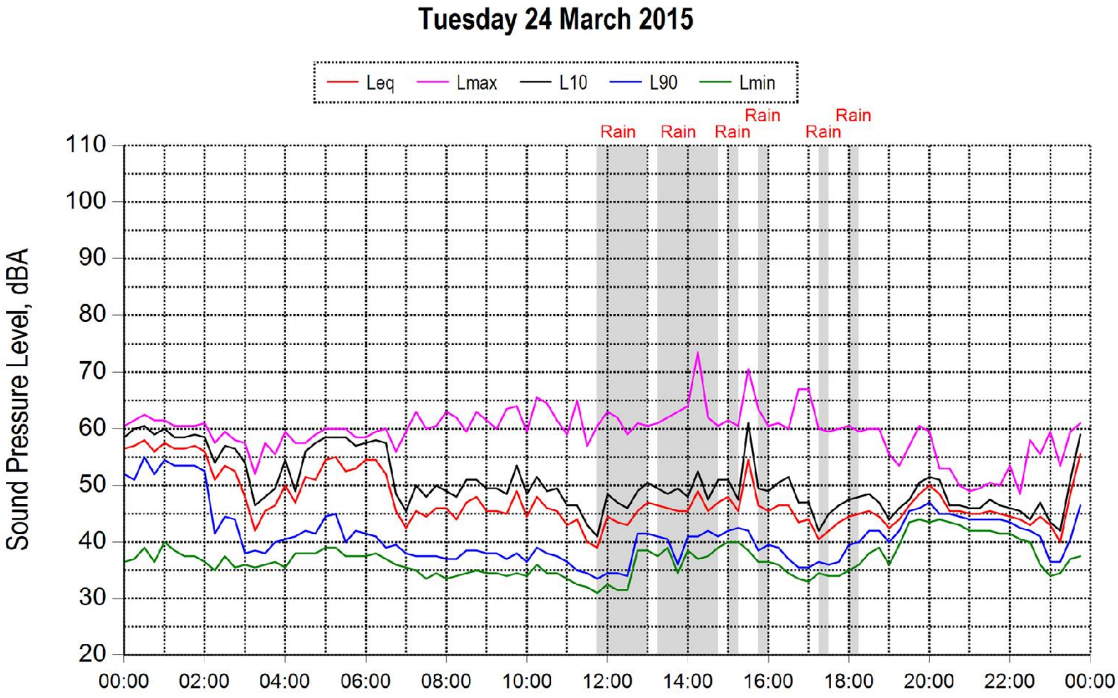


27 Dwyer Road, Bringelly





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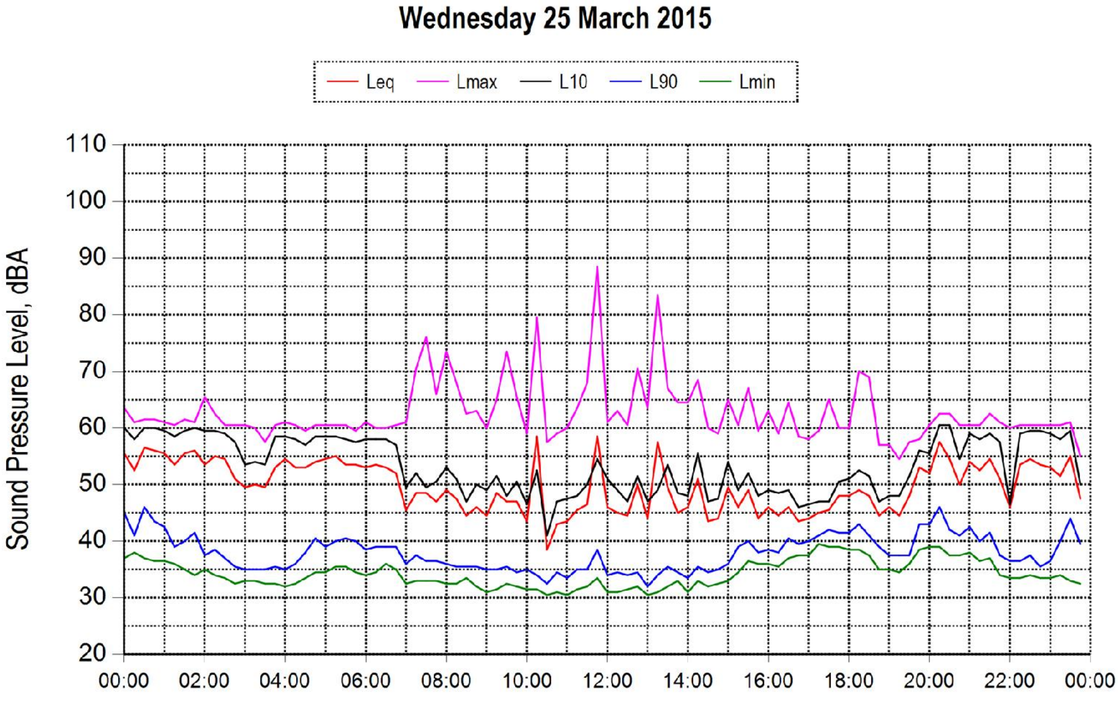

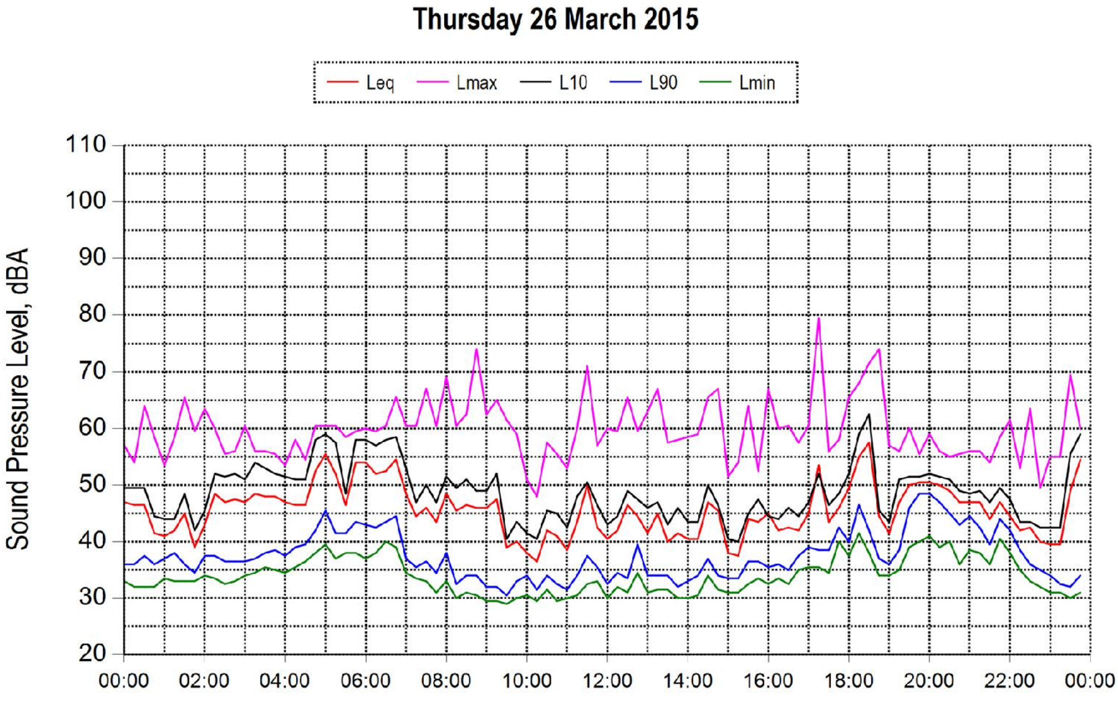

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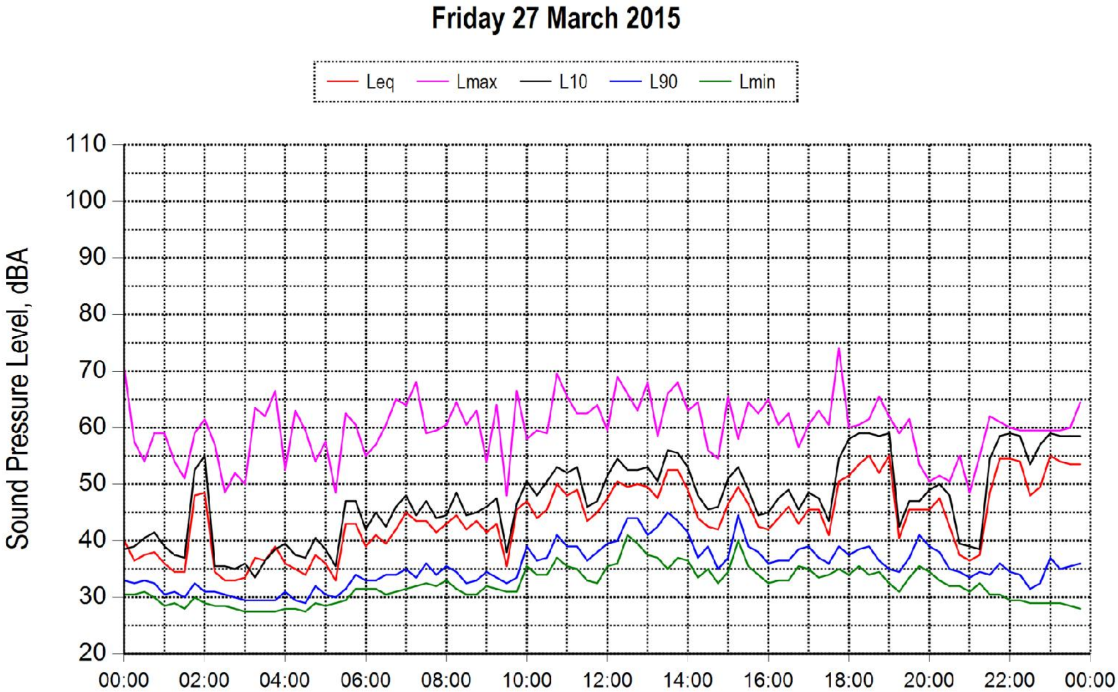

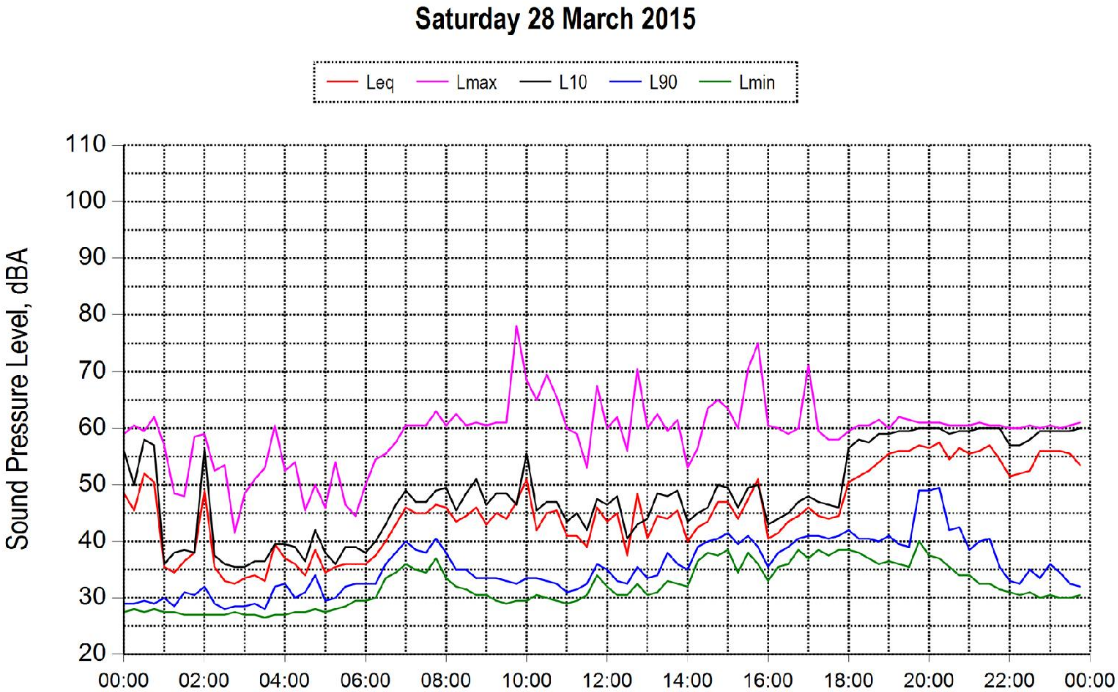

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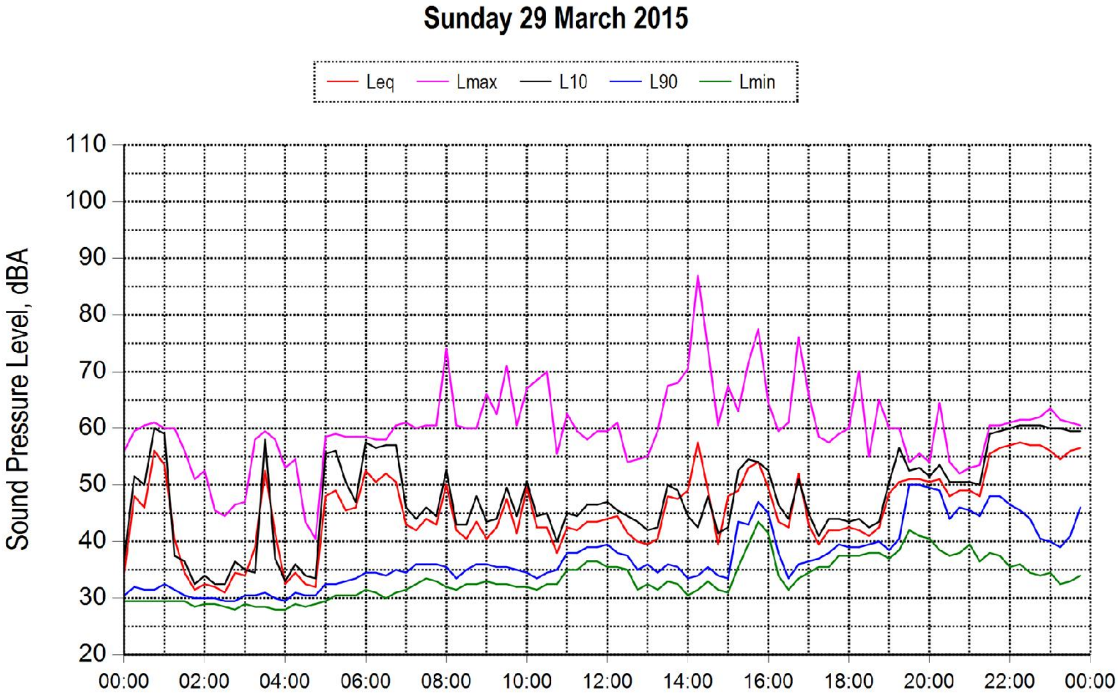

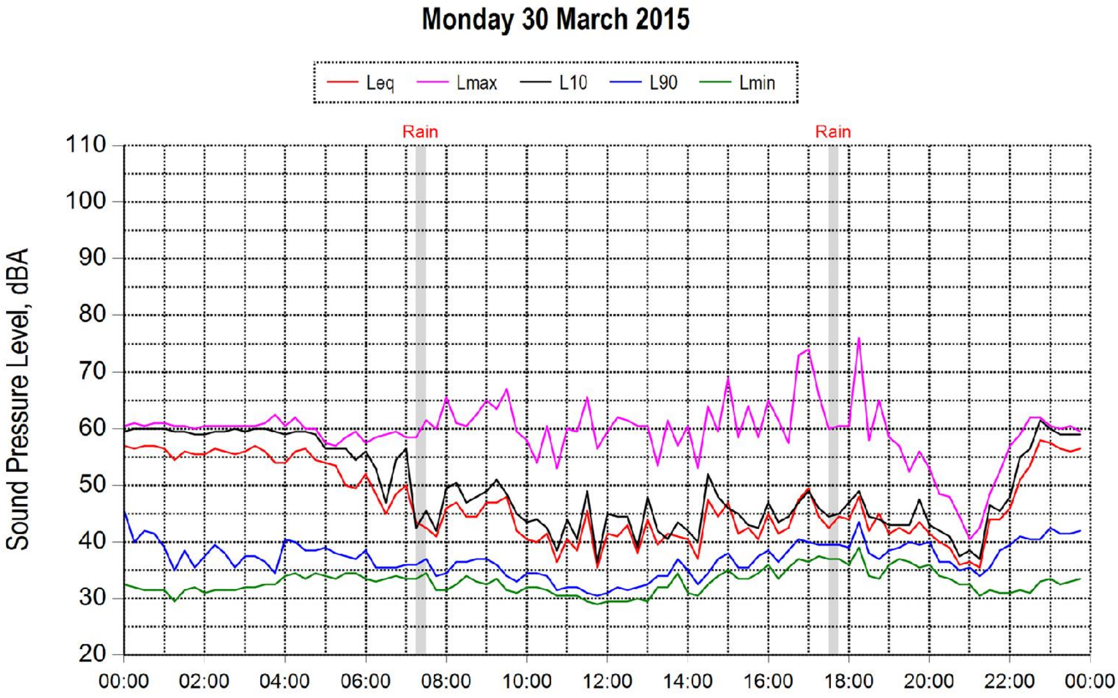

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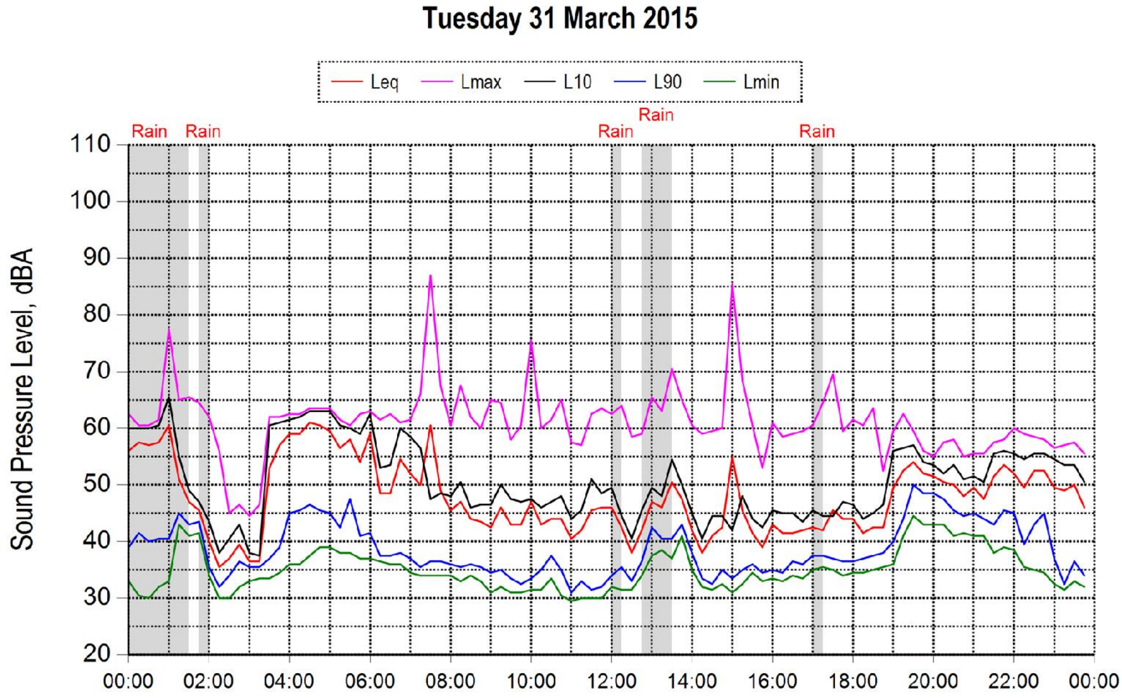

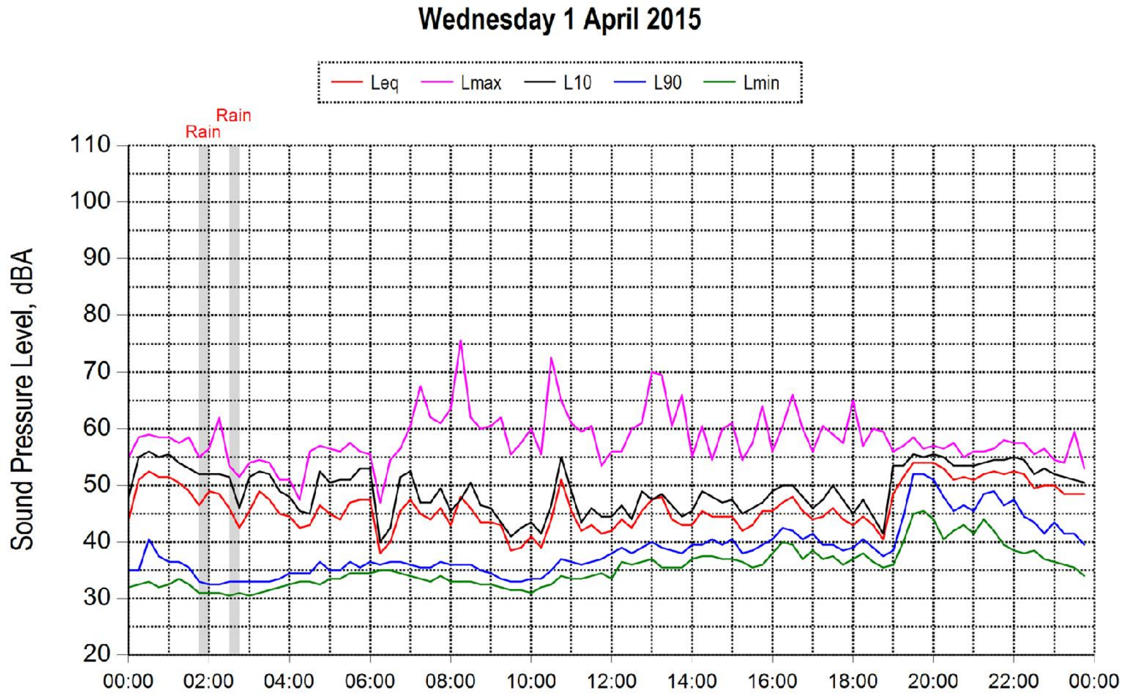

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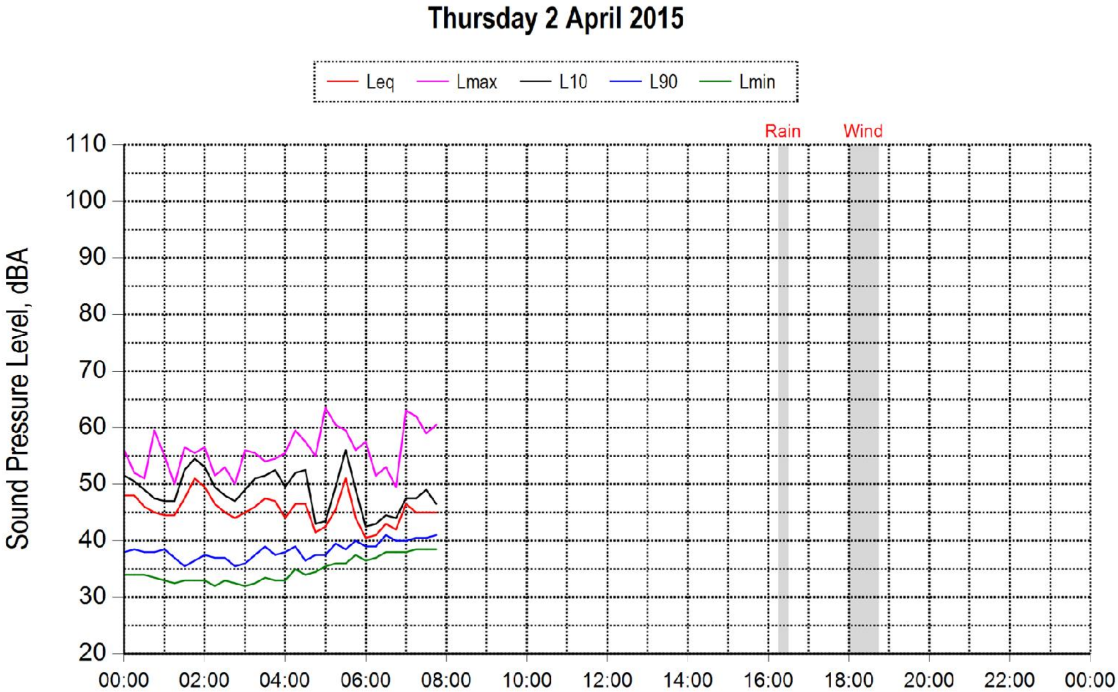
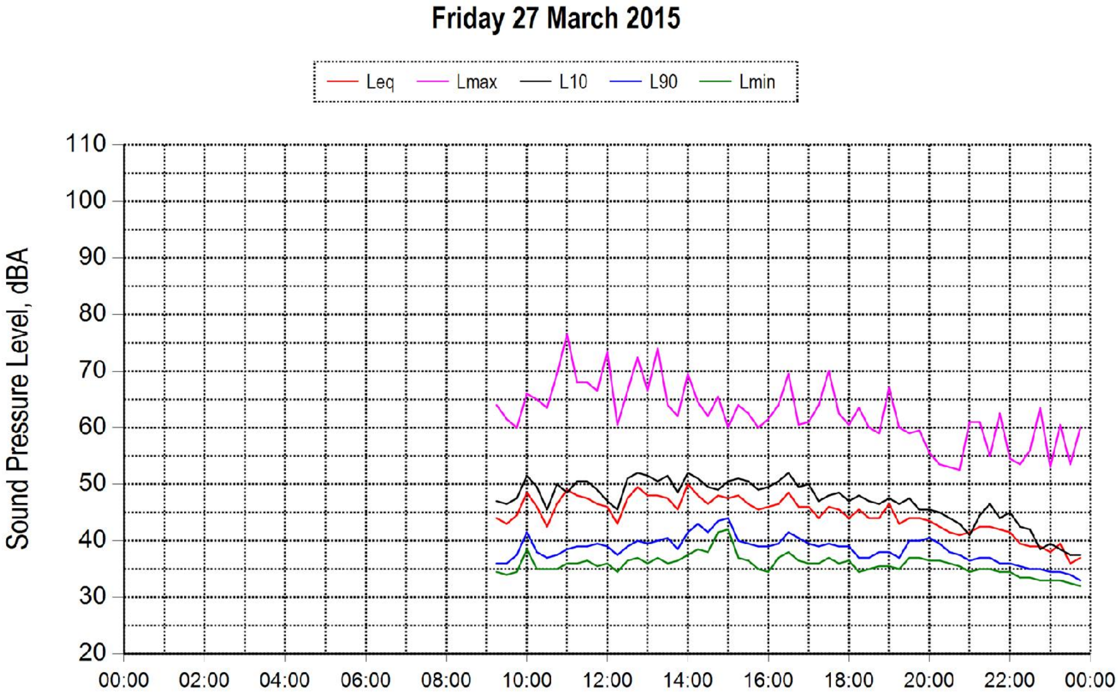
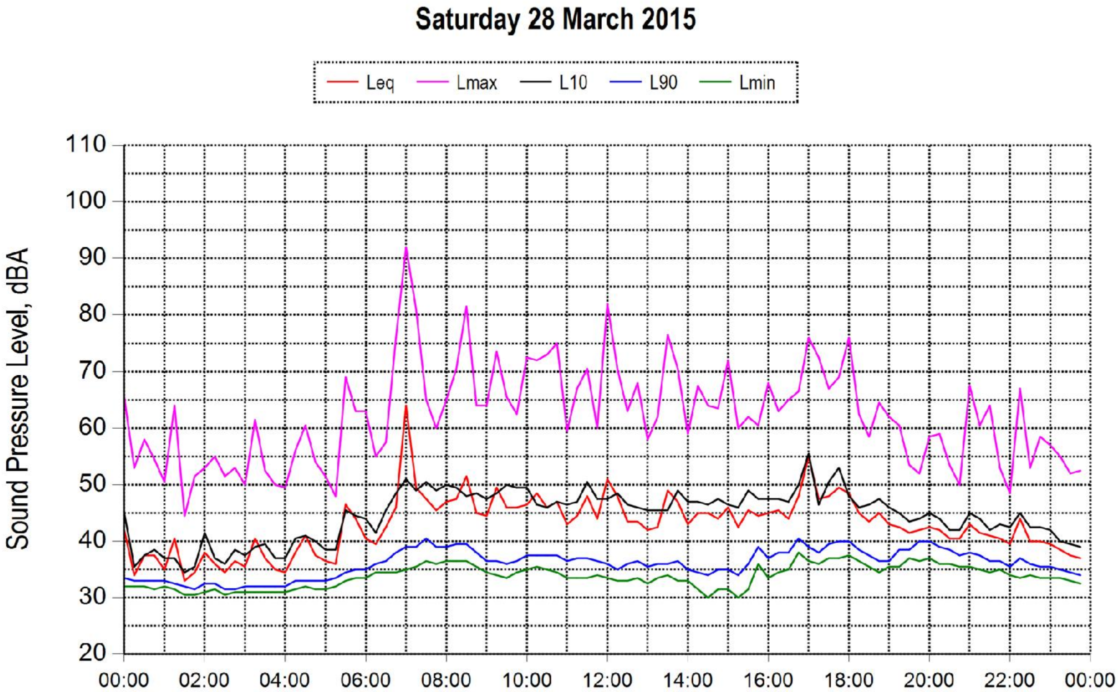


35 Ramsay Road, Rossmore





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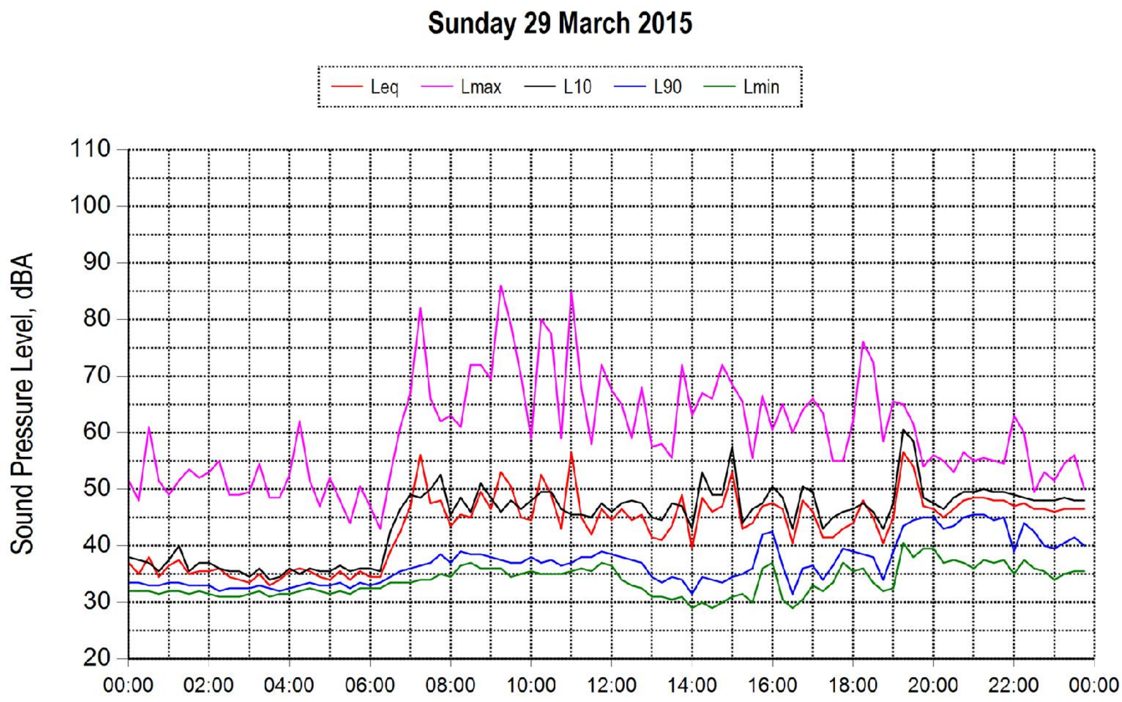

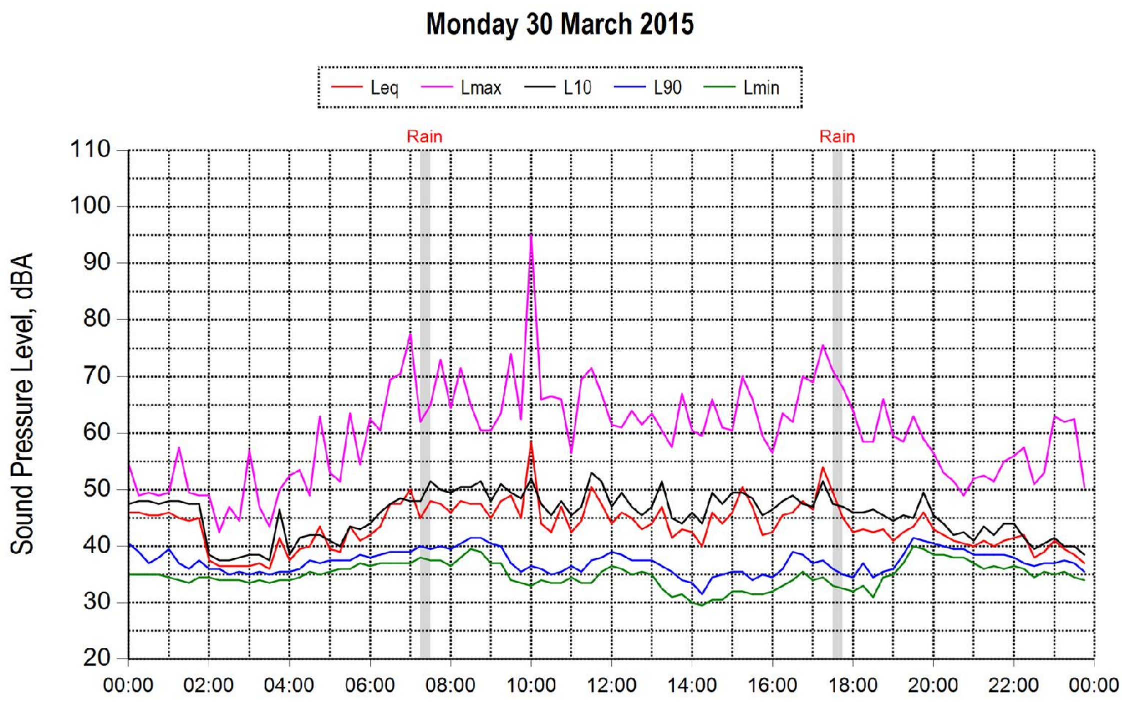

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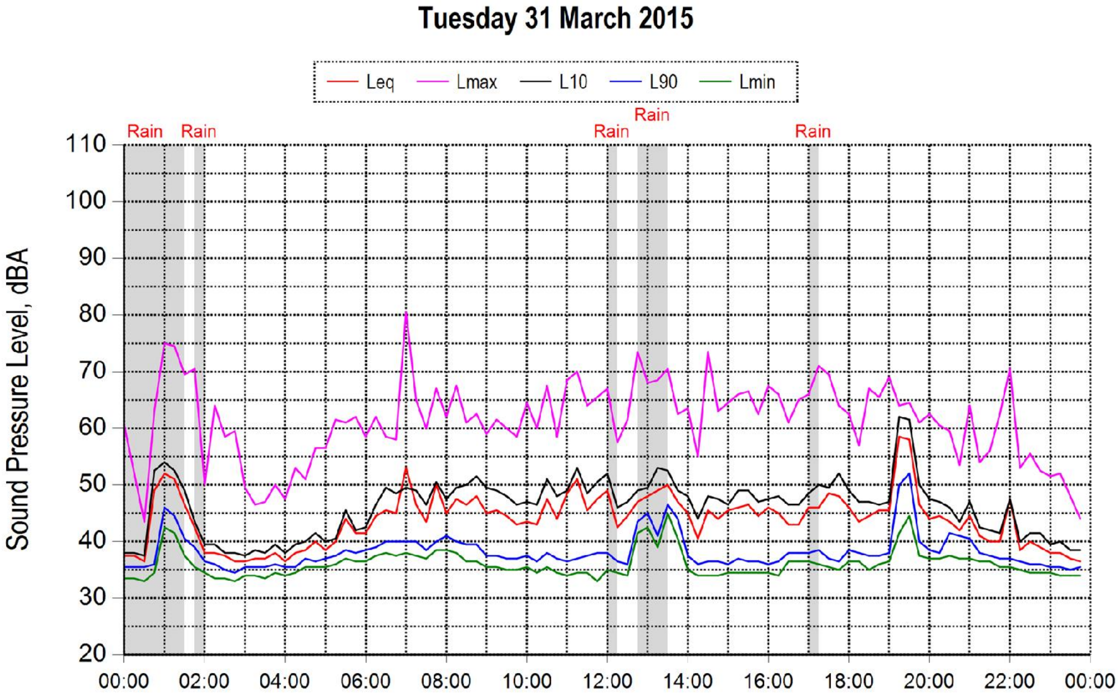

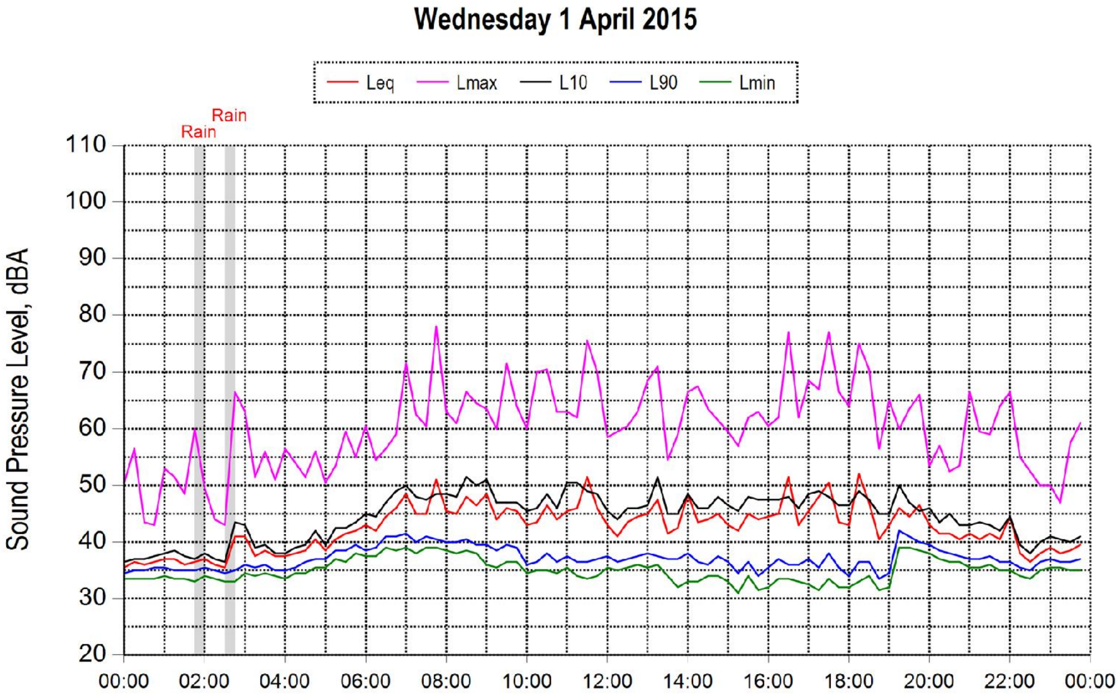

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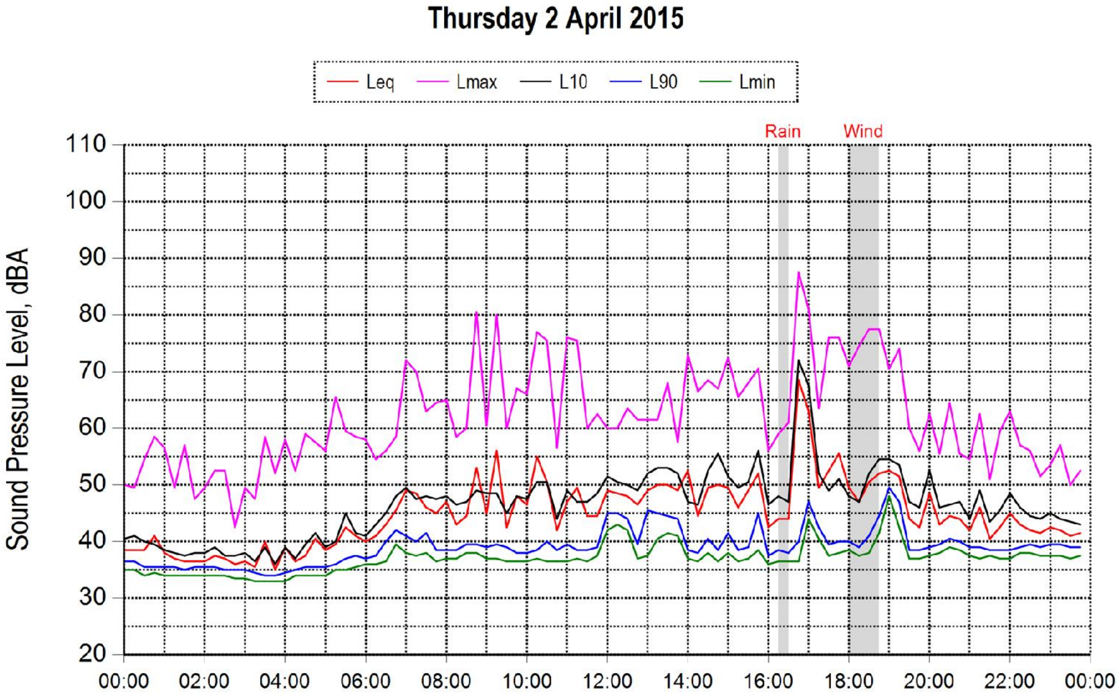
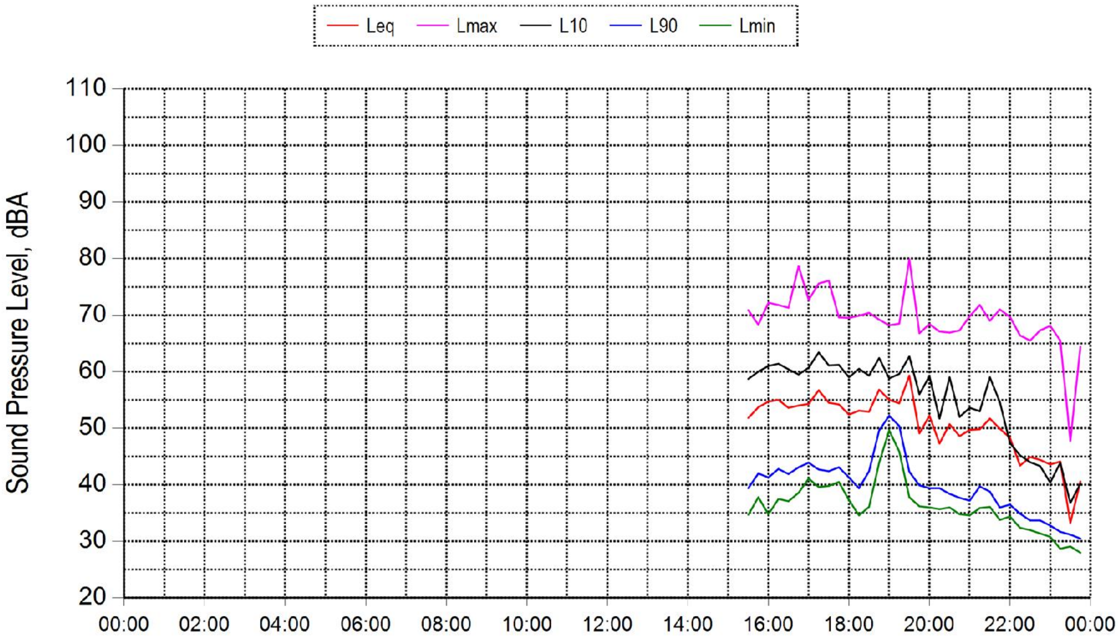
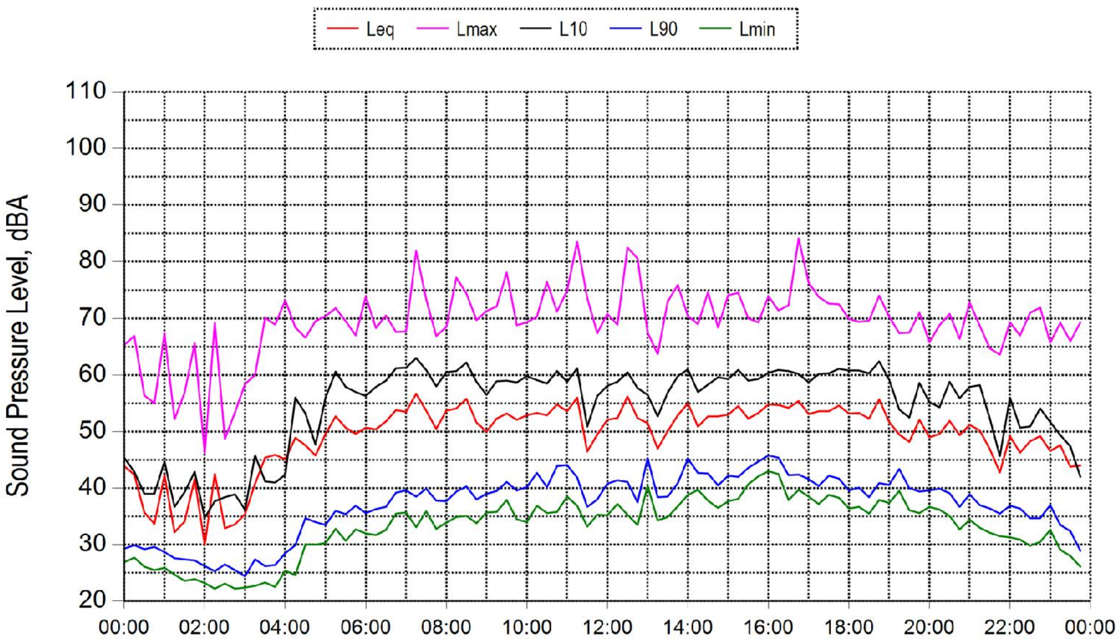


54 Ridgehaven Road, Silverdale

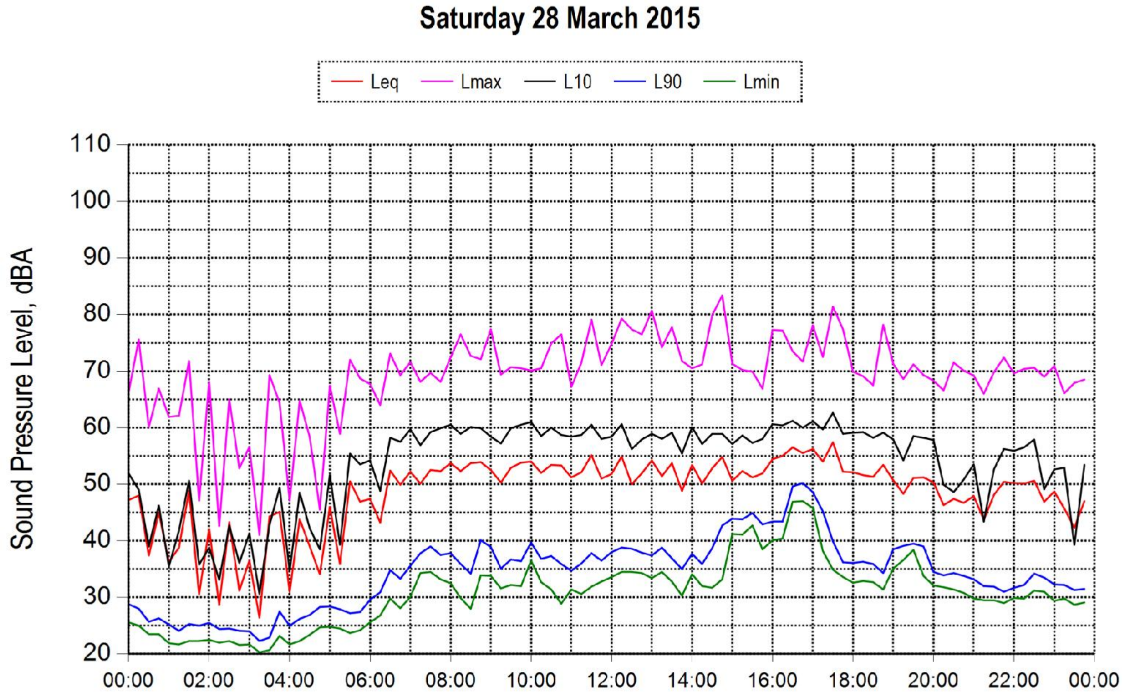
Thursday 26 March 2015

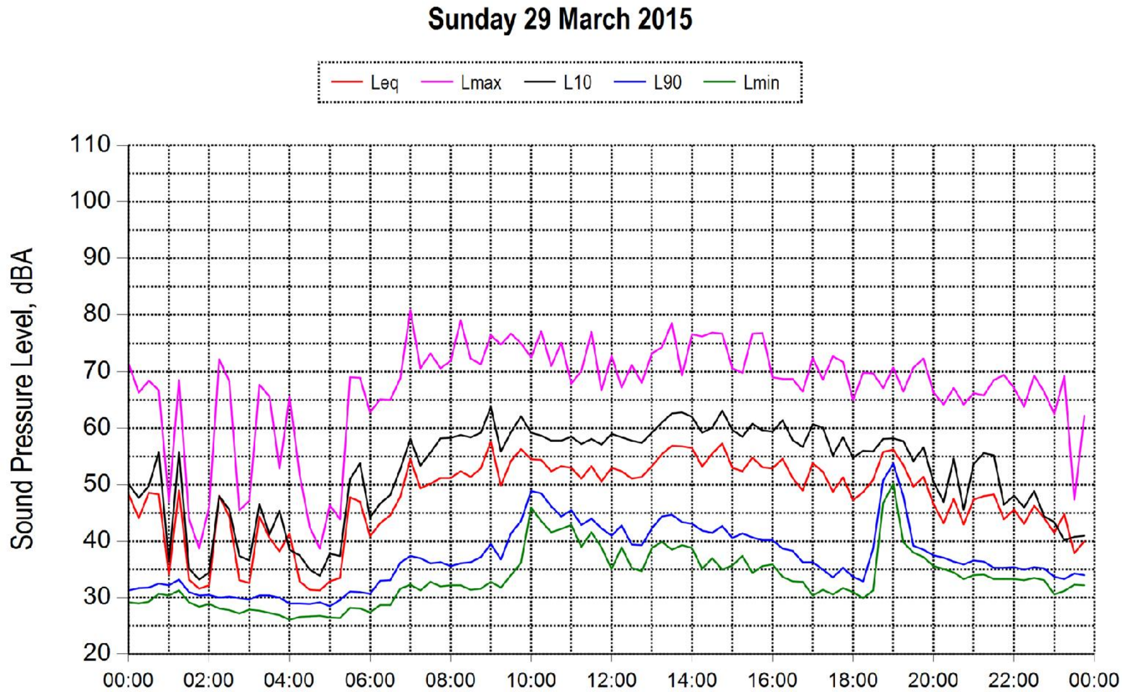


Friday 27 March 2015

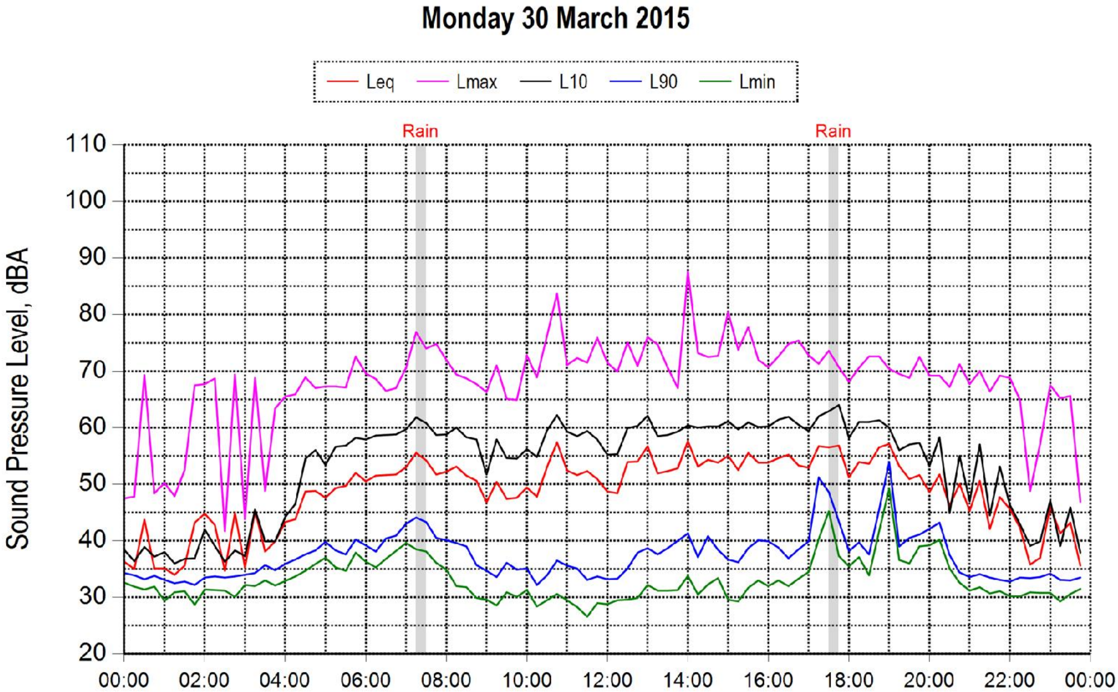


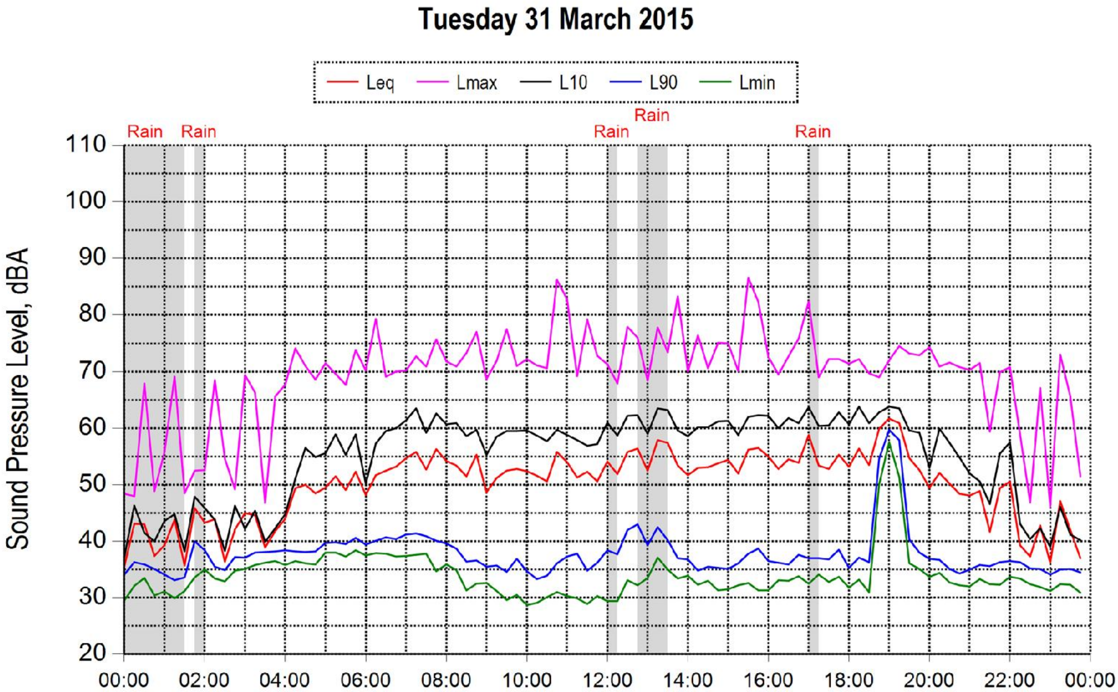
54 Ridgehaven Road, Silverdale



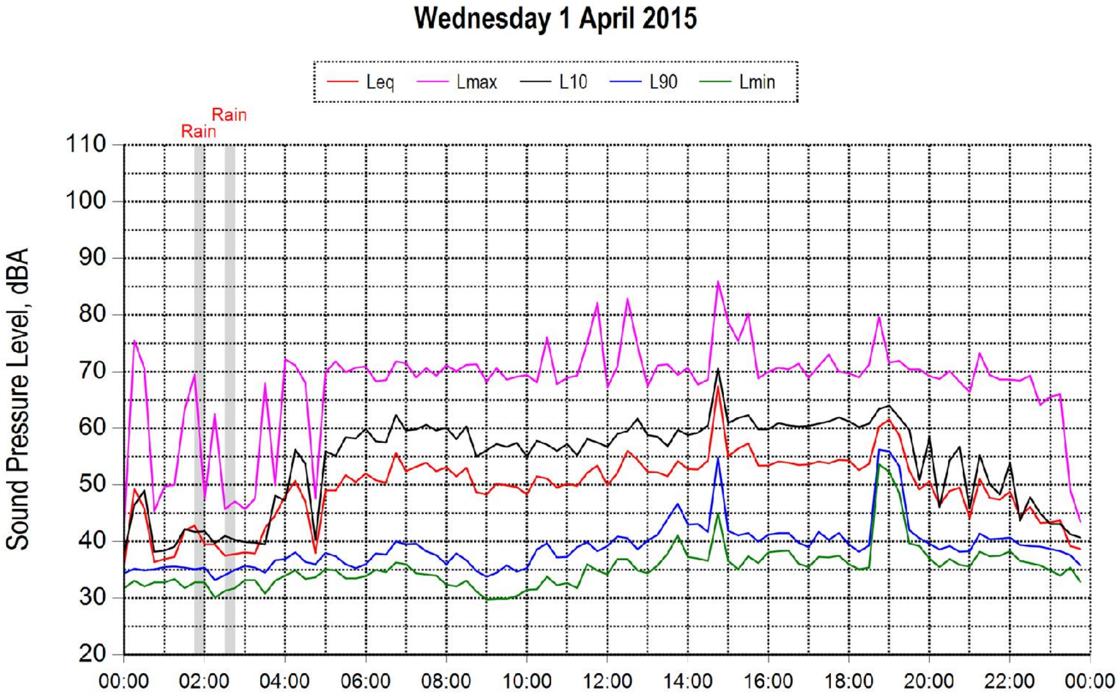


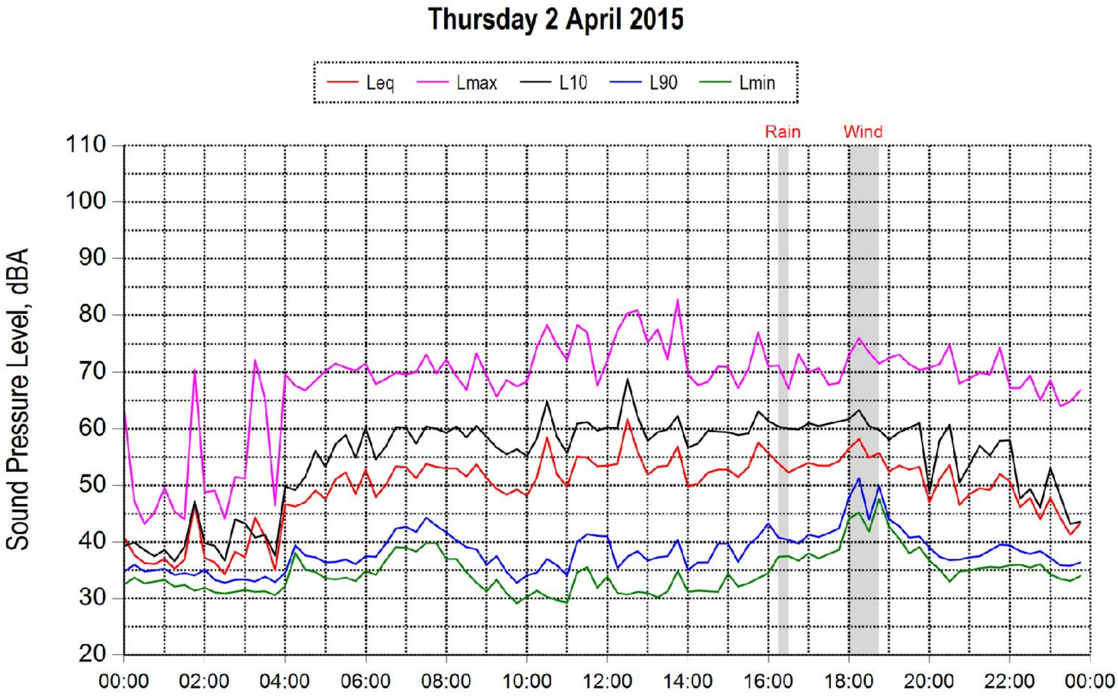
54 Ridgehaven Road, Silverdale



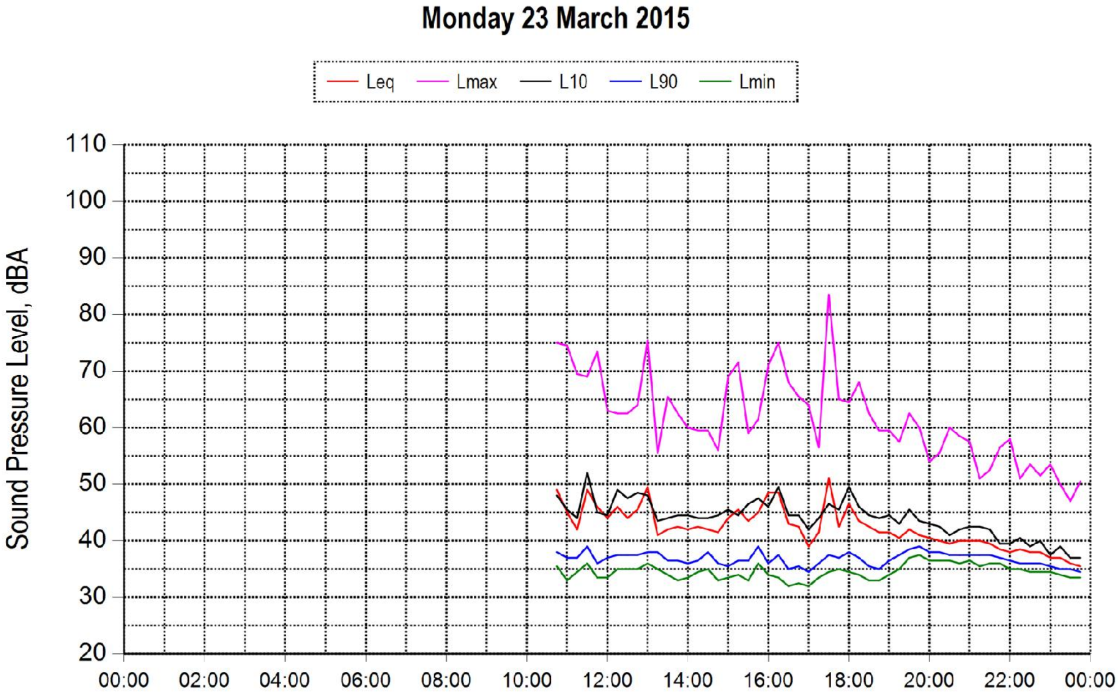


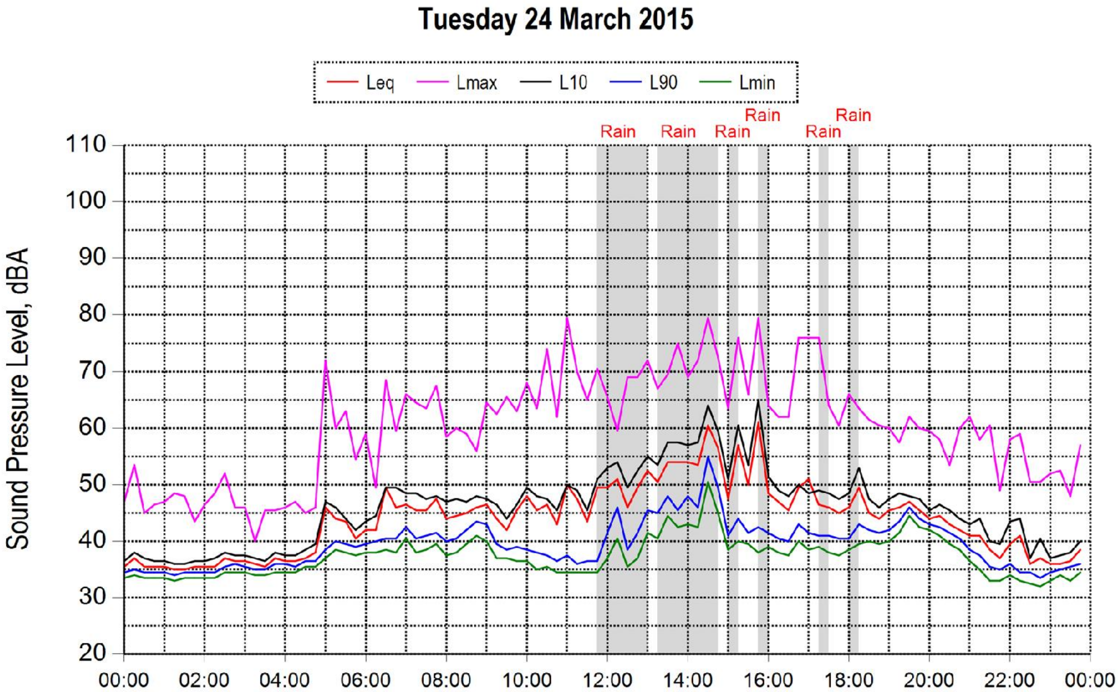
54 Ridgehaven Road, Silverdale



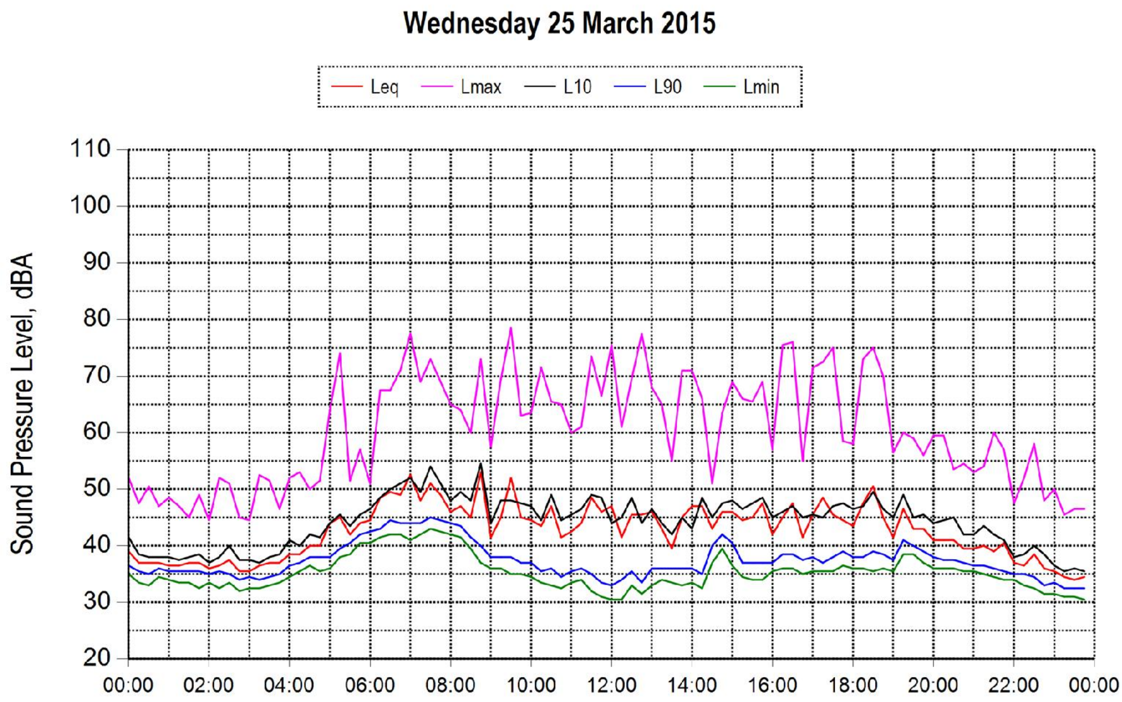


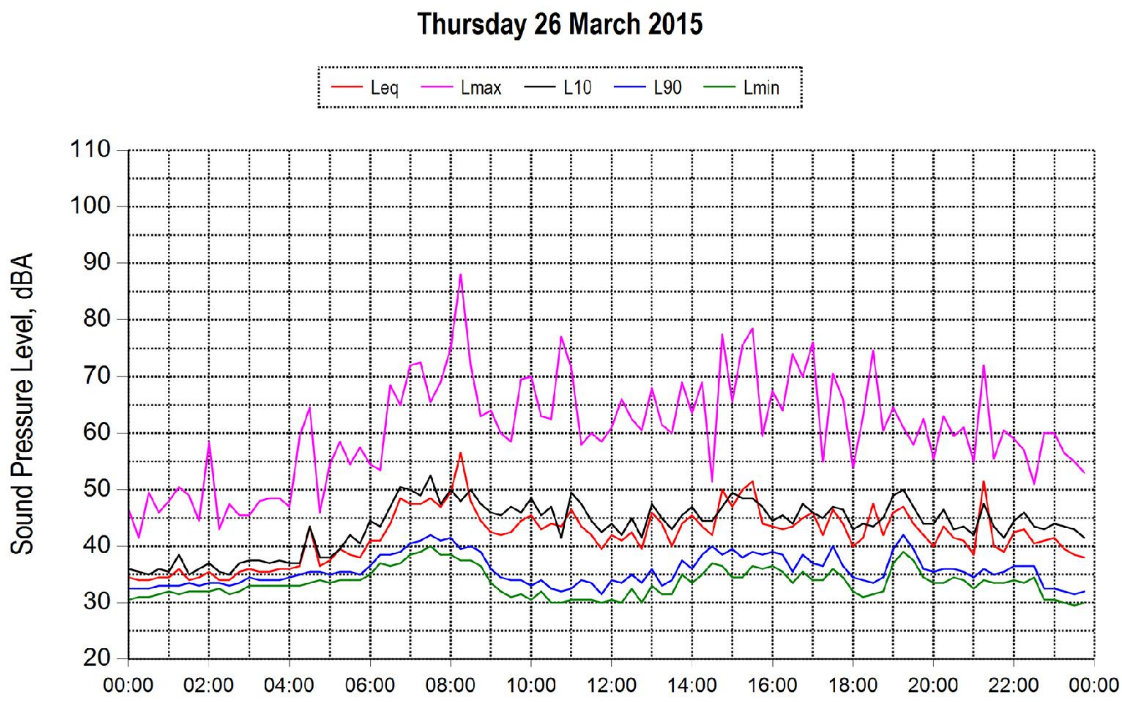
114 Mount Vernon Road, Mount Vernon





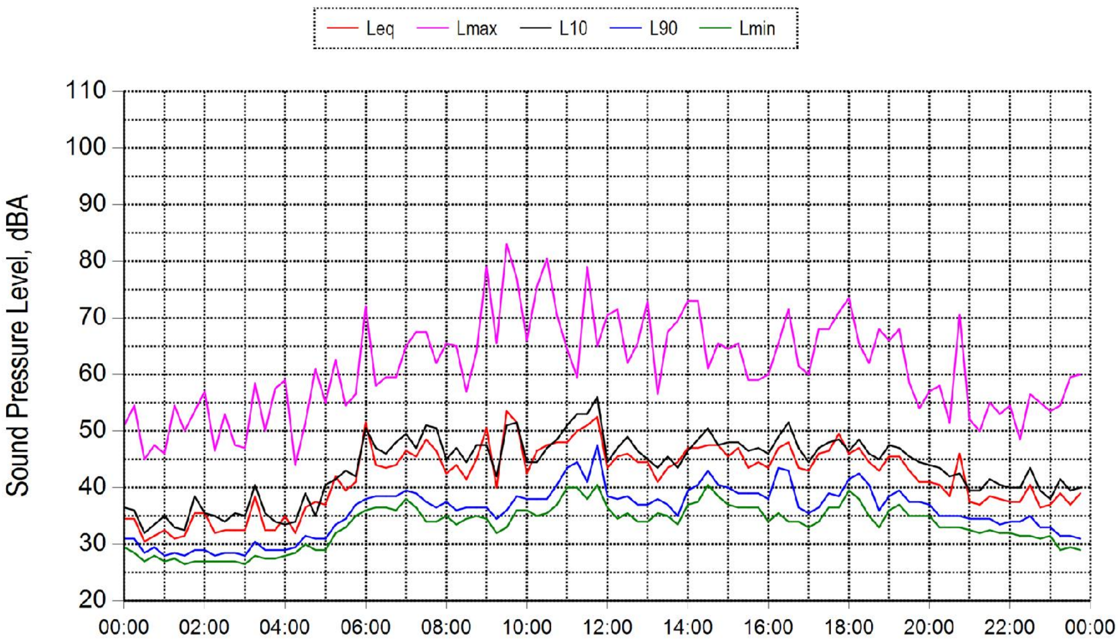
114 Mount Vernon Road, Mount Vernon



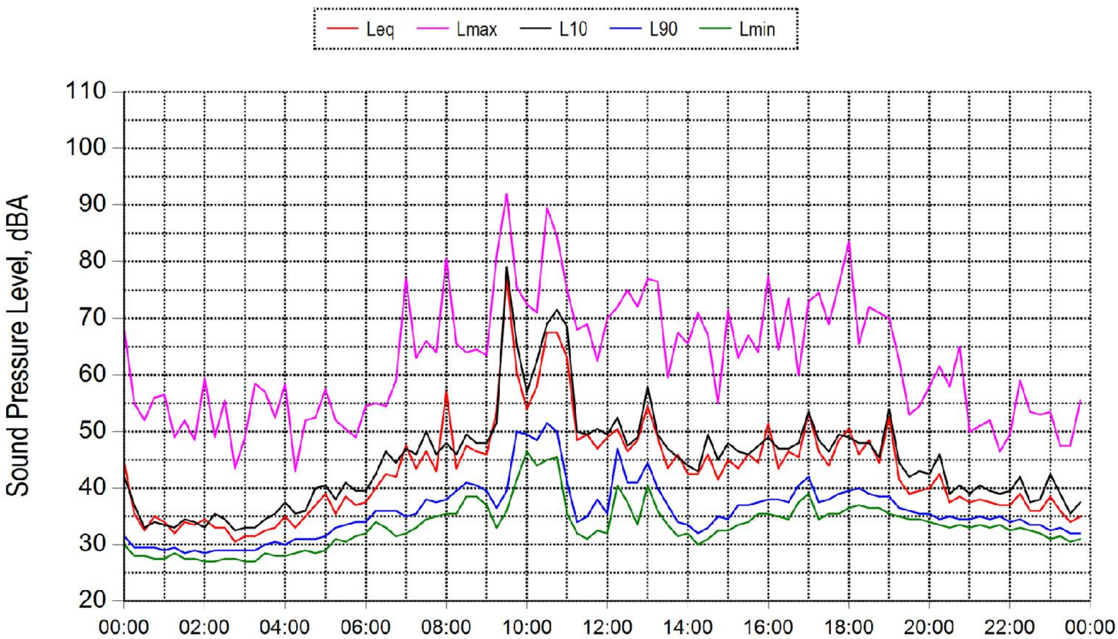


114 Mount Vernon Road, Mount Vernon

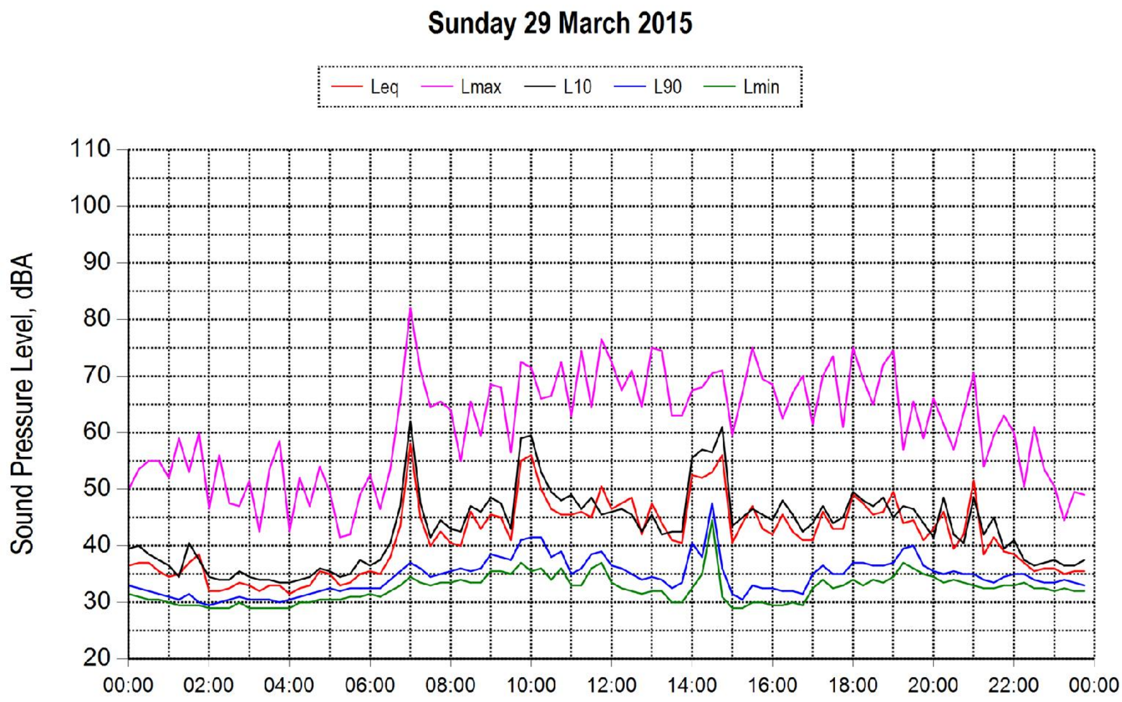
Friday 27 March 2015

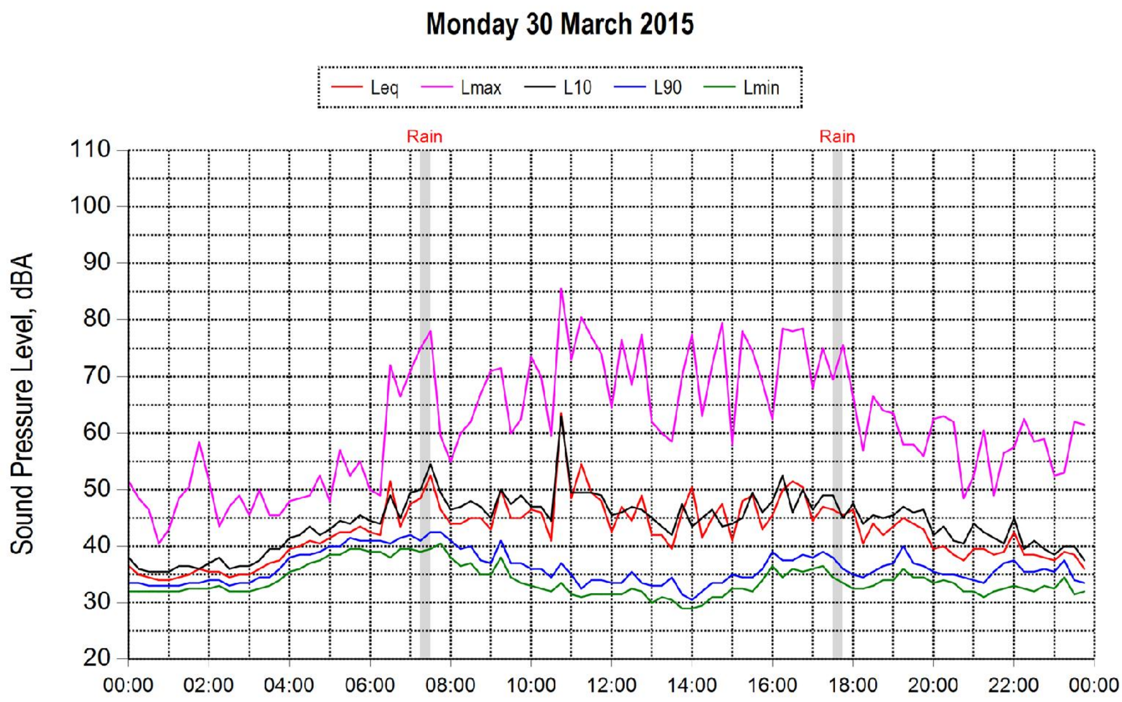


Saturday 28 March 2015

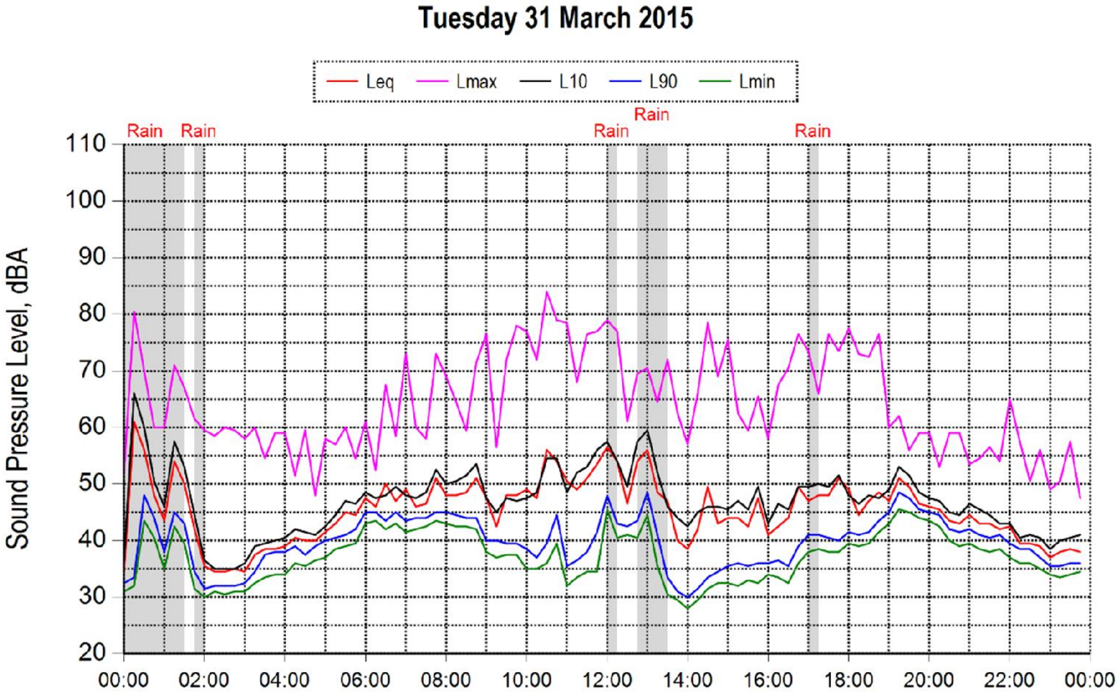


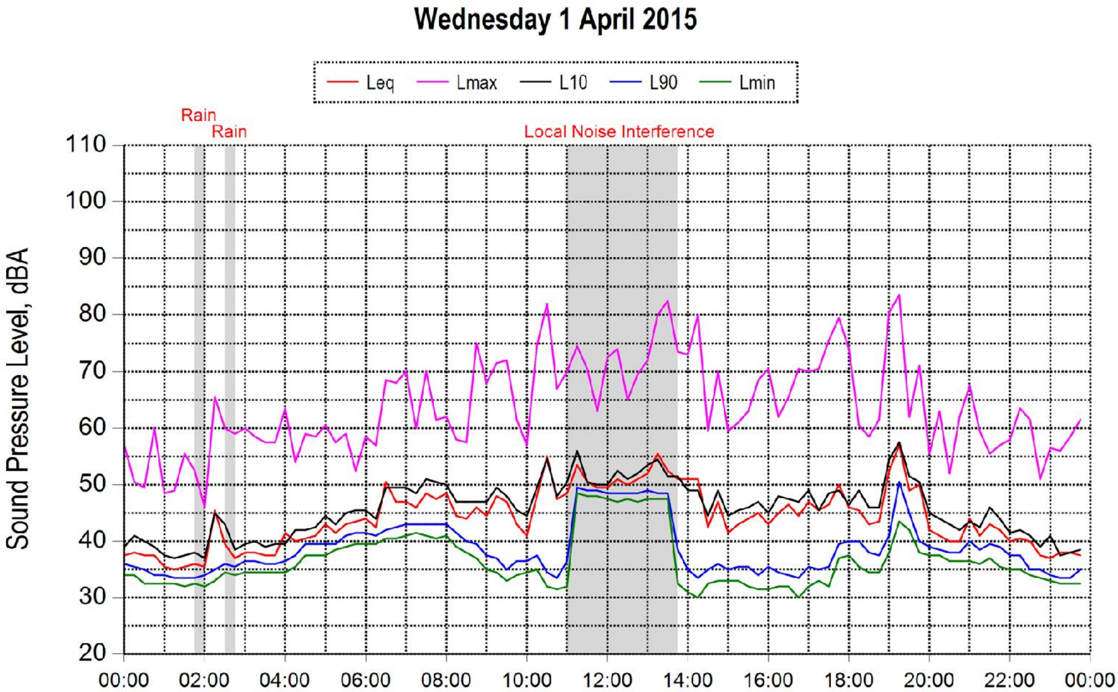
114 Mount Vernon Road, Mount Vernon





114 Mount Vernon Road, Mount Vernon





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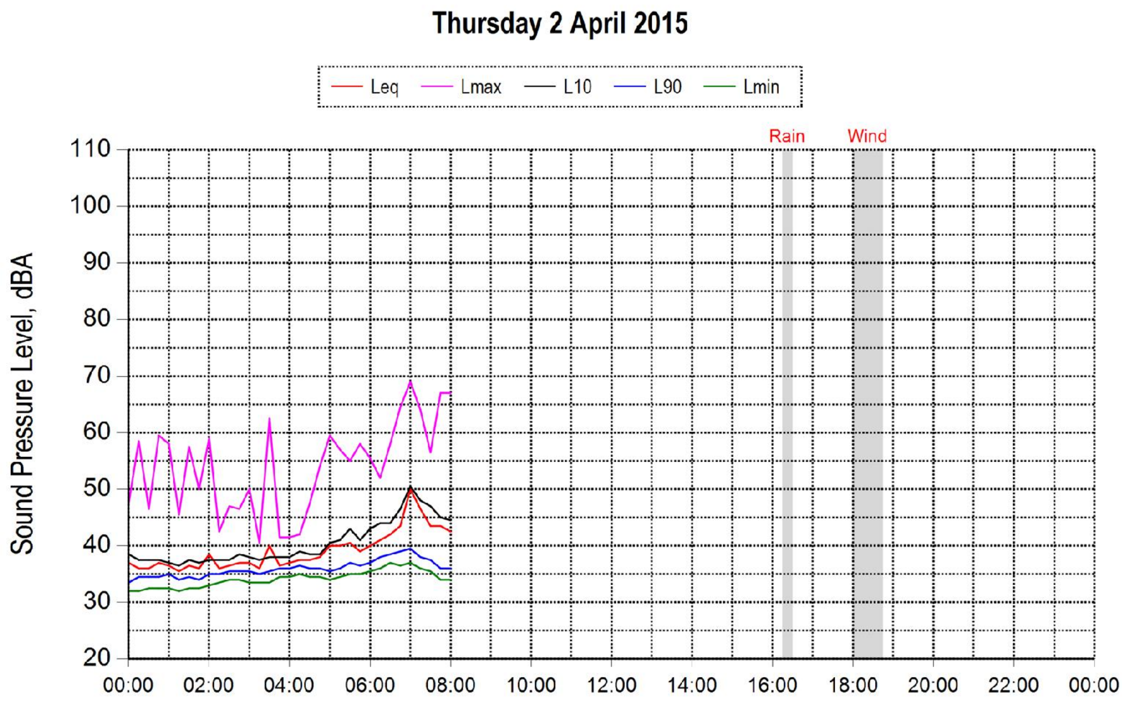

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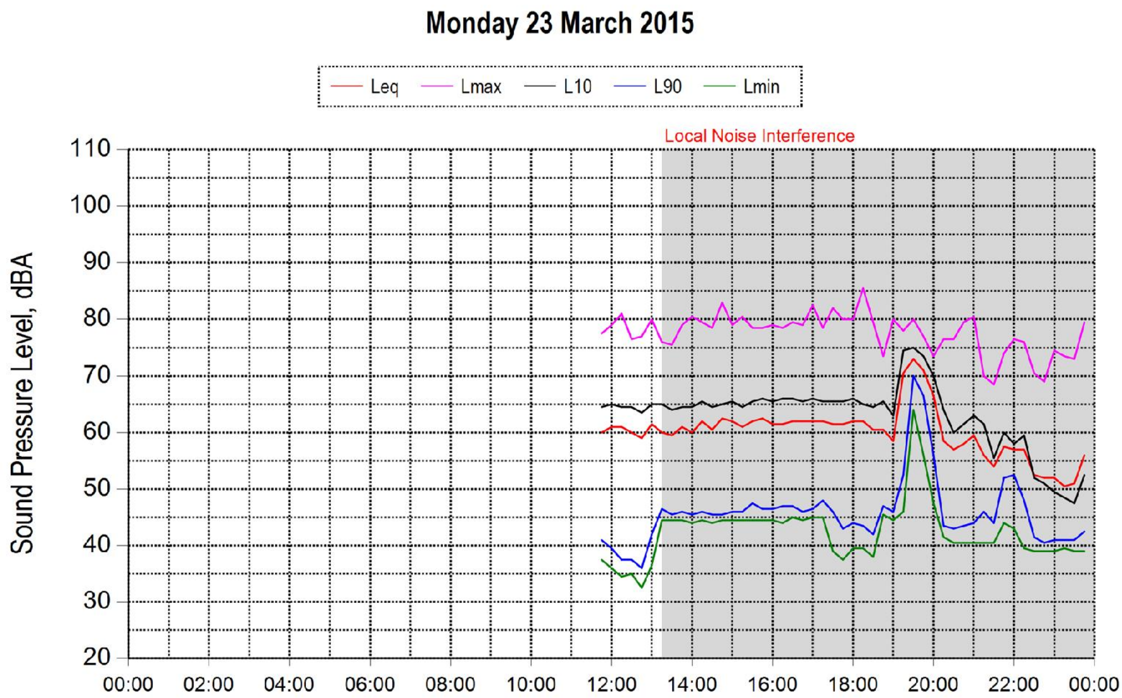

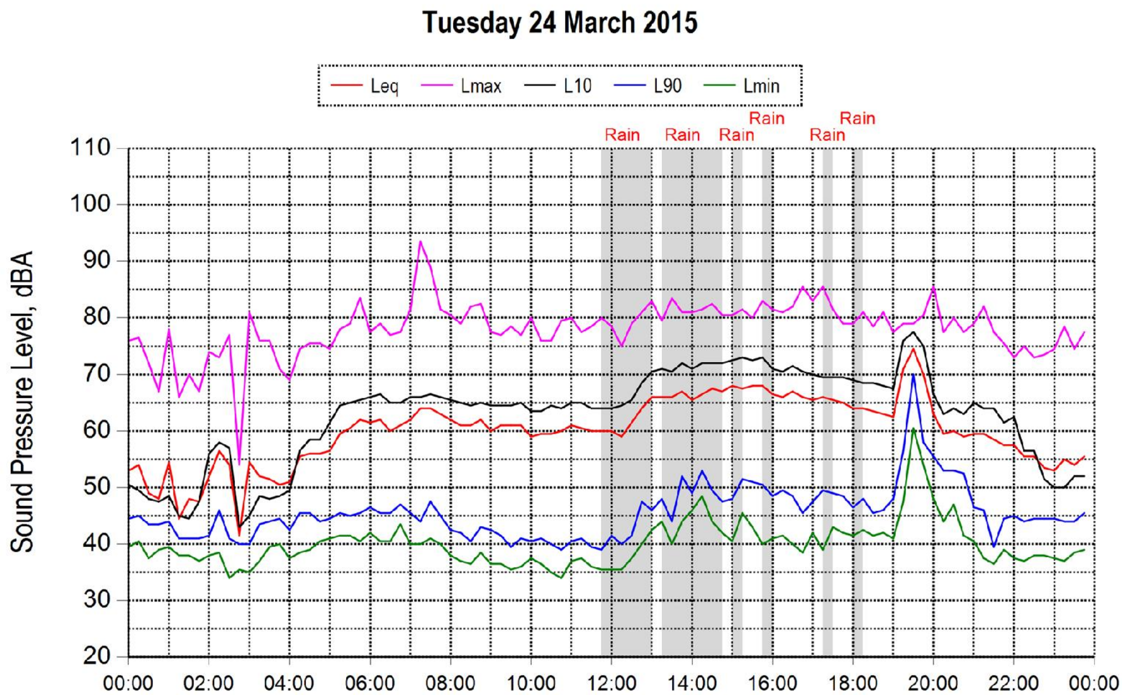

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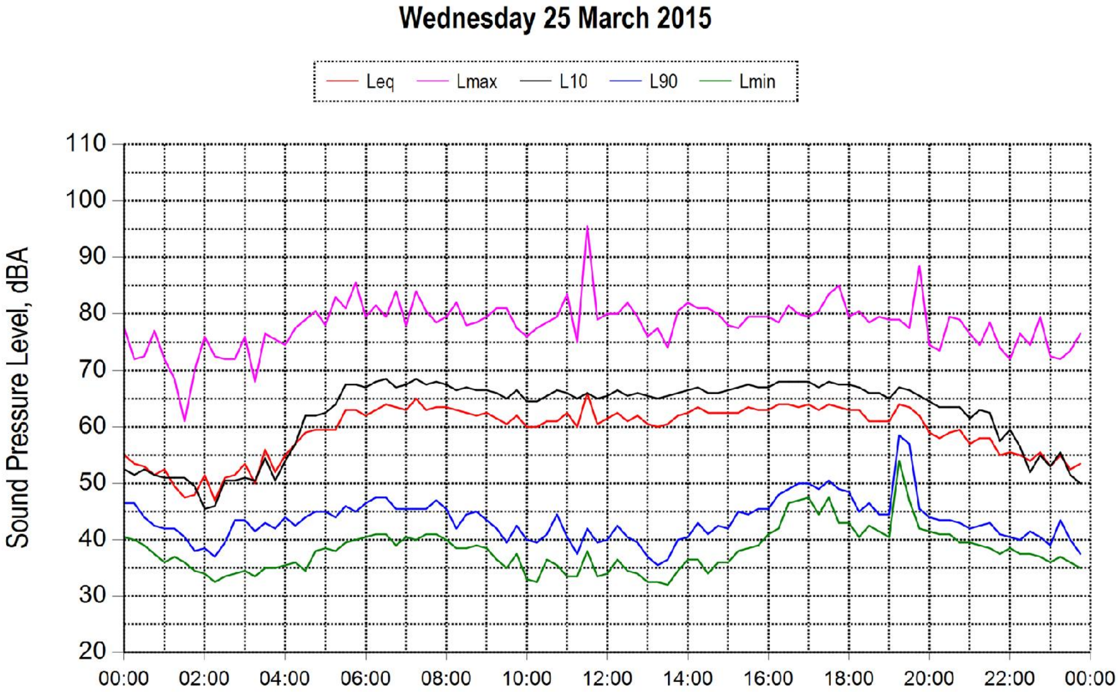

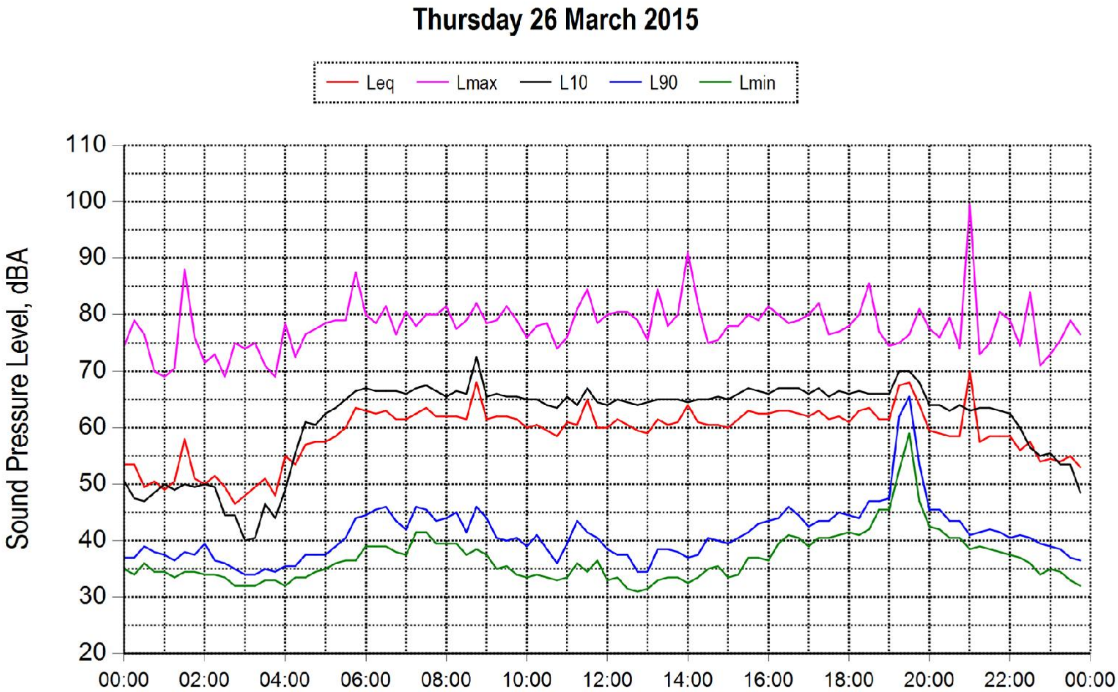

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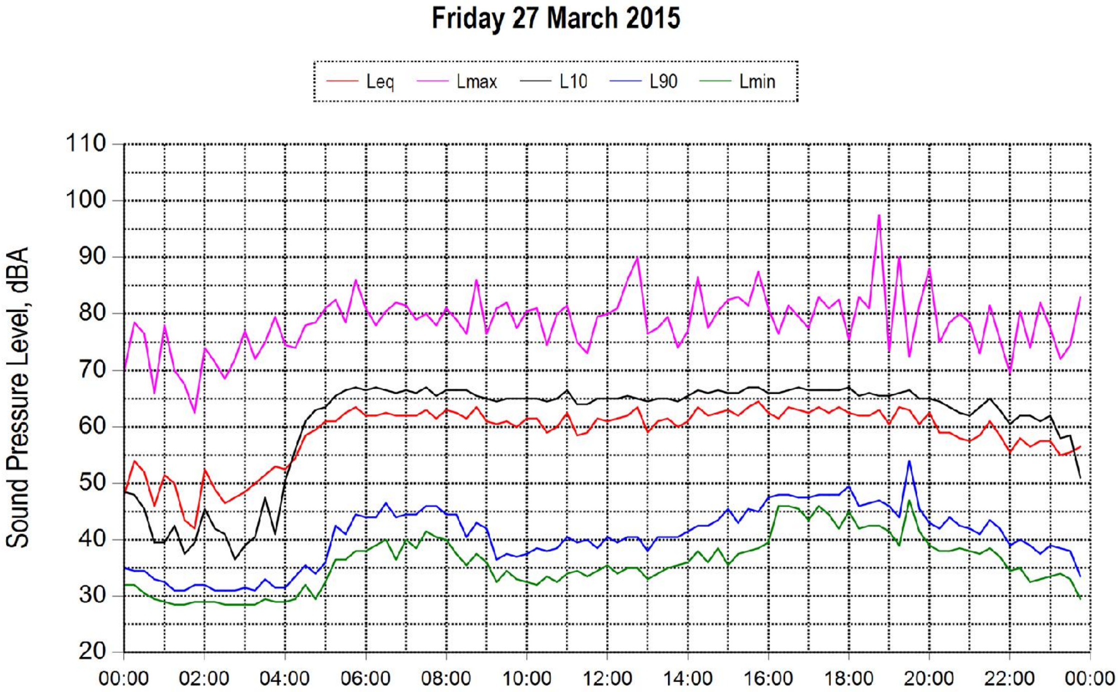

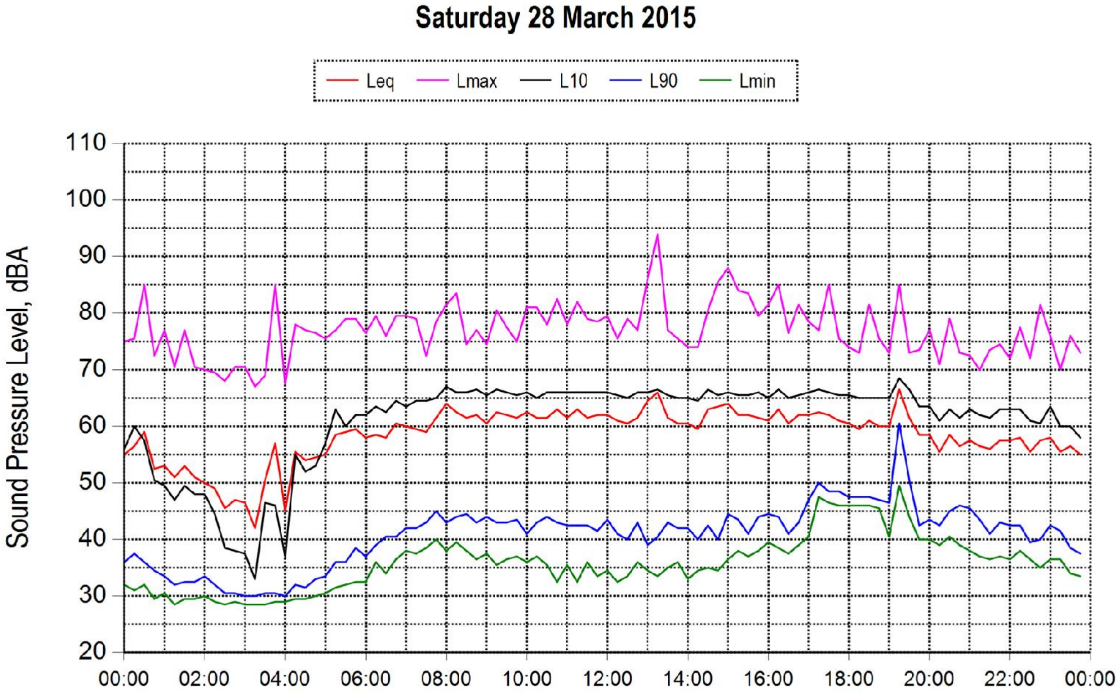

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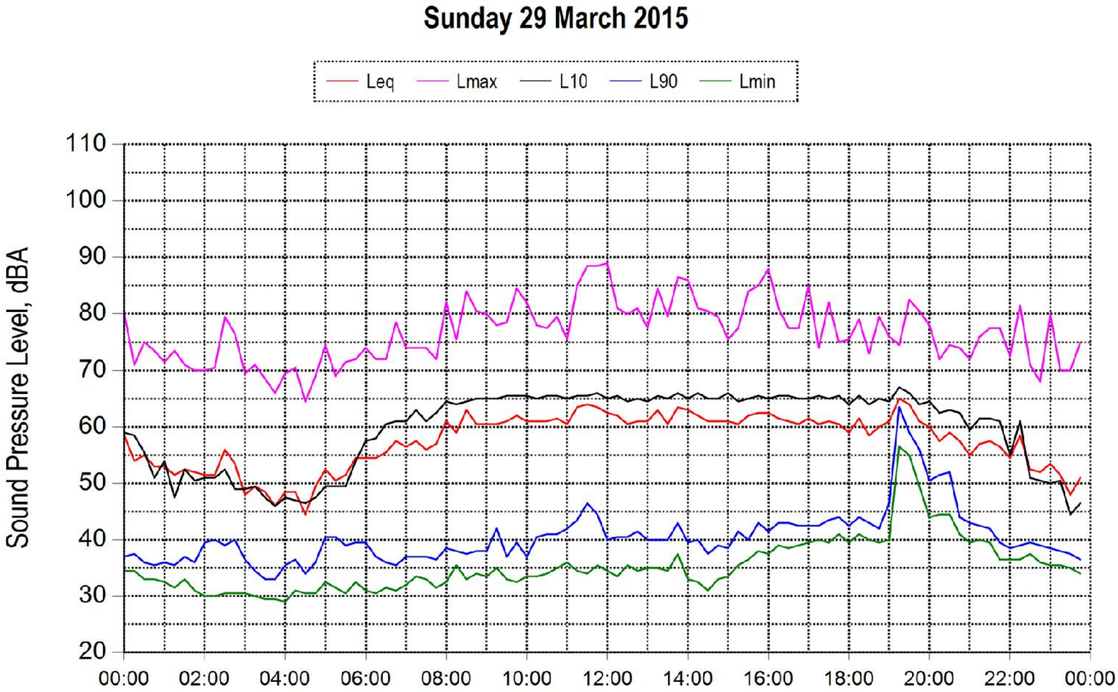

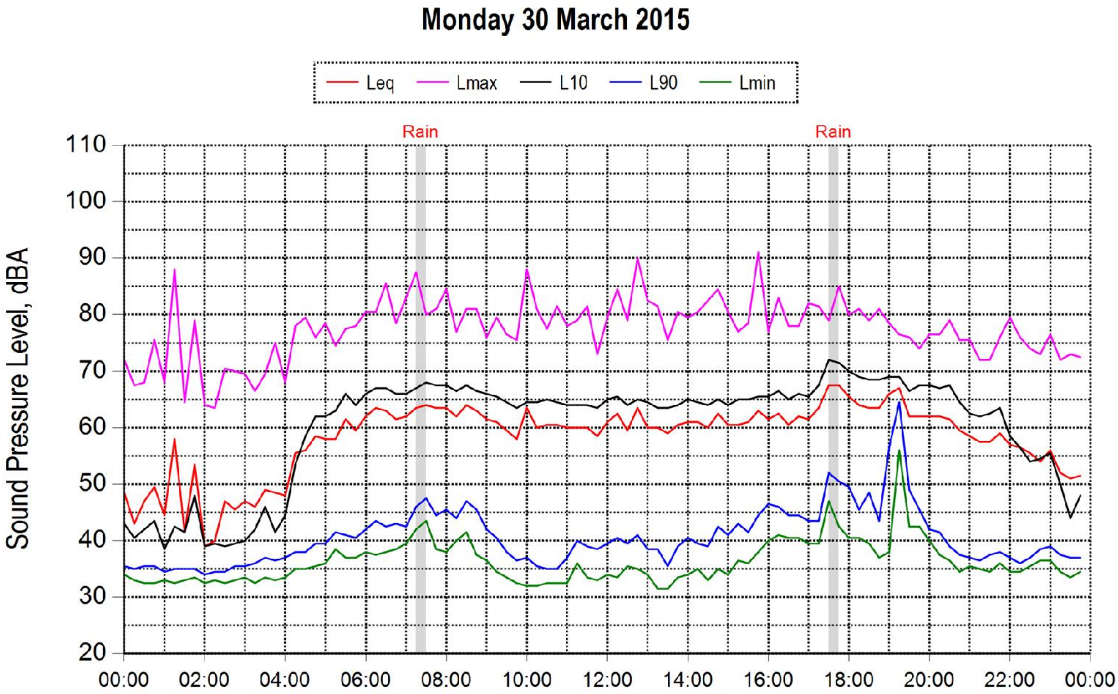

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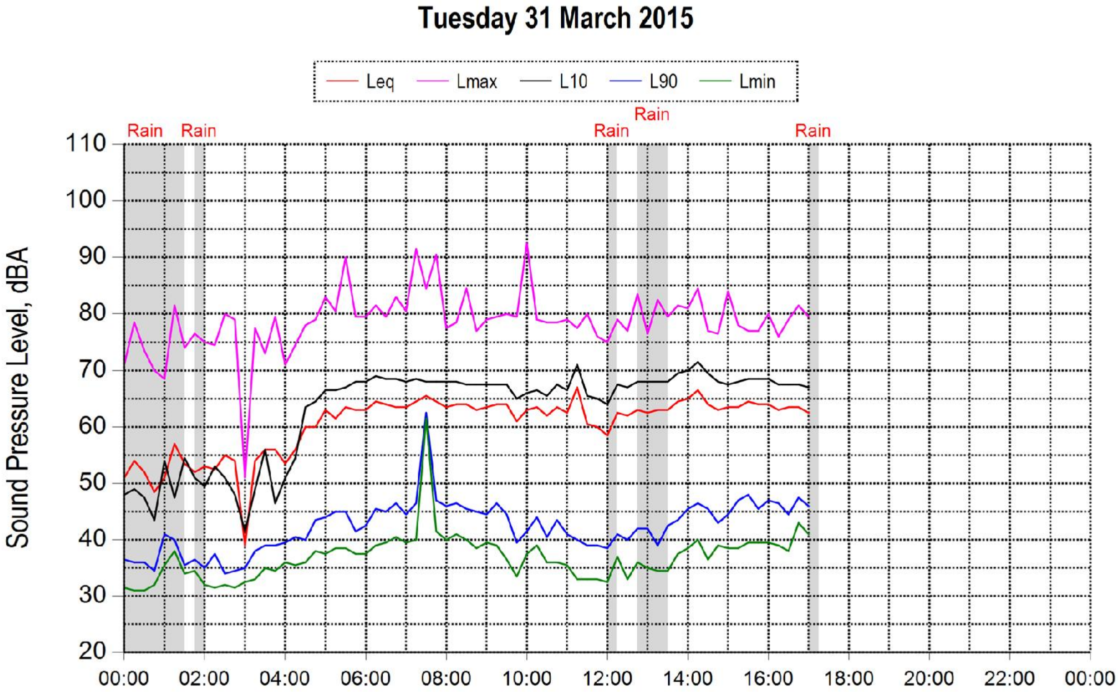
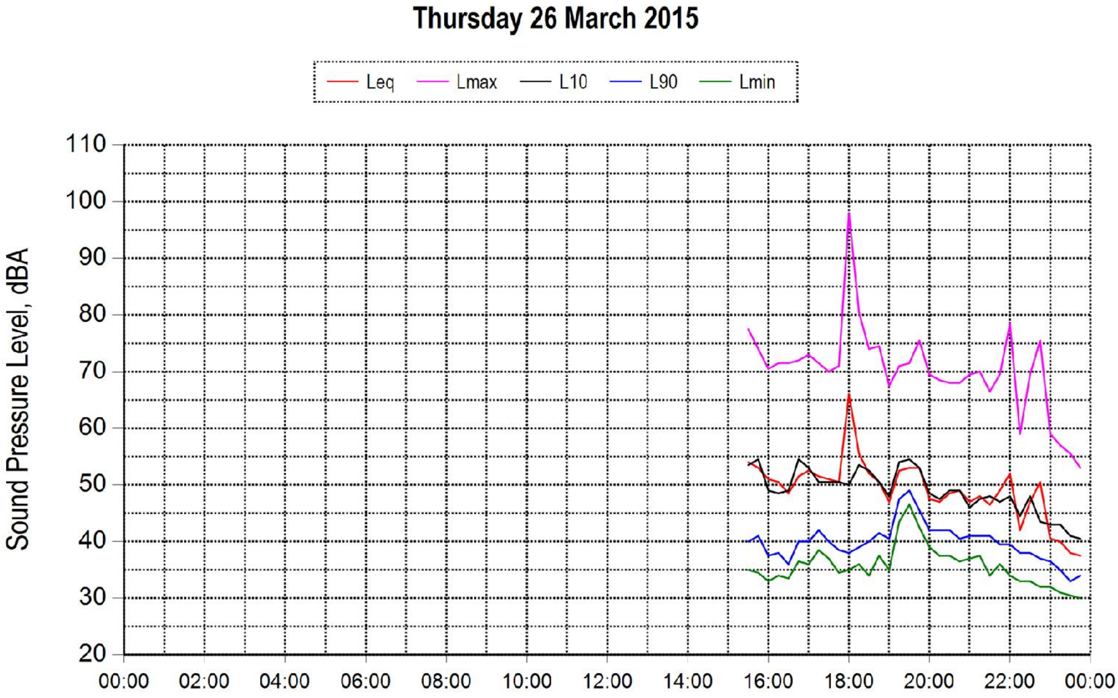
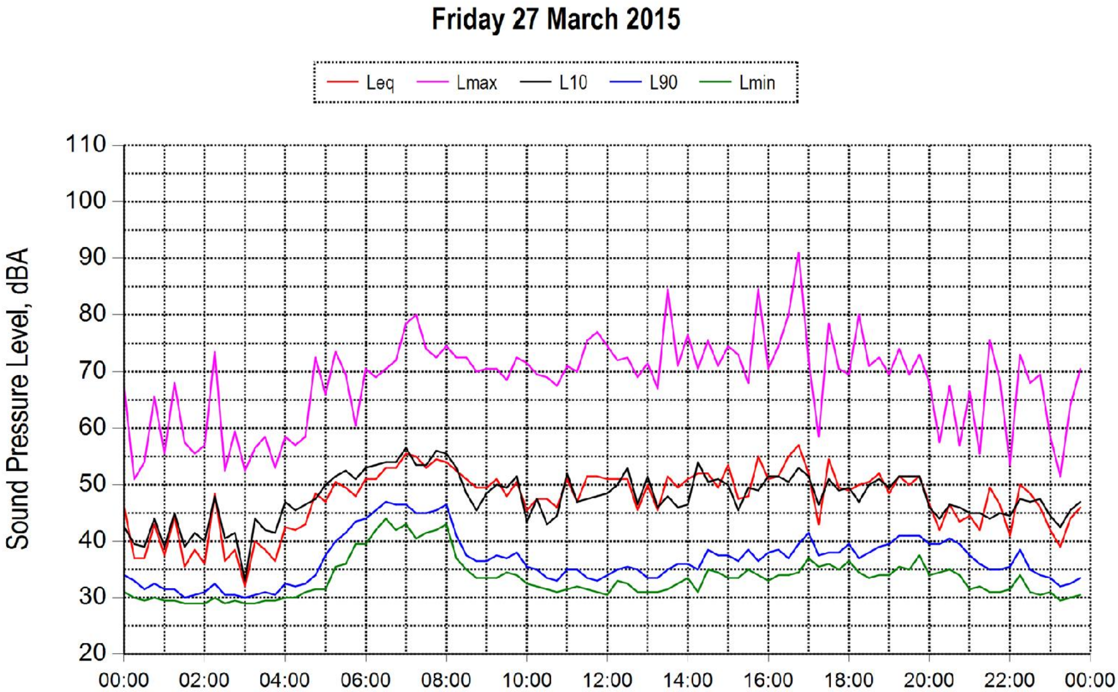


Twin Creeks Golf Club (2 Twin Creeks Drive, Luddenham)





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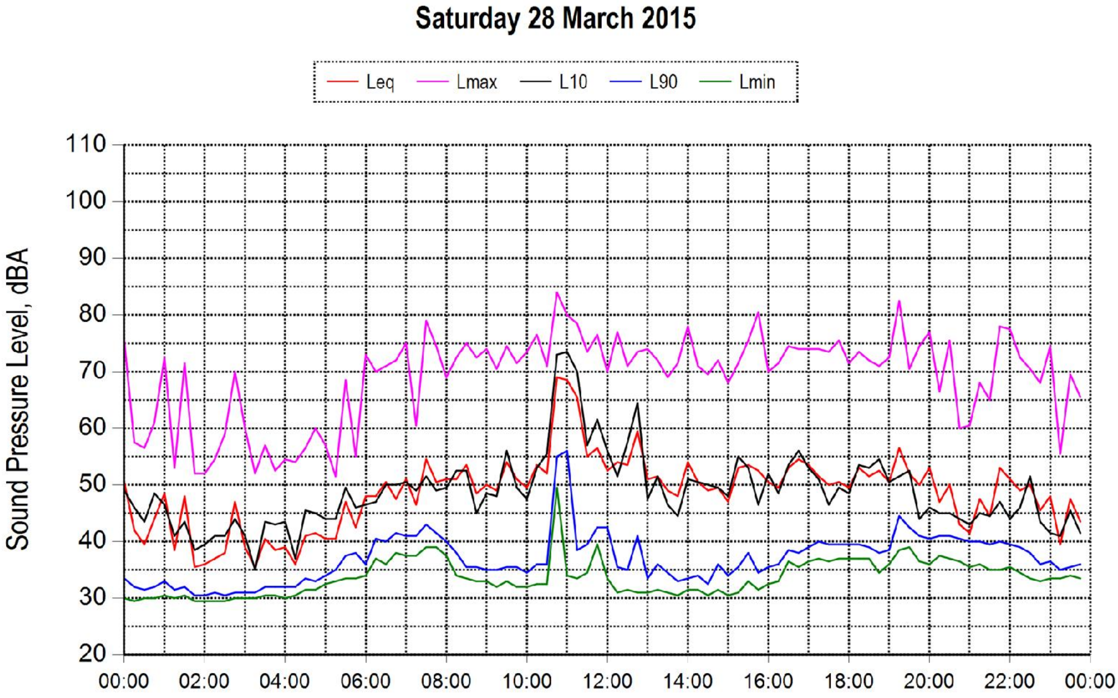

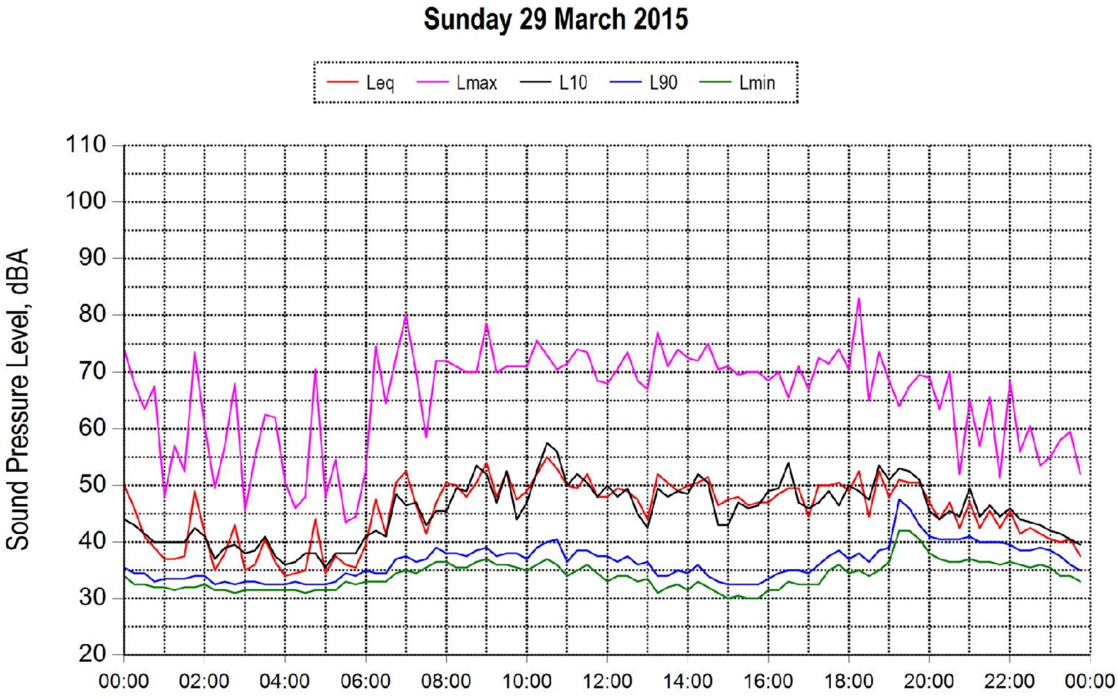

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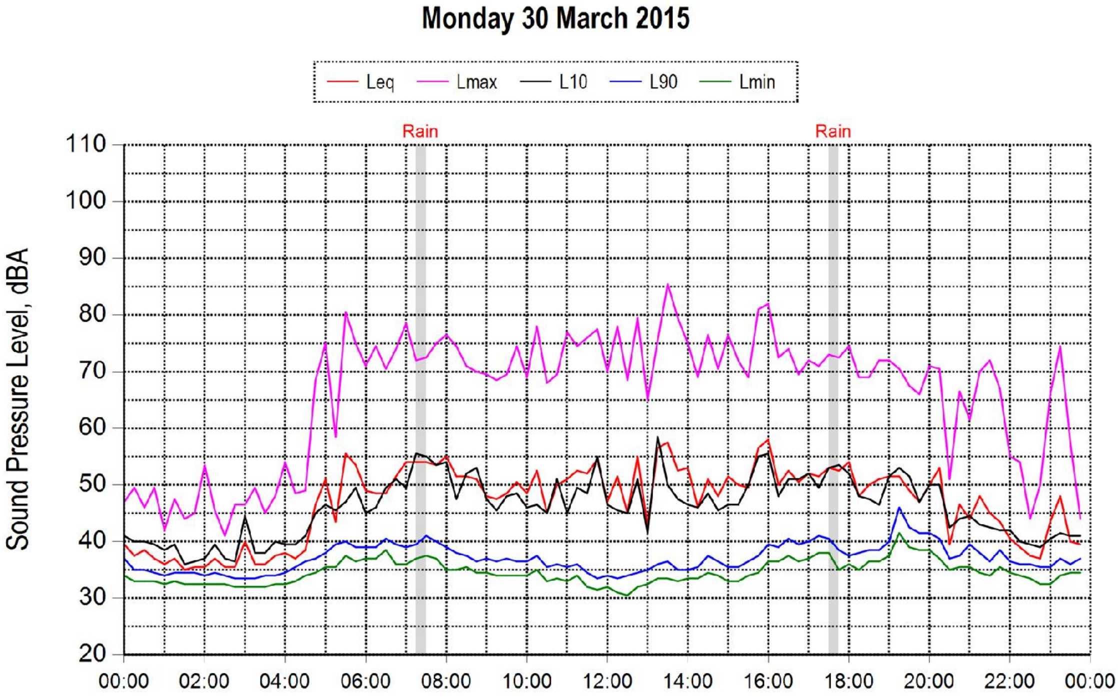

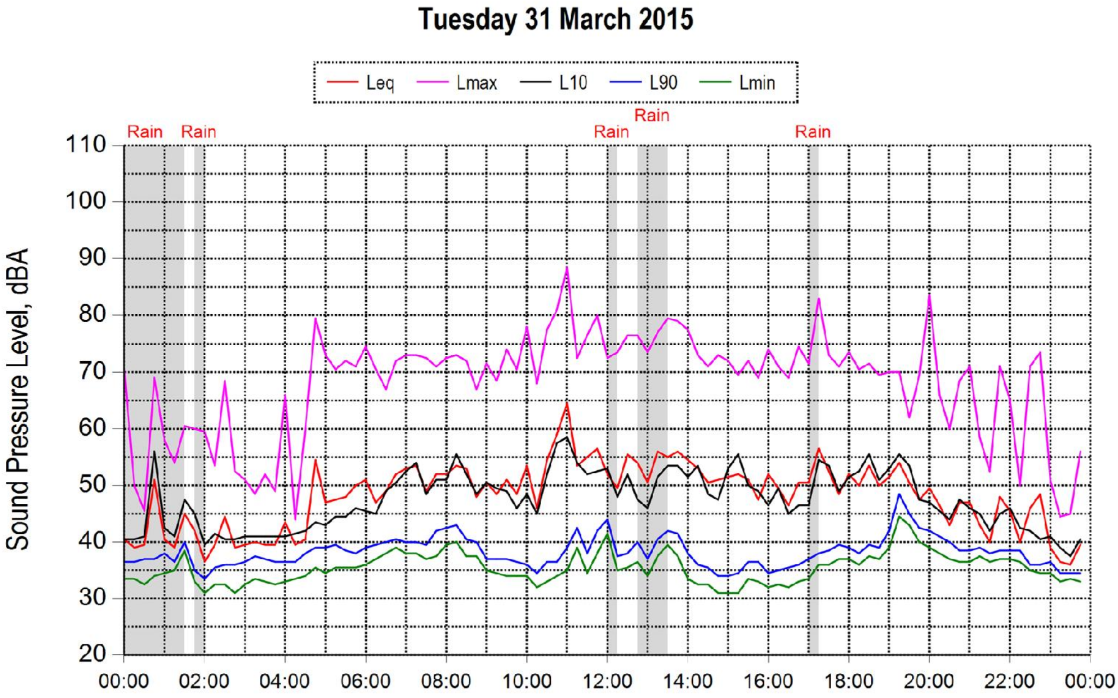

Twin Creeks Golf Club (2 Twin Creeks Drive, Luddenham)