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Appendix E2
Airport ground-based noise and vibration

ACOUSTICS AND AIR

WESTERN SYDNEY AIRPORT EIS

ASSESSMENT OF GROUND-BASED NOISE

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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. For the purposes of this assessment, these activities include taxiing operations and ground running of aircraft engines for maintenance purposes. Airport construction noise and vibration emissions are also considered.

The assessment has been undertaken as part of the environmental impact statement (EIS) for the proposal. Aircraft overflight noise, which includes noise generated by aircraft in flight or when taking off or landing, is addressed in a separate EIS technical report (Appendix E1).

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.

Regulation of Airport Noise

Ground-based operational noise at airports is regulated by the Airports (Environment Protection) Regulations 1997. These regulations include specific limits for certain activities at certain times of the day and provide other more general principles to avoid offensive noise that intrudes on individual, community or commercial amenity.

It is important to note however, that these regulations do not apply to noise generated by an aircraft in flight or when landing, taking off or taxiing at an airport. Noise emissions associated with these activities are regulated under other Commonwealth regulations.

Noise associated with taxiing operations are addressed in this report while noise associated with aircraft in-flight, taking off or landing (including reverse thrust noise) is included in the aircraft overflight technical report (Appendix E1).

The Airports (Environment Protection) Regulations also apply to noise generated from the construction, maintenance or demolition of a building or other structure at an airport.

Assessment of Ground-Based Operational Noise

Because the Airports (Environment Protection) Regulations 1997 do not identify directly applicable criteria for engine operational noise emissions, noise criteria have been developed uniquely for this assessment based on the NSW *Industrial Noise Policy (INP)*. While the *INP* has no application to the regulation of Commonwealth-leased airports, it provides a basis for assessing potential noise impacts in specific circumstances.

Criteria have been established for the night time (the most sensitive period) based on the measured existing background noise levels. This may represent a conservative assessment approach because future ambient noise levels in the vicinity of the airport site are likely to be higher than current measured levels as, consistent with regional planning policies and development plans, the noise character of much of the surrounding area is expected to change from that associated with a rural residential land use to that of an urbanised area.

The following residential noise criteria have been adopted for this assessment taking into account any intermittency of the noise in question.

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

The assessment of the initial (Stage 1) airport development shows that people living in areas such as Luddenham, Badgerys Creek, Bringelly, Wallacia and Greendale could be expected to be affected by noise levels above these criteria during night time hours (10.00pm-7.00am) 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 land uses. The assessment shows that up to five educational institutions, three places of worship, two passive recreation areas and one active recreation area would be affected by engine operational noise levels above the criteria established for this study.

There are limits to the extent that mitigation measures can be applied to reduce the impacts of ground-based engine operational noise. One source of engine operating noise 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 restrict engine runs on high power at night time, except for abnormal situations where essential unplanned engine testing is required to take place during those hours.

Based on experience at other airports around the world, noise level reductions from engine ground running of around 10dBA (an effective halving of the perceived noise level) may be achieved by construction of a 15 m high partial enclosure around the run-up area.

The noise impact from aircraft taxiing is much lower as aircraft engines are at idle. Specific noise mitigation for this noise source is less likely to be required.

Apart from these operational noise sources, 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 other operational noise sources assessed.

Assessment of Construction Noise and Vibration

Noise levels have been calculated for the bulk earthworks stage of the proposed main construction works, which is expected to be the noisiest stage. Noise levels have been calculated for four potential 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 criteria in the Airports (Environment Protection) Regulations 1997.

If blasting is carried out as part of the construction, it may be necessary to limit the maximum instantaneous charge of the blast to avoid high vibration and airblast levels outside the airport boundary. Consideration should be given to incorporating relevant criteria and procedures for managing, monitoring and reporting blasting vibration and airblast as part of the construction management planning for the proposed airport.

During construction, heavy and light vehicles are expected to predominantly 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

Traffic modelling conducted for the EIS shows that operation of the proposed airport would increase road traffic in the area surrounding the airport site. Road traffic increases attributable to the operation of the proposed airport are not expected to result in significant noise level increases for the majority of surrounding roads. Sections of Elizabeth Drive, Adams Road and the proposed M12 are predicted to experience a noise level increase greater than 2dBA due to airport-induced traffic. Impacts associated with the development of both motorways and local road upgrades and realignments would be separately assessed as part of the planning for these projects and necessary noise mitigation measures included at that time.

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 1,780 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Airport operations are expected to commence 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 (referred to as the Stage 1 development) 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 approximately 10 million passengers per year as well as freight operations. 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 subject to relevant approvals.

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 joint scoping study is being undertaken with the NSW Government to determine rail needs for Western Sydney and the airport. A potential final rail alignment will be determined through the joint scoping study with the New South Wales Government, with any significant enabling work required during Stage 1 expected to be subject to a separate approval and environmental assessment process.

As demand increases, additional aviation infrastructure and aviation support precincts are expected to be developed until the first runway reaches capacity at around 37 million passenger movements. At this time, expected to be around 2050, a second parallel runway is expected to be required. In the longer term, approximately 40 years after operations commence, the airport development is expected to fully occupy the airport site, with additional passenger and transport facilities for around 82 million passenger movements per year.

On 23 December 2014, 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. A draft Airport Plan was exhibited for public comment with the draft EIS late in 2015.

Following receipt of public comments, a revised draft Airport Plan has been developed. The revised draft Airport Plan is the primary source of reference for, and companion document to, the EIS. The revised draft Airport Plan identifies a staged development of the proposed airport. It provides details of the initial development being authorised, as well as a long term vision of the airport's development over a number of stages. This enables preliminary consideration of the implications of longer term airport operations. Any airport development beyond Stage 1, including the construction of additional terminal areas or supporting infrastructure to expand the capacity of the airport using the first runway or construction of a second runway, would be managed in accordance with the existing process in the Airports Act. This includes a requirement that, for major airport developments (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 EPBC Act 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;*
    - *noise and vibration from construction activities and machinery.*

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

1.3 Scope of this Report

This report addresses noise and vibration impacts associated with both the construction and operation phases of the proposed airport development.

Operational noise sources are associated with the following components of the proposed airport:

- ground running of aircraft engines;
- taxiing of aircraft; and

- changes in traffic volumes in the area surrounding the airport.

Apart from these operational noise sources, other noise would be generated within the proposed airport by vehicle movements, mechanical plant, air conditioning units, generators and a range of other activities. However, noise from these sources will be much lower in level than the other operational noise sources assessed.

The use of auxiliary power units (APUs) on aircraft has not been assessed because it is assumed that mains 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 noise sources. Noise from aircraft take-off and landing, including reverse thrust, is assessed in the Aircraft Overflight Technical Report (Appendix E1).

Operational noise at airports is regulated by the Airports (Environment Protection) Regulations 1997. Importantly, the regulations do not cover noise emissions from aircraft taxiing operations, which are addressed under the Air Navigation (Aircraft Noise) Regulations. The Airports (Environment Protection) 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 similar procedures will 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 address community reaction:

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

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 AS 1055: 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 of monitoring [the minimum duration required by the *INP* (7 days)] was completed. Further measurements were carried out at Luddenham during the first half of March 2016.

The measurement locations are described in Table 2-1 and shown in Figure 2-1. All measurement locations were free field locations on the side of the building towards the proposed airport. 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 the level of noise 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 is shown in Table 2-1.

Table 2-1 Measured Background Noise Levels (L_{A90}) around the proposed Western Sydney Airport site

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
8 Wade Close, Luddenham	Monday 7/3/16 – Wednesday 16/3/16	35	36	34

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

According to the *INP*, where the RBL has been measured as less than 30dBA, it should be assumed to be 30dBA 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 30-38dBA for the night period.

Figure 2-1 Background Noise Measurement Locations

3 ASSESSMENT OF AIRPORT GROUND-BASED OPERATIONAL NOISE

The Airports (Environment Protection) Regulations 1997 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.

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 which are regulated by the *INP*. It is not intended that these criteria would be used for future regulation of the activities considered in this study.

It is also important to distinguish between ground-based noise and aircraft overflight noise. When aircraft fly over a location, the resultant noise is often relatively high in level, but short in duration (typically a few seconds). In contrast, taxiing is relatively continuous at a lower noise level and ground running occurs only occasionally, but up to five minutes on high power at a time. The methods of assessing ground-based noise are therefore quite different from those for overflight noise, largely because of the different human perceptions of these noise types. For ground-based noise, ANEF and N60 and N70, as used for aircraft overflight noise, are not normally used.

3.1 Regulation of Ground-Based Noise

The ground-based operational noise at airports is regulated by the Airports (Environment Protection) Regulations 1997. These regulations include specific limits for certain activities at certain times of the day and provide the regulatory framework for noise generated at an airport site other than noise generated by aircraft in flight, landing, taking off or taxiing. The regulations provide for appointment of an airport environment officer at each airport to oversight the operation of the regulations.

Under the regulations, an operator of an undertaking at an airport has a duty to take all reasonable and practicable measures to prevent the generation of 'offensive noise' or, if prevention is not reasonable or practicable, to minimise the generation of offensive noise from the undertaking. Noise is considered 'offensive' if it is generated at a volume, in a way, or under a circumstance that, in the opinion of an airport environment officer, offensively intrudes on individual, community or commercial amenity.

The regulations set out certain factors that an airport environment officer must take into account in forming this opinion. These factors include the volume, tonality and 'impulsive character' of the noise, the time of day and duration of the noise, background noise levels when the noise is generated, and the location of sensitive receptors (or commercial receptors if there is no affected sensitive receptor) in relation to the noise.

In forming this opinion, airport environment officers must also take into account the excessive noise guidelines in the regulations. The excessive noise guidelines set out specific indicators of excessive noise in relation to specific types of noise, such as noise from construction, road traffic and rail traffic.

In relation to ground-based engine running, there are no specific indicators, however, the regulations provide that noise should be generated consistently with the master plan for the airport (see below). Noise levels are to be determined using Australian Standard AS 1055.

In relation to other airport activities, such as aircraft refuelling, aircraft repairs, operation of plant and machinery, embarkation or disembarkation of passengers and operation of audible alarms and warning systems, the guidelines provide that noise should not exceed background noise levels at the sensitive receptor site between 7.00am and 10.00pm by more than 5dBA and between 10.00pm and 7.00am by more than 3dBA.

The question of whether the measures taken by operators to prevent or minimise the generation of offensive noise are 'reasonable and practicable' is a judgment to be made by an airport environment officer. In making this judgment, the officer must have regard to the circumstances in which the noise is generated, the state of technical knowledge about preventing or minimising noise from the relevant kind of undertaking, and all measures that might practicably be used to prevent or minimise the noise.

Airport environment officers have the power to enforce compliance with the duty to avoid excessive noise by issuing an environment protection order. If an airport environment officer finds that an operator is in breach of the duty, the officer may make an environment protection order directing the operator to comply with the duty by taking particular action to prevent or minimise the excessive noise. Failure to comply with an environment protection order is a breach of the regulations and an offence under the *Airports Act 1996*.

3.1.1 Monitoring

Under the regulations, the airport-lessee company (ALC) is required to monitor the level of noise generated at the airport, in accordance with the environment strategy in the airport master plan. If monitoring discloses excessive noise, the company must give to the airport environment officer a written report about the excessive noise and the details of any remedial action being taken.

3.1.2 Master plan environment strategy obligations

The ALC will be required to include an environment strategy in its first draft master plan which must detail the sources of environmental impact associated with civil aviation operations at the airport; the monitoring to be carried out in connection with the environmental impact; and the measures to be carried out to prevent, control or reduce this impact. The environment strategy is required to include the proposed systems of testing, measuring and sampling to be carried out for possible or suspected excessive noise procedures in relation to how and when engine run-ups can be undertaken would be established under the environment strategy. Each master plan, including the environment strategy, is subject to a public consultation process and requires approval from the Infrastructure Minister.

3.1.3 Aircraft taxiing noise

Part 6 of the Airports Act and the Airports (Environment Protection) Regulations set out the framework which would regulate the generation of noise at the proposed airport, other than noise generated by aircraft in flight (including when landing, taking off or taxiing at the airport). Nevertheless, this report addresses noise generated by aircraft taxiing as a ground-based noise source. While for noise assessment purposes taxiing is addressed in this report, it is not considered to be part of the ground based noise regulatory framework established under the Regulations. This reflects the general division of responsibility for noise management between Airservices Australia and the ALC.

For aircraft taxiing, it is relevant to note that aircraft operating in Australia must meet noise standards specified in the Air Navigation (Aircraft Noise) Regulations 1984. These regulations require aircraft to be verified as complying with noise standards established by the International Civil Aviation Organization (ICAO). The regulations carry strict penalties for operating an aircraft without a noise certificate issued under ICAO standards. The regulations also provide for exceptional circumstances where dispensations to enable limited operation of non-compliant aircraft may be applied for. Dispensations will include conditions that are intended to mitigate the impact of aircraft noise on the community.

These regulations ensure that aircraft using airports in Australia, including the proposed Western Sydney Airport, whether in flight or on the ground, are compliant with internationally accepted noise standards and practices.

Although not consistent with the regulatory framework for this activity, considering aircraft taxiing as a ground-based noise source for assessment purposes provides a convenient way of isolating and evaluating noise generated by taxiing, particularly given that taxiing operations have not been taken into account in the Aircraft Overflight Technical Report and associated noise exposure modelling (Appendix E1).

3.1.4 Construction noise

The Airports (Environment Protection) Regulations state that noise generated from construction, maintenance or demolition of a building or other structure at an airport should not exceed 75dBA $L_{10,15min}$ at the site of a sensitive receptor.

3.2 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 noise level from an industrial development does not exceed two noise criteria at residential locations, as measured outside:

- Intrusiveness criterion ($L_{Aeq,15min}$) – this criterion is calculated as RBL +5dB; and
- Amenity criterion ($L_{Aeq,period}$) – 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 and based on the relatively low background noise levels measured, the intrusiveness criterion is the more stringent at all locations and it has conservatively been adopted in this case.

For ground-based operational noise the *INP* intrusiveness criterion would be the RBL (as shown in Table 2-1) + 5dB. However, further consideration is necessary before finalising the airport-specific criteria for the different noise types. Further, it should be noted that the criteria may increase over time as the background noise levels increase owing to planned residential, commercial and road and rail infrastructure development, some of which will occur before or at the same time as the airport opening.

3.2.1 Adopted *INP* Criteria for Residential Locations

The *INP* based intrusiveness noise criteria for residential land uses have been determined by adding 5dB 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 – Tuesday 31/3/15	43	47	40
Twin Creeks Golf & Country Club (2 Twin Creeks Drive, Luddenham)	Thursday 26/3/15 – Thursday 2/4/15	39	43	38
8 Wade Close, Luddenham	Monday 7/3/16 – Wednesday 16/3/16	40	41	39

Note: Where the background noise level is less than 30dBA, the *INP* indicates that it may be taken as 30dBA.

The night time noise criteria are the most important (most stringent) 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 currently in the range 35-43dBA.

So that the noise contours presented 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 40dBA can be taken as generally appropriate for residential locations at night in the vicinity of the airport. This approach is consistent with the broad approach generally adopted for EIS reports of this type.

The adoption of a 40dBA criterion at night is also conservative when compared to the ambient noise levels likely to be experienced at the time when the Stage 1 airport operations become significant, i.e. many years from now when substantial additional urban development is planned at a regional scale. The 40dBA criterion is based on the assumed background noise level of 35dBA, and AS 1055.2-1997[(R14)] which advises that the average background noise level at night in *areas with medium density transportation or some commerce or industry* would likely be 40dBA.

3.2.2 *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 10dB. 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	*INP* 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

3.2.3 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.

3.3 Noise Criteria for Engine Ground Running

Engine ground running is a test operation of an engine attached to an aircraft. It is a mandatory procedure for all aircraft returning into service after engine maintenance. A typical test consists of a period of running the engine at idle power, a short full power run of the engine or a combination of both. When possible, aircraft are oriented into the wind during an engine ground run. Engine testing rules and procedures are generally established to reflect the individual characteristics of an airport, including whether the airport supports regular engine maintenance works, the location of sensitive receptors and whether noise emissions from testing can be shielded. At major Australian airports, each engine test needs to be approved by the airport operator in consultation with air traffic control to ensure they are conducted safely and at approved locations. Extensive records are kept of each engine ground run including the date of the run, the type of aircraft, the site of the run, the aircraft heading, the number of engines run, the time of each run and the power settings used. The noise level associated with the engine run may also be recorded.

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 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 five minutes in any night. Therefore, the night time residential criterion for this activity has been set using the industrial noise criterion as 5dB over the general *INP* night time criterion for residential receivers; that is 45dBA, in accordance with the *INP* duration adjustment. The criteria for other land uses have been set 5dB 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.

3.4 Noise Criteria for Taxiing

Noise from taxiing during day time operations is expected to be relatively continuous, rather than intermittent. However, the limited number of aircraft movements proposed during the night time will result in more intermittent noise. It has been assumed that, during the busiest 15-minute period at night time, forecast to be at 10.00pm and 6.00am, the resulting noise would be relatively continuous for Stage 1 operations. 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. The relevant criterion for residential receivers subject to taxiing noise has been adopted as 40dBA and the criteria in Table 3-2 have been adopted for other land uses (see Section 3.1.1). These criteria apply at night.

3.5 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 dwellings and hospitals. For the other uses, they apply during the daytime. However, the $L_{Aeq,15min}$ levels expected from ground running and taxiing operations will be the same irrespective of time of day.

3.6 Prediction Method

Ground-based operational noise levels have been predicted for the initial airport development and for the long term development. Stage 1 operations would cater for approximately 10 million passenger movements per year and are the focus of this assessment. This level of activity is presently expected to occur around five years after the commencement of operations. Noise levels were calculated using the CadnaA noise model. 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 expected final landform of the airport and the buildings assumed to be constructed during the initial airport development and the long term airport development.

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 class F stability from Concawe(R1), which is equivalent to a temperature inversion. Concawe is a document that describes environmental noise calculation procedures, including methods of assessing the effects of different weather conditions.

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.

Noise contours were prepared and incorporated in the draft EIS based on predictions using CadnaA and the prediction algorithms taken from ISO 9613-1:1993(E)(R15) with the Concawe Class F stability.

Subsequent to publication of the draft EIS and during further analysis of ground running noise mitigation options, it was found that the ISO algorithm led to unexpected and inconsistent results, probably relating to the method of dealing with ground effects prescribed by the ISO approach. Accordingly, the operational noise contours have now been prepared using CadnaA incorporating the Concawe prediction algorithm and Concawe Class F stability. The use of the Concawe algorithms is a much more accurate and representative approach because it takes better account of the ground effects on noise propagation.

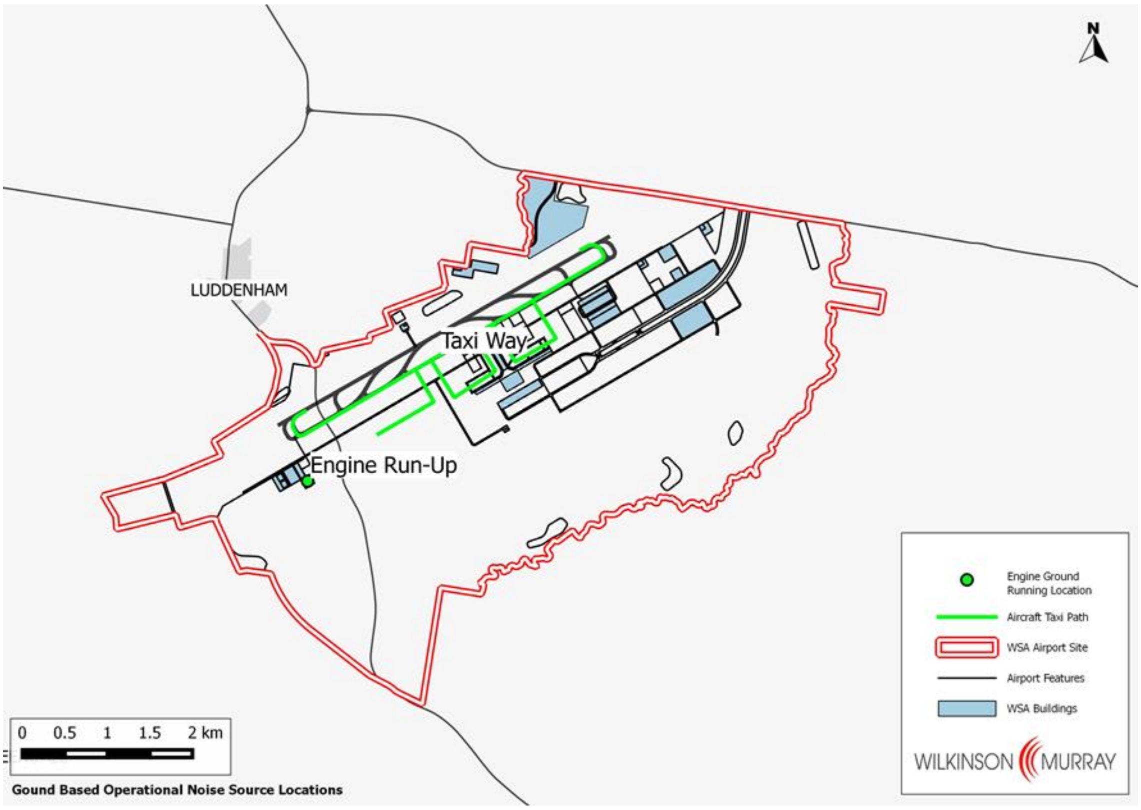
3.7 Aircraft Engine Ground Running Noise for Initial Airport Development

It has been assumed that aircraft ground runs would occur at the location shown in the indicative airport layout at 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 151dBA has been assumed for ground running using high power, based on measurements of aircraft taking off. This level was determined by measuring aircraft takeoff at Brisbane Airport over two days in November 2005, because take-off noise is dominated by the noise of the engines on high power. From the measured sound pressure levels, the sound power levels were determined by allowing for the distance from the aircraft to the measurement position. The measured levels are shown in Table 3-4.

Table 3-4 Sound Power Level emitted during Takeoff at Angle of Maximum Emission

Aircraft Type	Maximum Sound Power Level (Energy Mean) dBA	No. of Events on which Level is Based
737-400	151	8
737-700	151	8
737-800	151	15
777-200	147	3
A320	147	3
A330	157	2

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



The high level measured from the A330 is based on only two recorded events and is therefore considered relatively unrepresentative. A sound power level of 151dBA has been adopted as the highest level.

For the worst-case meteorological condition assumption, that being a temperature inversion, the calculated noise contours as reported in the draft EIS 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.

Figure 3-2 Worst-Case $L_{Aeq,15min}$ Engine Ground Running Noise Contours as published in the Draft EIS – Night Stage 1

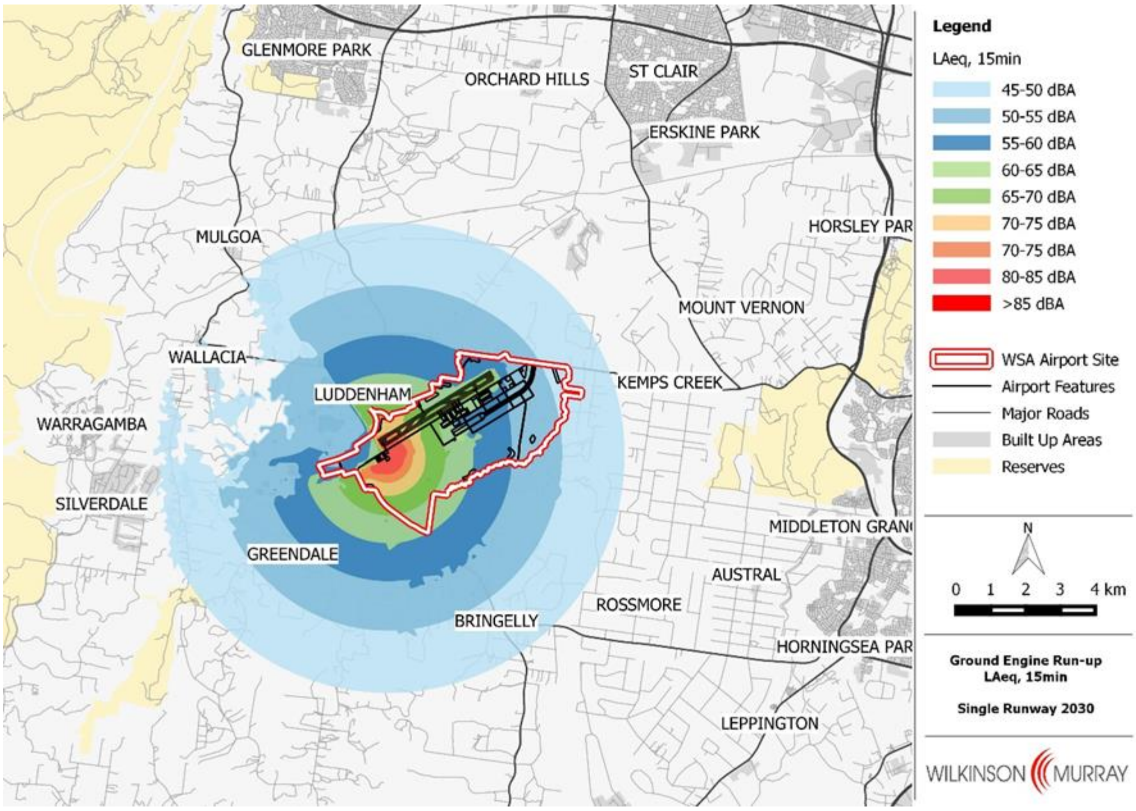
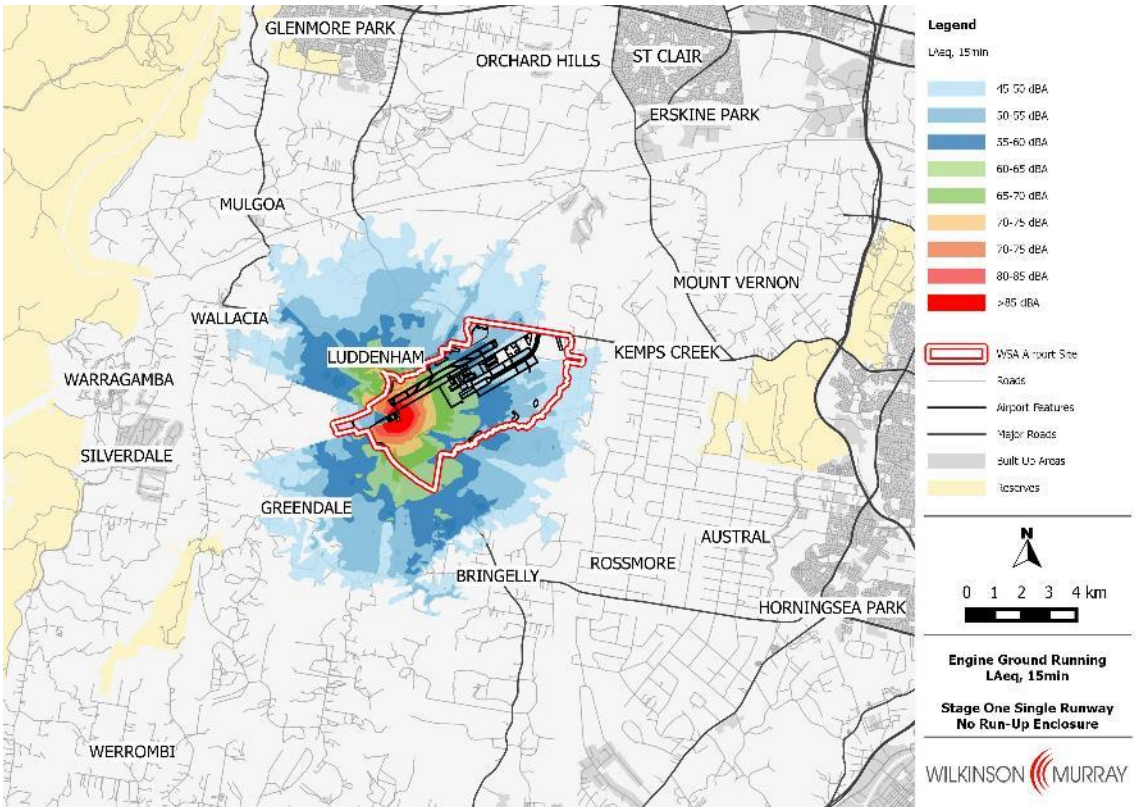


Figure 3-3 shows the ground running noise contours calculated using the updated prediction approach. These contours more closely reflect the effects of the ground conditions surrounding the airport site, which is expected from the change in prediction procedure. They reflect more realistic noise shielding of the hangar assumed to be adjacent to the run-up area and show increased noise levels to the north and south-east, but generally reduced noise levels elsewhere.

Figure 3-3 Worst-Case $L_{Aeq,15min}$ Engine Ground Running Noise Contours – Night Stage 1



3.8 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 has been assumed for the proposed initial airport development by applying a line source along each taxiway.

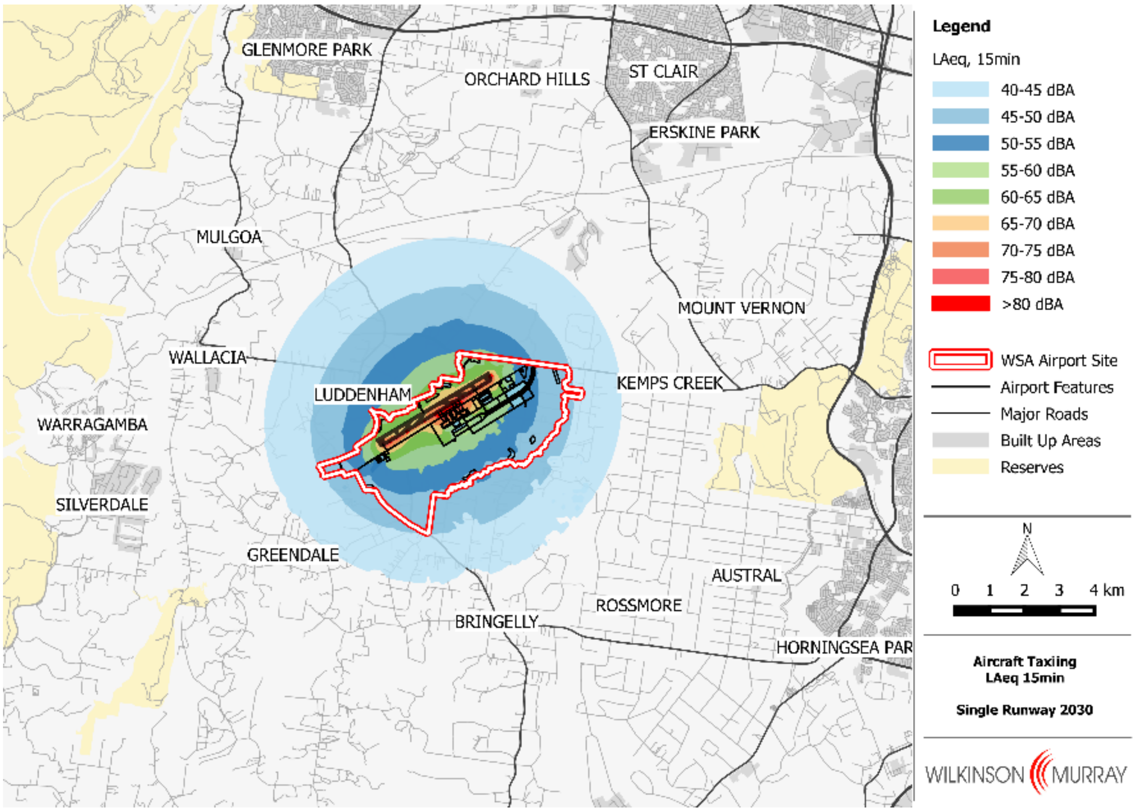
A sound power level (noise level at source) for each aircraft of 138dBA has been assumed. This is the highest level measured for aircraft taxiing, based on measurements at Brisbane Airport. Measurement involved the recording of maximum noise levels as aircraft at Brisbane Airport taxied past the measurement location and the conversion of measured levels to sound power levels. Table 3-5 shows the measured results from which the highest energy mean level of 138dBA was adopted.

Table 3-5 Measurement of Sound Power Level of Aircraft Taxiing

Aircraft Type	Sound Power Level, dBA	
	Individual Measurement	Energy Mean
747 (all types)	137, 134, 136, 142	138
737 (all types)	126, 126, 139	135
717	120	120
A330	129	129
777	132	132

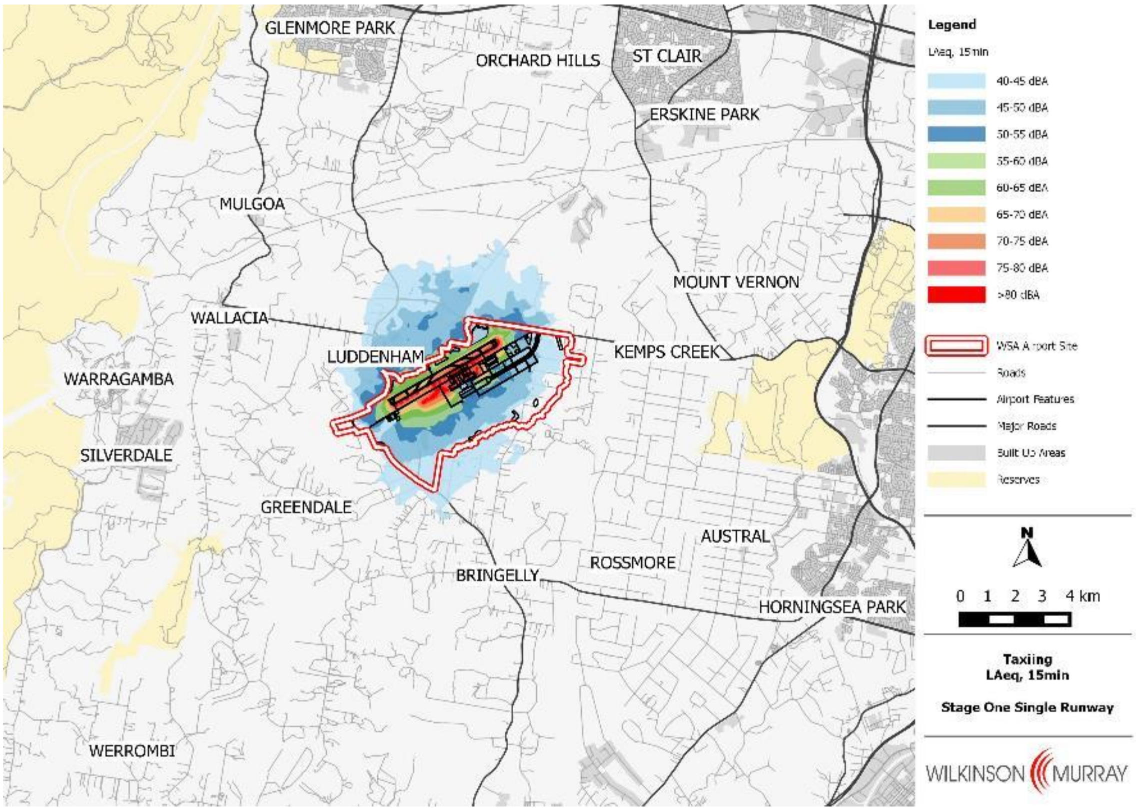
The $L_{Aeq,15min}$ noise levels from taxiing operations were predicted for worst-case meteorological conditions. The noise contours published in the draft EIS are shown in Figure 3-4 for the initial development.

Figure 3-4 Worst-Case $L_{Aeq,15min}$ Taxiing Noise Contours as published in Draft EIS – Night Stage 1



The revised noise contours calculated using the updated prediction method are shown in Figure 3-5. These contours again reflect the ground effects in the surrounding area and show reduced levels generally when compared with the draft EIS.

Figure 3-5 Worst-Case $L_{Aeq,15min}$ Taxiing Noise Contours – Night Stage 1



3.9 Assessment of Initial (Stage 1) Airport Development

Noise impact contours for engine ground running and aircraft taxiing are shown in Figure 3-3 and Figure 3-5, which depict the worst-case noise levels predicted to emanate from the Stage 1 airport into adjacent areas.

Table 3-6 shows the estimated population that may be exposed to levels of ground-based operational noise above the residential intrusiveness criteria during the night time period during the Stage 1 operation under worst-case conditions. The affected populations are generally consistent with the number of residences indicated in the draft EIS.

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 3-6 Predicted Residential Noise Impact of Ground-Based Operational Noise under Worst-Case Conditions – Stage 1

Noise Type	Noise Criterion	Population Affected above Criterion
Engine Ground Running	45dBA	4,471
Taxiing	40dBA	1,610

Note: Population exposures are estimates only for 2030.

The impact of ground-based operational noise on other receiver types surrounding the airport is summarised in Table 3-7. 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, and reflects a reduced impact when compared to the draft EIS.

Table 3-7 Predicted Noise Impact of Ground-Based Operational Noise on Other Receiver Types under Worst-Case Conditions – Stage 1

Noise Type	Other Buildings & Land Uses Affected above Criterion		
	Building or Land Use Type	Criterion	Number
Engine Ground Running	Educational Institutions	55dBA	5
	Hospitals	60dBA	0
	Place of Worship	60dBA	3
	Passive Recreation	60dBA	2
	Active Recreation	65dBA	1
Taxiing	Educational Institutions	50dBA	0
	Hospitals	55dBA	0
	Place of Worship	55dBA	0
	Passive Recreation	55dBA	0
	Active Recreation	60dBA	0

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

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 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 has the potential to affect residences in:

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

The predicted noise exposure from aircraft taxiing extends over a much smaller area and would primarily affect Luddenham.

The other uses likely to be affected by at least one of these noise types are shown in Table 3-8.

Table 3-8 Other Uses to be affected by Engine Ground Running

Type of Use	Facilities
Education	Holy Family Catholic Primary & Church
	Luddenham Childcare Centre
	Schoolies at Mulgoa
	Luddenham Public School
	Bringelly Child Care Centre
Places of Worship	Holy Family Catholic Primary & Church
	St James Luddenham
	Luddenham Uniting Church
Passive Recreation	Freeburn Park, Luddenham
	Willmington Reserve, Luddenham
Active Recreation	Sales Park, Luddenham

3.10 Assessment of Long Term Airport Development

The noise impacts discussed in Section 3.9 above relate to the proposed Stage 1 airport development. The long term airport development is expected to involve the development of a second parallel runway some time around 2050. Such long 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 long term airport development using the same methods as for the initial airport development. The assumed noise source locations are shown in Figure 3-6 and the noise contours published in the draft EIS are shown in Figure 3-7 and Figure 3-8.

Figure 3-6 Ground-Based Operational Noise Source Locations – Indicative Long Term Layout

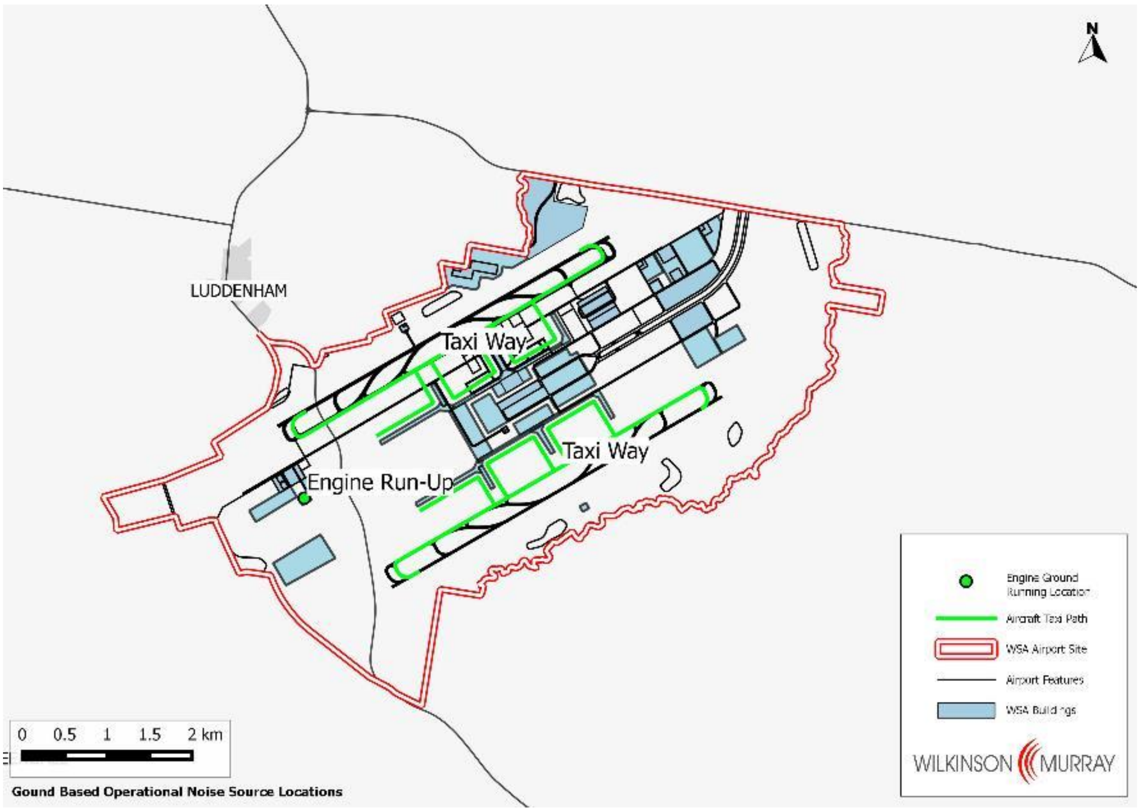


Figure 3-7 Worst-Case $L_{Aeq,15min}$ Engine Ground Running Noise Contours as published in the Draft EIS – Night Long Term

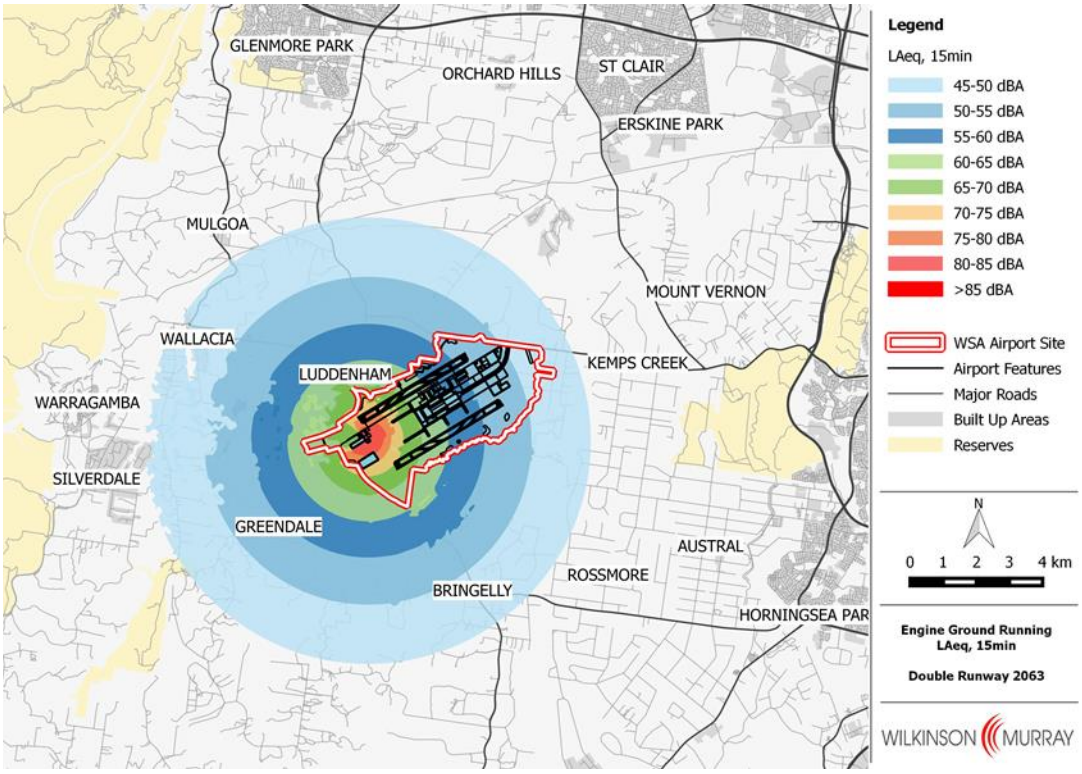
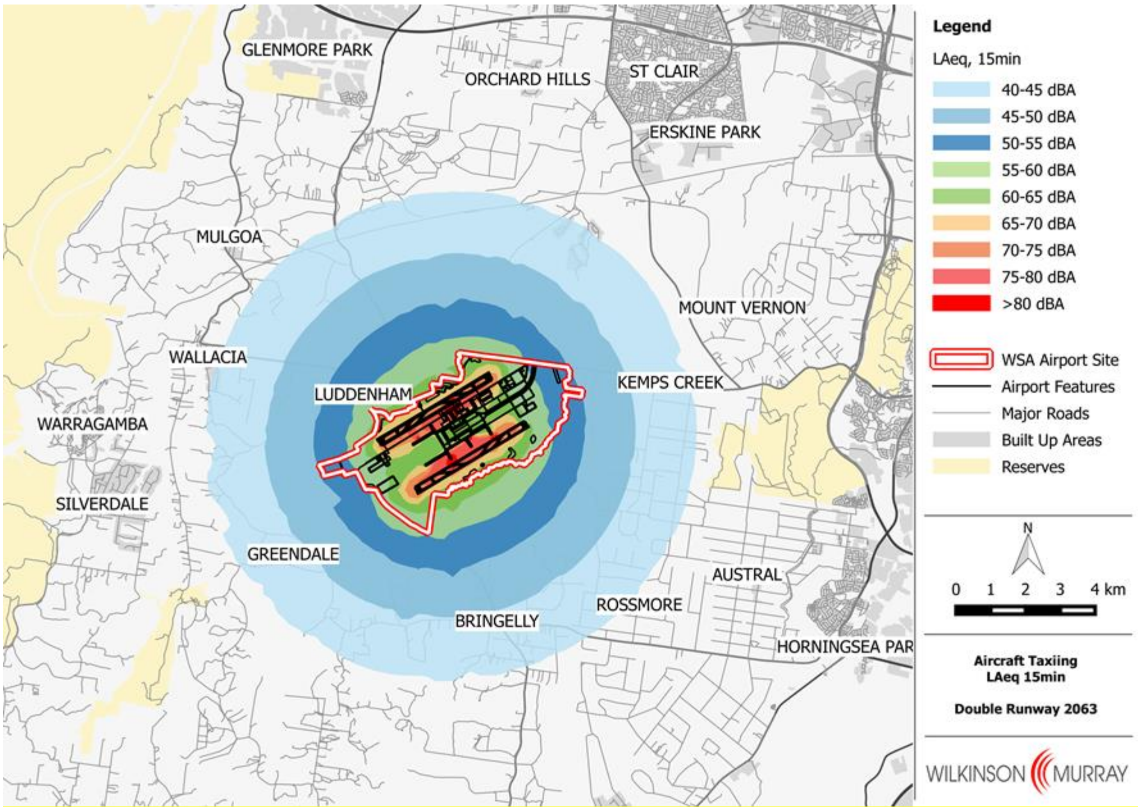


Figure 3-8 Worst-Case $L_{Aeq,15min}$ Taxiing Noise Contours as published in the Draft EIS – Night Long Term



The revised noise contours, based on the revised prediction procedure, are shown in Figure 3-9 and Figure 3-10.

Figure 3-9 Worst-Case $L_{Aeq,15min}$ Engine Ground Running Noise Contours – Night Long Term

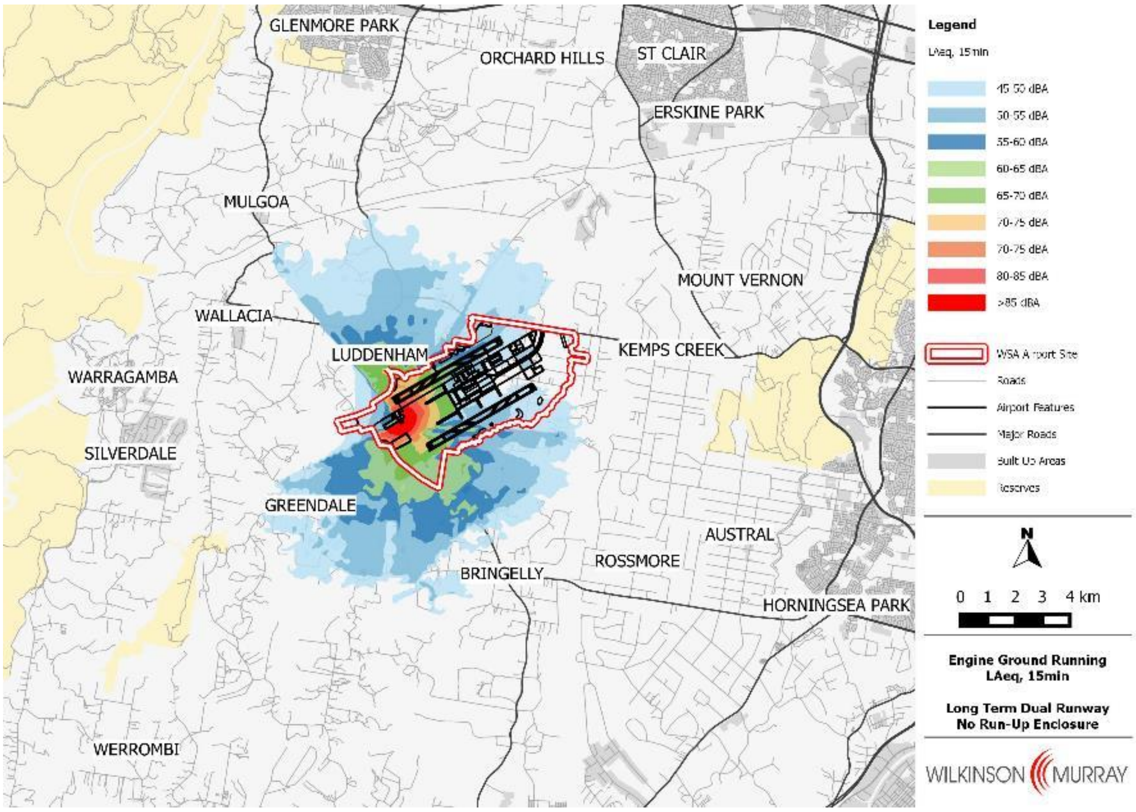
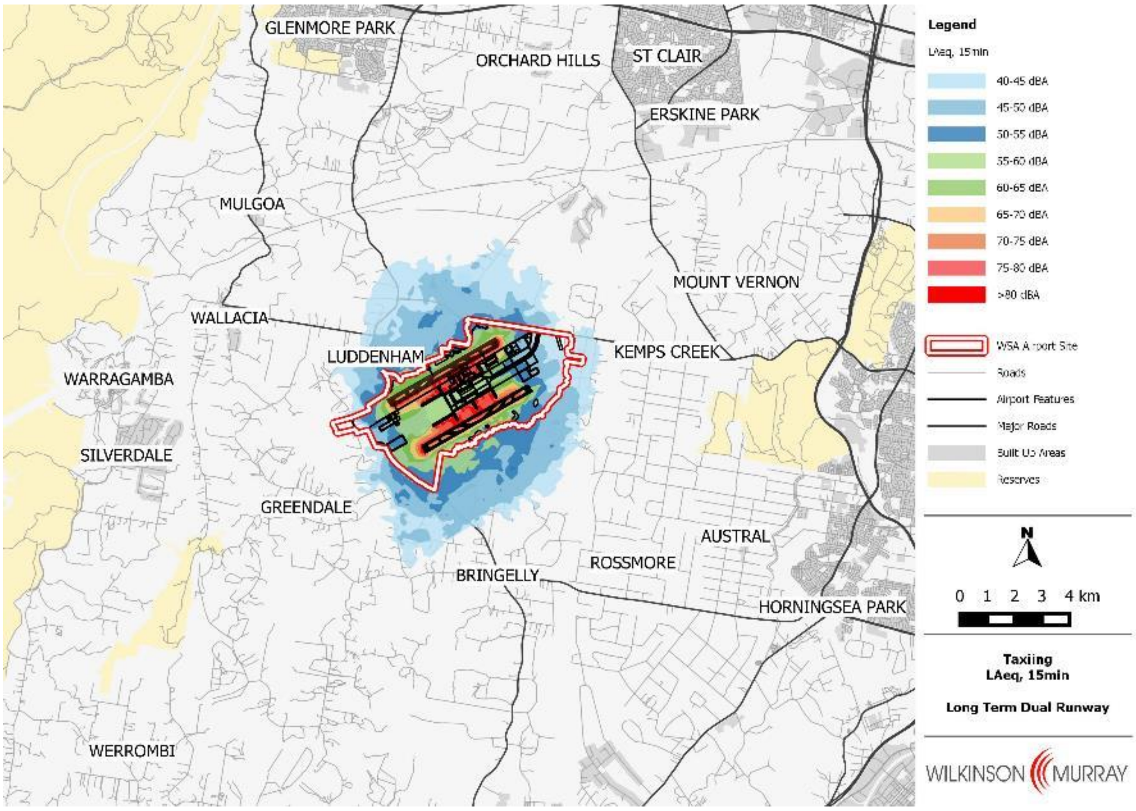


Figure 3-10 Worst-Case $L_{Aeq,15min}$ Taxiing Noise Contours – Night Long Term



Both sets of revised contours for the long term assessment scenario reflect the ground effects surrounding the airport site. Further, the noise contours for engine ground running also reflect a change in the modelled building adjacent to the engine run-up area. The building was modelled for the draft EIS in this scenario at a height of 20 m, but has been revised to a height of 35 m in line with the assumed airport layout contained in the revised draft Airport Plan. This revision is shown to provide greater shielding and reduced noise levels to the west of the airport site.

Engine ground running noise is not predicted to change substantially and will be generally shielded by buildings developed for the long term development. The taxiing noise contours reflect the increased aircraft movements across a larger portion of the airport site under parallel runway operations.

3.11 Mitigation of Ground-Based Operational Noise Impact

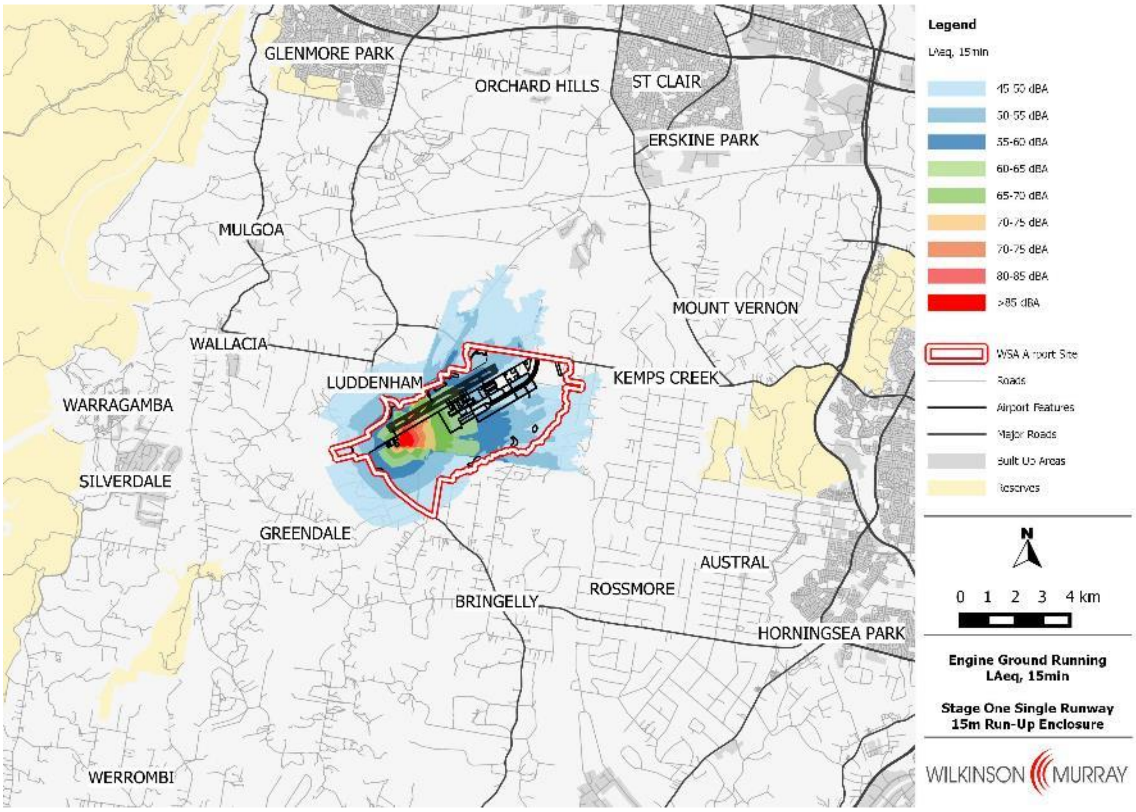
There are practical limits on the mitigation measures that can be applied to reduce the impact of ground-based operational noise sources and there are limited examples in Australia to assist in defining a practical strategy.

Engine ground running on high power would normally be carried out during the day time, but may occasionally be required at night. Limiting the use of high engine power runs at night to circumstances in which they are absolutely necessary, is a strategy that could be considered. This strategy is employed at a number of Australian airports and would reduce the impact of ground running noise at the proposed airport.

It may also be practicable to construct a partial enclosure around a dedicated run-up bay. Based on such enclosures at other airports around the world, this enclosure could be constructed using walls approximately 15 m high to form a U-shaped enclosure which is open to the north-east and which incorporates a blast deflector along the south-western side. The opening is suggested on the north-eastern side because there would be fewer residents affected in this direction. Whilst the prevailing wind direction may not allow the use of this enclosure for ground running at all times, it is anticipated that the enclosure could be used for ground running at night time when relatively still conditions would generally occur.

Figure 3-11 shows ground running noise contours at night time, in the event that an enclosure is in place. These contours have again been drawn for class F stability conditions (temperature inversion). It can be seen that the reduction to the north-west, south-west and south-east would be in the order of 10dB, being limited by the effect of the assumed temperature inversion which tends to reduce the amount of attenuation by barriers.

Figure 3-11 Worst-Case $L_{Aeq,15min}$ Engine Ground Running Noise Contours with Run-Up Bay Enclosure – Stage 1



An enclosure of this type could be constructed using heavy panels, such as concrete panels, supported by steel posts. Given the height of the enclosure, the footings or supports for the walls of the enclosure would be substantial.

Proprietary run-up enclosures are also available. Some of these have been constructed using an acoustically treated airway to allow wind to blow through. This would allow engine running with the aircraft orientated in any direction, which would in turn allow the use of the enclosure under all or most wind conditions.

Aircraft taxiing noise would be relatively low in comparison to other noise associated with operation of the airport. There are few, if any, practicable mitigation measures that would reduce this noise.

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 70dBA (N70 5-10)[R11] from Stage 1 operations. 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 of the Stage 1 development within the airport site. Construction outside the site, 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 to assist in assessing the noise impact.

4.1 Airports (Environment Protection) Regulations

The regulations state that noise generated from construction, maintenance or demolition of a building or other structure at an airport should not exceed 75dBA $L_{10,15min}$ at the site of a sensitive receptor. These regulations would apply to construction noise after an airport lease has been granted.

4.2 Assessment Criteria

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

Although the Airports (Environment Protection) Regulations apply to airport construction noise, these regulations do not fully describe the impact of the noise upon potentially affected residents and other uses.

The *ICNG* provides a method for managing noise levels emanating from construction sites in New South Wales. It recommends a process and noise management levels (NML) which can be used to describe the impact. 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 noise level +10dB for residential locations, noting that background noise levels in the vicinity of the airport are likely to increase before the Stage 1 airport is constructed as a result of ongoing residential, commercial and road and rail infrastructure developments. For works outside of normal construction hours, the NML is background + 5dB. The *ICNG* includes a 'highly noise affected' NML, which is set at 75dBA and represents the point at which there may be strong community reaction to noise. This noise level is equivalent to the criterion set in the Airports (Environment Protection) Regulations for construction noise.

This assessment has assumed that airport construction works occur primarily between 6.00am and 6.00pm, six days a week(R2). Some work may 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 39dBA and 49dBA for standard hours. For assessment of construction noise, a NML of 45dBA may reasonably be adopted for all residential receivers, for week-day construction. Equally, for weekend works and early morning works, an NML of 40dBA 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

4.2.2 Vibration Criteria

Potential damage from vibration caused by construction of the proposed airport is addressed in this section. In Australia, in the absence of an applicable Australian Standard, the most stringent vibration standard, the German Standard DIN 4150-3: 1999(R5), is mostly used to assess building 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

4.2.3 Blasting Criteria

During construction of the proposed Western Sydney Airport, it is possible that blasting would be carried out as part of site preparation. This section addresses the potential impact of vibration and airblast from such blasting.

During blasting, vibration is generated in the ground and this vibration may propagate to the surrounding area and cause effects upon buildings and building occupants. Ground vibration has the potential to shake buildings and cause disturbance to occupants and, at higher levels, has the potential to damage buildings.

Airblast is the air pressure wave (sometimes referred to as overpressure) which is generated as the energy of a blast is released into the atmosphere. Airblast can propagate through the air to the surrounding area and can cause effects at nearby buildings. The pressure wave may shake the building and cause disturbance to occupants. At higher levels, it can cause damage to the building, including breaking windows at very high levels.

The Australian and New Zealand Environment and Conservation Council (ANZECC) guideline – *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZECC, 1990)[R13] recommends residential criteria for the assessment of vibration and airblast from blasting. Table 4-3 summarises the criteria recommended by the ANZECC guidelines. It should be noted that the vibration criteria are higher than those set for other construction vibration because of the very short duration of blast vibration.

Table 4-3 ANZECC Recommended Vibration & Airblast Criteria

Issue	Measure	Criterion for 95% of Blasts	Criterion for 100% of Blasts
Vibration	mm/s PPV	5 mm/s	10 mm/s
Airblast	dBL Peak	115dBL	120dBL

These criteria are designed to protect the comfort of occupants of residential buildings. Higher criteria would apply if the only purpose were to avoid damage to buildings.

4.3 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 assumed for this assessment: bulk earthworks and aviation infrastructure construction. The bulk earthworks stage is expected to be the noisiest and Table 4-4 provides a summary of typical Sound Power Levels, or SWLs, (at source) of the plant which may to be used during this stage.

Table 4-4 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

4.4 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 4-5, based on the GHD Construction Planning Report(R2).

Table 4-5 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

For the purposes of this assessment, it is assumed that bulk earthworks would occur over four areas of the airport site at different times: North Sector, North-West Sector, South-West Sector and East Sector. The equipment shown in Table 4-5 has been assumed to operate in each sector at a time.

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.

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

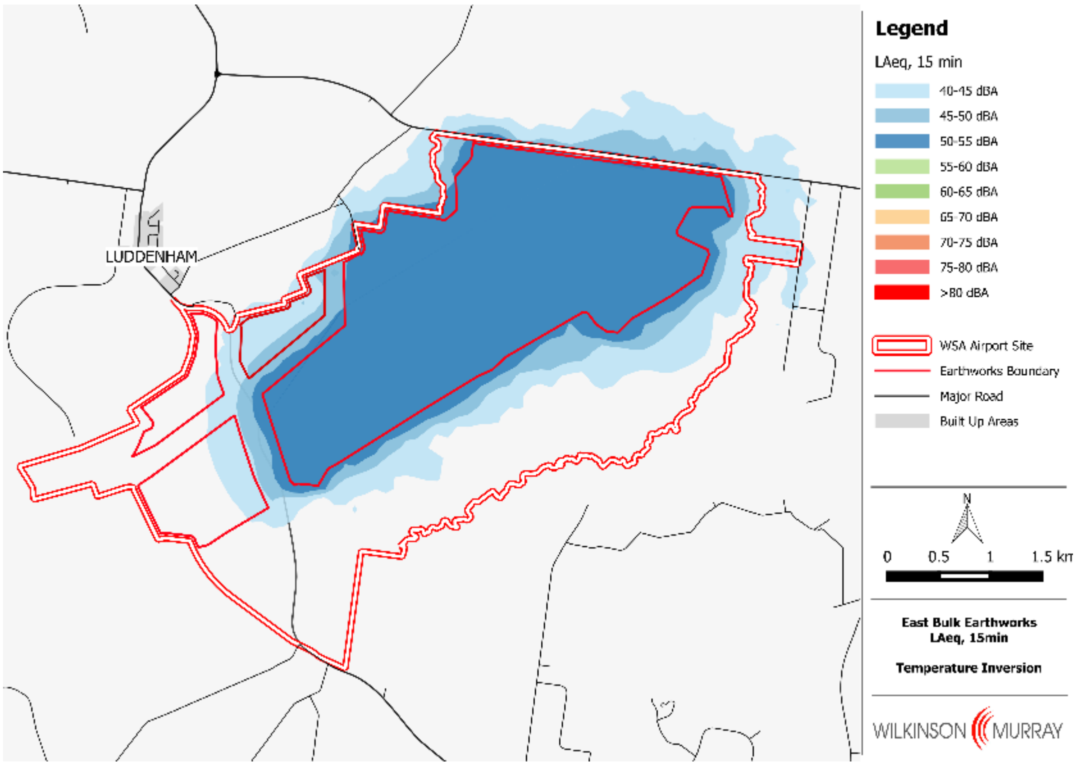


Figure 4-2 North Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Temperature Inversion

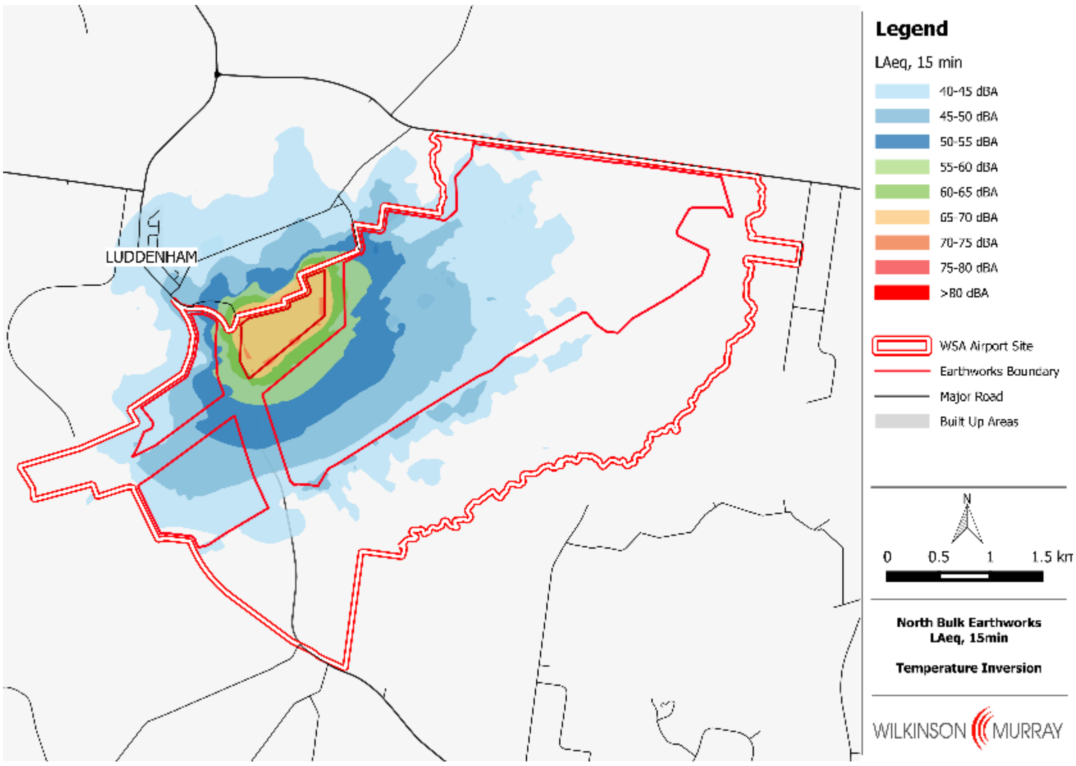


Figure 4-3 North-West Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Temperature Inversion

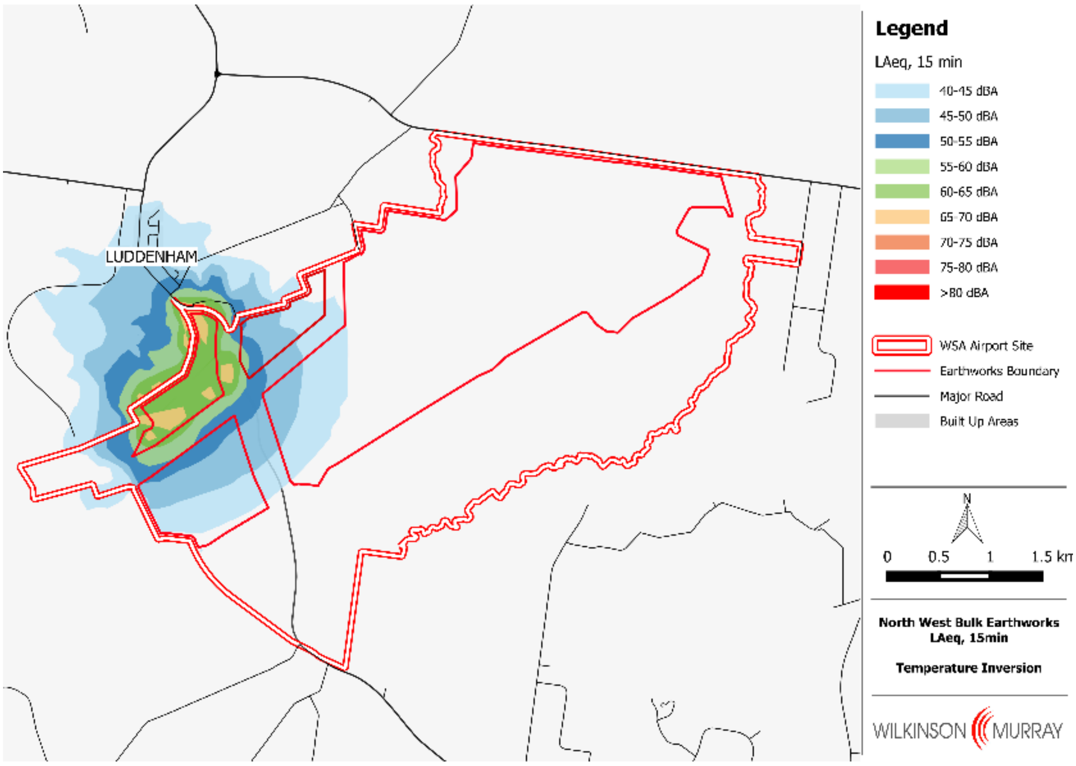


Figure 4-4 South-West Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Temperature Inversion

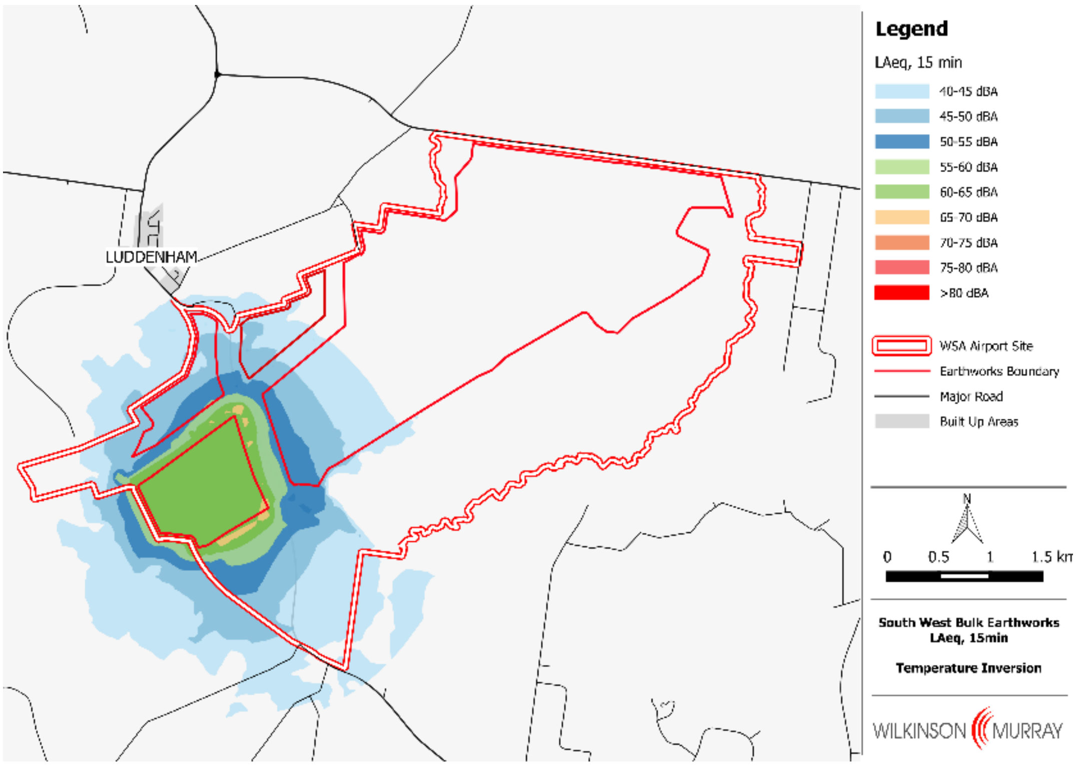


Figure 4-5 East Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Isothermal

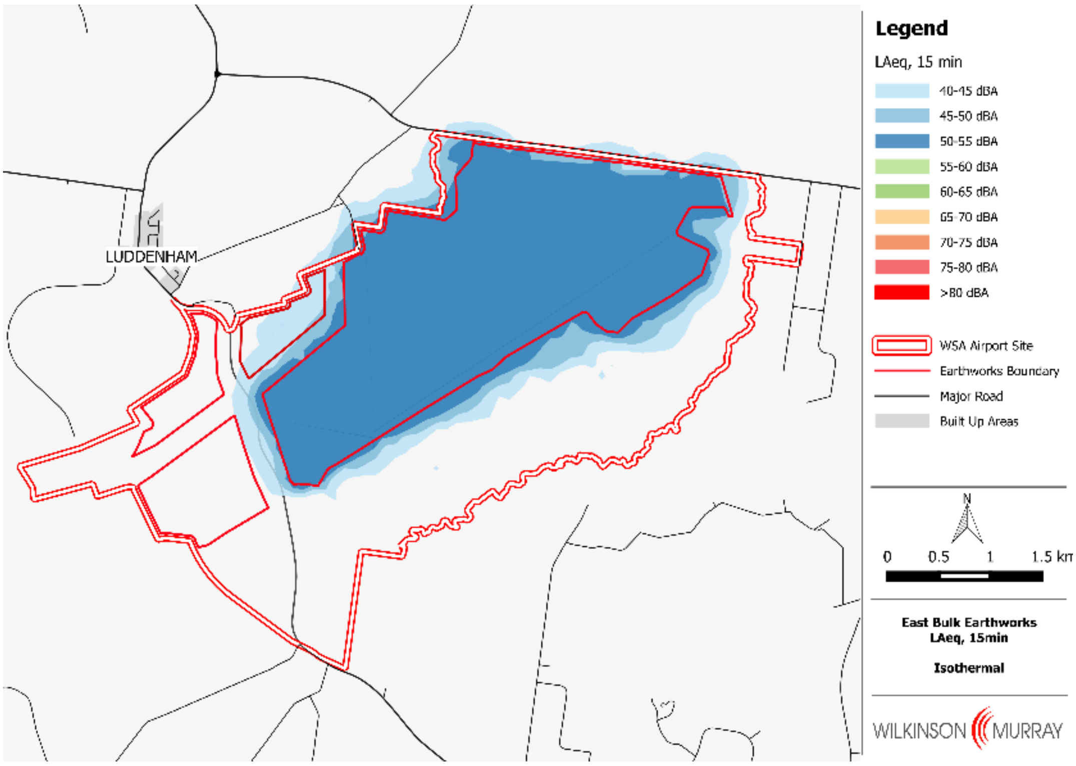


Figure 4-6 North Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Isothermal

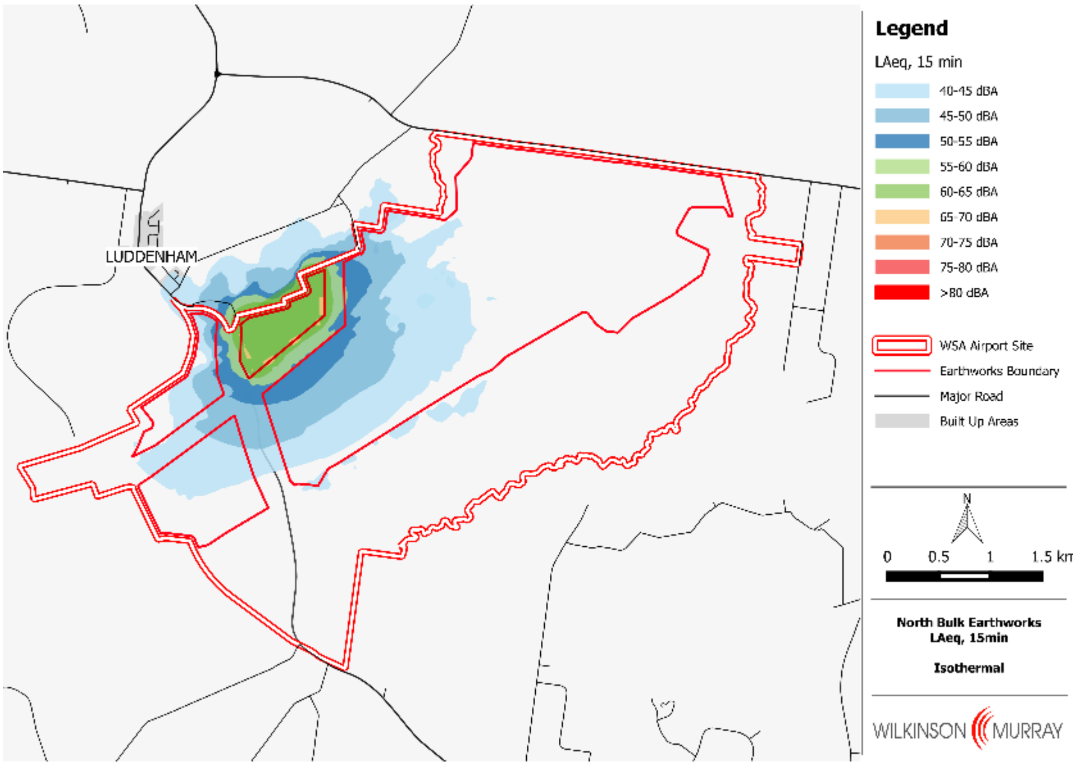


Figure 4-7 North-West Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Isothermal

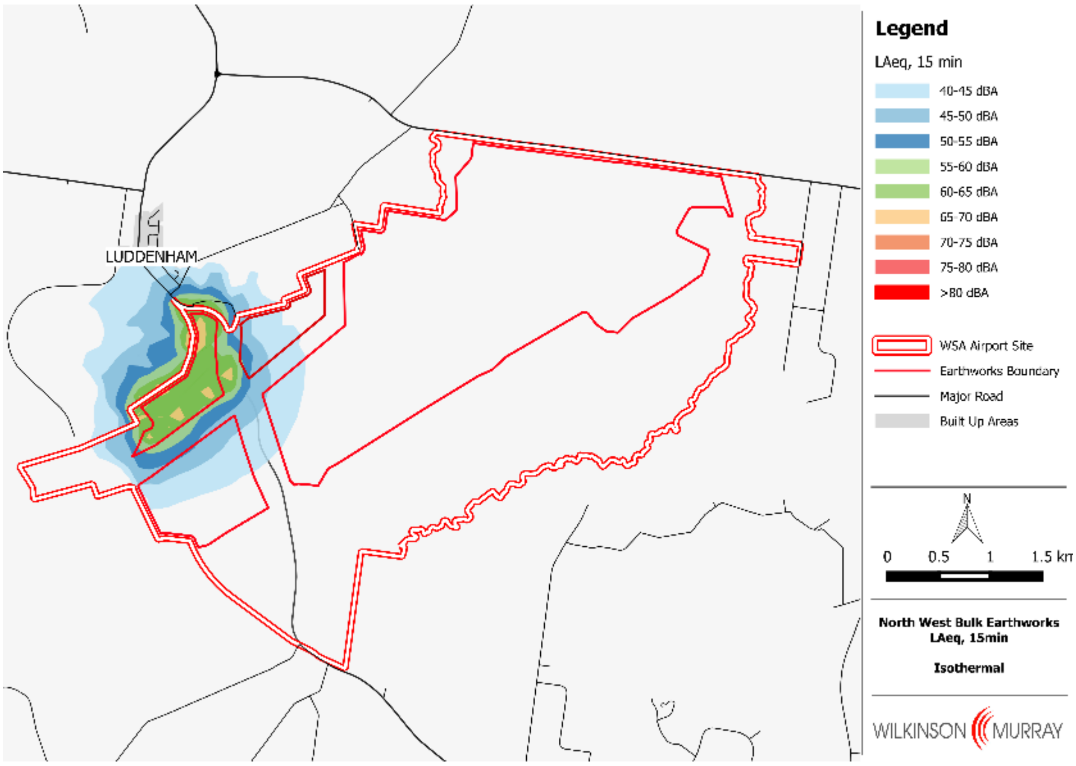
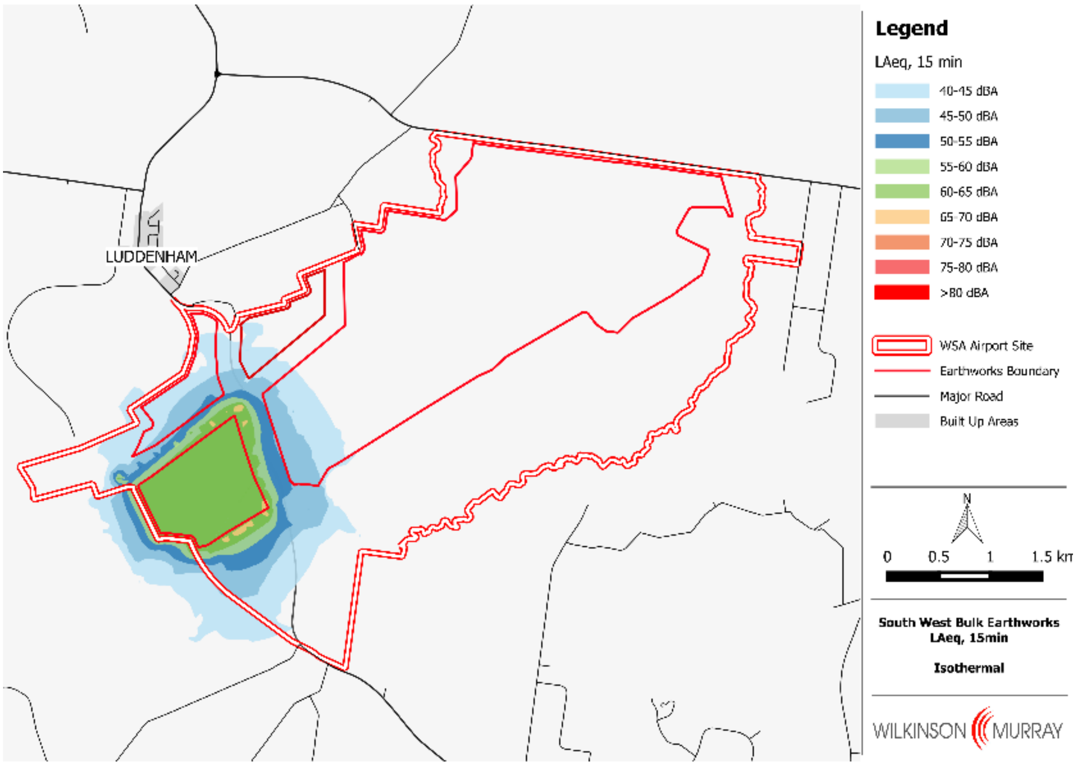


Figure 4-8 South-West Sector Bulk Earthworks $L_{Aeq,15min}$ Contours – Isothermal



4.5 Assessment of Construction Noise according to Airports (Environment Protection) Regulations

No residential receivers are predicted to be affected by construction noise levels above the acceptable criterion of 75dBA in the Airports (Environment Protection) Regulations.

4.6 Assessment of Construction Noise according to NSW *ICNG*

The total population predicted to be affected by noise levels above the NSW NML during standard construction hours is shown in Table 4-6 and outside of standard construction hours in Table 4-7. No residential receivers would be affected by construction noise above the 'highly noise affected' NML established under the *ICNG*. No other uses are predicted to be affected by construction noise levels above the relevant NMLs.

Table 4-6 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	45dBA	0
North	45dBA	103
North-West	45dBA	199
South-West	45dBA	14

Note: Population exposures are estimates only.

Table 4-7 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	40dBA	48
North	40dBA	527
North-West	40dBA	531
South-West	40dBA	140

Note: Population exposures are estimates only.

Construction noise levels above the NML are not predicted to extend far beyond the airport boundary, largely because construction noise would be generated during daytime only, with only infrequent noise being generated during non-standard hours. The localities likely to be affected by construction noise are Luddenham and Badgerys Creek.

4.7 Construction Noise Mitigation Measures

Without mitigation, noise levels from construction activities have been predicted to exceed the NSW NML 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 can be considered. The contractors responsible for the construction works should implement a plan for managing construction noise and vibration. The plan should 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;
- noise monitoring and reporting;
- communication with potentially affected residents; and
- complaints management and response.

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.

4.8 Construction Vibration Assessment

Vibration would be generated by the proposed construction works. As a very conservative approach, the lower guideline value (from DIN 4150-3) applying to vibration-sensitive buildings (3 mm/s) has been adopted as the threshold of damage from construction vibration.

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

Figure 4-9 Previously Measured Vibration Levels

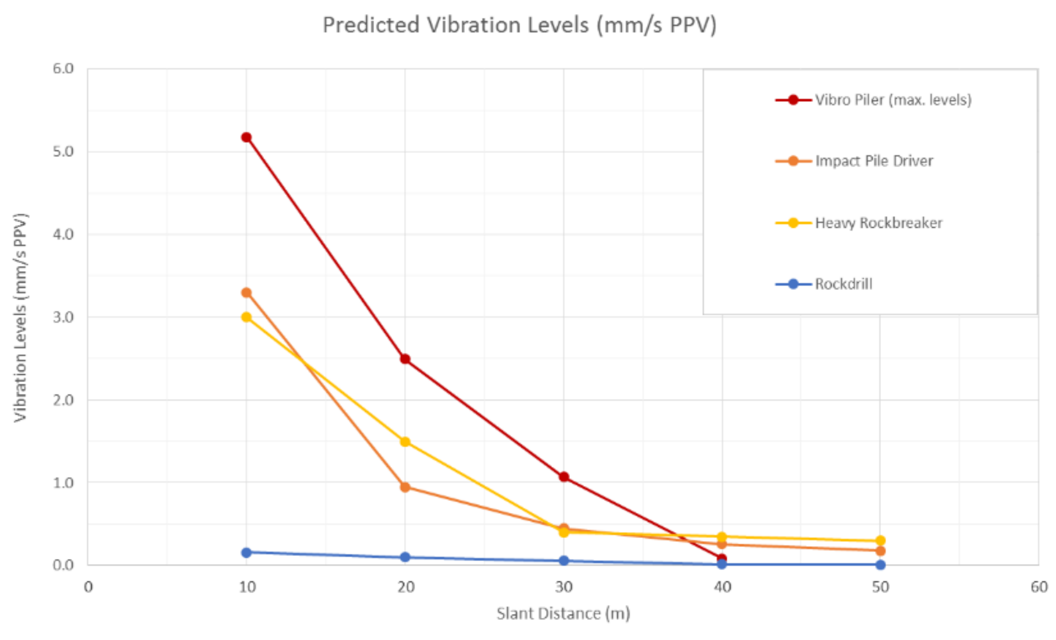


Figure 4-9 shows that the 3 mm/s value could be achieved even when using the piling method generating the highest vibration level at a distance of less than 20 m. Given that piling associated with building construction would occur well within the proposed airport boundary, there would be no risk of damage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

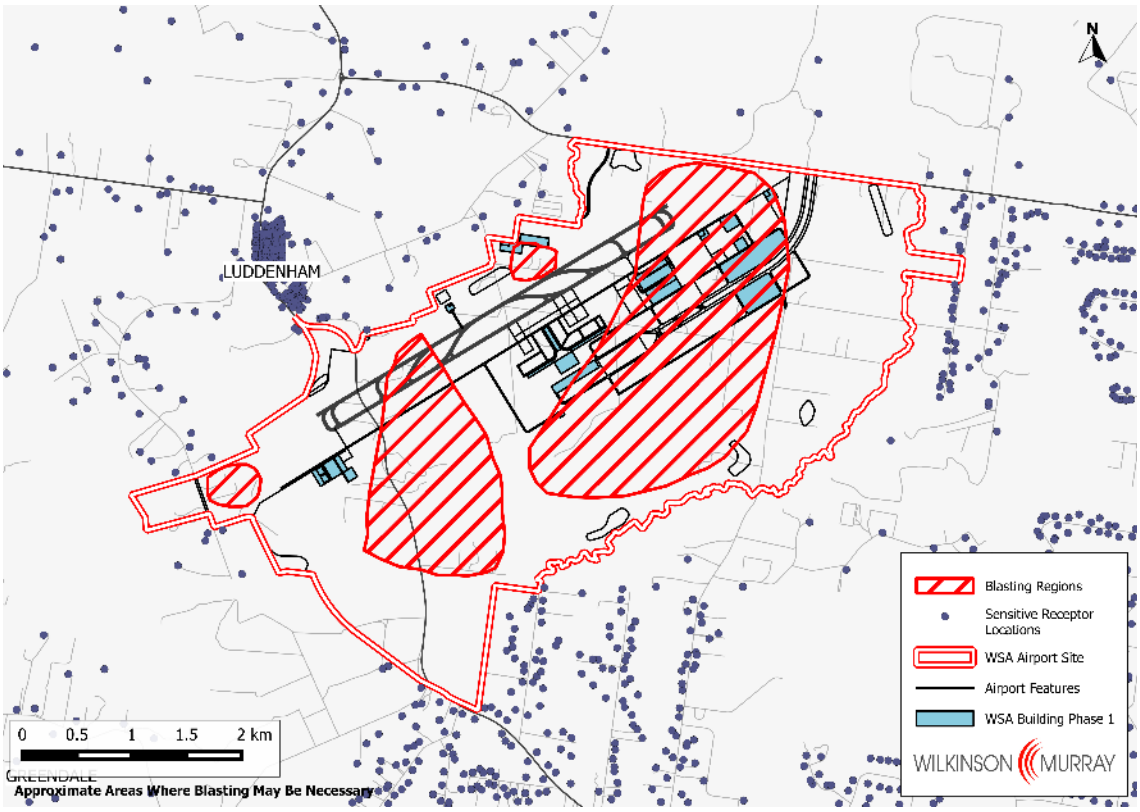
Vibration may also be generated by the ripping of rock, but again the 3 mm/s guideline value is likely to be complied with inside the airport boundary and there is no risk of damage outside the airport boundary.

4.9 Blast Vibration & Airblast Assessment

4.9.1 Possible Area of Blasting

The common Bringelly shale and Luddenham dyke found on the site at the airport can be readily ripped during site preparation. However, the isolated and thicker fine-grained sandstone deposits found throughout the site may not be able to be ripped and it is this rock which may possibly be blasted. Test bore holes have identified a number of locations where such sandstone exists in bands of more than one metre and the locations are indicated generally in Figure 4-10. However, the full extent of the fine grained sandstone deposits is not clear.

Figure 4-10 Areas where fine grained sandstone deposits have been identified



4.9.2 Blast Methods

The test boreholes indicate sandstone bands of up to 5 m, but mostly around 2 m. For this analysis, a conservative assumption of 5 m thickness has been made to define the case which is likely to generate the highest vibration and airblast levels.

For an assumed sandstone band of 5 m, it is likely that small scale bench blasting would be used and this has been assumed in the preliminary analysis. As an assumption in the absence of specific information, Table 4-8 shows likely blast parameters for bench blasting.

Table 4-8 Assumed Blast Design

Parameter	Assumed Value
Bench height	5 m
Hole spacing	2 m
Hole diameter	50 mm
Burden	2 m
Stemming	2 m
Charge per hole	5 kg

With a charge per hole of 5 kg, it is relatively practicable to fire one hole per delay setting the maximum instantaneous charge (MIC) at 5 kg.

4.9.3 Vibration & Airblast Prediction

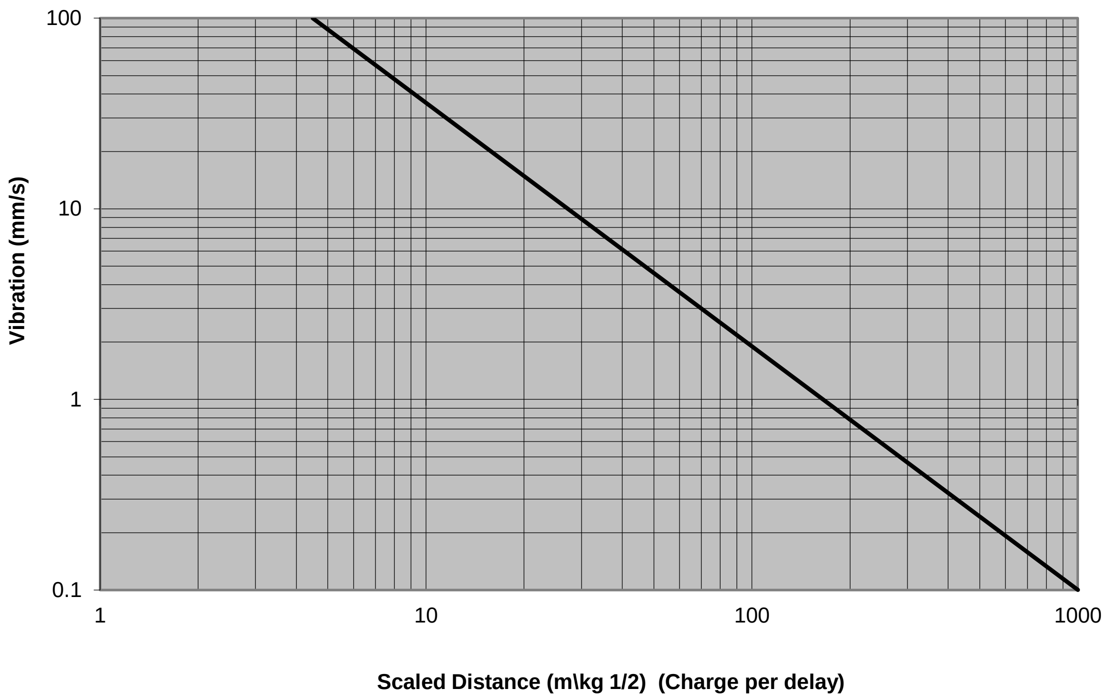
The only receivers in the vicinity of the airport which could be affected by vibration and airblast from construction blasting are residential receivers, as shown in Figure 4-10. The closest residential building would be approximately 150 m from a potential blast site. The closest receiver has been assumed in the analysis below to determine the highest level of impact.

The vibration level from blasting depends upon the distance from the blast as well as the charge, measured as the maximum instantaneous charge (MIC).

Wilkinson Murray has monitored numerous previous blasts, both large and small, and has separately carried out test blasting to obtain information to allow prediction of vibration levels. The monitoring and testing was mainly in sandstone rock.

The results of the vibration monitoring and testing have been analysed using procedures developed by the USA Bureau of Mines using scaled distance techniques. The result is a vibration prediction graph which is shown in Figure 4-11. The line in the figure allows prediction of the upper end of the range of vibration levels to be expected.

Figure 4-11 Wilkinson Murray Vibration Prediction Curve



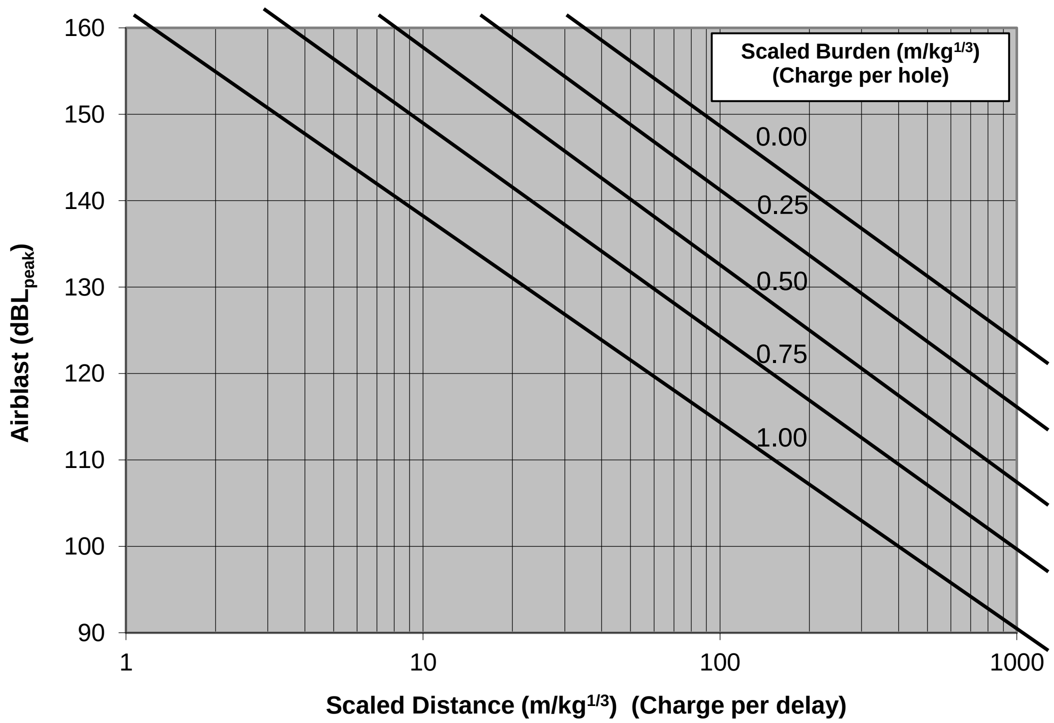
Using the graph, a level of 3.5 mm/s has been predicted at the nearest residence at 150 m, based on an MIC of 5 kg (scaled distance 67 $m/kg^{0.5}$). It is therefore concluded that the only restriction required to meet the 95% vibration criterion is to blast one hole per delay, or alternatively, to limit the MIC to 5 kg. At distances greater than 150 m, larger MIC levels would be possible.

It is important to note that the vibration criterion from blasting is higher than that for other construction blasting because of the very short duration of blast vibration.

The airblast level from a blast depends on the distance from the blast and the charge, expressed as MIC. However, the airblast level also depends upon the degree of confinement of the charge. For bench blasting, the degree of confinement is indicated by the burden and stemming depth.

The blast monitoring and testing carried out by Wilkinson Murray has allowed the airblast prediction curve in Figure 4-12 to be prepared. This figure is based on procedures developed by the USA Bureau of Mines using scaled distance and scaled burden techniques.

Figure 4-12 Wilkinson Murray Airblast Prediction Curve



Based on the assumed bench blast design, the scaled depth calculates to approximately 1 $m/kg^{1/3}$. Using this value, an airblast level of 113dBL has been predicted at a distance of 150 m to the closest residential location. This indicates that the 115dBL 95% criterion recommended by the ANZECC guidelines can be complied with if the MIC is limited to 5 kg. However, it would also be necessary to ensure that the burden and stemming were maintained at no less than 2 m. In fact, the airblast level from such construction blasting is highly dependent upon the ability of the contractor to maintain charge confinement.

It is concluded that it will be possible to ensure that vibration and airblast from construction blasting on the proposed airport site does not affect nearby sensitive receivers.

4.10 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 and the main routes used during the busiest stage of construction is identified in GHD 2015(R2). This information has been used to predict the change in road traffic noise due to construction.

The construction traffic noise levels have been calculated as described below in Section 5 (applying to operational traffic) and the calculated increases are shown in Table 4-9. 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 given the natural growth in background traffic volumes between 2011 and 2016.

Table 4-9 Construction Traffic Noise Increases on Elizabeth Drive

Road	Section	L_{Aeq} Noise Level Increase (dB)	
		Day	Night
Elizabeth Drive	West of Mamre Road	0.6	1.1
	West of Devonshire Road	0.9	0.5
	West of Lawson Road	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 levels expected from construction traffic would be less than 2dBA. 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 traffic in the vicinity of the airport site. Planning for a proposed new M12 Motorway running generally parallel to and north of Elizabeth Drive from the M7 to The Northern Road is being progressed by the NSW Government. When constructed, this motorway will 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 noise impact of the expected change in road traffic associated with operation of the proposed airport has been undertaken.

Although not considered specifically in this assessment, it is noted that noise generated from road traffic on an airport site is regulated by the Airports (Environment Protection) Regulations, which set 24 hour and night time equivalent continuous noise standards.

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 years 2030 and 2063 (Appendix J(R9)) with and without the airport. Noise levels at typical distances from these roads have been calculated using the 'Calculation of road traffic noise' procedure (*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 changes in noise level due to airport related traffic in 2030 and 2063. Table 5-1 shows that with the proposed airport there would be a decrease in road traffic noise on some roads due to proposed development of the M12 Motorway. With the airport, the expected noise level increase is less than 2dB compared to the 'without airport' scenario for the majority of roads. 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. This outcome reflects the relative proportion of airport-induced traffic as a component of the total regional traffic forecast to use these roads.

Two sections of Elizabeth Drive, part of the proposed M12 and part of Adams Road are predicted to experience an increase greater than 2dBA for both the Stage 1 and the long term development stages.

Given the large setbacks of existing dwellings adjacent to the affected roads, the road noise levels expected during Stage 1 development will still be low. For example, the closest dwelling to Elizabeth Drive is located approximately 75 m back from the road.

Table 5-1 Predicted Road Traffic Noise Level increases due to Airport Development (compared to base case of no airport) – Stage 1 and Long Term

Road	Section	Effect of Airport Development (dB Increase)			
		Stage 1		Long Term	
		Day	Night	Day	Night
Mamre Road	Mamre Road north of Elizabeth Drive	1.2	0.4	1.8	1.9
	Mamre Road north of Mount Vernon Road	0.4	-0.4	0.2	-0.2
	Mamre Road north of Abbotts Road	0.6	-0.4	0.4	0.1
	Mamre Road north of Bakers Lane	0.4	-0.4	0.2	0.0
	Mamre Road north of Erskine Park Road	0.5	-0.4	0.1	-0.2
	Mamre Road north of Luddenham Road	0.6	-0.3	0.2	-0.1
	Mamre Road north of Banks Drive	0.4	-0.4	0.2	0.0
Luddenham Road	Luddenham Road south of South Creek	0.2	0.1	0.6	0.9
	Luddenham Road south of Twin Creeks Golf Club	0.7	-0.5	0.9	-0.2
Elizabeth Drive	Elizabeth Drive west of Mamre Road	0.5	0.1	1.9	1.7
	Elizabeth Drive west of Devonshire Road	0.7	0.3	**2.1**	1.5
	Elizabeth Drive west of Lawson Road	1.9	**2.1**	**3.5**	**4.2**
	Elizabeth Drive west of Badgerys Creek Road	0.7	0.3	1.3	1.3
	Elizabeth Drive west of Adams Road	0.7	0.3	1.5	1.1
	Elizabeth Drive west of The Luddenham Road	0.4	-0.2	0.4	0.7
Camden Valley Way	Camden Valley Way west of M7	0.2	-0.2	0.1	0.0
	Camden Valley Way west of Croatia Avenue	0.2	-0.2	0.1	0.0
	Camden Valley Way west of Talana Drive	0.1	-0.2	0.1	0.0
	Camden Valley Way south of Bringelly Road	0.6	-0.3	0.1	0.0
Bringelly Road	Bringelly Road west of Cowpasture Road	0.2	-0.2	0.2	0.0
	Bringelly Road east of Edmondson Avenue	0.2	-0.2	0.2	-0.1
	Bringelly Road west of Fourth Avenue	0.1	-0.2	0.1	0.0
	Bringelly Road west of King Street	0.1	-0.2	0.1	0.0
	Bringelly Road west of Allenby Road	0.1	-0.2	0.1	0.0
	Bringelly Road west of Kelvin Park Drive	0.1	-0.2	0.0	0.0
Adams Road	Adams Road south of Elizabeth Drive	0.3	-0.2	**2.1**	0.7
	Adams Road west of Anton Road	0.3	-0.2	**2.0**	0.7
	Adams Road west of Jamison Street	0.3	-0.1	1.5	0.5
Erskine Park Road	Erskine Park Road north of Explorers Way	0.2	-0.2	0.2	0.1
	Erskine Park Road north of Bennet Road	0.3	-0.2	0.2	0.2
	Erskine Park Road north of Lenore Drive	0.3	-0.2	0.3	0.2
	Erskine Park Road east of Mamre Road	0.4	-0.3	0.1	0.2

Road	Section	Effect of Airport Development (dB Increase)			
		Stage 1		Long Term	
		Day	Night	Day	Night
The Northern Road	The Northern Road north of Homestead Road	0.0	-0.1	-0.8	0.0
	The Northern Road south of Glenmore Parkway	0.1	0.0	-0.8	0.4
	The Northern Road north of Kings Hill Road	0.2	-0.1	-0.7	0.6
	The Northern Road north of Littlefields Road	0.2	0.0	-0.7	0.7
	The Northern Road north of Elizabeth Drive	0.1	0.2	-0.7	0.8
	The Northern Road north of Park Road	0.2	-0.1	-1.0	-0.1
	The Northern Road north of Adams Road	-0.7	-0.8	-0.2	-3.3
	The Northern Road north of Badgerys Creek Road	0.5	-0.3	0.6	0.8
	The Northern Road north of Bringelly Road	0.4	-0.3	0.4	0.6
	The Northern Road north of Carrington Road	0.1	0.0	0.0	0.1
	The Northern Road north of Northern Road	0.3	-0.2	0.1	0.0
	The Northern Road north of Cobbity Road	0.2	-0.2	0.0	0.0
	The Northern Road north of Hillside Drive	0.3	-0.2	0.0	-0.1
	The Northern Road north of The Old Northern Road	0.3	-0.3	-0.1	-0.2
	The Northern Road north of Camden Valley Way	1.2	-0.5	0.0	0.1
Narellan Road	Narellan Road west of Hume Highway	0.3	-0.4	0.0	0.0
	Narellan Road west of Hartley Road	0.2	-0.4	0.0	0.0
	Narellan Road west of Camden Bypass	0.4	-0.4	0.1	0.0
	Narellan Road east of Camden Valley Way	0.4	-0.4	0.1	0.0
Wallgrove Road	Wallgrove Road north of Wonderland Drive	0.6	-0.4	0.2	0.2
	Wallgrove Road north of Old Wallgrove Road	0.2	-0.2	0.0	0.5
	Wallgrove Road north of Redmayne Road	0.1	0.0	0.3	0.3
	Wallgrove Road north of Horsley Drive	0.1	-0.1	0.3	0.3
	Wallgrove Road north of Elizabeth Drive	0.3	-0.3	0.4	0.3
M7	M7 south of M4	1.9	0.1	0.1	-0.1
	M7 south of Old Wallgrove Road	1.6	0.2	0.1	0.0
	M7 north of Redmayne Road	0.8	0.0	0.1	0.0
	M7 north of Elizabeth Drive	1.4	0.0	0.0	0.0
	M7 north of Cowpasture Road	1.3	0.0	-0.1	0.0
	M7 north of Hoxton Park Road	1.5	0.1	-0.2	0.0
	M7 north of Kurrajong Road	1.6	0.2	-0.1	-0.1
	M7 north of Camden Valley Way	1.6	0.2	-0.1	-0.1
	M7 north of Brooks Road	1.2	0.0	0.0	-0.1
	M7 north of Campbelltown Road	0.9	0.0	0.0	0.0
	M7 north of Campbelltown Road	0.9	0.0	0.0	0.0
M31	M31 north of Narellan Road	0.9	0.0	0.0	0.0
M4	M4 west of M7	0.9	-0.1	0.1	0.0
	M4 west of Roper Road	0.6	-0.2	0.2	0.1
	M4 west of Mamre Road	0.5	-0.2	0.1	0.0
	M4 east of The Northern Road	0.6	-0.3	0.4	0.0
	M4 west of The Northern Road	0.5	-0.3	0.0	0.0
M12	M12 west of M7	0.0	1.0	-0.4	1.5
	M12 west of Mamre Road	0.6	**2.4**	**2.6**	**6.2**
	M12 west of Airport Access	0.3	1.9	1.8	**5.4**

Note: Source of traffic volumes – Appendix J.

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 3-3 and Figure 3-5 for Stage 1 operations.

Under worst-case conditions, engine ground 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 include Luddenham, Badgerys Creek, Bringelly, Wallacia and Greendale. Residences in these localities would be affected by these noises along with some schools and other educational institutions, places of worship, and passive and active recreation areas.

In reality, for any individual engine run, not all of the above areas would be affected to the degree shown in Figure 3-3. 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. Limiting the use of high power engine runs during night time to special circumstances where they are absolutely necessary, as is the case at many major airports in Australia, is a strategy that should be considered in preparing a noise management plan for the proposed airport. 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 10dB in areas close to the airport.

If, based on operational experience, this source of noise is found to cause unacceptable impacts, it may also be possible to construct a large enclosure around the run-up area to shield the surrounding area from noise. Such an enclosure may be able to be used at night, resulting in a possible noise reduction of approximately 10dB.

Aircraft taxiing would generate relatively lower noise levels. Noise from aircraft taxiing would primarily affect Luddenham village.

The design for the proposed airport is indicative, and the noise levels resulting from ground-based activities are expected to be further considered closer to the commencement of operations based on the detailed design and layout of airport infrastructure. Some controls on 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 is expected to commence operations in the mid 2020s. By this time, technological improvements and 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 plan for the proposed airport will be developed in consultation with the community and other stakeholders prior to the commencement of operations. This plan will be developed in parallel with the detailed airport design so that the local community and other important stakeholders are 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 mitigate construction noise impacts, a plan for managing construction noise and vibration should be developed prior to main construction works. This plan should address construction hours, equipment noise controls, noise monitoring and reporting, and complaint / response procedures.

Preliminary analysis indicates that blasting may need to be carried out close to residences (as close as 150 m). In order to meet the ANZECC vibration and airblast criteria, in such circumstances the MIC should be restricted to a maximum of 5 kg and the charge should be well confined by strictly maintaining the burden and stemming (or charge depth) to 2 m. This finding is preliminary, being based on only limited information at this early stage in the planning process, and further more detailed analysis of blast vibration and airblast would be required prior to the commencement of blasting.

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.

Road traffic noise levels with and without an airport were compared to determine the impact of airport related traffic. During operation of the proposed airport, road traffic noise level increases in the surrounding area due to airport traffic are predicted to be small for the majority of roads. However, airport traffic is expected to increase total traffic noise levels by more than 2dB for section of Elizabeth Drive, Adams Road and the proposed M12 Motorway, which is expected to be the principal road access for the airport. For existing roads and proposed future motorways, the noise impacts of traffic would be incorporated into the planning and assessment processes and mitigation provided as required at that time.

7 REFERENCES

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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.

(Liner) Z-Weighted Noise Level (dBL) – This is a value representing the loudness of a sound at a specific time across all sound frequencies. This level is un-weighted and is useful in measuring low frequency sound.

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.

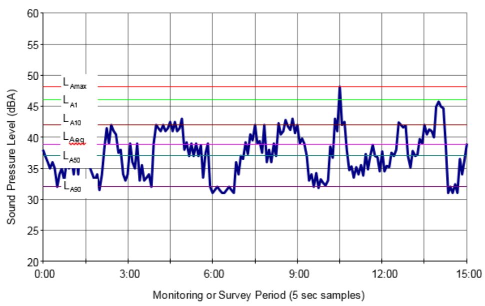
L_{A90} – The L_{A90} level is the A-weighted noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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



BLASTING TERMINOLOGY

Delay – The delay (often called millisecond delay) is the interval of time between the ignition of two consecutive charges. Delays are often used in blasting to ensure that all separate charges in the blast are not ignited simultaneously.

Burden – The distance from the free rock face to the charge.

Stemming – The fill material placed in a blast hole on top of the charge.

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.

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

Long 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) is issued by the NSW Department of Environment and Climate Change and recommends Noise Management Levels (NMLs) to manage construction noise levels at noise sensitive receivers. Where construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices are applied 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 indicative layout 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

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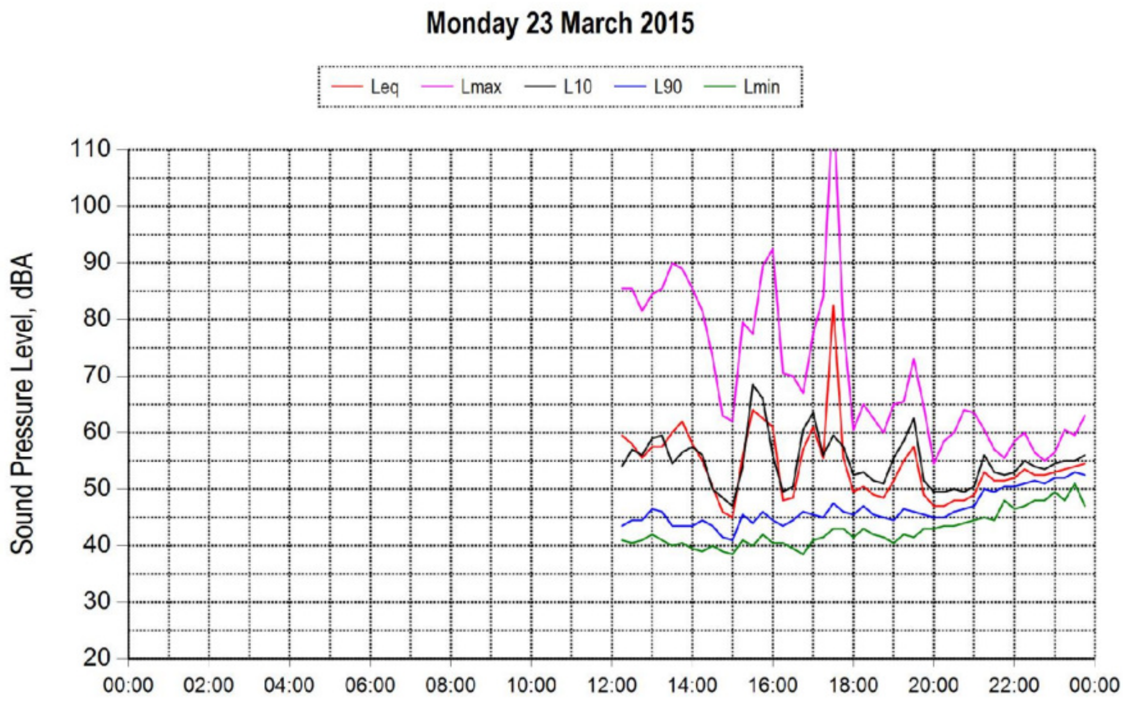

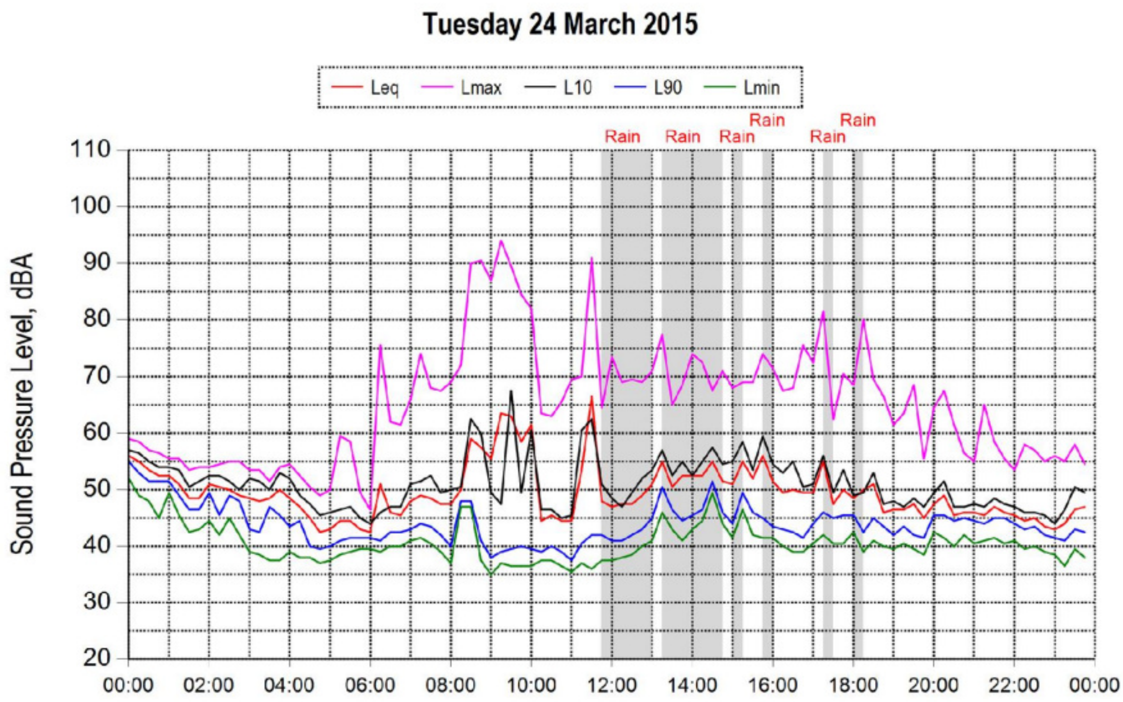

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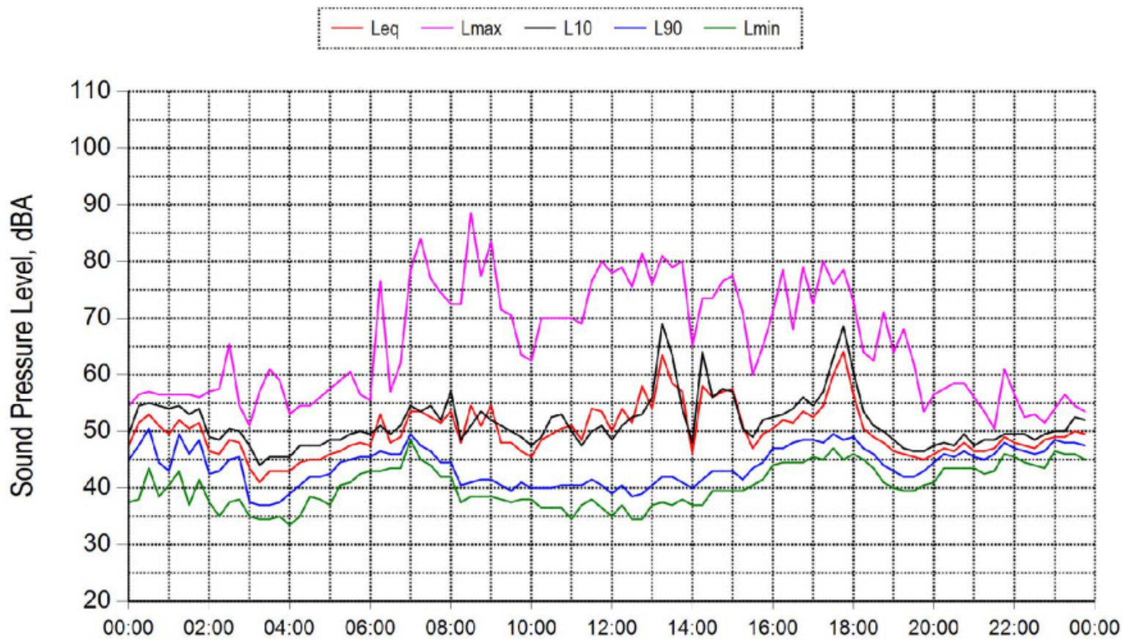

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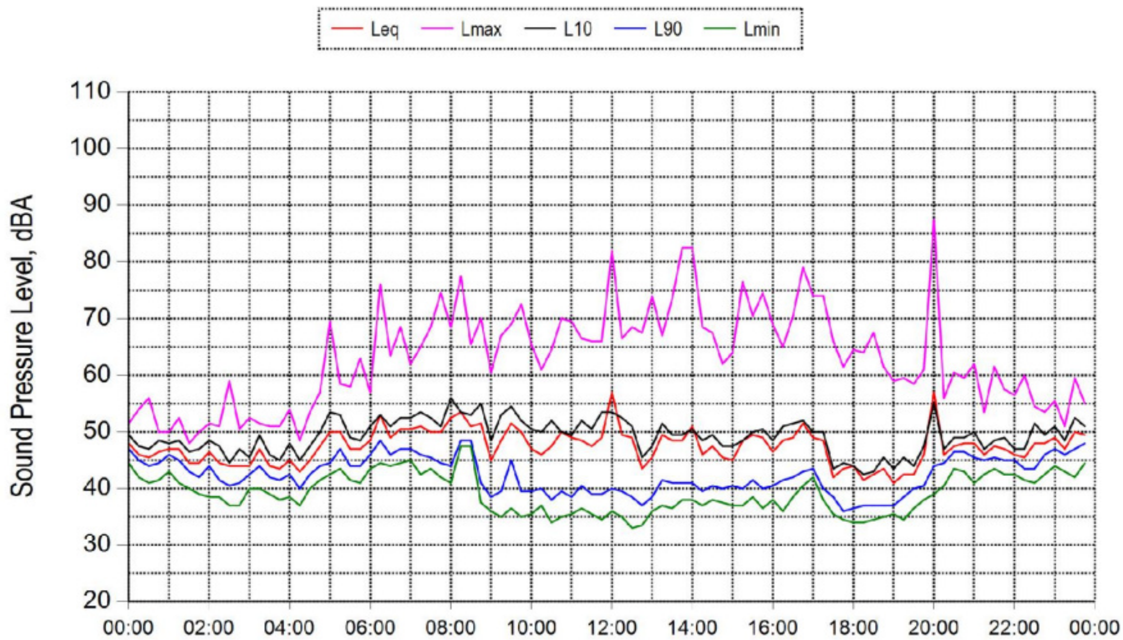

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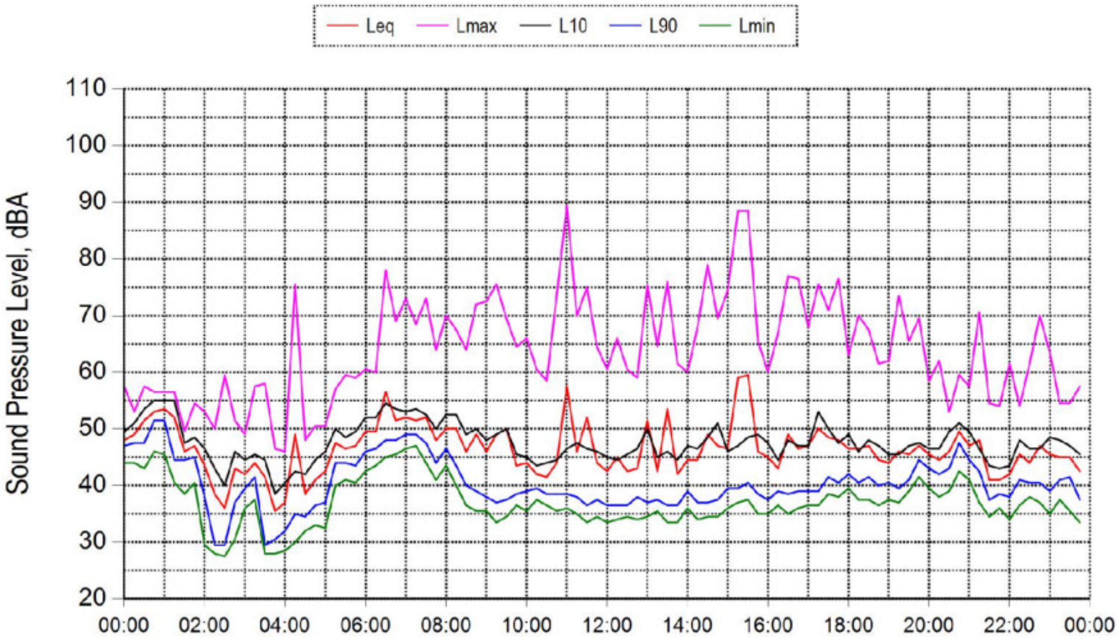

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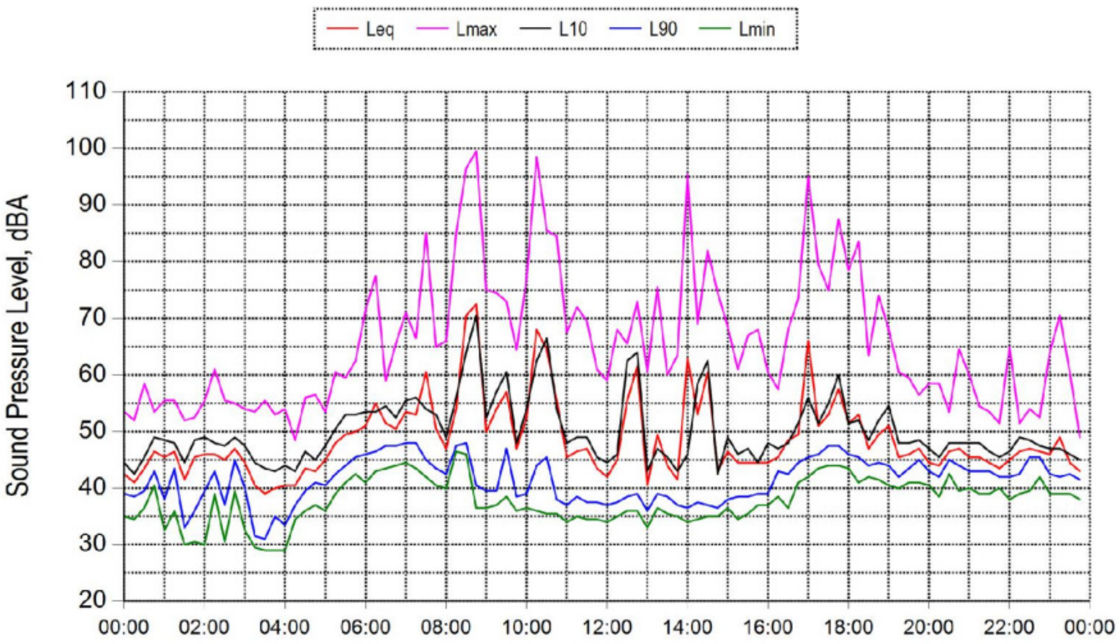

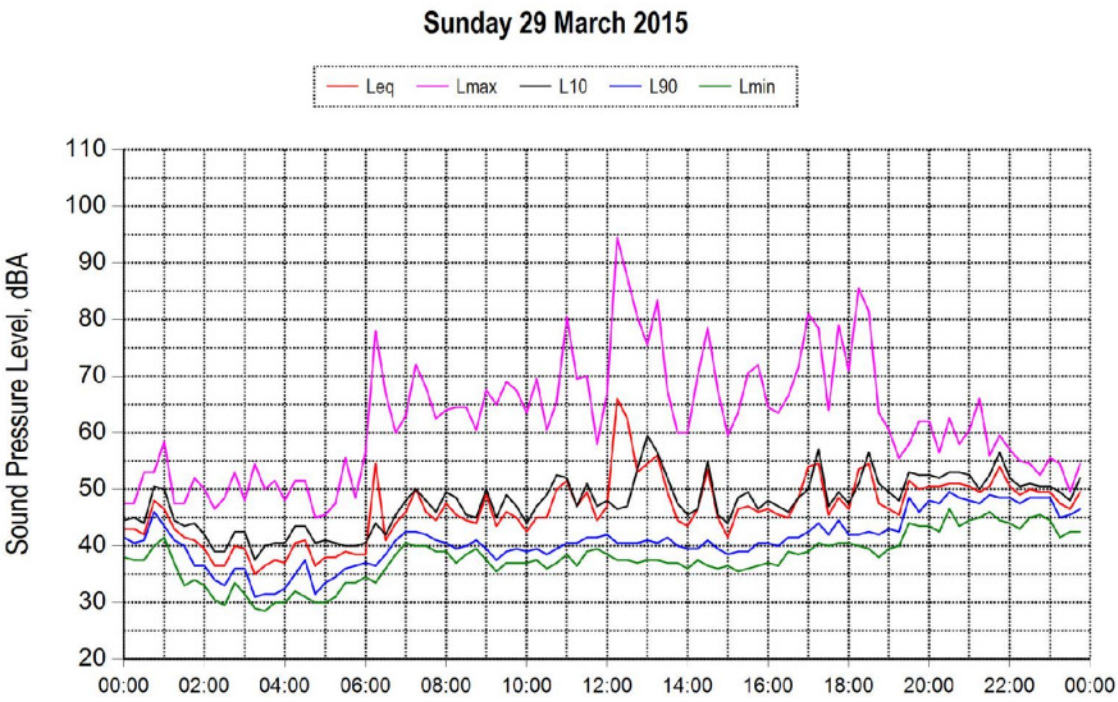
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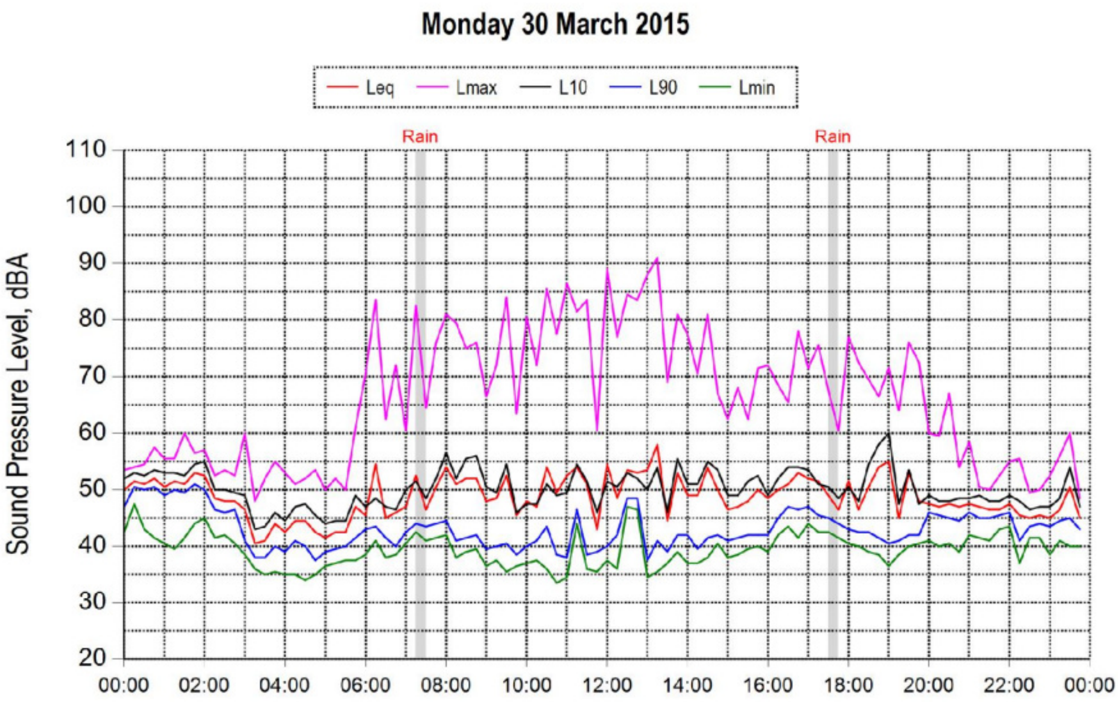
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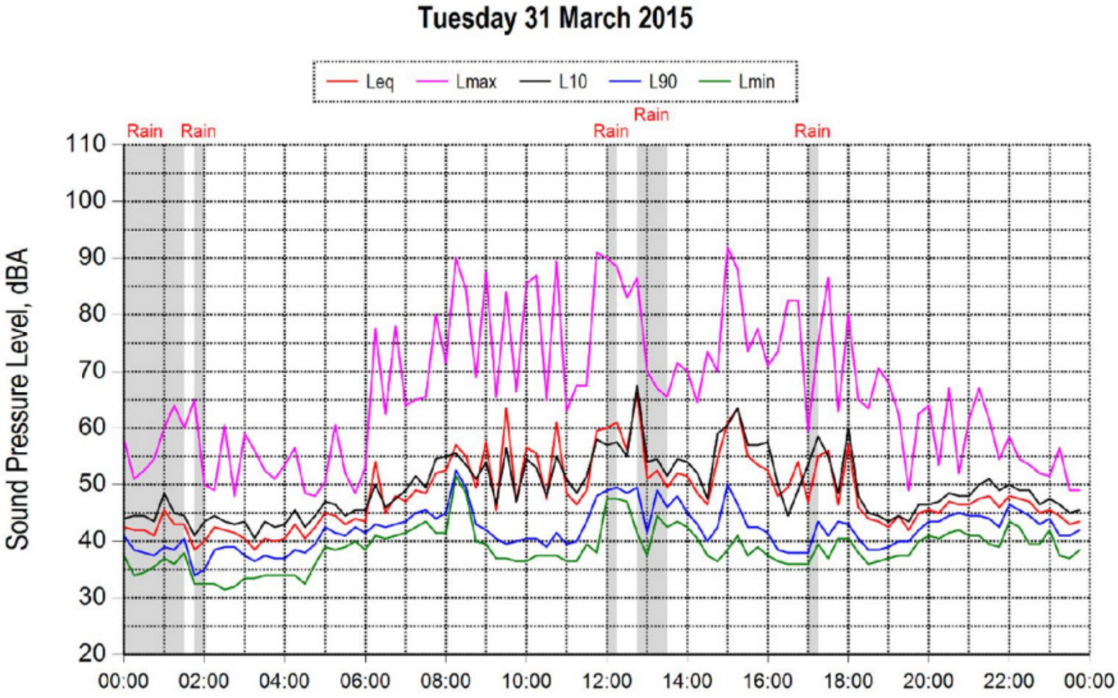
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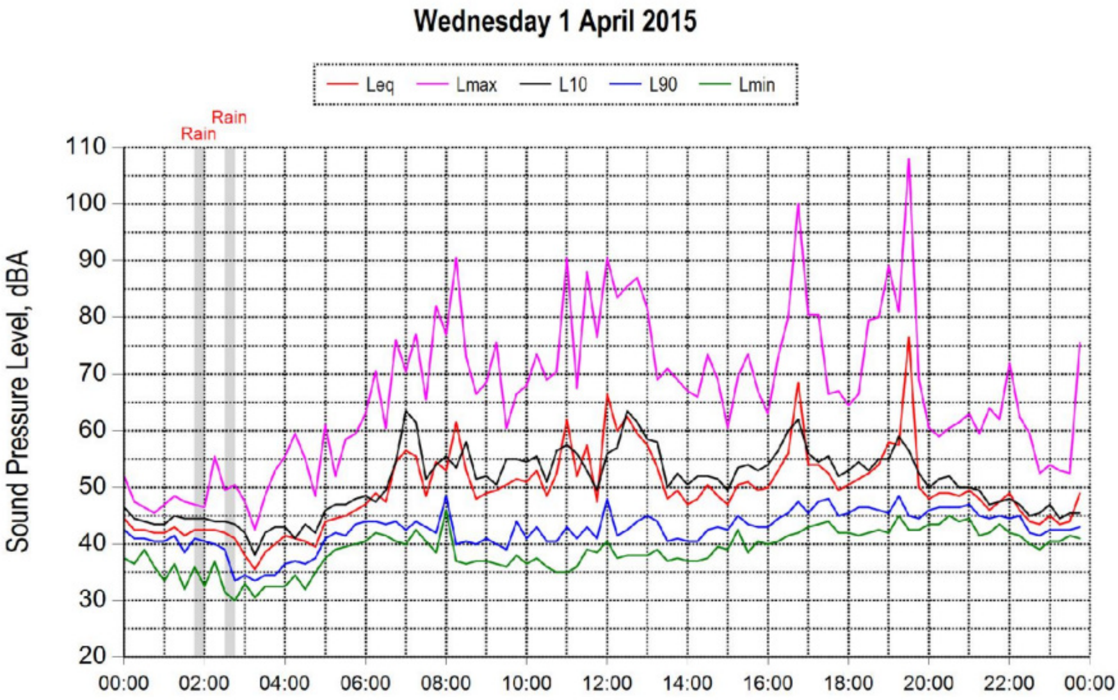
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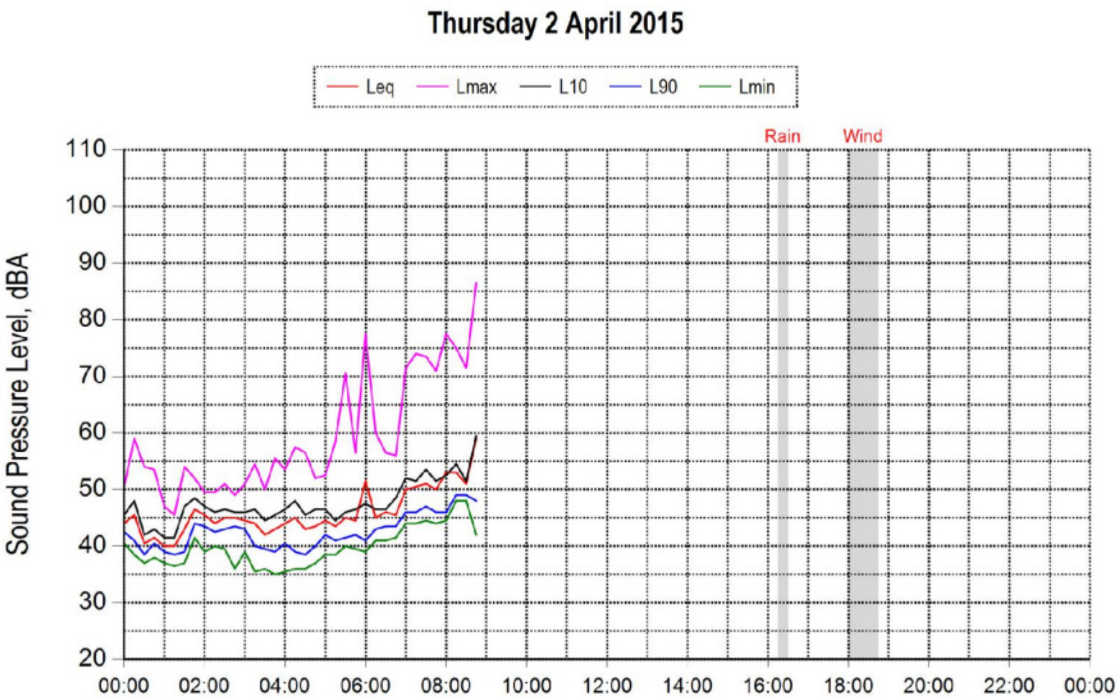
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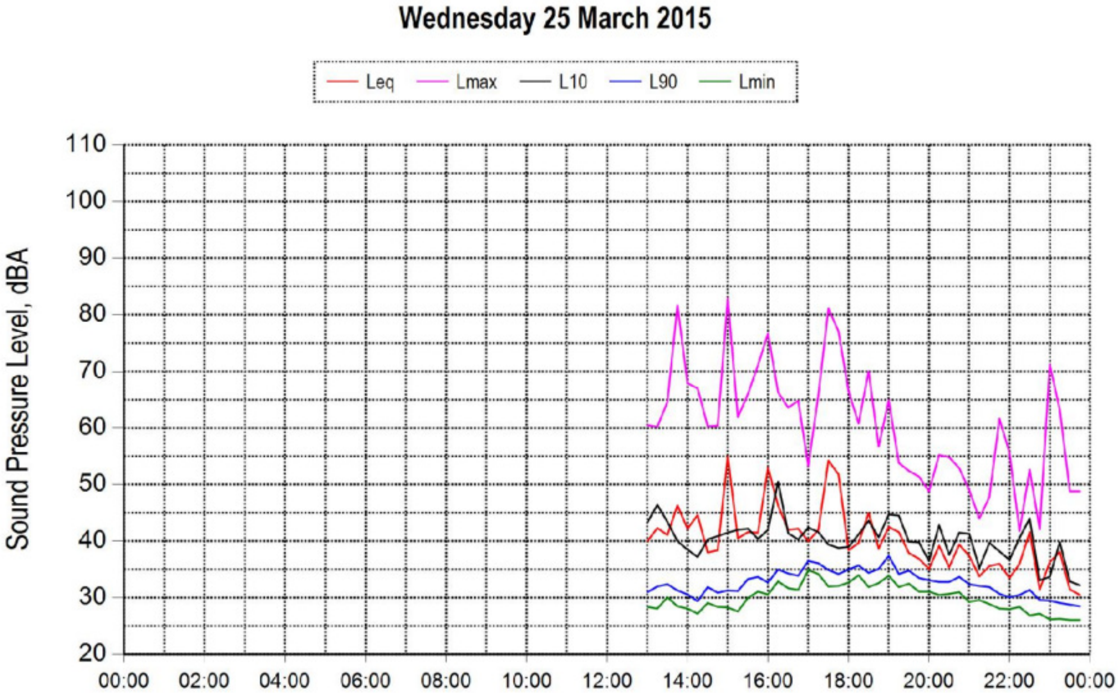
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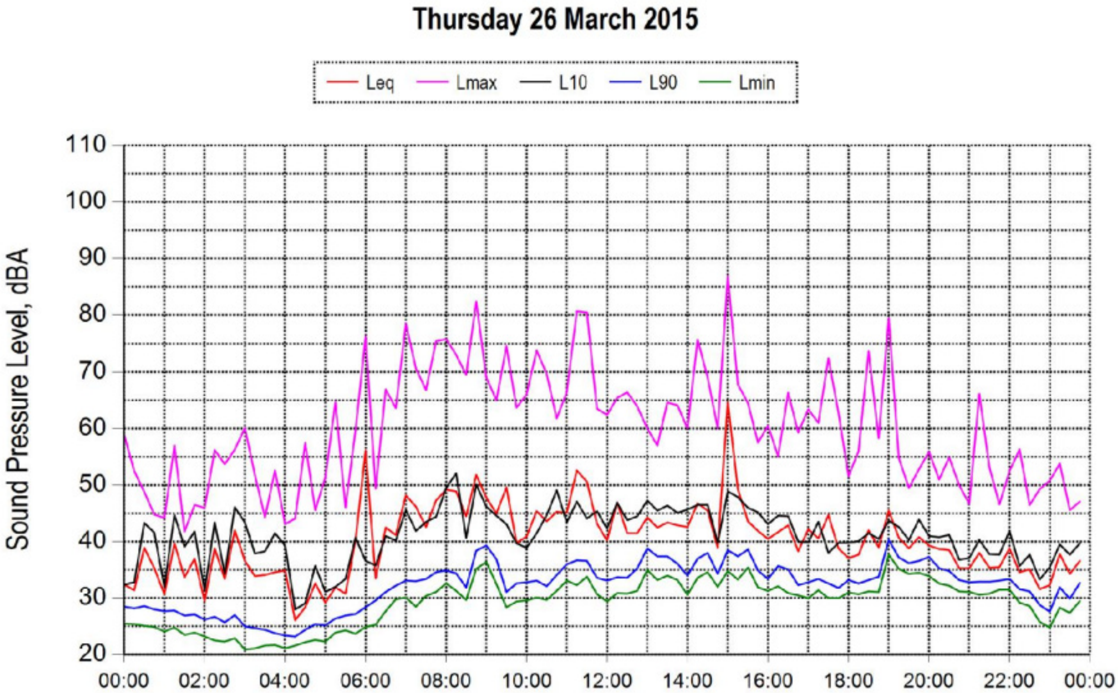
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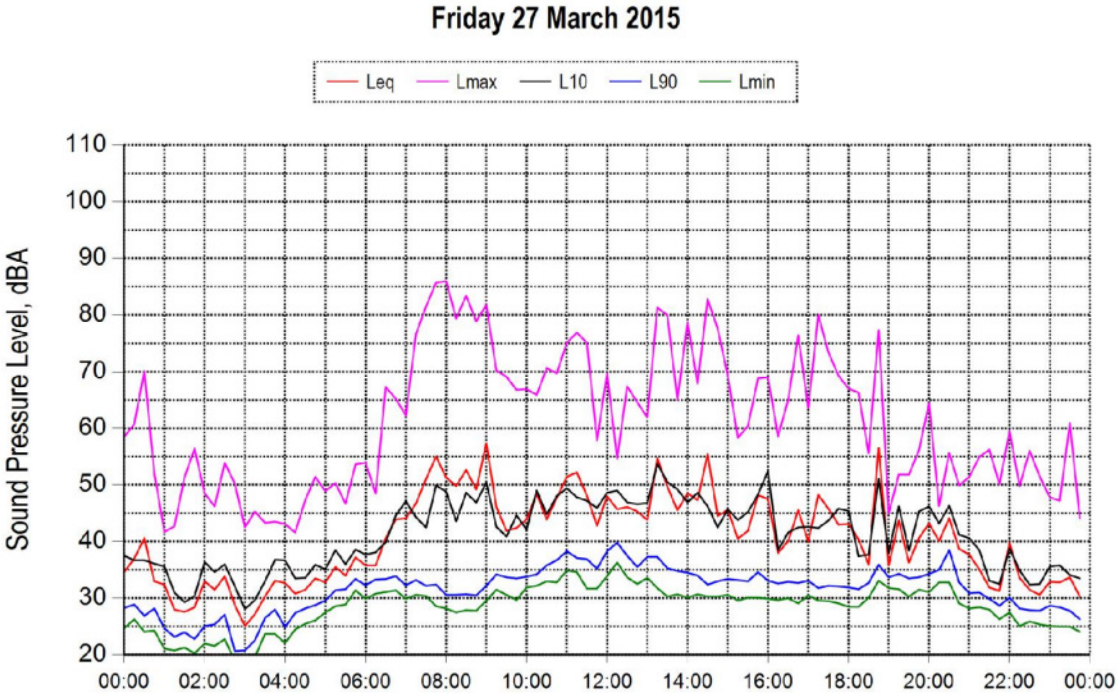
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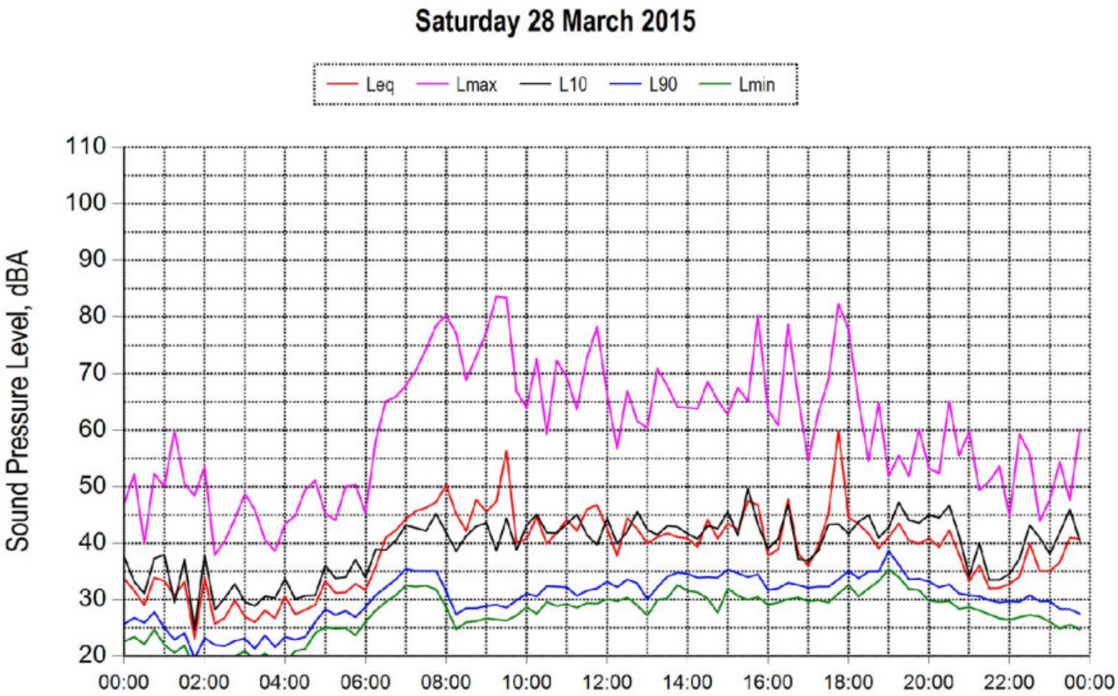
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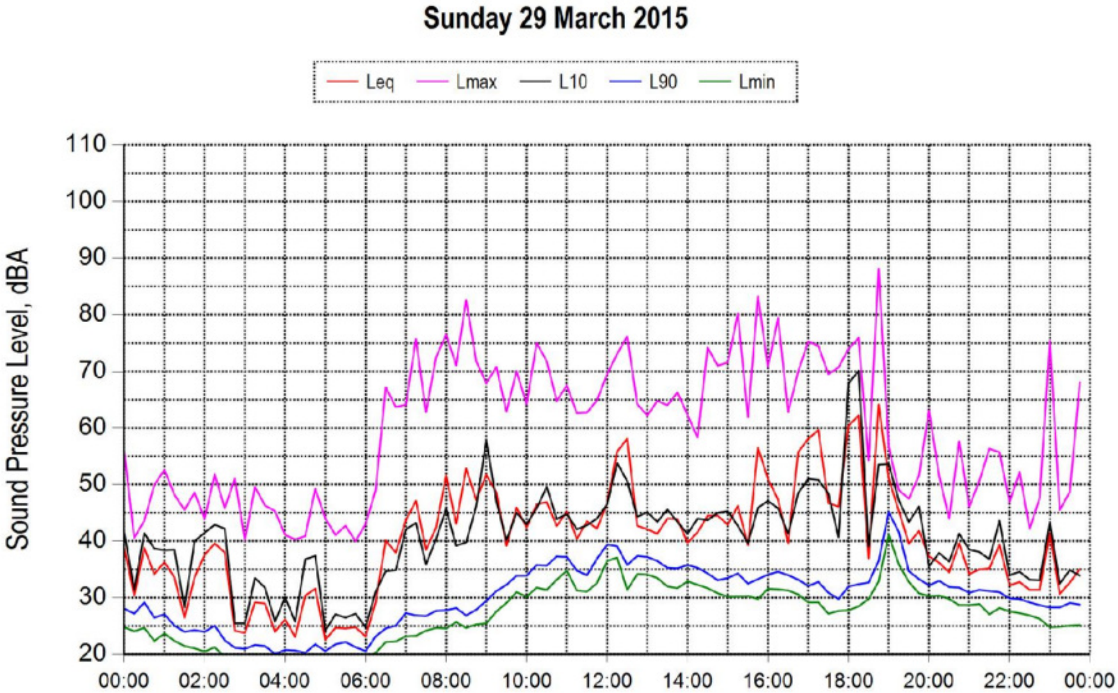
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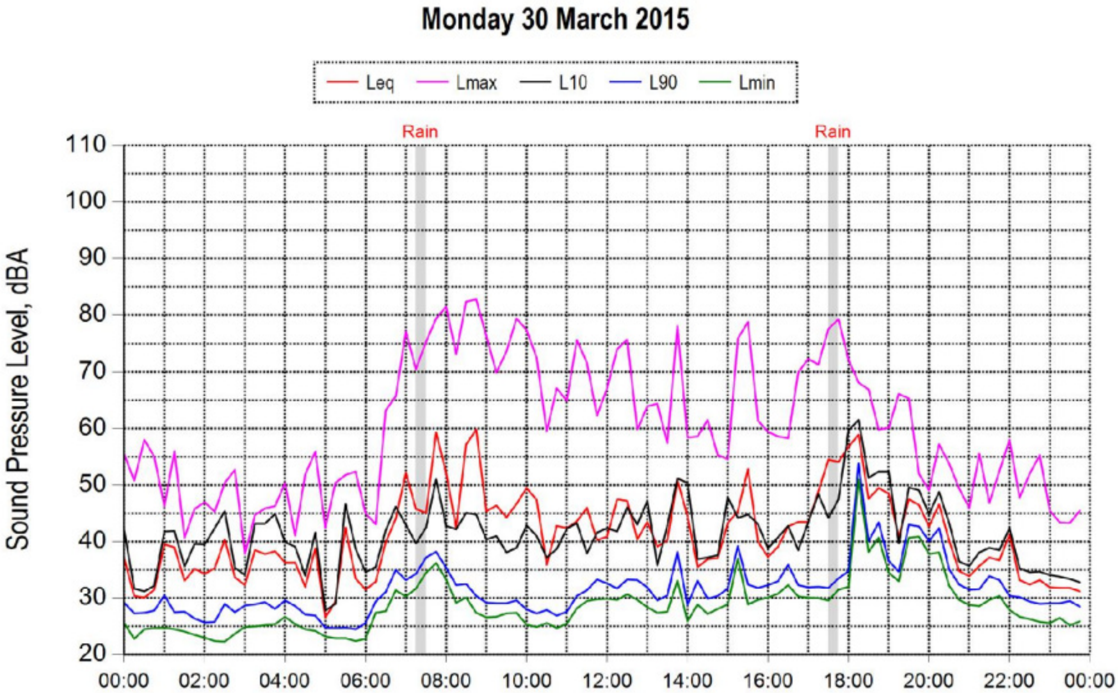
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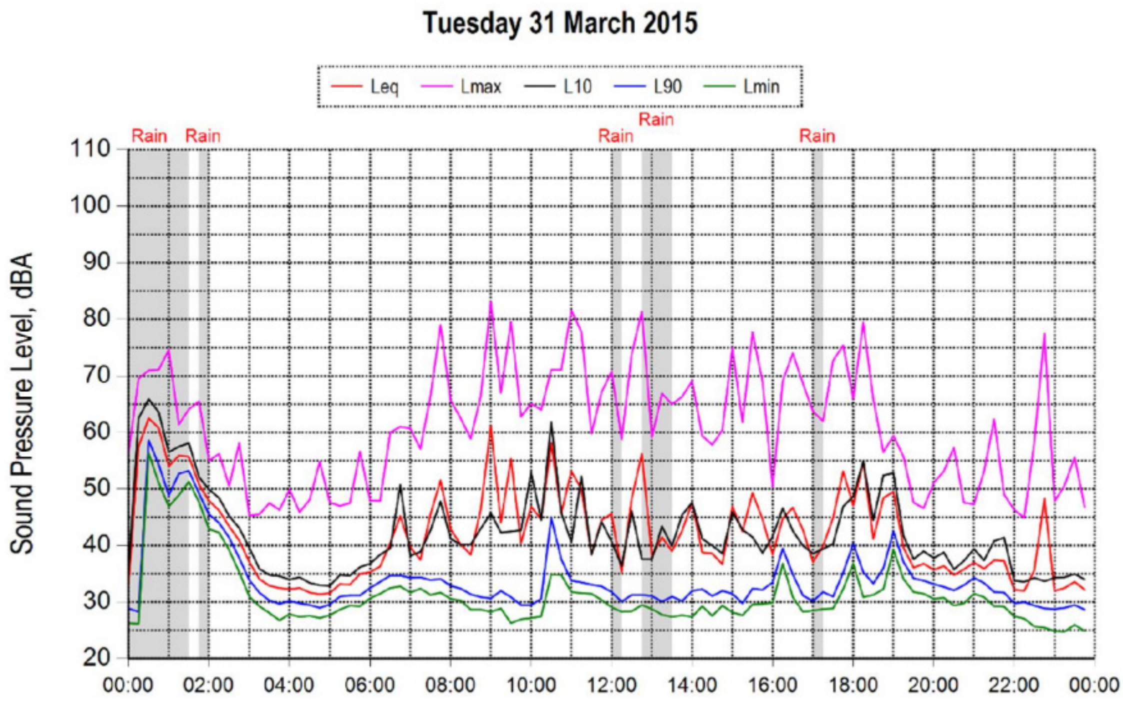

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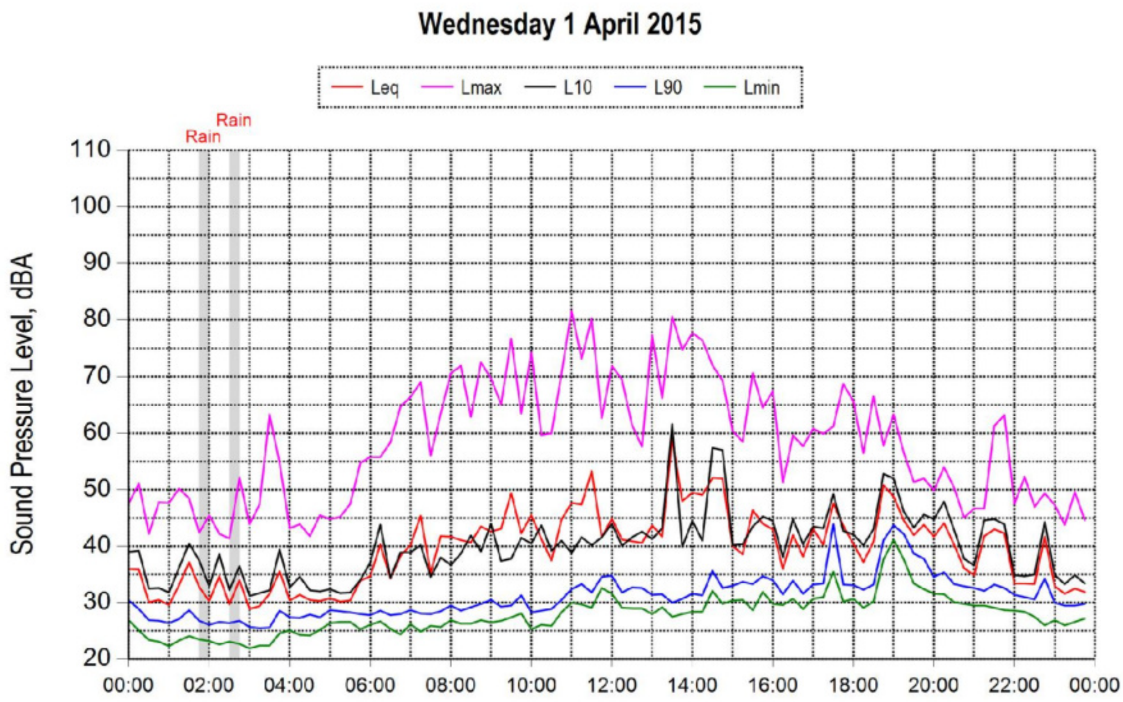

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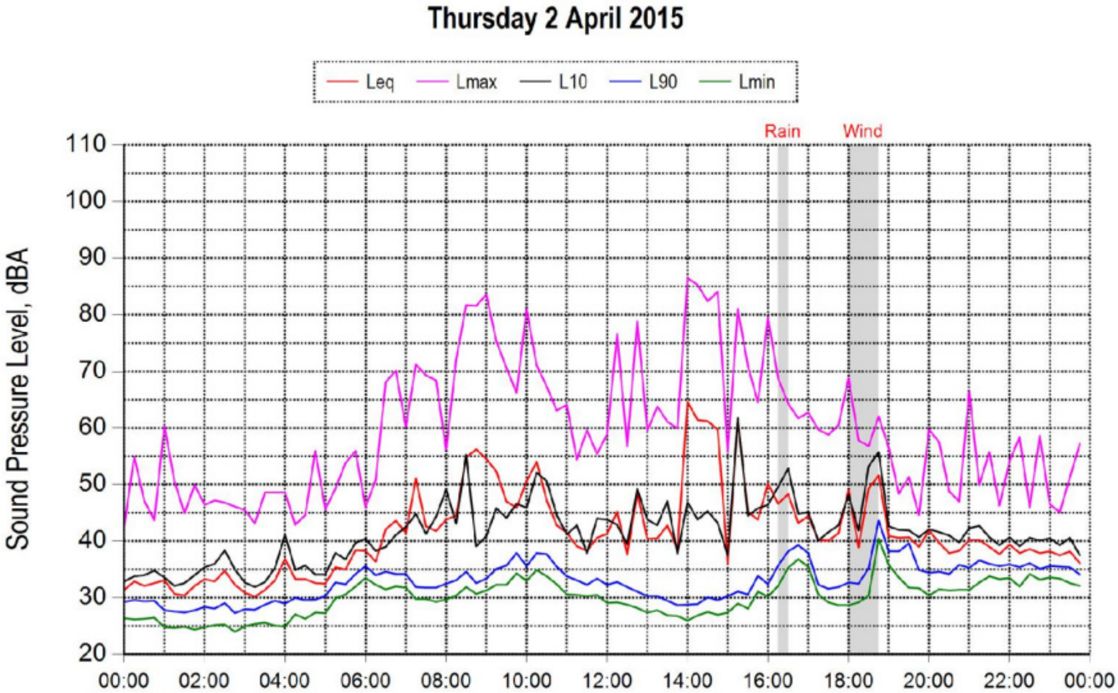
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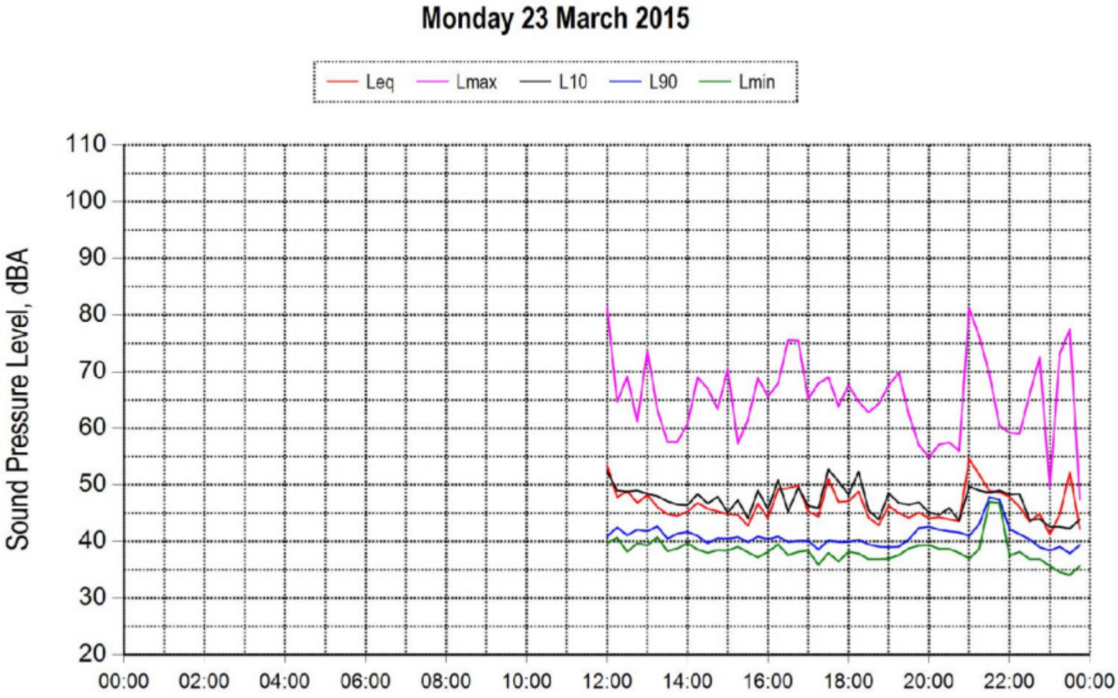

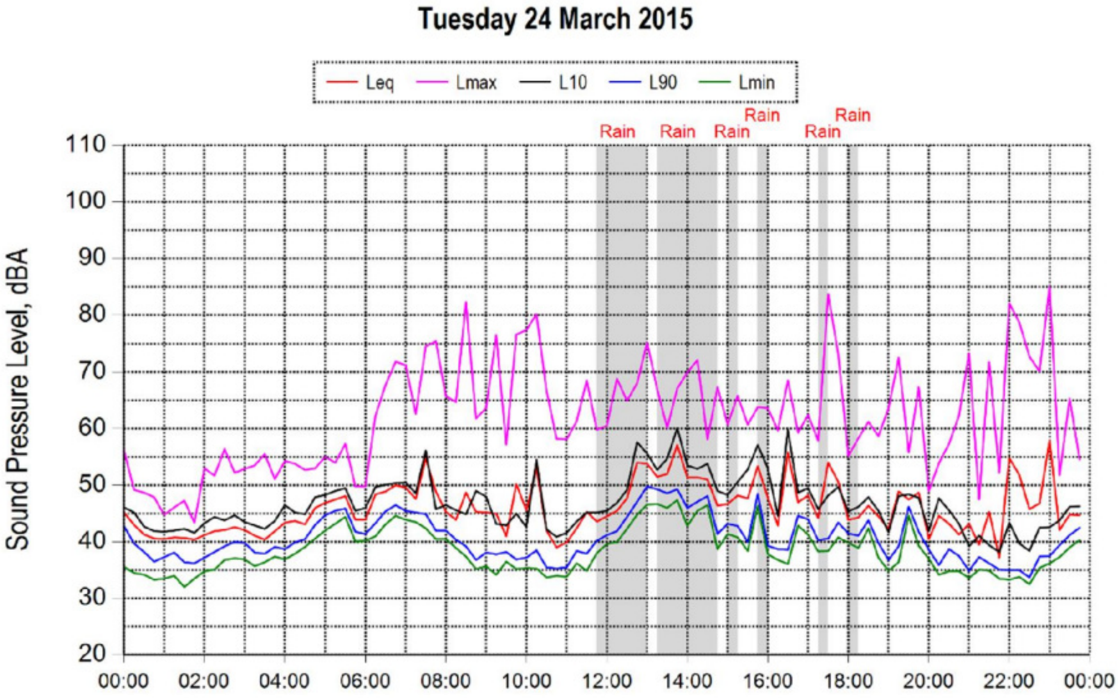

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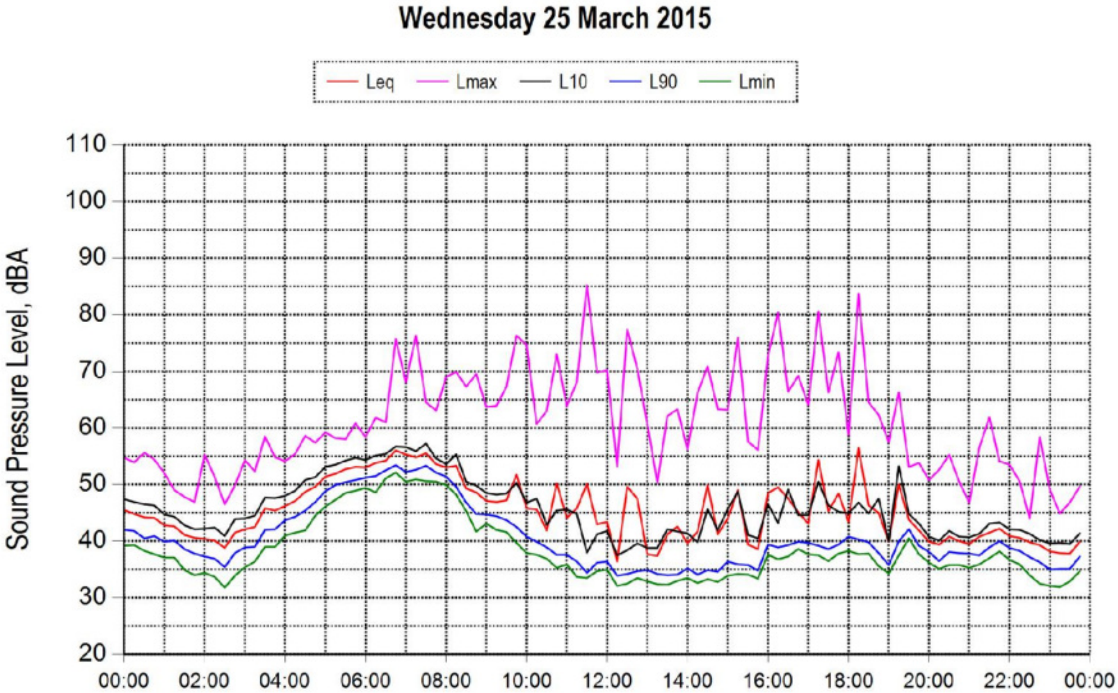

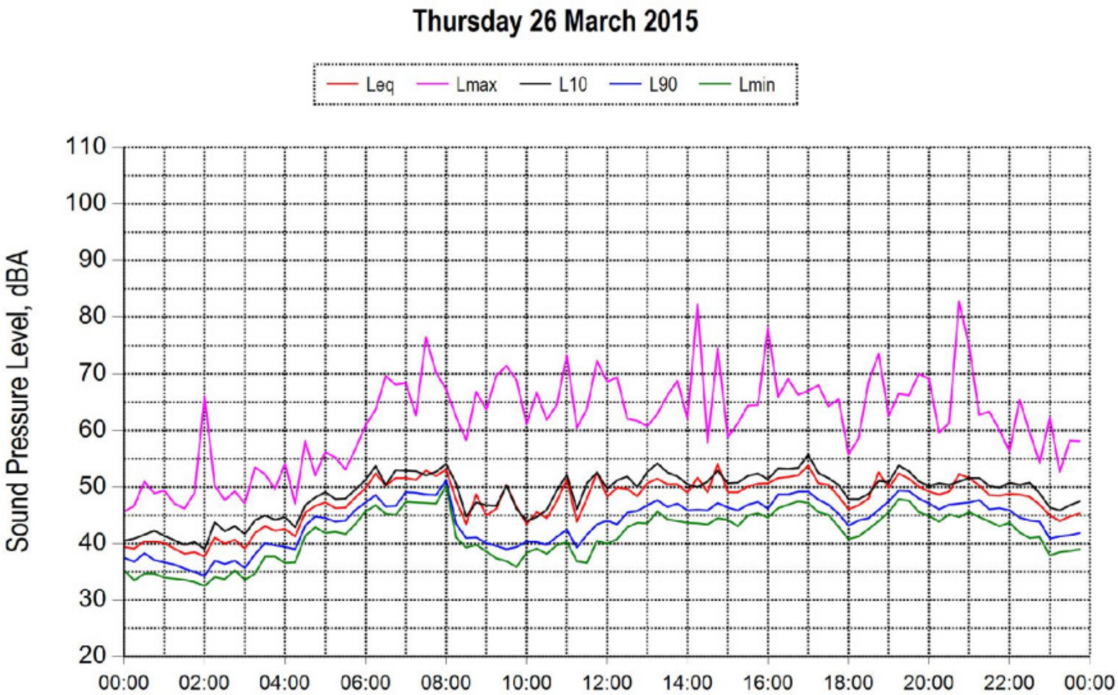

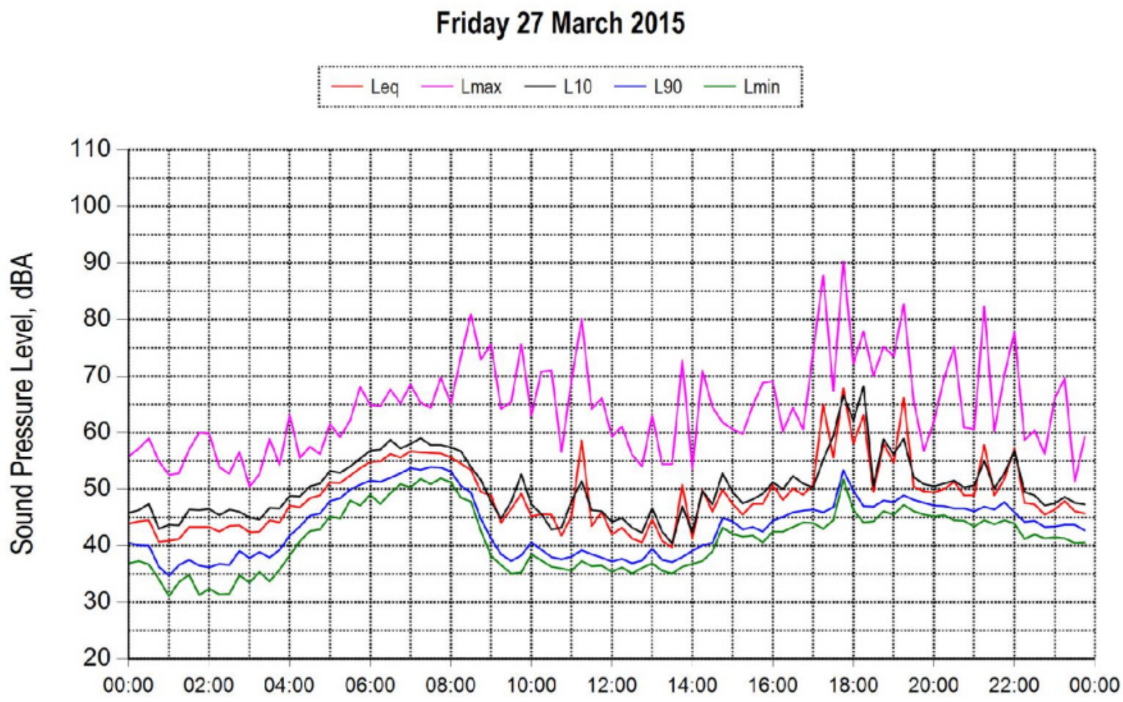
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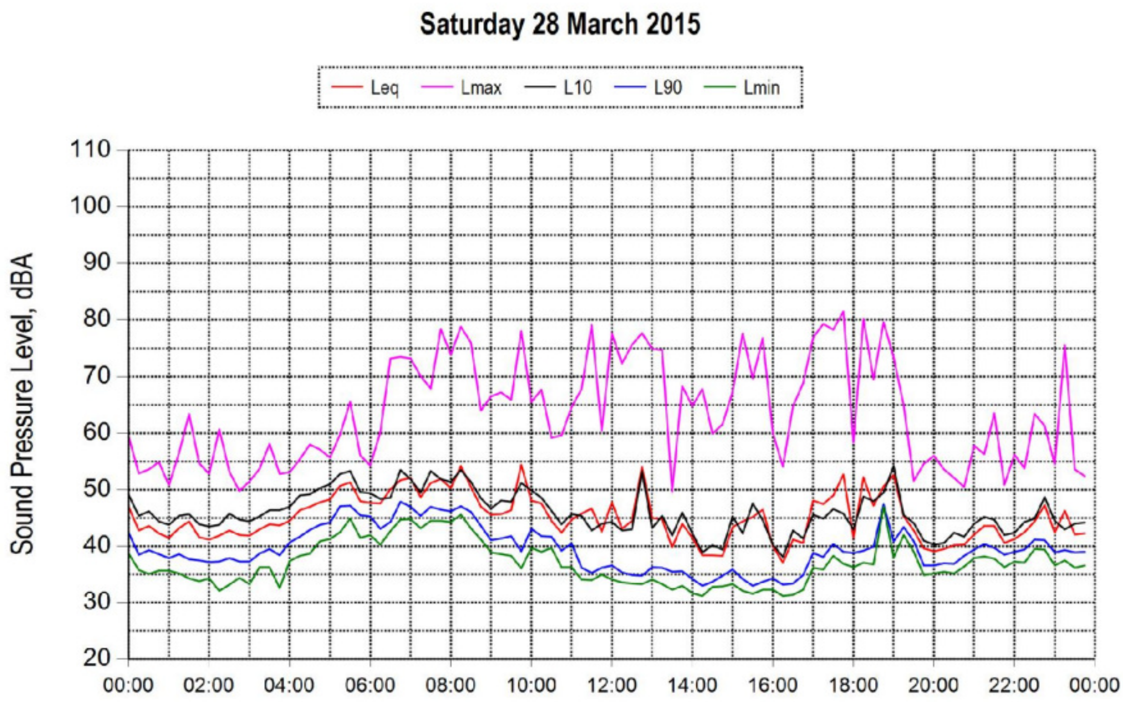
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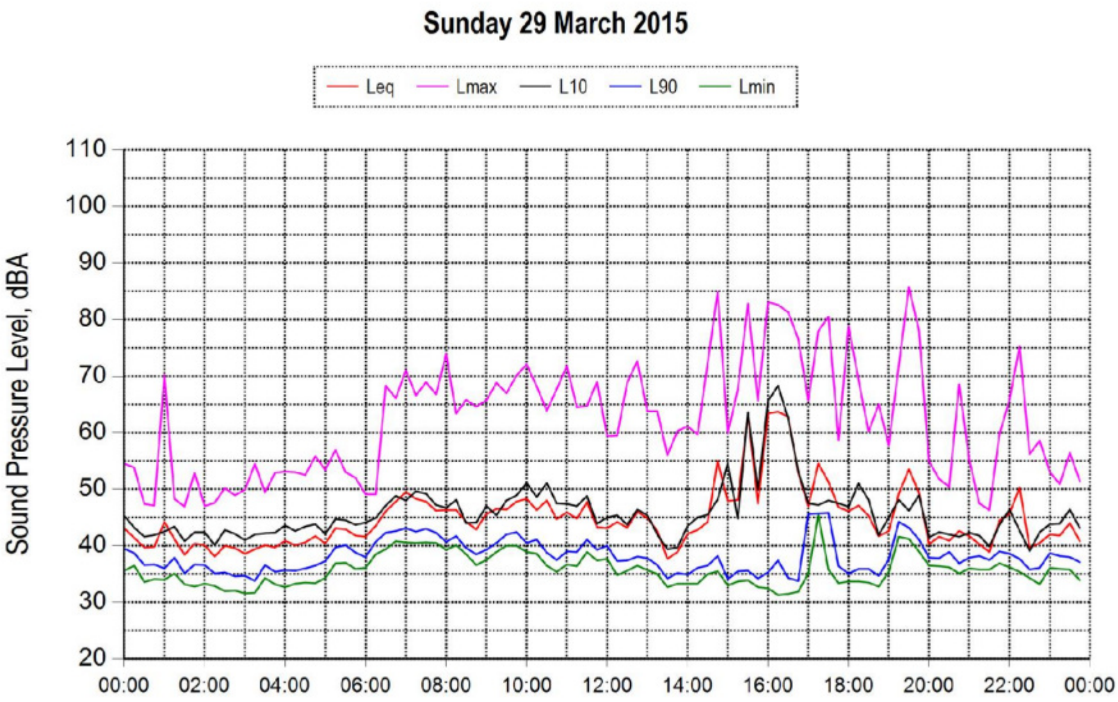
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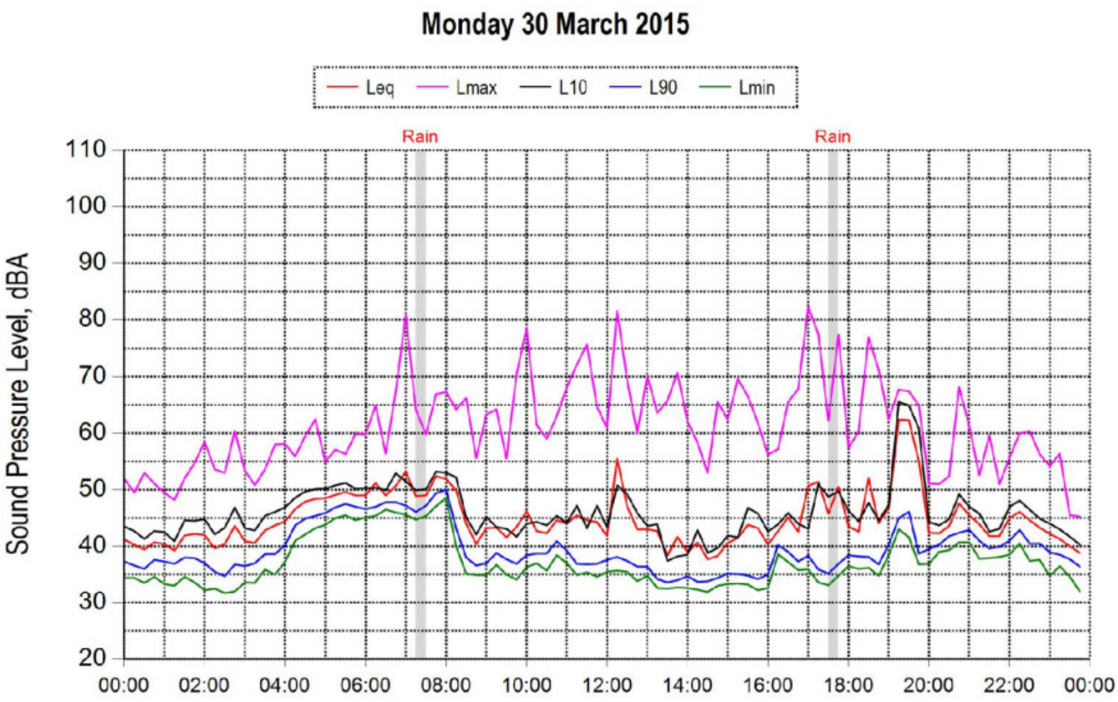
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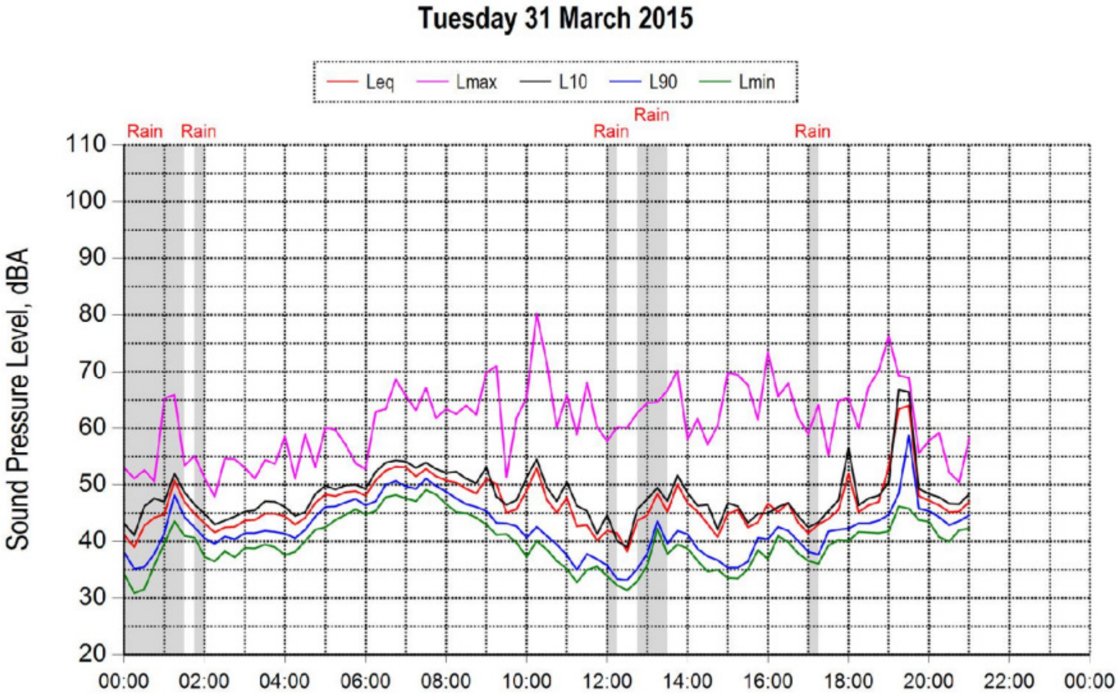

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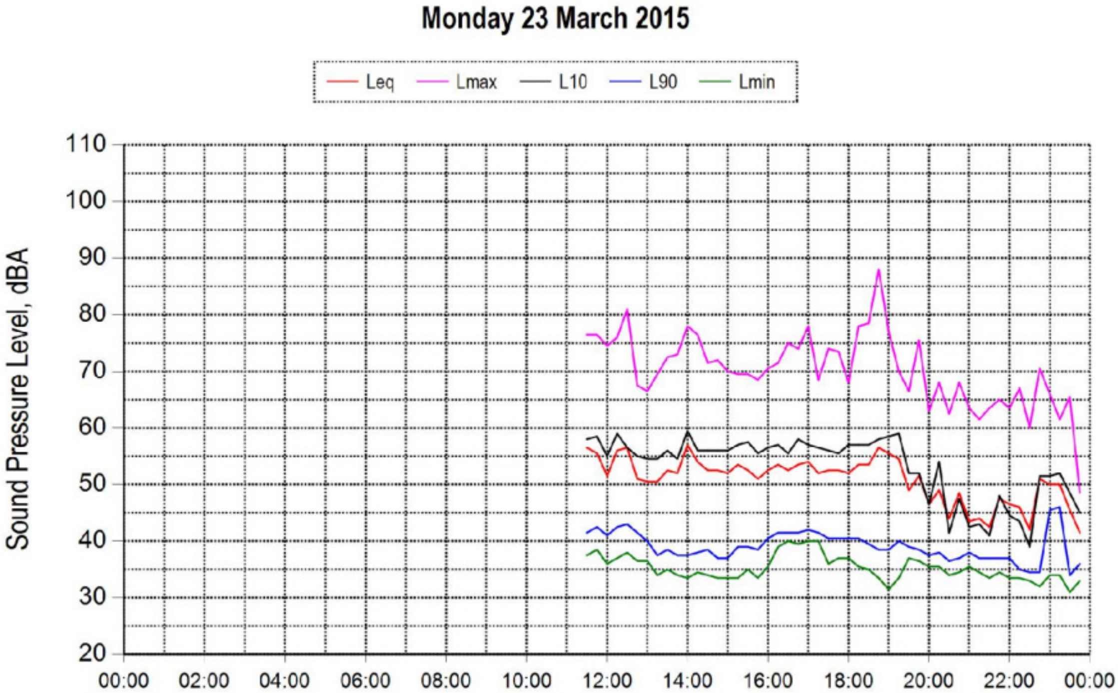

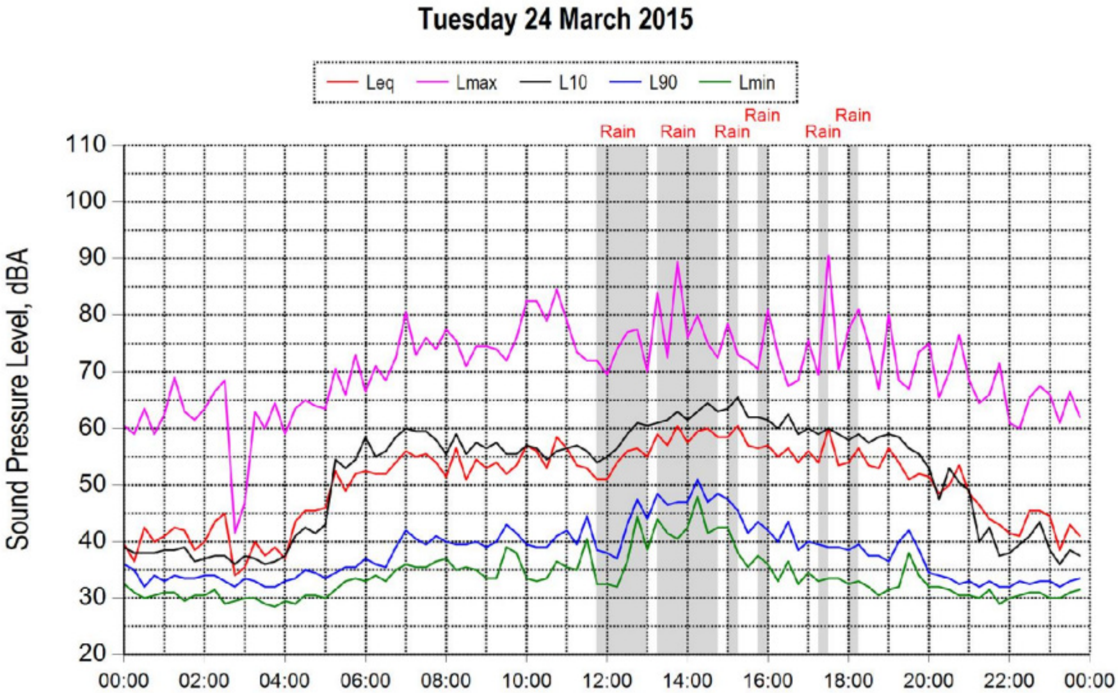

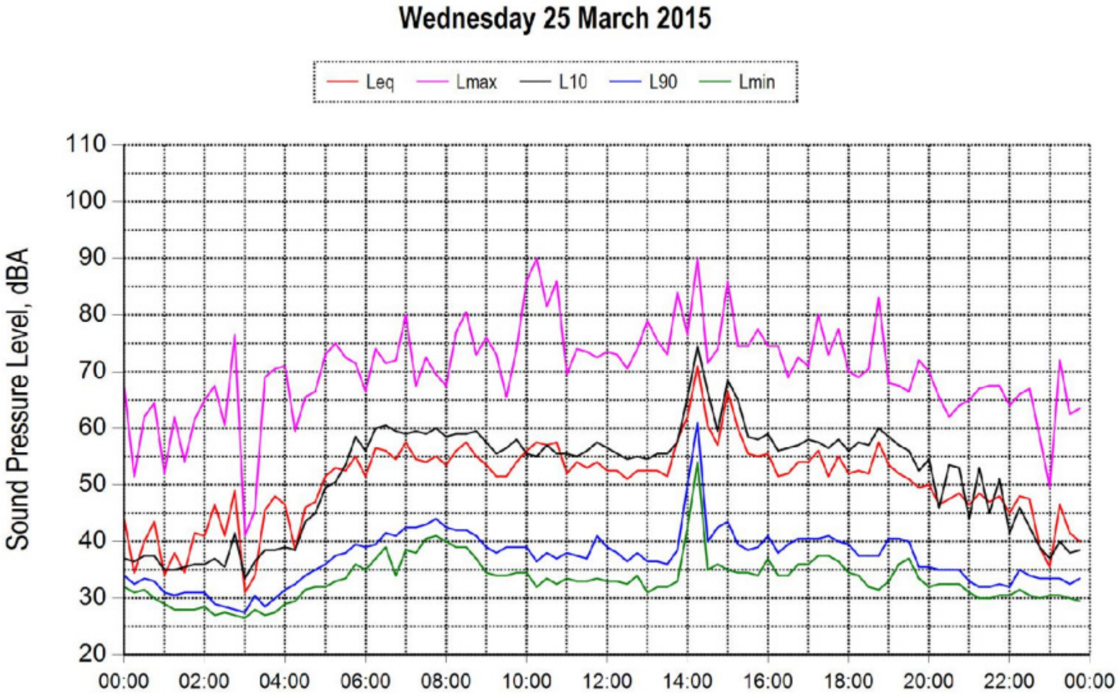
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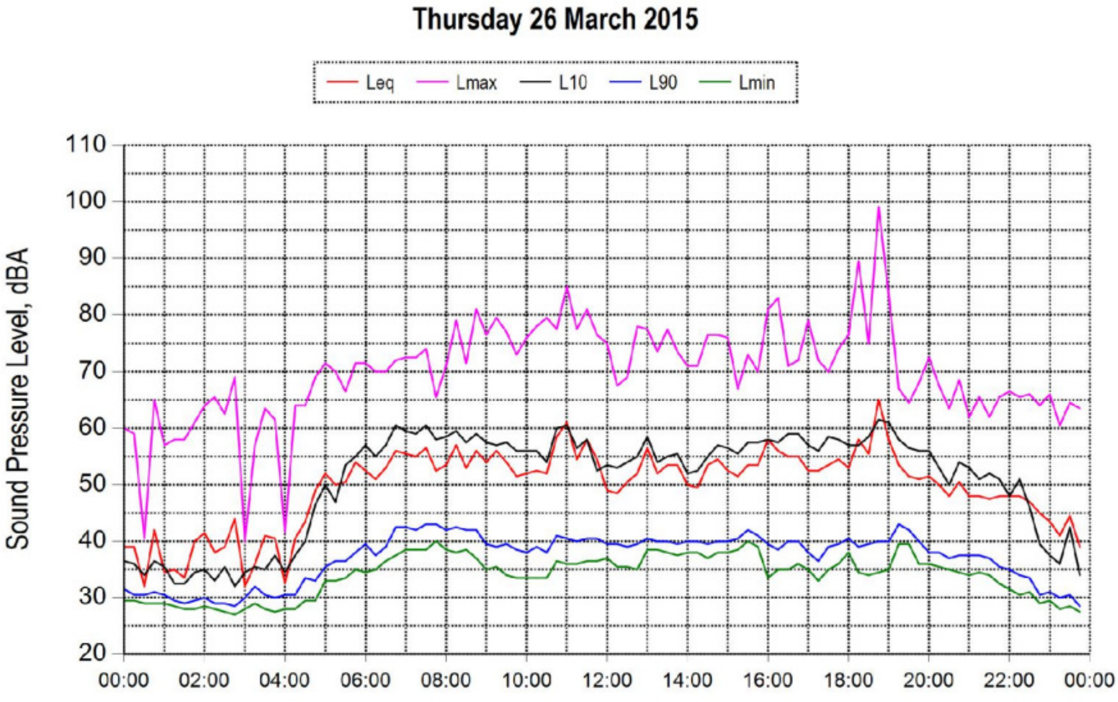
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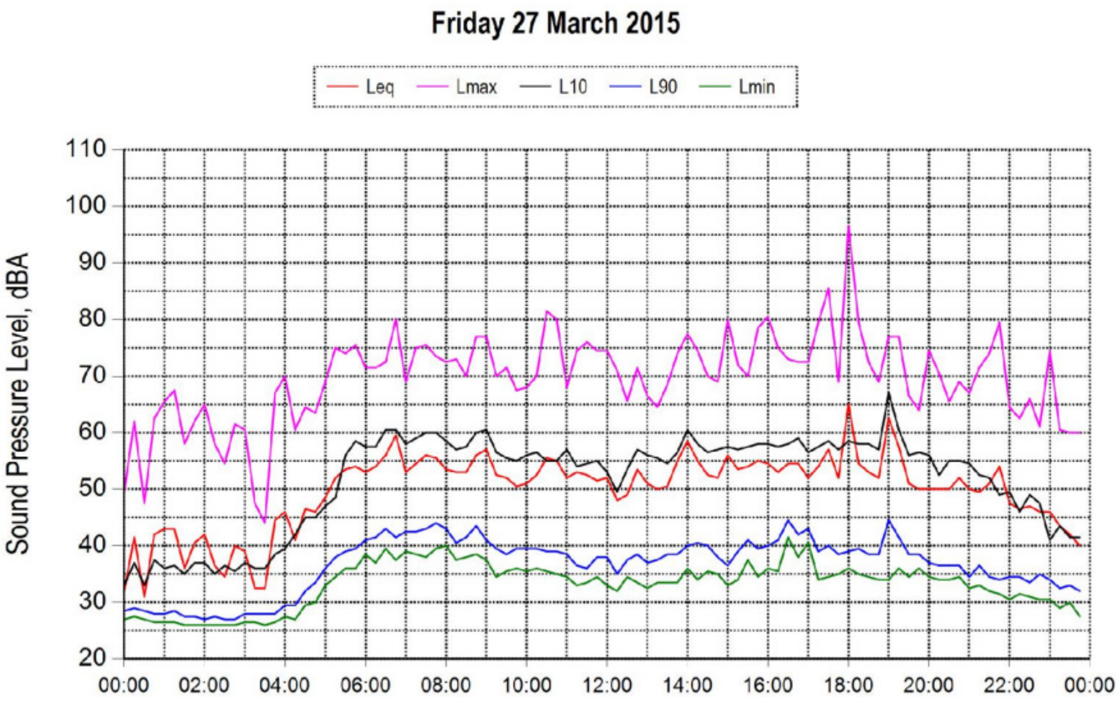
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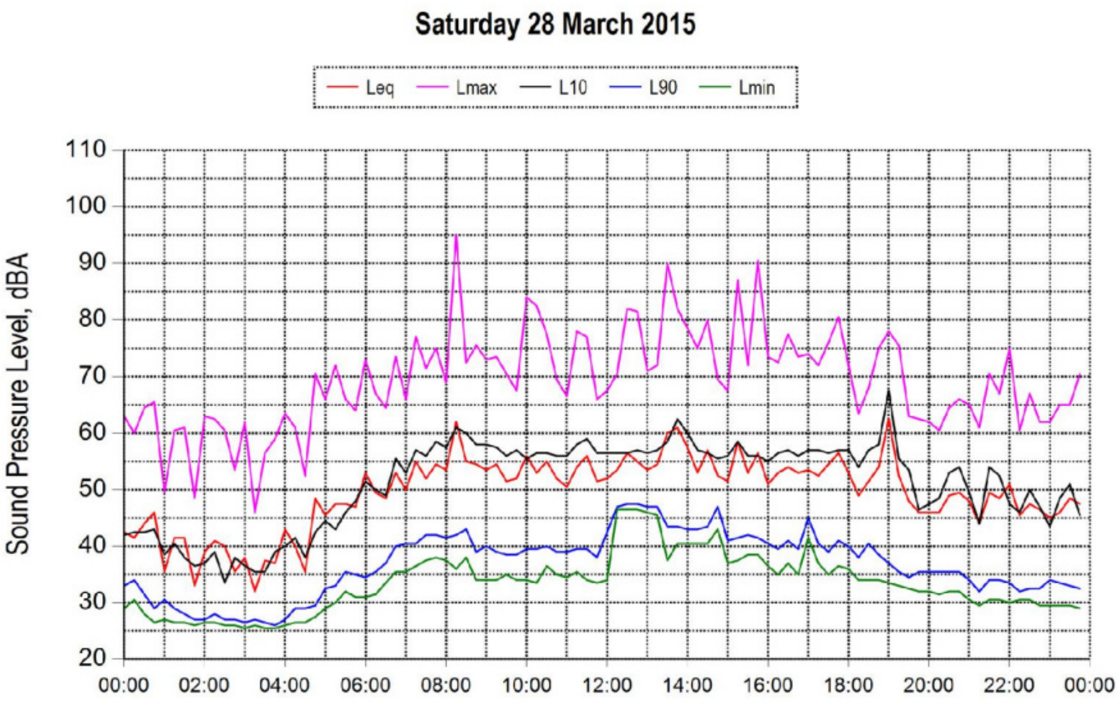
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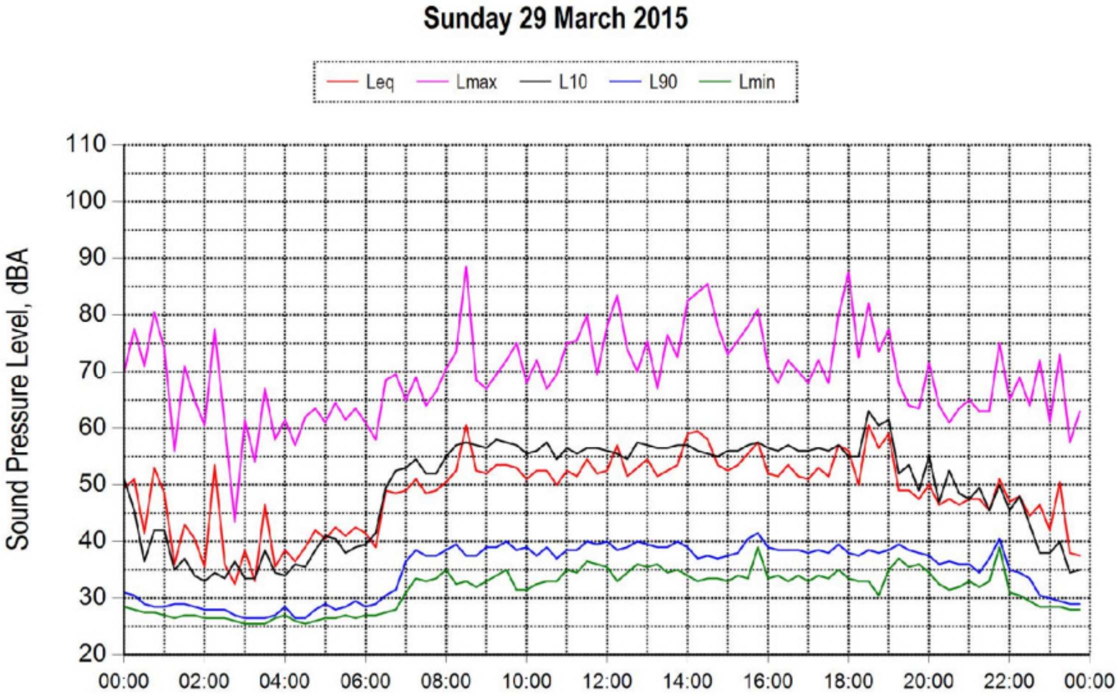
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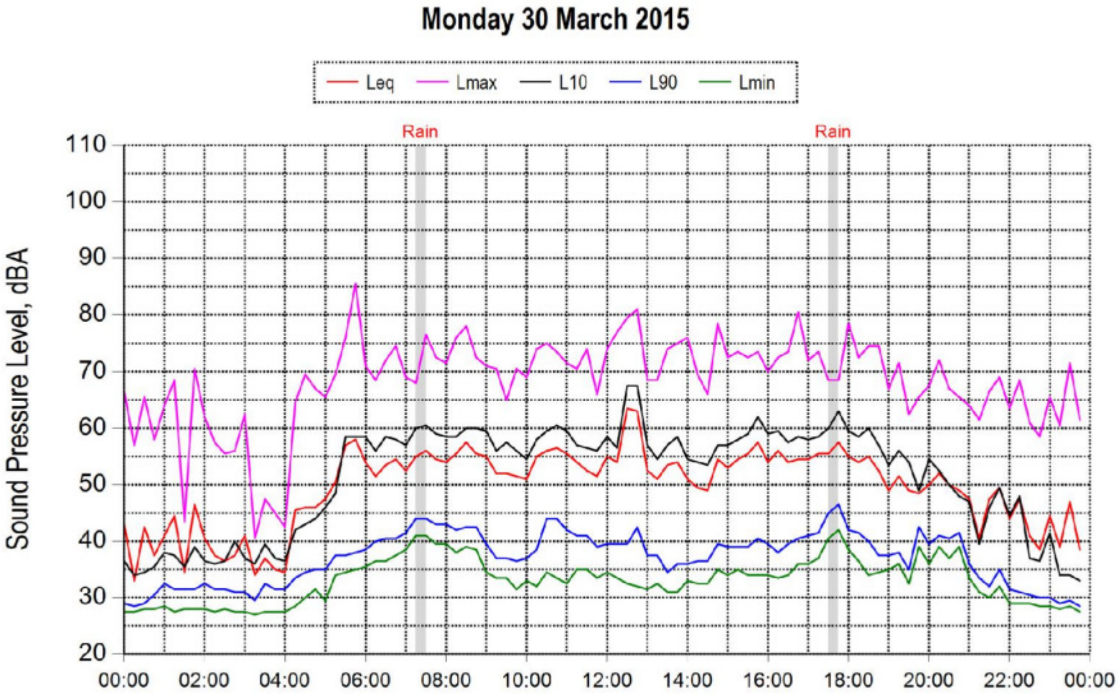
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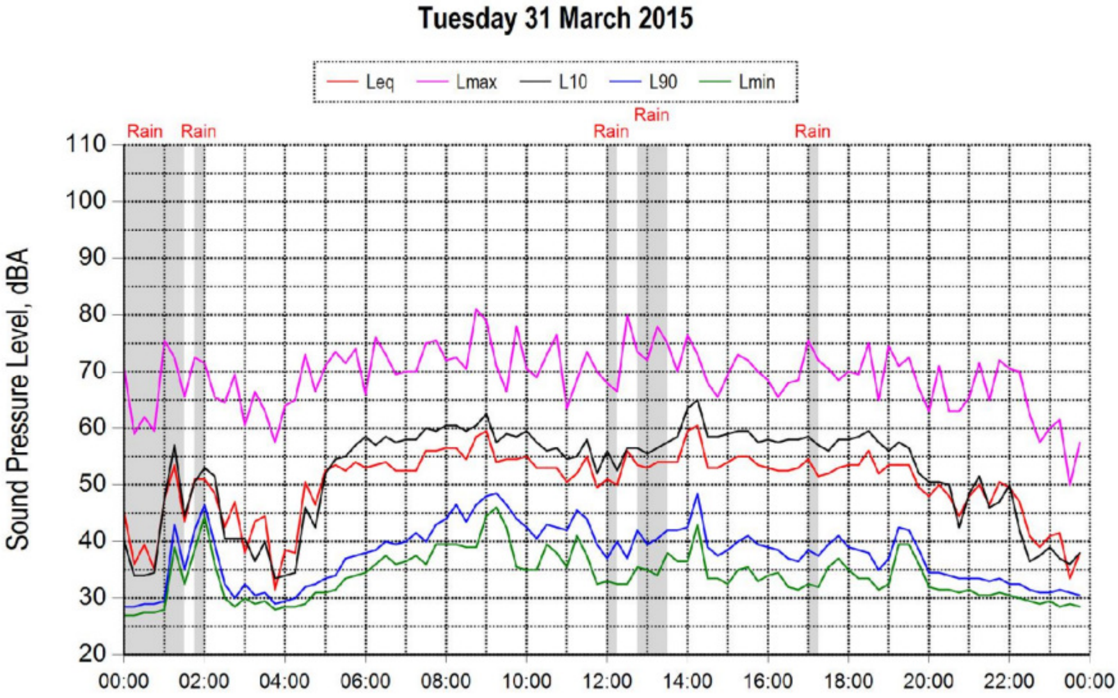
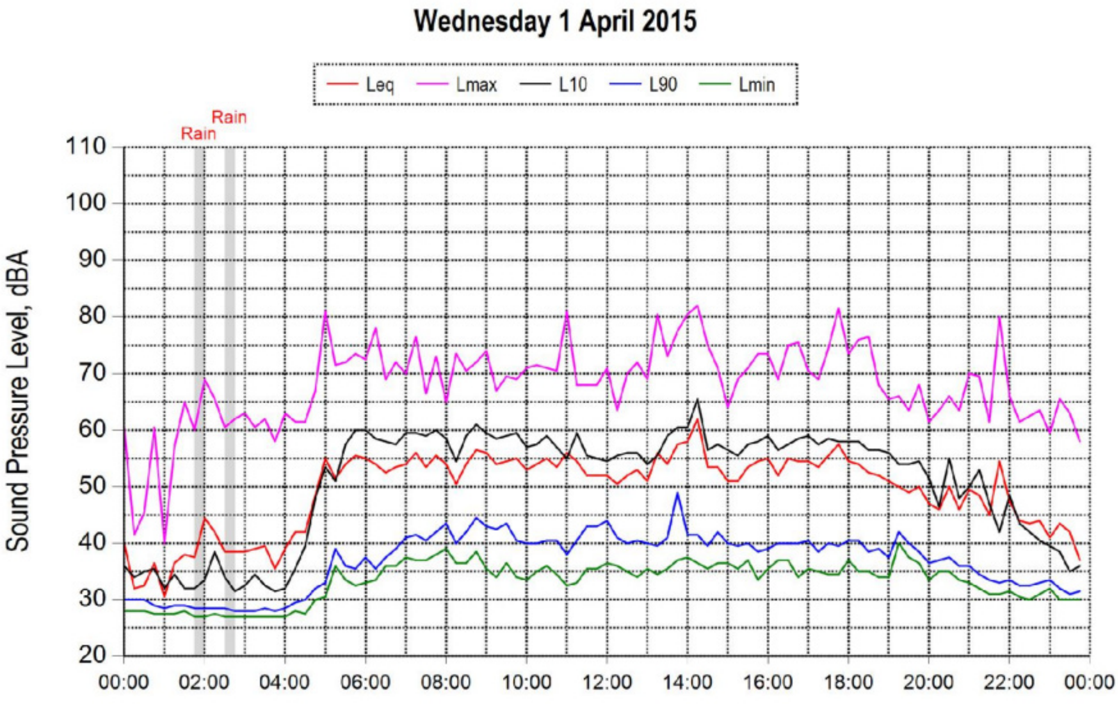
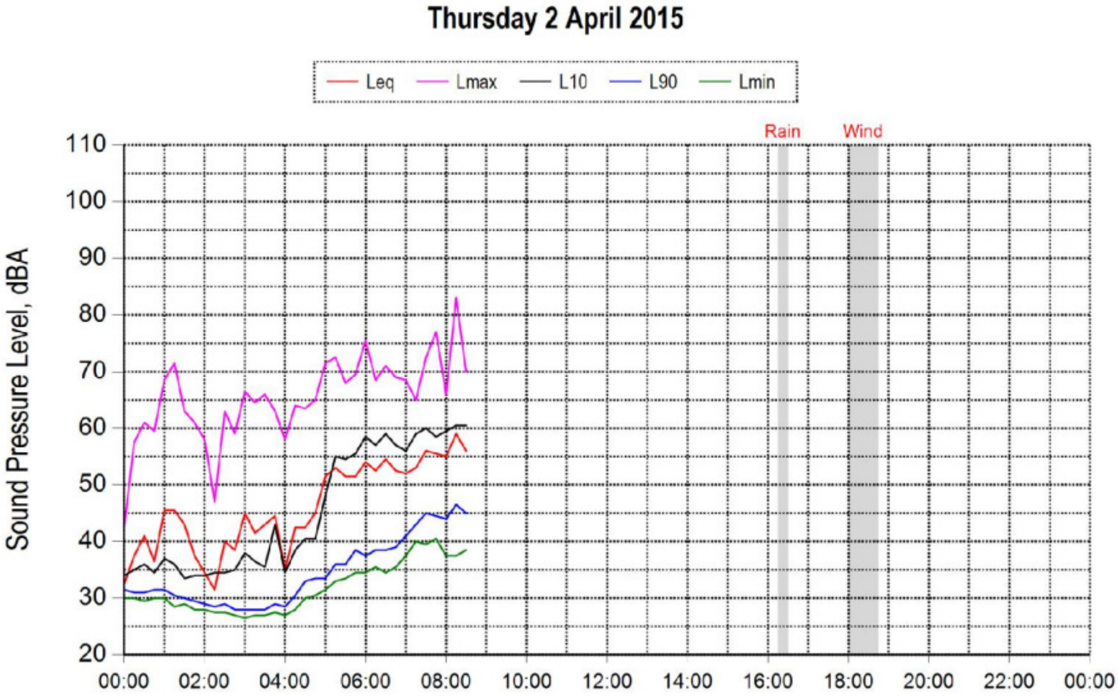
25 Peter Pan Avenue, Wallacia



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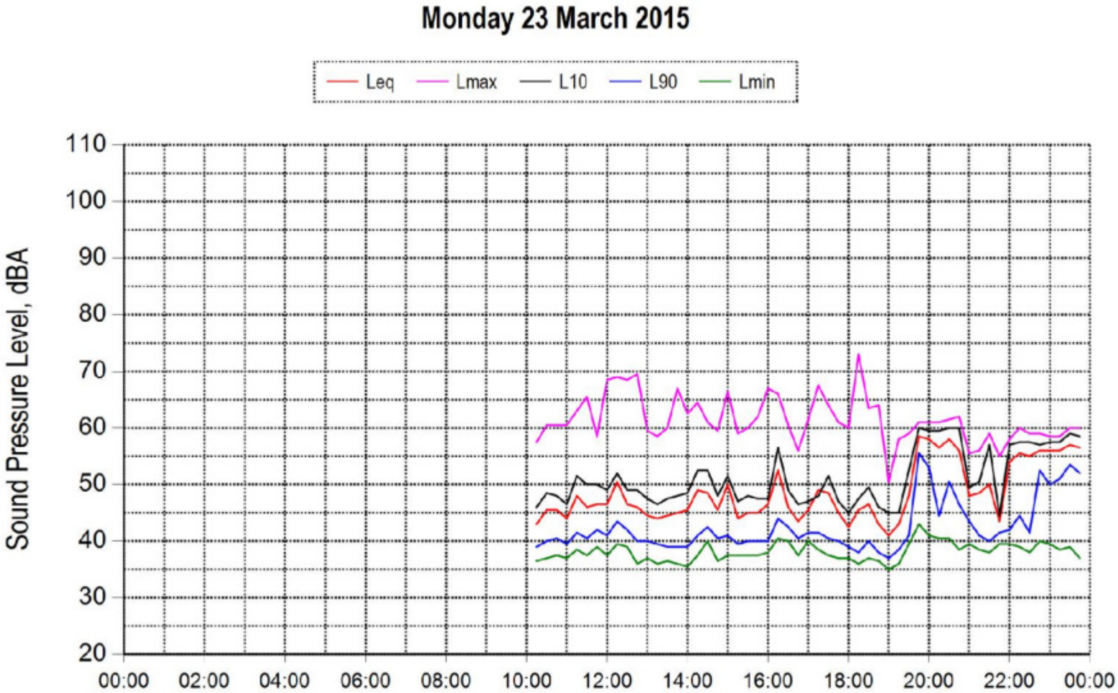
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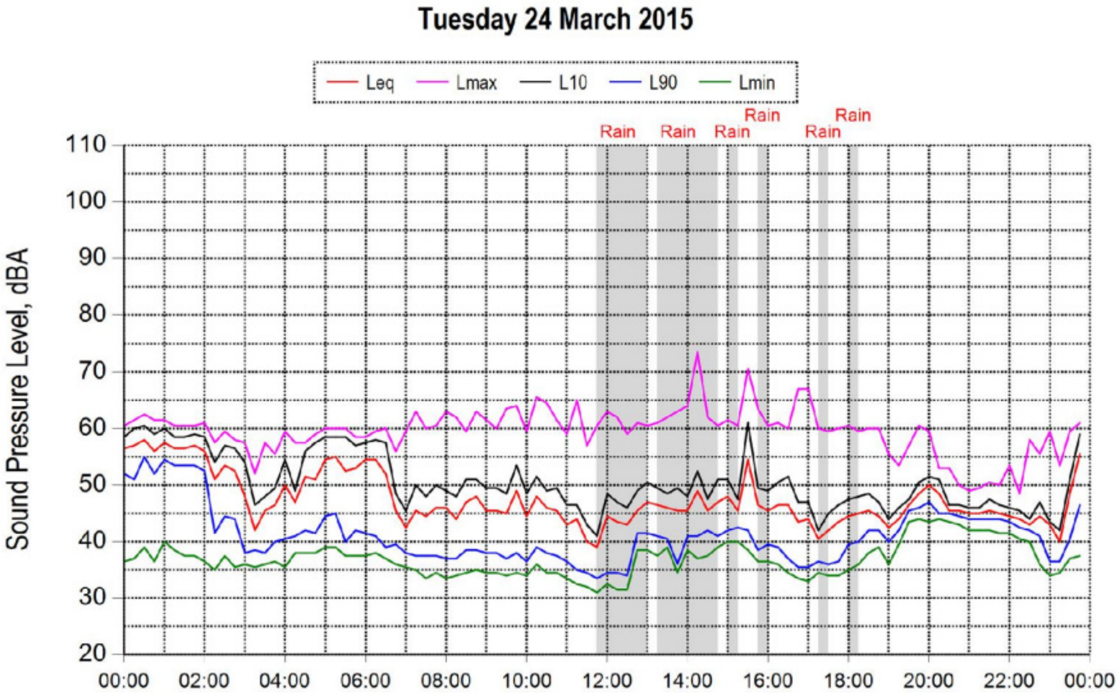
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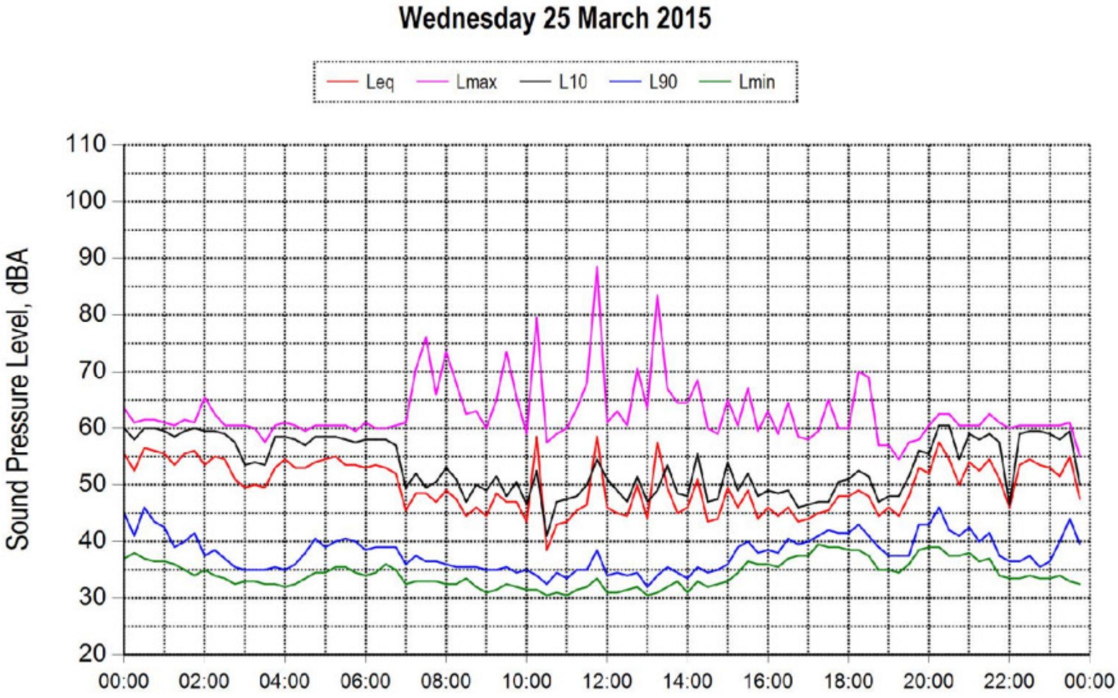
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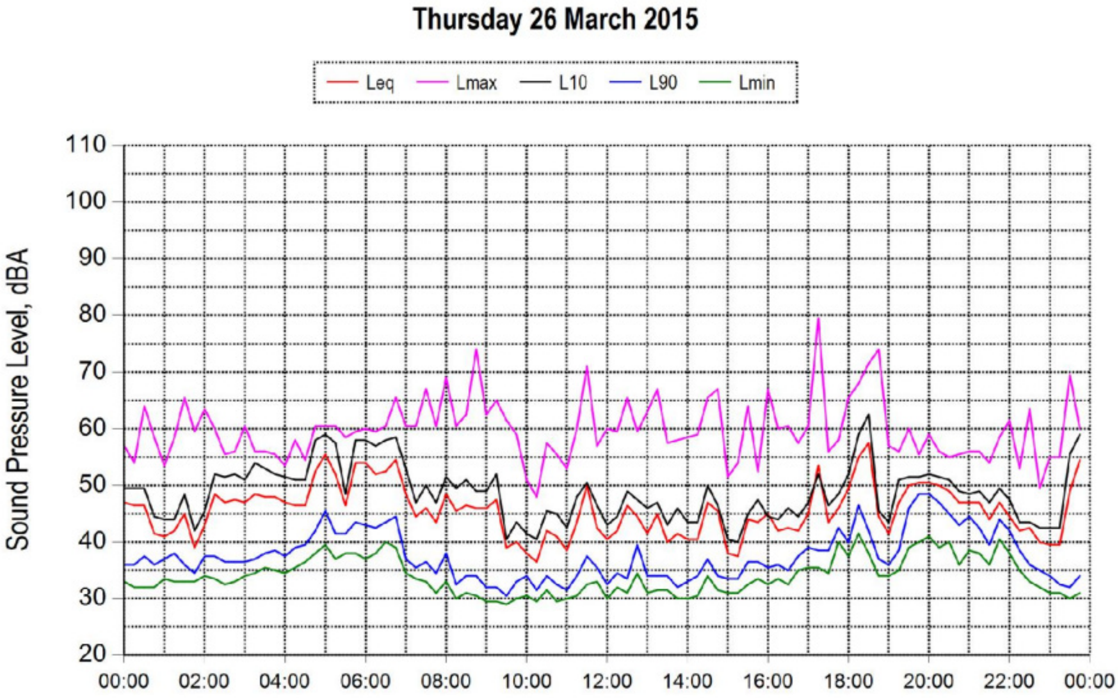
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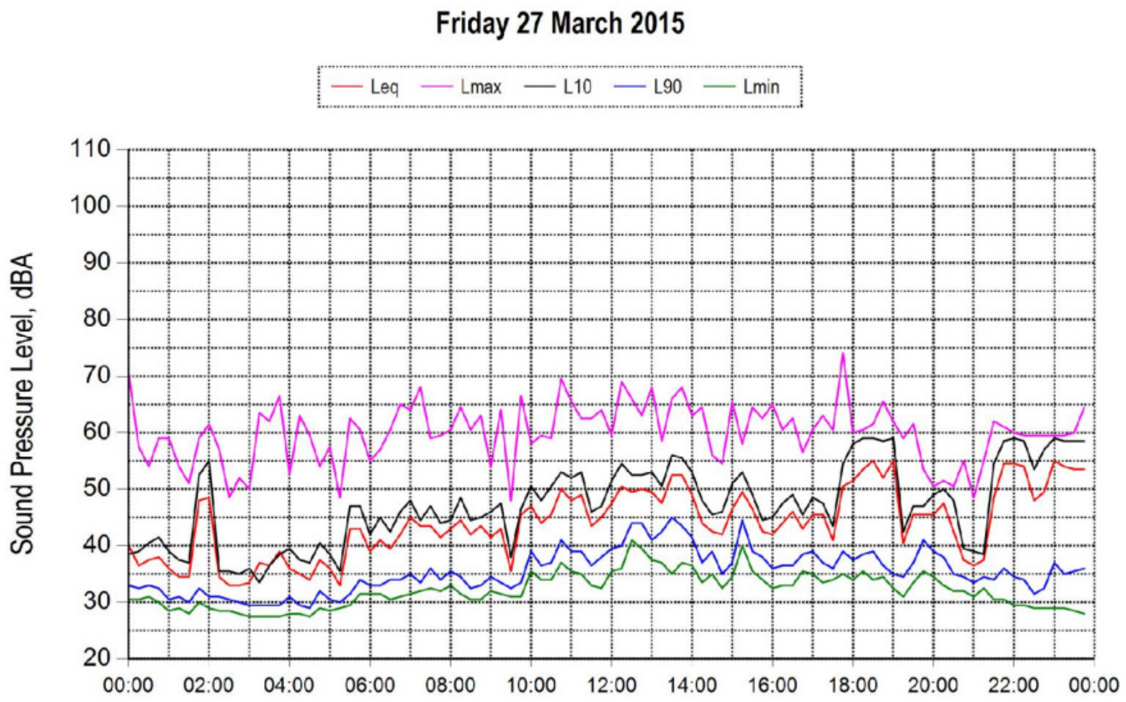
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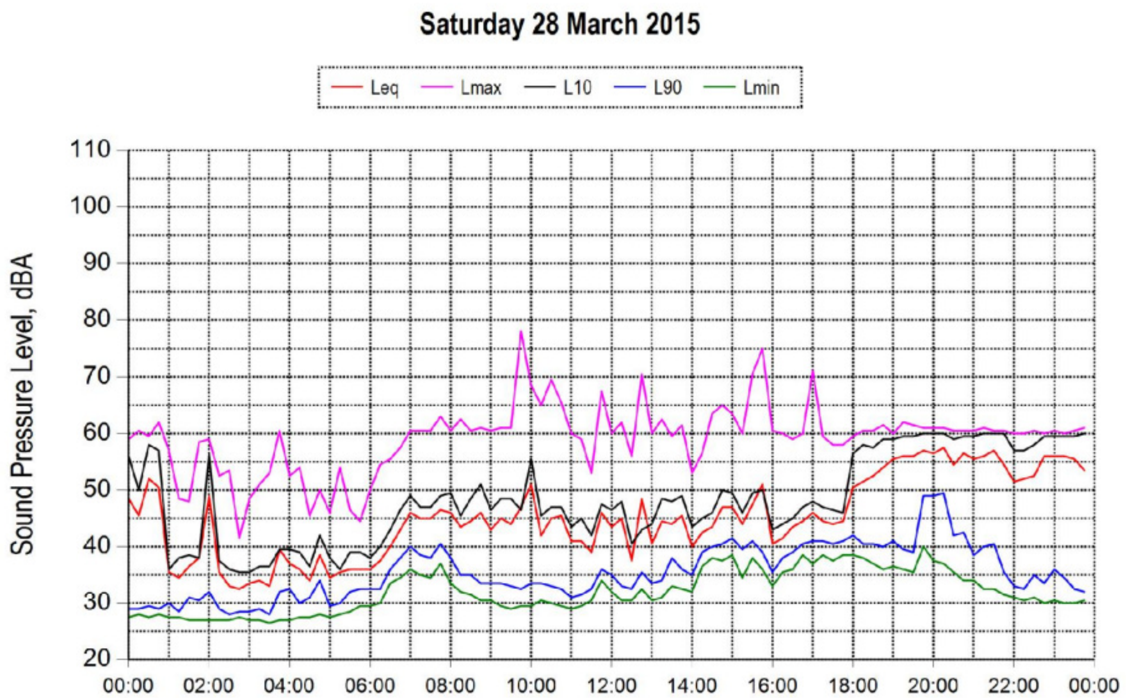
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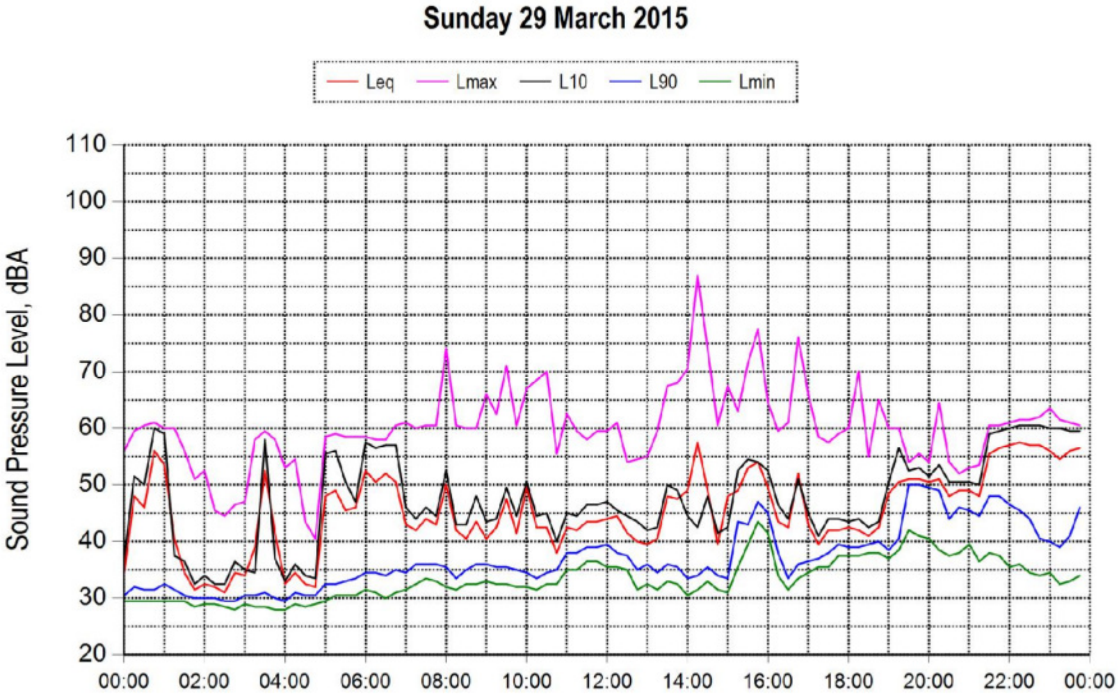
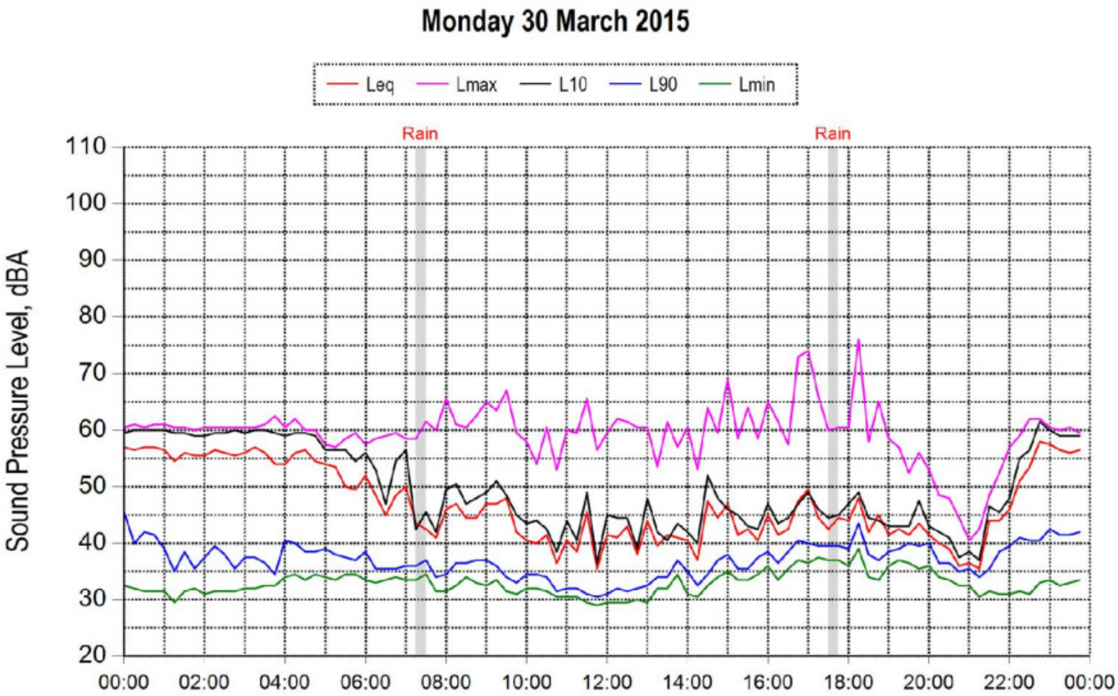
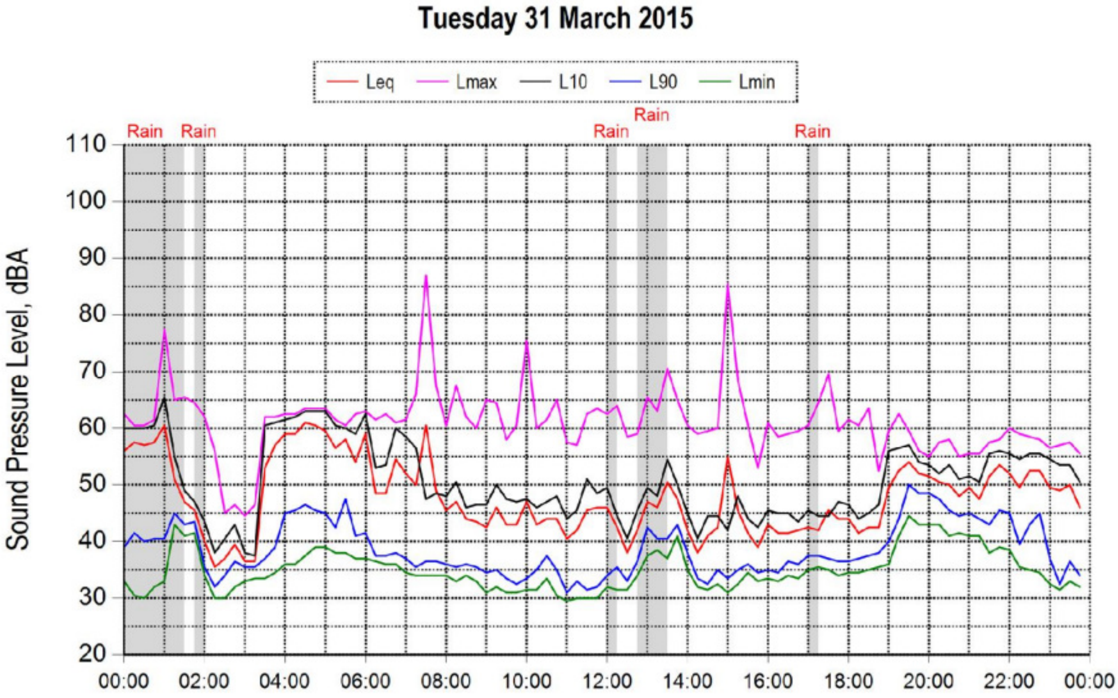
27 Dwyer Road, Bringelly



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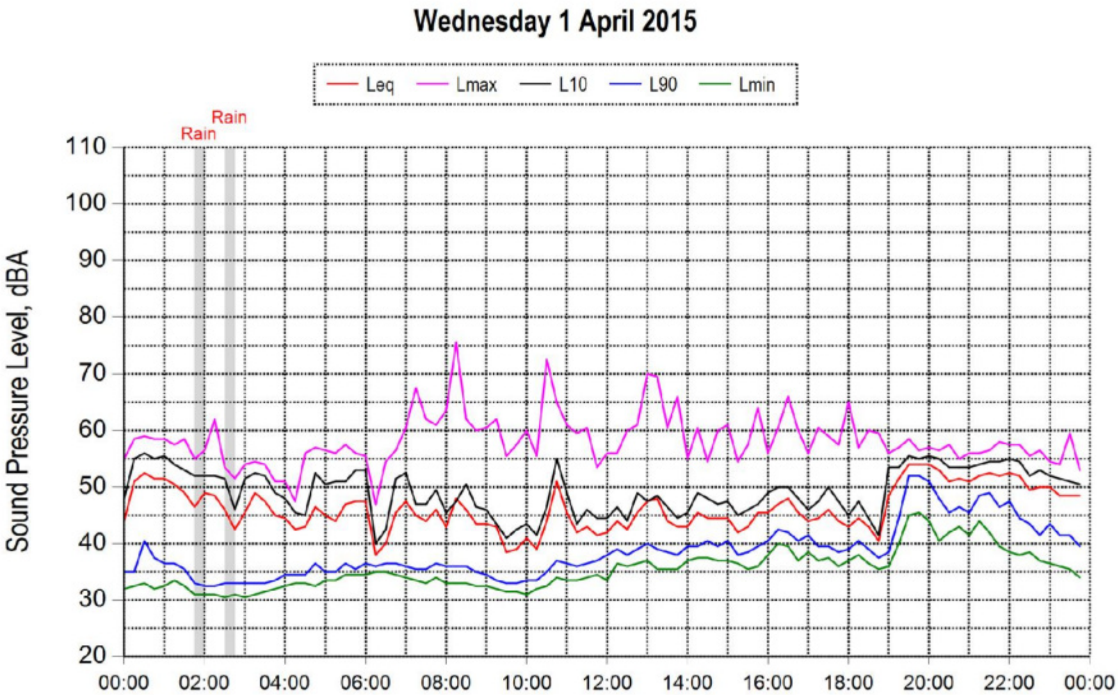
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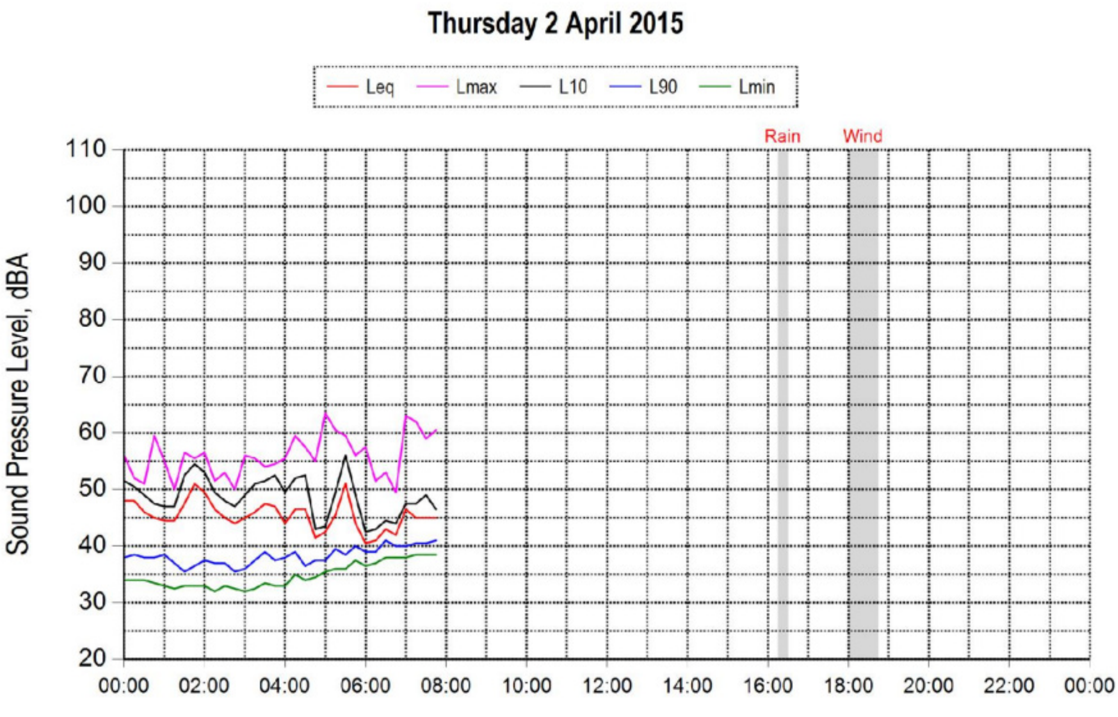
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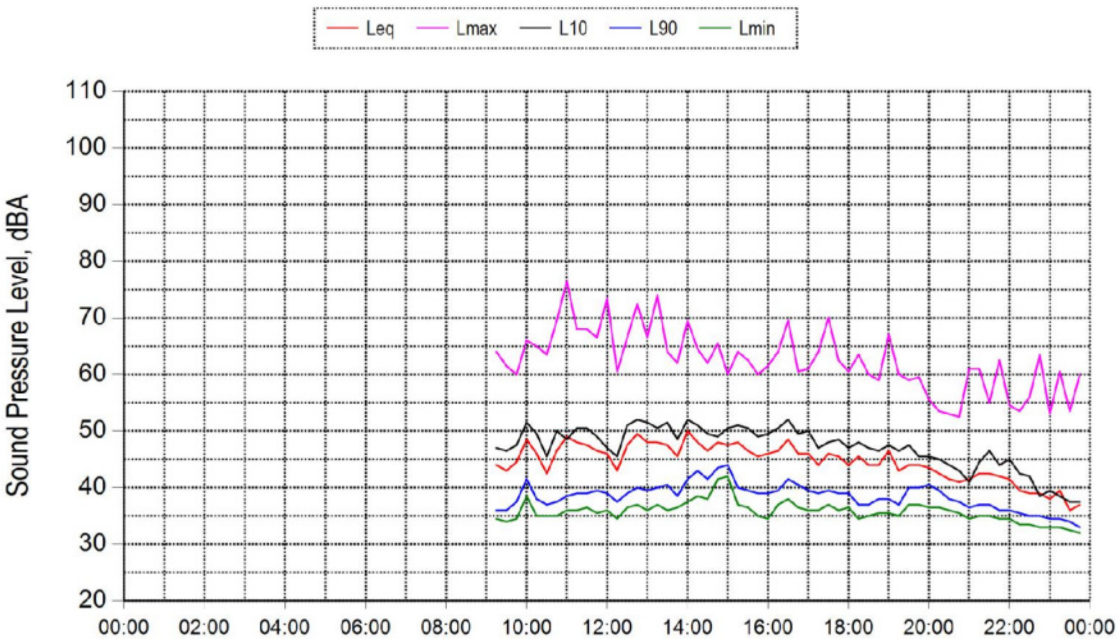
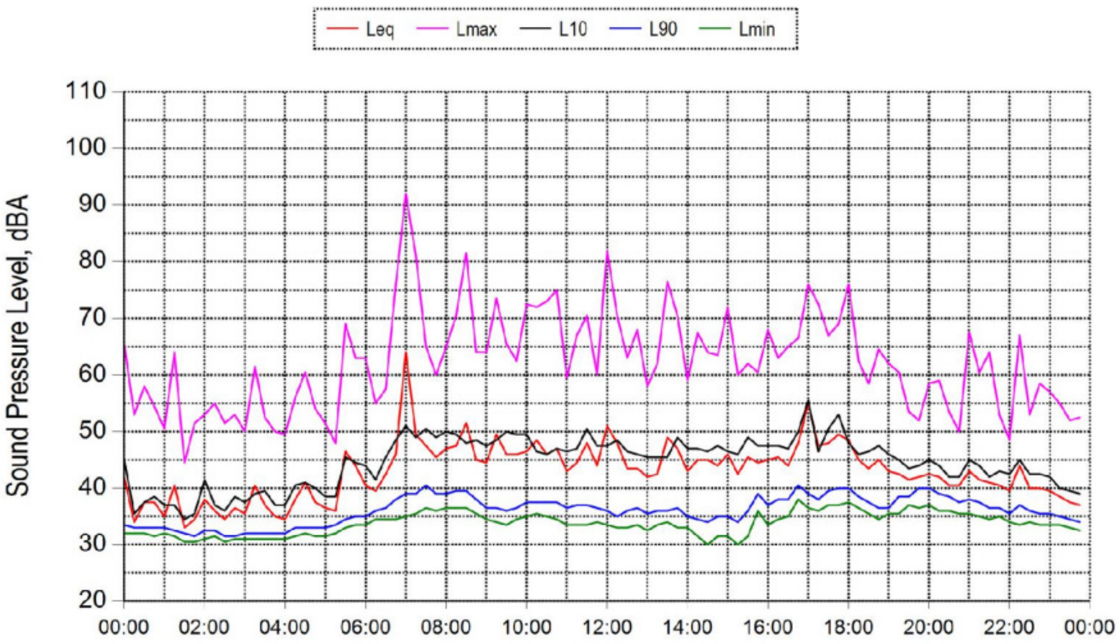
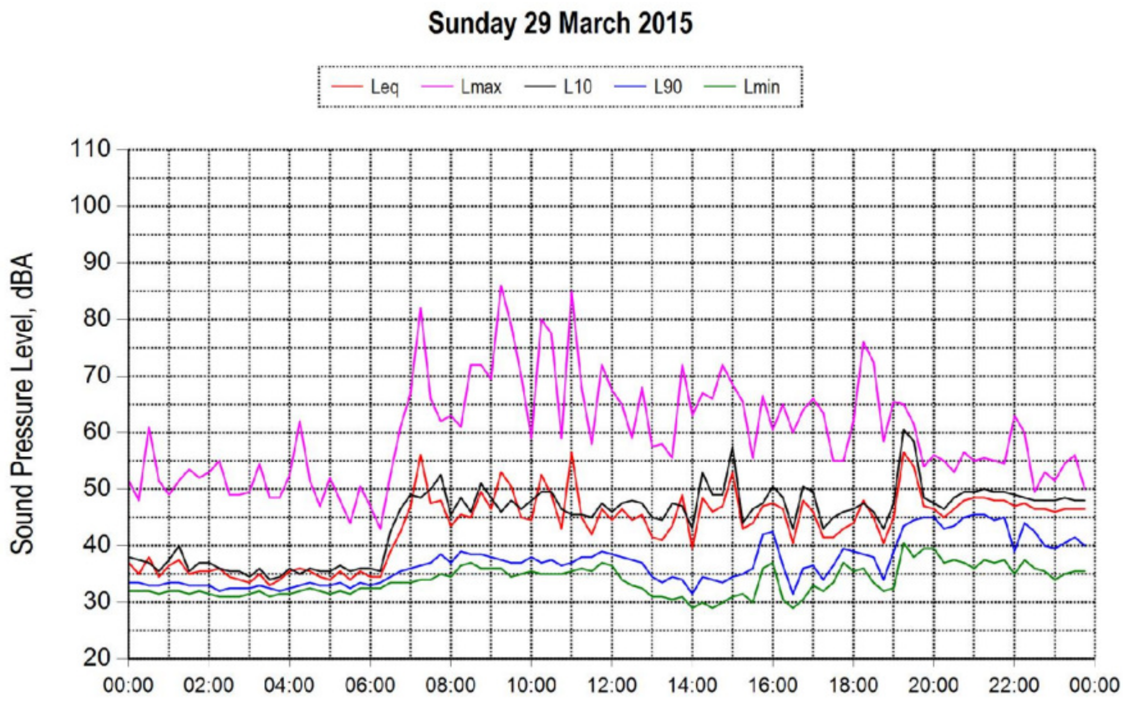
Friday 27 March 2015



Saturday 28 March 2015

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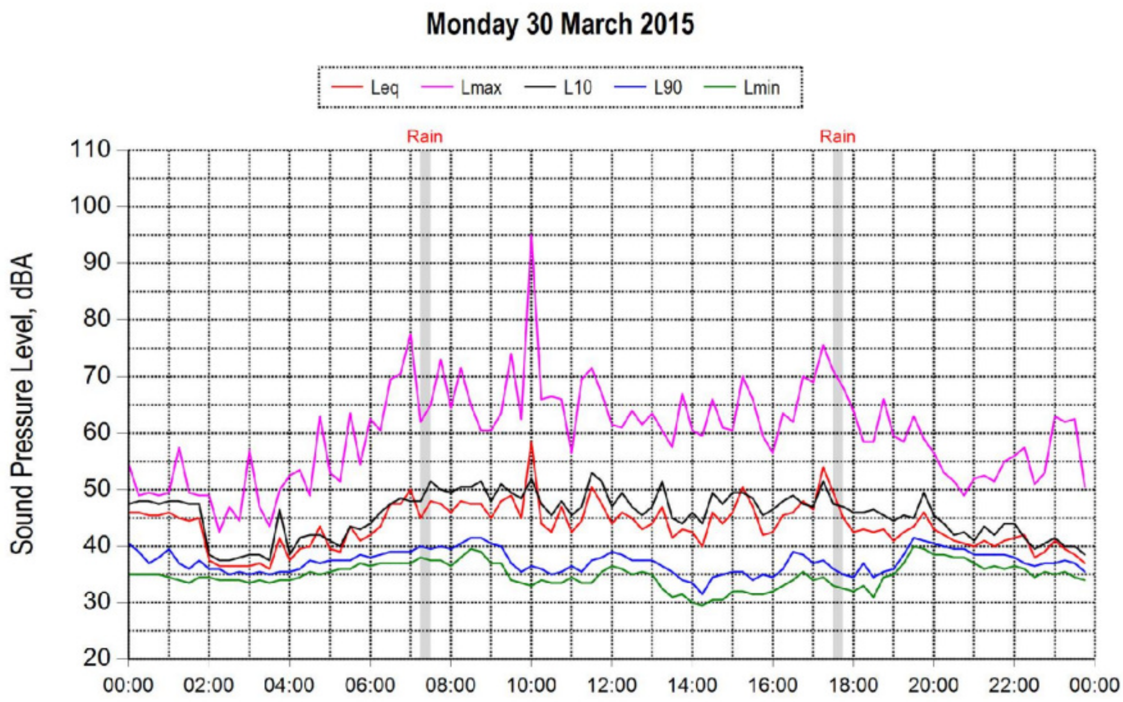
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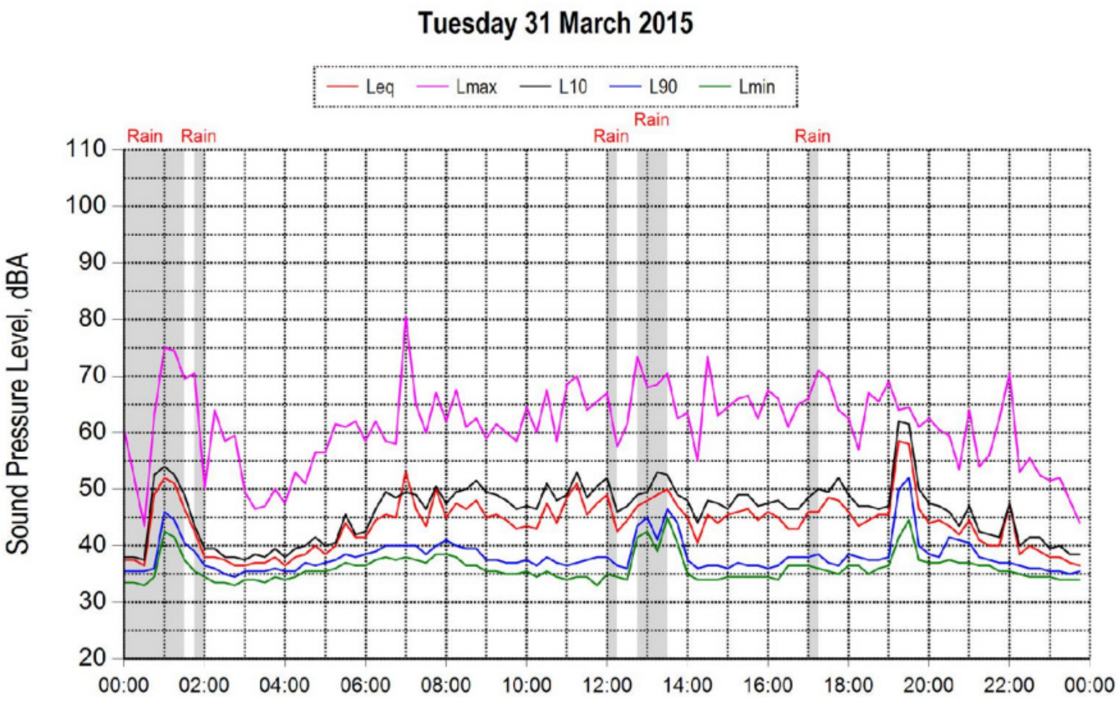
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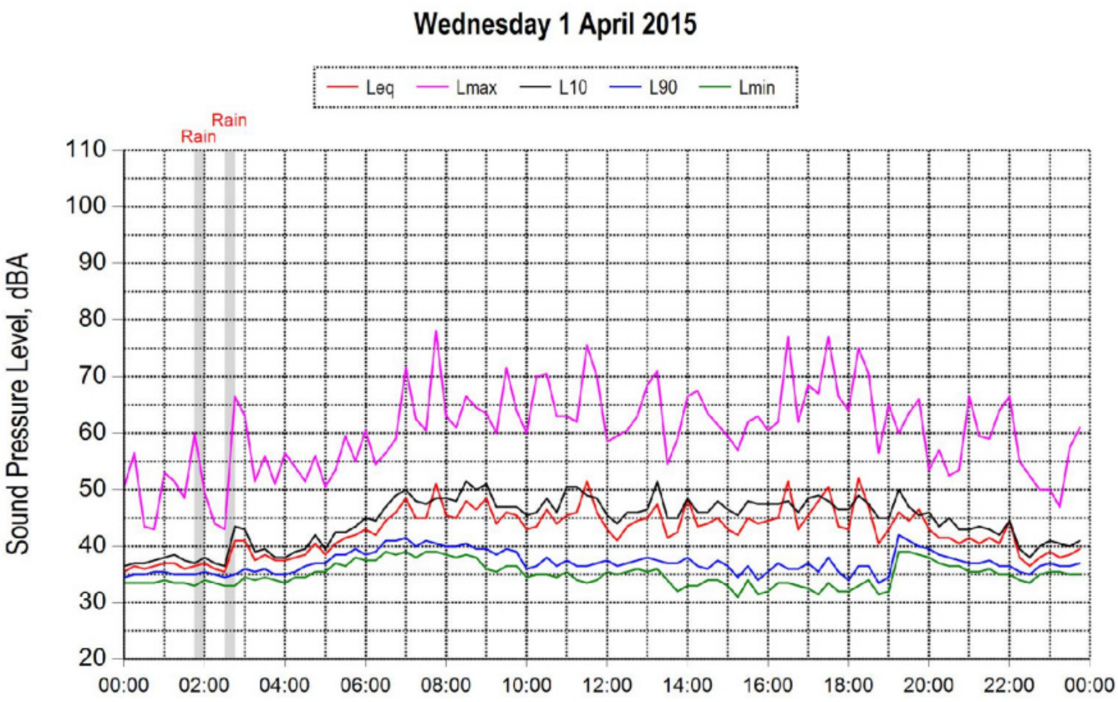
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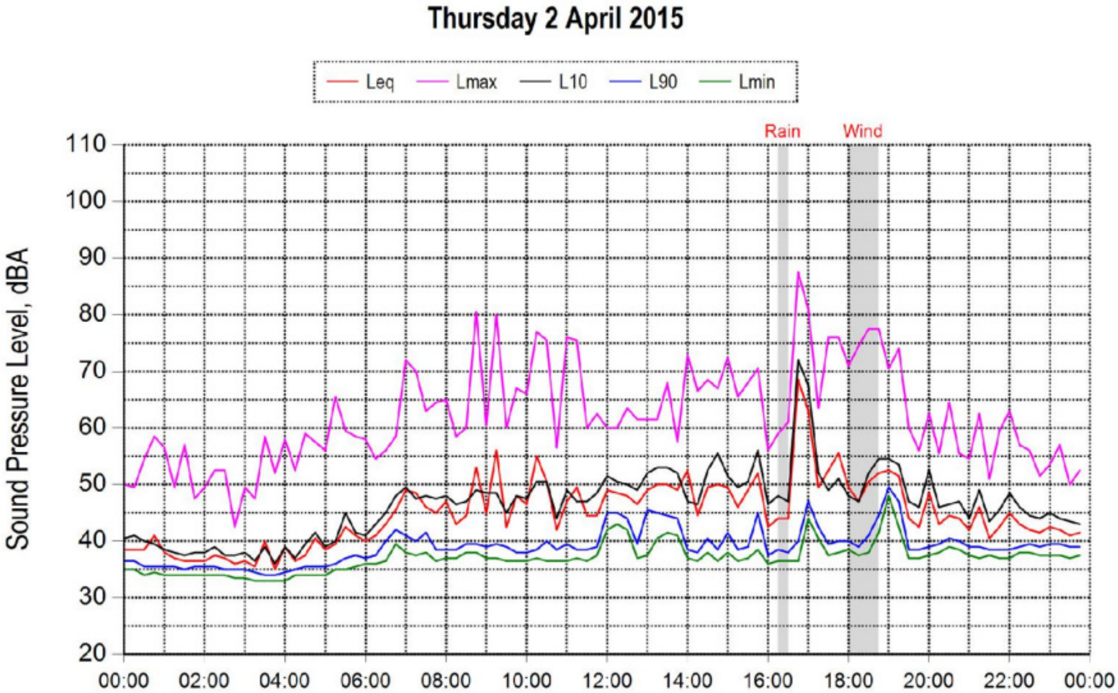
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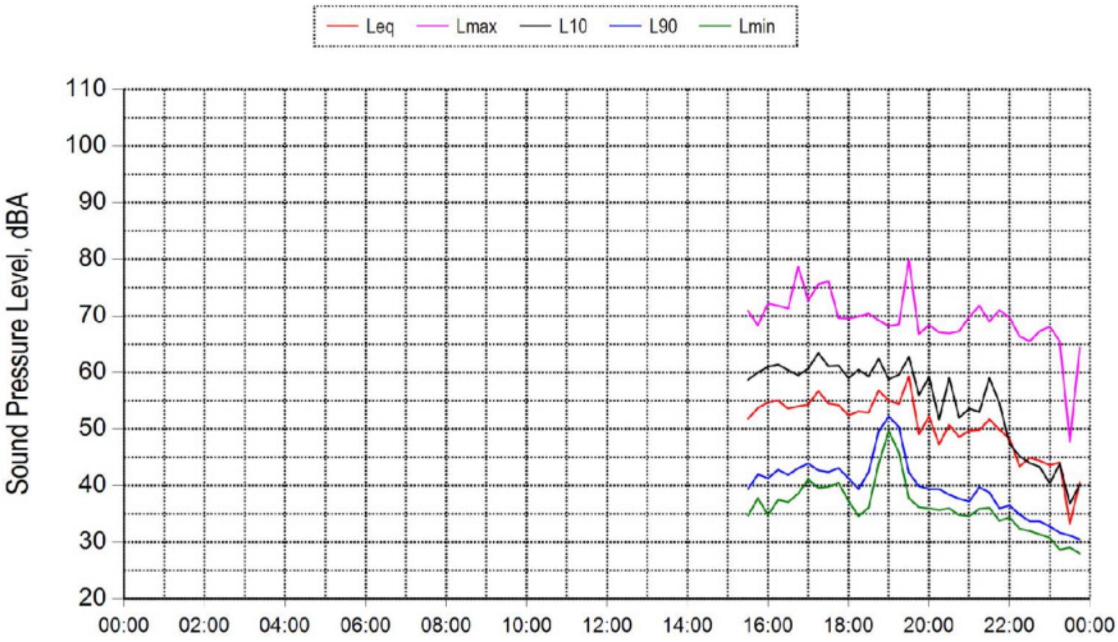
Thursday 26 March 2015



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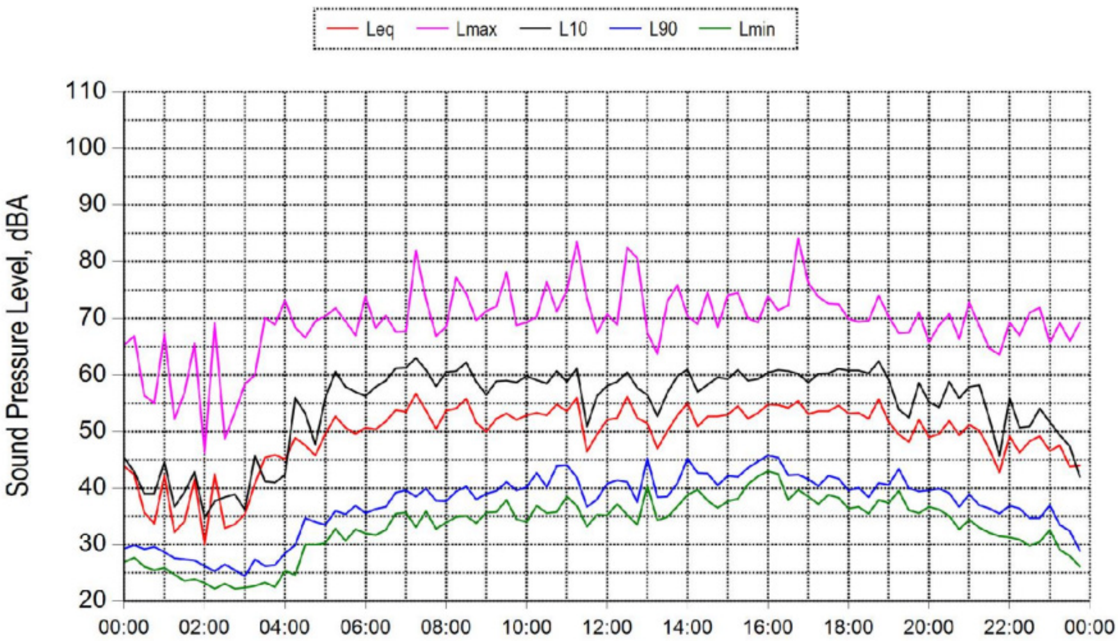

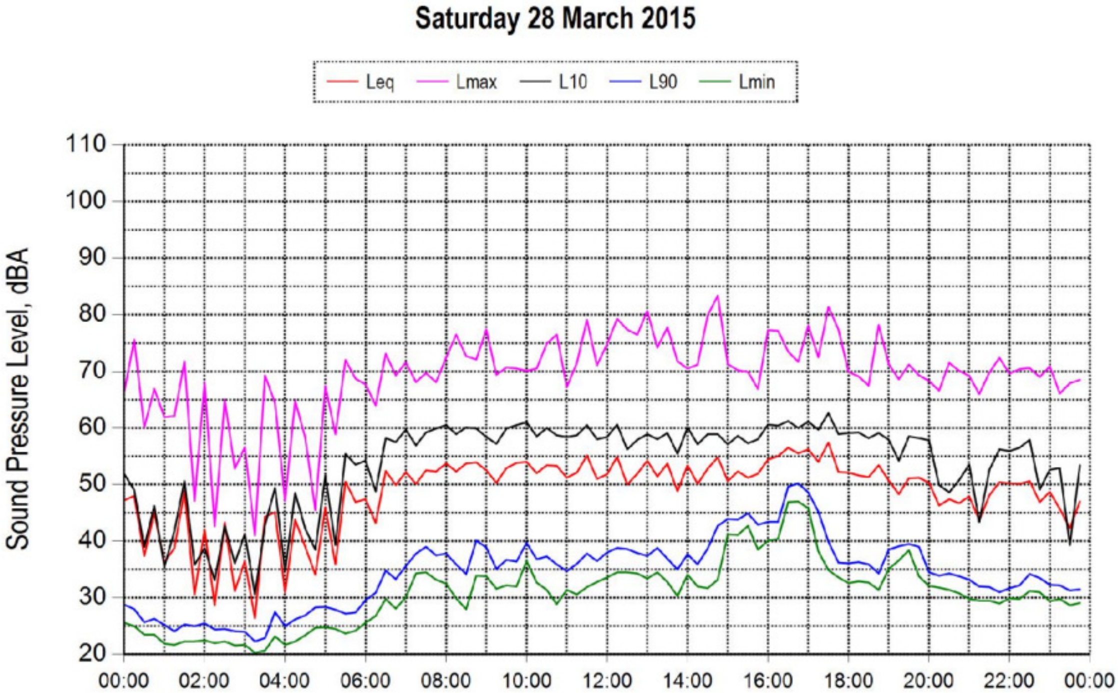
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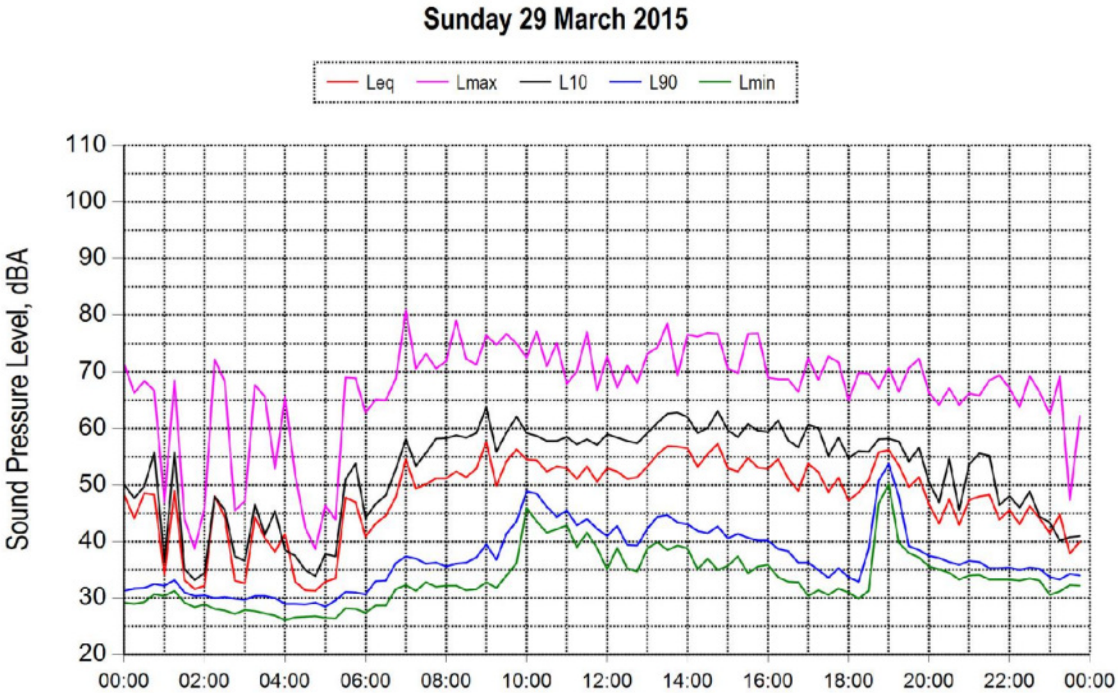
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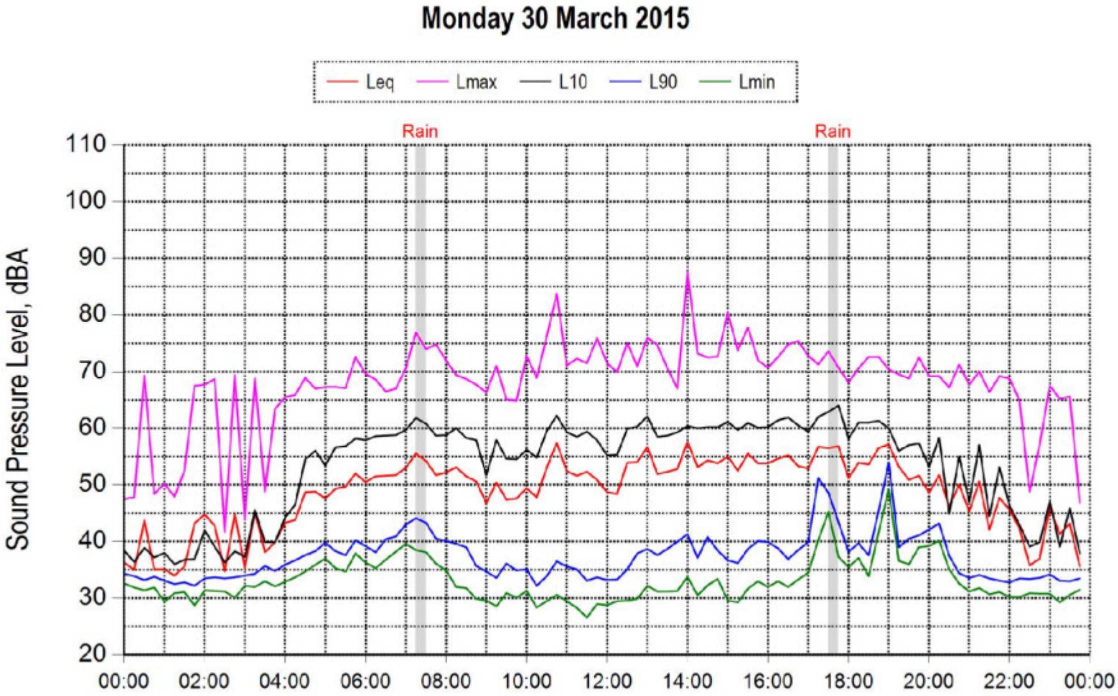
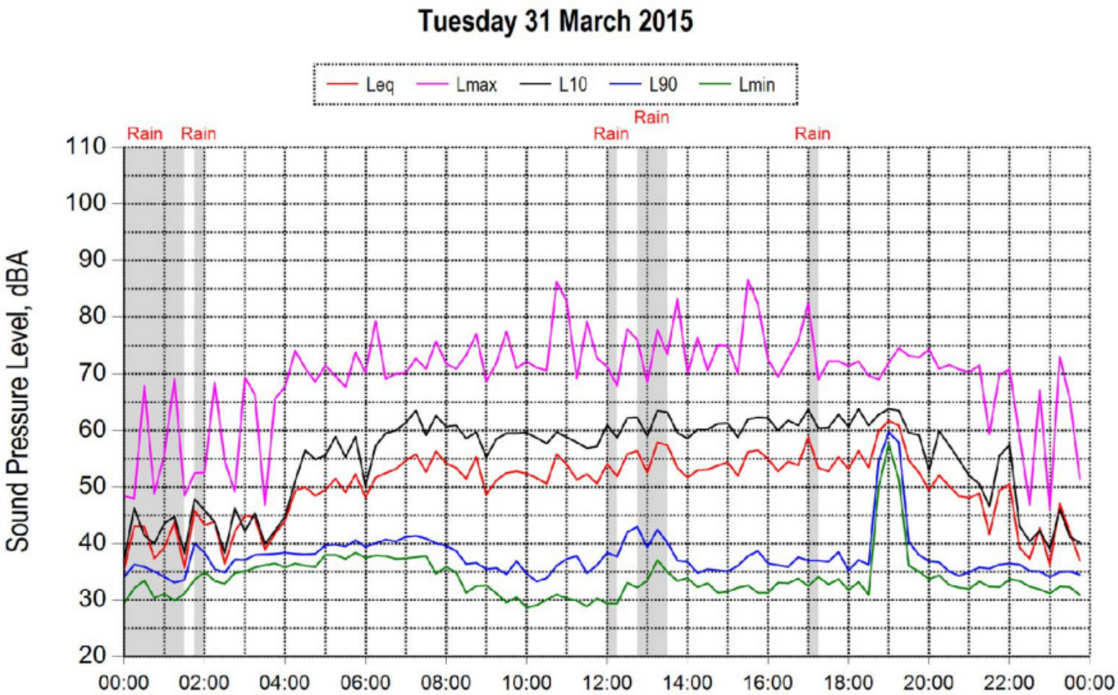
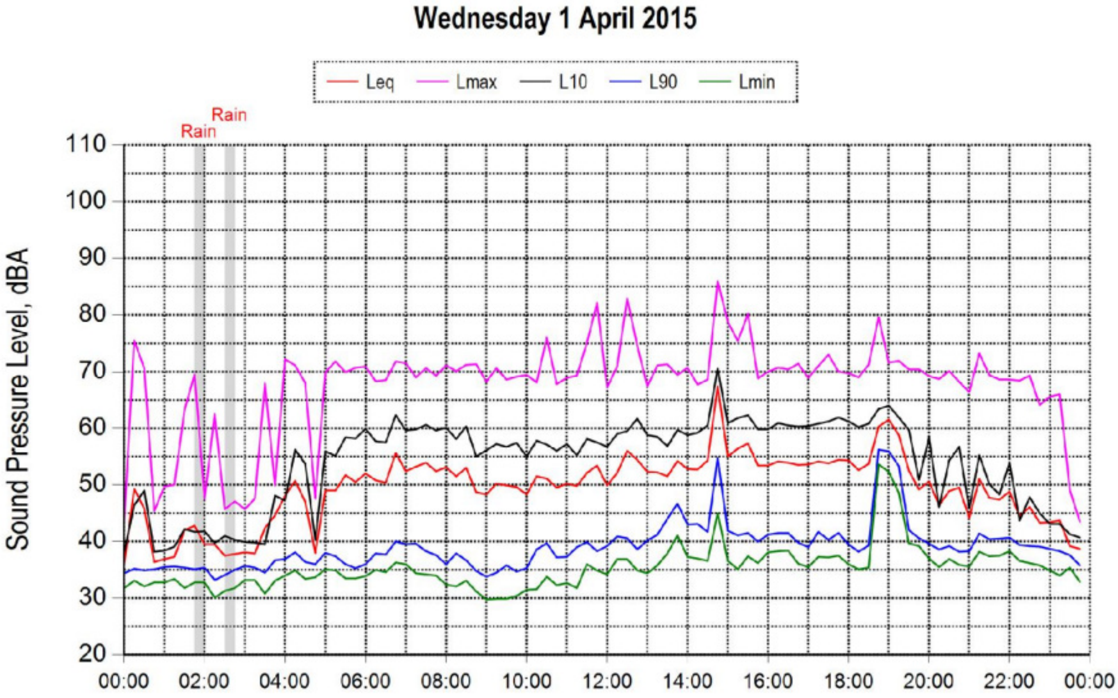
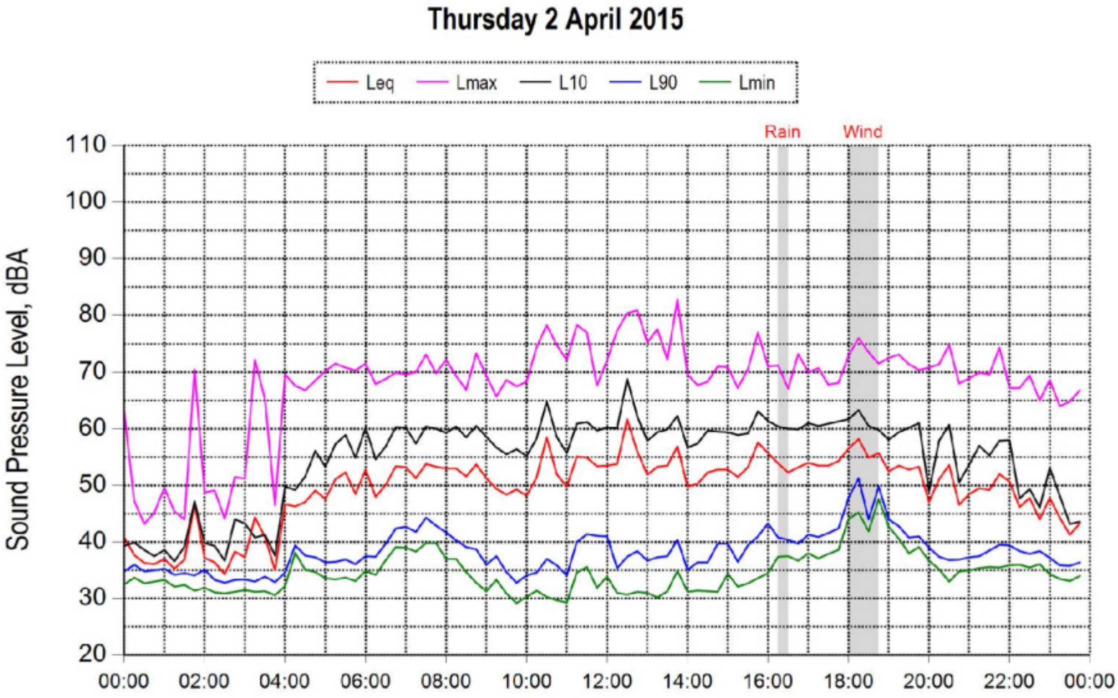
54 Ridgehaven Road, Silverdale

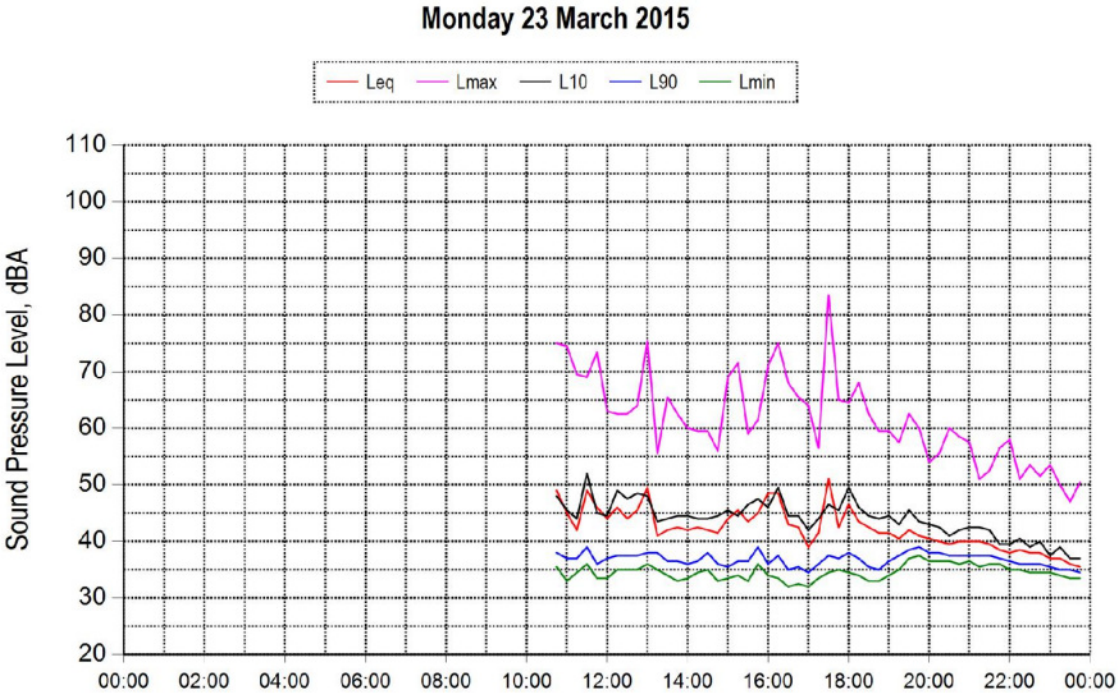




54 Ridgehaven Road, Silverdale



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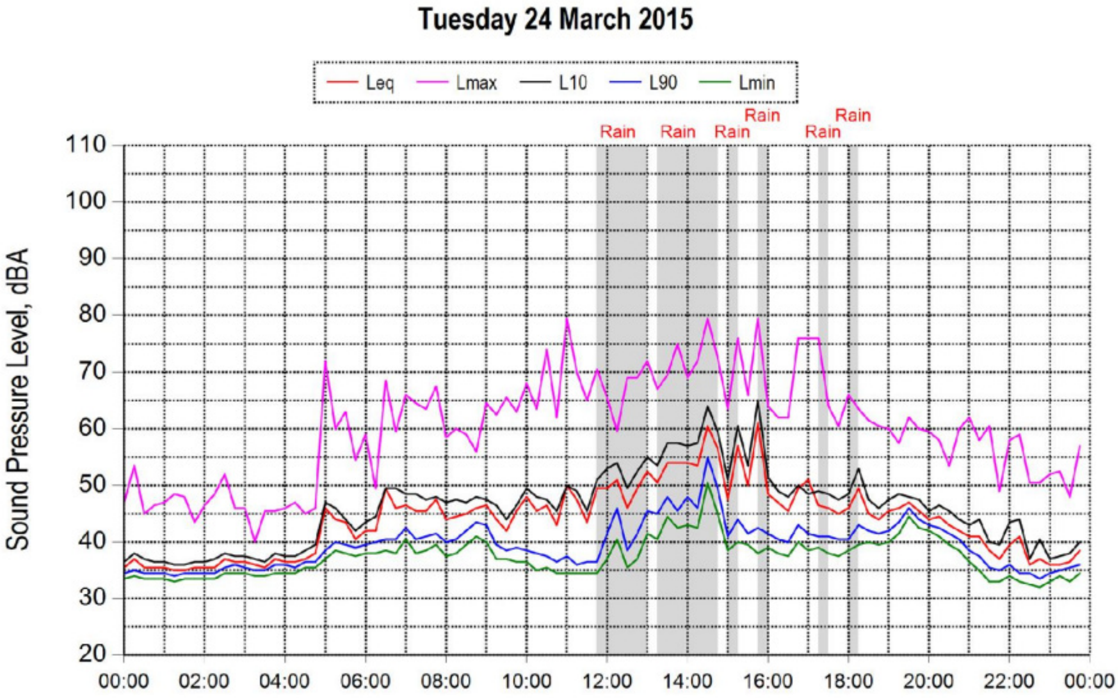
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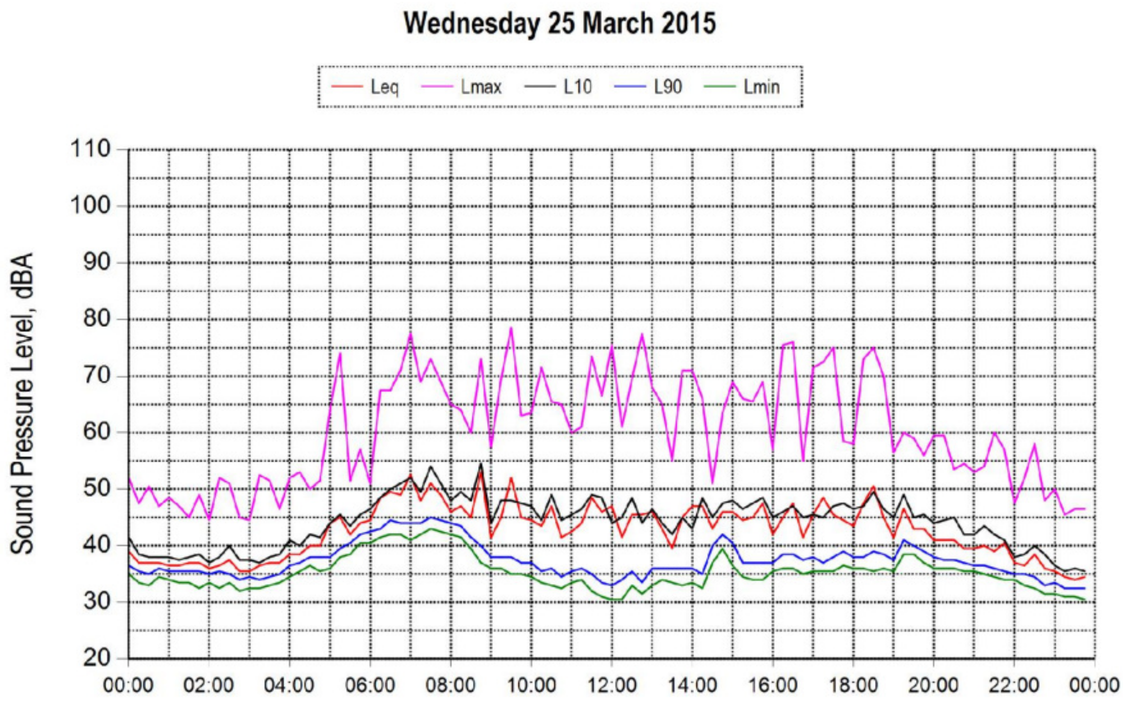
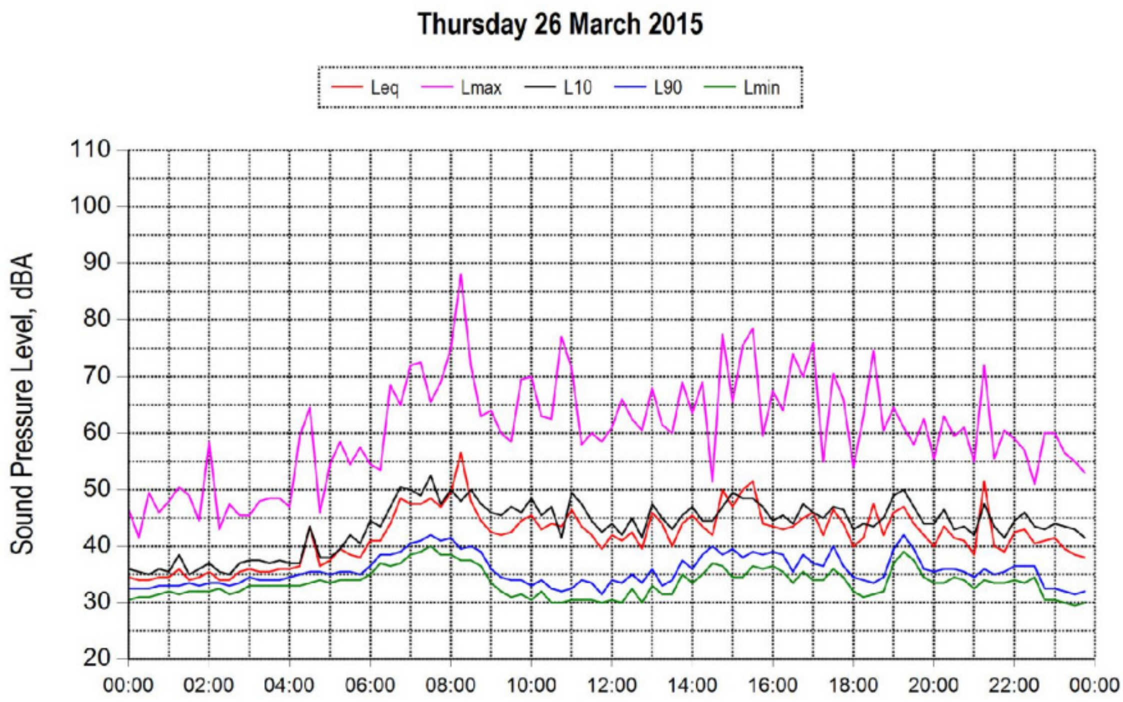
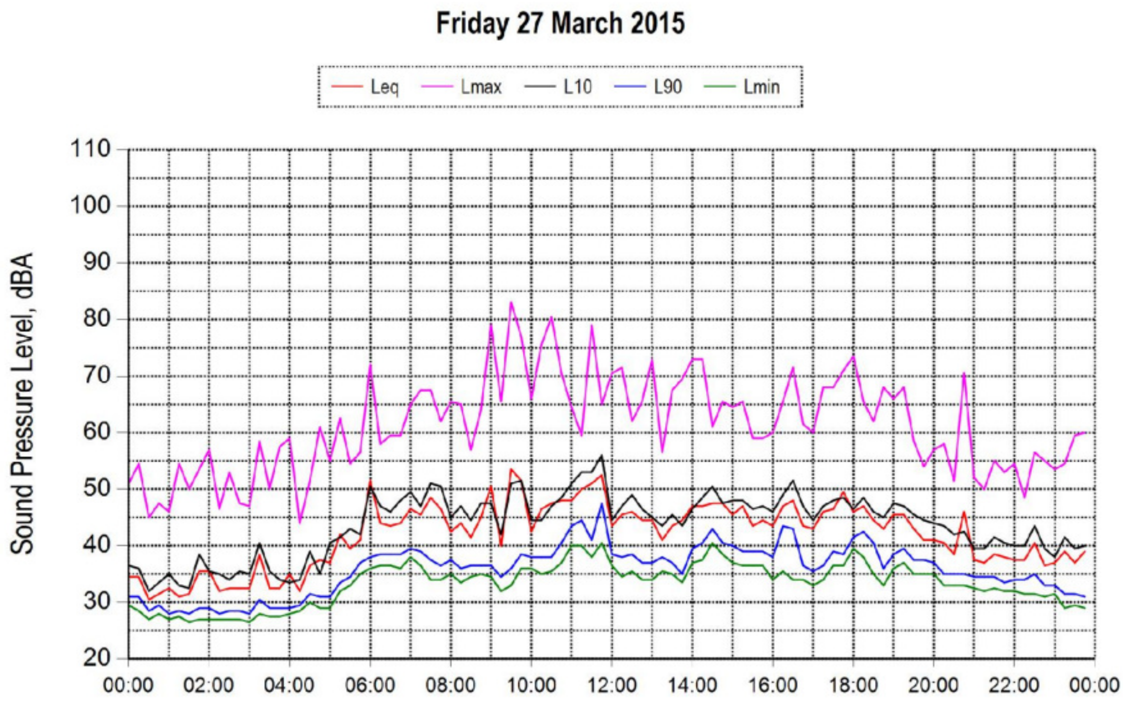
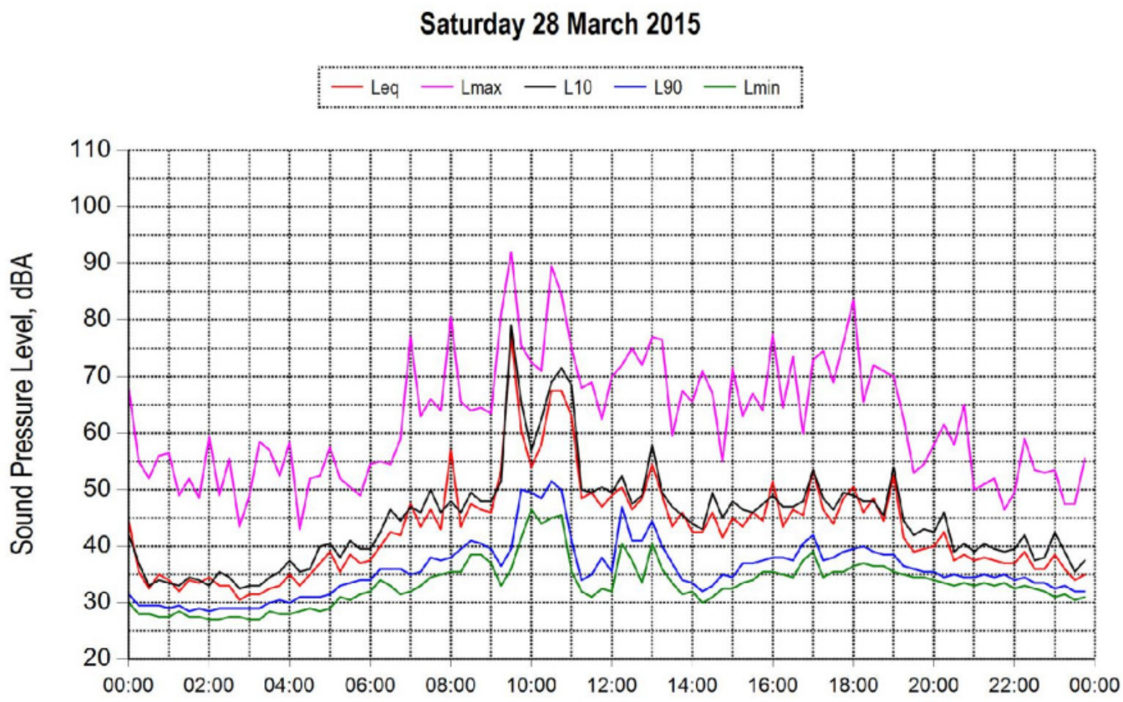
114 Mount Vernon Road, Mount Vernon

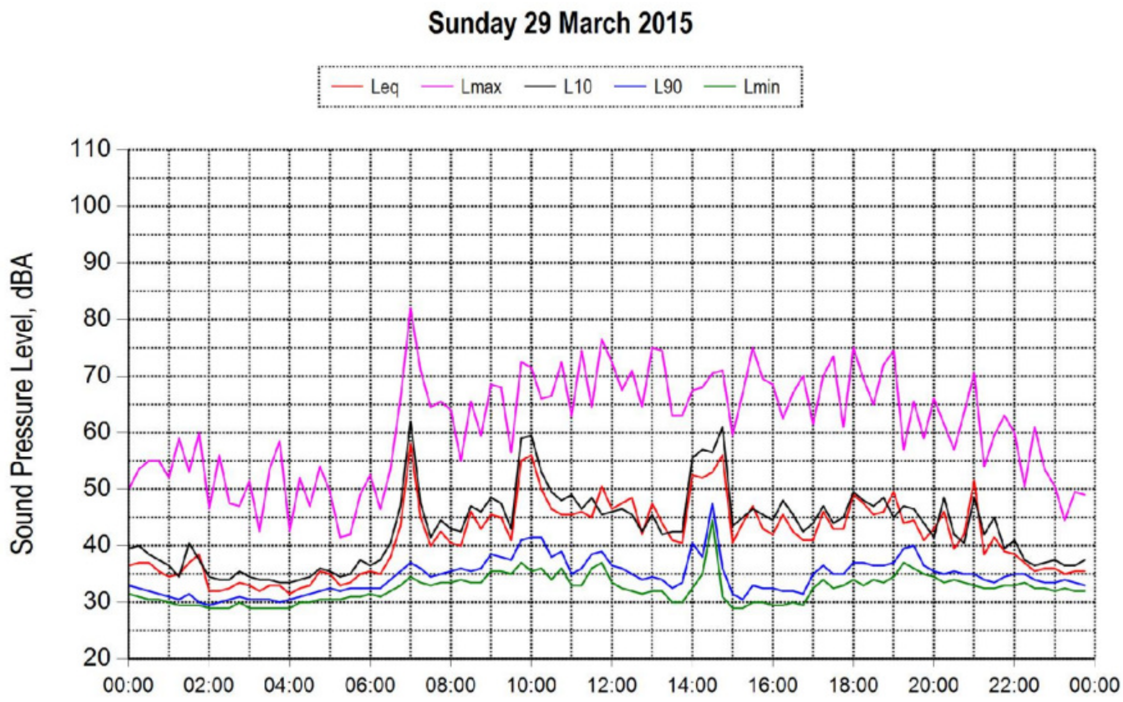




114 Mount Vernon Road, Mount Vernon



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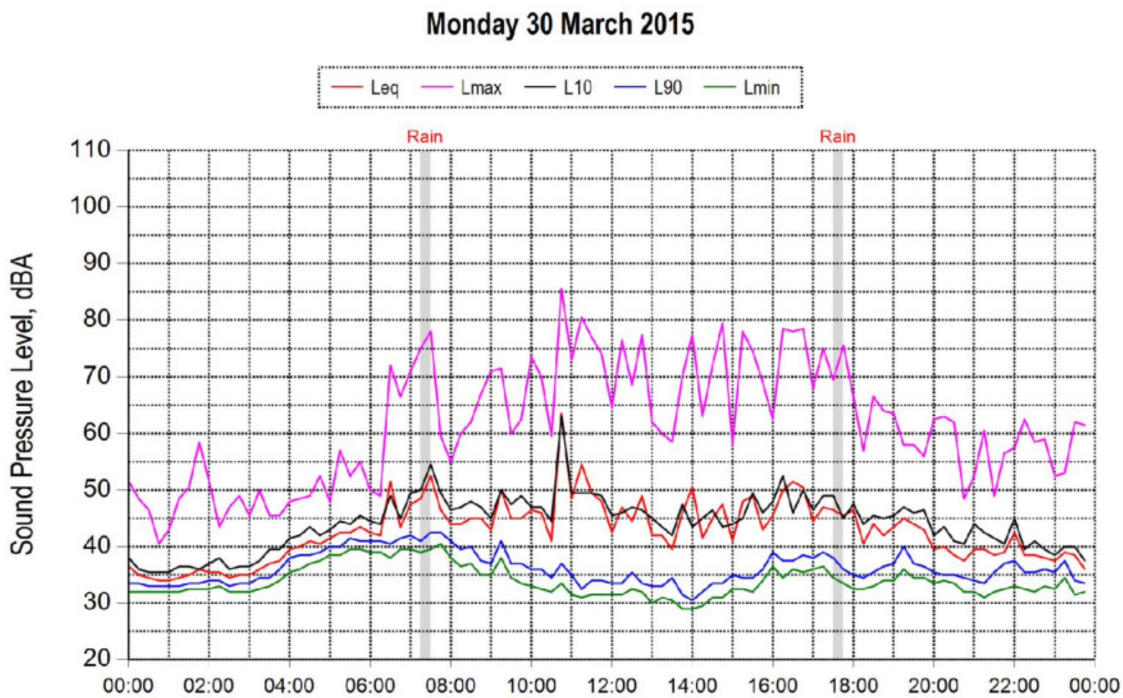
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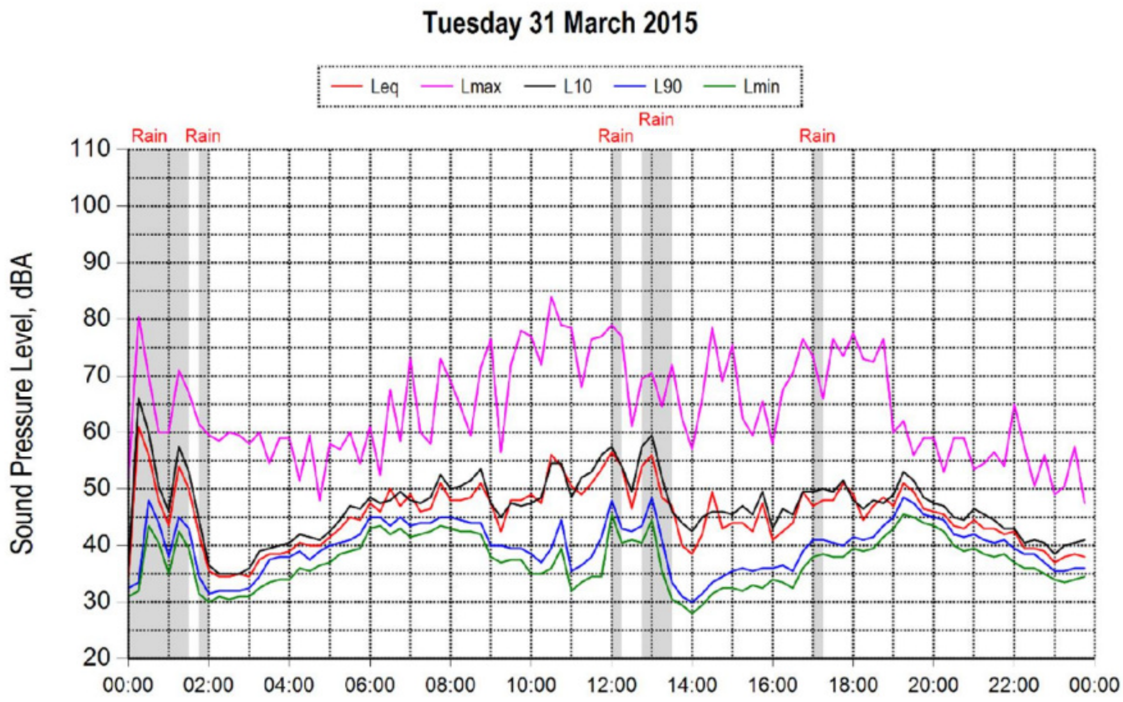
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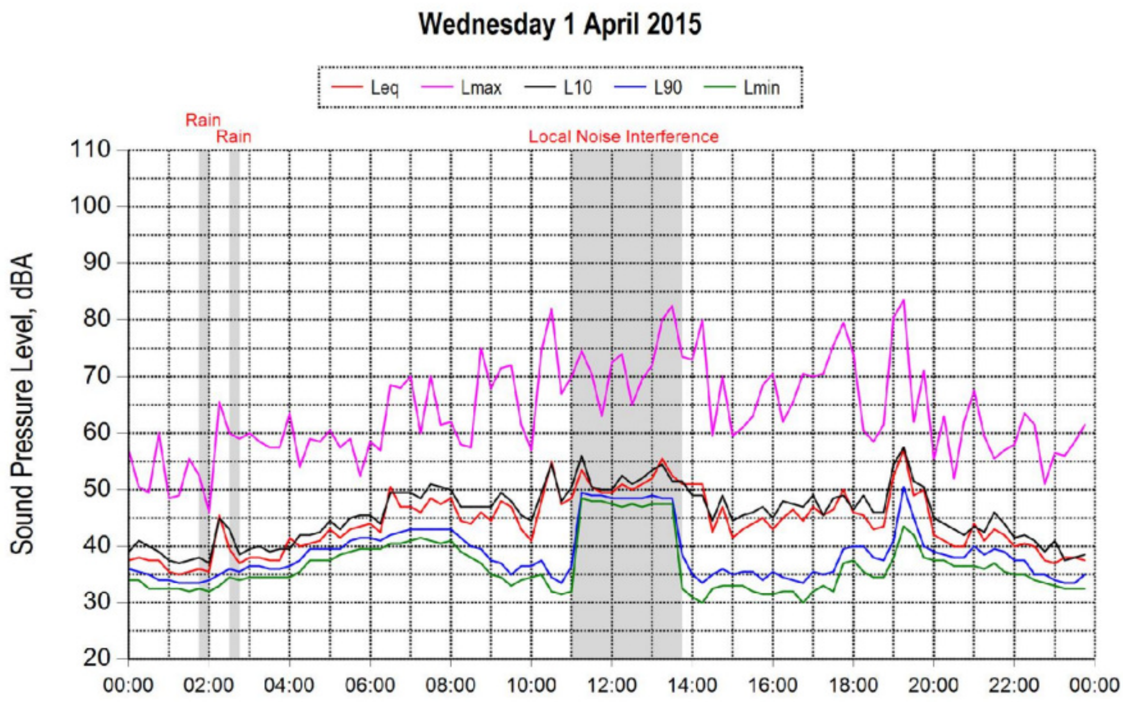
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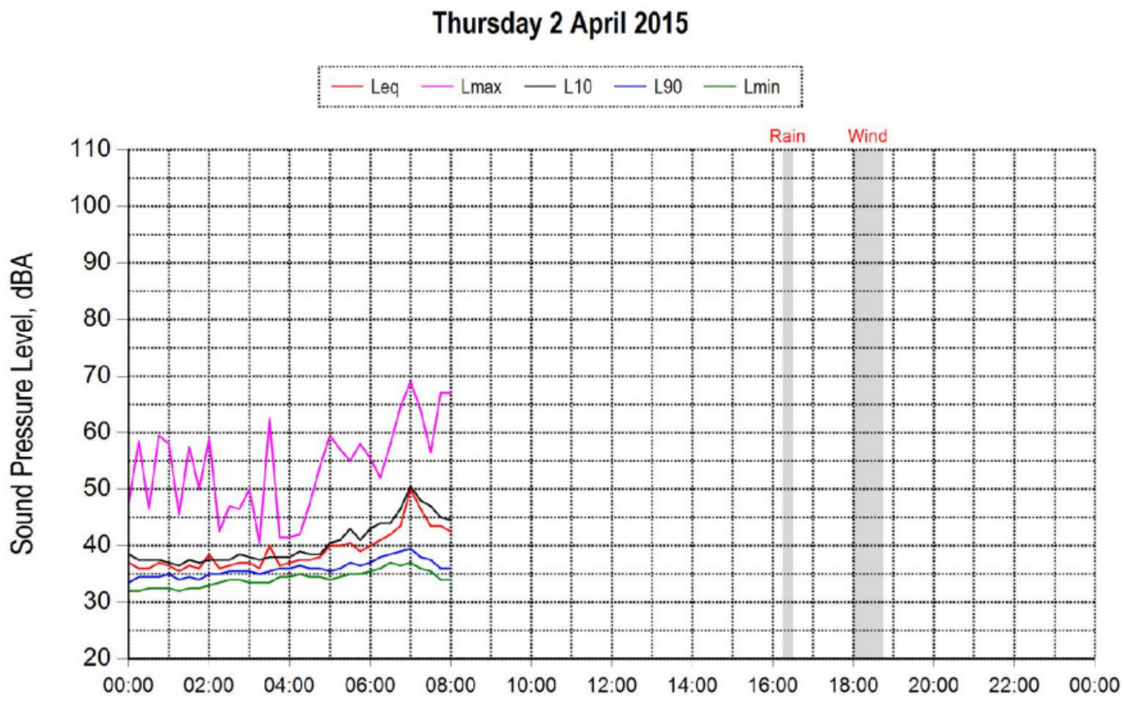
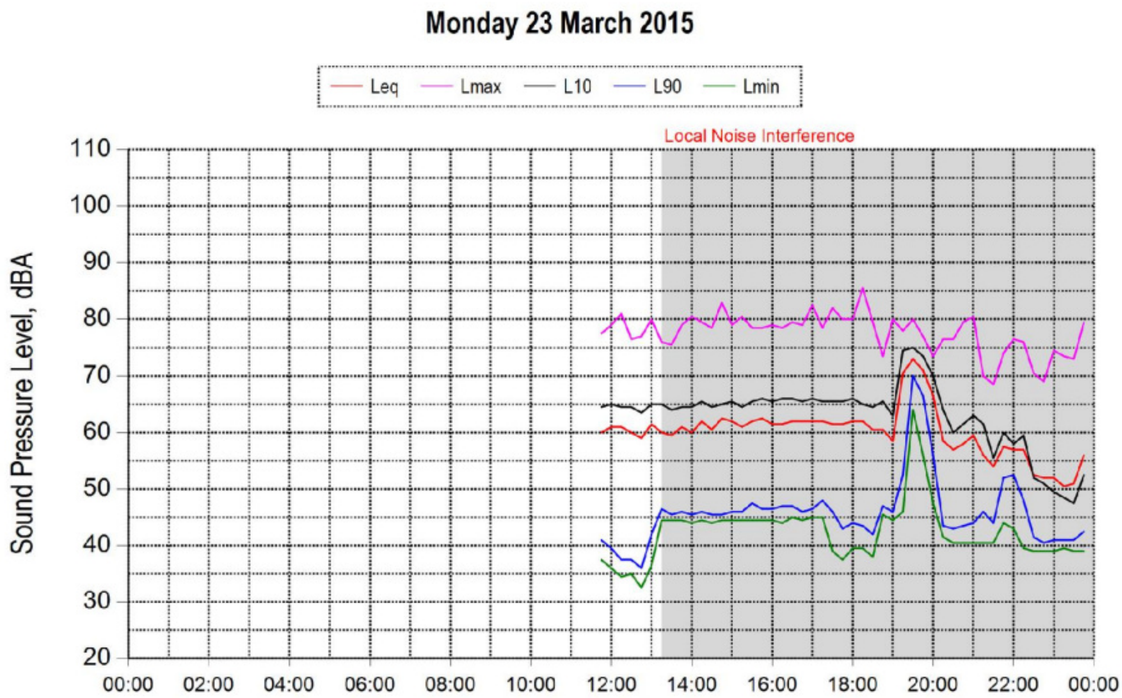
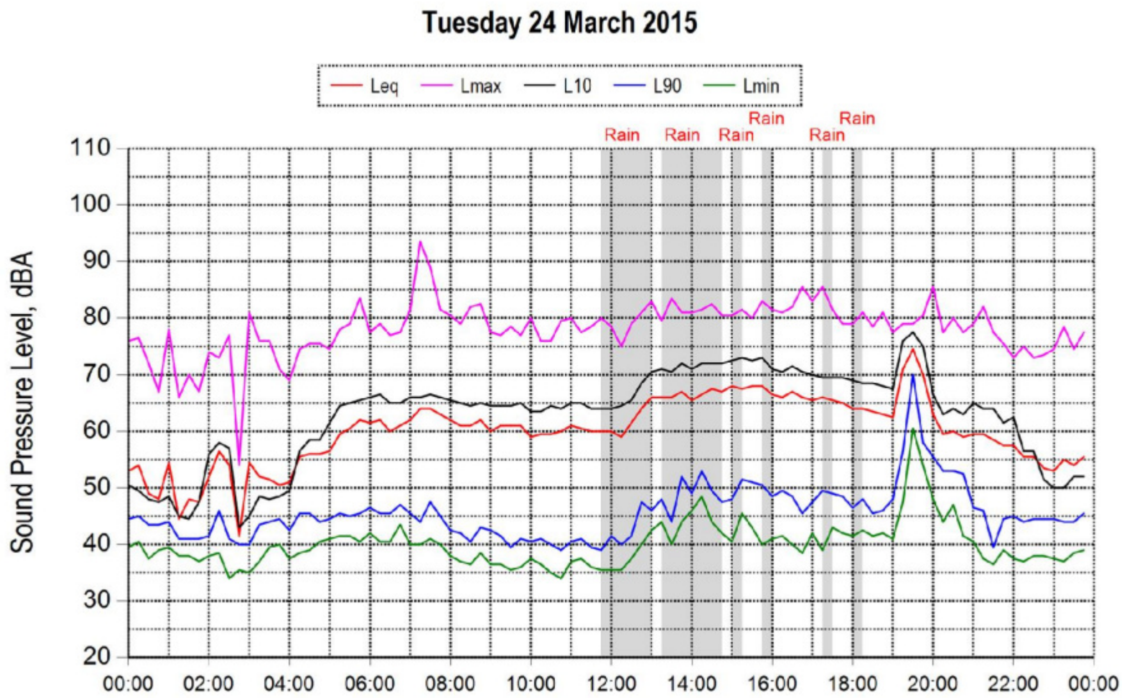
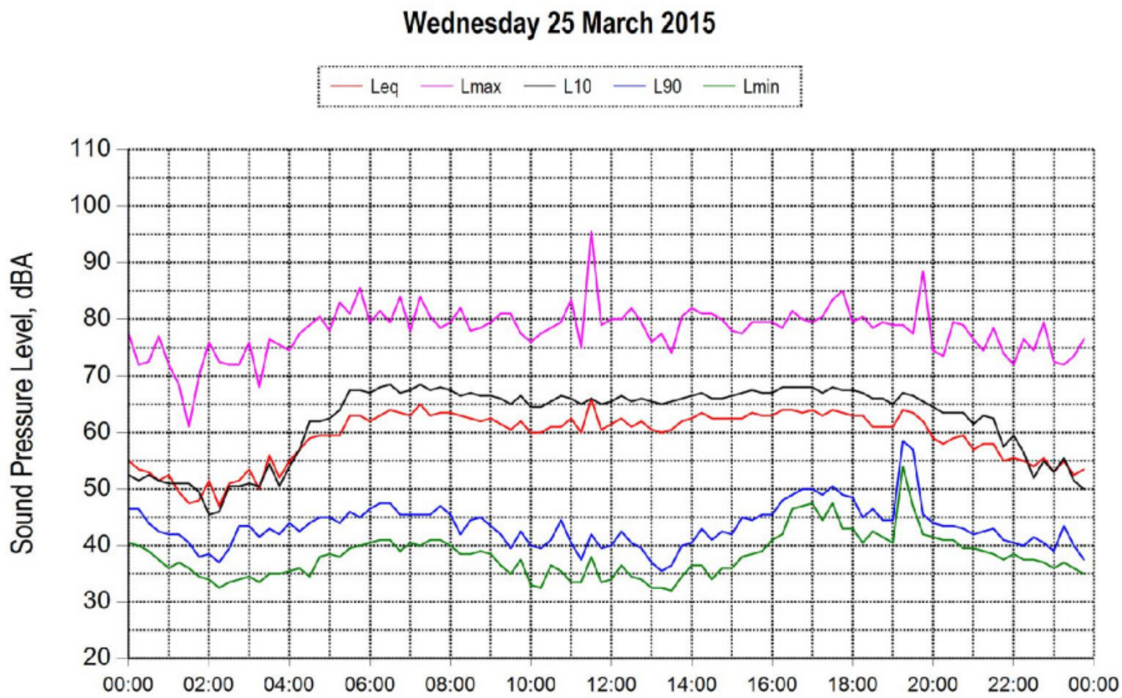
114 Mount Vernon Road, Mount Vernon



120 Vincent Avenue, Mulgoa



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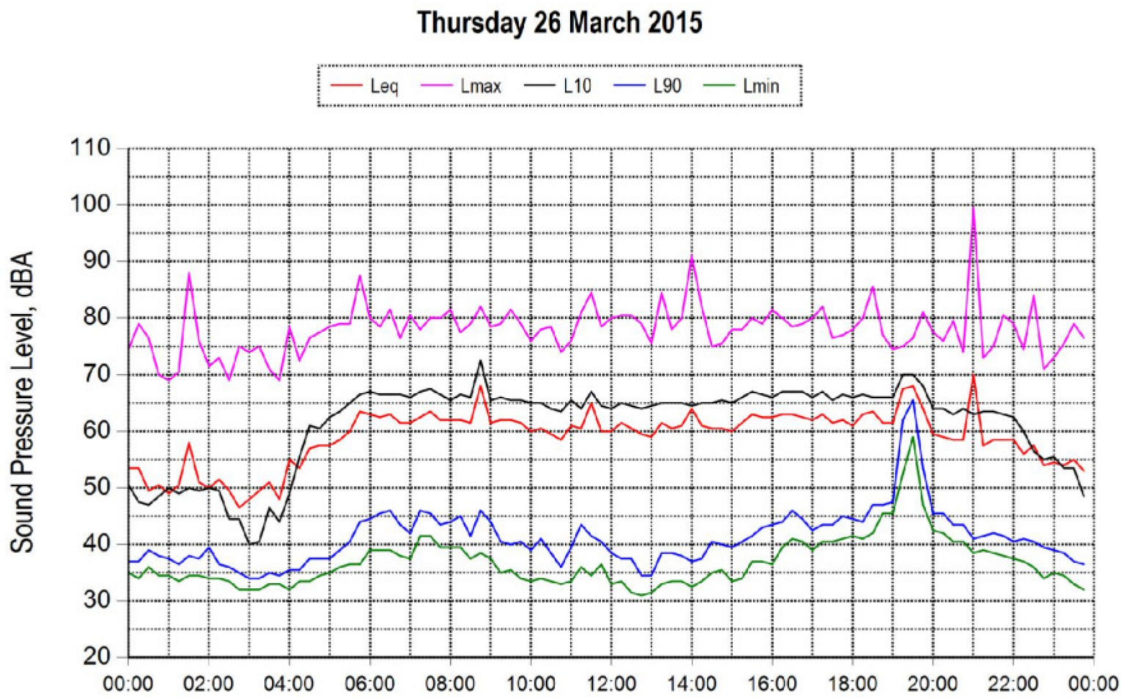
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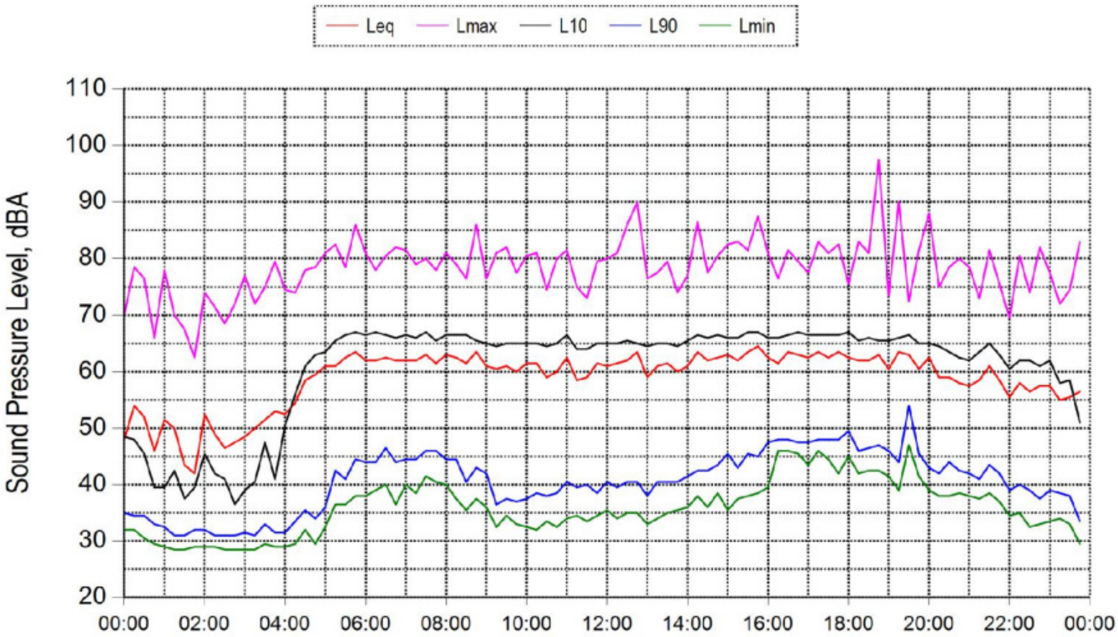
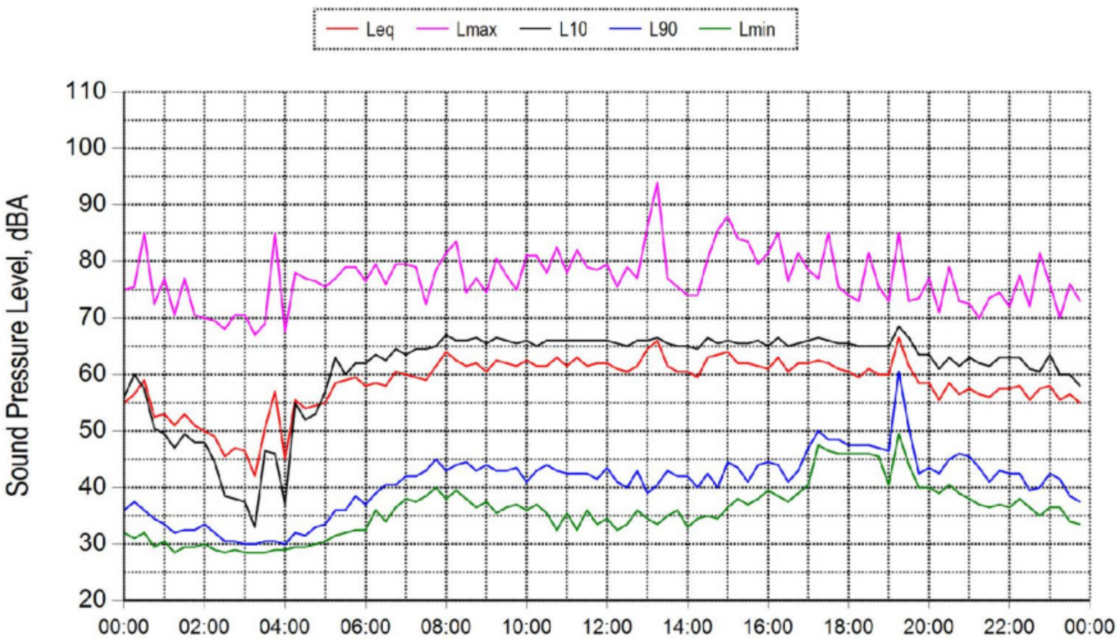
120 Vincent Avenue, Mulgoa

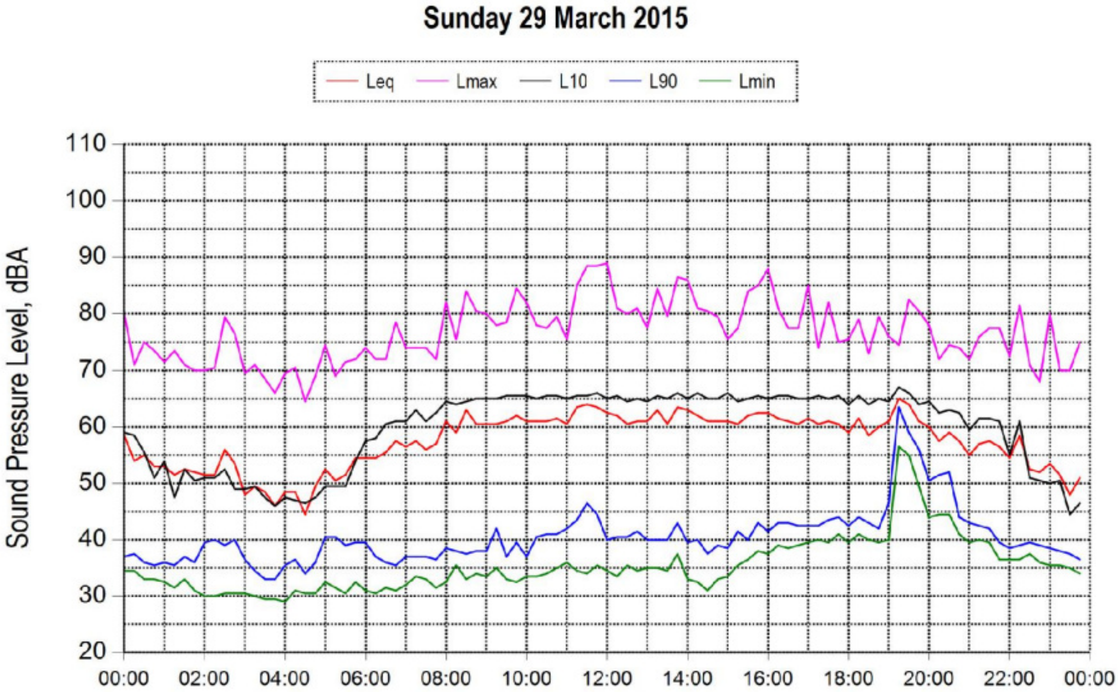
Friday 27 March 2015

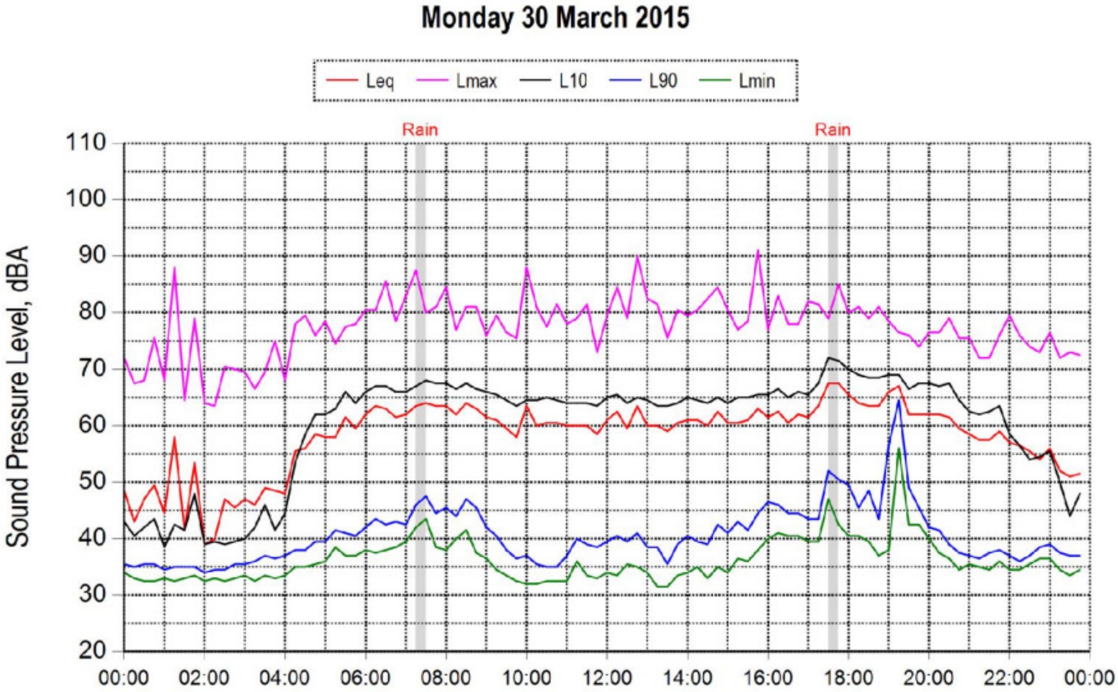


Saturday 28 March 2015



120 Vincent Avenue, Mulgoa





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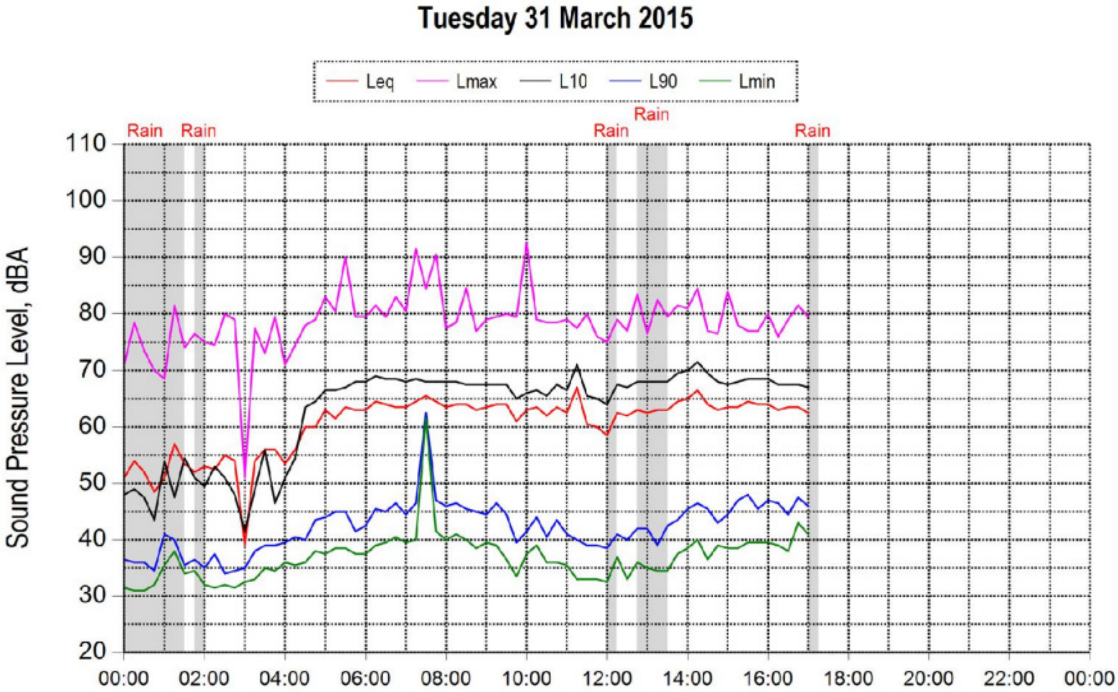

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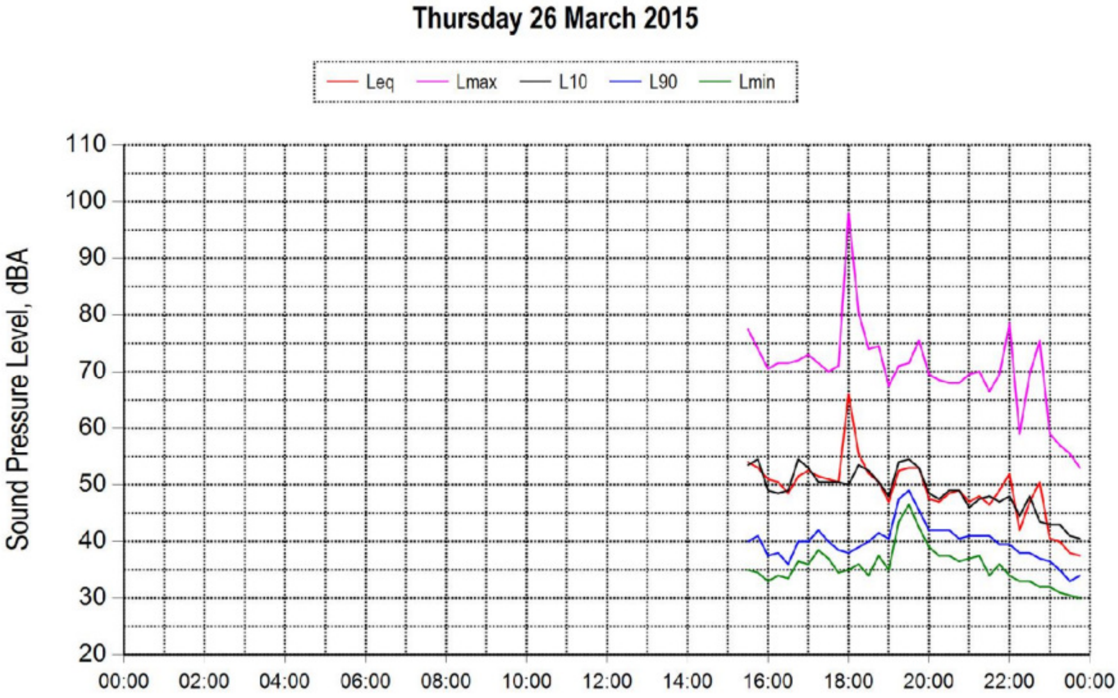

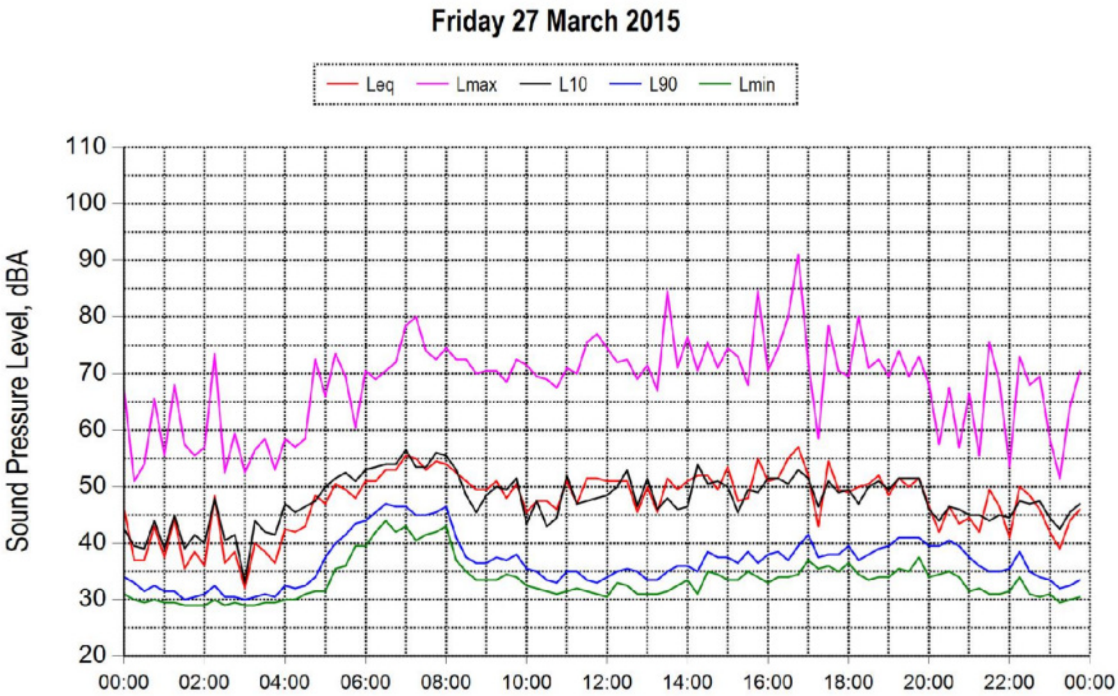

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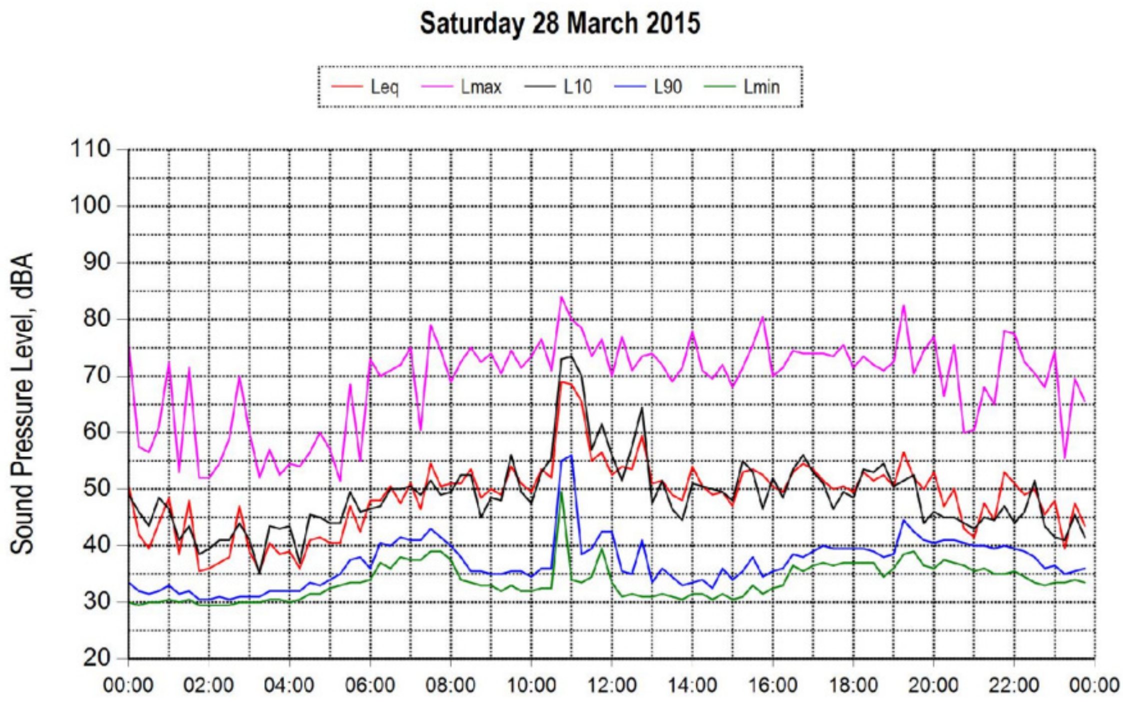

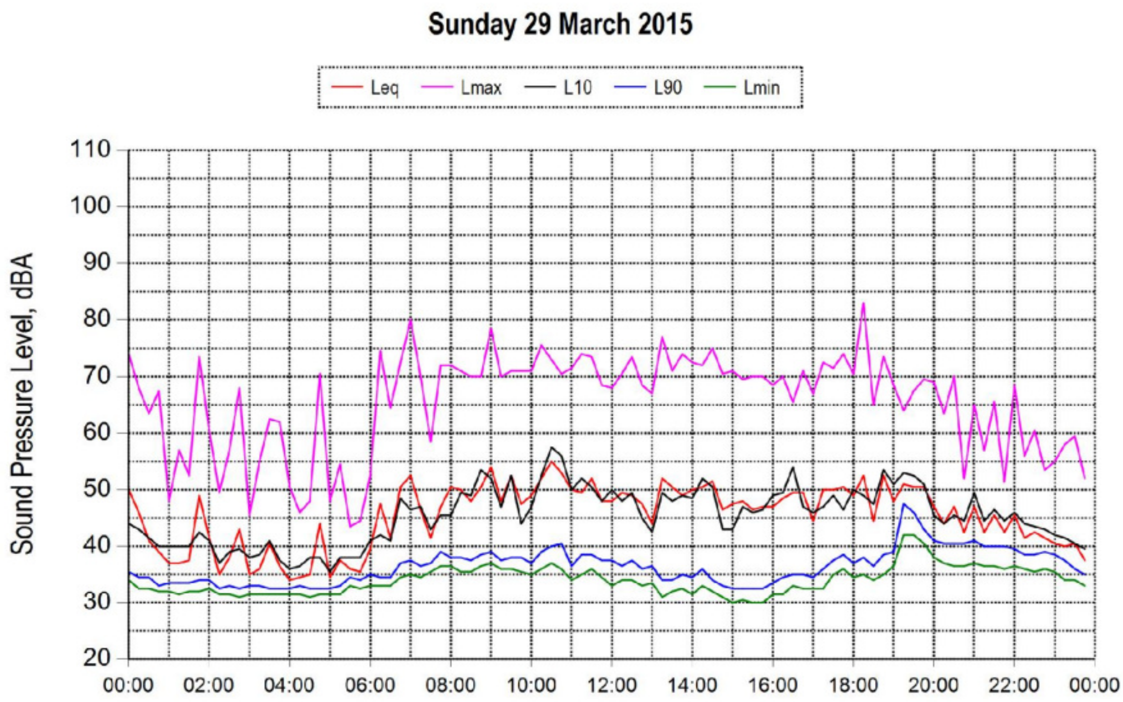

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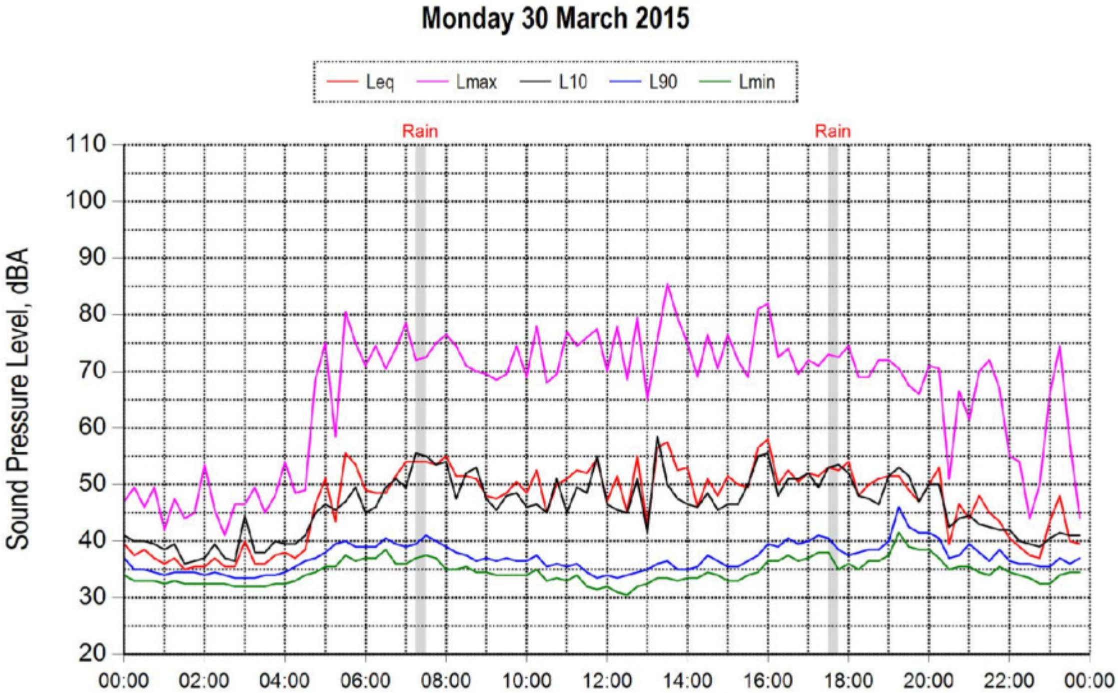

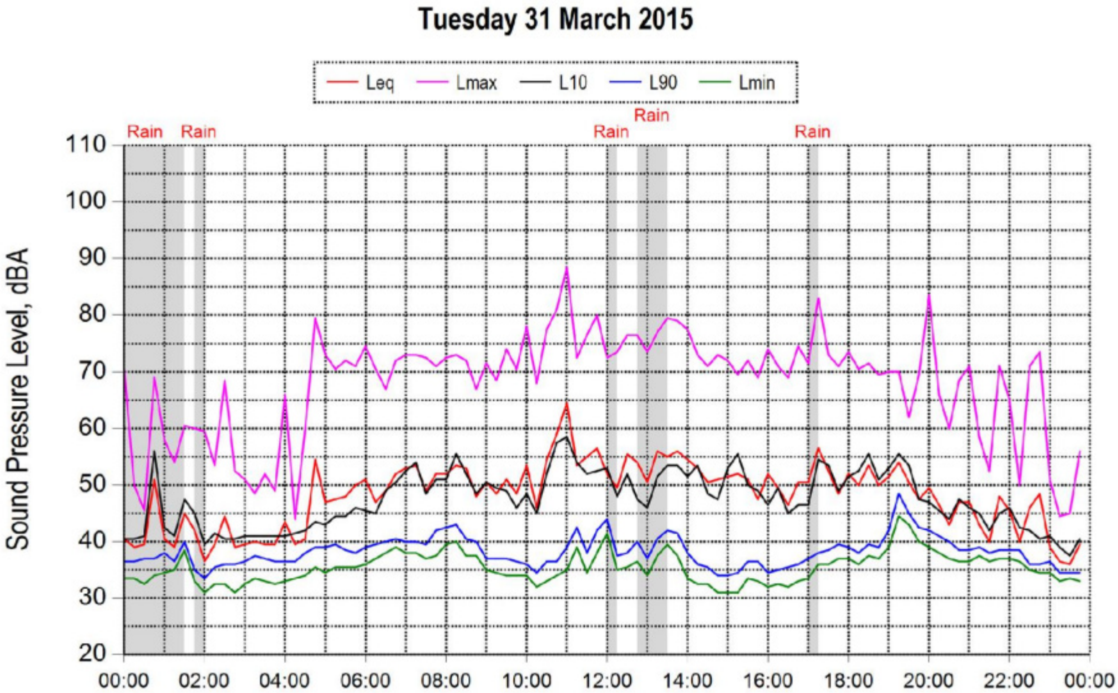

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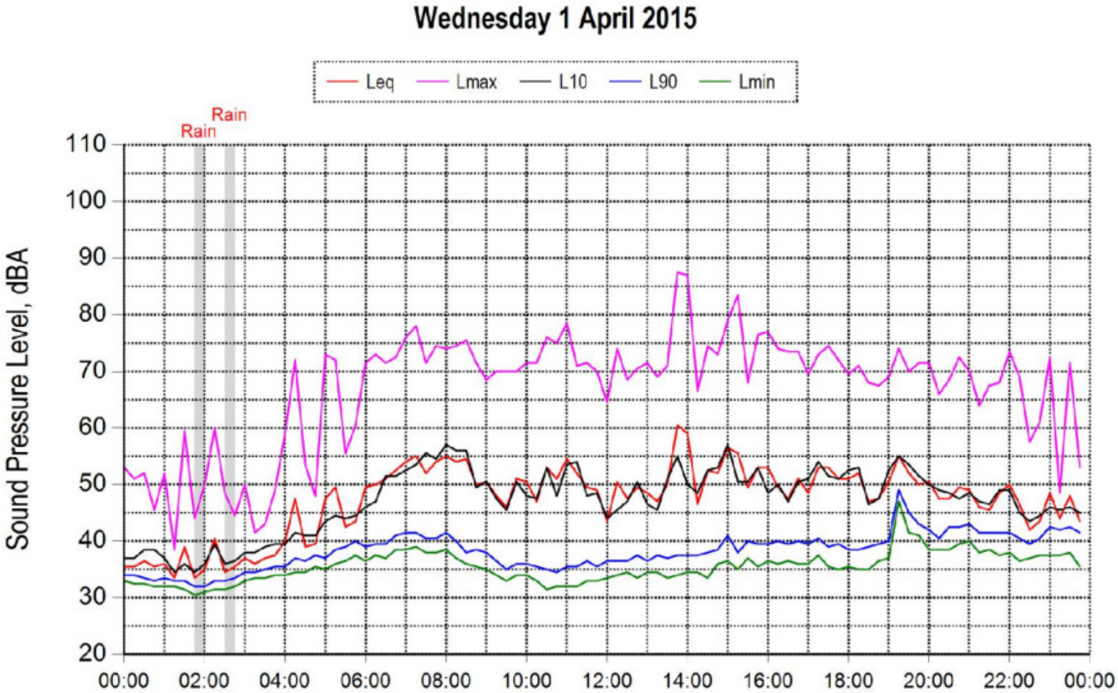
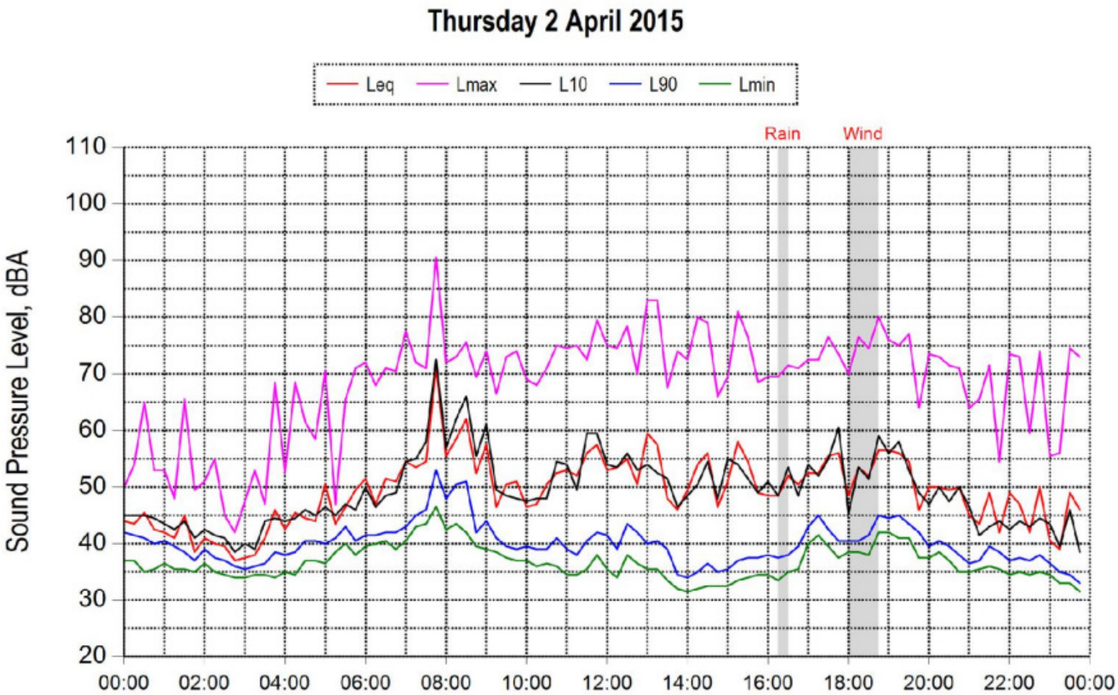
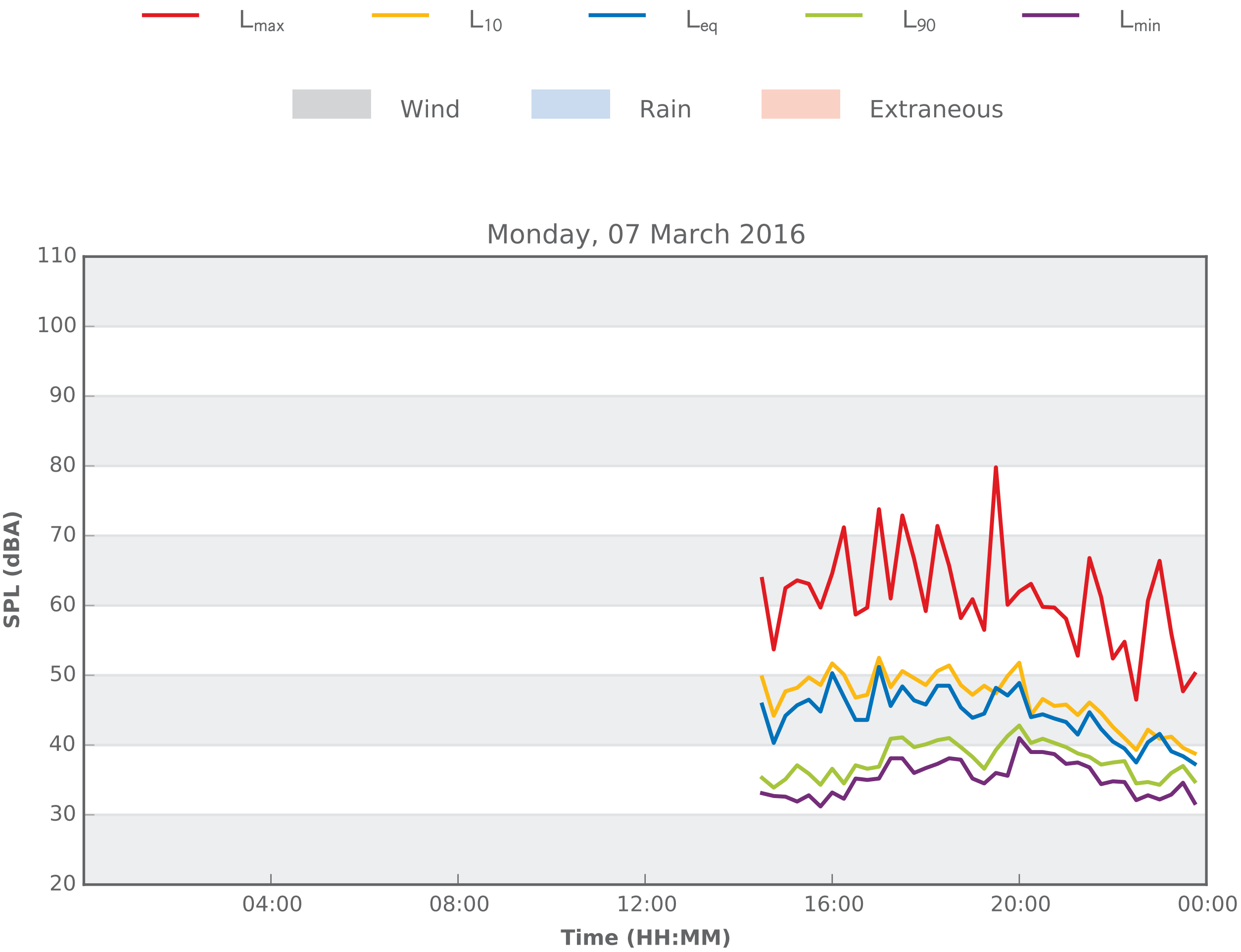
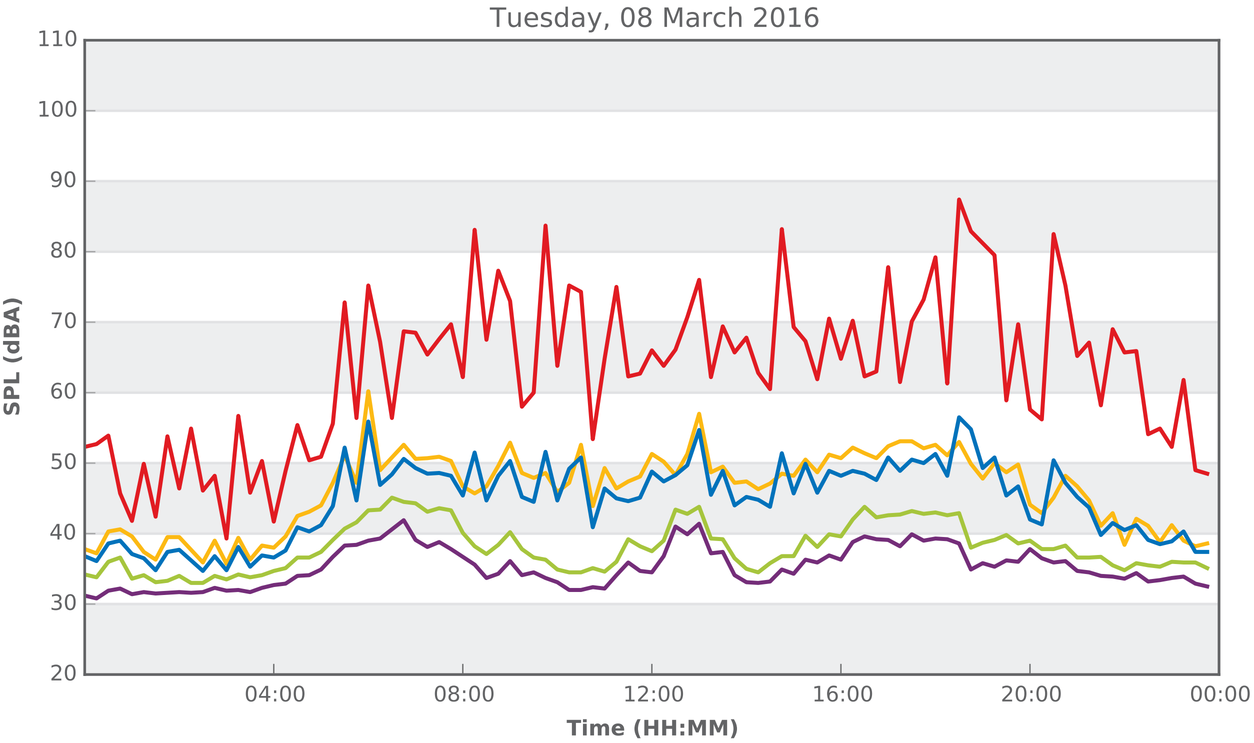




8 Wade Close, Luddenham

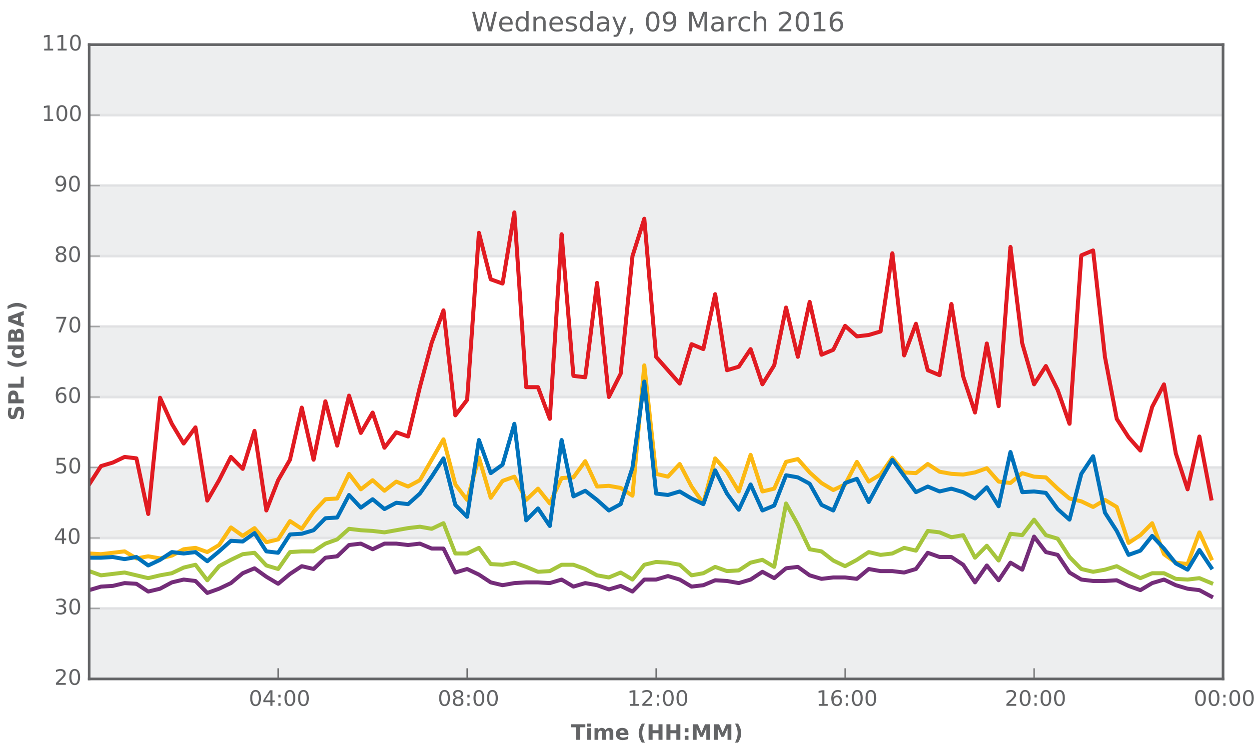


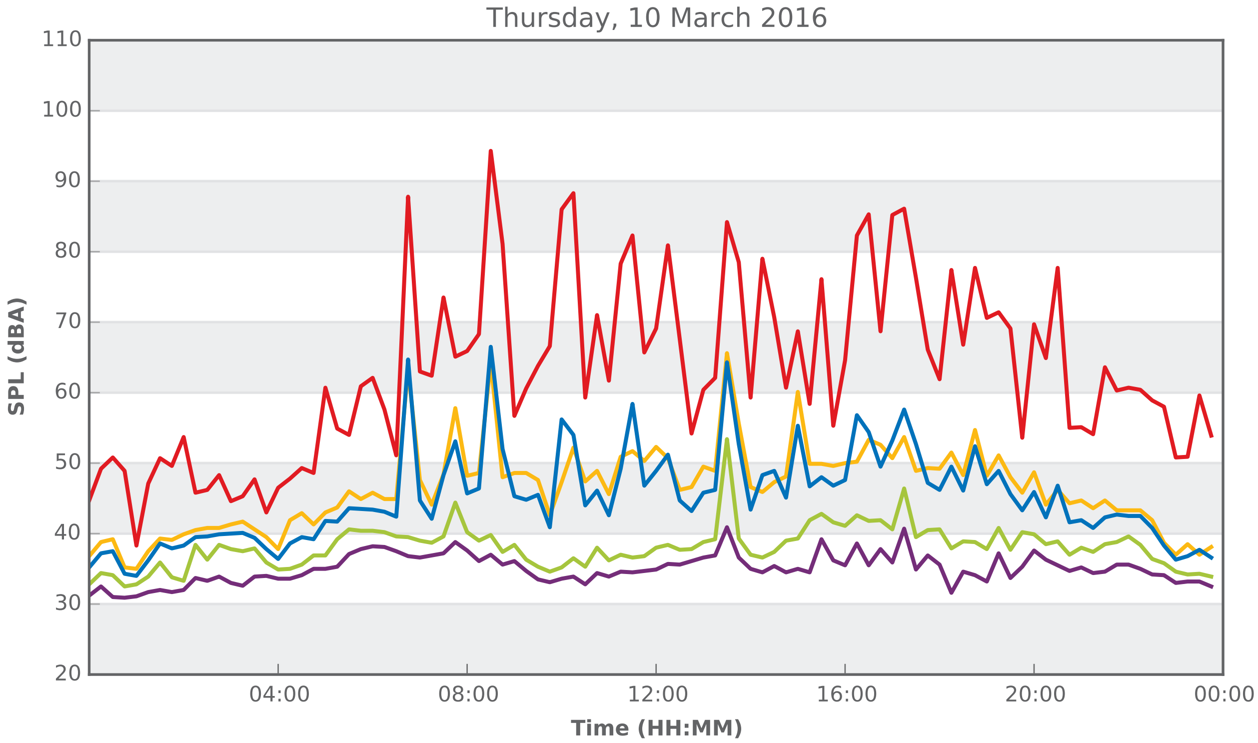


8 Wade Close, Luddenham

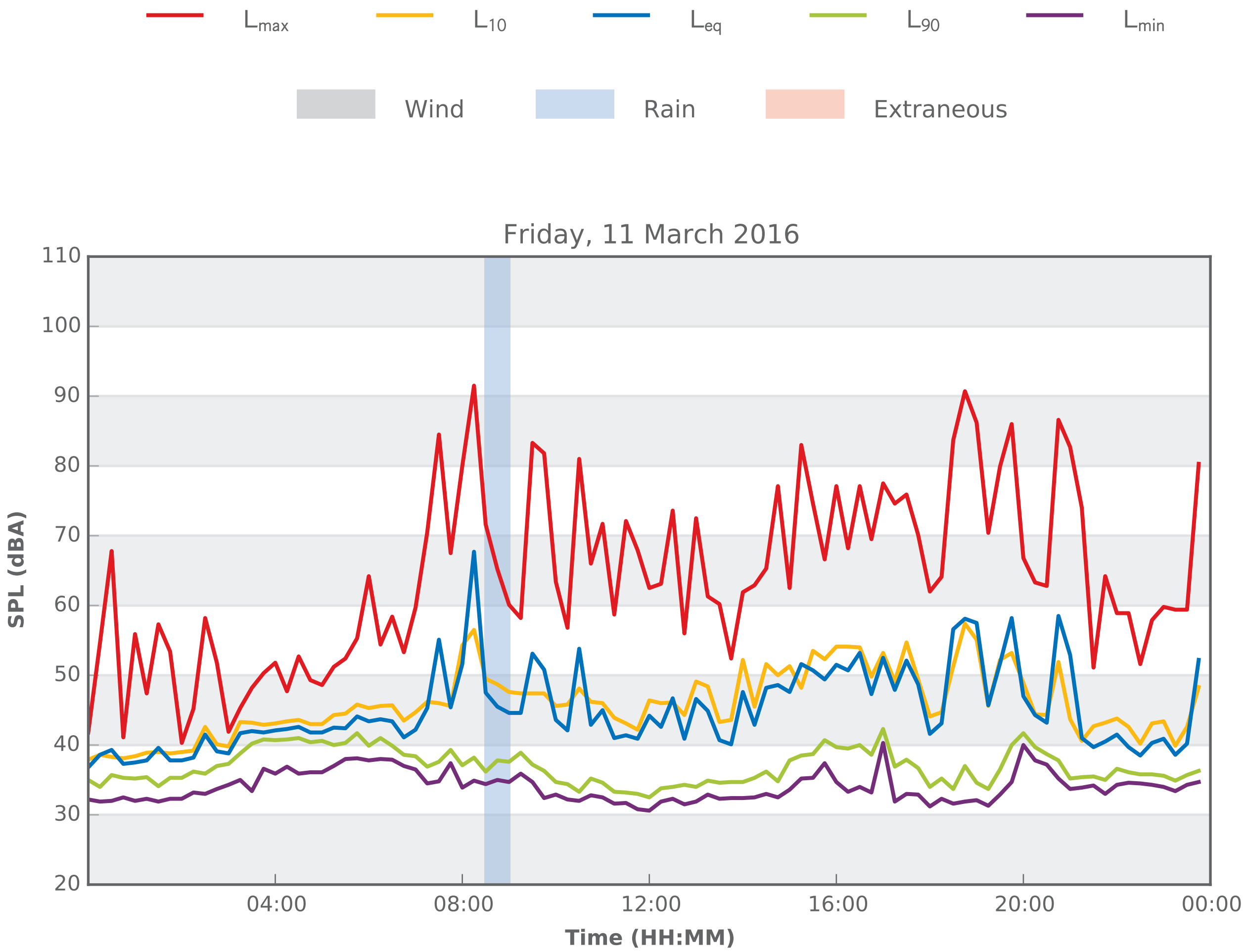
Lmax L10 Leq L90 Lmin

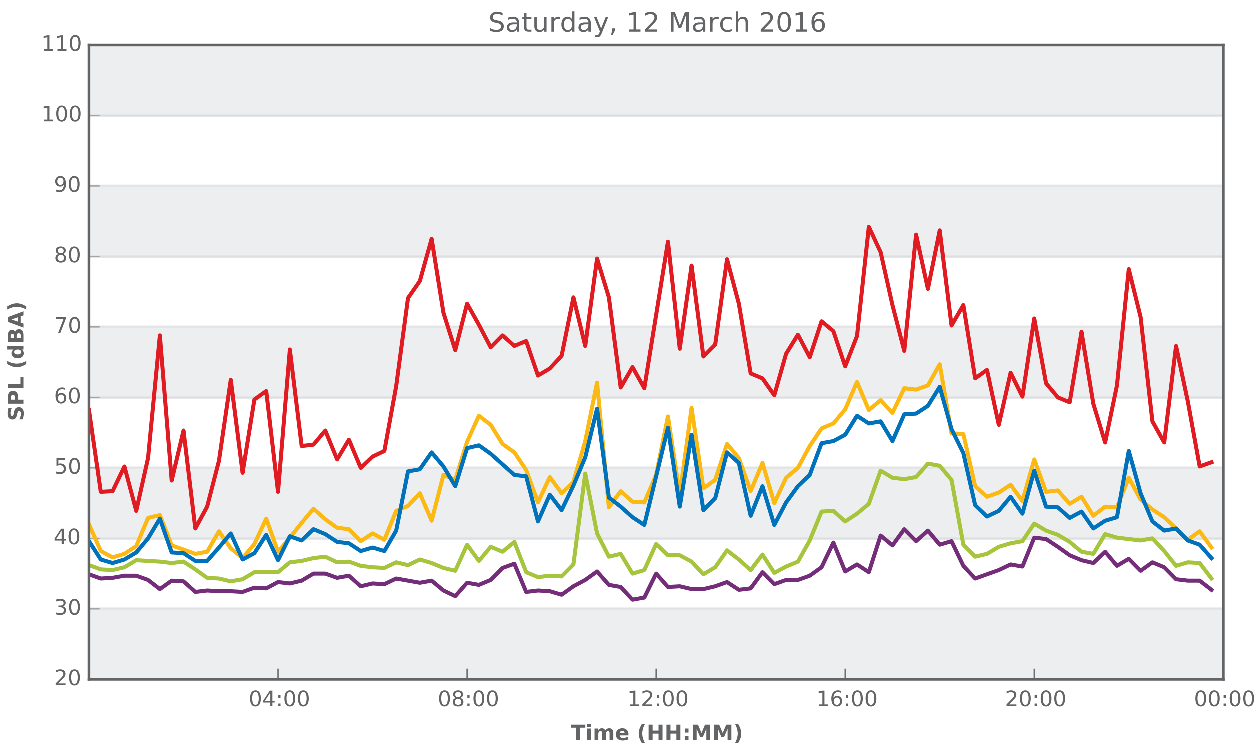
Wind Rain Extraneous





8 Wade Close, Luddenham





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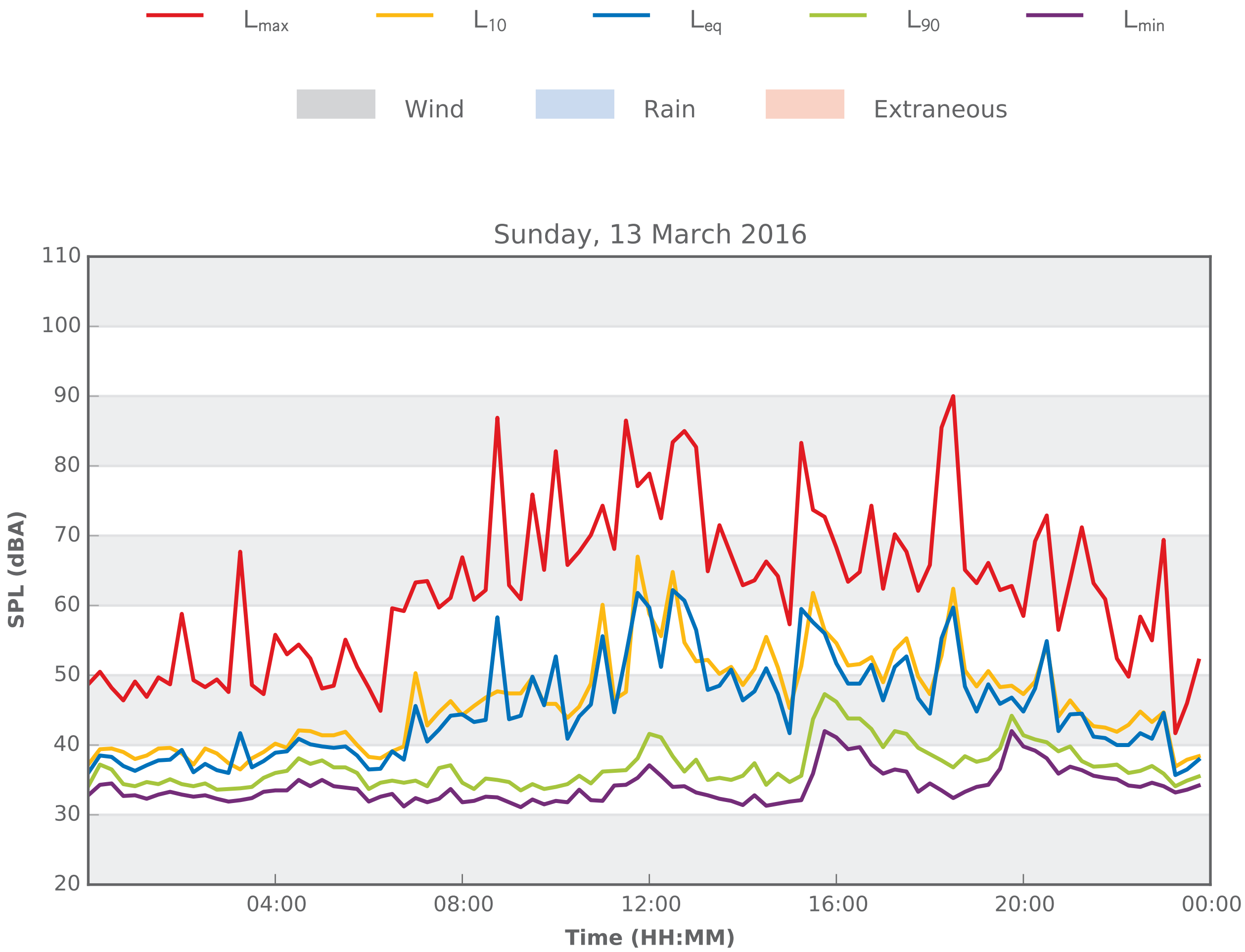

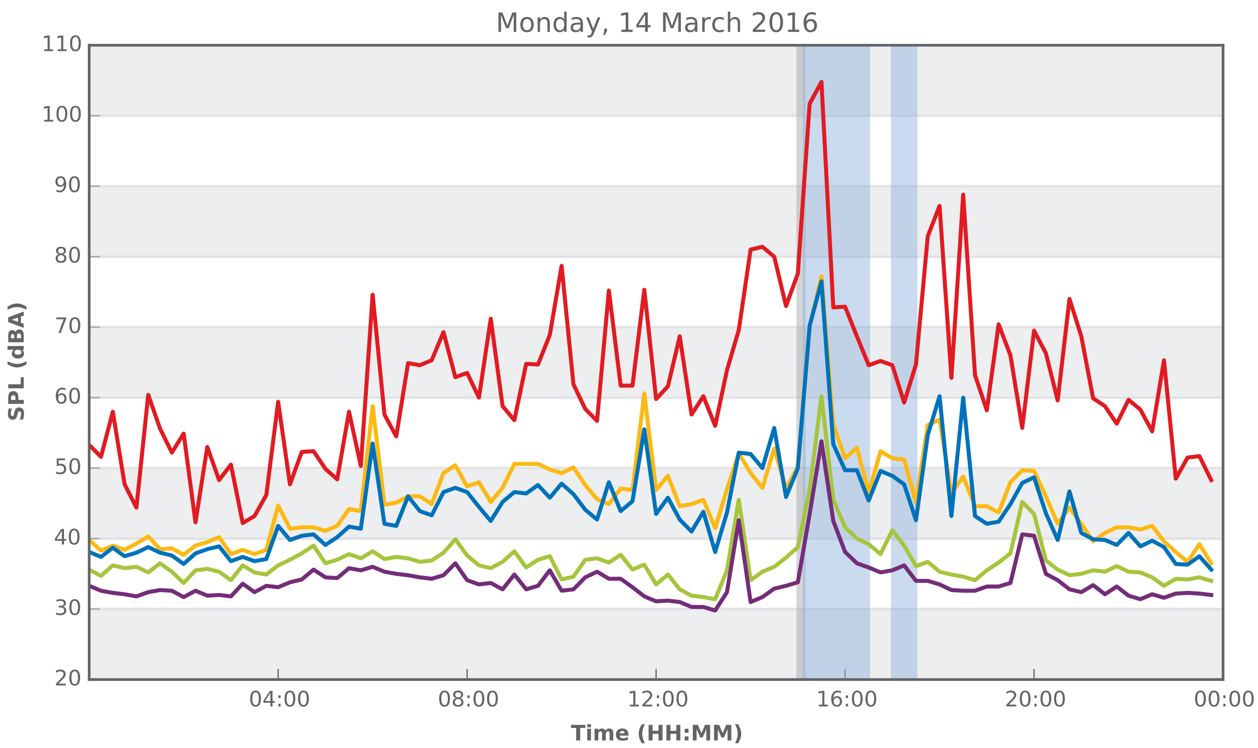

8 Wade Close, Luddenham